PURDUE
SCHOOL OF SCIENCE
IUPUI

Science Building (LD) 222
402 N. Blackford Street
Indianapolis, IN 46202
(317) 274-0625
www.science.iupui.edu/science

Contents

IUPUI School of Science History

Indiana University (IU) established its first extension center at Indianapolis in 1916, although the first IU course was taught in Indianapolis in 1890. The Indianapolis campus of Purdue University grew out of World War II training programs sponsored by Purdue, and began its major operations in 1946. Indiana University established the Indianapolis regional campus in the mid-1960s. In 1968, the Trustees of Indiana University created Indiana University at Indianapolis, and less than a year later, in 1969, the trustees of Indiana and Purdue universities merged their Indianapolis operations to form Indiana University–Purdue University at Indianapolis (IUPUI). Indiana University was selected to administer the campus. Purdue brought to the merger a growing complex of degree programs and Purdue's traditional strengths in the physical sciences, engineering, and technology. The name of the campus was changed to Indiana University–Purdue University Indianapolis in 1992. As of 2005, IUPUI enrolled more than 28,000 students.

A restructuring of undergraduate programs at IUPUI in the fall of 1972 created three new schools: the School of Liberal Arts (humanities and the social sciences), the School of Engineering and Technology, and the School of Science (physical, behavioral, and life sciences).

After being housed for almost 22 years on the 38th Street campus, the School of Science made a historic move in two phases into two buildings on the main campus during 1991-1993.

The School of Science

IUPUI
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The School of Science offers undergraduate and graduate programs that prepare students for a variety of careers. As part of its instructional mission, the school also provides non–science majors with the scientific background to help them become more aware and better-informed consumers and citizens. Scientists advance the boundaries of our knowledge of the natural world through applied and basic research. Science benefits society by providing fundamental knowledge and technical advances in such areas as health, ecology, computer and software design, mathematical modeling, and chemistry. Science informs the social sciences with scientific understanding of psychology, applications of statistics, and an understanding of environmental issues. Science contributes to the arts and humanities by offering knowledge of the physical universe and the symmetry and wonder of nature.

In addition to preparing students for science-related careers and for advanced study in graduate school, an undergraduate program in one of the sciences is an excellent background for professional study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important.

A background in the sciences also opens the door to employment in the high-tech industry in sales and management.

Supplementing the full-time instructional staff, with ranks ranging from instructor through full professor, is a contingent of well-qualified, experienced lecturers who are recruited from the reserve of talent existing in the Indianapolis area.

Centers of Research Excellence in the School of Science

Earth and Environmental Science (CEES)
Evidence-Based Practices in Rehabilitation Psychology
Nanoscale Imaging
Regenerative Biology and Medicine
Therapeutic Neuroscience
Visual Information Sensing and Computing

Degree Programs in the School of Science

The School of Science at Indiana University–Purdue University Indianapolis awards students degrees from both Purdue University (PU) and Indiana University (IU). This list shows all the degrees awarded and the institution granting the degree.

Biology
Bachelor of Arts PU

Bachelor of Science	PU
Master of Science	PU
Doctor of Philosophy[1,2]	
Biotechnology	
Associate of Science	PU
Bachelor of Science	PU
Chemistry	
Associate of Science	PU
Bachelor of Arts	PU
Bachelor of Science	PU
Master of Science	PU
Doctor of Philosophy[1,2]	
Computer and Information Science	
Bachelor of Science	PU
Master of Science	PU
Doctor of Philosophy[1]	
Environmental Science	
Bachelor of Science	IU
Forensic and Investigative Sciences	
Bachelor of Science	IU
Geology	
Bachelor of Arts	IU
Bachelor of Science	IU
Master of Science	IU
Interdisciplinary Studies	
Bachelor of Science	PU
Mathematical Sciences	
Bachelor of Science	PU
Master of Science	PU
Pure/Applied Math	
Applied Statistics	
Math Education	
Doctor of Philosophy[1,2]	
Physics	
Bachelor of Science	PU
Bachelor of Science (Physics)/Master of Science (Mechanical Engineering) dual degree program	PU/PU
Master of Science	PU
Doctor of Philosophy[1,2]	
Psychology	
Bachelor of Arts	PU
Bachelor of Science	PU
Master of Science	PU
Industrial/Organizational (I/O) Psychology	
Clinical Rehabilitation Psychology	
Doctor of Philosophy in Clinical Rehabilitation Psychology	PU
Doctor of Philosophy[1]	

Joint M.D.–Ph.D. Degrees[1,2] Several departments participate in the joint M.D.–Ph.D. program with the Indiana University School of Medicine. In this program students concurrently earn an Indiana University Doctor of Medicine degree and a Ph.D. degree in the School of Science.

Certificate Programs in the School of Science

The School of Science at Indiana University–Purdue University Indianapolis also awards a Purdue University (PU) certificate.

Computer and Information Science
Certificate in Applied Computer Science PU

Admissions and Transfers

All students entering the School of Science must have been officially admitted to the university by the IUPUI Office of Admissions, Cavanaugh Hall, Room 129, 425 University Blvd., Indianapolis, IN 46202-5143. Further information and application forms may be obtained at this address, by calling (317) 274-4591, or on the Web at www.enroll.iupui.edu.

Applicants should be aware that, under Indiana law, criminal convictions might result in ineligibility for admission to certain programs at IUPUI. For the School of Science, criminal convictions may also result in ineligibility for enrollment in certain courses or participation in certain projects. Questions regarding school policy on such matters should be addressed to the associate dean for Faculty Affairs and Undergraduate Education.

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[1] Purdue University Ph.D. Programs, pursued at IUPUI, arranged through Purdue, West Lafayette.

[2] Indiana University Ph.D. Programs, pursued at IUPUI, in departments or programs of the Indiana University School of Medicine in which School of Science faculty hold adjunct appointments.

Beginning Students

Students entering IUPUI directly from high school should file their applications for admission early in their senior year.

Acceptance to the university as a new student is influenced by several factors. The Office of Admissions is guided by the following:

1. The applicant should be a high school graduate or be scheduled to graduate before enrolling at IUPUI.
2. The extent to which the student meets or exceeds the minimum subject requirements indicated below is considered. For admission to the School of Science, the student's record should include the following course work:

Subjects	Semesters
English	8
History and Social Science	6
Algebra	4
Geometry	2
Trigonometry[1]	1-2
Laboratory Science[2] (including chemistry and biology)	6
Combination of foreign language, additional mathematics, laboratory science, social science, or computer science courses	6-7

Applicants to the School of Science are strongly encouraged to complete AP science and mathematics courses if available at their high school. Applicants considering majors in physics or chemistry are encouraged to complete a calculus course in high school.

In planning high school electives, the curricula of the various departments of the School of Science contained in this bulletin should be reviewed. Departmental advisors will be glad to help with planning for admission.

3. All applicants are required to take the Scholastic Aptitude Test (SAT) or the American College Test (ACT). IUPUI requires that the writing section of the test also be completed. It is recommended that these tests be taken in the spring of the junior year in high school or fall of the senior year.

The Undergraduate Admissions Office will examine your high school transcript and standardized test scores to determine both your admission to the university and your acceptance to the School of Science.

Students should declare a major when applying for admission so a departmental advisor can be assigned.

Transfer Students

From IUPUI Schools, Indiana University Campuses, and Purdue University Campuses

Prospective transfer students should have a minimum grade point average of 2.0 on a 4.0 scale, meet the requirements of the department they wish to enter, and be in good disciplinary standing. In order to be accepted for admission to the School of Science, students must first provide the materials indicated below.

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[1] Students who plan to major in chemistry, computer science, or physics must have taken an advanced mathematics course that includes trigonometry.

[2] It is advised that one semester of chemistry be included in laboratory science course work.

1. An IUPUI or other Indiana University campus student should file a record change form, which may be obtained from the School of Science or the student's current school. The form is also available online at www.enroll.iupui.edu.
2. A Purdue University campus student must make an official application through the IUPUI Office of Admissions. www.enroll.iupui.edu

From Other Colleges and Universities

Students who have earned transfer credit for 12 credit hours and have a minimum cumulative grade point average of 2.0 on a 4.0 scale from other institutions may be considered for admission to the School of Science. Admittance to the school is contingent upon acceptance into a departmental program. Students should submit the following with their application for admission to the IUPUI Office of Undergraduate Admissions:

1. a copy of their high school record showing satisfactory completion of entrance requirements
2. an official transcript of work completed in each institution previously attended
3. evidence of good academic and disciplinary standing at the institution last attended

The Office of Admissions evaluates credit from other institutions, and the major department and the School of Science determine its applicability toward degree requirements in the School of Science.

A marginal applicant may be granted admission, admitted on probation, or have admission denied.

Transfer Credit

The student's major department and the School of Science determine acceptability of transfer credits from another college or university to the School of Science.

From IUPUI to Other Indiana University and Purdue University Campuses

Students transferring from IUPUI to other Indiana University and Purdue University campuses should consult the appropriate departments at those campuses about equivalence of courses.

International Students

International students seeking admission to the School of Science at IUPUI must submit the international application for admission, which is available online from the IUPUI Office of International Affairs at www.iupui.edu/~oia. Additional information can be obtained at IUPUI Office of International Affairs, Union Building 207, 620 Union Drive, Indianapolis, IN 46202-5167; phone: (317) 274-7000; fax: (317) 278-2213; e-mail: oia@iupui.edu.

Undergraduate Nondegree Students

Students who hold a bachelor's degree from IUPUI or another university may register at IUPUI as **Undergraduate Nondegree** students. This enrollment status is desirable for students who need to take a small number of undergraduate courses in order to apply for medical school or other professional programs in, for example, dentistry, occupational therapy, optometry, pharmacy, physical therapy, and veterinary medicine. Students enrolled as undergraduate nondegree pay undergraduate tuition and fees, but may only register for undergraduate courses. Undergraduate nondegree students who enroll in graduate courses may be administratively withdrawn from these courses and may forfeit tuition and associated fees. Undergraduate nondegree students may seek academic advising through the School of Science. Students enrolled as undergraduate nondegree are not eligible for loans or other forms of financial aid through IUPUI, though they may seek loans or support through banks or other financial institutions.

Graduate Students

To be considered for admission, a candidate must have a bachelor's degree from an accredited institution and must show promise of ability to engage in advanced work and evidence of adequate preparation to pursue graduate study in the field chosen. The minimum standard for unconditional admission to the graduate school is a graduation grade point average of 3.0 (B) or the equivalent. An applicant not meeting these requirements should take the aptitude tests section of the Graduate Record Examination (GRE). Individual departments may set higher grade point requirements and may require the submission of additional evidence of academic performance, such as GRE scores.

A minimal score of 550 on the Test of English as a Foreign Language (TOEFL) is required for admission to the graduate school for applicants whose native language is not English. Departments may set higher requirements. Applicants in the Indianapolis area may substitute the IUPUI English as a Second Language (ESL) Placement Examination for the TOEFL. Information about this test is available from the Office of International Affairs online at www.iupui.edu/~oia.

Application should normally be made at least three months before the beginning of the session in which the student wishes to enroll. However, late applications may also be accepted. Applicants will be advised of the action taken on their applications by the dean of the Purdue University Graduate School. Applications to the Department of Geology will be considered by the Department of Geology and forwarded to the IUPUI office of the Indiana University Graduate School; applicants will be notified of the results by the graduate advisor in the Department of Geology.

Qualified students may be authorized to pursue a Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette, or the Indiana University School of Medicine. For further details, contact the department in which study is desired.

Applicants should be aware that, under Indiana law, criminal convictions might result in ineligibility for admission to certain programs at IUPUI. For the School of Science, criminal convictions may also result in ineligibility for enrollment in certain courses or participation in certain projects. Questions regarding school policy on such matters should be addressed to the Associate Dean for Faculty Affairs and Undergraduate Education.

Financial support in the form of teaching and research assistantships is available through the departments of the School of Science. Students who want to be considered for IUPUI fellowships must submit GRE (verbal/quantitative/analytic) scores. Area examination scores may be submitted for consideration.

Degree-Seeking Graduate Student Application

Application to all graduate programs must be made by electronic applications accessible through the School of Science Web site (www.science.iupui.edu). Application fees are submitted online at the time of application. If necessary, paper applications may be obtained from each department.

Applicants must submit complete, official transcripts of all previous college and university studies and three letters of academic reference for evaluation by the major department.

Graduate Nondegree Program

The graduate nondegree classification is normally used by students whose intent is to take course work for personal improvement. A student who wishes to become a candidate for an advanced degree should consult with the chosen major department at the time of application for admission as a graduate nondegree student. The major department will advise applicants of the procedure for obtaining status as a degree-seeking student. An application to become a graduate nondegree student is obtained through the IUPUI Graduate Office at the following Web site www.iupui.edu/~gradoff/grd. Additional information can be obtained at the IUPUI Graduate Office, Union Building 518, 620 Union Drive, Indianapolis, IN 46202-5167; phone: (317) 274-1577.

No more than 12 hours of credit earned under this classification may be used on a plan of study for a Purdue University degree program without approval of the major department and the Purdue University Graduate School. Similarly, not more than 9 hours of credit earned under this classification may be used in a plan of study for an Indiana University degree program without approval of the major department.

Bulletin Designation and Program Planning

Bulletin Designation

All colleges and universities establish certain academic requirements that must be met before a degree is granted. These regulations concern such things as curricula and courses, majors and minors, and campus residence. Advisors, directors, and deans will aid students in meeting these requirements, but students are responsible for fulfilling them. At the end of the course of study, the faculty and the Board of Trustees vote on the conferring of degrees. If requirements have not been satisfied, degrees will be withheld pending satisfactory completion of these requirements. For this reason, students need to acquaint themselves with all regulations and to remain informed throughout their university career.

This bulletin lists the requirements and regulations in effect for students who are admitted to the School of Science in August 2006 (fall semester). Students who enter after this date may be subject to different requirements; students who entered before August 2006 may elect to follow the graduation requirements that were in effect at the time of their admission to their degree program or the graduation requirements that became effective thereafter. However, the requirements chosen must be from only one bulletin. If a student has not completed an associate degree program within four years of admission, or a bachelor's degree program within eight years of admission, the student may be obliged by the major department to meet the requirements of a subsequent bulletin. Additionally, students in good standing who have not been enrolled at the university for two or more consecutive years must satisfy the requirements of the School of Science bulletin in effect upon their return.

Program Planning and Advising Guidelines

The experience of academic advisors and of successful students suggests the following guidelines for effective planning of undergraduate programs:

1. Students should be thoroughly familiar with all academic requirements that must be met before a degree is granted.
2. Students should seek appointments with academic advisors in their major departments before the dates established by the university calendar for registration. In such conferences students should, as a minimum objective, make certain that they review their degree requirements and that they have made an appropriate plan for the next semester.

3. Each student should understand that the responsibility for determining an appropriate academic program and for meeting every degree requirement rests with the student; faculty or staff members acting in the capacity of advisors are obligated only to assist students in meeting this responsibility. Any student who needs clarification of any of the requirements for the degree program is urged to obtain this clarification from an academic advisor or from the School of Science, Science Building 222; phone: (317) 274-0625.

Undergraduate Programs

Baccalaureate Degrees

School of Science requirements are the minimal requirements in various areas, and individual departments may require more, as stated in their degree descriptions. Students should consult with departmental advisors in planning their courses of study.

General Requirements

1. A minimum of 124 credit hours (122 for geology) must be completed. Approval must be obtained from the School of Science to use as credit toward graduation any course that was completed 10 or more years previously.
2. A minimum grade point average of 2.0 is required.
3. A minimum of 24 credit hours must be taken in a major subject (see departmental requirements) with a minimum grade point average of 2.0. No grade below C– is acceptable in the major subject.
4. At least four courses totaling a minimum of 12 credit hours in the major subject must be completed at IUPUI (see departmental requirements).
5. Residence at IUPUI for at least two semesters and completion, while at IUPUI, of at least 32 credit hours of work in courses at the 300 level or higher are required.
6. With the approval of the Associate Dean for Faculty Affairs and Undergraduate Education, students who have had at least four semesters of resident study may complete up to 15 credit hours of the senior year at another approved college or university.
7. Courses taken on the Pass/Fail option may be applied only as general electives and not toward degree area requirements of the school or department. Courses taken on the Pass/Fail option may apply to the 32 credit hours residency requirement listed in item 5 if the course is at the 300-level or higher.
8. No more than 64 credit hours earned in accredited junior colleges can be applied toward a degree.
9. Students may enroll in independent study (correspondence) courses for general electives up to a maximum of 12 credit hours with permission of the associate dean for Faculty Affairs and Undergraduate Education. Independent study (correspondence) courses may not apply to the 32 credit hours residency requirement listed in item 5.
10. With permission of the appropriate department, credit may be earned through special credit examination. Credits earned by special credit examination may be used toward the total credit hours required and to satisfy area requirements for a degree.
11. The following courses do not count for any credit toward any degree program in the School of Science: AGR 101; BIOL N120; CSCI N100-level courses; CPT 106; all Indiana University remedial and developmental arts and sciences courses; EDUC U205, X100, X150, X151, X152; ENG W001, W130; MATH M010, 001, M001, 002, 110, 111, 123, 130, 132, 136; PHYS 010; UCOL U112.

    Note that CHEM C100 may count for general elective credit only if the student has not already established credit in CHEM C101 or CHEM C105/ CHEM C106, or equivalent courses. Otherwise, CHEM C100 does not count for credit in any given degree program.

    Note that if credit has been established for both GEOL G132 and GEOL G107, then only GEOL G107 may apply to Area IIIC. In this case, GEOL G132 may count as a general elective provided that credit was established in GEOL G132 preceding GEOL G107.
12. Courses taken outside of the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of studio, clinical, athletic, or performing arts course work will be approved. Consult a school or departmental advisor.
13. An application for a degree must be filed with the director of Student Records and Retention in the School of Science, Science Building, room 222, by February 1 if graduation is anticipated in May or August, or by October 1 if graduation is anticipated for December. Candidates for December, May, or August graduation of a particular academic year may participate in the May Commencement. Students should also be registered in the appropriate section of CAND 991 (0 credit hours) during their final semester before graduation. See the online course offerings for listings on CAND 991 Candidate for Graduation.
14. In general, credit is not allowed for both of two overlapping courses. Examples of course overlaps include:

    BIOL N100 and BIOL K101/BIOL K103

BIOL N214/BIOL N215 and BIOL N261
BIOL N212/BIOL N213 and BIOL N217
CHEM C101 and CHEM C105 and/or CHEM C106
CHEM C102 and CHEM C341/CHEM C343
CHEM C110 and CHEM C341
CHEM C360 and CHEM C361
CHEM C325 and CHEM C410/CHEM C411
GEOL G110 and GEOG G107
GEOL G185 and GEOG-G 185
MATH M119 and MATH 221 or MATH 163
MATH 151 or 159 and MATH 153/154
MATH 151 and MATH 159
MATH 221/222 and MATH 163/164
PHYS P201/P202 or 218/219 and PHYS 152/251
PSY B320 and BIOL L391 Addictions (IU East)
SCI I120 and UCOL U110
STAT 301 and PSY B305

In addition, any course that is retaken is considered an overlap. Consult with your academic advisor regarding other overlapping courses.

15. See statements about required First-Year Experience Course and Capstone Experience in the description of the Bachelor of Arts degree and Bachelor of the Science degree programs.

Area Requirements for Baccalaureate Degrees

The faculty of the School of Science has adopted the following degree requirements for the Bachelor of Arts and Bachelor of Science degrees. Students may follow the School of Science and departmental requirements that are in effect when they enter the School of Science, or they may choose new requirements that become effective after that date.

School of Science requirements are the minimal requirements in various areas, and individual departments may require more, as stated in their degree descriptions. Students should consult with departmental advisors in planning their courses of study.

Bachelor of Arts Degree and Bachelor of Science Degree Requirements

The requirements for these bachelor's degree programs include the common general education core approved by the faculties of both the School of Liberal Arts and the School of Science. This general education core, together with the major, is a curriculum based on the IUPUI Principles of Undergraduate Learning (see the front part of this bulletin for a description of these principles).

First-Year Experience Course

Each beginning freshman and transfer student (with less than 18 credit hours) in both the Bachelor of Arts and Bachelor of Science programs in the School of Science is required to take either SCI I120 Windows on Science (1 cr.) or an equivalent freshman experience course that may be offered by a department in which the student is a major. Beginning psychology majors are required to take PSY B103 Orientation to a Major in Psychology (1 cr.).

Area I

English Composition and Communication Skills

Both Bachelor of Arts and Bachelor of Science students are required to take two courses in English composition worth at least 3 credit hours each and COMM R110 Fundamentals of Speech Communication (3 cr.). The English composition requirement is partially satisfied by completing ENG W131 (or ENG W140). The second composition course must have ENG W131 (or ENG W140) as a prerequisite. An appropriate course in technical or research writing may be used to complete the second composition course requirement. Consult departmental guidelines. A grade of C or higher must be obtained in both composition courses.

Area II

Foreign Language

1. A first-year proficiency in a foreign language is required for the Bachelor of Arts degree program. Note that American Sign Language may be used to satisfy this requirement.

   This requirement may be satisfied in one of the following ways:
   i. by completing first-year courses (8-10 credit hours) in a single language with passing grades;
   ii. by completing a second-year or third-year course with a grade of C or higher;
   iii. by taking a placement test and placing into the 200 level or higher.

   See the School of Liberal Arts section of this bulletin for items related to the placement test, courses numbered 117, nonnative speakers, and credit for lower division language courses.

2. Check the department section of the bulletin for any reference to a language proficiency requirement for a Bachelor of Science degree program.

Area III

IIIA Humanities, Social Sciences, and Comparative World Cultures

Four courses totaling 12 credit hours are required. The courses are to cover each of four areas:

1. HIST H114 History of Western Civilization II (3 cr.)
2. One course in humanities from List H
3. One course in social sciences from List S
4. One course in comparative world cultures from List C

Courses taken from lists H, S, and C must be outside the student's major.

It is recommended that the student see an academic advisor for updated lists.

Note that some courses may appear on more than one list. A cross-listed course may apply to only one of the required areas specified by the lists.

List H: Humanities

Afro-American Studies (AFRO)
A150 Survey of the Culture of Black Americans (3 cr.)

American Studies (AMST)
A103 Topics in American Studies (3 cr.)

Art History (HER)
H100 Art Appreciation (3 cr.)
H101 History of Art I (3 cr.)
H102 History of Art II (3 cr.)

Classical Studies (CLAS)
C205 Classical Mythology (3 cr.)

Communication Studies (COMM)
T130 Introduction to Theatre (3 cr.)

English (ENG)
L105 Appreciation of Literature (3 cr.)
L115 Literature for Today (3 cr.)

Film Studies (FILM)
C292 Introduction to Film (3 cr.)

Folklore (FOLK)
F101 Introduction to Folklore (3 cr.)

World Languages and Cultures (FLAC)
F200 Cultural Encounters (3 cr.)

History (HIST)
H105 American History I (3 cr.)
H106 American History II (3 cr.)
H108 Perspectives on the World to 1800 (3 cr.)
H113 History of Western Civilization I (3 cr.)
H217 The Nature of History (3 cr.)

Music (MUS)
M174 Music for the Listener (3 cr.)

Philosophy (PHIL)
P110 Introduction to Philosophy (3 cr.)
P120 Ethics (3 cr.)

Religious Studies (REL)
R133 Introduction to Religion (3 cr.)
R173 American Religion (3 cr.)
R180 Introduction to Christianity (3 cr.)
R212 Comparative Religions (3 cr.)

Women's Studies (WOST)
W105 Introduction to Women's Studies (3 cr.)

List S: Social Sciences

Afro-American Studies (AFRO)
A150 Survey of the Culture of Black Americans (3 cr.)

Anthropology (ANTH)
A104 Culture and Society (3 cr.)
(Note: ANTH A304 may be substituted for ANTH A104. Students may not receive credit for both.)

Communication Studies (COMM)
C180 Introduction to Interpersonal Communication (3 cr.)

Economics (ECON)
E101 Survey of Current Economic Issues and Problems (3 cr.)
E201 Introduction to Microeconomics (3 cr.)
E202 Introduction to Macroeconomics (3 cr.)

English (ENG)
G104 Language Awareness (3 cr.)

Folklore (FOLK)
F101 Introduction to Folklore (3 cr.)

Geography (GEOG)
G110 Introduction to Human Geography (3 cr.)
G130 World Geography (3 cr.)

History (HIST)
H117 Introduction to Historical Studies (3 cr.)

Political Science (POLS)
Y101 Principles of Political Science (3 cr.)
Y103 Introduction to American Politics (3 cr.)
Y213 Introduction to Public Policy (3 cr.)
(Note: POLS Y213 and SPEA V170 are equivalent courses. Students may not receive credit for both.)
Y219 Introduction to International Relations (3 cr.)

Psychology (PSY)
B104 Psychology as a Social Science (3 cr.)
B310 Life Span Development (3 cr.)

Public and Environmental Affairs, School of (SPEA)
V170 Introduction to Public Affairs (3 cr.)
(Note: POLS Y213 and SPEA V170 are equivalent courses. Students may not receive credit for both.)

Sociology (SOC)
R100 Introduction to Sociology (3 cr.)
R121 Social Problems (3 cr.)

Women's Studies (WOST)
W105 Introduction to Women's Studies (3 cr.)

List C: Comparative World Cultures

Anthropology (ANTH)
A104 Culture and Society (3 cr.)
(Note: ANTH A304 may be substituted for ANTH A104. Students may not receive credit for both.)

Classical Studies (CLAS)
C205 Classical Mythology (3 cr.)

World Languages and Cultures (FLAC)
F200 Cultural Encounters (3 cr.)

Geography (GEOG)
G110 Introduction to Human Geography (3 cr.)

History (HIST)
H108 Perspectives on the World to 1800(3 cr.)

Political Science (POLS)
Y217 Introduction to Comparative Politics(3 cr.)

Religious Studies (REL)
R133 Introduction to Religion (3 cr.)
R212 Comparative Religions (3 cr.)

IIIB Junior/Senior Integrator (3 cr.) One course from a list of Junior/Senior Integrator courses is required for this area (see academic advisor for details). The Junior/Senior Integrator is designed to integrate the areas of humanities, social sciences, and science. Prerequisites: at least junior standing; ENG W131; a second composition course applicable to Area I; one course applicable to Area IIIC Physical and Biological Sciences; one course applicable to area IIID Mathematical Sciences; one course in the major; HIST H114; and two courses taken from two of the H, S, and C lists. For a particular semester, Junior/Senior Integrator courses may be found under INTG offerings in the online *Course Offerings* or from the School of Science.

IIIC Physical and Biological Sciences Both Bachelor of Arts and Bachelor of Science students are required to complete at least four science lectures courses totaling a minimum of 12 credit hours outside the major department. At least one of the courses must have a laboratory component.

Courses that do not count in Area IIIC include AST A130; BIOL N100, BIOL N200, CHEM C100, GEOL G130, GEOL G135, PHYS 140, and all agriculture courses.

Courses that do not count for any credit toward any degree program in the School of Science include BIOL N120 and PHYS 010.

Except for laboratory courses combined with corresponding lecture courses, 1 credit hour and, in general, 2 credit hour courses do not apply to this area. *In addition, students must obtain grades of C– or higher in their Area IIIC courses. However, a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements. Courses can be chosen from the following departments:

Astronomy Biology
Chemistry Forensic and Investigative Science
Geology Physics

Note that if credit has been established for both GEOL G132 and GEOL G107, then only GEOL G107 may apply to Area IIIC. In this case, GEOL G132 may count as a general elective provided that credit was established in GEOL G132 preceding GEOL G107.

Note that GEOG G107 Physical Systems of the Environment (3 cr.)/GEOG G108 Physical Systems of the Environment: Laboratory (2 cr.) may apply to Area IIIC with approval of the student's major department. Also, GEOG G185 Global Environmental Change (3 cr.) is an acceptable substitute for GEOL G185 Global Environmental Change (3 cr.).

IIID Mathematical Sciences Bachelor of Arts students must have at least one course of at least 3 credit hours in mathematics and one course of at least 3 credit hours in computer science.

Bachelor of Science students must have at least two courses beyond algebra and trigonometry, totaling 6 credit hours. In addition, one course of at least 3 credit hours in computer science is required. Courses in applied statistics are not acceptable.

MATH M010, 001, MATH M001, 002, 110, 111, 123, 130, 132, 136; CSCI N100-level courses; and CPT 106 do not count for any credit toward any degree in the School of Science. Computer Science CSCI N241 does not count in this area, but may count as a general elective. *Students must obtain grades of C– or higher in their Area IIID courses. However, a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements. Courses can be chosen from the following departments:

Computer Science Mathematical Sciences

Area IV

Major Department Consult the listing of the major department for courses required within the major subject as well as courses required by the major department in the other areas.

Capstone Experience Course

Each undergraduate major in the School of Science is to be provided a **Capstone Experience** (research, independent study/project, practicum, seminar, or field experience). The capstone, required of all majors, is to be an independent, creative effort of the student that is integrative and builds on the student's previous work in the major. See departmental sections of the bulletin for specific information about capstone courses.

Minors

See the departmental sections of this bulletin for information on minor fields of study. Minors are awarded only with the completion of a bachelor's degree. Independent Study (correspondence) courses may not be used to fulfill a minor program.

Requirements for minors offered by departments in the School of Science are as follows:

1. A minimum of 18 credit hours must be taken in a minor subject.
2. A minimum of 6 credit hours in the minor subject must be taken at IUPUI.
3. No grade below C– is acceptable in the minor subject.
4. A minimum grade point average of 2.0 is required for the complete minor program.

Check with the department offering the minor for additional restrictions or requirements.

Certificate Programs

See departmental sections of bulletin.

Associate Degree

Some associate degree programs are in the approval process. Consult the department of interest.

School of Science requirements are the minimal requirements in various areas, and individual departments may require more, as stated in their degree descriptions. Students should consult with departmental advisors in planning their courses of study.

General Requirements

1. A minimum of 62 credit hours (60 for geology) must be completed. Acceptance must be obtained from the School of Science to use as credit toward graduation any course that was completed 10 or more years previously.
2. A minimum grade point average of 2.0 is required.
3. A minimum of 15 credit hours must be taken in a major subject (see departmental requirements) with a minimum grade point average of 2.0. No grade below C– is acceptable in the major subject.
4. At least three courses totaling a minimum of 9 credit hours in the major subject must be completed at IUPUI (see departmental requirements).
5. Residence at IUPUI is required for at least two semesters and the enrollment in and completion of at least 32 credit hours of course work required for the completion of the degree.
6. With the approval of the associate dean for Faculty Affairs and Undergraduate Education, students who have had at least four semesters of resident study may complete up to 15 credits in their terminal year at another approved college or university.
7. Courses taken on the Pass/Fail option can be applied only as general electives and not toward degree area requirements of the school or department. Courses taken on the Pass/Fail option may apply to the 32 credit hours residency requirement listed in item 5.
8. No more than 32 credit hours earned in accredited junior colleges can be applied toward an associate degree.
9. Students may enroll in independent study (correspondence) courses for general electives up to a maximum of 6 credit hours with permission of the associate dean for Faculty Affairs and Undergraduate Education. Independent Study (correspondence) courses may not apply to the 32 credit hours residency requirement listed in item 5.
10. With permission of the appropriate department, credit may be earned through special credit examination. Credits earned by special credit examination may be used toward the total credit hours required and to satisfy area requirements for a degree.
11. The following courses do not count for any credit toward any degree program in the School of Science: AGR 101; BIOL N120; all Indiana University remedial or developmental arts and sciences courses; CSCI N100-level courses; CPT 106; EDUC U205, X150, X151, X152; ENG W001, W130; MATH M010, 001, M001, 002, 110, 111, 123, 130, 131, 132, 136; PHYS 010; UCOL U112.

    Note that CHEM C100 may count for general elective credit only if the student has not already established credit in CHEM C101 or CHEM C105/ CHEM C106, or equivalent courses. Otherwise, CHEM C100 does not count for credit in any given degree program.

    Note that if credit has been established for both GEOL G132 and GEOL G107, then only GEOL G107 may apply to Area IIIC. In this case, GEOL G132 may count as a general elective provided that credit was established in GEOL G132 preceding GEOL G107.
12. Courses taken outside of the Schools of Science and Liberal Arts must receive departmental approval. No credits are allowed for clinical, athletic, or performing arts course work. See the department advisor for details.
13. In general, credit is not allowed for both of two overlapping courses. See the departmental advisor for details and item 14 under "General Requirements" for the baccalaureate degree.

14. An application for a degree must be filed with the director of Student Records and Retention in the School of Science, Science Building, room 222, by February 1, if graduation is anticipated in May or August, or by October 1, if graduation is anticipated for December. Candidates for December, May, or August graduation of a particular academic year may participate in the May Commencement. Students should also be registered in the appropriate section of CAND 991 (0 credit hours) during their final semester before graduation. See the online *Course Offerings* for listings on CAND 991 Candidate for Graduation.

Area Requirements for Associate Degrees

The faculty of the School of Science has adopted the following degree requirements for the associate degree. Students may follow the School of Science and departmental requirements that are in effect when they enter the School of Science, or they may choose new requirements that become effective after that date. However, the requirements must be chosen from only one bulletin. A student who has not completed an associate degree program within four years of entering the School of Science may be obliged by the major department to meet the requirements of a subsequent bulletin. Additionally, students in good standing who have not been enrolled at the university for two or more consecutive years must satisfy the requirements of the School of Science bulletin in effect upon their return.

School of Science requirements are the minimal requirements in various areas, and individual departments may require more, as stated in their degree descriptions. Students should consult with departmental advisors in planning their courses of study.

For the Associate Degree in Applied Biotechnologies, please speak with a departmental advisor for area specific course requirements.

Associate Degree Requirements

First-Year Experience Course

Each beginning freshman and transfer student (with less than 18 credit hours) in an associate degree program in the School of Science is required to take either SCI I120 Windows on Science (1 cr.) or an equivalent freshman experience course that may be offered by a department in which the student is a major. Beginning psychology majors are required to take PSY B103 Orientation to a Major in Psychology (1 cr.).

Area I

English Composition and Communication Skills

Two courses in English composition worth at least 3 credit hours each and COMM R110 Fundamentals of Speech Communication (3 cr.) are required. The English composition requirement is partially satisfied by completing ENG W131 (or ENG W140). The second composition course must have ENG W131 (or ENG W140) as a prerequisite. An appropriate course in technical or research writing may be used to complete the second composition course requirement. Consult departmental guidelines. A grade of C or higher must be obtained in both composition courses.

Area II

Foreign Language

The School of Science requires no foreign language for an associate degree.

Area III

IIIA Humanities, Social Sciences, and Comparative World Cultures One course of at least 3 credits taken from the Humanities List H, Social Sciences List S, or the Comparative World Cultures List C; or HIST H114 History of Western Civilization II (3 cr.). (See lists under Area IIIA, Bachelor of Arts degree and Bachelor of Science degree requirements.)

IIIB Junior/Senior Integrator The School of Science requires no Junior/Senior Integrator course for an associate degree.

IIIC Physical and Biological Sciences* Two courses outside the major department totaling at least 6 credit hours are required. At least one of the courses must have a laboratory component.

Courses that do not count in Area IIIC include AST A130; BIOL N100, BIOL N200, CHEM C100, GEOL G130, GEOL G135, PHYS 140, and all agriculture courses.

Courses that do not count for any credit toward any degree program in the School of Science include BIOL N120 and PHYS 010.

Except for laboratory courses combined with corresponding lecture courses, 1 credit hour and, in general, 2 credit hour courses do not apply to this area. *Students must obtain grades of C– or higher in their Area IIIC courses. However, a single grade of D+ or D will be allowed for one course only.* Check with the major department for additional restrictions or requirements. Courses can be chosen from the following departments:

Astronomy	Biology
Chemistry	Forensic and Investigative Science

Geology Physics

Note that if credit has been established for both GEOL G132 and GEOL G107, then only GEOL G107 may apply to Area IIIC. In this case, GEOL G132 may count as a general elective provided that credit was established in GEOL G132 preceding GEOL G107.

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*For exceptions to this area, refer to the description of the associate degree program offered by the specific department.

Note that GEOG G107 Physical Systems of the Environment (3 cr.)/GEOG G108 Physical Systems of the Environment: Laboratory (2 cr.) may apply to Area IIIC with approval of the student's major department. Also, GEOG G185 Global Environmental Change (3 cr.) is an acceptable substitute for GEOL G185 Global Environmental Change (3 cr.).

IIID Mathematical Sciences One course of at least 3 credit hours in mathematics. The student must obtain a grade of C– or higher for the course. Note that MATH M010, 001, M001, 002, 110, 111, 123, 130, 132, and 136 do not count for any credit toward any degree in the School of Science.

Area IV

Major Department Consult the listing of the major department for courses required within the major subject as well as courses required by the major department in other areas.

Graduate Programs

Master of Science Degrees

Purdue University Master of Science degrees are offered in all School of Science departments except geology, which offers an Indiana University Master of Science degree. All departments award either a thesis or nonthesis option.

Doctor of Philosophy Degrees

A Purdue University Ph.D. program in Clinical Rehabilitation Psychology is offered by the Department of Psychology. Purdue University Ph.D. Programs pursued at IUPUI, arranged through Purdue, West Lafayette, are available in biology, chemistry, computer science, mathematics, physics, and an additional area of psychology.

Indiana University Ph.D. Programs pursued at IUPUI in departments or programs of the Indiana University School of Medicine in which School of Science faculty hold adjunct appointments are available.

Joint M.D.–Ph.D. Degrees Several departments participate in the joint M.D.–Ph.D. program with the Indiana University School of Medicine. In this program students concurrently earn an Indiana University Doctor of Medicine degree in the School of Medicine and a Ph.D. degree arranged through the School of Science. Students interested in this option should consult the program in which they wish to earn the Ph.D.

General Requirements for Graduate Programs

1. Students must be seeking graduate degrees.
2. The student must meet the general requirements of the Indiana University Graduate School or the Purdue University Graduate School, depending on the degree. Specific requirements of the individual department in which the student enrolls must also be met. Special departmental requirements are listed under the major department.
3. At least 30 academic credits are required for the master's degree and at least 90 academic credits are required for the Ph.D. Some programs may require more credits. The maximum number of transfer credits allowed is 12 hours, but some programs may allow fewer. The student's major department and the Office of the Associate Dean determine acceptability of transfer credits from another college or university for Faculty Affairs and Undergraduate Education. No work may be transferred from another institution unless the grade is a B or higher.
4. Students must meet graduate school resident study requirements. At least one-half of the total credit hours used to satisfy a Purdue master's degree must be earned while in residence at IUPUI. At least 30 credit hours of IU graduate work must be completed while enrolled on a campus of Indiana University to satisfy the master's degree. At least one-third of the total credit hours used to satisfy degree requirements must be earned (while registered for doctoral study) in continuous residence on the IUPUI campus. The major department should be consulted for other more specific rules.
5. All nonnative speakers of English must submit results of the Test of English as a Foreign Language (TOEFL). A minimal score of 550 on the TOEFL is required. Departments may set higher standards. Applicants in the Indianapolis area may substitute the IUPUI English as a Second Language (ESL) Placement Examination for the TOEFL. Information about this test is available from Office of International Affairs online at www.iupui.edu/~oia.

6. Each student must file a plan of study that conforms to the departmental and disciplinary requirements. This is normally done in consultation with a faculty advisory committee. A tentative plan of study should be drawn up in advance of registration for the first semester of graduate work. This should be done by the student and the graduate advisor. Students and advisors should pay careful attention to the deadlines established by the graduate schools for filing plans of study.
7. Students must meet the grade and grade point average requirements. Only grades of A, B, or C are acceptable in fulfilling graduate school requirements in any plan of study. An advisory committee or department may require higher performance than C in certain courses. Grades of Pass (P) are not acceptable. Specific cumulative grade point average requirements, if any, are determined by the individual departments.
8. Students must fulfill departmental requirements regarding oral and written examinations. These requirements vary by program and students should consult the major department. The graduate school has no general requirement for oral and written examinations for the nonthesis master's degree.

Graduate Nondegree Study

A student who has previously earned a bachelor's degree may enroll in graduate courses without making formal application as a degree-seeking student. Application as a graduate nondegree student is, however, required and may be obtained through the IUPUI Graduate Office at the Web site www.iupui.edu/ ~gradoff/grd. Additional information can be obtained at the IUPUI Graduate Office, Union Building, room 518, 620 Union Drive, Indianapolis, IN 46202-5167; phone (317) 274-1577. Students should consult the major department to determine how many credits earned in a nondegree status may be transferred into a graduate degree program.

Academic Regulations

Grading or Academic Policies

See the front of the bulletin for general information about grades. The following policies are specific to the School of Science.

Pass/Fail Option During the four years of their undergraduate program, all undergraduates in good standing (with an overall GPA of 2.0 or higher) may enroll in up to eight elective courses to be taken with a grade of P or F. The Pass/Fail option is open for a maximum of two courses per year, including summer sessions. For this option, the year is defined as August 15 to August 15. The Pass/Fail option form is available in School of Science departmental offices and in the School of Science, LD 222.

The course selected for Pass/Fail grading must be an elective. It may not be used to satisfy any of the school area requirements, nor may it be counted as a part of the student's major. If the course is at the 300 level or higher, with a grade of P, the course may apply to the 32 credit hour School of Science residency requirement. A grade of P cannot be changed subsequently to a grade of A, B, C, or D.

Withdrawal Students may officially withdraw from classes without penalty during the first half of a semester or session if they secure the approval of the advisor; a grade of W (Withdrawal) is recorded on the final grade report. Students may withdraw from classes during the third quarter of a semester or session if they secure the approval of their advisor and the instructor of the course; the instructor may assign a grade of W or F. The grade so assigned is recorded on the final grade report. A student may withdraw from classes during the last quarter of a semester or session only under extraordinary circumstances. In such cases, the student must secure the approval of the advisor, the instructor of the course, and the dean of the school; the instructor may assign a grade of W or F. A written justification from a doctor, member of the clergy, advisor, etc., must be presented indicating that the student could not have withdrawn earlier. The grade so assigned is recorded on the final grade report. The necessary form for withdrawal from a course is available in School of Science departmental offices and in the School of Science, LD 222.

Students who alter their schedules, whether by personal incentive or by departmental directive, must follow correct withdrawal procedures. Students who do not follow these procedures risk jeopardizing their record by incurring a failing grade in a course not properly dropped, or they risk not receiving credit for work done in a course that has not been properly added.

Grade Replacement Policy The Grade Replacement Policy is available only to undergraduate students. It may be exercised for a maximum of 15 credit hours, no more than two times for a given course, with each attempted replacement counting toward the 15 credit hour limit. Any grade may be replaced with the last grade earned for the course. The replaced grade will then be excluded from the cumulative grade point average. However, the course listing and the replaced grade will remain on the student's academic record with an "X" notation indicating that the grade is excluded from the cumulative grade point average.

The policy became effective beginning with the fall 1996 semester, and any courses being used to replace an earlier grade must have been taken in the fall of 1996 or later. Grades previously granted FX will be honored and will count toward the 15 credit hour limit. Once invoked, a student may not subsequently request reversal of the grade replacement granted for a given course. Also, this policy is not available for graduate students or students seeking any second undergraduate degree. A student interested in accessing the Grade Replacement Policy should contact the School of Science, LD 222.

Degree Grade Point Average

The School of Science computes a school grade point average, which is the basis for recommending the awarding of a degree. This grade point average is computed at the completion of the degree program. Only the most recent grade in repeated courses counts in computing the school grade point average for the purpose of graduation. Remedial courses and courses that overlap are also excluded.

Special Credit

Special credit by examination, by credentials, and/ or by experience may be awarded in order to help qualified students earn their degrees more quickly. Each instructional department determines which of its courses are available for special credit and establishes procedures to determine student eligibility, administer evaluations for special credit, and grade students. The evaluations are as comprehensive as those given in the course. Credit earned by examination will be assigned an A (highest passing grade) or S (passing grade). Credit earned by credentials and/ or experience will be assigned an S. An S (passing) grade is considered to be equivalent to performance at a minimum grade level of C.

Responsibility for initiating a request for special credit in a specific course normally rests with the student. To find out if special credit is warranted, the student should consider meeting first with the department chair, advisor, or course instructor.

For additional information, refer to the front part of this bulletin under “Special Credit.”

Auditing Courses

University policy permits the auditing of courses, but audited courses may not be retaken later for academic credit. Written permission from the instructor to audit a class must be obtained before the student attempts to register. See the front of the bulletin for general information about auditing courses.

Review of Final Grade in a Course

A student has the right to request and receive a review of the student’s final grade in a course. However, the request for such a review must be made in a timely manner; that is, within one year of the completion of the course.

Petition for Grade Change

Faculty Petition A faculty member may request a change of grade for a student. This request can be honored only after approval of the department chairperson and the School of Science Associate Dean for Faculty Affairs and Undergraduate Education.

Student Petition In certain cases, a student may request a change of grade. Students should contact the School of Science, LD 222, for information about procedures and time limits for applicable cases.

Science Scholars List and Dean’s Honor List

The School of Science recognizes exceptional academic performance in baccalaureate and associate degree programs before graduation from the university by periodically publishing the Science Scholars List and the Dean’s Honor List. The Science Scholars List names full-time students (taking 12 or more credit hours) or part-time students (taking at least 5 credit hours) who have completed at least 26 credit hours of course work at IUPUI and who have a semester and cumulative grade point average (GPA) of at least 3.75. The Dean’s Honor List contains the names of the students who have achieved a GPA of 3.5 or higher during a semester in which they carry 12 or more credit hours. Part-time students (taking 5 or more credit hours) who have completed at least 26 credit hours of course work at IUPUI will be included on the Dean’s Honor List if they have a semester and cumulative GPA of 3.5 or higher.

Courses assigned a deferred grade (R) will count toward the 12 credit hour minimum required of full-time students. Courses taken on a Pass/Fail basis will not count toward the 12 credit hour minimum. Students who received an Incomplete (I) will not be placed on the Science Scholars List or the Dean’s Honor List. No Science Scholars List or Dean’s Honor List is published for the summer sessions.

Candidates for Baccalaureate Degrees

Students are considered to be candidates in good standing for baccalaureate degrees awarded by the School of Science when they have been admitted as regular students by the Office of Admissions, when their last semester’s grade point average is not less than a 2.0, and when their cumulative grade point average is not below this same level.

Double Major

A double major is awarded to students who simultaneously complete the requirements for two Purdue Bachelor of Science degree programs or two Purdue Bachelor of Arts degree programs in the School of Science. Students who plan to double major must have their programs approved by both major departments and the associate dean for Faculty Affairs and Undergraduate Education. A form to petition for a double major can be obtained from the School of Science, LD 222. A student declaring a double major must satisfy the departmental requirements for the second major as stated in the School of Science bulletin in effect when the second major is approved.

Double Degree

A student may be awarded two degrees by simultaneously completing bachelor's degree programs from two different schools at IUPUI or by simultaneously completing two baccalaureate major programs from the School of Science, one leading to a Purdue Bachelor of Arts degree and the other leading to a Purdue Bachelor of Science degree, or one leading to a Purdue degree and the other leading to an Indiana University degree. A student who plans to pursue a double degree must receive approval from the two major departments and the academic deans of the schools awarding the degrees. A form to petition for a double degree can be obtained from the School of Science, LD 222. A student who declares a double degree, and who is accepted by a department in the School of Science for the additional degree program, must satisfy the requirements for that program as stated in the School of Science bulletin in effect when the additional degree program is approved.

Change of Major within the School of Science

A student who desires to change majors within the School of Science should petition the School of Science, LD 222. If the petition is approved, the student may be placed under the bulletin in effect during the time of admission into the new major.

Second Baccalaureate Degree

Normally the holder of a bachelor's degree who wishes to pursue a further educational goal is encouraged to consider a graduate degree program. However, a student interested in pursuing a second degree should apply through the IUPUI Office of Admissions, Cavanaugh Hall, room 129, 425 University Blvd., Indianapolis, IN 46202-5143. Further information and application forms may be obtained at this address, by calling (317) 274-4591, or online at www.enroll.iupui.edu.

In order to be admitted to the degree program, the applicant must meet admission requirements of the School of Science and of the department. If admitted, the candidate will be placed under the bulletin in effect during the time of admission into the second-degree program.

Degrees Awarded with Distinction

IUPUI recognizes outstanding performance in course work by awarding associate or bachelor's degrees with distinction. Purdue degrees are awarded with distinction and highest distinction. Indiana University degrees are awarded with distinction, high distinction, and highest distinction. (Cords designating graduation with distinction are the only cords to be worn at commencement.)

To award graduation with distinction for baccalaureate degrees or associate degrees, there must be at least 20 students in the respective pool of spring candidates.

To be eligible for graduation with distinction, candidates must complete all the requirements of their degree programs. Additionally, the following conditions apply:

1. A candidate for a baccalaureate degree with distinction must have a minimum of 65 credit hours of course work from Purdue University or Indiana University applicable to the graduation index (degree grade point average) on record. A candidate for the associate degree with distinction must have a minimum of 35 credit hours of course work from Purdue University or Indiana University applicable to the graduation index on record;
2. The minimum graduation index for distinction (Purdue and IU degrees) shall be no less than the 90th percentile of the graduation indexes of all the graduates in the school for the spring semester, provided that the index is at least 3.30;
3. Of those who qualify for distinction under these rules for the spring semester, the six-tenths of the baccalaureate (associate) graduates having the highest graduation indexes shall be designated as graduating with high distinction (IU degrees only);
4. Of those who qualify for distinction under these rules for the spring semester, the three-tenths of the baccalaureate (associate) graduates having the highest graduation indexes shall be designated as graduating with highest distinction (Purdue and IU degrees);
5. The minimum graduation indexes determined for the spring semester for graduation with distinction, high distinction, and highest distinction shall be applied for graduation with those respective levels of distinction for the subsequent summer sessions and fall semester.

Academic Standing

Academic Probation

A student whose cumulative grade point average (GPA) falls below a 2.0 will be placed on probation. The student may continue studies provided the student achieves a GPA of at least 2.0 for each semester while on probation. Once the cumulative GPA is at least 2.0, the student will be removed from probationary status. A student will be advised of probationary status by letter from the associate dean for Faculty Affairs and Undergraduate Education.

Dismissal

A student on probation who has completed a minimum of 12 IUPUI grade point average (GPA) hours is subject to dismissal if the student fails to attain a GPA of at least 2.0 in any two consecutive IUPUI semesters (fall and spring), including the semester that the student was first placed on probation.

A student can also be dismissed from the university when, in the opinion of the associate dean for Faculty Affairs and Undergraduate Education of the School of Science, the student has ceased making progress in the degree program.

Readmission

A student dismissed for the first time must remain out of school at least one regular (fall or spring) semester. During the semester out of school, the student may petition the School of Science for readmission. A student dismissed for the second time must remain out of school at least two regular semesters (fall and spring), but may petition for readmission during the second semester out of school. Readmission after a second dismissal is extremely rare.

In order to allow sufficient time for considering a petition for readmission, a student eligible to submit a petition should do so before June 15 for the fall semester, October 15 for the spring semester, or March 15 for either summer session.

A student readmitted will be so informed by letter from the Associate Dean for Faculty Affairs and Undergraduate Education. The letter will indicate any conditions and restrictions affecting readmission and continuance in the degree program.

Special Programs

Teaching Certification

Becoming a Licensed Teacher

Top quality science and mathematics teachers are in high demand, and the IU School of Education at IUPUI is recognized as a leader in urban education. Students who want to become teachers of middle school and/or high school science or mathematics must take specific programs of study aligned to the standards for teaching these subject areas. Teachers must fully understand the content they teach, the realities of schools, and methods for successfully teaching every child. This requires earning a major or a degree in the School of Science and completing a teacher preparation program in the School of Education.

Mathematics and science majors who want to become teachers need to seek advising from the School of Science as soon as possible so that they take the right courses as they complete their majors. Mathematics majors often find they can complete both their major in mathematics and the *Learning to Teach/Teaching to Learn (LTTL)* program as part of their bachelor's degree. Science majors typically complete their bachelor's degree in science and then enter the *Transition to Teaching (T2T)* program as post baccalaureate students, earning the first half of their master's degree in this 12-month teacher education program. The *Transition to Teaching* program is also an option for mathematics graduates or returning students.

Admission to either the undergraduate (LTTL) or the graduate (T2T) teacher education program is competitive. Students must complete a formal application and have most of the required courses in the major, passing PRAXIS test scores, a clear criminal history check, and at least a 2.5 overall GPA. Specific information about admission to each program is available on the School of Education Web site. education.iupui.edu

Both the *Learning to Teach/Teaching to Learn* program and the *Transition to Teaching* program enable students to earn Rules 2002 Indiana teacher licenses. The LTTL program consists of 43 credit hours of undergraduate study, sequenced across four semesters including a final semester of student teaching. The T2T program is 18 credit hours (plus program fees) of graduate study done while practice teaching in schools everyday for one school year.

Note: Information about teacher education and licensing may change for many reasons, including legislative mandates and state policies. Students need to check for current information on the School of Education Web site, education.iupui.edu, and meet with School of Education advisors regularly.

Preprofessional Programs

Premedical Program

Students planning to apply to medical school must choose a degree program in addition to taking courses that fulfill the admission requirements for their chosen medical school. While many opt to complete their degrees with science majors, other fields of specialization are acceptable. Freshmen should declare their chosen major and seek advising for their degree requirements from the advisor in their major department. IUPUI also offers health professions advising in the School of Science and the School of Liberal Arts. Premedical students should consult the health professions advisor in their school once they have completed the 10 credit hours of biology and 10 credit hours of inorganic chemistry required for medical school in order to plan the timing for the MCAT test and the admission process to medical school.

Predental, Preveterinary, Preoptometry Programs

Admission to professional schools is highly competitive. The preprofessional student is therefore urged to elect a degree program rather than fulfilling the minimum requirements of these schools. Students who choose predental, preveterinary medicine, and preoptometry are usually placed in the Department of Biology where preprofessional advising is available. Predental students are also encouraged to meet with the health professions advisor in the School of Science to plan for the testing and admission process required by dental schools. Refer to the Department of Biology section of this bulletin for the required courses for Indiana University School of Optometry and Purdue University School of Veterinary Medicine.

Graduate students holding non-science degrees who are electing courses in the School of Science to prepare for medical or dental school are also invited to use the health professions advising service for help with the admission process.

Prepharmacy Program

The prepharmacy program at IUPUI consists of approximately 70-90 credit hours of course work required to apply to pharmacy school. Students declaring prepharmacy upon admission to IUPUI are assigned to the Department of Biology, where prepharmacy advising is available. After completion of the required courses for admission, students apply to the pharmacy school of their choice. Refer to the Department of Biology section of this bulletin for required courses to apply to the pharmacy program at the Purdue School of Pharmacy and Pharmacal Sciences.

Pre-Occupational Therapy Program

Students may take any undergraduate program and include a set of core courses needed as prerequisites for a graduate degree in occupational therapy at the Indiana University School of Health and Rehabilitation Sciences. Undergraduate degree programs in biology or psychology in the School of Science may be of interest to the pre-occupational therapy student. Advising for the undergraduate degree and planning the requirements for application/admission to a graduate degree program in occupational therapy is available in those departments. An academic advisor in the IUPUI School of Health and Rehabilitation Sciences is also available for consultation.

The following is a list of courses fulfilling prerequisites required for graduate studies in occupational therapy.

*BIOL N217 Human Physiology (5 cr.)
and
*BIOL N261 Human Anatomy (5 cr.)
or
*BIOL N212/BIOL N213 Human Biology(3 cr./2 cr.) **and**
*BIOL N214/BIOL N215 Human Biology(3 cr./2 cr.)
PSY B310 Life Span Development (3 cr.)
PSY B380 Abnormal Psychology (3 cr.)
*PSY B305 Statistics (3 cr.)
or
*STAT 301 Elementary Statistical Methods I(3 cr.)
AHLT W105 Medical Terms for the Health Sciences (1 cr.)
or
CLAS C209 Medical Terms from Greek and Latin (2 cr.)

***Note:** Biology and statistics courses must be taken no more than seven years before admission.

The program requires a minimum of 12 hours of observation in three or more sites.

The pre-occupational therapy student should consult with an academic advisor for updates of pre-occupational therapy criteria.

Pre-Physical Therapy Program

Students may take any undergraduate program and include a set of core courses needed as prerequisites for a graduate degree in physical therapy at the Indiana University School of Health and Rehabilitation Sciences. Undergraduate degree programs in biology, chemistry, or psychology in the School of Science may be of interest to the pre-physical therapy student. Advising for the undergraduate degree and planning the requirements for application/admission to a graduate degree program in physical therapy is available in those departments. An academic advisor in the IUPUI School of Health and Rehabilitation Sciences is also available for consultation.

The following is a list of courses fulfilling prerequisites required for graduate studies in physical therapy.

BIOL N217 Human Physiology (5 cr.)
BIOL N261 Human Anatomy (5 cr.)
CHEM C105/CHEM C125
Principles of Chemistry I/Lab (5 cr.)
CHEM C106/CHEM C126
Principles of Chemistry II/Lab (5 cr.)
PSY B310 Life Span Development (3 cr.)
PHYS P201/PHYS P202
General Physics I/II (5 cr./5 cr.)
or
PHYS 218/219 General Physics (4 cr./4 cr.)
PSY B104 Psychology as a Social Science(3 cr.)
or
PSY B105 Psychology as a Biological Science (3 cr.)
PSY B305 Statistics (3 cr.)
or
STAT 301 Elementary Statistical Methods I(3 cr.)

Two courses, 3 credit hours each, in the humanities, social sciences areas.

The pre-physical therapy student should consult with an academic advisor for updates of pre-physical therapy requirements.

Honors Program

The IUPUI Honors Program is open to students in both the Purdue and Indiana University degree programs. Students with an overall grade point average (GPA) of 3.0 after their first full semester of work, entering freshmen with a minimum combined math and verbal (critical reading) SAT score of 1200, or ACT of 26, and those who have graduated in the top 10 percent of their high school class, are automatically invited to participate in the Honors Program. Students with a GPA of less than 3.0 may be permitted to take honors courses. They should, however, discuss the matter with their academic advisor and the honors advisor before doing so.

In general, students may take no more than 6 credit hours of honors work each semester. Students may earn honors credit by taking special Honors Program courses (HON H300, HON H399, HON H400), by taking specially designated sections of multisection courses, by doing special overseas or internship work, or by contracting for honors credit using an H-Option contract in conjunction with regular classes.

H-Option contracts are the most popular and frequent way that students earn honors credit. An H-Option requires that a student work out with the instructor of a course a specific contract for a paper, field project, oral presentation, etc., early in the semester. The contract is not merely an extension of the regular class work, but an opportunity not provided by regular assignments. All the necessary signatures of approval, including that of the director of the Honors Program, must be submitted to the Honors Program office before consent to begin the project will be given.

Students completing honors work or an honors degree will, upon request, receive an honors course record listing all honors work, to be included with official university grade transcripts.

For additional information, contact the IUPUI Honors Program, University College, UC 3140, 815 W. Michigan Street, Indianapolis, IN 46202-5164; phone (317) 274-2314; www.universitycollege.iupui.edu/ honors.

To obtain an honors degree in computer science, mathematics, or physics, a student must have a cumulative grade point average of 3.3 and a minimum of 24 credit hours, with a 3.5 average in honors work. 6 hours of honors credit must be outside the student’s major field. A senior thesis track is also available. To obtain an honors degree in biology, chemistry, geology, or psychology, a student should follow the requirements described below.

Biology

Students with a GPA of 3.3 and 12 hours of credit, or entering high school students with a minimum combined math and verbal (critical reading) SAT score of 1200 or who are graduating in the top 10 percent of their high school class, qualify for the Biology Honors Program. Students wishing to participate in the Biology Honors Program must first receive approval from the Department of Biology. Students may choose from two tracks. In Track 1 (honors with thesis), students must complete 21 credit hours of honors work including 6 credit hours outside of biology and 15 credit hours in biology. These biology hours are to include 4 credit hours of BIOL K101/BIOL K103 honors sections of lab/recitation, 6 credit hours in honors sections of BIOL K493, and 5 credit hours in H-Option biology courses and/or 500-600-level biology courses. In Track 2 (honors without thesis), students must complete 24 credit hours of honors work. These hours are to include 6 credit hours outside of biology, 4 credit hours of BIOL K101/BIOL K103 honors sections of lab/recitation, and 14 credit hours in H-Option biology courses and/or 500-600-level biology courses.

Chemistry

Students with a minimum GPA of 3.0 may be admitted into the Chemistry Honors Program with approval of the Honors Program and the Department of Chemistry and Chemical Biology. After entering the program, maintenance of a GPA of 3.3 in all courses and of 3.5 in honors courses is necessary. The curriculum committee of the chemistry department will approve any honors Bachelor of Science degrees awarded in chemistry. In addition to meeting general honors requirements, students who intend to graduate with honors in chemistry must complete 24 honors credit hours, consisting of 1 credit hour in the CHEM C301 or CHEM C302 Chemistry Seminar, 6 credit hours in CHEM C409 Chemical Research, 5 credit hours of H-Options in undergraduate courses and/or graduate chemistry courses, and 12 credit hours of honors credit in courses outside of chemistry.

Geology

For the Bachelor of Science degree, honors students must complete 24 credit hours of honors work, 18 credit hours in geology and 6 credit hours in other approved honors courses. For the Bachelor of Arts degree, the requirements are 15 credit hours in geology and 9 credit hours outside geology in other approved honors courses. The following upper-division geology courses are approved for H-Option contracts: GEOL G205 Reporting Skills in Geoscience, GEOL G209 History of the Earth, GEOL G221 Earth Materials, GEOL G222 Introductory Petrology, GEOL G304 Principles of Paleontology, GEOL G323 Structural Geology, GEOL G334 Principles of Sedimentation and Stratigraphy, GEOL G403 Optical Mineralogy and Petrography, GEOL G404 Geobiology, plus GEOL G410 Undergraduate Research in Geology (1 cr.), GEOL G406 Introduction to Geochemistry, GEOL G413 Introduction to Geophysics, GEOL G415 Principles of Geomorphology, GEOL G416 Economic Geology, GEOL G430 Principles of Hydrology, and GEOL G499 Honors Research in Geology. The student must complete 3 credit hours in GEOL G499 Honors Research in Geology to satisfy the requirements for the honors component. The overall grade point average must be 3.3 with a 3.5 in all honors work.

Psychology

To graduate with honors, the student must earn at least 24 hours of honors credit, 6 credit hours of which must be in psychology and 6 credit hours of which must be outside of psychology (the remaining 12 credit hours can be either). At least 3 hours of this credit must be for PSY B499 Honors Research, which culminates in an honors thesis. Only grades of A or B will count for honors credit. To graduate with honors, the student must have an overall GPA of 3.3 with at least a 3.5 in honors and psychology courses.

Undergraduate Research Program

The School of Science has established a school-wide undergraduate research program to encourage and recognize undergraduates who participate in research projects with faculty in the school.

A student may qualify for transcript certification of completion of the Undergraduate Research Program. The School of Science Research Committee, which certifies the student's right to the certification, requires a research portfolio. This portfolio is to be presented to the committee for approval by April 1 for May graduation, by July 1 for August graduation and by November 1 for December graduation in the semester in which the student expects to graduate. Upon approval of the portfolio, the committee forwards its recommendation of certification to the registrar. Certification is awarded concurrently with the degree.

Students may participate in all or part of this program. To receive transcript certification, the student must fulfill all of the following requirements:

1. Register for and complete 5 credit hours of formal research in his/her department. Each department in the school can provide detailed information about research credits. The student should consult his/her department advisor.
2. Prepare a written product from the research. This may include a senior thesis or journal publication.
3. Attend one outside scientific meeting at the state or national level.
4. Participate in a formal symposium. The student must present a paper in a formal competition that the school will sponsor during the spring semester each year. Students in this program will be encouraged to present work at a professional scientific meeting.

5. Prepare a research portfolio. Further information, including how to prepare the research portfolio, may be obtained from the program director: Pamela Crowell, Associate Dean, School of Science, LD 222; phone: (317) 278-1144; e-mail: pcrowel@iupui.edu.

Extracurricular Activities

A wide variety of activities are available to School of Science students, both activities sponsored by the School of Science and those open to all students. Students seeking involvement in campus-wide activities, such as the IUPUI Undergraduate Student Government, should contact the Office of Campus and Community Life in the basement of University College, UC 002, call (317) 274-3931, or visit www.life.iupui.edu.

Clubs and Organizations in the School of Science

The following activities are of particular interest to students in the School of Science:

Science Undergraduate Student Council and Science Graduate Student Council

These councils, composed of student representatives from each department in the School of Science, advise the dean and the school on matters of concern to students. Each council decides how to allocate the student activity fee to support school projects, departmental clubs, and other initiatives.

Departmental Clubs

Most departments within the School of Science sponsor clubs and other activities for majors and interested students. Contact the specific department for additional information.

Scholarships and Awards

Faculty nominate and select students for various annual scholarships and awards offered by the School of Science, its departments, or by individuals and organizations interested in advancing science education and research.

School of Science

D. J. Angus Scientech Education Foundation Scholarship is awarded to an undergraduate science major from Marion County, or one of the contiguous counties, who has demonstrated financial need, a minimum grade point average of 2.80, and shows future promise.

Frank G. Lambertus Memorial Scholarship is awarded to a student who has shown outstanding academic progress since the previous year.

John D. Barnwell Memorial Scholarship is awarded to a student in the School of Science who has effectively integrated the sciences and the arts into his or her undergraduate career.

Indianapolis Project SEED Scholarship is awarded to an IUPUI undergraduate student who is pursuing his/her first degree in science, engineering, technology or one of the health sciences and who has successfully participated in the American Chemical Society Indiana Chapter Project SEED summer research program. Preference will be shown to a School of Science major. It is renewable based on academic performance.

Robert W. Tuveson Memorial Scholarship is awarded to a student majoring in the biological sciences. Consideration is given to financial need, academic performance, and future promise.

School of Science Alumni Association Outstanding Science Student Scholarship is awarded to a School of Science major who plans to graduate within one year of receiving the scholarship and who has demonstrated how his/her personal life experiences have affected his/her educational career.

School of Science Dean's Scholarships recognize School of Science majors attending IUPUI who excel academically and show promise of success in their future careers.

Department of Biology

Award for Outstanding Academic Achievement is awarded to the student with the best overall academic record in the Department of Biology.

Biology Research Award is awarded to undergraduate and graduate students making the most outstanding contributions in scientific research.

Elizabeth Steele Creveling Memorial Scholarship is awarded to the outstanding continuing graduate student pursuing a thesis program in the Department of Biology.

Richard O. McCracken Memorial Scholarship is awarded to the outstanding sophomore or junior biology major.

Ronald E. Kirk Memorial Award is awarded to the outstanding freshman biology student.

Student Services Award is given to the faculty member, student, or staff member whose contributions and activities have had a significant positive impact on the experiences of biology students beyond the classroom.

The Tah Tah Self Achievement Award is awarded to a biology major who plans to pursue a medical career. Preference is shown to African American females.

Department of Chemistry and Chemical Biology

American Institute of Chemists Student Research and Recognition Award is awarded to an outstanding senior student majoring in chemistry.

Chemical Rubber Company Outstanding Freshman Award is awarded to the outstanding student in general chemistry.

Frank J. Welcher Award is awarded to the graduating senior with greatest professional promise.

Loren T. Jones Award is awarded to the graduating senior with the highest academic achievement in a Bachelor of Science degree program.

Loren T. Jones Memorial Scholarship is awarded as summer support to an outstanding chemistry major.

Outstanding Undergraduate Analytical Chemistry Award sponsored by the American Chemical Society.

Patricia A. Boaz Award is awarded to the graduating senior with highest academic achievement in a Bachelor of Arts degree program.

Scott Alan Kent Memorial Scholarship is awarded to a promising sophomore or junior chemistry major.

Department of Computer and Information Science

Gersting Graduate Student Award is awarded to an outstanding graduate student in computer and information science.

Gersting Undergraduate Student Award is awarded to an outstanding graduating senior in computer and information science.

Department of Geology

Academic Achievement Award is awarded to the graduating senior with highest academic achievement.

Arthur Mirsky Geology Fellowship is awarded to an outstanding master's degree student.

The Carl H. Johnson Achievement Scholarship supports students working in interdisciplinary fields of applied environmental problems. The scholarship is inspired by Matt and Susan Cornacchione's daughter and memorializes Susan's father.

The CEES Internship Award is awarded to an IUPUI undergraduate student who is affiliated with the IUPUI Center for Earth and Environmental Science as a research intern.

Geology Alumni Scholarship is awarded to a senior geology major.

Indiana Geology and Gem Society Scholarship is awarded to a sophomore or junior geology major.

Leadership and Service Award is awarded to the graduating senior with outstanding leadership and service to the department.

Department of Mathematical Sciences

Anna K. Suter Award is awarded to the outstanding senior mathematics major.

Anna K. Suter Scholarship is awarded to full-time undergraduate mathematics majors. It is renewable based on academic performance.

Best Academic Performance by a Graduate Student Award is awarded for exceptional scholastic performance by a beginning graduate student and an advanced graduate student.

Igor Kuznetsov Graduate Student Teaching Award is awarded for outstanding performance in classroom teaching by a graduate student.

Outstanding Undergraduate Award is awarded to an outstanding junior or senior (or both) based on achievements in advanced mathematics.

Yuri Abramovich Memorial Scholarship is awarded to an undergraduate or graduate student who is enrolled in the School of Science and who has a keen interest in the study of mathematics, who demonstrates academic excellence especially in mathematics courses beyond the sophomore level, and who shows promise for a career in mathematics.

Department of Physics

D. J. Angus-Scientech Award is awarded by the Department of Physics to the most improved sophomore or junior student in the physical sciences and engineering.

The Forrest Meiere Prize for Outstanding Physics Major is awarded to the undergraduate major with the best academic record.

Outstanding Graduate Student Award is based upon achievements in research and academics.

The University Physics Award is awarded to the best student in the physics 152/251-course sequence.

Department of Psychology

Arnold M. Quittner Dissertation Award is awarded to a Ph.D. student in the clinical rehabilitation psychology program who has successfully defended his/her Ph.D. proposal and has a clear plan for publication of his/her dissertation.

Graduate Psychology Award is awarded to the most outstanding graduate student in the programs of industrial/organizational psychology and clinical rehabilitation psychology.

Paul McKinley Award is awarded to the most outstanding graduate student in the Ph.D. psychobiology of addictions program.

Robert G. Neel Award is awarded to the graduating psychology major with highest academic achievement.

Robert I. Long Award is awarded to the most outstanding graduating psychology major.

The Psi Chi Scholarship is awarded to a psychology major who is an active member of the IUPUI Chapter of Psi Chi.

Student Research Award is awarded to the psychology major who has demonstrated the most skill as a research scientist.

Other Recognition

In addition, many science honor students compete successfully for scholarships awarded by IUPUI. Freshmen with a high level of achievement are eligible for election to the IUPUI chapters of Alpha Lambda Delta and Phi Eta Sigma honorary societies. Psychology majors may be elected to the Psi Chi Honorary, which recognizes outstanding students in that discipline.

Distinguished Faculty and Staff Awards

The School of Science proudly salutes faculty and staff who have distinguished themselves in the areas of teaching, research, or service. The following full-time faculty and staff have been chosen by their colleagues and students to receive awards in recognition of their outstanding contributions to the academic mission of the School of Science and the university.

W. David Laverell	1975
L. Kent Morrison	1976
Gordon H. Fricke	1977
Erwin Boschmann	1978
Frederick W. Kleinhans	1978
Terry L. Hall	1979
Robert D. Hall	1980
John F. Kremer	1980
Patricia A. Boaz	1981
Martin J. O’Donnell	1981
Forrest T. Meiere	1982
Peter W. Rabideau	1982
Frederick C. Thatcher	1982
Erwin Boschmann	1983
Robert D. Hall	1983
David J. Malik	1983
Martin J. O’Donnell	1983
Stanley Aeschleman	1984
Elaine V. Alton	1984
Patricia A. Boaz	1984
Marvin D. Kemple	1984
John F. Kremer	1984
B. D. Nageswara Rao	1984
Richard Bodonyi	1985

Frederick W. Kleinhans	1985
Arthur Mirsky	1985
Richard G. Pflanzer	1985
D. W. Rajecki	1985
J. Roger Ware	1985
Shirley A. Bayer	1986
Joan B. Lauer	1986
J. Roger Ware	1986
C. D. Aliprantis	1987
Owen Burkinshaw	1987
Judith L. Gersting	1987
John F. Kremer (two awards)	1987
Richard R. Patterson	1987
J. Roger Ware	1987
Pascal de Caprariis	1988
Theodore W. Cutshall	1988
Robert D. Hall	1988
Charles Schauf	1988
C. D. Aliprantis	1989
Rosalie Bandy*	1989
John M. Gersting	1989
Florence L. Juillerat	1989
Raima M. Larter	1989
Florence L. Juillerat	1990
Kenneth B. Lipkowitz	1990
David J. Malik	1990
Arthur Mirsky	1990
Gregor M. Novak	1990
Richard J. Wyma	1990
Rosalie Bandy*	1991
Gary R. Bond	1991
Richard O. McCracken	1991
Forrest T. Meiere	1991
Gregor M. Novak	1991
Gordon H. Fricke	1992
Florence L. Juillerat (two awards)	1992
Jerome A. Kaminker	1992
Kenneth B. Lipkowitz	1992
Kathryn J. Wilson	1992
Paul L. Dubin	1993
Gordon H. Fricke	1993
Florence L. Juillerat	1993
John F. Kremer	1993
David J. Malik	1993
B. D. Nageswara Rao	1993
Florence L. Rogers*	1993
Stephen R. Wassall	1993
Robert G. Bringle	1994
Laura J. Jenski	1994
James M. Murphy	1994
Kim S. Nguyen*	1994
Andrew P. Barth	1995
Robert G. Bringle	1995
Scott E. Evenbeck	1995
Florence L. Juillerat	1995
Laura J. Jenski	1995
Marvin D. Kemple	1995
Charmaine Kremer*	1995
Robert W. Keck	1995
John F. Kremer	1995
Raima M. Larter	1995
Martin J. O'Donnell	1995

Clifford E. Dykstra	1996
Robert L. Gluekauf	1996
Joseph E. Kuczkowski	1996
Martin J. O'Donnell	1996
Lenore P. Tedesco	1996
John T. Hazer	1997
Harry L. June	1997
Mathew J. Palakal	1997
Daniel H. Robertson	1997
Jeffrey X. Watt	1997
Marshall C. Yovits	1997
Victor M. H. Borden	1998
Robert G. Bringle (two awards)	1998
Andrew D. Gavrin	1998
Andrew J. Harris	1998
Harry L. June	1998
Joan B. Lauer	1998
Gregor M. Novak	1998
Frank A. Schultz	1998
Wilmer K. Fife	1999
Kathy E. Johnson	1999
Joseph E. Kuczkowski	1999
Eric C. Long	1999
Joseph L. Thompson* (two awards)	1999
Jeffrey X. Watt	1999
Gary R. Bond	2000
Angel B. Campbell*	2000
Marie C. Chastain*	2000
Andrew D. Gavrin	2000
Charles R. Goodlett	2000
James M. Murphy	2000
Catherine (Kitty) A. Perkins*	2000
Rajeev R. Raje	2000
Sharon Z. Rangazas	2000
James W. Seubert	2000
J. Roger Ware	2000
John J. (Jack) Breen	2001
Robert G. Bringle	2001
Clifford E. Dykstra	2001
Andrew D. Gavrin	2001
Pat Gould*	2001
Bob E. Hall*	2001
Alexander R. Its	2001
Kathleen Marrs	2001
Mark D. Shermis	2001
William H. Stillwell	2001
Joseph L. Thompson*	2001
Robert W. Yost	2001
Drew C. Appleby	2002
Pavel M. Bleher	2002
Michelle R. Boshears*	2002
Robert G. Bringle	2002
Judy E. Carlson	2002
Philip S. Fastenau	2002
Robert D. Hall	2002
David J. Malik	2002
Arthur Mirsky	2002
Robert D. Rigdon	2002
Stanley Sunderwirth	2002
Jeffrey X. Watt	2002
Drew C. Appleby (three awards)	2003
Dawn G. Bauman*	2003

Robert G. Bringle	2003
Clifford E. Dykstra	2003
Connie L. Ely*	2003
Alexander R. Its (three awards)	2003
Elizabeth N. Its	2003
Suzanne K. Merrell*	2003
Michal Misiurewicz	2003
David Nurok	2003
Lenore P. Tedesco	2003
Joseph L. Thompson*	2003
Sidneye T. Trowbridge	2003
J. Roger Ware	2003
Jeffrey X. Watt	2003
Martin Bard	2004
Dring N. Crowell	2004
Sharon L. Fricke	2004
Bart Ng	2004
Robert D. Rigdon	2004
Robert W. Yost	2004
Bethany S. Neal-Beliveau	2005
Zhe-Yu (Jeff) Ou	2005
Joan P. Rainey*	2005
Gautam Vemuri	2005
Cynthia C. Williams*	2005

*Professional staff member.

Department of Biology

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Indianapolis, IN 46202-5132
Phone: (317) 274-0577; fax: (317) 274-2846
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Professors Bard, D. Crowell, Lees (Chair), Stillwell, Stocum *(Dean Emeritus)*

Professor Emeritus Keck, Ockerse

Associate Professors Emeriti Juillerat, Pflanzer

Associate Professors Allen, Blazer-Yost, Chernoff, Clack (IUPU Columbus), P. Crowell (*Associate Dean, School of Science)*, Randall, Watson, K. Wilson

Assistant Professors Belecky-Adams, R. Li, Malkova, Marrs, X. Wang

Lecturers Clark, Vaughan, Yost, Zevin

Adjunct Professors Barman, Chintalacharuvu, Chism, Heiman, Krishnan, McIntyre, Petolino, Schild, Schoepp, Siddiqui, Sen, S., Smith, C., Smith, R., Srour, Vlahos, Witzmann, Zuckerman

Departmental Academic Advisors *Preprofessional*: Yost; *Prepharmacy*, *Preoptometry*, *Preveterinary*: Trowbridge; *Biology programs*: Trowbridge; *Graduate programs*: Lees

The Department of Biology offers undergraduate instructional programs leading to the Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degrees. These programs are designed to prepare students for a variety of careers in the biological sciences and allow

sufficient flexibility to accommodate the needs and interests of students. Postgraduate activities frequently selected by biology majors include graduate schools, medical and dental schools, other health care professions, agricultural schools, industrial positions in research and technology, and secondary teaching. The selection of a particular degree program in biology should be made in consultation with a departmental advisor.

The Department of Biology offers graduate study leading to the Master of Science (M.S.) degree. The M.S. degree program may be completed with a thesis option or with a nonthesis option. Among the nonthesis options is the M.S. degree in the teaching of biology, which is designed primarily for secondary school teachers, and a one-year preprofessional option for those seeking admission to medical or dental schools. The Doctor of Philosophy (Ph.D.) degree can be pursued in a variety of areas through the Purdue University Graduate School and through several programs and departments in the Indiana University School of Medicine.

The Department of Biology regards research as an important component of its programs at both the undergraduate and graduate levels. Students may work in such specific areas as microbial genetics, membrane biochemistry and biophysics, immunology, plant cell and molecular biology, neuroanatomy, morphogenesis and ultra structure of plants, recombinant DNA, cell biology, developmental biology, regenerative biology, microbiology, oncology, plant and animal tissue culture, and computer-based biology simulations.

Bachelor of Arts

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Written Communication (6 cr.)
ENG W131 Elementary Composition I (3 cr.).
A second writing course with ENG W131 as a prerequisite, e.g. ENG W132 (or ENG W150), ENG W231, or TCM 320.

Oral communication
COMM R110 Fundamentals of Speech Communication (3 cr.).

Area II Foreign Language See School of Science requirements under “Undergraduate Programs.” Students must have first-year proficiency in a foreign language (10 cr.): exam placement, two 5 credit courses, or three courses (3 cr., 3 cr., and 4 cr.).

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.)
HIST H114 History of Western Civilization II (3 cr.)
One course (3 cr.) from a list of humanities courses, List H
One course (3 cr.) from a list of social science courses, List S
One course (3 cr.) from a list of comparative world cultures courses, List C

Area IIIB Junior/Senior Integrator (3 cr.) This course is from a list of integrator courses. Consult academic advisor.

Area IIIC Physical and Biological Sciences
Physics Two semesters of basic physics (PHYS P201-PHYS P202 or PHYS 152-251).

Chemistry Two semesters of Principles of Chemistry (CHEM C105/CHEM C125 3/2 cr.; CHEM C106/CHEM C126 3/2 cr.), two semesters of organic chemistry lecture and one semester of laboratory (CHEM C341, CHEM C342, CHEM C343), plus prerequisite basic sequence or background to enter sequence above. The second laboratory in organic chemistry (CHEM C344) is required for admission to some medical schools and is strongly recommended for students in most other programs. Consult a departmental advisor.

Area IIID Mathematical Sciences MATH 159. (However, the starting point for mathematics courses should be worked out with a departmental advisor based on the math placement test and/or background of the student.) The computer science requirement may be satisfied with CSCI N201, CSCI N207, or CSCI N211.

Note: Computer Science CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Biology Requirements
Required Core Sequence:
BIOL K101 BIOL K103 Concepts of Biology I and II
BIOL K322 Genetics and Molecular Biology
BIOL K341 Principles of Ecology and Evolution

Upper-Level Courses

A. At least one lecture course from each of areas I-III listed below.

B. Three laboratory courses beyond BIOL K101– BIOL K103 selected from areas I-IV below. To receive credit for a laboratory for which there is an accompanying pre- or corequisite lecture, the lecture must be completed with a minimum grade of C–. A maximum of 2 credit hours of BIOL K493 Independent Research may be applied to the biology credit hour requirement. BIOL K493 will count as one laboratory course.

C. Capstone Experience. This requirement is met by taking either BIOL K493 Independent Research (1 cr.) or BIOL K490 Capstone (1-3 cr.) in the senior year. BIOL K490 addresses the integration of knowledge in the principles of undergraduate education as well as values and ethics as they relate to the student's major. It is generally taken in the senior year. The capstone is an independent, creative effort by the student that is integrative and builds on the student's previous work in the major; it may include research projects, independent study and projects, a practicum, a seminar, and/or a field experience.

D. Electives consisting of sufficient lecture and laboratory course work to total 30 credit hours (including core sequence credit hours). These credits may be selected from any of the areas I-IV below.

Areas/Electives

I. Molecular Area

Undergraduate Level

BIOL K338 Introductory Immunology
BIOL K339 Immunology Laboratory
BIOL K483 Biological Chemistry
BIOL K484 Cellular Biochemistry

Undergraduate and Graduate Level

BIOL 507 Principles of Molecular Biology
BIOL 516 Molecular Biology of Cancer
BIOL 530 Introductory Virology
BIOL 550 Plant Molecular Biology
BIOL 559 Endocrinology
BIOL 561 Immunology
BIOL 564 Molecular Genetics of Development
BIOL 570 Biological Membranes
BIOL 651 Cellular Immunology

II. Cellular Area

Undergraduate Level

BIOL K324 Cell Biology
BIOL K325 Cell Biology Laboratory
BIOL K356 Microbiology
BIOL K357 Microbiology Laboratory

Undergraduate and Graduate Level

BIOL 532 Topics in Bacteriology
BIOL 566 Developmental Biology
BIOL 571 Developmental Neurobiology

III. Organismal Area

Undergraduate Level

BIOL K331 Embryology
BIOL K332 Plant Growth and Development
BIOL K333 Embryology Laboratory
BIOL K345 Behavioral Ecology
BIOL K350 Comparative Animal Physiology
BIOL K411 Global Change Biology

Undergraduate and Graduate Level

BIOL 556 Physiology I
BIOL 557 Physiology II

IV. Biotechnology Electives

Undergraduate Level

BIOL K493 Independent Research

Undergraduate and Graduate Level

BIOL 540 Topics in Biotechnology
BIOL 548 Techniques in Biotechnology
BIOL 568 Regenerative Biology and Medicine

Additional laboratory courses for the B.A.

BIOL K323 Genetics and Molecular Biology
Laboratory
BIOL K342 Principles of Ecology and Evolution Laboratory

The Department of Biology will accept 20 credit hours toward graduation outside the Schools of Science and Liberal Arts. A maximum of 15 credit hours of biology earned previously at other institutions is applicable toward the major for the B.A. degree.

Once admitted, students are expected to fulfill their course requirements within the major at IUPUI.

Bachelor of Science

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150), ENG W231, or TCM 320.

Area II No foreign language is required. However, knowledge of a foreign language is strongly recommended for any student planning to attend graduate school.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.)

HIST H114 History of Western Civilization II (3 cr.)

One course (3 cr.) from a list of humanities courses, List H

One course (3 cr.) from a list of social science courses, List S

One course (3 cr.) from a list of comparative world cultures courses, List C

Area IIIB Junior/Senior Integrator (3 cr.) This course is from a list of integrator courses. Consult academic advisor.

Area IIIC Physical and Biological Sciences

Physics Two semesters of basic physics (PHYS P201-PHYS P202 or PHYS 152-251).

Chemistry Two semesters of Principles of Chemistry (CHEM C105/CHEM C125 3/2 cr.; CHEM C106/CHEM C126 3/2 cr.), two semesters of organic chemistry with laboratory (CHEM C341, CHEM C342, CHEM C343, CHEM C344), plus prerequisite basic sequence or background to enter sequence above. (A course in analytical chemistry or biochemistry is also strongly recommended; determination should be made in consultation with departmental advisor.)

Area IIID Mathematical Sciences Course work through two semesters of calculus (MATH 221-222 or MATH 163-164). Starting point to be worked out with departmental advisor based on the math placement test and/or background of the student. The computer science requirement may be satisfied with CSCI N201, CSCI N207, or CSCI N211.

Note: Computer Science CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Biology Requirements

Required Core Sequence
BIOL K101-BIOL K103 Concepts of Biology I and II
BIOL K322 Genetics and Molecular Biology
BIOL K341 Principles of Ecology and Evolution
BIOL K493 Independent Research; 2 cr. min., 3 cr. max.
BIOL K494 Senior Research Thesis

Upper-Level Courses

A. At least one lecture course from each of areas I-III listed below.
B. Four laboratory/lecture courses beyond BIOL K101-BIOL K103 selected from areas I-V. To receive credit for a laboratory for which there is an accompanying pre- or corequisite lecture, the lecture must be completed with a minimum grade of C–.
C. BIOL K494 Senior Research Thesis. This will consist of the completion of BIOL K493 activities (2 to 3 credit hours) and the preparation of a written report on the results of the research project. The title and nature of the BIOL K493-BIOL K494 sequence is to be determined in consultation with the department research sponsor.

   Capstone Experience: This requirement is met upon completion of BIOL K493.
D. Electives consisting of sufficient lecture and laboratory course work to total 40 credit hours (including core sequence credit hours). These credits may be selected from any of the areas I-IV below.

Areas/Electives

I. Molecular Area

Undergraduate Level
- BIOL K338 Introductory Immunology
- BIOL K339 Immunology Laboratory
- BIOL K483 Biological Chemistry
- BIOL K484 Cellular Biochemistry

Undergraduate and Graduate Level
- BIOL 507 Principles of Molecular Biology
- BIOL 516 Molecular Biology of Cancer
- BIOL 530 Introductory Virology
- BIOL 550 Plant Molecular Biology
- BIOL 559 Endocrinology
- BIOL 561 Immunology
- BIOL 564 Molecular Genetics of Development
- BIOL 570 Biological Membranes
- BIOL 651 Cellular Immunology

II. Cellular Area

Undergraduate Level
- BIOL K324 Cell Biology
- BIOL K325 Cell Biology Laboratory
- BIOL K356 Microbiology
- BIOL K357 Microbiology Laboratory

Undergraduate and Graduate Level
- BIOL 532 Topics in Bacteriology
- BIOL 566 Developmental Biology
- BIOL 571 Developmental Neurobiology

III. Organismal Area

Undergraduate Level
- BIOL K331 Embryology
- BIOL K332 Plant Growth and Development
- BIOL K333 Embryology Laboratory
- BIOL K345 Behavioral Ecology
- BIOL K350 Comparative Animal Physiology
- BIOL K411 Global Change Biology

Undergraduate and Graduate Level
- BIOL 556 Physiology I
- BIOL 557 Physiology II

IV. Biotechnology Electives

Undergraduate Level
- BIOL K493 Independent Research

Undergraduate and Graduate Level
- BIOL 540 Topics in Biotechnology
- BIOL 548 Techniques in Biotechnology
- BIOL 568 Regenerative Biology and Medicine

Additional laboratory courses for the B.S.
- BIOL K323 Genetics and Molecular Biology Laboratory
- BIOL K342 Principles of Ecology and Evolution Laboratory

The Department of Biology will accept 20 credit hours toward graduation outside the Schools of Science and Liberal Arts. A maximum of 20 credit hours of biology earned previously at other institutions is applicable toward the major for the B.S. degree.

Once admitted, students are expected to complete their course requirements within the major at IUPUI.

Minor in Biology

The Department of Biology offers an undergraduate minor in biology with the following requirements:

BIOL K101 Concepts of Biology I (5 cr.)
BIOL K103 Concepts of Biology II (5 cr.)
BIOL K322 Genetics and Molecular Biology (3 cr.)
BIOL K341 Principles of Ecology and Evolution (3 cr.)
Additional BIOL K-prefixed biology course of at least 3 credits

At least half of the minimum 19 credit hours required to minor in biology must be completed at IUPUI. The minor requires a minimum grade point average of 2.0, and all grades must be C– or higher. Correspondence courses may not be used to fulfill requirements for the minor.

Honors in Biology

The Department of Biology offers two separate tracks that lead to a degree with honors. Admission to either program requires a combined math and verbal (critical reading) SAT of 1200, or placement in the top 10 percent of the high school class for incoming freshmen, or a minimum GPA of 3.3 based on at least 12 hours of university work for continuing students. Students must maintain an overall GPA of 3.3 and an honors GPA of 3.5 to remain in good standing in the program.

Track 1 in biology is an honors-with-thesis program consisting of a total of 21 credit hours of honors registrations. 6 credit hours are taken outside of the major; 4 credit hours are taken as the special experimental laboratory and recitation sections of freshman biology (BIOL K101 and BIOL K103); 5 hours are taken as H-Option registrations or 500-level courses; and 6 credit hours are taken as BIOL K493 Independent Research and BIOL K494 Senior Research Thesis.

Track 2 is an honors program without thesis and consists of a total of 24 credit hours of honors registrations. This option requires 6 credit hours of honors outside of the major, the BIOL K101 and BIOL K103 sections, and 14 credit hours of H-Option or 500-level course registrations.

Biology Plans of Study

No single semester-by-semester plan of study will guide all students through the degree options because of the flexibility encouraged within the programs. However, one possible sequence of courses for each option is given below; variations from these examples of plans of study should be made in consultation with a departmental advisor.

Bachelor of Arts Sample Program (124 cr. required)

Freshman Year

First Semester

SCI I120 Windows on Science	1
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 153 Algebra and Trigonometry I	3
ENG W131 Elementary Composition I	3
	17

Second Semester

BIOL K103 Concepts of Biology II	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 154 Algebra and Trigonometry II	3
ENG W132 Elementary Composition II	3
	16

Sophomore Year

Third Semester

BIOL K322 Genetics and Molecular Biology	3
BIOL K323 Genetics and Molecular Biology Laboratory	2
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
Humanities-List H	3
Elective or major's course	3
	16

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
COMM R110 Fundamentals of Speech Communication	3
CSCI Course	3
Elective or major's course	3
	14

Junior Year

Fifth Semester

BIOL K341 Principles of Ecology and Evolution	3
PHYS P201 General Physics I	5
Comparative World Cultures-List C	3
Foreign language I	3
Social Sciences-List S	3
	17

Sixth Semester

BIOL Course and Lab (Area II)	5
HIST H114 History of Western Civilization II	3
PHYS P202 General Physics II	5
Foreign language II	3
	16

Senior Year

Seventh Semester

BIOL Course and Lab (Area I)	5
Junior/Senior Integrator	3
Foreign language III	4
Elective	3
	15

Eighth Semester

BIOL K493 Independent Research or	1
BIOL K490 Capstone in Biology	1
BIOL Course and Lab (Area III)	4
Electives	7
CAND 991 Candidate for Graduation	0
	13

Bachelor of Science Sample Program (124 cr. required)

The major has 40 credit hours.

The School of Science Purdue degrees are 124 credit hours. To graduate in four years a student generally must take four semesters of 15 credits and four semesters of 16 credits. When figuring the number of credit hours that you will take each semester, students should be sure to consider the effect on total number of credit hours balanced over four years.

Freshman Year

First Semester

SCI I120 Windows on Science	1
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
Elective or precalculus math	3
	17

Second Semester

BIOL K103 Concepts of Biology II	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 221 Calculus for Technology I	3
ENG W132 Elementary Composition II	3
	16

Sophomore Year

Third Semester

BIOL K322 Genetics and Molecular Biology	3
BIOL K323 Genetics and Molecular Biology Laboratory	2
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2

MATH 222 Calculus for Technology II	3
Humanities—List H	3
	16

Fourth Semester

BIOL Course and Lab (Area II)	5
CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
COMM R110 Fundamentals of Speech Communication	3
Social Sciences—List S	3
	16

Junior Year

Fifth Semester

BIOL K341 Principles of Ecology and Evolution	3
BIOL K342 Principles of Ecology and Evolution Laboratory	2
PHYS P201 General Physics I	5
CSCI Course	3
Comparative World Cultures—List C	3
	16

Sixth Semester

PHYS P202 General Physics II	5
HIST H114 History of Western Civilization II	3
BIOL Course and Lab (Area III)	4
Elective	3
	15

Senior Year

Seventh Semester

BIOL Course and Lab (Area I)	5
BIOL K493 Independent Research	1
Junior/Senior Integrator	3
Elective or major's requirement	3
Elective or major's requirement	3
	15

Eighth Semester

BIOL K493 Independent Research	1
BIOL K494 Senior Research Thesis	1
BIOL major's requirement	3
Elective or major's requirement	4
Elective or major's requirement	4
CAND 991 Candidate for Graduation	0
	13

Master of Science

Degree Options

M.S. Nonthesis in Interdisciplinary Biology This program requires a minimum of 30 credit hours of registration, at least 21 of which must be in biology. For students who wish to combine biology training with work in a secondary area as a mechanism to meet career objectives, up to 9 credit hours can be taken in the secondary area. Advanced-level undergraduate course work hours are limited to 6. Examples of secondary areas include, but are not limited to, chemistry, mathematics, public affairs, business, statistics, law, computer science, administration, and, for those interested in teaching, education. For those students with no secondary area of interest, all 30 credit hours may be taken in biology. The program requires registrations in BIOL 595 Special Assignments and BIOL 696 Seminar. The former consists of an independent, creative project done in association with a faculty member. Typical examples include a limited laboratory research experience or a library research assignment. The results of the project are reported both in writing and orally in BIOL 696.

M.S. Preprofessional Nonthesis This program also consists of a minimum of 30 credit hours, all of which must be taken over two semesters. This challenging program is highly intensified and is open only to those students who meet a high admission standard based on undergraduate GPA and GRE scores. The program is available to those students planning careers in medicine, dentistry, optometry, or other health-related fields and differs from the interdisciplinary nonthesis M.S. by having no requirement for the 595 and 696 registrations.

M.S. with Thesis This 30 credit hour program requires a minimum of 9 credit hours of 500- and 600-level course work in biology, chosen in consultation with the student's graduate advisory committee, and intensive research leading to a thesis. Most full-time students should expect to spend two full years to complete this program. Areas in which research opportunities are available include: immune dysfunction, yeast molecular biology, renal physiology, wound repair and tissue regeneration, oncology, tumor immunology, plant hormones, antifungal antibiotics, developmental genetics, cell biology, membrane biochemistry and biophysics, molecular toxicology, plant tissue culture, plant physiological ecology, plant and animal molecular biology, and regenerative biology and medicine. The overall emphasis of the department's research program focuses on questions at the cellular, biochemical, and molecular levels. Many of the projects provide a foundation in biotechnology and an excellent preparation for biomedical and industrial applications.

Co-Op M.S. with Thesis This modification of the thesis M.S. is open to full-time M.S. students. Here, research is conducted at the university and at a local industrial laboratory. The project is the result of a collaborative arrangement between a faculty member and an industrial scientist. This program is open to a small group of students and is available only in cases where industrial support is committed.

Admission Requirements

1. Students must hold a bachelor's degree from an accredited institution of higher learning and demonstrate good preparation in biological sciences, organic chemistry, physics, and mathematics.
2. Students must take the GRE aptitude tests.
3. Three letters of recommendation are required.
4. A minimum graduation grade point average of 3.0 or its equivalent is required for unconditional admission.

Transfer of Credit

Transfer credit to be used in the nonthesis option may be given for up to 9 credit hours of graduate work completed elsewhere with a grade of B or higher. Such credit may be used only in the secondary area and will be accepted only after one semester of satisfactory work is completed in residence at IUPUI. Transfer credit is not accepted in the thesis option. Up to 12 hours of biology graduate credit taken at IUPUI under graduate nondegree status may be transferred to the thesis or nonthesis options.

Requirements

Grades

Only grades of A, B, or C are acceptable, although performance higher than C may be required. Pass/Fail grades are unacceptable.

Residence Requirements

Thirty (30) credit hours of registration are required for the M.S. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Final Examination

A comprehensive written or oral examination in the individual's primary area may be required of nonthesis students unless their cumulative GPA is 3.0 or higher. The final examination for thesis students will consist of a thesis defense, which will be done in conjunction with BIOL 696 Seminar.

All students are required to take BIOL 696 Seminar. The creative project required of all nonthesis students will provide the basis for the public presentation.

Financial Assistance

The Department of Biology has financial support available in the form of tuition-refund assistantships, associate faculty positions, fellowships, and stipends from local industry on a limited basis.

Doctor of Philosophy—Purdue University

The degree of Doctor of Philosophy (Ph.D.), the highest earned degree conferred by Purdue University, can be pursued in the Department of Biology through Purdue University, West Lafayette. The doctoral degree is restricted to those scholars who have demonstrated superior ability in a recognized academic discipline. The Ph.D. degree is not awarded on the basis of time spent in residence or following the completion of any specific number of formal courses, nor is the degree granted on the basis of miscellaneous course studies and research effort. The entire Ph.D. program must be rationally related, should be highly research oriented, and should culminate in a thesis of scholarly merit indicative of the candidate's ability to conduct original research in a recognized field of specialization.

Ph.D. programs are directed by professors who work in close association with selected graduate students. In practice, doctoral programs are composed of formal courses, guided individual study in a chosen field or discipline, study in such cognate subjects as may be required by the candidate's advisory committee, and original research that serves as the basis of a scholarly thesis.

As part of their graduate training, all Ph.D. candidates are expected to teach at least quarter time for one year.

Ninety (90) credit hours of registration are required for the Ph.D. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Fields of Study

Ph.D. degrees are offered in most of the fields described for the M.S. degree. Until a major professor is named, a student is counseled by a temporary advisor. In order to help familiarize students with the department and to assist the student in the selection of a major professor, a series of laboratory rotations is available.

Admission and Qualifying Examination

To enter the Ph.D. program, a student must satisfy the admission requirements for the M.S. with thesis option and also take a qualifying examination in two areas at the end of the first year of graduate study. By the end of the second year, both must have been passed with a grade of B or higher. The examination areas are as follows: (1) immunobiology, (2) biochemistry and molecular biology, (3) cell and developmental biology, and (4) membrane biology.

Plan of Study

Each prospective candidate for the doctoral degree, with the approval of the head of the Department of Biology, shall select a major professor from the department who will act as the chairperson of the student's advisory committee and who will direct the research. An advisory committee of five faculty members who have been approved to guide graduate students will then be appointed.

The plan of study shall include a primary area and related area or areas. The plan will be appropriate to meet the needs of the student in a chosen field as determined by the advisory committee. The Graduate School of Purdue University does not impose any minimum number of required course credit hours, but the plan shall specify the area or field of interest in which the student proposes to study and to conduct research. The plan will include the specific courses that the student is expected to complete, all specific course and language (if any) requirements, and 2 credit hours of BIOL 696 Seminar.

The department or school head, the school dean, and the dean of the Graduate School at Purdue University, West Lafayette, must approve the plan of study. The graduate school dean reserves the right to refer any or all plans of study to the Purdue Graduate Council for review and approval when deemed advisable. The Graduate Council has the final authority to supervise the quality of all graduate programs.

Preliminary Examination

After the student has completed most of the formal study to the satisfaction of the advisory committee and met any language requirement(s), the student becomes eligible to take the preliminary examinations. The results of these written and oral examinations will be reported to the graduate school by the examining committee with an appropriate recommendation for the student's admission to candidacy, continued preparatory study, or discontinuation. The graduate school dean reserves the right to appoint additional members to the preliminary examining committee. The dean must be informed of the date and place of the examination and the membership of the examining committee at least two weeks before the examination. No examining committee shall have fewer than three faculty members.

The examining committee will conduct the written preliminary examination. In some cases, parts of the examination may be delegated to certain other staff members, but the final responsibility for the examination rests with the student's examining committee.

If the student does not pass the preliminary examinations, at least one semester must elapse before reexamination. Should the preliminary examinations be failed twice, the student may not be given a third examination, except upon the recommendation of the examining committee and with special approval of the Graduate Council.

Ph.D. Thesis

After admission to candidacy, the candidate must devote at least two semesters to research before the final examination.

The special research carried on as part of the doctoral work is expected to make a definite contribution to the candidate's chosen field of knowledge–a contribution of sufficient importance to merit publication. Each candidate must, therefore, prepare a thesis showing the research results.

After the research has been completed and the thesis written, the candidate shall be given a final examination in which the candidate defends the thesis and demonstrates to the examining committee all of the capabilities for which the Doctor of Philosophy degree is awarded. The examining committee shall consist of no fewer than four members. The dean of the graduate school reserves the right to appoint additional committee members and must be informed of the place and time of the final examination at least two weeks in advance.

Doctor of Philosophy—Indiana University

The Ph.D. degree conferred by Indiana University can be pursued under the direction of faculty in the Department of Biology who hold adjunct appointments with departments or programs in the Indiana University School of Medicine. All Indiana University doctoral degrees require 90 credit hours of registration; specific course and examination requirements vary with the department or program in which the student is enrolled. Contact the graduate program director in the Department of Biology for additional information.

Other Programs

Bachelor of Arts with Secondary Teaching Certification

Students planning to teach biology at the secondary school level usually enter the Bachelor of Arts degree program. Elective hours within this program will be used to satisfy the requirements of the School of Education and the State of Indiana.

Prepharmacy

The prepharmacy program comprises two years of study at IUPUI during which time students will apply to a Pharm.D. program at a school of pharmacy. The following scheme provides the course preparation for application to the School of Pharmacy and Pharmacal Sciences at Purdue University, West Lafayette. A similar program has been designed to interface with the Butler University School of Pharmacy; consult the prepharmacy advisor in the Department of Biology.

Prepharmacy Sample Program (Purdue University)

Year One

First Semester	
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 221 Calculus for Technology I	3
	16
Second Semester	
BIOL K103 Concepts of Biology II	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
ENG W132 Elementary Composition II	3
MATH 222 Calculus for Technology II	3
	16

Year Two

First Semester	
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
ECON E101 Survey of Current Economic Issues and Problems	3
PHYS P201 General Physics I	5
Elective	3
	16
Second Semester	
BIOL K356 Microbiology	3
BIOL K357 Microbiology Laboratory	2
CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
BIOL N261 Human Anatomy	5
	15

Summer Session

BIOL N217 Human Physiology	5
	5

Years Three and Beyond

The Doctor of Pharmacy (Pharm.D.) degree is now required to obtain a license to practice pharmacy. This program encompasses six years of study (two prepharmacy and four professional). Years three through six for the Pharm.D. degree are to be completed at the School of Pharmacy and Pharmacal Sciences, Purdue University, West Lafayette.

Preoptometry

This program is specifically designed for transfer to the professional program at Indiana University Bloomington. Typically, three preoptometry years are spent at IUPUI.

Preoptometry Program Requirements

Subject	Minimum credit hours required
Inorganic chemistry	8
Organic chemistry	4
English composition	2
Calculus	4
General physics	8
Psychology	
Introductory and above	4
Statistical techniques	3
Biology/Zoology	
Introductory	4
Microbiology	4
Advanced	3
Arts and humanities	6
Social and behavioral sciences	6
Foreign language	6-8
Electives	as needed
	90 credit hours

Preveterinary Medicine

IUPUI offers an organized four-semester preveterinary curriculum for students who want to meet the requirements for admission to the Purdue University School of Veterinary Medicine. This curriculum provides for a rigorous program in the biological and physical sciences that may be used as a basis for continued training in the Purdue University School of Agriculture should the degree of Bachelor of Science be desired.

Students who have successfully completed two or more years of preveterinary instruction at IUPUI are eligible to apply for admission to the School of Veterinary Medicine at Purdue University, West Lafayette. Admission to the School of Veterinary Medicine is highly competitive. Students are selected on the basis of college course work and grades, Graduate Record Exam (GRE) scores (General Aptitude Test only), and the extent and nature of the applicant's experience with animals and practicing veterinarians. The selection committee is also concerned with the individual's level of motivation, degree of maturity, and general character.

The requirements for admission to the preveterinary curriculum are the same as those for other programs in the School of Agriculture.

Preveterinary Medicine Sample Program

Freshman Year

First Semester

BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 221 Calculus for Technology I	3
	16

Second Semester

BIOL K103 Concepts of Biology II	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2

ENG W132 Elementary Composition II	3
MATH 222 Calculus for Technology II	3
	16

Summer Sessions

Humanities and Social Science Electives	6
	6

Sophomore Year

Third Semester

BIOL K322 Genetics and Molecular Biology	3
BIOL K323 Genetics and Molecular Biology Laboratory	2
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
PHYS P201 General Physics I	5
	15

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
COMM R110 Fundamentals of Speech Communication	3
PHYS P202 General Physics II	5
STAT 301 Elementary Statistical Methods I	3
	16

Summer Sessions

Humanities, social science electives	6
BIOC B500 Introductory Biochemistry	3
	9

Junior and Senior Years

Transfer to School of Veterinary Science and Medicine, Purdue University, West Lafayette.

Courses in Biology (BIOL)

All courses designed for the biology major are identified by the letter prefix K on the course number or have no prefix. All courses identified by the letter prefix N are primarily designed to serve students uncommitted to a degree in biology or students for whom these courses are appropriate to their curricular program (e.g., allied health).

Note: P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered during one or both of the summer sessions; Day = offered as a daytime section; Night = offered as an evening section; Equiv. = course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University, West Lafayette.

Undergraduate Level

K101 Concepts of Biology I (5 cr.) P: high school or college chemistry. Fall, day; Spring, day, night; Summer, day. An introductory course emphasizing the principles of cellular biology; molecular biology; genetics; and plant anatomy, diversity, development, and physiology.

K103 Concepts of Biology II (5 cr.) P: K101. Fall, day, night; Spring, day; Summer, day. An introductory biology course emphasizing structure, physiology, development, diversity, and behavior in animals, and evolution and ecology of plants and animals.

K295 Special Assignments (cr. arr.) P: consent of instructor. Fall, Spring. Special work, such as directed readings, laboratory or fieldwork, or presentation of material not available in the formal courses in the department.

K322 Genetics and Molecular Biology (3 cr.) P: K103 and CHEM C106. Fall, day. Spring of even-numbered years. The course covers the principles of classical and molecular genetics including Mendelian inheritance, linkage, nucleic acids, gene expression, recombinant DNA, genomics, immunogenetics, and regulation.

K323 Genetics and Molecular Biology Laboratory (2 cr.) P or C: K322. Fall, day. Applied principles of genetics and molecular biology using organisms of increasing complexity from viruses to fruit fly. Laboratory experiments include linkage analyses, deletion mapping, isolation of human chromosomes, mutagenesis, DNA extraction, restriction enzyme analysis, and PCR.

K324 Cell Biology (3 cr.) P: K103 and CHEM C106. Spring, day. Examination of the structure and activity of eukaryotic cells and sub cellular structures. Emphasis is on regulation of and interactions among sub cellular events, such as protein targeting, transmembrane signaling, cell movement, and cell cycle.

K325 Cell Biology Laboratory (2 cr.) P or C: K324. Spring, day. Experiments on the molecular and biochemical basis of organization and function of eukaryotic cells.

K331 Embryology (3 cr.) P: K103. Fall, Spring, day. The development of animals through differentiation of cells, tissues, organs, and organ systems will be examined.

K332 Plant Growth and Development (3 cr.) P: K101 and CHEM C341. Fall, day. An examination of growth and developmental patterns in plants as affected by growth regulators, age, heredity, photoperiod, and environmental factors.

K333 Embryology Laboratory (1 cr.) P or C: K331. Spring, day. Processes of animal development are examined in a series of classical and modern experiments using cell, tissue and embryo culture, drug treatments, and microscopic techniques.

K338 Introductory Immunology (3 cr.) P: K103 and CHEM C106. Fall, day, night. Principles of basic immunology with an emphasis on the cells and molecules underlying immunological mechanisms.

K339 Immunology Laboratory (2 cr.) P or C: K338. Fall, day, night. Demonstration of immunological principles by experimentation. Exercises include cells and factors of the innate and the adaptive immune systems.

K341 Principles of Ecology and Evolution (3 cr.) P: K103. Fall, day. A study of the interactions of organisms with one another and with their nonbiotic environments in light of evolution.

K342 Principles of Ecology and Evolution Laboratory (2 cr.) P or C: K341. Fall, day. Application of ecology and evolution principles in laboratory and field experiments as well as demonstration of techniques of general ecology.

K345 Behavioral Ecology (3 cr.) P: K341. Spring, night. An examination of the relationships among ecology, evolution, and behavior, including sexual selection and conflict, mating systems, altruism, and communication among animals.

K350 Comparative Animal Physiology (3 cr.) P: N107 or K103, CHEM C106. Spring, day. A comparative examination of principles of animal physiology from molecular to organismal levels using homeostasis, regulation, and adaptation as central themes.

K356 Microbiology (3 cr.) P: K103, CHEM C341. Spring, day, night. Introduction to microorganisms: cytology, nutrition, physiology, and genetics. Importance of microorganisms in applied fields including infectious disease.

K357 Microbiology Laboratory (2 cr.) P or C: K356. Spring, day. Laboratory experiments and demonstrations to yield proficiency in aseptic cultivation and utilization of microorganisms; experimental investigations of biological principles in relation to microorganisms.

K411 Global Change Biology (3 cr.) P: K101 and K103 or GEOL G109 and one course in chemistry or consent of instructor. Examination of changes in earth's environment over history. In-depth study of effects of environmental change, including global warming, on the ecology of various organisms.

K483 Biological Chemistry (3 cr.) P: CHEM C342. Fall, day. Chemistry of biologically important molecules including carbohydrates, lipids, proteins, and nucleic acids. Special emphasis on chemistry of intermediary metabolism.

K484 Cellular Biochemistry (3 cr.) P: CHEM C342. Spring, day, night. Emphasis on selected topics in cellular biochemistry, including nucleic acid: protein interactions, protein: protein interactions, protein synthesis, biogenesis of membranes, and signal transduction. Current techniques for studying these processes in higher eukaryotes will be discussed.

K490 Capstone (1 cr.) P: senior standing. Faculty-directed or approved independent library research on an area of public, scientific interest or a community service activity in local industry, government, schools, or other public science-related groups or organizations. Topics for independent research and a list of service opportunities are available in the Department of Biology Office.

K493 Independent Research (1-3 cr.) P: consent of instructor. Fall, Spring, Summer. A course designed to give undergraduate students majoring in biology an opportunity to do research in fields in which they have a special interest.

K494 Senior Research Thesis (1 cr.) P: K493. Fall, Spring, Summer. A formally written report describing the results or accomplishments of K493.

Advanced Undergraduate and Graduate Level

507 Principles of Molecular Biology (3 cr.) P: K322, CHEM C342, or consent of instructor. Fall, night. Molecular aspects of structure and function of nucleic acids and proteins, including recombinant DNA research. Prokaryotic and eukaryotic molecular biology are given equal weight.

516 Molecular Biology of Cancer (3 cr.) P: CHEM C342 and K322 or a course in biochemistry. A detailed course examining the molecular mechanisms controlling the growth of animal cells. Emphasis on current experimental approaches to defining the molecular basis of growth regulation in developing systems and the uncontrolled proliferation of cells in metabolic disorders, such as cancer.

530 Introductory Virology (3 cr.) P: K356, CHEM C342. Fall, odd years, night. Detection, titration, and chemistry of viruses; viral host interactions: bacteriophage-bacterium, animal virus-animal cell, plant virus-plant cell; tumor viruses: infection and transformation.

532 Topics in Bacteriology (2 cr.) P: K356, CHEM C342. Fall, even years, night. Selected topics in bacterial physiology: cell division, chemotaxis, bacterial plasmids, sporulation, bacterial toxins, recombinant DNA.

540 Topics in Biotechnology (3 cr.) P: K322 and CHEM C341, or consent of instructor. Fall, night. Examines research techniques and applications for several technologies situated at currently recognized biological frontiers, including recombinant DNA technology, hybridoma technology, protein engineering, agricultural research, and microbiological engineering.

548 Techniques in Biotechnology (3 cr.) P: K322, CHEM C342, or consent of instructor. Fall, day, night. Laboratory experience in techniques applicable to biotechnology: protein chemistry, molecular biology, and immunology.

550 Plant Molecular Biology (3 cr.) P: K322, CHEM C341, or consent of instructor. Fall, day, night. A comprehensive study of plant molecular biology and plant molecular genetics. Topics will include the structure and expression of plant nuclear, chloroplast, and mitochondrial genomes, and plant viruses.

556 Physiology I (3 cr.) P: K103, CHEM C342. Fall, night. Principles of physiology: nerve and muscle, temperature regulation, ion and water balance.

557 Physiology II (3 cr.) P: 556 or consent of instructor. Spring, night. A study of human cardiovascular, pulmonary, blood, and gastrointestinal systems. Higher neuronal functions and intersystem interactions will be discussed.

559 Endocrinology (3 cr.) P: 556 or equivalent, and CHEM C342. Fall. The study of hormone function. Consideration will be given to the role of hormones in growth, development, metabolism, homeostasis, and reproduction.

561 Immunology (3 cr.) P: K103, CHEM C341. Spring, night. Introduction to basic principles and experimentation in cellular and humoral immunology.

564 Molecular Genetics of Development (3 cr.) P: K322 or similar or consent of instructor. R: BIOL 566. Spring, day, night. Examines how key regulatory genes and molecular signaling pathways regulate development in both lower eukaryotic organisms and mammalian organ systems, with emphasis on the function and evolution of signaling molecules and transcription factor super families.

566 Developmental Biology (3 cr.) P: K322. Fall. Principles of animal development. The emphasis is on concepts and underlying mechanisms of developing and regenerating systems and stem cell properties, including molecular and biochemical approaches.

568 Regenerative Biology and Medicine (3 cr.) P: K324 or K331 or a biochemistry course. Spring. This course examines the mechanisms of natural regeneration (regenerative biology) and the application of these mechanisms to the development of therapies to restore tissues damaged by injury or disease (regenerative medicine).

570 Biological Membranes (3 cr.) P: CHEM C342 or consent of instructor. Spring, night. An examination of structure and function of biological membranes. Topics include lipid and protein composition and interactions, physiological properties of membranes, physiological methods of analysis, model membrane systems, and survey of specific biological membranes and their modes of action.

571 Developmental Neurobiology (3 cr.) P: consent of instructor. Fall, odd years, night. The major phases of nervous system development beginning with neurolation and neurogenesis and ending with the onset of physiological activity will be studied in a variety of animals, mainly avians and mammals (including man). Neural developmental disorders and behavioral ontogeny will also be considered.

595 Special Assignments (1-3 cr.) P: consent of instructor. Fall, Spring, Summer. Special work, such as directed reading, independent study or research, supervised library, laboratory or field work, or presentation of material not available in the formal courses of the department.

Graduate Level

641 Microbial Genetics (2 cr.) P: K323, CHEM C342, and consent of instructor. Spring, odd years, night. Genetics of bacteria, bacterial viruses, and other microorganisms with emphasis on organization, replication, and function of the genetic material.

651 Cellular Immunology (3 cr.) P: 561. Spring, night. Study of cells, molecules, and mechanisms comprising the cellular immune system in normalcy and disease.

696 Seminar (1 cr.) Fall, Spring. Each semester there are several separate offerings. They will likely be on the following topics: biochemistry, biology teaching, ecology and population biology, genetics, mechanisms of development, microbiology, neurobiology, and plant physiology. Oral presentations required. May be repeated for credit.

697 Special Topics (1-3 cr.) Fall, Spring. The frontiers of biology. Critical examination of developments in the various specialties represented by the members of the department. Currently, advanced work in the following and related fields can be offered: molecular genetics; structure and biosynthesis of biologically significant molecules; the nature of biological specificity and enzyme catalysis; the fine structure and chemistry of sub cellular particles, cells, and tissues; microbial and plant metabolism; comparative biochemistry; genetics and physiology of viruses, bacteria, fungi, protozoa, helminths, and cells of higher forms of life; the genetics, structure, development, and physiology of plants and animals, including endocrinology and work physiology; excitable membranes; neurobiology, ecology, systematics, and evolution of microorganisms, plants, and animals; host-parasite relationships including immunology; and the teaching of biology. The field in which work is offered will be indicated in the student's record. May be repeated for credit.

698 Research M.S. Thesis (cr. arr.)

699 Research Ph.D. Thesis (cr. arr.)

Courses for the Nonmajor

N100 Contemporary Biology (3 cr.) Fall, day, night; Spring, day, night; Summer. Selected principles of biology with emphasis on issues and problems extending into everyday affairs of the student.

N107 Exploring the World of Animals (4 cr.) Equiv. PU BIOL 109. Fall, day, night; Spring, day, night; Summer, day. This course introduces students to animals and their native environments. It surveys individual ecosystems and highlights the interactions, features, and characteristics of the animals found there. Examples of discussion topics include unique features of animals, animal relationships, societies and populations, exotic species, and behavior, including mating, communication, feeding and foraging, and migration. Environmental issues including the effects of pollution on ecosystems are also discussed. Not equivalent to K103.

N200 The Biology of Women (3 cr.) Fall, day, night; Spring, day, night; Summer. This course examines the biological basis for bodily functions and changes that take place throughout the life of females.

N212 Human Biology (3 cr.) Equiv. PU BIOL 201. Fall, day. First course in a two-semester sequence in human biology with emphasis on anatomy and physiology, providing a solid foundation in body structure and function.

N213 Human Biology Laboratory (1 cr.) P or C: N212. Fall, day. Accompanying laboratory for N212.

N214 Human Biology (3 cr.) P: N212. Equiv. PU BIOL 202. Spring, day. Continuation of N212.

N215 Human Biology Laboratory (1 cr.) P or C: N214. Spring, day. Accompanying laboratory for N214.

N217 Human Physiology (5 cr.) Equiv. IU PHSL P215. Fall, day; Spring, day; Summer, day. Lectures and laboratory work related to cellular, musculoskeletal, neural, cardiovascular, gastrointestinal, renal, endocrine, and reproductive function in humans.

N222 Special Topics in Biology (1-3 cr.) A variable-topic course dealing with current topics in biology. In a given semester, a topic such as disease, genetics, the environment, etc., will be dealt with as a separate course.

N251 Introduction to Microbiology (3 cr.) P: one semester general chemistry or one semester life science. Spring, night. This course includes a laboratory component. The isolation, growth, structure, functioning, heredity, identification, classification, and ecology of microorganisms; their role in nature and significance to humans.

N261 Human Anatomy (5 cr.) Equiv. IU ANAT A215. Fall, day, night; Spring, day, night; Summer, day, night. Lecture and laboratory studies of the histology and gross morphology of the human form, utilizing a cell-tissue-organ system-body approach.

N322 Introductory Principles of Genetics (3 cr.) P: N107 or K101. Equiv. PU AGR 430. Spring, night. Basic principles of plant and animal genetics. Emphasis on transmission mechanisms as applied to individuals and populations. For students in health and agricultural sciences.

N400 Biological Skills for Teachers (3 cr.) P: consent of instructor. Fall, night. Concepts and laboratory skills necessary to prepare teachers with diverse backgrounds to return to graduate academic biology courses are reviewed. Topics include general principles of biology, biochemistry, and biomathematics.

Biotechnology Program

IUPUI

723 W. Michigan Street, SL 306
Indianapolis, IN 46202-5132
Phone: (317) 274-0577; fax: (317) 274-2846

What has become known as the biotechnology industry has been going through some transforming changes that mandate more sophisticated workforce training at many levels. In order to place central Indiana at the forefront in the preparation of a suitable workforce for existing industry as well as a flexible training program that may be attractive to biotechnology industries considering a move to Indiana, IUPUI has developed education-training programs at the associate and bachelor's levels. These programs have been developed in collaboration with the several local biotechnology industries to ensure relevance and appropriateness of the education-training program content. Both programs include an extensive industrial internship that, along with the basic and applied courses in biotechnology, meet industrial objectives for preparation for positions in the biotechnology industry.

The two-year degree is not a terminal degree; rather, the credits earned are fully transferable to the four year bachelor's degree. Recognizing the rapidly changing landscape of the industry and the need for employers to move personnel to different workplace settings, the programs are flexible in that they are built upon a solid science foundation with specialization areas delivered through small sets of courses arranged into cassettes. Retraining is easily accomplished by returning for a cassette in another area. The specialization areas available at this time are molecular biology, cell culture and fermentation, and protein purification and formulation.

The curriculum of the bachelor's degree also allows sufficient flexibility within the major and with electives to meet basic requirements for application to most graduate and professional programs.

Degree Characteristics

Associate of Science in Applied Biotechnologies (ASAB)

- ~70 credit hour Purdue degree
- basic science course work in biology, chemistry, physics, and mathematics
- areas of specialization in molecular biology, cell culture and fermentation, and protein purification to meet industrial needs
- each area of specialization includes a related 6-credit internship
- graduates may enter the workforce immediately or enter the B.S. degree program
- all credits articulate fully to the bachelor's degree

Bachelor of Science in Biotechnology (BSB)

- 124 credit hour Purdue degree
- includes the full ASAB program
- additional courses in the major and flexibility to add areas of specialization
- full general-education course work in the humanities and social sciences
- flexibility to become eligible for most graduate and professional degree programs

Associate of Science in Applied Biotechnologies (ASAB)

For students seeking entry into the industrial job market as qualified laboratory and process technicians. Students who complete this two year, approximately 70 credit hour program will be able to enter the job market directly or, if they should choose at a later time, to complete additional course work toward a Bachelor of Science in Biotechnology degree with no loss of credits.

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Written Communication (6 cr.)
ENG W131 English Composition I (3 cr.)
TCM 320 Written Communication in Science and Industry (3 cr.)
No speech communication course is required for the Associate Degree in Applied Biotechnologies.

Area II No foreign language is required for an associate degree.

Area IIIA See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIB None.

Area IIIC Physical and Biological Science PHYS P201, CHEM C105, CHEM C125 Principles of Chemistry I with Laboratory (3 cr., 2 cr.) CHEM C106, CHEM C126 Principles of Chemistry II with Laboratory (3 cr., 2 cr.) CHEM C341 Organic Chemistry Lectures I (3 cr.)

Area IIID Mathematical Sciences MATH 153 and MATH 154. Two semesters of calculus are recommended (MATH 221, MATH 222 or MATH 163, MATH 164).

The starting point for mathematics courses should be worked out with a departmental advisor based on the math placement test and/or background of the student.

The computer science requirement may be satisfied with CSCI N207.

A statistics course is required: STAT 301.

Area IV Biotechnology Requirements

Required courses
BIOL K101 Concepts of Biology I (5 cr.)
BIOL K483 Biological Chemistry (3 cr.) **or** CHEM C484 Biomolecules and Catabolism (3 cr.)
BITN 200 Principles of Biotechnology (3 cr.)
BITN 210 Business and Regulatory Practices (3 cr.)
BITN 220 Cell Culture and Fermentation (2 cr.)
BITN 230 Analytical Methods in Biotechnology (2 cr.)
BITN 250 Biotechnology Internship (6 cr.)

Specialization Options

The following courses are required depending on the area of specialization chosen for the associate degree.

A. Fermentation Option
   BIOL K356 Microbiology (3 cr.)
   BIOL K357 Microbiology Laboratory (2 cr.)
   Fermentation Elective (2 cr.)
   Cassette elective (2 cr.)
B. Molecular Biology Option
   BIOL K322 Genetics and Molecular Biology (3 cr.)
   BIOL K323 Genetics and Molecular Biology Laboratory (2 cr.)
   BIOL Molecular Biology elective (3 cr.)
   Cassette elective (2 cr.)
C. Protein Purification and Formulation Option
   BITN 240 Protein Purification and Formulation (2 cr.)
   Cassette elective (2 cr.)

No grade below a C– will be accepted toward the degree program in any biology, biotechnology, or chemistry course.

To receive credit for a laboratory for which there is an accompanying pre- or corequisite lecture, the lecture must be completed with a minimum grade of C–.

Bachelor of Science in Biotechnology (BSB)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Written Communication (6 cr.)
ENG W131 English Composition I (3 cr.)
TCM 320 Written Communication in Science and Industry (3 cr.)

Speech Communication (3 cr.)
COMM R110 Fundamentals of Speech Communication (3 cr.)

Area II No foreign language is required for a Bachelor of Science degree. However, knowledge of a foreign language is strongly recommended for any student planning to attend graduate school.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.)

HIST H114 Western Civilization II (3 cr.)

List H One course from a list of humanities courses (3 cr.).

List S One course from a list of social science courses (3 cr.).

List C One course from a list of comparative world culture courses (3 cr.).

Area IIIB Junior/Senior Integrator (3 cr.) This course is from a list of integrator courses or integrator substitutable courses. Consult the academic advisor.

Area IIIC Physical and Biological Sciences

Chemistry Two semesters of Principles of Chemistry with laboratory (CHEM C105, CHEM C125; CHEM C106, CHEM C126). One semester of organic chemistry lecture (CHEM C341).

Physics One semester of basic physics (PHYS P201 or PHYS 152).

Area IIID Mathematical Sciences Course work through two semesters of calculus (MATH 221, MATH 222 or MATH 163, MATH 164). The starting point for mathematics courses should be worked out with a departmental advisor based on the math placement test and/or background of the student.

The computer science requirement may be satisfied with CSCI N207.

A statistics course is required: STAT 301.

Area IV Biotechnology Requirements

Required courses
BIOL K101 Concepts of Biology I (5 cr.)
BIOL K483 Biological Chemistry (3 cr.) or CHEM C484 Biomolecules and Catabolism (3 cr.)
BITN 200 Principles of Biotechnology (3 cr.)
BITN 210 Business and Regulatory Practices (3 cr.)
BITN 220 Cell Culture and Fermentation (2 cr.)
BITN 230 Analytical Methods in Biotechnology (2 cr.)
BITN 240 Protein Purification and Formulation (2 cr.)
BITN 250 Biotechnology Internship (6 cr.)
Cassette courses in area of specialization
Electives chosen with advisor to total at least 40 credits

No grade below a C– will be accepted toward the degree program in any biology, biotechnology and chemistry course.

To receive credit for a laboratory for which there is an accompanying pre- or corequisite lecture, the lecture must be completed with a minimum grade of C–.

A.S. in Applied Biotechnologies (ASAB)

There is no single semester-by-semester plan of study for the ASAB degree. However, one possible sequence of courses for the degree is given below. Variation from this sample plan of study should be made in consultation with a departmental advisor.

Cell Culture and Fermentation Option Sample Program

Freshman Year

First Semester

SCI I120 Windows on Science	1
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 153 Algebra and Trigonometry I or MATH 221 Calculus for Technology I	3
	17

Second Semester

BITN 210 Business and Regulatory Practices	3
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 154 Algebra & Trigonometry II or MATH 222 Calculus for Technology II	3
TCM 320 Written Communication in Science and Industry	3
	14

Sophomore Year

Third Semester

BITN 200 Principles of Biotechnology	3

BITN 220 Cell Culture and Fermentation	2
CHEM C341 Organic Chemistry Lectures I	3
CSCI N207 Data Analysis Using Spreadsheets	3
PHYS P201 General Physics I	5
	16

Fourth Semester

BITN 230 Analytical Methods in Biotechnology	2
Fermentation Elective	2
BIOL K356 Microbiology	3
BIOL K357 Microbiology Laboratory	2
STAT 301 Elementary Statistical Methods	3
Humanities elective (List H) **or**	
Social Sciences elective (List S) **or**	
Comparative World Cultures elective (List C) or	
HIST H114 History of Western Civilization II	3
	15

Junior Year

Fifth Semester

BITN 250 Biotechnology Internship	6
BIOL K483 Biological Chemistry	3
Cassette Elevtive	2
CAND 991 Candidate for Graduation	0
	11

Molecular Biology Option Sample Program

Freshman Year

First Semester

SCI I120 Windows on Science	1
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 153 Algebra and Trigonometry I **or**	
MATH 221 Calculus for Technology I	3
	17

Second Semester

BITN 210 Business and Regulatory Practices	3
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 154 Algebra and Trigonometry II **or**	
MATH 222 Calculus for Technology II	3
TCM 320 Written Communication in Science and Industry	3
	14

Sophomore Year

Third Semester

BITN 200 Principles of Biotechnology	3
BITN 220 Cell Culture and Fermentation	2
BIOL K322 Genetics and Molecular Biology	3
BIOL K323 Genetics and Molecular Biology Lab	2
CHEM C341 Organic Chemistry Lectures I	3
CSCI N207 Data Analysis Using Spreadsheets	3
	16

Fourth Semester

BITN 230 Analytical Methods in Biotechnology	2
Cassette Elective	2
BIOL K483 Biological Chemistry	3
BIOL Molecular Biology Elective	2
STAT 301 Elementary Statistical Methods	3

Humanities elective (List H) **or**	
Social Sciences elective (List S) **or**	
Comparative World Cultures elective (List C) **or**	
HIST H114 History of Western Civilization II	3
	15

Junior Year

Fifth Semester

BITN 250 Biotechnology Internship	6
PHYS P201 General Physics I	5
CAND 991 Candidate for Graduation	0
	11

Protein Purification and Formulation Option Sample Program

Freshman Year

First Semester

SCI I120 Windows on Science	1
BIOL K101 Concepts of Biology I	5
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 153 Algebra and Trigonometry I **or**	
MATH 221 Calculus for Technology I	3
	17

Second Semester

BITN 210 Business and Regulatory Practices	3
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 154 Algebra and Trigonometry II **or**	
MATH 222 Calculus for Technology II	3
TCM 320 Written Communication in Science and Industry.	3
	14

Sophomore Year

Third Semester

BITN 200 Principles of Biotechnology	3
BITN 220 Cell Culture and Fermentation	2
CHEM C341 Organic Chemistry Lectures I	3
CSCI N207 Data Analysis Using Spreadsheets	3
PHYS P201 General Physics I	5
	16

Fourth Semester

BITN 240 Protein Purification and Formulation	2
BITN 230 Analytical Methods in Biotechnology	2
STAT 301 Elementary Statistical Methods	3
Humanities elective (List H) or	
Social Sciences elective (List S) or	
Comparative World Cultures elective (List C) or	
HIST H114 History of Western Civilization II	3
Elective	3
	13

Junior Year

Fifth Semester

BITN 250 Biotechnology Internship	6
Cassette elective	2
BIOL K483 Biological Chemistry	3
CAND 991 Candidate for Graduation	0
	11

Courses in Applied Biotechnology (BITN)

Notes: P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered during one or both summer sessions; Day = offered as a daytime section; Night = offered as an evening section.

Undergraduate

200 Principles of Biotechnology (3 cr.) P: BIOL K101, CHEM C105/CHEM C125. Spring, day or night. Scope, history, and contemporary issues in biotechnology, the basics of structure and synthesis of biomolecules, the central dogma, and genetic manipulation will be reviewed. The course will also cover the legal and ethical issues relevant to regulated industries and will cover career potential and paths in the biotechnology industry.

210 Business and Regulatory Practices (3 cr.) P or C: BITN 200. Fall, day or night. This course will present an overview of the general operating procedures of the biotechnology industry. Covered will be the regulatory bodies impacting the industry and the guidelines for validating, monitoring and documenting industry regulatory compliance.

220 Cell Culture and Fermentation (2 cr.) P: BITN 210. Fall, day or night. The laboratory course will cover media construction, sterile technique, and nutritional requirements of prokaryotic and eukaryotic cells. Students will cultivate a number of cell types using the bioreactor and recover and analyze product. Documentation of process and instrument qualification will be emphasized.

230 Analytical Methods in Biotechnology (2 cr.) P: BITN 220, CHEM C126. Spring, day or night. The lab course will illustrate the applications of microscopy, enzyme assays, protein characterization, spectrophotometry, chromatographic methodologies, separation techniques, bioassays, and other analytical methods commonly employed in the biotechnology industry.

240 Protein Purification and Formulation (2 cr.) P: BITN 230, CHEM C341. Fall, day or night. An in depth review of protein properties accompanied by exercises used to separate, purify, and assay protein products will be presented. Methods for preparing protein products for the distribution, including freeze-drying, precipitation, and crystallization will be illustrated.

250 Biotechnology Internship (1 to 6 cr.) P: BITN 230 or BITN 240, CHEM C341. Spring, fall, and summer, day. An intensive, hands-on experience in an industrial laboratory related to the cassette specialization. Reinforcement of principles of business and regulatory practices and biotechnology methods, and experience in manufacturing processes in the industrial setting will be included.

Department of Chemistry and Chemical Biology

IUPUI
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Phone: (317) 274-6872, fax: (317) 274-4701
www.chem.iupui.edu

Professors Dykstra (Chancellor's Professor), Long, Malik (Chancellor's Professor), O'Donnell, Schultz (Chairperson)

Professors Emeriti Boschmann *(Associate Vice President)*, Dubin, Fife, Sunderwirth *(IUPU Columbus)*

Associate Professors Minto, Muhoberac, Naumann, Nurok, Sen

Associate Professor and Associate Dean Emeritus Fricke

Associate Professors Emeriti Cutshall, Nurok, Wyma

Assistant Professors Deo, Oh

Assistant Scientists Blacklock, Dria, Forsythe

Research Professors Boyd, Scott

Lecturer/Coordinator of Student Services Nguyen

Lecturers Anliker, Jacob

Departmental Academic Advisors Contact the department for assignment to an advisor.

Chemistry is the science that studies substances, both natural and synthetic, and their compositions, properties, transformations, and interactions with external forces.

The Department of Chemistry and Chemical Biology offers the Associate of Science in Chemistry (A.S.) degree, the Bachelor of Arts (B.A.) degree, the Bachelor of Science in Chemistry (B.S.) degree with a chemistry option and a biological chemistry option, and the Master of Science (M.S.) degree. All degrees carry the general requirements of the School of Science, which are described elsewhere in this bulletin. An undergraduate minor in chemistry is also offered. The Bachelor of Science degree carries certification by the American Chemical Society (ACS) Committee on Professional Training. The Master of Science degree has both a thesis and nonthesis option. An Industrial Co-op Program is also offered for the Master of Science degree. Qualified students may be authorized to pursue the Doctor of Philosophy (Ph.D.) degree in chemistry in the areas of analytical, biological, inorganic, organic, and physical chemistry. Contact the Department for details or visit the Web site chem.iupui.edu.

To enter the undergraduate curriculum in chemistry, a student should have completed a minimum of two years of algebra, one semester of trigonometry, one year each of chemistry and physics, and two years of a modern foreign language. The choice of a particular degree program in chemistry and the selection of courses for that degree must be made in consultation with a departmental advisor.

Courses for Nonmajors

Students in programs that require only one semester of chemistry should take C100, C101, or C110, depending on their specific degree program. C100 and C110 are both nonmathematical introductions to chemistry, while C101 requires one semester of high school algebra. Students in programs that require two semesters of chemistry take either C101/C121 with C110/C115 or the C105/C125 with C106/C126 sequence. (See specific program for degree major.) The C105/C125 with C106/C126 sequence is designed for students pursuing advanced work in scientific fields (e.g., biology, chemistry, geology, medicine, and physics). Students with an insufficient background in high school chemistry for C105 should take C101 as a preparatory course. Credit for C101 cannot count toward the total credit hours needed for graduation if either of the following courses are taken: C105, C106. Completion of C101 does not qualify a student for admission to C106.

Academic Advising in Chemistry

Academic success requires frequent and regular interaction between students and faculty in the classroom as well as outside it. In keeping with this departmental philosophy, chemistry majors are required to meet with their advisor at least once a year, preferably in the first half of the fall semester. Students who do not meet with their advisor by October 21 will not be permitted to register for the following spring semester until their advisor approves their registration.

Course Prerequisites

The department enforces all prerequisites for chemistry courses as indicated in the course listing of this bulletin. For course equivalency of prerequisites, consult the instructor.

Associate of Science in Chemistry

For students seeking entry into the industrial job market as qualified chemical laboratory and process technicians. Students who complete this two year, 62 credit hour program will be able to enter the job market directly or, if they should choose at a later time, to complete additional course work toward a Bachelor of Arts degree in chemistry with no loss of credits.

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II No foreign language is required.

Area IIIA See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Area IIIB None.

Area IIIC Physical and Biological Sciences In order to satisfy the science electives for this program students must take at least two courses totaling at least 8 credit hours of advanced chemistry, mathematics/physics, or biology courses. Students must select courses from at least two of the three areas indicated and should consult with their advisor for course selection.

Area IIID Mathematical Sciences MATH 159 and STAT 301. Computer Science CSCI N201 is also required. An additional advanced mathematics course, i.e. MATH 221 Calculus for Technology I, can be used to partially satisfy the science elective requirement of this program. The Department requires a minimum grade of C– in MATH 159, STAT 301, and CSCI N201 (D grades are unacceptable).

Area IV Chemistry Concentration Requirements C105, C125[1], C106, C126[2], C311, C341, C342, C343, and C344. A total of 22 credit hours of chemistry are required. An additional advanced chemistry course can be used to partially satisfy the science elective requirement of this program. The Department of Chemistry requires a minimum grade of C in all chemistry courses (C– grades are unacceptable).

Bachelor of Arts Preprofessional Chemistry Major

For students who require a knowledge in chemistry as a basis for work in other fields such as business, dentistry, environmental science and policy, law, medicine, or other allied health fields. Recommended for premedical and predentistry students.

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIC Physical and Biological Sciences PHYS P201 and PHYS P202 (recommended PHYS 152 and PHYS 251). Also, at least two additional courses outside chemistry having a laboratory component, which may be chosen from, for example, biology, geology, or physics.

Area IIID Mathematical Sciences MATH 221 and MATH 222 (recommended MATH 163 and MATH 164). One computer science course is also required.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Chemistry Concentration Requirements C105, C125[1], C106, C126[2], C311, C325, C341, C342, C343, C344, C360 (recommended C361), C494, and C495. Recommended C484. A Total of 32 credit hours of chemistry courses is required. The Department requires a minimum grade of C in all chemistry courses (C– grades are unacceptable).

Bachelor of Science in Chemistry, Professional Chemistry Major, A.C.S. Certified

This degree is for students who plan to be professional chemists or secondary school teachers or who plan to pursue graduate studies in chemistry. It carries certification by the Committee on Professional Training of the American Chemical Society. Two options are available: a chemistry option and a biological chemistry option.

Degree Requirements (Chemistry Option)

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II No foreign language is required.

Area IIIC Physical and Biological Sciences PHYS 152, PHYS 251, and at least two additional courses outside chemistry, which may be chosen from, for example, biology, geology, or physics.

Area IIID Mathematical Sciences MATH 163, MATH 164, and MATH 261. One computer science course is also required.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Chemistry Concentration Requirements C105, C125[1], C106, C126[2], C311, C341, C342, C343, C344, C361, C362, C363, C410, C411, C430, C435, C484, C494 and C495. A Total of 45 credit hours of chemistry courses is required. The Department of Chemistry requires a minimum grade of C in all chemistry courses (C– grades are unacceptable).

In addition to the above requirements, a minimum of 6 additional credit hours of advanced chemical elective courses is required. Courses may be chosen from the following: CHEM C309, C409 (3 cr. min.), C372, C485, C486 or any graduate-level chemistry course (permission required).

Degree Requirements (Biological Chemistry Option)

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Areas I, IIIA, and IIIB See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, ENG W233, ENG W290, or TCM 320.

Area II No foreign language is required.

Area IIIC Physical and Biological Sciences PHYS 152, PHYS 251, BIOL K101, and BIOL K103. Beyond the introductory level, an additional 3 credit hours of biology should be chosen from one of the following: BIOL K324 Cell Biology, BIOL K356 Microbiology, or BIOL K322 Genetics and Molecular Biology.

Area IIID Mathematical Sciences MATH 163, MATH 164, and MATH 261. One computer science course is also required.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Chemistry Concentration Requirements C105, C125[1], C106, C126[2], C311, C341, C342, C343, C344, C361, C362, C363, C430/C435, C484, C485, C486, C494, and C495. A Total of 45 credit hours of chemistry courses is required. The Department requires a minimum grade of C in all chemistry courses (C– grades are unacceptable).

In addition to the above requirements, a minimum of 6 additional credit hours of advanced chemical elective courses is required. Courses may be chosen from the following: CHEM C309, C409 (3 cr. min.), C372, C410, any graduate-level chemistry course (permission required), BIOL 540, or BIOL 548.

Chemistry Plans of Study

Associate of Science in Chemistry Sample Program (62 cr. required)

Freshman Year

First Semester	
CHEM C105 Principles of Chemistry I	3
CHEM C125[1] Experimental Chemistry I	2
MATH 159 Algebra and Trigonometry	5
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
HIST H114, List H, S, or C Elective	3
	17

Second Semester	
CHEM C106 Principles of Chemistry II	3
CHEM C126[2] Experimental Chemistry II	2
STAT 301 Elementary Statistics	3
ENG W132 Elementary Composition II	3
CSCI N201 Programming Concepts	3
	14

Sophomore Year

Third Semester	
CHEM C311 Analytical Chemistry Laboratory	2
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
Physical or biological science elective	4
General elective	3
General elective	2

16

[1] If C105 has been taken for 5 credits, C125 is not required.

[2] If C106 has been taken for 5 credits, C126 is not required.

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
COMM R110 Fundamentals of Speech Communication	3
Physical or biological science elective	4
General elective	3

15

Bachelor of Arts Preprofessional Chemistry Major Sample Program (124 cr. required):

Freshman Year

First Semester

CHEM C105 Principles of Chemistry I	3
CHEM C125[1] Experimental Chemistry I	2
MATH 221 Calculus for Technology I	3
ENG W131 Elementary Composition I	3
HIST H114 History of Western Civilization II	3
SCI I120 Windows on Science	1

15

Second Semester

CHEM C106 Principles of Chemistry II	3
CHEM C126[2] Experimental Chemistry II	2
MATH 222 Calculus for Technology II	3
PHYS P201 General Physics I	5
Second composition course	3

16

Sophomore Year

Third Semester

CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
PHYS P202 General Physics II	5
COMM R110 Fundamentals of Speech Communication	3
Foreign Language I	3

16

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
CSCI course	3
Physical or biological science elective	3-5
Foreign Language II	3

14-16

Junior Year

Fifth Semester

CHEM C311 Analytical Chemistry Laboratory	2
Physical or biological science elective	3-5
Foreign language III	4
Humanities—List H	3
General elective	3

15-17

Sixth Semester

CHEM C325 Introductory Instrumental Analysis	5
CHEM C360 Elementary Physical Chemistry	3
CHEM C494 Introduction to Capstone	1

Comparative World Cultures—List C	3
Social Sciences—List S	3
Elective	3
	18

Senior Year

Seventh Semester

Junior/Senior Integrator	3
Electives	12
	15

Eighth Semester

CHEM C495 Capstone in Chemistry	1
Electives	14
CAND 991 Candidate for Graduation	0
	15

Bachelor of Science: Sample Program, Chemistry Option, Professional Chemistry Major, A.C.S. Certified (124 cr. required)

Freshman Year

First Semester

CHEM C105 Principles of Chemistry I	3
CHEM C125[1] Experimental Chemistry I	2
MATH 163 Integrated Calculus and Analytic Geometry I	5
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
	14

Second Semester

CHEM C106 Principles of Chemistry II	3
CHEM C126[2] Experimental Chemistry II	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
PHYS 152 Mechanics	4
Second composition course	3
	17

Sophomore Year

Third Semester

CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
MATH 261 Multivariate Calculus	4
PHYS 251 Heat, Electricity, and Optics	5
COMM R110 Fundamentals of Speech Communication	3
	17

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
CSCI course	3
HIST H114 History of Western Civilization II	3
Elective	3
	14

Junior Year

Fifth Semester

CHEM C311 Analytical Chemistry Laboratory	2
CHEM C362 Physical Chemistry of Molecules	4
Elective	3
Humanities—List H	3
Physical or biological science elective	4-5
	16-17

Sixth Semester

CHEM C361 Physical Chemistry of Bulk Matter	3
CHEM C363 Experimental Physical Chemistry	2
CHEM C494 Introduction to Capstone	1
Physical or biological science elective	3-5
Comparative World Cultures—List C	3
Social Sciences—List S	3
15-17	

Senior Year

Seventh Semester

CHEM C410 Principles of Chemical Instrumentation	3
CHEM C411 Principles of Chemical Instrumentation Laboratory	2
CHEM C484 Biomolecules and Catabolism	3
Junior/Senior Integrator	3
Advanced chemical elective	3
Elective	3
17	

Eighth Semester

CHEM C430 Inorganic Chemistry	3
CHEM C435 Inorganic Chemistry Laboratory	1
CHEM C495 Capstone in Chemistry	1
Advanced Chemical elective	3
Electives	6
CAND 991 Candidate for Graduation	0
14	

Bachelor of Science: Sample Program Biological Chemistry Option-Professional Chemistry Major-A.C.S. Certified (124 cr. required)

Freshman Year

First Semester

CHEM C105 Principles of Chemistry I	3
CHEM C125[1] Experimental Chemistry I	2
MATH 163 Integrated Calculus and Analytic Geometry I	5
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
14	

Second Semester

CHEM C106 Principles of Chemistry II	3
CHEM C126[2] Experimental Chemistry II	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
PHYS 152 Mechanics	4
Second composition course	3
17	

Sophomore Year

Third Semester

CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
MATH 261 Multivariate Calculus	4
PHYS 251 Heat, Electricity, and Optics	5
COMM R110 Fundamentals of Speech Communication	3
17	

Fourth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
BIOL K101 Concepts of Biology I	5

CSCI elective	3
HIST H114 History of Western Civilization II	3
	16

[1] If C105 has been taken for 5 credits, C125 is not required.

[2] If C106 has been taken for 5 credits, C126 is not required.

Junior Year

Fifth Semester

CHEM C311 Analytical Chemistry Laboratory	2
CHEM C362 Physical Chemistry of Molecules	4
BIOL K103 Concepts of Biology II	5
Humanities—List H	3
	14

Sixth Semester

CHEM C361 Physical Chemistry of Bulk Matter	3
CHEM C363 Experimental Physical Chemistry	2
CHEM C494 Introduction to Capstone	1
Advanced biology course	3
Comparative World Cultures—List C	3
Social Sciences—List S	3
Elective	3
	18

Senior Year

Seventh Semester

CHEM C484 Biomolecules and Catabolism	3
Junior/Senior Integrator	3
Advanced chemical elective	3
Electives	6
	15

Eighth Semester

CHEM C430 Inorganic Chemistry	3
CHEM C435 Inorganic Chemistry Laboratory	1
CHEM C485 Biosynthesis and Physiology	3
CHEM C486 Biological Chemistry Laboratory	2
CHEM C495 Capstone in Chemistry	1
Advanced chemical elective	3
CAND 991 Candidate for Graduation	0
	13

The Department will not grant credit for a course when considerable duplication of course content may occur with another course taken. In general, credit will be allowed for the higher-level course, but not for the lower-level course. The following listings are considered to be duplications (lower-level courses listed first):

CHEM C360	and	CHEM C361
MATH 221-222	and	MATH 163-164
PHYS P201-P202	or	218-219 and PHYS 152-251
PHYS 100 or 200	and	PHYS P201, 218, or 152

For example, if a student has earned credit in MATH 163-164, the student will receive no credit for MATH 221-MATH 222, even if earned previously.

On occasion, a student who initially enrolled in the preprofessional B.A. in chemistry program decides to transfer to the B.S. in Chemistry program, having already taken one or more of the above-listed lower-level courses. The following policies will apply:

- If a student has a minimum grade of B (B– or lower is unacceptable) in CHEM C360 and approval of the departmental chairperson, credit will be granted for CHEM C361 and the student may proceed to CHEM C362.

- If a student has earned credit for the MATH 221-MATH 222 sequence, the student will be placed in MATH 164. If the student passes MATH 164, the MATH 163-MATH 164 requirement will be considered fulfilled. Credit will be granted for MATH 221 and MATH 164 only (8 credit hours). If the student does not pass MATH 164, the student must start with MATH 163.
- If a student has earned credit for MATH 221 only, the student must take the MATH 163-MATH 164 sequence, and no credit will be allowed for MATH 221.
- If a student has earned credit for the PHYS P201-PHYS P202 or PHYS 218-PHYS 219 sequence, the student will be placed in PHYS 251. If the student passes PHYS 251, the PHYS 152-PHYS 251 requirement will be considered fulfilled. Credit will be granted for PHYS P201 and PHYS 251 only (10 credit hours). If the student does not pass PHYS 251, the student must start with PHYS 152.
- If a student has earned credit for PHYS P201 or PHYS 218 only, the student must take the PHYS 152-PHYS 251 sequence, and no credit will be allowed for PHYS P201 or PHYS 218.

On occasion, a student who initially enrolled in the B.S. in Chemistry program decides to transfer to the preprofessional B.A. in chemistry program, having already taken one or more of the above-listed higher-level courses. A higher-level course will always substitute for a lower-level course to satisfy the requirement.

The Department will accept a maximum of 15 credit hours toward graduation in courses outside the Schools of Science, Liberal Arts, Business, Engineering, and Public and Environmental Affairs (e.g., technology, physical education, military science, therapy, etc.).

Minor in Chemistry

The undergraduate minor in chemistry requires a minimum of 20 credit hours of chemistry courses. The following courses are required: CHEM C105, C125, C106, C126, C341, C342, C343, and either CHEM C311 or C360. MATH 222 and PHYS P202 are prerequisites for CHEM C360. For other requirements see the School of Science requirements under “Undergraduate Programs, Minors” elsewhere in this bulletin.

Graduate Programs (M.S. and Ph.D. Degrees)

Admission Requirements

The prospective student should have a bachelor’s degree from an accredited institution, show promise of ability to engage in advanced work, and have adequate preparation, at least 35 credit hours of chemistry, broadly representative of the fields of the discipline, in a chemistry curriculum. The GRE subject exam in chemistry is strongly recommended.

Incoming students with an undergraduate grade point average (GPA) of 3.0 or higher (on a 4.0 scale) will automatically be recommended for admission as regular graduate students. Those with a GPA below 3.0 will be admitted as temporary graduate students with the provision that a 3.0 average must be achieved in the first three graduate courses (or 9 credit hours) if they are to be admitted as regular graduate students.

Application for Admission

Inquiries concerning the application process can be made directly to the Department by writing to Graduate Admissions, Department of Chemistry and Chemical Biology, IUPUI, 402 N. Blackford Street, Indianapolis, IN 46202-3272; phone (317) 274-6876; www.chem.iupui.edu. Applications for full-time study should be completed by March for the following fall semester to ensure complete consideration for fellowships and other financial support (see “Graduate Program Financial Aid” in this section). Applications for part-time graduate admission may be submitted at any time.

Temporary graduate students who wish to enroll in courses, though not necessarily in a degree program, should contact the IUPUI Graduate Office, Union Building, room 518, 620 Union Drive, Indianapolis, IN 46202-5167; phone (317) 274-1577. Students should be aware that no more than 12 credit hours earned as a nondegree student may be counted toward a degree program.

Transfer Credit

The Department will accept by transfer a maximum of 6 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions.

Graduate Program Financial Aid

All full-time thesis graduate students receive support stipends through teaching assistantships, research assistantships, departmental fellowships, university fellowships, or through the Industrial Co-op Program. Full-time students receive fee remissions; students with assistantships and fellowships are also eligible for health insurance. Consult the graduate advisor for current funding levels.

Master of Science Program

The M.S. program in chemistry, which awards a Purdue University degree, requires 30 credit hours of study beyond the baccalaureate level. It is designed for students seeking careers as professional chemists. Graduates of the program often choose industrial positions, but others enter Ph.D. programs in chemistry or related areas. Graduates have been placed in positions throughout the United States and abroad.

General Degree Options and Requirements

Specific area requirements (core courses) apply for course work. Courses from three of the following areas must be taken: analytical, biological, inorganic, organic, and physical. Typically, students take three courses in their primary area and two courses outside of it to meet these requirements.

The M.S. degree can be earned through any of three different options: the thesis option, the Industrial Co-op Program, and the nonthesis option.

Thesis Option This traditional full-time program requires 15 credit hours of course work and 15 credit hours of thesis research. The research activity culminates in the completion and defense of a thesis. This option is available to full- or part-time students.

Industrial Co-Op Program This full-time program has the same requirements as the thesis option, but it includes industrial work experience in the Indianapolis area. The program is described in detail in the following section, "Master of Science Industrial Co-op Program."

Nonthesis Option The nonthesis option requires 30 hours of course work alone. Because actual research experience is essential in an advanced chemistry program, this option is recommended for part-time students only. Students in this option are usually employed full time and are already engaged in research activity as part of their employment. However, nonthesis students may still enroll in a limited amount of research study that applies to the degree requirements (usually through CHEM 599).

Master of Science
Industrial Co-op Program

Although most chemists seek careers in industry upon completion of their educational goals, few have had industrial experience or the opportunity to develop an appreciation for the types of problems presented in the industrial setting. The Industrial Co-op Program in Indianapolis is designed to provide industrial experience and to offer an alternative approach to career preparation. Most graduates leave with a strong, research-based M.S. degree plus meaningful work-study experience commensurate with graduate-level training. Students may also enter the Ph.D. program and participate in the co-op program for the first two years of their residency.

The M.S. Industrial Co-op Program requires 24 months of full-time study. The first semester consists of intensive course work, interviews with personnel from several local industrial laboratories, and familiarization with faculty research interests. In the second and subsequent semesters, the student continues course work and engages in parallel work experience and academic experience, consisting of 20 hours per week at an industrial lab and 20 hours per week in an academic lab. This work experience is commensurate with the student's background and interests and is an important part of the overall training program. The faculty thesis advisor and the industrial supervisor serve together to monitor each student's progress in the program.

Most students who enter the co-op program have sound academic backgrounds and some research experience, and they desire industrial experience and an opportunity to pursue graduate studies in chemistry.

Ph.D. Program

The Ph.D. program is a full-time, thesis-based research program. This program provides a substantially larger research component than that of the M.S. degree and requires original and significant research contributions by the student. As a result, the Ph.D. student is qualified for employment where the ability to design, develop, and complete a research program is expected.

The program is part of the Purdue University system-wide doctoral program in chemistry, and, as such, identical requirements apply to all campuses participating in the program.
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To establish candidacy, students must pass five written "cumulative" examination questions within their first four semesters and submit a written research report by the end of the fourth semester. An oral examination is due by the end of the fifth semester (an original proposal and an up-to-date summary of the student's dissertation research), and a formal seminar is due by the end of the sixth semester.

Course requirements include 20 credit hours of approved graduate courses:

1. 9 credit hours in a major area
2. 9 credit hours outside the major area (in at least two other areas)

3. among items 1 and 2 above, 12 credit hours must be 600-level courses
4. 2 credit hours of 695 Seminar
5. 70 credit hours of research (699 Ph.D. Thesis Research)

Joint M.D.-Ph.D. Program

The Department participates in the joint M.D.-Ph.D. program with the Indiana University School of Medicine. In this program, students concurrently earn an Indiana University M.D. degree and Purdue University Ph.D. degree in chemistry. Students take courses in both chemistry and medicine, with several courses simultaneously satisfying both degree requirements.

Eligible students must be admitted separately to the School of Medicine and the Department of Chemistry and Chemical Biology. Once admission to each is approved, students, together with advisors from medicine and chemistry, plan a tentative course outline for a concurrent program. Graduate and teaching assistantships or fellowships are arranged primarily through the Department of Chemistry and Chemical Biology.

Medical Biophysics Ph.D. Program

In cooperation with departments in the Indiana University School of Medicine and the Purdue University School of Science, this interdisciplinary program leads to an Indiana University Ph.D. degree in biophysics. The program is designed to give talented graduate students the skills required of the next generation of biologically oriented scientists. The program combines a core of courses in molecular and cellular biophysics with flexible electives and a seminar program. The training is oriented primarily toward faculty-directed research with focus points at the boundaries of the traditional disciplines of physics, chemistry, and biology. Prospective students should contact the director of graduate programs in the chemistry department for further information.

Biomedical Engineering Ph.D. and Master's Program

Biomedical engineering is a rapidly emerging interdisciplinary field combining engineering, chemistry, biology, and medicine. The curriculum involves mathematics, engineering, and classical and medical sciences. The doctoral program is a joint effort between the Biomedical Engineering Programs at IUPUI and Purdue University, West Lafayette. In this case, students apply to the West Lafayette campus and can take courses and do research at IUPUI. Students for the master's program apply to the Biomedical Engineering Program at IUPUI.

Courses in Chemistry (CHEM)

Notes: P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered during one or both summer sessions; Day = offered as a daytime section; Night = offered as an evening section.

Undergraduate

C100 The World of Chemistry (3 cr.) A topically oriented, nonmathematical introduction to the nature of matter. Topics covered include fossil fuel and nuclear sources of power; environmental issues involving chemistry such as recycling, acid rain, air and water pollution, global warming, ozone depletion; genetic modification of foods, DNA profiling, use of food additives and herbal supplements; and other public policy issues involving science.

C101 Elementary Chemistry I (3 cr., lecture, recitation) P: at least one semester of high school algebra. Usually taken concurrently with C121. Fall, day, night; Spring, day, night; Summer II, day. Essential principles of chemistry, atomic and molecular structure, bonding, properties and reactions of elements and compounds, stoichiometry, solutions, and acids and bases. For students who are not planning careers in the sciences and for those with no previous course work in chemistry. Note: most degree programs that include C101 require the concurrent laboratory, C121.

C105 Principles of Chemistry I (3 cr., lecture, recitation) P: two years of high school algebra and one year of high school chemistry. Fall, day, night; Spring, day; Summer I, day. Usually taken concurrently with C125. A placement examination may be required for admission to this course. See "Chemistry Placement Examination" above. Principles of inorganic and physical chemistry emphasizing physical and chemical properties, atomic and molecular structure, chemical bonding, and states of matter.

C106 Principles of Chemistry II (3 cr., lecture, recitation) P: C105 or equivalent. Fall, day; Spring, day, night; Summer II, day. Continuation of C105. Usually taken concurrently with C126. Topics include condensed phases, solution chemistry, thermodynamics, equilibrium, and kinetics.

C110 The Chemistry of Life (3 cr.) High school chemistry recommended. Optional laboratory: C115. A nonmathematical introduction to organic molecules and their transformation to useful materials such as drugs and polymers. An emphasis is placed on the chemical features of biomolecules including hormones and neurotransmitters, proteins, lipids (fats), carbohydrates (sugars), and nucleic acids (DNA/RNA). The chemistry of enzymes, carcinogens, vitamins, antihistamines, anesthetics, genetic engineering, mental health, and other health-related topics.

C115 Laboratory for C110 The Chemistry of Life (2 cr.) P or C: C110. Laboratory work illustrating topics covered in C110.

C121 Elementary Chemistry Laboratory I (2 cr.) P or C: C101 (3 cr.) Fall, day, night; Spring, day, night; Summer II, day. Introduction to the techniques and reasoning of experimental chemistry. Emphasis is given to study of physical and chemical properties of inorganic compounds.

C125 Experimental Chemistry I (2 cr., lecture, laboratory) P or C: C105 or equivalent. Fall, day, night; Spring, day; Summer I, day. Laboratory work illustrating topics covered in C105.

C126 Experimental Chemistry II (2 cr., lecture, laboratory) P: C105 and C125; P or C: C106 or equivalent. Fall, day; Spring, day, night; Summer II, day. Continuation of C125. Laboratory work illustrating topics covered in C105 and C106.

C209 Special Problems (1-2 cr.) P: two semesters of college chemistry and consent of instructor. Every semester, time arranged. Individually supervised special problems of chemical interest, e.g., environmental problems, development of experiments, development of audiovisual materials, etc. May be repeated for credit, but maximum of 2 credit hours may be applied toward a chemistry degree.

C301 Chemistry Seminar I (1 cr.) P or C: C409 and consent of instructor. Fall, day. Topics in various areas of chemistry. Students are required to attend departmental seminars and prepare and present at least one seminar on their research. C301 and C302 may be elected three semesters for credit.

C302 Chemistry Seminar II (1 cr.) P or C: C409 and consent of instructor. Spring, day. Content same as C301.

C309 Cooperative Education in Chemistry (1 cr.) P: general and organic chemistry and consent of departmental chairperson. Every semester, time arranged. Industrial or similar experiences in chemically oriented employment. Grade is determined on basis of employment visitations, a written student report, and a supervisor evaluation report. May be repeated for a maximum of 5 credit hours, of which 3 may be used to satisfy an advanced chemistry elective.

C311 Analytical Chemistry Laboratory (2 cr.) P: C106 and C126. Fall. Laboratory instruction in fundamental analytical processes including solution equilibria, theory and applications of electrochemistry and spectrophotometry, and chemical methods of separation.

C325 Introductory Instrumental Analysis (5 cr.) P: C311. Spring. Instrumental methods of chemical analysis and separation for the chemical technician or preprofessional chemistry major.

C341 Organic Chemistry I (3 cr.) P: C106. Fall, day, night; Spring, day; Summer I, day. Comprehensive study of organic compounds. Valence bond theory, stereochemistry, and physical properties of organic compounds are discussed in detail. Introduction to reaction mechanisms and to spectroscopic identification. Synthesis and reactions of selected compounds are also discussed.

C342 Organic Chemistry II (3 cr.) P: C341. Fall, day; Spring, day, night; Summer II, day. Continuation of C341. The chemistry of aromatic compounds and other major functional groups are discussed in detail. Multistep synthetic procedures and reaction mechanisms are emphasized. Introduction to biological chemistry.

C343 Organic Chemistry Laboratory I (2 cr.) P: C126; P or C: C341. Fall, day, night; Spring, day, night; Summer I, day. Fundamental laboratory techniques of organic chemistry, introduction to spectroscopic methods of compound identification, and general synthetic methods.

C344 Organic Chemistry Laboratory II (2 cr.) P or C: C342; P: C343. Fall, night; Spring, day, night; Summer II, day. Preparation, isolation, and identification of organic compounds, spectroscopic methods of compound identification, qualitative organic analysis, multistep synthesis.

C360 Elementary Physical Chemistry (3 cr.) P: C106, MATH 222, PHYS P202. Spring, day. Properties of gases and liquids, intermolecular forces, diffusion, chemical thermodynamics, ligand binding, kinetics, and introduction to quantum chemistry and spectroscopy. Includes topics in biophysical chemistry. For students who desire a survey course in physical chemistry.

C361 Physical Chemistry of Bulk Matter (3 cr.) P: C106, MATH 164, and PHYS P202 or PHYS 251 and C: MATH 261. Spring, even years, day; Spring, odd years, night. Kinetic–molecular theory, gases, liquids, thermodynamics, statistical mechanics, solutions, transport properties, and phase and chemical equilibria.

C362 Physical Chemistry of Molecules (4 cr.) P: C106, MATH 164, and PHYS P202 or PHYS 251 and C: MATH 261. Fall, day. Quantum chemistry, symmetry, atomic and molecular structure and spectra, solids, chemical kinetics, photochemistry, and introduction to statistical thermodynamics.

C363 Experimental Physical Chemistry (2 cr.) P: C361 and C: C362 or P: C362 and C: C361. Spring. Experimental work to illustrate principles of physical chemistry and to introduce research techniques.

C371 Chemical Informatics I (1 cr.) P: C106, Fall. Basic concepts of information representation, storage, and retrieval as they pertain to chemistry. Structures, nomenclature, molecular formulas, coding techniques for visualization of chemical structures and properties.

C372 Chemical Informatics II: Molecular Modeling (2 cr.) P: C341. Introduction to computer representation of molecular structure and simulation of chemical reactions; visualizing fundamental chemical concepts, such as reaction paths of standard organic reactions, molecular orbital diagrams, vibrations and conformational changes; quantitative structure activity relationships (QSAR), pharmacophore docking to biomolecules, and related methods for drug design.

C409 Chemical Research (1-4 cr.) P: junior or senior standing and consent of instructor. Every semester, time arranged. Chemical or literature research with a report. Can be elected only after consultation with research advisor and approval of program. May be taken for a total of 10 credit hours, which count toward graduation. Three (3) credit hours may be used to satisfy the advanced chemical elective in the Bachelor of Science in Chemistry degree program.

C410 Principles of Chemical Instrumentation (3 cr.) P: C311 and C361. P or C: C362. Fall. Modern methods of instrumental analysis, including spectroscopy, chromatography, and electrochemistry.

C411 Principles of Chemical Instrumentation Laboratory (2 cr.) P: C311. P or C: C410. Fall. Laboratory instruction in the instrumental analysis techniques discussed in C410.

C430 Inorganic Chemistry (3 cr.) P: C362. Spring. Atomic structure; periodic trends and properties of the elements. Introduction to symmetry and group theory. Valence bond, molecular orbital and ligand field theories of bonding and their application to structure and properties of inorganic and organ metallic compounds. Spectroscopic properties and acid-base, oxidation-reduction, and coordination reactions of inorganic compounds.

C435 Inorganic Chemistry Laboratory (1cr.) P or C: C430. Spring. Synthesis, characterization, and study of chemical and physical properties of inorganic and organ metallic compounds.

C471 Chemical Information Sources (1cr.) P: C341. Fall. Techniques for the storage and retrieval in both printed and computer-readable formats; sources of chemical information, including Chemical Abstracts; development of search strategies; and online searching of chemical databases.

C472 Computer Sources for Chemical Information (1cr.) P: C471. Spring. Techniques for the utilization of the major computer-based information tools found in academic and industrial environments.

C484 Biomolecules and Catabolism (3 cr.) P: C342. Fall. The chemical and biophysical properties of biologically important molecules and systems. Special emphasis on the relationship between structure and function in proteins, nucleic acids, and biomembranes, as well as bioenergetics, kinetics, allosteric interactions, and enzyme catalysis.

C485 Biosynthesis and Physiology (3 cr.) P: C484. Spring. Mechanisms of biological catalysis, metabolism, biosynthesis.

C486 Biological Chemistry Laboratory (2 cr.) P: C484 or equivalent. P or C: C485. Spring. An introduction to the important laboratory techniques currently employed by practicing biological chemists, including biomolecule isolation, purification, enzyme kinetics, and biomolecule characterization by electrophoresis, centrifugation, and spectroscopic methods.

C494 Introduction to Capstone (1 cr.) P: junior standing, B.A. or B.S. program. Fall, day; Spring day.

C495 Capstone in Chemistry (1 cr.) P: senior standing, B.A. or B.S. program. Fall, day; Spring, day. Independent study, under the supervision of a chemistry faculty member or appropriate academic advisor can be earned by completion of: (a) a chemical research project; (b) a library research project in an area of current scientific investigation; (c) a research investigation in industry; or (d) a service activity in university, government, public schools, or other science-related groups or organizations. Students will report the results of their activities in both a formal written report and oral presentation, prepare portfolios of undergraduate work in chemistry, discuss recent scientific literature, and explore chemistry in society. Enrollment in the Capstone in Chemistry requires joint approval of the capstone instructor and the independent project advisor.

C496 Methods in Teaching Chemistry (1 cr.) P: C105. Fall; Spring. Designed for workshop leaders, this course offers continued support and training in group dynamics and learning theory. The larger goals for this course are to continue the development of leadership skills, foster ongoing communication among workshop leaders, and provide an environment for reviewing content knowledge.

Graduate

Please consult the online IUPUI course offerings for a listing of graduate lecture courses offered each fall or spring semester.

533 Introductory Biochemistry (3 cr.) P: C342 or equivalent. A rigorous one-semester introduction to biochemistry.

542 Inorganic Chemistry (3 cr.) P: C362 or equivalent or consent of instructor. Atomic structure; periodic trends and properties of the elements. Introduction to symmetry and group theory. Valence bond, molecular orbital, and ligand field theories of bonding and their application to structure and properties of inorganic and organ metallic compounds. Spectroscopic properties and acid-base, oxidation-reduction, and coordination reactions of inorganic compounds. Advanced topics in main group or transition element chemistry.

575 Intermediate Physical Chemistry (3 cr.) P: C362 or equivalent. Quantum theory of atoms and molecules, theories of chemical bonding, molecular spectroscopy, methods for determining molecular structure, and electrical and magnetic properties.

599 Special Assignments (1-4 cr.) P: consent of instructor. Every semester including summer I and II, time arranged. Directed reading or special work not included in other courses.

621 Advanced Analytical Chemistry (3 cr.) P: C311 and C410. A critical survey of recent developments in chemical and instrumental methods of analysis.

629 Chromatographic Methods of Analysis (3 cr.) P: C410 or equivalent or consent of instructor. Principles and practice of modern gas and liquid chromatography and capillary electrophoresis are developed from an integrated point of view. Emphasis is placed both on theory and on features useful for practical analytical separations.

634 Biochemistry: Structural Aspects (3 cr.) P: C311, C342, C361, and C362 or equivalent. Chemistry of materials of biochemical interest: carbohydrates, lipids, proteins, amino acids, nucleic acids, porphyrins, biochemistry of blood.

636 Biochemical Mechanisms (3 cr.) P: one year of physical chemistry and 651. The chemical basis of enzymatic catalysis with particular emphasis on catalytic interactions important in aqueous media.

641 Advanced Inorganic Chemistry (3 cr.) P: C430 or 542 or equivalent or consent of instructor. Applications of symmetry and group theory to structure, bonding and spectral properties of inorganic compounds. Advanced topics in main group and transition element chemistry including determination of structure from physical and spectroscopic properties, bonding in coordination, and organ metallic compounds and inorganic reaction mechanisms.

651 Advanced Organic Chemistry (3 cr.) P: C342 or equivalent. Modern structural organic chemistry. Introduction to bonding theory, stereochemistry, and computational chemistry.

652 Synthetic Organic Chemistry (3 cr.) P: 651 or 657. An advanced treatment of methods for preparing major types of organic functionalities and bonds, stressing stereochemical and regiochemical control, and employing mechanistic organic chemistry for understanding choice of reagents and reactions conditions.

657 Reaction Mechanisms (3 cr.) P: C342 or equivalent or consent of instructor. Modern structural organic chemistry, introduction to physical organic chemistry, mechanisms of representative reactions, and methods used for understanding reactivity in organic transformations.

672 Quantum Chemistry (3 cr.) P: one year of physical chemistry. Basic principles of classical and quantum mechanics, approximation methods, atomic structure, spectroscopy, application of group theory, and theory of molecular bonding.

675 Chemical Kinetics (2 or 3 cr.) P: one year of physical chemistry. Experimental and theoretical considerations of chemical reaction rates and mechanisms.

682 Statistical Thermodynamics (3 cr.) P: C362 or equivalent. Application of statistical mechanics to the description of imperfect gases, liquids, and solutions, to order-disorder phenomena in solids and surfaces; Monte Carlo techniques and molecular dynamics.

696 Special Topics in Chemistry (1-3 cr.) P: Bachelor of Science in chemistry from an accredited institution or consent of instructor. Lectures on selected topics of current interest, as follows:

Analysis and Characterization of Synthetic Polymers A description of the principles and techniques of solution characterization and molecular weight methods, polymer spectroscopy, thermal analysis, and evaluation of mechanical properties.

Analytical Spectroscopy Survey of modern techniques, applications of spectroscopy, and imaging in analytical chemistry.

Applied Computational Chemistry and Molecular Modeling Applied computational techniques that are widely used in the chemical and pharmaceutical industry, including computational chemistry, molecular modeling, and computer-aided synthesis.

Bioanalytical Chemistry Modern techniques for the study of biological macromolecules, such as protein and peptides, carbohydrates, DNA, RNA, and lipids, including (1) spectroscopy (UV-Vis, Raman, NMR, mass spectrometry, and light scattering); (2) bioseparations (chromatography, electrophoresis, and microdialysis); (3) electrochemistry (sensors, electron transfer, and LCEC); and (4) miscellaneous topics (amino acid analysis, sequencing, microcalorimetry, and immunochemistry).

Biochemistry-Dynamic Aspects Mechanisms of biological catalysis, metabolism, biosynthesis, regulation of genetic information, and molecular biology.

Bioelectrochemistry Principles of electrochemical measurements including potentiometry, amperometry, and linear sweep and cyclic voltammetry and application to the study and utilization of biological molecules. Topics covered include redox transformations in biological systems, electron transfer between electrodes and biological molecules, and electrochemical sensors for detection and quantitation of biological analytes.

Bioinorganic Chemistry A study of the occurrence, properties, and mechanistic roles of transition and main group elements in biological processes including photosynthesis, oxygen evolution, respiration, nitrogen fixation, metabolic detoxification, and electron transfer.

Bioorganic Chemistry Structure and reactivity of biological macromolecules, such as proteins, enzymes, and nucleic acids, and their relevance to bioorganic chemistry. Current experimental studies of enzymes, nucleic acids, and model systems.

Biomaterials Introduction to the field of biomaterials science including chemistry, physics, and engineering of biomaterials; biological and biochemical aspects of biomaterials; and biomaterials in medicine.

Biophysical Chemistry The study of structure and properties of biologically important macromolecules in solution using physical techniques, with special emphasis on optical, fluorescence, and magnetic resonance spectroscopy to describe protein conformation, denaturation, catalytic center structure, thermodynamics of ligand binding, time-dependent processes, and membrane properties.

Chemical Information Technology Overview of chemical informatics techniques, including chemical information and data systems, chemical structure and data representation and search systems, and bioinformatics techniques.

Electroanalytical Chemistry Principles of modern methods of electroanalytical chemistry and quantitative applications to electrode reaction mechanisms and analytical determinations.

Medicinal Chemistry The application of basic concepts of organic chemistry, biochemistry, and pharmacology to the design of organic medicinal agents as well as recent advances in synthesis and evaluation of pharmaceuticals.

Organometallics in Organic Synthesis Recent developments in the use of transition metals in synthetic organic methodology. Emphasis is placed on applications of methods in the synthesis of complex organic molecules.

Protein Structure and Function Physical forces stabilizing protein structure; protein folding. Essential features of macromolecular interactions. Introduction to enzyme kinetics and chemical mechanism in enzyme reactions.

Group Theory in Chemistry This course is on molecular symmetry and how we obtain information about the quantum states of molecules through application of group theoretical techniques related to the symmetries of molecules.

698 Research M.S. Thesis (cr. arr.)

699 Research Ph.D. Thesis (cr. arr.)

Department of Computer and Information Science

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Academic Advising Appointments Please call the department.

Professors Bukhres, Palakal *(Chair)*

Professor and Dean Emeritus Yovits

Emeritus Faculty Olson

Associate Professors Baker, Chang, Fang, Mukhopadhyay, Patterson, Raje, Tuceryan, Zheng

Assistant Professors Chen, Dai, Huang, Xia, Zou

Lecturers Allen, Harris, Molnar, D. Roberts, M. Roberts

Adjunct Professors Mostafa, Pidaparti

The department offers Purdue University Bachelor of Science (B.S.) and Master of Science (M.S.) degrees. It also offers a Certificate in Applied Computer Science. Students interested in research may arrange to pursue a Doctor of Philosophy (Ph.D.) degree through the Purdue University Graduate School. The programs of study emphasize the basic principles of computing and information processing, which include the creation, representation, display, storage, transformation, and transmission of information, as well as the software to accomplish these. Because computers are used in all segments of society, the theory and practice of computer and information science are pervasive and the field is, therefore, interdisciplinary. It is also young and dynamic, as evidenced by the growth of the computer industry, so the curriculum itself evolves rapidly.

Bachelor of Science

Students completing the undergraduate degree in computer and information science will have acquired a fundamental understanding of computing, information processing, and information communication. The department's graduates serve in a variety of programming, software engineering, database administration, systems analysis, management, and research positions.

Degree Requirements

Note: *These degree requirements are effective for students admitted beginning in the fall of 2005.*

See the School of Science requirements under ''Undergraduate Programs" in this bulletin for the general and area degree requirements. Computer science majors are admitted only provisionally to the program until they have completed MATH 221 or 163 and CSCI 230 and 240 with a grade point average of 2.7 or higher for the three courses. Please note that computer and information science courses below CSCI 230 or CSCI N311, mathematics courses below

MATH 221 or 163, and statistics courses below STAT 301 are not credited toward the degree. Furthermore, the School of Science will not accept certain university courses for the computer science degree program. The Bachelor of Science degree program in computer science requires a minimum of 124 credit hours.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I English Composition and Communication Skills (9 cr.) See the School of Science requirements under ''Undergraduate Programs" in this bulletin for details.

ENG W131 Elementary Composition I
COMM R110 Fundamentals of Speech Communication

The second semester of English composition *must* be satisfied with:

TCM 320 Written Communication in Science and Industry

Area II Foreign Language There is no foreign language required for the B.S. degree.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.) The information about the IIIA requirements in the School of Science part of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult a departmental advisor before registering for these courses.

HIST H114 History of Western Civilization II and at least one course from *each* of the following three lists is required:

Humanities
Social Sciences
Comparative World Cultures

Area IIIB Junior/Senior Integrator (3 cr.) See the School of Science requirements under ''Undergraduate Programs" in this bulletin for details.

Area IIIC Physical and Biological Sciences The Department of Computer and Information Science requires all computer science majors to take PHYS 152 and three other physical science courses chosen from the areas of biology, chemistry, geology, and physics, or from certain courses in engineering. Each course that counts as one of the physical science required courses *must* have a lecture component and be at least 3 credit hours. Courses that *may not* be used to fulfill Area IIIC requirements include: BIOL N100, N107, N120, N200; CHEM C100, C101, C102, C110; PHYS 010, 100, 140, 200, 218, 219, P201, P202; AST A100, A105, A130; GEOL G107, G115, G130, G132, G135; and all agriculture and geography courses. Consult a departmental academic advisor concerning the acceptability of other courses. The following engineering courses *may* be applied toward Area IIIC requirements: ECE 201, 202, and 266. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement.

Area IIID Mathematical Sciences Computer Science majors are required a minimum of 15 credit hours of mathematical sciences. No grade below C– is acceptable in this area. Five course requirements are MATH 221 or 163, MATH 222 or 164, MATH 351 or 511, STAT 301, 416 or 511 and one computational elective chosen from:

MATH 179 Computers and Mathematics
MATH 261 Multivariate Calculus
STAT 512 Applied Regression Analysis
STAT 514 Design of Experiments
CSCI 414 Numerical Methods

Mathematically oriented or computer oriented courses in other schools *cannot* be used to fulfill these requirements. They may not count toward the degree in computer science either. Consult a departmental advisor before registering for such courses.

Area IV Major Requirements Minimum requirements include 23 credit hours of core computer science courses and at least 30 additional hours of computer science and supporting course electives. Core courses are: CSCI 230, 240, 340, 362, 402, 403, and 495. Students who do not maintain a minimum GPA of 2.5 in MATH 221 or 163, and in CSCI 230, 240, 340, and 362 will not be permitted to continue as departmental majors.

Computer and Information Science Electives

Students are encouraged to focus their required electives in such areas as database, datamining, biometric computing, 3D game engine programming, or network security. Students choose a minimum of 10 courses from among the list of computer science and supporting course electives. No more than 3 courses can be chosen from the select list of N-series courses; a minimum of 5 courses must be CSCI 400 level or above, and no more than 2 courses can be chosen from a recommended list of courses outside of computer science.

CSCI N-Series and 300 level Electives—Choose no more than three

CSCI 300 Systems Programming
CSCI 355 Introduction to Programming Languages
CSCI N311 Advanced Database Programming, Oracle
CSCI N321 System and Network Administration
CSCI N335 Advanced Programming, Visual Basic
CSCI N342 Server Side Web Development
CSCI N343 Object-Oriented Programming for the Web
CSCI N345 Advanced Programming, Java
CSCI N351 Introduction to Multimedia Programming
CSCI N431 E-Commerce with ASP.NET
CSCI N435 Data Managment Best Practices with ADO.NET
CSCI N451 Game Programming in Scripting Languages
CSCI N452 3D Game Programming
CSCI N461 Software Engineering for Applied Compter Science
CSCI N499 Topics in Applied Computing (topic varies)

CSCI 400 and 500 level Electives—Choose at least five courses

CSCI 432 Security in Computing (New Course)
CSCI 435 Multimedia Information Systems
CSCI 436 Principles of Computer Networking
CSCI 437 Introduction to 3D Game Graphics (New Title)
CSCI 438 Advanced Game Development (New Course)
CSCI 441 Client-Server Database Systems
CSCI 443 Database Systems
CSCI 448 Biometric Computing (New Course
CSCI 450 Principles of Software Engineering
CSCI 452 Object-Oriented Analysis and Design
CSCI 463 Analysis of Algorithms
CSCI 470 Automata and Formal Languages
CSCI 475 Scientific Computing I
CSCI 476 Scientific Computing II
CSCI 477 High Performance Computing
CSCI 481 Data Mining
CSCI 485 Expert System Design
CSCI 487 Artificial Intelligence
CSCI 490 Variable Title
CSCI 536 Data Communication and Computer Networks
CSCI 541 Database Systems
CSCI 548 Bioinformatics
CSCI 590 Cryptography and Network Security (P or C: CSCI 436)

Computer Science Supporting Electives—Choose no more than two courses. Note that this list of courses is not all inclusive. Other courses outside of computer science can be considered and can be counted with prior written approval of a computer science faculty.

NEWM N204 Introduction to Interactive Media
NEWM N210 Introduction to Digital Sound
NEWM N230 Introduction to Game Design and Development
NEWM N304 Interactive Media Applications
NEWM N330 Game Design, Development, and Production
NEWM N335 Computer-Based Character Simulation/Animation II
CIT 303 Communications Security and Network Controls
CIT 402 Design and Implementation of Local Area Networks
CIT 406 Advanced Network Security
CIT 420 Digital Forensics
CIT 440 Computer Network Design
HERR A371 Introduction to Interactive Design
HERR A471 Advanced Interactive Design
INFO I300 Human Computer Interaction
INFO I310 Multimedia Arts: History, Criticism, and Technology
INFO I320 Distributed Systems and Collaborative Comp
BUS S302 Management Information Systems
BUS L203 Commercial Law I
BUS L303 Commercial Law II
ECE 204 Introduction Electrical and Electron Circuits
ECE 362 Microprocessor Systems and Interfacing
ECE 471 Embedded Systems
STAT 514 Design of Experiments

Minor in Computer and Information Science

The undergraduate minor in computer and information science requires at least 20 credit hours in computer science courses, including CSCI 230, 240, 340, 362, and two CSCI elective courses chosen from 400 level or N400 level courses. Course prerequisites must be fulfilled prior to enrollment in CSCI courses.

A minimum GPA of 2.5 must be maintained in these courses. At least 9 credit hours of the minor must be taken at IUPUI.

Students who wish to pursue a minor in computer and information science must consult with a department advisor, who can be reached at (317) 274-9727. They must also file a formal application.

Minor in Business

The School of Business grants a minor in business to computer and information science students. This requires 16 credit hours of business courses and 24 credit hours of related courses. The business courses are distributed as free elective credit toward the total of 124 credit hours needed for a bachelor's degree. The requirements for a business minor include the following courses:

Business courses

1. BUS A100, BUS A201, and BUS A202 are to be taken as prerequisite courses; a GPA of 2.3 (C+) in these courses is required.
2. BUS F301, BUS M301, and BUS P301 are to be taken concurrently after completing the prerequisite courses.

Related courses

1. MATH 163.
2. STAT 416 or STAT 511.
3. ECON E201 and ECON E202.
4. CSCI 230, CSCI 443, and CSCI 541.

Certificate in Applied Computer Science

The certificate program introduces computer science principles, develops practical skills in market-driven software applications, and prepares students to be successful with emerging technologies. The program is designed to supplement and enhance a primary degree program. It serves current IUPUI students and returning adults who are interested in gaining knowledge and skills in computing applications.

Those who earn the certificate will have demonstrated that they have the core competencies necessary for entry-level positions in information technology. They will have the ability to solve complex problems, design and implement algorithms, apply computer science theory to practical problems, adapt to technological change and to program in at least two languages.

Admission Requirements

A cumulative GPA of at least 2.0, junior standing, and successful completion (no grade below C–) of:

CSCI N201 Programming Concepts or equivalent competency
CSCI N241 Fundamentals of Web Development
MATH M118 Finite Mathematics or equivalent

Students must declare their intent to earn this certificate before completing the core requirements (9 credit hours) described below. No more than 9 credit hours earned before to admission to the program will be accepted toward certification.

Program Requirements

Students are required to successfully complete 18 credit hours (six courses) to earn the certificate. Three courses are core requirements and three courses are advanced electives. Core requirements must be completed before enrolling in the advanced electives. No individual grade below a C– is acceptable toward certification. At least 9 credit hours in the certificate program must be taken in the Department of Computer and Information Science. A GPA of at least 2.0 is required for the complete certificate program.

Required Core CSCI Courses (9 credit hours):

CSCI N301 Fundamental Computer Science Concepts
CSCI N341 Introduction to Client-Side Web Programming
CSCI N485 Capstone Project in Applied Computing

Advanced Electives (9 credit hours):

In addition to the three core courses, students must successfully complete three other N-series courses at a level higher than CSCI N301. CIT 303, 402, and 440 may also be used to fulfill advanced elective requirements.

To enroll in this certificate program, students must be formally admitted by the Office of Undergraduate Admissions on the IUPUI campus. For currently enrolled (admitted) IUPUI students, an online application is available at www.cs.iupui.edu/academicprograms/ certApplication.html. Credit may be given for applicable courses taken at other colleges or universities.

Bachelor of Science Sample Program (124 cr. required)

Freshman Year

First Semester	
CSCI C230	4
MATH 221 or 163	*3-5
ENG W131	3
List H	3
Unrestricted elective (1)	3
SCI 120	1
	***17-19**

Second Semester	
CSCI 240	4
CSCI 340	3
MATH 222 or 164	*3-5
HIST H114	3
Science elective (1)	*3-5
	***16-18**

Sophomore Year

Third Semester	
CSCI elective (1)	3
CSCI elective (2)	3
CSCI 362	3
PHYS 152 (Sci 2)	4
COMM R110	3
	16

Fourth Semester	
CSCI elective (3)	3
CSCI elective (4)	3
List C	3
MATH 351	3
Unrestricted elective (2)	3
	15

Junior Year

Fifth Semester	
CSCI 402	3
CSCI elective (5)	3
STAT 301, 416, or 511	3
Science Elective (2)	*3-5
List S	3
	***15-17**

Sixth Semester	
CSCI 403	3
Required Computational Elective	*3-4
CSCI elective (6)	3
Unrestricted elective (3)	3
Science elective (4)	*3-5
	***15-18**

Senior Year

Seventh Semester	
CSCI elective (7)	3
CSCI elective (8)	3
CSCI 495	3
TCM 320	3
Unrestricted elective (4)	3
	15

Eighth Semester	
CSCI elective (9)	3
CSCI elective (10)	3
JR/SR Integrator	*3-5
Unrestricted elective (5)	3
Unrestricted elective (6)	3
CAND 991	0
	***15-17**

Note: Three to six (3-6) unrestricted (free) electives are required to earn 124 credit hours depending on the calculus sequence and physical science courses chosen by the student.

Master of Science

This program leads to a Master of Science degree from Purdue University. Many courses are offered in the late afternoon or evening to accommodate working students.

Computer science continues to evolve rapidly, so research experiences are an essential aspect of graduate study. Students will expand their knowledge of modern computing and pursue either a research thesis or project. Students are expected to work closely with their faculty advisor and to contribute to the growth of knowledge in the field.

Application for Admission

Submit applications for admission to the graduate program directly to the Department of Computer and Information Science by May 1 for the following fall semester and September 15 for the following spring semester. To be considered for departmental graduate assistance for the following fall semester, all application materials *must* be received by *December 15*. Financial support is generally not available for spring admissions. Apply early because it may take up to six months to complete the application process.

Students interested in advanced study or students who are required to complete preparatory courses and are waiting on application processing may take courses as graduate nondegree students. However, no more than 12 graduate credit hours earned as a nondegree student may be counted toward a graduate degree program.

See the department's Web site (www.cs.iupui.edu) for additional information on requirements and application deadlines. For guidelines and online applications, follow the link to the IUPUI Graduate Office on the department's Web site.

General Admission Requirements

The applicant to the graduate program must have a four-year bachelor's degree or equivalent.

The applicant's record should demonstrate strong individual accomplishments and recommendations from independent references and exhibit outstanding achievement as indicated by the grade point average for each degree over his or her entire academic record. An applicant is expected to have a GPA of at least a 3.0 on a scale of 4.0.

All applicants must submit their scores on the General Aptitude Test of the Graduate Record Examination (GRE). The applicants are strongly encouraged to submit scores for the computer science subject test.

All applicants should have a background in the following core areas of computer science:

a. software development experience in a high-level language
b. data structures and algorithms
c. systems (operating systems, compilers, and programming languages)
d. theory (discrete math and theory of computation)
e. hardware (computer architecture)

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and numerical computations.

All applicants whose native language is not English must submit a Test of English as a Foreign Language (TOEFL) score of at least 600 on the paper-based test, or 250 on the computer-based test, or pass an equivalent test administered by the university.

Provisional Admission

Those students who do not satisfy the admission requirements may request *provisional admission only* to the graduate program if they satisfy the following requirements:

possess a bachelor's degree with a cumulative GPA of 3.0 on a 4.0 scale

and

have taken 5 semester hour credits of calculus (MATH 163 or equivalent)

and

CSCI 265 (C++) or equivalent experience or credit.

If provisional admission to the graduate program in computer science is granted, the student will be required to satisfy the stipulations of the admission, which may include satisfactorily completing one or more courses, before admission without provisions is granted.

Degree Requirements

To receive the Master of Science degree, the applicant must be admitted as a graduate student *without provisions* and complete 30 semester credit hours of study in CSCI courses numbered 500 or above, at least 6 credit hours of which must be from the following core courses:

CSCI 503 Operating Systems
CSCI 504 Concepts in Computer Organization
CSCI 565 Programming Languages
CSCI 580 Algorithm Design, Analysis, and Implementation

Each student is required to submit to the graduate committee for approval an initial plan of study during the first year in the program. This is prepared in consultation with the faculty advisor. Before the semester of expected graduation, the student's formal plan of study must be submitted to, and accepted by, the Purdue University Graduate School. Each student must register in CAND 991 for 0 credits during the final semester before graduation.

Credit for Courses from Outside the Department

Credit for graduate courses taken at other institutions may be transferred with the approval of the graduate committee and the Graduate School if the courses have not been used for other degree requirements. Transfer credits are normally limited to 6 credit hours and are restricted to courses in which the grade is B or higher. Up to 6 credit hours of graduate credit from a closely related discipline may be used to substitute for the elective courses, subject to approval by the department before enrollment.

Assessment

The student's graduate examination committee will examine the student's project or thesis and general proficiency in computer science. Grades of A and B are expected; up to 6 credit hours of C may be included, provided an overall GPA of 3.0 (B) is maintained. Other grades are unacceptable.

Programs of Study

The department offers two programs of study within its M.S. program: the Research Program and the Applied Program.

The objective of the Research Program is to help students develop a general knowledge of computer science, depth in a specific area, and an ability to do independent research. The student learns research techniques by working in close cooperation with a faculty member while doing the thesis research. In addition to the two core courses and 6 to 9 credit hours of thesis work, the student completes a sufficient number of electives from the department's graduate level courses to satisfy the requirement of 30 credits hours total.

The objective of the Applied Program is to develop skills and knowledge of the computer science fundamentals and an ability to apply these to practical problems. In addition to the two core courses, it requires at least two courses in a specialization, 3 to 6 credits of work in the M.S. Project course, 695, and a sufficient number of electives from the department's graduate courses to complete the requirement of 30 credits hours. The course work is designed to provide breadth of knowledge to the professional as well as specialized knowledge in the areas that the project will require. The project normally involves at least two semesters of intensive work on an application of the course material to a problem of practical importance. This might be a project from the student's work environment, internship, or a faculty member's work. Its objective is generally of a more immediately practical nature than the thesis in the Research Program. The student carries out the project under the supervision of a faculty member.

The Applied Program offers a menu of courses from which the individual selects one or more specializations to prepare for the proposed project. To define a specialization, the graduate advisor and student identify in the plan of study two or more courses that provide depth in a cohesive theme.

Doctor of Philosophy

Students interested in research in certain areas and who qualify may be admitted to pursue a Ph.D. degree. Information on the general nature of the program appears in the "Graduate Programs" section of the School of Science part of this bulletin. Consult the department's Web page (www.cs.iupui.edu) for more specific information on how this might be arranged.

Courses in Computer and Information Science (CSCI)

Note: P = prerequisite; C = corequisite; R = recommended; Fall = offered fall semester; Spring = offered spring semester; Summer = offered in the summer session.

Undergraduate Level

N100-Level Courses

Courses in this category are primarily for majors outside of science. They are especially for those who are not familiar with computers. These courses do not satisfy the computer science course requirement for School of Science majors.

N100 Introduction to Computers and Computing (3 cr.) P or C: MATH 001, M001, or equivalent. No computing experience assumed. How computers work, word processing, spreadsheets, file management, and Internet skills. Emphasis on problem-solving techniques. Lecture and laboratory. Credit given for only one of CSCI N100, CPT 106, or BUS K201.

N199 Introductory Computing Topics (topic varies) (1-3 cr.) Seminars in emerging technologies. May be repeated for credit.

N200-Level Courses

Courses at this level or higher satisfy the computer science course requirement for School of Science majors with the major department's approval (except N241, which counts only as elective credit). They assume some previous use of computers. Consult your faculty advisor before registering. The courses do not fulfill requirements for the computer science major nor the Certificate in Applied Computer Science.

N201 Programming Concepts (3 cr.) Summary of basic computing topics, problem solving techniques, and their application to computing. Introduction to programming concepts with a focus on language-independent principles, such as algorithm design, debugging strategies, essential control structures, and basic data structure concepts. Lecture and laboratory.

N205 Computing for the Paralegal (3 cr.) Summary of basic computing topics, problem solving techniques, and their application to computing. Introduction to software and problem solving methods of special interest to those entering the paralegal profession. Jointly offered with the Continuing Studies Paralegal Program. Lecture and laboratory.

N207 Data Analysis Using Spreadsheets (3 cr.) P: MATH 111. Summary of basic computing topics. An introduction to data analysis using spreadsheets. Emphasis on the application of computational problem-solving techniques. Lecture and laboratory.

N211 Introduction to Databases (3 cr.) Summary of basic computing topics. Introduction to database design concepts, creation of user forms, development of databases, querying techniques, and building reports. Focus on relational database systems from development and administration point of view. Lecture and laboratory.

N241 Fundamentals of Web Development (3 cr.) Introduction to writing content for the Internet and World Wide Web. Emphasis on servers, hand-coded HTML, Cascading Style Sheets, and extending HTML with other Web technologies. Lecture and laboratory.

N299 Survey of Computing Applications (topic varies) (1-3 cr.) An introduction to an emerging technology in the computing field. It will emphasize the various problems technology helps to solve and specific problem-solving strategies. Lecture and laboratory. May be repeated for credit.

N300- and N400-Level Courses

Prerequisite for all N300-level courses: one CSCI course at the N200 level or equivalent. Courses preceded with an asterisk(*) cannot be used as required electives for computer science B.S. majors.

***N301 Fundamental Computer Science Concepts (3 cr.)** P: MATH M118. An introduction to fundamental principles of computer science, including hardware architecture, algorithms, software engineering, and data storage. Lecture and laboratory.

***N305 C Language Programming (3 cr.)** The basics of computer programming concepts using the C programming language. Emphasis on problem solving and algorithm implementation using a universal subset of the C programming language. Lecture and laboratory.

***N307 Introduction to Programming Using Java (3 cr.)** P: N241 or equivalent. Introduction to programming concepts focusing on the Java language. Essential algorithm design, basic program control concepts, essential data concepts, debugging, and testing programs. The course will also include object-oriented programming, creating user interfaces, event handling, and multiplatform programming issues. *This course is primarily for students in the School of Informatics.*

N311 Advanced Database Programming, Oracle (3 cr.) P: N211 or equivalent. Focus on the concepts and skills required for database programming and client server development. Concepts will apply to any modern distributed database management system. Emphasis on developing Oracle SQLPlus scripts, PL/SQL server side programming, and Oracle database architecture. Students with programming experience in ODBC compliant languages will be able to practice connecting such languages to an Oracle database. Lecture and laboratory.

N321 System and Network Administration (3 cr.) P: N301 or equivalent. Fundamental concepts of system administration. Design and administration of network servers and workstations. Focus on basic network concepts, such as user account administration, resource allocation, security issues, and Internet service management. Lecture and laboratory.

***N331 Visual Basic Programming (3 cr.)** An introduction to programming with a focus on rapid application development environments, event-driven programming, and programming in the Windows environment. Course will demonstrate how the major application types (spreadsheets, databases, text editors) are written. Lecture and laboratory.

N335 Advanced Programming, Visual Basic (3 cr.) P: N331 or equivalent. Databases and VB, object-oriented design and practice, the component object model, interobject communication, related RAD environments such as VB for Applications and ActiveX using the Windows API, and generating online help. Lecture and laboratory.

***N341 Introduction to Client-Side Web Programming (3 cr.)** P: N241 or equivalent. Introduction to programming with a focus on the client-side programming environment. Programming using languages commonly embedded in Web browsers. Lecture and laboratory.

N342 Server-Side Programming for the Web (3 cr.) P: N341. Designing and building applications on a Web server. Focuses on the issues of programming applied to Web servers. Emphasis on relational database concepts, data design, languages used on the server, transaction handling, and integration of data into Web applications.

N343 Object-Oriented Programming for the Web (3 cr.) P: N341 or N307. Algorithm design and development within the object-oriented paradigm. Students will utilize Java to create Web-based application software with strong user interaction and graphics. In addition, students will utilize Oracle and SQL to learn introductory database design principles, coupling backend database operation to application software. Lecture and laboratory.

N345 Advanced Programming, Java (3 cr.) P: N307 or N331 or N341 or equivalent. A Java language course designed for students familiar with programming and the World Wide Web. Focus on the unique aspects of Java, Applet, and GUI design, object-oriented programming, event-handling, multithreaded applications, animation, and network programming. Lecture and laboratory.

N351 Introduction to Multimedia Programming (3 cr.) An integration of computing concepts and multimedia development tools. An introduction to the science behind multimedia (compression algorithms and digital/audio conversion). Use of authoring tools to create compositions of images, sounds, and video. Special emphasis given to using the Web as a multimedia presentation environment. Lecture and laboratory.

***N355 Introduction to Virtual Reality (3 cr.)** Explore concepts of 3D imaging and design including primitive shapes, transformations, extrusions, face sets, texture mapping, shading, and scripting. Lecture and laboratory.

***N361 Fundamentals of Software Project Management (3 cr.)** P: N300-level programming class or consent of instructor. Tools and techniques used to manage software projects to successful completion. Problem-solving focus to learn specification development and management, program success metrics, UML modeling techniques, code design and review, principles, testing procedures, usability measures, release and revision processes, and project archival. Lecture and laboratory.

N399 Topics in Computing (topic varies) (1-3 cr.) P: N200-level course or equivalent. An investigation of an emerging language or topic in computing. May be repeated for credit.

N431 E-Commerce with ASP.NET (3 cr.) P: N331 or equivalent. Topics include basic Web controls, form validation, connecting to an Enterprise-level database, SSL, and sending e-mail within an ASP.NET Web page. A significant software development final project creating a functional Web store is featured. Lecture and laboratory.

N435 Data Management Best Practices with ADO.NET (3 cr.) P: N331 or equivalent. A study of managing data in the .NET environment. Focus on strategies to efficiently manage data for large-scale projects. Topics include XML, DataSets, SQL, and error management. Lecture and laboratory.

N443 XML Programming (3 cr.) P: N241 and an N300-level programming course. Fundamentals of XML programming language. After mastering fundamental XML scripting syntax, the course focuses on narrative-centric and data-centric XML applications. Narrative content includes CSS, DTD and XSLT, and X-path, -link, and -pointer tools; data-centric content includes the DOM, Schemas, and ADO/ASP. A required masterpiece project summarizes course competencies. Lecture and laboratory.

N451 Web Game Development (3 cr.) Study of basic game development principles with a focus on client-side Web delivers. Topics to include creation of sprite objects, user interaction concepts, basic intelligence concepts, game data structures, and basic game physics. Lecture and laboratory.

N461 Software Engineering for Applied Computer Science (3cr.) P: N361 or consent of the instructor. This is a survey course covering software engineering concepts, tools, techniques, and methodologies. The topics covered include software engineering, software process and its difficulties, software lifecycle models, project planning including cost estimation, design methodologies including structured design, data structure-oriented design, object-oriented design, and software testing. This course is intended for nonmajors and credit will not be awarded to computer science majors.

***N485 Capstone Project in Applied Computing (3 cr.)** P: N301 and N341. This course provides students with a mechanism for producing and integrating technical achievement meritorious of program culmination. The project will demonstrate subject matter mastery within project development guidelines and reflect both a breadth and depth of technically focused problem-solving skills.

N499 Topics in Applied Computing (topic varies) (1-3 cr.) P: N300-level course or equivalent. An investigation and examination of an emerging discipline in applied computer science.

Courses for Majors

230 Computing I (4 cr.) P or C: MATH 221 or MATH 163. The context of computing in history and society, information representation in digital computers, introduction to programming in a modern high-level language, introduction to algorithm and data structures, their implementation as programs.

240 Computing II (4 cr.) P: 230. Continues the introduction of programming began in CSCI 230, with particular focus on the ideas of data abstraction and object-oriented programming. Topics include programming paradigms, principle of language design, object-oriented programming, programming and debugging tools, documentation, recursion, linked data structures, and introduction to language translation.

242 Computing II for Engineers (2 cr.) Overview of fundamentals of operating systems; introduction to programming languages, file organization, and database concepts.

265 Advanced Programming (3 cr.) P or C: ECE 264 and CSCI 242 or CSCI 230. Spring. Learn advanced programming skills and concepts. Introduction to software engineering: problem specification and program design with emphasis onobject-oriented programming, programming style, debugging, and documentation. A significant software project's required. (This course is for computer engineering and computer information systems majors.)

300 Systems Programming (3 cr.) P or C: 230 and 240. Fall. Assembly language programming and structure of a simple and a typical computer. Pseudo operations, address structure, subroutines, and macros. File I/O and buffering techniques. Interfacing with high-level languages. Assemblers: one- and two-pass assemblers, system dependent and independent assembler features, and design options. Loaders, linkers, and macro processors.

340 Discrete Computational Structures (3 cr.) P: 240 and MATH 221 or MATH 163. Fall. Theory and application of discrete mathematics structures and their relationship to computer science. Topics include mathematical logic, sets, relations, functions, permutations, combinatorics, graphs, Boolean algebra, digital logic, recurrence relations, and finite-state automata.

355 Introduction to Programming Languages (3 cr.) P: 240 and 340. Spring. Programming language concepts and different paradigms of programming. Topics include syntax and semantics of high-level languages, parsing methods, subprograms and their implementation, data abstraction, language translation overview including lexical analysis, syntax-directed translation, symbol table handling, code generation, functional programming, logic programming, and object-oriented programming.

362 Data Structures (3 cr.) P: 240 and 340. Spring. A study of the design and analysis of data structures and algorithms. Abstract data types: arrays, stacks, queues, lists, trees, and graphs. Algorithms: sorting, searching, and hashing. File structures: organization and access methods.

402 Architecture of Computers (3 cr.) P: 340. Fall. Basic logic design. Storage systems. Processor organization: instruction formats, addressing modes, subroutines, hardware and microprogramming implementation. Computer arithmetic, fixed and floating point operations. Properties of I/O devices and their controllers. Interrupt structure. Virtual memory structure, cache memory. Examination of architectures such as microcomputers, minicomputers, and vector and array processors.

403 Introduction to Operating Systems (3 cr.) P: 362, and 402. Spring. Operating system concepts; history, evolution and philosophy of operating systems. Concurrent processes, process coordination and synchronization, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage and file management, device management, security and protection, networking, and distributed and real-time systems.

414 Numerical Methods (MATH 414) (3 cr.) P: MATH 262 or MATH 351. Fall. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, and numerical solution of ordinary differential equations. Not open to students with credit in 512.

432 Security in Computers (3 cr.) P:403. An introduction to computing security to include cryptography, identity and authentication, software security, operatiing system security, trusted operating system design and evaluation, network threats and defenses, security management, legal aspects of security, privacy and ethics.

435 Multimedia Information Systems (3 cr.) P or C: CSCI 362, MATH 351/511. Multimedia inforamtion systems concepts, evolution of multimedia information systems, media and supporting device commonly associated, image databases, techniques for presenting visual information, video databases, multimodels, audio databases, text databases, and multimedia information systems architecture.

436 Principles of Computer Networking (3 cr.) P: CSCI 362. Survey of underlying principles, fundamental problems, and their solutions in designing computer networks. Laboratory projects include using network systems and network simulation environments. Topics include: motivations, networking topologies, layered open systems protocols, transmission capacity, circuit and packet switching, packet framing and error correction, routing, flow and congestion control, and internetworking.

437 Introduction to Computer Graphics (3 cr.) P: 362 and MATH 351/511. An introduction to 3D programming with emphasis on game engine development using 3D graphics techniques and the standard and platform independent OpenGL library. Topics include lighting, shading, texture mapping, coordinate systems and transformations, collision detection, 3D geometric and physically based modeling and animation.

438 Advanced Game Development (3 cr.) P: 437. Advanced game design and development principles and technologies. Students will gain practical experience through extensive game development project. Topics include character animation, special effects, user interface design, networking for computer games, game engine components and variations, game performance considerations, artificial intelligence, and ethics in computer games.

441 Client-Server Database Systems (3 cr.) P or C: CSCI 362. Database system concepts, data models database design, CASE tools, SQL, query processing and query optimization, transaction processing, reliability and security issues, database interactions on the World Wide Web.

443 Database Systems (3 cr.) P: 362. Fall. Relational database systems: architecture, theory, and application. Relational data structure, integrity rules, mathematical description, data manipulation. Standard SQL and its data manipulation language, engineering aspects of database design in industry, introduction to nonrelational database systems.

446 Introduction to Microprocessor Architecture (3 cr.) P: 402. Introduction to programmable logic; elements of microprocessor system design; interrupt structures; interfacing using LSI devices; hardware timers; interactive debugging; physical device I/O programming; vectored and polled service; microprocessor architecture; and self-paced laboratory using A/D converters, D/A converters, etc.

448 Biometric Computing (3 cr.) P: CSCI 362 and STAT 416 or STAT 511. Biometrics is capturing and using physiological and behavioral characteristics for personal identification. It is set to become the successor to the PIN. This course will introduce computational methods for the implementation of various biometric technologies including face and voice recognition, fingerprint and iris identification, and DNA matching.

450 Principles of Software Engineering (3 cr.) P: CSCI 362. Fall. Tools and techniques used in software development. Lifecycle concepts applied to program specification, development, and maintenance. Topics include overall design principles in software development; the use of structured programming techniques in writing large programs; formal methods of program verification; and techniques and software tools for program testing, maintenance, and documentation. *A primary goal of this course is to provide experience in team development of software.*

452 Object-Oriented Analysis and Design (3 cr.) P: CSCI 362. Spring. Introduction to the object-oriented paradigm in software development. Basic concepts: objects, classes, messaging, inheritance, and methodologies. Analysis: defining objects, structures, attributes, and services. Design: transforming the analytic model into the design model. Implementation: comparison of the support features provided by languages such as Smalltalk, C++, Eiffel, and CLOS. A significant design project is required.

463 Analysis of Algorithms (3 cr.) P: 362. Techniques for analyzing and comparing algorithms. Average case analysis in sorting and searching; dynamic programming: greedy algorithms, amortized analysis, and applications; matrix algorithms: polynomials, discrete Fourier transforms, and fast Fourier transforms, parallel algorithms: examples in sorting, searching, graphs, and matrices, computational complexity, polynomial complexity classes P, NP.

470 Automata and Formal Languages (3 cr.) P: 362. Fall. Introduction to formal languages and automata theory: finite automata and regular expressions, context-free grammars and languages, pushdown automata, equivalence of CFGs and pushdown automata, application of pushdown automata in parsing, closure properties, pumping lemmas, decision procedures, Turing machines, computability, undecidability, and a brief survey of the Chomsky hierarchy.

475 Scientific Computing I (3 cr.) P: 230 and MATH 351. P or C: MATH 262. Fall. Solving scientific problems on computers. Languages for scientific computing. Software development on workstations: using tools the environment provides, organization of programs. Computer architecture: impact on software and algorithms. Problem formulation: model selection/ simplification, relationship to numerical methods. Solution of linear equations: methods and packages. Nonlinear equations and optimization problems.

476 Scientific Computing II (3 cr.) P: 475. Spring. Elementary statistical computing: time series analysis, model fitting, robust methods, generation of pseudorandom numbers, and Monte Carlo methods. Interpolation and curve fitting; numerical integration. Solving ordinary differential equations. Use of packaged environments and symbolic computation for scientific purposes.

477 High Performance Computing (3 cr.) P: 476. Fall. Architecture of supercomputers: pipelined, vector, SIMD, MIMD; implications for algorithm and program design; and vectorization, parallelization, loop restructuring, and nonstandard language features. Splitting computation between supercomputers and workstations; interactive analysis of remote machines' output. Numerical methods for large-scale problems: examples from continuum mechanics, graphical visualization, and statistical computing. A project is required.

481 Data Mining (3 cr.) P or C: 240, MATH 351/ 511, STAT 511/416. An introduction to data warehousing and OLAP technology for data mining, data processing, languages and systems, and descriptive data mining: characterization and comparison, association analysis classification and predication, cluster analysis mining complex types of data, application, and trends in data mining.

485 Expert System Design (3 cr.) P: 362. Overview of artificial intelligence; expert system technology; early expert systems: MYCIN, DENDRAL; theoretical foundations, uncertainty measures, knowledge representation, inference engines; reasoning mechanisms: forward and backward chaining; and explanation systems, expert system shells, tools, and intelligent hybrid systems.

487 Artificial Intelligence (3 cr.) P: 362. Study of key concepts and applications of artificial intelligence. Problem-solving methods, state space search, heuristic search, knowledge representation: predicate logic, resolution, natural deduction, nonmonotonic reasoning, semantic networks, conceptual dependency, frames, scripts, and statistical reasoning; advanced AI topics in game playing, planning, learning, and connectionist models.

490 Topics in Computer Sciences for Undergraduates (1-5 cr.) By arrangement. Fall, spring, summer. Supervised reading and reports in various fields. Open to students only with the consent of the department.

495 Explorations in Applied Computing (1-6 cr.) Fall, spring, summer. Explorations in Applied Computing is an undergraduate capstone experience. Students will work in teams, advised by faculty and external liaisons, to solve real-world computing problems. This hands-on experience will cultivate technical expertise, utilization of analytical thinking, quantitative reasoning, project management skills, and communication skills.

Advanced Undergraduate and Graduate Level

These courses require admission to the graduate program or permission of the department.

502 Compiling and Programming Systems (3 cr.) P: 300. R: 470. Fall. Basic principles of compilers and compiler design; control of translation, loading, and execution; symbolic coding systems; lexical and syntactic analysis; design and operation of assemblers and macroprocessors; and design of interpretive systems. Students are expected to complete a large programming project as part of the course.

503 Operating Systems (3 cr.) P: 403. Spring. Basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, and mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, and access control; file systems; resource management; and evaluation and prediction of performance.

504 Concepts in Computer Organization (3 cr.) P: 402.The fundamentals of computer hardware for computer scientists. An overview of the organization of modern computers, ranging from sequential to advanced machines. CISC, RISC, and vector processors; multiprocessors; virtual storage, hierarchical memory; interaction with O/S; connection models; high-level programming support; and cost/performance analysis.

506 Management of the Software Development Process (3 cr.) A survey of the fundamental principles and concepts of managing a software project. Topics include life cycle models, standards and goals, cost estimation, risk analysis, tool use, component reuse, traceability, metrics, and process control and improvement. Students are required to apply management concepts using a project-based approach.

507 Object-Oriented Design and Programming (3 cr.) An advanced exploration of the object-oriented model and programming. Topics range from a review of the object model to advanced concepts such as abstraction mechanisms, standard library/packages, OO design using an OO language, and the syntax and the semantics of constructs.

512 Numerical Methods for Engineers and Scientists (3 cr.) P: MATH 351 or MATH 511; MATH 510; and knowledge of programming. Not open to students with credit in 414. Not normally accepted for graduate credit in computer science programs. A survey of the useful methods of computation. Solution of nonlinear equations and systems of nonlinear equations. Numerical methods for systems of linear equations. Approximate differentiation and integration. Numerical solution of ordinary differential equations. Introduction to partial differential equations and elementary approximation methods.

514 Numerical Analysis (3 cr.) P: 414 or equivalent. Iterative methods for solving nonlinear equations, linear difference equations, applications to solution of polynomial equations, differentiation and integration formulas, numerical solution of ordinary differential equations, and round-off error bounds.

515 Numerical Analysis of Linear Systems (3 cr.) P: knowledge of programming, and MATH 351 or MATH 511. Computational aspects of linear algebra; linear equations and matrices; direct and iterative methods; eigenvalues and eigenvectors of matrices; error analysis.

516 Computational Methods in Applied Mathematics (3 cr.) P: 265 and MATH 510 or consent of instructor. A study of techniques such as direct integration, shooting, finite difference, finite elements, method of weighted residuals, and methods of characteristics for solving problems in fluid mechanics, solid mechanics, dynamics, and other fields of applied mathematics.

520 Computational Methods in Analysis (3 cr.) P: 230 or equivalent, and MATH 351 or MATH 511. A treatment of numerical algorithms for solving classical problems in real analysis with primary emphasis on linear and nonlinear systems of equations and on optimization problems; the writing, testing, and comparison of numerical software for solving such problems; and a discussion of the characteristics of quality software for implementing these algorithms.

536 Data Communication and Computer Networks (3 cr.) P: 402. Data communications: communication hardware technologies including local area and long-haul network hardware, circuit and packet switching, interfaces between computer and network hardware, and performance issues. Network architecture: protocol software and conceptual layering, reliable delivery over an unreliable channel, transport protocols, virtual circuits, datagrams, Internet working as a fundamental design concept, the client-server paradigm, naming and name binding, name servers, addressing and address resolution, routing and routing algorithms, congestion and flow control techniques, network file systems, distribution of computation, and DARPA Internet protocols (TCP/IP) as examples of protocol organization.

537 Introduction to Distributed Computing (3 cr.) P: 503 and 536. Introduction to the principles and methods in the design of distributed computing systems. It covers the fundamentals of distributed computing from four perspectives: underlying communication media, protocols and their implications; operating system issues; high-level language constructs; and distributed algorithms.

***538 The Design of Interactive Systems (3 cr.)** Fundamental concepts and tools employed in designing the interaction between humans and machines and the mediating interfaces. Topics include: design problem, interface design concepts, experimental design and analysis, cognitive and predictive models, the design project, case studies, and applications.

***539 Computing with Distributed Objects (3 cr.)** An introductory treatment of the distributed-object model and programming. The topics range from a review of the distributed and object models of computation to advanced concepts such as remote method invocations, object brokers, object services, open systems, and future trends for distributed-object systems.

541 Database Systems (3 cr.) P: 443 or equivalent. Spring. Fundamentals for the logical design of database systems. The entity-relationship model, semantic model, relational model, hierarchical model, network model. Implementations of the models. Design theory for relational databases. Design of query languages and the use of semantics for query optimization. Design and verification of integrity assertions, and security. Introduction to intelligent query processing and database machines.

543 Introduction to Simulation and Modeling of Computer Systems (3 cr.) P: 265 and STAT 511 or equivalent. Simulation: discrete event simulation, process-oriented simulation, generating random numbers, simulation languages, simulation examples of complex systems. Nondeterministic models: random variables, Poisson process, moment generating functions, statistical inference, and data analysis. Modeling: elementary queuing models, network of queues, and applications to performance evaluation of computer systems.

547 Information Storage and Retrieval and Natural Language Processing (3 cr.) P: 541. Complex data structures of fields within records, as well as clustered, multilist, and inverted files; key decoding by tree and randomized techniques; overall techniques of classical document retrieval systems, e.g., the MEDLARS and NASA systems; overall techniques of automatic document retrieval systems, e.g., TIP and SMART, the internal structure of SMART; question answering systems; and natural language translation.

548 Introduction to Bioinformatics (3 cr.) P: 340, BIOL K483, CHEM C483, or MATH 511. Analysis of biological data employing various computational methods to obtain useful information in the emerging area of bioinformatics. Topics include structures, functions and evolution of proteins and nucleic acids, retrieval and interpretation of bioinformation from the Internet, learning principles, algorithms and software for sequence alignment, similarity search of sequence databases, estimation of phylogenetic trees, structural prediction, and functional inference.

549 Intelligent Systems (3 cr.) This course will discuss problems in the area of intelligent systems. Topics include the formalisms within which these problems are studied, the computational methods that have been proposed for their solution, and the real-world technological systems to which these methods have been applied.

550 Computer Graphics (3 cr.) An introduction to computer graphics. Topics include the concepts, principles, algorithms, and programming techniques in 3D interactive computer graphics. Emphasis is on the development and applications of 3D graphic algorithms and methods.

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*Course pending approval.

552 Advanced Graphics and Visualization (3 cr.) P: 550. An introduction to data visualization methods and tools, and related graphics techniques. Students will explore a variety of data representation and modeling techniques, their corresponding visualization algorithms, and practical visualization applications in scientific, engineering, and biomedical fields.

556 Fault-Tolerant Computing (3 cr.) P: 362. Concepts of fault-tolerant computing; phases of fault-tolerance; applications to commercial, communication, and aerospace systems; fault-tolerance in multiprocessor systems; diagnosis techniques; software fault-tolerance.

565 Programming Languages (3 cr.) P: 300. R: 470. Fall. An exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; abstract data types; axiomatic semantics using Hoare's logic and Dijkstra's predicate transformers; denotational semantics; functional, object-oriented, and logic programming; concurrency and Owicki-Gries theory. Example languages include ML, Ada, Oberon, LISP, PROLOG, and CSP.

580 Algorithm Design, Analysis, and Implementation (3 cr.) P: 463 and 470. Basic techniques for designing and analyzing algorithms: dynamic programming, divide-and-conquer, balancing, upper and lower bounds on time and space costs, worst case and expected cost measures. A selection of applications such as disjoint set union/find, graph algorithms, search trees, pattern matching. The polynomial complexity classes P, NP, and co-NP; intractable problems.

582 Automata and Formal Languages (3 cr.) P: 470. Spring. Finite automata, regular expressions; push-down automata, context-free grammars; and languages and behaviors. Closure properties, pumping lemmas, and decision procedures. Deterministic context-free languages and LR(k) parsing; brief survey of the Chomsky hierarchy.

585 Mathematical Logic I (MATH 585) (3 cr.) Students should register for MATH 585. P: MATH 351. Formal theories for propositional and predicate calculus with study of models, completeness, and compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

590 Topics in Computer Science (3 cr.) By arrangement. Fall, spring. Directed study for students who wish to undertake individual reading and study on approved topics.

Graduate Level

614 Numerical Solution of Ordinary Differential Equations (3 cr.) P: 514. Numerical solution of initial-value problems by Runge-Kutta methods, general one-step methods, and multistep methods. Analysis of truncation error, discretization error, and rounding error. Stability of multistep methods. Numerical solution of boundary-value and eigenvalue problems by initial-value techniques and finite difference methods.

615 Numerical Solution of Partial Differential Equations (3 cr.) P: 515 and MATH 523. The numerical solution of hyperbolic, parabolic, and elliptic equations by finite difference methods; iterative methods (Gauss-Seidel, overrelaxation, alternating direction) for solving elliptic equations; discretization and round-off errors; explicit and implicit methods for parabolic and hyperbolic systems; the method of characteristics; the concept of stability for initial value problems.

660 Design of Translating Systems (3 cr.) P: 502. Systems design of higher-level programming languages and their processors; symbol tables, lexical scan, syntax scan, object code generation and optimization; boot-strapping techniques, higher-level translators, self-compilers, and decompilers; and heuristic generators.

661 Formal Compiling Methods (3 cr.) P: 502. Application of concepts developed in formal language and automata theory to the design of programming languages and their processors. Models of syntactic analysis, including canonical precedence, LR(k) and LL(k) parsing methods and variants; efficiency of each. Synthesis techniques, including symbol tables, storage administration, parameter mechanisms, garbage collection; optimization considerations. Models of synthesis, including level, affix, attributed grammars; prospects of fully automating compiler design. Applicative vs. procedural languages and their implementations based on semantic definition of a language (LISP, Lucid) and on proof-like techniques (PROLOG, equational systems); merits of such approaches.

695 M.S. Project (1-9 cr., maximum of 6 credit hours apply to degree) P: consent of instructor. The student integrates and applies the knowledge gained from the formal course work to formulate and execute a solution to a problem of practical importance. The faculty advisor and the sponsoring organization mentor, if applicable, provide guidance and evaluation.

698 Research M.S. Thesis (1-18 cr.)

Environmental Science Program

Environmental science is an interdisciplinary field of study that investigates questions related to the human population, natural resources, and environmental management. It includes the study of the interrelationships in the modern environment of humans and natural phenomena and focuses on important modern concerns, like how our global climate is changing and how that change may affect human activities, how to maintain and improve vital natural resources like drinking water, and how to manage and balance the quality of the environment in the face of improving the quality of life in the United States and abroad.

The Bachelor of Science in Environmental Science is an interdisciplinary degree within the School of Science that is offered in partnership with the School of Public and Environmental Affairs and the School of Liberal Arts. Additional environmental programs are offered in the Schools of Science, Public and Environmental Affairs, and Liberal Arts. The Department of Geology offers both the Bachelor of Arts and Bachelor of Science degrees in Geology with opportunities to study environmental problems. The School of Public and Environmental Affairs offers the Bachelor of Science in Public Health degree with a major in Environmental Science and Health. The School of Liberal Arts offers the Bachelor of Arts degree in Geography and a variety of environmentally focused courses in various disciplines. See program listings in each school for additional information or speak with the program advisor for information about different environmental degrees.

Bachelor of Science in Environmental Science

IUPUI
Engineering, Science, and Technology Building, SL 118
723 W. Michigan Street
Indianapolis, IN 46202-5132
Phone: (317) 274-7484; fax: (317) 274-7966
www.environmentalscience.iupui.edu

Participating Faculty

Professors Filippelli, Lindsey, McSwane, Ottensmen, Siegel

Associate Professors Brothers, Dwyer, Ritchie, Tedesco, Wilson

Assistant Professors Jacinthe, Licht, Lin, Swope, P. Vidon, Wang, Yamada

Lecturers Thomas, E. Vidon

Associate Faculty Cantwell, Hlavek, Holm, Magoun, Thompson

Program Director Tedesco *(Science, Geology)*

Academic Advisors Tedesco *(Science, Geology)*, Ritchie *(SPEA)*, Wilson *(Liberal Arts, Geography)*

The Bachelor of Science of Environmental Science (B.S.E.S.) degree is awarded by Indiana University. This program prepares students for graduate studies and for a variety of careers with emphasis on investigation of the environment by federal and state agencies, industry, and consulting firms. The program allows flexibility to accommodate the needs and interests of all students. There are three Environmental Science Concentrations within the Bachelor of Science of Environmental Science Program. Selection of a particular concentration should be made in consultation with the program advisor.

Earth and Water Resources

Understanding interactions between land, soil, and water is critical to ensuring environmental quality. The Earth and Water Resources concentration provides students with a quantitative background in soils, hydrogeology, and biogeochemistry and an understanding of biological interactions, processes affecting soil and water resources, and advanced analytical techniques related to environmental quality assessments. Students can pursue detailed course work in either the Water or Earth options of this concentration and are prepared for continued advanced study or careers in government, industry, and environmental consulting.

Environmental Management

The Environmental Management concentration prepares students who wish to focus on the management of pollution in the air, land, and water. Students who complete this concentration have the theoretical foundation and applied skills needed to characterize hazards, track the fate and transport of pollutants, identify health and environmental effects of pollutants, and plan and manage programs to control environmental hazards. The required courses in the concentration focus on identification and solving multimedia problems in solid and hazardous waste, water quality and wastewater treatment, and air quality in the outdoors, inside homes, or in industrial workplaces. The options allow students to focus more specifically on the assessment of pollution, policy and planning, or occupational safety and health. Students are prepared for careers in government, industry, and nonprofit agencies.

Environmental Remote Sensing and Spatial Analysis

Spatial information technologies provide important tools for measurement, analysis, and modeling of environmental systems and their dynamic interaction with human impacts. The Environmental Remote Sensing and Spatial Analysis concentration builds theoretical background and advanced knowledge in spatial analytical techniques using remote sensing (satellite and airborne sensors), geographic information system (GIS), and global positioning system (GPS) technologies. The concentration emphasizes integration of these technologies and their applications to problems of environmental modeling and analysis.

Research Areas

Faculty and students in the Departments of Geology (Science), Geography (Liberal Arts), and the School of Public and Environmental Affairs are actively engaged in basic and applied research. Specific research areas include geochemistry, hydrology, paleoclimate, sedimentology, biogeochemical cycles, soils, wetland restoration, water resource analysis, environmental remote sensing, land cover dynamics, urban ecosystems, human health and the environment, environmental and water resources planning, environmental health policy, public health, food science, and indoor air quality.

Centers and Programs

Center for Earth and Environmental Science

The Center for Earth and Environmental Science (CEES) at IUPUI is an interdisciplinary research and outreach center promoting science-based environmental stewardship through research, education, and public service. Research activities at CEES focus on applied urban environmental issues in four core areas: water resource evaluation; wetland ecosystem restoration; the fate and transport of environmental contaminants; and environmental data management, mapping, and visualization.

CEES has developed a network of experimental ecosystem restoration sites throughout central Indiana that are evaluating restoration strategies for riparian and wetland ecosystems and investigating watershed and water quality improvement strategies. CEES is developing an integrated network of remote environmental sensors that are actively monitoring water quality throughout area streams, reservoirs, riparian, and groundwater systems in an effort to support faculty and student research programs, improve our understanding of water resources and provide critical information to support environmental decision-making and water resource management. In partnership with the local water company, CEES is evaluating approaches to maintaining sustainable water resources for central Indiana. Through a long-term research and development program, CEES researchers are working to understand triggers of algal blooms in drinking water reservoirs, evaluate watershed best management approaches to reduce contaminants in source water, develop rapid assessment tools, and assess water supplies.

CEES works with community stakeholder groups to facilitate watershed management programs and provides research and infrastructure support to area environmental consulting firms, nonprofit agencies, and local, state and federal government agencies. CEES is also partnering with area schools, museums, parks and nature centers to develop and support authentic, high quality science education programs for students, and families, and provide instructional support and training for teachers. CEES public service programs are building capacity for service learning in the environmental sciences by providing opportunities for students and the community to engage in hands-on projects that address current environmental issues and improve natural areas in Central Indiana.

For more information, contact:
Center for Earth and Environmental Science
723 W. Michigan Street
Indianapolis, IN 46202
(317) 274-7154
www.cees.iupui.edu

Center for Urban Policy and the Environment

The Center for Urban Policy and the Environment is a nonpartisan, applied research organization in the School of Public and Environmental Affairs at IUPUI. The Center, founded in 1992, is now one of the largest of its kind in the country.

Any social and economic issues that affect quality of life are of interest to Center researchers. Some of the research topics have ranged from community safety and riverboat gambling to neighborhood empowerment, urban development and land use, the economic impact of the arts and sports, and drinking water and sewer infrastructures. With an award of general support from Lilly Endowment, Inc., Center scholars have conducted ongoing studies on Central Indiana. These investigations have helped policy makers understand how investments by households, businesses, governments, and nonprofits have influenced the Central Indiana region.

Center scholars, staff, and graduate student interns typically form project teams and work in partnership with local governments, nonprofit organizations, and private businesses. Over the years, the Center has worked with more than 150 clients and partners. These include the city of Indianapolis, the Indiana Port Commission, Indianapolis-Marion County Public Library, Indiana Gaming Commission, Indiana General Assembly and Office of the Governor, Indianapolis Museum of Art, Indianapolis Neighborhood Housing Partnership, Indiana Land Resources Council, and the Ford Foundation.

For more information, contact:
Center for Urban Policy and the Environment
School of Public and Environmental Affairs
342 N. Senate Avenue, 3rd Floor
Indianapolis, IN 46204-1708
www.urbancenter.iupui.edu

Campus Sustainability Initiative

An interdisciplinary campus coalition, the Campus Sustainability Initiative is spearheading an environmental sustainability program at IUPUI, integrating faculty, staff, and students university-wide. IUPUI administrators, schools and departments are already involved in the research, education, and implementation of sustainability, including renewable energy and fuel cells, environmental research, urban planning, greenways, and green building cons.

For more information, contact:
Center for Earth and Environmental Science
723 W. Michigan Street
Indianapolis, IN 46202
(317) 274-7154
www.cees.iupui.edu

Student Organizations

Environmental Awareness League The mission of the Environmental Awareness League (EAL) is "to promote awareness of environmental issues and to exchange the latest ideas and tools in order to better the future of environmental health." The League promotes service activities (such as river clean-ups and recycling programs), sponsors social activities (such as the hiking, river rafting, IUPUI Carnival in the Courtyard, and IUPUI Student Activities and Volunteer Fair), and offers professional development and networking opportunities (guest speakers and tours to industrial plants).

Green IUPUI Green IUPUI explores issues related to promoting a sustainable society, both at IUPUI and globally. Activities include educational outreach at events on campus and in the City of Indianapolis, as well as opportunities to study energy efficiency, ecological sustainability, and water, earth, and air quality.

Geology Club The Geology Club organizes a number of activities related to learning about earth sciences, including trips to the field and to museums, and informal discussions with faculty on research topics and career possibilities. The Club provides an opportunity to meet and socialize with other students with interests in earth sciences.

Bachelor of Science

(Granted by Indiana University)

Degree Requirements

First Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows in Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I English Composition and Communication Skills (9 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied by ENG W132 or ENG W231. GEOL G205 may partially satisfy the writing requirement in Area I.

Area II Foreign Language No foreign language proficiency is required for the Bachelor of Science degree.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIB Junior/Senior Integrator (3 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin. GEOG G310 and GEOG G315 cannot be utilized as the Junior/Senior Integrator for the Environmental Management Concentration.

Area IIIC Physical and Biological Sciences (33 cr.) BIOL K101/K103, CHEM C105/C106, GEOL G107, G110/G120, PHYS P201/P202. No grade below C– will be accepted in any of these courses.

Area IIID Mathematical Sciences (12 cr.) MATH 221/222; CSCI N207 or another course approved by the program advisor; and SPEA K300, STAT 301, or GEOG G488 or a course in statistics approved by the program advisor. No grade below
C– will be accepted in any of these courses.

Note: Computer Science CSCI N100 level courses and CPT 106 do not count for credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as an elective.

Area IV Major Core and Concentration Requirements

Core Requirements Twenty six (26) credit hours of environmental science core courses including GEOL G221, SPEA H316, SPEA E326, and PHIL P237 in addition to GEOG G303 or GEOL G430; BIOL K341 or GEOG G307; GEOG G338 or GEOG 336; and SPEA H459 or an approved field methods course. No grade below C– will be accepted in any of these courses.

Concentration Requirements Eighteen to nineteen (18 to 19) credit hours of courses within one of three Environmental Science Concentrations. Students select one of the Environmental Science Concentrations – Earth and Water Resources, Environmental Management, or Environmental Remote Sensing and Spatial Analysis.

a. Earth and Water Resources Eighteen (18) credit hours, including:
CHEM C341 Organic Chemistry I
*GEOL G431 Wetlands
*GEOL G586 Soil Biogeochemistry
*GEOL G445 Analytical Methods for Natural Systems *(capstone requirement)*
and

Water Resources option, take the following:
GEOL G451 Principles of Hydrology
SPEA E455 Limnology or SPEA E410 Introduction to Environmental Toxicology

Earth Resources option, take the following:
GEOL G406 Introduction to Geochemistry
BIOL K356 Microbiology or SPEA E410 Introduction to Environmental Toxicology

No grade below C– will be accepted in any of these courses in the Earth and Water Resources concentration.

b. Environmental Management Eighteen to nineteen (18-19) credit hours, including:
CHEM C341 Organic Chemistry I
SPEA E431 Water Supply and Wastewater Management
SPEA E451 Air Pollution and Control
SPEA E452 Solid and Hazardous Waste Management
and

Pollution Assessment option, take the following:
SPEA H433 Industrial Hygiene
SPEA H460 Techniques in Environmental Science and Health *(capstone requirement)*

Policy and Planning option, take the following:
GEOG G438 Advanced Geographic Information Systems
SPEA H416 Environmental Health Policy *(capstone requirement)*

Occupational Safety and Health option, take the following:
SPEA E410 Introduction to Environmental Toxicology
SPEA H433 Industrial Hygiene *(capstone requirement)*

No grade below C– will be accepted in any of these courses in the Environmental Management concentration.

c. Environmental Remote Sensing and Spatial Analysis Eighteen (18) credit hours, including:

1. GEOG G336 Introduction to Remote Sensing and Air Photo Interpretation
   or GEOG 338 Introduction to Geographic Information Systems
2. GEOG G337 Computer Cartography and Graphics
   or INFO I400 Programming for Geographic Information Systems
   or *GEOL G546 Planetary Remote Sensing
3. Three courses chosen from:
   GEOG G436 Advanced Remote Sensing: Digital Imaging Processing
   GEOG G438 Advanced Geographic Information Systems
   *GEOG G442 Seminar in Remote Sensing
   GEOG G488 Applied Spatial Statistics
   *GEOL G436 Geologic Remote Sensing
4. GEOG G439 Seminar in Geographic Information Systems *(capstone requirement)*

No grade below C– will be accepted in any of these courses in the Environmental Remote Sensing and Spatial Analysis concentration.

Other Requirements See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin.

GEOL G445 satisfies the School of Science capstone requirement for the Earth and Water Resources concentration.

SPEA H460 satisfies the School of Science capstone requirement for the Pollution Assessment option of Environmental Management concentration.

SPEA H416 satisfies the School of Science capstone requirement for the Policy and Planning option of Environmental Management concentration.

SPEA H433 satisfies the capstone requirement for the Occupational Safety and Health option of Environmental Management concentration.

GEOG G439 satisfies the capstone requirement for the Environmental Remote Sensing and Spatial Analysis concentration.

Environmental Science Plans of Study

There is no single semester-by-semester plan of study for the B.S.E.S. degree because of the flexibility encouraged within the program and the three concentration options. However, one possible sequence of courses for each concentration is given below. Variations from these sample plans of study should be made in consultation with the program advisor.

Bachelor of Science Environmental Science Sample Program

Earth and Water Resources concentration(122 cr. required)

Degree Requirements

Freshman Year

First Semester	
GEOL G110 Physical Geology	3
GEOL G120 Physical Geology Laboratory	1
CHEM C105 Principles of Chemistry I	3
PHIL P237 Environmental Ethics	3
ENG W131 Elementary Composition I	3
MATH 221 Calculus for Technology I	3
SCI I120 Windows on Science	1
	17

Second Semester	
CHEM C106 Principles of Chemistry II	3
GEOL G107 Environmental Geology	3
MATH 222 Calculus for Technology II	3
COMM R110 Fundamentals of Speech Communication	3
Second Composition Course	3
	15

Sophomore Year

Third Semester	
GEOL G221 Earth Materials	4
BIOL K101 Concepts of Biology I	5
CSCI N207 Data Analysis Using Spreadsheets	3
CHEM C341 Organic Chemistry I	3
HIST H114 History of Western Civilization II	3
	18

Fourth Semester	
BIOL K103 Concepts of Biology II	5
GEOG G338 Introduction to Geographic Information Systems	3
SPEA K300 Statistical Techniques	3
GEOL G430 Principles of Hydrology	3
SPEA H316 Environmental Science and Health	3
	17

Junior Year

Fifth Semester	
PHYS P201 General Physics I	5
SPEA E326 Mathematical Methods in Environmental Science	3
*GEOL G431 Wetlands	3
Comparative World Cultures—List C	3
SPEA H459 Environmental Science and Health Data Analysis	4
	18

Sixth Semester

PHYS P202 General Physics II	5
Humanities—List H	3
*GEOL G586 Soil Biogeochemistry	3
GEOL G451 Principles of Hydrogeology	3
Social Sciences—List S	3
	17

Senior Year

Seventh Semester

SPEA E455 Limnology	3
BIOL K341 Principles of Ecology and Evolution	3
*GEOL G445 Analytical Methods for Natural Systems	3
Electives	3
	12

Eighth Semester

Electives	5
BIOL K411 Global Change Biology (Junior/Senior Integrator)	3
CAND 991 Candidate for Graduation	0
	8

*Represents a new course, pending approval.

Bachelor of Science Environmental Science Sample Program

Environmental Management Concentration (122 cr. required)

Freshman Year

First Semester

GEOL G110 Physical Geology	3
GEOL G120 Physical Geology Laboratory	1
CHEM C105 Principles of Chemistry I	3
PHIL P237 Environmental Ethics	3
ENG W131 Elementary Composition I	3
MATH 221 Calculus for Technology I	3
SCI I120 Windows on Science	1
	17

Second Semester

CHEM C106 Principles of Chemistry II	3
GEOL G107 Environmental Geology	3
MATH 222 Calculus for Technology II	3
COMM R110 Fundamentals of Speech Communication	3
Second Composition Course	3
	15

Sophomore Year

Third Semester

GEOL G221 Earth Materials	4
BIOL K101 Concepts of Biology I	5
CSCI N207 Data Analysis Using Spreadsheets	3
CHEM C341 Organic Chemistry I	3
	15

Fourth Semester

BIOL K103 Concepts of Biology II	5
GEOG G338 Introduction to Geographic Information Systems	3
SPEA K300 Statistical Techniques	3
GEOL G430 Principles of Hydrology	3

SPEA H316 Environmental Science and Health	3
	17

Junior Year

Fifth Semester

PHYS P201 General Physics I	5
SPEA E326 Mathematical Methods in Environmental Science	3
SPEA E451 Air Pollution and Control	3
Comparative World Cultures—List C	3
SPEA H459 Environmental Science and Health Data Analysis	4
	18

Sixth Semester

PHYS P202 General Physics II	5
Humanities—List H	3
SPEA E431 Water Supply and Wastewater Treatment	3
SPEA H460 Techniques in Environmental Science and Health or Elective	3 or 4
Social Sciences—List S	3
	17 or 18

Senior Year

Seventh Semester

SPEA E452 Solid and Hazardous Waste Management	3
BIOL K341 Principles of Ecology and Evolution	3
Junior/Senior Integrator	3
GEOG G438 Advanced Geographic Information Systems or Elective	3
HIST H114 History of Western Civilization II	3
	15

Eighth Semester

SPEA E410 Introduction to Environmental Toxicology or Elective	3
SPEA H416 Environmental Health Policy *(capstone)* or SPEA H433 Industrial Hygiene *(capstone)* or Elective	3
Elective	2
CAND 991 Candidate for Graduation	0
	8

Bachelor of Science Environmental Science Sample Program

Environmental Remote Sensing and Spatial Analysis Concentration (122 cr. required)

Freshman Year

First Semester

GEOL G110 Physical Geology	3
GEOL G120 Physical Geology Laboratory	1
CHEM C105 Principles of Chemistry I	3
PHIL P237 Environmental Ethics	3
ENG W131 Elementary Composition I	3
MATH 221 Calculus for Technology I	3
SCI I120 Windows on Science	1
	17

Second Semester

CHEM C106 Principles of Chemistry II	3
GEOL G107 Environmental Geology	3
MATH 222 Calculus for Technology II	3
COMM R110 Fundamentals of Speech Communication	3

Second Composition Course	3
	15

Sophomore Year

Third Semester

GEOL G221 Earth Materials	4
BIOL K101 Concepts of Biology I	5
CSCI N207 Data Analysis Using Spreadsheets	3
CHEM C341 Organic Chemistry I	3
HIST H114 History of Western Civilization II	3
	18

Fourth Semester

BIOL K103 Concepts of Biology II	5
GEOG G338 Introduction to Geographic Information Systems	3
SPEA K300 Statistical Techniques	3
GEOG 303 Weather and Climate	3
SPEA H316 Environmental Science and Health	3
	17

Junior Year

Fifth Semester

PHYS P201 General Physics I	5
SPEA E326 Mathematical Methods in Environmental Science	3
GEOG 336 Introduction to Remote Sensing	3
SPEA H459 Environmental Science and Health Data Analysis	4
Comparative World Cultures—List C	3
	18

Sixth Semester

PHYS P202 General Physics II	5
Humanities—List H	3
GEOG 488 Applied Spatial Statistics	3
GEOG 337 Computer Cartography and Graphics	3
Social Sciences—List S	3
	17

Senior Year

Seventh Semester

GEOG 436 Advanced Remote Sensing: Digital Image Processing	3
GEOG 307 Biogeography: The Distribution of Life	3
GEOG 438 Advanced Geographic Information Systems	3
Elective	...3
	12

Eighth Semester

Elective	2
GEOG 439 Seminar in Geographic Information Systems *(capstone)*	3
BIOL K411 Global Change Biology *(JR/SR Integrator)*	3
CAND 991 Candidate for Graduation	0
	8

Forensic and Investigative Sciences Program

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Professor Siegel *(Program Director)*

Program Academic Advisor Shea

Forensic science is the application of the methods of science to matters involving the public. In many cases this means the application of science in solving crimes. Forensic science is multidisciplinary; it involves chemistry, biology, physics, math, biochemistry, engineering, computer science, psychology, medicine, law, criminal justice, etc. Forensic scientists analyze evidence and testify in court. They may be called upon to attend some crime scenes, train police investigators and attorneys, and conduct research.

In the fall of 2004, IUPUI began the first forensic science degree program in Indiana. Completion of this program leads to the Bachelor of Science in Forensic and Investigative Sciences (FIS). All students take a core of science classes and university requirements after which each student chooses one of the current eight concentrations:

- Chemistry
- Biology
- Computer Forensics
- Criminal Justice
- Psychology
- Environmental Science and Health Investigations
- Anthropology
- Geology

The program includes courses in imaging and photography, law and forensic science, and laboratory courses in forensic chemistry and biology as well as an opportunity to complete either an internship at a crime laboratory or a research project with a member of faculty. Graduates of the program will be able to seek employment in crime labs, scientific industries, environmental agencies, and federal or local law enforcement.

Admission to the Major

All students who seek admission into this major will be placed into a Pre—FIS status until the requirements listed below are satisfied, at which time the student will be unconditionally admitted into the FIS major.

The specific credit, GPA, and course requirements for admission to the FIS program depend upon the student admission status indicated below.

A. IUPUI student:
Completion of at least 56 credits, including the following courses:
   i. FIS 205
   ii. BIOL K101
   iii. CHEM C105, 125, 106, 126
   iv. MATH 221, 222
   v. SPEA J101

The overall GPA for the 56 credits must be at least 2.5. The cumulative GPA for the specific courses listed above must be at least 2.5.

B. Transfer student:
Completion of at least 56 credits, including the following courses (or acceptable equivalents from other institutions):
   i. FIS 205
   ii. BIOL K101
   iii. CHEM C105, 125, 106, 126
   iv. MATH 221, 222
   v. SPEA J101

The overall GPA for the 56 credits must be at least 2.5. The cumulative GPA for the specific courses listed above (or their equivalent) must be at least 2.5.

C. Student who has already earned a bachelor's degree:
Completion of the following courses (or acceptable equivalents if first degree was taken at another institution):
   i.FIS 205
   ii.BIOL K101
   iii. CHEM C105, 125, 106, 126
   iv. MATH 221, 222
   v. SPEA J101

The overall GPA for the first degree must be at least 3.0. The cumulative GPA for the specific courses listed above (or their equivalent) must be at least 2.5.

Bachelor of Science

This degree is for students who plan to work in thecriminal justice system as a scientist in a crime laboratory or other enforcement environment. Scientific areas include anthropology, biology, chemistry, environmental science, geology, and psychology. Other suitable careers include computer forensics, law, and criminal investigation.

Degree Requirements

See the School of Science requirements under "Undergraduate Programs" in this bulletin for additional restrictions.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Skills (9 cr.)

Written Communication (6 cr.)

A minimum grade of C must be obtained in both composition courses.

ENG W131 English Composition I

The second semester of English composition may be satisfied only by ENG W132 (or ENG W150), ENG W231, or TCM 320.

Oral Communication (3 cr.)

A minimum grade of C must be obtained

COMM R110 Fundamentals of Speech Communication

Area II Foreign Language The School of Science requires no foreign language for a Bachelor of Science degree.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.)

HIST H114 Western Civilization II

Only those courses listed below may be used to satisfy List H and S.

List C course: ANTH A104 Cultural Anthropology *recommended* (or another course from List C)
List H course: PHIL P393 Biomedical Ethics
List S course: PSY B104 Psychology as a Social Science

Area IIIB Junior/Senior Integrator (2 cr.)

LAW D774 or LAW N774 Law and Forensic Science offered through the School of Law

Area IIIC Physical and Biological Sciences

A minimum grade of C must be obtained in all Area IIIC science courses.

Physics Two semesters of basic physics (PHYS P201 and PHYS P202)

Chemistry Two semesters of introductory college chemistry with a laboratory (CHEM C105, CHEM C125 and CHEM C106, CHEM C126).

Area IIID Mathematical Sciences

A minimum grade of C must be obtained in all Area IIID mathematics and computer science courses.

MATH 221, MATH 222, and CSCI N301.

Area IV Major Courses (56 to 60 cr.)

A minimum grade of C must be obtained in all Area IV major courses.

a. Required forensic science courses (18 cr.) FIS 205, FIS 305, FIS 401, FIS 402 and FIS 403.
b. Required biology courses (10 cr.) BIOL K101, BIOL K322, and BIOL K323.
c. Required chemistry courses (10 cr.) CHEM C341, CHEM C343, CHEM C342, and CHEM C344.
d. Required psychology course (3 cr.) PSY B375.
e. Required criminal justice courses (9 cr.) SPEA J101, SPEA J303, and SPEA J320.
f. Required statistics course (3 cr.) STAT 301.
g. Required forensic imaging courses (6 cr.) INFO I250/INFO I251 or INFO I260/INFO I261.
h. Required Capstone Experience (1 to 4 cr.) FIS 490.

Concentrations (10 to 17 cr.)

a. Forensic Chemistry Concentration (10 cr.) CHEM C311, CHEM C325, and CHEM C484.
b. Forensic Biology Concentration (14 cr.) BIOL K324, BIOL K325, BIOL K483, BIOL K484, and BIOL 548.

c. Forensic Computing Concentration (12 cr.) CSCI N311, CSCI N321, CSCI 490 Cyber Crime Analysis, and CSCI 490 Biometric Computing.
d. Criminal Justice Concentration (12 cr.) SPEA J222 Murder in America (or SPEA J272 Terrorism), SPEA J301, SPEA J324, and an approved 3 credit criminal justice elective.
e. Forensic Psychology Concentration (15 cr.) PSY B105, PSY B307, PSY B310, PSY B370 and PSY B380.
f. Environmental Science and Health Investigation Concentration (16 to 17 cr.) Required: SPEA H316, SPEA H459, and SPEA H460. Electives (select 2): GEOG G338, GEOL G451, SPEA V450 (or SPEA E400), SPEA E431, SPEA H431, SPEA E451, or SPEA E452.
g. Forensic Anthropology (15 cr.) ANTH B301, ANTH B370, ANTH B426, ANTH B480, and ANTH P405.
h. Forensic Geology (14 cr.) GEOL G110, GEOL G120, GEOL G221, GEOL G445, and a 3cr. forensic geology course to be determined.

Area V Electives A minimum of 124 credit hours must be completed for graduation. The number of electives required will depend upon the number of credit hours completed for the capstone experience and upon which concentration is selected.

Forensic and Investigative Sciences Sample Plan of Study

Bachelor of Science
(124 cr. required)

Freshman Year

First Semester

CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 221 Calculus for Technology I	3
SPEA J101 American Criminal Justice System	3
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
	15

Second Semester

BIOL K101 Concepts of Biology I	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 222 Calculus for Technology II	3
COMM R110 Fundamentals of Speech Communication	3
	16

Sophomore Year

Third Semester

FIS 205 Concepts of Forensic Science	3
PHYS P201 General Physics I	5
PSY B104 Psychology as a Social Science	3
Second composition course (ENG W132, ENG W231, or TCM 320)	3
HIST H114 Western Civilization II	3
	17

Fourth Semester

CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
PHYS P202 General Physics II	5
CSCI N301 Fundamental Computer Science Concepts	3
SPEA J320 Criminal Investigation	3
	16

Junior Year

Fifth Semester

CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
PSY B375 Psychology and the Law	3
Forensic Imaging Course I (INFO I250 or INFO I260)	3

SPEA J303 Evidence	3
PHIL P393 Biomedical Ethics	3
	17

Sixth Semester

BIOL K322 Genetics and Molecular Biology	3
BIOL K323 Genetics and Molecular Biology Laboratory	2
Forensic Imaging Course II (INFO I251 if INFO I250 or INFO I261 if INFO I260)	3
Concentration course	3
STAT 301 Elementary Statistical Methods	3
ANTH A104 Cultural Anthropology	3
	17

Summer between junior and senior year

LAW D774 or LAW N774 Law and Forensic Science	2

Senior Year

Seventh Semester

FIS 401 Forensic Science with Laboratory I	4
FIS 402 Forensic Science with Laboratory I	4
Concentration course	2-5
Concentration course	3
	13-16

Eighth Semester

FIS 305 Professional Issues in Forensic Science	3
FIS 403 Forensic Science with Laboratory III	4
FIS 490 Capstone in Forensic Science	1
Concentration course/elective	3
Concentration course/elective	3-4
CAND 991 Candidate for Graduation	0
	14-18

The Forensic and Investigative Sciences Program will not grant credit for a course when considerable duplication of course content occurs with another course that has been taken for credit. In general, credit will be allowed for the higher-level course, but not for the lower-level course. The following listings are considered to be duplications (lower-level courses listed first):

MATH 221-222	and	MATH 163-164
PHYS P201-P202	or	218-219 and PHYS 152-251

For example, if a student has earned credit in MATH 163-164, the student will receive no credit for MATH 221-222, even if earned previously.

The Forensic and Investigative Sciences Program will accept a maximum of 15 credit hours toward graduation in courses outside the Schools of Science, Public and Environmental Affairs, Liberal Arts, Business, Engineering (e.g., courses taken in technology, physical education, military science, art, etc.).

As a result of completing a Bachelor of Science in Forensic and Investigative Sciences and depending on the concentration selected, a student may earn enough credit hours to satisfy the requirements for a minor in chemistry or psychology in addition to the major in FIS. Also, a student majoring in FIS, with the selection of additional electives, may also earn minors in other areas (e.g., biology minor, criminal justice general minor, or environmental science and health minor). Please consult with the academic advisor for the FIS program and the appropriate academic unit that awards the minor.

Courses in Forensic and Investigative Sciences (FIS)

Notes: P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered during one or both summer sessions; Day = offered as a daytime section; Night = offered as an evening section.

Undergraduate Level

205 Concepts of Forensic Science (3 cr.) Fall, day, night. An introduction to forensic science and the criminal justice system. Evidence collection and analysis. Forensic chemistry including drugs and trace evidence. Forensic biology including blood splatter, DNA, pathology, entomology, and anthropology. Forensic science and the law.

305 Professional Issues in Forensic Science (3 cr.) P: FIS 205 required. Spring, day. Open only to majors in the FIS program or with consent of the instructor. Ethical issues in forensic science. History, development, and culture of crime laboratories. Expert testimony, quality assurance, and control in a crime lab. Preparing for employment in a forensic science agency; locating jobs and preparing for interviews.

401 Forensic Science I (4 cr., lecture, laboratory) P: FIS 205, CHEM C342, CHEM C344 and open only to majors admitted to the FIS Program. Fall, day. Analysis of forensic chemical and trace evidence including illicit drugs, hairs and fibers, glass and soil, paints and polymers, fire and explosion residues, and fingerprints and document.

402 Forensic Science II (4 cr., lecture, laboratory) P: BIOL K322, and BIOL K323 and open only to majors admitted to the FIS program. Fall, day. Analysis of forensic biological evidence including blood and other bodily fluids. Blood spatter pattern analysis.

403 Forensic Science III (4 cr., lecture, laboratory) P: FIS 401 and FIS 402, and open only to majors admitted to the FIS program. Spring, day. Forensic analysis of DNA evidence.

490 Forensic Science Capstone (1-4 cr.) P: senior standing in FIS Program and program advisor approval. Fall, day, night; Spring, day, night; Summer, day, night. One of the following: Internship at an approved crime laboratory or other organization, library research or laboratory research supervised by an FIS faculty member. Final paper required in all cases.

Department of Geology

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Professor Filippelli (Chair)

Professor Emeritus Mirsky

Associate Professors Barth, Pachut, Rosenberg, Tedesco

Assistant Professors Jacinthe, Licht, Lin, Swope, Vidon

Lecturer Thomas

Adjunct Professors Brothers, Cohen, Ghosh, Kleinhans, Lindsey, Perry, Preer, Robinson, Savarese, Simmel, Souch

Departmental Academic Advisor Barth

Geology is the study of the planet Earth—the materials of which it is made, the processes that act upon these materials, and the history of the planet and life forms since its origin. Geology considers the physical forces acting on the earth, the chemistry of its constituent materials, and the biology of its past inhabitants. Geology also includes the study of the interrelationships in the modern environment of humans and geological phenomena and focuses on such important concerns as how our global climate is changing and how that change will affect human activities.

The Department of Geology offers the Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degrees from Indiana University. These programs prepare students for graduate studies and for a variety of careers with emphasis on investigation of the environment by federal and state agencies, industries, and consulting companies. The programs allow flexibility to accommodate the needs and interests of all students. Selection of a particular program should be made in consultation with a departmental advisor.

The Department of Geology offers graduate study leading to the Master of Science (M.S.) degree granted by Indiana University. The M.S. program offers both thesis and nonthesis options.

Faculty and students of the Department of Geology are actively engaged in basic and applied research. Specific research areas include petrology, geochemistry, glacial geology, paleoclimate, biomineralization, sedimentology, history of geology, and paleontology.

Bachelor of Arts

(Granted by Indiana University)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied by ENG W132 or ENG W231. GEOL G205 may partially satisfy the writing requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.

Area II First-year proficiency in a modern foreign language is required for the Bachelor of Arts degree program. See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIA See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIB See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIC Physical and Biological Sciences See the School of Science requirements under "Undergraduate Programs" in this bulletin, but all four courses must include laboratories; at least two of the four courses must include CHEM C105/ CHEM C125, CHEM C106/CHEM C126; and at least one of the four courses must be in biological sciences. No grade below C– will be accepted in any of these courses.

Area IIID Mathematical Sciences MATH 153-154 or MATH 159 and CSCI N207 or another CSCI course approved by the Department of Geology. No grade below C– will be accepted in any of these courses.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Geology Concentration Requirements 36 credit hours of geology, including G110, G205, G206, G209, G221, G222, G303, G323, G334, and two 300-level or higher geology courses. Other 100-level courses and G300 do not count toward the geology concentration of 36 credit hours, but may be applied as electives toward the university-required total of 122 credit hours. No grade below C– will be accepted in any of these courses.

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin. GEOL G420, G460, or G495 may be used to satisfy the School of Science capstone requirement, upon approval by the Department of Geology. The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts.

Bachelor of Science

(Granted by Indiana University)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with less than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied by ENG W132 or ENG W231. GEOL G205 may partially satisfy the writing requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.

Area II No foreign language proficiency is required.

Area IIIA See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIB See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Area IIIC Physical and Biological Sciences CHEM C105/CHEM C125, CHEM C106/CHEM C126; PHYS P201-PHYS P202 or PHYS 152-PHYS 251; and two courses in biological sciences, with the Department of Geology's approval. No grade below C– will be accepted in any of these courses.

Area IIID Mathematical Sciences MATH 163-164; CSCI N207 or another CSCI course approved by the Department of Geology; and one course in statistics approved by the Department of Geology. No grade below C– will be accepted in any of these courses.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Geology Concentration Requirements 39 credit hours of geology, including G110, G205, G206, G209, G221, G222, G303, G323, G334, two 300-level or higher geology courses, and a field camp of at least 3 credit hours approved by the faculty of the Department of Geology. Other 100-level courses and G300 do not count toward the geology concentration requirement of 39 credit hours, but may be applied as electives toward the university-required total of 122 credit hours. No grade below
C– will be accepted in any of these courses.

General Two science courses at the 300-400 level approved by the Department of Geology. No grade below C– will be accepted in any of these courses.

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements" in this bulletin. GEOL G420, G460, or G495 may be used to satisfy the School of Science capstone requirement, upon approval by the Department of Geology. The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts.

Minor in Geology

(Granted by Indiana University)

The undergraduate minor in geology requires 18 credit hours of courses, with an overall grade point average of 2.0 (C) and with no grade less than a C–, distributed as follows:

1. Students must complete the following five courses that total 12 credit hours: G110 (3 cr.), G130 (1 cr.), G206 (1 cr.), G209 (3 cr.), and G221 (4 cr.).
2. Students must complete an additional 6 credit hours minimum, including two of the following courses: G222 (4 cr.), G304 (3 cr.), G334 (4 cr.), G406 (3 cr.), G415 (3 cr.), G430 (4 cr.), and G451 (3 cr.).

At least 9 credit hours of the minor must be taken at IUPUI. In addition, recommended courses include one year of college chemistry and at least one course in college algebra.

Geology Plans of Study

There is no single semester-by-semester plan of studyfor either the B.A. or B.S. degree because of the flexibility encouraged within the program. However, one possible sequence of courses for each degree is given below; variations from these sample plans of study should be made in consultation with a departmental advisor.

Bachelor of Arts Sample Program (122 cr. required)

Freshman Year

First Semester

GEOL G110 Physical Geology	3
GEOL G206 Advanced Physical Geology Laboratory	1
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
ENG W131 Elementary Composition I	3
MATH 153 Algebra and Trigonometry I	3
SCI I120 Windows on Science	1
	16

Second Semester

CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 154 Algebra and Trigonometry II	3
COMM R110 Fundamentals of Speech Communication	3
Second composition course	3
	14

Sophomore Year

Third Semester

GEOL G209 History of the Earth	3
GEOL G221 Earth Materials	4
BIOL N107 Exploring the World of Animals	4
CSCI N207 Data Analysis Using Spreadsheets	3
HIST H114 History of Western Civilization II	3
	17

Fourth Semester

GEOL G205 Reporting Skills in Geoscience	3
GEOL G222 Introductory Petrology	4
BIOL K101 Concepts of Biology I	5
Social Sciences—List S	3
	15

Junior Year

Fifth Semester

GEOL G303 Geologic Mapping and Field Methods	4
GEOL G334 Principles of Sedimentation and Stratigraphy	4
Comparative World Cultures—List C	3
Junior/Senior Integrator	3
Elective	3
	17

Sixth Semester

GEOL G323 Structural Geology	4
Humanities—List H	3
Elective	3
Elective	3
Elective	3
	16

Senior Year

Seventh Semester

GEOL G400-level electives	6
300-level elective	3
Elective	3
Elective	3
	15

Eighth Semester

300-level Electives	9
Elective	3
CAND 991 Candidate for Graduation	0
	12

Bachelor of Science Sample Program (122 cr. required)

Freshman Year

First Semester

GEOL G110 Physical Geology	3
GEOL G206 Advanced Physical Geology Laboratory	1
ENG W131 Elementary Composition I	3
MATH 163 Integrated Calculus and Analytic Geometry I	5
CSCI N207 Data Analysis Using Spreadsheets	3
SCI I120 Windows on Science	1
	16

Second Semester

COMM R110 Fundamentals of Speech Communication	3
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
Second composition course	3
	16

Sophomore Year

Third Semester

GEOL G209 History of the Earth	3
GEOL G221 Earth Materials	4
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
PHYS P201 General Physics I	5
	17

Fourth Semester

GEOL G205 Reporting Skills in Geoscience	3
GEOL G222 Introductory Petrology	4
BIOL K101 Concepts of Biology I	5
PHYS P202 General Physics II	5
	17

Junior Year

Fifth Semester

GEOL G303 Geologic Mapping and Field Methods	4
GEOL G334 Principles of Sedimentation and Stratigraphy	4
BIOL K103 Concepts of Biology II	5
HIST H114 History of Western Civilization II	3
	16

Sixth Semester

GEOL G323 Structural Geology	4
STAT 301 Elementary Statistical Methods I	3

300-400-level Non-geology Science Elective	3
Social Sciences—List S	3
Elective	3
	16

Senior Year

Seventh Semester

GEOL G400-level electives	6
Comparative World Cultures—List C	3
Humanities—List H	3
	12

Eighth Semester

Field Course	3
300-400-level Non-geology science elective	3
Junior/Senior Integrator	3
Elective	3
CAND 991 Candidate for Graduation	0
	12

Master of Science

The Department of Geology graduate program leads to a Master of Science degree from Indiana University. The program is administered by a departmental graduate advisory committee, composed of the graduate advisor and two or more members of the graduate faculty.

Admission Requirements

Prospective students should have a bachelor's degree in geology, including a summer field course, and a minimum of a B (3.0) average in geology courses. One year of chemistry and mathematics through college algebra and trigonometry are required. Individuals with a bachelor's degree in another area of science are also encouraged to apply; the departmental graduate advisory committee will prescribe a plan of study to remove deficiencies. The Graduate Record Examination (GRE) General Test is required; the Subject Test in Geology is optional. Each student must submit three letters of recommendation.

Financial Aid

Admitted students may be appointed as research assistants or as teaching assistants in introductory geology courses. Several such assistantships are available each year. Assistantships include remission of tuition and fees.

Degree Requirements

Both thesis and nonthesis options are available. Both options require at least 18 credit hours of nonresearch course work in geology and at least 3 credit hours in courses approved for graduate credit from allied sciences, mathematics, or the environmental program of the School of Public and Environmental Affairs (SPEA). Up to 6 credit hours of 400-level courses approved for graduate credit may be counted toward the degree with the approval of the graduate advisor. The thesis option requires the completion of 30 credit hours, 6 of which are taken as G810 Research (the thesis). The nonthesis option requires the completion of 36 credit hours, 3 of which consist of a research project taken as G700 Geologic Problems. The departmental graduate committee must approve elective credits outside of the Department of Geology for both options.

Admitted students will be assigned a three-person advisory committee at the beginning of the first year of graduate study. The committee will prescribe a study program based on the interests of the student and the principal graduate advisor. Students must complete all degree requirements within six years of beginning this study program. A B (3.0) average or higher must be maintained, and no grade below C is acceptable.

Bachelor of Science/Master of Science Program

The B.S./M.S. program combines the undergraduate B.S. program with the M.S. program in geology, leading to the award of an Indiana University bachelor's and master's degree with completion of the M.S. thesis. The departmental graduate advisory committee administers the B.S./M.S. program.

Admission Requirements

Prospective students should have advanced standing in the undergraduate program. Students should apply to the program in early spring of the junior year. Students should submit GRE scores and three letters of recommendation. Application requires a minimum GPA of 3.0 and will be considered by the departmental graduate committee.

Degree Requirements

Course and thesis requirements are the same as those listed under the Master of Science program in this bulletin. Upon acceptance into the program, the student will prepare a research and course plan in consultation with a graduate academic advisory committee. Research reading and data collection begins in the summer before the senior year of undergraduate study and will be completed in the following summer. The fifth year of study is devoted to graduate course work and completion of the M.S. thesis.

Courses in Geology (GEOL)

Courses with numbers in the 100s and 200s are lower-division undergraduate courses. Courses with numbers in the 300s and 400s are upper-division undergraduate courses that may, in some cases, be used for graduate credit. Courses in the 300s may be used for graduate credit by graduate students in education, but not by other students. Courses in the 400s may be taken for graduate credit by all graduate students. Courses numbered 500 or higher are graduate courses.

Note: P = prerequisite; C = corequisite; R = recommended; Fall = offered fall semester; Spring = offered spring semester; Summer = offered in the summer session; Day = offered as a daytime section; Night = offered as an evening section. For courses with no designated semester or section, consult the online course offerings. Equiv. = course is equivalent to the indicated course taught at Indiana University Bloomington or the indicated course taught at Purdue University West Lafayette.

G107 Environmental Geology (3 cr.) P: none. Fall, spring, summer. An introduction to geology through discussion of geological topics that show the influence of geology on modern society. Topics include mineral and energy resources, water resources, geologic hazards and problems, geology and health, and land use.

G109 Fundamentals of Earth History (3 cr.) P: none. Fall, spring, summer. Basic principles of earth history: geologic time, basic rock types, reconstructing past environments. Physical development of the earth: its interior, mountain formation, plate tectonics. Origin and development of life: evolution, the fossil record. With laboratory GEOL G119, equivalent to IUB GEOL G104, IUB GEOL G112, and PU GEOS 112.

G110 Physical Geology (3 cr.) P: none. Fall, spring, summer. Introduction to processes within and at the surface of the earth. Description, classification, and origin of minerals and rocks. The rock cycle. Internal processes: volcanism, earthquakes, crustal deformation, mountain building, plate tectonics. External processes: weathering, mass wasting, streams, glaciers, ground water, deserts, coasts. With laboratory GEOL G120, equivalent to IU GEOL G103, IU GEOL G111, and PU GEOS 111.

G115 Introduction to Oceanography (3 cr.) P: none. Fall, spring, summer. Nonmathematical introduction to the geology, biology, and physical characteristics of the ocean. Includes waves, tides, and currents of the world ocean, the adaptations and distribution of marine animals, pollution of the marine ecosystem, and an introduction to the global ocean/atmosphere system.

G117 Environmental Geology Laboratory (1 cr.) P or C: G107. Fall, spring, summer. Laboratory exercises in environmental aspects of the geosciences. To accompany G107.

G119 Fundamentals of Earth History Laboratory (1 cr.) P or C: G109. Fall, spring, summer. Laboratory studies of rocks, fossils, and stratigraphic principles to reconstruct past environments and interpret earth history. To accompany G109.

G120 Physical Geology Laboratory (1 cr.) P or C: G110. Fall, spring, summer. Laboratory studies of minerals and rocks, landscapes, and earth structures. To accompany G110 for nongeology majors.

G123 Art and the Earth Sciences (3 cr.) The principles of geology and the evolution of the Earth and life as revealed by art objects. Use of earth materials in art. The influence of art history on the development of modern geologic thought. Laboratories in lithography, etching, music, morphing, and microscopy.

G130 Short Courses in Earth Science (topic varies) (1 cr.) P: none. Five-week short courses on a variety of topics in the earth sciences. Examples of topics include lunar and planetary geology; geology of Indiana; geology of national parks; glaciers; water; gemstones; geology of art; earthquakes and volcanoes; dinosaurs. Each short course is one credit; no topic may be taken for credit more than once.

G132 Environmental Problems (3 cr.) This course is offered via the Internet and provides experience in addressing some problems that arise in studies of the environment. Particular attention is given to developing skills in evaluating scientific articles; specifically, the relevance of the information in an article, the credibility of the author, and the accuracy and usefulness of the quantitative information provided. The kinds of problems considered in this course will vary from semester to semester, but will be chosen from a list that includes global warming, tropical rain forests, acid rain, water pollution, solid waste disposal, appropriate use of land, and the ability of regulations to protect the environment. Three or four such topics will be covered each semester.

G135 Indiana Geology (3 cr.) An in-depth investigation of Indiana's geology, including minerals and rocks, geologic time, mineral resources, fossils, topography, soil, water resources, and special geologic features such as the Falls of the Ohio River and Indiana Dunes.

G136 Indiana Geology Field Experience (1 cr.) P or C: G107, G110, or G135. Application of geologic principles to the solution of geologic problems in field settings. Projects on geologic topics, including sedimentary rocks and fossils, soils, mineral resources, hydrology, glacial history, and karst topography. Students undertake two projects per semester and must be available on two Saturdays for field work. Preparation for field days uses a combination of television, the Web, and e-mail. Each project requires a written report.

G180 Dinosaurs (3 cr.) P: none. Fall, spring, summer. A survey of the characteristics and evolution of dinosaurs. Topics include: occurrence of dinosaur remains in the fossil record, basic anatomy, principles used in classification, types of predatory and plant-eating dinosaurs, environments occupied during life, biology and behavior, extinction theories, dinosaur hunters, and dinosaurs in the media and the public eye.

G199 Service Learning in Geology (1 cr.) P or C: G107, G110, or G115. Students participate in community service projects. Completion of the project includes a paper reflecting on how the service experience contributed to their application of the principles of general education.

G205 Reporting Skills in Geoscience (3 cr.) P: G110, G209, and ENG W131. Spring. Techniques of presenting written and oral reports from the geoscience approach. The written report: mechanics of format and illustrations, proper citation of geoscience literature, the abstract, proofreading, and editing. The oral report: effective presentation and response to audience questions, simulating a professional science meeting.

G206 Advanced Physical Geology Laboratory (1 cr.) P or C: G110. Fall, spring. The laboratory study of minerals, rocks, topographic maps and aerial photographs, landforms and landscapes, structural geology, and geologic maps.

G209 History of the Earth (3 cr.) P: G110, G206. Fall, spring. Earth history emphasizing physical and biological evolution. Geologic time, stratigraphic correlation, plate tectonics, depositional environments, paleogeography, and evolution of life. Laboratory. Field trips.

G221 Earth Materials (4 cr.) P: G206 and CHEM C105. Fall. Crystallography: symmetry, morphology, classes. Mineral chemistry, physics, and genesis. Description, identification, association, occurrence, and use of common and important minerals.

G222 Introductory Petrology (4 cr.) P: G221 and CHEM C106. Spring. Igneous, sedimentary, and metamorphic rocks: composition, field occurrence, characteristics, classification, origin, laboratory description, and identification.

G300 Environmental and Urban Geology (3 cr.) P: G107 or G110 or consent of instructor. Significance of regional and local geologic features and geologic processes in land use planning; use of geologic data in areas of rapid urbanization to properly utilize mineral and water resources and to assess potential geologic hazards.

G303 Geologic Mapping and Field Methods (4 cr.) P: G205, G209, and G222; or consent of instructor. Fall. Brunton-compass and GPS/GIS mapping. Measuring and describing stratigraphic sections of sedimentary rocks and surficial deposits. Mapping geologic structures. Field hydrology. Interpretation of maps, aerial photographs, and satellite imagery.

G304 Principles of Paleontology (3 cr.) P: G209 or consent of instructor. Spring. Biological principles applied to the fossil record. Examination of the quality of the fossil record, taxonomic principles and procedures, analytical techniques, evolutionary theory, evolution and paleoecology of species, populations and communities, diversification and extinction, paleogeography. Laboratories: systematics, stratigraphic distribution, and ecology of major fossilized invertebrate phyla.

G307 Environmental Problems and Restoration (3 cr.) P: One introductory college course in geology, biology, or chemistry and one course in college algebra. Human impact on natural environments in urban settings, emphasizing field and laboratory exercises designed for developing proficiency and understanding in sampling, testing and data analysis of ground and surface water, soils, and ecosystems. Creating and delivering presentations geared for public education regarding urban environmental problems and their remediation.

G323 Structural Geology (4 cr.) P: G205, G206, G209, G222, and G303. Spring. Nature and origin of primary and secondary structural features of the earth's crust, with emphasis on mechanics of deformation and origin, and three-dimensional problems illustrating structural concepts. Laboratory.

G334 Principles of Sedimentation and Stratigraphy (4 cr.) P: G205, G209, and G222. P or C: G303. Fall. Processes and factors influencing genesis of sedimentary particles and their deposition. Interpretation of depositional environments. Sedimentary facies and interpretation of stratigraphic record from outcrop, core sequence, and remote sensing. Laboratory. Field trip.

G403 Optical Mineralogy and Petrography (3 cr.) P: G205 and G222. Identification of rock-forming minerals in fragments and thin sections using principles of optical crystallography and the petrographic microscope. Description of common igneous, sedimentary, and metamorphic rocks and interpretation of their genesis using hand specimens and thin sections.

G404 Geobiology (3 cr.) P: G205, G209, and G222, and BIOL K101 or BIOL K103 or BIOL N107, or consent of instructor. Principles of paleontology. Emphasis on invertebrates. Major patterns and fundamentals of biological evolution as revealed by the fossil record. Use of fossils in the study of stratigraphy and earth's history. Laboratory exercises examine the form, ecology, and stratigraphic record of major phyla with a fossil record.

G406 Introduction to Geochemistry (3 cr.) P: G205, CHEM C106, or consent of instructor. Interactions between geology, chemistry, and biology in natural systems. Explores biogeochemical processes on small scales and in terms of global cycles, as well as human impacts on biogeochemical cycling.

G410 Undergraduate Research in Geology (1-3 cr.) P: G205, junior standing, and consent of instructor. Field and laboratory research in selected problems in geology. May be repeated. A total of 3 credit hours may be applied toward the degree.

G413 Introduction to Geophysics (3 cr.) P: G205 and consent of instructor. Applications of gravity, magnetics, seismology, electricity, and other methods of mineral exploration, engineering, and environmental investigations.

G415 Principles of Geomorphology (3 cr.) P: G205, G209, G222, and G303. P or C: G334. Natural processes that create landforms and landscapes. Physics and chemistry of weathering and soil formation. Dynamics of mass wasting, streams, and glaciers. Includes field and laboratory investigations.

G416 Economic Geology (3 cr.) P: G205 and G222; or consent of instructor. Origin, geologic occurrence, distribution, use, and conservation of important geologic natural resources: metallic minerals; industrial minerals and rocks; coal, petroleum, natural gas, and other energy resources.

G420 Regional Geology Field Trip (1-3 cr.) P: G205 or consent of instructor. Summer. Field trip to selected regions for study of mineralogic, lithologic, stratigraphic, structural, paleontologic, geomorphologic, or other geological relationships.

G430 Principles of Hydrology (4 cr.) P: G205, G206, MATH 153, CHEM C106, PHYS P202 or PHYS 251, and introductory biology. An introduction to the hydrologic cycle, reviewing processes such as precipitation, evaporation and transpiration, infiltration, runoff, streamflow and watersheds, and groundwater.

G436 Geological Remote Sensing (3 cr.) P: GEOL G222, GEOG G336, and PHYS P202 or consent of instructor. Spectroscopic analysis of rocks and minerals from terrestrial and extraterrestrial environments, and geologic application of remotely sensed spectral information. Topics include mapping rock-forming minerals, assessing and monitoring geologic hazards, and exploration for mineral deposits.

G445 Applied Analytical Techniques in Geology (3 cr.) P: G221, CHEM C105, CHEM C106, and consent of instructor. Principles of advanced analytical techniques, including X-ray analysis, electron beam imaging and analysis, and mass spectrometry, with applications in geosciences. Lectures on theory followed by laboratory exercises. Students will complete individual or collaborative research projects.

G451 Principles of Hydrogeology (3 cr.) P: G205 and G110; or consent of instructor. R: G334. Geologic and hydrologic factors controlling the occurrence and dynamics of groundwater. Emphasis on basic physical and chemical relationships between water and geologic material.

G460 Internship in Geology (3 cr.) P: G303, G304, G323, G334. Fall, spring, summer. Industrial or similar experiences in geologically oriented employment. Projects jointly arranged, coordinated, and evaluated by faculty and industrial/governmental supervisors.

G490 Seminar in Geology (1-3 cr.) P: junior or senior standing and consent of instructor. Readings and discussion of selected topics. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

G495 Senior Thesis in Geology (1 cr.) P: G303, G304, G323, G334, and two 400-level geology courses. Capstone experience involving a research project. Written report required.

G499 Honors Research in Geology (3 cr.) P: approval of departmental Honors Committee.

Graduate Level

G502 Trace Element and Isotope Geochemistry (3 cr.) P: CHEM C360 or CHEM C361 or G406. Principles governing the distributions of trace elements, radioisotopes, and stable isotopes in igneous, metamorphic, or sedimentary environments. Emphasis on applications to petrology and geochronology.

G525 Glacial Geology (3 cr.) P: G415 or consent of instructor. Formation, dynamics, and regimen of glaciers. Erosional and depositional processes and landforms. Glaciation of North America with emphasis on stratigraphy, soils, climates, and physical changes resulting from glacial processes and environments. Field investigations and a student research project required.

G527 Geological Oceanography (3 cr.) P: graduate standing, G334, and G413. Geological features and processes operating in the oceans; continental shelf, slope and ocean-basin geomorphology, sedimentology, structure, and composition; origin and geologic history of seawater and ocean basins.

G535 Quaternary Geology (3 cr.) P: G415 or consent of instructor. Characteristics, distribution, and origin of Pleistocene and recent deposits, stratigraphy, and chronology; formation of associated landforms, landscapes, paleosols, and soils and Quaternary environments and paleoclimatic interpretation.

G545 Applied Analytical Techniques in Geology (3 cr.) P: G221, CHEM C105, CHEM C106, and consent of instructor. Principles of advanced analytical techniques, including X-ray analysis, electron beam imaging and analysis, and mass spectrometry, with applications in geosciences. Lectures on theory followed by laboratory exercises. Students will complete individual or collaborative research projects.

G546 Planetary Remote Sensing (3 cr.) P: Previous course work in remote sensing, or consent of instructor. Application of multi-spectral data for exploration and mapping of planetary surfaces.

G550 Surface-Water Hydrology (3 cr.) P: G430 or G451. In-depth analysis of surface water components of hydrologic cycle: hydrometeorology, evaporation/ transpiration, rainfall-runoff relationships, open-channel flow, flood hydrology, and statistical and probabilistic methods in hydrology.

G551 Advanced Hydrogeology (3 cr.) P: G430 or G451. Advanced treatment of concepts fundamental to subsurface hydrologic processes. Applications to groundwater resource development and environmental protection such as aquifer mechanics and well hydraulics, heterogeneity and anisotropy, ground water and surface water interactions, unsaturated flow, and tracer and contaminant transport.

G585 Environmental Geochemistry (3 cr.) P: G406 or consent of instructor. Aquatic and environmental geochemistry, including freshwater and marine systems, natural and human-induced changes to geochemical systems, and the geochemical record of paleoceanographic and paleoclimatic variations.

G595 Data Analysis Techniques in Geoscience (3 cr.) P: STAT 301 and CSCI N207, or equivalent. Application of statistical and numerical analysis techniques to geoscience data, including sampling methods, confidence intervals, least squares methods, correlation, time series analysis, and multivariate techniques. Emphasis on using a computer to solve geoscience problems.

G596 Topics in Applied Environmental Geology (3 cr.) P: consent of instructor. Application of geologic principles to common environmental problems. Topics covered include waste site assessment, flood hazard analysis and mitigation, slope stability, and hydrogeology. Application of principles to problems pertaining to urban planning, earthquake-resistant design, and waste site/landfill development.

G621 Modeling Hydrological Systems (3 cr.) P: G430 or G451 and consent of instructor. Introduction to groundwater flow and solute transport modeling. Includes development of equations describing ground water flow and applied ground water/contaminant transport modeling, using a variety of current software packages.

G635 Soil Geomorphology (3 cr.) P: G415. Application of geomorphic principles in evaluation of weathering and soil formation; systems analysis of soil-landscape models; and paleogeomorphology and paleopedology. Lectures and discussion; field and laboratory problems.

G640 Fluvial Geomorphology (3 cr.) P: G415 or consent of instructor. Survey of fluvial processes including sediment transport, bed and bank erosion, and river metamorphosis. Examination of the controls on channel form. Analysis of landform genesis with an emphasis on feature sedimentology and stratigraphy. Application of fluvial geomorphic principles to land management and restoration of riparian ecosystems.

G645 Carbonate Sedimentology (3 cr.) P: G334 or consent of instructor. Spring. Course focuses on origin and generation of carbonate grains, description of modern carbonate depositional environments, interpretation of ancient limestone and dolomite sequences, and carbonate diagenesis.

G690 Advanced Geology Seminar (cr. arr.) P: consent of instructor.

G700 Geologic Problems (1-5 cr.) P: consent of instructor. Consideration of special geologic problems.

G810 Thesis Research (6 cr.)

Interdisciplinary Studies Bachelor of Science Degree Program

School of Science, IUPUI
Science Building, LD 222
402 N. Blackford Street
Indianapolis, IN 46202-3276
Phone: (317) 274-0626; fax: (317) 274-0628

Director Associate Dean and Associate Professor Andrew D. Gavrin

Program Advisor Joseph L. Thompson, jlthomp@iupui.edu

The purpose of the Bachelor of Science in Interdisciplinary Studies Program is to provide an opportunity for IUPUI students to construct individual majors that are science based, interdisciplinary, and not represented by existing major programs. Instead of a proscribed area of study as with standard majors, the Interdisciplinary Studies major will accommodate a variety of plans of study, with courses drawn from many subject areas in the sciences and beyond. The Interdisciplinary Studies degree program provides an academic structure that encourages creative and motivated undergraduates to design unique science-based interdisciplinary majors. In collaboration with a faculty mentor, students will create plans of study that demonstrate coherence, rigor, rationale, and vision. The B.S. in Interdisciplinary Studies requires a capstone project or internship experience, including a strong writing component. Particular plans of study may take advantage of the IUPUI Honors Program, the IUPUI Undergraduate Research Opportunities Program, the Consortium for Urban Education to include relevant courses taught at five other Indianapolis colleges and universities, or may include specialized service learning experiences in consultation with the IUPUI Center for Public Service and Leadership.

Each individualized major student, in consultation with the program advisor, will select a faculty mentor that best fits the student's interests. Once assigned, the student will work with the faculty mentor to develop a plan of study outlining the proposed curriculum, which will be submitted to a faculty committee for approval. As progress is made on the approved curriculum, the student will be expected to maintain a journal of this progress. The journal will be periodically reviewed by the program advisor, faculty mentor, and faculty committee to ensure progress is made and to provide guidance for course enrollment.

Though not meant to be a definitive list, examples of interdisciplinary majors with an emphasis in the sciences include:

Art Therapy
Art Restoration and Preservation
Geochemistry
Chemical Science and Technology
Music Therapy
Physics of Music
Scientific Writing

Admission

All students admitted to the Interdisciplinary Studies Program must have a minimum GPA of 2.50 and meet existing admission requirements of the School of Science. A student may apply for admission to the Interdisciplinary Studies Program by enrolling in a 1-credit hour tutorial (SCI I200) and preparing an in-depth proposal for an interdisciplinary studies major under the guidance of a faculty mentor who will function as the main program advisor for the student. The student is accepted for admission to the Interdisciplinary Studies Program when the faculty mentor and the Educational Policies Committee of the School of Science approve the student's proposal.

Before admission to the Interdisciplinary Studies Program, students must have completed a minimum of 15 credit hours of course work, but no more than 60 credit hours. The course work must include ENG W131, a science course with lab, and an appropriate level mathematics course. All science and mathematics courses on record must have minimum grades of C. Courses included in a specific interdisciplinary studies major may have prerequisites specified by the departments that offer them.

Curriculum

The curriculum for each interdisciplinary studies student will vary so as to meet the particular academic objective of the student. The interdisciplinary studies major area will consist of a coherent set of courses that define a clearly recognizable focus of study for which faculty can provide oversight and ensure intellectual integrity and rigor. A faculty committee will approve all interdisciplinary study major areas, and each student in the program will work closely with a faculty mentor.

The interdisciplinary major will comprise 40 credit hours of regular courses from at least two disciplines, a 1-hour tutorial, and culminate with a 3 to 6 hour senior capstone project or internship. The tutorial will include the development of an in-depth proposal for the major and the regular submission of a journal on the progress in the major.

- A minimum of 124 credit hours distributed as follows
  General education (47 credits)
  Interdisciplinary major with courses from at least two disciplines (40 credits)
  Electives (37 credits)
- The 40 credit hours within the interdisciplinary major has the following framework:
  a) SCI I200 Tutorial in Interdisciplinary Studies (1 credit) includes the development of an in-depth proposal for the major and the submission of a journal on progress in the major
  b) SCI I494 (3-6 credits) Internship in Science-Based Fields or SCI I495 (3-6 credits) Readings and Research in Science to address the senior capstone experience
  c) 36 credit hours of courses from at least two disciplines defining the major area

Requirements

For details on school-specific policies, see the School of Science requirements under ‘‘Undergraduate Programs” in this bulletin. Please note that at least 32 credit hours of course work must be at the 300-level or higher.

First-Year Experience Course Beginning freshmen and transfer students with less than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.), PSY B103 Orientation to a Major in Psychology (1 cr.), or an equivalent first-year experience course.

Area Requirements

Area I English Composition and Communication Skills (9 cr.)

English Composition (6 cr.)
ENG W131 Elementary Composition I (3 cr.)
Second Composition Course that has ENG W131 as a prerequisite
Speech Communication (3 cr.)
COMM R110 Fundamentals of Speech Communication (3 cr.)

Area II Foreign Language There is no foreign language required for the B.S. degree. However, if knowledge of a foreign language is pertinent to the interdisciplinary major, a student may choose to pursue one.

Area IIIA Humanities, Social Sciences, and Comparative World Cultures (12 cr.) The information about the IIIA requirements in the School of Science part of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult the program advisor before registering for these courses.

HIST H114 History of Western Civilization II (3 cr.)

At least one course from *each* of the following three lists is required:

Humanities (3 cr.)
Social Sciences (3 cr.)
Comparative World Cultures (3 cr.)

Area IIIB Junior/Senior Integrator (3 cr.) See the School of Science requirements under ‘‘Undergraduate Programs” in this bulletin for details.

Area IIIC Physical and Biological Sciences See the School of Science requirements under “Undergraduate Programs” in this bulletin. Four courses outside the major from the physical/biological sciences, one of which must include a corresponding laboratory. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement. No grade below C– will be accepted in any of these courses. Consult the program advisor concerning the acceptability of courses.

Area IIID Mathematical Sciences (9 cr.)

Two courses beyond algebra and trigonometry. (6 cr.)
One course in computer science. (3 cr.)

No grade below C– will be accepted in any of these courses.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Interdisciplinary Major Concentration (40 cr.) Minimum requirements include 40 credit hours of core interdisciplinary major courses.

All courses applicable to the major must have a minimum grade of C.

Other Requirements

1. SCI I200 Tutorial in Interdisciplinary Studies (1 cr.) is a tutorial under the supervision of a faculty mentor to guide a student in the development of a proposal to pursue a specially focused, science-based, interdisciplinary major. The student-generated proposal must include justification for selecting the interdisciplinary major, a comprehensive plan of study that lists courses comprising the major and a timetable for completing the plan, rationale for coherence of the plan, and a description of future prospects in terms of graduate/professional study and/or career opportunities. The student will be required to consult faculty in the fields that encompass the interdisciplinary major.

   The proposal must be submitted for approval to the School of Science Educational Policies Committee that has faculty representation from all departments in the school. Upon approval, the student will commence the program and maintain a journal detailing progress on the plan of study. The plan may be modified only in consultation with the faculty mentor and with approval of the Educational Policies Committee. The faculty mentor will determine the grade for the tutorial.
2. Interdisciplinary Major (36 cr.)
3. The Senior Capstone Experience will be accomplished through either SCI I494 Internship in Science-Based Fields (3-6 cr.) or SCI I495 Readings and Research in Science (3-6 cr.). For a student choosing the internship experience, there must be a direct match to the interdisciplinary major in an industrial, business, government, or other suitable setting. The student's faculty mentor must approve the internship. A comprehensive written report of the internship experience is required. Alternatively, a student may be engaged in a research project under faculty oversight that links directly to the student's interdisciplinary major. The faculty mentor must approve the research project. The student is required to submit a detailed research report at the conclusion of the project.

Courses in General Science (SCI)

Note: P = prerequisite; Fall = offered fall semester; Spring = offered spring semester.

SCI I120 Windows on Science (1 cr.) Fall, spring. Designed for new and prospective science majors, the course covers an integrative overview of science, examining science and society, the scientific method and community of scientists, undergraduate research, professional ethics, an exploration of science-based careers, and strategies for success as a science major.

SCI I200 Tutorial in Interdisciplinary Studies (1 cr.) Fall, spring. Tutorial under the supervision of a faculty mentor to develop a proposal to pursue a plan of study focused on a science-based, interdisciplinary area. The proposal is to be submitted to the review committee for approval. Each student will maintain a journal on the progress on the plan of study.

SCI I494 Internship in Science-Based Fields (1-6 cr.) P: junior or senior standing and program advisor approval. Fall, spring. A semester of full-time or part-time internship experience in an industrial, government, or business setting matching the student's academic or career objective. A comprehensive written report on the experience is required.

SCI I495 Readings and Research in Science (1-3 cr.) P: junior or senior standing, consent of instructor(s), and approval of review committee. Every semester, time arranged. Independent, interdisciplinary study and research in science and science-related fields. A major paper must be submitted. May be repeated for a maximum of 6 credit hours.

Department of Mathematical Sciences

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Professors Bleher *(Chancellor's Professor)*, Boukai *(Chair)*, Burkinshaw, Chin, Cowen *(Dean, School of Science)*, Frankel, A. Its *(Distinguished Professor)*, Misiurewicz, Ng *(M. L. Bittinger Chair Professor)*, Penna, A. Sen, Shen, Wojciechowski

Professors Emeriti Alton, Crown, Hutton, Kaminker, Kleyle, Kuczkowski, Rothman

Associate Professors Ernst, Geller, Ji, Kitchens, Klimek, Mukhin, Podgorski, Rigdon *(Associate Chair)*, Sarkar, Tam, Tarasov, Watt *(Associate Dean, School of Science)*

Associate Professors Emeriti Luke, John G. Miller, Patterson

Assistant Professors Buse, Kuznetsov, Li, Perez, Rubchinsky, Rusu *(IUPU Columbus)*, Zhu

Adjunct Professors Bittinger, Morton, Reid, Worth

Adjunct Associate Professor Yiannoutsos

Adjunct Assistant Professor Y. Wang

Senior Lecturers Carlson, E. Its, Rangazas

Lecturers Farris, Fokin, Hall, Hernandez, Hicks, Kitt, Melsheimer, Meshulam, John L. Miller, Parks, Rainey, Ziemian

Mathematical sciences include the areas of pure and applied mathematics, mathematics education, and statistics. Mathematics involves the study of problems in areas such as algebra, geometry, analysis, and logic and of problems arising in the real world. Mathematics and statistics are used in the physical sciences, engineering, and the social, life, and management sciences. Mathematics education involves the training of prospective secondary teachers.

Degree Programs

The department offers the Purdue University Bachelor of Science degree in mathematics with options in pure mathematics, applied mathematics, actuarial science, and secondary school teaching.

Purdue graduate degrees offered include the Master of Science, Master of Science (Option for Teachers), and Master of Science (Concentration in Applied Statistics). Additionally, qualified students may be authorized to pursue the Ph.D. in mathematics in areas where a program has been arranged with Purdue, West Lafayette.

Bachelor of Science

Students are encouraged to declare a mathematics major in the freshman year, so they can receive proper academic advising. A grade point average of 2.5 with no failing grades in mathematics courses through MATH 351 is a minimum indication of success in this major.

Degree Requirements

The baccalaureate degree general requirements, the area requirements, and the Bachelor of Science degree requirements are listed earlier in this bulletin (see the School of Science requirements under “Undergraduate Programs”). For a Bachelor of Science degree in mathematics, the following additional requirements and restrictions apply:

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I No additional requirements. The second semester of English composition may be satisfied by ENG W132 (or ENG W150), ENG W231, or TCM 320.

Area II All degree options require 5 credit hours in a modern foreign language.

Area III The following apply to all degree options:

1. Mathematics courses below MATH 163 and those mathematics courses in which the student has received grades below C– do not count toward the degree.
2. Certain courses, such as CHEM C101, CHEM C102, CHEM C110; PHYS 100, 200, PHYS P201, PHYS P202 may not be used to fulfill the science requirement, Area IIIC, of the School of Science. (Also, only mathematics majors in the Secondary School Teaching Option may use PHYS 218, 219 to apply to the Area IIIC science requirements.) If in doubt about a particular course, the student should consult a mathematics department advisor.

Note: Refer to specific mathematics option major requirements for any additional Area IIIC course requirement.

3. The Area IIID computer science requirement must be in a higher-level programming course (not BASIC). A grade of C (2.0) or better is required.

Area IV Mathematics courses in which a student has received grades below C (2.0) do not count in Area IV. The Area IV requirements for the secondary area of concentration and the major for the four degree options—pure mathematics, applied mathematics, actuarial science, and secondary teaching—are described in the following sections. There is no single semester-by-semester plan of study for any of the options because flexibility is encouraged within the various programs. However, a sample program that shows one possible sequence of courses is given for each option. Variations from the sample program should be made in consultation with the student’s advisor. Because of the complexity of the requirements and because certain courses are not offered every semester, it is important that each student consult the assigned advisor as soon as possible in order to proceed through a proper plan of study for the chosen degree program. A minimum grade point average of 2.5 is required in all mathematics courses that count toward the major.

Area IV Secondary Area of Concentration Requirements So that each student can acquire some depth of study in a subject outside of the major area, the Department of Mathematical Sciences requires students to have a secondary area of concentration outside of the department. The secondary area of concentration consists of at least 18 credit hours and includes at least three courses beyond the introductory level. It is subject to the approval of the student’s advisor. Although a secondary area of concentration is usually in one department, it may be from two or more if the advisor approves.

Courses may be used for the double purpose of fulfilling the general requirements and for fulfilling the secondary area of concentration requirements of the Department of Mathematical Sciences. For students in the Pure Mathematics Option or the Applied Mathematics Option, a secondary area in one of the physical sciences or in a subject that makes serious use of mathematics, such as computer science, engineering, or economics, is desirable. Students in the Secondary School Teaching Option satisfy the requirements for a secondary area by the courses they take to meet the professional education requirement. Students in the Actuarial Science Option satisfy the requirements for a secondary area by the required economics and business courses they take.

The requirement of 18 credit hours in a secondary area of concentration does not, by itself, constitute an official minor that would be acknowledged on the student's transcript. A minor must be offered through the department or school in which the minor is taken. Students in the Actuarial Science Option satisfy the requirements for a minor in economics by the economics courses they are required to take (but students must apply to the Department of Economics in order for an official minor to be awarded).

Major Requirements

Pure Mathematics Option

With this option, students will be well prepared for graduate work in pure mathematics. However, students with undergraduate degrees in pure mathematics have also been successful with graduate studies in business administration, computer science, economics, educational research, engineering, law, medicine, operations research, physics, psychology, and statistics. Persons with advanced degrees in pure mathematics find careers primarily in college teaching, but careers in business, industry, or government service are also possible.

Courses taken to satisfy the Area IIIC requirements must include PHYS 152 (or a more advanced physics course).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. Analysis: MATH 441-442
3. MATH 453 Beginning Abstract Algebra
4. MATH 462 Elementary Differential Geometry or MATH 510 Vector Calculus
5. Twelve (12) additional credit hours selected from MATH 276 and mathematics and statistics courses at the 300-level or above. Courses in computer science or courses in other departments of the School of Science that have an appropriate mathematical content may be selected with the approval of the advisor. Normally, no more than 6 credit hours will be approved outside of mathematics and statistics.
6. The 45 credit hours of courses required above must include at least 6 credit hours from a course sequence listed below, other than MATH 441-442
7. 2 credit hours of MATH 492 Capstone Experience

Course Sequences

Advanced calculus: MATH 510 and 525

Algebra: MATH 453, and 505 or a higher-level algebra course

Analysis: MATH 441, and 442 or a higher-level analysis course

Geometry: MATH 462, and 561 or a higher-level geometry course

Differential equations: MATH 520, and 537 or higher-level differential equations course

Modeling: MATH 426, and 417 or a higher-level modeling course

Numerical analysis: MATH 414, and CSCI 515 or a higher-level numerical analysis course

Probability and statistics: two STAT courses numbered 311 or higher

Scientific computing: CSCI 475 and 476[1]

Theoretical computer science: CSCI 340 and 470[1]

Pure Mathematics Option Sample Program (124 cr. required)

Freshman Year

First Semester

MATH 163 Integrated Calculus and Analytic Geometry I	5
SCI I120 Windows on Science	1
COMM R110 Fundamentals of Speech Communication	3
ENG W131 Elementary Composition I	3
Physical or biological science	4
	16

Second Semester

MATH 164 Integrated Calculus and Analytic Geometry II	5
CSCI 230 Computing I	4
Physical or biological science	3
Second composition course	3
	15

Sophomore Year

Third Semester	
MATH 261 Multivariate Calculus	4
HIST H114 History of Western Civilization II	3
PHYS 152 Mechanics	4
Free electives	6
	17

Fourth Semester	
MATH 262 Linear Algebra and Differential Equations	4
MATH 351 Elementary Linear Algebra	3
Physical or biological science	3
Humanities—List H	3
Free elective	3
	16

Junior Year

Fifth Semester	
MATH 441 Foundations of Analysis	3
MATH or STAT Elective	3
Foreign Language	5
Social Sciences—List S	3
Free elective	3
	17

Sixth Semester	
MATH 442 Foundations of Analysis II	3
MATH 510 Vector Calculus	3
Comparative World Cultures—List C	3
Free electives	6
	15

Senior Year

Seventh Semester	
MATH 453 Beginning Abstract Algebra	3
MATH or STAT elective	3
Junior/Senior Integrator	3
Free electives	5
	14

Eighth Semester	
MATH or STAT electives	6
MATH 492 Capstone Experience	2
Free electives	6
CAND 991 Candidate for Graduation	0
	14

Applied Mathematics Option

Graduates with training in applied mathematics are employed in business, industry, and government. They would probably work as part of a team and would often need to communicate mathematical ideas to persons trained in other subjects. In many instances, they would need to formulate problems for solution on a computer and then interpret the answers. Thus, besides a fundamental knowledge of mathematics, a knowledge of what computers can do is essential. This option is also a good preparation for graduate study in applied mathematics, computer science, statistics, and engineering.

Courses taken to satisfy the Area IIIC requirements must include PHYS 152 and 251 (or more advanced physics courses).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. MATH 414 Numerical Methods
3. MATH 510 Vector Calculus
4. Mathematical modeling: MATH 417 or 426
5. MATH 441 Foundations of Analysis
6. Twelve (12) additional credit hours selected from MATH 276 and mathematics and statistics courses at the 300 level or above. Courses in computer science or courses in other departments of the School of Science that have an appropriate mathematical content may be selected with the approval of the advisor. Normally, no more than 6 credit hours will be approved outside of mathematics and statistics.
7. The 45 credit hours of courses required above must include at least 6 credit hours in each of two of the course sequences listed below. Students planning on attending graduate school in mathematics are advised to take MATH 442.
8. 2 credit hours of MATH 492 Capstone Experience

Course Sequences

Advanced calculus: MATH 510 and 525

Algebra: MATH 453, and 505 or a higher-level algebra course

Analysis: MATH 441, and 442 or a higher-level analysis course

Differential equations: MATH 520, and 537 or a higher-level differential equations course

Geometry: MATH 462, and 561 or a higher-level geometry course

Modeling: MATH 426, and 417 or a higher-level modeling course

Numerical analysis: MATH 414, and CSCI 515 or a higher-level numerical analysis course

Probability and statistics: two STAT courses numbered 311 or higher

Scientific computing: CSCI 475 and 476[1]

Theoretical computer science: CSCI 340 and 470[1]

Applied Mathematics Option Sample Program (124 cr. required)

Freshman Year

First Semester

MATH 163 Integrated Calculus and Analytic Geometry I	5
CSCI 230 Computing I	4
SCI I120 Windows on Science	1
ENG W131 Elementary Composition I	3
HIST H114 History of Western Civilization II	3
	16

Second Semester

MATH 164 Integrated Calculus and Analytic Geometry II	5
COMM R110 Fundamentals of Speech Communication	3
Second composition course	3
Free electives	6
	17

Sophomore Year

Third Semester

MATH 261 Multivariate Calculus	4
PHYS 152 Mechanics	4
Humanities—List H	3
Free electives	6
	17

Fourth Semester

MATH 262 Linear Algebra and Differential Equations	4
MATH 351 Elementary Linear Algebra	3
PHYS 251 Heat, Electricity, and Optics	5
Free Elective	3

	15

[1] Students are generally allowed to select only one of these two course sequences.

Junior Year

Fifth Semester

MATH 414 Numerical Methods	3
PHYS 310 Intermediate Mechanics	4
MATH or STAT Elective	3
Social Sciences—List S	3
Foreign language	3
	16

Sixth Semester

MATH 426 Introduction to Applied Mathematics and Modeling **or**	
MATH 417 Discrete Modeling and Game Theory	3
MATH 510 Vector Calculus	3
PHYS 342 Modern Physics	3
Comparative World Cultures—List C	3
Foreign language	3
	15

Senior Year

Seventh Semester

MATH 441 Foundations of Analysis	3
MATH or STAT Elective	3
Junior/Senior Integrator	3
Free Electives	5
	14

Eighth Semester

MATH 492 Capstone Experience	2
MATH or STAT Electives	6
Free electives	6
CAND 991 Candidate for Graduation	0
	14

Actuarial Science Option

The Actuarial Science Option for mathematics majors will provide students with the strong background in mathematics, statistics, and economics necessary to analyze financial risks. This concentration aims to prepare students for the first three actuarial examinations administered by the professional actuarial organizations. The secondary area of concentration for students in this option is fulfilled by required courses in business and economics.

Actuarial science deals with the analysis of financial consequences of risk. Actuaries are highly trained professionals, well versed in mathematical, statistical, and economic techniques that enable them to evaluate financial risk of uncertain future events, especially those pertaining to health care, insurance, and pension plans. Actuaries answer risk-related questions by developing, implementing, and interpreting sophisticated mathematical models.

The Area IV major requirements are as follows:

1. Core Curriculum: MATH 163, 164, 261, 262, and 351 (or 511)
2. ECON S201, ECON E202 or ECON S202, ECON E305, ECON E321, ECON E322
3. BUS A200, BUS K201[1], BUS F300, BUS F305
4. MATH 375 Mathematical Theory of Interest
5. Mathematical Modeling: MATH 417 or MATH 426[2]
6. STAT 416 Probability and STAT 417 Statistical Theory

[1] See your advisor to learn about alternative ways to meet this requirement.

[2] Prerequiites for MATH 426 include PHYS 152.

7. Actuarial Models: STAT 472-473

8. 2 or 3 hour STAT elective at the 300 level or above (not STAT 301, 302, or 311) Suggested course: STAT 371 (Prep for Actuarial Exam 1)
9. 3 credit hour MATH or STAT selected from MATH 276 and mathematics and statistics courses at the 300-level or above (not STAT 301, 302, or 311). Suggested course: STAT 350 Introduction to Statistics
10. 2 credit hours of MATH 492 Capstone Experience

Actuarial Science Option Sample Program (124 cr. required)

Freshman Year

First Semester

MATH 163 Integrated Calculus and Analytic Geometry I	5
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
COMM R110 Fundamentals of Speech Communication	3
Physical or Biological Science Elective with Lab	5
	17

Second Semester

MATH 164 Integrated Calculus and Analytic Geometry II	5
CSCI 230 Computing I	4
Physical or Biological Science Elective	3
Second Composition Course	3
	15

Sophomore Year

Third Semester

MATH 261 Multivariate Calculus	4
STAT 350 Introduction to Statistics	3
ECON S201 Introduction to Microeconomics: Honors	3
BUS A200 Foundations of Accounting	3
HIST H114 History of Western Civilization II	3
	16

Fourth Semester

MATH 262 Linear Algebra and Differential Equations	4
MATH 351 Elementary Linear Algebra	3
ECON E202 or ECON S202 Introduction to Macroeconomics	3
BUS K201 The Computer in Business	3
Humanities—List H	3
	16

Junior Year

Fifth Semester

STAT 416 Probability	3
BUS F300 Introduction to Financial Management	3
ECON E322 Intermediate Macroeconomic Theory	3
Comparative World Cultures—List C	3
Physical or biological science elective	3
	15

Sixth Semester

STAT 417 Statistical Theory	3
MATH 375 Mathematical Theory of Interest	3
STAT 371 Prep for Actuarial Exam 1	2
BUS F305 Intermediate Corporate Finance	3
Foreign language	5
	16

Senior Year

Seventh Semester

STAT 472 Actuarial Models I	3
ECON E305 Money and Banking	3
Junior/Senior Integrator	3
Physical or biological science elective	3
Free Elective	3
	15

Eighth Semester

STAT 473 Actuarial Models II	3
MATH 417 Discrete Modeling and Game Theory	3
ECON E321 Intermediate Microeconomic Theory	3
MATH 492 Capstone Experience	2
Free elective	3
CAND 991 Candidate for Graduation	0
	14

Secondary School Teaching Option

Students who wish to teach in secondary schools must meet the requirements for teacher certification in the state in which they expect to teach. Interested persons can obtain these requirements by writing to the Department of Public Instruction, Certification Office, in the capital city of any state.

In order to satisfy Indiana state law, a student should have 40 credit hours in general-education courses and a specified core of professional education courses as part of the requirement for a teaching license. Students should be sure to see an advisor to ensure that these hours are properly distributed and that the professional education requirements are met.

Courses taken to satisfy the Area IIIC requirements must include either Physics 218 or Physics 152 (or a more advanced physics course).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. MATH 276 Discrete Math
3. MATH 300 Logic and the Foundations of Algebra
4. MATH 453 Abstract Algebra
5. MATH 463 Intermediate Euclidean Geometry for Secondary Teachers
6. Probability and statistics: STAT 311 or 350 or 416 or 511
7. MATH 583 History of Elementary Mathematics

Secondary School Teaching Option Sample Program (124 cr. required)

Freshman Year

First Semester

MATH 163 Integrated Calculus and Analytic Geometry I	5
ENG W131 Elementary Composition I	3
SCI I120 Windows on Science	1
PSY B104 Psychology as a Social Science	3
HIST H114 History of Western Civilization II	3
	15

Second Semester

MATH 164 Integrated Calculus and Analytic Geometry II	5
MATH 276 Discrete Math	3
COMM R110 Fundamentals of Speech Communication	3
ENG W132 Elementary Composition II	3
Humanities—List H	3
	17

Sophomore Year

Third Semester

MATH 261 Multivariate Calculus	4
MATH 300 Logic and the Foundations of Algebra	3
EDUC H341 American Culture and Education	3
Foreign Language	5

	15

Apply to Teacher Education Program

Fourth Semester

MATH 262 Linear Algebra and Differential Equations	4
CSCI 230 Computing I	4
Comparative World Cultures—List C	3
PHYS 218 General Physics	4
	15

Junior Year

Fifth Semester

MATH 351 Elementary Linear Algebra	3
STAT 350 Introduction to Statistics	3
EDUC M322 Diversity/Learning: Reaching Every Adolescent	6
EDUC M301 Field Experience	1
Physical or Biological Science	4
	17

Sixth Semester

MATH 463 Intermediate Euclidean Geometry for Secondary Teachers	3
Physical or biological science	3
EDUC M403 Field Experience	0
EDUC M457 Methods of Teaching Senior High/Junior High/Middle School Mathematics	4
EDUC S430 Teaching/Learning in the High School	3
	13

Senior Year

Seventh Semester

MATH 453 Abstract Algebra	3
EDUC M303 Field Experience: Middle School	1
EDUC M469 Content Area Literacy	3
EDUC S420 Teaching/Learning in Middle School	3
Physical or biological science	3
Junior/Senior Integrator	3
	16

Eighth Semester

EDUC M451 Student Teaching: Junior High/ Middle School **or** EDUC M480 Student Teaching in the Secondary School	16
MATH 583 History of Mathematics	3
CAND 991 Candidate for Graduation	0
	19

Minor in the Mathematical Sciences

An undergraduate minor in mathematics would be useful in many fields. A scientist or engineer may need a knowledge of differential equations and linear algebra, while someone in business or a social science may need a background in probability or statistics.

Requirements

1. The calculus sequence MATH 163, 164, and 261 (14 cr.)
2. Two additional courses selected from mathematics courses numbered 262 or higher or from statistics courses numbered 311 or higher
3. 9 credit hours of the minor must be completed at IUPUI
4. The grade in each course submitted for the minor must be C (2.0) or higher

Correspondence courses may not be used to fulfill requirements for the minor.

Graduate Programs

The Department of Mathematical Sciences offers graduate training leading to the Purdue University Master of Science degree. Qualified students may be authorized to pursue the Ph.D. in mathematics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. The M.S. degree requires two years of graduate study, and the Ph.D. degree typically requires two to three additional years of study.

Admission Requirements

Students entering a graduate program in mathematics should have completed an undergraduate program containing as many courses as possible in abstract algebra, linear algebra, advanced calculus, differential equations, logic and foundations, and probability.

Students entering the graduate program in applied mathematics should have completed an undergraduate program in mathematics or an undergraduate program in engineering or physical sciences that was strongly oriented toward mathematics.

Students entering the master's program in applied statistics must have a bachelor's degree from an accredited institution. The minimal mathematics requirement for admission to this program includes an undergraduate sequence in univariate and multivariate calculus (equivalent to MATH 163, 164, 261) and one mathematics course beyond the calculus level. Prospective applicants who do not have this background must take all or part of the calculus sequence prior to admission to the program. Applicants who lack a course beyond the calculus sequence must complete such a course as soon as possible after conditional admission.

Application for Admission

Students who wish to pursue an advanced degree in the Department of Mathematical Sciences should complete an online application available from the department's Web site at www.math.iupui.edu. For Ph.D. applicants, GRE general test scores are required, and the GRE mathematics subject test is highly recommended. Foreign students for whom English is not their native language and who have not completed a bachelor's or master's degree program from an English-speaking university must submit TOEFL scores. While this application is being processed, the student may enter IUPUI as a graduate nondegree student. No more than 12 hours of credit earned under this classification may be applied toward an advanced degree. Those who do not want to pursue an advanced degree, but who desire to take graduate courses for personal improvement may also take courses under the graduate nondegree classification.

Transfer Credit

The Department of Mathematical Sciences will accept by transfer a maximum of 9 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions.

Assistantships and Fellowships

Financial support is available to qualified students in the form of University Fellowships, graduate teaching assistantships, and tuition scholarships. Additional summer support is available through summer teaching for students whose performance in course work and assistantship duties is satisfactory.

English Requirements

All advanced degree candidates are required to demonstrate acceptable proficiency in English composition.

Foreign students for whom English is not their native language and who have not completed a bachelor's or master's degree program from an English-speaking university must take the ESL exam administered by the IUPUI English as a Second Language Program. Students not scoring sufficiently high will be required to take designated courses in English while pursuing their graduate studies.

Master of Science

A minimum of 30 credit hours of course work is required for an M.S. degree. Course grades must be A or B with the possible exception of at most two grades of C. Neither a thesis nor a comprehensive examination is required. Several core courses are specific to an M.S. plan of study and vary according to the student's interest in (a) pure mathematics with a Ph.D. objective, (b) pure mathematics without a Ph.D. objective, (c) applied mathematics with a Ph.D. objective, or (d) applied mathematics without a Ph.D. objective. The remaining courses are selected by the student and his or her advisory committee.

Master of Science (Option for Teachers)

This nonthesis program requires a minimum of 30 credit hours of course work and is tailored for secondary school teachers and students who are preparing to become secondary school teachers. Core requirements include a course in geometry, a course in algebra, a course in analysis, a course in modeling/differential equations, and a course in probability. (See the Department of Mathematical Sciences for a more complete description of this program.) Course grades must be A or B with the possible exception of at most two grades of C.

Master of Science (Concentration in Applied Statistics)

The Master of Science degree with a concentration in Applied Statistics consists of a minimum of 30 credit hours. Course grades must be A or B with the possible exception of at most two grades of C. Candidates for this degree may choose either the thesis option or the nonthesis option. Both options require 15 credit hours in the core curriculum consisting of STAT 512, 514, 519, 524, and 528. The two-course sequence in probability and mathematical statistics (STAT 519, 528) must be taken by all degree candidates. A combined written and oral final examination is required.

The nonthesis option consists of 15 credit hours beyond the core curriculum, at least 9 of which must be statistics (STAT) courses. The remaining courses may be taken in mathematics or in areas relevant to statistical applications, subject to approval of the academic advisor.

The thesis option requires a thesis worth 6 credit hours on a topic approved by the candidate's academic advisor. At least 6 of the remaining 9 credit hours must be taken in statistics or in a subject related to statistical applications that have been approved by the advisor. An oral defense of the thesis is required.

Doctor of Philosophy

Qualified students may be authorized to pursue the Ph.D. in mathematics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. To be admitted to candidacy for the Ph.D. degree, the student must have fulfilled the following requirements and must have been accepted by the graduate committee of the Department of Mathematical Sciences.

Requirements

1. The student must satisfy, by one of the five options approved by the graduate school, the foreign language requirement in German, Russian, or French.
2. The student must pass qualifying examinations in four subject areas: abstract algebra, real analysis, and two additional areas chosen by the student from a list of approved areas. A student may attempt any particular qualifier examination up to three times, but there are time limits imposed by the department for passing all four examinations.
3. The student must submit to the graduate school through the department a plan of study including at least 42 credit hours of approved graduate course work.
4. The student must pass advanced topics examinations. These oral or written examinations may be taken only by students who have completed requirement 2.

A candidate will be recommended to the faculty to receive the Ph.D. degree after a thesis, submitted in final form, has been accepted by the advisory committee and presented before an open colloquium or seminar.

The department has set time limits for completion of the Ph.D. degree.

Courses in Mathematical Sciences (MATH)

Note: Statistics courses (STAT) follow MATH listings. P = prerequisite; C = corequisite; R = recommended; Fall = offered fall semester; Spring = offered spring semester; Summer = offered in the summer session. For courses with no designated semester, consult the online course offerings. Equiv. = course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University West Lafayette.

Special Developmental Courses

M001 Introductory Algebra (6 cr.) P: Placement test or self elect for students who need more time on task. Fall, spring, summer. This is a first course in the study of algebra. Real numbers, algebraic expressions, solving equations, graphing equations, operations with polynomials, factoring polynomials, rational expressions and equations, solutions of systems of equations, radical expressions, and problem-solving strategies are taught.

001 Introduction to Algebra (4 cr.) Placement. Fall, spring, summer. Covers the material taught in the first year of high school algebra. Numbers and algebra, integers, rational numbers, equations, polynomials, graphs, systems of equations, inequalities, radicals. Credit does not apply toward any degree.

Undergraduate Level

Lower-Division Courses

110 Fundamentals of Algebra (4 cr.) P: 001 or M001 (with a minimum grade of C–) or placement. Intended primarily for liberal arts and business majors. Integers, rational and real numbers, exponents, decimals, polynomials, equations, word problems, factoring, roots and radicals, logarithms, quadratic equations, graphing, linear equations in more than one variable, and inequalities. This course satisfies the prerequisites needed for M118, M119, 130, 136, and STAT 301.

111 Algebra (4 cr.) P: 001 or M001 (with a minimum grade of C) or placement. Fall, spring, summer. Real numbers, linear equations and inequalities, systems of equations, polynomials, exponents, and logarithmic functions. Covers material in the second year of high school algebra. This course satisfies the prerequisites needed for M118, M119, 130, 136, 153, 154, and STAT 301.

M118 Finite Mathematics (3 cr.) P: 111 or 110 (with a minimum grade of C–) or equivalent. Fall, spring, summer. Set theory, logic, permutations, combinations, simple probability, conditional probability, Markov chains. An honors option is available in this course.

S118 Honors Finite Mathematics (3 cr.) P: Mastery of two years of high school algebra. Designed for students of outstanding ability in mathematics. Covers all material of M118 and additional topics from statistics and game theory. Computers may be used in this course, but no previous experience is assumed.

M119 Brief Survey of Calculus I (3 cr.) P: 111 or 110 (with a minimum grade of C–) or equivalent. Fall, Spring, Summer. Sets, limits, derivatives, integrals, and applications. An honors option is available in this course.

S119 Honors Brief Survey of Calculus I (3 cr.) P: Mastery of two years of high school algebra. Designed for students of outstanding ability in mathematics. Covers all material of M119 and additional topics. Computers may be used in this course, but no previous experience is assumed.

123 Elementary Concepts of Mathematics (3 cr.) Mathematics for liberal arts students; experiments and activities that provide an introduction to inductive and deductive reasoning, number sequences, functions and curves, probability, statistics, topology, metric measurement, and computers.

130 Mathematics for Elementary Teachers I (3 cr.) P: 111 or 110 (with a minimum grade of C–) or equivalent. Fall, Spring, Summer. Numeration systems, mathematical reasoning, integers, rationals, reals, properties of number systems, decimal and fractional notations, and problem solving.

132 Mathematics for Elementary Teachers II (3 cr.) P: 130; one year of high school geometry. Fall, Spring, Summer. Rationals, reals, geometric relationships, properties of geometric figures, one-, two-, and three-dimensional measurement, and problem solving.

136 Mathematics for Elementary Teachers (6 cr.) P: 111 or 110 (with a minimum grade of C) or equivalent; one year of high school geometry. Fall, spring, summer. 136 is a one-semester version of 130 and 132. Not open to students with credit in 130 or 132.

153 Algebra and Trigonometry I (3 cr.) P: 111 (with a minimum grade of C) or two years of high school algebra. Fall, Spring, Summer. 153-154 is a two-semester version of 159. Not open to students with credit in 151 or 159. 153 covers college-level algebra and provides preparation for 163 and 221.

154 Algebra and Trigonometry II (3 cr.) P: 153 (with a minimum grade of C) or five semesters of high school algebra. Fall, Spring, Summer. 153-154 is a two-semester version of 159. Not open to students with credit in 151 or 159. 154 covers college-level trigonometry and provides preparation for 163 and 221.

159 Precalculus (5 cr.) P: 111 (with a minimum grade of B) or placement. Fall, Spring, Summer I. 159 is a one-semester version of 153-154. Not open to students with credit in 153 or 154. 159 covers college-level algebra and trigonometry and provides preparation for 163 and 221.

163 Integrated Calculus and Analytic Geometry I (5 cr.) P: 154 or 159 (with a minimum grade of C) or equivalent, and one year of geometry. Equiv. IU MATH M211. Fall, Spring, Summer I. Review of plane analytic geometry and trigonometry, functions, limits, differentiation, applications of differentiation, integration, the fundamental theorem of calculus, and applications of integration. An honors option is available in this course.

S163 Honors Integrated Calculus and Analytic Geometry I (5 cr.) P: Precalculus or trigonometry and consent of instructor. This course covers the same topics as Math 163. However, it is intended for students having a strong interest in mathematics who wish to study the concepts of calculus in more depth and who are seeking mathematical challenge.

164 Integrated Calculus and Analytic Geometry II (5 cr.) P: 163 (with a minimum grade of C–). Equiv. IU MATH M212. Fall, Spring, Summer I. Transcendental functions, techniques of integration, indeterminate forms and improper integrals, conics, polar coordinates, sequences, infinite series, and power series. An honors option is available in this course.

S164 Honors Integrated Calculus and Analytic Geometry II (5 cr.) P: S163 (with a minimum grade of B–) or 163 (with a minimum grade of A–). This course covers the same topics as Math 164. However, it is intended for students having a strong interest in mathematics who wish to study the concepts of calculus in more depth and who are seeking mathematical challenge.

179 Computers and Mathematics (3 cr.) P: 163. Exploration of some modern mathematical concepts, using the computer as an experimental tool. Possible topics include iteration, fixed points, convergence, stability/instability, chaos, fractals. Function approximation: polynomials, splines, and computer graphics. Calculus: numerical approximations, and symbolic manipulations. Arithmetic with large integers: prime numbers, factorization, encryption, and unsolved problems in number theory.

190 Topics in Applied Mathematics for Freshmen (3 cr.) Treats applied topics in mathematics at the freshman level. Prerequisites and course material vary with the applications.

221 Calculus for Technology I (3 cr.) P: 154 or 159 (with a minimum grade of C–) or equivalent, and one year of geometry. Fall, Spring, Summer. Analytic geometry, the derivative and applications, and the integral and applications.

222 Calculus for Technology II (3 cr.) P: 221 (with a minimum grade of C–). Fall, Spring, Summer. Differentiation of transcendental functions, methods of integration, power series, Fourier series, and differential equations.

261 Multivariate Calculus (4 cr.) P: 164. Equiv. IU MATH M311. Fall, Spring, Summer. Spatial analytic geometry, vectors, curvilinear motion, curvature, partial differentiation, multiple integration, line integrals, and Green's theorem. An honors option is available in this course.

262 Linear Algebra and Differential Equations (4 cr.) P: 164. R: 261. Fall, Spring, Summer. First-order equations, higher-order linear equations, initial and boundary value problems, power series solutions, systems of first-order equations, Laplace transforms, and applications. Requisite topics of linear algebra: vector spaces, linear independence, matrices, eigenvalues, and eigenvectors.

276 Discrete Math (3 cr.) P or C: 163 or consent of instructor. Logic, sets, functions, integer algorithms, applications of number theory, mathematical induction, recurrence relations, permutations, combinations, finite probability, relations and partial ordering, and graph algorithms.

290 Topics in Applied Mathematics for Sophomores (3 cr.) Treats applied topics in mathematics at the sophomore level. Prerequisites and course material vary with the applications.

Upper-Division Courses

300 Logic and the Foundations of Algebra (3 cr.) P: 163. Fall. Logic and the rules of reasoning, theorem proving. Applications to the study of the integers; rational, real, and complex numbers; and polynomials. Bridges the gap between elementary and advanced courses. Recommended for prospective high school teachers.

333 Chaotic Dynamical Systems (3 cr.) P: 164 or 222. The goal of the course is to introduce some of the spectacular new discoveries that have been made in the past twenty years in the field of mathematics known as dynamical systems. It is intended for undergraduate students in mathematics, science or engineering. It will include a variety of computer experiments using software that is posted on the web.

351 Elementary Linear Algebra (3 cr.) P: 261. Not open to students with credit in 511. Fall, Spring. Systems of linear equations, matrices, vector spaces, linear transformations, determinants, inner product spaces, eigenvalues, and applications.

375 Theory of Interest (3 cr.) P: 261. An introduction to the theory of finance, including such topics as compound interest, annuities certain, amortization schedules, sinking funds, bonds, and related securities.

390 Topics in Applied Mathematics for Juniors (3 cr.) Treats applied topics in mathematics at the junior level. Prerequisites and course material vary with the applications.

398 Internship in Professional Practice (1-3 cr.) P: Approval of Department of Mathematical Sciences. Professional work experience involving significant use of mathematics or statistics. Evaluation of performance by employer and Department of Mathematical Sciences. May count toward major requirements with approval of the Department of Mathematical Sciences. May be repeated with approval of the Department of Mathematical Sciences for a total of 6 credits.

414 Numerical Methods (CSCI 414) (3 cr.) P: 262 and a course in a high-level programming language. Not open to students with credit in CSCI 512. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, and numerical solution of ordinary differential equations.

417 Discrete Modeling and Game Theory (3 cr.) P: 262 and 351 or 511, or consent of instructor. Linear programming; mathematical modeling of problems in economics, management, urban administration, and the behavioral sciences.

424 The Teaching of Mathematics in Middle and Junior High Schools (2 cr.) Designed to prepare the prospective teacher to plan, present, and evaluate mathematics lessons, determine goals, manage instruction, and use a variety of instructional strategies.

425 The Teaching of Mathematics in Secondary Schools (2-3 cr.) Designed to prepare the prospective teacher to plan, present, and evaluate mathematics lessons, determine goals, manage instruction, and use a variety of instructional strategies.

426 Introduction to Applied Mathematics and Modeling (3 cr.) P: 262 and PHYS 152. Introduction to problems and methods in applied mathematics and modeling. Formulation of models for phenomena in science and engineering, their solution, and physical interpretation of results. Examples chosen from solid and fluid mechanics, mechanical systems, diffusion phenomena, traffic flow, and biological processes.

441 Foundations of Analysis (3 cr.) P: 261. Set theory, mathematical induction, real numbers, completeness axiom, open and closed sets in Rm, sequences, limits, continuity and uniform continuity, inverse functions, differentiation of functions of one and several variables.

442 Foundations of Analysis II (3 cr.) P: 441. Continuation of differentiation, the mean value theorem and applications, the inverse and implicit function theorems, the Riemann integral, the fundamental theorem of calculus, point-wise and uniform convergence, convergence of infinite series, and series of functions.

453 Beginning Abstract Algebra (3 cr.) P: 351 or consent of instructor. Basic properties of groups, rings, and fields, with special emphasis on polynomial rings.

456 Introduction to the Theory of Numbers (3 cr.) P: 261. Divisibility, congruences, quadratic residues, Diophantine equations, and the sequence of primes.

462 Elementary Differential Geometry (3 cr.) P: 351. Calculus and linear algebra applied to the study of curves and surfaces. Curvature and torsion, Frenet-Serret apparatus and theorem, and fundamental theorem of curves. Transformation of R2, first and second fundamental forms of surfaces, geodesics, parallel translation, isometries, and fundamental theorem of surfaces.

463 Intermediate Euclidean Geometry for Secondary Teachers (3 cr.) P: 300 and one year of high school geometry, or consent of instructor. History of geometry. Ruler and compass constructions, and a critique of Euclid. The axiomatic method, models, and incidence geometry. Presentation, discussion and comparison of Hilbert's, Birkhoff's, and SMSG's axiomatic developments.

490 Topics in Mathematics for Undergraduates (1-5 cr.) By arrangement. Open to students only with the consent of the department. Supervised reading and reports in various fields.

491 Seminar in Competitive Math Problem-Solving (1-3 cr.) Approval of the director of undergraduate programs is required. This seminar is designed to prepare students for various national and regional mathematics contests and examinations such as the Putnam Mathematical Competition, the Indiana College Mathematical Competition and the Mathematical Contest in Modeling (MCM), among others. May be repeated twice for credit.

492 Capstone Experience (1-3 cr.) By arrangement.

495 TA Instruction (0 cr.) For teaching assistants. Intended to help prepare TAs to teach by giving them the opportunity to present elementary topics in a classroom setting under the supervision of an experienced teacher who critiques the presentations.

Advanced Undergraduate and Graduate Level

504 Real Analysis (3 cr.) P: 441 or consent of instructor. Completeness of the real number system, basic topological properties, compactness, sequences and series, absolute convergence of series, rearrangement of series, properties of continuous functions, the Riemann-Stieltjes integral, sequences and series of functions, uniform convergence, the Stone-Weierstrass theorem, equicontinuity, and the Arzela-Ascoli theorem.

505 Intermediate Abstract Algebra (3 cr.) P: 453 or consent of instructor. Group theory with emphasis on concrete examples and applications. Field theory: ruler and compass constructions, Galois theory, and solvability of equations by radicals.

510 Vector Calculus (3 cr.) P: 261. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes' theorem, divergence theorems, and applications to engineering and the physical sciences.

511 Linear Algebra with Applications (3 cr.) P: 261. Not open to students with credit in 351. Matrices, rank and inverse of a matrix, decomposition theorems, eigenvectors, unitary and similarity transformations on matrices.

518 Advanced Discrete Mathematics (3 cr.) P: 262 or consent of instructor. This course covers mathematics useful in analyzing computer algorithms. Topics include recurrence relations, evaluation of sums, integer functions, elementary number theory, binomial coefficients, generating functions, discrete probability, and asymptotic methods.

519 Introduction to Probability (STAT 519) (3 cr.) P: 262. See course listing for STAT 519.

520 Boundary Value Problems of Differential Equations (3 cr.) P: 261 and 262. Sturm-Liouville theory, singular boundary conditions, orthogonal expansions, separation of variables in partial differential equations, and spherical harmonics.

522 Qualitative Theory of Differential Equations (3 cr.) P: 262 and 351. Nonlinear ODEs, critical points, stability and bifurcations, perturbations, averaging, nonlinear oscillations and chaos, and Hamiltonian systems.

523 Introduction to Partial Differential Equations (3 cr.) P: 262 and 510, or consent of instructor. Method of characteristics for quasilinear first-order equations, complete integral, Cauchy-Kowalewsky theory, classification of second-order equations in two variables, canonical forms, difference methods of hyperbolic and parabolic equations, and Poisson integral method for elliptic equations.

525 Introduction to Complex Analysis (3 cr.) P: 261 and 262. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; and elementary conformal mapping.

526 Principles of Mathematical Modeling (3 cr.) P: 262 and 510, or consent of instructor. Ordinary and partial differential equations of physical problems, simplification, dimensional analysis, scaling, regular and singular perturbation theory, variational formulation of physical problems, continuum mechanics, and fluid flow.

527 Advanced Mathematics for Engineering and Physics I (3 cr.) P: 262. R: 511. Linear algebra, systems of ordinary differential equations, Laplace transforms, Fourier series and transforms, and partial differential equations.

528 Advanced Mathematics for Engineering and Physics II (3 cr.) P: 537 or consent of instructor. Divergence theorem, Stokes' Theorem, complex variables, contour integration, calculus of residues and applications, conformal mapping, and potential theory.

530 Functions of a Complex Variable I (3 cr.) P or C: 544. Complex numbers, holomorphic functions, harmonic functions, and linear transformations. Power series, elementary functions, Riemann surfaces, contour integration, Cauchy's theorem, Taylor and Laurent series, and residues. Maximum and argument principles. Special topics.

531 Functions of a Complex Variable II (3 cr.) P: 530. Compactness and convergence in the space of analytic functions, Riemann mapping theorem, Weierstrass factorization theorem, Runge's theorem, Mittag-Leffler theorem, analytic continuation and Riemann surfaces, and Picard theorems.

532 Elements of Stochastic Processes (STAT 532) (3 cr.) P: 519. See course listing for STAT 532.

535 Theoretical Mechanics (3 cr.) P: 262 and PHYS 152. Kinematics and dynamics of systems of particles and of rigid bodies, Lagrange and Hamilton-Jacobi equations, oscillations about equilibrium, Hamiltonian systems, integral invariants, and transformation theory.

536 Perturbation and Asymptotic Analysis (3 cr.) P: 525 or 530, and 523. Matched asymptotic expansions, inner and outer expansions, strained coordinates and multiple scales, and turning point analysis.

537 Applied Mathematics for Scientists and Engineers I (3 cr.) P: 261, 262, and consent of instructor. Covers theories, techniques, and applications of partial differential equations, Fourier transforms, and Laplace transforms. Overall emphasis is on applications to physical problems.

544 Real Analysis and Measure Theory (3 cr.) P: 441 or consent of instructor. Algebras of sets, real number system, Lebesgue measure, measurable functions, Lebesgue integration, differentiation, absolute continuity, Banach spaces, metric spaces, general measure and integration theory, and Riesz representation theorem.

545 Principles of Analysis II (3 cr.) P: 544. Continues the study of measure theory begun in 544.

546 Introduction to Functional Analysis (3 cr.) P: 545. By arrangement. Banach spaces, Hahn-Banach theorem, uniform boundedness principle, closed graph theorem, open mapping theorem, weak topology, and Hilbert spaces.

547 Analysis for Teachers I (3 cr.) P: 261. Set theory, logic, relations, functions, Cauchy's inequality, metric spaces, neighborhoods, and Cauchy sequence.

548 Analysis for Teachers II (3 cr.) P: 547. Functions on a metric space, continuity, uniform continuity, derivative, chain rule, Riemann integral, fundamental theorem of calculus, and double integrals.

549 Applied Mathematics for Secondary School Teachers (3 cr.) P: 262 and 351. Summer, odd-numbered years. Applications of mathematics to problems in the physical sciences, social sciences, and the arts. Content varies. May be repeated for credit with the consent of the instructor.

550 Algebra for Teachers I (3 cr.) P: 351. Definitions and elementary properties of groups, rings, integral domains, and fields. Intended for secondary school teachers.

551 Algebra for Teachers II (3 cr.) P: 550. Polynomial rings, fields, vector spaces, and matrices.

552 Applied Computational Methods II (3 cr.) P: 559 and consent of instructor. The first part of the course focuses on numerical integration techniques and methods for ODEs. The second part concentrates on numerical methods for PDEs based on finite difference techniques with brief surveys of finite element and spectral methods.

553 Introduction to Abstract Algebra (3 cr.) P: 453 or consent of instructor. Group theory: finite abelian groups, symmetric groups, Sylow theorems, solvable groups, Jordan-Hölder theorem. Ring theory: prime and maximal ideals, unique factorization rings, principal ideal domains, Euclidean rings, and factorization in polynomial and Euclidean rings. Field theory: finite fields, Galois theory, and solvability by radicals.

554 Linear Algebra (3 cr.) P: 351. Review of basics: vector spaces, dimension, linear maps, matrices, determinants, and linear equations. Bilinear forms, inner product spaces, spectral theory, and eigenvalues. Modules over principal ideal domain, finitely generated abelian groups, and Jordan and rational canonical forms for a linear transformation.

559 Applied Computational Methods I (3 cr.) P: 262 and 351 or 511. Computer arithmetic, interpolation methods, methods for nonlinear equations, methods for solving linear systems, special methods for special matrices, linear least square methods, methods for computing eigenvalues, iterative methods for linear systems; methods for systems of nonlinear equations.

561 Projective Geometry (3 cr.) P: 351. Projective invariants, Desargues' theorem, cross-ratio, axiomatic foundation, duality, consistency, independence, coordinates, and conics.

562 Introduction to Differential Geometry and Topology (3 cr.) P: 351 and 442. Smooth manifolds, tangent vectors, inverse and implicit function theorems, submanifolds, vector fields, integral curves, differential forms, the exterior derivative, DeRham cohomology groups, surfaces in E3, Gaussian curvature, two-dimensional Riemannian geometry, and Gauss-Bonnet and Poincaré theorems on vector fields.

563 Advanced Geometry (3 cr.) P: 300 or consent of instructor. Topics in Euclidean and non-Euclidean geometry.

571 Elementary Topology (3 cr.) P: 441. Topological spaces, metric spaces, continuity, compactness, connectedness, separation axioms, nets, and function spaces.

572 Introduction to Algebraic Topology (3 cr.) P: 571. Singular homology theory, Ellenberg-Steenrod axioms, simplicial and cell complexes, elementary homotopy theory, and Lefschetz fixed point theorem.

578 Mathematical Modeling of Physical Systems I (3 cr.) P: 262, PHYS 152, PHYS 251, and consent of instructor. Linear systems modeling, mass-spring-damper systems, free and forced vibrations, applications to automobile suspension, accelerometer, seismograph, etc., RLC circuits, passive and active filters, applications to crossover networks and equalizers, nonlinear systems, stability and bifurcation, dynamics of a nonlinear pendulum, van der Pol oscillator, chemical reactor, etc., introduction to chaotic dynamics, identifying chaos, chaos suppression and control, computer simulations, and laboratory experiments.

581 Introduction to Logic for Teachers (3 cr.) P: 351. Not open to students with credit in 385. Logical connectives, rules of sentential inference, quantifiers, bound and free variables, rules of inference, interpretations and validity, theorems in group theory, and introduction to set theory.

583 History of Elementary Mathematics (3 cr.) P: 261. A survey and treatment of the content of major developments of mathematics through the eighteenth century, with selected topics from more recent mathematics, including non-Euclidean geometry and the axiomatic method.

585 Mathematical Logic I (CSCI 585) (3 cr.) P: 351. Formal theories for propositional and predicate calculus with study of models, completeness, and compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

587 General Set Theory (3 cr.) P: 351. Informal axiomatization of set theory, cardinal numbers, countable sets, cardinal arithmetic, order types, well-ordered sets and ordinal numbers, axiom of choice and equivalences, paradoxes of intuitive set theory, and Zermelo-Fraenkel axioms.

588 Mathematical Modeling of Physical Systems II (3 cr.) P: 578. Depending on the interests of the students, the content may vary from year to year. Emphasis will be on mathematical modeling of a variety of physical systems. Topics will be chosen from the volumes *Mathematics in Industrial Problems* by Avner Friedman. Researchers from local industries will be invited to present real-world applications. Each student will undertake a project in consultation with one of the instructors or an industrial researcher.

598 Topics in Mathematics (1-5 cr.) By arrangement. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

Graduate Level

611 Methods of Applied Mathematics I (3 cr.) P: consent of instructor. Introduction to Banach and Hilbert spaces, linear integral equations with Hilbert-Schmidt kernels, eigenfunction expansions, and Fourier transforms.

612 Methods of Applied Mathematics II (3 cr.) P: 611. Continuation of theory of linear integral equations; Sturm-Liouville and Weyl theory for second-order differential operators, distributions in n dimensions, and Fourier transforms.

626 Mathematical Formulation of Physical Problems I (3 cr.) P: graduate standing and consent of instructor. Topics to be chosen from the following: Tensor formulation of the field equations in continuum mechanics, fluid dynamics, hydrodynamic stability, wave propagation, and theoretical mechanics.

627 Mathematical Formulation of Physical Problems II (3 cr.) P: 626. Continuation of 626.

642 Methods of Linear and Nonlinear Partial Differential Equations I (3 cr.) P: 520, 523, and 611. Topics from linear and nonlinear partial differential equations, varied from time to time.

646 Functional Analysis (3 cr.) P: 546. Advanced topics in functional analysis, varying from year to year at the discretion of the instructor.

672 Algebraic Topology I (3 cr.) P: 572. Continuation of 572; cohomology, homotopy groups, fibrations, and further topics.

673 Algebraic Topology II (3 cr.) P: 672. continuation of 672, covering further advanced topics in algebraic and differential topology such as K-theory and characteristic classes.

692 Topics in Applied Mathematics (1-3 cr.)

693 Topics in Analysis (1-3 cr.)

694 Topics in Differential Equations (1-3 cr.)

697 Topics in Topology (1-3 cr.)

699 Research Ph.D. Thesis (cr. arr.)

Courses in Statistics (STAT)

Undergraduate Level

Lower-Division Courses

113 Statistics and Society (3 cr.) Intended to familiarize the student with basic statistical concepts and some of their applications in public and health policies as well as in social and behavioral sciences. No mathematics beyond simple algebra is needed, but quantitative skills are strengthened by constant use. Involves much reading, writing, and critical thinking through discussions on such topics as data ethics, public opinion polls and the political process, the question of causation the role of government statistics, and dealing with chance in everyday life. Applications include public opinion polls, medical experiments, smoking and health, the consumer price index, state lotteries, and the like. STAT 113 can be used for general education or as preparation for later methodology courses.

190 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading course or special topics course at the freshmen level. Prerequisites and course material vary with the topic.

290 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading course or special topics course at the sophomore level. Prerequisites and course material vary with the topic.

Upper-Division Courses

301 Elementary Statistical Methods I (3 cr.) P: MATH 110 or 111 or equivalent. Not open to students in the Department of Mathematical Sciences. Fall, Spring. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, and correlation and regression. Software is used throughout.

302 Elementary Statistical Methods II (3 cr.) P: 301 or equivalent. Continuation of 301. Multiple regression and analysis of variance, with emphasis on statistical inference and applications to various fields.

311 Introductory Probability (3 cr.) P: MATH 261 or equivalent. Not open to students with credit in 416. Fall. Fundamental axioms and laws of probability; finite sample spaces and combinatorial probability; conditional probability; Bayes theorem; independence; discrete and continuous random variables; univariate and bivariate distributions; binomial, negative binomial, Poisson, normal, and gamma probability models; mathematical expectation; and moments and moment generating functions.

350 Introduction to Statistics (3 cr.) P: MATH 163 or equivalent. Fall, Spring. A data-oriented introduction to the fundamental concepts and methods of applied statistics. 350 is intended primarily for majors in the mathematical sciences (mathematics, actuarial sciences, mathematics education). The objective is to acquaint the students with the essential ideas and methods of statistical analysis for data in simple settings. It covers material similar to that of 511 but with emphasis on more data-analytic material. Includes a weekly computing laboratory using Minitab.

371 Prep for Actuarial Exam I (2 cr.) This course is intended to help actuarial students prepare for the Actuarial Exam P.

390 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading course or special topics course at the junior level. Prerequisites and course material vary with the topic.

416 Probability (3 cr.) P: MATH 261 or equivalent. Not open to students with credit in 311. Fall, Spring. An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability, Bayes theorem, discrete and continuous random variables, moments and moment generating functions, continuous distributions and their properties, law of large numbers, and central limit theorem.

417 Statistical Theory (3 cr.) P: 416. R: 350 or equivalent. Spring. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions.

472 Actuarial Models I (3 cr.) P: 417 or equivalent. Mathematical foundations of actuarial science emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums. This course, together with its sequel, 473, provides most of the background for Course 3 of the Society of Actuaries and the Casualty Actuarial Society.

473 Actuarial Models II (3 cr.) P: 472. Continuation of 472. Together, these courses cover contingent payment models, survival models, frequency and severity models, compound distribution models, simulation models, stochastic process models, and ruin models.

490 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading and reports in various fields.

Advanced Undergraduate and Graduate Level

511 Statistical Methods I (3 cr.) P: MATH 164. Descriptive statistics; elementary probability; random variables and their distributions; expectation; normal, binomial, Poisson, and hypergeometric distributions; sampling distributions; estimation and testing of hypotheses; one-way analysis of variance; and correlation and regression.

512 Applied Regression Analysis (3 cr.) P: 511. Inference in simple and multiple linear regression, estimation of model parameters, testing and prediction. Residual analysis, diagnostics and remedial measures. Multicollinearity. Model building, stepwise, and other model selection methods. Weighted least squares. Nonlinear regression. Models with qualitative independent variables. One-way analysis of variance. Orthogonal contrasts and multiple comparison tests. Use of existing statistical computing package.

513 Statistical Quality Control (3 cr.) P: 511. Control charts and acceptance sampling, standard acceptance plans, continuous sampling plans, sequential analysis, and response surface analysis. Use of existing statistical computing packages.

514 Designs of Experiments (3 cr.) P: 512. Fundamentals, completely randomized design, and randomized complete blocks. Latin squares, multiclassification, factorial, nested factorial, incomplete blocks, fractional replications, confounding, general mixed factorial, split-plot, and optimum design. Use of existing statistical computing packages.

515 Statistical Consulting Problems (1-3 cr.) P: consent of advisor. Consultation on real-world problems involving statistical analysis under the guidance of a faculty member. A detailed written report and an oral presentation are required.

516 Basic Probability and Applications (3 cr.) P: MATH 261 or equivalent. A first course in probability intended to serve as a foundation for statistics and other applications. Intuitive background; sample spaces and random variables; joint, conditional, and marginal distributions; special distributions of statistical importance; moments and moment generating functions; statement and application of limit theorems; and introduction to Markov chains.

517 Statistical Inference (3 cr.) P: 511 or 516. A basic course in statistical theory covering standard statistical methods and their applications. Includes unbiased, maximum likelihood, and moment estimation; confidence intervals and regions; testing hypotheses for standard distributions and contingency tables; and introduction to nonparametric tests and linear regression.

519 Probability Theory (3 cr.) P: MATH 261 or equivalent. Sample spaces and axioms of probability, conditional probability, independence, random variables, distribution functions, moment generating and characteristics functions, special discrete and continuous distributions—univariate and multivariate cases, normal multivariate distributions, distribution of functions of random variables, modes of convergence and limit theorems, including laws of large numbers and central limit theorem.

520 Time Series and Applications (3 cr.) P: 519. A first course in stationary time series with applications in engineering, economics, and physical sciences. Stationarity, autocovariance function and spectrum; integral representation of a stationary time series and interpretation; linear filtering; transfer function models; estimation of spectrum; and multivariate time series. Use of existing statistical computing packages.

521 Statistical Computing (3 cr.) C: 512 or equivalent. A broad range of topics involving the use of computers in statistical methods. Collection and organization of data for statistical analysis; transferring data between statistical applications and computing platforms; techniques in exploratory data analysis; and comparison of statistical packages.

522 Sampling and Survey Techniques (3 cr.) P: 512 or equivalent. Survey designs; simple random, stratified, and systematic samples; systems of sampling; methods of estimation; ratio and regression estimates; and costs. Other related topics as time permits.

523 Categorical Data Analysis (3 cr.) P: 528 or equivalent, or consent of instructor. Models generating binary and categorical response data, two-way classification tables, measures of association and agreement, goodness-of-fit tests, testing independence, large sample properties. General linear models, logistic regression, and probit and extreme value models. Loglinear models in two and higher dimensions; maximum likelihood estimation, testing goodness-of-fit, partitioning chi-square, and models for ordinal data. Model building, selection, and diagnostics. Other related topics as time permits. Computer applications using existing statistical software.

524 Applied Multivariate Analysis (3 cr.) P: 528 or equivalent, or consent of instructor. Extension of univariate tests in normal populations to the multivariate case, equality of covariance matrices, multivariate analysis of variance, discriminant analysis and misclassification errors, canonical correlation, principal components, and factor analysis. Strong emphasis on the use of existing computer programs.

525 Intermediate Statistical Methodology (3 cr.) C: 528 or equivalent, or consent of instructor. Generalized linear models, likelihood methods for data analysis, and diagnostic methods for assessing model assumptions. Methods covered include multiple regression, analysis of variance for completely randomized designs, binary and categorical response models, and hierarchical loglinear models for contingency tables.

528 Mathematical Statistics (3 cr.) P: 519 or equivalent. Sufficiency and completeness, the exponential family of distributions, theory of point estimation, Cramer-Rao inequality, Rao-Blackwell Theorem with applications, maximum likelihood estimation, asymptotic distributions of ML estimators, hypothesis testing, Neyman-Pearson Lemma, UMP tests, generalized likelihood ratio test, asymptotic distribution of the GLR test, and sequential probability ratio test.

529 Applied Decision Theory and Bayesian Analysis (3 cr.) C: 528 or equivalent. Foundation of statistical analysis, Bayesian and decision theoretic formulation of problems; construction of utility functions and quantifications of prior information; methods of Bayesian decision and inference, with applications; empirical Bayes; combination of evidence; and game theory and minimax rules, Bayesian design, and sequential analysis. Comparison of statistical paradigms.

532 Elements of Stochastic Processes (MATH 532) (3 cr.) P: 519 or equivalent. A basic course in stochastic models including discrete and continuous time processes, Markov chains, and Brownian motion. Introduction to topics such as Gaussian processes, queues and renewal processes, and Poisson processes. Application to economic models, epidemic models, and reliability problems.

533 Nonparametric Statistics (3 cr.) P: 516 or equivalent. Binomial test for dichotomous data, confidence intervals for proportions, order statistics, one-sample signed Wilcoxon rank test, two-sample Wilcoxon test, two-sample rank tests for dispersion, and Kruskal-Wallis test for one-way layout. Runs test and Kendall test for independence, one- and two-sample Kolmogorov-Smirnov tests, and nonparametric regression.

536 Introduction to Survival Analysis (3 cr.) P: 517 or equivalent. Deals with the modern statistical methods for analyzing time-to-event data. Background theory is provided, but the emphasis is on the applications and the interpretations of results. Provides coverage of survivorship functions and censoring patterns; parametric models and likelihood methods, special life-time distributions; nonparametric inference, life-tables, estimation of cumulative hazard functions, and the Kaplan-Meier estimator; one- and two-sample nonparametric tests for censored data; and semiparametric proportional hazards regression (Cox Regression), parameters' estimation, stratification, model fitting strategies, and model interpretations. Heavy use of statistical software such as Splus and SAS.

598 Topics in Statistical Methods (1-3 cr.) P: consent of instructor. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

698 Research M.S. Thesis (6 cr.) P: consent of advisor. M.S. thesis in applied statistics.

Department of Physics

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Professors Kemple, Ou, Rao, Vemuri (Chair)

Professors Emeriti Kaplan, Meiere, Novak, Vasavada

Associate Professor Emeritus Seubert

Associate Professors Gavrin *(Associate Dean, School of Science)*, Kleinhans, Wassall

Assistant Professors Betancourt, Cheng, Decca, Joglekar, Petrache, Rader

Lecturers Ross, Woodahl

Departmental Academic Advisor Woodahl

Physics is the study of matter and energy, from the smallest scale, as in the study of elementary particles, to the largest, as in the study of the formation and evolution of stars and galaxies. In this sense, physics is the science that underlies all of the other sciences. In principle, as well as in practice, physics is involved in virtually all scientific and technical endeavors (e.g., biophysics, geophysics, health physics, etc.).

Physicists tend to view themselves primarily as solvers of problems, especially problems that can be expressed in mathematical terms. Physics students are trained to solve complex problems by learning to analyze complex relations in mathematical terms, often with the help of today's fast computers. Because of this broadly based and flexible problem-solving background, physics graduates find employment in a variety of fields, many of which are not directly associated with physics.

The Department of Physics offers a program leading to a Bachelor of Science degree from Purdue University. In addition, the department offers courses in physics and astronomy for nonmajors. The department also offers graduate courses that lead to a Purdue Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree in physics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette.

Members of the department conduct research in several disciplines of physics and participate in joint projects with a number of other research groups, such as the Indianapolis Center for Advanced Research and the IU School of Medicine. Student participation in these projects is welcomed and encouraged.

Students majoring in physics consolidate their undergraduate studies by putting what they have learned to use in a capstone experience in one of the department's research laboratories. Each student joins a member of the faculty in a project that provides experience in a professional setting. The student must obtain the approval of a faculty member and register for PHYS 490.

Guide to Service Courses

Each student should consult an advisor in the department in which a degree is sought to determine which service course is appropriate. A general guide to the schools served by these courses is as follows:

AST A100-AST A105: General science courses for students in all majors.

AST A130: Focused short courses for students in all majors.

PHYS 140: Focused short courses for students in all majors.

PHYS 100: For students in allied health, business, and liberal arts (a traditional survey course).

PHYS 200: For students in education, SPEA, and liberal arts (a nontraditional course).

PHYS 218-219: A noncalculus sequence for technology students.

PHYS P201-PHYS P202: A noncalculus sequence for preprofessional students.

PHYS 152-251-342: For students in science and engineering requiring a calculus-based sequence.

Bachelor of Science

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Areas I, II, III Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under "Undergraduate Programs"). The second semester of English composition may be satisfied only with ENG W132 (or ENG W150), ENG W231, ENG W250, ENG W290, ENG W331, ENG W350, or TCM 320.

The Department of Physics has the following additional requirements:

Area IIIC Physical and Biological Sciences Courses must include CHEM C105/CHEM C125 and CHEM C106/CHEM C126 with laboratory or their approved equivalent.

Area IIID Mathematical Sciences 24 credit hours of courses in mathematics, which must include MATH 163, 164, 261, and 262 or equivalent, plus 3 or 6 more credit hours above the level of MATH 262 (see below). The computer science requirement of the School of Science may be satisfied with CSCI 230, CSCI N305, CSCI N331, or any higher-level CSCI course.

Note: Computer Science CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Physics Concentration The Department of Physics offers four options for students pursuing the Bachelor of Science degree: a traditional physics program, a biophysics option, a program designed for students planning a career in physics teaching, and an accelerated program in physics and mechanical engineering. This program is known as the BPMME program because students earn both a bachelor's in physics and a master's in mechanical engineering.

Students pursuing the traditional program must complete: PHYS 152, 251, 300, 310, 330, 342, 353, 400, 401, 416, 442, and 490. These students must complete 6 hours of mathematics above the level of MATH 262 in courses approved by the Department of Physics.

Students pursuing the biophysics option must complete: Students pursuing the teaching option must complete: PHYS 152, 251, 310, 330, 342, 353, and 490. The Department of Physics may substitute other science courses for the 400-level courses and recommend education courses in order to meet teacher certification requirements. These students must complete 6 hours of mathematics above the level of MATH 262 in courses approved by the Department of Physics.

Students pursuing the program in physics and mechanical engineering must complete: PHYS 152, 251, 310, 330, 342, 353, and 416. These students must complete 3 hours of mathematics above the level of MATH 262 in courses approved by the Department of Physics. Students in this program must satisfy additional requirements specified by the Department of Mechanical Engineering.

Courses taken outside the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of clinical, athletic, or performing arts courses will be approved. See the departmental advisor for details.

Bachelor of Science—Biophysics Option

For students who desire an interdisciplinary knowledge of physics and biology pursuant to a career in medicine or biophysics. The program meets typical medical school entrance requirements.

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 18 credit hours are required to take SCI I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Areas I, II, III Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under ''Undergraduate Programs''). The second semester of English composition may be satisfied only with ENG W132 (or ENG W150), ENG W231, ENG W250, ENG W290, ENG W331, ENG W350, or TCM 320.

The Department of Physics, Biophysics Option has the following additional requirements:

Area IIID Mathematical Sciences 18 credit hours of courses in mathematics, which must include MATH 163, 164, 261, and 262 or equivalent. The computer science requirement of the School of Science may be satisfied with CSCI 230, CSCI N305, CSCI N331, or any higher-level CSCI course.

Note: Computer Science CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Physics (Biophysics) Concentration Requirements

Physics: A minimum of 26 hours of physics is required.

PHYS P201 or PHYS 152 and PHYS P202 **or** PHYS 251 (Introductory Physics).
Two of the following three courses: Mathematical Physics 300, Mechanics 310, Electricity and Magnetism 330.
342 Modern Physics and 353 Lab, 442 Quantum Mechanics, and 490 Physics (Biophysics) Capstone experience (3 hrs).

Biology: A minimum of 15 hours of biology is required.

General Biology: BIOL K101 and BIOL K103.
Five additional hours of Biology drawn from
BIOL K324/BIOL K325 Cell Biology and lab, **or**
BIOL K356/BIOL K357 Microbiology and lab, **or**
BIOL K483 Biological Chemistry and BIOL K484 Cellular Biochemistry.

Chemistry: A minimum of 23 hours of chemistry is required.
General Chemistry: CHEM C105/CHEM C125 and CHEM C106/CHEM C126.
Organic Chemistry: CHEM C341/CHEM C343 and CHEM C342/CHEM C344.
Physical Chemistry: CHEM C360 or CHEM C361.

Courses taken outside the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of clinical, athletic, or performing arts courses will be approved. See the departmental advisor for details.

Bachelor of Science Sample Program (124 cr. required)

The Department of Physics recommends the following sample program leading to the degree of Bachelor of Science.

Freshman Year

First Semester	
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 163 Integrated Calculus and Analytic Geometry I	5
SCI I120 Windows on Science	1
ENG W131 Elementary Composition I	3
	14

Second Semester	
PHYS 152 Mechanics	4
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
Second composition course	3
	17

Sophomore Year

Third Semester	
PHYS 251 Heat, Electricity, and Optics	5
MATH 261 Multivariate Calculus	4
CSCI Course	3
HIST H114 History of Western Civilization II	3
	15

Fourth Semester	
PHYS 300 Introduction to Elementary Mathematical physics	3
PHYS 342 Modern Physics	3
MATH 262 Linear Algebra and Differential Equations	4
COMM R110 Fundamentals of Speech Communication	3
One Course from List H, S, or C	3
	16

Junior Year

Fifth Semester	
PHYS 310 Intermediate Mechanics	4
MATH Course	3
One course from remaining Two H, S, or C lists	3
One course from remaining H, S, or C lists	3
Elective	3
	16

Sixth Semester

PHYS 330 Intermediate Electricity and Magnetism	3
PHYS 353 Electronics Laboratory	2
MATH course	3
Physical or biological science elective	3
Junior/Senior Integrator	3
Elective	3
	17

Senior Year

Seventh Semester

PHYS 400 Physical Optics	3
PHYS 401 Physical Optics Laboratory	2
PHYS 442 Quantum Mechanics	3
Physical or biological science elective	3
Elective	3
	14

Eighth Semester

PHYS 416 Thermal Physics	3
PHYS 490 Undergraduate Research and Capstone Experience	1-3
Electives	8-10
CAND 991 Candidate for Graduation	0
	12-16

Bachelor of Science: Biophysics Option Sample Program (Minimum 124 cr. required)

Freshman Year

First Semester

PHYS P201 General Physics I	5
or PHYS 152 Mechanics	4
CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 163 Integrated Calculus and Analytic Geometry I	5
SCI I120 Windows on Science	1
Total	**15-16**

Second Semester

PHYS P202 General Physics II	5
or PHYS 251 Heat, Electricity, and Optics	5
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
Total	**15**

Sophomore Year

Third Semester

BIOL K101 Concepts of Biology I	5
CHEM C341 Organic Chemistry I	3
CHEM C343 Organic Chemistry Laboratory I	2
MATH 261 Multivariate Calculus	4
ENG W131 Elementary Composition I	3
Total	**17**

Fourth Semester

PHYS 300 Introduction to Elementary Mathematical PhysicS	3
BIOL K103 Concepts of Biology II	5
CHEM C342 Organic Chemistry II	3
CHEM C344 Organic Chemistry Laboratory II	2
MATH 262 Linear Algebra and Differential Equations	4
Total	**17**

Junior Year

Fifth Semester

PHYS 310 Intermediate Mechanics	4
BIOL K324 Cell Biology	3
BIOL K325 Cell Biology Laboratory	2
CSCI Course	3-4
HIST H114 History of Western Civilization II	3
Total	**15-16**

Sixth Semester

PHYS 342 Modern Physics	3
PHYS 353 Electronics Laboratory	2
CHEM C360 Elementary Physical Chemistry	3
Second composition course	3
One course from list H, S, or C	3
Elective	2
Total	**16**

Senior Year

Seventh Semester

PHYS 442 Quantum Mechanics	3
PHYS 490 Capstone Experience	3
One course from remaining two H, S, or C lists	3
Junior/Senior Integrator course	3
Elective	3
Total	**15**

Eighth Semester

COMM R110 Fundamentals of Speech Communication	3
One course from remaining H, S, or C lists	3
Electives	8
CAND 991 Candidate for Graduation	0
Total	**14**

Bachelor of Science and Master of Science (BPMME) Sample Program (142 cr. required)

The Department of Physics recommends the following sample program for students pursuing the BPMME program.

Freshman Year

First Semester

CHEM C105 Principles of Chemistry I	3
CHEM C125 Experimental Chemistry I	2
MATH 163 Integrated Calculus and Analytic Geometry I	5
SCI I120 Windows on Science	1
ENG W131 Elementary Composition I	3
	14

Second Semester

PHYS 152 Mechanics	4
CHEM C106 Principles of Chemistry II	3
CHEM C126 Experimental Chemistry II	2
MATH 164 Integrated Calculus and Analytic Geometry II	5
Second composition course	3
	17

Summer of Freshman Year

Two courses from list H, S, or C	6
	6

Sophomore Year

Third Semester

PHYS 251 Heat, Electricity, and Optics	5
MATH 261 Multivariate Calculus	4

CSCI Course	4
HIST H114 History of Western Civilization II	3
	16

Fourth Semester

PHYS 310 Intermediate Mechanics	4
PHYS 342 Modern Physics	3
MATH 262 Linear Algebra and Differential Equations	4
COMM R110 Fundamentals of Speech Communication	3
Elective	3
	17

Summer of Sophomore Year

One course from list H, S, or C	3
	3

Junior Year

Fifth Semester

PHYS 330 Intermediate Electricity and Magnetism	3
PHYS 353 Electronics Laboratory	2
ME 272 Mechanics of Materials	4
ME 330 Modeling and Analysis of Dynamic Systems	3
Physical or biological science elective	5
	17

Sixth Semester

PHYS 416 Thermal Physics	3
ME 462 Engineering Design	4
MATH Course	3
Physical or biological science elective	3
Junior/Senior Integrator	3
	16

Senior Year

Seventh Semester

ME 5## ME primary area course	3
Elective (4##-5##) Engineering or Physics (e.g., PHYS 400)	3
MATH 537 Applied Mathematics for Scientists and Engineers I	3
	9

Eighth Semester

ME 5## ME primary area course	3
Elective (4##-5##) Engineering or Physics (e.g., PHYS 400)	3
MATH 538 Applied Mathematics for Scientists and Engineers II	3
	9

Fifth Year

Ninth Semester

PHYS 550 Introduction to Quantum Mechanics	3
ME 5## ME primary area course	3
ME 5## ME primary area course	3
	9

Tenth Semester

ME 698 (thesis option) **or** ME 5## (nonthesis option)	3
ME 698 (thesis option) **or** ME 5## (nonthesis option)	3
Science elective: Graduate PHYS **or** MATH course	3
CAND 991 Candidate for Graduation (with B.S. in Physics)	0

CAND 991 Candidate for Graduation (with M.S. in ME)	0
	9

Notes: Students should take PHYS 550 Introduction to Quantum Mechanics and one other physics or mathematics course, e.g., PHYS 510 Physical Mechanics or PHYS 600 Methods of Theoretical Physics, during the last two years.

The primary and related area courses are listed in the *Department of Mechanical Engineering Master's Program Handbook* (Edition 2000).

Minor in Physics

The Department of Physics offers an undergraduate minor in physics with the following requirements:

- The introductory physics sequence: PHYS 152 and 251.
- Modern Physics: PHYS 342.
- 6 more credit hours chosen from PHYS 300, 310, 330, 400, 416, or 442.
- The grade for each course submitted for the minor must be a C (2.0) or higher.

Correspondence courses may not be used to fulfill requirements for the minor.

Graduate Programs

The Department of Physics offers graduate programs leading to Purdue University Master of Science and Doctor of Philosophy degrees. For master's degree students, both thesis and nonthesis options are available.

Admission Requirements

Students who seek to enroll in the physics graduate program should have a baccalaureate degree from an accredited institution and have a background in the usual undergraduate courses in physics, mathematics, and other sciences. An average grade point average of 3.0 (B) or higher in physics courses is expected. Graduates from related fields of study in pure and applied science or engineering may be accepted on a probationary basis until they have completed any necessary undergraduate courses in physics. The Graduate Record Examination (GRE) is normally expected of all applicants. The GRE physics test is recommended, but not required.

Transfer Credit

The Department of Physics will normally accept, from approved institutions, a maximum of 6 transfer hours of graduate credit that are in excess of undergraduate degree requirements.

Application for Admission

Application materials and information can be obtained online at www.physics.iupui.edu or by writing to the chairperson of the graduate committee, IUPUI Department of Physics, Science Building, LD 154, 402 N. Blackford Street, Indianapolis, IN 46202-3273; phone (317) 274-6900. While the application is being processed, it is possible to enter IUPUI as a temporary graduate student. Generally, only 12 hours of credit earned under this classification may be counted toward an advanced degree.

Financial Assistance

Most physics graduate students receive financial support. Types of support available include teaching and research assistantships, fellowships, and tuition remission.

Master of Science

The general requirements include admission to regular graduate status, completion of the English requirement, a passing score on the Physics Qualifying Examination, satisfactory completion of an approved plan of study, and 30 hours of graduate credit as outlined below.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in English composition or by scoring 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination. Students who do not satisfy the English requirement by either of the above methods may take a written examination administered by the Department of English to demonstrate their proficiency. Students whose native language is not English must pass the TOEFL examination with a grade of 550 or higher and take a diagnostic test when they arrive at IUPUI. The score on this test will determine what English courses are required.

The Physics Qualifying Examination is administered throughout the Purdue graduate system and must be taken, at the latest, after completing the introductory graduate courses. Two attempts are permitted to obtain a passing grade.

The student's plan of study is worked out in cooperation with the student's graduate advisor and committee. It must be submitted and accepted by the graduate school no later than the semester before the one in which the student plans to graduate. The English requirement must be satisfied before the plan of study may be filed.

The master's degree requires the satisfactory completion of 30 credit hours of course work at the 500 and 600 level. Twenty-four (24) credit hours must be in physics and biophysics, including one laboratory course. In the thesis option, 6 of the physics credit hours will be earned by enrolling in PHYS 698 Research M.S. Thesis. This option requires a written thesis. In the nonthesis option, 6 of the physics credit hours will typically be earned through enrollment in PHYS 590 Reading and Research. This option requires a written report. Six (6) credit hours must be in mathematics, which may be replaced in part by PHYS 600 Methods of Theoretical Physics. The grade requirements are A or B in 500-level courses; A, B, or C in 600-level courses; A, B, or C in mathematics courses; and a minimum grade point average of 2.8.

Doctor of Philosophy

Qualified students may be authorized to pursue the Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. Students are usually expected to complete an M.S. degree before pursuing the Ph.D. degree. Interested students should contact the Department of Physics for further details.

Research Interests and Facilities

The department's major research strengths and facilities are in the area of biological physics and magnetic resonance, in experimental and theoretical laser physics and quantum optics, and in experimental materials physics. The physics faculty directs use of four magnetic resonance spectrometers in two locations. In addition, the school has a high-performance absorption spectrometer equipped to examine cryogenic samples, as well as other instrumentation for biophysical research. Current experimental research includes EPR and NMR investigations of cells, enzymes, proteins, and model membranes. Theoretical work involves calculations and computer simulations of magnetic resonance line shapes, studies of the biophysics of photosynthesis, and theoretical condensed matter physics. The optics labs are equipped with argon ion, titanium sapphire, diode, and helium-neon lasers, in addition to state-of-the-art equipment, including digital oscilloscopes and spectrum analyzers, which allow students and faculty to probe fundamental issues in laser noise and the quantum nature of light. The materials lab includes an advanced magnetron sputter deposition system, and systems for the measurement of magnetic and electronic properties of thin film materials. All students have access to the IUPUI computing facilities, which include dedicated Unix machines, as well as the minicomputers in the department. Several ongoing projects involve collaborations with the IU School of Medicine, Methodist Hospital of Indiana, and other departments in the School of Science.

Courses in Physics (PHYS)

The courses in this section are not listed in strict numerical order; courses are grouped according to levels of difficulty.

Note: Astronomy courses (AST) follow PHYS listings. P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered in the summer session; Day = offered as a daytime section; Night = offered as an evening section; Equiv. = course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University West Lafayette.

Undergraduate Level

010 Pre-Physics (3 cr.) P: MATH 159, or MATH 153 and 154, or equivalent. Fall, Spring. For students not ready to take the algebra- and trigonometry-based courses in physics (218 and P201). Basic concepts of physics. Methods of analyzing physics problems. Setting up equations for physics problems. Interpreting information in physics problems. Analyzing and presenting the results of laboratory measurements. Extensive drill in these topics.

100 Physics in the Modern World (5 cr.) P: introductory high school mathematics. Spring, day. Ideas, language, methods, and impact of physics today.

140 Short Courses in Physics (1 cr.) Five-week short courses on a variety of topics related to the physical world. Examples of topics include: Waves and Particles Are the Same Thing, Relativity, Quarks and Other Inhabitants of the Zoo, Why Things Work and Why They Don't, Lasers and Holography, Physics of Star Trek.

200 Our Physical Environment (3 cr.) Fall, night; Spring, night. A nonmathematical introduction to physical concepts and methods by means of examples from daily life and current technological applications.

218 General Physics (4 cr.) P: MATH 159 or equivalent. Fall, night; Spring, night; Summer, day. Lecture, one discussion section and one two-hour laboratory each week.Mechanics, conservation laws, gravitation; simple harmonic motion and waves; kinetic theory, heat, and thermodynamics for students in technology fields.

219 General Physics (4 cr.) P: 218. Fall, night; Spring, night; Summer, day. Lecture, one discussion section and one two-hour laboratory each week. Electricity, light, and modern physics.

P201 General Physics I (5 cr.) P: MATH 159 or equivalent. Fall, day; Spring, night; Summer, day. Three lectures, one discussion section, and one two-hour laboratory period each week.Newtonian mechanics, wave motion, heat, and thermodynamics. Application of physical principles to related scientific disciplines, especially life sciences. Intended for students preparing for careers in the life sciences and the health professions.

P202 General Physics II (5 cr.) P: P201. Fall, night; Spring, day; Summer, day. Three lectures, one discussion section, and one two-hour laboratory period each week. Electricity and magnetism; geometrical and physical optics; introduction to concepts of relativity, quantum theory, and atomic and nuclear physics.

152 Mechanics (4 cr.) P or C: MATH 164. Equiv. IU PHYS P221. Fall, day; Spring, day, night; Summer, day. Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; properties of matter; and simple harmonic and wave motion. For more information, visit our Web page at webphysics.iupui.edu/introphysics.

251 Heat, Electricity, and Optics (5 cr.) P: either P201 or 152. P or C: MATH 261. Equiv. IU PHYS P222. Fall, day, night; spring, day; summer, day. Heat, kinetic theory, elementary thermodynamics, and heat transfer. Electrostatics, electrical currents and devices. Magnetism and electromagnetic radiation. Optics. For more information, visit our Web page at webphysics.iupui.edu/introphysics.

299 Introduction to Computational Physics (2 cr.) P: 152. Fall. Application of computational techniques to physical concepts. Topics include mechanics, oscillations, chaos, random processes, etc.

300 Introduction to Elementary Mathematical Physics (3 cr.) P: P202 or 251, and MATH 261. Spring. Brief but practical introduction to various mathematical methods used in intermediate-level physics courses. Vector analysis, orthogonal coordinate systems, matrices, Fourier methods, complex numbers, special functions, and computational methods. Emphasis will be on worked examples and the application of these methods to physics problems.

310 Intermediate Mechanics (4 cr.) P: P202 or 251 and 300 or MATH 262. Fall. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy; and elements of hydromechanics and elasticity.

330 Intermediate Electricity and Magnetism (3 cr.) P: P202 or 251 and 300 or MATH 262. Spring. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equations; electromagnetic waves.

342 Modern Physics (3 cr.) P: P202 or 251 and MATH 261. Equiv. IU PHYS P301. Spring. A survey of basic concepts and phenomena in atomic, nuclear, and solid state physics.

353 Electronics Laboratory (2 cr.) P: 251. Spring. Introduction to electronic circuits and test equipment for scientists. Circuits including LRC networks, diodes, transistors, amplifiers, and digital components will be constructed and measured using oscilloscopes, function generators, and digital multimeters. Results will be analyzed in terms of basic circuit properties such as impedance and frequency response.

400 Physical Optics (3 cr.) P: 330. Fall. Electromagnetic waves; wave theory of reflection, refraction, diffraction, and interference. Spatial and temporal coherence. Fourier optics, coherent imaging, and holography. Polarization phenomena; Jones vectors and matrices.

401 Physical Optics Laboratory (2 cr.) P: 330. C: 400 (majors). Experiments to accompany PHYS 400 in reflection, refraction, and interference using lasers. Interferometry. Diffraction patterns with emphasis on Fourier analysis and Fourier transformations. Polarization, Brewster's angle. Coherence length of lasers.

416 Thermal Physics (3 cr.) P: 342, and 310 or 330. Spring. Temperature, equations of state, first and second laws of thermodynamics, entropy and applications, kinetic theory, transport processes, statistical mechanics.

442 Quantum Mechanics (3 cr.) P: 342, and 310 or 330. Fall. Inadequacies of classical physics; wave packets and Schrödinger equation, one-dimensional problems; operator formulation of quantum mechanics; linear harmonic oscillator; angular momentum; hydrogen atom; and Pauli principle and application to helium atom.

470 Reading in Special Topics (1-3 cr.)

480 Solar Energy Usage (3 cr.) P: MATH 164 or equivalent, and two courses in general physics. Theoretical and practical aspects, including collector design, modeling of solar systems, economic evaluation of solar alternatives, and photovoltaics.

490 Undergraduate Reading and Research (1-3 cr.) Independent study for undergraduates.

Advanced Undergraduate and Graduate Level

501 Physical Science (3 cr.) Fall, Spring. Survey of the physical sciences with emphasis on methods of presentation appropriate to the elementary school. Graduate credit is extended only for elementary school teacher programs.

510 Physical Mechanics (3 cr.) P: 310 or equivalent, and courses in calculus and differential equations. Mechanics of particles, rigid bodies, and vibrating systems.

515 Thermodynamics (3 cr.) P: 310 and 330 and a course in differential equations or advanced calculus. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction of statistical mechanics and its relation to thermodynamics; and treatment of ideal gases.

517 Statistical Physics (3 cr.) P: 342, 510, and 515 or equivalent. Laws of thermodynamics; Boltzmann and quantum statistical distributions, with applications to properties of gases, specific heats of solids, paramagnetism, black-body radiation, and Bose-Einstein condensation; Boltzmann transport equation and transport properties of gases; and Brownian motion and fluctuation phenomena.

520 Mathematical Physics (3 cr.) P: 310, 322, 330, or consent of instructor. Vectors and vector operators, tensors, infinite series, analytic functions and the calculus of residues, partial differential equations, and special functions of mathematical physics. When interests and preparation of students permit, calculus of variations and/or group theory are covered.

522 Coherent Optics and Quantum Electronics (3 cr.) P: 330, 442, and 550, or ME 587. Recent experimental and theoretical developments in optics, emphasizing concepts of coherence. Fourier optics and the quantum theory of radiation. Applications to lasers and masers, nonlinear optics, holography, and quantum electronics.

530 Electricity and Magnetism (3 cr.) P: 330 or equivalent. Electrostatic problems; theory of dielectrics; theory of electric conduction; electromagnetic effects due to steady and changing currents; magnetic properties of matter; Maxwell's equations; and electromagnetic radiation.

533 Principles of Magnetic Resonance (3 cr.) P: 550 or equivalent. Magnetic resonance in bulk matter; classical and quantum descriptions, relaxation, CW and pulse experiments, interactions and Hamiltonians. Magnetic interactions between electrons and nuclei; nuclear quadrupole interaction, crystal field interactions, and effect of molecular motion. High-resolution NMR spectra; EPR of free-radical solutions; and powder patterns.

545 Solid-State Physics (3 cr.) P: an undergraduate course in modern physics. Crystal structure; lattice vibrations; free electron theory of solids; band theory of solids; semiconductors; superconductivity; magnetism; and magnetic resonance.

550 Introduction to Quantum Mechanics (3 cr.) P: 342 and at least one other junior-level course in each of mathematics and physics or equivalent. Brief historical survey; waves in classical physics; wavepackets; uncertainty principle; operators and wave functions; Schrödinger equation and application to one-dimensional problems; the hydrogen atom; electron spin; multielectron atoms; periodic table; molecules; periodic potentials; and Bloch wave functions.

556 Introductory Nuclear Physics (3 cr.) P: 550 or equivalent. Theory of relativity; brief survey of systematics of nuclei and elementary particles; structure of stable nuclei; radioactivity; interaction of nuclear radiation with matter; nuclear reactions; particle accelerators; nuclear instruments; fission; and nuclear reactors.

570 Selected Topics in Physics (3 cr.) Specialized topics in physics selected from time to time.

590 Reading and Research (1-3 cr.)

593 Advanced Physics Laboratory (3 cr.)

Graduate Level

600 Methods of Theoretical Physics (3 cr.) P: graduate standing in physics or consent of instructor. 600 is designed to provide first-year physics graduate students with the mathematical background for subsequent studies of advanced mechanics, electrodynamics, and quantum theory. Topics include functions of a complex variable, ordinary and partial differential equations, eigenvalue problems, and orthogonal functions. Green's functions, matrix theory, and tensor analysis in three and four dimensions.

601 Methods of Theoretical Physics II (3 cr.) P: 600 or equivalent. A continuation of 600.

610 Advanced Theoretical Mechanics (3 cr.) P: 510 or equivalent. Lagrangian and Hamiltonian mechanics; variational principles; canonical transformations; Hamilton-Jacobi theory; theory of small oscillations; and Lagrangian formulation for continuous systems and field.

617 Statistical Mechanics (3 cr.) P: 660 or equivalent. Classical and quantum statistical mechanics.

630 Advanced Theory of Electricity and Magnetism (3 cr.) P: 530 and 600, or equivalent. The experimental origins of Maxwell's equations. Electrostatics and magnetostatics; solution of boundary value problems. Quasistatic currents. Electromagnetic energy and momentum and the Maxwell stress tensor. Foundations of optics. Radiation from antennas, multipole expansion; waveguides.

631 Advanced Theory of Electricity and Magnetism (3 cr.) P: 630 or equivalent. Covariant formulation of electrodynamics; Lienard-Wiechert potentials; radiation from accelerated particles; Cerenkov radiation; dynamics of relativistic particles; radiation damping; and introduction to magnetohydrodynamics.

633 Advanced Topics in Magnetic Resonance (3 cr.) P: 533 or consent of instructor. Rotation operators, coupling of angular momenta, Wigner-Eckhart theorem, and density matrix; theory of magnetic resonance, relaxation in liquids, chemical exchange, double resonance, cross-polarization, and magic angle spinning; two-dimensional NMR, correlation spectroscopy, and exchange and NOE spectroscopies; application to biological macromolecules; time domain EPR; and line shape under slow motion.

660 Quantum Mechanics I (3 cr.) P: 530, 550, 600, and 610, or equivalent. Origins of the quantum theory, the uncertainty and complementarity principles. The Schrödinger equation and its solutions for simple physical systems. Mathematical formulation of the quantum theory. Applications: simple harmonic oscillator, theory of angular momentum, and hydrogen atom. Time-independent and time-dependent perturbation theory. The Pauli exclusion principle. Spin of the electron. Elementary theory of scattering.

661 Quantum Mechanics II (3 cr.) P: 601, 630, and 660, or equivalent. Symmetry and conservation laws. The Klein-Gordon and Dirac equations. Interaction of radiation with matter. Applications of quantum mechanics to atomic structure. Scattering theory.

670 Selected Topics in Physics (1-3 cr.) P: consent of instructor. Specialized topics in physics, varied from time to time.

685 Physics Seminar (0-1 cr.) Offered on Pass/Fail basis only. May be repeated for credit. Weekly physics seminar presented by faculty and invited speakers from outside the department.

698 Research M.S. Thesis (cr. arr.)

699 Research. (cr. arr.) Ph.D. thesis.

Courses in Astronomy (AST)

The Department of Physics has academic, advising, and administrative responsibility for the courses in astronomy offered at IUPUI.

A100 The Solar System (3 cr.) Fall. Survey of the solar system, including the Earth, sun, moon, eclipses, planets and their satellites, comets, laws of planetary motion, etc. Discussion of the origin of the solar system, life on earth, and the possibilities of extraterrestrial life. Also astronomical instruments and celestial coordinates.

A105 Stars and Galaxies (3 cr.) Spring. Survey of the universe beyond the solar system, including stars, pulsars, black holes, principles of spectroscopy and the H-R diagram, nebulae, the Milky Way, other galaxies, quasars, expanding universe, cosmology, and extraterrestrial life.

A130 Short Courses in Astronomy (1 cr.) Five-week short courses on a variety of topics in astronomy. Examples of topics include: the Big Bang, Black Holes, Astronomy from your BackYard, How to See Stars, The Birth and Death of Our Sun.

Department of Psychology

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www.psynt.iupui.edu

Professors Appleby, Bond *(Chancellor's Professor)*, Bringle *(Chancellor's Professor)*, Fetterman *(Chair)*, Goodlett, Hazer, Kremer, Murphy

Professors Emeriti Davis, Hanford, Rajecki, Tzeng

Associate Professors Borden *(Associate Vice Chancellor)*, Evenbeck *(Associate Vice Chancellor and Dean of University College)*, Devine, Fastenau, Felsten *(IUPU Columbus)*, Graham, Johnson, Lauer, McGrew, Neal-Beliveau, Svanum, Williams

Associate Professors Emeriti Fleener, Fortier, Goldberg, Ware

Assistant Professors Ashburn-Nardo, Bigatti, Christie *(IUPU Columbus)*, Harold

Lecturers Compton *(IUPU Columbus)*, Ehrmann, Guare, Kroupa

Associate Scientist Stewart

Assistant Scientists Badia-Elder, Salyers

Adjunct Professors Alexy, Austin, Basse-Tomusk, Feinberg, Kareken, McKinzie, Metzner, Shain, Sharp, Tarr, Trexler, Unverzagt, Wagner, Zimet

Psychology is the study of behavior. Psychologists apply the scientific method to increase their understanding of human and animal behavior. Behavior is enormously diverse, and psychologists seek answers to a range of questions that are as varied as how eyes perceive light and form, how children develop a sense of morality, and under what conditions people help in emergencies. As an applied profession, psychologists use research results to solve personal and social problems.

Because the subject matter of psychology is broad, psychologists have become specialized. Specialization allows each psychologist to apply the general principles of science and behavior to a given area of interest. These include motivation and learning, child and adult development, social behavior of humans and animals, personality, thought processes, consumer behavior, and many more. Psychologists who function as applied professionals specialize in areas that include clinical, counseling, health care, rehabilitation, and industrial psychology.

The IUPUI Department of Psychology provides a varied undergraduate curriculum that leads to either the Bachelor of Arts (B.A.) or the Bachelor of Science (B.S.) degree in psychology from Purdue University. Graduate programs include Master of Science (M.S.) degrees in two specialty areas of psychology—industrial/organizational and clinical rehabilitation—and Doctor of Philosophy (Ph.D.) degrees in clinical rehabilitation psychology and psychobiology of addictions. Besides this professional and preprofessional training, the department serves the needs of students in many other fields by providing introductory and advanced courses in psychology. Students in the undergraduate program can choose to focus broadly on various aspects of psychology, or they can elect to concentrate on more specialized areas in which graduate training is offered.

The choice of a particular program for majors should be made in consultation with one of the academic advisors. Contact the Psychology Advising Office [LD 123, (317) 274-6765] to schedule an appointment with an academic advisor. The course PSY B103 Orientation to a Major in Psychology is recommended for students currently exploring psychology as a potential major. The department strongly recommends that undergraduate majors become involved with the Psychology Club or the honorary society, Psi Chi.

The Department of Psychology also offers several opportunities for students to gain research experience with faculty. Two courses entitled Readings and Research (B292 freshman/sophomore and B492 junior/senior) offer students the opportunity to earn 1-3 credits for successfully participating in a research project under the direction of a faculty mentor. Capstone Honors Research (B499) is available for students who have maintained a GPA of 3.2 or higher and who have successfully completed B305 Statistics and B311 Introductory Laboratory in Psychology. Eligible students must apply to take Capstone Honors Research in the spring semester before they plan to participate in the program. Capstone Honors Research is always a two-semester (fall and spring) experience that includes both completion of an independent research project as an honors thesis under the supervision of a faculty mentor, as well as participation in the Capstone Honors Research seminar that meets on alternating Fridays throughout the academic year. Students may enroll in 3-6 credits of B499 to fulfill the department capstone requirement, as described below. While participation in the undergraduate honors program in the department is strongly encouraged, it is not required for enrollment in B499. For a more detailed description of departmental research programs, please review the psychology department Web page (www.psynt.iupui.edu) or consult an academic advisor.

Bachelor of Arts

Degree Requirements

The School of Science requirements for a Bachelor of Arts degree are listed in this bulletin (see the School of Science requirements under “Undergraduate Programs”).

Area Requirements

Area I See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150) or ENG W231.

Area II A first-year proficiency in a modern foreign language is required. See the School of Science requirements under “Undergraduate Programs” for details.

Area IIIA See the School of Science requirements under “Undergraduate Programs” in this bulletin. Note that courses taken from the S (Social Sciences) list cannot be psychology courses.

Area IIIB One course from a list of Junior/ Senior Integrator courses is required for this area (see academic advisor for details). The Junior/Senior Integrator is designed to integrate the areas of humanities, social sciences, and science. Prerequisites: at least junior standing, ENG W131, a second composition course applicable to Area I, one course applicable to Area IIIC, one course applicable to Area IIID, HIST H114, and two courses taken from two of the H, S, and C lists.

Area IIIC and IIID See the School of Science requirements under “Undergraduate Programs” in this bulletin.

CSCI N207 Data Analysis Using Spreadsheets is recommended.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV See the following section, "Major in Psychology (B.A. or B.S.)."

Bachelor of Science

Degree Requirements (all except Behavioral Neuroscience Track)

The School of Science requirements for a Bachelor of Science degree are listed in this bulletin under "Undergraduate Programs."

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150) or ENG W231.

Area II No foreign language is required.

Area IIIA See the School of Science requirements under "Undergraduate Programs" in this bulletin. Note that courses taken from the S (Social Sciences) list cannot be psychology courses.

Area IIIB One course from a list of Junior/ Senior Integrator courses is required for this area (see academic advisor for details). The Junior/Senior Integrator is designed to integrate the areas of humanities, social sciences, and science. Prerequisites: at least junior standing, ENG W131, a second composition course applicable to Area I, one course applicable to Area IIIC, one course applicable to Area IIID, HIST H114, and two courses taken from two of the H, S, and C lists.

Area IIIC and IIID See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Two of the required four courses must be biology and/or chemistry courses. Recommended course sequences are CHEM C101-CHEM C110, or CHEM C105-CHEM C106, or BIOL N212-BIOL N213 and BIOL N214-BIOL N215.

CSCI N207 Data Analysis Using Spreadsheets is recommended.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV See the following section, "Major in Psychology (B.A. or B.S.)."

Bachelor of Science (Behavioral Neuroscience Track)

Degree Requirements

Area Requirements

Area I See the School of Science requirements under "Undergraduate Programs" in this bulletin. The second semester of English composition may be satisfied with ENG W132 (or ENG W150) or ENG W231.

Area II No foreign language is required.

Area IIIA See School of Science requirements under "Undergraduate Programs" in this bulletin. Note that courses taken from the S (Social Sciences) list cannot be psychology courses.

Area IIIB One course from a list of Junior/ Senior Integrator courses is required for this area (see academic advisor for details). The Junior/Senior Integrator is designed to integrate the areas of humanities, social sciences, and science. Prerequisites: at least junior standing, ENG W131, a second composition course applicable to Area I, one course applicable to Area IIIC, one course applicable to Area IIID, HIST H114, and two courses taken from two of the H, S, and C lists.

Area IIIC Physical and Biological Sciences

BIOL K101, BIOL K103, BIOL K322, CHEM C105, CHEM C125, CHEM C106, CHEM C126.

Area IIID Mathematical and Computer Sciences

MATH M118 and MATH M119, or MATH 163 and 164.

CSCI N207 Data Analysis Using Spreadsheets is recommended.

Note: Computer Science CSCI N100-level courses and CPT 106 do not count for any credit toward any degree in the School of Science. Also, CSCI N241 does not count in Area IIID, but may count as a general elective.

Area IV Psychology See the following section, "Major in Psychology." Students must take B320, B398, B394, either B492 or I545, and B499.

Major in Psychology (B.A. or B.S.)

The Department of Psychology at IUPUI has a program for majors that requires 40 credit hours of selected course work. Students pursuing a B.S. degree must select a Capstone Lab, Capstone Independent Research (PSY B497), or Capstone Honors Research (PSY B499) as the capstone course (see below). Students are encouraged to consult with an academic advisor for determination of whether to pursue a B.A. or a B.S. degree.

Introductory Psychology

(Three courses; 7 credit hours)
B103
B104
B105

Research Methods

(Two courses; 6 credit hours)
B305
B311

Core Areas

(Six courses; 18 credit hours)

Select six courses from the following:

B307	B310	B320	B334
B340	B344	B356	B358
B370	B380	B398	B424

Psychology Specialization (Two courses; 6 credit hours)

Any two different numbered upper-level (300 or above) psychology courses.

Capstone (One course; 3 credit hours)

Select one course from the following options:

Advanced Lab or Honors Research (B.S. degree requires one of these research courses)

B423	B425	B431	B445	B457
B461	B471	B481	B499	

Practicum (does not fill requirement for B.S. degree)

B462	B482

Capstone Seminar (does not fill requirement for B.S. degree)
B454

Psychology Major Concentrations

The IUPUI Department of Psychology provides students with the opportunity to develop a concentration in a particular subdiscipline of psychology by successfully completing a minimum of (a) one core course (except for Behavioral Neuroscience and the Psychology of Addictions, which require two), (b) two specialization courses, and (c) one capstone course aligned with one of the four areas of psychology listed below. Concentrations are recommended for students who are considering graduate school or employment in one of these areas. Students who have successfully completed the requirements for one of these concentrations will receive a certificate of completion after graduation. Students should consult an academic advisor for more information about pursuing one of these concentrations and should officially apply for a concentration by completing and submitting the application sheet available in the Psychology Department office (LD 124).

CONCENTRATIONS	CORE AREA COURSES	SPECIALIZATION COURSES	CAPSTONE
Behavioral Neuroscience (B.S. only) (23 credit hours of chemistry and biology are also required)*	*Required* B320 Behavioral Neuroscience B398 Brain Mechanisms of Behavior *Recommended* B344 Learning B356 Motivation	B394 Drugs and Behavior **and** B492 Independent Research **or** I545 Psychopharmacology	B497/B499 Capstone/Honors Resear
Clinical Rehabilitation Psychology (B.A. or B.S.)	*Required* B380 Abnormal Psychology *Recommended* B307 Tests and Measurement	*Choose two of the following three courses.* B322 Introduction to Clinical Rehabilitation Psychology B365 Stress and Health B386 Introduction to Counseling	B482 Capstone Practicum in Clinica Rehabilitation Psychology (B.A. or (B386 is a prerequisite for B482.) B481 Capstone Laboratory in Clinic Rehabilitation Psychology (B.A. or B.S.)

	B320 Behavioral Neuroscience		B497/B499 Capstone/Honors Resear (B.A. or B.S.)
Industrial/Organizational Psychology(B.A. or B.S.)	*Required* B358 Introduction to Industrial/ Organizational Psychology *Recommended* B307 Tests and Measurement B370 Social Psychology	B366 Concepts and Applications in Organizational Psychology B368 Concepts and Applications in Personnel Psychology	B462 Capstone Practicum in Industr Organizational Psychology (B.A. o B497/B499 Capstone/Honors Resear (B.A. or B.S.) B471 Capstone Laboratory in Social Psychology (B.A. or B.S.) (B370 is prerequisite for B471.)
Psychology of Addictions (B.A. or B.S.)	*Required* B320 Behavioral Neuroscience B380 Abnormal Psychology *Recommended* B356 Motivation	*Choose two of the following three courses.* B394 Drugs and Behavior B396 Alcohol, Alcoholism, and Drug Abuse B386 Introduction to Counseling	B497/B499 Capstone/Honors Resear (B.A. or B.S.) B481 Capstone Laboratory in Clinic Rehabilitation Psychology (B.A. or B.S.) B482 Capstone Practicum in Clinica Rehabilitation Psychology (B.A. or (B386 is a prerequisite for B482.)

*BIOL K101 (5), BIOL K103 (5), BIOL K322 (3), CHEM C105 (3), CHEM C106 (3), CHEM C125 (2), and CHEM C126 (2) are required.

Minor in Psychology

The Department of Psychology offers an undergraduate minor program in psychology that requires 18 credit hours of selected course work. Interested students should obtain information from and submit an application to the psychology secretary. Applications must be approved by the Department of Psychology. Course requirements are as follows:

Introductory Psychology

(Two courses; 6 credit hours)
B104
B105

Core Areas (Three courses; 9 credit hours)

Select three courses from the following:

B307	B310	B320	B334
B340	B344	B356	B358
B370	B380	B398	B424

Psychology Elective

(One course; 3 credit hours)

Any additional upper-level (300 or above) psychology course.

No grade lower than C– is acceptable for any course in the minor.

A minimum grade point average of 2.0 in minor courses is required.

A minimum of 6 credit hours of the minor must be taken at IUPUI.

Correspondence courses may not be used to fulfill requirements for the minor.

Psychology Plans of Study

There is no single semester-by-semester plan of study for either the B.A. or the B.S. degree. However, one possible sequence of courses for the B.A. degree and one for the B.S. degree is given in the sample program that follows. Variations from these examples should be made based on the student's career plans, through consultation with an academic advisor. For career and graduate school information related to psychology, please read "Life beyond the Bachelor's Degree: A Primer for Psychology Majors" (www.psynt.iupui.edu/bulletin/primer.htm) or refer to "Preparing for Graduate School" or "Preparing for a Job" listed under "Other Links" on the psychology department Web page (www.psynt.iupui.edu).

Bachelor of Arts Sample Program (124 cr. required)

Freshman Year

First Semester

PSY B104 Psychology as a Social Science	3
ENG W131 Elementary Composition I	3
HIST H114 History of Western Civilization II	3

COMM R110 Fundamentals of Speech Communication		3
Foreign language I*	5	
	15-17	

Second Semester

PSY B103 Orientation to a Major in Psychology		1
PSY B105 Psychology as a Biological Science		3
MATH M118 Finite Mathematics	3	
ENG W132 Elementary Composition II	3	
Foreign language II*	5	
	13-15	

Sophomore Year

Third Semester

PSY B305 Statistics	3
PSY core courses	6
Humanities—List H	3
Physical or biological science elective	3-5
15-17	

Fourth Semester

PSY B311 Introductory Laboratory in Psychology		3
PSY core course	3	
CSCI N207 Data Analysis Using Spreadsheets		3
Social Sciences—List S	3	
Comparative World Cultures—List C	3	
	15	

Junior Year

Fifth Semester

PSY core courses	6
PSY specialization course	3
Physical or biological science elective	3-5
Elective	3
15-17	

Sixth Semester

PSY core course	3
PSY specialization course	3
Physical or biological science elective	3-5
Junior/Senior Integrator	3
Elective	3
15-17	

Senior Year

Seventh Semester

PSY capstone	3
Electives	12
15	

Eighth Semester

Electives	15-18
CAND 991 Candidate for Graduation	0
15-18	

Bachelor of Science Sample Program (124 cr. required)

Freshman Year

First Semester

PSY B104 Psychology as a Social Science	3	
ENG W131 Elementary Composition I	3	
HIST H114 History of Western Civilization II	3	
COMM R110 Fundamentals of Speech Communication		3
Social Sciences—List S	3	
	15	

[1] For students needing courses to establish first-year proficiency in a modern foreign language. Otherwise, other courses may be taken to fulfill area requirements or electives.

Second Semester		
PSY B103 Orientation to a Major in Psychology		1
PSY B105 Psychology as a Biological Science		3
CSCI N207 Data Analysis Using Spreadsheets		3
MATH M118 Finite Mathematics	3	
ENG W132 Elementary Composition II	3	
Humanities—List H	3	
	16	

Sophomore Year

Third Semester		
PSY B305 Statistics	3	
PSY core courses	6	
Physical or biological science elective	3-5	
Comparative World Cultures—List C	3	
	15-17	
Fourth Semester		
PSY B311 Introductory Laboratory in Psychology	3	
PSY core courses	6	
MATH M119 Brief Survey of Calculus I	3	
Physical or biological science elective	3-5	
	15-17	

Junior Year

Fifth Semester		
PSY core courses	6	
PSY specialization course	3	
Physical or biological science elective	3-5	
Elective	3	
	15-17	
Sixth Semester		
PSY specialization course	3	
Physical or biological science elective	3-5	
Junior/Senior Integrator	3	
Electives	6	
	15-17	

Senior Year

Seventh Semester		
PSY capstone	3	
Electives	12	
	15	
Eighth Semester		
Electives	16	
CAND 991 Candidate for Graduation	0	
	16	

Undergraduate Honors Program in Psychology

Psychology majors admitted to the IUPUI Honors Program will be eligible to participate in all psychology honors courses and to graduate with honors in psychology. Usually honors credit is based on individual student-faculty agreement to enhance normal course requirements. Students who are not in the IUPUI Honors Program, but who meet the minimum GPA criterion will be able to participate in honors courses, but will not receive honors credit. For currently enrolled students who have completed at least 12 credit hours, the GPA criterion for admission to the honors program is 3.3. For new students, the criteria for admission are recentered SAT scores of 1200 or graduation in the top 10 percent of the high school class.

To graduate with honors, the student must earn at least 24 hours of honors credit, 6 of which must be in psychology and 6 of which must be outside of psychology (the remaining 12 can be either in or outside psychology). At least 3 hours of this credit must be PSY B499 Honors Research, which should culminate in an honors thesis. Only grades of A or B will count for honors credit. To graduate with honors, the student must have an overall GPA of at least 3.3 with a GPA of at least 3.5 in honors and psychology courses.

For additional information, contact the director of the IUPUI Honors Program, University College, 3140, 815 W. Michigan Street, IUPUI, Indianapolis, IN 46202-5154; phone (317) 274-2314, or see a psychology advisor.

Psi Chi Honorary Society To become a member of the Psi Chi Honorary Society, undergraduate psychology majors must have an overall GPA of 3.0 and a GPA of 3.5 in psychology. The current membership fee is $45. Interested students should submit an application to the Psi Chi faculty advisor.

Graduate Programs

The department offers Purdue University Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree programs. At the M.S. level, programs are offered in industrial/organizational psychology and clinical rehabilitation psychology. At the Ph.D. level, programs are offered in clinical rehabilitation psychology and psychobiology of addictions.

M.S. Programs

Graduate training at the M.S. level is designed to provide students with theory and practice that will enable them to apply psychological techniques and findings in a subsequent job setting. Depending on the program, the M.S. degree may be completed on a full- or part-time basis and normally takes two or three years to finish. Depending on the case, a minimum of 36 credit hours is required, including departmental core, area core, and elective courses.

Industrial/Organizational Psychology

This emphasis is designed to prepare individuals for positions in industry or for entry into an industrial/ organizational doctoral program. Students are familiarized with the scientist-practitioner model, which emphasizes both research and the application of problem-solving skills to organizational problems. Students in the program are taught analytic methods for diagnosing work-related problems, developing solutions, and evaluating the effectiveness of those solutions. While the primary focus of the curriculum is on the traditional personnel psychology areas of selection, training, and performance evaluation, students also learn about topics such as decision-making, motivation, leadership, and organizational effectiveness.

Clinical Rehabilitation Psychology

This program is designed to prepare students in the science of clinical rehabilitation psychology. The program is intended for individuals who plan to enter or continue careers or education in the behavioral sciences, health, or rehabilitation fields upon completion of the M.S. degree. The program's focus upon core skills and methods would be particularly suitable for those students who plan to pursue the Ph.D. degree following completion of the M.S., or for those students who have an interest in jobs in health care settings that involve research design and collection and analysis of data. A core set of courses introduces the methods and basic skills of clinical rehabilitation psychology, including courses in counseling and psychological assessment. The curriculum is flexible and designed to be individually tailored by selection of elective courses and practicum experiences. Graduation requires the completion of a minimum of 36 hours of graduate course work, including the required core, electives, and at least two practicum placements. The program does not require a thesis, although students who have research interests are encouraged to pursue a faculty mentor relationship and a thesis option.

Ph.D. Programs

Clinical Rehabilitation Psychology

Using a scientist-practitioner model, this program integrates the assessment and intervention skills traditionally associated with clinical psychology and rehabilitation psychology. The emphasis is on optimizing the adaptation to the community of persons with disabilities and chronic illnesses. Graduates of the program will be qualified to assume positions as direct-service providers, planners, academicians, trainers, evaluators, researchers, and consultants. The program emphasizes rigorous academic training, which is combined with practical application in a wide variety of rehabilitation centers in Indianapolis and elsewhere. Full-time study and a minimum of 85 credit hours (postbaccalaureate) are required, and the program is expected to take five years to complete. The program includes diverse training in psychology, including a psychology core, statistics and measurement, rehabilitation psychology, internships and practica, and an empirical thesis and doctoral dissertation. Rehabilitation specialty courses covering a broad range of disabling conditions and intervention techniques are offered. A course in ethics is also required.

Psychobiology of Addictions

This program is designed to promote a comprehensive understanding of the neurobiological bases of behavior, with an emphasis on the behavioral and neurobiological aspects of drugs of abuse and addictive behaviors. General goals of the program are to develop knowledge and expertise in the neurobiological mechanisms of behavior, develop skills in applying methods of behavioral neuroscience research to the problems of alcohol and drug abuse and addiction, and train competence in communication and teaching of knowledge and research skills. Students will obtain broad-based training in the combined disciplines of the neurosciences (e.g., behavioral and developmental neuroscience, psychopharmacology, neurobiology) and in the behavioral sciences (e.g., experimental psychology, cognitive psychology, learning, experimental design and analysis, and animal models of drug abuse and addiction). The psychobiology of addictions program is an IUPUI program that is regulated through the Department of Psychological Sciences at Purdue, West Lafayette. Students take course work at IUPUI, but must meet all Purdue requirements and must have at least two committee members from Purdue for significant program milestones, such as Ph.D. preliminary examinations and dissertation research committees. A minimum of 85 credit hours (postbaccalaureate) are required, plus approval of the course of study by the student's advisory committee. The program intends to train students seeking careers in teaching and/or research in academic environments, medical institutions, pharmaceutical firms, and governmental agencies.

Financial Support

Financial support for eligible graduate students at both the M.S. and Ph.D. levels is available through teaching and research assistantships, tuition stipends, and fellowships. Full assistantships require a minimum of 20 hours of work per week and include at least partial tuition remission in addition to salary.

Admission Requirements

Industrial/Organizational Psychology

Undergraduate training in psychology, mathematics, and the physical sciences is highly desirable, though not required. Applicants should have had at least one undergraduate course in statistics, as well as one in tests and measurements. If those courses have not been completed, the student will be required to complete them as prerequisites for admission to the program. To be considered for admission without probation, applicants must obtain (a) a baccalaureate degree from a college or university of recognized standing, (b) a GPA of 3.0 or higher on a 4.0 scale, (c) a minimum subtotal on the GRE verbal and quantitative of 1100 with a quantitative score of a least 550, and (d) three favorable letters of recommendation. The student who does not meet the above standards, but shows potential for graduate studies, could be recommended for conditional admission.

Clinical Rehabilitation Psychology

Undergraduate training in psychology, mathematics, and the physical sciences is highly desirable, though not required. Undergraduate course work must include psychology courses in (1) tests and measurement, (2) statistics, (3) human physiology or physiological psychology, and (4) abnormal psychology. If those courses have not been completed, the student will be required to complete them as prerequisites for admission to the program.

Students may apply directly to the Ph.D. program or to the terminal M.S. program (or both simultaneously). For an applicant to be considered for admission to the M.S. program, the applicant must obtain (a) a baccalaureate degree from a college or university of recognized standing, (b) a GPA of 3.0 or higher on a 4.0 scale, (c) a minimum subtotal on the GRE verbal and quantitative of 1100 with a quantitative score of a least 550, and (d) three favorable letters of recommendation.

The Ph.D. program seeks talented and motivated persons who have an interest in psychology and rehabilitation and who have the potential to make creative contributions as clinical rehabilitation psychologists. Admission to the Ph.D. program is competitive and only under unusual circumstances will students be considered for admission if they fail to meet the following minimum standards: (a) an undergraduate and graduate grade point average of 3.2 or higher on a 4.0 scale, (b) a minimum composite GRE score (verbal and quantitative) of 1200, (c) three favorable letters of recommendation, and (d) a personal statement expressing an interest in the field of rehabilitation psychology. Prior clinical and research experience is recommended, but not required, for admission.

Psychobiology of Addictions

This Ph.D. program is designed for individuals interested in academic or research careers studying the physiological bases of addictive behaviors and drugs of abuse. Successful applicants typically have (a) an undergraduate and graduate grade point average of 3.2 or higher on a 4.0 scale, (b) a minimum composite GRE score (verbal and quantitative) of 1200, (c) three favorable letters of recommendation, and (d) a personal statement expressing an interest in the psychobiology of addictions. Students with undergraduate degrees in psychology or the life sciences (e.g., biology, chemistry) are encouraged to apply.

Admission Information

Students are admitted only for fall enrollment, and the deadline for receipt of application materials is February 1. Students interested in information about admission to graduate programs in psychology should write directly to the graduate program coordinator, Department of Psychology, Indiana University–Purdue University Indianapolis, Science Building LD 124, 402 N. Blackford Street, Indianapolis, IN 46202-3275; or phone (317) 274-6945.

Transfer Credit

A maximum of 12 credit hours can be transferred into the M.S. program, and a maximum of 36 credit hours can be transferred into the doctoral program. Transfer hours will be accepted only if they are appropriate and judged acceptable by the student's plan-of-study committee.

Temporary Student Status

A student may enroll in some graduate program courses without formal admission after making application as a temporary graduate student. No more than 12 hours of credit may be applied to an advanced degree program if an individual is later admitted as a regular graduate student. However, if an application to a regular degree program is approved during the session in which a person is enrolled for the 12th credit hour as a nondegree registrant, then all credits taken before and during that term will be eligible for inclusion in a plan of study for a degree program. For inclusion, the courses must be appropriate to the degree program and acceptable to the department and the graduate school. No course in which a grade of less than B (e.g., B–) has been received will be permitted in a plan of study if the course was taken while the student was enrolled as a nondegree registrant. Nondegree registrants may be required to secure consent from each of the departments in which they would like to register for courses.

Research Facilities

The Department of Psychology has extensive laboratory and computer facilities to support faculty and student research. More than 8,000 square feet of laboratory space in the School of Science complex is devoted to psychological research in the areas of clinical rehabilitation psychology, industrial/ organizational psychology, life span development, cognition, and sensation and perception. Separate animal quarters and modern laboratories are also available to support research in animal experimental psychology and psychobiology. Computer support includes microcomputer clusters and networks within the department and terminal connections to several mainframe computers. Internship and practicum sites are available at the Indiana University Medical Center and with numerous other organizations in metropolitan Indianapolis.

Research Interests of Faculty

Major research interests of faculty include applied social psychology, biofeedback, cross-cultural investigations, industrial/organizational psychology, quantitative psychology, measurement theory and development, physiological psychology, program planning and evaluation, clinical rehabilitation psychology, behavioral psychopharmacology, addictions, cognitive developmental psychology, learning, and student/faculty performance. A current and more detailed listing of faculty research interests is available from the department.

Courses in Psychology (PSY)

Note: P = prerequisite; C = corequisite; Fall = offered fall semester; Spring = offered spring semester; Summer = offered during the summer session. For courses with no designated semester, consult the online course offerings. Equiv. = course is equivalent to the indicated course taught at Indiana University Bloomington, or the indicated course taught at Purdue University West Lafayette.

Undergraduate Level

B103 Orientation to a Major in Psychology (1 cr.) This course will help students establish goals for their academic experience in three areas: career, relationships, and personal life. They will be introduced to psychological resources on campus, the faculty, and student organizations. They also will make a curriculum plan to meet their learning objectives.

B104 Psychology as a Social Science (3 cr.) Equiv. to IU PSY P102 and PU PSY 120. Fall, Spring, Summer. Introduction to scientific method, individual differences, personality, developmental, abnormal, social, and industrial psychology.

B105 Psychology as a Biological Science (3 cr.) Equiv. to IU PSY P101 and PU PSY 120. Fall, Spring, Summer. Research methods and content areas of learning, sensation-perception, psychophysiology, motivation, emotions, and statistics.

B252 Topics in Psychology (1-3 cr.) Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 4 credit hours.

B292 Readings and Research in Psychology (1-3 cr.) P: consent of instructor. Fall, Spring. Independent readings and research on psychology problems. For freshmen and sophomores only.

B305 Statistics (3 cr.) P: B104 or B105, and 3 credits of mathematics that carry School of Science credit. Equiv. to IU PSY K300, PSY K310, and PU PSY 201. Fall, Spring, Summer. Introduction to basic statistical concepts; descriptive statistics and inferential statistics. Introduction to data analytic software.

B307 Tests and Measurement (3 cr.) P: 3 credit hours of psychology and B305. Equiv. to IU PSY P336 and PU PSY 202. Overview of statistical foundations of psychological measurement (e.g., test development, norms, reliability, validity). Survey of commonly used assessment instruments (e.g., intelligence/aptitude, personality, academic achievement tests) and applications of psychological testing in different settings (e.g., clinical, industrial/organizational, school, forensic/legal settings). Recommended for students considering graduate training in clinical, industrial/organizational, school, or related areas of psychology.

B310 Life Span Development (3 cr.) P: 3 credit hours of psychology. Fall, Spring, Summer. Equiv. to PU PSY 230. Emphasizes the life span perspective of physical and motor, intellectual and cognitive, language, social and personality, and sexual development. Commonalities across the life span, as well as differences among the various segments of the life span, are examined. Theory, research, and practical applications are stressed equally.

B311 Introductory Laboratory in Psychology (3 cr.) P: B105 and B305 or consent of instructor. Equiv. to IU PSY P211, and PU PSY 203. Fall, Spring. Introductory laboratory in experimental methods and statistical treatment of data in several areas of psychology; introduction to experimental report writing.

B320 Behavioral Neuroscience (3 cr.) P: B105. Equiv. to IU PSY P326 and PU PSY 220. Review of necessary background in neurophysiology and neuroanatomy followed by the relationship of physiology to sensory processes, motivation, and learning. Emphasis on research with animals.

B322 Introduction to Clinical Rehabilitation Psychology (3 cr.) P: 3 credit hours in psychology. This course surveys various aspects of the practice of clinical rehabilitation psychology from a scientist-practitioner perspective. Aspects of the historical framework of clinical psychology will be discussed. In addition, various aspects of the present state of clinical psychology will be covered in addition to directions for the future. Specific topics to be addressed include health psychology, new trends in diagnosis and assessment, changing health care patterns and the impact of managed care, and specific areas of rehabilitation and case management.

B334 Perception (3 cr.) P: B105. Equiv. to IU PSY P329 and PU PSY 310. Consideration of the concepts and research in perception. Relation of sense organ systems to human behavior. Some attention to social and cultural factors.

B340 Cognition (3 cr.) P: B105 or consent of instructor. Equiv. to IU PSY P335 and PU PSY 200. A survey of information-processing theories from historical antecedents through current theories. Research methodology and theory will be emphasized throughout the discussion of issues such as perception, attention, memory, reasoning, and problem solving.

B344 Learning (3 cr.) P: B105. Equiv. to IU PSY P325 and PU PSY 314. History, theory, and research involving human and animal learning and cognitive processes.

B354 Adult Development and Aging (3 cr.) P: B310 or consent of instructor. Equiv. to PU PSY 367. Examines changes that occur with age in the following areas: intelligence, memory, personality, sexuality, health, living environments, economics, developmental disorders, and treatment for developmental disorders.

B356 Motivation (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P327 and PU PSY 333. Study of motivational processes in human and animal behavior, how needs and incentives influence behavior, and how motives change and develop.

B358 Introduction to Industrial/Organizational Psychology (3 cr.) P: 3 credit hours of psychology or consent of instructor. Equiv. to IU PSY P323 and PU PSY 372. This course surveys various aspects of behavior in work situations using the scientist-practitioner perspective. Traditional areas covered from personnel psychology include selection, training, and performance appraisal; areas surveyed from organizational psychology include leadership, motivation, and job satisfaction.

B360 Child and Adolescent Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P316 and PU PSY 235. Development of behavior in infancy, childhood, and adolescence, including sensory and motor development and processes such as learning, motivation, and socialization.

B362 Practicum in Child Psychology (3 cr.) P: consent of instructor. Experience working with children in field setting. May be repeated once.

B365 Stress and Health (3 cr.) P: 3 hours of psychology. This course will familiarize students with the study of physical health within the field of psychology. Topics include the relationship between stress and health, health promotion, health behaviors, chronic illness, and the patient-physician relationship. Research methods in health psychology as well as major theories underlying the field will be examined and evaluated. Psychological variables related to physical health will be examined within the framework of these theories. Practical application of constructs will be emphasized through activities and writing assignments.

B366 Concepts and Applications in Organizational Psychology (3 cr.) P: B358 or consent of instructor. Some organizational psychology topics introduced in the I/O psychology survey course are covered in more depth. Advanced information is presented for each topic, and students have the opportunity for several different hands-on applications, including case projects and computer exercises. Example topics are organizational culture, employee attitudes, motivation, and leadership.

B368 Concepts and Applications in Personnel Psychology (3 cr.) P: B358 or consent of instructor. Some personnel psychology topics introduced in the I/O psychology survey course are covered in more depth. Advanced information is presented for each topic, and students have the opportunity for several different hands-on applications, including case projects and computer exercises. Example topics are job analysis, selection, performance appraisal, and training.

B370 Social Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P320 and PU PSY 240. Fall, Spring, Summer. Study of the individual in social situations including socialization, social perception, social motivation, attitudes, social roles, and small group behavior.

B374 Group Dynamics Theory and Research (3 cr.) P: B370. An intensive survey of research and theory on the behavior of small groups and the research methods by which groups are studied.

B376 The Psychology of Women (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P460 and PU PSY 239. A survey of topics in psychology as related to the biological, social, and psychological development of women in modern society.

B380 Abnormal Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P324 and PU PSY 350. Fall, Spring, Summer. Various forms of mental disorders with emphasis on cause, development, treatment, prevention, and interpretation.

B382 Practicum in Community Psychology (3 cr.) P or C: B370 or B380 and consent of instructor. Experience working with individuals who may have a wide range of psychological problems. Focus is upon both the individual and helping agency as factors in the community.

B386 Introduction to Counseling (3 cr.) P: B104, B310, and B380. This course will help students acquire a repertoire of basic counseling interview skills and strategies and expose students to specific helping techniques. This will be an activity-based course and students will enhance the general-education goals of listening and problem solving.

B394 Drugs and Behavior (3 cr.) P: B105. Equiv. to PU PSY 428. An introduction to psychopharmacology, the study of drugs that affect behavior, cognitive functioning, and emotions, with an emphasis on drugs of abuse. The course will explore how drugs alter brain function and the consequent effects, as well as the long-term consequences of drug exposure.

B396 Alcohol, Alcoholism, and Drug Abuse (3 cr.) Provides introduction to the use, misuse, and dependent use of alcohol and other mood-altering drugs. Topics include basic principles of drug action, the behavioral and pharmacological effects of drugs, and the factors that influence use, abuse, and addiction. Addiction assessment, treatment, and treatment outcome also will be covered.

B398 Brain Mechanisms of Behavior (3 cr.) P: B320. Spring. An advanced topical survey of the neurobiological basis of behavior, focusing on the neural substrates and the cellular and neurochemical processes underlying emotions, motivation and goal-directed behavior, hedonic experience, learning, and cognitive function. Integrates experimental research across different levels of analysis (genetic, molecular, cellular, neural systems).

B420 Humanistic Psychology (3 cr.) A comprehensive survey of the field of humanistic psychology. Explores human experience as a focal point in the study of psychology. Use of didactic and experiential teaching methods.

B422 Professional Practice (1-3 cr.) P: consent of instructor. Can include a professional internship in the community, peer advising in the psychology advising office, or teaching internship in the department. Faculty mentor must approve and oversee activity. Academic work will be required to earn credit.

B423 Capstone Laboratory in Physiological Psychology (3 cr.) P: B311, B305, and B320. Equiv. to IU PSY P426. Experiments and demonstrations in physiological psychology.

B424 Theories of Personality (3 cr.) P: 3 credit hours of psychology. Equiv. to IU PSY P319 and PU PSY 420. Methods and results of the scientific study of personality, including the development, structure, and functioning of the normal personality.

B425 Capstone Laboratory in Personality (3 cr.) P: B305, B311 and B424. Demonstrations and experiments in personality research.

B431 Capstone Laboratory in Cognition (3 cr.) P: B311, B305, and B340. Equiv. to IU PSY P435. Experiments and demonstrations in cognitive psychology.

B445 Capstone Laboratory in Learning (3 cr.) P: B311, B305, and B344. Equiv. to IU PSY P 436. Experiments and demonstrations involving learning and cognitive processes in nonhuman animals.

B452 Seminar in Psychology (1-3 cr.) P: B305 and B311. Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

B454 Capstone Seminar in Psychology (3 cr.) P: B305 and B311 or consent of instructor. Topics in psychology and interdisciplinary applications, which have been approved to fulfill the capstone course requirement.

B457 Capstone Laboratory in Motivation (3 cr.) P: B311, B305, and B356. Equiv. to IU PSY P436. Experiments and demonstrations in motivation.

B460 Behavior Management (3 cr.) P: consent of instructor. Equiv. to IU PSY P430 and PU PSY 380. Conducted as a seminar and a practicum for psychology majors and teachers in the principles and methods of behavior management.

B461 Capstone Laboratory in Developmental Psychology (3 cr.) P: B311, B305, and B310 or B360. Equiv. to IU PSY-P 429. Principal research methods in developmental psychology and their application to selected problems.

B462 Capstone Practicum in Industrial/ Organizational Psychology (3 cr.) P: B366 or B368 or equivalent and consent of instructor. Provides students with work experience, one day per week, in local organizations. Practice will be obtained in using the applied skills of industrial psychology to solve actual organizational problems.

B471 Capstone Laboratory in Social Psychology (3 cr.) P: B311 and B305. P or C: B370. Equiv. to IU PSY P421. Observational, correlational, and experimental studies in social psychology.

B472 Practicum in Group Dynamics (3 cr.) P: 6 credit hours of psychology and consent of instructor. Equiv. to IU PSY P321. Application in the field of group dynamics through experience as a participant in group sensitivity training.

B481 Capstone Laboratory in Clinical Rehabilitation Psychology (3 cr.) P: B305, B311, and B380. This course will familiarize students with research methods within the field of clinical psychology. As a capstone course, it requires students to access the information and skills learned throughout their undergraduate studies, especially in the courses listed as prerequisites. As a laboratory, it requires students to use their knowledge and skills to conduct an independent research study to further develop and consolidate their understanding of psychology as a science.

B482 Capstone Practicum in Clinical Rehabilitation Psychology (3 cr.) P: B386 and consent of instructor. Students are placed in a clinical/community setting and gain applied practicum experience working with individuals who have psychological, medical, and/or physical health problems. Relevant multicultural issues will be addressed.

B492 Readings and Research in Psychology (1-3 cr.) P: consent of instructor. Equiv. to IU PSY P495 and PU PSY 390 and 391. Fall, Spring, Summer. Independent readings and research on psychological problems.

B499 Capstone Honors Research (cr. arr.) P: consent of instructor. Equiv. to IU PSY P499. Fall, Spring, Summer. Independent readings and research resulting in a research paper.

Graduate Level

I501 Multicultural Counseling (3 cr.) P: graduate standing. This course explores the role of increasing diversity in the U.S. population and how it will affect the delivery of mental health services. The focus of the course is on different ethnic and minority groups, their customs and values, and the impact that these cultural factors have on the utilization of psychological services.

518 Memory and Cognition (3 cr.) A graduate-level survey of theories and research concerned with the acquisition, retention, and retrieval of information. Topics include amnesia, eyewitness memory, forgetting, developmental trends in memory, related issues in attention, language processing, and problem solving.

540 History of Psychology (3 cr.) P: 9 credit hours of psychology. A review of the philosophical, theoretical, and methodological issues that entered into the development of modern psychology. Emphasis on historical themes that continue to be active in the science and profession of psychology.

I544 Psychobiology of Learning and Motivation (3 cr.) P: B320 or equivalent. The course examines past and present biologically based theories of learned and motivated behavior. Neural processes of feeding, drinking, aggression, fear, anxiety, and sexual behavior will be emphasized. Selected coverage of behavioral research principles used to investigate these processes also will be discussed.

I545 Psychopharmacology (3 cr.) P: 615 or consent of instructor. A survey of the effects of drugs on behavior, cognitive functioning, and emotions. Emphasis will be placed on the practical advantages of understanding how psychotropic drugs work, and on how the brain functions in health and disease. Students will be exposed to the most current theories and research in the field.

I549 Introduction to Vocational Rehabilitation (3 cr.) P: 9 credit hours of psychology. Philosophy, procedures, and practices underlying the vocational rehabilitation movement, including the historical, social, cultural, and economic factors and legislation that have contributed to its rapid development.

I555 Medical and Psychosocial Aspects of Chronic Illness (3 cr.) P: 9 credit hours of psychology including I549. Provides medical information for rehabilitation counselors and introduces students to medical terminology. Includes knowledge of the etiology, prognosis, methods of treatment, and effects of disabling conditions, and implications for the rehabilitation counselor. Counselor relationships with other health-related personnel are emphasized.

565 Interpersonal Relations (3 cr.) P: 9 credit hours of psychology. Review of major current theoretical formulations of the interpersonal relationship, including a discussion of some of the more prominent research. Focus is primarily on two-person interpersonal relations.

570 Industrial Psychology (3 cr.) Survey of the applications of psychological principles and of research methodology to the various human problems in the industry, such as personnel selection and appraisal, the organizational and social context of human work, the job and work situation, human errors and accidents, and psychological aspects of consumer behavior.

572 Organizational Psychology (3 cr.) A survey of basic behavioral science research and thinking as these contribute to the understanding of individual, dyadic, group, intergroup, and other large organization behavioral phenomena. The topics covered include motivation, perception, attitudes and morale, communication, leadership, conflict, problem solving, behavior change, and organizational effectiveness.

574 Psychology of Industrial Training (3 cr.) P: 3 credit hours of psychology. Use of psychological measurement techniques in assessing training needs and evaluating training effectiveness and the application of learning research and theory to industrial training.

I578 Occupational Analysis (3 cr.) P: 570. Survey of systematic study of human work, including techniques for analyzing jobs and occupations for personnel and related purposes. Survey of occupational research and related topics. Practice in job analysis.

I580 Survey of Clinical Approaches with Children and Adolescents (3 cr.) P: 9 credit hours in psychology. Introduction to the following as they relate to children and adolescents: (1) psychopathological disorders and behavior problems, (2) theories of psychopathology and behavior problems, (3) evaluation techniques, and (4) therapeutic and behavioral change procedures. This is a lecture course.

590 Individual Research Problems (1-3 cr.) P: 12 credit hours of psychology and consent of instructor. Opportunity for students to study particular problems in any field of psychology or to learn research techniques under the guidance of a faculty member.

I591 Psychopathology (3 cr.) P: enrollment in psychology graduate program or consent of instructor. An intensive survey of the methods, theories, and research concerning the nature, causes, and development of psychopathology. An evaluation of current systems of assessment and classification of abnormal behavior is emphasized.

I595 Seminar in Teaching Psychology (0-3 cr.) P: consent of the Department of Psychology. A problem-solving approach to teaching psychology at IUPUI. Planning the course; anticipating problems; and dealing with ongoing teaching problems. Current faculty members will present their innovative techniques. Participants will evaluate each other's classroom performance.

600 Statistical Inference (3 cr.) P: Student must be a degree-seeking student in psychology graduate program or have consent of instructor and B305 or equivalent. Emphasis on principles underlying both parametric and nonparametric inference.

601 Correlation and Experimental Design (3 cr.) P: 600. Continuation of 600, with emphasis on the design and analysis of experiments.

605 Applied Multivariate Analysis (3 cr.) P: 600. A survey of the most frequently employed multivariate research techniques, such as multivariate generalizations of univariate tests and analysis of variance, principal components, canonical analysis, and discriminant analysis. A central theme of the course is the general linear model, both univariate and multivariate. A multipurpose program for this model provides the student with practical experience in conducting multivariate research.

608 Measurement Theory and the Interpretation of Data (3 cr.) P: 600 and B307, or equivalent. The theory of measurement and the development of reliability and the Spearman-Brown equations, true scores and variables, and correction for attenuation. Variance or covariance of combinations of variables. Item analysis and test construction strategies. Reliability and validity of measurements and the influence of measurement error and measurement threats to research design.

611 Factor Analysis (3 cr.) P: 600. Theory and applications of factor analysis in psychological research.

I613 Psychiatric Rehabilitation (3 cr.) P: consent of instructor. A seminar examining recent developments in the rehabilitation of persons with severe psychiatric disabilities. Covers assertive case management, vocational approaches, clubhouse models, residential alternatives, psychoeducation, and the consumer movement. Field observations complement classroom instruction. Issues in program planning and cost effectiveness will be discussed.

I614 Behavioral Medicine in Rehabilitation (3 cr.) P: consent of instructor. The theory and practice of behavioral medicine will be explored. Emphasis is on the application of behavioral principles to individuals suffering from various chronic diseases or disabilities including spinal cord injury, chronic pain, cancer, diabetes, strokes, cardiovascular diseases, and epilepsy.

615 Introduction to Psychobiology (3 cr.) P: consent of instructor. A survey of the integrated neurosciences emphasizing physiological psychology. Neural processes of sensory and motor function, arousal and sleep, motivation, learning and memory, language function, and personality disorders will be presented with selected coverage of neuroanatomy, neurophysiology, neuropharmacology, and neuroendocrinology. Both normal and pathological functions will be covered.

I618 Interventions in Health Psychology (3 cr.) P: consent of instructor. The goal of the course is to familiarize students with clinical interventions and research relevant to health problems and lifestyle. This will enable students to critically evaluate the work that has been accomplished, and to design and implement intervention protocols.

622 Animal Learning (3 cr.) A survey of the methods, problems, and research in Pavlovian, instrumental, and operant conditioning. Current issues and attempts at theoretical integration are highlighted. Emphasis is also given to the empirical and conceptual foundations of the present views on the mechanisms governing learned behavior.

624 Human Learning and Memory (3 cr.) P: a first course in human learning and consent of instructor. Selected survey of important problems in the encoding, storage, and retrieval of laboratory and naturalistic events.

628 Perceptual Processes (3 cr.) This course is an advanced introduction to the psychology of perception. The course emphasizes visual and auditory perception, reviewing basic concepts, methodologies, research findings, and theoretical approaches. Theories of direct perception, constructivist perception, and computational vision are discussed in detail.

640 Survey of Social Psychology I (3 cr.) P: B370 or equivalent. An extensive survey of methods, research, and theory in social psychology.

I643 Field Methods and Experimentation (3 cr.) P: 600. Covers methods appropriate for field experimentation and program evaluation. Topics will include quasi-experimental designs, sampling procedures, and issues associated with program evaluation.

646 Seminar in Social-Personality Psychology (3 cr.) P: consent of instructor. A seminar covering a special topic in personality or social psychology. Specific topic varies from seminar to seminar.

I650 Developmental Psychology (3 cr.) Major concepts, principles, and facts concerning the biological and environmental influences on behavioral and psychological development. Particular emphasis on essential principles of ontogenetic development (life span) emerging from current research in genetics and psychology.

655 Cognitive Development (3 cr.) P: consent of instructor. An analysis of research findings and current theories relevant to the development of cognitive processes. Emphasis on the changing characteristics of some fundamental cognitive processes. Special attention is given to verbal behavior and language.

I664 Psychological Assessment in Rehabilitation I (3 cr.) P: consent of instructor. Presentation of general principles of psychological assessment, professional practice, interviewing, intelligence/cognitive assessment, and psychological report writing. Supervised practice in the development of direct service skills in interviewing, behavioral observation, and psychometric assessment of cognitive abilities. Emphasis on functional implications of test results for rehabilitation populations.

I665 Intervention I: Counseling Approaches (3 cr.) P: consent of instructor. Introduces doctoral students to intervention procedures used in rehabilitation psychology. The course has both didactic and clinical skills components, involving traditional counseling interventions, behavior therapy, and biofeedback. Applications to disabled populations will be emphasized.

I666 Intervention II: Cognitive Behavioral Interventions (3 cr.) P: consent of instructor. Theory, research, and clinical application of cognitive-behavioral therapy (CBT). Addresses the history and development of CBT, assessment and intake interview process, CBT intervention techniques, and CBT treatment of several disorders. Relevant multicultural issues will also be discussed.

I669 Psychological Assessment in Rehabilitation II (3 cr.) P: I664 and consent of instructor. Presentation of psychometric foundations and the basic prediction model in personality/interest assessment. Coverage of the history of personality, assessment, personality development, and supervised clinical practice in personality/interest assessment in rehabilitation. Emphasis on prediction of everyday functioning.

I670 Ethical, Legal, and Cultural Issues in Psychology (3 cr.) P: admission to graduate training in psychology or consent of instructor. Exploration of models of ethical decision making. Examination of ethical principles and legal mandates that apply to professional psychology including psychologists' roles in health care service delivery, consultation (clinical and organizational), research, and teaching. Examination of cultural issues, including issues related to ethnicity, age, gender, religion, and sexual orientation.

I675 Human Neuropsychology (3 cr.) P: admission to graduate training in psychology or consent of instructor. Review of essential neuroanatomy, survey of experimental and correlational research methods in the study of brain-behavior relationships, and overview of the history of neuropsychology. Critical examination of neural models for human behavior: hemispheric specialization and integration, sensation/ perception, motor skills, language, spatial processing, attention, memory, executive operations, and gender differences.

I676 Principles of Clinical Neuropsychology (2 cr.) P: admission to graduate training in clinical rehabilitation psychology or consent of instructor. Application of theoretical models of brain-behavior relationships to evaluation of patients with suspected nervous system disorders. Review of neuropsychological profiles associated with various neurological and psychiatric disorders. Examination of ethical/cultural issues in neuropsychological evaluation. This course does not provide training in test administration (see PSY I677).

I677 Neuropsychological Assessment Lab (1 cr.) P: I664 and I669 and admission to graduate training in clinical rehabilitation psychology. Students must register for I676 concurrently with I677. Training and supervised practice in neuropsychological assessment techniques and procedures. Critical review of the psychometric properties of prevailing assessment tools. Review models of interpretation/reporting. Development of proficiencies in administering prominent neuropsychological tests, neuropsychological interviewing, and writing of reports that integrate multidisciplinary data.

680 Seminar in Industrial-Personnel Psychology (3 cr.) P: 570, 572, and 601. Extensively surveys the various areas of industrial-personnel psychology (e.g., selection, placement, training, performance appraisal). Provides a critical and up-to-date review of recent and classical research in these areas.

681 Seminar in Research Methodologies of Industrial/Organizational Psychology (3 cr.) P: 570, 572, 601, or consent of instructor. Intensive analysis of application of various research and statistical methods to the study of human behavior in organizational settings.

682 Advanced Seminar in Industrial/ Organizational Psychology (3 cr.) P: 570, 572, or equivalent. Special topics in industrial and organizational psychology are offered on a rotating basis. Examples of the special topics are work motivation, leadership, advanced selection and placement, and performance appraisal. One topic will be treated each semester.

683 Seminar in Industrial-Social Psychology (3 cr.) P: 570, 572, or equivalent. Study of research and theory emphasizing social perception, attitudes, supervisory behavior, employee participation, motivation, and organizational structure.

684 Practicum in Industrial/Organizational Psychology (3 cr.) P: 570, 572, and consent of instructor. Practical experience in the development and implementation of field research in organizational settings. Gives students the opportunity to spend eight hours per week in local business organizations to gain experience and skills in industrial/organizational psychology.

I689 Practicum in Clinical Rehabilitation Psychology (3 cr.) P: I549 and consent of instructor. Supervised practice of rehabilitation psychology in a community agency or organization.

I691 Seminar in Clinical Rehabilitation Psychology (3 cr.) P: consent of instructor. Current trends, problems, and developments in rehabilitation. Students pursue a special interest and share information and experience with the group. Individual reports and group discussions.

I697 Internship in Clinical Psychology (0-9 cr.) P: consent of instructor. Opportunities for application of theory and practice of rehabilitation psychology and case management in a rehabilitation setting under supervision of the Department of Psychology and the agency.

698 Research M.S. Thesis (3 cr.)

699 Research Ph.D. Thesis (0-12 cr.)

General Science

General Science courses offer opportunities for interdisciplinary study for both beginning and advanced students.

Courses in General Science (SCI)

Note: P = prerequisite; Fall = offered fall semester; Spring = offered spring semester.

SCI I120 Windows on Science (1 cr.) Fall, spring. Designed for new and prospective science majors, the course covers an integrative overview of science, examining science and society, the scientific method and community of scientists, undergraduate research, professional ethics, an exploration of science-based careers, and strategies for success as a science major.

SCI I200 Tutorial in Interdisciplinary Studies (1 cr.) Fall, Spring. Tutorial under the supervision of a faculty mentor to develop a proposal to pursue a plan of study focused on a science-based, interdisciplinary area. The proposal is to be submitted to the review committee for approval. Each student will maintain a journal on the progress on the plan of study.

SCI I294 Beginning Science-Based Internship (1-3 cr.) P: sophomore or junior standing and program advisor approval. Fall, spring. A semester of full- or part-time beginning internship experience in an industrial, government, or business setting matching the student's academic/career objective. A comprehensive written report on the experience is required.

SCI I494 Internship in Science-Based Fields (1-6 cr.) P: junior or senior standing and program advisor approval. Fall, spring. A semester of full-time or part-time internship experience in an industrial, government, or business setting matching the student's academic or career objective. A comprehensive written report on the experience is required.

SCI I495 Readings and Research in Science (1-3 cr.) P: junior or senior standing, consent of instructor(s), and approval of review committee. Every semester, time arranged. Independent, interdisciplinary study and research in science and science-related fields. A major paper must be submitted. May be repeated for a maximum of 6 credit hours.

Administrative Officers

School of Science Administration

CARL C. COWEN, Ph.D., *Dean*

PAMELA L. CROWELL, Ph.D., *Associate Dean for Research and Graduate Education*

ANDREW D. GAVRIN, Ph.D., *Associate Dean for Faculty Affairs and Undergraduate Education*

KIM S. NGUYEN, Ed.D., *Assistant Dean for Student Recruitment and Special Projects*

JEFFREY X. WATT, Ph.D. *Associate Dean for Undergraduate Students and Outreach*

Departmental Chairpersons

N. DOUGLAS LEES, Ph.D., *Department of Biology*

FRANKLIN A. SCHULTZ, Ph.D., *Department of Chemistry and Chemical Biology*

MATHEW J. PALAKAL, Ph.D., *Department of Computer and Information Science*

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Faculty

Alexy, William D., *Adjunct Assistant Professor of Psychology (1992); B.A., 1971, Concord College; M.A., 1972, Radford University; Ph.D., 1981, State University of New York at Buffalo.* Specialty: Rehabilitation Counseling.

Allen, Jeffrey T., *Lecturer in Computer and Information Science (2003); B.S., 1993, Purdue University.* Specialty: Microsoft Windows Programming.

Allen, Ruth D., *Associate Professor of Biology (1993); B.Sc., 1983, Ph.D., 1986, University of New Castle, Australia.* Specialty: Immunology.

Anliker, Keith S., *Lecturer in Chemistry (2002); B.A., 1982, University of Northern Iowa; M.S., 1985, Purdue University.* Specialty: Chemical Education.

Appleby, Drew C., *Professor of Psychology (1999); B.A., 1969, Simpson College; M.S., 1971, Iowa State University; Ph.D., 1972, Iowa State University.* Specialty: Teaching and Learning.

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Baker, Pauline, *Associate Professor of Computer Science (2002); B.A., 1974, Cornell University; M.S., 1977, Syracuse University; Ph.D., 1997, University of Illinois.* Specialties: Visual Information Sensing and Computing, Visualization and Interactive Spaces.

Bard, Martin, *Professor of Biology (1975); B.S., 1965, City College of New York; Ph.D., 1971, University of California, Berkeley.* Specialty: Molecular Genetics.

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Belecky-Adams, Teri L., *Assistant Professor of Biology (2001); B.S., 1985, University of Wyoming; Ph.D., 1994, University of Cincinnati College of Medicine.* Specialties: Developmental Biology, Retinal Regeneration.

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Bigatti, Silvia M., *Assistant Professor of Psychology (2000); B.A., 1995, San Diego State University; Ph.D., 2000, San Diego State University/University of California, San Diego Joint Doctoral Program in Clinical Psychology.* Specialty: Behavioral Medicine/Health Psychology.

Bittinger, Marvin, *Adjunct Professor of Mathematical Sciences (1968); B.S., 1963, Manchester College; M.S., 1965, The Ohio State University; Ph.D., 1968, Purdue University.* Specialty: Mathematics Education.

Blacklock, Brenda J., *Assistant Scientist (2005); B.S., 1989, University of Waterloo; Ph.D., 1994, University of Alberta.* Specialty: Biochemistry.

Blazer-Yost, Bonnie J., *Associate Professor of Biology (1993); B.S., 1973, Lebanon Valley College; Ph.D., 1984, University of Pennsylvania.* Specialty: Physiology.

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Bond, Gary R., *Chancellor's Professor of Psychology (1983); B.S., 1966, Michigan State University; M.A., 1972, Ph.D., 1975, University of Chicago.* Specialties: Psychiatric Rehabilitation, Program Evaluation.

Borden, Victor, M. H., *Associate Vice Chancellor, Management and Institutional Research and Associate Professor of Psychology (1992); B.A., 1979, University of Rochester; M.S., 1983, Ph.D., 1987, University of Massachusetts-Amherst.* Specialties: Statistical Methods, Secondary Data Analysis, Institutional Performance Indicators, Student Life Research.

Boschmann, Erwin, *Associate Vice President for Distributed Education and Professor Emeritus of Chemistry (1968); B.A., 1963, Bethel College (Kansas); M.S., 1965, Ph.D., 1968, University of Colorado.* Specialties: General Chemistry, Inorganic Chemistry, Bioinorganic Chemistry.

Boukai, Benzion, *Chairperson and Professor of Mathematical Sciences (1990); B.A., 1983, M.A., 1985, University of Haifa, Israel; Ph.D., 1988, State University of New York at Binghamton.* Specialties: Statistical Theory, Applied Statistics, Applied Probability.

Boyd, Donald, *Research Professor of Chemistry (1986); B.S., 1963, Pennsylvania State University; Ph.D., 1968, Harvard University.* Specialty: Organic Chemistry.

Bringle, Robert Gordon, *Chancellor's Professor of Psychology (1974); B.A., 1969, Hanover College; M.S., 1972, Ph.D., 1974, University of Massachusetts.* Specialties: Social Psychology, Program Evaluation, Methodology.

Brothers, Timothy S., *Adjunct Associate Professor of Geology (1984); B.A., 1978, University of California, Davis; M.A., 1981, Ph.D., 1985, University of California, Los Angeles.* Specialties: Biogeography, Human Impacts on Vegetation.

Bukhres, Omran A., *Professor of Computer Science (1995); B.S., 1984, Indiana University; M.S., 1986, University of Dayton; Ph.D., 1990, North Dakota State University.* Specialties: Distributed Database Systems, Mobile Computing Applications, Workflow Management Systems, Database Issues in Chem-Bioinformatics.

Burkinshaw, Owen, *Professor of Mathematical Sciences, (1972); B.S., 1966, M.S., 1968, Ohio University; Ph.D., 1972, Purdue University.* Specialty: Functional Analysis.

Buse, Olguta, *Assistant Professor of Mathematical Sciences (2005); B.S., 1996, University of Bucharest; Ph.D., 2002, SUNY at Stony Brook.* Specialty: Symplectic Geometry, Algebraic Topology.

Carlson, Judy E., *Senior Lecturer in Mathematical Sciences (1999); B.A., 1975, M.S., 1979, Indiana State University.* Specialty: Mathematics Education.

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Cheng, Ruihua, *Assistant Professor of Physics (2005); B.Sc., 1993, Northern Jiaotong University; M.Sc., 1996, Northern Jiaotong University; M.Sc., 2000, University of Nebraska-Lincoln; Ph.D., 2002, University of Nebraska-Lincoln.* Specialties: Condensed Matter, Magnetic Nano Structures.

Chernoff, Ellen A. G., *Associate Professor of Biology (1986); B.A., 1973, Ph.D., 1978, University of Chicago.* Specialties: Developmental Biology, Regenerative Biology.

Chin, Raymond C. Y., *Professor of Mathematical Sciences (1990); B.A.E., 1962, M.A.E., 1964, Rensselaer Polytechnic Institute; Ph.D., 1970, Case Western Reserve University.* Specialties: Parallel Solution of Partial Differential Equations, AsymptotiC–Numerical Methods.

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Clack, James W., *Assistant Professor of Biology (1990, IUPU Columbus); B.A., 1974, Indiana University; Ph.D., 1982, Purdue University.* Specialties: Neurobiology, Visual Physiology.

Clark, Patricia, *Lecturer in Biology (2003); B.A., 1983, Franklin College; M.A., 1986, Ph.D., 2000, Indiana University.* Specialties: Ecology and Ethology, Biology Education.

Cohen, Michael R., *Adjunct Professor of Geology (1968); B.S., 1960, City University of New York; M.A., 1963, Columbia University; M.S.T., 1964, Ph.D., 1968, Cornell University.* Specialties: Science and Environmental Education.

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Feinberg, Judy R., *Adjunct Assistant Professor of Psychology (1995); B.S., 1970, Indiana University; M.S., 1973, Butler University; Ph.D., 1990, Purdue University.* Specialties: Rheumatology, Orthopaedic Surgery, Patient Compliance.

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Fife, Wilmer K., *Professor Emeritus of Chemistry (1971); B.S., 1955, Case Institute of Technology; Ph.D., 1960, The Ohio State University.* Specialties: General Chemistry, Organic Chemistry, Biochemistry.

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Fokin, Vladimir, *Lecturer in Mathematical Sciences (2002); B.S., 1993, M.S., 1995, Novosibirsk State University, Russia; M.S., 1999, Purdue University.* Specialties: Mathematical Physics, Partial Differential Equations.

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Fricke, Gordon H., *Associate Dean Emeritus for External Development, School of Science, and Associate Professor Emeritus of Chemistry (1972); B.A., 1964, Goshen College; M.S., 1966, State University of New York at Binghamton; Ph.D., 1970, Clarkson College of Technology.* Specialties: General Chemistry, Analytical Chemistry.

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Geller, William, *Associate Professor of Mathematical Sciences (1994); A.B., 1982, Harvard University; Ph.D., 1989, University of California, Berkeley.* Specialty: Dynamical Systems.

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Goldberg, Carlos I., *Associate Professor Emeritus of Psychology, (1969); B.S., 1961, Brooklyn College; M.A., 1964, Ph.D., 1969, City University of New York.* Specialties: Social Psychology, Panic Disorder, Agoraphobia, Obsessive-Compulsive Disorder.

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Grahame, Nicholas J., *Associate Professor of Psychology (2005); B.A., 1987, Vassar College; Ph.D., 1992, Binghamton University.* Specialty: Behavioral Genetics.

Guare, John C., *Lecturer in Psychology (2002); B.A., 1977, M.A., 1982, State University of New York College at Brockport; Ph.D., 1991, University of Pittsburgh.* Specialty: Health Psychology.

Haitjema, Hendrick M., *Adjunct Associate Professor of Geology (part-time), School of Science, and Associate Professor of Public and Environmental Affairs, School of Public and Environmental Affairs (1989); M.S., 1976, Delft University of Technology, Netherlands; Ph.D., 1982, University of Minnesota.* Specialties: Groundwater Mechanics, Groundwater Flow Modeling, Soil Mechanics.

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Hanford, Peter V., Specialties: Experimental Analysis of Behavior, Motivation. *Professor Emeritus of Psychology, (1960); B.S., 1952, M.S., 1953, Ph.D., 1958, Pennsylvania State University.*

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Keck, Robert William, *Professor Emeritus of Biology (1972); B.A., 1962, M.S., 1964, University of Iowa; Ph.D., 1968, The Ohio State University.* Specialty: Plant Physiology.

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Kleyle, Robert M., *Professor Emeritus of Mathematical Sciences (1973); B.A., 1960, Duquesne University; M.S., 1962, University of Pittsburgh; Ph.D., 1968, Harvard University.* Specialty: Statistics.

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Kremer, John F., *Professor of Psychology (1975); B.A., 1966, St. Meinrad College; M.S., 1969, University of Notre Dame; M.S., 1974, Ph.D., 1975, Loyola University.* Specialties: Clinical Psychology, Evaluating Teaching, Teaching Introductory Psychology.

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Kuczkowski, Joseph E., *Associate Dean Emeritus for Academic Programs and Student Development, School of Science, and Professor Emeritus of Mathematical Sciences (1966); B.S., 1961, Canisius College; M.S., 1963, Ph.D., 1968, Purdue University.* Specialties: Semigroup Theory, Mathematics Education, College Student Development.

Kuznetsov, Alexey S., *Assistant Professor of Mathematical Sciences (2005); B.S., 1994, M.S., 1996, Ph.D., 1999, Nizhny Novgorod State University.* Specialty: Mathematical Physics, Nonlinear Dynamical Systems.

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Li, Richard, *Assistant Professor of Biology (2005); B.M., 1982, Shanghai College of Chinese Medicine; Ph.D., 1992, University of Wisconsin-Madison.* Specialty: Forensic Biology.

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Long, Eric C., *Professor of Chemistry (1991); B.S., 1984, Albright College; Ph.D., 1989, University of Virginia.* Specialties: Biological Chemistry, Peptide and Metallopeptide-DNA Interactions.

Luke, Jon, *Associate Professor Emeritus of Mathematical Sciences and Associate Professor of Computer and Information Science (1975); B.S., 1962, M.S., 1963, Massachusetts Institute of Technology; Ph.D., 1966, California Institute of Technology.* Specialty: Applied Mathematics.

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