College of Science

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Contents

About Purdue University

A commitment to serving the people was Purdue University's founding principle as the Indiana link in the nationwide chain of land-grant colleges and universities. Purdue, which opened its doors on September 16, 1874, with a student body of 39 and a staff of six, has grown into a world-class institution of nearly 68,800 students and more than 17,800 faculty and staff members systemwide.

Purdue graduates have been to the moon, to the highest levels of business and government, and to Sweden to receive the Nobel Prize. Others among the more than 375,000 living alumni are noted agriculturalists, scientists, teachers, engineers, pharmacists, journalists, veterinarians, and athletes who have contributed to the well-being of our society.

Purdue has been a vital resource to the people of Indiana, the nation, and the world — from its land-grant foundation to its status today as a prominent land-, sea-, and space-grant institution.

Making higher education available to the people was the plan in 1862 when President Lincoln signed the Morrill Act, which gave public lands to any state that would use proceeds from the sale of the land to support a college that would teach agriculture and the mechanic arts.

Three years after passage of the land-grant act, the Indiana General Assembly voted to take advantage of the provisions. Competition among various areas of the state culminated in 1869 when the assembly accepted $150,000 from Lafayette civic leader John Purdue, $50,000 from Tippecanoe County, and 100 acres of land from local citizens. In appreciation, the institution was named Purdue University and was established in West Lafayette. The University officially opened for classes September 16, 1874.

Purdue quickly established prominence in agriculture and engineering, answering the immediate needs of the people. And it has since built solid reputations in veterinary medicine, technology, a range of sciences, pharmacy, nursing, management, liberal arts, health sciences, education, and consumer and family sciences.

The physical growth of campus also has been dramatic. Originally the campus consisted of three buildings rising out of Indiana farmland. Today the main campus encompasses 157 major buildings. The Purdue system has expanded to include Purdue campuses at Fort Wayne, Hammond, and Westville, and degree programs at Indiana University-Purdue University Indianapolis and Indiana University-Purdue University Columbus. Purdue's College of Technology exists in seven Indiana communities in addition to the West Lafayette campus.

Answering the people's needs goes beyond educating productive graduate and undergraduate students. Purdue is a highly respected research institution, with research and sponsored program expenditures of $406 million in the 2003–04 fiscal year on the West Lafayette campus. In addition, the University offers its expertise to the state of Indiana in numerous ways, as well as to business and industry, retailers, and teachers.

Outreach programs include the Purdue University Cooperative Extension Service, with sites in each of Indiana's 92 counties serving as a gateway to lifelong learning. The Office of Continuing Education and Conferences serves tens of thousands of adult learners annually through Purdue courses for personal and professional development offered on campus, off campus, and by distance education.

Purdue is a cultural and recreational hub for people in northwestern Indiana. The Edward C. Elliott Hall of Music houses 6,025 spectators for music, dance, theatre, and pop entertainment. Boilermaker fans crowd Ross-Ade Stadium, Mackey Arena, and the Intercollegiate Athletic Facility for Big Ten Conference football, basketball, and volleyball.

Purdue University ranks among the largest and most prestigious colleges and universities in the United States. Its position of leadership and influence stems in large part from its world-renowned reputation for engineering, science, and technology, but its preeminence is bolstered by an exciting array of academic disciplines. On

the West Lafayette campus, there are more than 200 majors/specializations to choose from within the following schools and colleges:

College of Agriculture

Among the nation's highest ranked and most prestigious institutions, the college offers excellent teaching, research, extension, and international programs. More than 40 programs of study prepare scientists, engineers, business representatives, producers, information specialists, and resource managers for professional careers in the world's food and natural resource systems. See www.agriculture.purdue.edu/oap.

College of Consumer and Family Sciences

The college, one of the largest and highest ranking of its kind in the nation, prepares men and women for careers related to the needs of families and consumers. Students can choose a bachelor of science degree program from 15 majors in the areas of family studies and child development, consumer sciences and consumer business, hospitality, nutrition, health and fitness, tourism, and education. The Department of Hospitality and Tourism Management also offers an associate degree program. See www.cfs.purdue.edu.

College of Education

The state and nationally accredited College of Education prepares high quality elementary, middle school, and secondary teachers and other education professionals for the essential roles they play in guiding the education of our youth and in stimulating their learning. The faculty accomplishes this through a variety of interdisciplinary instructional programs in teacher education, research in the educational process, and engagement with Indiana schools. The college meets this commitment by reaffirming the longstanding belief that the education of teachers is a campuswide responsibility. The college also provides distinctive graduate programs designed to advance the competence of education specialists. The graduate population includes those preparing to be teachers, instructional leaders, administrators, school counselors, counseling psychologists, curriculum specialists, teacher educators, and educational researchers. See www.education.purdue.edu.

College of Engineering

The College of Engineering is internationally known for the quality and scope of programs. Students launch their careers with a common first-year program in the Department of Engineering Education. Once they have completed that program, they choose from undergraduate engineering curricula in aeronautics and astronautics, agricultural and biological, biomedical, chemical, civil, computer, construction engineering and management, electrical, food process, industrial, interdisciplinary, land surveying and geomatics, materials, mechanical, or nuclear. Every school and department offers graduate degree programs. See https://engineering.purdue.edu/Engr.

School of Health Sciences

This school offers a variety of health-related study areas, including medical technology, medical physics, radiological health science (health physics), occupational health science (industrial hygiene), environmental health science, and general health science programs. It also administers the premedical, predental, and pre-allied health programs, including occupational and physical therapy and dental hygiene. Students completing the programs and gaining experience in the field may qualify for professional certification. See www.healthsciences.purdue.edu.

College of Liberal Arts

The college offers essentially all of the traditional disciplines of the humanities, social and behavioral sciences, and creative arts. Majors and minors are available in 11 departments: communication; English; foreign languages and literatures; health and kinesiology; history; philosophy; political science; psychological sciences; sociology and anthropology; speech, language, and hearing sciences; and visual and performing arts. Students can prepare themselves in more than 50 majors, including 11 undergraduate interdisciplinary programs. See www.cla.purdue.edu.

Krannert School of Management

Degree programs include accounting, management, industrial management, and economics. Accounting and management programs focus on finance, marketing, operations, human resources, and strategic planning. The industrial management program combines management and technical education with a manufacturing management,

engineering, or science minor. The accounting program combines a management background with extensive education in accounting principles and practices. All programs include coursework in the arts, humanities, and international and cross-cultural aspects of modern business. See www.krannert.purdue.edu.

School of Nursing

The School of Nursing prepares qualified men and women from diverse backgrounds for meaningful and rewarding careers as professional nurses. Both baccalaureate and graduate degrees are offered on the West Lafayette campus. The rigorous, innovative programs of classroom, laboratory, clinical, and field studies in local, state, national, and international settings prepare Purdue nursing graduates for leadership positions in the global healthcare marketplace. The nationally accredited undergraduate program qualifies the student for licensure as a registered nurse (RN) and for entry into graduate studies in nursing and other areas. This program is distinctive in admitting nursing majors at the freshman year and in offering early hands-on clinical courses at the sophomore level. The master's degree program on the West Lafayette campus offers specialization as an Adult Nurse Practitioner (ANP). Other advanced specializations — including nurse practitioner and clinical specialist options — also are offered through a consortium with other Purdue campuses. See www.nursing.purdue.edu.

School of Pharmacy and Pharmaceutical Sciences

The school offers an accredited professional program leading to the Doctor of Pharmacy degree. This program combines a basic and applied science background as well as clinical experience allowing students to function as licensed pharmacists to provide pharmaceutical care. The two prepharmacy years can be taken either at Purdue's School of Pharmacy or at another institution. The school also has a four-year, non-licensure-eligible B.S. in Pharmaceutical Sciences degree designed for entry-level pharmaceutical industry positions or as a foundation for advanced education. See www.pharmacy.purdue.edu.

College of Science

Actuarial science, biological sciences, chemistry, computer sciences, earth and atmospheric sciences, mathematics, physics, statistics, math and science secondary school teaching, and interdisciplinary science programs prepare students for immediate careers or advanced study. Premedical, predental, and preveterinary options, a cooperative education program, study abroad, and honors programs are available. Students may pursue official minors in other areas outside their major. Enrollment in science while deciding on a major in any field is encouraged. A highly qualified faculty, state-of-the-art facilities, and ongoing research keep teaching up to date.

College of Technology

The eight departments and 22 specializations in the College of Technology prepare students to meet the technological needs of business, industry, and government. Technology students begin taking courses in their major as early as the freshman year. Courses and other opportunities allow students to experience a variety of hands-on, real-world applications. The college awards associate, bachelor's, and graduate degrees. See www.purdue.edu/technology.

School of Veterinary Medicine

This professional school, which graduated its first class in 1963, has assumed a leading position nationally and internationally in veterinary education. The school is one of only 28 in the United States that grant the Doctor of Veterinary Medicine degree. The veterinary technology program is accredited by the American Veterinary Medical Association (AVMA) and awards Associate of Science and Bachelor of Science degrees. The Associate of Science degree is also offered via distance learning. The veterinary technology program at Purdue is the only such program in the state of Indiana and one of only two AVMA programs administered by a school of veterinary medicine. See www.vet.purdue.edu/admissions.

Graduate School

All programs of graduate study and research leading to advanced degrees come under the jurisdiction of this school. They include programs of study leading to the degrees of Doctor of Philosophy, Educational Specialist, Master of Arts, Master of Arts in Teaching, Master of Fine Arts, Master of Business Administration, Master of Science, and Master of Science in various professional fields. See www.gradschool.purdue.edu.

College of Science

Organization and Purpose

Science — the effort to observe, understand, and utilize the laws of nature — is an ancient discipline. Today, science is more exciting than ever because of the speed with which new insights are obtained and often applied to vital human problems, such as population growth, disease, pollution, energy shortages, and food production.

The College of Science at Purdue University offers many undergraduate and graduate programs that will prepare you for a variety of careers. Scientists are encouraged by society to pursue new avenues of research, either as individuals or as part of great research teams employing many scientists. They are needed to design computers and computer programs, locate and analyze natural resources, help find ways to protect our environment, and apply research findings to industrial and human problems. Scientists are needed as teachers at all levels of education. They are sought as administrators for governmental organizations using other scientists or engineers and as salespeople and managers by companies with science-based products.

Undergraduate education in 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 College of Science also is very interested in helping students whose goal is not a career in science but a general education with emphasis on the scientific aspects of our society.

The College of Science at Purdue is an excellent place to acquire an education in science. Its seven instructional departments give you the chance to increase your knowledge of science by interacting with first-rate scientists who also are gifted teachers and by working with modern equipment in well-designed laboratory experiments. The departments also have honors programs if you are qualified and fine libraries that allow you to pursue, in depth, subjects in which you have an interest. You also may choose to pursue a minor in an area of the College of Science or in other areas of the university.

Choosing a Major

Science today is a collection of specializations — and that can be confusing to students who know they want to study science but who aren't ready to commit themselves to a particular subdivision of the field. The undergraduate plans of study in the College of Science reflect the many specializations within science, but there also are opportunities for students to get a broad education in one or more of the sciences.

An important concern will be deciding between the main divisions of science study at Purdue — the life and physical sciences or the mathematical and computational sciences. If you are not sure what specific science to choose as a major, start in the subject you like best and sample other sciences as a first-year student. The first-year programs in the seven departments of the school are similar enough that switching from one science major to another is usually simple, if you decide your initial choice is not best for you.

Decisions about options offered within each department need not be made until at least your sophomore year, and often not until your junior year. Many students obtain a broad science education as undergraduates and delay specialization until graduate school.

If you have a specific interdisciplinary career objective in mind, you might consider one of the options suggested under the Interdisciplinary Science Program or plan to supplement your major courses with those offered by other schools or colleges of the University.

Choosing a major is not always easy, but help is available. Science Counseling advisors and faculty members will be happy to provide information and guidance.

Scholarships

The College of Science grants scholarships based on academic merit to highly qualified applicants each year. During recent years, more than $400,000 in scholarship money has been distributed annually by the College of Science to outstanding students. Top students will receive invitations to apply for scholarships; however scholarship applications are open to all students pursuing a science major.

For beginning students, successful applicants typically will be among the top 10 percent of their high school class, have strong grades in high school math and science courses, and have outstanding standardized test scores (greater than 1350 on the combined SAT exams, or 32 on the ACT exams) as well as outstanding participation in math and science competitions, high school activities, and honors. Continuing students who compete successfully for scholarships usually have at least a 3.5/4.0 overall GPA in addition to a strong record in leadership, community service, and research.

For further information, contact the Scholarship Coordinator, College of Science, Mathematical Sciences Building or visit the college scholarship Web site at www.science.purdue.edu/prospective_students/scholarships. For information about other types of financial assistance, see page 19.

Cooperative Education Program

The College of Science Cooperative Education Program gives science students the opportunity to alternate periods of supervised professional employment with periods of University coursework while studying for their bachelor's degrees.

If you choose to participate in cooperative education, it may take longer to earn your degree, but you will receive several important benefits. Based on past experience of students in co-op programs, you can expect that (1) your earnings from your employment will be enough to pay a substantial portion of your remaining years of employment/studies, and (2) you will gain valuable professional experience in your scientific field — giving you a feeling for the career you select, making your coursework more relevant, and increasing your value as a future employee.

As a co-op student, you will attend Purdue for about two academic years before your first work experience. After that, you will alternate periods of academic study with periods of work experience. The actual study-work schedule depends on your major and cooperative education employer.

Your cooperative education employer will have been approved by the University and will have agreed to give you a meaningful work experience related to your scientific interests. Normally, you will work for the same employer throughout your baccalaureate program and be given increasing responsibility with each work period.

Each department in the College of Science determines its own eligibility requirements for co-op participation and has a departmental coordinator of cooperative education. (Departmental requirements are given in the departmental sections of this catalog.) The departmental coordinator counsels co-op students and has information about available jobs.

You must apply to the coordinator in your department to be accepted into the co-op program. If you are an interdisciplinary science student, apply to the coordinator in the department of your major science concentration or to the College of Science cooperative education coordinator. If you are interested in co-op, you should contact the departmental coordinator as early as possible to facilitate job placement and to assure your eligibility.

The University, through a cooperative education coordinator, supervises you and your employer during work periods. After each work period, you must write a comprehensive report about your work experience. When they graduate, students who complete at least four work periods receive a certificate indicating that they have completed the cooperative education program.

While employed as a co-op student, you must register for noncredit departmental courses numbered 091, 092, 093, 094, or 095 and pay the special University fee for co-op registration.

Teacher Education Program

Purdue University offers programs that prepare students for teaching in early childhood, middle childhood (elementary education), early adolescence (junior high/middle school), adolescence/young adulthood (secondary), and exceptional needs (special education). Program standards, curricula, and licensure are in accord with regulations promulgated by the Indiana Professional Standards Board (IPSB) and authorized by the National Council for Accreditation of Teacher Education (NCATE). Descriptions of performance-based programs may vary by content areas. Official performance-based program guidelines are available via the College of Education Office of Professional Preparation and Licensure (OPPL) Web site at http://admin2.education.purdue.edu/oppl. Students seeking additional clarification and guidance should consult with an academic counselor or faculty advisor.

A person who already holds a bachelor's degree may wish to complete a teacher education program as an "undergraduate for licensing

only" student. If this option is chosen and a second baccalaureate degree is not desired, please contact the Office of Professional Preparation and Licensure for a transcript evaluation. Eligibility requirements do apply.

Title II Reporting Requirements. Purdue University is in compliance with Title II reporting requirements. Please visit http://admin2.education.purdue.edu/oppl/2002/title2 to obtain complete details. If you are unable to access this Web site, please contact the Office of Professional Preparation and Licensure at Beering Hall of Liberal Arts and Education, Room 3229, 100 N. University Street, West Lafayette, IN 47907-2098 for a copy of the report.

2004–05 Teacher Education Requirements

The following information outlines the assessment of students completing a teacher education program at Purdue University in 2004–05. In order to complete the Teacher Education Program, students must successfully pass through Gates A, B, and C in order to meet all requirements for licensing at Gate D.

Students are required to attend the Teacher Education Orientation presented by the Office of Professional Preparation and Licensure (OPPL) during Block I or the CDFS 100 classes in order to fully understand the requirements and procedures. Please note that an application to the Teacher Education Program is required to pass through Gate A for admission to the Teacher Education Program. An application is NOT required for Gate B or Gate C. In order to be licensed in the state of Indiana, a license application must be submitted for Gate D.

Required Criteria and Suggested Time Line

Note: Remain flexible. The length of time to complete the Teacher Education Program is determined by academic progress and career planning. Additional time may be necessary if you are: (a) changing your degree objective (CODO) or transferring, (b) overcoming a grade point average (GPA) below the required Teacher Education Program standard, (c) pursuing an additional major or licensure area, or (d) encountering other unknown needs or circumstances.

Before the First Semester

1. Admission to Purdue University.
2. Admission to the respective academic college, i.e., Agriculture, Consumer and Family Sciences, Education, Liberal Arts, Science, or Technology.
3. Assignment to, and guidance by, an academic counselor.

Consult with your academic counselor regularly to ensure that the required criteria are met and coursework is successfully completed in the sequence authorized by the Purdue University Teacher Education Council.

Requirements for Passing through Gate A

(An application and a Signature Form are required. See No. 8 in the following text.)

1. Submit a signed Signature Form to OPPL. The student's signature acknowledges that he or she will read the teacher education information on the OPPL Web site, referring to it regularly in order to remain informed of the standards and responsibilities in the Teacher Education Program process. The signature also confirms understanding of the following:
   - Limited Criminal History reports may be required throughout the Teacher Education Program for field experiences, and a report will be required for licensing.
   - Purdue University will check the Zachary's Law Registry periodically.
   - The Indiana Professional Standards Board will review misdemeanor/felony convictions at the time of licensing.

2. Complete required courses for Gate A, with no grade lower than a "C" and no "Incomplete or "I."
   - Most program areas — Block I (EDCI 205 and 285).
   - Early Childhood Education — CDFS 210.
   - Special Education — Block I (EDCI 205 and 285) and EDPS 260.

3. Maintain a minimum overall GPA as established by the program area.
4. Maintain a professional education GPA of 3.0/4.0 with no grade lower than a "C" and no "I" for any single professional education course. Courses include Curriculum and Instruction and Educational Studies courses in addition to courses designated by a program area as professional education courses.
5. Maintain a minimum content/major GPA as established by the program area.
6. Meet satisfactory assessment of the initial portfolio as defined by faculty. (For Early Childhood Education (ECE) majors, see the Unit Assessment Component Chart for ECE.)

7. Meet Praxis I: Preprofessional Skills Tests (PPST) or Computerized PPST with the following scores:

	PPST Scale	*Computer-Based Test Scale Taken after 1/02*
Reading	176 or above	176 or above
Writing	172 or above	172 or above
Mathematics	175 or above	175 or above

All scores must be officially submitted to Purdue University by the Educational Testing Service. For more details, please refer to the *Purdue Teacher Education Program Testing Requirements* sheets available from the Office of Professional Preparation and Licensure, Beering Hall, Room 3229, 101 N. University Street, West Lafayette, IN 47907-2098. These test scores also meet part of the state licensure requirements.

8. Submit a completed teacher education application to the Office of Professional Preparation and Licensure if all of the above requirements have been met or will be met by the end of the semester (or summer session if enrolled in summer classes). The application may be marked to hold for current semester grades or test score reports. The application due date is the last day of classes each semester. A student must be enrolled in the college that houses the teacher education major in order to apply for Gate A. The Signature Form must be submitted by the time the application is submitted.
9. Receive written notification of status through Gate A from the Office of Professional Preparation and Licensure.
10. If denied admission, reapplication is required.

Requirements for Passing through Gate B

(No application is required.)

1. Complete required courses for Gate B, with no grade lower than a "C" and no "I":
   - Most program areas — Block II (EDPS 235, 265).
   - Early Childhood Education — CDFS 212B (grade of "B"), 310, and 318, and EDPS 260.
   - Special Education — Block II (EDPS 235, 265) and EDPS 270 and 460.
2. Maintain a minimum overall GPA as established by the program area.
3. Maintain a professional education GPA of 3.0/4.0 with no grade lower than a "C" and no "I" for any single professional education course. Courses include Curriculum and Instruction and Educational Studies courses in addition to courses designated by a program area as professional education courses.
4. Maintain a minimum content/major GPA as determined by the program area.
5. Meet satisfactory assessment of the beginning portfolio as defined by faculty.
6. Request a Limited Criminal History Report if required for field experiences throughout the Teacher Education Program. The Zachary's Law Registry also will be checked periodically.
7. Failure to meet or comply with the above requirements will result in removal from methods courses.
8. Receive written notification of status through Gate B from the Office of Professional Preparation and Licensure.
9. Contact the Office of Field Experiences (OFE) by mid-September of the academic year preceding the student teaching semester (i.e., junior year) to receive a pass code in order to complete the online Student Teaching Application on the Internet by the first of November.

Note: A student must pass through Gates A and B before submitting the Student Teaching Application form to OFE. This application serves as a "letter of intent" and does not imply automatic placement.

Requirements for Passing through Gate C

(No application is required.)

1. Complete required courses for Gate C, with no grade lower than a "C" and no "I":
   - Most program areas — Specific methods courses.
   - Early Childhood Education — CDFS 405, 406, and 408 with grades of "B."
   - Elementary Education — Block III (EDCI 361 and 362), IV (EDCI 363, 364, and 365), and V (EDCI 430 and 466).
2. Pass Praxis II: Subject Assessments/Specialty Area Tests required by the Indiana Professional Standards Board (IPSB) for licensing. For information on required tests and passing scores, please consult a Purdue *Teacher Education Program Testing Requirements* sheet and the PRAXIS Series Registration Bulletin for Praxis I/II.

Note: Praxis II tests are only offered six times a year, and advance registration is required.

3. Maintain a minimum overall GPA as established by each program area.
4. Maintain a professional education GPA of 3.0/4.0 with no grade lower than a "C" and no "I" for any single professional education course. Courses include Curriculum and Instruction and Educational Studies courses, in addition to courses designated by a program area as professional education courses.
5. Maintain a minimum content/major GPA as established by each program area.
6. Meet satisfactory assessment of the developing portfolio as defined by faculty.
7. Successfully pass the Foreign Language Education Area Board of Admission and Retention, FLEABAR II, for all foreign language majors, except French.
8. Receive written notification of status through Gate C from the Office of Professional Preparation and Licensure.
9. Successful completion of requirements through Gate C of the Teacher Education Program allows OPPL to authorize the student to enter the student teaching semester. The Office of Field Experiences will confirm the student teaching placement for each student.
10. Request a Limited Criminal History Report if required for field experiences. The Zachary's Law Registry also will be checked periodically.
11. Begin job search through the Center for Career Opportunities — Education Careers.

Requirements for Passing through Gate D

(License application is required. See No. 9 in the following text.)

1. Student teaching through the Office of Field Experiences:
   - Professional education courses, including methods courses, must be successfully completed before student teaching.
   - Student teaching is possible only after passing through Gate C.
   - A grade of "C" or above must be earned in EDCI/EDPS 496, 498, 499, or CDFS 450 Supervised Teaching.
2. Maintain a minimum overall GPA as established by each program area.
3. Maintain a professional education GPA of 3.0/4.0 with no grade lower than a "C" and no "I" for any single professional education course. Courses include Curriculum and Instruction and Educational Studies courses, in addition to courses designated by a program area as professional education courses.
4. Maintain a minimum content/major GPA as established by each program area.
5. Meet satisfactory assessment of the proficient portfolio as defined by faculty.
6. Continue to meet all criteria for passing through Gates A, B, and C.
7. Request a Limited Criminal History Report for licensure. The Zachary's Law Registry also will be checked periodically.
8. Receive degree. Recommendation for licensure is contingent upon the posting of the degree on the transcript.
9. Apply through OPPL for an Indiana Teaching License, even if leaving the state of Indiana. For more details, consult the Indiana Licensure instruction packet provided by OPPL at the student teacher orientation. The license application may be submitted to OPPL two months prior to the last day of required courses. Do not send the license application to the Indiana Professional Standards Board, since a recommendation from Purdue University is required.

Note: The Indiana Professional Standards Board (IPSB) will ask the following questions on the license application:

- Have you ever had a credential, certificate, or license to teach denied, revoked, or suspended in Indiana or in any other state?
- Have you ever been convicted of a felony?
- Have you been convicted of a misdemeanor other than minor traffic violations since January 15, 1994?

If a conviction of a misdemeanor or felony (including a suspended sentence) is documented, the applicant will be required to submit a written explanation and copies of court records with the license application. The IPSB is solely responsible for the review and response in the case of misdemeanor or felony convictions.

10. Apply for licensure in other states, if desired. Contact the licensing office in the particular state and request application materials. Consult the National Association of State Directors of Teacher Education and Certification (NASDTEC) for Web sites, addresses, and telephone numbers.

Note: If additional coursework is completed at Purdue University for future licensing, submit an evaluation request or renewal application to OPPL.

Admissions

Admissions Inquiries and Procedures

All inquiries about admissions (whether you are entering from high school, transferring from another institution, or re-entering after being out of school) should be addressed to: Office of Admissions, Purdue University, Schleman Hall, 475 Stadium Mall Drive, West Lafayette, IN 47907-2050; admissions@purdue.edu; (765) 494-1776.

Your first inquiry concerning admission should include (1) the amount of education you have completed; (2) your plans for further education, indicating your area of interest; and (3) the approximate date of your entrance to Purdue. On the basis of the information you provide, the Office of Admissions will send you an application as well as general material describing the University and specific information pertaining to your educational interests.

When you are entering directly from high school, the Office of Admissions suggests that you file your application for admission early in your senior year.

Campus Visits

A visit to the campus and an interview with an admissions counselor will help you determine which educational programs at Purdue are in keeping with your educational background and your future career interests. Such a campus visit is especially appropriate during your junior year in high school.

The Office of Admissions is open each weekday from 8 a.m. to 5 p.m. No appointment is necessary; however, if you would like a personal tour of the campus, contact the Office of Admissions before your visit.

Students interested in Purdue have a variety of opportunities to visit the campus. Some programs, such as Fall Preview Days and Introducing Purdue, offer more formal agendas that include admissions presentations, college or school and program sessions, and campus tours. Prospective students and their families also can make individual visits; the Office of Admissions offers several admissions sessions on a daily basis, Monday through Friday, followed by a walking tour of campus. Students planning a visit to campus should first contact the Office of Admissions or visit the Admissions Web site — www.purdue.edu/Admissions — for further information.

Core 40 — Indiana Students

Purdue University applauds the state's efforts to strengthen Indiana's high school students' academic preparation and encourages all students graduating from high school in 1998 and beyond to complete the Core 40 requirements. In addition to considering high school courses, Purdue will continue to use other factors such as grade point average, class rank, trends in achievement, honors courses, and test scores when reviewing applications for admissions. We will evaluate applicants on an individual basis and in relation to their requested majors. Program limitations also will continue to be a factor in admission to certain majors.

Admissions Criteria

Your acceptance as a new student at Purdue is influenced by many factors. Specifically, the Admissions Committee is guided by the following:

1. Your graduation from a high school accredited by a state department of public instruction.
2. The extent to which you meet or exceed minimum subject matter requirements. Most applicants far exceed the minimum requirements indicated in the following table. For admission to the College of Science, your record must include:

Subjects	Semesters Required
English	8
History or social studies	2
Academic math*	6
Laboratory science†	4
Foreign language	4

** Includes algebra, geometry, trigonometry, calculus, etc.*

† Includes biology, chemistry, physics, earth/space sciences, physiology/anatomy, etc.

In satisfying the entrance requirements in laboratory science, it is advisable for at least one semester to be in chemistry. If it is possible for you to exceed the above requirements, biology and physics are recommended in addition to chemistry.

In planning your other electives while in high school, you should review the starting points of the curricula in the College of Science (pages 27-30).

3. Quality requirements.
- Quality is determined by considering a combination of overall academic achievement, rank in class, test scores, ability to be successful, grade average in college preparatory subjects, grades in courses related to the student's major, trends in achievement, completion of high school subject matter requirements, time of year you apply, and the strength of the college preparatory program.
- Preference will be given to Indiana residents.
- Because the total number of students who may be accepted as beginners is limited, admissions may close at any time.

4. Required tests.
- All applicants who have not completed a full year of college work are required to provide SAT or ACT scores.
- Students are encouraged to take either the SAT or the ACT in the spring of the junior year.

5. Information provided by your high school counselor.

Because this catalog is used for two to three years, you should refer to www.purdue.edu/Admissions for the most current and accurate information about admission to the College of Science for beginning students.

Advance Deposit on Fees

If you are a new student admitted for the fall semester, you must make an advance deposit of $100 that is nonrefundable (except as indicated below). This deposit is to reserve a place for you on the new student roster. Students admitted on or before April 10 must submit the deposit by May 1. Those admitted after April 10 must submit the deposit within three weeks (21 days) after the date of the Offer of Admission.

If you receive an Offer of Admission but fail to make the required deposit of $100 within the time allotted, you automatically forfeit your right to a place on the new student roster.

The $100 advance deposit will be applied to your first semester fees and is not associated with your University housing application or contract. If, for valid reasons, you find that you cannot attend the University, notify the Office of Admissions before July 1, and you will receive a partial refund.

Early Enrollment for Superior Students

If you are a high school student with a highly superior scholastic record during the first three years of high school, you may qualify for admission to Purdue without high school graduation.

The regular entrance requirements are supplemented by certain objective measurements of your qualification to advance to the university level. In this way, the University tries to recognize and provide for individual rates of learning and achievement.

As a nongraduate of high school, you will be considered for admission if you (1) have earned 12 or more credits toward graduation; (2) have a highly superior school record; (3) are strongly recommended by your principal; (4) have the approval of your parents for college entrance without high school graduation; (5) qualify by your performance on prescribed admissions tests; and (6) are approved by the University Admissions Committee.

Purdue cannot guarantee high school diplomas under this arrangement, but it cooperates with whatever arrangement the state or local school system may have for awarding a high school diploma to a successful participant in this plan.

Admission with Advanced Standing

On the basis of your CEEB Advanced Placement Examination, Purdue advanced credit examination, or high school record, you, as a first-year student, may receive advanced credit and/or advanced placement.

Transfer Students

If you are transferring from another college or university, you must comply with the following admissions procedures:

1. Submit an official undergraduate application for admission.

2. Forward official transcripts of work done at institutions previously attended (both high school and college). A separate transcript must be provided by each institution, regardless of whether credit is requested.

To be considered for admission, transfer students should apply as soon as possible for the term they wish to enter. To be admitted, students must have the necessary grade point average at the time they apply (and any required college coursework) and meet high school subject matter requirements.

Because this catalog is used for two to three years, you should refer to www.purdue.edu/Admissions for the most current and accurate information about admission to the College of Science for transfer students.

Transfer (or Advanced) Credit

Credit for courses at Purdue University will be given for work of equivalent character and amount successfully completed at another accredited college. Advanced standing will be determined on the basis of these credits. Advanced credit will be regarded as provisional and may be withdrawn by the director of admissions upon recommendation of the head of the department concerned if dependent work is not satisfactorily completed.

When credit earned at another college or university is transferred to Purdue and accepted toward advanced standing, the credit is converted into terms of Purdue courses and applied to the program of study. It remains for you, the student, to complete the program, and your schedule of courses each term will be adjusted accordingly. It does not follow that your classification at Purdue or the time necessary for completion of the required work for a degree will be in line with what was expected at the previous institution. Grades are not transferred; only credits in courses are recorded.

Students participating in college-credit courses taught concurrently for high school and college credit during the regular school day by local high school teachers must validate the credit by submitting satisfactory results on the College Board Advanced Placement Examination or the Purdue advanced credit examination, as determined by the subject department. The determination of use of transfer credit in part or in full to satisfy graduation requirements is the responsibility of the school head or his or her designated representative, in accordance with the regulations of the University faculty.

All credentials are submitted with the understanding that they become the property of Purdue University.

Early Registration — Day on Campus

The Office of Admissions invites you to campus for one day of early registration during the summer before your first semester as a new student. This day is set aside for you to meet with your academic counselor and to select your first-semester classes. The University then will proceed with the registration process and mail you a fee statement and your class schedule.

Orientation

The Office of Admissions' Orientation and New Student Programs offers several programs to help beginning and transfer students adjust to Purdue. Boiler Gold Rush is for new, beginning students and includes a variety of activities designed to help them make a smooth transition into Purdue. Students who begin their studies at Purdue at other times of the year also have the opportunity to participate in orientation. Invitations to these different programs are mailed to the students at the appropriate time.

Nondegree Students

If you are an adult living near one of Purdue's campuses and you want to take a course at the University without seeking a degree or following a regular plan of study, you can apply for admission as a nondegree student. You must show that you have the background and course prerequisites necessary for the course or courses in which you are interested. The Office of Admissions will advise you on admissions procedures.

International Students

If you are an applicant from another country, your application and supporting documents will be evaluated by the staff in the Office of International Students and Scholars. You will be admitted on the basis of credentials certifying the completion of preparatory studies comparable to requirements for United States citizens applying at the same entry level. Guidelines for determining admissibility are specified in the "Admissions Criteria" section of this publication. English translations must accompany transcripts and other credentials. You also must submit satisfactory evidence of your ability to comprehend English as shown by a TOEFL (Test of English as a Foreign Language) score of at least 550 (213 computer-based score). The minimum score for First-Year Engineering applicants is 567 (233 computer-based score.)

You must furnish sufficient evidence of adequate financial support for your studies at Purdue.

The Office of International Students and Scholars will assist you in entering the United States and the University. The office also will provide other services such as orientation programs, immigration advising, and personal and cross-cultural counseling. See the Web site at www.iss.purdue.edu.

Military Training

Reserve Officers' Training Corps (ROTC) is available for all men and women who are full-time students. You can pursue military courses in conjunction with the academic curriculum and receive academic credits. If you complete the program, you will receive a commission as an officer in the Army, Navy, Marine Corps, or Air Force. You do not incur a commitment until you are accepted into the program and enroll in the third-year course or accept an ROTC scholarship. Scholarships that assist with tuition, incidental fees, and textbooks are available through all four services. A monthly allowance is available for students who sign a contract. Additional information is available in the College of Liberal Arts catalog, or you can contact any of the military departments directly. All ROTC offices are located in the Armory.

Time of Entrance

Purdue University offers instruction during two semesters and summer session. You can begin most programs of study with any semester or during the summer. The semesters start in August and January, and the summer modules begin in May, June, and July. Students may begin the following programs only at the times stated: flight, nursing, and the Undergraduate Studies Program, fall; the specific veterinary technology program you are interested in will determine when you may begin your studies.

Proof of Immunization

Indiana state law requires proof of immunization for the following vaccine preventable diseases as condition of enrollment on residential campuses of state universities: measles, mumps, rubella, diphtheria, and tetanus. In addition, international students must provide documentation that they have been tested for tuberculosis after arriving in the United States. Information regarding compliance will be forwarded to all admitted students.

The Purdue Statewide Academic System

Admission to Another Purdue Campus

Purdue's educational system provides students access to a full complement of the University's faculty, resources, and academic programs. Whether you're enrolled at Calumet, Fort Wayne, North Central, or West Lafayette, you can pursue a degree from Purdue University and fulfill your career aspirations.

As one of the nation's top research institutions, Purdue is recognized around the world for the quality of its programs and its graduates. When you pursue your goals at a Purdue campus, you'll earn your share of that reputation. You'll enjoy all the challenges as well as the benefits and rewards associated with a preeminent university. Purdue University's quality is available across the state, and the primary goal of each campus is to help each student excel through discovery, learning, and engagement.

For information about what is offered at each Purdue University campus, use the following contact list.

Calumet	www.calumet.purdue.edu adms@calumet.purdue.edu
Fort Wayne	www.ipfw.edu ipfwadms@ipfw.edu
North Central	www.pnc.edu admissions@pnc.edu
West Lafayette	www.purdue.edu admissions@purdue.edu

There also are Purdue programs offered at Indiana University-Purdue University Indianapolis. Go to www.iupui.edu for more information.

Admission to the College of Technology — Statewide

The College of Technology resides in seven Indiana communities in addition to the West Lafayette campus. A unique partnership of education, business, industry, and government, these community-based locations feature quality curriculum requirements; faculty who are as highly qualified as their West Lafayette-campus peers; low student-to-faculty ratios; and the opportunity to earn a degree from Purdue University.

Technology programs at all locations emphasize hands-on, real-world applications to engineering principles. Students learn marketable skills to meet the defined needs of Indiana business and industry. Purdue College of

Technology graduates are well prepared for immediate employment and enjoy one of the University's highest job-placement rates and some of the highest starting salaries for undergraduate majors.

In addition to academics, these College of Technology locations offer opportunities to get involved in on-campus and community activities. They also provide a full range of student services to ensure a rewarding college experience and future success.

The College of Technology Web site is www.purdue.edu/technology. For information about what is offered at each location, contact the Office of Admissions on the West Lafayette campus at admissions@purdue.edu or contact the location that interests you. The following list provides contact information for each location.

West Lafayette
Michael O'Hair
(765) 494-2554
mtohair@purdue.edu

Anderson/Muncie
Jack Beasley
(765) 641-4552
cjackrun@purdue.anderson.edu

Columbus/Southeastern Indiana
Nancy Wilson Head
(812) 348-7210
headn@purdue.edu

Indianapolis
Ray Thompson
(317) 484-1824
rethompson@tech.purdue.edu

Kokomo/Lafayette
Tom Capozzoli
(765) 455-9216
tkcapozzoli@puk.indiana.edu

New Albany
Richard Kopp
(812) 941-2353
rdkopp@puna.indiana.edu

Richmond
Brian Alenskis
(765) 973-8354
baalenskis@pur.indiana.edu

South Bend/Elkhart
David Frantz
(574) 237-4180
dwfrantz@pusb.iusb.edu

Readmission

Students who are dropped from Purdue University for academic deficiency must be out of the University for at least one semester (not including summer session) and must apply for readmission through the Office of the Dean of Students. There are deadlines for submitting an application with a $100 fee, and for removing all encumbrances. A student may strengthen his or her application by submitting evidence of successful coursework from another institution. Information about the readmission process is available from the Office of the Dean of Students, Schleman Hall, 475 Stadium Mall Drive, West Lafayette, IN 47907-2050; telephone (765) 494-1747.

Nondiscrimination Policy Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability, or status as a disabled or Vietnam era veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1 which provides specific contractual rights and remedies. Additionally, the University promotes the full realization of equal employment opportunity for women, minorities, persons with disabilities and Vietnam era veterans through its affirmative action program.

Expenses

The cost of attending Purdue University varies, depending on variety of factors, including where a student chooses to live; travel expenses; food costs; enrollment in a special program, college, or school, etc. Basic minimum costs for the two-semester 2004–05 school year on the West Lafayette campus are shown in Table 1. Some academic programs may have additional fees. Contact the department if you have questions.

Full-time students are charged a general service fee and a technology fee that provides them with access to a variety of services and privileges. With payment of these fees, students have access to the Purdue University Health Center (PUSH) that covers medical clinical office visits, nutrition consultations, health education services, and a limited number of sessions for psychological counseling. Additional fees are charged for lab, x-ray, urgent care, physical therapy, and other services.

Payment of the general fees also provides students with access to the Recreational Sports Center and the Boilermaker Aquatic Center for recreational sports activities, and allows deep-discount ticket prices for most Convocations-sponsored events and for Intercollegiate Athletics contests with presentation of a student ID card.

Miscellaneous personal expenses include such items as clothing, transportation, telephone, newspapers and magazines, dry cleaning and laundry, entertainment, etc.

Refunding of Fees and Tuition

Registered students who find it necessary to cancel their registration before the beginning of classes, upon the recommendation of the registrar, will receive a 100 percent refund of all fees and tuition.

Non-Title IV Aid

Students who withdraw during the first six weeks of a semester, with the recommendation of the registrar, will receive a partial refund of the general service fee and tuition. More specifically, the percentage of refund is determined as follows:

Fall or Spring Semester

1. Withdrawal during the first or second week, 80 percent refund
2. Withdrawal during the third or fourth week, 60 percent refund
3. Withdrawal during the fifth or sixth week, 40 percent refund

No portion of the health, student activity, recreation facilities, technology, or academic building facilities fee will be refunded once classes begin.

Table 1. 2004–05 Estimated Costs West Lafayette Campus (Fall and Spring Semesters)

Items	Indiana Resident	Nonresident
Tuition/Fees	$6,092*†	$18,700*†
Room/Board	7,020	7,020
Books/Supplies	940	940
Travel	230	320
Miscellaneous	1,040	1,040
Total	**$15,322**	**$28,020**

** First-time students enrolled at the West Lafayette campus beginning in the Fall 2002 Semester and thereafter pay these higher fees. Undergraduate, graduate, and professional students who were enrolled as degree-seeking students in the Spring 2002 Semester on the West Lafayette campus will pay a lower fee. To maintain eligibility for a lower fee, students must be continuously enrolled (Fall and Spring semesters); eligible students will pay a lower fee until the date of attainment of one degree or until the Fall 2007 Semester, whichever comes first.*

† Your budget can vary, depending on your state of residence and the type of housing and academic program you select. Some programs have additional fees: Engineering, $532; Management, $832; Flight, individual courses in the program have additional fees that can be reviewed at www.purdue.edu/bursar or by contacting the Department of Aviation Technology. International students pay an additional $50 per semester.

Rates and refund schedules are subject to change without published notice.

Title IV Aid

Once classes begin, refunds are prorated based on the date of withdrawal from class(es). Refunds are based on a diminishing scale through 60 percent of the semester. Refunds are calculated on all fees and tuition.

Summer Modules

Refunds for summer modules are proportionate on the same basis as semester refunds.

Financial Aid

Purdue University recognizes that not all students and their parents can afford to finance a college education entirely from their income and assets. To ensure that all students have an opportunity to obtain a college education regardless of their financial circumstances, the University, through the Division of Financial Aid, administers a fourfold program of scholarships, grants, employment opportunities, and loans.

The Purdue University Division of Financial Aid administers federal, state, and University financial assistance programs. These programs require students to have a high school diploma or GED. Information regarding the GED is available through any public high school or any state department of education/public instruction.

Most types of aid are based upon financial need and satisfactory academic progress. To be considered for all types of financial aid, you must submit a Free Application for Federal Student Aid (FAFSA). This form can be obtained from a local high school guidance office; from the Division of Financial Aid, Schleman Hall of Student Services, Room 305, 475 Stadium Mall Drive, West Lafayette, IN 47907-2050; or via the World Wide Web at www.fafsa.ed.gov.

You should apply early for Purdue University financial aid. Eligible FAFSAs postmarked or transmitted by March 1 will receive preference in the awarding of aid. We encourage you to have proof of mailing.

You are welcome to visit the campus to discuss not only family budgeting in order to meet college expenses, but also the types of available aid and the application procedure. Walk-in counselors are available from 8 a.m. to 5 p.m. on Monday, Tuesday, Wednesday, and Friday, and from 1 to 5 p.m. on Thursday. Phone counselors are available from 8 a.m. to 5 p.m. Monday through Friday. Telephone access to your aid status is available 24 hours a day by phoning (765) 494-5050, and computer access to your aid status is available at www.ssinfo.purdue.edu.

Resident Assistants

University Residences has a plan whereby graduate and undergraduate students who are at least 21 years of age by the end of their first semester of employment with University Residences can be hired as a resident assistant (RA). An RA devotes approximately 20 hours each week to his or her duties in this capacity, with most of the time scheduled during evenings and weekends. Compensation for an RA position includes tuition remission, room and board, and a cash salary. Applications and additional information for those interested in becoming a resident assistant can be found at www.housing.purdue.edu.

Living Accommodations

University housing, facilities, and programs are available to all students based on Purdue's policy of equal opportunity regardless of national origin, race, or religion. It is the University's desire and expectation that all others providing housing or services to Purdue students will do so in a manner consistent with this policy. However, the University does not approve or disapprove specific housing accommodations since it believes that the choice of housing rests with you, the student.

As a Purdue student, you have a variety of choices when it comes to choosing your new home while attending school. You can live in one of 14 University Residences, a fraternity or sorority house, cooperative housing, or in a privately operated facility within the local community.

On your application for admission to the University, you will be asked to indicate the type of living accommodations in which you are interested. If you are accepted to Purdue and have specified a preference for University hous-

ing, you will receive a University Residences application. Acceptance for admission to the University does not, however, guarantee the availability of housing accommodations.

The housing application must be filled out and returned promptly. This housing application is in addition to your admissions application to the University.

University Residences for Undergraduate Men and Women

University Residences provides accommodations for approximately 11,100 single undergraduate men and women.

The all-male residences include Cary Quadrangle, providing accommodations for 783 students, and Tarkington and Wiley Halls, each providing space for about 700 students.

Seven University Residences — Owen, McCutcheon, Harrison, Shreve, Earhart, and Hillenbrand halls — house approximately 800 students each, and Meredith Hall accommodates 600 students. These are coeducational units with male and female students assigned to separate areas of each building.

Duhme, Shealy, Wood, Warren, and Vawter halls comprise the all-women's residences and are referred to as Windsor Halls.

All residences contain generous lounge space, recreation areas, kitchenettes, study spaces, and post office facilities.

As a student, you may choose from three plans consisting of 10, 15, or 20 meals a week, as suits your lifestyle. University Residences offers students who are sophomore 3 and above the Black Meal Plan, consisting of a block of 210 meals, and the Gold Meal Plan, consisting of 300 meals. With these plans, you may use your meal swipes as often as you wish. All meal plans include Dining Dollars, which may be used to buy additional food items at University Residences' Dining Services retail operations, such as grills and mini-marts. You may eat at any University Residences' Dining Services facility by using your University ID card.

Computer labs are available in each University Residences hall. If you bring a personal computer, you may use the Residences' optional Ethernet connections or data-over-voice service to access the University computing network directly from your room.

Room and board rates in 2004–05 vary from $5,022 to $7,784, depending on your chosen meal plan option, residence, and room size.

Approximately 700 spaces in Hawkins Hall are reserved for assignment to older undergraduate students. Accommodations in Hawkins Hall are on a room-only basis. The cost for a room in 2004–05 ranges from $320 to $585 a month depending on the type of room selected; that includes local telephone service with voice mail and call waiting.

More than 1,000 spaces for single undergraduate students are available in Hilltop Apartments. The apartments house two, three, or four students and are available for both single male and female students. All normal policies and regulations of University Residences apply to the apartments. Students living in the apartments may choose a meal plan that allows access to any University Residences Dining Services facility, or they may choose a non-board option. The room and board rate for 2004–05 in the apartments ranges from $5,570 to $8,530 a year.

(Rates quoted are subject to change as approved by the Board of Trustees and undoubtedly will be somewhat higher during the 2005–06 period of this publication.)

Visit www.housing.purdue.edu for additional information.

Accommodations for Married Students/Families

At Purdue Village, there are 1,000 University Residences-operated apartments located within a one-mile walking distance of the main campus. The apartments are unfurnished and equipped with a stove and refrigerator. There are one-bedroom and two-bedroom apartments, with the two-bedroom apartments having washers and dryers.

One-bedroom apartment costs range from $492 to $513 a month. Two-bedroom units range from $615 to $632 a month. Your rent payment covers all utilities, including local telephone service and Boiler TV (cable). These rates are effective during the 2004–05 academic year and are subject to change as approved by the Board of Trustees.

Each apartment is equipped with a connection for the campus cable TV system as well as for the campus computing network. The apartments are not air-conditioned, but tenants may bring or purchase their own air-conditioning unit as long as it meets specified criteria, has

compatible voltage ratings, and the apartment's maintenance staff does the installation.

For more information on Purdue Village, visit www.housing.purdue.edu, call (800) 440-2140, or fax (800) 440-2141.

Cooperatives

Cooperative houses also provide housing for students. These houses are large residences that are owned and operated by 20 to 50 students. Seven women's houses and five men's houses have been recognized officially by the Office of the Dean of Students, and each house has a live-out faculty or staff advisor.

Students in cooperative houses significantly decrease their housing costs by contributing three to four hours of house duties a week. Residents of cooperatives pay an average of $3,000 per academic year for room and board. New members are selected by current members through a rush process each January.

To obtain information about becoming a cooperative member, contact the Office of the Dean of Students, Schleman Hall, Room 250; 475 Stadium Mall Drive; West Lafayette, IN 47907-2050; (765) 494-1231. Students are expected to complete and return application information by February 1 or earlier for membership the following fall semester.

Additional information is available at www.purduecooperatives.com.

Fraternities and Sororities

Purdue has 46 fraternities and 24 sororities. Most members live in chapter houses, and membership is by invitation.

Sororities provide an opportunity in the fall for interested women students to see each of the sororities, but the formal new member recruitment period is held just before the beginning of the second semester. Yearly costs for sororities range from $3,300 to $4,380. The average number of women living in a sorority is 68.

In the fall, the Interfraternity Council provides recruitment information through which interested men can become acquainted with the fraternity system. Open recruitment is conducted throughout the academic year. The average number of men belonging to a fraternity is 72, and costs range from $800 to $2,300 a semester.

For additional information, contact the Office of the Dean of Students; Purdue University; Schleman Hall, Room 250; 475 Stadium Mall Drive; West Lafayette, IN 47907-2050; (765) 494-1232. Online information is available at www.purdue.edu/gogreek.

Services

Accelerated Programs

The departments of the College of Science give a variety of honors and offer advanced placement courses. Through the awarding of additional credit hours, you are permitted to complete your programs at an accelerated rate as well as enroll in scientific courses of greater depth.

You also can establish credit by examination on specific Purdue courses. Eligibility is based on advanced work done in high school or on independent study.

For specific information, contact the Science Counseling Office.

Academic Advising

The College of Science Counseling Office will be a valuable resource for you as an undergraduate. Generally, you will work with the same advisor throughout your freshman and sophomore years. During your junior and senior years, you may be assigned a faculty advisor in addition to a professional advisor. Your academic advisor will aid you in developing your total educational plan. In addition to coursework, your education may include the pursuit of experiences such as internships, research opportunities, volunteer work, or study abroad. You will meet with your advisor for curriculum planning assistance each semester. During advising appointments, you will discuss course requirements for your major, placement criteria for courses, elective choices, concentrations and minors of interest, special opportunities, co-curricular opportunities, and your academic progress. Your advisor also will be available to discuss your career goals, refer you to appropriate resources, and address other issues of concern to you.

In the course of your studies, you will encounter situations governed by state laws and University regulations. Although you will be

responsible for the fulfillment of degree requirements, your advisor will help keep you informed about such requirements and advise you concerning ways to satisfy various regulations. A thorough study of this *College of Science* bulletin as well as other official University publications is recommended, although they do not include all of the University rules and regulations. From time to time, you will be given notice of required actions (other than those listed in this bulletin) at your campus address or in the campus press.

Whether you are a prospective student or are already enrolled at the University, you are welcome to write or visit the Science Counseling Office in Room 231, Mathematical Sciences Building. The office is open weekdays from 8 a.m. to 5 p.m.

Center for Career Opportunities – Science Division

The Center for Career Opportunities office in Science — CCO-Science — can help you figure out where you want to go and how to get there. A career counselor can help you find a particular career path, make sure you are in the right major to suit your interests, and help you technically improve your resume and find experiences to enhance it in your job search or other post-graduate plans.

You may make an appointment with a career counselor in the Science Counseling Office, Room 231, Mathematical Sciences Building, or phone 494-1771 to make an appointment.

Science Diversity Office

The Science Diversity Office is an umbrella organization that encompasses both the Multicultural Science Programs and the Women in Science Programs. The College of Science believes that all students have a better educational experience within a diverse environment. Therefore, programming is available to increase the recruitment and retention of students who are underrepresented in the College of Science. All programs are open to all students regardless of race or gender.

Multicultural Science Programs

The College of Science offers programming to increase the number of underrepresented groups graduating in the sciences. Activities include precollege activities for middle and senior high school students, summer transitional programs for high school graduates, classes to cultivate leadership and academic success, mathematics enrichment instruction, and personal counseling.

The Association of Multicultural Students, founded in 1972, offers opportunities for multicultural students to grow academically and professionally by featuring workshops, incentive programs, community outreach programs, and coalition building.

Women in Science Programs

The College of Science is committed to making careers in all areas of science accessible to female students. The goals of the Women in Science Programs are to provide personal support, enhance self-esteem, and share effective strategies to assist women in achieving their academic goals. Components of the Women in Science Programs include a residential program for first-year women, tutoring, an undergraduate mentoring program, and a graduate mentoring program.

The residential program puts a group of first-year women together on several floors of a University residence. Tutoring and other special programs, including the undergraduate mentoring program, are available directly in the University residence. In the undergraduate mentoring program, each first-year woman in the residence is matched with a more advanced student in the same major to provide a unique mentoring relationship.

Both the undergraduate and graduate mentoring programs provide monthly dinner programs featuring speakers of interest to women in the College of Science.

Directors and Special Program Coordinators

Meredith Graham, Coordinator of New Student Recruiting, graham@science.purdue.edu

Cher W. Yazvac, Coordinator, Center for Career Opportunities–Science Division; yazvac@science.purdue.edu

Barbara S. Clark, Director of Science Diversity Office; BarbClark@purdue.edu

Zenephia E. Evans, Director of Multicultural Science Programs; zevans@purdue.edu

Counseling

Each college or school has a general counseling office and academic advisors who can answer questions about degree requirements, registration, dropping and adding courses, and withdrawal from school.

Mature and qualified faculty and staff, graduate students, and older undergraduate students are employed on the University Residences counseling staffs and live in the halls to assist students with personal and scholastic problems.

The Office of the Dean of Students is staffed by professionally trained counselors who provide personal, educational, and career counseling. They can, for example, offer assistance or refer you to specialized help in such areas as vocational choice, campus activities, scholastic concerns, multicultural programs, assistance for students with disabilities, home and community relationships, and coping strategies.

Other campus services for students include the Counseling and Guidance Center, Counseling and Psychological Services, Financial Advising Service, International Students and Scholars, Learning Center, Marriage and Family Therapy Center, Steer Audiology and Speech-Language Center, Student Health Center, and Writing Lab.

Services for Students with Disabilities

Services for students with disabilities (physical, mental, and learning disabilities) are provided through the Adaptive Programs division of the Office of the Dean of Students. Services vary according to the needs of students. They include interpreters, readers, note-taking assistance, accessible class scheduling, parking permits, and help working with professors. For further information, contact the Office of the Dean of Students. The Web site is www.purdue.edu/odos/adpro. The general office number is (765) 494-1747, and the TDD number for people with hearing or speech impairments is (765) 494-1247.

College of Education Academic Services

The College of Education's Academic Services Unit offers several types of assistance important to students enrolled in teacher education programs. At Purdue, students in teacher education programs are academic majors in the colleges of Agriculture, Education, Consumer and Family Sciences, Liberal Arts, Science, and Technology. The College of Education offers majors in the fields of elementary education, social studies education, and special education. The Academic Services Unit within the College of Education assists all students in teacher education, regardless of the college in which their major is housed, by providing the following specialized services: admission and retention, field experiences, and licensure.

The Office of Professional Preparation and Licensure processes students' applications for all teacher education programs, provides information about programs available at Purdue, and monitors students' progress for retention within programs. As a student, you should be aware that admission to the Purdue University Teacher Education Programs is a separate and distinct step beyond admission to the University and that the standards for admission to, and retention in, teacher preparation programs are higher than those required to remain in good standing within the University. This office also provides explanation and interpretation of teacher licensing requirements. Students who have completed teacher education programs are evaluated and recommended for licenses. This office makes licensing records as well as accreditation support available.

The Office of Field Experiences coordinates all placements in area schools in order to provide students with the early field experiences and student teaching experiences required in all teacher education programs.

Center for Career Opportunities

The staff of the campus-wide Center for Career Opportunities will assist you with your career-related employment search. Counseling, guidance, and a wide variety of job search services related to internships and full-time employment are available.

The center maintains contacts with many industrial and business organizations as well as with governmental and non-profit agencies. You can arrange interviews with employer representatives or explore current openings for internships or full-time positions. For more information, refer to the center's home page at

www.cco.purdue.edu.

The Technology Resources Center

The Technology Resources Center (TRC) provides curricular materials, instructional resources, and technology support and service for educators. It assists students, pre-service teachers, faculty, and staff to ensure that they possess the necessary skills to use technology in support of their professional goals. This includes a 24-workstation computing facility, software and equipment checkout, and an e-Portfolio development site. The TRC also serves as a textbook review site for annual state textbook adoption services. See http://admin2.education.purdue.edu/ edit/trc.

For Further Information

General Information. The *General Information* bulletin will give you further details about admission, fees, expenses, financial aid, registration, living accommodations, student activities, student services, requirements for graduation, transfer students, ROTC, and other areas of student interest.

University Regulations. The *University Regulations* bulletin will provide details about academic, conduct, and student organization policies and procedures. You can request copies from Purdue Marketing Communications, South Campus Courts, Building D, 507 Harrison Street, West Lafayette, IN 47907-2025; (765) 494-2034; or access the Web site at www.purdue.edu/oop/univregs.

Graduation Rates. Graduation rates for the West Lafayette campus are available by contacting the Office of Management Enrollment, Schleman Hall, 475 Stadium Mall Drive, West Lafayette, IN 47907-2050; (765) 494-0292, enrollmentmanagement@purdue.edu. These rates are calculated and made available as required by the Student Right-to-Know and Campus Security Act.

Alcohol Policy. Purdue students are subject to Indiana law, which prohibits consumption or possession of alcoholic beverages by anyone under 21 years of age. The University does not permit alcohol to be brought onto Purdue property, with certain exceptions, by any person regardless of age. Fraternity and sorority houses and student cooperative housing units are considered off-campus housing and are permitted to have alcoholic beverages, but they must observe specific University guidelines and state law.

The University does not have the responsibility or the authority to control off-campus student drinking, but it does attempt to give students the opportunity to make informed and mature decisions about alcohol use. A variety of educational and counseling programs are offered to help students deal with all aspects of alcohol and drug use, from peer pressure to dependency.

Safety. The University strives to provide a safe and secure environment for students, staff, and visitors. The University distributes an annual security report containing campus crime statistics and information relating to campus safety and security policies and programs. The report is available on the Web at www.adpc.purdue.edu/PhysFac/police. A paper copy may be requested by calling (765) 494-8221 or contacting the Purdue University Police Department, Terry House, 205 S. Intramural Drive, Purdue University, West Lafayette, IN 47907-1971.

Intellectual Property. All students are subject to the University policy on intellectual property, Executive Memorandum B-10, which can be found at www.purdue.edu/oop/policies/

The Office of the Vice President for Information Technology is in charge of the integrated computing and telecommunications services on the West Lafayette campus. The information technology (IT) program, formally known by the acronym ITaP, serves Purdue faculty, staff, and students.

Computing services range from the very visible computing laboratories that are located throughout campus to the unseen but essential enterprise applications that facilitate the business of the University. Computing staff install, maintain, operate, and repair computer equipment, and provide services including career accounts, e-mail, calendering, directories, and database administration.

In addition to laboratory facilities, instructional services include:

1. The WebCT course management system.
2. Technology in the Classroom (TIC) sites.
3. Help in preparing multimedia materials to enhance instruction.
4. Grants for innovative instructional projects using information technology.
5. The Digital Learning Collaboratory, a joint project with the Purdue University Libraries.
6. The Adaptive Programs lab for those with special needs.
7. Web-based access to many software applications (DACS).

Distributed computing and grid computing are basic elements in the computing program. An IBM SP, a Regatta, and Linux clusters provide supercomputing power for intensive computational needs ranging from simulations and modeling to computational chemistry.

The optical fiber network known as I-Light links Purdue's West Lafayette campus to Indiana University and Indiana University-Purdue University Indianapolis (IUPUI) and joins computers at Indiana University and Purdue into a virtual machine room with teraflop capabilities. Parallel programming services and archival storage systems are available to researchers.

The Envision Center for Data Perceptualization provides visualization computing and multimedia production services as well as animation and rendering capabilities, computer-aided design, large-scale data handling, haptic interaction capabilities, and virtual environment creation. Within the center there is an access grid node linking the University to several hundred research sites around the globe, plus portable versions of the node to facilitate videostreaming. Separate video production and audio-visual duplication facilities are available as are satellite uplink and downlink capabilities and broadcast and network services.

Policies and best practices provide the foundation for a security system that also includes:

1. Firewall protection.
2. Free anti-virus applications.
3. Spam filtering.
4. Authentication and authorization procedures.
5. Vulnerability scanning.
6. Forensics.

Telecommunications services provided by ITaP range from basic phone services for campus offices and residences to wireless connectivity in areas throughout the campus. ItaP supports the infrastructure that links campus buildings by optical fiber and provides commodity Internet to residences and offices as well as connectivity to Internet 2 for researchers.

ITaP negotiates contracts for mass purchases of informational technology equipment and licenses for software used by University personnel. As an additional service, ITaP has negotiated significant discounts for faculty, staff, and students on personal purchases of hardware available through the Web, and for software media sold on campus. The hardware discounts also are available to Purdue alumni.

To help University personnel stay up to date on the rapidly changing information technology field, courses and one-on-one consulting are available on every aspect of computing and telecommunications, including selecting phone systems, basic use of Microsoft office applications, programming, visualization, instructional media, e-learning, and research techniques.

For additional information, please consult www.itap.purdue.edu, call (765) 494-4000, or visit the ITaP Customer Service Center in Stewart Center, Room G068, 128 Memorial Mall, West Lafayette, IN 47907-2034.

Libraries

The collections and services of the Purdue University Libraries are an important resource for your educational experience.

The University Libraries system on the West Lafayette campus includes 13 subject-oriented libraries and the Hicks Undergraduate Library. The libraries provide a print collection of more than 2,400,000 volumes and over 2,500,000 microforms of older scholarly materials and many current scientific and technical reports. Approximately 20,000 serial titles are received, including periodicals and serial publications of societies, institutions, and the federal and state governments. Federal government publications are received on a depository basis. The libraries also offer a wide variety of electronic information sources, including bibliographic databases and electronic journals.

THOR (THe Online Resource), found at www.lib.purdue.edu, is the Libraries' gateway to electronic services including the local catalog, indexes, full-text resources, tutorials, selected newspapers from around the world, ready references such as dictionaries, the online catalogs of other libraries, and more. THOR is accessible from anywhere that the World Wide Web can be accessed.

The John W. Hicks Undergraduate Library may serve many of your library needs, particularly during your first two years as a Purdue student. You will find assistance in locating information needed for papers and speeches as well as an extensive collection of reserve books for course assignments.

The Digital Learning Collaboratory (DLC) is located in the Undergraduate Library. It is a joint initiative of Purdue Libraries and Information Technology at Purdue. The DLC supports student learning through access to state-of-the-art hardware and software for creating multimedia projects in individual, group work, and instructional settings. It facilitates the integration of information and technology literacy into the undergraduate curriculum.

During your college career, you will use one or more of the subject-oriented libraries. The University has a tradition of strong specialized libraries, where journals, books, and reference materials for particular fields are located. These libraries also provide access to the Libraries' online bibliographic and full-text resources, directing you to the specialized resources needed for research and investigation in the various subjects.

Students in the sciences will find most of the materials needed for study and research in one or more of the libraries specializing in the physical and life sciences. Reference and instruction services are available in each of these libraries.

The Life Sciences Library is the principal library resource for the Department of Biological Sciences as well as for the College of Agriculture. The library has more than 80,000 bound volumes and 1,100 journal subscriptions as well as publications received on exchange with research institutions throughout the world. All areas of the biological sciences are represented, as well as biochemistry, botany and plant pathology, food science, forestry and natural resources, entomology, and environmental sciences.

The M. G. Mellon Library of Chemistry maintains a strong collection of materials and information on services related to the field of chemistry. The 56,000-volume collection includes over 300 journals in all areas of chemistry. Extensive reference services include access to the major indexes to chemical information, spectral data sources, and hazardous substance information in both print and electronic formats.

The Earth and Atmospheric Sciences Library contains more than 30,000 volumes, including a comprehensive collection of U.S. Geological Survey and state survey publications. There are subscriptions to about 250 journals. Additional resources include a consolidated map collection of nearly 200,000 topographic and geologic maps, a large collection of navigation maps, gazetteers, aerial photos, and a Geographic Information Systems station that includes a map scanner.

The Mathematical Sciences Library, the principal library resource for the departments of Computer Sciences, Mathematics, and Statistics, provides an excellent collection especially strong in journals, conference proceedings, and professional society publications. The library contains more than 59,000 volumes.

The Physics Library is the principal library resource for research and instruction in physics. The 59,000-volume collection includes about 260 journals with emphasis on condensed matter and solid state physics, semiconductor physics, astrophysics, high energy physics, and materials science.

Numerous electronic resources also support study and research in these fields. Libraries and staff in each library assist users in retrieving information in all formats.

Study Abroad

Through Programs for Study Abroad, you gain international experience, develop maturity and independence, and increase your knowledge of other cultures. These traits help prepare you for a successful career after graduation from Purdue.

With over 200 programs in more than 45 countries, you — like all Purdue students — have the opportunity to participate in study, work, or internships abroad. You can take courses in your major or minor, or earn general elective credits. Some programs are designed for students in specific areas of study, while others are open to all Purdue students regardless of major. Academic credit transfers back to Purdue, allowing you to fit study abroad into your four-year plan. You remain enrolled as a regular Purdue student while on study abroad programs, and you therefore are eligible for Purdue University scholarships and financial aid, which may be applied to program fees.

Programs for Study Abroad awards a limited number of scholarships to students who have been approved for study abroad based on need and merit. In addition, a variety of other scholarships also are available. Information about all scholarships can be found on the Study Abroad Web site.

Study Abroad programs vary by discipline, foreign language ability, and length of stay — from one week to one year — making study abroad accessible for all students. You can apply online at www.studyabroad.purdue.edu.

Graduation Requirements

The College of Science offers two bachelor's degrees, the Bachelor of Science (B.S.) and the Bachelor of Science in Chemistry (B.S. in Chemistry).

The two bachelor's degrees are traditional four-year degrees. All programs leading to the two degrees have certain requirements in common:

1. Satisfaction of various University-wide requirements, i.e., academic scholarship, residence, fee payments, etc., as described in the Purdue University *General Information* bulletin.
2. Completion of either the general requirements of the College of Science and of your departmental major (see "Actuarial Sciences," "Biological Sciences," "Chemistry," "Computer Sciences," "Earth and Atmospheric Sciences," "Mathematics," "Physics," "Statistics," pages 32–99) or "Interdisciplinary Science" (pages 97–99).

If you successfully complete the requirements of one of the departmental honors programs (see listings within the applicable sections), your transcript will be appropriately annotated.

It is the responsibility of each student to become familiar with degree requirements, graduation requirements, and all other aspects regarding academic progress. Each student is assigned an advisor who will assist the student in planning curricula and will give advice that assists the student toward timely graduation. However, the ultimate responsibility for understanding and completing degree and graduation requirements lies with the student, not the advisor.

General Requirements — B.S. Degree

Students earn a B.S. degree by completing a major in one of the seven departments of the College of Science or by completing an interdisciplinary science major. (The B.S. in Chemistry is awarded to those who complete the program approved by the American Chemical Society; information can be found on page 50.)

In addition to meeting these general requirements, students with departmental majors must complete the requirements established by their departments.

B.S. Degree Requirements: College of Science

Total 124 (or more) semester credits.
English composition: 3–7 credits
Modern foreign language: 6–16 credits
General education: 18 or more credits
Mathematics requirements: 11 or more credits
Science requirements: 12 or more credits

Total of 124 (or more) Semester Credits

An average of 15.5 credits per semester is sufficient to accumulate 124 credits in eight semesters. Students with a graduation index of less than 3.0 are advised not to take more than 17 credits in any one semester. At least 32 of these credits must be taken in residence at Purdue, in accordance with University regulations.

English Composition

Students must complete Freshman Composition — ENGL 106 (First-Year Composition) (4 cr.) or ENGL 108 (Accelerated First-Year Composition) (3 cr.) — and an advanced composition course. The faculty that teaches freshman composition determines whether a student is placed in ENGL 106 or 108. The advanced composition course must be at or above the 200-level and must be approved by the dean of the College of Science or the dean's designee.

Courses currently approved include: ENGL 205 (Introduction to Creative Writing), ENGL 304 (Advanced Composition), ENGL 306 (Introduction to Professional Writing), ENGL 309 (Computer-Aided Publishing), ENGL 406 (Review Writing), ENGL 419 (Multimedia Writing), ENGL 420 (Business Writing), ENGL 421 (Technical Writing), and ENGL 424 (Writing for the Computer Industry). Each course counts for three credit hours.
Note: Enrollment in advanced composition courses might be limited.

Modern Foreign Language

All College of Science majors are expected to have proficiency in another language besides their native language. "Native language" refers to the language of instruction in the school that awarded the high school diploma. Competency in the second language must be demonstrated at the fourth-semester college level by completing, with a regular passing grade, a fourth-semester, college-level course in a modern foreign language or by passing an equivalent proficiency examination.

To demonstrate proficiency in your native language you may either a) present your high school transcript or equivalent, which states the language of instruction; b) successfully pass an approved exam in your native language; c) successfully complete a literature course or a course beyond the 202-level taught in your native language. If this course is a literature, history, or culture course, it may fulfill part of your general education requirement.

If your native language is not English, you may satisfy the foreign language requirements by demonstrating your competence in English by completing the English composition requirement of the College of Science and COM 114 (Fundamentals Of Speech Communication) (3 cr.).

You may not earn credit toward graduation for courses below the 300-level in your native language. The Foreign Languages and Literatures department may not allow any native speaker to take 301/302 or 401/402 language development courses in their native language but will allow students to take history, literature, and culture courses.

If you expect to pursue graduate studies, you should note that at some universities one requirement for a Ph.D. in science is a reading knowledge of one or two modern languages. For serious work in many areas of science, such knowledge is absolutely necessary.

If you successfully complete the professional semester in a high school teaching curriculum or the applied physics curriculum, you need only complete, with a regular passing grade, a second-semester, college-level course in a modern language or pass an equivalent proficiency examination.

General Education

You must complete 18 credits of study in the humanities, social sciences, and behavioral sciences. The College of Science identifies the following five broad areas:

1. Humanities: literature, philosophy, and aesthetics
2. Social Studies: history or political science
3. Behavioral Sciences: economics, psychology, sociology, and anthropology
4. Communication:

   Skills: COM 224 (Communicating in the Global Workplace), COM 314 (Advanced Presentational Speaking), or COM 320 (Small Group Communication);

   Aesthetics/General Education: COM 240 (Introduction to Oral Interpretation), COM 250 (Mass Communication and Society), COM 251 (Introduction to the Electronic Mass Media), COM 312 (Rhetoric in the Western World), COM 316 (Controversy in American Society), COM 318 (Principles of Persuasion), or COM 329 (History of the Mass Media).

5. Interdisciplinary Studies: Any African American, American, Jewish, Religious, or Women's Studies course; any culture or civilization course in Foreign Language, EDPS 235 (Learning and Motivation); SCI 460 (Science and Society); and University honors courses (HONR) (only 3 honors credits may be used to meet general education requirements)

General Education Course Distribution

A minimum of 18 credits is required and must be distributed as follows:

a. Two courses must be from areas 1, 2, or 3, in the same department.
b. Two more courses must be from one of the remaining two areas (1, 2, or 3 only) not chosen to meet requirement "a." These two courses do not have to be in the same department, but they must be in the same area.
c. Two more courses from any of the five areas (1, 2, 3, 4, and 5).

Courses at the 500-level may be taken pass/not pass to satisfy the general education requirement. Courses below the 500-level must be taken for a letter grade to meet this requirement.

Unacceptable General Education Courses

Independent research courses are not acceptable. Courses cross-listed with a course in the College of Science or any that have a laboratory or studio component are also not acceptable. In addition, the following specific courses are not acceptable to meet this requirement: PHIL 150 (Principles of Logic), PHIL 450 (Symbolic Logic), PHIL 550 (Advanced Symbolic Logic), PSY 204 (Use Of Computers in Psychology), PSY 500 (Statistical Methods Applied to Psychology, Education, and Sociology), PSY 501 (Mathematics Essential for Quantitative Psychology), and SOC 382 (Introduction to Methods of Social Research).

If you have any questions about the general education requirements, please ask your advisor to help you early in your course planning.

Mathematics

You must take at least 11 credits of mathematics courses selected to meet the requirements of your departmental major. All mathematics courses must be at the level of calculus or above.

Science

Students in the College of Science must complete four laboratory science courses outside of their major discipline. At least two of the courses must be foundational laboratory science coursework in biological sciences, chemistry, earth and atmospheric sciences, or physics offered at a level appropriate for science majors. A list of acceptable courses is available at www.science.purdue.edu/catalog/lab. In addition to other and more advanced courses in these areas, certain courses in computer science or engineering may also be approved to complete the requirement. Courses, including their laboratory component, must be at least three credits each.

Academic Policies

"Pass/Not-Pass" Option. In addition to the grades "A," "B," "C," etc., traditionally assigned to indicate the level of performance in class work, an alternate grading system, the pass/not-pass option, has been established. This option gives you the opportunity to broaden your education with minimal concern for grades earned. Only free electives and courses at the 500-level in the 18-credit general education block may be taken under the pass/not-pass option.

The option is open only to students who are classified as sophomores or upper-division students. This option is not available to students on probation.

You may elect to use the pass/not-pass option for no more than two courses per year and not more than 20 percent of the 124 credits required for graduation. These two restrictions do not apply to credits taken beyond the 124-credit requirement for graduation. For example, if you complete 130 credits, you may take the extra six credits pass/not-pass, if those six credits are not specific courses required by your major or by the college.

The pass/not-pass option cannot be elected for a course that already appears on your academic record. If you decide to take a course again, you cannot do so on a pass/not-pass basis. If you are enrolled in a course under this option, you have the same obligations as those who will receive a letter grade. Courses taken under the pass/not-pass option are not used in computing grade indexes. See *University Regulations* for more information.

Multiple Course Enrollments. Occasionally, College of Science students may find it necessary to repeat coursework in order to make appropriate progress toward their degree objectives. Science students may attempt a course twice with the permission of their advisor. A third enrollment in a course, or an equivalent course, requires the permission of the dean or designee. An "attempt" is considered to be any time a course is recorded on the academic record, including withdrawals.

Declaration of Major. It is expected that students will refine their academic goals during the course of taking classes. Students must have declared a major in the College of Science before registering for classes in the college as a junior. Occasionally students will decide to pursue a different major outside of the College of Science but will have not yet met the entrance requirements for the new program. Students in the College of Science may register as an "undesignated" student for no more than four semesters, and only while classified as a freshman or sophomore.

Academic Credit Load. In accordance with University policy, Science students may take up to 18 credits with the permission of their academic advisor. Enrollment in more than 18 credits requires permission of the dean or designee. Students with a graduation index of less than 3.0 are advised not to take more than 17 credits in any one semester. Students on academic probation may not attempt more than 15 credits without permission.

Equivalent, Preparatory, and Transfer Courses. Current and relevant academic coursework is essential to providing a quality academic experience for science students. Credit that was earned more than 10 years ago may not be acceptable to meet degree requirements of the College of Science. A determination by the dean or designee about the acceptability of old coursework will be made upon request.

The College of Science utilizes lists maintained by the Office of the Registrar at www.purdue.edu/Registrar/InteralOps/CourseLists/index.htm to determine which courses might be used to meet degree requirements as alternatives to those listed in this document. In addition, certain courses have been determined by the faculty to be preparatory and will not be accepted toward graduation from the College of Science. That listing is available at the same Web location.

Transfer students are welcome, but students are expected to complete at least 50% of the credits in their major in residence, with the vast majority of upper-level courses taken at Purdue. Exceptions will be reviewed by the dean or designee.

Minors. Science students may pursue minors in areas outside of their major that have been approved by the various faculties of the University. See www.science.purdue.edu/catalog/minors for the list of currently approved minors for College of Science students.

Abbreviations

The following abbreviations of subject fields are used in the "Graduation Requirements" and the "Plans of Study" sections of this catalog. Alphabetization is according to abbreviation.

ABE—Agricultural and Biological Engineering
AGEC—Agricultural Economics
AGRY—Agronomy
ANSC—Animal Sciences
ANTH—Anthropology
ASTR—Astronomy
BCHM—Biochemistry
BIOL—Biological Sciences
BMS—Basic Medical Sciences
BTNY—Botany and Plant Pathology
C E—Civil Engineering
CHE—Chemical Engineering
CHM—Chemistry
COM—Communication
C S—Computer Science
EAS—Earth and Atmospheric Sciences
ECON—Economics
EDCI—Educational Curriculum and Instruction
EDFA—Educational Foundations and Administration
EDPS—Educational Psycho-Educational Studies
ECE—Electrical and Computer Engineering
ENGL—English
ENGR—Engineering
ENTM—Entomology
FNR—Forestry and Natural Resources
HORT—Horticulture
HSCI—Health Sciences
IE—Industrial Engineering
MA—Mathematics
ME—Mechanical Engineering
MGMT—Management
MSE—Materials Engineering
PHIL—Philosophy
PHYS—Physics
POL—Political Science
PSY—Psychology
SCI—General Science
SOC—Sociology
STAT—Statistics

Plans of Study

The College of Science undergraduate program gives you the opportunity to acquire a broad science education and/or to concentrate your studies in one of more than 60 specialized scientific areas. This wide variety of study is provided by the seven academic departments — Biological Sciences, Chemistry, Computer Science, Earth and Atmospheric Sciences, Mathematics, Physics, and Statistics — and by the interdisciplinary science major as supplemented by courses offered in other colleges/schools of the University.

All of the options described in the following pages are based on major programs in the College of Science. The names of the options are frequently taken from the supplementary courses. Students who want more depth in one of these supplementary areas than is possible while pursuing a science major should consult the bulletin of the college/school offering the supplemental courses for a possible major in that field.

In the charts throughout the "Plans of Study" section, figures enclosed in parentheses signify the number of credit hours, e.g., (3) signifies three credit hours.

In addition to satisfying various University-wide degree requirements, each science student must complete either the requirements of the college/school and of a departmental major or complete the requirements of an interdisciplinary science major. Details about departmental and interdisciplinary science plans of study and requirements follow.

The seven departments offer the more or less traditional scientific majors; the interdisciplinary science major is for students whose interests and professional plans require broad training in several sciences, and in many cases, substantial work outside the College of Science. Examples of career objectives that might be met within interdisciplinary science include science and technical writing, food science, prelaw, biometry, and environmental science.

Actuarial Science

The interdisciplinary actuarial science major is administered jointly by the Department of Mathematics and the Department of Statistics. The purpose of the program is to provide the broad quantitative background in mathematics, statistics, and related areas that is necessary for success in the actuarial profession and to provide the academic background needed to pass the first three to four actuarial exams.

Actuaries use mathematics, statistics, and financial theory to study uncertain future events, especially those of concern to insurance and pension programs. Actuaries may work for insurance companies, consulting firms, government, employee benefits departments of large corporations, hospitals, banks and investment firms, or, more generally, in businesses that need to assess the financial consequences of risk. A career as an actuary is better described as a "business" career with a technical basis than as a "technical" career. Actuaries assess their work as challenging and interesting and generally enjoy a good working environment. Actuaries are well paid and, according to several studies, the profession is more open than others to women and members of underrepresented minority groups. As might be expected, entry into the profession is very competitive, and success in the field demands commitment and hard work during college and the few years after graduation when the actuarial exams continue to be taken.

To become an actuary, one must become an associate, and ultimately a fellow, of one of the professional societies — the Society of Actuaries (SOA) or the Casualty Actuarial Society (CAS) — by passing examinations administered by them, completing required coursework, and satisfying additional requirements. The Purdue actuarial science program provides preparation for the first four examinations as well as fulfilling the economics, finance, and applied statistical methods requirements of SOA/CAS. Students who wish to pursue actuarial careers should coordinate their actuarial exam schedules with their academic plans of study and may begin taking exams in the freshman year. For more information about the examinations, including application forms and publications of the societies, contact the director of the actuarial science program, Mathematical Sciences Building.

For current information on the academic program, as well as more career information, see our Web site at www.math.purdue.edu/actuary.

In meeting the following requirements, a student will also automatically fulfill the College of Science graduation requirements listed on pages 27–29.

In addition to courses required for graduation, students should carefully consider electives that will coordinate with an actuarial career. In particular, additional courses from Krannert School of Management or courses in writing and communication are very helpful. Most actuarial majors also obtain a statistics degree and a management minor.

Actuarial Science Requirements

Actuarial Science Core — *36 credits*

ECON 251 (Microeconomics) (3 cr.) and ECON 252 (Macroeconomics) (3 cr.) — *6 cr.*

MA 370 (Mathematical Theory of Interest) (3 cr.) — *3 cr.*

MGMT 200 (Introductory Accounting) (3 cr.); MGMT 201 (Management Accounting I) (3 cr.); MGMT 310 (Financial Management) (3 cr.) — *9 cr.*

All of the following:

STAT 472–473 (Actuarial Models I and II) (6 cr.); STAT 512 (Applied Regression Analysis) (3 cr.); MATH/STAT 416 (Probability) (3 cr.); STAT 417 (Statistical Theory) (3 cr.) — *15 cr.*

MATH/STAT 474 (Methods of Random Modeling) (3 cr.) or STAT 490T (Time Series Analysis) (3 cr.) — *3 cr.*

Science Requirements — *12–15 credits*

Four courses in laboratory sciences.

Mathematics Requirements — *19–21 credits*

MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) — *4–5 cr.*

One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 173 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) — *4–5 cr.*

One of: MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus II) (5 cr.), MA 271 (Several Variable Calculus) (5 cr.) — *4–5 cr.*

MA 351 (Elementary Linear Algebra) (3 cr.) or MA 350 (Elementary Linear Algebra: Honors) (3 cr.) — *3 cr.*

MA 366 (Ordinary Differential Equations) (4 cr.) — *3 cr.*

Additional Requirements — *36–41 credits*

English Composition: See page 28 for English composition requirements. — *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements" on page 28). — *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences, and behavioral sciences. (See page 29 for requirements.) — *18 cr.*

Free Electives — *21–31 credits*

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

Grade Requirements

All actuarial science majors must have a graduation index of at least 2.5 in MA 351, MA 366, and all courses required for the actuarial science core.

Special Programs and Opportunities

The Actuary Club coordinates a very active summer internship program. The majority of internship opportunities are for juniors, although a number of sophomores and even freshmen participate in the program.

Actuarial Science Sample Plan of Study*

Freshman Year					
1	MA 161 (4–5) or 165, 173, 181, 271 Calculus	MA/STAT 170 (2) Actuarial Sci.	ENGL 106 (3) Composition	C S 158, 177 or 180 (3)† C Prog.	Language (3)
2	MA 162 (4–5) or 166, 174, 182 Calculus	MA 370 (3) Interest Theory	ENGL (3)	COM 114 (3)‡ Com.	Language (3) Exam MF: May
Sophomore Year					
3	MA 261 (4) Calculus	Lab Science (3–4)	MGMT 200 (3) Accounting 1	ECON 251 (3) Micro-Econ.	Language (3)
4	MA 351 or 350 (3) Linear Alg.	STAT 350 (3)‡ Statistics	MGMT 201 (3) Accounting II	ECON 252 (3) Macro-Econ.	Language (3)
Junior Year					
5	MATH 366 (4) Diff. Eq.	MA/STAT 416 (3) Probability	MGMT 310 (3) Finance	Gen Ed (3)	Elective
6	STAT 490T (3) Time Series	STAT 417 (3) Statistics	Gen Ed (3)	Lab Science (3–4)	MA/ST 371 (2) Exam P: May
Senior Year					
7	STAT 472 (3) Act. Model 1	STAT 512 (3) Regression	MGMT 411 (3)‡ Investments	Lab Science (3–4)	Gen Ed (3)
8	STAT 473 (3) Act. Model II	Elective	Gen Ed (3)	Elective	Elective Exams M: May

By taking all of these classes, a student obtains complete preparation for the first three to four actuarial exams, fulfills the applied statistics and the corporate finance requirements for Fellow of the Society of Actuaries (FSA), as well as fulfilling the requirements for the actuarial science degree, the statistics degree, and the management minor.

** See www.math.purdue.actuary for other sample plans of study.*
† Highly recommended lab science.
‡ Highly recommended free electives. STAT 350 is required for the statistics degree.

Biological Sciences

The biological sciences are undergoing an extraordinary revolution, and these plans of study are designed to help students successfully master this explosion of knowledge. The Department of Biological Sciences at Purdue University was one of the first in the country to recognize that it is not necessary to separate the life sciences by type of organism and that all living organisms depend upon the same cellular and molecular organization. We have emphasized structure and function throughout the living world and, thus, can prepare students for a wide range of curricula and careers.

It is important to recognize that the study of biological organisms also requires an understanding of the physical and chemical world. Thus, our curriculum requires courses in chemistry, physics, and mathematics/computer science/statistics. Biology builds upon this knowledge and tries to understand the complexity that gives rise to living organisms and, ultimately, to biological diversity. Our curriculum is designed so that this basic biological knowledge can readily be applied to critical problems in health and medicine, agriculture and the management of other renewable resources, and the nature of populations and their control.

The amount of biological information is exploding, and the rate at which it is discovered is incredible. It is essential that we provide opportunities for students to focus on an area of specialization built upon a common base. Thus, we begin our curriculum with the four-semester biology core. This set of courses, with both lecture and laboratory components each semester, provides a comprehensive foundation for all biology majors. The sequence begins with an overview of evolutionary and organism concepts and the way organisms interact with their environment and with each other. Next, we cover the principles of organism structure, function, and development, and explore the relationship among these topics. We then move deeper and deeper into the cell and study how cells are structured and how they function. Finally, the principles of genetics and molecular biology are provided to students who are now well versed in the chemical and quantitative sciences. Such students are now able to fully grasp the nature of molecular genetics as well as the quantitative components of classical genetics.

By the third year, students can build upon the courses in chemistry, physics, math, and the biology core, and branch out into one of a number of areas. Those interested in medicine or veterinary medicine can concentrate on paraprofessional studies. Those who are still interested in sampling many areas of biology can take our general biology emphasis or consider biology teaching. Those who might want to specialize in a particular area can do so in majors such as biochemistry; cell and developmental biology; ecology, evolutionary, and population biology; genetic biology; microbiology; molecular biology; neurobiology and physiology, and plant molecular biology and physiology.

These disciplinary emphases are differentiated by upper-level undergraduate and graduate courses that are nationally known for their excellence. However, the key to our curriculum is the way that advanced laboratory courses and experiences are built into the degree. Thus, we have a series of advanced modular laboratories that provide state-of-the-art experimentation for upper-class students in all disciplines. In addition, we emphasize undergraduate research so that all students can perform independent research in laboratories within the Department of Biological Sciences, in other laboratories on the Purdue campus, and in various industrial and government laboratories. Many students who participate in this program have written undergraduate honors theses and have been co-authors on papers in top scientific journals. This is the type of experience that can only be obtained at a research-intensive institution such as Purdue with the tremendous resources available from federal and industrial grants.

Finally, the Department of Biological Sciences has developed a student-centered environment to enable all students to succeed. There are two seminars for first-year students. In the first semester, students may take a resource and problem-solving seminar that is coordinated with the first-semester biology course, BIOL 121. The second-semester seminar, titled the Alumni Career Seminar, is one in which successful alumni talk to students about their careers and their science and why the path between points A and B in career planning is almost never a straight line! These and many other elements of our curriculum were designed

in conjunction with resources provided by the Howard Hughes Medical Institute Undergraduate Initiative Program. The Department of Biological Sciences at Purdue is one of only a handful of major institutions that have received support from this organization over many years. We have utilized these resources to develop many new courses and approaches to teaching and learning, and we are confident that we will continue this excellence in undergraduate learning well into the twenty-first century.

The three broad areas of concentration in this department include:

1. Basic biology
2. Biology teaching
3. Preprofessional studies

Our graduates pursue a broad variety of career opportunities. Many go into professional schools (medicine, veterinary medicine, dentistry, etc.) or graduate schools in biology, biochemistry, management, education, and other health-related programs. Students who enter the workforce after the bachelor of science degree take positions such as research assistants, associate scientists, laboratory technicians, and technologists in industry, government, hospitals, and universities; teachers in junior highs and high schools; salespeople in scientific and health-related firms; and park/zoo staff. Because of the strong training in basic sciences and analytical thinking, biologists are well poised to meet the demands of a constantly changing workplace … and of their constantly evolving selves.

The Web site for the biology department can be found at www.biology.purdue.edu.

General Degree Requirements

The Biology Core consists of courses taken during a sequence of four semesters required of all undergraduate majors. The sequence begins with an overview of the evolutionary development of organismal diversity and ways organisms interact with their environment and each other; it is followed by a course that introduces the principles of plant and animal development and explores the relationship between their structure and function. The third course includes the study of how cells are structurally organized and how they function. Finally, students are introduced to the principles of genetics and the molecular mechanisms of gene expression, mutation, and replication.

In addition to the core and elective biology courses, students majoring in biology must take certain courses in chemistry, mathematics, and physics, as well as English, foreign language, humanities, and the social sciences. In meeting the various requirements (in the following summary), a student automatically fulfills the College of Science graduation requirements listed on pages 27–29.

A student wishing to graduate with a degree from the Department of Biological Sciences must have a 2.0 grade point average in all biology and biology elective courses required for his or her major. This may include courses outside the Department of Biological Sciences if such courses fulfill biology or biology elective requirements for that major.

Additionally, each student wishing to graduate with a degree from the Department of Biological Sciences must also complete a 500-level biology course other that 500 or 542. This course may be a required course, a biology elective, or a free elective.

Students have the choice of focusing or broadening their education by the selection of electives. These elective courses are offered in many aspects of biology. Usually, they take these specialized courses after the sophomore year. It is advantageous for a student to decide by the end of the sophomore year what aspect of the biological sciences he or she wants to emphasize in order to begin the correct sequence of courses required by each major. The majors described on the following pages build on the biology core courses.

Biological Sciences Requirements

Biology Core ***17 credits***

BIOL 121 (Diversity, Ecology, and Behavior) (2 cr.); BIOL 131 (Development, Structure, and Function of Organisms) (3 cr.); BIOL 136 (Quantitative and Problem Solving Skills) (0.5 cr.); BIOL 137 (Handling Cells and Tissues; Microscopy) (0.5 cr.); BIOL 138 (Information and Communication Skills) (0.5 cr.); BIOL 139 (Measurements and Basic Solution Chemistry) (0.5 cr.); BIOL 231 (Cell Structure and Function) (3 cr.); BIOL 232 (Laboratory Cell Structure and Function) (2 cr.); BIOL 241 (Genetics and Molecular Biology) (3 cr.); and BIOL 242 (Laboratory in Genetics and Molecular Biology) (2 cr.)

Upper-Level Biology *15–42 credits*

Each student majoring in biology is required to select additional credit hours of upper-division biology courses beyond the core. Courses that can be selected are determined by the individual major and areas in which the student is interested.

Science Requirements *27–31 credits*

One of the following sequences:

Either CHM 115 and 116 (General Chemistry) or CHM 125 and 126 (Introduction to Chemistry, I and II) *8–10 cr.*

One of the following three sequences:

a. CHM 255–255L, and 256–256L (Organic Chemistry and Organic Chemistry Laboratory)

b. CHM 257 and 257L (Organic Chemistry and Organic Chemistry Laboratory) (5 cr.) and either CHM 333 (Principles of Biochemistry) (3 cr.) or BCHM 307 (Biochemistry) (3 cr.)

c. CHM 261–262 (Organic Chemistry) and 263–264 (Organic Chemistry Laboratory) *8 cr.*

Plus one of the following:

BCHM 221 (Analytical Biochemistry)* (3 cr.); BCHM 561 (General Biochemistry)* (3 cr.); CHM 224 (Quantitative Analysis)* (4 cr.); CHM 321 (Analytical Chemistry)* (4 cr.); CHM 372 (Physical Chemistry)* (4 cr.); CHM 373 (Physical Chemistry)* (3 cr.); CHM 533 (Biochemistry)*(3 cr.) *3–4 cr.*

PHYS 220 and 221 (General Physics) (total 8 cr.); or PHYS 152 (Mechanics), PHYS 241 (Electricity and Optics), PHYS 252 (Electricity and Optics Laboratory), and 290D (Heat and Thermal) (total 9 cr.) *8–9 cr.*

For specific chemistry sequences and additional requirements, see individual biology majors on the following pages.

For specific physics sequences and additional requirements, see individual biology majors on the following pages.

Mathematics Requirements *12–14 credits*

Select one of the following:

a. MA 223–224 (Introductory Analysis I and II) (6 cr.);

b. MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (6 cr.);

c. MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.);

d. MA 173 (Calculus and Analytic Geometry II) (5 cr.) *9–10 cr.*

One of the following (two if MA 223–224 are chosen from above):

a. Calculus: MA 174 (Multivariable Calculus; continuation of 173) (4 cr.); MA 271 (Several Variable Calculus) (5 cr.); or MA 261 (Multivariate Calculus; follows MA 162 or 165) (4 cr.) *4–5 cr.*

b. Probability: STAT 311 (Introductory Probability) (3 cr.) *3 cr.*

c. Statistics: STAT 503 (Statistical Methods for Biology) (3 cr.); or STAT 511 (Statistical Methods) (3 cr.) *3 cr.*

d. Computer Programming: C S 154 (Fortran Programming) (3 cr.) or C S 158 (C Programming) (3 cr.) or C S 177 (Programming with Multimedia Objects) (4 cr.) *3–4 cr.*

For specific mathematics sequences and additional requirements, see individual majors on the following pages.

Additional Requirements *33–41 credits*

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28). *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences, and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives *0–19 credits*

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

Biological Sciences Majors and Requirements

The majors in biology offered by the Department of Biological Sciences reflect several principal areas of faculty strength. Programs also are offered in preprofessional areas. Descriptions of the majors and their requirements follow.

** Required for all biology majors except the biology teaching major.*

Biology Major

This program is designed to allow for a broad foundation in the biological sciences while providing sufficient free electives for the student to explore and develop additional interests. The student is given maximum flexibility in designing a plan of study that may contain courses from a wide variety of biology disciplines.

Biology Major Requirements 15 credits

In addition to the requirements listed under "General Degree Requirements" on page 27, fifteen credits in the upper-division courses listed in group A, group B, and laboratory courses are required to complete a biology major. These credits must include at least one laboratory course and at least one course from each group as a minimum distribution requirement.

Group A

Select from the following:

BIOL 415 (Introduction to Molecular Biology) (3 cr.), BIOL 416 (Molecular Virology) (3 cr.), BIOL 420 (Eukaryotic Cell Biology) (3 cr.), BIOL 438 (General Microbiology) (3 cr.), BIOL 439 (Laboratory in Microbiology) (2 cr.), BIOL 444 (Human Genetics) (3 cr.), BIOL 446 (Cellular Microbiology) (3 cr.), BIOL 481 (Eukaryotic Genetics) (3 cr.), BIOL 495N (Introduction to Neurobiology) (3 cr.), BIOL 495S (Introduction to Bioinformatics) (3 cr.), BIOL 511 (Introduction to X-Ray Crystallography) (3 cr.), BIOL 514 (Laboratory in Crystallography) (2 cr.), BIOL 515 (Molecular Genetics) (2 cr.), BIOL 516 (Molecular Biology of Cancer) (3 cr.), BIOL 517 (Molecular Biology: Proteins) (2 cr.), BIOL 519: (Molecular Biology: Nucleic Acids) (2 cr.), BIOL 529 (Bacterial Physiology) (3 cr.), BIOL 533 (Medical Microbiology) (3 cr.), BIOL 538 (Molecular, Cellular, and Developmental Neurobiology) (3 cr.), BIOL 541 (Genetic Biology) (3 cr.), BIOL 549 (Microbial Ecology) (2 cr.), BIOL 550 (Plant Molecular Biology) (3 cr.), BIOL 562 (Neural Systems) (3 cr.), BIOL 573 (The Molecular Biology of Animal Cells) (3 cr.), BIOL 595A (Protein Bioinformatics) (2 cr.), BIOL 595K (Methods and Measurements in Physical Biochemistry) (3 cr.)

BCHM 561 (General Biochemistry I)* (3 cr.), BCHM 562 (General Biochemistry II) (3 cr.), BCHM 572 (Advanced Biochemical Techniques) (2–4 cr.)

CHM 533 (Introductory Biochemistry)* (3 cr.)

Group B

Select from the following:

BIOL 301 (Human Design: Anatomy and Physiology 1)† (3 cr.), BIOL 302 (Human Design: Anatomy and Physiology 2)† (3 cr.), BIOL 455 (Animal Physiology) (3 cr.), BIOL 483 (Environmental and Conservation Biology) (3 cr.), BIOL 493 (Introduction to Ethology) (3 cr.), BIOL 495I (Reproductive Physiology) (3 cr.), BIOL 537 (Immunobiology) (3 cr.), BIOL 551 (Biophysical Plant Physiology I) (3 cr.), BIOL 559 (Endocrinology) (3 cr.), BIOL 580 (Evolution) (3 cr.), BIOL 585 (Ecology) (3 cr.), BIOL 591 (Field Ecology) (4 cr.), BIOL 592 (The Evolution of Behavior) (3 cr.), BIOL 595D (Developmental Biology) (3 cr.), BIOL 595G (Animal Communication) (3 cr.), BIOL 597 (Sex and Evolution) (3 cr.)

HORT 301 (Plant Physiology) (4 cr.)

Laboratory Courses

Select from the following:

BIOL 439 (Laboratory in General Microbiology) (2 cr.)

BIOL 500 (Modular Upper-Division Laboratory Courses)‡ (2 cr.): BIOL 500A (Animal Physiology) or BIOL 500I (Introduction to Protein Expression)

BIOL 514 (Laboratory in Crystallography) (2 cr.)

BIOL 542 (Modular Upper-Division Laboratory Courses)‡ (1 cr.): BIOL 542B (Bacterial Genetics), BIOL 542C (Animal Cell Culture), BIOL 542F (Introduction to Labview), BIOL 542G (Introduction to Nucleic Acid Sequence Analysis), BIOL 542M (Microscopy and Cell Biology), BIOL 542N (Neurophysiology), BIOL 542R (Exploration of Protein Structure), BIOL 542S (Chromatin Structure), BIOL 542U (DNA Sequencing Lab), BIOL 542V (Molecular Virology)

BIOL 591 (Field Ecology) (4 cr.)

** These courses may be used as biology electives or to meet the chemistry requirement, but not both.*

† If both BIOL 301 and 302 are completed, three of the six credits will count toward the 15-credit requirement. The other three credits will count as free electives. If only BIOL 301 or 302 is completed, the credits will count only as free-elective credits.

‡ Students who choose to meet the laboratory requirement for the biology major with modular upper-division laboratory courses must take BIOL 500I and one additional 500 or 542 module. Advisors will have the complete list of available modules for any given semester.

BIOL 394 or 494 (Biology Research) or BIOL 499 (Biology Honors Thesis Research), taken during the junior or senior years, and BIOL 495C (Ideas in Science and Law), can be used as partial fulfillment of the 15-elective-hour requirement. However, these credits cannot be used to fulfill the minimum distribution requirement or the laboratory requirement.

Students who anticipate working immediately after earning a B.S. in biology should consider supplementing departmental requirements with courses in applied areas. Advisors can make specific recommendations.

Biochemistry Major

Biochemistry investigates the chemical and molecular foundations of life processes. A student may study the transfer of genetic information into biological structures, the conversion of nutrients into cell constituents and their utilization as sources of energy, the storage of memory, and the chemical nature of neural processes. Relevant laboratory techniques include electrophoresis, chromatography, Western blotting, protein sequence analysis, and peptide mapping. Understanding the development and application of enzymatic assays is fundamental to the field of study. Students can also study biochemistry through majors in the Department of Chemistry in the College of Science (page 49) and the Department of Biochemistry in the College of Agriculture.

To complete the biochemistry major, the following courses must be selected when fulfilling the "General Degree Requirements" listed on page 37:

a. MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (10 cr.), or MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.), or MA 173 (Calculus and Analytic Geometry II) (5 cr.) *5–10 cr.*

b. C S 177 (Programming with Multimedia Objects) (4 cr.) or C S 158 (C Programming) (3 cr.) or C S 154 (FORTRAN Programming) (3 cr.) *3–4 cr.*

c. CHM 261–262 (Organic Chemistry) (6 cr.) and CHM 263–264 (Organic Chemistry Laboratory) (2 cr.) *8 cr.*

d. BCHM 221 (Analytical Biochemistry) (3 cr.) or CHM 224 (Introductory Quantitative Analysis) (4 cr.) or CHM 321 (Analytical Chemistry I) (4 cr.) *3–4 cr.*

Biochemistry Major Requirements **30–34 credits**

STAT 503 (Statistical Methods for Biology) (3 cr.) *3 cr.*

One of the following:

a. CHM 372 (Physical Chemistry) (4 cr.)

b. CHM 373–374 (Physical Chemistry) (6 cr.) *4–6 cr.*

BCHM 561–562 (General Biochemistry I and II) (6 cr.); BIOL 415 (Molecular Biology)* (3 cr.); BIOL 420 (Eukaryotic Cell Biology)* (3 cr.); BIOL 515 (Molecular Genetics)* (2 cr.) or BIOL 519 (Molecular Biology: Nucleic Acids)* (2 cr.); BIOL 517 (Molecular Biology: Proteins)* (2 cr.); BIOL 529 (Bacterial Physiology)* (3 cr.) or BIOL 550 (Plant Molecular Biology)* (3 cr.) or BIOL 573 (Molecular Biology of Animal Cells)* (3 cr.); BIOL 500I (Introductory Module: Protein Expression) (2 cr.) *21 cr.*

One of the following:

a. Two additional 500 or 542 laboratory modules (various course titles). (See page 38 for a list of BIOL 500 and 542 modules) (2–3 cr.)

b. BIOL 439 (Microbiology Laboratory) (2 cr.)

c. BIOL 514 (Laboratory in Crystallography) (2 cr.)

d. Four credits of undergraduate research – BIOL 394 or 494 (Biology Research) or BIOL 499 (Biology Honors Thesis Research). (Must be approved in advance by the Biophysics, Biochemistry, and Structural Biology Area Committee (4 cr.) *2–4 cr.*

Biochemistry Honors Curriculum

Additionally, students in the biochemistry honors curriculum must complete, as part of the "General Degree Requirements" listed on page 27, PHYS 152 (Mechanics), PHYS 241 (Electricity and Optics), PHYS 252 (Electricity and Optics Laboratory), and PHYS 290D, (Heat and Thermal). Students must also complete one of the following:

a. CHM 321 (Analytical Chemistry I) (4 cr.) (from "General Degree Requirements")

b. CHM 373–374 (Physical Chemistry) (6 cr.) (from "Biochemistry Major Requirements")

** One of these courses may be replaced by one of the following courses: BIOL 416 (Molecular Virology), BIOL 438 (General Microbiology), BIOL 511 (Introduction to X-Ray Crystallography), BIOL 537 (Immunology), or BIOL 595K (Methods and Measurement in Physical Biochemistry). Only one substitution is allowed.*

Students in the Biochemistry Honors Curriculum may use MA 261 (Multivariate Calculus) to replace one of the following: STAT 503 (Statistical Methods for Biology), C S 154 (FORTRAN Programming), C S 158 (C Programming), or C S 177 (Introduction to Computer Science).

Additionally, a 3.0 graduation index is required at the time of graduation.

Biology Teaching Major

The biology teaching program at Purdue University combines a strong emphasis on biology content knowledge with a thorough grounding in the theoretical and practical aspects of science teaching. A student completing the requirements in biology teaching is qualified to teach high school life science. Biology teaching majors are advised that it is wise to select an additional developmental area, such as middle school, and additional courses in physics, chemistry, or earth and atmospheric science.

Although each state has different requirements for teacher certification, an Indiana certificate will be reciprocal in many states. In addition, students can ascertain the requirements in other states by writing directly to the Certification Office, Department of Public Instruction, in the capital city of any state. Indiana now requires those seeking certification to pass the PRAXIS I and PRAXIS II exams.

Prospective teachers are exempt from the second year of the foreign-language requirement and from the last course of the chemistry requirement. During the professional semester, students take coursework on campus followed by student teaching.

Biology Teaching Major Requirements **42 credits**

Upper-Division Courses ***10 credits***

Ten additional credits in the upper-division courses listed in groups A and B (following) are required to complete a biology teaching major. These 10 credits must include at least one laboratory course and, as a minimum distribution requirement, each group must be represented by at least one course in a student's selections.

Group A

Select from the following:

BIOL 415 (Introduction to Molecular Biology) (3 cr.), BIOL 416 (Molecular Virology) (3 cr.), BIOL 420 (Eukaryotic Cell Biology) (3 cr.), BIOL 438 (General Microbiology) (3 cr.), BIOL 439 (Laboratory in Microbiology) (2 cr.), BIOL 444 (Human Genetics) (3 cr.), BIOL 446 (Cellular Microbiology) (3 cr.), BIOL 481 (Eukaryotic Genetics) (3 cr.), BIOL 495N (Introduction to Neurobiology) (3 cr.), BIOL 495S (Introduction to Bioinformatics) (3 cr.), BIOL 511 (Introduction to X-Ray Crystallography) (3 cr.), BIOL 514 (Laboratory in Crystallography) (2 cr.), BIOL 515 (Molecular Genetics) (2 cr.), BIOL 516 (Molecular Biology of Cancer) (3 cr.), BIOL 517 (Molecular Biology: Proteins) (2 cr.), BIOL 519 (Molecular Biology: Nucleic Acids) (2 cr.), BIOL 529 (Bacterial Physiology) (3 cr.), BIOL 533 (Medical Microbiology) (3 cr.), BIOL 538 (Molecular, Cellular, and Developmental Neurobiology) (3 cr.), BIOL 541 (Genetic Biology) (3 cr.), BIOL 549 (Microbial Ecology) (2 cr.), BIOL 550 (Plant Molecular Biology) (3 cr.), BIOL 562 (Neural Systems) (3 cr.), BIOL 573 (The Molecular Biology of Animal Cells) (3 cr.), BIOL 595A (Protein Bioinformatics) (2 cr.), or BIOL 595K (Methods and Measurements in Physical Biochemistry) (3 cr.)

BCHM 561 (General Biochemistry I) (3 cr.), BCHM 562 (General Biochemistry II) (3 cr.), or BCHM 572 (Advanced Biochemical Techniques) (2–4 cr.)

CHM 533 (Introductory Biochemistry) (3 cr.)

Group B

Select from the following:

BIOL 301 (Human Design: Anatomy and Physiology 1)* (3 cr.), BIOL 302 (Human Design: Anatomy and Physiology 2)* (3 cr.), BIOL 455 (Animal Physiology) (3 cr.), BIOL 483 (Environmental and Conservation Biology) (3 cr.), BIOL 493 (Introduction to Ethology) (3 cr.), BIOL 495I (Reproductive Physiology) (3 cr.), BIOL 537 (Immunobiology) (3 cr.), BIOL 551 (Biophysical Plant Physiology I) (3 cr.), BIOL 559 (Endocrinology) (3 cr.), BIOL 580 (Evolution) (3 cr.), BIOL 585 (Ecology) (3 cr.), BIOL 591 (Field Ecology) (4 cr.), BIOL 592 (The Evolution of Behavior) (3 cr.), BIOL 595D (Developmental Biology) (3 cr.), BIOL 595G (Animal Communication) (3 cr.), BIOL 597 (Sex and Evolution) (3 cr.)

HORT 301 (Plant Physiology) (4 cr.)

** If both BIOL 301 and 302 are completed, three of the six credits will count toward the 10-credit requirement. The other three credits will count as free electives. If only BIOL 301 or 302 is completed, the credits will count only as free-elective credits.*

Laboratory Courses

Select from the following:

BIOL 439 (Laboratory in General Microbiology) (2 cr.); BIOL 500 (Modular Upper-Division Laboratory Courses)* (2 cr.) (see page 38 for a complete list of BIOL 500 modules); BIOL 514 (Laboratory in Crystallography) (2 cr.); BIOL 542 (Modular Upper-Division Laboratory Courses)* (1 cr.) (see page 38 for a complete list of BIOL 542 modules); or BIOL 591 (Field Ecology) (4 cr.)

BIOL 394 or 494 (Biology Research) or BIOL 499 (Biology Honors Thesis Research) (maximum 2 cr.), taken during the junior or senior years, and BIOL 495C, (Ideas in Science and Law) can be used as partial fulfillment of the 10-credit requirement. However, these credits cannot be used to fulfill the minimum distribution requirement or the laboratory requirement.

Professional Education Courses 32 credits

The following education courses are required for certification to teach in Indiana schools. In addition, EDPS 235 can be used in partial fulfillment of the College of Science general education requirement.

EDCI 205 (Exploring Teaching as a Career) (3 cr.); EDCI 270 (Introduction to Educational Technology and Computing) (2 cr.); EDCI 285 (Multiculturalism and Education) (3 cr.); EDPS 235 (Learning and Motivation) (3 cr.); EDPS 265 (The Inclusive Classroom) (3 cr.); EDFA 200 (History and Philosophy of Education) (3 cr.); EDCI 421 (The Teaching of Biology in Secondary Schools) (3 cr.); EDCI 428 (Teaching Science in the Middle and Junior High School) (2 cr.); and EDCI 498 (Supervised Teaching) (10 cr.)

Cell and Developmental Biology Major

Cell biologists study the structure and function of cells and cellular components. This includes study of the structure and function of subcellular organelles; the cytoskeleton; signal transduction across the plasma membrane; cell cycle regulation; the processes of DNA replication, transcription and translation; and the regulation of gene expression. In developmental biology, students learn how these cellular and molecular phenomena can be used by an embryo to produce a new organism during developmental processes such as induction and pattern formation.

Cell and Developmental Biology Major Requirements 20–22 credits

Cell and Developmental Biology Courses 16–18 credits

BIOL 420 (Eukaryotic Cell Biology) (3 cr.); BIOL 595D (Developmental Biology) (3 cr.); and BIOL 415 (Introduction to Molecular Biology), or BIOL 481 (Eukaryotic Genetics), or BIOL 515 (Molecular Genetics) (2–3 cr.) *8–9 cr.*

BIOL 500I (Introductory Module: Protein Expression)

Two other BIOL 500 or BIOL 542 lab courses. See page 38 for a complete list of courses titles *2–3 cr.*

BCHM 561 (General Biochemistry I) (3 cr.) *3 cr.*

Electives 4 credits

Select 4 credits from:

BIOL 415 (Introduction to Molecular Biology) (3 cr.); BIOL 416 (Molecular Virology) (3 cr.); BIOL 438 (General Microbiology) (3 cr.); BIOL 444 (Human Genetics) (3 cr.) BIOL 455 (Animal Physiology) (3 cr.); BIOL 481 (Eukaryotic Genetics) (3 cr.); BIOL 495I (Reproductive Physiology) (3 cr.); BIOL 495S (Introduction to Bioinformatics) (3 cr.); BIOL 515 (Molecular Genetics) (2 cr.); BIOL 516 (Molecular Biology of Cancer) (3 cr.); BIOL 517 (Molecular Biology: Proteins) (2 cr.); BIOL 519 (Molecular Biology: Nucleic Acids) (2 cr.); BIOL 537 (Immunobiology) (3 cr.); BIOL 538 (Molecular, Cellular, and Developmental Neurobiology) (3 cr.); BIOL 550 (Plant Molecular Biology) (3 cr.); BIOL 559 (Endocrinology) (3 cr.); BIOL 573 (The Molecular Biology of Animal Cells) (3 cr.); BIOL 595Z (Cellular Biology of Plants) (3 cr.); up to three credits of BIOL 394 or 494 (Biology Research), or BIOL 499 (Biology Honors Thesis Research). Research selections must have approval of the Cell, Molecular, and Developmental Biology Area Committee. (1–3 cr.), BCHM 221 (Analytical Biochemistry) (3 cr.); CHM 224 (Introductory Quantitative Analysis) (4 cr.); CHM 321 (Analytical Chemistry I) (4 cr.); CHM 372 (Physical Chemistry) (4 cr.); CHM 373 (Physical Chemistry) (3 cr.)

** Students who choose to meet the laboratory requirement for the biology teaching major with modular upper-division laboratory courses must take BIOL 500I and one additional 500 or 542 module. Advisors will have the complete list of available modules for any given semester.*

Ecology, Behavior, and Evolutionary Biology Major

This area investigates how organisms interact with their physical environment and other organisms, from an evolutionary perspective. Ecologists' work includes research and/or teaching involving population genetics and evolution, adaptive strategies for survival, the nature of populations, and community ecology. Ecologists also offer technical services in connection with environmental impact decisions and regional planning, and environmental education at various levels as teacher, naturalist, or journalist. Students with a particularly strong interest in the environment may choose to select the environmental science option. This option allows greater latitude in selecting electives to broaden one's environmental perspective. Students interested in this area may consider programs in interdisciplinary science (page 97) and the College of Agriculture.

Ecology, Behavior, and Evolutionary Biology Major Requirements 17–20 credits

Ecology, Behavior, and Evolutionary Biology Courses 10–13 credits

BIOL 580 (Evolution) (3 cr.);
BIOL 585 (Ecology) (3 cr.) *6 cr.*
BIOL 592 (Evolution of Behavior) (3 cr.) or
BIOL 595G (Animal Communication) (3 cr.) or
BIOL 597 (Evolution of Behavior) (3 cr.) *3 cr.*
One of the following:

a. BIOL 394 (Biology Research) (1–4 cr.)
b. BIOL 494 (Biology Research) (1–4 cr.)
c. BIOL 499 (Biology Honors Thesis Research)(1–4 cr.)
d. BIOL 591 (Field Ecology)* (4 cr.) *1-4 cr.*

Electives 7 credits

Select from the following:

BIOL 415 (Introduction to Molecular Biology) (3 cr.); BIOL 438 (General Microbiology) (3 cr.); BIOL 439 (Laboratory in Microbiology) (2 cr.); BIOL 444 (Human Genetics) (3 cr.); BIOL 481 (Eukaryotic Genetics) (3 cr.); BIOL 483 (Environmental and Conservation Biology) (3 cr.); BIOL 493 (Introduction to Ethology) (3 cr.); BIOL 495S (Introduction to Bioinformatics) (3 cr.); BIOL 515 (Molecular Genetics) (2 cr.); BIOL 541 (Genetic Biology) (3 cr.); BIOL 549 (Microbial Ecology) (2 cr.); BIOL 562 (Neural Systems) (3 cr.); BIOL 591 (Field Ecology)* (4 cr.); BIOL 592 (The Evolution of Behavior) (3 cr.); BIOL 595G (Animal Communication) (3 cr.); BIOL 597 (Sex and Evolution) (3 cr.); ANSC 511 (Population Genetics) (3 cr.); ANTH 535 (Foundations of Biological Anthropology) (3 cr.); ANTH 536 (Primate Ecology) (3 cr.); BCHM 561 (General Biochemistry I) (3 cr.); BCHM 562 (General Biochemistry II) (3 cr.); BTNY 555 (Aquatic Botany) (3 cr.); EAS 572 (Paleoecology) (3 cr.); ENTM 500 (Fundamentals of Entomology) (4 cr.); FNR 501 (Limnology) (3 cr.); FNR 581 (Ecological Impact Analysis) (3 cr.)

Environmental Science Option Requirements

To complete a major in ecology, evolutionary, and population biology with the environmental science option, the following are required:

Environmental Science Courses 10–13 credits

BIOL 580 (Evolution) (3 cr.);
BIOL 585 (Ecology) (3 cr.) *6 cr.*
BIOL 592 (Evolution of Behavior) (3 cr.) or
BIOL 595G (Animal Communication) (3 cr.) or
BIOL 597 (Evolution of Behavior) (3 cr.) *3 cr.*
One of the following:

a. BIOL 394 (Biology Research) (1–4 cr.)
b. BIOL 494 (Biology Research) (1–4 cr.)
c. BIOL 499 (Biology Honors Thesis Research)(1–4 cr.)
d. BIOL 591 (Field Ecology)* (4 cr.) *1–4 cr.*

Electives 7 credits

Select from the following†: BIOL 438 (General Microbiology) (3 cr.); BIOL 439 (Laboratory in General Microbiology) (2 cr.); BIOL 483 (Conservation Biology) (3 cr.); BIOL 549 (Microbial Ecology) (2 cr.); BIOL 591 (Field Ecology)* (4 cr.); BIOL 595G (Animal Communication) (3 cr.); ABE 526 (Watershed Systems Design) (3 cr.); AGEC 415 (Community and Resource Development) (3 cr.); AGRY 580 (Soil Microbiology) (3 cr.); BCHM 561 (General Biochemistry I) (3 cr.); BCHM 562 (General Biochemistry II) (3 cr.); BTNY 555 (Aquatic Botany) (3 cr.); C E 350 (Environmental Engineering) (3 cr.); C E 352 (Biological Principles of Environmental Engineering) (3 cr.); C E 542 (Hydrology) (3 cr.); C E 555 (Microbial Degration of Pollutants) (3 cr.); EAS 403 (Physical Oceanography) (3 cr.); EAS 420 (Global Change Modeling) (3 cr.); EAS 572

** BIOL 591 may be used as a required course or as four credits of biology elective, or as three credits of biology elective plus a required course.*

† Additional courses relevant to ecology, behavior, and evolution offered by the Department of Biological Sciences as well as other departments also may satisfy the biology elective requirement upon permission from the Biology Counseling Office.

(Paleoecology) (3 cr.); EAS 587 (Chemical Evolution of Ground Water) (4 cr.); ENTM 460 (Aquatic Entomology) (3 cr.); ENTM 500 (Fundamentals of Entomology) (4 cr.); FNR 488 (Global Environmental Issues) (3 cr.); FNR 501 (Limnology) (3 cr.); FNR 541 (Ecology and Management of Harvested Wildlife) (2 cr.); FNR 542 (Ecology and Management of Declining, Rare and Endangered Species) (2 cr.); FNR 543 (Conservation Biology I) (3 cr.); FNR 544 (Conservation Biology II) (3 cr.); FNR 545 (Fisheries Science and Management) (3 cr.); FNR 547 (Vertebrate Population Dynamics) (3 cr.); FNR 581 (Ecological Impact Analysis) (3 cr.); POL 523 (Environmental Politics and Public Policy) (3 cr.)

The Biology Counseling Office has a list of courses offered by the departments in the colleges of agriculture and liberal arts that will satisfy general education and elective requirements as well as broaden the perspectives of students interested in the variety of subdisciplines of ecology.

Genetic Biology Major

Genetics is the science of information transfer from one generation to another. We learn the laws of inheritance in all creatures big and small, how they evolve, and how they change. On the molecular level we learn about DNA and RNA; on the cellular level, we discover what makes a cell cancerous; and on an organismal level, we examine the reproductive habits of various organisms. Crucial principles include the structure, function, and transmission of genes. Laboratory techniques explore genetic engineering from the "inside." Genetics is crucial to all of biology; so, a genetics major has wide applicability. Students interested in applied genetics also should consider programs in the College of Agriculture.

Genetic Biology Major Requirements **18–21 credits**

Genetic Biology Courses ***12–15 credits***

BCHM 561 (General Biochemistry I) (3 cr.) or CHM 533 (Introductory Biochemistry) (3 cr.); BIOL 441 (Senior Seminar in Genetics) (1 cr.); BIOL 438 (General Microbiology) (3 cr.); and BIOL 481 (Eukaryotic Genetics), BIOL 515 (Molecular Genetics), or BIOL 541 (Genetic Biology) (2–3 cr.) *9–10 cr.*

One of the following:

a. BIOL 500I (Introductory Module: Protein Expression) (2 cr.) and two other BIOL 500 or BIOL 542 lab courses. See page 38 for a complete list of course titles. (2–3 cr.)

b. Three credits of BIOL 394 (Biology Research), or BIOL 494 (Biology Research), or BIOL 499 (Biology Honors Thesis Research). Must be approved in advance by Molecular Genetics and Microbiology Area Committee. (3 cr.) *3–5 credits*

Electives ***6 credits***

Select from the following: BIOL 416 (Molecular Virology) (3 cr.); BIOL 444 (Human Genetics) (3 cr.); BIOL 481 (Eukaryotic Genetics) (3 cr.); BIOL 495S (Introduction to Bioinformatics) (3 cr.); BIOL 515 (Molecular Genetics) (2 cr.); BIOL 516 (Molecular Biology of Cancer) (3 cr.); BIOL 519 (Molecular Biology: Nucleic Acids) (2 cr.); BIOL 541 (Genetic Biology) (3 cr.); BIOL 550 (Plant Molecular Biology) (3 cr.); BIOL 573 (The Molecular Biology of Animal Cells) (3 cr.); BIOL 580 (Evolution) (3 cr.); AGRY 530 (Plant Genetics) (3 cr.); ANSC 511 (Population Genetics) (3 cr.); BCHM 562 (General Biochemistry II) (3 cr.)

Microbiology Major

Microbiology includes the study of viruses, bacteria, and fungi. A student can expect to study topics such as microbial growth, nutrition, metabolism, pathogenesis, morphogenesis, and production of antibiotics.

The American Board of Microbiology, a committee of the American Academy of Microbiology, has established a National Registry of Microbiologists to recognize individuals at the bachelor's level who have an adequate understanding of basic and applied microbiology. Parts of the requirements for registration specify 30 credits in biological sciences, 20 credits of which must be in microbiology. It is likely that similar criteria will be used for classification as a microbiologist by the U.S. Civil Service Commission. Students should consider this when selecting elective courses.

Microbiology Major Requirements **17–18 credits**

Microbiology Courses ***14–15 credits***

BIOL 438 (General Microbiology) (3 cr.); BIOL 439 (Laboratory in Microbiology) (2 cr.); BIOL 529 (Bacterial Physiology) (3 cr.); BCHM 561 (General Biochemistry I) (3 cr.); BIOL 441 (Senior Seminar in Genetics) (1 cr.) *12 cr.*

BIOL 481 (Eukaryotic Genetics) (3 cr.). or BIOL 515 (Molecular Genetics) (2 cr.), or BIOL 541 (Genetic Biology) (3 cr.) *2–3 cr.*

Electives ***3 credits***

Select from the following:

BIOL 416 (Molecular Virology) (3 cr.); BIOL 446 (Molecular Bacterial Pathogen) (3 cr.); BIOL 495S (Introduction to Bioinformatics) (3 cr.); BIOL 500 or 542 (Modular Laboratory Courses; see page 38 for a complete list of titles) (1-2 cr.); BIOL 515 (Molecular Genetics) (3 cr.); BIOL 533 (Medical Microbiology) (3 cr.); BIOL 541 (Genetic Biology) (3 cr.); BIOL 549 (Microbial Ecology) (2 cr.); BCHM 562 (General Biochemistry II)

Microbiology Honors Curriculum

Microbiology Honors Course Requirements ***14–23 credits****

To complete the microbiology honors curriculum, the following courses must be selected when fulfilling the "General Degree Requirements" listed on page 37:

MA 261 (Multivariate Calculus) (4 cr.), or MA 174 (Multivariable Calculus) (4 cr.), or MA 271 (Several Variable Calculus) (5 cr.)

CHM 261–262 (Organic Chemistry) (6 cr.) and CHM 263–264 (Organic Chemistry Laboratory) (2 cr.)

Additionally, students in the microbiology honors curriculum must complete one of these courses:

C S 177 (Programming with Multimedia Objects) (4 cr.), or C S 158 (C Programming) (3 cr.), or C S 154 (FORTRAN Programming) (3 cr.) *3–4 cr.*

Students in the microbiology honors curriculum must complete three of these courses/course sequences:

a. CHM 321 (Analytical Chemistry I) (4 cr.)
b. MA 262 (Linear Algebra and Differential Equations) (4 cr.)
c. PHYS 152 (Mechanics) (4 cr.), PHYS 241 (Electricity and Optics) (3 cr.), PHYS 252 (Electricity and Optics Laboratory) (1 cr.), PHYS 290D (Heat and Thermal) (1 cr.)
d. CHM 372 (Physical Chemistry) (4 cr.) or both CHM 373 and 374 (Physical Chemistry) (3 cr.)
e. STAT 503 (Statistical Methods for Biology) (3 cr.) *11-19 cr.**

For the microbiology honors curriculum, a 3.0 graduation index is required at the time of graduation.

Molecular Biology Major

Molecular biology is similar to biochemistry in its analytic approach and emphasis on the fundamental processes of life on the molecular level. Its distinction lies in its focus on the manipulation of DNA and RNA molecules through recently developed techniques. Much of the current application is in the area of gene expression. Students can expect to study the molecular control mechanisms associated with DNA replication, RNA transcription and processing, and growth control. Relevant laboratory techniques include electrophoresis, chromatography, gene sequencing analysis, Southern and Northern blot procedures, and gene cloning and expression.

The following courses are required to complete a major in molecular biology:

Molecular Biology Major Requirements **23–24 credits**

To complete the molecular biology major, the following courses must be selected when fulfilling the "General Degree Requirements" listed on page 37:

C S 177 (Programming with Multimedia Objects) (4 cr.), or C S 158 (C Programming) (3 cr.), or STAT 503 (Statistical Methods for Biology) (3 cr.) *3–4 cr.*

CHM 261–262 (Organic Chemistry) (6 cr.) and CHM 263–264 (Organic Chemistry Laboratory) (2 cr.) *8 cr.*

CHM 372 (Physical Chemistry) (4 cr.) or both CHM 373–374 (Physical Chemistry) (6 cr.) *4–6 cr.*

Molecular Biology Courses ***13–14 credits***

BIOL 415 (Introduction to Molecular Biology) (3 cr.); BIOL 500I (Introductory Module: Protein Expression) (2 cr.); two additional BIOL 500 or 542 lab modules (see page 38 for a complete list of titles) (1–2 cr.); BCHM 561–562 (General Biochemistry I and II) (6 cr.)

** PHYS courses may also be chosen as part of the General Degree Requirements listed on page 37.*

Electives ***10 credits***

Select from the following:

BIOL 416 (Molecular Virology) (3 cr.); BIOL 420 (Eukaryotic Cell Biology) (3 cr.); BIOL 444 (Human Genetics) (3 cr.); BIOL 481 (Eukaryotic Genetics) (3 cr.); BIOL 495S (Introduction to Bioinformatics) (3 cr.); BIOL 511 (X-Ray Crystallography) (3 cr.); BIOL 515 (Molecular Genetics) (2 cr.); BIOL 516 (Molecular Biology of Cancer) (3 cr.); BIOL 517 (Molecular Biology, Proteins) (2 cr.); BIOL 519 (Molecular Biology, Nucleic Acids) (2 cr.); BIOL 537 (Immunobiology) (3 cr.); BIOL 538 (Molecular, Cellular, and Developmental Neurobiology) (3 cr.); BIOL 541 (Genetic Biology) (3 cr.); BIOL 550 (Plant Molecular Biology) (3 cr.); BIOL 573 (The Molecular Biology of Animal Cells) (3 cr.); BIOL 620 (Advanced Topics in Eukaryotic Cell Biology) (3 cr.); up to three credits of BIOL 394 or 494 (Biology Research) or BIOL 499 (Biology Honors Thesis Research) (1–3 cr.). (Research must be approved in advance by the Cell, Molecular, and Developmental Biology Area Committee); BCHM 221 (Analytical Biochemistry) (3 cr.); CHM 224 (Introduction to Quantitative Analysis) (4 cr.); CHM 321 (Analytical Chemistry I) (4 cr.)

Molecular Biology Honors Curriculum **10–15 credits**

Additionally, students in the molecular biology honors curriculum must complete, as part of the "General Degree Requirements" listed on page 27, PHYS 152 (Mechanics), PHYS 241 (Electricity and Optics), PHYS 252 (Electricity and Optics Laboratory), and PHYS 290D, (Heat and Thermal).

Students must also complete one of the following:

a. CHM 321 (Analytical Chemistry I) (4 cr.) (from "Molecular Biology Major Requirements")
b. CHM 373–374 (Physical Chemistry) (6 cr.) (from "General Degree Requirements")

Neurobiology and Physiology Major

Physiology is the study of the functions of living organisms and the organ and tissue systems of which they are composed. The goal of physiology is to understand, in terms of physical and chemical principles, the mechanisms that operate in living organisms from the subcellular level to the level of the whole animal, the emphasis is on how these mechanisms are integrated to produce a viable organism. Neurobiology is the study of the structure, function, and development of the nervous system. It originated, in part, as a subdiscipline of physiology. In recent years, neurobiology is one of the most rapidly changing and exciting areas of biology.

Neurobiology and Physiology Major Course Requirements **18–21 credits**

Neurobiology and Physiology Courses ***12–15 credits***

Biology: BIOL 455 (Animal Physiology) (3 cr.), or BIOL 538 (Molecular, Cellular, and Developmental Neurobiology) (3 cr.), or BIOL 562 (Neural Systems) (3 cr.) *3 cr.*

BIOL 495N (Introduction to Neurobiology) (3 cr.) or BIOL 559 (Endocrinology) (3 cr.) *3 cr.*

One of the following:

a. BIOL 500A (Animal Physiology Laboratory) (2 cr.) or BIOL 542N (Laboratory in Neurophysiology) (1 cr.); Two other BIOL 500 or BIOL 542 lab courses. See page 38 for a complete list of course titles. (2-3 cr.)
b. Three credits of BIOL 394 (Biology Research), or BIOL 494 (Biology Research), or BIOL 499 (Biology Honors Thesis Research). Must be approved in advance by Neurobiology and Physiology Area Committee. (3 cr.) *3–5 cr.*

One of the following:

BCHM 561 (General Biochemistry I) (3 cr.), CHM 372 (Physical Chemistry) (4 cr.), CHM 373 (Physical Chemistry) (3 cr.), or CHM 533 (Introductory Biochemistry) (3 cr.) *3–4 cr.*

Electives ***6 credits***

Select 6 credits from the following four options:

a. BIOL 301 (Human Design: Anatomy and Physiology I) (3 cr.) and BIOL 302 (Human Design: Anatomy and Physiology II) (3 cr.). (Both courses must be completed, but only three of these credits may be used toward this requirement.).
b. Any advanced biology elective (400- or 500-level) with the exception of BIOL 497 (Biology Honors Seminar), BIOL 498 (Biology Teaching), or one-credit electives in biology. BIOL 495 or 595 (Special Assignments in Biology) requires the approval of the Neurobiology and Physiology Area Committee.
c. Three (but no fewer) credits of advanced research (BIOL 394, 494, or 499) can count toward the six-credit requirement, provided the research is not also used as a substitute for a modular laboratory course. Approval of the Neurobiology and Physiology Area Committee is required.
d. BCHM 562 (General Biochemistry II) (3 cr.)

Plant Physiology and Molecular Biology Major

Plant physiologists and molecular biologists study the molecular and physiological mechanisms by which plants control their basic biological processes at the cellular, tissue and organ, and whole organism levels. A student will study plant physiology, DNA organization and expression, chloroplast and mitochondrial molecular biology, and will employ techniques utilizing transgeneic plants as research tools.

Plant Physiology and Molecular Biology Major Requirements 23–25 credits

Plant Physiology and Molecular Biology Courses 17–19 credits

BCHM 561 (General Biochemistry I) (3 cr.) 3 cr.

One of the following:

BIOL 550 (Plant Molecular Biology) (3 cr.); HORT 551 (Biophysical Plant Physiology I) (3 cr.); HORT 553 (Plant Growth and Development) (3 cr.); BIOL 640 (Metabolic Plant Physiology) (3 cr.) *3 cr.*

One of the following:

a. BIOL 500I (Introductory Module: Protein Expression) (2 cr.) and two other BIOL 500 or BIOL 542 lab courses. See page 38 for a complete list of course titles. (2–3 cr.)

b. Three credits of BIOL 394 (Biology Research), or BIOL 494 (Biology Research), or BIOL 499 (Biology Honors Thesis Research). Must be approved in advance by the Molecular Genetics and Microbiology Area Committee. (3 cr.) *3–5 cr.*

BTNY 316 (Plant Anatomy) (4 cr.) *4 cr.*

HORT 301 (Plant Physiology) (4 cr.) *4 cr.*

Electives 6 credits

Any 400- or 500- level biology courses; BCHM 221 (Analytical Biochemistry) (3 cr.); CHM 224 (Introductory Quantitative Analysis) (4 cr.); CHM 321 (Analytical Chemistry I) (4 cr.); CHM 372 (Physical Chemistry) (4 cr.); CHM 373 (Physical Chemistry) (3 cr.).

Biological Sciences Honors Research Program

The Department of Biological Sciences sponsors an honors research program to supplement the formal course offerings in the department's degree programs, to increase the breadth and depth of the student's knowledge of modern biology, and to lead to an honors research program designation at graduation. The program offers guided study in biology through independent research. It is available to any qualified student in the University who plans to complete a major or minor concentration in the biological sciences.

The requirements for graduation with honors in research are:

1. A minimum 3.0 cumulative GPA (however, a student with a lower GPA may petition the Undergraduate Honors Committee)
2. Conducting research supervised by a research director selected by the student, with the research plan approved by the Undergraduate Honors Committee
3. Completion of an honors research thesis approved by the research director and the head of the Department of Biological Sciences
4. Enrollment and participation in BIOL 497 (Honors Seminar), which is required of juniors and seniors but is optional for other honors research students
5. Presentation and discussion of the research during class and at Undergraduate Research Day

Advantages of the Honors Research Program

1. Students have the opportunity to grasp a better understanding of the thought processes and methods for developing new scientific knowledge. The program provides a practical research experience and contributes to a better preparation for graduate and professional schools.
2. Biology honors students have close contact with a functioning research group. They have the opportunity to carry out basic research and, if significant results are obtained, to publish their data.
3. Students who complete the honors research program are recognized on their transcript for having done so and receive the bachelor's designation "with honors."
4. Students who complete the honors research program are considered for the annual Singleton Award that recognizes the honors student who best exemplifies research excellence and scholarship.

Honors Curriculum Programs

An honors curriculum program is available in the following majors: microbiology, biochemistry, and molecular biology. Each major that offers an honors curriculum program has designated advanced courses/course sequences that are required to earn a degree in the honors curriculum. Additionally, a 3.0 graduation index is required at the time of graduation. For specific requirements, see the applicable individual major section.

Special Programs and Opportunities

Preprofessional Major

This is a program designed for students who plan to attend a school of medicine, dentistry, optometry, or veterinary medicine upon completion of their coursework at Purdue. The program allows students to complete approximately three-fourths of the credit hours and all of the courses required for graduation in six semesters. After successfully completing the first year at an accredited school of medicine, dentistry, optometry, or veterinary medicine, the student may transfer his or her professional school credits back to Purdue, and the Bachelor of Science degree is granted. This is called the three-plus-one program.

It is important for the student who chooses to enroll in the three-plus-one program to realize that enrollment in the program does not guarantee admission to a professional school. Medical schools no longer encourage students to apply after three years of study, but will review the applications of three-plus-one students. Strong students enrolled in the three-plus-one program often are admitted to schools of dentistry, veterinary medicine, and optometry.

Three-plus-one students who are not accepted to a professional school after the third year have the option of completing a fourth year of study in the biological sciences and earning the B.S. degree. Three-plus-one students should meet regularly with their academic advisors to ensure that they are meeting the professional school requirements and to develop an alternate plan of study should they need to add a fourth year of undergraduate coursework.

Undergraduate Research

Students interested in doing research but who will not participate in the Honors Research Program can do for credit. Students must fill out the "Initial Enrollment for Undergraduate Research" form available in the Biology Counseling Office. Once the form is approved, students register for credit in BIOL 194, 294, 394 or 494, depending upon their semester classification. These courses can be repeated for credit.

Special Assignments

Students who would like to undertake special study in areas not available through formal coursework offered by the department are strongly encouraged to find a faculty member whose work is in the area of their interest and arrange to enroll in special assignment courses: BIOL 195, 295, 395, and 495. The special study can be directed readings; independent study; supervised library, laboratory, or field work; or discussions. Credit will be given for the work, and a title of the area investigated will appear on the transcript. These courses can be repeated for credit.

Summer Internships

Students are encouraged to pursue summer internships both off and on campus. For the past several years, the Department of Biological Sciences has offered summer research fellowships for biology majors. Students selected for these internships do 10 weeks of research at Purdue and receive a generous stipend. The Biology Counseling Office also collects information about other available summer internships.

Cooperative Education

The Department of Biological Sciences participates in the Cooperative Education Program as described on page 9. Interested students should contact the Coordinator of Cooperative Education, Department of Biological Sciences, Room 1–123, Lilly Hall of Life Sciences. The department coordinator will have information about available programs and can offer advice.

To be eligible for the Cooperative Education Program, a student must have a cumulative index of 2.5 or better and have an index of 2.8 or better in biology courses at the end of three semesters.

If grade achievements do not meet these requirements but a student possesses other qualifications that should be considered, he or she can petition for special consideration.

While a co-op student employee, a student must register for the noncredit departmental courses in the sequence BIOL 091, 092, 093, 094, and 095 and pay the special University fee for co-op registration.

Under specified circumstances, students who want to participate in some form of independent study while off campus can register for Special Assignments: BIOL 395 or 495 (1–4 cr.) with the consent of the departmental coordinator of the program.

Minor in Biological Sciences

The minor in biological sciences is designed to allow a non-biology major to establish a strong background knowledge of the biological sciences. It requires courses that cover the spectrum of basic biology, from diversity and ecology to molecular biology and genetics. Students who complete the minor will have sufficient background to understand foundational concepts from any area of biology and their application in everyday settings.

Minor in Biological Sciences — Requirements **16–18 credits**

The minor in biological sciences requires the following courses:

One of these two sequences: *7–8 cr.*

a. BIOL 121 (Diversity, Ecology, and Behavior) (2 cr.), BIOL 131 (Development, Structure, and Function of Organisms) (3 cr.), BIOL 136 (Quantitative and Problem Solving Skills Laboratory) (0.5 cr.), BIOL 137 (Handling Cells and Tissues; Microscopy Laboratory) (0.5 cr.), BIOL 138 (Information and Communication Skills Laboratory) (0.5 cr.), and BIOL 139 (Measurements and Basic Solution Chemistry Laboratory) (0.5 cr.) *7 cr.*

b. BIOL 110 (Fundamentals of Biology I) (4 cr.), and BIOL 111 (Fundamentals of Biology II) (4 cr.) *8 cr.*

And the following courses:

BIOL 231 (Cell Structure and Function) (3 cr.) or BIOL 295E (Biology of the Living Cell) (3 cr.); and BIOL 232 (Cell Structure and Function) (2 cr.) *5 cr.*

Plus one of the following sets of courses: *4–5 cr.*

a. BIOL 241 (Genetics and Molecular Biology) and BIOL 242 (Genetics and Molecular Biology) (5 cr.)

b. AGRY 320 (Genetics) and AGRY 321 (Genetics Laboratory) (4 cr.)

The following courses are prerequisite or corequisite for some of the above courses:

CHM 115 (General Chemistry) (4 cr.), and CHM 116 (General Chemistry) (4 cr.)

Chemistry

The Department of Chemistry offers five baccalaureate programs:

A. Bachelor of Science in Chemistry (American Chemical Society (ACS)-certified). *54–56 credits*

B. Bachelor of Science degree with chemistry major, including specializations in atmospheric chemistry, biochemistry, computational chemistry, environmental chemistry, and materials science. *40–79 credits*

C. Bachelor of Science degree with chemistry teaching major. *71–73 credits*

D. Bachelor of Science in Chemistry/Bachelor of Science in Chemical Engineering. *87–89 credits*

E. Bachelor of Science in Chemistry/Bachelor of Science in Materials Science and Engineering. *93–95 credits*

The educational objectives for individual programs are given in the "Special Degree Requirements" section.

In the last 5 years, 40% of chemistry graduates attend graduate school, 40% start working in industry (primarily chemical and pharmaceutical industry), 10% go to professional schools (medicine, law), and 10% become teachers.

The most recent Web information can be found at: www.chem.purdue.edu.

General Degree Requirements

The following courses are required for chemistry majors in all programs. In meeting these general degree requirements, you also will automatically fulfill the College of Science graduation requirements listed on 27-29.

Special requirements for individual degrees are given in the following section.

Chemistry Core ***39–41 credits***

CHM 125 (General Chemistry) (5 cr.), or CHM 115 (General Chemistry) (4 cr.), or CHM 123 (General Chemistry for Engineers I) (4 cr.) *4–5 cr.*

CHM 126 (General Chemistry II) (5 cr.), or CHM 116 (General Chemistry) (4 cr.), or CHM 124 (General Chemistry for Engineers II) (4 cr.) *4–5 cr.*

CHM 241 (Introductory Inorganic Chemistry (4 cr.); CHM 342 (Inorganic Chemistry) (3 cr.); CHM 261 (Organic Chemistry) (3 cr.); CHM 265 (Organic Chemistry Laboratory (2 cr.); CHM 294 (Sophomore Chemistry Seminar) (1 cr.); CHM 262 (Organic Chemistry) (3 cr.); CHM 266 (Organic Chemistry Laboratory) (2 cr.); CHM 321 (Analytical Chemistry) (4 cr.); CHM 373 (Physical Chemistry) (3 cr.); CHM 374 (Physical Chemistry) (3 cr.); CHM 376 (Physical Chemistry Laboratory) (2 cr.); CHM 494 (Junior–Senior Chemistry Seminar) (1 cr.) *31 cr.*

Science Requirements 15–18 credits

PHYS 152 (Mechanics) (4 cr.); PHYS 241 (Electricity and Optics) (3 cr.) or PHYS 261 (Electricity and Optics) (4 cr.); PHYS 252 (Electricity and Optics Laboratory) (1 cr.); PHYS 290D (Heat and Thermal) (1 cr.) *9–10 cr.*

Two other science courses (3 credits or above) in biology, earth and atmospheric sciences, physics (300 or above level), astronomy, and computer science. All courses should be for science majors and not designed for elementary teachers. Check with your advisor for approval.* *6–8 cr.*

Mathematics Requirements 12–14 credits

MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) *4–5 cr.*

One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 13 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) *4–5 cr.*

One of: MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus II) (5 cr.), MA 271 (Several Variable Calculus) (5 cr.) *4–5 cr.*

Additional Requirements 36–41 credits

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See Modern Foreign Language requirements on page 28). *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences, and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives 18 cr.

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge in chemistry or to gain experience in a non-chemistry area that is of special interest or that will help professionally. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

Grade Requirement

An undergraduate student is expected to have an average grade point index of at least 2.0 in general chemistry courses and in CHM 241 (Introductory Organic Chemistry), CHM 261 (Organic Chemistry), and CHM 265 (Organic Chemistry Laboratory) or CHM 267 (Organic Chemistry, Honors) to continue in a chemistry program. A student must have an average grade point index of at least 2.0 in required chemistry courses to graduate in any of the chemistry options, except for the teaching option, which requires an index of 2.5.

Chemistry Degrees/Majors

Bachelor of Science in Chemistry

This degree program is designed primarily for students planning professional careers as chemists in industry, universities, or research institutes. This degree program fulfills the recommendations of the Committee on Professional Training of the American Chemical Society (ACS); graduates who follow this program will be certified by the American Chemical

** Examples of approved courses for chemistry majors are: BIOL 110–111 (Fundamentals of Biology I and II) (4 cr.); BIOL 286–287 (Introduction to Ecology) (4 cr.); BIOL 231 (Cell Structure and Function) (3 cr.); EAS 111 (Physical Geology) (3 cr.); EAS 403 (Physical Oceanography) (3 cr.); ASTR 363–364 (Intermediate Astronomy I and II) (3 cr.); C S 158 (C Programming) (3 cr.).*

Society as having fulfilled its recommended requirements.

By concentrating advanced elective credit hours in biochemistry and by taking biology courses for the laboratory science requirement, this degree provides an excellent preparation for medical, dental, or veterinary schools. This program would particularly benefit those planning careers in medical research.

B.S. in Chemistry (ACS) Additional Requirements — 16 credits

The following courses are required for this option in addition to those listed under "General Degree Requirements" on page 49:

CHM 342L (Inorganic Chemistry Laboratory) (1 cr.); CHM 424 (Analytical Chemistry II) (4 cr.); CHM 513 (Chemical Literature) (1 cr.); Advanced chemistry elective (3 cr.); and CHM 533 (Introductory Biochemistry) (3 cr.) — *12 cr.*

MA 262 (Linear Algebra and Differential Equations) (4 cr.) — *4 cr.*

Bachelor of Science Degree with Chemistry Major

This degree program is designed for those who want less specialized training in chemistry than is required for the B.S. in Chemistry degree. This program requires the basic courses listed under the "General Degree Requirements" section and permits 9 to 22 credit hours in free electives.

Free electives allow a student to build a program of study in another area to complement a chemistry background. It is possible, for example, to concentrate elective credit hours in one of the following areas: administration, biochemistry, chemical literature, chemical physics, computer applications in chemistry, cosmochemistry, geochemistry, patent law, and preprofessional.

More information about recommended courses for these programs as well as other programs of study are available from an advisor or faculty member.

Bachelor of Science with Chemistry Major — Options

ACS-Accredited Degree in Chemistry/ Biochemistry

Biochemists study the chemical basis of life. Some of the major problems include the transfer of genetic information to biological structures, the conversion of nutrients into cell constituents and their utilization as sources of energy, the storage of memory, and the chemical nature of neural processes. Furthermore, biochemists are interested in the chemical details of important processes such as photosynthesis, blood clotting, fertilization, and other functions that may be unique to certain organisms.

A major in biochemistry also is available through the Department of Biochemistry in the College of Agriculture, and students majoring in the Department of Biological Sciences can elect a biochemistry concentration as listed on page 39.

ACS-Accredited Degree in Chemistry/ Biochemistry Additional Requirements — 22 credits

The following courses are required for this option in addition to those listed under "General Degree Requirements" on page 49:

BIOL 231 (Biology III: Cell Structure and Function) and BIOL 232 (Laboratory in Biology III: Cell Structure and Function) (5 cr.); BIOL 241 (Biology IV: Genetics and Molecular Biology) and BIOL 242 (Laboratory in Biology IV: Genetics and Molecular Biology) (5 cr.) — *10 cr.*

CHM 533 (Introductory Biochemistry) (3 cr.); CHM 538 (Molecular Biotechnology) (3 cr.); and CHM 499 (Undergraduate Research in Biochemistry) (6 cr.) — *12 cr.*

Atmospheric Chemistry

Measurements of atmospheric constituents conducted since the middle of the 19th century have shown that human activities have had a significant impact on the chemical composition of the atmosphere. These changes are manifested in local and global scale pollution problems, including stratospheric ozone depletion, increases in ground level ozone and photochemical smog, global climate change, and acid rain. Problems associated with global atmospheric change have resulted in an increased demand for scientists with a solid education in the fundamentals of atmospheric chemistry. To help meet this need and to provide a unique opportunity for our students in applied chemistry, the Department of Chemistry has created an atmospheric chemistry degree option. Students completing this option will then be well positioned to seek employment with government

environmental agencies or with consulting and manufacturing firms in the private sector, or to go on to graduate school.

Atmospheric Chemistry
Additional Requirements **19 credits**

The following courses are required for this option in addition to those listed under "General Degree Requirements" on page 48-49:

CHM 424 (Analytical Chemistry II) (4 cr.); CHM 581 (Atmospheric Chemistry) (3 cr.); CHM 582 (Chemistry of the Earth's Upper Atmosphere) (3 cr.) *10 cr.*

EAS 225 (Science of the Atmosphere) (3 cr.); EAS 421 (Atmospheric Thermodynamics) (3 cr.); EAS 525 (Atmospheric Observation on Measurements) (3 cr.) *9 cr.*

It is suggested that students who are pursuing this option take EAS 431 (Synoptic Laboratory) (1 cr.).

Computational Chemistry

Scientists today routinely use computer models to study complicated chemical systems. With the availability of high-speed computing from the desktop to the supercomputer, chemical problems can be studied extensively as computer models. This degree option will prepare individuals with computing skills and a technical understanding of the chemical sciences for careers in science where computers are one more tool used every day to solve complex chemical problems.

Computational Chemistry
Additional Requirements **25 credits**

The following courses are required for this option in addition to those listed under "General Degree Requirements" on page 49:

Chemistry: Undergraduate Research in Computational Chemistry or related field: CHM 499 (Special Assignments) (6 cr.); and CHM 579 (Computational Chemistry) (3 cr.) *9 cr.*

Computer Science: C S 180 (Programming I) (4 cr.); C S 240 (Programming in C) (3 cr.); C S 251 (Data Structures) (3 cr.); C S 314 (Numerical Methods) (3 cr.); and C S 334 (Interactive Computer Graphics and Visualization) (3 cr.) *16 cr.*

Environmental Chemistry

Society faces many challenges involving environmental issues. Important issues such as ground water pollution, hazardous chemical waste treatment, ozone depletion, radioactive waste treatment, industrial hygiene, and water treatment require a strong fundamental understanding of the chemistry involved. This degree option has been designed to provide students a means to tailor a field of study with an emphasis on chemistry and the environment.

Environmental Chemistry
Requirements **31–33 credits**

The following courses are required for this option in addition to those listed under "General Degree Requirements" on page 49:

One of the following:

a. BIOL 231 (Biology III: Cell Structure and Function) (3 cr.), BIOL 232 (Laboratory in Biology III: Cell Structure and Function) (2 cr.), BIOL 241 (Biology IV: Genetics and Molecular Biology) (3 cr.), and BIOL 242 (Biology IV: Genetics and Molecular Biology) (2 cr.)

b. EAS 243–244 (Earth Materials I and II) (8 cr.) *8–10 cr.*

C E 353 (Physico-Chemical Principles of Environmental Engineering) (4 cr.); CHM 481 (Topics in Environmental Chemistry) (3 cr.); CHM 424 (Analytical Chemistry II) (4 cr.) *11 cr.*

Undergraduate research: CHM 499 (Special Assignments) (6 cr.). (Undergraduate research in an environmentally related area. Need not be restricted to the Chemistry Department, e.g. C E 497 (Civil Engineering Projects), HSCl 490 (Special Topics), FNR 499 (Forestry & Natural Resources Honors Thesis), etc. Students must complete two semesters of research. In special cases, an additional 6 credits of environmental electives may be substituted). *6 cr.*

Environmental electives ***6 credits***

At least one must be at the 400/500 level. Choose from the following (or see your advisor):

Earth and Atmospheric Sciences: EAS 519 (Applications of Environmental Geosciences) (3 cr.)

Chemistry: CHM 533 (Introductory Biochemistry) (3 cr.); CHM 548 (Radiochemistry) (3 cr.)

Civil Engineering: C E 350 (Environmental Engineering) (3 cr.); C E 352 (Biological Principles of Environmental Engineering) (3 cr.); C E 456 (Wastewater Treatment) (3 cr.); C E 542 (Hydrology) (3 cr.)

Forestry and Natural Resources: FNR 488 (Global Environmental Issues) (3 cr.); FNR 581 (Environmental Impact Analysis) (3 cr.)

Health Sciences: HSCI 345 (Occupational Disease) (3 cr.); HSCI 347 (Industrial Hygiene Hazard Evaluation) (3 cr.)

Statistics: STAT 511 (Statistical Methods) (3 cr.)

In order to fulfill the general education requirement, it is suggested that students consider taking some or all of the following courses:

POL 223 (Introduction to Environmental Policy) (3 cr.) and POL 523 (Environmental Politics and Public Policy) (3 cr.); C E 553 (Environmental Law for Engineers) (3 cr.) (recommended as a free elective).

Materials Science Specialization

This plan of study meets the requirements for the B.S. with Chemistry major as well as providing a strong background in materials science and engineering. Please refer to the College of Engineering Catalog for more information on the materials science and engineering field.

Materials Science Specialization Additional Requirements — 31 credits

In addition to the requirements for the B.S. with Chemistry major, the following courses are required:

MA 262 (Linear Algebra and Differential Equations) (4 cr.) — *4 cr.*

MSE 230 (Structure and Properties of Materials) (3 cr.); MSE 235 (Materials Properties Laboratory) (2 cr.); MSE 240 (Processing and Properties of Materials) (3 cr.); MSE 335 (Materials Characterization Laboratory) (3 cr.); MSE 340 (Transport Phenomena) (3 cr.); MSE 350 (Thermodynamics of Materials) (3 cr.); MSE 367 (Materials Processing Laboratory) (3 cr.); MSE 370 (Electrical, Optical, and Magnetic Properties of Materials) (3 cr.) — *23 cr.*

CHE 544 (Structure and Physical Behavior of Polymer Systems) (3 cr.); CHM 342L (Inorganic Chemistry Lab) (1 cr.) — *4 cr.*

Bachelor of Science Degree with Chemistry Teaching Major

This program of study meets the requirements for certification to teach chemistry in the secondary schools of Indiana in addition to meeting the requirements for the B.S. degree with chemistry major on page 50. Students preparing to teach in junior/high/middle/secondary schools (grades 5–12) must meet the requirements set by the Teacher Education Council. These requirements are outlined in the Guide to Teacher Preparation and Licensure from the Office of Professional Preparation (OPPL) at Purdue http://admin2.soe.purdue.edu/oppl/.

The program of study for prospective teachers differs from the program leading to the B.S. degree with a chemistry major in three minor requirements: CHM 533 (Introduction to Biochemistry) is required, foreign language is two semesters, and Organic Chemistry Laboratory can be substituted by CHM 263 and 264, which have one less credit respectively. However, all chemistry education students are encouraged to take CHM 265 and 266 to meet the regular chemistry major requirements in case they switch to a non-teaching option.

The following 32 credit hours of education courses are required for certification to teach in Indiana high schools. One of the courses, EDCI 428 is taken during the first six weeks of the professional semester, before student teaching.

Bachelor of Science Degree with Chemistry Teaching Major Requirements — 32 credits

Professional Education

EDCI 270 (Introduction to Educational Technology and Computing) (2 cr.), and EDFA 200 (History and Philosophy of Education) (3 cr.) — *5 cr.*

EDCI 205 (Exploring Teaching as a Career) (3 cr.), and EDCI 285 (Multiculturalism and Education) (3 cr.) — *6 cr.*

EDPS 235S (Learning and Motivation) (3 cr.) and EDPS 265 (The Inclusive Classroom) (3 cr.) — *6 cr.*

EDCI 424 (The Teaching of Earth/Physical Science in Secondary Schools) (3 cr.), EDCI 428 (Teaching Science in the Middle and Junior High School) (2 cr.), and EDCI 498 (Supervised Teaching) (10 cr.) — *15 cr.*

Bachelor of Science in Chemistry/ Bachelor of Science in Chemical Engineering

The Department of Chemistry and the School of Chemical Engineering offer a joint program for students that lead to a dual degree of B.S. in Chemistry and B.S. in Chemical Engineering. Graduates of this program will be certified as having fulfilled the recommended requirements of the American Chemical Society. The curriculum in chemical engineering is accredited by the Engineer's Council for Professional Development.

B.S. in Chemistry/ B.S. in Chemical Engineering Requirements

First-year engineering requirements — *31–37 credits*

For admission to this degree program, students must complete the plan of study for first-year engineering (with a grade point index of 2.5), which is:

Chemistry: CHM 125 (Introduction to Chemistry I) (5 cr.), CHM 115 (General Chemistry) (4 cr.), or CHM 123 (General Chemistry for Engineers I) (4 cr.); and either CHM 126 (Introduction to Chemistry II) (5 cr.), CHM 116 (General Chemistry (4 cr.), or CHM 124 (General Chemistry for Engineers II) (4 cr.) *8–10 cr.*

Mathematics: MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (10 cr.); or MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.) *8–10 cr.*

Physics: PHYS 152 (Mechanics) (4 cr.) *4 cr.*

Computer science: C S 156 (C Programming for Engineers) (2 cr.) or C S 158 (C Programming) (3 cr.) *2–3 cr.*

Engineering: ENGR 106 (Engineering Problem-Solving and Computer Tools) (2 cr.) and ENGR 100 (Freshman Engineering Lectures) (1 cr.) *3 cr.*

Communications: COM 114 (Fundamentals of Speech Communication) (3 cr.) *3 cr.*

English composition: ENGL 106 (English Composition) (4 cr.) or ENGL 108 (Accelerated First-Year Composition) (3 cr.) *3–4 cr.*

Additional requirements — *41 credits*

In addition to the requirements for the ACS B.S. in Chemistry degree on page 50 and First-Year Engineering described above, the following courses are required:

CHE 205 (Chemical Engineering Calculations) (3 cr.); CHE 211 (Introductory Chemical Engineering Thermodynamics) (3 cr.); CHE 306 (Design of Staged Separation Processes) (3 cr.); CHE 320 (Statistical Modeling and Quality Enhancement) (3 cr.); CHE 330 (Principles of Molecular Engineering) (3 cr.); CHE 348 (Chemical Reaction Engineering) (3 cr.); CHE 377 (Momentum Transfer) (3 cr.); CHE 378 (Heat and Mass Transfer) (3 cr.); CHE 434–435 (Chemical Engineering Laboratory) (6 cr.); CHE 450 (Design and Analysis of Processing Systems) (3 cr.); CHE 456 (Process Dynamics and Control) (3 cr.) *36 cr.*

I E 343 (Engineering Economics) (3 cr.) *3 cr.*

Engineering electives — *6 credits*

The following courses satisfy particular requirements of the School of Chemical Engineering: 18 cr. of General Education, the general elective requirements; CHM 321 (Analytical Chemistry I) and CHM 424 (Analytical Chemistry II), two engineering electives; and CHM 342 (Inorganic Chemistry), and one technical elective. In the chemistry plan, CHE 211 (Introductory Chemical Engineering Thermodynamics) can count as a laboratory science and CHE 456 (Process Dynamics and Control) can count as a chemistry elective. Details about the requirements of the B.S. in Chemical Engineering curriculum as well as acceptable chemical engineering and engineering electives are explained in the College of Engineering Web site.

Bachelor of Science in Chemistry/ Bachelor of Science in Materials Science and Engineering

The Department of Chemistry and the School of Materials Engineering offer a joint program that leads to a dual degree of B.S. in Chemistry and B.S. in Materials Science and Engineering. Graduates of this program will be certified as having fulfilled the requirements of the American Chemical Society and accredited by the Accreditation Commission of the Accreditation Board for Engineering and Technology.

For admission to this degree program, students must complete the plan of study for First-Year Engineering (with an index of 2.5) which is:

CHM 125 (Introduction to Chemistry I) (5 cr.), CHM 115 (General Chemistry) (4 cr.), or CHM 123 (General Chemistry for Engineers I) (4 cr.); and either CHM 126 (Introduction to Chemistry II) (5 cr.), CHM 116 (General Chemistry (4 cr.), or CHM 124 (General Chemistry for Engineers II) (4 cr.) *8–10 cr.*

MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (10 cr.); or MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.) *8–10 cr.*

PHYS 152 (Mechanics:) (4 cr.) *4 cr.*

C S 156 (C Programming for Engineers) (2 cr.) or C S 158 (C Programming) (3 cr.) *2–3 cr.*

ENGR 106 (Engineering Problem-Solving and Computer Tools) (2 cr.) and ENGR 100 (Freshman Engineering Lectures) (1 cr.) *1 cr.*

COM 114 (Fundamentals of Speech Communication) (3 cr.) *3 cr.*

ENGL 106 (English Composition) (4 cr.) *4 cr.*

In addition to the requirements for the ACS B.S. in Chemistry degree (page 50) and First-Year Engineering described above, the following courses are required:

M E 270 (Basic Mechanics I) (3 cr.) *3 cr.*

MSE 230 (Structure and Property of Materials) (3 cr.); MSE 235 (Materials Properties Laboratory) (2 cr.); MSE 240 (Processing and Properties of Materials) (3 cr.); MSE 335 (Materials Characterization Laboratory) (3 cr.); MSE 340 (Transport Phenomena) (3 cr.); MSE 350 (Thermodynamics of Materials) (3 cr.); MSE 367 (Materials Processing Laboratory) (3 cr.); MSE 370 (Electrical, Optical, and Magnetic Properties of Materials) (3 cr.); MSE 382 (Mechanical Response of Materials) (3 cr.); MSE 430 (Materials Processing and Design I) (3 cr.); MSE 440 (Materials Processing and Design II) (3 cr.) *33 cr.*

Engineering electives ***6 credits***

Details about the requirements of the B.S. in Materials Science and Engineering curriculum as well as acceptable engineering electives can be found in the College of Engineering Catalog.

Preprofessional Preparation

Any chemistry degree program can serve as an excellent basis of preparation for dental, medical, or veterinary school. Knowledge of chemistry is a valuable asset when studying biochemistry, physiology, endocrinology, pharmacology, and anatomy.

For example, a student who wants to apply to medical school, in addition to the courses in his or her chemistry program, will need one year of biology (Fundamentals of Biology I and II: BIOL 110–111 or Cell Structure and Function: BIOL 231/232 and Genetics and Molecular Biology: BIOL 241/242) to meet general admission requirements for most medical schools. Since admission requirements vary, it is essential to check the specific requirements for each school that interests the student.

Honors Program

The Department of Chemistry has an honors program for superior students. Participation can begin during the sophomore year, and a student will be assigned to advanced sections in chemistry courses taken during the sophomore year. During the junior and senior years, a student engages in undergraduate research, participates in research seminars, and completes honors courses in the selected degree plan. The undergraduate research experience (CHM 499) is to be a minimum of six credits. In addition, the student must write an honor's thesis based on the CHM 499 work. A committee of two faculty members will read the thesis, and the student will give a public presentation of the research.

Admission to the chemistry honors program must be made by the junior year. The honors student is expected to achieve and maintain a scholastic graduation index of at least 3.4. Students fulfilling requirements of the chemistry honors program will be graduated "with honors in chemistry."

Honors Program Courses

Except for CHM 499, the honors courses listed below replace the corresponding courses in the degree requirements.

Chemistry: CHM 267 (Organic Chemistry Laboratory [Honors]) (2 cr.), CHM 268 (Organic Chemistry Laboratory) (2 cr.), and CHM 323 (Analytical Chemistry I [Honors]) (4 cr.)

Undergraduate Research: CHM 499 (Special Assignments) (6 cr. minimum)

Special Programs and Opportunities

Cooperative Education Program

The Department of Chemistry participates in the Cooperative Education Program as described on page 9. This program requires five years and involves four work periods, either semesters or summer modules, with a cooperating company in the chemical industry. As a student gains experience, he or she is given increasingly responsible industrial assignments and receives more compensation.

A student can enter the program at the end of the freshman or sophomore year if he or she ranks in the upper half of the class, has completed two semesters of Chemistry, and has a Chemistry index greater than 2.80. Information is available from the Coordinator of Cooperative Education in the Department of Chemistry. Check with your advisor for further information.

Chemistry Minor

A student may earn a minor in chemistry upon completion of 16 credit hours of chemistry courses beyond general chemistry (CHM 115 and 116, 125 and 126, or 123 and 124). The following courses (designed for non-science majors) will not count toward a minor: CHM 224 (Introductory Quantitative Analysis), CHM 257 (Organic Chemistry [for non-science majors]), and CHM 333 (Principles of Biochemistry).

Up to three credits of undergraduate research (CHM 499) may be used toward fulfillment of the minor. All courses must be offered by the Department of Chemistry, Purdue University.

Computer Science

Because computer science is a young and rapidly developing field, the curriculum must be revised frequently to keep it up-to-date.

The Department of Computer Science offers a Bachelor of Science (B.S.) degree program. An honors designation is available for students who fulfill requirements beyond those for the B.S. Qualified students in the bachelor's program may participate in the Cooperative Education Program.

Purdue Computer Science graduates are in demand in business, industry, research organizations, and government. They are faculty in highly ranked departments, researchers at internationally recognized labs, and leaders and innovators in industry and government. They apply skills in conceptualization and problem-solving to develop computational solutions for today and beyond.

While some of the more routine computer support and coding jobs are being relocated overseas, the demand for well-trained and highly qualified computer scientists in the U.S. remains strong. Virtually every field of science and engineering is affected by computing, and computer scientists play a key role in interdisciplinary efforts that bring the power of computing technology to these areas.

The demand for Computer Science graduates encompasses all sectors of business, industry, education, and government. Some of the exciting growth areas and opportunities include:

- Bioinformatics
- Computational nanotechnology
- Data integration and data mining
- Distributed and peer-to-peer computing
- Graphics and visualization
- Information assurance and security
- Mobile and wireless systems
- Software engineering

The most recent information is available at www.cs.purdue.edu.

General Degree Requirements 124 credits

The following requirements include the B.S. degree requirements of the College of Science. A total of 124 credits is required. Mathematics courses below the level of calculus (MA 161) cannot be used to satisfy any degree requirements.

Computer Science Core 38 credits*

C S 180 (Programming I) (4 cr.); C S 182 (Foundations of Computer Science) (3 cr.); C S 240 (Programming in C) (3 cr.); C S 250 (Computer Architecture) (4 cr.); C S 251 (Data Structures) (3 cr.); C S 352 (Compilers: Principles and Practice) (3 cr.); C S 354 (Operating Systems) (3 cr.); C S 381 (Introduction to the Analysis of Algorithms) (3 cr.) *26 cr.*

**Grades of "A," "B," or "C" are required in the courses used to fulfill the above requirements.*

Four other computer science courses at or above the 300 level. (12 cr.) *12 cr.*

In addition, all new computer science majors are strongly urged to take C S 192 (Freshman Resources Seminar). *1 cr.*

Science Requirements ***12–18 credits***

Four approved courses in biology, chemistry, earth and atmospheric sciences, physics, astronomy, or electrical engineering. EE 270 (Introduction to Digital System Design) (4 cr.) and EE 362 (Introduction to Computer Engineering) (4 cr.) are permitted.

Mathematics Requirements ***15–17 credits***

MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) *4–5 cr.*

One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 13 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) *4–5 cr.*

One of: MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus II) (5 cr.), MA 271 (Several Variable Calculus) (5 cr.) *4–5 cr.*

Linear Algebra: MA 265 (Linear Algebra) (3 cr.), MA 350 (Honors Linear Algebra), or MA 351 (Elementary Linear Algebra) (3 cr.) *3 cr.*

Additional Requirements ***36–37 credits***

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See Modern Foreign Language requirements on page 28). *12 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences, and behavioral sciences. (See page 29 for requirements.) (18 cr.) *18 cr.*

Free Electives ***10–26 credits***

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. Courses from departments other than Computer Science must be approved by the student's academic advisor.

Free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory programming courses regardless of the language used. Students must take at least as many free electives as are needed to bring the credit hour total to 124.

Honors Program

The Department of Computer Science awards honors to graduating students who have satisfied the requirements listed below. Students enter the CS honors program in one of three ways:

1. By invitation to the science freshman honors program upon admission.
2. By invitation to the science freshman honors program after their first semester.
3. By application. Students may request admission to the Computer Science honors program to be effective in the semester following the completion of their lower-division core courses. The Undergraduate Committee may grant admission if they have at least a 3.25 cumulative grade point average, at least a 3.60 cumulative grade point average in computer science courses, and the recommendation of their advisor.

Honors students must maintain the above grade point requirements to remain in the honors program.

Honors students are encouraged, but not required, to take C S 197 (Freshman Honors Seminar) (class 1, credit 1, pass/not pass) in the fall and spring semesters of their freshman year. The seminar covers the history, context, and future of computer science.

Honors Course Requirements

The "four other computer science courses at or above the 300 level" required for the bachelor's degree must include C S 497 (see below) and an approved 500-level course. ("Approved" means approved by the Computer Science Undergraduate Committee for the purpose of achieving honors.)

Elementary Linear Algebra: MA 350 (Honors Elementary Linear Algebra) or MA 351 (Elementary Linear Algebra) (3 cr.)

An approved mathematics course beyond MA 351 or an approved statistics course beyond STAT 511.

ECE 270 (Introduction to Digital System Design) (4 cr.)

C S 397 (Honors Seminar) (no credit, eight meetings, offered each semester). Honors students should typically take C S 397 the semester before taking C S 497. C S 397 is required to be taken only once. C S 397 may be taken (with the permission of the student's advisor) by students not yet admitted to the honors program to help determine whether to apply to the program. C S 397 meetings focus on what is involved in research, how to select a research project, and presentations by C S 497 students on their research projects.

C S 497 (Honors Research Project) (3 cr., offered each semester). Each student in the honors program must complete a group research project directed by Computer Science faculty members. Each group must submit a technical report describing its work and results and must also give a short presentation in C S 397. One semester of the project may be counted as one of the "four computer science courses at or above the 300 level" required for the bachelor's degree. One more semester, if approved by the Undergraduate Committee, can be used as a free elective.

Honors students may use C S 490 (Topics in Computer Science for Undergraduates) courses only as free electives.

Special Programs and Opportunities

Cooperative Education Program

The department participates in the Cooperative Education Program described on page 29. To be eligible for the Cooperative Education Program, students must:

1. Be in the Computer Science bachelor's degree program.
2. Have a grade point average of at least 3.0 in Computer Science courses.
3. Have an overall grade point average of at least 2.8.

Students are normally expected to complete C S 180 (Programming I), C S 182 (Foundations of Computer Science), and C S 240 (Programming in C) before their first work session, and either C S 250 (Computer Architecture) or C S 251 (Data Structures) before their second work session.

To receive a Cooperative Education certificate of completion, students must complete at least four work sessions after completing C S 180, 182, and 240, and either 250 or 251 with grades of "C" or better. At least two of the four sessions must be semesters.

For additional information, please see www.cs.purdue.edu/courses/co-op.html, or send email to coop@cs.purdue.edu.

Minor Concentration in Computer Science

To obtain a minor concentration in computer science, students must pass, with grades of "A," "B," or "C," the following courses: C S 180 (Programming I) (4 cr.), C S182 (Foundations of Computer Science) (3 cr.), C S 240 (Programming in C) (3 cr.), C S 250 (Computer Architecture) (4 cr.), and C S 251 (Data Structures) (3 cr.).

Earth and Atmospheric Sciences

Earth and atmospheric sciences focus on the study of the atmosphere, oceans, and the solid earth. These disciplines are concerned with the quality of life and the physical environment in which we live. Earth and atmospheric scientists have accepted the challenge of arriving at solutions to basic and applied problems that affect our planet.

Faculty and students in the Department of Earth and Atmospheric Sciences study a wide range of geophysical phenomena. These phenomena include events that affect daily life on earth, such as mineral and oil exploration and weather forecasting, events that are the source of devastating natural disasters, such as earthquakes, landslides, and tornadoes, and events that explore the distant past or the projected future of our stay on earth, such as climate change, plate tectonics, and Arctic and Antarctic fossil discoveries.

The Department of Earth and Atmospheric Sciences prepares students to investigate a variety of problems. The basic core courses listed on pages 59-60, supplemented by courses relevant to each specialized area of interest, provide a broad scientific education that prepares students for graduate programs or for entry-level employment positions after completing the B.S. degree.

A master's degree is desirable for research, advancement in secondary school teaching in Indiana, and many positions in government or industry. The Ph.D. degree is required for advancement in university teaching and higher-level positions in research.

Earth and atmospheric sciences students have many career options. The following are several possible areas of emphasis, and the career options that may be available to students. For specific information on which core and option would best match a program, please speak with an advisor.

Careers in Earth and Atmospheric Sciences

Atmospheric Science (Meteorology). Meteorology is the study of atmospheric phenomena. This includes the physics, chemistry, and dynamics of the atmosphere; and many of the interactions between the atmosphere, solid earth, and oceans.

The undergraduate meteorology curriculum includes not only core courses in atmospheric science, but also complementary exposure to mathematics, physics, chemistry, and computer science. Thus, graduates are prepared to enter the work force in specialties such as weather forecasting and air pollution as well as to further their education by pursuing graduate degrees.

Geology. Geology is the study of the internal structure, materials, chemical/physical processes, and physical/biological history of the earth. Students of geology encounter science in the broadest sense because geology involves the application of principles of physics, mathematics, biology, and chemistry as well as many aspects of engineering and environmental sciences.

Because the scope of geology is broad, specialized branches have evolved. For example, geomorphologists investigate the nature and origin of land forms by studying the causes and effects of dynamic earth processes; structural geologists are concerned with the arrangement of rock masses in the earth's crust and the types of forces that have affected them; and stratigraphers investigate the thickness, geometry, and distribution of layered rocks to understand the chronology of geologic events.

Geologists also may specialize as economic geologists who explore the earth for various kinds of mineral deposits and supervise their development. Others may become groundwater geologists concerned with the distribution, movement, and chemical quality of our precious underground water supply. Many have become petroleum geologists who explore for and develop deposits of coal, oil, natural gas, and other earth resource materials. Another area that appeals to many geology majors is environmental geology, in which geological skills are required to help predict, avoid, or mitigate problems connected with pollution, urban development, and geologic hazards such as flooding and excessive erosion.

Students completing the B.S. curriculum in geology would be prepared to undertake graduate studies for advanced degrees or enter a variety of careers related to some of the specialty areas.

Paleontology and Paleoecology. Paleontology is the study of fossils, with the aim of discerning the nature, occurrence, and evolution of life throughout geologic time. Paleoecology deals with the relationship between fossil organisms and their inferred environments. Coursework in this area emphasizes methods by which data derived from fossils can be interpreted and applied to geologic and biologic problems.

Geochemistry, Mineralogy, and Petrology. This program uses concepts from disciplines such as chemistry, physics, and mathematics to help clarify geological phenomena and problems. In general, the problems are directly related to the basic materials comprising the earth, namely, the origin and occurrence of minerals, rocks, and ore deposits. Mineralogy, petrology, and geochemistry are so closely related that a combined treatment is necessary.

Engineering Geology. Engineering geology involves the use of geological data, techniques, and principles to interpret the geologic factors affecting the planning, design, and safety of engineering projects. The undergraduate curriculum should be a blend of engineering and geology courses designed to teach engineering principles and foster understanding of engineering problems.

Engineering geology work includes studies related to site location and investigation; environmental assessment; design recommendations; construction, monitoring, and maintenance of engineering structures such as dams, tunnels, bridges, buildings, mines, cut slopes in rocks, quarries, etc.; and analysis of the geology of urban areas.

Hydrogeology. The hydrogeologist is called on to assess an area for groundwater development potential for domestic, industrial, or agricultural supply. His or her skills may be required to

determine the origin and fate of naturally occurring or man-made chemicals in ground water.

Hydrogeology is also intimately related to knowledge of earth surface processes (geomorphology), environmental studies, engineering geology, and exploration geophysics. A background in these related specialties is desirable.

Geophysics. Geophysics applies principles of physics to the study of the earth. Studies of natural gravity, magnetic and electrical fields, seismic wave propagation, and heat flow are used to deduce the nature of the earth's interior - the structure, composition, physical properties, and dynamic processes that cause earthquakes and move continents. Similar studies are used to explore for petroleum and mineral deposits, and to investigate the shallow portions of the earth's crust to determine conditions that influence the location of engineering structures.

Geophysics includes theoretical and laboratory studies as well as field investigations that may be located in interesting and remote areas of the world. Often geophysicists use sophisticated instrumentation, computer processing of data, and interpretation and integration of information from several related disciplines.

Environmental Geoscience. Using a broad background in geology as their foundation, environmental geoscientists use an interdisciplinary approach to study groundwater contamination, landfill management, landslide risk, urban planning, and many other contemporary environmental issues. These scientists must develop quantitative problem-solving skills acquired in an educational framework that couples their geological background with basic principles of chemistry, physics, mathematics, and engineering. They often are consulted on decisions regarding environmental public policy.

A special curriculum has been developed that is founded on a strong geology background supplemented by interdisciplinary work in science, engineering, and social science. Graduates of this program can expect to fill the growing need for environmental scientists at the B.S. degree level or to move on to graduate work in one of the geological or environmental sciences.

Earth/space science teaching. Students preparing to teach in junior high/middle/secondary schools (grades 5-12) must meet the requirements set by the University-wide Teacher Education Council. Copies of the sections of the booklet that apply to prospective high school earth/space science teachers are available in the College of Science Counseling Office.

It is possible to meet the College of Science humanities and social sciences requirements without meeting the humanities and social sciences requirements for teacher licensing in Indiana. For details about how to meet both requirements, see your counselor.

Prospective teachers are exempt from the second year of the foreign language requirement if they successfully complete the professional semester within the baccalaureate program. The professional semester is the one in which courses are taken at Purdue for six weeks, followed by a teaching practicum for 10 weeks.

Marine Science. Students interested in pursuing a career in marine sciences are encouraged to major in earth or atmospheric sciences, or another basic science such as biology. A program can be arranged that will qualify students to study marine science in graduate school.

The most recent web information can be found at: http://www.purdue.edu/eas/

General Degree Requirements

Students must complete the requirements for one of the following options:

1. Solid Earth Science: 51 credits
2. Atmospheric Science: 42-50 credits, depending on option
3. Environmental Geoscience: 73-74 credits
4. Earth/Space Science Teaching: 83-86 credits

The following courses are required of all B.S. students in earth and atmospheric sciences. In meeting these general degree requirements, students automatically will fulfill the College of Science graduation requirements listed on pages 27-29. Students transferring into the Department of Earth and Atmospheric Sciences after the freshman year should talk to the departmental counselor about specific earth and atmospheric sciences requirements that may be waived by the department's Undergraduate Committee.

Earth and Atmospheric Sciences Requirements

Science Requirements (all options)	***17 credits***
Chemistry: CHM 115 and 116 (General Chemistry) (Earth/space science teaching majors can substitute CHM 111 and CHM 112 (General Chemistry)).	*8 cr.*
Physics: PHYS 152 (Mechanics)	

(4 cr.); PHYS 241 (Electricity and Optics) (3 cr.); PHYS 252 (Electricity and Optics Lab) (1 cr.); and PHYS 290D (Thermo Unit) (1 cr.). (Earth/space science teaching majors can substitute PHYS 220 and 221 (General Physics) (4 cr. each). *9 cr.*

Mathematics Requirements (all options) ***19–21 credits***

MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) *4–5 cr.*

One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 173 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) *4–5 cr.*

One of: MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus II) (5 cr.), MA 271 (Several Variable Calculus) (5 cr.) *4–5 cr.*

MA 262 (Linear Algebra and Differential Equations) (4 cr.), or MA 272 (Differential Equations and Linear Algebra) (4 cr.) *4 cr.*

(Environmental geosciences majors can substitute MA 266 (Ordinary Differential Equations) (3 cr.).

C S 158 (Programming I) (3 cr.) *3 cr.*

(Earth/Space science teaching can substitute C S 177).

Additional Requirements ***31–36 credits***

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28). *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives ***12–21 credits***

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

The earth/space science teaching program has additional option requirements, which include 18 credit hours of education courses. The number of free electives that can be selected to complete the 124 credit hours needed for graduation will depend on a student's option and the courses taken to meet the general degree requirements. Students in atmospheric science who wish to be qualified for employment as meteorologists in the federal government must elect EAS 433 (Synoptic Laboratory II) (1 cr.) and EAS 434 (Weather Analysis and Forecasting) (3 cr.).

Additional Requirements for Entry into the Upper Division in All Options

A student pursuing a major in solid earth geosciences, environmental geosciences, earth/space science teaching, or atmospheric science must satisfy the following requirements before being permitted to enter the upper division:

1. Completion of MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.), and MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), CHM 115 (General Chemistry) (4 cr.) and CHM 116 (General Chemistry) (4 cr.), and PHYS 152 (Mechanics) (4 cr.), or equivalents with a grade of "C" or better; and

2. Completion of required lower-division courses in the student's major area, each with a grade of "C" or better.

For the application of these requirements, entry into the upper division is defined as registration for the semester that includes EAS 351 (Structural, Tectonic, and Basis Analysis) (4 cr.) (for solid earth geosciences); or EAS 421 (Atmospheric Thermodynamics) (3 cr.) (for atmospheric science) in the course selection.

Grade Requirement

To graduate in any EAS major, a student must have an average grade point average of 2.0 or above in EAS courses required for the major.

Earth and Atmospheric Science majors and options

Students must complete the general degree requirements on page 59-60, plus one of four cores:

1. Solid earth science
2. Atmospheric science
3. Environmental geoscience
4. Earth/space science teaching.

Within the atmospheric science core, students may choose from four options: synoptic meteorology, atmospheric dynamics, atmospheric physics, and atmospheric chemistry.

Solid Earth Science Requirements 51 credits

Solid Earth Science Core *39 credits*

EAS 109 (The Dynamic Earth) (3 cr.); EAS 143 (Freshman Seminar in Earth Science) (1 cr.); EAS 112 (Historical Geology) (4 cr.); EAS 243 (Earth Materials I) (4 cr.); EAS 244 (Earth Materials II) (4 cr.); EAS 351 (Structural, Tectonic, and Basin Analysis) (4 cr.); EAS 352 (Structural Geology) (3 cr.); EAS 390 (Geologic Field Methods) (3 cr.); EAS 309 (Computer-Aided Analysis for Geosciences) (3 cr.); EAS 450 (Physics and Chemistry of Solid Earth) (4 cr.); EAS 490 (Field Geology Summer Field Camp) (6 cr.). *39 cr.*

Students participate in the field camp the summer before the senior year. Additional information about the field camp is on page 63.

You must complete one option in addition to the core requirements above.

Additional Science and Engineering

In the solid earth curriculum, at least 6 credits are required in EAS regular courses (exclusive of seminar and reading courses) numbered 300 and above in EAS to fulfill the EAS curriculum electives. At least 6 credits numbered 200 and above in science, engineering, or agriculture are required to fulfill the science/engineering electives. Students can consult their academic advisors for appropriate courses. *12 cr.*

Atmospheric Science Requirements 42–50 credits

Atmospheric Science Core *27 credits*

EAS 109 (The Dynamic Earth) (3 cr.); EAS 133 (Freshman Seminar in Atmospheric Science) (1 cr.); EAS 225 (Science of the Atmosphere) (3 cr.); EAS 320 (Physics of Climate) (3 cr.); EAS 421 (Atmospheric Thermodynamics) (3 cr.); EAS 422 (Atmospheric Dynamics I) (3 cr.); EAS 431 (Synoptic Laboratory I) (1 cr.); EAS 432 (Synoptic Laboratory II) (1 cr.); EAS 532 (Atmospheric Physics I) (3 cr.); EAS 535 (Atmospheric Observations and Measurements) (3 cr.). *24 cr.*

Statistics elective (select one): STAT 301 (Elementary Statistical Methods) (3 cr.), STAT 433 (Statistical Methods for Computer Users) (3 cr.), STAT 501 (Experimental Statistics I) (3 cr.), STAT 511 (Statistical Methods) (3 cr.). *3 cr.*

Note: STAT 433 cannot be used to satisfy both the statistics and the computer applications electives identified in the options.

Options *15–23 credits*

Synoptic Meteorology Option *16 credits*

EAS 423 (Atmospheric Dynamics II) (3 cr.); EAS 433 (Synoptic Laboratory III) (1 cr.); EAS 434 (Weather Analysis and Forecasting) (3 cr.). *7 cr.*

Mathematics elective: 3 cr. from any 300-level or above mathematics course. MA 303 (Differential Equations and Partial Differential Equations for Engineering and the Science) (3 cr.) is strongly recommended for students interested in employment with the National Weather Service. *3 cr.*

Computer applications elective (select one): EAS 309 (Computer-Aided Analysis for Geosciences) (3 cr.); EAS 409 (Application of Microcomputers to Meteorology) (3 cr.); EAS 509 (Data Analysis Techniques in Geosciences) (3 cr.); C S 314 (Numerical Methods) (3 cr.). *3 cr.*

Synoptic elective (select one): EAS 325 (Aviation Meteorology) (3 cr.); EAS 520 (Theory of Climate) (3 cr.); EAS 534 (Tropical Meteorology) (3 cr.); EAS 536 (Introduction to General Circulation) (3 cr.); EAS 538 (Cumulus Dynamics) (3 cr.); C E 557 (Air Quality Management) (3 cr.). *3 cr.*

Atmospheric Dynamics Option *15 credits*

EAS 423 (Atmospheric Dynamics II) (3 cr.); MA 303 (Differential Equations and Partial Differential Equations for Engineering and the Sciences) (3 cr.). *6 cr.*

Science/Engineering elective: 3 cr. from any science or engineering course at the 300-level or above. *3 cr.*

Dynamics electives (select two): EAS 309 (Computer-Aided Analysis for Geosciences), 509 (Data Analysis Techniques in Geosciences), 520 (Theory of Climate),

525 (Radar Meteorology), 534 (Tropical Meteorology), 536 (Introduction to General Circulation), 538 (Cumulus Dynamics), or any MA, C S, or STAT course at the 300 level or above. *6 cr.*

Atmospheric Physics Option *15 credits*

EAS 533 (Atmospheric Physics II) (3 cr.); MA 303 (Differential Equations and Partial Differential Equations for Engineering and the Sciences) (3 cr.). *6 cr.*

Computer applications elective (select one): EAS 309 (Computer-Aided Analysis for Geosciences), 409 (Application of Microcomputers to Meteorology), 509 (Data Analysis Techniques in Geoscience), C S 314 (Numerical Methods), STAT 433 (Statistical Methods for Computer Users). *3 cr.*

Physics elective: 3 cr. from any 300-level or above physics course. *3 cr.*

Atmospheric physics elective (select one): EAS 423 (Atmospheric Dynamics II), 520 (Theory of Climate), 525 (Radar Meteorology), 534 (Tropical Meteorology), 536 (Introduction to General Circulation). *3 cr.*

Atmospheric Chemistry Option *23 credits*

EAS 521 (Atmospheric Chemistry I) (3 cr.); EAS 522 (Chemistry of the Earth's Upper Atmosphere) (3 cr.); CHM 241 (Introductory Inorganic Chemistry) (4 cr.); CHM 257 (Organic Chemistry) (4 cr.); CE 558 (Sampling and Analysis of Source and Atmospheric Air Contaminants) (3 cr.). *17 cr.*

Mathematics elective: 3 cr. from any 300-level or above mathematics course. *3 cr.*

Computer applications elective (select one): EAS 309 (Computer-Aided Analysis for Geosciences) (3 cr.), 409 (Application of Microcomputers to Meteorology) (3 cr.), 509 (Data Analysis Techniques in Geosciences) (3 cr.), C S 314 (Numerical Methods) (3 cr.), STAT 433 (Statistical Methods for Computer Users) (3 cr.). *3 cr.*

Environmental Geoscience Requirements 73–74 credits

Environmental Geoscience Core *40 credits*

EAS 109 (The Dynamic Earth) (3 cr.); EAS 143 (Freshman Seminar in Earth Science) (1 cr.); EAS 113 (Environmental Geology) (3 cr.); EAS 243 (Earth Materials I) (4 cr.); EAS 313 (Applied Geomorphology) (3 cr.); EAS 351 (Structural, Tectonic, and Basin Analysis) (4 cr.); EAS 474 (Sedimentation and Stratigraphy) (4 cr.); EAS 385 (Principles of Engineering Geology) (3 cr.); EAS 390 (Geologic Field Methods) (3 cr.); EAS 490 (Field Geology Summer Field Camp) (6 cr.); EAS 584 (Hydrogeology) (3 cr.); EAS 519 (Applications of Environmental Geosciences) (3 cr.). .

Additional Science and Engineering *33–34 credits*

CHM 257 (Organic Chemistry) (4 cr.); CHM 257L (Organic Chemistry Laboratory) (1 cr.); AGRY 255 (Soil Science) (3 cr.); BIOL 121 (Biology I: Diversity, Ecology and Behavior) (2 cr.); BIOL 287 (Laboratory in Introduction to Ecology) (2 cr.); BIOL 483 (Environmental and Conservation Biology) (3 cr.). *15 cr.*

CE 352 (Biological Principles of Environmental Engineering) (3 cr.) or CE 353 (Physio-Chemical Principles of Environmental Engineering) (4 cr.). *3–4 cr.*

Environmental electives: 6 cr. from a list of specified courses. Must be approved by the student's academic advisor. *6 cr*

For the Environmental Geoscience option, the following three courses must be taken, and may also counts towards the General Education Requirement: POL 223 (Introduction to Environmental Policy) (3 cr.), and POL 523 (Environmental Politics and Public Policy) (3 cr.), and PHIL 290 (Environmental Ethics) (3 cr.). *6 cr.*

Earth/Space Science Teaching 83–86 credits

To complete the earth/space science requirements for Indiana certification, grades 5-12, the following are required:

Science courses *48–51 credits*

EAS 109 (The Dynamic Earth) (3 cr.); EAS 143 (Freshman

Seminar in Earth Science) (1 cr.); EAS 112 (Historical Geology) (4 cr.); EAS 243 (Earth Materials I) (4 cr.); EAS 351 (Structural, Tectonic, and Basin Analysis) (4 cr.); EAS 352 (Structural Geology) (3 cr.); EAS 390 (Geologic Field Methods) (3 cr.); EAS 490 (Field Geology Summer Field Camp) (6 cr.). *28 cr.*

One of the following: CHM 111 and 112 (General Chemistry); or CHM 115 and 116 (General Chemistry). *6–8 cr.*

One of the following:

a. PHYS 152 (Mechanics), PHYS 241, PHYS 252 (Electricity and Optics) and PHYS 290D (Heat and Thermal)

b. PHYS 220 and 221 (General Physics). *8–9 cr.*

C S 177 or 158 (Introduction to Computer Science) (3 cr.) *3 cr.*

One of the following:

EAS 104 (Oceanography) (3 cr.); EAS 105 (The Planets) (3 cr.); EAS 115 (Dinosaurs) (3 cr.); EAS 116 (Earthquakes and Volcanoes) (3 cr.); EAS 120 (Introduction to Geography) (3 cr.); EAS 138 (Thunderstorms and Tornadoes) (3 cr.); EAS 221 (Survey of Atmospheric Science) (3 cr.); EAS 225 (Science of the Atmosphere) (3 cr.); ASTR 263 (Descriptive Astronomy: The Solar System) (3 cr.); ASTR 264 (Descriptive Astronomy: Stars and Galaxies) (3 cr.). *3 cr.*

Professional Education ***35 credits***

EDCI 270 (Introduction to Educational Technology and Computing) (2 cr.); EDFA 200 (History and Philosophy of Education) (3 cr.); EDCI 205 (Exploring Teaching as a Career) (3 cr.); EDCI 285 (Multiculturalism and Education) (3 cr.); EDPS 235 (Learning and Motivation) (3 cr.); EDPS 265 (The Inclusive Classroom) (3 cr.); EDCI 424 (The Teaching of Earth/Physical Science in the Secondary Schools) (3 cr.); EDCI 428 (Teaching Science in the Middle and Junior High School) (2 cr.); EDCI 498 (Supervised Teaching) (10 cr.). *35 cr.*

EDCI 428 is taken during the first six weeks of the professional semester, before student teaching. A student can choose either the seventh or eighth semester for the professional semester.

Honors Research Program

Outstanding students are invited to participate in the Earth and Atmospheric Sciences Honors Research Program. The focus of this program is the completion of an undergraduate research thesis and the oral presentation of this research in a departmental seminar. The thesis can be a laboratory, field, or theoretical investigation. This program offers students the opportunity to have closer contact with the faculty of the department and to explore in depth a specific topic of their interest through tutorials, independent research, and seminars. The student thus obtains a better preparation for advanced study or a career in the geosciences after completion of the B.S. degree.

A student can graduate with honors in earth and atmospheric sciences by completing the following requirements:

1. At least a 3.25 cumulative graduation index;
2. Successful completion of EAS 494 (Undergraduate Seminar);
3. Faculty approval of a research thesis supervised and approved by a member of the faculty; and
4. Submission of application for graduation with honors during the semester before graduation.

If you are interested in this program, contact the Chair of the Undergraduate Committee, Department of Earth and Atmospheric Sciences.

Special Programs and Opportunities

Summer Field Camp

Earth science majors must take a six-week summer field camp in the western United States. The camp experience brings together the various solid earth courses and helps students make the transition from classroom scholar to field-based geologist. Through the camp, they gain an appreciation of the problems professional scientists encounter.

Students generally find it easier to comprehend the subject matter of subsequent courses as a result of the summer field camp, which they are encouraged to attend between the junior and senior years.

Earth and Atmospheric Sciences Minor

Students who wish to complement their major area of study with coursework in the earth and atmospheric sciences may be interested in the department's minor program.

Earth and Atmospheric Sciences Minor Course Requirements	**17 credits**
EAS 111 (Physical Geology), or EAS 109 (The Dynamic Earth) (3 cr.).	*3 cr.*
EAS 221 (Survey of Atmospheric Science), or EAS 225 (Science of the Atmosphere) (3 cr.).	*3 cr.*
EAS 230 (Laboratory in Atmospheric Science) (1 cr.).	*1 cr.*
Ten additional credits selected from any 200-level or above EAS courses. One 100-level EAS course may be used to meet this requirement.	*10 cr.*

Earth and Atmospheric Sciences Sample Programs

Each sample program shows one possible way to construct a plan of study in a particular option; the sample program is only an example. Students can change the arrangement — and sometimes choices — of courses that may be better for them. Academic advisors can help with these selections.

Atmospheric Science Synoptic Meteorology Option Sample Program

Freshman Year						
1	ENGL 106 (4)	CHM 115 (4)	MA 161 (5)	EAS 109 (3)*		
2	CHM 116 (4)	MA 162 (5)	EAS 133 (1)*	General Education (3)	Language (3)	
Sophomore Year						
3	PHYS 152 (4)	MA 261 (4)	EAS 225 (3)*	Language (3)	General Education (3)	
4	PHYS 241 (3)	PHYS 252 (1)	PHYS 290 (1)	MA 262 (4)	EAS 320 (3)*	Language (3)
Junior Year						
5	EAS 421 (3)* EAS 431 (1)*	MA Elective (3)	C S 158 (3)	Language (3)	General Education (3)	
6	EAS 422 (3)*	EAS 532 (3)*	Advanced Comp (3)	STAT Elective (3)	C S Elective (3)	EAS 432 (1)*
Senior Year						
7	EAS 423 (3)* EAS 433 (1)†	EAS 535 (3)*	Free Elective (3)	General Education (3)	General Education (3)	
8	General Education (3)	EAS 434 (3)†	Free Elective (3)	Synoptic Elective (3)		

Atmospheric Dynamics Option Sample Program

Freshman Year						
1	ENGL 106 (4)	CHM 115 (4)	MA 161 (5)	EAS 109 (3)*		
2	CHM 116 (4)	MA 162 (5)	EAS 133 (1)*	General Education (3)	Language (3)	
Sophomore Year						
3	PHYS 152 (4)	MA 261 (4)	General Education (3)	Language (3)	EAS 225 (3)*	
4	PHYS 241 (3)	PHYS 252 (1)	PHYS 290 (1)	MA 262 (4)	EAS 320 (3)*	Language (3)
Junior Year						
5	EAS 421 (3)* EAS 431 (1)*	MA 303 (3)	C S 158 (3)	Language (3)	General Education (3)	
6	EAS 422 (3)* EAS 432 (1)*	EAS 532 (3)*	Advanced Comp (3)	STAT Elective (3)	General Education (3)	C S Elective (3)
Senior Year						
7	EAS 423 (3)*	EAS 535 (3)*	Free Elective (3)	General Education (3)	General Education (3)	General Education (3)
8	Science or Engineering Elective (3)	Dynamics Elective (3)	Dynamics Elective (3)	Free Elective (3)		

** This is a core course in the department.*
† Completion of this course is required for employment by the federal government.

Atmospheric Physics Option Sample Program

Freshman Year						
1	ENGL 106 (4)	CHM 115 (4)	MA 161 (5)	EAS 109 (3)*		
2	CHM 116 (4)	MA 162 (5)	EAS 133 (1)*	General Education (3)	Language (3)	
Sophomore Year						
3	PHYS 152 (4)	MA 261 (4)	General Education (3)	Language (3)	EAS 225 (3)*	
4	PHYS 241 (3)	PHYS 252 (1)	PHYS 290 (1)	MA 262 (4)	EAS 320 (3)*	Language (3)
Junior Year						
5	EAS 421 (3)* EAS 431 (1)*	MA 303 (3)	C S 158 (3)	Language (3)	General Education (3)	
6	EAS 422 (3)* EAS 432 (1)*	EAS 532 (3)*	Advanced Comp (3)	STAT Elective (3)	C S Elective (3)	
Senior Year						
7	EAS 533 (3)*	EAS 535 (3)*	General Education (3)	EAS Phys Elective (3)	General Education (3)	
8	General Education (3)	Free Elective (3)	Free Elective (3)	PHYS Elective (3)	General Elective (3)	

Atmospheric Chemistry Option Sample Program

Freshman Year						
1	ENGL 106 (4)	CHM 115 (4)	MA 161 (5)	EAS 109 (3)*		
2	CHM 116 (4)	MA 162 (5)	EAS 133 (1)*	General Education (3)	Language (3)	
Sophomore Year						
3	PHYS 152 (4)	MA 261 (4)	CHM 241 (4)*	EAS 225 (3)*	Language (3)	
4	PHYS 241 (3)	PHYS 252 (1)	PHYS 290 (1)	MA 262 (4)	EAS 320 (3)*	Language (3)
Junior Year						
5	EAS 421 (3)* EAS 431 (1)*	CHM 257 (4)*	C S 158 (3)	Language (3)	MA Elective (3)	
6	EAS 422 (3)* EAS 432 (1)*	EAS 532 (3)*	C S Elective (3)	STAT Elective (3)	Advanced Comp (3)	
Senior Year						
7	EAS 521 (3)	EAS 535 (3)*	General Education (3)	General Education (3)	General Education (3)	
8	General Education (3)	EAS 522 (3)	General Education (3)	CE 558 (3)		

** This is a core course in the department.*

Solid Earth Science Option Sample Program

Freshman Year						
1	ENGL 106 (4)	EAS 109 (3)*	MA 161 (5)	CHM 115 (4)	EAS 143 (1)	
2	EAS 112 (4)*	MA 162 (5)	CHM 116 (4)	Language (3)		
Sophomore Year						
3	PHYS 152 (4)	EAS 243 (4)*	MA 261 (4)	Language (3)		
4	PHYS 241 (3)	PHYS 252 (1)	EAS 244 (4)*	MA 262 (4)	PHYS 290 (1)	Language (3)
Junior Year						
5	Science or Engineering Elective (3)	EAS 351 (4)*	C S 158 (3)	Language (3)		
6	EAS 309 (3)*	EAS 390 (3)*	EAS 352 (3)*	General Education (3)	Advanced Comp (3)	
	EAS 490 — Field Geology Summer Field Camp (6 credits)					
Senior Year						
7	EAS 450 (4)*	EAS Elective (3)	Science or Engineering Elective (3)	General Education (3)	General Education (3)	
8	General Education (3)	General Education (3)		EAS Elective (3)	General Education (3)	

Earth/Space Science Teaching Option (Grades 5–12) Sample Program

Freshman Year						
1	ENGL 106 (4)	EAS 109 (3)*	MA 161 (5)	CHM 115 (4) or CHM 111 (3)	EAS 143 (1)	
2	EAS 112 (4)*	MA 162 (5)	CHM 116 (4) or CHM 112 (3)	COM 114 (3)	General Education (3)	
Sophomore Year						
3	PHYS 152 or PHYS 220 (4)	EAS 243 (4)*	MA 261 (4)	EDCI 205 (3)	EDCI 285 (3)	
4	PHYS 241 (3) or PHYS 221 (4)	PHYS 252 (1)	PHYS 290 (1)	MA 262 (4)	EDPS 235 (3)	EDPS 265 (3)
Junior Year						
5	General Education (3)	EAS 351 (4)*	C S 158 (3)	Language (3)		
6	EAS/ASTR (3)† Elective	EAS 390 (3)*	EDCI 270 (2)	EDFA 200 (3)	EAS 352 (3)	Language (3)
	EAS 490 — Field Geology Summer Field Camp (6 credits)					
Senior Year						
7	General Education (3)	General Education (3)	General Education (3)	EDCI 424 (3)	Advanced Comp (3)	
8	EDCI 428 (2)	EDCI 498 (10)				

** This is a core course in the department.*

† Select one course from the following: EAS 104, 105, 115, 116, 120, 138, 221, 225; ASTR 263, 264.

Environmental Geosciences Option Sample Program

Freshman Year						
1	ENGL 106 (4)	EAS 109 (3)*	CHM 115 (4)	MA 161 (5)	EAS 143* (1)	
2	EAS 113 (3)*	CHM 116 (4)	MA 162 (5)	Language (3)		
Sophomore Year						
3	EAS 243 (4)*	PHYS 152 (4)	MA 261 (4)	Language (3)	AGRY 255 (3)	
4	MA 262 (4) or MA 266 (3)	PHYS 241(3)	PHYS 290 (1) PHYS 252 (1)	POL 223 (3)	Language (3)	CHM 257, 257L (5)
Junior Year						
5	BIOL 121 (2)	EAS 351* (4)	EAS 313 (3)	Language (3)	CE 353 (4) or CE 352 (3)	
6	EAS 390 (3)*	EAS 474 (4)*	C S 158 (3)	EAS 385 (3)*	BIOL 287 (2)	Advanced Comp (3)
	EAS 490 — Field Geology Summer Field Camp (6 credits)					
Senior Year						
7	BIOL 483 (3)	EAS 309 or STAT 301 or STAT 503 (3)	EAS 584 (3)*	General Education (3)	PHIL 290 (3)	Environmental Elective (3)
8	Environmental Elective (3)	EAS 519 (3)*	General Education (3)	POL 523 (3)	General Education (3)	

** This is a core course in the department.*

Mathematics

The Department of Mathematics offers a broad range of programs leading to the Bachelor of Science degree. Students majoring in another area of science may also choose to pursue a minor in mathematics. Detailed descriptions of these programs and brief summaries of the kinds of careers for which graduates are prepared can be found in the "Plans of Study" section. More information about career opportunities is available from the College of Science Counseling Office and by taking MA 108 (Mathematics as a Profession and a Discipline) (1 cr.).

Some math graduates choose to continue their education in professional schools such as law schools, business schools, or medical schools. Others choose to teach. Many graduates choose to go on to graduate school in mathematics, engineering, computational finance, and other areas. Job options include positions such as database managers, programming, actuarial work, software engineering, military work, insurance, banking, and finance.

The most recent web information can be found at: www.math.purdue.edu/

General Degree Requirements

All mathematics majors must satisfy the following general degree requirements. In doing so, they will automatically fulfill the College of Science requirements listed on pages 27–29. A total of 124 credit hours is required. Mathematics courses below MA 161 (except MA 108) do not count as credit toward graduation.

Mathematics Requirements 43–81 credits

One of the following calculus sequences 12–15 credits

a. MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (10 cr.) and MA 261 (Multivariate Calculus) (4 cr.); *14 cr.*

b. MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.), and MA 261 (Multivariate Calculus) (4 cr.) *12 cr.*

c. Calculus: MA 173 (Calculus and Analytic Geometry II) (5 cr.) and MA 174 (Multivariable Calculus) (4 cr.); *9 cr.*

d. MA 181 (Honors Calculus I) (5 cr.) and MA 182 (Honors Calculus II) (5 cr.) *10 cr.*

e. MA 271 (Several Variable Calculus) (5 cr.) *5 cr.*

MA 366 (Differential Equations) (4 cr.) (except for the statistics option). Students transferring from other majors and those getting a second major in mathematics may replace MA 366 with MA 266 (with a "B" or better). *4 cr.*

MA 351 (Linear Algebra) (3 cr.) or MA 350 (Algebra: Honors) (3 cr.). Students transferring from other majors and those getting a second major in mathematics may replace MA 351 with MA 265 (with a "B" or better). *3 cr.*

One of the following seven programs (Courses required in these programs are listed beginning on page 70.): *24–57 credits*

Core Mathematics Option	*24 cr.*
Applied Mathematics Option	*27 cr.*
Business Mathematics Option	*30 cr.*
Computer Science Option	*24 cr.*
Mathematics Education Option	*56–57 cr.*
Operations Research Option	*24 cr.*
Statistics Option	*27–28 cr.*

Science Requirements 12–19 credits

Four courses. See page 29 for requirements.

Additional Requirements 36–41 credits

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors except teaching majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28). *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives 20–46 credits

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. Free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

It is recommended that all mathematics majors take MA 108 as a free elective in their first semester.

Grade requirement

All mathematics majors must have a graduation index of 2.0 in MA 351 (or MA 350), MA 366, and the courses used to fulfill one of the options.

Service courses

The following courses are recommended for undergraduate students outside the Department of Statistics or the Department of Mathematics and may not be taken by students within the departments: STAT 113, 225, 301, 501, 502, and 503.

Other courses recommended for undergraduates outside the department are STAT 311, 511, 512, 513, and 514. These courses often are taken by undergraduates in statistics or mathematics, or by graduate students in other fields.

Entry into Upper-Division and Honors Courses

The Department of Mathematics accepts students as upper-division majors after they complete MA 351 (Linear Algebra) (3 cr.) or MA 350 (Algebra – Honors) (3 cr.).

Any of the options can be enriched under the honors program described on page 73. Students who want to maximize their educational opportunities are urged to consider this program.

Many of the required courses can be replaced by more advanced courses. Consult academic advisors for details.

MA 181–182 and 350, 440, and 450 are, respectively, honors versions of Calculus 351, 341, and 453. The honors version of a course has content: material is covered in greater depth and/or more material is covered. Honors courses are recommended for students intending to pursue graduate work in any area involving mathematics or simply for those interested in a more challenging and rewarding educational experience.

Mathematics Options

Seven options for mathematics majors are described in this section. They are designed to provide foundations for a variety of careers in fields that use mathematics. Students in any option are encouraged to use their electives to build breadth in all of the mathematical sciences (pure and applied mathematics, computer science, and statistics). Such breadth is especially appreciated by employers in business, industry, and government.

Core Mathematics Option

This option provides preparation for graduate study in pure mathematics or for advanced work in theoretical sciences and in other fields where strong mathematical backgrounds are valuable, such as business administration, economics, computer science, statistics, educational research, psychology, law, and medicine.

Core Mathematics Option
Course Requirements **24 credits**

MA 353 (Linear Algebra II) *3 cr.*
MA 362 (Vector Calculus), or MA 510 (Vector Calculus) *3 cr.*
MA 341 (Foundations of Analysis) or MA 440 (Real Analysis: Honors) *3 cr.*
MA 453 (Elements of Algebra) or MA 450 (Algebra: Honors) *3 cr.*
Any four courses from among the following (but no more than two from each group):

a. C S 240 (Programming Laboratory C), C S 251 (Data Structures) (3 cr.)
b. C S 314 (Numerical Methods), C S 514 (Numerical Analysis), C S 515 (Numerical Analysis of Linear Systems), C S 520 (Computational Methods in Analysis) (3 cr.)
c. MA 454 (Galois Theory) (3 cr.)
d. MA 520 (Boundary Value Problems), MA 523 (Introduction to PDEs), MA 543 (Introduction to the Theory of Differential Equations) (3 cr.)
e. MA 375 (Introduction to Discrete Mathematics), MA 385 (Introduction to Logic), MA 387 (Set Theory and the Real Numbers), C S 381 (Introduction to the Analysis of Algorithms), C S 483 (Introduction to the Theory of Computation) (3 cr.)
f. MA 425 (Complex Analysis), MA 440 (Real Analysis), MA 442 (Multivariate Analysis I), MA 521 (Introduction to Optimization Problems) (3 cr.)
g. MA 462 (Elementary Differential Geometry), MA 571 (Elementary Topology) (3 cr.)
h. MA/STAT 416 (Probability), STAT 516 (Basic Probability and Applications), STAT 417 (Statistical Theory), STAT 517 (Statistical Inference) (3 cr.) *12 cr.*

Applied Mathematics Option

Graduates with training in applied mathematics are employed in business, industry, and government. Their jobs involve working with scientists in other fields, so some breadth is desirable, for instance, in physics, computer science, statistics, economics, or engineering.

This option also provides good preparation for graduate studies in applied mathematics and in subjects that use mathematics.

Applied Mathematics Option Course Requirements	**27 credits**
MA 362 (Topics in Vector Calculus) or MA 510 (Vector Calculus)	*3 cr.*
C S 314 (Numerical Methods) or C S 514 (Numerical Analysis)	*3 cr.*
MA 353 (Linear Algebra II)	*3 cr.*
MA 303 (Differential Equations for Engineering and the Sciences), or MA 304 (Differential Equations and Partial Differential Equations for Engineering and the Sciences).	*3 cr.*
MA 341 (Foundations of Analysis); MA 440 (Real Analysis: Honors)	*3 cr.*
MA 425 (Elements of Complex Analysis), MA 525 (Introduction to Complex Analysis)	*3 cr.*
MA 453 (Elements of Algebra I) or MA 450 (Algebra: Honors)	*3 cr.*
MA 520 (Boundary Value Problems of PDEs), or MA 523 (Introduction to PDEs), or special topics course with approval of the undergraduate committee chairman.	*3 cr.*
One of the following: MA 375 (Introduction to Discrete Mathematics), MA 421(Linear Programming and Optimization Techniques), MA 521 (Introduction to Optimization Problems), MA/STAT 416 (Probability), STAT 516 (Advanced Probability and Options with Numerical Methods)	*3 cr.*

Business Mathematics Option

An analytical background is becoming increasingly valuable for students who wish to pursue careers in business. This option, designed with the help of business and financial professionals, gives a strong mathematical foundation and courses in related areas to provide a suitable background for such a career. Students choosing this option should consider obtaining a minor in management.

Business Mathematics Option Course Requirements	**30 credits**
MGMT 200 (Introductory Accounting)	*3 cr.*
Two of: MA 375 (Introduction to Discrete Mathematics), C S 314 (Numerical Methods), STAT 417 (Statistical Theory), STAT 517 (Statistical Inference), or MA 421 (Linear Programming and Optimization Techniques).	*6 cr.*
Two of: MA 370 (Mathematical Theory of Interest), MGMT 310 (Financial Management), MGMT 411 (Investment Management), MGMT 544 (Database Management Systems), or MGMT 323 (Introduction to Market Analysis).	*6 cr.*
MA/STAT 416 (Probability), or STAT 516 (Basic Probability and Applications)	*3 cr.*
MA 341 (Foundations of Analysis), or MA 440 (Real Analysis: Honors)	*3 cr.*
MA 353 (Linear Algebra II)	*3 cr.*
MA 453 (Elements of Algebra I) or MA 450 (Algebra: Honors)	*3 cr.*
STAT 512 (Applied Regression Analysis)	*3 cr.*

Computer Science Option

This option provides a substantial mathematical background while preparing students for computer-related careers.

Computer Science Option Course Requirements	**24 credits**
C S 240 (Programming Laboratory C)	*3 cr.*
C S 251 (Data Structures)	*3 cr.*
C S 314 (Numerical Methods)	*3 cr.*
One of: C S 334 (Fundamentals of Computer Graphics), C S 381 (Introduction to the Analysis of Algorithms), C S 483 (Introduction to the Theory of Computation), C S 514 (Numerical Analysis), C S 515 (Numerical Analysis of Linear Systems), or C S 520 (Computational Methods in Analysis)	*3 cr.*
Two of: MA 353 (Linear Algebra II), MA 385 (Introduction to Logic), MA 453 (Elements of Algebra), or MA 450 (Algebra: Honors)	*6 cr.*
MA 375 (Introduction to Discrete Mathematics)	*3 cr.*
One of: MA 341 (Foundations of Analysis), MA 362 (Vector Calculus), MA 387 (Set Theory and the Real Numbers), MA/STAT 416 (Probability), STAT 516 (Basic Probability and Applications), MA 421 (Linear Programming and	

Optimization Techniques) (3 cr.), MA 425 (Elements of Complex Analysis), MA 525 (Introduction to Complex Analysis), MA 453 (Elements of Algebra), MA 450 (Algebra: Honors), MA 462 (Elementary Differential Geometry), or MA/STAT 474 (Random Modeling). *3 cr.*

Operations Research Option

Roughly speaking, operations research is the science of decision making. It uses mathematics, statistics, and computer science to determine the optimal way of performing a sequence of operations or to choose which of several competing programs is best. In this way, operations research can be an important component of the management of large projects.

Operations Research Option Course Requirements	**24 credits**
Numerical Analysis: C S 314 (Numerical Methods), or C S 514 (Numerical Analysis)	*3 cr.*
MA 353 (Linear Algebra II)	*3 cr.*
MA 362 (Topics in Vector Calculus) or MA 510 (Vector Calculus)	*3 cr.*
MA 453 (Elements of Algebra I) or MA 450 (Algebra: Honors)	*3 cr.*
MA/STAT 416 (Probability) or STAT 516 (Basic Probability and Applications), and STAT 417 (Statistical Theory) or STAT 517 (Statistical Inference)	*6 cr.*
One of: C S 520 (Computational Methods in Analysis), MA 341 (Foundations of Analysis), MA 440 (Real Analysis: Honors), MA/STAT 474 (Random Modeling) (3 cr.), MA 523 (Introduction to PDEs), MA 543 (Introduction to the Theory of Differential Equations)	*3 cr.*
One of: MA 375 (Introduction to Discrete Mathematics), MA 421 (Linear Programming and Optimization Techniques), MA 521 (Introduction to Optimization Problems), IE 335 (Operations Research – Optimization)	*3 cr.*

Statistics Option

Professional statisticians deal with – among other things – the collection and statistical analysis of data, the design of experiments, and quality control.

This option prepares students for work in statistics. A dual degree in mathematics and statistics can be obtained. See page 94.

Statistics Option Course Requirements	**27–28 credits**
One of: MA 366 (Ordinary Differential Equations), MA 375 (Introduction to Discrete Mathematics), MA 421 (Linear Programming and Optimization Techniques), MA 425 (Complex Analysis), MA 525 (Introduction to Complex Analysis), MA 453 (Elements of Algebra), MA 450 (Algebra: Honors), or MA 520 (Boundary Value Problems of Differential Equations)	*3–4 cr.*
MA 353 (Linear Algebra II)	*3 cr.*
MA 362 (Vector Calculus), or MA 442 (Multivariate Analysis I: Honors), or MA 510 (Vector Calculus)	*3 cr.*
STAT 350 (Introduction to Statistics)	*3 cr.*
MA 341 (Foundations of Analysis), or MA 440 (Real Analysis: Honors)	*3 cr.*
MA/STAT 416 (Probability), or STAT 516 (Basic Probability and Applications)	*3 cr.*
STAT 417 (Statistical Theory), or STAT 517 (Statistical Inference)	*3 cr.*
STAT 512 (Applied Regression Analysis)	*3 cr.*
One of: MA/STAT 474 (Random Modeling), I E 530 (Quality Control), STAT 513 (Statistical Quality Control), or STAT 514 (Design of Experiments)	*3 cr.*

Mathematics Education Option

This option provides the mathematical preparation necessary for teaching secondary school mathematics in Indiana.

Teacher certification requires a professional semester consisting of six weeks of coursework at Purdue followed by 10 weeks of student teaching. EDCI 426 is taken during the first six weeks of the professional semester, before student teaching. A student can choose either the seventh or eighth semester for the professional semester.

Students completing this option are exempt from the second year of modern foreign language.

Requirements for teacher certification vary from state to state. They can be obtained by writing to the Certification Office, Department of Public Instruction, in the capital city of the state of interest.

Mathematics Education Course Requirement	**56–57 credits**
Mathematics Courses	***24–25 credits***
MA 301 (Introduction to Real Analysis) (3 cr.)	*3 cr.*
One of the following: MA 341(Foundations of Analysis), 353 (Linear Algebra II), MA 375 (Introduction to Discrete Mathematics), MA 425 (Elements of Complex Analysis) (3 cr.), MA 525 (Introduction to Complex Analysis) (3 cr.), or MA 440 (Real Analysis) (3 cr.)	*3 cr.*
MA 453(450) (Elements of Algebra)(3 cr.)	*3 cr.*
MA 460 (Geometry) (3 cr.)	*3 cr.*
STAT 311 (Introductory Probability) (3 cr.), MA/STAT 416 (Probability) (3 cr.), or STAT 516 (Basic Probability and Applications) (3 cr.)	*3 cr.*
One of the following: C S 158 (C Programming) (3 cr.), C S 154 (Fortran Programming) (3 cr.), C S 177 (Programming with Multimedia Objects), or C S 180 (Programming I) (4 cr.).	*3–4 cr.*
Two additional three-credit courses in mathematics, statistics, or computer sciences at the 300-level or above, approved by the Undergraduate Mathematics Committee. At least one of these must be in mathematics.	*6 cr.*
Professional Education Courses	***32 credits***
EDCI 270 (Introduction to Educational Technology and Computing) (2 cr.), EDFA 200 (History and Philosophy of Education) (3 cr.), EDCI 205 (Exploring Teaching as a Career) (3 cr.), EDCI 285 (Multiculturalism and Education) (3 cr.), EDPS 235 (Learning and Motivation) (3 cr.), EDPS 265 (The Inclusive Classroom) (3 cr.), EDCI 425 (Teaching of Mathematics in Secondary Schools) (3 cr.), EDCI 426 (Teaching Mathematics In The Middle And Junior High School) (3 cr.), EDCI 498M (Supervised Teaching In Secondary Mathematics Education) (3 cr.)	

Actuarial Science

An interdisciplinary program in actuarial science is offered jointly by the Department of Mathematics and the Department of Statistics. See page 32.

Honors Program

The Department of Mathematics offers a wide variety of educational opportunities for superior students. Honors courses are available from the freshman level to the senior level. Qualified undergraduates may also substitute graduate-level classes for undergraduate classes.

Most honors classes are taught in small sections (usually fewer than 20 students). This provides a unique opportunity for students to experience a small college atmosphere in the midst of a large university. Honors work also gives the student the opportunity to obtain a richer and deeper knowledge of mathematics. This is particularly important for individuals contemplating graduate work, either in mathematics or some mathematics-related discipline.

There is also an official "honors option. Students who successfully complete the requirements for this program are certified at the time of graduation as having graduated "with honors in mathematics." Students may enter the program any time after completing MA 351 (or MA 350). Entering the honors program indicates an intention to meet the more rigorous requirements of graduation "with honors" as outlined below. There is no penalty if a student later changes plans.

In the honors program, students must satisfy the general degree requirements via one of the options listed and include MA 440, 442, and 450 in all options except Education, which requires only 440 and 442. In either case, a grade point average of at least 3.35 is required in these courses.

Special Programs and Opportunities

Cooperative Education Program. The Department of Mathematics participates in the Cooperative Education Program as described on page 9. If interested, a student should contact the Coordinator of Cooperative Education, Mathematics Department, Mathematical Sciences Building.

To be eligible for the Cooperative Education Program, a student must:

1. Have completed one of the following calculus sequences:
   a. MA 161–162 (Plane Analytic Geometry and Calculus, I and II) (10 cr.) and MA 261 (Multivariate Calculus) (4 cr.)

b. MA 165–166 (Analytic Geometry and Calculus, I and II) (8 cr.), and MA 261 (Multivariate Calculus) (4 cr.)
c. Calculus: MA 173 (Calculus and Analytic Geometry II) (5 cr.) and MA 174 (Multivariable Calculus) (4 cr.)
d. MA 181 (Honors Calculus I) (5 cr.) and MA 182 (Honors Calculus II) (5 cr.)
e. MA 271 (Several Variable Calculus) (5 cr.)

2. Have at least a 3.0 grade index in all mathematics, statistics, and computer science courses and;

3. Have an overall graduation index of at least 2.8.

Although it is not required, students are encouraged to take C S 154 (Fortran Programming) (3 cr.), C S158 (C Programming) (3 cr.), C S 177 (Programming with Multimedia Objects) (4 cr.), or C S 180 (Programming I) (4 cr.) before starting their work experience.

Mathematics Minor

The mathematics minor provides a strong background in mathematics for students majoring in some other discipline. To qualify for the minor, the following classes must be completed with an average grade index of at least 2.0.

Mathematics Minor Course Requirements	**12–13 credits**
One of the following: MA 351 (Elementary Linear Algebra) (3 cr.), MA 350 (Elementary Linear Algebra: Honors) (3 cr.), MA 511 (Linear Algebra with Applications) (3 cr.), MA 265* (Linear Algebra) (3 cr.).	*3 cr.*
One of the following MA 453 (Elements of Algebra) (3 cr.), MA 450 (Algebra: Honors) (3 cr.), MA 341 (Analysis: Foundations of Analysis) (3 cr.), MA 440 (Real Analysis: Honors) (3 cr.).	*3 cr.*
Two additional courses selected from the following:	
MA 301 (An Introduction to Proof Through Real Analysis) (3 cr.), or MA 341 (Foundations of Analysis) (3 cr.), or MA 362 (Topics in Vector Calculus) (3 cr.), or MA 510 (Vector Calculus) (3 cr.), or MA 425 (Elements of Complex Analysis) (3 cr.), or MA 525 (Introduction to Complex Analysis) (3 cr.), or MA 440 (Real Analysis: Honors) (3 cr.).	*3 cr.*
MA 375 (Introduction to Discrete Mathematics) (3 cr.), MA 453 (Elements of Algebra) (3 cr.), MA 450 (Algebra: Honors) (3 cr.), or MA 454 (Galois Theory) (3 cr.).	*3 cr.*
MA 353 (Linear Algebra II with Applications) (3 cr.).	*3 cr.*
MA 366† (Differential Equations) (4 cr.) or MA 520 (Boundary Value Problems of Differential Equations) (3 cr.), or MA 523 (Introduction to PDEs) (3 cr.)	*3–4 cr.*

** For many students, MA 265 may not be adequate preparation for upper-division mathematics classes. Students planning mathematics minor should consider taking MA 351 instead. Only students with a very firm grasp of the MA 265 material should contemplate taking MA 353 without 351.*

† MA 266, with at least a "B" can be used in place of MA 366. MA 262 will not be accepted for the minor.

Mathematics Sample Plans of Study

Core Mathematics Option Sample Plan

Freshman Year					
1	MA 161 or 165 (4–5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)†
2	MA 162, (166, 173, 181) (4–5)	C S 158, 154, 177, or 180 (3-4)*	Language (3)	Gen. Ed. (3)	
Sophomore Year					
3	MA 261 (271, 174, 182) (4–5)	MA 301 (3)‡	Language (3)	Gen. Ed. (3)	Elective
4	MA 362 (510) (3)	MA 351 (350) (3)	Language (3)	Ged Ed. (3)	Lab Science (3–4)
Junior Year					
5	MA 366 (4)	MA 341 (440) (3)	ENGL COMP II	Lab Science (3–4)	Elective
6	MA Elective (3)§	MA353 (3)	Gen. Ed. (3)	Elective	Elective
Senior Year					
7	MA Elective (3)§	MA 453 (450) (3)	Gen. Ed. (3)	Elective	Elective
8	MA Elective (3)§	MA Elective (3)§	Gen. Ed. (3)	Elective	Elective

** If a CS class is not taken, then an additional lab science is required. Note: C S 180 is a prerequisite for most upper-level CS classes.*

† Free elective.

‡ Strongly recommended as a free elective.

§ Any four courses from among the following (but no more than two from each group): Analysis: MA 425 (525), 440 (which can be taken in addition to 341), 442, 521; Algebra: MA 454; Differential Equations: MA 520, 523, 543; Discrete Mathematics, Foundations: MA 375, 385, 387, C S 381, C S 483; Geometry: MA 462, 571; Computer Sciences: C S 240, 251; Numerical Analysis: C S 314, 415, 514, 515, 520; Statistics, Probability: STAT 416 (516), 417 (517). Other choices may be approved. See your advisor.

Applied Mathematics Option Sample Plan

Freshman Year						
1	MA 161 or 165 (4–5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)*	
2	MA 162, 166, 173, or 181 (4–5)	Lab Science (3–4)	Language (3)	Gen Ed. (3)		
Sophomore Year						
3	MA 261, 271, 174, or 182 (4-5)	MA 351 (350) (3)	MA 301 (3)†	Language (3)	Gen. Ed. (3)	C S 158 (154, 177, 180) (3)‡
4	MA 362 (510) (3)	Lab Science (3-4)	Language (3)	Gen. Ed. (3)		
Junior Year						
5	MA 366 (4)	MA 341 or 440 (3)	ENGL COMP II	Elective	Elective	
6	MA 353 (3)	C S 314 (514) (3)	MA 303 304 (3)	Gen. Ed. (3)	Elective	
Senior Year						
7	MA 453 or 450 (3)	MA/STAT (3)§	Gen. Ed. (3)	Elective	Elective	
8	MA 520 or 523 (3)‖	Gen. Ed. (3)	Elective	Elective	MA 425 or 525 (3)	

** Free elective.*

† Strongly recommended as a free elective.

‡ If a CS class is not taken, then an additional lab science is required. Note: C S 180 is a prerequisite for most upper-level CS classes.

§ One of: MA 421 (521) (MA 341 and 353 are strongly recommended as prerequisites for MA 521); MA 375, MA/STAT 416 (STAT 516).

‖ Students can use certain topics courses to fulfill this requirement (as approved by the Math Undergraduate Committee Chair.)

Business Mathematics Option Sample Plan

Freshman Year					
1	MA 161 or 165 (4-5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)*
2	MA 162 (166, 173, 181) (4-5)	C S 158, 154, 177 or 180 (3–4)†	Language (3)	Gen. Ed. (3)	
Sophomore Year					
3	MA 261 (4) (271, 174, 182)	MA 301 (3)‡	Language (3)	Gen. Ed. (3)	MGMT 200 (3)
4	Option (3)§	Language (3)	Gen. Ed. (3)	STAT 350 (3)‡	MA 351 (350) (3)
Junior Year					
5	MA/STAT 416 (STAT 516) (3)	MA 353 (3)	ENGL COMP II	Lab Science (3-4)	Elective
6	Option (3)§	MA 341 or 440 (3)	Gen. Ed. (3)	Elective	Lab Science (3–4)
Senior Year					
7	MA 366 (4)	MA 453 (3)	Option (3)‖	Gen. Ed. (3)	Elective
8	STAT 512 (3)	Option (3)‖	Gen. Ed. (3)	Elective	Elective

** Free elective.*

† If a CS class is not taken, then an additional lab science is required. Note: C S 180 is a prerequisite for most upper-level CS classes.

‡ Strongly recommended as a free elective.

§ Option: two of MA 375, C S 314, STAT 417 (517), or MA 421.

‖ Option: two of MA 370, MGMT 310, 323 (411), 544.

Note: STAT 512 has STAT 350, 511, or 417/517 as a prerequisite. MGMT 310 and 544 have prerequisites.

Computer Science Option Sample Plan

Freshman Year					
1	MA 161 or 165 (4–5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)*
2	MA 162 (166, 173, 181) (4–5)	C S 180 (4)	Language (3)	Gen. Ed. (3)	
Sophomore Year					
3	MA 261 (271, 174, 182) (4-5)	C S 240 (3)	Language (3)	Gen. Ed. (3)	C S 182 (3)*
4	MA 351 (3)	C S 251 (3)	Language (3)	Gen. Ed. (3)	Elective
Junior Year					
5	MA 366 (4)	MA 375 (3)	Lab Science (3-4)	ENGL COMP II	Elective
6	C S 314 (3)	Option (3)§	Elective	Gen. Ed. (3)	Lab Science (3–4)
Senior Year					
7	C S/STAT (3)‡	Option (3)§	Elective	Gen. Ed. (3)	Elective
8	Gen. Ed. (3)	Elective	Elective	Elective	MA/STAT||

** Free elective.*
† MA 385 is offered only in the spring semester.
‡ One of: C S 334, 381, 483, 514, 515, 520.
§ Option: two of MA 353, 385, 453 (450).
|| Option: one of MA 341, 362, 387, 421, 425, 462, 453 (450), MA/STAT 416 (516), MA/STAT 474.

Statistics Option Sample Plan

Freshman Year					
1	MA 161 or 165 (4–5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)*
2	MA 162, 166, 173 or 181 (4–5)	C S 158 (154, 177, 180) (3)†	Language (3)	Gen. Ed. (3)	
Sophomore Year					
3	MA 261, 271, 174 or 182 (4–5)	STAT 350 (3)	Language (3)	Gen. Ed. (3)	MA 301 (3)‡
4	MA/STAT 416 or STAT 516 (3)	MA 351 (350) (3)	Language (3)	Gen. Ed. (3)	
Junior Year					
5	MA 353 (3)	STAT 417 or 517 (3)	ENGL COMP II (3)	Lab Science (3–4)	Elective
6	MA 362, 442, or 510 (3)	Elective	Lab Science (3–4)	Gen. Ed. (3)	
Senior Year					
7	MA 341 or 440 (3)	STAT 512 (3)¶	Gen. Ed. (3)	Elective	Elective
8	MA Option§	STAT Option‖	Elective	Gen. Ed. (3)	Elective

** Free elective.*

† If a CS class is not taken, then an additional lab science is required. Note: C S 180 is a prerequisite for most upper-level CS classes.

‡ Strongly recommended as a free elective.

§ MA Option: one of MA 366, MA 375, MA 421, MA 425, MA 453 (450), MA 520.

‖ STAT Option: one of STAT 513, STAT 514, MA/STAT 474, or IE 530.

¶ STAT 512 has STAT 350, 511, or 517 as a prerequisite.

Operations Research Option Sample Plan*

Freshman Year					
1	MA 161 or 165 (4–5)	Lab Science (3–4)	Language (3)	ENGL 106 or 108 (3–4)	MA 108 (1)†
2	MA 162, 166, 173, or 181 (4–5)	Lab Science (3–4)	Language (3)	Gen. Ed. (3)	
Sophomore Year					
3	MA 261, 271, 174, or 182 (5)	MA 301 (3)‡	Language (3)	Gen. Ed. (3)	Elective
4	MA/STAT 416 or STAT 516 (3)	MA 351 or 350 (3)	Language (3)	Gen. Ed. (3)	Lab Science
Junior Year					
5	STAT 417 or 517 (3)	MA 362 or 510 (3)	ENGL COMP II	C S 158, 154, 177 or 180 (3)§	Elective
6	C S 314 or 514 (3)	Option‖	Gen. Ed. (3)	Elective	Elective
Senior Year					
7	MA 353 (3)	MA 366 (4)	Gen. Ed. (3)	Elective	
8	MA 453 or 450 (3)	Option (3)¶	Gen. Ed. (3)	Elective	Elective

** Students should take some industrial engineering operations research courses as electives, choosing from IE 335, 336, 502, 535, 536, 537, and 538.*

† Free elective.

‡ Strongly recommended as a free elective.

§ If a CS class is not taken, then an additional lab science is required. Note: C S 180 a is prerequisite for most upper-level CS classes.

‖ Option: one of MA 421 (521), MA 375, IE 335.

¶ Students select one course from C S 520; MA 341 (440), 523, 543, MA/STAT 474.

Mathematics Education Option Sample Plan

Freshman Year						
1	MA 161 or 165 (4–5)	Language (3)	Lab Science (3–4)	ENGL 106 or 108 (3–4)	MA 108 (1)*	
2	MA 162, 166, 173, or 181 (4–5)	Language (3)	C S 158, 154, 177 or 180 (3)	Lab Science (3–4)	EDCI 270 (2)	
Sophomore Year						
3	MA 261, 271, 174, 182 (4–5)	MA 460 (3)	EDCI 205 (3)	EDCI 285 (3)	Lab Science (3-4)	
4	MA 351 or 350 (3)	Lab Science (3–4)	Gen. Ed. (3)	STAT 311 MA/STAT 416 or STAT 516 (3)	Elective (3)	
Junior Year						
5	MA 301 (3)	MA 366 (4)	EDPS 265 (3)	EDPS 235 (3)	Gen. Ed. (3)	Elective‡
6	MA/C S/STAT Elective†	MA 453 or 450 (3)	Gen. Ed. (3)	EDFA 200 (3)	Gen. Ed. (3)	
Senior Year						
7	Problem Solving§	MA Elective†	EDCI 425 (2–3)	ENGL COMP II (3)	Gen Ed. (3)	
8	EDCI 426 (2)	EDPS 498M (10)				

** Free elective.*

† Students take MA, C S, or STAT electives at the 300 level or higher, approved by the Undergraduate Committee at least one must be a MA courses.

‡ Strong students are encouraged to apply for admission into the free elective MA 484, supervised teaching of one section of MA 153.

§ Students select one course from MA 341, 353, 375, 425, or 440.

Physics

Physics is the study of matter and energy, and the fundamental forces of nature that govern the interactions between particles. Physicists study a wide range of physical phenomena, from quarks to black holes, from individual atoms to the many-body systems of superconductors. It is the foundation of all the physical sciences. The knowledge and problem-solving skills acquired by physics graduates enable them to pursue careers in a wide range of scientific and professional disciplines.

A Bachelor of Science degree from the Department of Physics prepares students to investigate a variety of problems in the area of physics. The basic core courses, supplemented by courses relevant to each specialized major option, provide a broad scientific education that prepares students for entry into physics-related careers as well as for advanced study in graduate schools in physics, engineering, other sciences, and professions such as law, medicine, and finance.

A master's degree is desirable for research, advancement in secondary school teaching in Indiana, and many positions in government or industry. The Ph.D. degree is required for advancement at a university and higher level positions in research.

The undergraduate program in Purdue's Department of Physics prepares students for participation in the frontiers of discovery in nanotechnology, condensed matter, nuclear physics, high energy particle physics, astronomy, biophysics, medical physics, and other branches of physics.

The Department of Physics emphasizes undergraduate research as an integral part of the learning experience that reinforces and amplifies skills acquired in the classroom. A seminar class is offered in the first semester to introduce freshman students to "Current Topics in Physics Research." The class serves to familiarize students with research being carried out currently in the department and prepares them to become involved in undergraduate research as early as their second semester at Purdue.

In their second year, students are encouraged to enroll in a one-credit-hour seminar class that helps them explore different careers in physics. It offers an opportunity for students to meet with alumni and professors in the Department of Physics and to learn valuable career development skills from these experiences.

The Department of Physics offers a Bachelor of Science with a major in physics with different specializations, including joint programs with the College of Engineering. A physics/math double major is also available to physics majors by taking seven additional courses in math.

A bachelor's degree in physics prepares students to pursue careers in an extraordinary variety of areas, including technical and managerial careers in industry, and basic research in universities, industrial laboratories, and national laboratories. The general problem solving skills developed in physics studies serve students well not only in careers in physics, but also in careers in other sciences, engineering, law, medicine, management, finance, and government.

Some examples of careers chosen by physics majors include: teacher, research scientist, lawyer, physician, architect, technical salesperson, electrical engineer, aeronautical engineer, astronaut, geophysicist, software designer, technical analyst, reliability engineer, and process engineer.

The most recent information can be found at www.physics.purdue.edu

The following courses are required of all Bachelor of Science physics majors. In meeting these requirements, candidates will also automatically fulfill the College of Science graduation requirements listed on pages 27–29. The core courses taken by all physics majors provide a solid foundation in classical mechanics, electricity and magnetism, waves and optics, quantum mechanics, thermal and statistical physics, modern physics, relativity, electronics, and computational physics. Choices are offered in advanced laboratory.

General Degree Requirements

Physics Major Requirements 31–55 credits

Students must complete the requirements for one of the following options:

1. Physics (35-41 credit hours in physics)
2. Physics with Honors (55 credit hours in physics)
3. Applied Physics (31-37 credit hours in physics)
4. Applied Physics - Honors (42 credit hours in physics)
5. Physics Teaching (31-39 credit hours in physics)
6. Dual B.S. degrees in Physics, and Materials Science and Engineering (31 credit hours in physics)

Science Requirements (All Plans) ***14–18 credits***

CHM 115 or 123 or 125 (Chemistry I) *4–5 cr.*
CHM 116 or 124 or 126 (Chemistry II) *4–5 cr.*
Six to eight additional credit hours of two laboratory sciences selected from allowed courses in biology, chemistry, earth and atmospheric science, astronomy, computer science or engineering. *6–8 cr.*

Mathematics Requirements (All Plans) ***21–23 credits***

Choose one course from each group:
a. MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.), or MA 165 (Analytic Geometry and Calculus I) (4 cr.) *4–5 cr.*
b. MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 173 (Calculus and Analytical Geometry II) (5 cr.), or MA 181 (Honors Calculus I) 5 cr.) *4–5 cr.*
c. MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus) (5 cr.), or MA 271 (Several Variable Calculus) (5 cr.) *4–5 cr.*
d. MA 262 (Linear Algebra and Differential Equations) (4 cr.), MA 266 (Ordinary Differential Equations) (3 cr.), MA 366 (Ordinary Differential Equations) (4 cr.) *3–4 cr.*
Six additional credit hours of approved courses in mathematics. *6 cr.*

Additional Requirements ***36–41 credits***

English Composition: See page 28 for English composition requirements. *6–7 cr.*
Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28). *12–16 cr.*
General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives: (All Plans) ***0–22 credits***

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. Students must take at least as many free electives as are needed to bring the credit hour total to 124.

A student can also use free electives to acquire a minor in a related field or in other departments in the College of Science.

Grade Requirement

Students majoring in physics or applied physics must have a grade point average of 2.0 or above in all physics courses. For students majoring in honors physics program or in honors applied physics program, grades of "A" or "B" must be maintained in all physics and mathematics courses. For teaching majors, the minimum grade requirement is 2.5 in content areas and 3.0 in professional education courses.

Physics Major – Options

Students wishing to major in physics should complete the "General Degree Requirements" on pages 82–83, plus requirements specific to the physics option.

Physics

This program offers a specialization in physics as the core of a broad general education. By using free electives in the program, a student can include concentrations in condensed matter physics (PHYS 545), nuclear physics (PHYS 556), astrophysics (PHYS 560), particle physics (PHYS 564), and other areas. Students also are encouraged to participate in one or two semesters of individual research projects with a selected faculty member (PHYS 593).

Opportunities for employment in fields related to physics will be enhanced by taking free-electives in other science courses, such as biological sciences, bio-nucleonics, chemistry, computer science, geosciences, geophysics, meteorology, and/or in various branches of engineering. With assistance from an advisor, a student can prepare an individualized program suited to career plans by selecting electives from these areas or from any other area within the University. Normally, these courses are taken as juniors or seniors (see the sample program on pages 88–92).

Physics Major course requirements	**34–43 credits**
One of the following:	
a. PHYS 162 (Particle Kinematics and Conservation Laws) and PHYS 163 (Mechanics, Heat, and Kinetic Theory), or	
b. PHYS 152 (Mechanics)	*4–9 cr.*
One of the following:	
a. PHYS 271 and PHYS 271L (Electricity and Magnetism),	
b. PHYS 241 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal),	
c. PHYS 261 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal)	*5–6 cr.*
PHYS 342 or 344* (Modern Physics)	*3–4 cr.*
PHYS 342L (Modern Physics Laboratory) and PHYS 450 (Optics Laboratory)	*3 cr.*
PHYS 310 or 410* (Intermediate Mechanics)	*3–4 cr.*
PHYS 322 or 422* (Optics)	*3 cr.*
PHYS 330 or 430* (Intermediate Electricity and Magnetism)	*3 cr.*
PHYS 360 or 460* or 550 (Quantum Mechanics)	*3 cr.*
PHYS 515 or 416* (Thermal and Statistical Physics)	*3–4 cr.*
Advanced Physics Laboratory Requirement: Electronic Techniques for Physical Research: PHYS 536; or approved advanced laboratory courses e.g. PHYS 580 (Advanced Computational Physics), or PHYS 670F (Advanced Physics Laboratory)	*3–4 cr.*

Physics: Honors

The honors program offers an intensive concentration in physics that provides a solid foundation for advanced studies. Successful graduates of this challenging program are recognized for both the depth and breadth of their physics education, and they have gone on to the premier graduate schools in the country and ultimately to many different career choices.

The honors program provides a solid theoretical and experimental background in mechanics, electromagnetism, optics, thermal physics, quantum mechanics, and the micro-structure of matter. See the sample program on page 89).

A very important feature of this plan is a senior-year research project (PHYS 593) in some area of modern physics, such as condensed matter physics, nuclear physics, elementary particle physics, biophysics, geophysics, etc. Students receive individual supervision and guidance from a faculty member whose specialty matches the area of their research project. PHYS 593 introduces students to the type of research atmosphere they later might encounter as professional physicists, and it promotes self-motivation and independence in their work.

Students interested in the honors program typically start by taking PHYS 162 and 163 as freshmen. Students from other majors who have taken PHYS 152 and 241/261 may switch into the Honors Physics major. However, it is advisable that all students pursuing the honors program take PHYS 344, 422, and 450 during the second semester of the sophomore year. Admission to, and continuation in, the honors program requires a grade of "A" or "B" in all physics and mathematics courses or special permission from the Physics Undergraduate Committee.

Physics: Honors course requirements	**54–55 credits**
PHYS 162 (Particles, Kinematics, and Conservation Laws)	*4 cr.*
PHYS 163 (Mechanics, Heat, and Kinetic Energy)	*5 cr.*
PHYS 271 and 271L (Electricity and Magnetism)	*6 cr.*
PHYS 344 (Modern Physics: Honors)	*4 cr.*
PHYS 422 (Optics: Honors)	*3 cr.*
PHYS 342L and PHYS 450 (Intermediate Laboratories)	*3 cr.*
PHYS 410 and PHYS 411 (Physical Mechanics I, II: Honors)	*5 cr.*
PHYS 430 and PHYS 431 (Electricity and Magnetism I, II: Honors)	*5 cr.*
PHYS 460 and PHYS 461 (Quantum Mechanics I, II)	*6 cr.*
PHYS 416 (Thermal and Statistical Physics: Honors)	*4 cr.*

**Required for Honors. May be used as substitute with the permission of the department.*

Advanced Physics Laboratory Requirement

PHYS 536 (Electronic Techniques for Physical Research) or approved advanced laboratory courses, e.g. PHYS 580 (Advanced Computational Physics) or PHYS 670F (Advanced Physics Laboratory) *3–4 cr.*

Senior Honors Project: PHYS 593, two semester-total of 6 credits or approved by the department. *6 cr.*

Applied Physics

The applied physics plan of study is especially geared toward providing the physics graduate with specific expertise in preparation for immediate employment in the corporate research world or in government laboratories, in addition to further graduate study. Students obtain a solid physics background plus significant experience in one or more specialties of their own choosing, selected from a wide range of choices from Purdue's Science and Engineering colleges.

The basic plan of study combines about 29-39 credit hours of physics with 30 credit hours of applied electives.

Applied Physics course requirements **59–69 credits**

PHYS 162 (Particle Kinematics and Conservation Laws) and PHYS 163 (Mechanics, Heat, and Kinetic Theory), or PHYS 152 (Mechanics) *4–9 cr.*

Electricity and Magnetism:

One of the following:

a. PHYS 271 and PHYS 271L (Electricity and Magnetism, and Laboratory) (6 cr.)

b. PHYS 241 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal) (5 cr.)

c. PHYS 261 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal) (6 cr.) *5–6 cr.*

Modern Physics: PHYS 342 (3 cr.) or 344* (4 cr.) *3–4 cr.*

Intermediate Laboratories: PHYS 450 (Optics Laboratory) (2 cr.) and PHYS 342L (Modern Physics Laboratory) (1 cr.) (if PHYS 342 is taken) *2–3 cr.*

Intermediate Mechanics: PHYS 310 (4 cr.) or 410* (3 cr.) *3–4 cr.*

Intermediate Optics: PHYS 322 or 422* *3 cr.*

Intermediate Electricity and Magnetism: PHYS 330 or 430* *3 cr.*

Quantum Mechanics: PHYS 360 or 460* or 550 *3 cr.*

Thermal and Statistical Physics: PHYS 515 or 416* *3–4 cr.*

Applied physics elective courses totaling 30 credit hours are required in addition to above courses. These must be approved and signed by the advisor. A number of recommended specialties for this major have been listed below. New combinations are also possible to arrange in consultation with the department. Each student is required to have a major concentration in one specialty (14 credit hours or more), or a minor concentration in two specialties (9 credit hours or more each). Four of the elective courses must involve laboratory work.

Note: Only six credit hours of foreign language are required for regular or honors applied physics programs. Applied electives with laboratory components may be used to satisfy part of the College of Science Laboratory Science requirement (See the sample program on page 89).

Applied Physics — Specialties

The specialties under the applied physics curriculum include nanoscience and nanotechnology, nuclear engineering, aeronautical and astronautical engineering, biophysics and biomedical engineering, medical physics, computer science, electrical and computer engineering, and geophysics. Individually tailored specialties may be chosen by the student in consultation with an advisor.

Materials Specialty. This program of study is based on the currently existing model for the Bachelor of Science with the Applied Physics Specialization. It incorporates a core of nine physics (31 credits) courses and seven MSE (20 credits) courses and, in addition, provides for 16 credits of technical electives for building a strong background in the area of materials and applied physics. The sample study plan requires a total of 132 credits for graduation. See the sample program on page 90.

**Required for Honors*

Applied Physics with Honors

A Bachelor of Science degree with a major in applied physics with honors can be obtained by replacing several required courses in the regular applied physics program with the corresponding honors courses. All other applied physics requirements must still be met. In addition, grades of "A" or "B" must be maintained in all physics and mathematics courses.

Applied Physics: Honors course requirements	**67–68 credits**
PHYS 162 (Particles, Kinematics, and Conservation Laws) (4 cr.)	*4 cr.*
PHYS 163 (Mechanics, Heat, and Kinetic Energy) (5 cr.)	*5 cr.*
One of the following options:	
a. PHYS 271 and PHYS 271L (Electricity and Magnetism)	
b. PHYS 241 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal)	
c. PHYS 261 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal)	*5–6 cr.*
PHYS 344 (Modern Physics) (4 cr.)	*4 cr.*
PHYS 422 (Optics) (3 cr.)	*3 cr.*
PHYS 430 (Intermediate Electricity and Magnetism) (3 cr.)	*3 cr.*
PHYS 460 (Quantum Mechanics) (3 cr.)	*3 cr.*
PHYS 416 (Thermal and Statistical Physics) (4 cr.)	*4 cr.*
PHYS 450 (Intermediate Laboratory) (2 cr.)	*2 cr.*
PHYS 461 (Quantum Mechanics II: Honors) (4 cr.)	*4 cr.*

Applied physics elective courses totaling 30 credit hours are required in addition to above courses. This must be approved and signed by the advisor. A number of recommended specialties for this major were listed in the previous section. New combinations are also possible to arrange in consultation with the department. Each student is required to have a major concentration in one specialty (14 credit hours or more), or a minor concentration in two specialties (9 credit hours or more each). Four of the elective courses must involve laboratory work.
Note: Only six credit hours of foreign language are required for regular or honors applied physics programs. Applied electives with laboratory components may be used to satisfy part of the College of Science laboratory science requirement.

Physics Teaching

This degree provides a strong background in physics, in addition to a license to teach physics at a high school and middle school level. The requirements for this degree are listed below. Additional guidelines are available at the College of Science Counseling Office (www.science.purdue.edu/counseling/) and the Office of Professional Preparation and Licensure (http://admin2.soe.purdue.edu/oppl/program.html).

Since teacher certification requirements are determined by each individual state, a student will need to contact the state education licensing agency in state(s) where he or she plans to teach. This information is available online at www.nasdtec.org/state-info.tpl. Prospective teachers are exempt from the second year of the foreign language requirement, provided they successfully complete the professional semester within the baccalaureate program. The professional semester is the one that includes six weeks of a methods course at Purdue and 10 weeks of teaching. To receive a Bachelor of Science with a major in physics teaching, a student must maintain a grade-point average of 2.5 or above in all physics courses, and 3.0 or above in education courses required to meet licensing requirements.

Physics Teaching Course Requirements	**63–71 credits**
Physics courses	***31–39 credits***
One of the following options:	
a. PHYS 162 (Particle Kinematics and Conservation Laws) and PHYS 163 (Mechanics, Heat, and Kinetic Theory)	
b. PHYS 152 (Mechanics)	*4–9 cr.*
One of the following options:	
a. PHYS 271 and PHYS 271L (Electricity and Magnetism)	
b. PHYS 241 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal)	

**Required for Honors*

c. PHYS 261 (Electricity and Optics) and PHYS 252 (Electricity and Optics Laboratory) and PHYS 290D (Heat and Thermal) *5–6 cr.*

d. PHYS 251 (Heat, Electricity, and Optics), PHYS 252 (Electricity and Optics Laboratory), and PHYS 290D (Heat and Thermal) *5–6 cr.*

PHYS 342 (Modern Physics) or 344* (Modern Physics: Honors) (3-4 cr.) *3–4 cr.*

PHYS 342L (Modern Physics Laboratory) and PHYS 450 (Optics Laboratory I: Honors) (3 cr.) *3 cr.*

PHYS 310 (Intermediate Mechanics) or 410* (Physical Mechanics I: Honors) (3-4 cr.) *3–4 cr.*

PHYS 322 (Intermediate Optics) or 422* (Intermediate Optics: Honors) (3 cr.) *3 cr.*

PHYS 330 (Intermediate Electricity and Magnetism) or 430* (Intermediate Electricity and Magnetism: Honors) (3 cr.) *3 cr.*

One of: PHYS 360 (Quantum Mechanics), PHYS 460* (Quantum Mechanics: Honors), PHYS 550 (Introduction to Quantum Mechanics) (3 cr.) *3 cr.*

One of: PHYS 536 (Electronics Techniques for Research), PHYS 580 (Computational Physics), PHYS 670F (Advanced Physics Laboratory) (3-4 cr.) *3–4 cr.*

Professional Education courses ***32 credits***

EDCI 270 (Introduction to Educational Technology and Computing) (2 cr.), EDFA 200 (History and Philosophy of Education) (3 cr.), EDCI 205 (Exploring Teaching as a Career) (3 cr.), EDCI 285 (Multiculturalism and Education) (3 cr.), EDPS 235 (Learning and Motivation) (3 cr.), EDPS 265 (The Inclusive Classroom) (3 cr.), EDCI 425 (Teaching of Mathematics in Secondary Schools) (3 cr.), EDCI 428 (Teaching Mathematics in the Middle and Junior High School) (2 cr.), EDCI 498M (Supervised Teaching in Secondary Mathematics Education) (10 cr.) *32 cr.*

Bachelor of Science with a major in Physics and Bachelor of Science in Materials Science and Engineering

This is a five-year joint program for the dual degree of Bachelor of Science with a major in Physics and Bachelor of Science in Materials Science and Engineering. The program requires 10 semesters and is designed to satisfy the accreditation requirements for both degrees. As indicated in the sample plan, a total of 159 credits is required (see the sample program on page 91). Students need to complete the requirements of the Physics core major and those courses required for the Materials Science and Engineering.

Special Programs and Opportunities

Fifth-Year M.S. Option. Many positions for physicists require a Master of Science in physics. Students who complete the Bachelor of Science requirements in Applied Physics at Purdue with at least a 3.0 grade-point average can apply for admission to the Graduate School as a Master's candidate in Applied Physics. The Master's degree requirements (12 credit hours in physics and 18 credit hours in applied electives) can be completed in one year under the usual rules of the Graduate School.

Cooperative Education Program. The Department of Physics participates in the Cooperative Education Program. Interested students can contact the Cooperative Education Coordinator, Department of Physics, Physics Building at 765-494-5383.

Under the physics or applied physics honors programs, a student with a grade index of 2.8 or better, or under the physics or applied physics regular programs, a student with a grade index of 3.0 or better (or in the upper half of class) is eligible to apply for the Cooperative Education Program. Normally, a student would complete the curriculum through the third or fourth semester before leaving campus for a work period.

The department also encourages students to participate in study abroad, summer internship programs, and summer undergraduate research opportunities offered across the world.

**Required for Honors*

Physics Minor

The physics minor provides a strong background in physics for students majoring in some other discipline at Purdue University. To qualify for the minor, the following classes must be completed with an average grade index of at least 2.0.

Physics Minor Course Requirements **17–23 credits**

One of the following:
a. PHYS 152 (Mechanics) (4 cr.),
b. PHYS 162 (Particles, Kinematics, and Conservation) and PHYS 163 (Mechanics, Heat, and Kinetic Theory) (9 cr.) *4–9 cr.*

One of the following: PHYS 241 (Electricity and Optics) (3 cr.), PHYS 261 (Electricity and Optics) (4 cr.), PHYS 271(Electricity and Magnetism: Honors) (5 cr.) *3–5 cr.*

One of the following: PHYS 342 (Modern Physics), PHYS 344 (Modern Physics: Honors) *3–4 cr.*

One of the following: PHYS 252 (Electricity and Magnetism), PHYS 271L (Electricity and Magnetism Laboratory), PHYS 342L (Modern Physics Laboratory) (1 cr.) *1 cr.*

Six additional credit hours from 300-, 400-, and 500-level Physics or Astronomy courses until the minimum of 17 credits has been reached. *6 cr.*

Physics Sample Program

Freshman Year

1	PHYS 162 (4)	CHM 115, 125 or 123 (4–5)	ENGL 106 or 108 (3–4)	MA 161 or 165 (4–5)	
2	PHYS 163 (5)	MA 162 or 166 (4–5)	CHM 116, 126 or 124 (4–5)	Language (3)	

Sophomore Year

3	PHYS 271 (5), 271L (1)	MA 261 (4)	Adv. English Composition (3)	Language (3)	
4	PHYS 342 (3), 342L (1)	MA 262 (4)	Gen Ed (3)	Language (3)	

Junior Year

5	PHYS 322 (3)	PHYS 310 (4) PHYS 450 (2)	MA Elective (3)	Language (3)	Gen Ed (3)
6	PHYS 330 (3)	PHYS 360 (3)	MA Elective (3)	Gen Ed (3)	Gen Ed (3)

Senior Year

7	PHYS 515 (3)	Lab Science (3–4)	Gen Ed (3)	Free Electives	
8	PHYS 536 (4)	Lab Science (3–4)	Gen Ed (3)	Free Electives	

Physics — Honors Sample Program

Freshman Year						
1	PHYS 162 (4)	MA 161 or 165 (4–5)	CHM 115, 125 or 123 (4–5)	ENGL 106 or 108 (3–4)	Language (3)	
2	PHYS 163 (5)	MA 162 or 166 (4–5)	CHM 116, 126 or 124 (4–5)	Gen Ed (3)	Language (3)	
Sophomore Year						
3	PHYS 271 (5), 271L (1)	MA 261 (4)	Adv. English Composition(3)	Language (3)	Gen Ed (3)	
4	PHYS 344 (4)	PHYS 422 (3), 450 (2)	MA 262 (4)	Language (3)		
Junior Year						
5	PHYS 410 (3)	PHYS 430 (3)	PHYS 342L (1)	MA Elective (3)	Gen Ed (3)	
6	PHYS 411 (2)	PHYS 460 (3)	PHYS 431 (2)	MA Elective (3)	Gen Ed (3)	Lab Science (3–4)
Senior Year						
7	PHYS 593 (3)	PHYS 461 (3)	PHYS 416 (4)	Gen Ed (3)		
8	PHYS 593 (3)	PHYS 536 (4)	Lab Science (3)	Gen Ed (3)		

Applied Physics Sample Program

Freshman Year						
1	PHYS 162 (4)	CHM 115, 125 or 123 (4–5)	ENGL 106 or 108 (3–4)	MA 161 or 165 (4–5)		
2	PHYS 163 (5)	CHM 116 (4)	PHYS 152 (4)	Language (3)		
Sophomore Year						
3	PHYS 271 (5)	PHYS 271L (1)	MA 261 (4)	Language (3)	Applied Elective (3)	
4	PHYS 342 (3)	PHYS 342L (1)	MA 262 (4)	Applied Elective (3)	Gen Ed (3)	
Junior Year						
5	PHYS 322 (3)	PHYS 450 (2)	MA 362 (3)	Applied Elective (3)	Gen Ed (3)	
6	PHYS 330 (3)	MA 303(3)	Applied Elective (3)	Applied Elective (3)	Gen Ed (3)	
Senior Year						
7	PHYS 515 (3)	PHYS 310 (4)	Applied Elective (3)	Applied Elective (3)	Gen Ed (3)	
8	PHYS 360 (3)	Three Applied Electives (9)	Two Gen Ed (6)	Adv. English Composition (3)		
M.S. in Applied Physics						
1	Two PHYS Courses (6)		Three Applied Electives (9)			
2	Two PHYS Courses (6)		Three Applied Electives (9)			

Applied Physics — Honors Sample Program

Freshman Year						
1	PHYS 162 (4)	MA 161 or 165 (4–5)	CHM 115, 123 or 125 (4–5)	ENGL 106 or 108 (3–4)		
2	PHYS 163 (5)	MA 162 or 166 (4–5)	CHM 116, 124 or 126 (4–5)	Language (3)		
Sophomore Year						
3	PHYS 271 (5)	PHYS 271L (1)	MA 261 (4)	Applied Elective (3)	Language (3)	
4	PHYS 344 (4)	PHYS 422 (3)	PHYS 450 (2)	MA 262 (4)	Gen Ed (3)	
Junior Year						
5	PHYS 410 (3)	PHYS 430 (3)	MA 362 (3)	Applied Elective (3)	Gen. Ed. (3)	
6	PHYS 460 (3)	Ma 303 (3)	Two Applied Elective (6)	Adv. English Composition (3)	Gen Ed (3)	
Senior Year						
7	PHYS 416 (4)	PHYS 461 (3)	Two Applied Electives (6)	Gen Ed (3)		
8	Gen Ed (3)	Gen Ed (3)	Four Applied Electives (12)			
M.S. in Applied Physics						
1	Two PHYS Courses (6)		Three Applied Electives (9)			
2	Two PHYS Courses (6)		Three Applied Electives (9)			

Bachelor of Science with Applied Physics and Materials Specialization Sample Program

Freshman Year						
1	PHYS 162 (4)	MA 161 or 165 (4–5)	CHM 115, 123 or 125 (4–5)	ENGL 106 or 108 (3–4)		
2	PHYS 163 (5)	MA 162 or 166 (4–5)	CHM 116, 124 or 126 (4–5)	Language (3)		
Sophomore Year						
3	PHYS 271 (5) PHYS 271L (1)	MA 261 (4)	MSE 230 (3)	MSE 235 (2)	Language (3)	
4	PHYS 342 (3) PHYS 342L (1)	MA 262 (4)	Adv. English Composition (3)	MSE 240 (3)	Gen Ed (3)	
Junior Year						
5	PHYS 322 (3)	PHYS 450 (2)	MA 362 (3)	MSE 335 (3) MSE 370 (3)	Gen Ed (3)	
6	PHYS 330 (3)	MA 303 (3)	MSE 340 (3)	MSE 367 (3)	Gen Ed (3)	Gen Ed (3)
Senior Year						
7	PHYS 310 (4)	PHYS 515 (3)	Elective (3)	Gen Ed (3)	Gen Ed (3)	
8	PHYS 360 (3)	Electives (13-14)				

Joint Program for the B.S. in Physics and B.S. in Materials Science and Engineering

Freshman Year						
1	CHEM 115 or 123 (4)	ENGL 106 or 108 (3–4)	Language (3)	C S 158 (3)	MA 161 or 165 (4–5)	
2	CHM 116 or 124 (4)	Language (3)	PHYS 152 (4)	ENGR 106 (2)	MA 162 or 166 (4–5)	
Sophomore Year						
3	PHYS 241 (3)	COM 114	MA 261 (4)	MSE 230 (3) MSE 235 (2)	Gen Ed (3)	
4	PHYS 342 (3)	PHYS 342L (1)	PHYS 252 (1) PHYS 290D (1)	MSE 240 (3) MSE 270 (3)	MA 262 (4)	
Junior Year						
5	PHYS 322 (3)	PHYS 450 (2)	CHM 373 (3)	EE 201 (3)	MA 303 (3)	Elective (3)
6	PHYS 330 (3)	MSE 340 (3)	C E 273 (3)	MA 362 (3)	Gen Ed (3)	
Senior Year						
7	PHYS 310 (4)	MSE 335 (3)	MSE 350 or MSE 370 (3)	CHM 261 (3)	PHYS 515 (3)	
8	PHYS 360 (3)	MSE 367 (3)	MSE 382 (3)	CHM 262 (3)	Gen Ed (3)	
Fifth Year						
9	MSE 430 (3)	Two MSE Electives (6)*	Gen Ed (3)	Gen Ed (3)		
10	MSE 440 (3)	MSE Elective (6)*	Gen Ed (3)	Adv. English Composition (3)		

** These electives are selected from approved course lists in the area of metals, ceramics, and polymers available from the School of Materials Engineering.*

Physics Major with Specialization in Physics Teaching

Freshman Year						
1	PHYS 162 (4)	MA 161 or 165 (4–5)	CHM 115, 123 or 125 (4-5)	Language (3)		
2	PHYS 163 (5)	MA 162 or 166 (4–5)	CHM 116, 124 or 126 (4–5)	Language (3)	EDCI 270 (2)	
Sophomore Year						
3	PHYS 271 (5)	PHYS 271L (1)	MA 261 (4)	BLOCK I (6)	ENGL 106 or 108 (3–4)	
4	PHYS 342 (3)	PHYS 342L (1)	MA 262 (4)	BLOCK II (6)	Adv. English Composition (3)	
Junior Year						
5	PHYS 310 (4)	PHYS 322 (3)	PHYS 450 (2)	MA 301 (3)	Gen Ed (3)	Lab Science (3–4)
6	PHYS 330 (3)	PHYS 360 (3)	MA 460 (3)	EDFA 200 (3)	Gen Ed (3)	Gen Ed (3)
Senior Year						
7	PHYS 536 (4)	EDCI 424 (3)	Gen Ed (3)	Gen Ed (3)	Lab Science (3-4)	
8	EDCI 428 (2)	EDCI 498 (10)				

Statistics

Statistics is the mathematical and computational study of data and chance. It is a methodological discipline — statisticians often work closely with people in other fields to design production of data, analyze data, and draw conclusions from data.

The Department of Statistics offers two plans of study leading to the Bachelor of Science degree:

1. Applied statistics option - emphasizes applied statistics, prepares for employment with the B.S. degree.
2. Mathematical statistics option – prepares for graduate study in statistics or other quantitative fields; leads to double major in mathematics (see page 94).

Students who complete the mathematical statistics option can arrange to obtain the M.S. in Applied Statistics degree in one additional calendar year of study (see page 95).

Students majoring in another discipline may also choose to pursue a minor in statistics.

Students interested in becoming actuaries should consider the interdisciplinary program in actuarial science (page 32) jointly administered by the Department of Statistics and the Department of Mathematics. Only one additional recommended course in the actuarial science program is required for the statistics major and most actuarial majors also obtain a statistics degree with a management minor.

The department also participates in the Cooperative Education Program (see page 9).

Statistics is one of the few major disciplines in which the expertise of a professional can have significant effect in fields as diverse as bioinformatics and medicine, finance and insurance, management and marketing, agriculture and forestry, economics and education, as well as communications and software design, to name a few. Statisticians design methods for collecting and interpreting data gathered by government, business and industry, and academia to aid in the planning, decision making and research crucial to modern society. Statisticians use computers as a tool for analyzing complex or massive data sets and solving mathematical problems. They use statistical techniques to discover relationships between disease and differences in the DNA sequences among individuals; predict election results, population growth, or the behavior of financial instruments; establish insurance or quality control standards; determine new drug effectiveness through clinical trials; or estimate the number of animals remaining in a vanishing species. The statisticians who hold advanced degrees develop and analyze statistical methods along with the mathematical and computational theories behind them.

The most recent information is available at http://www.stat.purdue.edu/academics/undergradProgram/index.html

General Degree Requirements

All statistics majors must satisfy the following general degree requirements. Students who meet these requirements also automatically fulfill the College of Science graduation requirements listed on pages 27–29. A total of 124 credit hours is required. Statistics courses numbered 310 or lower and mathematics courses numbered 159 and lower cannot be used as credit toward the degree. A higher-level course in the same subject area can be substituted for a requirement below. Consult academic advisors for details.

Statistics Major Course Requirements	**124 credits**
Mathematics and Statistics Requirements	***18 credits***
STAT 350 (Introduction to Statistics) (3 cr.)	*3 cr.*
MA 351 or 350 (Linear Algebra) (3 cr.)	*3 cr.*
MA 362, 440, or 510 (Advanced Calculus) (3 cr.)	*3 cr.*
STAT 416 or 516 (Probability) (3 cr.)	*3 cr.*
STAT 417 or 517 (Statistical Theory) (3 cr.)	*3 cr.*
STAT 512 (Applied Regression Analysis) (3 cr.)	*3 cr.*
One of the following two options	***6–9 credits***
Applied Statistics Option (6 cr.)	
Mathematical Statistics Option (9 cr.) (Courses required in these options are listed on page 94–95.)	

Science Requirements ***12–19 credits***

Four laboratory science courses. See pages 27–29 for requirements. *12–19 cr.*

Students are strongly encouraged to elect C S 158 (C Programming) or equivalent as one of the four courses for the laboratory science requirement.

Mathematics Requirements ***12–14 credits***

MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) *4–5 cr.*

One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 173 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) *4–5 cr.*

One of: MA 261 (Multivariate Calculus) (4 cr.), MA 174 (Multivariable Calculus) (4 cr.), MA 182 (Honors Calculus II) (5 cr.), MA 271 (Several Variable Calculus) (5 cr.) *4–5 cr.*

Additional Requirements ***36–41 credits***

English Composition: See page 28 for English composition requirements. *6–7 cr.*

Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28). *12–16 cr.*

General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives ***23–40 credits***

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

Grade Requirement

A 2.0 GPA in all mathematics and statistics courses used to meet the requirements of the major, and an overall GPA of 2.0 are required for graduation.

The two options for statistics majors are described in this section. Students are encouraged to select some free electives that will strengthen their major program. Such electives include additional courses in computer science, mathematics, or statistics, as well as courses in a discipline to which statistics is applied. Note that free electives can be selected from any department within the university.

Statistics Options

Applied Statistics Option

This option prepares students for careers in applied statistics, statistical programming, or other areas that require broad knowledge of statistical ideas and techniques. Students are encouraged to choose electives or a minor program in a field to which statistics is applied. Such breadth is appreciated by employers in business, industry, and government. Statistics faculty can suggest appropriate areas and courses. Because statisticians often manage and analyze large quantities of complex data, additional courses in computer science also are helpful. Advisors can help in selecting appropriate courses.

Applied Statistics Course Requirements **6 credits**

Two of the following: STAT 472 (Actuarial Models), STAT 473 (Actuarial Models), STAT 513 (Statistical Quality Control), STAT 514 (Design of Experiments), STAT 522 (Sampling and Survey Techniques).

Mathematical Statistics Option

This is a rigorous program that can lead to a double major in statistics and mathematics with the addition of MA 453 (Elements of Algebra I) or MA 450 (Algebra: Honors), and MA 366 (Ordinary Differential Equations). It prepares students for graduate work in either applied and mathematical statistics or a quantitative field. Students should consider electives in mathematics or additional courses in applied statistics. MA 301 (Introduction to Proof Through Real Analysis) is encouraged for most students as preparation for MA 341 (Foundations of Analysis).

Mathematical Statistics Course Requirements	9 credits
MA 353 (Linear Algebra II With Applications)	*3 cr.*
MA 341(Foundations of Analysis) or MA 440 (Real Analysis: Honors)	*3 cr.*
STAT 513 (Statistical Quality Control) or STAT 514 (Design of Experiments)	*3 cr.*

Honors

The designation "with honors in statistics" may be awarded at commencement to students who have completed the statistics major with the mathematical statistics option with distinction and with at least three of these course substitutions:

Statistics Honors Course Substitution Requirements

MA 350 (Elementary Linear Algebra: Honors) for MA 351 (Elementary Linear Algebra) (3 cr.)
MA 440 (Real Analysis: Honors) for MA 341 (Foundations of Analysis) (3 cr.)
MA 442 (Multivariate Analysis I: Honors), or MA 510 (Vector Calculus), for MA 362 (Topics in Vector Calculus) (3 cr.)
STAT 516 (Basic Probability and Applications) for STAT 416 (Probability) (3 cr.)
STAT 517 (Statistical Inference) for STAT 417 (Statistical Theory) (3 cr.)

Actuarial Science

An interdisciplinary program in actuarial science is offered jointly by the Department of Mathematics and the Department of Statistics. See page 32.

Special Programs and Opportunities

Cooperative Education Program

The Department of Statistics participates in the Cooperative Education Program as described on page 11. Interested students should contact the Coordinator of Cooperative Education, Department of Statistics, Mathematical Sciences Building. The department coordinator will have information about available programs and will be able to offer advice.

Fifth-Year M.S. Program

Many positions for statisticians require the M.S. in Applied Statistics degree. This is normally a two-year degree program. However, a student who elects the statistics major with mathematical statistics option can earn the M.S. in one additional year of study. Details appear in the Graduate School Bulletin. Students who are considering the fifth-year program should consult a faculty advisor about suitable electives in their undergraduate program.

Statistics Minor

The statistics minor offers a strong quantitative background for students majoring in another discipline. Five courses are required. At least three of these courses must be listed in the statistics department.

Statistic Minor Course Requirements	15 credits
1. Any introductory statistics course: STAT 350 (Introduction to Statistics) (3 cr.) STAT 503 (Statistical Methods for Biology) (3 cr.) STAT 511 (Statistical Methods) (3 cr.)	*3 cr.*
2. An introductory probability course: STAT 225 (Introduction to Probability Models) (3 cr.) STAT 311 (Introductory Probability) (3 cr.) STAT 416 (Probability) (3 cr.)	*3 cr.*
3. Applied Regression Analysis course: STAT 512 (Applied Regression Analysis) (3 cr.)	*3 cr.*
4. Two of the following courses: STAT 416 (Probability) (3 cr.) (if not used to satisfy requirement Number 2) STAT 417 (Statistical Theory) (3 cr.) STAT 513 (Statistical Quality Control) (3 cr.) STAT 514 (Design of Experiments) (3 cr.) IE 336 (Operations Research – Stochastic Models) (3 cr.)	*6 cr.*

Statistics Major with Applied Statistics Option Sample Program

Freshman Year					
1	MA 161 or 165 (4–5)	Laboratory Science (3–4)	Foreign Language (3)	ENGL 106 or 108 (3)	
2	MA 162, 166, 173, or 181 (4–5)	Laboratory Science (3–4)	Foreign Language (3)	Gen Ed (3)	
Sophomore Year					
3	C S 158 or 180 (3–4)	MA 261, 271, 174, or 182 (4–5)	Foreign Language (3)	Gen Ed (3)	
4	STAT 350 (3)	MA 351 (3)	Foreign Language (3)	Gen Ed (3)	C S or Lab Science (3–4)
Junior Year					
5	STAT 416 (3)	MA 362 (3)	Elective or Minor	Gen Ed (3)	Elective
6	STAT 417 (3)	STAT 513 (3)	Elective or Minor	Gen Ed (3)	Elective
Senior Year					
7	STAT 512 (3)	Elective	Elective or Minor	Gen Ed (3)	Elective
8	STAT 514 or 522 (3)	Elective	Elective or Minor	Gen Ed (3)	Elective

Statistics Major with Mathematical Statistics Option Sample Program*

Freshman Year					
1	MA 108 (1) (Elective)	MA 161 or 165 (4–5)*	Laboratory Science (3–4)	ENGL 106 or 108 (3)*	Foreign Language (3)
2	C S 158 or 180 (3–4)	MA 162, 166, 173, or 181 (4–5)*	Laboratory Science (3–4)	Gen Ed (3)	Foreign Language (3)
Sophomore Year					
3	STAT 350 (3)*	MA 261, 271, 174, or 182 (4–5)*	MA 301 (3)	C S or Lab Science (3–4)	Foreign Language (3)
4	MA 351 (3*)	MA 362 (3)*	Elective	Gen Ed (3)	Foreign Language (3)
Junior Year					
5	STAT 416 (3)*	MA 353 (3)*	Elective	Adv. English Composition (3)	Gen Ed (3)
6	STAT 417 (3)*	MA 341 (3)*	Elective	Gen Ed (3)	Elective
Senior Year					
7	STAT 512	STAT Elective (3)	Elective	Gen Ed (3)	Elective
8	MA Elective (3)	Elective	Elective	Gen Ed (3)	Elective

** In this sample program, the statistics and mathematics classes denoted with an asterisk fulfill the requirements of the option. (Possible substitutes for the asterisked courses have been listed previously.) The other courses are recommended. The required classes plus MA 366 and 453 (or 450) fulfill the requirements for the double major in statistics and mathematics.*

Interdisciplinary Science

The Interdisciplinary Science major is designed to give the student a Bachelor of Science degree with a broad base in the sciences. The major consists of a primary area, a supporting area, and the broad education of all College of Science majors. The core courses are common across the major, but the student customizes the major by selecting a departmental or interdepartmental primary area based in science and a supporting area that may come from any school at the University. There is a primary area representing each department in the College of Science, and cross-disciplinary areas will be explored and added as appropriate. Several supporting areas have been suggested, and a student may petition for approval of others.

Students completing the Interdisciplinary Science major have gone on to a variety of careers in and out of the world of science. These careers include medicine, law, and other advanced-study professions, scientific sales, technical and scientific writing, computer programming, and engineering.

The most recent information is available at: http://www.science.purdue.edu/current_students/majors.asp#inter

General Degree Requirements:

Interdisciplinary Science Major Course Requirements 69–85 credits

Interdisciplinary Core (Check primary area prerequisites before selecting core courses.) 39–49 credits

Biology (select one option): 8–9 credits

a. Both BIOL 110 and 111 (Fundamentals of Biology I), or

b. All of the following: BIOL 121 (Biology I), BIOL 131 (Biology II), BIOL 132 (Laboratory in Biology II), BIOL 136 (Quantitative and Problem Solving Skills), BIOL 137 (Handling Cells and Tissues, Microscopy), BIOL 138 (Information and Communication Skills), BIOL 139 (Measurements and Basic Solution Chemistry).

Chemistry (select one option): 8–10 credits

a. CHM 115 and 116 (General Chemistry I and II)

b. CHM 125 and 126 (Introduction to Chemistry I and II)

Computer Science (select one course): 3–4 credits

C S 154 (FORTRAN Programming), C S 158 (C Programming), C S 177 (Introduction to Computer Science), C S 180 (Programming I)

EAS (select one option): 3–4 credits

a. One of: EAS 100 (Planet Earth), EAS 109 (The Dynamic Earth), EAS 111 (Physical Geology), EAS 225 (Science of the Atmosphere) (3 cr.)

b. Both EAS 230 (Laboratory in Atmospheric Science) and EAS 221 (Survey of Atmospheric Science) (4 cr.)

Math (select one option): 6–10 credits

a. MA 161 (Plane Analytic Geometry and Calculus I) (5 cr.) or MA 165 (Analytic Geometry and Calculus I) (4 cr.) or MA 223 (Introduction Analysis I) (3 cr.) *4–5 cr.*

b. One of: MA 162 (Plane Analytic Geometry and Calculus II) (5 cr.), MA 166 (Analytic Geometry and Calculus II) (4 cr.), MA 173 (Calculus and Analytic Geometry II) (5 cr.), MA 181 (Honors Calculus I) (5 cr.) or MA 224 (Introductory Analysis II) (3 cr.) *4–5 cr.*

Physics (select one option): 8–9 credits

a. PHYS 152 (Mechanics), PHYS 241 (Electricity and Optics), PHYS 252 (Electricity and Optics Laboratory), PHYS 290D (Heat and Thermal)

b. PHYS 220 and 221 (General Physics)

Statistics (select one course): 3 credits

STAT 350 (Introduction to Statistics), or STAT 503 (Statistical Methods for Biology), or STAT 511 (Statistical Methods).

Primary Area: 12–18 credits

Biological Sciences: 16–18 credits

BIOL 231 and 232 (Cell Biology) (5 cr.) *5 cr.*

BIOL 241 and 242 (Genetics) (5 cr.) *5 cr.*

Biology elective at or above 400 level (2-3 cr.) *2–3 cr.*

CHM 255 and 255L; or 257 and 257L (Organic Chemistry) (4-5 cr.) *4–5 cr.*

Chemistry: 16 credits

CHM 241 (Inorganic Chemistry) (4 cr.) *4 cr.*

One of the following:

a. CHM 255, 255L, 256 and 256L (Organic Chemistry) (_cr.)

b. CHM 261, 262, 263, and 264 (Organic Chemistry) (8 cr.) *8 cr.*

CHM 372 (Physical Chemistry) (4 cr.) *4 cr.*

Computer Science: 16 credits

Note: For this primary area, C S 180 and MA 161 or equivalent must be part of the interdisciplinary core.

C S 182 (Foundations in Computer Science) (3 cr.) *3 cr.*
C S 240 (Programming in C) (3 cr.) *3 cr.*
C S 250 (Computer Architecture) (4 cr.) *4 cr.*
C S 251 (Data Structures) (3 cr.) *3 cr.*
C S elective at or above 300 level. (3 cr.) *3 cr.*

Earth and Atmospheric Sciences: *16 credits*

Note: For this primary area, EAS 111 or equivalent must be part of the interdisciplinary core.

EAS 230, EAS 221, or EAS 225 (Atmospheric Science) (4 cr.) *3 cr.*
Any EAS at or above 200 level; or EAS 112 (Historical Geology) *12 cr.*

Mathematics: *17 credits*

Note: For this primary area, MA 161 and MA 162 or equivalent must be part of the Interdisciplinary Core.

MA 261 (Multivariate Calculus) or equivalent (4 cr.) *4 cr.*
MA 366 or 262 (Differential Equations) (4 cr.) *4 cr.*
MA 351 or 350 (Linear Algebra) (3 cr.) *3 cr.*
One of the following:
a. MA 450 and 453 (Modern Algebra)
b. MA 341 (Analysis)
c. MA 440 (Analysis) *3 cr.*
MA elective at or above 300 level. (3 cr.) *3 cr.*

Physics: *13–14 credits*

Note: For this primary area, PHYS 152, 241, 252, and MA 161, MA 162 or equivalent must be part of the Interdisciplinary Core.

MA 261 (Multivariate Calculus) or equivalent (4 cr.) *4 cr.*
PHYS 342 or 344 (Modern Physics) (3-4 cr.) *3–4 cr.*
PHYS or ASTR electives at or above 300 level. (6 cr.) *6 cr.*

Statistics: *12–13 credits*

Note: For this primary area, MA 161 and MA 162 or equivalent must be part of the interdisciplinary core.

One of the following: STAT 225, 311, 416, 516 (Probability) (3 cr.) *3 cr.*
STAT 512 (Applied Regression Analysis) (3 cr.) *3 cr.*
STAT 513 or 514 (Statistical Methods) (3 cr.) *3 cr.*
One of the following: STAT 513 (Statistical Quality Control) (3 cr.), STAT 514 (DEsign of Experiments) (3 cr.), STAT 417 (Statistical Theory) (3 cr.), or MA 261 (Multivariate Calculus) (4 cr.) *3–4 cr.*

Environmental Biology: *17 credits*

BIOL 231 (Cell Structure and Function) (3 cr.) *3 cr.*
BIOL 241 (Genetics and Molecular Biology) (3 cr.) *3 cr.*
BIOL 483 (Environmental and Conservation Biology) (3 cr.) *3 cr.*
BIOL 585 (Ecology) (3 cr.) *3 cr.*
CHM 257 and 257L (Organic Chemistry) (5 cr.) *5 cr.*
Other primary areas that cross departments within the College of Science may be added as they are developed and approved.

Supporting Area: *18 credits*

Supporting area courses may not overlap core or primary area courses, but may overlap the General Education area. The supporting area may be built on the numerous minors (see www.science.purdue.edu/academic_programs/minors.asp), or may be built on any coherent grouping of courses with a central unifying theme. These might include management, preprofessional, international studies, foreign language, history, creative writing, science policy, ethics, psychology, women's studies, African American studies, etc. Any plan must be approved by the dean or designee.

Sample Supporting Area for Environmental Biology:

AGR 490 (Special Problems) (3 cr.), C E 350 (Environmental Engineering) (3 cr.), EAS 420 (Global Change Modeling) (3 cr.), FNR 488 (Global Environmental Issues) (3 cr.), PHIL 290 (Environmental Ethics) (3 cr.), POL 523 (Environmental Policy and Public Policy) (3 cr.)
Other courses may be used on approval.

Additional Requirements *36–41 credits*

English Composition: See page 28 for English composition requirements *6–7 cr.*
Modern Foreign Language: All College of Science majors are expected to have proficiency in two languages at the fourth-semester college level. (See "Modern Foreign Language Requirements," page 28.) *12–16 cr.*
General Education Requirements: You must complete 18 credit hours of study in the humanities, social sciences and behavioral sciences. (See page 29 for requirements.) *18 cr.*

Free Electives

Free electives can be selected from any department of the University. Students are encouraged to use free electives to broaden their knowledge. However, free elective credit is not allowed for courses that significantly overlap courses taken to fulfill departmental degree requirements. This excludes, in particular, introductory courses. Students must take at least as many free electives as is needed to bring the credit hour total to 124.

Information about Courses

Official Purdue University course information is available on the Web at www.purdue.edu/Purdue/course_info. Click on the "Course Information — All Campuses" link at the top of the page.

The Official Purdue University Course Repository is maintained by the Office of the Registrar and is updated instantaneously. It contains a multitude of information, including course descriptions and requisites for retired, current, and future courses offered at the West Lafayette campus as well as at Purdue Calumet, Purdue North Central, Indiana University-Purdue University Fort Wayne, Indiana University-Purdue University Indianapolis, and the College of Technology locations around the state.

The course information available online is organized by campus, program, and subject area, which enables you to tailor your search.

You also may want to consult your academic advisor if you have questions about the courses required for your plan of study.

College of Science Administration and Faculty

Administration

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Jeffrey T. Bolin, *Ph.D.,* Associate Dean of the College of Science, Research

George McCabe, *Ph.D.,* Associate Dean of the College of Science, Academic Affairs

Aditya Mathur, *Ph.D.,* Associate Dean of the College of Science, Graduate Studies and International Programs

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Alan H. Welch, *M.S.,* Assistant Dean of the College of Science, Undergraduate Students

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P. J. Hollenbeck, Associate Head of the Department

D. J. Minchella, Associate Head of the Department

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**Joint appointment with the Department of Computer Science.*

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S. A. McLuckey, Associate Head of the Department

F. E. Lytle, Associate Head of the Department

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Computer Science

S. E. Hambrusch, Head of the Department

J. T. Korb, Assistant Department Head

W. J. Gorman, Assistant to the Head of the Department

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**Joint appointment with the Department of Earth and Atmospheric Sciences.*

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Adjunct Appointments: C. Bailey-Kellogg, *Ph.D.;* J. Palsberg, *Ph.D.*

Lecturers: W. Crum, *M.S.*, E. King, *M.S.*, G. Rodriguez-Rivera, *Ph.D.;* K. L. VanZandt, *Ph.D.*

Earth and Atmospheric Sciences

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Industrial Technology
Mechanical Engineering Technology
Organizational Leadership and Supervision

Veterinary Medicine
Basic Medical Sciences
Veterinary Clinical Sciences
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Index