1989-91

Bulletin of the Purdue University
School of Science
at Indianapolis

Our Future Home

Indiana University-Purdue University at Indianapolis

IUPUI

Degree Programs in the School of Science

Biology

Bachelor of Arts .... (PU)
Bachelor of Science .... (PU)
Master of Science..................... (PU)

Chemistry

Bachelor of Arts .... (PU)
Bachelor of Science .... (PU)
Master of Science..................... (PU)

Computer and Information Science

Bachelor of Science .... (PU)
Master of Science..................... (PU)

Geology

Bachelor of Arts .... (IU)
Bachelor of Science .... (IU)
Master of Science..................... (IU)

Mathematical Sciences

Bachelor of Science .... (PU)
Master of Science..................... (PU)

Physics

Bachelor of Science .... (PU)
Master of Science..................... (PU)

Psychology

Bachelor of Arts .... (PU)
Bachelor of Science .... (PU)
Master of Science..................... (PU)
Doctor of Philosophy in
    Rehabilitation Psychology .... (PU)

Qualified students may be authorized to pursue the Ph.D. degree in a science discipline (except geology) at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. Please contact the department of interest at IUPUI for further details.

Cover illustration: Artist's rendering of the new phase of the School of Science and School of Engineering and Technology complex being built on the main campus of IUPUI. The architect for the project is Edmund Larrabee Barnes, Associates. Another phase will be needed to complete the complex.

Bulletin of the Purdue University

School of Science

at Indianapolis

1125 East 38th Street
P.O. Box 647
Indianapolis, Indiana 46223

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IUPUI Calendar 1989-90

First Semester 1989-90

Classes begin	Monday, August 21
Labor Day recess	Monday, September 4
Thanksgiving recess begins	Monday, November 20
Classes resume	Monday, November 27
Classes end	Sunday, December 10
Final exams begin	Monday, December 11
Final exams end	Sunday, December 17

Second Semester 1989-90

Classes begin	Monday, January 8
Spring recess begins	Monday, March 5
Classes resume	Monday, March 12
Classes end	Sunday, April 29
Final exams begin	Monday, April 30
Final exams end	Sunday, May 6
Commencement	Sunday, May 13

Summer I 1990

Classes begin	Wednesday, May 9
Memorial Day recess	Monday, May 28
Classes end	Wednesday, June 20[1]

Summer II 1990

Classes begin	Monday, June 25
Independence Day holiday	Wednesday, July 4
Classes end	Tuesday, August 7[2]

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[1] Monday classes meet Wednesday, June 20.
[2] Wednesday classes meet Tuesday, August 7.

IUPUI Perspective

Indiana University established its first extension center at Indianapolis in 1916. The Purdue University Indianapolis campus grew out of World War II training programs sponsored by Purdue and began its major operations in 1946. Indiana University established an Indianapolis regional campus in the mid-1960s. The Indianapolis unit of the Indiana University regional campus system was separated from the other units in 1968 when Indiana University at Indianapolis was created by the Board of Trustees. Less than a year later, in 1969, the boards of trustees of Indiana and Purdue universities merged their Indianapolis operations to form Indiana University–Purdue University at Indianapolis. Indiana University was selected to administer the campus, and IUPUI is a core campus, along with Bloomington, of Indiana University.

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 Science (physical, behavioral, and life sciences), and the School of Engineering and Technology. Work in the School of Liberal Arts is concentrated on the main campus, just west of downtown Indianapolis. The School of Science and the School of Engineering and Technology utilize facilities on both the main and the 38th Street campuses. A new science building is scheduled to be built on the main campus and will open about 1991.

Because IUPUI combines the arts and sciences and professions, including engineering and technology, it is the most comprehensive public institution of higher learning in the state. This broad spectrum of educational opportunities enables its students to prepare for a wide range of careers. All degrees earned are from Indiana University or Purdue University.

IUPUI has an urban orientation. Most of its students commute, and many of its programs are directly related to metropolitan concerns and aspirations. IUPUI has an enrollment of almost 25,000 students, a faculty of 1,300, and an 8,000-member supporting staff. Professionals from business, industry, hospitals, and government agencies often serve as part-time lecturers in select disciplines, their practical experiences providing students with additional educational insights. School of Science students have the opportunity to participate in cooperative education programs with area industry.

IUPUI divisions include the country's second largest medical school, a dental school with an international reputation for its research in preventive dentistry, the state's only graduate-degree-granting school of nursing, and a division of allied health sciences. These, with associated teaching hospitals, clinics, and research facilities, form the state's major concentration of health care resources.

Other IUPUI units include the only graduate school of social work in the state, the country's oldest school of physical education, a law school with an urban emphasis, the nationally recognized Herron School of Art, and Schools of Continuing Studies, Education, Business, Journalism, and Public and Environmental Affairs. Purdue brought to the merger a growing complex of degree programs and Purdue's traditional strengths in the physical sciences, engineering, and technology.

Both the undergraduate and graduate divisions of IUPUI are fully accredited by the North Central Association of Colleges and Secondary Schools. This assures the recognition of IUPUI credits and enables graduates to study in virtually any school in the nation. Because of the organization of the School of Science, all degrees awarded are Purdue University degrees, except those given in geology, which are Indiana University degrees.

The School of Science

The School of Science offers many undergraduate and graduate programs that will prepare students for a variety of careers now open to scientists. Scientists are encouraged by society to pursue new avenues of research, either as individuals, or as part of research teams employing many scientists. Needed to design computers and computer programs, to locate and analyze natural resources, and to help find ways to protect our environment, scientists can apply research findings to industrial and human problems. They are wanted as administrators for governmental organizations using other scientists and as salespersons and managers by companies with science-based products.

Undergraduate training in one or several of the sciences is considered excellent background for graduate study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important. The School of Science also is very much interested in helping young people whose goal is not a career in science but a general education with emphasis on the scientific aspects of our culture.

Supplementing the full-time instructional staff, with rank 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.

The School of Science offers Bachelor of Arts degrees in biology, chemistry, geology, and psychology. Bachelor of Science degrees are offered in biology, chemistry, computer science, geology, mathematics, physics, and psychology. Master of Science degrees are offered in biology, chemistry, computer science, geology, mathematics, physics, and psychology. A Ph.D. program in rehabilitation psychology is also offered. All degrees awarded are Purdue University degrees, except those given in geology, which are Indiana University degrees. Qualified students may be authorized to pursue a Purdue Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette.

Awards

The faculty cooperates in nominating students for various annual awards offered by the School of Science departments or by organizations interested in science education.

Department of Biology

Indiana Multiple Sclerosis Society Award for achievement in scientific research (graduate or undergraduate) with a potential for significantly advancing understanding of disease

Eli Lilly Prize in Biotechnology for achievement in scientific research (graduate or undergraduate) related to the general area of biotechnology

Alltech Award for Excellence for a graduate student selected from among those with the best overall academic record who also has demonstrated a potential for quality research

C. V. Mosby Award for Scholarship for an undergraduate student selected from among those with the best overall academic record

Department of Chemistry

Academic Achievement Award for the graduating senior with highest achievement in a Bachelor of Arts degree program

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

Frank J. Welcher Award for the graduating senior with greatest professional promise

Chemical Rubber Company Award for the outstanding freshman student in general chemistry

Outstanding Undergraduate Analytical Chemistry Award sponsored by the American Chemical Society

Loren T. Jones Memorial Scholarship for summer support of an outstanding chemistry major

American Institute of Chemists Student Research and Recognition Award for an outstanding senior student majoring in chemistry

Department of Computer and Information Science

Outstanding Student Award for a major in computer and information science. This award is sponsored by the Indianapolis Center for Advanced Research.

Outstanding Graduate Student Award for a regular graduate student in computer and information science. This award is sponsored by the Indianapolis Center for Advanced Research.

Department of Geology

Academic Achievement Award for the graduating senior with highest academic achievement

Leadership and Service Award for the graduating senior with outstanding leadership and service to the department

Indiana Geology and Gem Society Scholarship for a sophomore or junior geology major

Geology Alumni Scholarship for a senior-year undergraduate geology major

Department of Mathematical Sciences

Anna K. Suter Award for the outstanding senior mathematics major

Anna K. Suter Scholarship for undergraduate mathematics majors. This scholarship covers tuition and books for one year. It is renewable based on academic performance. An additional, substantial cash award is also made when funds are available.

Outstanding Student Award for an outstanding junior or senior (or both) based on achievements in advanced mathematics

Department of Physics

Academic Achievement Award for the physics major with the best academic record

Golden A. Flake Award for the best student in the elementary physics course sequence for science majors

Department of Psychology

Robert G. Neel Award for the graduating senior with highest academic achievement

Robert I. Long Award for the most outstanding graduating senior

Student Research Award for the graduating senior who has demonstrated the most skill as a research scientist

Graduate Psychology Awards for the most outstanding graduate student in the applied social psychology, industrial/organizational psychology, and rehabilitation psychology programs

In addition, science honor students compete successfully for Outstanding Freshman Scholarships and Outstanding Upper Class 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 honoraries. Psychology majors may be elected to Psi Chi Honorary for students of that discipline.

Student Welfare and Responsibility

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. Advisers, 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 adequate fulfillment. For this reason, it is important for students 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 1989 (fall semester). Students who enter after this date may

be subject to different requirements; students who entered prior to August 1989 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 a degree program within eight years of admission, the student may be obliged by the major department to meet the requirements of a subsequent bulletin.

Program Planning and Counseling Guidelines

The experience of academic advisers 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 faculty advisers in their major departments on or before the dates established by the University calendar for academic counseling. 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 making an appropriate academic program and for meeting every degree requirement rests with the student; faculty or staff members acting in the capacity of advisers 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 a faculty adviser or from the Office of the Associate Dean for Academic Affairs, School of Science, Krannert Science Building 165, 1125 E. 38th Street [(317) 274-0625].

Confidentiality of Student Records

Indiana University, in compliance with the General Education Provisions Act, Section 438, titled Family Educational Rights and Privacy Act, provides that all student records are confidential and available only to the student and to the student's parents, if the student is under 21 and dependent as defined by IRS standards. The student may review his or her record upon request and may ask for deletions or corrections of the record in a hearing process described in detail in the booklet *Student Rights and Responsibilities*. References, recommendations, and other similar documents may carry a voluntary waiver relinquishing the student's right to review this specific material. The student may also release the record to others by signing a written release available in the offices that maintain records. Further details regarding the provisions of the Privacy Act and a list of offices where student records are kept may be found in the booklet *Student Rights and Responsibilities*, available in the Office of the Dean for Student Affairs, Administration Building 140, 355 N. Lansing Street [(317) 274-2546].

Student Conduct

Rules for student conduct are in keeping with the diverse nature of the student body and faith of the University in student responsibility.

A code of student conduct, enacted by the governing Indiana University Board of Trustees, is designed to assure due process for all students requiring disciplinary action. Student conduct is the responsibility of the dean of each school or academic division. Within the School of Science an Academic Appeals Committee assists the dean in these matters. The dean for student affairs has the assignment of implementing central administration action if necessary. More information can be obtained in the booklet *Student Rights and Responsibilities*.

Career and Employment Services

The Office of Career and Employment Services provides services for students and graduates in evaluating career interests and opportunities and assistance to graduating students in job-search strategies, resume preparation, interviewing techniques, and on-campus recruiting interviews.

The office maintains a career resource library containing company literature, occupational and career information, employment trends, and specific full-time employment opportunities at both the graduate and undergraduate levels.

Recruiting companies interview graduating students on campus during the fall and spring semesters. Students may take advantage of this opportunity by registering with the office located in the Business-SPEA Building 2010, 801 W. Michigan Street [(317) 274-2554].

In addition to the Office of Career and Employment Services, information about specific career fields is also available in the School of Science Office of the Associate Dean for Academic Affairs and in departmental chairpersons' offices.

Campus Housing

Admission to the University does not guarantee campus housing accommodations at IUPUI. Students must file separate applications for housing in order to reserve spaces and should apply as soon as they decide to attend school at this campus. Assignments are made based on the date of receipt of the application and the $15 application fee. Persons may apply for housing even though they are not yet admitted to the University.

Dormitory spaces for men and women total 339 beds. Accommodations include Ball Residence and Warthin Dormitory Suites. Graduate Townhouses and Warthin Apartments provide an additional 132 one- and two-bedroom living units on campus. Requests by students for specific dormitory roommates will be honored whenever possible, if the applications are received at approximately the same time and if both applicants make written requests on the application form to room together.

Academic-year campus housing assignments and billing information are usually mailed in July and early August. For additional information, please contact the Department of Campus Housing, Ball Residence 116, 1226 W. Michigan Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-7200].

Information for International Students

International students applying to study at IUPUI use the international application. In addition to academic qualifications, they must show proficiency in English and proof of financial support before the travel documents are issued. Application information may be obtained from the International Student Services Office, Union Building 574, 620 Union Drive, IUPUI, Indianapolis, Indiana 46202-2897, U.S.A. [(317) 274-7294]. The International Student Services Office is responsible for all travel documents and immigration concerns, orientation, adjustment to American living, and activities. Upon their arrival, all international students and exchange visitors must report to the International Student Services Office, Union Building 574.

Nondiscrimination Policy

Indiana University–Purdue University at Indianapolis provides its services without regard to sex, age, race, religion, ethnic origin, veteran status, or handicap. An Affirmative Action Office on each campus monitors the University's policies and assists individuals who have questions or problems related to discrimination.

Expenses and Financial Aid

Costs and Fees

The cost of attending IUPUI generally is related to the number of credit hours taken by the student. The fee structure for general academic areas of IUPUI as of fall 1988 is as follows:

	In-State	Out-of-State
Undergraduate	$61.45/credit hour	$172.15/credit hour
Graduate	$82.10/credit hour	$229.70/credit hour

There may be other fees, such as laboratory fees, late registrations fees, parking fees, and special fees for certain courses and programs.

Fees are subject to change without notice by action of the Board of Trustees of Indiana University. Inquiries about fees should be directed to the Office of the Bursar, Cavanaugh Hall 147, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2451]. Specific information about student fees and fee-related processes is found in the IUPUI *Schedule of Classes*.

Full-time undergraduate students usually enroll for 15 to 17 credit hours per semester; thus an entire year for an in-state resident costs about $2200 for fees, books, and class supplies. Other expenses such as transportation, food, and entertainment vary according to individual needs.

Refund Policy

Refunds during the fall and spring semesters and summer sessions are determined by the date of withdrawal as indicated below. Deadlines are calculated based on the first day of classes as stated in the IUPUI *Schedule of Classes*.

Courses scheduled 9-16 weeks in length		Courses scheduled 5-8 weeks in length	
1st week	100% refund	1st week	100% refund
2nd week	75% refund	2nd week	50% refund
3rd week	50% refund	3rd week	No refund
4th week	25% refund		
5th week	No refund		

To be eligible for a refund, students must submit a schedule adjustment form to the Registrar's Office, Cavanaugh Hall 133, 425 Agnes Street, for the course they wish to drop. Refund amounts are determined by the official date on which the withdrawal form is received by the IUPUI Registrar's Office.

Credit by Examination

The following policies apply to special credit awarded as the result of an examination:
1. If the special credit is awarded to the student during the first or second consecutive semester of enrollment at IUPUI, there is no charge.
2. If the student is a first-semester transfer student, there is a charge of $10 per credit hour.
3. If neither of the above conditions apply, the standard resident or nonresident credit hour charge will be assessed.

Credit by Credentials and/or Experience

Special credit awarded as a result of credentials or experience will be assessed at the rate of $10 per credit hour not to exceed $50 per course.

Health Care and Insurance

The Student-Employee Health Service (SEHS) is located in Coleman Hall, 1140 W. Michigan Street [(317) 274-8214]. All full-time IUPUI students are eligible for the program of outpatient health care provided by SEHS. There is no charge for the services of physicians, nurses, or speciality consultants. In addition, the SEHS clinic has available more than 90 specialty clinics to which students may be referred. The University has also arranged for an optional health insurance plan to supplement the services provided by the SEHS clinic. All students are eligible for this program through a private insurance carrier. Part-time students may be treated in the Student-Employee Health Service on a fee-for-service basis. Information is available at registration and at SEHS.

Financial Aid

It is the philosophy of IUPUI to encourage students in their educational goals and to reduce financial barriers. The University recognizes that many students and their parents cannot afford to finance a college education entirely from their own income and assets. For this reason, a program of financial assistance is available to admitted and enrolled students who have a demonstrated financial need. Aid is available in the form of grants, loans, and participation in the work-study program. Academic scholarships are also offered. For priority consideration, students should apply for financial assistance before March 1 for the following academic year.

Individuals desiring further information about any of the financial aid programs should write to the Office of Scholarships and Financial Aid, Cavanaugh Hall 103, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202, or call (317) 274-4162.

Veterans Benefits

Students eligible for education benefits from the Veterans Administration enroll according to the following benefits scale:

Undergraduate Benefits	Fall & Spring Semesters	Summer I	Summer II
Full time	12 cr. or more	4 cr.	4 cr.
Three-quarters time	9-11 cr.	3 cr.	3 cr.
One-half time	6-8 cr.	2 cr.	2 cr.
Tuition only	fewer than 6 cr.	1 cr.	1 cr.

Graduate Benefits	Fall & Spring Semesters	Summer I	Summer II
Full time	9 cr. or more	4 cr.	4 cr.
Three-quarters time	7-8 cr.	3 cr.	3 cr.
One-half time	5-6 cr.	2 cr.	3 cr.
Tuition only	fewer than 5 cr.	1 cr.	1 cr.

Further information on benefits, including Veterans Administration paid tutorial assistance and work-study opportunities, is available from the Office of Veterans Affairs at the Registrar's Office, Cavanaugh Hall 133, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-1501].

Admissions and Transfers

All students entering the School of Science must have been officially admitted to the University by the Office of Admissions, Cavanaugh Hall 129, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-4591]. Further information and application forms may be obtained at this address. All applications for admission must be accompanied by a $20 nonrefundable fee. Checks should be made payable to IUPUI.

IUPUI offers instruction during two semesters and two six-week summer sessions. Students may start a program of study with any regularly scheduled session. Sessions begin in August, January, and May.

Beginning Students

Students entering IUPUI directly from high school should file their application for admission at the end of their junior 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 graduate of a high school accredited by a state Department of Public Instruction.
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:

Subjects	Semesters
English	8
History or social studies	2
Algebra[1]	3
Geometry[1]	2
Trigonometry or fourth-semester algebra[1]	2
Laboratory science	2

Students may be admitted with some deficiencies in mathematics or laboratory science. Such deficiencies may be removed by taking courses offered by the School of Science. However, these courses may not be counted as credit toward a School of Science degree. If the high school offers more than the above mathematics courses, students may benefit from taking analytic geometry (precalculus mathematics). It is advised that one semester of chemistry be included in laboratory science.

In planning high school electives, the curricula of the various departments of the School of Science contained in this bulletin should be reviewed. Departmental counselors will be glad to help with preplanning for admission.
3. All applicants are required to take the Scholastic Aptitude Test (SAT) or the American College Test (ACT). It is recommended that these tests be taken in the spring of the student's junior year in high school.

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[1] Students in the B.A. and B.S. programs in psychology and the B.A. program in geology are required to have four semesters of mathematics, two of which will be in algebra, for admission to the School of Science.

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4. Indiana Residents
   a. Residents of Indiana must rank in the upper half of their high school graduating class or have a combined verbal-math SAT score of 950. In either case, neither SAT score may be below 400.
   b. Residents of Indiana must rank in the upper half of their high school graduating class or have an ACT composite score of 23. In either case, neither the verbal ACT score nor the math ACT score may be below 18.
   c. A marginal applicant may be granted admission, admitted on probation, or have admission denied.
5. Out-of-State Residents
   Out-of-state applicants must rank in the top third of their high school graduating class. They must also rank in the top third of the IUPUI distribution on the SAT or ACT.
6. Information provided by the high school counselor is considered.

Students should declare a major when applying for admission so that a departmental adviser can be assigned. Premedical and predental students should declare a chemistry or biology major at the time of admission.

Advanced Academic Standing
On the basis of departmental examinations, departmental credit and/or advanced placement may be awarded. To determine qualifications for such consideration, consult the department concerned.

SPAN (Special Pre-College-Age Nondegree Programs)
The SPAN program allows middle and high school students ranking in the top 10 percent of nationally standardized tests (SAT, IOWA, PSAT, etc.) and senior-year high school students ranking in the top 20 percent of their class to earn college credit prior to their graduation from high school. This permits them to be challenged in courses not available in their own schools and to develop better study and research skills while continuing their normal junior or senior high school education. To determine qualification, consult the high school counselor and the Honors Program at IUPUI.

Adult Nondegree Students
Adult applicants, especially those with work experience in the field in which they wish to study, receive special consideration. If admitted in this category by the Adult Education Coordinating Center, Cavanaugh Hall 001E, the student may enroll for up to 30 credit hours of course work, after which the student must apply for admission to the University before enrolling in additional classes. All applicable credit hours earned as an adult nondegree student may be counted toward a School of Science degree.

Transient Students
It is the responsibility of the individual as a transient student to determine whether credit hours earned at IUPUI may be applied toward the degree being sought from one's own university.

Transfer Students
From IUPUI Schools, Indiana University Campuses, and Purdue University Campuses
Students desiring to transfer should have a minimum grade point average of 2.0 on a 4.0 scale and be in good disciplinary standing. Upon processing of appropriate materials as indicated below, acceptance to the School of Science requires the signature of the chairperson of the department approving the request to pursue a degree program and the signature of the associate dean for academic affairs of the School of Science.
1. An IUPUI student must file a record change form, which may be obtained from the Office of the Associate Dean for Academic Affairs of the School of Science or the student's current school.
2. A student at another Indiana University campus must file an intercampus transfer form, which may be obtained from the office of the dean of the campus where the student is enrolled.
3. A Purdue University campus student must make an official application through the IUPUI Office of Admissions.

From Other Colleges and Universities
If the student has earned transfer credit for 12 credit hours and a cumulative grade point average of 2.0 (2.5 for nonresidents of Indiana) on a 4.0 scale in other institutions, he or she may be admitted to the School of Science. Admittance to the school is contingent upon acceptance into a departmental program. Submit with the application for admission:
1. a copy of the 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.

To assure admission for any given semester, the application should be received at least 30 days before the beginning of classes.

Credit from other institutions is evaluated by the Office of Admissions, and its applicability toward degree requirements in the School of Science is determined by the major department.

Transfer Credit

Acceptability of transfer credits from another college or university is determined by the student's major department. However, transfer credit will be allowed for the master's degree only after one semester of satisfactory work in residence at IUPUI.

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

See the section "Information for International Students" in this bulletin.

Graduate Students

To be considered for admission, candidates must have a baccalaureate 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 their chosen field. An applicant not meeting these requirements should take the Aptitude Tests Section of the Graduate Record Examination.

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 will also be accepted. The applicant will be advised of action on his or her application by the dean of the Purdue University Graduate School, or, for a geology applicant, the dean of the Indiana University Graduate School.

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

Financial support in the form of teaching and research assistantships is available through the departments of the School of Science.

Regular Graduate Student Application
Application forms for admission as a regular graduate student may be obtained from the major 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.

Temporary Graduate Student Application
Application for admission as a temporary graduate student must be made before a student starts graduate work. The temporary graduate student classification is primarily for those casual students who wish to take courses 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 temporary graduate student. The major department will advise applicants of the procedure for obtaining regular graduate student status. Admission as a temporary graduate student is obtained through the Adult Education Coordinating Center, Cavanaugh Hall 001E, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2066].

Not 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. 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.

Undergraduate Programs

University-wide changes in the undergraduate curriculum are pending. These changes, which will enhance undergraduate education, may result in changes in or additions to the degree requirements listed in this bulletin. Students should consult with their academic adviser at each stage of their undergraduate program of study to ensure that all degree requirements are met.

Baccalaureate Degree

General Requirements

1. A minimum of 124 credit hours (122 for geology) must be completed. Acceptance must be obtained from the Office of the Associate Dean for Academic Affairs 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. A minimum of 9 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 academic affairs, 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 can be applied only as general electives and not toward degree area requirements of the school or department.
8. Not more than 60 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 academic affairs. Also, by permission of the 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.
10. The following courses do not count for any credit toward any degree program in the School of Science: AGR 101; BIOL N120; CHEM C100; all COAS courses; EDUC U205, X150, X151, X152; ENG W001; and MATH 001, 002, 110, 111, 112, 123, 130, 131, 132.
11. Courses taken outside of the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of clinical, athletic, or performing arts course work will be approved. See the departmental counselor for details.
12. In general, credit is not allowed for both of two overlapping courses. See the departmental counselor for details.
13. An application for a degree must be filed in the Office of the Recorder, School of Science, Krannert Science Building 165 [(317) 274-0625] at least one semester prior to the anticipated graduation. Degrees are conferred in May, August, and December; Commencement is held only in May. Candidates for degrees in August may participate in May Commencement.

Area Requirements

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. However, the requirements must be chosen from only one bulletin. A student who has not completed a degree program within eight years of entering the School of Science may be obliged by the major department to meet the requirements of a subsequent bulletin. 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 counselors in planning their courses of study.

Students should note the following:
1. Check departmental descriptions for courses that are considered overlaps. Some courses may not be used to fulfill distribution requirements. Students should consult with their advisers on these points.
2. Cross-listed courses may count only once in fulfilling requirements.
3. English W131 and other composition courses may not be used to complete the Area III requirements.
4. It is recommended that a student who intends to pursue graduate studies plan to take the Graduate Record Examination (GRE) at the beginning of the senior year.

Bachelor of Arts Degree

Area I
English Composition and Communicative Skills   Two courses in English composition of at least 3 credit hours each and one course in speech skills of at least 3 credit hours are required. The English composition requirement is partially satisfied by completing ENG W131. A second course, in technical or research writing, may be used to complete the composition requirement. Consult departmental guidelines. A grade of C or better must be obtained in both composition courses.

Area II
Foreign Language   No courses are required by the School of Science. Consult departmental requirements.

Area III
IIIA Arts and Humanities   Four courses totaling at least 12 credit hours are required. There must be at least two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

American Studies	Journalism
English	Music
Fine Arts	Philosophy
Folklore	Religious Studies
French	Spanish
History	Theatre
German	

Performing arts and studio courses are not accepted as fulfilling arts and humanities requirements. Writing courses are not accepted as English or journalism courses.

IIIB Social and Behavioral Sciences   Four courses outside the major department totaling at least 12 credit hours are required. There must be at least two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

Anthropology	Linguistics
Economics	Political Science
Geography	Psychology
History	Sociology

IIIC Physical and Biological Sciences   At least four science courses totaling a minimum of 12 credit hours outside the major department are required. At least one of the courses must be a laboratory course. Not acceptable are BIOL N100, N120, N200; CHEM C100; GEOL G130; and all agriculture courses. Check major department for additional restrictions.

Biology	Geology
Chemistry	Physics (including Astronomy)

IIID Mathematical Sciences   One course of at least 3 credit hours in computer science (CSCI) is required. Check for additional departmental requirements.

Computer Science	Statistics
Mathematics	

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.

Bachelor of Science Degree

Area I

English Composition and Communicative Skills   Two courses in English composition of at least 3 credit hours each and one course in speech skills of at least 3 credit hours are required. The English composition requirement is partially satisfied by completing ENG W131. A second course, in technical or research writing, may be used to complete the composition requirement. Consult departmental guidelines. A grade of C or better must be obtained in both composition courses.

Area II

Foreign Language   No courses are required by the School of Science. Consult departmental requirements.

Area III

IIIA Arts and Humanities   Two courses totaling at least 6 credit hours are required. There must be two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

American Studies	Journalism
English	Music
Fine Arts	Philosophy
Folklore	Religious Studies
French	Spanish
History	Theatre
German	

Performing arts and studio courses are not accepted as fulfilling arts and humanities requirements. Writing courses are not accepted as English or journalism courses.

IIIB Social and Behavioral Sciences   Two courses outside the major department totaling at least 6 credit hours are required. There must be two courses in one discipline in either IIIA or IIIB. History is cross-listed and may be used in IIIA or IIIB, but not both.

Anthropology	Linguistics
Economics	Political Science
Geography	Psychology
History	Sociology

IIIC Physical and Biological Sciences   At least four science courses totaling a minimum of 12 credit hours outside the major department are required. At least one of the courses must be a laboratory course. Not acceptable are BIOL N100, N120, N200; CHEM C100; GEOL G130; and all agriculture courses. Check major department for additional restrictions.

Biology	Geology
Chemistry	Physics (not including Astronomy)

IIID Mathematical Sciences   At least two courses beyond algebra and trigonometry, totaling a minimum of 6 credit hours, are required. In addition, one course of at least 3 credit hours in computer science (CSCI) is required. Courses in applied statistics are not acceptable. Check for additional departmental requirements.

Computer Science	Statistics
Mathematics	

Area IV

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

Minors

See the departmental sections of this bulletin for information on minor fields of study. Not all departments offer a minor.

Requirements for minors offered by departments in the School of Science are:
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 in the minor subject.

Graduate Programs

Master of Science degrees are offered in computer science, biology, chemistry, geology, physics, psychology, and mathematics. A Ph.D. program in rehabilitation psychology is also offered. All degrees awarded are Purdue University degrees, except that given in geology,

which is an Indiana University degree. Qualified students may be authorized to pursue a Purdue Ph.D. degree at IUPUI in areas where a program has been arranged with Purdue, West Lafayette. For information on Ph.D. programs, consult the departmental sections of this bulletin.

Purdue University Graduate Degrees

General Requirements

1. Students must have regular graduate student standing.
2. Students must satisfy the English requirement. All degree-seeking graduate students are required to demonstrate a proficiency in English composition before filing a plan of study. Candidates for advanced degrees whose native language is English satisfy the English requirement (1) if they earned no grade below B in graded undergraduate courses in composition prior to graduate admission (Pass/Fail or S grades are not acceptable), (2) if they achieve scaled scores of 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination (GRE) or 36 or higher on the Graduate Management Admission Test, or (3) if they can certify exemption from undergraduate composition on the basis of both a Scholastic Aptitude Verbal test score of at least 650 and a rank in the upper 10 percent of their high school class. If the student takes the GRE or the Graduate Management Admission Test after applying for admission to the Graduate School, the student must be certain the Educational Testing Service sends test scores to the Graduate School.
   Those not cleared as specified above must write a test paper for the Writing Review Committee and are held for further writing if the test paper is not acceptable. Students so held are expected to work toward satisfying the requirement without delay. The student should make certain that the Writing Review Committee sends the Graduate School notice of satisfaction when completed. See the administrative assistant in the Office of the Academic Dean for the person to contact for clearance in this manner.
3. Students must file a plan of study. The plan of study shall include a primary area and a related area or areas that are chosen on the basis of the student's interests and needs. 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 individual graduate adviser. The formal plan of study should be submitted as soon as possible and before the final semester. The English requirement must be met before the plan of study may be filed.
4. Students must meet the grades and index requirements. Only grades of A, B, and C are acceptable on a plan of study. An advisory committee may require higher performance than C in certain courses. There is no general Graduate School cumulative index requirement. Specific requirements, if any, are up to the individual departments.
5. Students must complete the credit hours of work required. This varies by department from 30 to 36 hours of credit.
6. Students must fulfill departmental requirements regarding oral and written examinations. The Graduate School has no general requirement for oral and written examinations for the master's degree. In any department the final examinations may be waived if the student meets the minimum requirements of the department. In any event, a final examining committee is appointed for each candidate for the master's degree. The committee must certify to the Graduate School either that the student has passed the required examinations of the department in which the major graduate study has been taken or that the committee is satisfied with the accomplishment of the student as based on a committee conference.

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 temporary graduate student is, however, required and may be accomplished through the IUPUI Adult Education Coordinating Center, Cavanaugh Hall 001E, 425 Agnes Street, IUPUI, Indianapolis, Indiana, 46202 [(317) 274-2066]. A maximum of 12 credit hours of courses completed as a temporary student may be used in completing the requirements of a degree upon acceptance as a degree-seeking student and upon departmental approval.

Indiana University Graduate Degrees

Consult the Department of Geology section of this bulletin for information. A maximum of 9 credit hours of course work completed as a temporary graduate student may be used in completing the requirements of a degree upon acceptance as a degree-seeking student and upon departmental approval.

Academic Regulations

Grades

The School of Science uses a grading system that may include plus and minus grades, as well as straight grades, for all undergraduate and graduate courses.

A+ (4.0)
A (4.0)
A− (3.7)
B+ (3.3)
B (3.0)
B− (2.7)
C+ (2.3)
C (2.0)
C− (1.7)
D+ (1.3)
D (1.0)
D− (0.7)
F (0.0) (No credit) Failed the work in a course or failed to complete an official withdrawal
R (Deferred Grade)
S Satisfactory
P Passed (See Pass/Fail option)
F Failing (See Pass/Fail option) (No credit)

Instructors have the prerogative of using the plus-minus or the conventional grading system for their courses.

Pass/Fail Option During the four years of his or her undergraduate program, any undergraduate student in good standing (not on probation) 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 the School of Science departmental offices and in the Office of the Associate Dean for Academic Affairs, Krannert Science Building 165 [(317) 274-0625].

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 concentration area. The course or courses may be used to meet the 300-400 level course requirement. A grade of P cannot be changed subsequently to a grade of A, B, C, or D.

Computation of GPA To compute the grade point average (GPA), the number of grade points received (4.0 for an A, 3.0 for a B, etc.) is multiplied by the number of credit hours assigned for each course. The sum of grade points received for all courses is then divided by the total number of course credit hours. Grades of P and S are not included in the computation; a grade of F is included.

Withdrawal Students may officially withdraw from classes without penalty during the first half of a semester or session if they secure the approval of their adviser; 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 adviser and the instructor of the course; a grade of W or F may be assigned by the instructor of the course. The grade so assigned is recorded on the final grade report. Students may withdraw from classes during the last quarter of a semester or session if they secure the approval of their adviser, the instructor of the course, and the dean of their school; a grade of W or F may be assigned by the instructor of the course. The grade so assigned is recorded on the final grade report. *Students will be allowed to withdraw from class during the last quarter of the semester only under extenuating circumstances. A written justification from a doctor, clergyman, adviser, etc., must be presented.* The necessary form for withdrawal from a course is available in the School of Science departmental offices and in the Office of the Associate Dean for Academic Affairs, Krannert Science Building 165 [(317) 274-0625].

Students who alter their schedule, whether by personal incentive or by departmental directive, must follow 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 may risk not receiving credit for work done in a course that has not been properly added.

Incomplete The grade of I (Incomplete) indicates that the work is satisfactory as of the end of the semester but has not been completed. The grade of Incomplete may be given only when the student has completed three-fourths of the semester with course work of passing quality. Instructors may award the grade of Incomplete only upon a showing of such hardship to a student as would render it unjust to hold the student to the time limits previously fixed for the completion of the work.

Removal of Incomplete The removal of a grade of Incomplete is the responsibility of the student. A grade of Incomplete must be removed within one year from the time that is given. An Incomplete grade that has not been removed by the end of one year will be converted by the Registrar's Office to the grade of F. The dean may authorize adjustment of the one year period in exceptional circumstances.

FX Option The FX option is available only to undergraduate students and may be exercised for no more than three courses, totaling no more than 10 credit hours. By applying the FX option, a student who retakes a course previously failed shall have only the second grade in that course counted in the determination of the official transcript cumulative grade point average. The grade of FX is used to replace the original grade of F on the transcript and is not counted in computing the grade point average. A student may exercise the FX option no more than once for a given course. The student's transcript shall record all enrollments in the course and all grades earned for each enrollment, with an FX understood as reflecting an original grade of F.

In retaking the course, the student must receive a grade of A, B, C, D, S, or P to remove the original F grade. The designation W (Withdrawal) will not remove the original F unless the student is withdrawn from the original enrollment. Under this policy, a student may replace a grade through reenrollment only in a course in which a grade of F was received. A grade of D, C, or B cannot be improved by this policy. *Students who wish to take advantage of this option must secure the approval of the School of Science associate dean for academic affairs and fill out the FX form at the beginning of the semester in which the course is repeated.* The FX option form is available in the School of Science Office of the Associate Dean for Academic Affairs, Krannert Science Building 165 [(317) 274-0625].

Courses Repeated

The School of Science computes a school grade point average, which is the basis for recommending the awarding of a degree. The computation of this grade point average, including repeated courses, is done during the senior year at IUPUI and is made using the rule that only the most recent grade in repeated courses counts in computing the school grade point average for the purpose of graduation. The official grade point average, which is based upon all grades earned, appears on all transcripts.

Credit by Examination and Special Credit

Students may receive course credit by examination or credit for credentials and/or experience. Departments within the School of Science authorize and determine such credits and administer the exams in their areas. The student must obtain a special credit form from the consenting department, obtain the necessary signatures, and pay the examination or special credit fee to the Office of the Bursar (see "Expenses and Financial Aid" in this bulletin). 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.

Course Audits

Auditing of courses is permitted under University policy, but audited courses may not be retaken at a later date for academic credit. Written permission from the instructor to audit a class must be obtained before the student attempts to register.

Petition for Grade Change

Faculty Petition A faculty member may request a change of grade for the student. This request can be honored only after approval of the department chairperson and the School of Science associate dean for academic affairs.

Student Petition In certain cases, a student may request a change of grade. Students should contact the School of Science Office of the Associate Dean for Academic Affairs (Krannert Science Building 165) for information about procedures and time limits for applicable cases. The student must begin the appeals process at the instructor level and must do so within 90 days of when the student would reasonably be expected to have been notified of the grade.

Class Standing

Class standing is based on the number of credit hours completed:

Freshman . . . . 0 to 25 Junior . . . . 56 to 85
Sophomore . . . . 26 to 55 Senior . . . . .86 or more

Change of Record

The necessary forms for changing information appearing on the student's permanent record regarding student address, school of enrollment, or major field of study are available in the School of Science Office of the Associate Dean for Academic Affairs (Krannert Science Building 165) or in the IUPUI Registrar's Office (Cavanaugh Hall 133).

Science Scholars List and Dean's Honor List

The School of Science recognizes exceptional academic performance prior to graduation from the University by periodically publishing the Science Scholars List and the Dean's Honor List. The Science Scholars List is a list of names of full-time or part-time students who have completed at least 26 credit hours of course work at IUPUI and who have a semester and cumulative 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 who are juniors or seniors and who have a cumulative and semester GPA of 3.5 or higher also will be included on the Dean's Honor List. Courses assigned a deferred grade (R) will count toward the 12 credit hours 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 a baccalaureate degree awarded by the School of Science when they have been admitted as regular students by the Office of Admissions, their last semester's grade point average is not less than a 2.0, and 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 academic affairs. A form to petition for a double major can be obtained from the Office of the Associate Dean for Academic Affairs, School of Science, Krannert Science Building 165 [(317) 274-0625]. 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 baccalaureate 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 Office of the Associate Dean for Academic Affairs, School of Science, Krannert Science Building 165 [(317) 274-0625]. 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.

Second Baccalaureate Degree

Normally the holder of a baccalaureate degree who wishes to pursue a further educational goal is encouraged to become qualified for admission to a graduate degree program. In certain cases, however, the associate dean for academic affairs of the School of Science may admit a student who has earned a baccalaureate degree to candidacy for a second baccalaureate degree. The student should petition the dean for this privilege before beginning the program. If such admission is granted, the candidate must meet the requirements of the School of Science and of the department in which the student is a candidate. Completion of 32 credit hours of course work at the 300 level or above at IUPUI is required. This required course work is in addition to course work applied to any other undergraduate degree awarded at IUPUI.

Degrees Awarded with Distinction

IUPUI recognizes outstanding performance in course work of any student by awarding bachelor's degrees with distinction. Purdue degrees are awarded with Distinction and Highest Distinction. IU degrees are awarded with Distinction, High Distinction, and Highest Distinction. To be eligible a student must have taken a minimum of 60 credit hours at IUPUI.

GPA	Purdue	IU
3.5500-3.7499	Distinction	Distinction
3.7500-3.8499	Highest Distinction	High Distinction
3.8500-4.0000		Highest Distinction

Academic Standing

Academic Probation

Full-time students are on academic probation when either their semester grade point average or cumulative grade point average is below 2.0. Part-time students are on academic probation when their grade point average for two consecutive semesters or cumulative grade point average is below 2.0.

Each student on academic probation will be so advised by letter from the associate dean for academic affairs of the School of Science. The student is informed of all conditions and restrictions required for reestablishing a status of good academic standing.

Dismissal

Students are dismissed from the University when, in the opinion of the associate dean for academic affairs of the School of Science, they have ceased to make progress toward their degree.

Full-time students are subject to dismissal when they have failed to attain a grade point average of 2.0 in any two consecutive semesters and when their cumulative grade point average is below 2.0.

Part-time students are subject to dismissal when their grade point average for three consecutive semesters or cumulative grade point average is below 2.0.

Each student who is dismissed will be so advised by letter from the Office of the Dean for Academic Affairs.

Readmission

A student dismissed for the first time may immediately petition the Office of the Dean for Academic Affairs for readmission. A student dismissed for the second time may submit a petition for readmission after a period of at least one regular semester.

In order that petitions for readmission have sufficient time for consideration, students eligible to submit them should do so before July 1 for the fall semester, November 15 for the spring semester, and April 1 for the summer sessions.

Students who are readmitted will be so informed by letter from the associate dean for academic affairs. They are informed of conditions and restrictions upon which readmission depends.

Special Facilities and Services

Libraries

The IUPUI library system is composed of six separate libraries that are open to all students enrolled at the University. These are located at the dental school, Herron School of Art, University Library, law school, medical school, and 38th Street campus. The School of Physical Education maintains a reference room of professional physical education materials, and the School of Education maintains a Curriculum Center. The dental, Herron, law, and medical libraries contain specialized collections reflecting their respective curricula. The collections at the University Library and the 38th Street campus cover a wide range of academic disciplines from humanities to science, engineering, and technology. In addition, they offer online data base searching and abstracts and indexes on CD ROM. Specialized microfiche collections are available in artificial intelligence, robotics, CAD/CAM, and acid rain. The School of Science and Engineering Library also houses a large collection of NASA reports on microfiche. Since lending policies and procedures vary slightly among the different libraries, students should consult with personnel at the main desk of each library before checking out books and other materials.

Instructional Media Services

Audiovisual learning centers are located in the Krannert Science Building at the 38th Street campus, and in Cavanaugh Hall. The centers provide a variety of audiovisual materials, equipment, and services for student and faculty use. Study carrels equipped with cassette tape recorders and slide projectors provide convenient facilities for individual study of recorded course and reference material. Equipment available for classroom and laboratory use includes audio and video tape recorders, closed-circuit TV, and various projectors (overhead, movie, and slide).

Academic Computing Services

Academic Computing Services provides computer assistance to the faculty, staff, and students of IUPUI and the other campuses of Indiana University. Computing Services is located in the basement of the Engineering and Technology Building on the main campus and houses two IBM 4381s and a VAX 8800. Both timesharing and batch processing are available on the mainframes. In addition, there is extensive microcomputer support available through Computing Services. Terminal and microcomputer clusters are available at the 38th Street Data Center and various sites on the main campus. The responsibilities of Computing Services are the support of academic computing and research. Technical assistance is available for programming problems, statistical analysis, and acquisition and use of computer software and hardware. Programs can be designed and written for faculty and other researchers by Computing Services personnel. Consulting is available at all Computing Services locations to assist students, faculty, and other researchers with programming problems. A brochure describing all services offered is available in the User Support Center, Engineering and Technology Building 1030, 799 W. Michigan Street. For more information, contact the director of Academic Computing Services, Engineering and Technology Building 1023, 799 W. Michigan Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-0707].

Special Programs

Teacher's Certificate

A student earning a baccalaureate degree in the School of Science may also receive a standard junior high, middle school, secondary teacher's certificate. The standard certificate qualifies the holder to teach in the subject matter areas for which it is endorsed in any public middle school, junior high school, or secondary school in Indiana. The standard certificate is granted upon completion of a baccalaureate degree based on a program of teacher education and the recommendation of the graduating institution. It is valid for five years from the completion of program requirements and may be renewed.

Students who plan to obtain a teaching certificate must be admitted formally to the teacher education program by the end of their sophomore year. Admission to teacher education is dependent on successful completion of the Admission to Teacher Education Competency Test and course prerequisites listed in the School of Education Undergraduate Program Bulletin.

Application forms and competency test information are available from the student's departmental adviser or from the School of Education, 902 W. New York Street, Indianapolis, Indiana 46223.

A candidate for a junior high, middle school, secondary teacher's certificate *and* a bachelor's degree must satisfy the appropriate degree requirements of the IUPUI School of Science, the departmental requirements, and the School of Education certification requirements. The student must, therefore, plan a complete program with a School of Science adviser and a School of Education adviser to ensure that all requirements are satisfied.

A candidate for a junior high, middle school, secondary teacher's certificate must earn a baccalaureate degree that includes 124 credit hours. The student must have a grade point average of 2.3 (C +) or above in all University work taken. The student must earn a grade point average of 2.3 (C +) in all education courses (with at least a C in the methods courses), and a grade point average of 2.3 (C +) in all the course work of the teaching major and of the teaching minor if one exists.

For a standard certificate, the state of Indiana sets the following general education, professional education, and subject matter area requirements:

General Education (40 cr.)
Humanities: a minimum of 18 credit hours chosen from, for example, English, fine arts, folklore, foreign language, music, philosophy, speech, and theater
Social and Behavioral Sciences: a minimum of 9 credit hours chosen from, for example, anthropology, economics, geography, history, political science, psychology, and sociology
Life and Physical Sciences: a minimum of 9 credit hours—subject matter area meets this requirement; some departments specify lab sciences.
Electives as needed for a total of 40 credit hours

Professional Education (31 cr.)
EDUC H340 Education and American Culture (3 cr.)
EDUC M300 Teaching in a Pluralistic Society (3 cr.)
EDUC M314 Teaching in the Junior High, Middle School, and Secondary School (3 cr.) **and**
    EDUC M301 Laboratory/Field Experience (0 cr.)
EDUC M464 Methods of Teaching Junior High, Middle School, and Secondary School Reading
    (3 cr.) **and** EDUC M401 Laboratory/Field Experience (0 cr.)
EDUC M440-M478 Methods of Teaching (major academic area) (4 cr.)
EDUC M480 Student Teaching: Secondary (10 cr.)
EDUC P255 Educational Psychology for Junior High, Middle School, and Secondary Teachers
    (3 cr.) **and** EDUC M201 Laboratory/Field Experience (1 cr.)
EDUC W200 Microcomputing for Education (1 cr.)

Note: All methods courses must be completed before a student may enroll in EDUC M480 Student Teaching. During the semester of student teaching, the student normally does not enroll in other courses.

All science teaching programs must include courses in nutrition and drug and alcohol education.

Consult a School of Education adviser for any changes in or additions to these requirements.

Predental and Premedical Programs
Admission to dental and medical schools is highly competitive. The preprofessional student is therefore urged to elect a degree program, rather than to strive for the minimal requirements of these schools. Skilled preprofessional counseling is available in the Departments of Biology and Chemistry, which also offer preprofessional degree programs. This service will assist the student to prepare well for the professional school admissions process. It will also suggest alternative, rewarding career opportunities should the application to the professional school be unsuccessful. Graduate students holding nonscience degrees, who are electing courses in the School of Science to prepare for professional school, are also invited to use this counseling service.

Honors Program
The IUPUI Honors Program is open to students in both the Purdue and Indiana University degree programs. Students with a 3.3 overall grade point average after their first full semester

of work or entering freshmen with a combined SAT score of 1200 or those who graduated in the top 10 percent of their high school class are invited to participate in the Honors Program. Students with less than a 3.3 grade point average may be permitted to take honors courses. They should, however, discuss the matter with their adviser and the honors counselor before doing so.

To obtain an honors degree in all departments in the School of Science, except geology and psychology, a student must have a cumulative grade point average of 3.3 and a minimum of 24 credit hours, with a 3.5 grade point average in honors work. Six (6) hours of honors credit must be outside the student's major field. Students majoring in geology or psychology should follow the requirements below since both departments have their own departmental requirements.

Geology
For the Bachelor of Science degree, the student must complete 24 credit hours of honors work, 18 in geology and 6 in other approved honors work. For the Bachelor of Arts degree, the requirements are 15 credit hours in geology and 9 credit hours outside geology in other approved honors work. The following upper division geology courses are approved for H-Option contracts: G323 Structural Geology; G334 Principles of Sedimentation and Stratigraphy; G403 Optical Mineralogy and Petrography; G404 Geobiology (3 cr.) plus G410 Undergraduate Research in Geology (1 cr.); G406 Introduction to Geochemistry; G413 Introduction to Earth Physics; G415 Principles of Geomorphology; G416 Economic Geology; G430 Principles of Hydrology; G499 Honors Research in Geology. The student must complete 3 credit hours in G499 Honors Research in Geology to satisfy the requirements for the honors component. The overall grade point average must be 3.3 with a 4.0 in all honors work.

Psychology
To graduate with honors in psychology, students must earn at least 24 hours of honors credit, 12 in psychology and 6 that may be outside psychology. The remaining 6 credit hours may be in either division. At least 3 credit hours must be earned in PSY B499 Honors Research, which requires an honors thesis. Only grades of A or B will count for honors credit. To graduate with honors, the student must have an overall grade point average of 3.3, with at least a 3.5 in honors courses and at least a 3.5 in psychology courses.

In general, students may take no more than 6 credit hours of honors work a semester. Students may earn honors credit by taking special honors courses (H300, H399, H400), by taking specially designated sections of multisection courses, by taking special overseas or internship work, or by contracting for honors credit using an H-Option contract in conjunction with regular classes. H-Options 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., during the first four weeks of the semester. By the end of that period, the H-Option form with all the necessary signatures must be submitted to the Honors Program.

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 Honors Program, Education–Social Work Building 2126, 902 W. New York Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2660].

## Cooperative Education Program
The School of Science Cooperative Education Program gives science students the opportunity of supervised professional employment with course work while studying for degrees. The program is currently available in only select situations.

A student should apply directly to the cooperative education coordinator within the student's department for information and specifics of program implementation or contact the Professional Practice Program, Career and Employment Services Office, Business-SPEA Building 2010, 801 W. Michigan Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2554].

Officer Training Programs (ROTC)
Both Army and Air Force ROTC are available to IUPUI students. Completion of either program leads to a commission as a 2nd Lieutenant. Programs are available to both men and women. Courses are pursued in conjunction with academic curriculum and receive academic

credit as electives. Placement credit is available to veterans and students with high school ROTC backgrounds. Two-, three-, and four-year scholarships are available for qualified students. For information, contact a professor of military science (Army ROTC) at (317) 274-2691 or a professor of aerospace studies (Air Force ROTC) at (812) 885-4191.
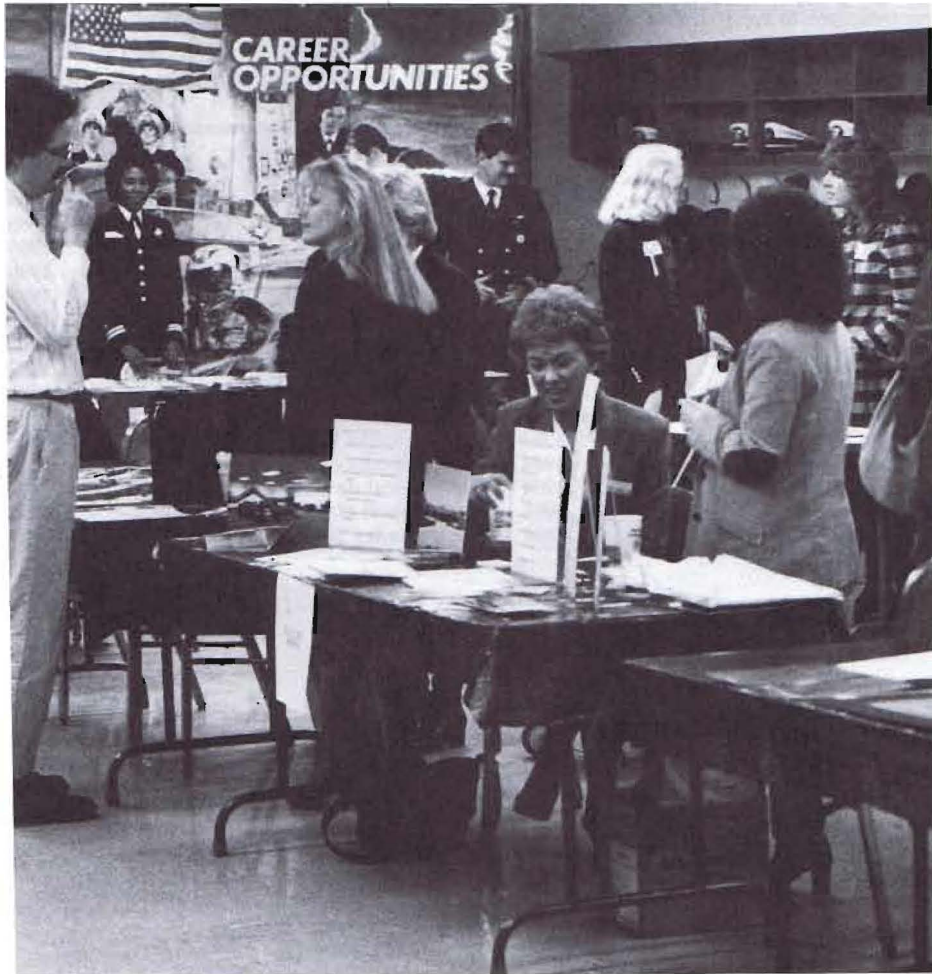
At Career Focus Day students meet with representatives of business, industry, and government.

Distinguished Faculty Awards

The School of Science proudly salutes faculty members who have distinguished themselves in the areas of teaching, research, or service. The following full-time faculty members 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.

H. David Laverell	1975	John F. Kremer	1984
L. Kent Morrison	1976	B. D. Nageswara Rao	1984
Gordon H. Fricke	1977	Richard Bodonyi	1985
Erwin Boschmann	1978	Frederick W. Kleinhans	1985
Frederick W. Kleinhans	1978	Arthur Mirsky	1985
Terry L. Hall	1979	Richard Pflanzer	1985
Robert D. Hall	1980	D. W. Rajecki	1985
John F. Kremer	1980	J. Roger Ware	1985
Patricia A. Boaz	1981	Shirley Bayer	1986
Martin O'Donnell	1981	Joan Lauer	1986
Forrest T. Meiere	1982	J. Roger Ware	1986
Peter W. Rabideau	1982	Roko Aliprantis	1987
Frederick Thatcher	1982	Owen Burkinshaw	1987
Erwin Boschmann	1983	Judith Gersting	1987
Robert D. Hall	1983	John F. Kremer (two awards)	1987
David Malik	1983	Richard Patterson	1987
Martin O'Donnell	1983	J. Roger Ware	1987
Stanley Aeschleman	1984	Theodore Cutshall	1988
Elaine V. Alton	1984	Pascal de Caprariis	1988
Patricia A. Boaz	1984	Robert D. Hall	1988
Marvin Kemple	1984	Charles Schauf	1988

Department of Biology

Professors Bayer, Ockerse, Sanborn (Emeritus), Schauf (Chairperson)

Associate Professors Bard, Jarrett, Juillerat, Keck, Lees (Director, Graduate Program), McCracken, Pflanzer, Russo, Stillwell, Wilson

Assistant Professors Chernoff, Jenski, Kirk, Witzmann (Columbus Center)

Adjunct Professors Butler, Chandrasekhar, Ingolia, McIntyre, Petersen, Zuckerman

Lecturers Wiese, Zevin

Departmental Counselors *Preprofessional:* Ockerse; *Prepharmacy and preoptometry:* Lees; *Preveterinary:* McCracken; *Biology programs:* McCracken, Ockerse; *Graduate programs:* Lees

The Department of Biology offers 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 our 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 counselor.

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 in interdisciplinary biology. Among the nonthesis options is the M.S. degree in the teaching of biology, which is designed primarily for secondary school teachers. Within the thesis option are the M.S. in biotechnology, which is designed to provide classroom and research experience in a variety of applied disciplines, and the Industrial Co-op Program, which includes research in one of several industries in the Indianapolis area.

The degree of Doctor of Philosophy (Ph.D.) can be pursued in the Department of Biology in a variety of areas. The Ph.D. program comprises formal courses, guided individual study, and original research culminating in a scholarly thesis.

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, parasitology, neuroanatomy, morphogenesis and ultrastructure of plants, recombinant DNA, mosquito ecology, protein chemistry, and plant and animal tissue culture.

Bachelor of Arts

Degree Requirements

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

Area II There is no foreign language requirement; however, knowledge of a foreign language is strongly recommended for the student planning to attend graduate school.

Areas IIIA and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin.

Area IIIC Physical and Biological Sciences
Physics Two semesters of basic physics (PHYS P201-P202 or PHYS 152-251)
Chemistry Through two semesters of organic chemistry lecture and one semester of laboratory (CHEM C341, C342, C343), plus prerequisite basic sequence or background to enter sequence above. Basic chemistry sequence to be worked out with departmental counselor based on SAT scores and/or background of the student. The second laboratory in organic chemistry (CHEM C344) is required for admission to medical school and is strongly recommended for students in most other programs—consult departmental counselor.

Area IIID Mathematical Sciences MATH 150. The starting point to be worked out with departmental adviser based on the math placement test and/or background of the student. The computer requirement may be satisfied with CSCI 206, CSCI 207, or CSCI 220.

Area IV Biology Requirements
Required Core Sequence:
    K101-K103 (Concepts of Biology I and II)
    K322 (Genetics lecture)
    K341 (Ecology lecture)

Upper Level Courses
A. At least one lecture course from each of areas I-III listed below.
B. Three laboratory courses beyond K101-K103 selected from areas I-IV below. A maximum of two credit hours of K493 Independent Research may be applied to the biology credit hour requirement. K493 will count as one laboratory course.
C. 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
      K483 Biological Chemistry
    Undergraduate and Graduate Level
      530 Introductory Virology
      559 Endocrinology
      561 Immunology
      570 Biological Membranes
      583 Biological Regulation
II. Cellular Area
    Undergraduate Level
      K356 Microbiology
      K357 Microbiology Laboratory
    Undergraduate and Graduate Level
      501 Cell Physiology
      532 Topics in Bacteriology
      551 Plant Physiology
      552 Laboratory in Plant Physiology
      566 Developmental Biology
      567 Laboratory in Developmental Biology
      569 Cellular Neurobiology
      571 Developmental Neurobiology
III. Organismal Area
    Undergraduate Level
      K331 Embryology
      K332 Plant Growth and Development
      K443 Medical Parasitology and Entomology
    Undergraduate and Graduate Level
      556 General and Comparative Physiology
      557 Mammalian Systemic Physiology
IV. Biotechnology Electives
    Undergraduate Level
      K317 Laboratory Techniques in Biology
      K477 Techniques of Transmission Electron Microscopy
      K493 Independent Research
    Undergraduate and Graduate Level
      540 Topics in Biotechnology
      565 Laboratory in Immunology
Additional laboratory courses for the B.A.
    K323 Genetics Laboratory
    K342 Ecology 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 at other institutions is applicable toward the major for the B.A. degree.

Bachelor of Science

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. The second semester of English composition may be satisfied with ENG W132, ENG 231, or TCM 320.

Area II There is no foreign language requirement; however, knowledge of a foreign language is strongly recommended for the student planning to attend graduate school.

Areas IIIA and IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin.

Area IIIC Physical and Biological Sciences
Physics Two semesters of basic physics (PHYS P201-P202 or PHYS 152-251).
Chemistry Through two semesters of organic chemistry with laboratory (CHEM C341, C342, C343, C344), plus prerequisite basic sequence or background to enter sequence above. Basic chemistry sequence to be worked out with departmental counselor based on SAT scores and/or background of the student. (A course in analytical chemistry or biochemistry is also strongly recommended—determination to be made in consultation with departmental counselor.)

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 adviser based on the math placement test and/or background of the student. The computer requirement may be satisfied with CSCI 206, CSCI 207, or CSCI 220.

Area IV Biology Requirements
Required Core Sequence:
    K101-K103 (Concepts of Biology I and II)
    K322, K323 (Genetics with laboratory)
    K341, K342 (Ecology with laboratory)
    K493 (Independent Research; 2 cr. min., 3 cr. max.)
    K494 (Senior Research Thesis)

Upper Level Courses
A. At lease one course from each of areas I-III listed below.
B. Two laboratory courses beyond the core sequence laboratories selected from areas I-IV.
C. K494 Senior Research Thesis. This will consist of the completion of K493 activities and the preparation of a written report on the results of the research project. The title and nature of the K493-K494 sequence is to be determined in consultation with the department research sponsor.
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
      K483 Biological Chemistry
    Undergraduate and Graduate Level
      530 Introductory Virology
      559 Endocrinology
      561 Immunology
      570 Biological Membranes
      583 Biological Regulation
II. Cellular Area
    Undergraduate Level
      K356 Microbiology
      K357 Microbiology Laboratory
    Undergraduate and Graduate Level
      501 Cell Physiology
      532 Topics in Bacteriology
      551 Plant Physiology
      552 Laboratory in Plant Physiology
      566 Developmental Biology

567 Laboratory in Developmental Biology
569 Cellular Neurobiology
571 Developmental Neurobiology

III. Organismal Area
    Undergraduate Level
        K331 Embryology
        K332 Plant Growth and Development
        K443 Medical Parasitology and Entomology
    Undergraduate and Graduate Level
        556 General and Comparative Physiology
        557 Mammalian Systemic Physiology

IV. Biotechnology Electives
    Undergraduate Level
        K317 Laboratory Techniques in Biology
        K477 Techniques of Transmission Electron Microscopy
        K493 Independent Research
    Undergraduate and Graduate Level
        540 Topics in Biotechnology
        565 Laboratory in Immunology

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 at other institutions is applicable toward the major for the B.S. degree.

Biology Plans of Study

There is no single semester-by-semester plan of study for any of the degree options because of the flexibility encouraged within the program for each option. 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 counselor.

Bachelor of Arts Sample Program

Freshman

1	BIOL K101 (5) Concepts of Biology I-Plants	CHEM C105 (5) Principles of Chemistry I	MATH 147 (3)	ENG W131 (3) English Composition I	
2	BIOL K103 (5) Concepts of Biology II-Animals	CHEM C106 (5) Principles of Chemistry II	MATH 148 (3)	Second English Composition (3)	

Sophomore

3	Biology (3-5) Core or Area Elective Lecture, Biology Lab	CHEM C341 (3) Organic Chemistry I	CHEM C343 (2) Organic Chem. Laboratory I	PHYS P201 (5) or PHYS 152 (4) Physics	Elective (3) Arts and Humanities
4	Biology (3) Core or Area Elective Lecture	CHEM C342 (3) Organic Chemistry II	Elective (3) Behavioral and Social Sciences	PHYS P202 (5) or PHYS 251 (5) Physics	Comm C110 (3) Speech

Junior

5	Biology (3-5) Core or Area Elective Lecture, Biology Lab	Elective (3) Behavioral and Social Sciences	Elective (3) Arts and Humanities	Computer Elective (3)	Elective (3)
6	Biology (3-5) Core or Area Elective Lecture, Biology Lab	Elective (3) Arts and Humanities	Elective (3) Behavioral and Social Sciences	Elective (3)	Elective (3)

Senior

7	Biology (3) Core or Area Elective Lecture	Elective (3) Behavioral and Social Sciences	Elective (3)	Elective (3)	Elective (3)
8	Biology (1-5) Elective	Elective (3) Arts and Humanities	Elective (3)	Elective (3)	Elective (3)

Bachelor of Arts with Secondary Teaching Certification Sample Program

Freshman

1	BIOL K101 (5) Concepts of Biology I-Plants	CHEM C105 (5) Principles of Chemistry I	MATH 147 (3) Algebra and Trig. I	ENG W131 (3) English Composition
2	BIOL K103 (5) Concepts of Biology II-Animals	CHEM C106 (5) Principles of Chemistry II	MATH 148 (3) Algebra and Trig. II	Second English Composition (3)

Sophomore

3	Biology (5) Core or Area Elective Lecture, Biology Lab	CHEM C341 (3) Organic Chemistry I	EDUC H340 (3) Education and Am. Culture	COMM C110 (3) Speech	CSCI 206 (3) Computer Programming
4	Biology (4) Core or Area Elective Lecture, Biology Lab	CHEM C342 (3) Organic Chemistry II	Elective (3) Behavioral and Social Sciences	Elective (3) Humanities or Foreign Language	EDUC M201 and P255 (4) Educational Psychology

Junior

5	Biology (3) Core or Area Elective Lecture, Biology Lab	CHEM C343 (2) Organic Chem. Lab I	Elective (3) Humanities or Foreign Language	PHYS P201 (5) Physics	EDUC M314 (3) Teaching in JH, MS, or SS
6	Biology (3) Core or Area Elective Lecture	Elective (3) Humanities or Foreign Language	Elective (3) Behavioral and Social Sciences	PHYS P202 (5) Physics	EDUC M300 (3) Teaching in Plur. Society

Senior

7	Biology (5) Core or Area Elective Lecture, Biology Lab	EDUC 464 (3) Methods of Teaching	EDUC M449 (4) Methods of Teaching	Drug and Alcohol Education (3)	Biology N400 (3) Biological Skills for Teachers
8	EDUC M480 (10) Student Teaching	Elective (3) Social and Behavioral Sciences			

Bachelor of Science Sample Program

Freshman

1	BIOL K101 (5) Concepts of Biology I-Plants	CHEM C105 (5) Principles of Chemistry I	MATH 221 (3) or MATH 163 (5) Calculus	ENG W131 (3) English Composition
2	BIOL K103 (5) Concepts of Biology II-Animals	CHEM C106 (5) Principles of Chemistry II	MATH 222 (3) or MATH 164 (5) Calculus	Second English Composition (3)

Sophomore

3	Biology (3-5) Core or Area Elective Lecture, Biology Lab	CHEM C341 (3) Organic Chemistry I	CHEM C343 (2) Organic Chem. Laboratory I	PHYS P201 (5) or PHYS 152 (4) Physics	COMM C110 (3) Speech
4	Biology (3-5) Core or Area Elective Lecture, Biology Lab	CHEM C342 (3) Organic Chemistry II	CHEM C344 (2) Organic Chem. Laboratory II	PHYS P202 (5) or PHYS 251 (5) Physics	Elective (3) Arts and Humanities

Junior

5	Biology (3-5) Core or Area Elective Lecture, Biology Lab		Elective (3) Behavioral and Social Sciences	Elective (3)	Elective (3) Arts and Humanities
6	Biology (3-5) Core or Area Elective Lecture, Biology Lab	Elective (3)	Elective (3) Behavioral and Social Sciences	Elective (3)	Biology K493 (1-2) Independent Research

Senior

7	Biology (3) Core or Area Elective Lecture	Biology K493 (1-2) Independent Research	Computer Elective (3)	Electives (6)
8	Biology (1-5) Elective	Biology K494 (1) Senior Thesis	Electives (9)	

Master of Science

Degree Options

M.S. Nonthesis in Interdisciplinary Biology   This program requires 21 credit hours in biology, including a creative project to be defined in consultation with the graduate advisory committee, and 9 credit hours in a supporting secondary area. Secondary areas may be chosen from a wide variety of subjects that relate to the student's career objective or interest. Examples would include, but not be limited to, chemistry, mathematics, public affairs, business, statistics, law, computer science, and health administration. The M.S. degree in the teaching of biology is conferred when the supporting area is education. Primary area courses must include BIOL 540 Topics in Biotechnology (3 cr.) and at least one course from each of the following areas: concepts of metabolism, concepts of homeostasis, and continuity of life. In addition, a creative project (BIOL 595 Special Assignments, 3 cr.) *must* be taken. The topic and nature of the project will be determined in consultation with the student's graduate adviser.

Course Areas in Interdisciplinary Biology
I.   Concepts of Metabolism
    501 Cell Physiology
    530 Introductory Virology
    532 Topics in Bacteriology
    697 Special Topics (where appropriate)
II. Concepts of Homeostasis
    551 Plant Physiology
    552 Laboratory in Plant Physiology
    556 General and Comparative Physiology
    557 Mammalian Systemic Physiology
    559 Endocrinology
    561 Immunology
    569 Cellular Neurobiology
    570 Biological Membranes
    583 Biological Regulation
    697 Special Topics (where appropriate)
III. Continuity of Life
    566 Developmental Biology
    567 Laboratory in Developmental Biology
    571 Developmental Neurobiology
    641 Microbial Genetics
    697 Special Topics (where appropriate)

M.S. with Thesis   This program requires a minimum of 9 credit hours of 500-600 level course work in biology, chosen in consultation with the student's graduate committee, and intensive research leading to a thesis. Within the thesis program is a focused program in biotechnology. There are five areas in biotechnology where course and research experiences are available. They are recombinant DNA, protein chemistry, tissue culture, immunology, and biomembrane technology. Minimum course work requirements include BIOL 540 Topics in Biotechnology (3 cr.), 3 credit hours from the research biotechnology area, and 3 credit hours from a secondary biotechnology area.

Course Areas in Biotechnology
I.   Recombinant DNA
    530 Introductory Virology
    532 Topics in Bacteriology
    641 Microbial Genetics
II. Protein Chemistry
    697 Special Topics (where appropriate)
III. Tissue Culture
    697 Topics in Tissue Culture
IV. Immunology
    561 Immunology
    565 Laboratory in Immunology
    697 Topics in Immunology

V. Biomembrane Technology
    569 Cellular Neurobiology
    570 Biological Membranes

M.S. Industrial Co-Op Program   The combined effort of the Purdue University School of Science at Indianapolis, IUPUI, and the industrial community of Indianapolis affords a unique opportunity to quality students seeking graduate work in biology. The M.S. Industrial Co-op Program normally requires 24 months (4 semesters) of full-time study, leading to a Purdue M.S. degree in biology. Students are urged to inquire about those firms currently participating and the specific research areas available as these may change from time to time. All academic requirements are identical to the normal Purdue M.S. with thesis option. The program includes graduate biology courses in the areas specified under "M.S. with Thesis" above, laboratory research, and seminars. In this program, students are vital members of local industrial research groups during the co-op period.

To be eligible for the co-op program students must first meet the usual admission requirements for the M.S. with thesis option. During the first semester of graduate work, students will interview with local industry, and co-op assignments will be made by the graduate adviser and the industrial representatives. If a mutually satisfactory position cannot be found for a particular student, the student will be able to continue in the department's normal M.S. program. Neither students nor employers have a commitment for continued employment at the end of the students' program. However, the program allows close contact between students and employers and serves as an excellent basis for career decisions.

Admission Requirements

1. Students must hold a baccalaureate degree from an accredited institution of higher learning and demonstrate good preparation in the following subjects:
   biological sciences
   organic chemistry
   physics
   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 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 better. 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.

Grades

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

Requirements

Residence Requirements
Two units of residence (26 credit hours or more) are required for the M.S. degree. Students entering with advanced standing from another graduate school are credited with resident study commensurate with the graduate work accomplished.

Final Examination
A comprehensive written or oral examination in the individual's primary area will be required of all nonthesis students. 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 available financial support in the form of tuition-refund assistantships, associate faculty positions, and stipends from local industry on a very limited basis.

Doctor of Philosophy

The degree of Doctor of Philosophy (Ph.D.), the highest earned degree conferred by Purdue University, can be pursued in the Department of Biology. 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.

Ph.D. candidates must satisfy the requirement of one foreign language chosen from French, German, or Russian.

Six units of residence (78 credit hours or more) are required for the Ph.D. degree. Students entering with advanced standing from another graduate school are credited with resident study 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 adviser. 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 better. The examination areas are as follows: (1) animal physiology, (2) biochemistry, (3) biophysics, (4) developmental biology, (5) ecology, (6) population genetics and evolution, (7) genetics, (8) microbiology, (9) neurobiology, (10) plant physiology.

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 plan of study must be approved by the department or school head, the school dean, and

the dean of the Graduate School at West Lafayette.·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 written preliminary examination will be conducted by the examining committee. 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 is permitted. 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. The candidate must, therefore, prepare a thesis showing the results of his or her research.

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.

Other Programs

Prepharmacy

Currently the prepharmacy program is designed to encompass one year at IUPUI followed by four years at Purdue University, West Lafayette. However, it is possible to complete two full years of credit prior to transfer. The prepharmacy program has also been designed to interface with the School of Pharmacy at Butler University.

Prepharmacy Sample Program

Freshman

1	BIOL K101 (5) Concepts of Biology I-Plants	CHEM C105 (5) Principles of Chemistry I	MATH 147 (3) or MATH 163 (5) or MATH 221 (3)	ENG W131 (3) English Composition	Elective (1)
2	BIOL K103 (5) Concepts of Biology II-Animals	CHEM C106 (5) Principles of Chemistry II	MATH 148 (3) or MATH 164 (5) or MATH 222 (3)	SPCH C110 (3) Speech	Elective (3)

Sophomore through Senior

Transfer to School of Pharmacy and Pharmacal Sciences, Purdue University, West Lafayette campus

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	3
English composition	2
Calculus	4
General physics	8
Psychology	
Introductory and above	4
Statistical techniques	3
Biology/Zoology	
Introductory	4
Comparative or human anatomy	4
Advanced	3
Arts and humanities	6
Social and behavioral sciences	6
Foreign language	6-8
Elective	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 also 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.

The student who has successfully completed two or more years of preveterinary instruction at IUPUI is eligible to apply for admission to the School of Veterinary Medicine at Purdue University in West Lafayette. Admission to the School of Veterinary Medicine is highly competitive. Students are selected on the basis of college course work and grades, Veterinary Aptitude Test scores, 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 Sample Program

Freshman

#					
1	BIOL K101 (5) Concepts of Biology I-Plants	MATH 147 (3) or MATH 221 (3)	CHEM C105 (5) Principles of Chemistry I	ENG W131 (3) English Composition I	
2	BIOL K103 (5) Concepts of Biology II- Animals	MATH 148 (3) or MATH 222 (3)	CHEM C106 (5) Principles of Chemistry II	ENG W132 (3) English Composition II	

Sophomore

#					
3	ECON E202 (3) Economics	CHEM C341 (3) Organic Chemistry I	CHEM C343 (2) Organic Chem. Laboratory I	PHYS P201 (5) Physics	BIOL K322 (3) Genetics BIOL K323 (2) Genetics Laboratory
4	ANSC 221 (3) Animal Nutrition	CHEM C342 (3) Organic Chemistry II	CHEM C344 (2) Organic Chem. Laboratory II	PHYS P202 (5) Physics	COMM C110 (3) Speech

Nine (9) credit hours of arts and humanities course work must be taken in conjunction with the above or during summer sessions.

Junior and Senior

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

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 normal to their curricular program (e.g., Allied Health).

Note: P—prerequisite; C—concurrent registration; R—recommended; 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—Plants (5 cr.) P: High school or college chemistry. Fall, day, night; Spring, day, night. An introductory course emphasizing the principles of cellular biology; molecular biology; genetics; and plant anatomy, diversity, development, and physiology.

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

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

K309 Computer Applications in Biology and Medicine (3 cr.) P: Sophomore standing and one semester of biology. Spring, day. Provides the undergraduate with experience in the major applications of the computer to the life sciences. Topics: computer hardware, software, BASIC programming concepts, and application packages. Projects: micro and mainframe computer experiences with databases, simulations, statistical packages, computer graphics, networks, and computer interfacing to laboratory equipment. This course may not be used for Area IV (biology major) credit.

K317 Laboratory Techniques in Biology (3 cr.) P: CHEM C106 and one year of college biology. Spring, day, night. A laboratory course for undergraduate students designed to offer "hands on" experience in instrumentation and to develop technical, as well as library and writing, skills.

K322 Genetics (3 cr.) P: K103, CHEM C106. Fall; day. Principles of genetics at the molecular, cellular, organismal, and population level.

K323 Genetics Laboratory (2 cr.) P or C: K322. Fall, day. Applied principles of genetics using organisms of increasing complexity, from viruses to the fruit fly.

K331 Embryology (4 cr.) P: K103. Spring, day, night. 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, CHEM C341. Fall, day, night. An examination of growth and developmental patterns in plants as affected by growth regulators, age, heredity, photoperiod, and environmental factors.

K341 Principles of Ecology (3 cr.) P: K103. Fall, day. A study of the basic concepts of the interrelation of living organisms and their environment.

K342 Ecology Laboratory (2 cr.) P or C: K341. Fall, day. Experiments in the laboratory and field to illustrate the principles and techniques of ecology.

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, night. Laboratory experiments and demonstrations to yield proficiency in aseptic cultivation and utilization of microorganisms; experimental investigations of biological principles in relation to microorganisms.

K433 Medical Parasitology and Entomology (3 cr.) P: K103 or equivalent. Spring, odd years, day, night. A case-oriented approach to the study of the major parasitic diseases of man. Emphasis will be placed on parasite and vector life cycles, disease symptomatology and treatment, and control measures.

K477 Techniques of Transmission Electron Microscopy (3 cr.) P: K103, CHEM C341, and consent of instructor. Spring, day, night. Biological tissue preparation, ultramicrotomy,

photography, and related laboratory techniques for transmission electron microscopy. Also considered are principles of fixation and staining, cytochemical techniques, and interpretation of ultrastructure.

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

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 a field 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.

Undergraduate and Graduate Level

501 Cell Physiology (3 cr.) P: K103, CHEM C342. Spring, day, night. A study of cells at the physiological level, including the structure and function of organelles and membranes, enzymology, energy relationships and metabolic control, response to radiation, excitability and contractility, and the regulation of cell growth and differentiation.

530 Introductory Virology (3 cr.) P: K356, CHEM C342. Fall, odd years, day, 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 and CHEM C342. Fall, even years, day, 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.

551 Plant Physiology (3 cr.) P: K103, CHEM C342. Spring, day, night. The major processes of plant function (photosynthesis, carbohydrate metabolism, translocation, water relations, and ion uptake) and the

integration of these processes in plant growth and development.

552 Laboratory in Plant Physiology (2 cr.) P or C: 551. Spring, day, night. Quantitative experiments in plant physiology. Emphasis on modern experimental methods of investigating physiological processes.

556 General and Comparative Physiology (3 cr.) P: K103, CHEM C342, PHYS 219. Fall, day, night. Principles of physiology. Nerve and muscle, temperature regulation, ion and water balance.

557 Mammalian Systemic Physiology (3 cr.) P: 556 or consent of instructor. Spring, day, 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, even years, day, night. 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. Fall, day. Introduction to the basic principles of immunology and serology at the molecular, cellular, and organismal level.

565 Laboratory in Immunology (3 cr.) P: 561. Spring, day, night. Laboratory experiments and demonstrations using classical immunological techniques and current immunoassays. Emphasis on basic concepts with an introduction to clinical and applied immunology.

566 Developmental Biology (3 cr.) P: 501 and K322. Spring, odd years, day, night. Principles of development with emphasis on concepts and underlying mechanisms, including descriptive, physiological, and molecular approaches.

567 Laboratory in Developmental Biology (1 cr.) P or C: 566. Spring, odd years, day, night. Descriptive and experimental study of plants and animals.

569 Cellular Neurobiology (2 cr.) P: 501, CHEM C106, PHYS P202 or consent of instructor. Fall, night. A study of nerve cells and their interactions. Main topics include excitation, synaptic transmission, neural plasticity, and the cellular basis of brain function. The electrophysiological aspects of these topics are emphasized.

570 Biological Membranes (3 cr.) P: Either 501, CHEM C342, or consent of instructor. Spring, odd years, day, night. An examination of structure and function of biological membranes. Topics include lipid and protein composition and interactions,

day; Summer, day. Lectures and laboratory work related to cellular, musculoskeletal, neural, cardiovascular, gastrointestinal, renal, endocrine, and reproductive function in humans.

N251 Introduction to Microbiology (3 cr.) P: One semester general chemistry or one semester life science. Spring, day. 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.) P: None. Equiv. IU Anatomy 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 AGRY 430. Spring, day, 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.

Department of Chemistry

Professors Boschmann, Fife, O'Donnell, Rabideau (*Chairperson*), Schultz, Zeldin
Professor Emeritus Welcher
Associate Professors Boaz, Cutshall, Dubin, Fricke, Larter, Lipkowitz, Malik, Nurok, Wyma
Assistant Professor Muhoberac
Adjunct Professors Boyd, Jackson, Scriven, Shields
Departmental Counselors For chemistry programs, all chemistry faculty. Contact the department for assignment to a counselor.

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

The Department of Chemistry offers the Bachelor of Arts degree, the Bachelor of Science degree, and the Master of Science degree.[1] A minor in chemistry is also offered. The Bachelor of Science degree carries certification by the American Chemical Society 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 Ph.D. degree in chemistry in areas where a program equivalent to that at West Lafayette can be arranged. Please contact the Department of Chemistry at IUPUI for further details.

To enter the 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 counselor.

Students in programs that require only one semester of chemistry should take C101. Students with an insufficient background in high school chemistry to qualify for C105 should take C101 as a preparatory course. Students in programs that require two semesters of chemistry take either the C101-C102 sequence, the C105-C106 sequence, or the C111-C112 sequence (see specific program for degree major). The C101-C102 sequence is designed for students who do not need chemistry as a tool subject. The C105-C106 sequence is designed for students pursuing advanced work in scientific fields (e.g., biology, chemistry, geology, medicine, physics). The C111-C112 sequence is designed for students who are majoring in engineering or who desire a non-laboratory version of C105-C106. If engineering students wish to take a laboratory, they may enroll in either the C105-C106 sequence or enroll in C125 along with C111 and in C126 along with C112. C105 is considered equivalent to the combined courses C111-C125 and C106 is considered equivalent to the combined courses C112-C126. Credit can only be earned in either the C105-C106 sequence or the C111-C125 and C112-C126 sequence. If both C101 and C105 or C111 are taken, the credit hours earned in C101 will not count toward the total credit hours needed for graduation. Admission to C106 or C112 on a basis of C101 is not granted.

Bachelor of Arts

PREPROFESSIONAL CHEMISTRY MAJOR

For students who require a knowledge in chemistry as a basis for work in other fields. Suitable for students who plan chemical industry positions as laboratory technicians. Recommended for premedical students with minimum preparation.

Degree Requirements

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

Area II There is no foreign language requirement.

[1] All degrees carry the general requirements of the School of Science. These are described elsewhere in this bulletin.

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

Area IIID Mathematical Sciences   MATH 221, MATH 222 (recommended MATH 163 and 164), and CSCI 220.

Area IV Chemistry Concentration Requirements   C105, C106, C310, C311, C325, C341, C342, C343, C344, C360 (recommended C361). Recommended C483. Total of 32 credit hours of chemistry courses required.

Bachelor of Science
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.

Degree Requirements

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

Area II   There is no foreign language requirement.

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

Area IIID Mathematical Sciences   MATH 163, MATH 164, MATH 261, MATH 262, and CSCI 220.

Area IV Chemistry Concentration Requirements   C105, C106, C310, C311, C335, C341, C342, C343, C344, C361, C362, C363, C410, C411, and C430. Total of 42 credit hours of chemistry courses required.

In addition to the above requirements, a minimum of 3 additional credit hours of advanced technical elective courses is required. Courses may be chosen from the following: CHEM C409 (3 cr. min.), CHEM C483, any graduate level chemistry course (permission required), CSCI 320 or CSCI 330, MATH 351, any 300 level physics course (400 level excluded).

Chemistry Plans of Study
Bachelor of Arts—Preprofessional Chemistry Major

Freshman

1	CHEM C105 (5) Principles of Chem. I	MATH 221 (3) Calculus	ENG W131 (3) Composition I	Elective (4)	
2	CHEM C106 (5) Principles of Chem. II	MATH 222 (3) Calculus	PHYS P201 (5) Gen. Physics I	Second English Composition (3)	

Sophomore

3	CHEM C341 (3) Organic Chem. I	CHEM C343 (2) Organic Chem. Lab I	PHYS P202 (5) Gen. Physics 2	COMM C110 (3) Speech	Elective (3)
4	CHEM C342 (3) Organic Chem. II	CHEM C344 (2) Organic Chem. Lab II	CSCI 220 (3) Computer Programming	Electives (7)	

Junior

5	CHEM C310 (3) Analytical Chemistry	CHEM C311 (1) Analytical Chem. Lab	Electives (12)	
6	CHEM C325 (5) Quantitative Anal./Inst.	CHEM C360 (3) Elem. Physical Chemistry	Electives (8)	

Senior

7	Electives (15)
8	Electives (15)

Bachelor of Science—Professional Chemistry Major—A.C.S. Certified

Freshman

1	CHEM C105 (5) Principles of Chem. I	MATH 163 (5) Calculus I	ENG W131 (3) Composition I	COMM C110 (3) Speech
2	CHEM C106 (5) Principles of Chem. II	MATH 164 (5) Calculus II	PHYS 152 (4) Mechanics	Second English Composition (3)

Sophomore

3	CHEM C341 (3) Organic Chem. I	CHEM C343 (2) Organic Chem. Lab I	MATH 261 (4) Multivar. Calculus	PHYS 251 (5) Heat, Elec., Optics
4	CHEM C342 (3) Organic Chem. II	CHEM C344 (2) Organic Chem. Lab II	MATH 262 (4) Lin. Algebra Diff. Eq.	CSCI 220 (3) Computer Programming	Elective (3)

Junior

5	CHEM C310 (3) Analytical Chemistry	CHEM C311 (1) Analytical Chem. Lab	CHEM C361 (3) Phys. Chem. I	Electives (9)
6	CHEM C362 (3) Phys. Chem. II	CHEM C363 (2) Experimental Phys. Chem.	Electives (9)	

Senior

7	CHEM C410 (3) Instrumental Methods	CHEM C411 (2) Instrumental Methods Lab	CHEM C430 (3) Inorganic Chemistry	Electives (8)
8	CHEM C335 (2) Inorganic Chem. Lab	Technical Elective (3)	Electives (11)	

The Department of Chemistry 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 221-222, 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 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 221-222 sequence, the student will be placed in MATH 164. If the student passes MATH 164, the MATH 163-164 requirement will be considered fulfilled. 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 163-164 sequence, and no credit will be allowed for MATH 221.

If a student has earned credit for the PHYS P201-P202 or PHYS 218-219 sequence, the student will be placed in PHYS 251. If the student passes PHYS 251, the PHYS 152-251 requirement will be considered fulfilled. 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 152-251 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.

In all situations outlined above, the student will receive the total credit hours for the courses allowed.

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

Minor in Chemistry

The minor in chemistry requires 24 credit hours of chemistry courses. The following courses are required: CHEM C105, C106, C310, C341, C342, C343, and C360. MATH 222 and PHYS P202 are prerequisites for CHEM C360. For other requirements see "Undergraduate Programs, Minors" in this bulletin.

Master of Science

The complete course and research work for the M.S. degree in chemistry with thesis or nonthesis option is offered at IUPUI. The nonthesis program is designed mainly for the part-time student who works in local industry or in chemistry-related fields such as quality control, high school teaching, etc., and the thesis program is designed for the full-time student who is preparing for a career in the research-oriented fields of chemistry.

Admission Requirements

The prospective student should have a bacccalaureate degree from an accredited institution, show promise of ability to engage in advanced work, and have made an adequate preparation (approximately 35 credit hours of course work in undergraduate chemistry) to enter graduate study in chemistry. Anyone not meeting these requirements should take the Aptitude Test of the Graduate Record Examination or seek immediate counseling.

Incoming students with an undergraduate grade point average of 3.0 or higher (A = 4.0) will automatically be recommended for admission as regular graduate students. Those with an average 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

Regular graduate student application forms should be obtained from the Department of Chemistry, Krannert Science Building, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(317) 274-6872]. Usually eight weeks are required for final approval of these applications. Regular graduate students are eligible to become candidates for advanced degrees.

Temporary graduate student application forms may be obtained from the Adult Education Coordinating Center, Cavanaugh Hall 001E, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2066]. The temporary graduate classification is primarily for those who wish to take courses for personal improvement. Not more than 12 hours of credit earned under this classification may be applied toward an advanced degree.

Transfer Credit

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

General Degree Requirements

The general requirements include admission to regular graduate status, completion of the English requirement, and satisfactory completion of an approved plan of study. A suitable research or library thesis must be submitted for the thesis option.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in 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.

A plan of study should be drawn up by the student and the graduate adviser in advance of registration for the first semester of graduate work. The English requirement must be satisfied before the plan of study may be filed. Only grades of A, B, and C are acceptable as satisfactorily completing an approved plan of study. All grades earned count toward the calculation of the grade point average.

Departmental Degree Requirements

The requirements for each degree are designed to provide both depth and diversity in knowledge. Of the 30 credit hour requirement for the nonthesis program or the 20 credit hour course requirement for the thesis program, 12 credit hours must be at the chemistry 600 level and 9 credit hours must be in a declared major. Courses from three of the following areas must be taken: biochemistry, organic, analytical, inorganic, and physical. Electives to meet the total number of credit hours may be taken in other departments, but prior approval of the advisory committee is required. A minimum grade point average of 3.0 must be maintained.

Financial Assistance

The Department of Chemistry has available financial support in the form of teaching assistantships, associate faculty positions, and research fellowships. More information can be obtained by writing to the departmental chairperson.

Master of Science Industrial Co-op Program in Chemistry

The combined effort of the Purdue University School of Science, IUPUI, and the industrial community of Indianapolis affords a unique opportunity to quality students seeking graduate work in chemistry. The M.S. Industrial Co-op Program requires 24 months of full-time study, and provides a Purdue M.S. degree in chemistry. It includes a parallel work experience of 20 hours per week during the final 20 months of the program. Graduates of this program may expect to be quite competitive in the industrial job market.

Academic Program

All academic requirements are identical to the normal Purdue M.S. with thesis program. The first semester provides the most intense period of study, including an introduction to laboratory research, seminar, and visits to local industry. At the end of the fall semester, students will begin work experiences of 20 hours per week. Thesis research also formally begins at this point, and course work continues at a reduced rate throughout the 24-month program.

In this program, students are vital members of academic scientist research groups during the co-op period. Furthermore, meetings of the academic advisers, industrial supervisors, and students to discuss progress in all aspects of the program are required. These students will be much better prepared to contribute to the industrial effort than the usual co-op students since they will have completed a full semester of graduate study in addition to a baccalaureate degree.

Admission

Students must meet the usual admission requirements of the Purdue University Graduate School. Application materials are available from the Department of Chemistry, Krannert Science Building, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(317) 274-6872]. Completed applications, transcripts, and letters of recommendation should be sent to the graduate adviser in Indianapolis.

Acceptance into Co-op Option

During the first semester of graduate work, students will interview with local industry, and co-op assignments will be made by the graduate adviser and the industrial representatives. If

a mutually satisfactory position cannot be found for a particular student, the student will be offered a research or teaching assistantship in the department assuming satisfactory performance in course work.

Financial Support

A stipend will be awarded for the first 4 months. This stipend will be increased for the successful student for the remaining 20 months of the program. Those who are qualified but are not accepted or do not choose the co-op option can continue as teaching or research assistants in the department. Most students qualify for complete remission of tuition and fees.

Industrial Program

The industrial experience will consist of 20 hours per week for the last 20 months of the 24-month program at one of several fine laboratories within a five-mile radius of the University. (Students must furnish their own transportation.) Industrial participants include Eli Lilly and Co., EMS Laboratories, Inc., the Indiana State Board of Health, Merrell Dow Pharmaceuticals, and Reilly Tar and Chemical Co. The types of industrial positions may include any of the four traditional areas of chemistry, as well as medicinal (pharmaceutical) chemistry and biochemistry.

Areas of Research

Students may select a major from any of the four areas of chemistry (analytical, inorganic, organic, or physical). The research programs of the department are supported by a variety of high quality modern instrumentation.

Commitments

Neither students nor employers have a commitment for continued employment at the end of the students' program. However, the program allows 20 months of close contact between students and employers, and serves as an excellent basis for career decisions.

Students will be involved in employee-employer relationships with the industrial laboratory and as such will be subject to the normal terms of employment.

Doctor of Philosophy

Qualified students who wish to continue their study toward a doctorate in chemistry may do so. Students may pursue a Purdue Ph.D. degree at the Indianapolis campus by arrangement with the West Lafayette chemistry department and the Purdue University Graduate School. Recommendations for this degree program are required from both departments. The enrollment process for Ph.D. work at this location will be initiated by the Indianapolis research supervisor. Details of the program are available from the graduate adviser in the Department of Chemistry.

The course requirements for the Ph.D. are similar to the M.S. requirements, although the student may need to take 3 to 6 additional credit hours. The major additional requirement is the preliminary examination. This examination is both oral and written. The oral component involves preparing a research proposition not related to the candidate's thesis topic. The written component is based on the core curriculum of the division awarding the degree, i.e., analytical, inorganic, organic, or physical.

Courses in Chemistry (CHEM)

Note: P—prerequisite; C—concurrent registration; R—recommended; 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; Equiv.— course is equivalent to the indicated course taught at Indiana University, Bloomington, or the indicated course taught at Purdue University, West Lafayette.

C100 World of Chemistry (3 cr.) P: None. Fall, day; Spring, day. How molecules are built, react, and affect our lives. Lectures, demonstrations, and discussion. For students desiring only one semester of chemistry. Does not count toward any degree requirements in the School of Science.

C101 Elementary Chemistry I (5 cr., 3 cr. without laboratory) P: At least one semester of high school algebra. Equiv. PU CHEM 111-112. Fall, day, night; Spring, day, night; Summer, day, night. Essential principles of chemistry; atomic and molecular structure; bonding; properties and reactions of elements and compounds; stoichiometry; solutions; acids and bases. For students who are not planning careers in the sciences and for those with no previous course work in chemistry. Lectures, recitation, laboratory. *Note:* Most degree programs that include C101 require laboratory. Before registering for 3 credit hours, students should be certain that this meets the requirements of their program.

C102 Elementary Chemistry II (5 cr., 3 cr. without laboratory) P: C101. Continuation of C101. Equiv. PU CHEM 251-251L. Fall, day, night; Spring, day, night; Summer, day. Introduction to organic and biochemistry; organic compounds and their reactions. Lectures, recitation, laboratory.

C105 Principles of Chemistry I (5 cr., lecture, recitation, laboratory) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 125. Fall, day, night; Spring, day; Summer, day. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter.

C106 Principles of Chemistry II (5 cr., lecture, recitation, laboratory) P: C105. Equiv. PU CHEM 126. Fall, day; Spring, day, night; Summer, day. Continuation of C105. Topics in inorganic chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics.

C111 Chemical Science I (4 cr., lecture, recitation) P: Two years of high school algebra, one year of high school chemistry. Equiv. PU CHEM 101, IUPUI C105 lecture. Fall, day, night; Spring, day; Summer, day. Inorganic chemistry emphasizing physical and chemical properties, atomic and molecular structure, states of matter. A lecture course for engineering and other students. No laboratory requirement.

C112 Chemical Science II (3 cr., lecture) P: C111. Equiv. PU CHEM 102, IUPUI C106 lecture. Fall, day; Spring, day, night; Summer, day. Continuation of C111. Topics in inorganic chemistry emphasizing solution chemistry, thermodynamics, equilibrium, and kinetics. Included also are topics in organic chemistry.

C125 Experimental Chemistry I (1 cr., laboratory) P or C: C111 or equivalent. Fall, day, night; Spring, day; Summer, day. Scheduled with the C105 laboratory. Laboratory work illustrating topics covered in the lecture of C105 and C111.

C126 Experimental Chemistry II (2 cr., recitation, laboratory) P or C: C112 or equivalent. Fall, day; Spring, day, night; Summer, day. Scheduled with the C106 laboratory. Continuation of C125. Laboratory work illustrating topics covered in the lecture of C106 and C112.

C209 Special Problems (1-2 cr.) P: Two semesters of college chemistry and consent of instructor. Equiv. PU CHEM 290. 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 to 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 as satisfying an advanced chemistry elective.

C310 Analytical Chemistry (3 cr.) P: C106. With C311, Equiv. PU CHEM 321. Fall. Fundamental analytical processes including solution equilibria, theory and applications of electrochemistry and spectrophotometry, and chemical methods of separation.

C311 Analytical Chemistry Laboratory (1 cr.) P or C: C310. Fall. Laboratory instruction in the fundamental analytical techniques discussed in C310.

C325 Quantitative Analysis/Instruments (5 cr.) P: C106. Spring. Instrumental methods of chemical analysis and separation for the chemical technician or preprofessional chemistry major.

C335 Inorganic Chemistry Laboratory (2 cr.) P: C106 and consent of instructor. Preparation of inorganic and organometallic compounds illustrating special and advanced techniques, including characterization by modern physical methods.

C341 Organic Chemistry I (3 cr.) P: C106. Equiv. PU CHEM 261. Fall, day, night; Spring, day; Summer, day. Comprehensive study of aliphatic and aromatic compounds. Nomenclature, qualitative theory of valence, and reactions. Commercial and laboratory syntheses and uses of monofunctional compounds.

C342 Organic Chemistry II (3 cr.) P: C341. Equiv. PU CHEM 262. Fall, day; Spring, day, night; Summer, day. Syntheses and reactions of polyfunctional compounds. Natural and industrial products. Physical and chemical methods of purification.

C343 Organic Chemistry Laboratory I (2 cr.) P or C: C341. Equiv. PU CHEM 265. Fall, day, night; Spring, day, night. Summer, day. Fundamental laboratory techniques of organic chemistry and general synthetic methods.

C344 Organic Chemistry Laboratory II (2 cr.) P or C: C342. P: C343. Equiv. PU CHEM 266. Fall, day; Spring, day, night; Summer, day. Preparation, isolation, and identification of organic compounds; emphasis on modern research methods.

C360 Elementary Physical Chemistry (3 cr.) P: C106, MATH 222, PHYS P202. Spring, odd years, day; Spring, even years, night; Summer. Chemical thermodynamics, chemical equilibria, solutions, phase equilibria, electrochemistry, and kinetics. For students who desire a survey course in physical chemistry.

C361 Physical Chemistry I (3 cr.) P: C106, MATH 164, PHYS P202 or PHYS 251, CSCI 220. Equiv. PU CHEM 373 and 374. Fall, odd years, day; Fall, even years, night. Kinetic-molecular theory, gases, liquids, chemical thermodynamics, solutions, transport properties, phase and chemical equilibria.

C362 Physical Chemistry II (3 cr.) P: C361. Equiv. PU CHEM 375. Spring, even years, day; Spring, odd years, night. 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. P or C: 362. Equiv. PU CHEM 376. Spring, even years, day; Spring, odd years, night. Experimental work to illustrate principles of physical chemistry and to introduce research techniques.

C409 Chemical Research (1-4 cr.) P: Junior or senior standing and consent of instructor. Equiv. PU CHEM 499. Every semester, time arranged. Chemical or literature research with a report. Can be elected only after consultation with research adviser and approval of program. May be taken for a total of 10 credit hours, which count toward graduation. However, a maximum of 3 credit hours may be used to satisfy the 6 credit hours of advanced chemistry electives in the Bachelor of Science in chemistry degree program.

C410 Instrumental Methods of Analysis (3 cr.) P: C310, C311, C361. P or C: C362. Equiv. PU CHEM 424. Fall. Modern analytical methods, including electroanalytical techniques, quantitative spectrophotometry, chromatography, and radiochemical methods.

C411 Instrumental Methods of Analysis 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: One year of physical chemistry. Equiv. PU CHEM 342. Fall. An introduction to the principles of inorganic chemistry with emphasis on the chemistry of the nontransition elements. A brief introduction to coordination chemistry and ligand field theory.

C483 Biological Chemistry (3 cr.) P: C342 or equivalent. Equiv. PU CHEM 533. Spring, night. Chemistry of biologically important molecules, including carbohydrates, lipids, proteins, and nucleic acids. Special emphasis on chemistry of intermediary metabolism.

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

542 Inorganic Chemistry (3 cr.) P: One year of physical chemistry. Equiv. IU Chemistry C430. Fall. An introduction to the principles of inorganic chemistry with emphasis on the chemistry of the nontransition elements.

561 Fundamental Organic Chemistry (3 cr.) P: C342 or equivalent. Fall, odd years, night. A general survey of synthetic organic chemistry including some discussion of current organic theory. Graduate students with a declared major in organic chemistry may not apply 561 for credit.

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

599 Special Assignments (1-4 cr.) P: Consent of instructor. Every semester, on demand, time arranged. Directed reading or special work not included in other courses.

621 Advanced Analytical Chemistry (3 cr.) P: C310, C410. Equiv. IU C510. Fall, night. A critical survey of recent developments in chemical and instrumental methods of analysis.

629 Chromatographic Methods of Analysis (3 cr.) P: C410 or equivalent. Spring, night. Principles and practice of modern gas and liquid chromatography are developed from an integrated point of view. Emphasis is placed on those features useful in practical analytical separations. Instrumentation is described and evaluated using chemical examples from recent literature. Although column techniques are emphasized, thin-layer chromatography and electrophoresis methods are also described.

634 Biochemistry: Structural Aspects (3 cr.) P: C310, C342, C361, and C362 or equivalent. Fall, night. 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. Spring, day. 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. Equiv. IU Chemistry C530. Spring, even years, night. Bonding in inorganic chemistry, symmetry and group theory, transition metal chemistry, spectra and magnetism, mechanisms of inorganic reactions, limited survey of periodic table.

651 Advanced Organic Chemistry (3 cr.) P: C342 or equivalent. Equiv. IU Chemistry C540. Fall, night. Modern structural organic chemistry, including introductions to molecular orbital theory and reaction mechanisms.

652 Synthetic Organic Chemistry (3 cr.) P: 651. Equiv. IU Chemistry C543. Spring, odd years, night. An advanced treatment of methods for preparing major types of organic functionalities and bonds, stressing stereochemical control and involving mechanisms for understanding the reactions employed.

657 Reaction Mechanisms (3 cr.) P: 651. Fall, even years, night. Mechanisms of representative reactions and methods used in their investigation.

669 Theoretical Organic Chemistry (3 cr.) P: 651. Theoretical aspects of organic chemistry at the molecular level and its relationship to bonding and reactions.

672 Quantum Chemistry (3 cr.) P: One year of physical chemistry. Equiv. IU Chemistry C661. Fall, odd years, night. Basic principles of classical and quantum mechanics; exact solutions for simple systems; approximation methods; atomic structure; spectroscopy; application of group theory; theory of molecular binding.

675 Chemical Kinetics (2 or 3 cr.) P: One year of physical chemistry. Equiv. IU Chemistry C673. Spring, odd years, night. Experimental and theoretical considerations of chemical reaction rates and mechanisms.

682 Statistical Thermodynamics (3 cr.) P: C362 or equivalent. Spring, even years, night. Application of statistical mechanics to the description of imperfect gases, liquids, and solutions, to order-disorder phenomena in solids and surfaces, and to absolute reaction rate theory.

695 Seminar (0 or 1 cr.) For graduate students (may be repeated for credit). Groups meeting for review and discussion of important current literature in analytical, biological, inorganic, organic, and physical chemistry. Each graduate student is required to attend the seminar of his or her major subject.

696 Special Topics in Chemistry (1-3 cr.) On demand, night. Lectures on selected topics of current interest.

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

699 Research. Ph.D. Thesis (cr. arr.)
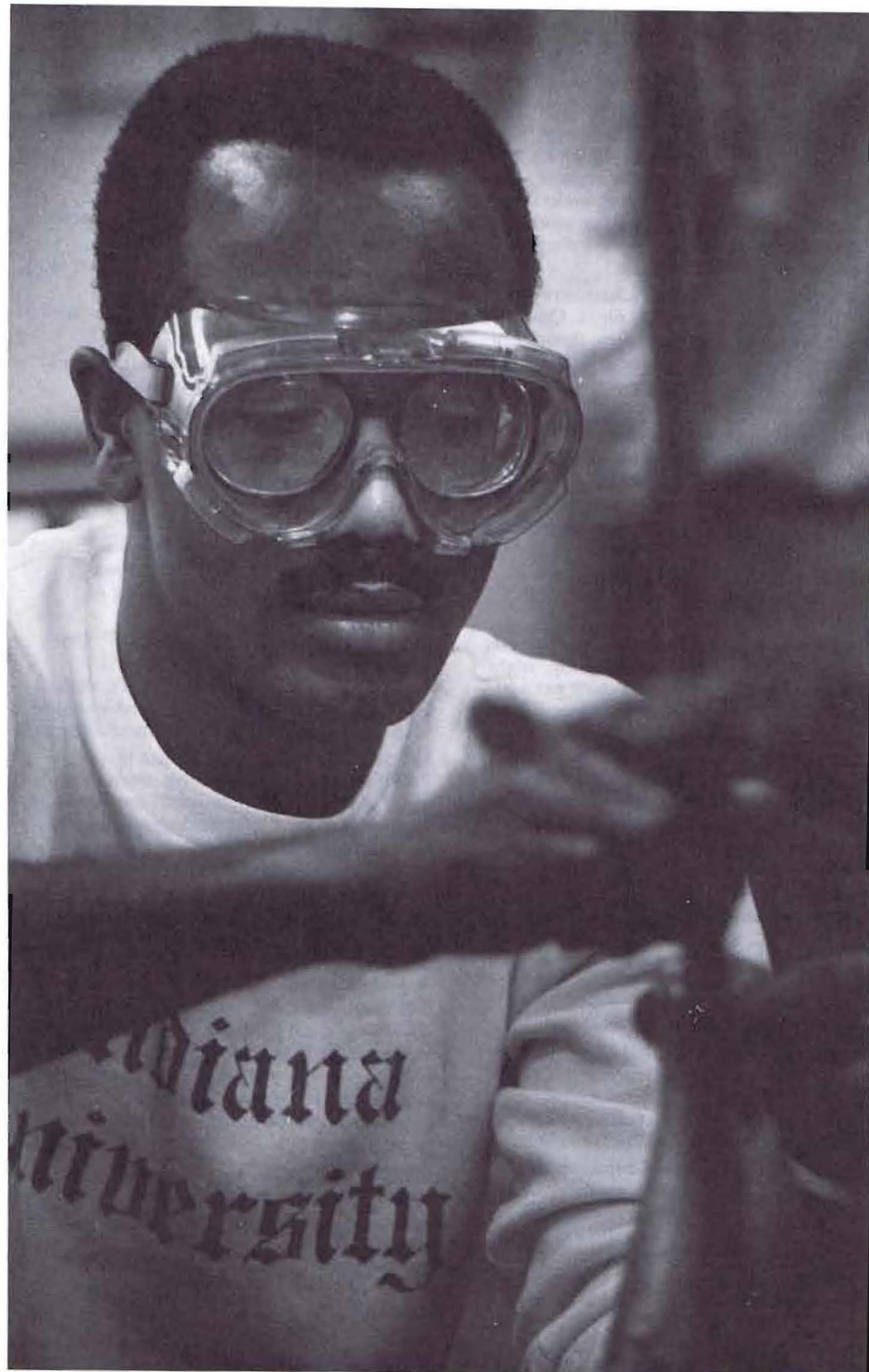
Department of Computer and Information Science

Professors John Gersting, Judith Gersting, Ng *(Acting Chairperson)*, Penna, Yovits
Associate Professors Luke, Olson, Patterson
Assistant Professor Palakal
Adjunct Assistant Professor Froehlke
Visiting Faculty Czech

The Department of Computer and Information Science offers the Bachelor of Science degree and the Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree. In addition, the department offers service courses to acquaint students in other disciplines with the application of computers to their fields of interest.

Computer scientists study the processing, representation, and retrieval of information by computers. Students completing the undergraduate degree in computer and information science may apply their knowledge to solve problems arising in almost any area of endeavor or to design new computer architectures and systems, or they may apply techniques of system analysis and information handling to a variety of situations in business, government, education, health sciences, etc. They are also prepared to pursue graduate work in computer and information science commensurate with their interests and abilities.

Bachelor of Science

Degree Requirements

See the section "Undergraduate Programs, Bachelor of Science Degree," in this bulletin for general degree requirements. Computer science majors are admitted only provisionally until they have completed MATH 163 and CSCI 230 with grades above C−. CSCI 308, computer and information science courses below CSCI 230, computer technology courses below CPT 264, mathematics courses below MATH 163, and statistics courses below STAT 311 do not count toward the degree. Certain School of Science courses do not count toward the degree program (see item 10 under "Undergraduate Programs, Baccalaureate Degree, General Requirements," in this bulletin).

Area I See School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. The second semester of English composition must be satisfied with TCM 320.

Area II There is no foreign language requirement.

Areas IIIA and IIIB Courses in other schools whose primary content is mathematical or concerns computers may not be used to fulfill Area IIIA or IIIB requirements. Consult the department for advice before registering for such courses.

Area IIIC Physical and Biological Sciences Courses that may not be used to fulfill Area IIIC requirements include: BIOL N100, N120, N200, K309; CHEM C100, C101, C102; PHYS 100, 200, 218, 219, P201, P202; AST A100, A105; GEOL G107, G115, G130; all agriculture courses. Consult the department counselor for advice concerning the acceptability of other courses.

The following engineering sequences may be applied toward Area IIIC requirements: EE 201, EE 202, EE 207, EE266, and EE267.

Area IV Major Requirements Minimum requirements include 53 credit hours of designated computer science and mathematics courses. Students who do not maintain a minimum grade point average of 2.5 in MATH 163, 164, 261 and in CSCI 230, 300, 330, 335 will not be permitted to continue as departmental majors.

Required courses:
1. The calculus sequence MATH 163, 164, 261
2. STAT 311 or STAT 511
3. The computer and information science core CSCI 230, 330, 300, 335
4. Three of the following four two-course sequences: CSCI 402 and 403; CSCI 440 and 541; CSCI 482 and 484; MATH 262 and CSCI 414 or MATH 414
5. Two computer and information science electives at the 400 level, or above, distinct from the three two-course sequences of item 4
6. Each student must complete at least one 500 level computer and information science course (CSCI 512 is not acceptable).

For those courses counted toward the degree but taken outside the Schools of Science and Liberal Arts, the department strongly urges that they be chosen so as to form a cohesive support area for the applications of computer and information sciences (e.g. certain courses in the School of Engineering and Technology or the School of Business).

Business Minor

The School of Business grants a minor in business to computer and information science students. This requires 30 credit hours of business-related courses. These 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:
1. Students must take CSCI 440 and 541 as one of their three two-course sequences.
2. Economics E201 and E202 may be used to satisfy Area IIIB requirements.
3. Students must take PSY B104 and Business A201, A202, L203, F301, M301, P301, and one 3 credit hour business elective at the 300 level or above for which prerequisites have been taken. Recommended courses include Business Z302, G406, J401, W311.
4. A grade point average of 2.3 (C+) must be maintained in the prerequisite courses before taking Business F301, M301, and P301.
5. Business F301, M301, and P301 must be taken concurrently.

Computer and Information Science Sample Program

A, B, C designate the 3 selected sequences in item 4 of Area IV requirements.

Freshman				
1	CSCI 230 (3) Computer Science	MATH 163 (5) Calculus	ENG W131 (3) Composition	Humanities or Soc. Science (3)	Free Elective (3)
2	CSCI 330 (3) Computer Science	MATH 164 (5) Calculus	COMM C110 (3) Speech	Humanities or Soc. Science (3)	Free Elective (3)

Sophomore				
3	CSCI 300 (3) Assembly Lang.	MATH 261 (4) Calculus	Laboratory Science (4-5)	Free Elective (3)	Free Elective (3)
4	CSCI 335 (3) Data Structures	CSCI (3) Sequence A1	Science Elective (3-5)	Free Elective (3)	Free Elective (3)

Junior				
5	CSCI (3) Sequence B1	CSCI (3) Sequence A2	STAT (3) Stat. Methods	Science Elective (3-5)	Free Elective (3)
6	CSCI (3) Sequence B2	TCM 320 (3) Written Comm.	Science Elective (3-5)	Free Elective (3)	Free Elective (3)

Senior				
7	CSCI (3) Sequence C1	Advanced CSCI Elective (3)	Humanities or Soc. Science (3)	Free Elective (3)	Free Elective (3)
8	CSCI (3) Sequence C2	Advanced CSCI Elective (3)	Humanities or Soc. Science (3)	Free Elective (3)	Free Elective (3)

Master of Science

This program, leading to a Purdue University degree, is offered in Indianapolis to serve primarily students from the Indianapolis area who are interested in computer and information science. Many courses are offered in the late afternoon or evening to accommodate working students.

Prerequisites for Admission

A bachelor's or equivalent degree and an overall grade point average of B or better are required by the Graduate School. Students must have completed the following courses or equivalents with grades of B or better before applying to the graduate program: MATH 163, 164, 261 and CSCI 230, 300, 330, 335, 402, 403, 482, 484. These courses carry no credit toward the graduate degree. Students are strongly advised to have taken mathematics courses in linear algebra and differential equations.

The Graduate Record Examination, General Aptitude Test is required for admission. Regular graduate student application forms should be obtained from the Department of Computer and Information Science, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(317) 274-9727].

While the graduate application is being processed, the student may take courses as a temporary graduate student. Students may also use temporary graduate student status to take any courses required for admission in which they may be deficient. No more than 12 hours of credit earned as a temporary graduate student may be applied toward a graduate degree. (Deficiency courses are not applied against the 12 credit hours since these courses carry no credit toward the degree.) Temporary graduate student application forms may be obtained from the Adult Education Coordinating Center, Cavanaugh Hall 001E, 425 Agnes Street, IUPUI, Indianapolis, Indiana 46223 [(317) 274-2066]. Temporary graduate students are encouraged to talk to the department counselor as they plan toward admission to the graduate program.

Program Requirements

The program consists of at least 30 credit hours of courses. The following courses are required of students who have not already had equivalent courses: CSCI 502 and CSCI 503; at least one of CSCI 514, 515, 516, 520; and at least one of CSCI 582 or MATH 585. The remaining courses are chosen by the student with the approval of the Graduate Committee. Generally these will consist of computer and information science courses numbered above 500, but a maximum of 6 credit hours of courses numbered above 500 in a related discipline may be allowed if approved in advance on the plan of study.

The student's formal plan of study must be submitted to and accepted by the Graduate School *before* the semester in which the student expects to receive the degree; students should submit a plan of study as soon as possible after admission to the graduate program. The English requirement (see the "Graduate Programs, Purdue University Graduate Degrees," item 2 in this bulletin) must be satisfied before the plan of study can be approved. An applicant whose native language is not English must take the Test of English as a Foreign Language (TOEFL) before applying for admission.

Standard of Performance

In the courses on a plan of study, grades of A and B are expected; up to 6 credit hours of grade C may be included provided an overall grade point average of 3.0 (B) is maintained. Other grades are unacceptable.

Transfer of Credit

Credit for graduate courses taken at other institutions may be transferred with 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. Application for the transfer of credit is made when the plan of study is presented for approval.

Doctor of Philosophy

Qualified students may be authorized to pursue the Ph.D. degree. Please contact the Department of Computer and Information Science at IUPUI for further details.

Courses in Computer and Information Science (CSCI)

Note: P—prerequisite; C—concurrent registration; R—recommended

Undergraduate Level

201 Computer Literacy: Applications and Concepts (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers intended for students in the humanities and liberal arts. Some programming with emphasis on non-numerical programs. Computer applications that affect everyday life. The impact of computers on society, including both problems and benefits. Computer applications in the humanities.

205 Computer Science for Allied Health (2 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Programming in BASIC with emphasis on microcomputers. Graphics image processing, especially as it relates to medical imaging in the allied health sciences.

206 Computer Programming (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Emphasis on problem solving and algorithm development using the BASIC and Pascal programming languages on microcomputers and mainframe computers. Primarily for education majors.

207 Computers in the Social Sciences (3 cr.) P: None. Not normally accepted for credit in computer science programs. An introduction to computers and computer programming. Elements of computer hardware and software, emphasis on problem solving, algorithm development, and programming in BASIC. Use of standard statistical packages. Social impact and ethical issues of computing.

208 The Computer in Business (3 cr.) P: MATH 118 or MATH 119 and sophomore standing. Not normally accepted for credit in computer science programs. Introduction to computers and their use in business. Elements of computer organization and data storage. Programming in FORTRAN to solve business-oriented problems; emphasis on structured programming. Developments in computing affecting business.

220 Programming I (3 cr.) P or C: MATH 163 or MATH 221. Not normally accepted for credit in computer science programs. An introduction to computer science. Emphasis on algorithm development and structured programming techniques. Programming in FORTRAN 77, including input/output, flow of control, arrays, subprograms. Program development and debugging. Fundamental concepts of computer organization. Social issues in computing.

230 Computer Science I (3 cr.) P or C: MATH 163. An introduction to computer science. Emphasis on algorithm development and structured programming techniques using Pascal. Topics include data types, input/output, procedures and functions, flow of control, arrays, records, files, and recursion.

300 Assembly Language Programming (3 cr.) P: 230 or equivalent. Assembly language programming and structure of a simple computer and a typical computer. Number and character representation. Pseudo operations, address structure, subroutines and macros. File I/O and buffering techniques. Interfacing with programs written in high level languages. One and two pass assemblers. Programming assignments on bit/byte manipulation, I/O buffering and interfacing with high level languages including parameter passing.

It is recommended that students do not take CSCI 300 and CSCI 330 concurrently.

308 The Microcomputer in Business (3 cr.) P: 208. Not normally accepted for credit in computer science programs. Microcomputer anatomy and operation. Selection and implementation of microcomputer hardware and software in a business environment: word processing; spreadsheet, database management; communications; payroll; general ledger; accounts payable; accounts receivable; inventory.

320 Programming II (3 cr.) P: 220 or equivalent. Not normally accepted for credit in computer science programs. Further emphasis on structured programming using a block structured higher level language such as Pascal. Advanced programming concepts: data types, recursion, scope of identifiers, elementary data structures. Program development and testing. Programming project required.

330 Computer Science II (3 cr.) P: 230 (or, with consent of instructor, 220). Further study of programming using a language such as Modula-2. Topics include advanced programming techniques and elementary data structures. A large-scale group software development project is required.

335 Data Structures (3 cr.) P: 330 and 300. Specification, representation, and manipulation of basic data structures in different languages; linked lists, arrays, stacks, queues, trees, strings. Symbol tables, Huffman codes, optimal search trees, pattern matching, priority queues, heaps, hash tables. Storage allocation, garbage collection, compaction, reference counts. Algorithm analysis.

402 Architecture of Computers (3 cr.) P: 335. 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, vector and array processors.

403 Systems Programming (3 cr.) P: 402. R: 461. Fundamental concepts of programming language processors and operating systems. Design of assemblers, macro processors, relocatable and linking loaders. BNF grammars, parsing, syntactic and semantic phases, optimization. Operating systems: design of monitors, kernels, process management, virtual devices, memory management.

414 Numerical Methods (3 cr.) P: 220 or equivalent, and MATH 262. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, numerical solution of ordinary differential equations. Not open to students with credit in 512.

437 Introduction to Computer Graphics (3 cr.) P: 335, and MATH 262 or MATH 351. Introduction to the basic principles of interactive computer graphics. Algorithms and data structures for two- and three-dimensional views. Geometric modeling. A survey of current hardware and software.

440 File Structures and Searching (3 cr.) P: 335. Basic concepts of data base management systems including: data models, data definition and manipulation languages, and high-level query languages. Basic techniques of file organization design: binary search, indexing, sequence and symbol tree structures, hashing, data compression, and format. Access methods. Secondary key searching: inverted files, multilists, multiple-attribute indexing. Design analysis: index selection and optimization, loading factor, maintenance, reorganization and performance evaluation. Data analysis: file design, maintenance reorganizations. Projects include programming in COBOL or PL/1.

446 Introduction to Microprocessor Architecture (3 cr.) P: 300 and 330. 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; self-paced laboratory using A/D converters, D/A converters, etc.

450 Programming Methodology (3 cr.) P: 330 and 482. 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; techniques and software tools for program testing; maintenance and documentation.

461 Introduction to Programming Languages (3 cr.) P: 330. R: 300. Study of syntax, semantics, and implementation of high level languages. Introduction to languages with features for large-scale programming, (e.g., Ada, Modula-2); systems programming, (e.g., Modula-2, C); parallel programming, (e.g., Ada, Modula-2); and functional programming, (e.g., Scheme and LISP).

482 Discrete Computational Structures (3 cr.) P: MATH 261. Discrete mathematical structures and their relationship to computer science. Topics from sets, relations, functions, permutations, combinatorics, graphs, trees, group theory, boolean algebra, recurrence relations, switching circuits, finite-state automata, codes.

484 Theory of Computation (3 cr.) P: 482. Techniques for analyzing and comparing algorithms are presented. Algorithms analyzed include those for sorting, searching, graph theory, combinatorics, computational geometry, matrices, and other problems. Computational complexity, including Turing machines, NP-completeness, and effective computability.

490 Topics in Computer Sciences for Undergraduates (1-5 cr.) By arrangement. Supervised reading and reports in various fields. Open to students only with the consent of the department.

Undergraduate and Graduate Level

502 Compiling and Programming Systems (3 cr.) P: 403. R: 484. 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; design of interpretive systems. Students are expected to complete a large programming project as part of the course.

503 Operating Systems (3 cr.) P: 502. 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, mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, access control; file systems; resource management; evaluation and prediction of performance.

512 Numerical Methods for Engineers and Scientists (3 cr.) P: 220 or equivalent, MATH 351 or MATH 511, and MATH 510. Not open to students with credit in 414. Not normally accepted for graduate credit in computer sciences 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; round-off error bounds.

515 Numerical Analysis of Linear Systems (3 cr.) P: 220 or equivalent, 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: 330, and MATH 510 or consent of instructor. A study of techniques such as direct integration, shooting, finite difference, finite element, method of weighted residuals, methods of characteristics, and others for solving problems in fluid mechanics, solid mechanics, dynamics, and other fields of applied mathematics.

520 Computational Methods in Analysis (3 cr.) P: 220 or 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; 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, internetworking 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, DARPA Internet protocols (TCP/IP) as examples protocol organization.

541 Database Systems (3 cr.) P: 440 or equivalent. 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: 220 or 230, 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 queueing models, network of queues, 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; 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; natural language translation.

556 Fault-Tolerant Computing (3 cr.) P: 335. 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: 403. R: 484. An exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; program verification using Hoare's logic and Dijkstra's predicate transformers; abstract data types; monitors and distributed processes; LISP; applicative languages and APL; data flow languages.

582 Automata and Formal Languages (3 cr.) P: 484. Finite automata, regular expressions; push-down automata, context-free grammars; their languages and behaviors. Closure properties, pumping lemmas, 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, compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

590 Topics in Computer Sciences (1-5 cr.) By arrangement. 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- and eigen-value 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; 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.
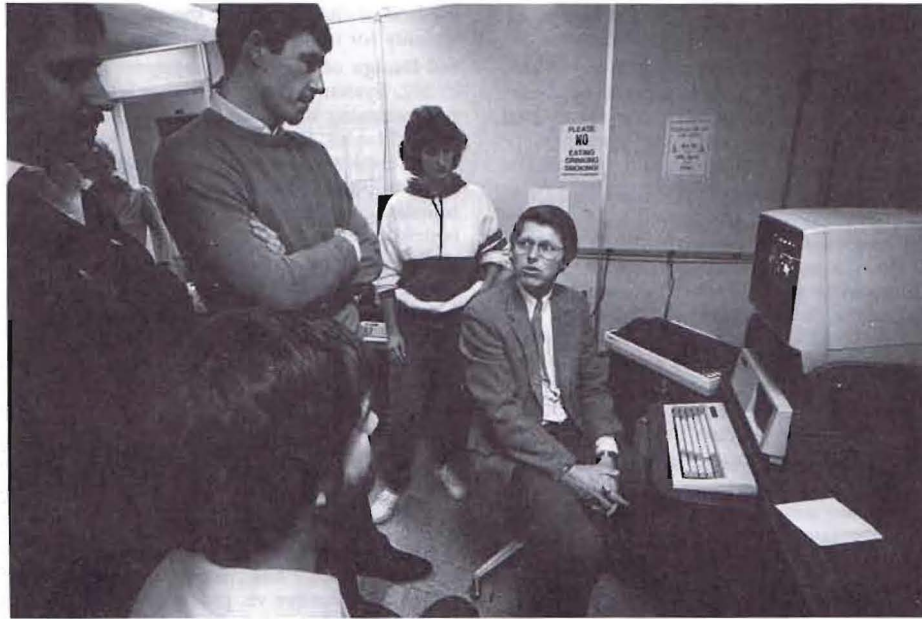
Department of Geology

Professor Mirsky (*Chairperson*)
Associate Professors de Caprariis, Hall, Pachut, Rosenberg
Assistant Professor Gustin
Adjunct Professors Banaszak, Ghosh, Park
Departmental Counselors Hall, Mirsky

Geology is the science of the earth—the systematic attempt by humans to understand the planet and the environment in which they dwell. Geology includes the location, extraction, and economic use of minerals, rocks, soils, water, coal, and petroleum. These natural resources compose the earth and make possible our modern technology and civilization. Geologists study the landforms produced by volcanoes, streams, winds, glaciers, and other surficial earth processes. They investigate the internal earth processes of earthquakes, mountain building, continental drift, and sea-floor spreading. Geology includes the fossils that record the development of life on the earth and also includes the investigation of the billions of years of earth history. Geology has recently expanded to include the study of the moon and the other planets in the solar system.

The Department of Geology furnishes training for (1) those who desire to become professional geologists and seek careers in industry, in research laboratories, in federal or state or local government, or in university or college teaching; (2) those who wish to teach earth science or geology at the secondary school level; and (3) those who seek a general knowledge of geology, its relationship to other sciences, and its importance to the environment in which we live.

The following undergraduate degree options are offered in geology: Bachelor of Arts (B.A.) in geology (with General Geology Option or Earth Science Secondary Teaching Certification Option), and Bachelor of Science (B.S.) in geology. The choice of a particular degree option and proposed plan of study must be made in consultation with a departmental counselor. A graduate program leads to the Master of Science (M.S.) degree with a concentration in environmental geology.

Bachelor of Arts
(Granted by Indiana University)

GENERAL GEOLOGY OPTION

Degree Requirements

Area I   See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin. The second semester of English composition may be satisfied by ENG W132, ENG W231, or TCM 220. GEOL G205 may partially satisfy this 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   There is no foreign language requirement.

Area IIIA   See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.

Area IIIB   See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin.

Area IIIC Physical and Biological Sciences   See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin, but all four courses must include a laboratory, and at least two of the four courses must include CHEM C105-C106, and at least one of the four courses must be in biological sciences. No grade below C − will be accepted in chemistry or in the other two courses to satisfy Area IIIC.

Area IIID Mathematical Sciences   MATH 147-148 or MATH 151; and CSCI 220 or CSCI 207. No grade below C − will be accepted in any of these courses.

Area IV Geology Concentration Requirements 37 credit hours of geology, including G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404, and two courses from among 400 level or higher geology electives (but note that G409 or G410 must each total at least 3 credit hours to be used in place of one—and only one—of these two 400 level courses). A maximum of 2 credit hours of G420 may be counted toward the geology concentration of 37 credit hours. GEOL G107, G115, and G130 do not count towards the geology concentration of 37 credit hours but may be applied as electives towards the University required total of 122 credit hours. Note that G205 is a prerequisite for G334 and all 400 level courses. This program can provide a broad general education and often an adequate background for professional employment in geology.

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements," in this bulletin. The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts.

EARTH SCIENCE SECONDARY TEACHING CERTIFICATION OPTION

Degree Requirements

A. **Humanities** 18-24 credit hours
   Area I For teacher certification the requirement is met by the School of Science requirement. The second course in English composition may be satisfied by ENG W132, ENG W231, or TCM 220. GEOL G205 may partially satisfy this requirement, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.
   Area II There is no foreign language requirement.
   Area IIIA See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.
B. **Social and Behavioral Sciences** 9-15 credit hours
   Area IIIB See the School of Science requirements.
C. **Life and Physical Sciences** 9-15 credit hours
   Areas IIIC and IIID Same as under General Geology Option above.
D. **Electives** as needed to obtain a total of 40 credit hours. Must include CSCI 220 or CSCI 207.

Earth Science Requirements (Area IV)

51 credit hours of geology and related subjects (including GEOL G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404) and CHEM C105-C106. No grade below C − will be accepted in geology and chemistry. The additional related subjects are chosen from among those courses listed in the certification requirements below.

Certification Requirements

Certification in science requires both a primary and support teaching area. Students pursuing the Earth Science Secondary Teaching Certification Option would earn a primary area of earth science and must choose a supporting area of either physical science or physics.

The courses required for a supporting area of physical science are: 8-10 credit hours of chemistry and 5-7 credit hours of physics, or 8-10 credit hours of physics and 5-7 credit hours of chemistry. The support area must total at least 15 credit hours of course work.

The courses required for a supporting area of physics are: PHYS 218-219 or PHYS 152-251, and 300 level physics electives to total 15 credit hours of physics.

In addition, general requirements for students seeking a science teaching major include nutrition, pharmacology, and in the case of an earth science primary area, one course in biology.

Students seeking a primary area of earth science must take GEOL G300 or Geography G315 and GEOL G416 in addition to the geology courses required of the baccalaureate degree.

The student should consult with a geology counselor for further information regarding courses to complete the certification requirements.

Professional Education Requirements

Refer to the front section of this bulletin under "Special Programs, Secondary Teacher's Certificate."

Other Requirements

See the School of Science requirements under "Undergraduate Programs, Baccalaureate Degree, General Requirements," in this bulletin, except electives to make a minimum of 124 credit hours, and an average grade of C+ or better for education courses (with at least a C in each course). The Department of Geology will accept 10 credit hours toward graduation outside the Schools of Science and Liberal Arts and Education.

Bachelor of Science
(Granted by Indiana University)

Degree Requirements

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. The second semester of English composition may be satisfied by ENG W132, ENG W231, or TCM 220. GEOL G205 may partially satisfy this 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 There is no foreign language requirement.

Area IIIA See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. First year of a foreign language does not apply toward satisfying this requirement.

Area IIIB See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin.

Area IIIC Physical and Biological Sciences CHEM C105-C106; PHYS P201-P202 or 152-251; and two courses in biological sciences, with 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 220 or CSCI 230; and one course in statistics with departmental approval. No grade below C− will be accepted in any of these courses.

Area IV Geology Concentration Requirements Geology: 44 credit hours including GEOL G109, G110, G119, G205, G206, G221, G222, G303, G323, G334, G404, G429, and two courses from among 400 level or higher geology electives (but note that G409 or G410 must total at least 3 credit hours to be used in place of one—and only one—of these two 400 level courses). A maximum of 2 credit hours of G420 may be counted toward the geology concentration of 44 credit hours. GEOL G107, G115, and G130 do not count toward the geology concentration of 44 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 geology courses.

General Two courses at 300-400 level in one or more of the following departments: biological sciences, chemistry, computer and information science (CSCI 320 or CSCI 414), mathematical sciences, and physics. With departmental approval, a third 400 level geology elective may substitute for one of these two courses. 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. 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 minor in geology requires 24 credit hours of geology 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 14 credit hours of course work in geology, including G109 (3), G119 (1), G110 (3), G206 (1), G221 (3), and G222 (3).
2. Students must complete an additional 10 credit hours minimum, including three of the following courses: G303 (4), G323 (3), G334 (3), and G404 (3)-G410 (1) (Note that G404-G410 counts as one selection.)

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 study for any of the three baccalaureate degree options, because of the flexibility encouraged within the program for each option. However, one possible sequence of courses for each option is given below; variations from these samples of plans of study should be made in consultation with a departmental counselor.

Bachelor of Arts, General Geology Option

Freshman

1	GEOL G109 (3) Geology: Evolution of the Earth	GEOL G119 (1) Historical Geology Lab	MATH 147 (3) Algebra & Trig I	ENG W131 (3) English Composition	Arts and Humanities (3)
2	GEOL G110 (3) Geology: Earth's Environment	G206 (1) Physical Geology Laboratory	MATH 148 (3) Algebra & Trig II	BIOL N107 (4) Animal Biology	Second English Composition (3)

Sophomore

3	GEOL G221 (3) Mineralogy	CHEM C105 (5) Principles of Chemistry I	COMM C110 (3) Speech	Arts and Humanities (3)	
4	GEOL G222 (3) Petrology	CHEM C106 (5) Principles of Chemistry II	Arts and Humanities (3)	GEOL G205 (3) Reporting Skills in Geoscience	Elective (3)

Junior

5	GEOL G303 (4) Maps & Field Methods	GEOL G323 (3) Structural Geology	Social and Behavioral Sciences (3)	Arts and Humanities (3)	Elective (3)
6	GEOL G334 (3) Sedimentation & Stratigraphy	Social and Behavioral Sciences (3)	Social and Behavioral Sciences (3)	Computers (3)	Elective (3)

Senior

7	GEOL G404 (3) Geobiology	GEOL G410 (1) Research in Geobiology	400 Level Geology (3)	Social and Behavioral Sciences (3)	300 Level Elective (3)	Elective (3)
8	400 Level Geology (3)	300 Level Elective (3)	300 Level Elective (3)	Elective (3)	Elective (3)

Bachelor of Arts, Earth Science Secondary Teaching Certification Option

Freshman

1	GEOL G109 (3) Geology: Evolution of the Earth	GEOL G119 (1) Historical Geology Lab	MATH 147 (3) Algebra & Trig 1	ENG W131 (3) English Composition	Arts and Humanities (3)	Social and Behavioral Sciences (3)
2	GEOL G110 (3) Geology: Earth's Environment	GEOL G206 (1) Physical Geology Laboratory	MATH 148 (3) Algebra & Trig II	BIOL N107 (4) Animal Biology	HPER 318 Pharmacology	Second English Composition (3)

Sophomore

3	EDUC H340 (3) Education	GEOL G221 (3) Mineralogy	CHEM C105 (5) Principles of Chemistry I	COMM C110 (3) Speech	FN 303 (3) Nutrition	
4	GEOL G222 (3) Petrology	CHEM C106 (5) Principles of Chemistry II	EDUC M201 (1) and P255 (3) Education	GEOL G205 (3) Reporting Skills in Geoscience	EDUC W200 (1) Microcomputing for Education	

Junior

5	GEOL G303 (4) Maps & Field Methods	GEOL G323 (3) Structural Geology	A100 or A105 (3) Astronomy	EDUC M300 (3) Education	EDUC M314 (3) and M301 (0) Education	
6	GEOL G115 (3) Oceanography	GEOL G334 (3) Sedimentation & Stratigraphy	EDUC M464 (3) Education	GEOG G315 (3) Geography	Computers (3)	

Senior

7	GEOL G404 (3) Geobiology	GEOL G410 (1) Research in Geobiology	GEOG G304 (3) Meteorology	EDUC M449 (5) and M401 (0) Education	400 Level Geology (3)	
8	400 Level Geology (3)	EDUC M480 (9) Education— Student Teach				

Summer Session (Sophomore and/or Junior year)

Social and Behavioral Sciences (3)	Arts and Humanities (3)	Social and Behavioral Sciences (3)	Arts and Humanities (3)	Arts and Humanities (3)

Bachelor of Science

Freshman

1	GEOL G109 (3) Geology: Evolution of the Earth	GEOL G119 (1) Historical Geology Lab	MATH 147 (3) Algebra & Trig I	ENG W131 (3) English Composition	Arts and Humanities (3)
2	GEOL G110 (3) Geology: Earth's Environment	GEOL G206 (1) Physical Geology Laboratory	MATH 148 (3) Algebra & Trig II	CHEM C105 (5) Principles of Chemistry I	Second English Composition (3)

Sophomore

3	GEOL G221 (3) Mineralogy	COMM C110 (3) Speech	MATH 163 (5) Calculus I	CHEM C106 (5) Principles of Chemistry II	
4	GEOL G222 (3) Petrology	MATH 164 (5) Calculus II	BIOL N107 (4) Animal Biology	GEOL G205 (3) Reporting Skills in Geoscience	

Junior

5	GEOL G303 (4) Maps & Field Methods	PHYS 152 (4) Physics I	GEOL G323 (3) Structural Geology	Computer Science (3)	
6	BIOL K101 (4) Botany	PHYS 251 (4) Physics II	400 Level Geology (3)	Statistics (3)	

Senior

7	GEOL G404 (3) Geobiology	GEOL G410 (1) Research in Geobiology	400 Level Geology (3)	Elective Area IV (3) 300-400 Level	Social and Behavioral Sciences (3)
8	GEOL G334 (3) Sedimentation & Stratigraphy	Elective Area IV (3) 300-400 Level	Elective (3)	Arts and Humanities (3)	Social and Behavioral Sciences (3)

G429—Summer Field Camp—(7)

Master of Science

(Granted by Indiana University)

The Department of Geology graduate program leads to the Master of Science degree with a concentration in environmental geology. The Master of Science degree program is administered under the chairperson by a graduate advisory committee composed of a graduate adviser and two graduate committee members appointed by the chairperson.

Admission Requirements

The prospective student in the master's program should have a baccalaureate degree in geology, including summer field camp, a 3.0 (B) grade point average in geology courses, one year each of chemistry and physics, mathematics through calculus, and a course in computer programming. Each candidate may submit Graduate Record Examination scores (on both the General Test and the subject test in geology) but must submit three letters of recommendation. Persons with a baccalaureate degree in another area of science are also encouraged to apply; a special admissions committee will prescribe a plan of study to remove deficiencies.

Transfer Credit

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

Course Requirements

Both thesis and nonthesis options are available.

The thesis option requires a minimum of 30 credit hours, including 6 credit hours for the thesis.

The nonthesis option requires a minimum of 36 credit hours, 3 of which must be in a research course requiring a written report. Students electing the nonthesis option also must include

among the 36 credit hours 6 credit hours in research skill courses (e.g. computer science, statistics, etc.).

Both thesis and nonthesis options require at least 6 credit hours in allied science and mathematics courses approved for graduate credit. Up to 6 credit hours of 400 level (senior) geology courses approved for graduate credit may count toward major field requirements.

Grades

A 3.0 (B) grade point average or higher must be maintained, but no more than 6 credit hours of grades below B are acceptable and no grade below C is acceptable.

Financial Aid

Qualified candidates for the master's degree may be appointed as part-time lecturers in introductory level courses. Several such positions are available each semester. Teaching positions include remission of about 80 percent of fees and tuition. In addition, grant-supported research assistantships may be available to exceptionally well-qualified candidates. Finally, all candidates may apply for University Fellowships.

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 which 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 with numbers in the 500s or higher are graduate courses.

Note: P—prerequisite; C—concurrent registration; 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 *Schedule of Classes.*

G107 Geology, Resources, and Man (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, land use, water supplies, geologic hazards and problems, geology and health, and new geological developments.

G109 Geology: Evolution of the Earth (3 cr.) P: None. Fall, Spring, Summer. Basic principles of interpreting earth history: geologic time, stratigraphic analysis, reconstructing past environments. Physical development of the earth: its interior, mountain building, continental drift, sea-floor spreading. Origin and development of life: evolution, the fossil record. With laboratory G119, equivalent to IU Geology G104, IU Geology G112, and PU GEOS 112.

G110 Geology: The Earth's Environment (3 cr.) P: None. Fall, Spring, Summer. Description, classification, and origin of minerals and rocks. Internal processes: earthquakes, rock deformation, origin of crustal structures. External processes:

landslides, streams, glaciers, groundwater, humans' geologic environment. With laboratory G120, equivalent to IU Geology G103, IU Geology G111, and PU GEOS 111.

G115 Introduction to Oceanography (3 cr.) P: None. Fall, Spring, Summer. Nonmathematical introduction to the history, geology, biology, and physical characteristics of the ocean. Includes volcanoes and earthquakes in the marine environment, currents of the world ocean, the life history of marine animals, and pollution of the marine ecosystem.

G119 Evolution of the Earth Laboratory (1 cr.) C: G109. Fall, Spring, Summer. Laboratory studies of fossils and stratigraphic analysis to reconstruct past environments and interpret earth history. To accompany G109.

G120 The Earth's Environment Laboratory (1 cr.) C: G110. Fall, Spring, Summer. Laboratory studies of minerals and rocks, landscapes, and earth structures. To accompany G110.

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; geology of cities; geology of gemstones; geology of art; energy; history of geology; earthquakes; volcanoes; prehistoric life; dinosaurs; fossil clocks and changing time. Each short course is one credit; no topic may be taken for credit more than once.

G205 Reporting Skills in Geoscience (3 cr.) P: G109 or G110, 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 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.

G221 Introductory Mineralogy (3 cr.) P: G206 or consent of instructor. Fall. Crystallography: symmetry, morphology, classes. Mineral chemistry, physics, and genesis. Description, identification, association, occurrence, and use of common and important minerals.

G222 Introductory Petrology (3 cr.) P: G221. 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 G109 or G110 or GEOG G107 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: G222 or consent of instructor. Pace-and-compass and plane-table mapping. Measuring and describing stratigraphic sections of sedimentary rocks and surficial deposits. Mapping geologic structures and structural interpretation of maps and aerial photographs. Environmental (land-use) mapping.

G309 Cooperative Education in Geology **(1-3 cr.)** P: G206, G222, G303. Industrial or government or similar experiences in geologically oriented employment. Grade is determined on basis of a written student report and a supervisor evaluation report. May be repeated for a maximum of 6 credit hours.

G323 Structural Geology (3 cr.) P: G206 and G222. R: G303. 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.

G334 Principles of Sedimentation and Stratigraphy (3 cr.) P: G205, G222 or consent of instructor. Spring. Interrelationship of sedimentation and stratigraphy: processes and factors influencing genesis of sedimentary strata; provenance, depositional environment, sedimentary facies, paleoecology; analytical techniques, application of principles to interpretation of stratigraphic record.

G403 Optical Mineralogy and Petrography (3 cr.) P: G205, G222. Identification of rock-forming minerals in fragments and thin-sections using principles of optical crystallography and the standard petrographic microscope. Description of common igneous, sedimentary, and metamorphic rocks and interpretation of their genesis using hand-specimens and thin-sections. Practical applications are considered.

G404 Geobiology (3 cr.) P: G109-G119, G205, and G222, and BIOL K101 or BIOL K103 or BIOL N107, or consent of instructor. Fall. Principles of paleontology. Application of biological principles and use of fossils in the study of earth history. Emphasis is on documentation of macroevolution and development of the basic theory of evolution. Laboratory exercises examine the form and ecology of major phyla with a fossil record. G410 (1 cr.) must be taken concurrently for field project by geology majors; optional for nonmajors.

G406 Introduction to Geochemistry (3 cr.) P: G205, G221, CHEM C106 or consent of instructor. Chemistry in the study of the earth employing elementary chemical thermodynamics, the phase rule, chemical equilibria, redox reactions, the radioactive decay law, and organic chemistry.

G409 Independent Study in Geology (1-3 cr.) P: Consent of instructor. Fall, day, night; Spring, day, night; Summer, day, night. Supervised independent study of topics and techniques in geology that are not

available in formal courses in the department.

G410 Undergraduate Research in Geology (1-6 cr.) P: G205, junior standing, and consent of instructor. Fall, day, night; Spring, day, night; Summer, day, night. Field and laboratory research in selected problems in geology. May be repeated. Total of 6 credit hours may be applied toward the degree.

G413 Introduction to Earth Physics (3 cr.) P: G205 and consent of instructor. Physics in the study of the earth, its origins, history, and internal constitution. Exploration techniques.

G415 Principles of Geomorphology (4 cr.) P: G205, G222, G303, G323. P or C: G334. Natural processes that create landforms and landscapes. Physics and chemistry of weathering and soil formation. Dynamics of mass wasting, streams, glaciers, wind, and shoreline processes. Includes field and laboratory investigations and a research project on a selected aspect of geomorphology.

G416 Economic Geology (3 cr.) P: G205, G222 or consent of instructor. Origin, geologic occurrence, distribution, use, and conservation of important geologic natural resources of the world. Metallic minerals; industrial minerals and rocks; coal, petroleum, natural gas, and other energy resources; water as a natural resource. Credit not given for both G416 and G316.

G420 Regional Geology Field Trip (1-2 cr.) P: G205 or consent of instructor. Seminar and field investigation of selected regions for study of mineralogic, lithologic, stratigraphic, structural, paleontologic, geomorphologic, or other geological relationships. Seminar held during spring semester. Six to ten days in the field during first summer session.

G429 Field Geology in the Rocky Mountains (7 cr.) P: G205, G221, G222, G303, G323, and G334. Summer. Seven weeks at Geologic Field Station in Montana. Geologic reconnaissance, measurement of stratigraphic sections, mapping on aerial photographs, construction of structure sections. Regional geomorphology, stratigraphy, and structure through South Dakota, the Black Hills, Wyoming, Montana, Yellowstone Park, and Glacier Park. Students register through the Department of Geology at Indiana University, Bloomington.

G430 Principles of Hydrology (4 cr.) P: G205, G206, MATH 148, CHEM C106, PHYS P202 or PHYS 251, and introductory biology. Introduction to the study of surface and subsurface water and water quality.

Includes field and laboratory investigations and a research project integrating geologic and hydrologic characteristics of selected areas in central Indiana.

G451 Principles of Hydrogeology (3 cr.) P: G205, G110 or consent of instructor. R: G334. Water resources; occurrence, regulation, and management of water; hydrologic cycle, water movement, water quality and pollution; surface and subsurface investigations; basinwide development of water resources.

G490 Seminar in Geology (2-3 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.

G499 Honors Research in Geology (3 cr.) P: Approval of departmental Honors Committee.

Graduate Courses[1]

G511 Stratigraphy of North America (3 cr.) P: G334 and G404, or equivalent. Lithostratigraphy, biostratigraphy, correlation, tectonic setting, and depositional environment of North American Phanerozoic rocks.

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 are required.

G551 Advanced Hydrogeology (3 cr.) P: G430 or G451. Basic principles and quantitative aspects of physical flow systems and chemistry of ground water and surface water. The relationships between water and geologic materials.

G561 Paleoecology (3 cr.) P: G334 and G404. Relationships between modern and fossil organisms and their physical, chemical, and biological environments, emphasis on techniques for interpreting past environmental conditions.

G585 Environmental Geochemistry (3 cr.) P: Consent of instructor. Application of organic geochemical methods in determining origins of fossil fuels and in defining biological and environmental histories of rocks.

G595 Data Analysis Techniques in Geoscience (3 cr.) P: STAT 301 and CSCI

[1] These courses are currently available. Other courses are being proposed to complement the program.

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220, or equivalent. Application of statistical and numerical analysis techniques to geoscience data, including error analysis, confidence intervals, least squares methods, correlation, time series analysis, and cluster analysis. Use of the computer to solve geoscience problems is emphasized, including petrological calculations and graphical displays.

G622 Urban Geology (3 cr.) P: Consent of instructor. Consideration of geologic factors in land-use planning in the urban setting. Availability and use of geologic resources, building and road materials, water supply, waste disposal, and geologic hazards. Emphasis on applications of principles to problem solving.

G635 Soil Geomorphology (3 cr.) P: G415. Application of geomorphic principles in evaluation of weathering and soil formation, systems analysis of soil-landscape models, present and past environments, paleogeomorphology and paleopedology, lecture discussion, field and laboratory problems.

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.)
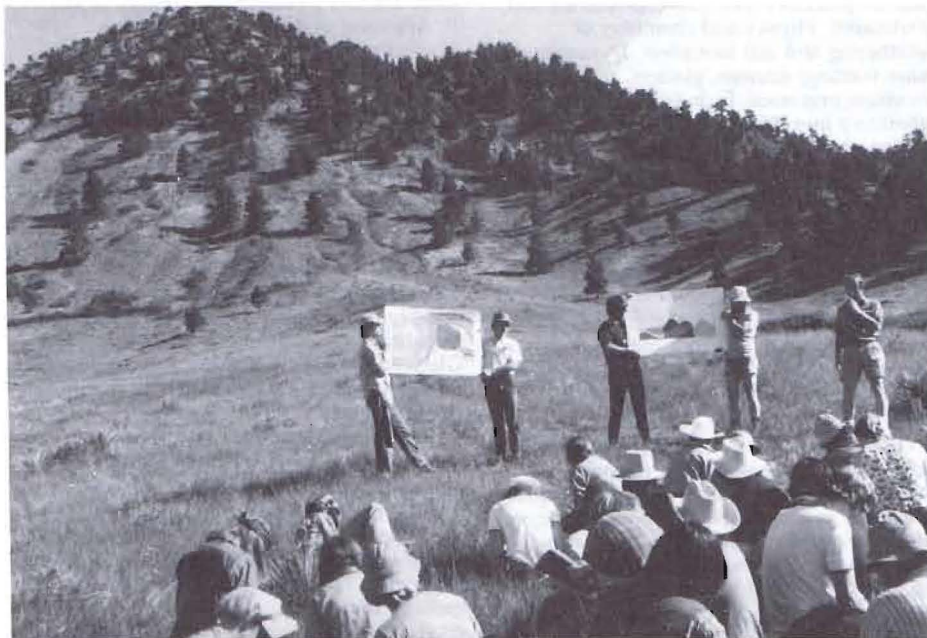
Department of Mathematical Sciences

Professors Aliprantis, Alton, Bittinger, Burkinshaw, Crown, Kaminker, Kleyle, Kuczkowski, Ng (*Chairperson*), Penna, Rothman
Professors Emeritus Bridges, Johnston, Sconce
Associate Professors Hutton, Luke, Miller (Columbus Center), Morrel, Patterson, Rigdon, Sen
Assistant Professors Frankel, Ji, Liu, Tam

Mathematical sciences includes 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 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 Bachelor of Science degree in mathematics with options in pure mathematics, applied mathematics, and secondary school teaching.

Graduate degrees offered are: Master of Science, Master of Science (Option for Teachers), and Doctor of Philosophy.

Bachelor of Science (Mathematics)

In order to receive proper counseling, a student is encouraged to declare a mathematics major in the freshman year. 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 "Undergraduate Programs"). For a Bachelor of Science degree in mathematics, the following additional requirements and restrictions apply:

Area I There is no additional requirement. The second semester of English composition may be satisfied by ENG W132, ENG W231, TCM 220, 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 with grades below C (2.0) do not count toward the major requirements for the degree.
2. Courses that are primarily mathematical may not be used to fulfill the arts and humanities requirement, Area IIIA, or the social and behavioral science requirement, Area IIIB, of the School of Science. If in doubt about a particular course, the student should consult a mathematics department counselor.
3. Certain courses, such as CHEM C101, C102; PHYS 100, 200, 218, 219; AST A100, A105; and GEOL G107 may not be used to fulfill the science requirement, Area IIIC, of the School of Science. If in doubt about a particular course, the student should consult a mathematics department counselor.
4. The Area IIID computer science requirement must be in a higher level programming course (not BASIC).

Area IV The Area IV requirements for the secondary area of concentration and the major for the three degree options 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 counselor. Because of the complexity of the above requirements, and because certain courses are not offered every semester, it is important that each student consult the assigned counselor as soon as possible in order to proceed through a proper plan

of study for the chosen degree program. A minimum of a 2.5 grade point average in all mathematics courses that count toward the major is required.

Area IV Secondary Area of Concentration Requirements

In order that each student acquire some depth of study in a subject outside of the major area, the Department of Mathematical Sciences requires the student to have a secondary area of concentration in an area 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 counselor. Although a secondary area of concentration is usually in one department, it may be from two or more if the counselor approves.

Courses may be used for the double purpose of fulfilling the general requirements and also 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 sequence of courses that they take to meet the professional education requirement.

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. One such minor, which is designed to be of particular interest to students choosing a career in actuarial sciences, is offered by the School of Business in conjunction with the Department of Mathematical Sciences. Students interested in the business minor for mathematics majors should contact the Department of Mathematical Sciences or the School of Business for exact requirements.
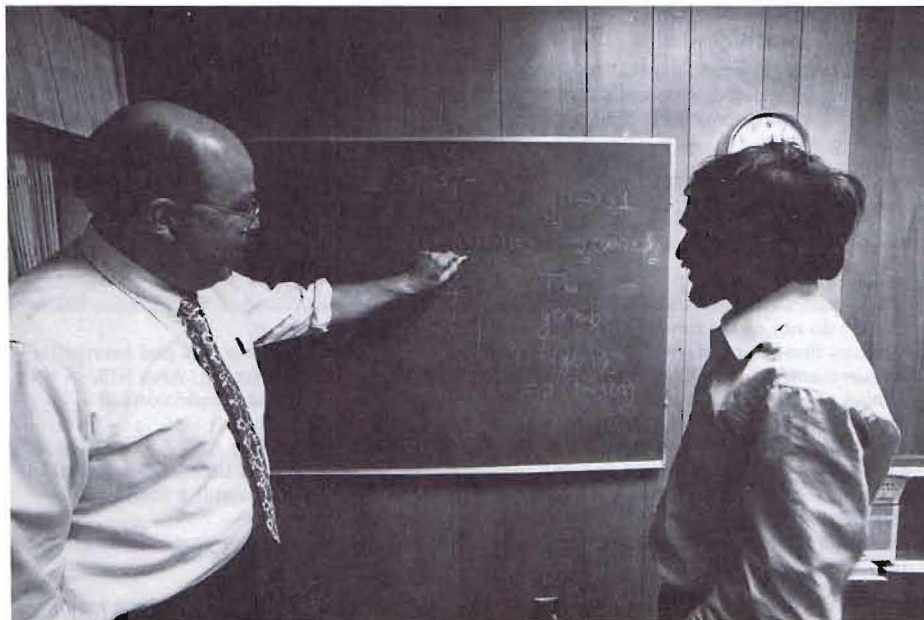
Area IV Major Requirements

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, engineering, educational research, law, medicine, operations research, psychology, statistics, and physics. Persons with advanced degrees in pure mathematics find careers primarily in college teaching, but careers in business, industry, or government service are also possible.

The Area IV major requirements are:
1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. Analysis: MATH 441-442
3. MATH 453 Abstract Algebra
4. MATH 462 Elementary Differential Geometry *or* MATH 510 Vector Calculus
5. 12 additional credit hours in mathematics or statistics courses at the 300 level or higher. 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 adviser. 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.

Course Sequences
Advanced calculus: MATH 510 and 525
Algebra: MATH 453, and 553 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 522 or a higher level differential equations course
Modeling: MATH 426, and 517 or a higher level modeling course
Numerical analysis: MATH 414, and 515 or a higher level numerical analysis course
Probability and statistics: STAT 311, and 511 or a higher level probability or statistics course
Theoretical computer science: CSCI 482 and 484

Pure Mathematics Options Sample Program

Freshman				
1 MATH 163 (5) Calculus	COMM C110 (3) Speech	ENG W131 (3) Composition	Laboratory Science (3-5)	Free Elective (3)
2 MATH 164 (5) Calculus	CSCI 220 (3) Programming I	Second English Composition (3)	Laboratory Science (3-5)	Free Elective (3)
Sophomore				
3 MATH 261 (4) Calculus	Free Elective (3)	Humanities or Soc. Science (3)	Science Elective (3-5)	Free Elective (3)
4 MATH 351 (3) Linear Algebra	MATH 262 (4) Differential Eq.	Humanities or Soc. Science (3)	Science Elective (3-5)	Free Elective (3)
Junior				
5 MATH 441 (3) Analysis	MATH or STAT Elective (3)	Humanities or Soc. Science (3)	Foreign Language (5)	Free Elective (3)
6 MATH 510 (3) Vector Calculus	MATH 442 (3) Analysis	Humanities or Soc. Science (3)	Free Elective (3)	Free Elective (3)
Senior				
7 MATH or STAT Elective (3)	MATH or STAT Elective (3)	Free Elective (3)	Free Elective (3)	Free Elective (3)
8 MATH 453 (3) Abstract Algebra	MATH or STAT Elective (3)	Free Elective (3)	Free Elective (3)	Free Elective (3)

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 often would 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.

The Area IV major requirements are:
1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. MATH 414 Numerical Methods
3. MATH 510 Vector Calculus
4. Mathematical modeling: MATH 426 *or* 517
5. 15 additional credit hours in mathematics or statistics courses at the 300 level or higher. 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 adviser. 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 in each of two of the course sequences listed below. Students planning on attending graduate school in mathematics are advised to take MATH 441-442.

Course Sequences
Advanced calculus: MATH 510 and 525
Algebra: MATH 453, and 553 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 522 or a higher level differential equations course
Modeling: MATH 426, and 517 or a higher level modeling course
Numerical analysis: MATH 414, and 515 or a higher level numerical analysis course
Probability and statistics: STAT 311, and 511 or a higher level probability or statistics course
Theoretical computer science: CSCI 482 and 484

Applied Mathematics Option Sample Program

Freshman				
1	MATH 163 (5) Calculus	Free Elective (3)	ENG W131 (3) Composition	Humanities or Soc. Science (3)	Free Elective (3)
2	MATH 164 (5) Calculus	CSCI 220 (3) Programming I	COMM C110 (3) Speech	Second English Composition (3)	

Sophomore				
3	MATH 261 (4) Calculus	Free Elective (3)	PHYS 152 (4) Mechanics	Humanities or Soc. Science (3)	Free Elective (3)
4	MATH 351 (3) Linear Algebra	MATH 262 (4) Differential Eq.	PHYS 251 (5) Heat, Electricity	Free Elective (3)	Free Elective (3)

Junior				
5	MATH 414 (3) Numerical Methods	MATH or STAT Elective (3)	PHYS 342 (4) Modern Physics	Humanities or Soc. Science (3)	Foreign Language (3)
6	MATH 510 (3) Vector Calculus	MATH 426 or MATH 517 (3) Mathematical Modeling	PHYS 310 (3) Mechanics	Humanities or Soc. Science (3)	Foreign Language (3)

Senior				
7	MATH or STAT Elective (3)	MATH or STAT Elective (3)	PHYS 322 (3) Oscillations and Waves	Free Elective (3)	Free Elective (3)
8	MATH or STAT Elective (3)	MATH or STAT Elective (3)	PHYS 330 (3) Electricity and Magnetism	Free Elective (3)	Free Elective (3)

SECONDARY SCHOOL TEACHING OPTION

To teach in secondary schools, you must meet the requirements for teacher certification in the state in which you expect to teach. You can obtain these requirements by writing to the Department of Public Instruction, Certification Office, in the capital city of any state.

According to Indiana state law, a student should have 40 semester hours in general education courses and a specified core of professional education courses as part of the requirement for a teaching license. You should be sure to see an adviser to ensure that these hours are properly distributed and that the professional education requirements are met. The secondary teaching program here which has been approved by the State of Indiana requires the completion of at least 38 semester hours of mathematics courses.

The Area IV major requirements are:
1. Core curriculum: MATH 163, 164, 261, 262, and 351
2. MATH 300 Logic and the Foundations of Algebra
3. MATH 453 Abstract Algebra
4. Geometry: MATH 563[1] (or 561)
5. Probability and statistics: STAT 311 or 511
6. One additional mathematics or statistics course at the 300 level or higher. 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 adviser.

Secondary School Teaching Option Sample Program

Freshman
1	MATH 163 (5) Calculus	Free Elective (3)	ENG W131 (3) Composition	Laboratory Science (3-5)	Humanities or Soc. Science (3)
2	MATH 164 (5) Calculus	PSY B104 or B105 (3) Psychology	ENG W132 (3) Composition	Laboratory Science (3-5)	EDUC W200 (1) Free elective (3)

Sophomore
3	MATH 261 (4) Calculus	CSCI 220 (3) Programming I	EDUC H340 (3) Ed. & Am. Culture	Laboratory Science (3-5)	COMM C110 (3) Speech
4	MATH 351 (3) Linear Algebra	MATH 262 (4) Differential Eq.	EDUC P255 (3) and EDUC M201 (1) Ed. Psychology	Laboratory Science (3-5)	Free Elective (3)

Junior
5	STAT 311 (3) Probability	MATH 300 (3) Foundations of Algebra	EDUC M300 (3) Intro. Teaching	Foreign Language (5)	EDUC M314 (3) Secondary Teaching
6	MATH 453 (3) Algebra I	EDUC M464 (3) Methods, Reading	Humanities or Soc. Science (3)	Free Elective (3)	

Senior
7	MATH or STAT Elective (3)	Free Elective (3)	EDUC M448[1] (4) Methods, Math	Humanities or Soc. Science (3)	Free Elective (3)
8	MATH 563[1] (3) Advanced Geometry		EDUC M480—Student Teaching (10-16)		

[1] MATH 563 is offered only in the spring of even-numbered years and EDUC M448 only in the fall of odd-numbered years.

Minor in the Mathematical Sciences

There are many fields in which a minor in mathematics would be useful. 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. Nine 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.

Graduate Programs

The Department of Mathematical Sciences offers graduate training leading to Purdue University M.S. and Ph.D. degrees. 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 in abstract algebra, linear algebra, advanced calculus, differential equations, logic and foundations, and probability as possible.

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 is highly mathematics oriented.

Application for Admission

The student who wishes to pursue an advanced degree in the Department of Mathematical Sciences should fill out a graduate student application form. Applicants are urged to submit GRE scores in mathematics. Foreign students for whom English is not the 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 temporary graduate student. Not 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 desire to take graduate courses for personal improvement, may also take courses under the temporary graduate student 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.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in 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 English department to demonstrate their proficiency.

Foreign students for whom English is not the 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; and (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 33 credit hours of course work and is tailored for secondary school teachers and students who are preparing to become secondary school teachers. Required courses are MATH 525, 544, 571, 553, 554, 519, and a course in geometry selected from MATH 561, 562, and 563. Course grades must be A or B with the possible exception of at most two grades of C.

Doctor of Philosophy

To be admitted to candidacy for the Ph.D. degree, the student must have fulfilled the following requirements and must have been accepted by some member of the staff who will supervise the student's research and who will act as chairman of the advisory committee.

Requirements
1. The student must satisfy, by one of the five options approved by the Graduate School, the foreign language requirement in two of: German, Russian, and French (or Italian if approved by the advisory committee).
2. The student must pass the qualifying examinations in analysis, in algebra, and in one area chosen from topology, applied mathematics, and numerical analysis. These are written examinations offered twice a year near the beginning of the fall and spring semesters. A student who fails one or both of the examinations will have the option, only once, of repeating them. Normally, a student would take the examination after one year of graduate courses.
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 work.
4. The student must pass advanced topics examinations in a major and a minor area. These oral or written examinations may be taken only by students who have completed the requirements in 2 and 3 above and one of the language requirements in 1 above.

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.

There are time limits set by the department for completion of the Ph.D. degree.

Courses in Mathematical Sciences (MATH)

Note: Statistics courses (STAT) follow MATH listings. P—prerequisite; C—concurrent registration; R—recommended; Fall—offered fall semester; Spring—offered spring semester; Summer—offered in the summer session. For courses with no designated semester, consult the *Schedule of Classes*. Equiv.—course is equivalent to the indicated course taught at Indiana University, Bloomington, or the indicated course taught at Purdue University, West Lafayette.

Special Service Courses

001 Remedial Algebra (3 cr.) P: Eighth-grade mathematics. Fall, Spring, Summer. Covers the material 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

111 Algebra (4 cr.) P: 001 or one year of high school algebra. Fall, Spring, Summer. Real numbers, linear equations and inequalities,

systems of equations, polynomials, exponents, logarithmic functions. Covers material in the third semester of high school algebra.

M118 Finite Mathematics (3 cr.) P: 111 or equivalent. Fall, Spring, Summer. Set theory, vectors, matrices, permutations, combinations, simple probability, conditional probability, linear programming, graphical and simplex methods, duality theorem.

M119 Brief Survey of Calculus I (3 cr.) P: M118 or 111 or equivalent. Fall, Spring, Summer. Sets, limits, derivatives and applications, integrals and applications, functions of several variables.

123 Elementary Concepts of Mathematics (3 cr.) P: None. Mathematics for liberal arts students; experiments and activities which 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[1] (3 cr.) P: 001 or one year of high school algebra; one year of high school geometry. Equiv. IU Mathematics T101. Fall, Spring. Numeration systems, mathematical reasoning, natural numbers, whole numbers, properties, algorithms, sets, sentences, logic.

131 Mathematics for Elementary Teachers II[1] (3 cr.) P: 130. Equiv. IU Mathematics T102. Fall, Spring. Number systems: numbers of arithmetic, integers, rationals, reals, mathematical systems, decimal and fractional notations; probability, simple and compound events, algebra review.

132 Mathematics for Elementary Teachers III[1] (3 cr.) P: 131. Equiv. IU Mathematics T103. Fall, Spring. Metric and nonmetric properties of geometric figures, measurement; introduction to the foundations of euclidean geometry; coordinate geometry.

147 Algebra and Trigonometry for Technology I (3 cr.) P: Three semesters of high school algebra. Fall, Spring, Summer. 147-148 is a two-semester version of 150. 147 covers algebra.

148 Algebra and Trigonometry for Technology II (3 cr.) P: Four semesters of high school algebra. Fall, Spring, Summer. 147-148 is a two-semester version of 150. 148 covers trigonometry.

150 Mathematics for Technology (5 cr.) P: Three semesters of high school algebra. Fall, Spring. 147-148 is a two-semester

version of 150. Fundamental laws of algebra, functions and graphs, trigonometric functions, linear equations, factoring, exponents, vectors, complex numbers, logarithms, ratio, proportion, variation.

151 Algebra and Trigonometry (5 cr.) P: Three semesters of high school algebra. A course for science and engineering students. Students taking 151 for credit cannot receive credit for 147, 148, or 150. Fall, Spring, Summer I. Topics of 150 including additional topics necessary for 163, such as mathematical induction, rational roots of polynomials, conic sections, sequences, and series.

163 Integrated Calculus and Analytic Geometry I (5 cr.) P: 151 or equivalent, and one year of geometry. Equiv. IU Mathematics M215. 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.

164 Integrated Calculus and Analytic Geometry II (5 cr.) P: 163. Equiv. IU Mathematics M216. Fall, Spring, Summer I. Transcendental functions, techniques of integration, indeterminant forms and improper integrals, conics, polar coordinates, sequences, infinite series, and power series.

221 Calculus for Technology I (3 cr.) P: 150 or equivalent, and one year of geometry. Fall, Spring, Summer. Analytic geometry, the derivative and applications, the integral and applications.

222 Calculus for Technology II (3 cr.) P: 221. Fall, Spring, Summer. Differentiation of transcendental functions, methods of integration, power series, Fourier series, differential equations.

261 Multivariate Calculus (4 cr.) P: 164. Equiv. IU Mathematics M311. Fall, Spring, Summer. Spatial analytic geometry, vectors, curvilinear motion, curvature, partial differentiation, multiple integration, line integrals, Green's theorem.

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, applications. Requisite topics of linear algebra: vector spaces, linear independence, matrices, eigenvalues, and eigenvectors.

Upper-Division Courses

300 Logic and the Foundations of Algebra (3 cr.) P: 163. Fall. Logic and the rules of

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[1] The sequence MATH 130, 131, 132 fulfills the mathematics requirement for elementary education majors.

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.

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, 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.

414 (CSCI 414) Numerical Methods (3 cr.) P: 262 and a course in a higher level programming language (other than BASIC). Not open to students with credit in CSCI 512. Fall. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, numerical solution of ordinary differential equations.

426 Introduction to Applied Mathematics and Modeling (3 cr.) P: 262 and 351. 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 $\mathbb{R}^m$, 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, series of functions.

453 Abstract Algebra (3 cr.) P: 351 or consent of the instructor. Fundamental properties of groups, rings, and fields with emphasis on structure, morphisms, quotients, fundamental homomorphism theorems.

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, fundamental theorem of curves. Transformation of $\mathbb{R}^2$, first and second fundamental forms of surfaces, geodesics, parallel translation, isometries, fundamental theorem of surfaces.

490 Topics in Mathematics for Undergraduates (1-5 cr.) By arrangement. Open only to students with the consent of the department. Supervised reading and reports in various fields.

S490 Senior Seminar (3 cr.)

Undergraduate and Graduate Level

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, applications to engineering and the physical sciences.

511 Linear Analysis (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.

517 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, managment, urban administration, and the behavioral sciences.

519 Introduction to Probability (3 cr.) P: 262. Algebra of sets, sample spaces, combinatorial problems, conditional probability, independence, random variables, distribution functions, characteristic functions, special distributions, limit theorems.

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, spherical harmonics.

522 Qualitative Theory of Differential Equations (3 cr.) P: 262 and 351. Laplace transforms, systems of linear and nonlinear ordinary differential equations, brief introduction to stability theory, approximation methods, other topics.

523 Introduction to Partial Differential Equations (3 cr.) P: 262 and 510 or consent of the 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; 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; 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.

530 Functions of a Complex Variable I (3 cr.) P or C: 544. Complex numbers, holomorphic functions, harmonic functions, linear transformations. Power series, elementary functions, Riemann surfaces, contour integration, Cauchy's theorem, Taylor and Laurent series, 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 Reimann surfaces, Picard theorems.

532 Elements of Stochastic Processes (3 cr.) P: 519 and 525. A basic course in stochastic processes including normal processes, covariance processes, Poisson processes, renewal processes, and Markov processes.

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; 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, turning point analysis.

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, 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, Hilbert spaces.

547 Analysis for Teachers I (3 cr.) P: 261. Set theory, logic, relations, functions, Cauchy's inequality, metric spaces, neighborhoods, Cauchy sequence.

548 Analysis for Teachers II (3 cr.) P: 547. Functions on a metric space, continuity, uniform continuity, derivative, chain rule, Reimann integral, fundamental theorem of calculus, double integrals.

550 Algebra for Teachers I (3 cr.) P: 351. Definitions and elementary properties of groups, rings, integral domains, fields. Intended for secondary school teachers.

551 Algebra for Teachers II (3 cr.) P: 550. Polynomial rings, fields, vector spaces, matrices.

553 Introduction to Abstract Algebra (3 cr.) P: 453. Group theory: Sylow theorems, Jordan-Holder theorem, solvable groups. Ring theory: unique factorization in polynomial rings and principal ideal domains. Field theory: ruler and compass constructions, roots of unity, finite fields, Galois theory, solvability of equations by radicals.

554 Linear Algebra (3 cr.) P: 351. Review of basics: vector spaces, dimension, linear maps, matrices, determinants, linear equations. Bilinear forms; inner product spaces; spectral theory; eigenvalues. Modules over principal ideal domain; finitely generated abelian groups; Jordan and rational canonical forms for a linear transformation.

556 Introduction to the Theory of Numbers (3 cr.) P: 261. Divisibility, congruences, quadratic residues, Diophantine equations, the sequence of primes.

561 Projective Geometry (3 cr.) P: 351. Projective invariants, Desargues' theorem, cross-ratio, axiomatic foundation, duality, consistency, independence, coordinates, 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 E^3, Gaussian curvature, two-dimensional Riemannian geometry, Gauss-Bonnet and Poincaré theorems on vector fields.

563 Advanced Geometry (3 cr.) P: 300 or consent of the instructor. Analysis of axiomatic systems, finite geometries, critique

of Euclid, axiomatic development, incidence, existence, betweenness, congruence, non-Euclidean geometry. Parallel postulate, Hilbert's geometry, hyperbolic geometry, models.

571 Elementary Topology (3 cr.) P: 441. Topological spaces, metric spaces, continuity, compactness, connectedness, separation axioms, nets, function spaces.

572 Introduction to Algebraic Topology (3 cr.) P: 571. Singular homology theory, Ellenberg-Steenrod axioms, simplicial and cell complexes, elementary homotopy theory, Lefschetz fixed point theorem.

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, 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 (CSCI 585) Mathematical Logic I (3 cr.) P: 351. Formal theories for propositional and predicate calculus with study of models, completeness, 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, Zermelo-Fraenkel axioms.

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.

T501 Remedial Mathematics for the Middle School–Junior High School Teacher (3 cr.) Set theory, systems of numeration, operations on whole numbers, mathematical sentences, integers, rational numbers, real numbers.

T502 Geometry for Middle School–Junior High School Teachers (3 cr.) Rational numbers, real numbers, measurement, geometry.

T503 Mathematics for Middle School–Junior High School Teachers (3 cr.) Additional topics not covered in T501 or T502.

Graduate Level

611 Methods of Applied Mathematics I (3 cr.) 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.

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. A continuation of 572; cohomology, homotopy groups, fibrations, further topics.

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

Courses in Statistics (STAT)

Undergraduate Level

Upper-Division Courses

301 Elementary Statistical Methods I (3 cr.) P: College algebra. Not open to students in the Department of Mathematical Sciences. Fall, Spring. A basic introductory statistics course with applications shown to various fields and emphasis placed on assumptions, applicability, and interpretations of various statistical techniques. Subject matter includes frequency distribution, descriptive statistics, elementary probability, normal distribution, applications, sampling distribution, estimation, hypothesis testing, and linear regression.

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. 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; moments and moment generating functions.

490 Topics in Statistics for Undergraduates
(1-5 cr.) Supervised reading and reports in various fields.

Undergraduate and Graduate Level

511 Statistical Methods I (3 cr.) P: MATH 164. Fall, Spring. Descriptive statistics; elementary probability; normal, bionomial, Poisson, and hypergeometric distributions; sampling distributions; testing hypotheses and estimation; one-way analysis of variance; chi-square test; correlation and regression.

512 Applied Regression Analysis (3 cr.) P: 511. Linear and multiple regression; nonlinear regression; analysis of variance; random, fixed, mixed models; nested factorial; expected mean squares; pooling; modifications under relaxed assumptions; multiple comparisons; variance of estimates; analysis of covariance.

513 Statistical Quality Control (3 cr.) P: 511. Control charts and acceptance sampling, continuous sampling plans, sequential analysis, statistics of combinations, and some nonparametric methods.

514 Design of Experiments (3 cr.) P: 512. Fundamentals, completely randomized design, randomized complete blocks; Latin square; multiclassification; factorial; incomplete blocks and fractional replications; confounding; lattice design; general mixed factorials; split plot; optimum design.

516 Basic Probability and Applications (3 cr.) P: MATH 262 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; Markov chains.

517 Statistical Inference (3 cr.) P: 516 or MATH 519. An introduction to the mathematical theory of statistical inference. Topics include sampling distributions, order statistics and their applications, point and interval estimation emphasizing the maximum likelihood method, the Neyman-Pearson Lemma, likelihood ratio tests, introduction to the normal linear model.

528 Foundations and Methods of Statistics I
(3 cr.) P: 516 or MATH 519 or equivalent. Topics include sampling distributions derived from normally distributed populations, asymptotic sampling distribution, the multivariate normal distributions and linear models, sufficient statistics, the Cramer-Rao inequality, the Rao-Blackwell Theorem, asymptotic properties of maximum likelihood estimates, hypothesis testing, asymptotic properties of likelihood ratio tests.

532 Elements of Stochastic Processes (3 cr.) See MATH 532.

Department of Physics

Professors Kaplan, Meiere, Pearlstein (*Chairperson*), Rao, Vasavada
Associate Professors Kemple, Kleinhans, Novak, Paik, Seubert, Thatcher
Assistant Professor Wassall
Departmental Counselors Meiere and Seubert

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. In addition, the department provides service courses in physics and astronomy. The department also offers graduate courses that lead to the Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree in physics at IUPUI in areas where a program equivalent to that at West Lafayette can be arranged.

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 ICFAR or the IU School of Medicine. Student participation in these projects is welcomed and encouraged.

Guide to Service Courses
Each student should consult an adviser in the department in which a degree is sought to determine which service course is appropriate. A general guide to the schools and divisions served by these courses is:

PHYS 100: Allied Health, Business, and Liberal Arts (a traditional survey course)

PHYS 200: Education, SPEA, and Liberal Arts (a nontraditional course)

PHYS 218-219: A noncalculus sequence for technology students

PHYS P201-P202: A noncalculus sequence designed for preprofessional students

PHYS 152-251-342: Science and Engineering (for students requiring a calculus-based sequence)

Bachelor of Science

Areas I, II, III   Minimum requirements for the School of Science are given in this bulletin under "Undergraduate Programs, Bachelor of Science Degree." The second semester English composition may be satisfied only with ENG W132, W231, W250, W290, W331, or W350. The Department of Physics has the following additional requirements:

Area IIIC Physical and Biological Sciences   Courses must include CHEM C105 and C106 with lab or their approved equivalent.

AREA IIID Mathematical Sciences   24 credit hours. Courses must include MATH 163, 164, 261, and 262 or equivalent, plus 6 more credit hours approved by the Department of Physics. (MATH 351 and 361 replace MATH 262 for dual math-physics majors.) The computer requirement may be satisfied only with CSCI 206, CSCI 220, or any CSCI course for which CSCI 220 is a prerequisite.

Area IV Physics Concentration   A concentration program in physics must include PHYS 152, 251, 310, 322, 330, 342, 342L, 350, 351, 515, 550, plus at least one approved course above the 300 level.

Courses taken outside the Schools of Science and Liberal Arts must receive departmental approval. No more than 6 credit hours of the clinical, athletic or performing arts type will be approved. See the departmental counselor for details.

The Department of Physics recommends the following program leading to the degree of Bachelor of Science.

For the secondary school teaching option the Department of Physics may substitute other science courses for the 500 level courses and recommend education courses in order to meet teacher certification requirements.

Electives should be chosen to satisfy the general requirements for a Bachelor of Science degree from Purdue University. They also may be chosen to satisfy requirements for certification as a high school teacher.

Bachelor of Science in Physics Sample Program

Freshman

| 1 | MATH 163 (5) Calculus | CHEM C105 (5) Principles of Chemistry I | ENG W131 (3) English Composition | Elective (3) | |
| 2 | MATH 164 (5) Calculus | CHEM C106 (5) Principles of Chemistry II | PHYS 152 (4) Mechanics | Second English Composition (3) | |

Sophomore

| 3 | MATH 261 (4) Calculus | PHYS 251 (5) Heat, Electricity, and Optics | Computers (3) | Elective (3) | |
| 4 | MATH 262 (4) Linear Algebra and Diff. Equations | PHYS 342 (3) Modern Physics | PHYS 342L (1) Modern Physics Lab | COMM C110 (3) Speech | Elective (3) |

Junior

| 5 | PHYS 310 (4) Intermediate Mechanics | PHYS 322 (3) Oscillations and Waves | PHYS 350 (2) Intermediate Lab I | Electives (6) |
| 6 | PHYS 330 (3) Electricity and Magnetism | PHYS 351 (2) Intermediate Lab II | Electives (12) | |

Senior

| 7 | PHYS 550 (3) Quantum Mechanics | PHYS 490 (1-3) Research | Electives |
| 8 | PHYS 515 (3) Thermodynamics | PHYS 490 (1-3) Research | Electives |

Graduate Programs

The Department of Physics offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees. Course work is normally offered on the IUPUI evening schedule. The program is designed to meet the needs of part-time students employed in the Indianapolis area, as well as traditional students who are preparing for a career in research-directed areas. For master's degree students, both a thesis and a nonthesis option are available.

Admission Requirements

The student who seeks 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. A grade point average of 3.0 (B) or better 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 from the chairman of the graduate committee, Department of Physics, Krannert Science Building 137, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(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

Many physics 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 are required to take a diagnostic test during their first semester 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 adviser 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 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 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, Krannert Science Building 137, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(317) 274-6900], 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. There are four magnetic resonance spectrometers in two locations

under the direction of physics faculty. In addition, there is 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 lineshapes, studies of the biophysics of photosyntheses, and theoretical condensed matter physics. Theorists have access to the IUPUI computing facilities, which include VAX 8800 and IBM 4381 systems, as well as the microcomputers in the department. Several of these 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)

Note: P—prerequisite; C—concurrent registration; 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.

100 Physics in the Modern World (5 cr.) P: Introductory high school mathematics. Fall, day, night; Spring, day, night; Summer, day, night. Ideas, language, methods, and impact of physics today.

200 Our Physical Environment (3 cr.) P: None. Fall, Spring. 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 150 or equivalent. Fall, day, night; Spring, day, night; Summer, day, night. 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, day, night; Spring, day, night; Summer, day, night. Electricity, light, and modern physics.

P201 General Physics I (5 cr.) P: MATH 151 or equivalent. Fall, Spring, Summer. 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. Three lectures, one discussion section, and one two-hour laboratory period each week.

P202 General Physics II (5 cr.) P: 201. Fall, Spring, Summer. Electricity and magnetism; geometrical and physical optics; introduction to concepts of relativity, quantum theory, atomic and nuclear physics. Three lectures, one discussion section, and one two-hour laboratory period each week.

152 Mechanics (4 cr.) P or C: MATH 164. Equiv. IU Physics P221. Fall, day, night; Spring, day, night; Summer, day, night. 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; simple harmonic and wave motion.

251 Heat, Electricity, and Optics (5 cr.) P: 152. Equiv. IU Physics P222. Fall, day, night; Spring, day, night. Heat, kinetic theory, elementary thermodynamics, heat transfer. Electrostatics, current electricity, electromagnetism, magnetic properties of matter. Geometrical and physical optics.

310 Intermediate Mechanics (4 cr.) P: MATH 261 and two terms of general physics. 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; elements of hydromechanics and elasticity.

322 Oscillations and Waves (3 cr.) P: 251. Fall. Modes of vibration of a system; emission and absorption of waves; properties of sound, electromagnetic, and particle waves including phenomena of refraction, reflection, dispersion, diffraction, interference, polarization, and double refraction; lasers and holography.

330 Intermediate Electricity and Magnetism (3 cr.) P: 251. P or C: MATH 262. Spring. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equations; electromagnetic waves.

342 Modern Physics (3 cr.) P: 251. Equiv. IU Physics P301. Spring. A survey of basic concepts and phenomena in atomic, nuclear, and solid state physics.

342L Modern Physics Laboratory (1 cr.) Laboratory experiments to accompany 342.

350 Intermediate Laboratory I (2 cr.) P or C: 322. (The prerequisite is waived for students enrolled in the science education degree program.) Fall. Lectures on geometrical optics; instructor demonstrations and student experiments involving mechanical and electromagnetic wave and oscillation phenomena.

351 Intermediate Laboratory II (2 cr.) P or C: 330. (The prerequisite is waived for students enrolled in the science education degree program.) Spring. Lectures on AC circuit theory; instructor demonstrations and student experiments involving particle diffraction, wave polarization, double refraction, AC circuits, and meters.

470 Reading in Special Topics (1-3 cr.)

480 Solar Energy Usage (3 cr.) P: MATH 164 or equivalent, and two terms of general physics. Theoretical and practical aspects including collector design, modeling of solar systems, economic evaluation of solar alternatives, and photo-voltaics.

490 Undergraduate Reading and Research (1-3 cr.) Independent study for undergraduates.

501 Physical Science (3 cr.) P: None. 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. Fall. Fundamental concepts of heat; theory and practice of heat measurements; first and second laws of thermodynamics, with applications; kinetic theory.

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, special functions of mathematical physics. When interests and preparation of students permit, calculus of variations and/or group theory are covered.

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; electromagnetic radiation.

545 Solid State Physics (3 cr.) P: Any undergraduate course in modern physics. Spring. Crystal structure; lattice vibrations; free electron theory of solids; band theory of solids; semiconductors; superconductivity; magnetism; 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. Fall. Brief historical survey; waves in classical physics; wavepackets; uncertainty principle; operators and wave functions; Schrodinger equation and application to one-dimensional problems; the hydrogen atom; electron spin; multi-electron atoms; periodic table; molecules; periodic potentials; Bloch wave functions.

556 Introductory Nuclear Physics (3 cr.) P: 550 or equivalent. Spring. 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; 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.)

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 treated 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.

610 Advanced Theoretical Mechanics (3 cr.) P: 510 or equivalent. Fall, Spring. Lagrangian and Hamiltonian mechanics; variational principles; canonical transformations; Hamilton-Jacobi theory; theory of small oscillations; Lagrangian formulation for continuous systems and field.

630 Advanced Theory of Electricity and Magnetism (3 cr.) P: 530 and 600 or equivalent. Fall, Spring. The experimental origins of Maxwell's equations. Electrostatics and magnetostatics; solution of boundary value problems. Quasi-static currents. Electromagnetic energy and momentum and the Maxwell stress tensor. Foundations of optics. Radiation from antennas, multi-pole expansion; waveguides.

660 Quantum Mechanics I (3 cr.) P: 530, 550, 600, and 610, or equivalent. Fall, Spring. Origins of the quantum theory, the uncertainty and complementarity principles. The Schrodinger equation and its solutions for simple physical systems. Mathematical formulation of the quantum theory. Applications: simple harmonic oscillator, theory of angular momentum, hydrogen atom. Time-independent and time-dependent perturbation theory. The Pauli exclusion principle. Spin of the electron. Elementary theory of scattering.

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

Courses in Astronomy (AST)

The Department of Physics has academic, counseling, and administrative responsibility for the courses in astronomy offered at IUPUI.

A100 The Solar System (3 cr.) P: None. 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 Stellar Astronomy (3 cr.) P: None. Spring. Survey of the universe beyond the solar system, including stars, pulsars, black holes, principles of spectroscopy and the H-R diagram, nebula, the Milky Way, other galaxies, quasars, expanding universe, cosmology, and extraterrestrial life.

Department of Psychology

Professors Davis, Hanford, Morris, Tzeng

Professor Emeritus Neel

Associate Professors Aeschleman, Bond, Bringle, Evenbeck, Fleener, Fortier, Goldberg, Hazer *(Chairperson)*, Kremer, Lauer, Rajecki, Rytting (Columbus Center), Svanum, Ware

Assistant Professors Glueckauf, Kleiner, Loher, Moehle, Rasmussen, Rice

Adjunct Professors Levitt, McBride, Metzner

Lecturer Williams

Psychology is the study of behavior and, as such, psychologists apply the scientific method to gain increasing 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, how children develop a sense of morality, or under what conditions people help in emergencies. As an applied profession, psychologists use the results of their research 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 some given area of interest. These include motivation and learning, child development, social behavior of humans and animals, personality, thought processes, consumer behavior, and many more. Psychologists who function as applied professionals have specialized 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 or the Bachelor of Science degree in psychology. Graduate programs include a Master of Science degree in three specialty areas of psychology (applied social, industrial/organizational, and rehabilitation) and a Doctor of Philosophy degree in rehabilitation psychology. In addition, qualified students may be authorized to pursue the Ph.D. degree in psychology in areas where a satisfactory program can be arranged. 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.

The choice of a particular program for majors should be made in consultation with one of the academic counselors. The department strongly recommends that undergraduate students include a practicum (PSY B362, B372, B382, or B472) and independent research experience (PSY B292 and B492) in their curricula.

Bachelor of Arts

Degree Requirements

The School of Science requirements for a Bachelor of Arts degree are listed in this bulletin under "Undergraduate Programs, Bachelor of Arts Degree."

Area I See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin. The second semester of English composition may be satisfied with ENG W132, ENG W231, or ENG W290.

Area II There is no foreign language requirement.

Area III See the School of Science requirements under "Undergraduate Programs, Bachelor of Arts Degree," in this bulletin. The computer requirement may be satisfied with any computer science course (CSCI 207 recommended).

Area IV See description below, "Requirements for Psychology Major."

Bachelor of Science

Degree Requirements

The School of Science requirements for a Bachelor of Science degree are listed in this bulletin under "Undergraduate Programs, Bachelor of Science Degree."

Area I   See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. The second semester of English composition may be satisfied with ENG W132, ENG W231, or ENG W290.

Area II   There is no foreign language requirement.

Area III   See the School of Science requirements under "Undergraduate Programs, Bachelor of Science Degree," in this bulletin. The computer requirement may be satisfied with any computer science course (CSCI 207 recommended).

Area IV   See description below, "Requirements for Psychology Major."

Major in Psychology (B.A. or B.S.)

The Department of Psychology at IUPUI has a program for majors that requires 33 credit hours of selected course work. The same requirements apply to both B.A. and B.S. majors. They are as follows:

Introductory Psychology (2 courses; 6 cr.)	Research Methods (3 courses; 9 cr.)	Core Areas (6 courses; 18 cr.)	
B104	B211	6 courses from:	
B105	B305	B307	B344
	1 lab from:	B310	B356
	B423 B457	B320	B370
	B425 B461	B334	B380
	B427 B471	B340	B424
	B431 B499		
	B445		

Counseling Suggestions

The Department of Psychology offers counseling suggestions for students interested in completing course work that will help prepare them for graduate school or appropriate employment after graduation. These programs are known informally as the Graduate School Option, the Psychological Services Option, and the Personnel-Industrial Option. Each of these options is outlined below.

The Graduate School Option (36 credit hours) is designed to help students acquire an appropriate background, particularly in research areas, prior to applying to graduate programs. The Psychological Services Option (42 credit hours) is designed to help students acquire an appropriate background in order to improve chances of obtaining employment in public and private agencies dealing with human and social problems. The Personnel-Industrial Option (42 credit hours) is designed to help students acquire the appropriate background to improve chances of obtaining employment in a variety of business settings. However, it should be noted that the department cannot guarantee entrance to graduate school, or employment, and these options are not recognized officially on diplomas.

Successful completion of any of the three options will satisfy the Area IV requirements for psychology majors. Beyond 6 credit hours of PSY B104-B105 Introductory Psychology, the following courses are recommended for each option:

Option	Research Methods	Core Areas	Other
Graduate School (36 cr.)	B211 B305 Any lab	Any six courses from those listed in "Psychology Major, Core Areas"	B492 Readings and Research or B499 Honors Research
Psychological Services (42 cr.)	B211 B305 1 lab from: B425 B461 B471	B307 B310 B370 B380 B424 1 course from: B320 B334 B344 B356	2 practica from: B362 B382 B472 1 course from: B364 B376 B460 or relevant 500 level psychology courses
Personnel-Industrial (42 cr.)	B211 B305 1 lab from: B425 B445 B457 B471	B307 B344 B356 B370 B424 1 course from: B310 6.6B320 B334 B380	B366 B368 B372

Minor in Psychology

The Department of Psychology offers a 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 minor counselor. Applications must be approved by the Department of Psychology. Course requirements are as follows:

Introductory Psychology (2 courses; 6 cr.)	Core Areas (3 courses; 9 cr.)	Elective (1 course; 3 cr.)
B104 B105	3 courses from: B307 B344 B310 B356 B320 B370 B334 B380 B340 B424	1 additional 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 9 credit hours of the minor must be taken at IUPUI.

Psychology Plans of Study

There is no single semester-by-semester plan of study for any of the degrees offered by the Department of Psychology. However, one possible sequence of courses for the B.A. degree and one for the B.S. degree are given below.

Bachelor of Arts Sample Program

Freshman

1	PSY B104 (3)	ENG W131 (3)	COMM C110 (3)	Area IIIA (3)	Elective (3)
2	PSY B105 (3)	Area IIIA (3)	Area IIIB (3)	Second English Composition (3)	Computer Course (3)

Sophomore

3	PSY B211 (3)	PSY Core (3)	Area IIIC (3-5)	Area IIIA (3)	Area IIIB (3)
4	PSY B305 (3)	PSY Core (3)	Area IIIC (3-5)	Area IIIA (3)	Area IIIB (3)

Junior

5	PSY Core (3)	PSY Elective (3)	PSY Elective (3)	Area IIIC (3-5)	Area IIIB (3)
6	PSY Core (3)	PSY Lab (3)	Area IIIC (3-5)	Electives (4-6)	

Senior

7	PSY Core (3)	PSY Elective (3)	Electives (11)
8	PSY Core (3)	Electives (12-14)	

Bachelor of Science Sample Program

Freshman

1	PSY B104 (3)	ENG W131 (3)	COMM C110 (3)	Area IIID (3-5)	Elective (1-3)
2	PSY B105 (3)	Area IIIA (3)	Area IIIB (3)	Computer Course (3)	Second English Composition (3)

Sophomore

3	PSY B211 (3)	PSY Core (3)	Area IIIA (3)	Area IIIB (3)	Area IIIC (3-5)
4	PSY B305 (3)	PSY Core (3)	Area IIIC (3-5)	Area IIID (3-5)	Elective (1-3)

Junior

5	PSY Core (3)	PSY Elective (3)	PSY Elective (3)	Area IIIC (3-5)	Elective (1-3)
6	PSY Core (3)	PSY Lab (3)	Area IIIC (3-5)	Electives (4-6)	

Senior

7	PSY Core (3)	PSY Elective (3)	Electives (11)
8	PSY Core (3)	Electives (14)	

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." 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 3.30. For new students, the criteria for admission are SAT scores of 1200 or graduation in the top 10 percent of the high school class.

To graduate with honors, students 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). At least 3 hours of this credit must be from 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 3.30, with at least 3.50 in honors courses and at least 3.50 in psychology courses.

For additional information, contact the director of the IUPUI Honors Program, Education–Social Work Building 2126, 902 W. New York Street, IUPUI, Indianapolis, Indiana 46202 [(317) 274-2660] or a psychology adviser.

Psi Chi Honorary Society To become a member of the Psi Chi Honorary Society the undergraduate student must have an overall GPA of 3.0, and a GPA of 3.5 in psychology. The fee for membership is $25 for life. Interested students should submit an application to the Psi Chi faculty adviser.

Graduate Programs

The department offers Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree programs. At the M.S. level, programs are offered currently in applied social psychology, industrial/organizational psychology, and rehabilitation psychology. At the Ph.D. level, an emphasis is offered currently in rehabilitation psychology. Doctoral study is also possible in other areas of psychology on an individualized basis if a satisfactory plan of study is developed and approved.

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. 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. Students are advised to complete a research thesis if they intend to continue doctoral studies or pursue other research career paths. If the M.S. is to be a terminal degree, students may elect a nonthesis option in most programs.

Applied Social Psychology The purpose of the program is to train students in the application of scientific principles and methods for the assessment of social problems, the development of remedial social programs, and the evaluation of existing programs that were designed to solve recurrent social problems. The subject matter of the program will focus on significant social issues and problems that affect individuals, organizations, and institutions in contemporary society. Training in research methods will emphasize investigations in natural settings, in conjunction with laboratory experimentation.

Industrial/Organizational Psychology The industrial/organizational emphasis is designed to provide students with the necessary knowledge and skills to work in personnel and other human resource areas. The course content of the program emphasizes the traditional personnel functions of selection, training, and performance evaluation. In addition, students become acquainted with other human resource functions such as supervision, job design, group processes for decision making, and the analysis of work motivation and satisfaction as related to individual adjustment and organizational effectiveness. Through selection of elective courses and topics for supervised individual research, a student can specialize in either traditional personnel or other human resource functions. The program follows the applied research model, which means that students are taught analytic methods for diagnosing

organizational problems, developing solutions, and evaluating the effectiveness of those solutions.

Rehabilitation Psychology   Traditionally, training programs in rehabilitation counseling have focused on helping disabled people adjust to their immediate environment, community, or society through individual and/or group counseling. A major goal is to assist them in entering or reentering the work force. While retaining essential elements of the conventional approach, the M.S. concentration in rehabilitation provides training directed at the development of the student as an agent of social change. Toward that end, institutional structures and dynamics are examined to help students understand how these systems impinge on and affect the lives of all people in general and of minority groups in particular. At the master's level, the rehabilitation counselor is a key member of the rehabilitation team, which may include a physician, psychologist, social worker, physical therapist, occupational therapist, special teacher, and/or other professional personnel. Typically, the counselor is responsible for the coordination and integration of services provided by these people. The counselor provides continuing services throughout the rehabilitation process with the goal of restoring disabled persons to the fullest possible physical, mental, social, vocational, and economic usefulness.

Ph.D. Program in Rehabilitation Psychology

Utilizing a scientist-practitioner model, this program is designed to train leaders in the field of rehabilitation psychology. Graduates of the program will be qualified to assume positions as executives, direct-service providers, planners, academicians, trainers, evaluators, researchers, and consultants. The emphasis of the program is on rigorous academic training, combined with practical application in a wide variety of rehabilitation centers available in Indianapolis and elsewhere. Full-time study and a minimum of 96 credit hours (post baccalaureate) 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.

Qualified students may be authorized to pursue the Ph.D. degree in psychology in other areas where a satisfactory program can be arranged. Interested students should contact the Department of Psychology, Krannert Science Building 54, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223 [(317) 274-6947].

Financial Support

Financial support for eligible graduate students at both the M.S. and Ph.D. levels is available through teaching and research assistantships and fellowships. All assistantships require a minimum of 20 hours of work per week and include at least partial tuition remission in addition to salary.

Admission Requirements

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 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.

For an applicant to be considered for unconditional admission to the terminal 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-point scale; (c) a minimum GRE score (verbal and quantitative) of 1100 with a quantitative score of at 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. Usually, the department will specify a minimum standard of performance that must be satisfied by the student after conditional admission in order to continue.

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 professional rehabilitation psychologists. Admission to the Ph.D. program is competitive and only under unusual circumstances will students be considered for admission who fail to meet these minimum standards: (a) a master's degree in rehabilitation psychology or in a cognate area from a college or university of recognized standing; (b) an undergraduate and graduate grade

point average of 3.0 or higher on a 4-point scale; (c) a minimum composite GRE score (verbal and quantitative) of 1150; (d) three favorable letters of recommendation; and (e) a personal statement displaying an interest in the field of rehabilitation psychology. Prior experience in rehabilitation is desirable but not required for admission.

Prospective applicants who have not received a master's degree are encouraged to apply to the master's program in rehabilitation psychology at IUPUI and may later apply to the Ph.D. program.

Admissions Information

Students interested in information about admission to graduate programs in this department should write directly to the graduate secretary, Department of Psychology, Krannert Science Building 54, 1125 E. 38th Street, P.O. Box 647, IUPUI, Indianapolis, Indiana 46223.

Research Facilities

The Department of Psychology has extensive laboratory and computer facilities to support faculty and student research. These facilities include more than 5000 square feet of renovated space including research cubicles and counseling offices. These facilities are computer controlled and equipped with closed circuit videotape recording capability. Animal facilities are also available. Computer support includes several microcomputers within the department, and terminal connections to several mainframe computers. Internship and practicum sites are available at such centers as Hook Rehabilitation Center of Community Hospital, Crossroads Rehabilitation Center, the Indiana University Medical Center, and other organizations in the metropolitan Indianapolis area.

Transfer Credit

A maximum of 9 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 a student's plan-of-study committee.

Temporary Student Status

A student may enroll in courses of the graduate program without formal admission after making application as a temporary graduate student. Not 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 twelfth credit hour as a nondegree registrant, then all credits taken prior to and during that term will be eligible for inclusion on 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 has been received will be permitted on a plan of study if the course was taken while 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 Interests of Faculty

Major research interests of faculty include the following: applied behavior analysis, applied experimental psychology, applied social psychology, biofeedback, cross-cultural investigations, industrial/organizational psychology, quantitative psychology, measurement theory and development, physiological psychology, program planning and evaluation, rehabilitation psychology, and vocational and prevocational training of disabled persons. A current and more detailed listing of faculty research interests is available from the department.

Courses in Psychology (PSY)

Note: P—prerequisite; C—concurrent registration; Fall—offered fall semester; Spring—offered spring semester; Summer—offered during the summer session. For courses with no designated semester, consult the *Schedule of Classes*. 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

B104 Psychology as a Social Science (3 cr.) Equiv. to IU Psychology 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 Psychology P101 and PU PSY 120. Fall, Spring, Summer. Research methods and content areas of learning, sensation-perception, psychophysiology, motivation, emotions, and statistics.

B125 Cognitive and Behavioral Self-Control (1 cr.) Students will be introduced to the basic principles of cognitive and behavioral self-control and will design and carry out a self-control program.

B211 Introductory Laboratory in Psychology (3 cr.) P: B105. Equiv. to IU Psychology P111, P211 and PU PSY 200. Fall, Spring. Introductory laboratory in psychology experimental methods, statistical treatment of data, in several areas of psychology; introduction to experimental report writing.

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 freshman and sophomore students only.

B305 Statistics (3 cr.) P: B104 or B105, and one year of high school algebra or equivalent. Equiv. to IU Psychology P354, K300, K310 and PU PSY 301. Fall, Spring, Summer. Introduction to basic statistical concepts; descriptive statistics and inferential statistics.

B307 Tests and Measurement (3 cr.) P: 3 credit hours of psychology and B305. Equiv. to PU PSY 302. Fall, Spring, Summer. An introduction to psychological measurement, including psychophysics, scaling techniques, psychological testing, and individual differences.

B310 Life Span Development (3 cr.) P: 3 credit hours of psychology. Fall, Spring, Summer. This course 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 equally stressed.

B320 Physiological Psychology (3 cr.) P: B105. Equiv. to IU Psychology P326 and PU PSY 329. Fall. 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.

B324 Psychophysiology of the Senses (3 cr.) P: B105. Equiv. to IU Psychology P329 and PU PSY 328. Spring. This course will consider vision, audition, taste, smell, touch, temperature sensitivity, and the vestibular and kinesthetic senses and their relation to behavior.

B326 Animal Behavior (3 cr.) P: B105. An introduction to the psychological and ethological accounts of behavior development. Emphasis on the application of the comparative method to the study of behavior of organisms.

B334 Perception (3 cr.) P: B105. Equiv. to IU Psychology P329 and PU PSY 310. Fall. 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. 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 Psychology P325 and PU PSY 311. Fall, Spring, Summer. 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. The course content 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 Psychology P327 and PU PSY 333. Fall, Spring, Summer. Study of motivational processes in human and animal behavior, how needs and incentives influence behavior, and how motives change and develop.

B360 Child and Adolescent Psychology (3 cr.) P: B310 or consent of instructor. Equiv. to IU Psychology P316 and PU PSY 235. Fall, Spring, Summer. 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: B360. Spring. Experience in working with children in field settings. May be repeated once.

B364 Introduction to Community Psychology (3 cr.) Begins with historical and conceptual underpinnings, community mental health practices, and alternative conceptions of deviance. Models of social intervention, including rational planning, organizational development, alternative institutions, community organizing, and experimental reform, are discussed in the context of public education, mental health, criminal justice, and urban housing. Also included are community research, evaluation, and training issues for the helping professions.

B366 Introduction to Organizational Psychology in Business and Industry (3 cr.) The study of organizational psychology as applied to business and industry. Brief coverage of historical development of organizational theory through current theories. Theory weaknesses and strengths. Special problems for business and industry and the methodology for scientific research on these problems will be presented. Some areas or problems to be discussed are organizational structure and climate, leadership and management, communication, motivation, morale, and productivity.

B368 Introduction to Personnel Psychology in Business and Industry (3 cr.) Psychological methods of assessment in personnel selection and placement, evaluation, and training. Methods and problems of psychological measurement, occupational analysis, human factors engineering, job evaluation, and wages and salary administration.

B370 Social Psychology (3 cr.) P: 3 credit hours of psychology. Equiv. to IU Psychology P420 and PU PSY 340. Fall, Spring, Summer. Study of the individual in social situations including socialization, social perception, social motivation, attitudes, social roles, and small group behavior.

B372 Practicum in Industrial Psychology (3 cr.) P: B366 and B368 or equivalent. This course will provide 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.

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 Psychology P460. Fall, Spring. 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 Psychology 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: B364, B370, or B380, and consent of instructor. Spring. Experience in working with individuals who may have a wide range of psychological problems. Focus is on both the individual and the helping agency as factors in the community.

B388 Human Sexuality (3 cr.) P: One introductory course in psychology. Fall, Spring. A survey of human sexuality to increase knowledge and comfort regarding sexuality in a variety of aspects; i.e., sexual behavior and response, influences of culture and environmental factors, psychological issues, disability effects on sexuality, sexual research, anatomy and physiology.

B420 Humanistic Psychology (3 cr.) A comprehensive survey of the field of humanistic psychology. The course will explore human experience as a focal point in the study of psychology. The instructor will utilize didactic and experiential teaching methods.

B423 Laboratory in Physiological Psychology (3 cr.) P: B320. Equiv. to IU Psychology P426 and PU PSY 427. Experiments and demonstrations in physiological psychology.

B424 Theories of Personality (3 cr.) P: 9 credit hours of psychology. Equiv. to IU Psychology P319 and PU PSY 423. Fall. Methods and results of the scientific study of personality, including the development, structure, and functioning of the normal personality.

B425 Laboratory in Personality (3 cr.) P: B211, B424, and B305. Equiv. to PU PSY 424. Spring. Demonstrations and experiments in personality research.

B427 Advanced Laboratory in Physiological Psychology (3 cr.) P: B423. Experiments and demonstrations in physiological psychology.

B431 Laboratory in Sensation and Perception (3 cr.) P: B211, B305, and either B324 or B334. Equiv. to IU Psychology P424 and PU PSY 312. Experiments and demonstrations in sensation and perception with an emphasis on their physiological basis.

B445 Laboratory in Learning (3 cr.) P: B211 and B344. Equiv. to IU Psychology P436 and PU PSY 312. Fall. Experiments and demonstrations involving learning and cognitive processes.

B452 Seminar in Psychology (1-3 cr.) Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

B457 Laboratory in Motivation (3 cr.) P: B211 and B356. Equiv. to IU Psychology P436 and PU PSY 312. Fall. Experiments and demonstrations in motivation.

B460 Behavior Management (3 cr.) P: Consent of instructor. Equiv. to IU Psychology P468. Spring. Conducted as a seminar and a practicum for psychology majors and teachers in the principles and methods of behavior management.

B461 Laboratory in Developmental Psychology (3 cr.) P: B211, B305, and B310 or B360. Equiv. to IU Psychology P429. Spring. Principal research methods in developmental psychology and their application to selected problems.

B464 Psychology of Language (3 cr.) P: 9 credit hours of psychology or consent of instructor. Fall. Survey of important topics in the psychology of language. Included are historical treatments, generative grammar, development of language, experimental psycholinguistics, and semantics.

B466 Seminar in Developmental Psychology (3 cr.) P: B310 or B360. Integration of practical experience with relevant psychological literature.

B471 Laboratory in Social Psychology (3 cr.) P: B211 and B305. P or C: B370. Equiv. to IU Psychology P421 and PU PSY 346. Spring. 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 Psychology P321 and PU PSY 348. Fall, Summer. Application in the field of group dynamics through experience as a participant in group sensitivity training.

B492 Readings and Research in Psychology (1-3 cr.) P: Consent of instructor. Equiv. to IU Psychology P495 and PU PSY 498. Fall, Spring, Summer. Independent readings and research on psychological problems.

B499 Honors Research (cr. arr.) P: Consent of departmental honors committee. Equiv. to IU Psychology P499 and PU PSY 499. Fall, Spring, Summer. Independent readings and research resulting in a research paper.

Graduate Level

(500 level courses also open to seniors.)

500 Statistical Methods Applied to Psychology, Education, and Sociology (3 cr.) P: B105 and one year of high school algebra or equivalent. Descriptive statistics and introduction to sampling statistics. Applied to psychological, sociological, and educational data.

505 Mental Measurement (3 cr.) P: 6 credit hours of psychology, including 500 or equivalent. Introduction to the general area of mental measurement. Theory and content of measuring devices in the fields of intelligence, interests, personality, and special aptitudes.

518 Memory and Cognition (3 cr.) A survey of theories and research concerned with processes in the acquisition, storage, and retrieval of information, as well as selected additional topics in cognitive psychology.

I521 Introduction to Applied Behavior Analysis (3 cr.) P: Consent of instructor. The course is designed to provide an advanced introduction to the philosophy, principles, and procedures of applied behavior analysis and a review of selected research. Practical, ethical, and legal constraints on behavior interventions will be considered. Research conducted in institutional, educational, and home settings will be emphasized.

523 Introduction to Theories of Psychotherapy (3 cr.) A survey of the major approaches to psychotherapy, including their theories of illness and cure. Three traditions are represented: psychoanalytical (e.g., Freud, Adler, Jung), behavioral (e.g., Miller and Dollard, Wolpe, Stampfl), and cognitive-

phenomenological (e.g., Rogers, Kelley, Binswanger).

526 Psycholinguistics (3 cr.) P: Consent of instructor. An introduction to the descriptive devices, central issues, and varying methodologies of psycholinguistics.

535 Psychology of Death and Dying (3 cr.) An examination of psychological research and theory related to death and the dying process. Topics include death concepts, attitudes, and fears; psychosocial predictors of death; effects of death on survivors; psychosocial factors related to individual differences and normative dying behaviors; stages of dying; effects of pain and drugs; and managing the dying process.

540 History of Psychology (3 cr.) A review of the philosophical, theoretical, and methodological issues that entered into the development of modern psychology. Emphasis is placed on historical themes that continue to be active in the science and profession of psychology.

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 recent legislation that have contributed to its rapid development.

550 Introduction to Clinical Psychology (3 cr.) P: 12 credit hours of psychology. The case-study method, including a discussion of the importance of historical information, the contribution of clinical tests to diagnosis, and a general survey of prevention and treatment techniques.

I552 Psychological Counseling Theory and Practice in Rehabilitation (3 cr.) P: 9 credit hours of psychology. Theories of counseling and their applicability in the individual counselor and his or her prospective counseling situation. The use of various tools in counseling.

I553 Introduction to Community Resources for Vocational Rehabilitation (3 cr.) P: Consent of instructor. Survey of rehabilitation and rehabilitation-related agencies and services in Indiana and the issues involved in their utilization. Includes site visits.

I554 Psychosocial Aspects of Disability (3 cr.) P: 9 credit hours of psychology. An examination of the effect of the socio-emotional impact of traumatic injury or chronic illness on human functioning and its role in the rehabilitation process.

I555 Medical Aspects of Disability (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.

557 Psychology of the Urban Environment (3 cr.) P: 500 or equivalent. Introductory course on the effects of the urban environment on human behavior. Theories and empirical studies concerning environmental stresses in urban settings will be discussed with a major emphasis given to field studies. Implications of theory and research findings for urban planning will be specified.

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. Utilization of psychological measurement techniques in assessing training needs and evaluating training effectiveness and the application of learning research and theory to industrial training.

577 Human Factors in Engineering (3 cr.) Survey of human factors in engineering, with particular reference to human functions in man-machine systems, and consideration of human abilities and limitations in relation to design of equipment and work environments.

I578 Occupational Analysis (3 cr.) P: 570. Survey of systematic study of human work, including techniques of analysis of 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.

585 Psychological Foundations of Consumer Behavior (3 cr.) P: 3 credit hours of psychology. A survey of the concepts and methods of psychology as they apply to the study of consumer behavior.

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 initiate themselves into research techniques under the guidance of a member of the staff.

593 Ethology (3 cr.) P: Consent of instructor. Animal behavior is analyzed in natural and experimental situations. Emphasis is on the observation of wild and domesticated animals. The effects of early experience, motivation, physiological mechanisms, adaptiveness, and the evolution of behavior are considered.

594 Special Topics in Ethology (3 cr.) P: 593 or equivalent. Special topics such as imprinting, human ethology, territoriality, orientation, communication, ethology of mammals, etc., will be critically examined in the light of current research findings. One selected topic at a time will be covered in each semester when the course is offered.

I595 Seminar in Teaching Psychology (0 cr.) P: Consent of the Department of Psychology. A problem-solving approach to teaching psychology at IUPUI. Planning the course; anticipating problems; 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: 500 or equivalent. Emphasis is given to 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.

606 Special Topics in Quantitative Psychology (3 cr.) P: Consent of instructor. A seminar covering such topics as linear models, statistical decision making, and multidimensional scaling.

607 Scaling and Measurement (3 cr.) An introduction to the theory of measurement and a survey of modern scaling methods (unidimensional and multidimensional, metric and nonmetric) within the framework of the modern theory of measurement.

608 Measurement Theory and the Interpretation of Data (3 cr.) P: 600 and 505 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.

I610 Dynamic Modeling in Rehabilitation and Health Systems (3 cr.) P: Consent of instructor. An introduction to System Dynamics as a method of computer modeling of rehabilitation and health systems. Includes weekly modeling exercises, and a simulation experiment using an already existing model.

611 Factor Analysis (3 cr.) P: 600. Theory and applications of factors analysis in psychological research.

612 Advanced Test Theory (3 cr.) P: 608 or consent of instructor. Item Sampling and latent ability theories of test scores, together with related problems and possible solutions. Developments by Lord, Cronbach, Rasch, and Birnbaum will be covered.

I612 Deinstitutionalization and the Planning of Community-Based Rehabilitation Service Systems (3 cr.) P: Graduate standing. An overview of the successes and failures of the deinstitutionalization movement in developmental disabilities and psychiatric disability. Covers principles of

conceptualizing, planning, and implementing community-based residential, vocational, and social skills training programs.

I613 Psychiatric Rehabilitation (3 cr.) P: Consent of instructor. A seminar examining recent developments in the rehabilitation of persons with severe psychiatric disabilities, including 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.) A survey of the integrated neurosciences for nonconcentrators emphasizing human 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.

624 Human Learning and Memory (3 cr.) P: Consent of instructor. (Formerly numbered 630) Theory of and experimental findings in human learning and memory.

628 Perceptual Processes (3 cr.) P: B334 or equivalent. General review of basic concepts and findings in the area of perception.

633 Seminar in Experimental Psychology (3 cr.) P: Consent of instructor. Critical analysis of current problems in experimental psychology. Emphasis on reviewing literature and on preparing and presenting papers.

640 Survey of Social-Personality Psychology I (3 cr.) P: B370 or equivalent. An extensive survey of methods, research, and theory in social-personality psychology.

641 Survey of Social-Personality Psychology II (3 cr.) P or C: 600. An extensive survey of methods, research, and theory in social-personality psychology.

I642 Cross-Cultural Social Psychology (3 cr.) P: 600 and 640. A survey of methodology and findings from cross-cultural analysis of social behavior. Findings are applied to the development of techniques for cross-cultural training.

I643 Field Methods and Experimentation (3 cr.) P: 600. The course will cover 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.

I648 Practicum in Applied Social Psychology (3 cr.) P: Consent of instructor. Students will participate in applied research and/or program evaluation in a community agency. The field experience, combined with a seminar, will provide on-site training and skill development under the supervision of the Department of Psychology and agency personnel.

I649 Internship in Applied Social Psychology (0 cr.) P: Consent of instructor. Open only to applied social psychology students in approved internship facilities. Provides opportunity for application of knowledge of program evaluation and/or social research under supervision of the agency and monitored by the Department of Psychology.

I650 Developmental Psychology (3 cr.) Major concepts, principles, and facts concerning the biological and environmental influences on behavioral and psychological development. Particular emphasis given to essential principles of ontogenetic development (life span) emerging from current research in genetics and psychology.

651 Development in Infancy and Childhood (3 cr.) P: Consent of instructor. Critical review of physical-motor, cognitive, and social development with special emphasis on infancy and early childhood.

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 is placed on the changing characteristics of some fundamental cognitive processes. Special attention is given to verbal behavior and language.

657 Language Acquisition (3 cr.) An examination of research and theory dealing with language acquisition in children. A linguistic framework is used to describe developing language. Topics considered include speech perception, grammatical development, meaning, language in

non-modal populations. Supervised laboratory experience.

659 Seminar in Developmental Psychology (3 cr.) P: Consent of instructor. A critical review of selected concepts, problems, and methods of research in developmental psychology.

680 Seminar in Industrial-Personnel Psychology (3 cr.) P: 570, 572, and 601. (Formerly numbered 681) Extensively surveys the various areas of industrial-personnel psychology (e.g., selection, placement, training, performance appraisal). Course provides a critical and up-to-date review of recent and classical research in these areas.

681 Seminr in Research Methodologies of Industrial/Organizational Psychology (3 cr.) P: 570, 572, 601 or consent of instructor. (Formerly numbered 680) 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. This course will give students the opportunity to spend eight hours per week within local business organizations in order to gain experience and skills in industrial/ organizational psychology.

I688 Human Sexuality (3 cr.) P: Graduate standing or consent of instructor. The course covers the total field of knowledge concerning human sexual behavior, including

anatomy, physiology, endocrinology, development, norms, deviations, special problems and remediation, and attitudes.

I689 Practicum in Rehabilitation Psychology (3 cr.) P: I549 and consent of instructor. Supervised practice of rehabilitation psychology in a community agency or organization.

I690 Career Development, Selection, and Placement in Rehabilitation (3 cr.) P: 9 credit hours of psychology. A survey of current methods and criteria used in job development, selective placement, and follow-up of handicapped and deprived individuals.

I691 Seminar in Rehabilitation Psychology (3 cr.) P: Consent of instructor. Current trends, problems, and developments in rehabilitation. Students pursue a special interest and mutually share information and experience with the group. Individual reports and group discussions.

I697 Internship in Rehabilitation Psychology (0 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. Dissertation (0 to 12 cr.)
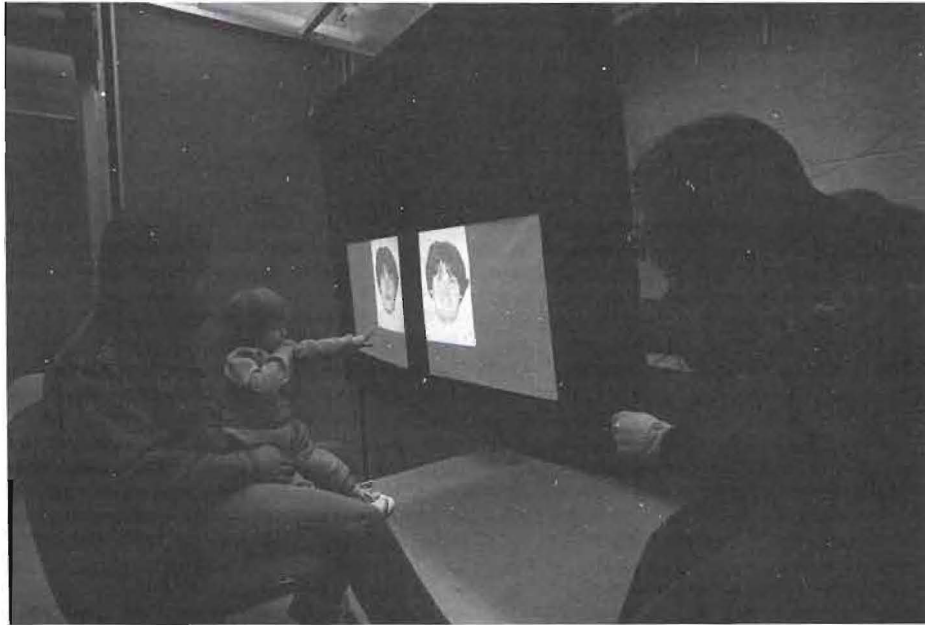
Resident Faculty

Aeschleman, Stanley, *Associate Professor of Psychology (1978); B.A., 1968, Western Illinois University; M.A., 1973, Ph.D., 1977, University of Kentucky.* Specialties: Applied Behavioral Analysis, Learning in Developmentally Delayed Children.

Aliprantis, C. D., *Professor of Mathematics and Adjunct Professor of Economics (1975); B.S., 1968, University of Athens, Greece; M.S., 1971, Ph.D., 1973, California Institute of Technology.* Specialties: Functional Analysis, Operator Theory, Mathematical Economics.

Alton, Elaine V., *Professor of Mathematics (1964); A.B., 1946, State University of New York, Albany; M.Ed., 1951, St. Lawrence University; M.A., 1958, University of Michigan; Ph.D., 1965, Michigan State University.* Specialty: Mathematics Education.

Banaszak, Konrad J., *Adjunct Professor of Geology; B.S., 1966, Beloit College; M.S., 1969, Ph.D., 1975, Northwestern University.* Specialties: Low Temperature Geochemistry, Environmental Hydrology, Economic Geology.

Bard, Martin, *Associate Professor of Biology (1975); B.S., 1965, City College of New York; Ph.D., 1971, University of California, Berkeley.* Specialty: Biochemical Genetics.

Bayer, Shirley A., *Professor of Biology (1982); B.A., 1963, St. Mary-of-the-Woods; M.A., 1969, California State University, Fullerton; Ph.D., 1974, Purdue University.* Specialty: Neurobiology.

Bittinger, Marvin, *Professor of Mathematics (1968); B.S., 1963, Manchester College; M.S., 1965, Ohio State University; Ph.D., 1968, Purdue University.* Specialty: Mathematics Education.

Boaz, Patricia A., *Director, Adult Education Coordinating Center, and Associate Professor of Chemistry (1967); B.S., 1944, Vassar College; Ph.D., 1951, State University of Iowa.* Specialties: General Chemistry, Physical Chemistry, Geochemistry.

Bond, Gary R., *Associate Professor of Psychology (1983); B.S., 1966, Michigan State University; M.A., 1972, Ph.D., 1975, University of Chicago.* Specialties: Psychiatric Rehabilitation, Program Evaluation.

Boschmann, Erwin, *Professor 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.

Boyd, Donald, *Adjunct Professor of Chemistry (1986); B.S., 1963, Pennsylvania State University; Ph.D., 1968, Harvard University.* Specialty: Organic Chemistry.

Bringle, Robert Gordon, *Associate Professor of Psychology (1974); B.A., 1969, Hanover College; M.S., 1972, Ph.D., 1974, University of Massachusetts.* Specialties: Social Psychology, Program Evaluation, Methodology.

Burkinshaw, Owen, *Professor of Mathematics (1972); B.S., 1966, M.S., 1968, Ohio University, Athens; Ph.D., 1972, Purdue University.* Specialty: Functional Analysis.

Butler, Larry D., *Adjunct Associate Professor of Biology (1983); B.S., 1973, Yale University; M.S., 1975, Ph.D., 1979, Cleveland State University.* Specialty: Immunology.

Chardrasekhar, Srinivasan, *Adjunct Assistant Professor of Biology (1987); B.Sc., 1970, M.S., 1973, University of Madras; M.Sc., 1977, Ph.D., 1981, State University of New York, Albany.* Specialty: Developmental Biology.

Chernoff, Ellen A. G., *Assistant Professor of Biology (1986); B.A., 1973, Ph.D., 1978, University of Chicago.* Specialty: Developmental Biology.

Crown, J. Conrad, *Professor of Mathematics (1969); B.S., 1943, Polytechnic Institute of Brooklyn; M.S., 1962, Ph.D., 1965, University of Connecticut.* Specialties: Numerical Analysis, Operations Research, Discrete Mathematics.

Cutshall, Theodore W., *Associate Professor of Chemistry (1961); B.S.Ch.E., 1949, Purdue University; M.S., 1959, Ph.D., 1964, Northwestern University.* Specialty: Organic Chemistry.

Davis, Robert, *Professor of Psychology (1976); B.S., 1958, Salisbury State College; M.Ed., 1962, Pennsylvania State University; Ed.D., 1968, University of Maryland.* Specialties: Rehabilitation Psychology, Counseling.

de Caprariis, Pascal, *Associate Professor of Geology (1978); B.S., 1964, M.S., 1967, Boston College; Ph.D., 1973, Rensselaer Polytechnic Institute.* Specialties: Geophysics, Quantitative Hydrology.

Dubin, Paul, *Associate Professor of Chemistry (1981); B.S., 1962, City University of New York; Ph.D., 1970, Rutgers University.* Specialties: Analytical Chemistry, Polymer Chemistry.

Evenbeck, Scott, *Associate Dean of the Indiana University School of Continuing Studies, Director of the IUPUI Division of Continuing Studies, and Associate Professor of Psychology (1972); A.B., 1968, Indiana University; M.A., 1971, Ph.D., 1972, University of North Carolina.* Specialties: Social Psychology, Program Evaluation, Methodology.

Fife, Wilmer K., *Professor of Chemistry (1971); B.S., 1955, Case Institute of Technology; Ph.D., 1960, Ohio State University.* Specialties: General Chemistry, Organic Chemistry, Biochemistry.

Fleener, Don E., *Associate Professor of Psychology (1966); B.S. (Ed), 1949, Indiana Central University; Ph.D., 1967, Indiana University.* Specialties: Behavioral Medicine, Clinical Psychology, Developmental Psychology.

Fortier, Robert H., *Associate Professor of Psychology (1966); B.S., 1947, Ph.D., 1952, Western Reserve University.* Specialties: Child Psychology, Personality.

Frankel, Michael L., *Assistant Professor of Mathematics (1984); M.S., 1971, Ph.D., 1984, University of Tel-Aviv.* Specialties: Applied Mathematics.

Fricke, Gordon H., *Associate Professor of Chemistry (1972); B.A., 1964, Goshen College; M.S., 1966, State University of New York, Binghamton; Ph.D., 1970, Clarkson College of Technology.* Specialties: General Chemistry, Analytical Chemistry.

Froehlke, Kristin, *Adjunct Professor of Computer and Information Science (1981); B.A., 1968, Marion College; M.S., 1970, Purdue University.* Specialty: Computer Science.

Gersting, John M., Jr., *Professor of Computer and Information Science (1970); B.S., 1962, Purdue University; M.S., 1964, Ph.D., 1970, Arizona State University.* Specialties: Database Systems, Computational Methods.

Gersting, Judith L., *Professor of Computer and Information Science (1970); B.S., 1962, Stetson University; M.A., 1964, Ph.D., 1969, Arizona State University.* Specialties: Logic, Fault-tolerant Computing.

Ghosh, Swapan K., *Adjunct Associate Professor of Geology (1988); M.S., 1973, University of Wisconsin, Milwaukee; Ph.D., 1975, Syracuse University.* Specialties: Environmental Geology, Sedimentary Geochemistry.

Glueckauf, Robert L., *Assistant Professor of Psychology (1988); B.A., 1975, University of Florida, Gainesville; M.S., 1979, Ph.D., 1981, Florida State University.* Specialty: Rehabilitation Psychology.

Goldberg, Carlos L., *Associate Professor of Psychology, (1969); B.A., 1961, Brooklyn College; M.A., 1964, Ph.D., 1969, City University of New York.* Specialties: Social Psychology, Urban Psychology.

Gustin, Mae S., *Assistant Professor of Geology (1987); B.S., 1979, Guilford College; M.S., 1983, University of North Carolina; Ph.D., 1987, University of Arizona.* Specialties: Petrology, Geochemistry, Economic Geology.

Hall, Robert D., *Associate Professor of Geology (1974); B.S., 1963, Purdue University; M.S., 1966, University of Colorado; Ph.D., 1973, Indiana University.* Specialties: Geomorphology, Environmental Geology, Hydrology, Physical Geology.

Hanford, Peter Vance, *Professor of Psychology, School of Science, and Adjunct Professor of Psychology, School of Medicine (1960); B.S., 1952, M.S., 1953, Ph.D., 1958, Pennsylvania State University.* Specialties: Experimental Analysis of Behavior, Motivation.

Hazer, John T., *Chairperson and Associate Professor of Psychology (1975); B.A., 1970, Miami University; M.A., 1974, Ph.D., 1976, Bowling Green State University.* Specialties: Industrial and Organizational Psychology, Human Resource Management.

Hutton, Lucreda, *Associate Professor of Mathematics (1975); B.S., 1967, Butler University; M.S., 1972, Purdue University; Ed.D., 1975, Indiana University.* Specialty: Mathematics Education.

Ingolia, Thomas D., *Adjunct Associate Professor of Biology (1983); B.S., 1974, University of Illinois, Urbana; Ph.D., 1978, University of California, Berkeley.* Specialty: Biochemistry.

Jackson, Billy G., *Adjunct Associate Professor of Chemistry (1971); B.S., 1953, Ph.D., 1957, Iowa State University.* Specialty: Organic Chemistry.

Jarrett, Harry W., III, *Associate Professor of Biology (1982); B.S., 1972, University of South Carolina; Ph.D., 1976, University of North Carolina.* Specialty: Biochemistry.

Jenski, Laura J., *Assistant Professor of Biology (1987); B.S., 1973, M.S., 1975, Northern Illinois University; Ph.D., 1979, University of Wisconsin.* Specialty: Immunology.

Ji, Ronghui, *Assistant Professor of Mathematics (1986); B.S., 1982, University of Science and Technology of China; Ph.D., 1986, State University of New York, Stony Brook.* Specialties: Operator Algebras, K-Theory.

Juillerat, Florence, *Associate Professor of Biology (1966); B.S., 1962, M.S., 1967, Ph.D., 1974, Purdue University.* Specialties: Cell Biology, Biology for Teachers, Biology for Nonmajors.

Kaminker, Jerome Alvin, *Professor of Mathematics (1973); B.A., 1963, University of California, Berkeley; M.A., 1965, Ph.D., 1968, University of California, Los Angeles.* Specialties: Operator Algebras, K-Theory.

Kaplan, Jerome I., *Professor of Physics (1974); B.S., 1950, University of Michigan, Ann Arbor; Ph.D., 1954, University of California, Berkeley.* Specialties: Condensed Matter, Solar Energy, Biological Physics.

Keck, Robert William, *Acting Dean, School of Science, and Associate Professor of Biology (1972); B.A., 1962, M.S., 1964, University of Iowa; Ph.D., 1968, Ohio State University.* Specialty: Plant Physiology.

Kemple, Marvin D., *Associate Professor of Physics (1977); B.S., 1964, Purdue University; M.S., 1965, Ph.D., 1971, University of Illinois, Urbana.* Specialties: Chemical Physics, Biological Physics.

Kirk, Ronald, *Assistant Professor of Biology (1968); A.S., 1955, Vincennes University; B.S., 1958, M.S., 1959, Ph.D., 1966, Purdue University.* Specialties: Invertebrate Zoology, Entomology, Ecology.

Kleiner, Kathleen A., *Assistant Professor of Psychology (1987); B.A., 1981, Franklin and Marshall College; M.A., 1985, Ph.D., 1985, Case Western Reserve.* Specialty: Cognitive Developmental Psychology.

Kleinhans, Frederick W., *Associate Professor of Physics (1972); B.S., 1965, University of Michigan; Ph.D., 1971, Ohio State University.* Specialties: Biological Physics, Computational Physics.

Kleyle, Robert M., *Professor of Mathematics (1973); B.A., 1960, Duquesne University, Pittsburgh; M.S., 1962, University of Pittsburgh; Ph.D., 1968, Harvard University.* Specialty: Statistics.

Kremer, John F., *Associate Professor of Psychology, School of Science, and Adjunct Assistant Professor of Psychology, School of Medicine (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, Aging, Program Evaluation.

Kuczkowski, Joseph E., *Associate Dean for Academic Affairs, School of Science, and Professor of Mathematics (1966); B.S., 1961, Canisius College; M.S., 1963, Ph.D., 1968, Purdue University.* Specialties: Semigroup Theory, Mathematics Education.

Larter, Raima M., *Associate Professor of Chemistry (1981); B.S., 1976, Montana State University; Ph.D., 1980, Indiana University, Bloomington.* Specialty: Theoretical Physical Chemistry.

Lauer, Joan B., *Associate Professor of Psychology (1973); A.B., 1964, Ph.D., 1973, Indiana University.* Specialties: Clinical Psychology, Physiological Psychology, Learning.

Lees, Norman Douglas, *Associate Professor of Biology (1973); A.B., 1967, Providence College; Ph.D., 1973, Northwestern University.* Specialties: Microbiology, Molecular Biology.

Levitt, Eugene, *Professor of Clinical Psychology and Director of the Section of Clinical Psychology, Department of Psychiatry, School of Medicine, and Adjunct Professor of Psychology (1976); B.A., 1948, City University of New York; M.A., 1950, Ph.D., 1952, Columbia University.* Specialty: Clinical Psychology.

Lipkowitz, Kenneth B., *Associate Professor of Chemistry (1976); B.S., 1972, State University of New York, Geneseo; Ph.D., 1975, Montana State University.* Specialties: Theoretical and Synthetic Organic Chemistry.

Liu, Wei-min, *Assistant Professor of Mathematics (1987); B.S., 1968, Shanghai College of Mechanical and Electrical Engineering; M.S., 1981, Shanghai Institute of Biochemistry; M.S., 1986, Ph.D., 1987, Cornell University.* Specialties: Dynamical Systems Theory, Differential Equations, Biomathematics.

Loher, Brian T., *Assistant Professor of Psychology (1986); B.S., 1980, Indiana University; M.A., 1984, Michigan State University.* Specialty: Industrial/Organizational Psychology.

Luke, Jon, *Associate Professor of Mathematics 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.

Malik, David J., *Associate Professor of Chemistry (1980); B.S., 1968, M.S., 1969, California State University; Ph.D., 1976, University of California, San Diego.* Specialties: Theoretical Physical Chemistry, Chemical Physics.

Mannan, Golam, *Associate Professor of Education and Adjunct Associate Professor of Psychology (1978); B.Sc., 1954, Carmichael College, Rangpur, Bangladesh; M.A., 1959, B.Ed., 1961, M.Sc., 1963, Rajshahi University, Bangladesh; M.S., 1966, Ph.D., 1967, Indiana University.* Specialty: Educational Psychology.

McBride, Angela B., *Professor and Associate Dean, School of Nursing, and Adjunct Professor of Psychology (1980); B.S.N., 1962, Georgetown University; M.S.N., 1964, Yale University; Ph.D., 1978, Purdue University.* Specialties: Developmental Psychology, Psychiatric Mental Health.

McCracken, Richard O., *Associate Professor of Biology (1977); B.S., 1965, M.S.T., 1967, University of Wisconsin, Whitewater; Ph.D., 1972, Iowa State University.* Specialties: Comparative Physiology, Cell Biology, Helminth Chemotherapy.

McIntyre, John A., *Adjunct Professor of Biology (1987); A.B., 1966, Rockford College; Ph.D., 1971, Wake Forest University.* Specialties: Immunology, Reproductive Biology.

Meiere, Forrest T., *Professor of Physics (1969); B.S., (Physics) and B.S. (Math), 1959, Carnegie-Mellon University; Ph.D., 1964, Massachusetts Institute of Technology.* Specialties: High Energy Physics, Biological Physics.

Metzner, Barbara S., *Adjunct Assistant Professor of Psychology (1986); A.B., 1962, M.S., 1964, Indiana University; B.A., 1979, Purdue University; Ed.D., 1983, Indiana University.* Specialty: Educational Research.

Miller, John Grier, *Associate Professor of Mathematics (1978, Columbus); S.B., 1963, S.M., 1964, University of Chicago; Ph.D., 1967, Rice University.* Specialty: Geometric and Algebraic Topology.

Mirsky, Arthur, *Chairperson and Professor of Geology (1967); B.A., 1950, University of California, Los Angeles; M.S., 1955, University of Arizona; Ph.D., 1960, Ohio State University.* Specialties: Urban Geology, History of Applied Geology, Environmental Geology, Geowriting, Evolution of the Earth.

Moehle, Kurt A., *Assistant Professor of Psychology (1984); B.A., 1977, M.A., 1980, Southern Illinois University; Ph.D., 1984, Memphis State University.* Specialties: Clinical Psychology, Neuropsychology, Rehabilitation Psychology, Behavioral Medicine/Health Psychology.

Morrel, Bernard B., *Associate Professor of Mathematics (1977); B.A., 1962, M.A., 1966, Ph.D., 1968, University of Virginia.* Specialties: Operator Theory, Functional Analysis.

Morris, Barnett B., *Professor of Psychology (1965); B.A., 1948, Brooklyn College; M.A., 1951, University of Nebraska; Ph.D., 1959, University of Oklahoma.* Specialties: Sensation, Perception, Statistics, Testing.

Muhoberac, Barry B., *Assistant Professor of Chemistry (1985); B.S., 1972, Louisiana State University; Ph.D., 1978, University of Virginia.* Specialty: Biophysical Chemistry.

Neel, Robert G., *Professor Emeritus of Psychology (1964); B.A., 1948, M.S., 1949, University of Denver; Ph.D., 1962, University of Michigan.* Specialties: Personnel and Industrial Psychology.

Ng, Bart, *Chairperson and Professor of Mathematics, and Acting Chairperson and Professor of Computer and Information Science (1975); B.S., 1968, St. Joseph College; M.S., 1970, Ph.D., 1973, University of Chicago.* Specialty: Applied Mathematics.

Novak, Gregor M., *Associate Professor of Physics (1964); M.S., 1964, University of Chicago; Ph.D., 1975, Indiana University.* Specialties: Mathematical Physics, ICAI on Microcomputers.

Nurok, David, *Associate Professor of Chemistry (1978); B.Sc., 1959, Ph.D., 1966, University of Capetown.* Specialties: Analytical Chemistry, Chromatography.

Ockerse, Ralph, *Professor of Biology (1976); B.A., 1956, State Teachers College, Netherlands;* B.S., 1962, Baldwin Wallace College; Ph.D., 1966, Yale University. Specialties: Plant Physiology, Cellular Biochemistry.

O'Donnell, Martin J., *Professor of Chemistry (1975); B.S., 1968, University of Iowa; Ph.D., 1973, Yale University.* Specialty: Organic Chemistry.

Olson, Andrew M., *Associate Professor of Computer and Information Science (1984); B.S., 1959, University of Wyoming; M.S., 1961, University of Wisconsin; D.Sc., 1969, Washington University.* Specialties: Computational Mathematics, Symbolic-numeric Algorithms.

Pachut, Joseph F., Jr., *Associate Professor of Geology (1978), B.A., 1972, State University of New York, Oneonta; Ph.D., 1977, Michigan State University.* Specialties: Invertebrate Paleontology, Paleoecology, Geobiology, Biometrics, Evolution of the Earth.

Paik, Han Won, *Associate Professor of Physics (1962); B.S., 1956, M.S., 1958, Yonsei University, Seoul, Korea; M.S., 1962, Northwestern University; Ph.D., 1970, Indiana University.* Specialty: High Energy Physics.

Palakal, Mathew J., *Assistant Professor of Computer and Information Science (1988); B. Comp. Sci., 1979, M. Comp. Sci., 1983, Ph.D., 1987, Concordia University, Montreal, Canada.* Specialty: Artificial Intelligence, Speech Recognition, Pattern Recognition, Image Processing.

Park, Richard A., Jr., *Adjunct Professor of Geology; B.S., 1961, Louisiana State University; M.S., 1965, Ph.D., 1966, University of Wisconsin.* Specialties: Ecology, Multivariate Statistical Analysis, Modeling Ecosystems.

Patterson, Richard R., *Associate Professor of Mathematics and Associate Professor of Computer and Information Science (1974); B.A., 1961, DePauw University; Ph.D., 1966, University of California, Berkeley.* Specialty: Geometric Modeling.

Pearlstein, Robert M., *Chairperson and Professor of Physics (1982); A.B., 1960, Harvard University; Ph.D., 1966, University of Maryland.* Specialties: Biological Physics, Statistical Mechanics.

Penna, Michael A., *Professor of Mathematics and Professor of Computer and Information Science (1973); B.A., 1967, Union College, Schenectady, N.Y.; A.M., 1968, Ph.D., 1973, University of Illinois, Urbana.* Specialty: Differential Geometry.

Petersen, Bruce H., *Adjunct Professor of Biology (1978); B.S., 1962, Utah State University; M.S., 1967, Ph.D., 1969, Indiana University.* Specialty: Immunology.

Pflanzer, Richard Gary, *Associate Professor of Biology (1969); A.B., 1964, Ph.D., 1969, Indiana University*. Specialty: Medical Physiology.

Rabideau, Peter W., *Chairperson and Professor of Chemistry (1970); B.S., Loyola University, 1964; M.S., Case Institute of Technology, 1967; Ph.D., 1968, Case Western Reserve University*. Specialty: Organic Chemistry.

Rajecki, D. W., *Associate Professor of Psychology (1980); B.A., 1968, Kent State University; Ph.D., 1972, University of Michigan*. Specialties: Aggression, Attitudes and Public Opinion, Animal Behavior.

Rao, B.D. Nageswara, *Professor of Physics (1978), B.S. (Honors), 1955, M.S., 1956, Andhra University, Waltair (A.P.), India; Ph.D., 1961, Aligarh Muslim University, Aligarh (U.P.), India*. Specialties: Nuclear Magnetic Resonance, Biological Physics.

Rasmussen, Jeffrey L., *Assistant Professor of Psychology (1984); B.A., 1979, University of Wisconsin; M.S., 1981, Ph.D., 1983, Tulane University*. Specialties: Quantitative Psychology, Computer Applications in Psychology.

Rice, James M., *Assistant Professor of Psychology (1984); B.S., 1977, Wright State University; M.A., 1979, Drake University; Ph.D., 1983, Southern Illinois University*. Specialties: Rehabilitation Psychology, Behavior Therapy.

Rigdon, Robert, *Associate Professor of Mathematics (1975); A.B., 1965, Princeton; Ph.D., 1970, University of California, Berkeley*. Specialty: Algebraic Topology.

Rosenberg, Gary D., *Associate Professor of Geology (1979), B.S., 1966, University of Wisconsin; Ph.D., 1972, University of California, Los Angeles*. Specialties: Biomineralization, Evolution, Paleobiochemistry, Historical Geology.

Rothman, Neal J., *Professor of Mathematics (1982); B.S., 1951, University of Delaware; M.S., 1954, Tulane University; Ph.D., 1958, Louisiana State University*. Specialties: Functional Analysis, Harmonic Analysis.

Russo, Raymond J., *Associate Professor of Biology (1976); B.S., 1966, Southeast Missouri State University; M.S., 1971, Northeast Missouri State University; Ph.D., 1977, University of Notre Dame*. Specialties: Ecology, Population Dynamics of Medically Important Insects.

Rytting, Marvin, *Associate Professor of Psychology (1975, Columbus); B.S., 1971, Brigham Young University; M.S., 1973, Ph.D., 1975, Purdue University*. Specialties: Personality, Social Psychology, Sociology of the Family.

Schauf, Charles, *Chairperson and Professor of Biology, (1986); S.B., 1965, University of Chicago; Ph.D., 1969, University of Chicago and Pritzger School of Medicine*. Specialty: Neurophysiology.

Schultz, Franklin A., *Professor of Chemistry (1987); B.S., 1963, California Institute of Technology; Ph.D., 1967, University of California, Riverside*. Specialties: Analytical Chemistry, Electro-Chemistry.

Scriven, Eric, *Adjunct Professor of Chemistry (1983); B.S., 1965, University of Salford, U.K.; M.S., 1967, University of Guelph, Canada; Ph.D., 1969, University of East Anglia, U.K.* Specialty: Organic Chemistry.

Sen, Asok K., *Associate Professor of Mathematics (1981); B.S., 1972, Indian Institute of Technology, India; M.S., 1975, University of Minnesota; Ph.D., 1979, Cornell University*. Specialty: Applied Mathematics.

Seubert, James W., *Associate Professor of Physics (1968); A.B., 1958, Washington University; M.S., 1964, Ph.D., 1968, Indiana University*. Specialty: Nuclear Physics.

Shields, James E., *Adjunct Professor of Chemistry (1977); A.B., 1956, DePauw University; Ph.D., 1961, University of California, Berkeley*. Specialty: Biochemistry.

Stillwell, William H., *Associate Professor of Biology (1978), B.S., 1967, State University of New York, Albany; M.S., 1973, Ph.D., 1974, Pennsylvania State University*. Specialties: Biochemistry, Membranes, Origin of Life.

Svanum, Soren, *Associate Professor of Psychology (1976); A.B., 1971, San Francisco State University; M.A., 1973, Ph.D., 1976, University of Montana*. Specialties: Clinical Psychology, Chemical Dependence, Health Care Psychology.

Tam, Richard Yiu Hang, *Assistant Professor of Mathematics (1986); B.S., 1980, University of Alberta, Edmonton, Canada; M.Sc., 1982, Virginia Polytechnic Institute and State University, Virginia; Ph.D., 1986, Cornell University*. Specialty: Applied Mathematics.

Thatcher, Frederick C., *Associate Professor of Physics (1970); B.S., 1961, University of Chicago; M.S., 1964, DePaul University; Ph.D., 1969, University of California, Riverside*. Specialties: Condensed Matter Physics, Applied Optics.

Tzeng, Oliver C. S., *Professor of Psychology (1976); B.Ed., 1966, National Taiwan Normal University; M.S., 1969, University of Wisconsin–Stout; Ph.D., 1972, University of Illinois*. Specialties: Quantitative Psychology; Cross-cultural Social Psychology, Personality.

Vasavada, K.V., *Professor of Physics (1970);* *B.S., 1958, University of Baroda, India.; M.S., 1960, University of Delhi, India; Ph.D., 1964, University of Maryland.* Specialties: High Energy Physics, Biological Physics.

Ware, Joseph Roger, *Associate Professor of Psychology (1982); B.S., 1957, M.S., 1961, University of Louisville; Ph.D., 1972, University of Kentucky.* Specialties: Humanistic Psychology, Group Dynamics, Psychological Type.

Wassall, Stephen R., *Assistant Professor of Physics (1984); B.Sc., Hons 1st Class, 1973, Southampton University; Ph.D., 1981, Nottingham University.* Specialties: Nuclear Magnetic Resonance, Biological Physics.

Williams, Margaret L., *Lecturer in Psychology (1988); B.S., 1980, Heidelberg College; M.S., 1984, Purdue University; M.B.A., 1987, Indiana University.* Specialty: Industrial Organizational Psychology.

Wilson, Kathryn J., *Associate Professor of Biology (1976); B.A., 1971, University of Wisconsin, Madison; M.S., 1976, Ph.D., 1976, Indiana University.* Specialties: Plant Developmental Anatomy and Morphology, Electron Microscopy.

Witzmann, Frank A., *Assistant Professor of Biology (1985, Columbus); B.A., 1976, The Defiance College; M.S., 1978, Ball State University; Ph.D., 1981, Marquette University.* Specialty: Muscle Physiology.

Wyma, Richard J., *Associate Professor of Chemistry (1969); A.B., 1958, Hope College; M.S., 1960, Ph.D., 1964, University of Michigan.* Specialties: General Chemistry, Physical Chemistry.

Yovits, Marshall C., *Professor of Computer and Information Science (1980); B.S., 1944, M.S., 1948, Union College; M.S., 1950, Ph.D., 1951, Yale University.* Specialty: Computer and Information Science.

Zeldin, Martel, *Professor of Chemistry (1981); B.S., 1959, Queens College; M.A., 1962, City University of New York; Ph.D., Pennsylvania State University.* Specialties: Inorganic Chemistry, Organometallic Chemistry, Polymer Chemistry.

Zuckerman, Steven H., *Adjunct Assistant Professor of Biology (1988); B.S., 1973, New York University; Ph.D., 1977, University of Minnesota.* Specialty: Immunology.

Degree Checklist for School of Science Bachelor of Arts Degree

The School of Science requirements are listed. For all areas, see appropriate sections of the bulletin for additional requirements or restrictions by schools or departments.

Area I English Composition and Communicative Skills   Two courses in composition totaling 6 credit hours. One course in speech of 3 credit hours.

Composition _____ _____   Speech _____

_____

Area II Foreign Language   No courses required by the school.

_____   _____

Area IIIA Arts and Humanities   Four courses totaling at least 12 credit hours.[1]

_____   _____

_____   _____

Area IIIB Social and Behavioral Sciences   Four courses totaling at least 12 credit hours.[1]

_____   _____

_____   _____

Area IIIC Physical and Biological Sciences   At least four science courses totaling a minimum of 12 credit hours outside the major department. (At least one of the above must be a laboratory course.)[2]

_____   _____

_____   _____

Area IIID Mathematical Sciences   One course in computer science.

_____   _____

Area IV Major   Consult departmental listing for courses required in the major as well as courses required in other areas by the department.

_____   _____   _____

_____   _____   _____

_____   _____   _____

[1] There must be at least two courses in one discipline in either IIIA or IIIB.
[2] Courses not acceptable for IIIC include BIOL N100, BIOL N120, BIOL N200, GEOL G130, all agriculture courses, and CHEM C100.

Degree Checklist for School of Science Bachelor of Science Degree

The School of Science requirements are listed. For all areas see appropriate sections of the Bulletin for additional requirements or restrictions by schools or departments.

Area I English Composition and Communicative Skills Two courses in composition totaling 6 credit hours. One course in speech of 3 credit hours.

Composition _____   Speech _____

_____

Area II Foreign Language No courses required by the school.

_____   _____

Area IIIA Arts and Humanities Two courses totaling at least 6 credit hours.[1]

_____   _____

Area IIIB Social and Behavioral Sciences Two courses totaling at least 6 credit hours.[1]

_____   _____

Area IIIC Physical and Biological Sciences At least four science courses totaling a minimum of 12 credit hours outside the major department. (At least one of the above must be a laboratory course.)[2]

_____   _____

_____   _____

Area IIID Mathematical Sciences At least two courses beyond algebra and trigonometry, totaling a minimum of 6 credit hours. One course in computer science.

_____   _____

_____   _____

Area IV Major Consult departmental listing for courses required in the major as well as courses required in other areas by the department.

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

[1] There must be two courses in one discipline in either IIIA or IIIB.
[2] Courses not acceptable for IIIC include BIOL N100, BIOL N120, BIOL N200, GEOL 130, all agriculture courses, and CHEM C100.

Index

IUPUI Offices

Joseph E. Kuczkowski
Associate Dean for Academic Affairs
School of Science
Krannert Science Building 165
1125 E. 38th Street
P.O. Box 647
IUPUI
Indianapolis, IN 46223
(317) 274-0625

Mary Ellen Alig
Administrative Assistant for Academic
  Affairs
School of Science Recorder
Krannert Science Building 165
1125 E. 38th Street
P.O. Box 647
IUPUI
Indianapolis, IN 46223
(317) 274-0625

Florence Rogers
Student Credentials Coordinator
Krannert Science Building 165
1125 E. 38th Street
P.O. Box 647
IUPUI
Indianapolis, IN 46223
(317) 274-0625

Office of Admissions
Cavanaugh Hall 129
425 Agnes Street
IUPUI
Indianapolis, IN 46202
(317) 274-4591

International Student Services
Union Building 574
620 Union Drive
IUPUI
Indianapolis, IN 46202-2697
USA
(317) 274-7294

Bursar's Office
Cavanaugh Hall 147
425 Agnes Street
IUPUI
Indianapolis, IN 46202
(317) 274-2451

Timothy L. Langston
Dean for Student Affairs
Administration Building 140
355 N. Lansing Street
IUPUI
Indianapolis, IN 46202
(317) 274-2546

Nonacademic Counseling Center
419 North Blackford Street
IUPUI
Indianapolis, IN 46202
(317) 274-2548

Registrar's Office
Cavanaugh Hall 119
425 Agnes Street
IUPUI
Indianapolis, IN 46202
(317) 274-1501

Office of Career and Employment Services
Business-SPEA Building 2010
801 W. Michigan Street
IUPUI
Indianapolis, IN 46202
(317) 274-2554

Office of Scholarships and Financial Aid
Cavanaugh Hall 103
425 Agnes Street
IUPUI
Indianapolis, IN 46202
(317) 274-4162

School of Science Bulletin Committee
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