FACULTY

DEAN
L. Scott Ellis

ASSOCIATE DEAN
Dana L. Delaware

PROFESSORS
Dawood Afzal, Russell G. Baughman, Brent Buckner, Kenneth N. Carter, Cynthia Cooper, Dana L. Delaware, Maria C. Di Stefano, Matt E. Eichor, L. Scott Ellis, Roger R. Festa, Kenneth R. Fountain, Kenneth D. Hahn, Victor F. Hoffman, John Hoffmann, Diane Janick-Buckner, Donald A. Kangas, Michael Kelrick, David L. McCurdy, Anne E. Moody, Jeffrey M. Osborn, Vaughan M. Pultz, Peter Rolnick, Mohammad Samiullah, George J. Schulte, George L. Shinn, Linda C. Twining, Glenn R. Wehner, H. David Wohlers

ASSOCIATE PROFESSORS
R. Charles Apter, Matthew Beaky, M. Scott Burt, Mark Campbell, Steven B. Carroll, Vinita C. Dew, Taner Edis, Laura Fielden-Rechav, Stephanie Foré, Michael Goggin, José Herrera, Elisabeth Hooper, Brian Lamp, Ian M. Lindevald, Michael L. Lockhart, James McCormick, Thomas E. Marshall, John O'Brien, Eric Patterson, John Rutter, Michael Seipel, Eduardo Velasco

ASSISTANT PROFESSORS
Jonathan Gering, Mehmet Goksu, Susan A. Guffey, Barbara Kramer, John Zhong Ma, Maria Nagan, Peter Ramberg, T.W. Sorrell, Anton Weisstein

INSTRUCTORS
Jeanne Mitchell, Brenda Moore

LECTURERS
Anne Bergey, Peter Goldman, Robert Nothdurft, Margaret Sorhus

DEGREES OFFERED

Bachelor of Arts, BA
Bachelor of Science, BS
Master of Science, MS

UNDERGRADUATE MAJORS

Agricultural Science (BS)
Biology (BA or BS)
Chemistry (BS)
Physics (BA or BS)

The Science Division is the administrative unit serving the faculties of Agricultural Science, Biology, Chemistry, and Physics. The faculty and staff in these disciplines are dedicated to the goal of student learning. State-of-the-art technology and instrumentation are found in classrooms and laboratories in newly-expanded and renovated Magruder Hall. The University Farm, located southwest of Kirksville, also supports the educational mission of the Science Division. Classwork in the sciences includes faculty lectures, small group recitations, student-led discussions, presentations, and investigative laboratories. Field trips, library work, and evening study are common events. Science faculty encourage students to participate in research projects, where more personal learning occurs. Many students present the results of their research at scientific meetings. Truman students completing degrees in science are prepared to enter professional school, graduate school, industry, business, and service careers.

Science Division professors represent the diversity and strength of science and technology in today's world. Research interests include such topics as neurobiology, molecular genetics of plants, plant/animal interactions, artificial insemination, surface chemistry, detection of small molecules, electromagnetic waves, and laser optics. Research is conducted in laboratories, in the field, in our greenhouse, in a new observatory, or through computer models. The Science Division has attracted outstanding scholars from some of America's finest universities to join the growing community of faculty leaders at Truman.

Students come to Truman to study science from throughout Missouri and from, literally, coast to coast. This diversified student body is served by a variety of organizations, including Beta Beta Beta (Biology), Alpha Chi Sigma (Chemistry), Sigma Pi Sigma (Physics), and Delta Tau Alpha (Agricultural Science). The American Medical Student Association, Pre-Veterinary Club, American Chemical Society, Society of Physics Students, Stargazers, Alpha Gamma Rho (Agriculture), Collegiate Farm Bureau, and the Horesman's Association also are active and include faculty in their activities. Finally, each science major is assigned a faculty member of the appropriate discipline as an academic advisor. Great opportunities for personal and professional interaction abound in the special relationship between advisor and advisee. At Truman, no student is merely a number on a university computer, and the Science Division is proud of the way that our faculty interacts with students.

Quality science education and quality student life are hallmarks of the Science Division. Science graduates boast a solid academic foundation for advanced study or leadership in various career opportunities. Experiences in the

major along with our liberal studies program reinforce in Truman graduates the qualities of life-long learners. Recent graduates are now in top professional and graduate schools around the country or have satisfying job responsibilities with leadership in the work force.

At Truman State University, the professional teaching degree is the Master of Arts in Education, built upon a strong liberal arts and sciences undergraduate degree. Science graduates are successful in this graduate program. Students who wish to become teachers should consult with their academic advisors as early as possible. The professional preparation component of this Master's degree program is administered in the Division of Education.

AGRICULTURAL SCIENCE PROGRAM

Pursuit of an undergraduate degree in Agricultural Science affords the opportunity for students to experience a holistic approach to the study of food and fiber production and their association and interaction with societal concerns. Our focus is on a sustainable agricultural system.

For majors, the goals of the agriculture program are:

1. To offer students a unique, liberal arts and sciences-based preparation for advanced study in graduate school, veterinary medicine, or other professional schools. A solid foundation in basic agricultural concepts along with advanced focus courses also prepare students for entry-level positions in business, agriculture production or government settings where a multidisciplinary, problem-solving approach is useful. Areas of specialization within Agricultural Science include:
   - Pre-Veterinary Medicine/Animal Science
   - Equine Science
   - Agricultural Business
   - Horticulture/Agronomy
2. To graduate students possessing a multidisciplinary understanding of agriculture. Students will gain philosophical, historical, sociological, political, economic, business, scientific, technical, and multicultural perspectives on the mobilization of agricultural inputs and their relationships with the production, processing, and delivery of food and fiber and the intricate association with society and the environment.
3. To graduate students with proficiency in basic skills, higher order thinking and problem-solving skills, leadership and management capabilities, and an appreciation for the need for collaboration.
4. To empower students with a well-developed understanding of their personal values.
5. To graduate students with the technical skills and scientific knowledge needed for entry into the agriculture industry and to foster a life-long approach to learning.

For students seeking a minor or students with non-degree seeking interest in Agricultural Science, the goals of the program are twofold. The first is to educate students about the agrarian contributions to human culture, about food and fiber production, and about the environmental and social consequences of using agriculture-related technology. The second goal is to promote and foster skills and attitudes associated with a liberal education and to utilize those skills on multidisciplinary investigations concerning science and society as a whole.

AGRICULTURAL SCIENCE

BACHELOR OF SCIENCE

			Semester Hours
Liberal Studies Program Requirements			**32-57**
Missouri Statute Requirement			**1-3**
Required Support			**12**
All Agricultural Science majors completing science-based Areas of Specialization must take the following:			
BIOL	107	Introductory Biology I**	4
CHEM	120	Chemical Principles I**	5
ECON	201	Principles of Microeconomics**	3

**May be used to fulfill LSP Requirements.

Bachelor of Science Requirements			**8-9**
Option 1: Agricultural Science			
CHEM	121	Chemical Principles II with Inorganic Chemistry	5
CHEM	320	Foundations of Organic Chemistry **OR**	
CHEM	329	Organic Chemistry I	3-4

Option 2: Agricultual Business

ECON 200 Principles of Macroeconomics 3

AND One course from the following list:

Any 200-level or above MATH; ECON 300, 302, 303, 304, 306, 307, 344, 345, 372, 402 or 403; STAT 375, 376, or 378; BSAD 352, 357, or 360.

MAJOR REQUIREMENTS			**27**
AGSC	108	Introduction to Agricultural Systems	4
AGSC	110	Principles of Plant Agriculture	4
AGSC	212	Principles of Soil Science	4
AGSC	260	Agricultural Markets and Products	3
AGSC	315	Principles of Animal Agriculture	4
AGSC	415	Ethical Issues in Sustainable Agriculture	3
AGSC	420	Seminar in Agriculture	1
AGSC	490	Practicum in Agriculture I*	2
AGSC	491	Practicum in Agriculture II*	2

*Practicum I and II will serve as the Capstone Experience.

Electives in Agricultural Science (AGSC Prefix) **15**

Area of Specialization **15**

Agricultural Science is a very broad and diverse discipline, with many possible areas of specialization and career opportunities. The Area of Specialization component is intended to allow each student the opportunity to broaden their knowledge and skill in one or more areas of study. These course selections are not limited to courses designated with the AGSC prefix and may include selections from any discipline related to the students' future goals. To this end, each student, in collaboration with their academic advisor, will submit a learning plan detailing their career goals and which course selections and experiences will allow them to pursue that goal. Learning plans must be approved by a majority of the Agricultural Science faculty by the end of the freshman year or for transfer students by the end of their first semester. Minors and internships are recommended.

Electives to Total **124**

DEPARTMENTAL HONORS IN AGRICULTURAL SCIENCE

1. 3.50 or above cumulative GPA.
2. Complete an individual research project (as approved/supervised by a faculty member) and present at the Student Research Conference or appropriate professional meeting or submit a paper for publication in an appropriate journal or research bulletin.
3. Achieve 75th percentile or above on ACAT or other approved senior test for agriculture.
4. Approval of a majority of non-abstaining AGSC faculty.

BIOLOGY PROGRAM

The undergraduate Biology Program is designed to stimulate and challenge students to develop skills in concept learning, to understand the strategies of investigation, to communicate ideas, and to accept responsibilities of scientific leadership. The program integrates advising, curriculum, research, and service experiences in order to fully develop the potential of each student. Graduates of this program have a comprehensive and deep understanding of the basic laws, principles, and current theories of biology from the cellular to the ecosystem level. Students are prepared for entry into graduate or professional schools as well as for positions in the private sector which require a liberal arts education and leadership skills. Because the Biology Program is structured to foster critical thinking, reading, and communications skills at the highest levels, students are encouraged to develop a set of personal goals and identify strategies for obtaining these goals. For example, a student may set a goal of participating in undergraduate research. Actions to meet this goal include planning with a faculty mentor and other students, writing a proposal, gathering data, analysis of data, and presenting results. By encouraging students to set goals, the faculty hopes to enhance the leadership quality of biology majors.

DEPARTMENTAL HONORS IN BIOLOGY

1. The student must declare her/his intent to complete the requirements listed below no later than two semesters prior to their date of graduation. A brief form is available from the Biology Convener.
2. Upon graduation, the student must have a cumulative GPA of 3.50 or greater, or score at the 75th percentile or greater on the MFAT.
3. The student must design and conduct an original research project in consultation with a Truman Biology faculty member. If the research is conducted off of the Truman campus (e.g., at Kirksville College of Osteopathic Medicine (KCOM) or a summer program), the consulting Truman Biology faculty member must be involved from the outset.
4. The student must complete a written manuscript that is of publishable quality and in journal style. The manuscript must be approved by a committee of at least three Truman Biology faculty.
5. The student must present a 20 minute seminar on the research at a regular Biology discipline weekly seminar. See your academic advisor or the Biology Convener for specific details.

In addition to the required courses for all biology majors a student may individualize their program in several ways. For example the student may elect to participate in a Departmental Honors program as described above; complete some courses which would apply toward the MS degree at Truman; or, individualize a program by selecting electives in biology that would increase depth of knowledge in one or more areas in biology. Many biology majors participate in research with Truman faculty. Conducting research while an undergraduate reinforces goals of the capstone experience of our Senior Seminar (BIOL 545). Truman's accelerated MS degree in Biology allows a student to continue a research investigation begun as an undergraduate.

In addition to classes offered at Truman, there are several cooperative programs affiliated with Biology. Students interested in medical technology may complete clinical classes at one of several medical technology schools in Missouri, Illinois, and Iowa. The Biology Program is also affiliated with the Gulf Coast Research Laboratory at Ocean Springs, Mississippi, where marine biology courses may be taken during the summer at the Laboratory with credit awarded by Truman. Truman is affiliated with the Reis Biological Station located near Steelville, Missouri. The site is available for study of Ozark habitats. Summer classes are offered with credit that can be transferred to Truman.

Biology majors at Truman may be eligible to participate in the University of Missouri Columbia School of Medicine Bryant Scholars Pre-admission Program. Two sophomores annually are selected from Truman to interview for early acceptance to the medical school. Qualified sophomores may apply for early acceptance to the Kirksville College of Osteopathic Medicine (KCOM) through the Pre-Osteopathic Scholars Program. Interested students should discuss these opportunities with their advisors. Finally, some courses completed at medical, veterinary, and other professional schools may be credited toward a Bachelor's degree in biology at Truman.

Biology majors should plan their schedules after discussion with an academic advisor. Classwork includes Liberal Studies Program requirements, biology core courses, biology electives, and biology support courses as follows.

BIOLOGY BA AND BS

For both the BA and the BS degrees, the following sequence of required Biology coursework is strongly recommended:
Freshman Year: fall BIOL 107 and BIOL 247;
spring BIOL 108
Sophomore Year: fall BIOL 200; spring BIOL 300
Junior Year: fall BIOL 301; spring BIOL 315 or 405
Completion of all of these courses is very strongly recommended prior to enrollment in BIOL 545 in the senior year. Biology majors are strongly encouraged to take CHEM 120 during the freshman year.

A Biology major must achieve at least a "C" grade in each of the following courses: BIOL 107, 108, 200, 247, 300, 301, 315 or 405, and 545. A minimum GPA of 2.0 is required for all Mathematics, Statistics, Computer Science, Chemistry, and Physics support courses for both the BA and BS degrees, all biology electives applied to the 15 hours of Biology electives for the BS degree, and all courses in the learning plan and foreign language courses for the BA degree.

All Biology majors must score at or above the 20th percentile on the nationally-normed senior exam (MFAT). Majors are encouraged to take this exam early in the spring semester of their senior year.

BIOLOGY
BACHELOR OF SCIENCE

			Semester Hours
Liberal Studies Program Requirements			**.32-57**
Missouri Statute Requirement			**.1-3**
Required Support			**.30**
MATH	198	Analytic Geometry and Calculus I**	.5
STAT	190	Basic Statistics**	.3
BIOL	107	Introductory Biology I**	.4
PHYS	185	College Physics I**	.4
PHYS	186	College Physics II**	.4
CHEM	120	Chemical Principles I**	.5
CHEM	121	Chemical Principles II with Inorganic Chemistry**	.5

**May be used to fulfill LSP requirements.

Bachelor of Science Requirements			**.8**
CHEM	329	Organic Chemistry I	.3
CHEM	330	Organic Chemistry I Lab	.1
CHEM	331	Organic Chemistry II	.3
CHEM	332	Organic Chemistry II Lab	.1

CHEM 333 is equivalent to the combination of CHEM 330 and CHEM 332.

MAJOR REQUIREMENTS

Biology Core			**.22**
BIOL	145	Freshman Seminar	.1
BIOL	108	Introductory Biology II	.4
BIOL	200	Cell Biology	.4
BIOL	300	Genetics	.4
BIOL	301	Introduction to Ecology	.4
BIOL	315	Physiology **OR**	
BIOL	405	Plant Physiology	.4
Capstone Experience			
BIOL	545	Senior Seminar	.1

NOTE: BIOL 107, 108, 200 should be taken prior to all other Biology courses.

Biology Major Electives . . . . . **.15**
Select a minimum of 15 hours of BIOL courses (see BIOL course descriptions for exceptions). CHEM 421 Biochemistry may be used as a Biology Elective.

Electives to Total . . . . . **.124**

BIOLOGY
BACHELOR OF ARTS

			Semester Hours
Liberal Studies Program Requirements			**.32-57**
Missouri Statute Requirement			**.1-3**
Required Support			**.31-35**
MATH	198	Analytic Geometry & Calculus I**	.5
BIOL	107	Introductory Biology I**	.4
PHYS	185	College Physics I**	.4
PHYS	186	College Physics II**	.4
CHEM	120	Chemical Principles I**	.5
CHEM	121	Chemical Principles II with Inorgainc Chemistry**	.5
CHEM	320	Organic Chemistry **OR**	.4
CHEM	329	Organic Chemistry I **AND**	.3
CHEM	330	Organic Chemistry I Lab **AND**	.1
CHEM	331	Organic Chemistry II **AND**	.3
CHEM	332	Organic Chemistry II Lab	.1)

**May be used to fulfill LSP requirements.
CHEM 333 is equivalent to the combination of CHEM 330 and CHEM 332.

Bachelor of Arts Requirements
Intermediate proficiency in ONE foreign language **0-6**

MAJOR REQUIREMENTS

Biology Core			**.22**
BIOL	145	Freshman Seminar	.1
BIOL	108	Introductory Biology II	.4
BIOL	200	Cell Biology	.4
BIOL	300	Genetics	.4
BIOL	301	Introduction to Ecology	.4
BIOL	315	Physiology **OR**	
BIOL	405	Plant Physiology	.4
Capstone Experience			
BIOL	545	Senior Seminar	.1

NOTE: BIOL 107, 108, 200 should be taken prior to all other Biology courses.

Learning Plan 15
Students will design an individualized Learning Plan in consultation with their academic advisor. The Learning Plan, to which very few restrictions apply, is intended to meet the life-long needs of the students. It could take the form of an academic minor, more Biology courses, or a mixture of courses from several disciplines. Learning Plans must be approved by a committee of Biology faculty. For more information on this option, please see your advisor, or the Biology Convener, for details.

Electives to Total . . . . . **.124**

CHEMISTRY PROGRAM
The degree offered is the Bachelor of Science, with programs in chemistry, pre-allopathic medicine, pre-osteopathic medicine, and pre-pharmacy.

The chemistry program is accredited by the American Chemical Society. Upon graduation, students receiving the university's Bachelor of Science degree in chemistry as described in this catalog meet the American Chemical Society requirements for certification.

CONTRIBUTION OF PROGRAM TO TRUMAN'S LIBERAL ARTS AND SCIENCE MISSION
The mission of the Chemistry program is the development of liberally-educated and critically-thinking chemists capable of functioning as professionals and supplying critical insight and judgment in their first professional experience.

The BS Chemistry degree blends a strong liberal arts component with a professional program. Courses in the Liberal Studies Program develop the necessary knowledge and basic skills for the Chemistry major to be a critical thinker. A year of study in general, organic, inorganic, physical, and analytical chemistry provides the fundamentals for being a critically-thinking scientist and chemist.

A lecture component of more than 600 clock hours covers the formal presentation of Chemistry.
The laboratory experience of more than 500 clock hours gives the student "hands-on" experience and knowledge of chemistry and the confidence and competence to:

1. Plan and execute experiments through the use of chemical literature.
2. Respond properly to the hazards of chemical manipulations.
3. Keep neat, complete experimental records.
4. Synthesize and characterize inorganic and organic compounds.
5. Perform accurate quantitative measurements.
6. Use and understand modern instruments.
7. Analyze data and assess the reliability of results.
8. Draw reasonable conclusions.
9. Communicate effectively through oral and written reports.

Undergraduate research integrates the components of a chemistry curriculum into a unified structure. Research helps the undergraduate acquire a spirit of inquiry, initiative, independence, sound judgment, patience, persistence, alertness, and reference skills using chemical literature. For the faculty members, research opportunities increase their enthusiasm, professional competence and scholarly productivity.

Integrative or Culminating Experience
The "community of learning" allows a student to integrate numerous experiences beginning as early as the freshman year and culminating with a variety of possible activities. In the freshman year, the activities may include introduction to research and involvement in science-oriented student organizations. The sophomore student may tutor and increase involvement in research. The junior and senior student may be invited to serve as lab assistants for lower division courses. Upperclass students write résumés, plan post-graduate activities, and continue to have research opportunities.

Special features of the Chemistry Program include:
1. "Communities of learning"
2. Seminar courses each year
3. Research
4. Honors program option
5. Senior External Examination

Special Facilities
The Science Division's organic chemistry laboratory is modern and equipped with IR and NMR instrumentation upon which all students receive "hands-on" experience in the use and interpretation of results. The analytical chemistry lab has computer integrated experiments offering "hands-on" experience with atomic absorption, UV/Visible spectrophotometry, HPLC, GC, and FT-IR. A wide range of standard techniques are introduced to provide each student with the background to succeed in both industry and graduate chemistry work.

The advanced labs for Physical Chemistry, Biochemistry, Instrumental Analysis, and Inorganic Chemistry provide a more challenging atmosphere to integrate fundamental techniques. Each lab has components of individual investigation.

The Chemistry discipline has state-of-the-art FT-IR and FT-NMR spectrophotometers and an X-ray Diffractometer which allow the student additional "hands-on" experience with computer-interfaced instruments that perform rapid, accurate, and precise chemical analyses. Modern chemical procedures require the student to be computer literate. The Chemistry discipline at Truman not only uses computers in most of the courses but provides a high degree of access to microcomputers for coursework and sophisticated research-quality calculations.

CHEMISTRY
BACHELOR OF SCIENCE

			Semester Hours
Liberal Studies Program Requirements			**32-57**
Missouri Statute Requirement			**1-3**
Required Support			**14-15**
MATH	198	Analytic Geometry & Calculus I**	5
MATH	263	Analytic Geometry & Calculus II	5
PHYS	195	Physics with Calculus I** **OR**	5
PHYS	185	College Physics I**	4
Bachelor of Science Requirements			**7-8**
PHYS	196	Physics with Calculus II **OR**	5
PHYS	186	College Physics II	4
MATH	264	Analytic Geometry & Calculus III	3
MAJOR REQUIREMENTS			**48**
CHEM	120	Chemical Principles I	5
CHEM	121	Chemical Principles II with Inorganic Chemistry	5
CHEM	222	Intro to Quantitative Analysis	4
CHEM	322	Instrumental Analysis	4
CHEM	323	Physical Chemistry I	3
CHEM	324	Physical Chemistry I Lab	1
CHEM	325	Physical Chemistry II	3
CHEM	326	Physical Chemistry II Lab	1
CHEM	329	Organic Chemistry I	3
CHEM	330	Organic Chemistry I Lab*	1
CHEM	331	Organic Chemistry II	3
CHEM	332	Organic Chemistry II Lab*	1
CHEM	421	Biochemistry	4
CHEM	475	Inorganic Chemistry	4
CHEM	145	Freshman Seminar	1
CHEM	245	Sophomore Seminar	1
CHEM	345	Junior Seminar	1
Capstone Experience:			
CHEM	445	Senior Seminar	1

**May be used to fulfill LSP requirements.

*CHEM 333 is equivalent to the combination of CHEM 330 and CHEM 332.

One advanced chemistry course and a minumum of two credit hours are required. With approval of advisor, students may select from the following list:

CHEM	422	Advanced Topics in Organic Chemistry	3
CHEM	430	Advanced Physical Chemistry	3
CHEM	431	Advanced Analytical Chemistry	3
CHEM	443	Chemistry Research III	1-3
CHEM	476	Advanced Inorganic Chemistry	3
CHEM	518	Advanced Topics	1-3

Electives to Total **124**

Students completing the University's bachelor of science program in chemistry as described in this catalog meet the American Chemical Society (ACS) requirements for certification upon graduation. Specific questions about the ACS certification requirements may be addressed to Dr. Maria Nagan, the certification officer, or the chemistry convener.

FURTHER DEGREE CRITERIA
Any student obtaining a bachelor's degree in Chemistry from Truman must:
1. complete 12 hours of 300-level or above Chemistry credits at Truman;
2. achieve at least a "C" in each of the courses listed as Major Requirements. A minimum GPA of 2.0, with a maximum of 5 credit hours of "D," is required for all courses listed as Required Support and Bachelor of Science Requirements;
3. score at or above the 20th percentile on the nationally-normed senior exam (e.g. MFAT);
4. must fulfill the university guidelines for a portfolio.

AREAS OF CONCENTRATION
The following areas of concentration are guides only; the student may elect other areas of concentration with approval of his/her advisor.

Students interested in pursuing Allopathic or Osteopathic Medicine may select from the following list of courses to reach a minimum of 15 hours. Students are expected to have completed appropriate prerequisites before enrolling in these courses.

BIOL	200	Cell Biology	4
BIOL	300	Genetics	4
BIOL	302	Comparative Anatomy	5
BIOL	304	Microbiology	4
BIOL	309	Histology	3
BIOL	315	Physiology	4
CHEM	421	Biochemistry	4
			15

DEPARTMENTAL HONORS IN CHEMISTRY
Any student can graduate with Honors in Chemistry under the following criteria:
1. Must complete the PHYS 195-196 sequence.
2. In 3 out of 5 of the "core" areas (organic, analytical, physical, inorganic, biochemistry) score at or above the 50th percentile on the discipline's nationally-normed exam.
3. The student must achieve the University's academic standards for graduating cum laude and one of the following criteria:
   a) The student has obtained a 90th percentile on the MFAT in Chemistry.
   b) The student has successfully progressed on a research project of at least two semesters' effort and has written a research report according to ACS certification guidelines and has given a research seminar/presentation. The student must register for two credits of research.

PHYSICS PROGRAM

"The science of physics seeks to understand the behavior of matter and energy at the most general and fundamental level. The sister sciences of chemistry, earth sciences, and biology (including parts of medical science) build on the laws of physics and rely on many instruments originally devised by physicists. Physics underlies engineering and most of modern technology, and it plays a basic and essential role in our economy and our culture..." (National Academy of Sciences)

The goals of an undergraduate physics major are: a) to provide a general understanding of the fundamental laws of the physical universe; b) to provide the skills necessary to plan an experiment, make precise measurements, analyze the results, and communicate findings; and c) to help the student understand the role of physics in shaping the present world and recognize its potential to benefit mankind through the application of fundamental knowledge.

The principal objective of Truman's Physics Program is to graduate students capable of critical thinking, independent learning, and scientific inquiry. The physics curriculum is a rigorous and challenging program designed to prepare students for graduate level study in physics and related fields. A strong emphasis is placed on close and frequent contact with individual faculty members who serve as course instructors and research mentors. A crucial feature of the program is individual research supervised by faculty.

Undergraduate research allows a student to experience the exploration and inquiry aspect of science and provides valuable skills and insights into the process of learning and doing physics. Many physics majors have strong ties to other disciplines such as chemistry, mathematics, computer science, education, music, philosophy, business and religion which then become part of research endeavors, minors, second majors or post graduate study.

Because of the fundamental nature of the subject area and the broad spectrum of subject matter covered, as well as the intense training in creative problem solving, the Physics graduate easily adapts to a large number of related fields, including biophysics, geophysics, all types of engineering, medicine, law, business, and mathematical financial analysis. To ensure the background necessary for a successful career in a variety of fields, a strong liberal arts and sciences component is included in the curriculum. This contains necessary courses in mathematics, computer science, literature, and communications skills.

Students intending to receive a bachelor's degree in Physics must take the Major Field Test-Physics during their last regular semester (fall or spring). In addition, students who wish to apply for admission to graduate programs in physics should take the Graduate Record Examination (subject Physics) in the semester prior to submitting applications.

DEPARTMENTAL HONORS IN PHYSICS
Departmental Honors in Physics are awarded to graduating students who meet at least one of the following two requirements:
a) a grade point average in physics courses required for the major which equals or exceeds 3.50, and a score at or above the 90th percentile in the Physics Major Field Test,
OR
b) a grade point average in physics courses required for the major which equals or exceeds 3.75, and a score at or above the 80th percentile in the Physics Major Field Test.

Overview of the Introductory Physics Courses: In all introductory physics courses, students will make extensive use of quantitative reasoning in applying the fundamental laws of physics to real-world problems, and will explore the physicist's approach to inquiry through laboratory investigations. Students will explore some of the history of physics, its technological, philosophical, and aesthetic aspects, and its place in the history of ideas.

PHYS 100, 185, 186, 195, 196 all satisfy the Scientific: Physical Science Mode of Inquiry within the Liberal Studies Program. PHYS 245 Astronomy and PHYS 246 Meterology also meet this LSP requirement. All include a laboratory a component.

PHYS 100 ("Concepts in Physics"): This is a one-semester course focusing primarily on the conceptual understanding of physics. It is typically taken by students not majoring in science. It does not prepare the student for advanced courses in physics; however, it has occasionally been taken by students as preparation for the PHYS 185-186 or PHYS 195-196 sequences. Basic algebra skills are expected of the student.

PHYS 185-186 ("College Physics"): This is a two-semester sequence which primarily surveys the core of classical physics (mechanics, electromagnetism, waves, and thermodynamics) at a level suitable for those with a strong background in algebra and trigonometry. This sequence is more broadly focused than PHYS 195-196 in its topical coverage, less deep in its treatment of physics, and less rigorous mathematically. It is not intended as preparation for advanced course in physics. College Physics is often taken by students following certain science major or pre-professional programs **other than** Physics, Pre-engineering, and Chemistry-Option I. It *does not* satisfy the requirements of these last three major programs, or of the physics minor. It *does* satisfy the major program requirements for Biology and for Chemistry-Option II.

PHYS 195-196 ("Physics with Calculus"): This two-semester sequence covers mechanics and electromagnetism at a level suitable for those with knowledge of calculus, and prepares the student for advanced courses in physics. The primary audience for this sequence consists of those planning advanced work in physics, engineering, or a related area. Students majoring in the natural sciences, in mathematics and related fields, or in other technical areas, and who wish to take introductory physics, should seriously consider taking PHYS 195-196 because of its depth. Students following major programs in physics or engineering are required to take the two-semester sequence PHYS 195-196.

PHYSICS
BACHELOR OF SCIENCE

			Semester Hours
Liberal Studies Program Requirements			**.32-57**
Missouri Statute Requirement			**.1-3**
Required Support			**.24**
MATH	198	Analytic Geometry & Calculus I**	.5
MATH	263	Analytic Geometry & Calculus II	.5
MATH	264	Analytic Geometry & Calculus III	.3
MATH	365	Ordinary Differential Equations	.3
CHEM	120	Chemical Principles I**	.5
STAT	290	Statistics**	.3

**May be used to fulfill LSP requirements.

Bachelor of Science Requirements			**.8**
CHEM	121	Chemical Principles II with Inorganic Chemistry	.5
MATH	357	Linear Algebra	.3
MAJOR REQUIREMENTS			**.49**
PHYS	145	Physics Seminar	.1
PHYS	195	Physics with Calculus I	.5
PHYS	196	Physics with Calculus II	.5
PHYS	250	Modern Physics I	.3
PHYS	251	Modern Physics II	.3
PHYS	275	Vibrations and Waves	.3
PHYS	320	Electronics	.3
PHYS	345	Junior Seminar	.1
PHYS	382	Mathematical Physics	.3
PHYS	386	Classical Mechanics	.3
PHYS	388	Advanced Laboratory	.3
PHYS	482	Electricity and Magnetism	.3
PHYS	486	Thermodynamics & Statistical Mechanics	3
PHYS	490	Senior Research I*	.3
PHYS	491	Senior Research II*	.1
PHYS	518	Advanced Topics**	.3
PHYS	580	Quantum Mechanics	.3

*Capstone courses
**Only those sections approved by the physics faculty will count toward this requirement. Students should consult their advisor.

Electives to Total **.124**
For those Physics Majors who are pursuing the Master of Arts in Education degree, electives will include 7 credits in education.

Further Degree Criterion:
All Physics majors must score at or above the 20th percentile on the nationally-normed senior exam (MFAT).

PHYSICS
BACHELOR OF ARTS

			Semester Hours
Liberal Studies Program Requirements			**.32-57**
Missouri Statute Requirement			**.1-3**
Required Support			**.26**
MATH	198	Analytic Geometry & Calculus I**	.5
MATH	263	Analytic Geometry & Calculus II	.5
MATH	264	Analytic Geometry & Calculus III	.3
MATH	365	Ordinary Differential Equations	.3
CHEM	120	Chemical Principles I**	.5
CHEM	121	Chemical Principles II with Inorganic Chemistry**	.5

**May be used to fulfill LSP requirements.

Bachelor of Arts Requirements
Intermediate proficiency in ONE foreign language .0-6

MAJOR REQUIREMENTS			**.28**
PHYS	145	Physics Seminar	.1
PHYS	195	Physics with Calculus I	.5
PHYS	196	Physics with Calculus II	.5
PHYS	250	Modern Physics I	.3
PHYS	251	Modern Physics II	.3
PHYS	275	Vibrations and Waves	.3
PHYS	345	Junior Seminar	.1
PHYS	382	Mathematical Physics	.3
PHYS	388	Advanced Laboratory	.3
PHYS	445	Advanced Physics Seminar* **OR**	.1
PHYS	491	Senior Research II*	.1

(PHYS 490 Senior Research I is required before completing PHYS 491.)
*Capstone Courses

Physics Electives **6**
Choose at least 6 hours from the list below; at least one course must be PHYS 386, PHYS 482, or PHYS 486

PHYS	246	Astronomy I	4
PHYS	320	Electronics	3
PHYS	380	Optics	3
PHYS	386	Classical Mechanics	3
PHYS	441	Physics Research I	1-3
PHYS	442	Physics Research II	1-3
PHYS	443	Physics Research III	1-3
PHYS	482	Electricity and Magnetism	3
PHYS	486	Thermodynamics & Statistical Mechanics	3
PHYS	490	Senior Research I **AND**	3
PHYS	491	Senior Research II	1*
PHYS	518	Advanced Topics	1-5
PHYS	580	Quantum Mechanics	3

*The one credit for PHYS 491 will be attributed to the Major Requirements section above.

Learning Plan 15
The learning plan may be any existing minor (excluding Physics) of which at least 15 hours are not counted elsewhere or it may be a group of appropriate courses chosen by the student and his or her advisor. The learning plan (and any future changes) must be approved by a committee consisting of the student's advisor and two other physics faculty members (normally approved by the end of the sophomore year).

Electives to Total **124**

Further Degree Criterion:
All Physics majors must score at or above the 20th percentile on the nationally-normed senior exam (MFAT).

PHYSICS-ENGINEERING DUAL DEGREE (3+2) PROGRAM

This program offers a combination of degree programs from two institutions that allows a student to receive two related degrees in five years. The 3+2 Dual Degree allows the student to earn a Bachelor of Arts in Physics from Truman and a Bachelor of Science from an engineering school (e.g., Rolla, MU, Iowa State, etc.) in ten semesters. The advantages of this program are many. Students graduate from Truman possessing a strong background in physics and a broad liberal arts background. The engineering degree provides the depth and focus of an engineering discipline, and the expertise to be a professional in the technical world. Such a background gives flexibility and breadth, the ability to communicate well, and the capability to work independently and in challenging environments.

The BA in Physics is a typical "four-year" degree from Truman. It provides the strong liberal arts core, the solid foundation of physics, and a personalized 15-hour learning plan through which a student tailors his or her degree to suit future plans. Students must complete the Liberal Studies Program and all Truman graduation requirements. Engineering courses comprise the **entirety** of the BA learning plan. Eight credit hours are to be finished at Truman and the remaining 7 hours are completed at the chosen engineering school. The Physics BA also requires 6 credit hours (2 courses) of physics-related electives, which are typically engineering courses taken at the engineering school. The Truman Residence Requirement for graduation is waived for students in this dual degree program.

Each 3+2 dual degree student will have a three-person engineering advisory committee who will work with the individual student before and after his or her transfer from Truman. This committee will serve as a liaison as the engineering courses are completed and the student applies for graduation from Truman. Please see a Physics faculty academic advisor for a more specific course listing for this dual degree program.

PRE-ENGINEERING

The pre-engineering program allows students to transfer to the engineering school of their choice after two years of work at Truman. Truman students are well prepared for the transfer, and they are actively recruited by various institutions, such as the University of Missouri campuses at Rolla and Columbia, with which transfer programs have been established. Among the advantages of the transfer program is the guarantee that all courses taken at Truman will transfer with the received grade.

SUGGESTED CURRICULUM
The following is a suggested curriculum for students interested in different areas within engineering. The Mathematics, Physics, and Chemistry sequences are essential components of the curriculum, as well as the courses offered exclusively for pre-engineers (PHYS 208 Design and Drafting, PHYS 383 Fundamentals of Electrical Circuits, and PHYS 387 Statics). PHYS 195-196, CHEM 120, and MATH 198 should be taken as part of the Liberal Studies Program. Specific courses may vary among fields of engineering (Aerospace Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Nuclear Engineering, Engineering Management, etc.). For example, STAT 290 (Statistics) is required for Ceramic Engineering, while CHEM 222 (Introduction to Quantitative Analysis) is required for Chemical and Metallurgical Engineering. Coursework may vary among engineering schools, so students should seek advice from a physics faculty member before registration.

			Semester Hours
FIRST YEAR-FALL SEMESTER			**17**
ENG	190	Writing as Critical Thinking	3
PHYS	145	Physics Seminar	1
PHYS	195	Physics with Calculus I	5
MATH	198	Analytic Geometry & Calculus I	5
Social Science Elective*			3

*PSYC 166 General Psychology is required for Engineering Management.

FIRST YEAR-SPRING SEMESTER			**16**
MATH	263	Analytic Geometry & Calculus II	5
PHYS	196	Physics with Calculus II	5
ECON	200	Principles of Macroeconomics **OR**	
ECON	201	Principles of Microeconomics	3
HIST	104	United States History I,1607-1877 **OR**	
HIST	105	United States History II, 1877-present	3

SECOND YEAR-FALL SEMESTER			**16**
MATH	264	Analytic Geometry & Calculus III	3
CHEM	120	Chemical Principles I	5
PHYS	387	Statics*	3
PHYS	208	Design and Drafting	2
Elective			3

*Some areas may not require this course.

SECOND YEAR-SPRING SEMESTER 17

MATH	365	Ordinary Differential Equations	.3
CHEM	121	Chemical Principles II with Inorganic Chemistry	.5
PHYS	383	Fundamentals of Electric Circuits**	.3
Elective			.3
Communication Skills Elective			.3

Communication Skills Elective is not required for Chemical or Electrical Engineering. Some areas may require a specific course such as COMM 170 Public Speaking.

**Not required for Engineering Management or Geological Engineering.

MINORS OFFERED

Students are encouraged to pursue study in an academic minor to provide contrasting and parallel study to the major. Serving to complement the major and help students further expand and integrate knowledge, academic minors are offered in a variety of disciplinary and interdisciplinary subjects. Students who choose to pursue minors should seek advice from faculty members in their minor disciplines as well as from their advisors in their major program.

Minimum requirements for all Academic Minor Programs:

1. A minimum GPA of 2.0 for all coursework within the Academic Minor Program.
2. A minimum of nine credit hours of the coursework for Academic Minor Programs must be taken through Truman State University, unless the discipline specifies a greater number of hours at Truman.

AGRICULTURAL BUSINESS MINOR

The Agricultural Business Minor requires the successful completion of 15-16 semester hours of courses, to include at least four of the following courses:

AGSC	260	Agricultural Markets and Products	.3
AGSC	303	Food and Agriculture Marketing	.3
AGSC	340	Futures and Options Markets	.3
AGSC	342	Agricultural Entrepreneurship	.3
AGSC	414	Agricultural Policy	.3

And at least one of the following:

AGSC	110	Principles of Plant Agriculture	.4
AGSC	212	Principles of Soil Science	.4
AGSC	218	Introduction to Horticulture	.4
AGSC	310	Forage Crops	.3
AGSC	311	Plant Nutrition	.3
AGSC	315	Principles of Animal Agriculture	.4
AGSC	320	Anatomy and Physiology of Domestic Animals	.4
AGSC	321	Animal Nutrition	.4
AGSC	327	Genetics of Animal and Plant Improvement	.3
AGSC	352	Animal Reproduction	.3

AGRICULTURAL STUDIES MINOR

(*Not available to Agriculture Science majors.*) The Agricultural Studies Minor requires the successful completion of 15-16 semester hours of courses, to include:

AGSC	108	Introduction to Agricultural Systems **OR**	
AGSC	100	Food, Agriculture, and the Environment	.4

At least one of the following:

AGSC	110	Principles of Plant Agriculture	.4
AGSC	212	Principles of Soil Science	.4
AGSC	218	Introduction to Horticulture	.4
AGSC	310	Forage Crops	.3
AGSC	311	Plant Nutrition	.3

And at least one of the following:

AGSC	315	Principles of Animal Agriculture	.4
AGSC	320	Anatomy and Physiology of Domestic Animals	.4
AGSC	321	Animal Nutrition	.4
AGSC	327	Genetics of Animal and Plant Improvement	.3
AGSC	352	Animal Reproduction	.3

NOTE: The remainder of the required 15 credit hours for the Agricultural Studies minor may be met with any course bearing an AGSC prefix and is not limited to those courses listed above. Neither AGSC 391/392 Internship in Agriculture nor more than 3 hours of AGSC 301 Special Problems in Agricultural Science may be taken to fulfill the requirements of the Agricultural Studies Minor.

EQUINE STUDIES MINOR

The Equine Studies Minor requires the successful completion of 17-18 semester hours as follows:

AGSC	193	Introduction to Equine Science	.3
AGSC	342	Agricultural Entrepreneurship	.3
AGSC	352	Animal Reproduction	.3
AGSC	353	Equine Reproduction Practicum	.2
AGSC	375	Equine Exercise Physiology	.3

OPTION A - Complete all three of the following:

AGSC	152	Horsemanship Level I	.1
AGSC	153	Horsemanship Level II	.1
AGSC	154	Horsemanship Level III	.1

OR

OPTION B - Complete one of the following:

AGSC	252	Horse Training Techniques	.3
AGSC	310	Forage Crops	.3
AGSC	321	Animal Nutrition	.4
AGSC	322	Animal Health	.3
AGSC	327	Genetics of Plants and Animals	.3

BIOLOGY MINOR

The Biology Minor requires the successful completion of a minimum of 15 credit hours in biology courses taken at Truman and includes:

Either one of the following two sequences: BIOL 107 & BIOL 108 or BIOL 103 & 106. Students who are awarded credit for these courses as a result of high school experiences cannot use such credit toward the 15 hour total. Students must take at least two (2) Biology courses at the 200 level or above, with the following restrictions: at least one of these courses must have a laboratory component. Prerequisites for advanced courses are expected to be met.

CHEMISTRY MINOR

The Chemistry Minor requires the successful completion of 16 semester hours of the following courses, including at least three credits of laboratory courses:

CHEM	222	Intro to Quantitative Analysis*	.4
CHEM	322	Instrumental Analysis*	.4
CHEM	323	Physical Chemistry I	.3
CHEM	324	Physical Chemistry I Lab	.1
CHEM	325	Physical Chemistry II	.3
CHEM	326	Physical Chemistry II Lab	.1
CHEM	329	Organic Chemistry I	.3
CHEM	330	Organic Chemistry I Lab**	.1
CHEM	331	Organic Chemistry II	.3
CHEM	332	Organic Chemistry II Lab**	.1

CHEM	421	Biochemistry*	4
CHEM	475	Inorganic Chemistry I*	4

*One of the four credits counts toward the credits of laboratory courses.
**CHEM 333 is equivalent to the combination of CHEM 330 and CHEM 332.

PHYSICS MINOR
The Physics Minor requires the successful completion of the following courses.

REQUIRED COURSES			**16**
PHYS	195	Physics with Calculus I	5
PHYS	196	Physics with Calculus II	5
PHYS	250	Modern Physics I	3
PHYS	275	Vibrations and Waves	3
ELECTIVE COURSES			**3**

Select at least three credit hours from PHYS 251 Modern Physics II, or any 300- to 500-level Physics course, or NASC 400 History of Science to 1700 and NASC 401 History of Science since 1700.

COURSE DESCRIPTIONS

Students who do not meet prerequisites for a course can request permission to take a course by meeting with the faculty member teaching the course, who in turn will recommend to the Dean that the student be enrolled in the class if appropriate.

AGRICULTURAL SCIENCE

AGSC 100 — Food, Agriculture, and the Environment
4 hours
A multidisciplinary study of the structure and function of agricultural systems and of their impact on society and the environment. Includes laboratory.

AGSC 108 — Introduction to Agricultural Systems
4 hours
A course providing a broad-based overview of soil, plant and animal science for beginning students of agriculture which encourages them to consider the interconnectivity of these agricultural sub-disciplines. This interconnectivity becomes a foundation to consider sustainable approaches to food and fiber production, and the impact of agricultural systems on humanity and the environment. Includes laboratory.

AGSC 110 — Principles of Plant Agriculture
4 hours
A comprehensive introduction to crop science and technology. Emphasizes crop physiology, genetics, and ecology, plus the application of these sciences to understanding and improving crop production systems.

AGSC 121 — Livestock Management Techniques
1 hour
The course will include practical use and application of anthelmintics, antibiotics, vaccines, insecticides, and growth stimulants. Participation in handling livestock, docking, pregnancy diagnosis, castration, and dehorning.

AGSC 122 — Introductory Meat Science
3 hours
Fundamental properties and composition of meat and its nutritive value. Carcass evaluation, wholesale and retail meat cut selection, grading, identification, and economic value.

AGSC 152 — Horsemanship Level I
1 hour
Mounting and dismounting, walk, trot, and canter equitation. Riding fees are charged. (Does not count as AGSC Elective or AGSC Specialization Area.)

AGSC 153 — Horsemanship Level II
1 hour
Equitation, basic maneuvers, showmanship. Riding fees are charged. Prerequisite: AGSC 152. (Does not count as AGSC Elective or AGSC Specialization Area.)

AGSC 154 — Horsemanship Level III
1 hour
Advanced equitation, advance maneuvers, competitive riding. Riding fees are charged. Prerequisite: AGSC 153. (Does not count as AGSC Elective or AGSC Specialization Area.)

AGSC 160 — Agricultural Techniques
1 hour
This course is designed to provide students with hands-on, practical experience in general agricultural techniques and management. Specific topics may vary semester to semester depending on student interest, farm needs, and other factors.

AGSC 193 — Introduction to Equine Science
2 hours (offered fall)
An introduction to the horse including general terminology, evolution and history, breed types, basic anatomy and physiology, behavior, diseases, and parasites. Laboratory included.

AGSC 212 — Principles of Soil Science
4 hours (offered fall)
A comprehensive introduction to soil science. Origin, formulation, characteristics and resultant management implications for use of soil resources, with applications for agriculture, the environment, waste disposal, engineering and society. Includes laboratory. Prerequisite: One course in biology or chemistry.

AGSC 218 — Introduction to Horticulture
4 hours
A broad introduction to horticultural science. Following an overview of the horticultural industry and its history, the "basics" of horticulture (plant structure, metabolism) will be introduced. Investigation of the environment and its influence on horticultural plants, and consideration of the practices and principles of manipulating and managing horticultural plants will then be considered. Prerequisites: AGSC 100, AGSC 108, BIOL 100 or BIOL 107.

AGSC 252 — Horse Training Techniques
3 hours (offered spring)
An introduction to the techniques used to train young horses. Students will work with young, untrained horses and learn how to handle, lead, lunge, ground drive, and start training under saddle. Prerequisite: AGSC 154, AGSC 193, and permission of the instructor.

AGSC 260 — Agricultural Markets and Products
3 hours
An introductory course examining the production, handling, and marketing of agricultural products. Investigates changing patterns of food consumption and analyzes the causes and consequences of the changes. Focus is placed on understanding the market structures ordering the flow of food and fiber goods from the producer to the consumer and the economic principles underlying these structures.

AGSC 301 — Special Problems in Agricultural Science
1-6 hours
Specialized projects in agriculture under supervision of a faculty member. No more than 6 hours may be applied to a degree in Agricultural Science. Prerequisite: consent of instructor.

AGSC 303 — Food and Agricultural Marketing
3 hours (offered fall, even years)
Application of food marketing strategies, market reseach in food marketing, use of direct marketing and other alternative marketing strategies by farmers, and analysis of the economic functions of agricultural markets. Prerequisite: AGSC 260.

AGSC 306 — Special Topics in Agricultural Science
1-6 hours
Lecture/laboratory course dealing with specific subject matter areas within agriculture. Topics may include, but not limited to, Beef Cattle Science, Sheep Management, Livestock Evaluation, Advanced Livestock Judging, and Weed Science. Prerequisite: consent of instructor.

AGSC 310 — Forage Crops
3 hours
Principles of forage culture, utilization and ecology. Prerequisite: AGSC 110.

AGSC 311 — Plant Nutrition
3 hours (offered fall, even years)
Plant nutritional requirements, fertilizers and fertilization practices, soil amendments, soil fertility as related to plant growth and the production and quality of food and fiber. Includes laboratory. Prerequisite: AGSC 212 or an introductory biology or chemistry course.

AGSC 312 — Plant Pathology
3 hours
The occurrence, identification, and natural history of plant pathogens plus the principles of their management will be discussed. Prerequisite: AGSC 110.

AGSC 313 — Plant Propagation
4 hours
An introductory plant propagation course, designed to provide the interested student with an understanding of the basics of sexual and asexual propagation and micropropagation techniques. Prerequisites: AGSC 100, AGSC 108, BIOL 100 or BIOL 107; and AGSC 218.

AGSC 315 — Principles of Animal Agriculture
4 hours
A comprehensive study of the role of animals in agricultural systems. Emphasis is placed on the biological principles applicable to animal production and methods of exploiting this knowledge for more efficient and humane production. Prerequisite: One course in biology and sophomore standing.

AGSC 318 — Landscape Materials and Landscaping
4 hours
Course focuses on woody landscape plants and their use in the landscape. Lecture targets identification and recognition of common woody landscape materials, including trees, shrubs and ground covers and their functional use in the landscape. Introductory principles of landscape design will also be covered. Prerequisites: AGSC 100, AGSC 108, BIOL 100 or BIOL 107; and AGSC 218.

AGSC 320 — Anatomy & Physiology of Domestic Animals
4 hours (offered spring, odd years)
A systems approach to the study of farm animal anatomy and physiology.

AGSC 321 — Animal Nutrition
4 hours
Various nutrients: their function, digestion, and metabolism by various species of animals. Prerequisites: CHEM 121 and AGSC 315.

AGSC 322 — Animal Health
3 hours (offered spring, even years)
A fundamental approach to disease mechanisms, principles of treatment and prevention, animal health regulations, infectious and non-infectious diseases, herd health programs in horses, cattle, and small animals. Includes laboratory.

AGSC 327 — Genetics of Animal and Plant Improvement
3 hours
The study of the genetic principles of animal and plant breeding as they relate to practical application in the agriculture industry. Emphasis is placed on the types of gene action, breeding plans, and selection applicable to profitable livestock and crop production.

AGSC 332 — Principles of Vegetable Production
4 hours
A study of the fundamental principles underlying commercial and home garden production of vegetables and the basic practices required to successfully produce the wide variety of vegetables adapted to the Midwest. Prerequisites: AGSC 100, AGSC 108, BIOL 100 or BIOL 107; and AGSC 218.

AGSC 340 — Futures and Options Markets
3 hours (offered fall, odd years)
History, mechanics and economic functions of futures and options markets: hedging, behavior of futures and options markets in the U.S. economy and the world, futures and options as a policy tool. Prerequisites: AGSC 260 or ECON 201.

AGSC 342 — Agricultural Entrepreneurship
3 hours (offered spring, odd years)
This course focuses on the operation and management of the agricultural business. The basic economic and business principles governing profitable and sustainable farm and agribusiness operations are emphasized. Prerequisite: AGSC 260.

AGSC 345 — Agricultural Markets, Prices and Trade
3 hours
Analysis of economic interdependencies among agricultural industries, geographically dispersed markets, alternative product forms and markets separated in time. Prerequisites: AGSC 260 and ECON 201.

AGSC 352 — Animal Reproduction
3 hours
A study of the anatomy and physiology of reproduction in mammals with major emphasis on farm animal species. Prerequisite: BIOL 107. Recommended: AGSC 315.

AGSC 353 — Equine Reproduction Practicum
2 hours
An experiential study of reproduction of horses. Prerequisite: AGSC 352.

AGSC 354 — Bovine Reproduction Practicum
2 hours
A hands-on study of the practical aspects of reproduction in cattle. Students will apply their knowledge of reproductive anatomy and physiology in hands-on field and laboratory exercises. Prerequisite: AGSC 352.

AGSC 355 — Ovine Reproduction Practicum
2 hours
This course is designed to familiarize students with the reproductive physiology and anatomy of the ewe and the ram, as well as the technical aspects of sheep breeding. Prerequisite: AGSC 352.

AGSC 375 — Equine Exercise Physiology
3 hours
A study of the horse as an athlete, including consideration of the physiological, anatomical, and psychological adaptations in this species which endow it with superior athletic abilities. Prerequisite: AGSC 193.

AGSC 391 — Internship in Agriculture
4-12 hours
Internship in an agriculturally-oriented business under the supervision of a university faculty member. Only 4 hours of AGSC 391 may be applied toward learning plan. Prerequisites: junior standing AND approval and assignment by university personnel and organization concerned. Co-requisite: AGSC 392.

AGSC 392 — Evaluation and Analysis of Internship
1-3 hours
Encompassing research, analytical analysis, and evaluation of internship experience. Only one hour of AGSC 392 may be applied toward learning plan. Co-requisite: AGSC 391.

AGSC 410 — Soil Conservation and Management
3 hours (offered spring)
Soil conservation and management - utilization, improvement, and preservation of soil productivity for crop production and environmental management. Includes laboratory. Prerequisites: AGSC 110 and AGSC 212.

AGSC 414 — Agricultural Policy
3 hours (offered spring, even years)
To provide an understanding of domestic and international issues in U.S. agricultural food policy. A study of major problems confronting agriculture. How public policy influences the nature and performance of U.S. and world agriculture. Prerequisite: AGSC 260.

AGSC 415 — Ethical Issues in Sustainable Agriculture
3 hours (offered fall)
A capstone course that asks students to carefully consider how they and other people define and judge good agricultural science and practice. Prerequisite: Senior standing.

AGSC 416 — Advanced Topics in Agronomy
3 hours
A capstone course in agronomic science to examine advanced topics in crop breeding, physiology, and protection.

AGSC 418 — Temperate Fruit and Nut Culture
4 hours
Management systems for the major fruit crops in the US including apples and pears, peaches, cherries, strawberries, grapes of various types, raspberries, blueberries, and related groups. Major nut crops (pecans, walnuts, almonds, etc.) will also be covered. Topics include climatic and soil conditions, cultural management, pruning and training. Includes laboratory. Prerequisites: AGSC 100, AGSC 108, BIOL 100 or BIOL 107; and AGSC 218.

AGSC 420 — Seminar in Agriculture
1 hour
Independent reading and research, writing of abstracts, résumés and outlines, and oral presentation of agriculturally-related topics. Prerequisite: junior or senior standing.

AGSC 422 — Grazing Animal Ecology
3 hours
An integrative course studying detailed interactions among soils, midwestern pasture plants, and grazing beef cattle and sheep. Prerequisite: AGSC 315 and AGSC 321.

AGSC 423 — Physiology of Lactation
3 hours
The study of the biology of lactation in livestock species. Relates cellular biology to management practices. Prerequisite: AGSC 315.

AGSC 427 — Swine Management Science
3 hours
Purebred and commercial swine breeding, feeding, marketing, and management methods. Prerequisite: AGSC 315.

AGSC 429 — Domestic Animal Behavior
3 hours
Animal behavior patterns and systems, socialization, environmental, genetic, and physiological factors as they relate to domestic animals and livestock production. Prerequisite: AGSC 315.

AGSC 441 — Agriculture Research
1-3 hours
Individual student research under close supervision of faculty. Enrollment in course requires approval of the supervising faculty. A total of 3 credits of Agriculture Research can be applied to the AGSC major as part of the Learning Plan (Area of Specialization) and AGSC electives.

AGSC 442 — Agriculture Research
1-3 hours
Continuation of AGSC 441.

AGSC 443 — Agriculture Research
1-3 hours
Continuation of AGSC 442.

AGSC 490 — Agriculture Practicum I
2 hours
AGSC 490/491 is the capstone course for Agricultural Science. Students will work collaboratively with faculty and other students to plan, develop, and execute an agricultural production enterprise (agronomic, horticultural or animal-related). Successful completion requires student teams to work together to solve problems by drawing on their collective experience and knowledge of plant science, soil science, animal science, and agricultural business and marketing. Prerequisites: Students enrolled in AGSC 490/491 must have either successfully completed all 100-, 200-, and 300-level Agricultural Science core courses or be concurrently enrolled in those they lack.

AGSC 491 — Agriculture Practicum II
2 hours
AGSC 490/491 is the second half of the capstone course for Agricultural Science. This is a continuation of AGSC 490 involving independent work by teams of students in conjunction with faculty mentors. Prerequisites: Students enrolled in AGSC 490/491 must have either successfully completed all 100-, 200-, and 300-level Agricultural Science core courses or be concurrently enrolled in those they lack.

BIOLOGY

BIOL 100 — Biology
4 hours (offered fall, spring)
General theme is similarities in living systems as viewed at various levels—the genetic code, energy production, homeostasis, and adaptations for survival. The scientific method as a mode of inquiry will be presented and used in laboratory investigations. (This course may not be used as Biology elective by a Biology major.)

BIOL 103 — General Botany
4 hours (offered spring)
This course focuses on the biological aspects of the plant kingdom, ranging from the sub-cellular level to ecological roles. Structural and physiological adaptations, present and past diversity, reproduction, genetics and evolution, ecological interactions, and ethnobotany are explored, including laboratory investigations. (This course may not be used as a Biology elective by a Biology major.)

BIOL 106 — General Zoology
4 hours (offered fall)
This course treats the broad discipline of animal biology from various perspectives, including biochemistry, cell biology, organ systems and physiology, behavior, and ecology. Major adaptive trends among types of animals, as shaped by natural selection, are studied, including laboratory investigations. (This course may not be used as a Biology elective by a Biology major.)

BIOL 107 — Introductory Biology I
4 hours (offered fall)
This course presents the unifying concepts of biology with a focus on the nature and philosophy of biological science, evolution by natural selection and the central role of DNA in evolution. Cellular and molecular levels of organization are studied. Laboratory investigations are included. Required of all Biology majors.

BIOL 108 — Introductory Biology II
4 hours (offered spring)
This course presents the unifying concepts of biology at the organismic level of organization. The diversity of life is emphasized. Laboratory included. Required of all Biology majors. Prerequisite: BIOL 107.

BIOL 145 — Freshman Biology Seminar
1 hour
Selected topics. Biology Freshman Seminar is required for all Biology Majors during the fall semester of the freshman year. It includes an introduction to the Biology program.

BIOL 150 — Honors Biology
4 hours (offered fall, spring)
General theme is similarities in living systems as viewed at various levels—the genetic code, energy production, homeostasis, and adaptations for survival. The scientific method as a mode of inquiry will be presented and used in laboratory investigations. Additional topics will be covered beyond what is addressed in BIOL 100 and selected topics may be covered in more detail than in BIOL 100. (This course may not be used as a Biology elective by a Biology major.) NOTE: General Honors Course.

BIOL 200 — Cell Biology
4 hours (offered fall)
A study of the molecular basis of cell form, function, and variation. Required of all Biology majors. Prerequisite: Successful completion of BIOL 107 and BIOL 108. Completion or co-enrollment in CHEM 120 is strongly suggested. NOTE: General Honors Course.

BIOL 204 — Introductory Microbiology
3 hours (offered spring)
Applied microbiology, studying the nature of bacteria and related microorganisms and their relationships to human economy and nature. Includes laboratory. Prerequisites: BIOL 100, CHEM 100, and MATH 156. (May not be used as biology elective - unrestricted elective only)

BIOL 214 — Anatomy and Physiology I
4 hours
First class in a two-semester sequence covering structure and function of the human body, using a systems approach. Laboratory component included. May not be used as a Biology elective by Biology majors. Prerequisites: CHEM 100 and concurrent or previous enrollment in BIOL 100.

BIOL 215 — Anatomy and Physiology II
4 hours
Second class in a two-semester sequence covering structure and function of the human body, using a systems approach. Laboratory component included. May not be used as a Biology elective by Biology majors. Prerequisite: BIOL 214.

BIOL 248, 249
Seminar II, III
1 hour each
Selected topics.

BIOL 300 — Genetics
4 hours (offered spring)
The nature, transmission, variation, and action of the genetic material. Required of all Biology Majors. Prerequisite: BIOL 107, BIOL 108, BIOL 200, and CHEM 121. NOTE: General Honors Course.

BIOL 301 — Introduction to Ecology
4 hours (offered fall)
This course documents and seeks to explain patterns of distribution and abundance of organisms in the natural world. Required of all Biology majors. Prerequisites: BIOL 107 and BIOL 108. NOTE: General Honors Course.

BIOL 302 — Comparative Anatomy
5 hours
The comparative morphology of vertebrates. Included are lectures on the evolution and function of organ systems and laboratories with dissections of representative vertebrates.

BIOL 304 — General Microbiology
4 hours (offered fall and spring)
The nature of microorganisms with an emphasis on bacteria, viruses, and fungi. Microscopy, cell structures and functions, metabolism, genetics, host defense, biological diversity, and environmental issues will be investigated. Includes laboratory. Prerequisites: BIOL 107 and CHEM 100 or CHEM 120. NOTE: General Honors Course.

BIOL 306 — Microtechnique with Lab
2 hours
Biological material preparation and staining for microscopic study. Prerequisite: Instructor's permission.

BIOL 309 — Histology
4 hours
Light and electron microscopic anatomy of representative mammalian cells, tissues, and organs. Prerequisites: BIOL 107, 108, and BIOL 200.

BIOL 312 — Local Flora
2 hours
Identification of trees in both winter and spring stages of growth and identification of common vascular plants with the use of taxonomic keys emphasized.

BIOL 313 — Plant Anatomy
4 hours
Comprehensive studies of the internal structure of vascular plants, focusing mainly on the anatomy of flowering plants. The course emphasizes structure-function relationships and anatomical adaptations of plants to various environmental conditions.

BIOL 314 — Plant Taxonomy
4 hours
Selected flowering plant families, characteristics, and possible evolutionary relationships.

BIOL 315 — Physiology
4 hours (offered spring)
Physiochemical analysis of body functions with emphasis on control systems which maintain homeostasis. Prerequisite: BIOL 200 and CHEM 121. (This course or BIOL 405 required for all Biology Majors). NOTE: General Honors Course.

BIOL 316 — Entomology
4 hours
The fundamentals of insect biology, life histories, pest management, and classification. Individual projects are required.

BIOL 317 — Economic Botany
3 hours
Industrial, medicinal, edible, crop, and ornamental plants with economic value.

BIOL 318 — Mycology
4 hours
Principles of fungal biology, including morphology, taxonomy, and the interactions of fungi with other organisms. A course in college biology is strongly recommended.

BIOL 325 — Human Physiology
4 hours
Introductory principles and concepts of human body function for Health and Exercise, Psychology, and Nursing majors. Emphasis on practical and applied examples of human health, exercise, and physical performance. Prerequisite: BIOL 100 or CHEM 100 or equivalent. NOTE: Biology majors must take BIOL 315 (Physiology) or BIOL 405 (Plant Physiology) to meet major requirements. BIOL 325 may not be used as a Biology elective by Biology majors—unrestricted elective only.

BIOL 343 — Oceanography
3 hours
A study of the biological and abiotic interactions within the ocean ecosystem. Prerequisite: BIOL 108.

BIOL 345 — Introduction to Mathematical Biology
3 hours
Students will study papers drawn from research literature in which mathematics is used to model biological systems, encompassing the molecular level to the community level of organization. Topics from matrix algebra, differential equations, discrete mathematics, probability and statistics will be introduced and developed through lectures, readings, and a computer lab. Data will be drawn from a variety of sources, including student laboratory experiments, research papers, and scientific databases. The course meets for two hours of lectures and two hours of biology/computer lab each week. Cross-listed as MATH 345, this course will be team-taught by a biologist and a mathematician. Prerequisites: MATH 198 and (BIOL 100 or BIOL 107) with grades of C or better.

BIOL 353 — Pathophysiology
3 hours
Principles and concepts of pathophysiology presented as alterations of normal physiological regulatory mechanisms in disease states. Prerequisite: BIOL 215 or BIOL 315 or BIOL 325.

BIOL 362 — Embryology and Developmental Biology
5 hours
Theory and principles of development. The laboratory includes experimental manipulation of living, developing organisms. Prerequisite: BIOL 200 and BIOL 300. NOTE: General Honors Course.

BIOL 363 — Human Ecology
3 hours
Ecology of humans and environmental problems. (May not be used as a biology elective by Biology majors—unrestricted elective only.)

BIOL 364 — Invertebrate Zoology
4 hours
Biology, taxonomy, structure, ecology, and phylogenetic relationships of invertebrate animals. Lecture and laboratory. Prerequisite: BIOL 108.

BIOL 365 — Human Anatomy
4 hours
The body as a whole, structural units, integrative systems, maintenance systems, and reproduction. Instructor's permission required for enrollment. (May not be used as a Biology elective by Biology majors—unrestricted elective only.)

BIOL 391 — Internship for Biology Majors
4-12 hours
On-the-job training in a biological field to complement the student's academic education. Only three hours total of BIOL 391 and 392 may be counted as biology electives.

BIOL 392 — Evaluation and Analysis of Internship
1-3 hours
Encompassing research, analytical analysis, and evaluation of internship experience. Only three hours total of BIOL 391 and 392 may be counted as biology electives.

BIOL 404 — Medical Microbiology
4 hours
A study of pathogenic microorganisms, their isolation, cultivation, identification, and control. Prerequisites: BIOL 304.

BIOL 405 — Plant Physiology
4 hours
Principles and laboratory experiments on plant function in the areas of water relations, photosynthesis, respiration, and growth. Prerequisites: BIOL 200 and CHEM 121. (This course or BIOL 315 required for all Biology Majors.) NOTE: General Honors Course.

BIOL 441 — Biology Research I
1-3 hours
Individual study and laboratory work on an assigned problem. Three hours only of biology research may be counted as Biology electives.

BIOL 442 — Biology Research II
1-3 hours
A continuation of BIOL 441.

BIOL 443 — Biology Research III
1-3 hours
A continuation of BIOL 442.

BIOL 444 — Independent Studies (Topic)
1-5 hours
This course provides flexibility for students who are in need of specific credit in topics. Only 3 hours may be counted as biology electives.

BIOL 501 — Limnology
4 hours
The ecology of aquatic habitats in which the biota of lakes and streams are studied by field surveys and individual projects.

BIOL 502 — Biometry
3 hours
The design and conduct of experiments and the analysis of biological data. Prerequisite: STAT 190 or equivalent.

BIOL 503 — Evolutionary Biology
3 hours
The study of evolution by natural selection, emphasizing mechanisms, historical development, and modern evidence. Data from the fields of genetics, molecular biology, population biology, paleontology and behavior may be considered. Prerequisite: BIOL 300 or equivalent. NOTE: General Honors Course.

BIOL 504 — Herpetology
4 hours
The taxonomy, life history, and distribution of amphibians and reptiles. The laboratory includes field trips.

BIOL 505 — Cytology
4 hours
Studies of cell structure and function by experimental methods. Prerequisites: BIOL 200 and BIOL 300.

BIOL 506 — Ornithology
4 hours
Avian biology with emphasis on field study.

BIOL 508 — Advanced Plant Taxonomy
3 hours
Historical taxonomy and experimental approaches; taxonomy problems, herbarium, morphological, cytological, statistical, and chemical techniques. Prerequisite: BIOL 314.

BIOL 509 — Comparative Plant Morphology
4 hours
Comparative investigations of the structure, life-cycles, and evolution of fossil and living vascular plants. Emphasis on such topics as: the origin of land plants, evolution of the ovule and flower, and the origin of flowering plants.

BIOL 510 — Ecology
3 hours
An advanced course in ecology examining the conceptual and theoretical foundations of population and community ecology. Reading and discussion of primary literature is emphasized. Prerequisite: BIOL 301.

BIOL 511 — Comparative Animal Physiology
4 hours
Physiological mechanisms of the major animal groups; physiological basis of ecological mechanisms for tolerating stresses of habitats; functional adaptations enabling extension of the population range. Prerequisite: BIOL 315 or equivalent.

BIOL 512 – Cellular Physiology
4 hours
An advanced study of the molecular biology of the cell with an experimental approach. The course will provide an in depth investigation into cell interactions with diverse environments, membrane functions, mechanisms of cellular regulation, the cytoskeleton, cell motility, evolution of cell functions, and energy matter conversions. Includes laboratory work. Prerequisite: BIOL 200.

BIOL 513 – Microbial Genetics
4 hours
Basic concepts of the structure, function, and replication of DNA, RNA, and protein. Includes principles of the genetic code, gene transfer and recombination, control of genetic information flow and enzyme activity, mechanisms of mutagenesis, DNA repair and modification, and genetic engineering. Prerequisite: BIOL 300 and BIOL 304, and one year of college chemistry.

BIOL 515 – Animal Behavior
3 hours
Physiology, natural history, and evolution of behavior. Laboratory is part of the course.

BIOL 516 – Ichthyology
4 hours
The life history, ecology, taxonomy, and distribution of fishes. The laboratory emphasizes the classification of North American freshwater fishes.

BIOL 517 – Mammalogy
4 hours
Mammal life history, behavior, classification, and distribution. Laboratory includes identification of Missouri species from prepared specimens and field trips.

BIOL 518 – Advanced Topics (Topic)
1-5 hours (each topic)
An in-depth study of selected science topics presented under formal classroom organization (not intended for individualized study). The total number of hours on a program is limited to 8; only those hours which have the approval of the student's advisor may be counted as biology electives.

BIOL 519 – Directed Field Studies
1-5 hours
An interim course to encourage scientific investigation of geographic regions. Ecological, geological, climatological, and anthropological phenomena are studied. Only 3 hours may be counted as Biology electives.

BIOL 520 – Immunology
4 hours
A study of the cells, tissues, molecules, and processes involved in the human body's homeostatic and defense mechanisms. Laboratory includes immunological techniques utilized in both the research and clinical laboratories. Prerequisite: BIOL 200 and BIOL 300.

BIOL 545 – Senior Biology Seminar
1 hour each
Selected topics, including a culminating review of the Biology Program. Senior Biology Seminar is required for all senior Biology Majors.

BIOL 598 – Workshop (Topic)
1-3 hours (each topic)
In-depth study of selected topics presented in a short period of time. The total number of hours on a program is limited to 8; only those hours which have the approval of the student's advisor may be counted as biology electives.

CHEMISTRY

CHEM 100 – Chemistry for Contemporary Living
4 hours (offered fall, spring, summer)
An introduction to the basic principles of modern chemistry and their applications to social, economic, and political issues. Basic Algebra skills are required and a Math ACT subscore of 22 or better. Two hours laboratory per week.

CHEM 120 – Chemical Principles I
5 hours (offered fall, spring, summer)
An introductory course with lab whose focus is the underlying principles that are common to all chemistry disciplines. Topics covered include: stoichiometry, equilibrium, kinetics, thermodynamics and applications of these principles to acid/base and precipitation reactions. Prerequisite: MATH 156 or higher math placement. NOTE: General Honors Course for students whose majors do not require CHEM 120 or CHEM 100.

CHEM 121 – Chemical Principles II with Inorganic Chemistry
5 hours (offered fall, spring)
This course, which includes a laboratory component, introduces atomic structure and bonding models and discusses their impact on the properties of matter. Topics covered include: periodicity, chemical bonding, coordination chemistry, electrochemistry, materials, descriptive chemistry of the elements, and spectroscopy. Prerequisite: CHEM 120. NOTE: General Honors Course.

CHEM 145 – Freshman Chemistry Seminar
1 hour (offered fall)
Provided to expedite transition of the student to the University. The seminar is designed to assist students in study skills, academic planning, goal setting, time management, and other abilities which are necessary for success in college.

CHEM 201 – Glass Blowing
1 hour
Laboratory. Constructing useful scientific apparatus from glass tubing.

CHEM 222 – Introduction to Quantitative Analysis
4 hours (offered fall, spring)
Lecture presents the theory of analysis performed in the laboratory. Laboratory includes gravimetric analysis, acid-base titration, pH titration, spectrophotometric trace analysis, ion-exchange, complexometric titration, gas chromatographic analysis, infra-red analysis, and flame-emission analysis. Laboratory 4 hours per week. Prerequisite: CHEM 121. NOTE: General Honors Course.

CHEM 245 – Sophomore Chemistry Seminar
1 hour (offered Fall)
An emphasis on safety and ethics.

CHEM 320 — Foundations of Organic Chemistry
4 hours (offered Spring, even calendar years)
A survey of nomenclature, reaction, and physical properties of organic functional groups, including a brief discussion of sugars, proteins, and nucleic acids. Limited exposure to theory and a preliminary introduction to mechanism to facilitate understanding of stereochemistry and reactions. Laboratory develops elementary techniques for running organic reactions and purification and characterization of organic molecules by simple tests. Course is intended for BA Biology majors and other majors requiring only one semester of organic chemistry. Prerequisite: CHEM 121. NOTE: General Honors Course.

CHEM 322 — Instrumental Analysis
4 hours (offered fall, spring)
Current analysis techniques; spectral methods, electroanalytical methods, chromatography, multistage separations, and other modern chemical methods. In laboratory, instrumental methods applied to analytical problems. Prerequisite: CHEM 222 and previous or concurrent enrollment in CHEM 323 or 325. NOTE: General Honors Course.

CHEM 323 — Physical Chemistry I
3 hours (offered fall only)
Gas laws, equations of state, thermodynamics, homogeneous, and hetrogeneous equilibria. The phase rule, chemical activities and coefficients. Prerequisite: CHEM 222. Co-requisites: MATH 264 and PHYS 185 or PHYS 195. NOTE: General Honors Course (must take CHEM 324 to receive General Honors credit).

CHEM 324 — Physical Chemistry I Laboratory
1 hour (offered fall only)
Selected experiments from topics listed in CHEM 323 and an individual project. To be taken with CHEM 323. Prerequisite: CHEM 222. Co-requisites: MATH 264 and PHYS 185 or 195. CHEM 332 or 333 are highly recommended as prerequisites. NOTE: General Honors Course in conjunction with CHEM 323.

CHEM 325 — Physical Chemistry II
3 hours (offered spring only)
Kinetic theory, chemical kinetics, symmetry, quantum mechanics, the solid state, atomic and molecular structure, bonding, and spectroscopy. Co-requisite: MATH 264, PHYS 186 or PHYS 196. NOTE: General Honors Course (must take CHEM 326 to receive General Honors credit).

CHEM 326 — Physical Chemistry II Laboratory
1 hour (offered spring only)
Selected experiments from topics listed in CHEM 325 and an individual project. To be taken with CHEM 325. Prerequisite: CHEM 222. CHEM 332 or 333 are highly recommended as prerequisites. NOTE: General Honors Course in conjunction with CHEM 325.

CHEM 328 — Forensic Science
3 hours
Principles of chemistry applied to forensic problems. Students will learn scientific techniques, instruments, and procedures used in crime laboratories. Prerequisite: 20 hours of chemistry.

CHEM 329 — Organic Chemistry I
3 hours (offered fall, spring)
Fundamental organic chemistry including nomenclature, synthesis, stereochemistry, reaction mechanisms on a molecular level, theoretical aspects of chemical bonding, and introductory chemical phenomena through alcohols. Prerequisite: CHEM 121. NOTE: General Honors Course (must take CHEM 330 or CHEM 333 to receive General Honors credit).

CHEM 330 — Organic Chemistry I Lab
1 hour (offered fall, spring)
Introduction to modern organic laboratory with emphasis on techniques of separation and purification including gas chromatography, distillation, extraction, and thin layer chromatography. Introduction to simple preparative experiments. Prerequisite: CHEM 329. NOTE: General Honors Course in conjunction with CHEM 329.

CHEM 331 — Organic Chemistry II
3 hours (offered fall, spring, summer)
Continuation of CHEM 329 with emphasis on increasing the scope of the student's organic knowledge. Aromatic chemistry, ketones, acids, acid derivatives, amines, polyfunctional groups, sugars, amino acids, proteins, and mechanisms of reactions. Examples from physiology are used. Prerequisite: CHEM 329. NOTE: General Honors Course (must take CHEM 332 or 333 to receive General Honors credit).

CHEM 332 — Organic Chemistry II Lab
1 hour (offered fall, spring)
Exploratory mechanistic and synthetic chemistry based on NMR and IR spectroscopy and modern synthetic methods. Prerequisite: CHEM 330, CHEM 331. NOTE: General Honors Course in conjunction with CHEM 331.

CHEM 333 — Organic Chemistry Lab
2 hours (offered fall, spring, summer)
Introduction to modern organic laboratory with initial emphasis on techniques of separation, purification, and qualitative identification, including crystallization, distillation, extraction, gas, the thin layer chromatography, etc. Simple preparative experiments followed by multistep syntheses. Exploratory mechanistic chemistry based on modern techniques such as NMR and IR spectroscoopy. This course is equivalent to the combination of CHEM 330 and CHEM 332. Prerequisite: CHEM 329 and pre- or co-requisite CHEM 331. NOTE: General Honors Course in conjunction with CHEM 329 or CHEM 331.

CHEM 345 — Junior Chemistry Seminar
1 hour (offered fall)
An introduction to chemical literature, online searching and assimilation of chemical information. These foci are synthesized into a professional presentation given over a topic in chemistry, chosen and researched by the student. Prerequisite: CHEM 245.

CHEM 360 — Scientific Publishing
3 hours
History, protocol, process, and problems of scribal (print) communications in scientific communities are presented in the context of a practicum experience in which students prepare a manuscript for publication in the technical literature. Topics covered include peer review, status-quality synergisms, editor-author interactions, citation development,

legal implications of copyright and plagiarism, professional issues in technical journalism, and the impact of misconduct in science on the integrity of scientific publishing. Prerequisites: Instructor's permission and completion of ENG 190, CHEM 121, and CHEM 222.

CHEM 391 — Internship for Chemistry Majors
4-12 hours
On-the-job-training in a chemistry field to complement the student's academic education. These credits are **only** elective credit. Only with **prior** Chemistry faculty approval will three credits of CHEM 391 and 392 be allowed for Chemistry Advanced Elective Credit.

CHEM 392 — Evaluation and Analysis of Internship
1-3 hours
Encompassing research, analytical analysis, and evaluation of internship experience. These credits are **only** elective credit. Only with **prior** Chemistry faculty approval will three credits of CHEM 391 and 392 be allowed for Chemistry Advanced Elective Credit. See listed criteria for CHEM 443.

CHEM 421 — Biochemistry
4 hours (offered fall, spring)
Introduction to biochemical terminology, concepts, theories, and laboratory techniques, including common classes of biological molecules, enzymatic reactions, and metabolism. All topics are studies in the context of modern biochemical literature and investigative laboratory experiments. Prerequisites: CHEM 331 and CHEM 332 or 333. NOTE: General Honors Course.

CHEM 422 — Advanced Topics in Organic Chemistry
3 hours (offered fall only)
Continuation of CHEM 331. Considers advanced topics in organic chemistry. Lecture only. Prerequisite: instructor's permission, CHEM 323-326, and CHEM 331/332 or 333.

CHEM 430 — Advanced Physical Chemistry
3 hours (offered spring-odd calendar years)
In-depth studies of topics in modern physical chemistry. Surface phenomena, applications of group theory, spectroscopy, X-ray diffraction. Primarily a lecture course intended for graduate school bound students. Co-requisite: CHEM 326. Prerequisite CHEM 323-325.

CHEM 431 — Advanced Analytical Chemistry
3 hours (offered spring)
In-depth study of advanced methods in analytical chemistry. Based on recent scientific literature. Prerequisite: Grade of C or better in CHEM 322.

CHEM 441 — Chemistry Research I
1-3 hours (offered fall, spring, summer)
Individual study and laboratory research under a member of the Chemistry faculty. Prerequisite: 20 hours of Chemistry.

CHEM 442 — Chemistry Research II
1-3 hours (offered fall, spring, summer)
Continuation of CHEM 441. Co-requisite or prerequisite: CHEM 441.

CHEM 443 — Chemistry Research III
1-3 hours (offered fall, spring, summer)
Co-requisite or prerequisite: CHEM 325 and CHEM 326 and approval of proposal by Chemistry discipline.
Criteria
1. Enrollment in the course will not be issued until research proposal has been approved.
2. The proposal which has been reviewed and approved by the faculty mentor must be submitted by December 1 for consideration for spring semester, August 1 for fall semester, and May 1 for summer session.
3. The final draft of the research report must be turned in to the research mentor and convener before issuance of a final grade.

CHEM 445 — Senior Chemistry Seminar
1 hour (offered fall)
Senior Seminar coordinates the transition of the graduating Chemistry Major to the next goal, whether professional employment or graduate school. The seminar assists the student in preparing for senior exams, developing a résumé and interview skills, setting long-range career goals, and applying to graduate school.

CHEM 475 — Inorganic Chemistry
4 hours (offered fall only)
Inorganic chemistry topics covered in detail and grounded in theoretical considerations, supported by laboratory experience. Topical discussions include group theory, bonding models, compound stability, spectroscopy of coordination compounds and other current topics in inorganic chemistry. Prerequisites: CHEM 323, CHEM 324, CHEM 325, and either CHEM 332 or CHEM 333.

CHEM 476 — Advanced Inorganic Chemistry
3 hours (offered spring only)
Considers recent advances in modern inorganic chemistry based on the current literature through extensive student contributions via oral and written components. Topics may include advanced spectroscopy, organometallics, bioinorganic chemistry and supramolecular chemistry. Prerequisite: CHEM 475.

CHEM 518 — Advanced Topics (Topic)
1-3 hours (each topic)
An in-depth study of selected Chemistry topics presented under formal classroom or laboratory organization. Prerequisite: CHEM 325-326. (Not intended for individualized study).

NATURAL SCIENCE

NASC 140 — Physical Geology
4 hours
This course includes laboratory investigations. A study of the materials comprising the crust of the earth and of the various processes which have shaped the surface of the earth.

NASC 331 — Philosophy of Science
4 hours
The course is designed to present the historical and philosophical foundations of science to pre-elementary education students. Prerequisites: BIOL 100, CHEM 100, or PHYS 100, or their equivalent.

NASC 400 — The History of Science to 1700
3 hours (offered fall only)
Introduction to basic topics in the history of science from ancient Greece to Isaac Newton. Students will read a variety

of primary and secondary sources covering three time periods: the origins of western science in Greece and the Middle East, the nature of science in medieval Islam and medieval Europe, and the Scientific Revolution in Europe (1500-1700). Emphasis is placed on the historical, philosophical, and religious influences on the emergence of western science. Previous knowledge of science or history is helpful, but not necessary. NOTE: General Honors Course.

NASC 401 — The History of Science since 1700
3 hours (offered spring only)
Introduction to basic topics in history of modern science from Isaac Newton to the present. Topics include the Chemical Revolution, the rise of the atomic theory, Darwin and evolution, Einstein and relativity, and Watson and Crick on DNA. Emphasis is placed on the historical, philosophical, and religious influences on the practice of modern science. Previous knowledge of science or history is helpful, but not necessary. NOTE: General Honors Course.

PHYSICS

PHYS 100 — Concepts in Physics
4 hours (offered fall, spring)
This course presents an overview of our understanding of the physical world, covering some of the main concepts, theories, and experimental techniques of physics. While the course focuses primarily on the conceptual understanding of physics, it also explores some of its historical, technological, philosophical, and aesthetic aspects, and its place in the history of ideas. The range of possible topics includes Newton's laws of motion, gravity, heat, sound, electricity, magnetism, light, relativity, quantum theory, elementary particles and nuclear physics. Basic algebra skills are expected of the students. The course has a laboratory component that emphasizes quantitative measurements.

PHYS 145 — Physics Seminar
1 hour (offered fall)
This seminar, offered pass/fail, will serve as an introduction to the physics discipline, while focusing on an area of modern physics (such as relativity, chaos, cosmology, elementary particles, etc.). This course is for physics and engineering majors.

PHYS 185 — College Physics I
4 hours (offered fall, spring)
The motion of objects, from particles to planets, is the focus of this course. The revolution in human understanding of *mechanics*, inspired by Galileo and developed by Newton and others is the lens through which our modern mechanical world is surveyed. Students will make extensive use of algebra and trigonometry in applying the fundamental laws of classical physics to real-world problems, and will explore the physicist's approach to inquiry through laboratory investigations. Prerequisite: MATH 186 or equivalent. NOTE: General Honors Course.

PHYS 186 — College Physics II
4 hours (offered fall, spring)
Maxwell's synthesis of electricity and magnetism in the mid-nineteenth century led to unexpected knowledge about the nature of light. It opened the door to a whole new world view developed by twentieth century physicists and paved the way for the technological revolution that characterizes modern life. Students will make extensive use of algebra and trigonometry in applying the fundamental laws of classical physics to real-world problems, and will explore the physicist's approach to inquiry through laboratory investigations. Prerequisite: PHYS 185. NOTE: General Honors Course.

PHYS 195 — Physics with Calculus I
5 hours (offered fall, spring)
Students will study the fundametal laws of motion (mechanics), plus thermodynamics, vibrations, and mechanical waves, mastering the skills and concepts needed for advanced work in science and engineering. Some of the history of physics, its technological, philosophical, and aesthetic aspects, and its place in the history of ideas will be explored. This course includes a laboratory component. Pre- or Co-requisite: MATH 198. NOTE: General Honors Course.

PHYS 196 — Physics with Calculus II
5 hours (offered fall, spring)
Students will study the fundamental laws of electromagnetism, plus fluids and optics, mastering the skills and concepts needed for advanced work in science and engineering. Students will also explore some of the history of physics, its technological, philosophical, and aesthetic aspects, and its place in the history of ideas. This course includes a laboratory component. Prerequisite: Grade of C or better in PHYS 195; Pre- or Co-requisite: MATH 263. NOTE: General Honors Course.

PHYS 208 — Design and Drafting
2 hours (offered fall)
The study of design-drafting as the language of a modern technological society, a graphic language which is as definite and separate as any other language. Emphasis upon the interpretation and visualization of graphic representations of engineering drawings. Includes a study of the theory and principles of computer-aided graphics and design.

PHYS 245 — Meteorology
4 hours
An introductory course which surveys the general principles and techniques of atmospheric science and introduces students to the atmospheric environment in which we live. Designed to give a better understanding of clouds, precipitation, air masses, frontal systems, jet streams, El Niño, weather forecasting, and our atmosphere in general. The course includes a laboratory component. Prerequisite: College Algebra and Trigonometry or Elementary Functions.

PHYS 246 — Astronomy I
4 hours (offered fall)
Qualitative and quanitative introduction to the development of astronomy which includes the contributions made by early astronomers, celestial mechanics, time, electromagnetic radiation, telescopes and astronomical instrumentation. Planets, planet motions, stellar motions, smaller solar system objects and the motions of these objects both apparent and real will be covered. Laboratory emphasis will be astronomical observations with telescopes, and during poor seeing conditions analysis of data collected by professional astronomers. Prerequisite: College Algebra and Trigonometry or Elementary Functions.

PHYS 250 — Modern Physics I
3 hours (offered fall)
An introductory course in relativity and quantum mechanics. Prerequisites: PHYS 196, MATH 263, with grades of "C" or better. NOTE: General Honors Course.

PHYS 251 — Modern Physics II
3 hours (offered spring)
A continuation of PHYS 250. Introduction to the quantum mechanical description of atmos, molecules, nuclei, particles, and condensed matter. Prerequisite: grade of "C" or better in PHYS 250. NOTE: General Honors Course.

PHYS 275 — Vibrations and Waves
3 hours (offered fall)
Physical systems disposed to simple harmonic motion and wave phenomena are studied in depth. Prerequisites: PHYS 196, MATH 263, with grades of "C" or better.

PHYS 320 — Electronics
3 hours (offered spring)
A strongly laboratory-oriented survey of electronic devices and circuits. Electronic test instruments; passive devices; transistors; operational amplifiers; logic chips. Prerequisite: grade of "C" or better in PHYS 196. NOTE: General Honors Course.

PHYS 345 — Junior Seminar
1 hour (offered spring)
A summary of the Physics coursework. Papers and presentations required. Pre- or co-requisite: PHYS 251.

PHYS 346 — Astronomy II
3 hours
Stellar astronomy and cosmology. Prerequisite: PHYS 246.

PHYS 360 — Radiation Science I
3 hours
The fundamentals of radioisotope techniques. Prerequisite: 4 hours of Chemistry or 4 hours of Physics.

PHYS 370 — Radiation Science II
3 hours
Radioisotope techniques relevant to problems in chemistry and biology. Prerequisite: PHYS 360.

PHYS 380 — Optics
3 hours
Optics at the intermediate level, including geometrical optics, wave optics, and quantum optics. Prerequisite: grade of "C" or better in PHYS 275. NOTE: General Honors Course.

PHYS 382 — Mathematical Physics
3 hours (offered spring)
Mathematical methods commonly used in physics. Topics may include vector and tensor analysis, matrices, Fourier transforms, special functions, functions of a complex variable, Taylor expansion, and partial differentiation. Prerequisites: grade of "C" or better in PHYS 196 and MATH 263. NOTE: General Honors Course.

PHYS 383 — Fundamentals of Electric Circuits
3 hours (offered spring)
Laws, Mesh and Nodal analysis of circuits, Network theorems, Transient and complete response of RL, RC, and RLC circuits. Frequency analysis and phasors. Prerequisites: PHYS 196, MATH 263.

PHYS 386 — Classical Mechanics
3 hours (offered fall)
Kinematics, dynamics of a particle, central forces, energy, and momentum. Lagrange and Hamilton's Equations, dynamics of a rigid body. Prerequisites: grade of "C" or better in PHYS 275 and PHYS 382. Pre- or Co-requisite: MATH 365. NOTE: General Honors Course.

PHYS 387 — Statics
3 hours (offered fall)
Engineering statics. Resultants of force systems, centroids, equilibrium, stresses in structures, friction, moments of inertia, products of inertia. Prerequisite: PHYS 195. Co-requisite: MATH 264.

PHYS 388 — Advanced Laboratory
3 hours (offered fall, spring)
Experiments in light, heat, electricity and magnetism, and modern physics. Pre- or co-requisite: PHYS 250. NOTE: General Honors Course.

PHYS 391 — Internship for Physics Majors
4-12 hours
On-the-job field training in scientific fields. To complement the student's academic education. Three hours only may be taken as part of restricted electives in the Major.

PHYS 392 — Evaluation and Analysis of Internship
1-3 hours
Encompassing research, analytical analysis, and evaluation of internship experiences. Co-requisite: PHYS 391.

PHYS 441 — Physics Research I
1-3 hours
Individual study, under the close supervision of a faculty member, on an assigned problem. The goal of the research is to produce work of a quality which can be published in a professional journal or reported at a professional meeting. Requires the approval of the supervising faculty member. NOTE: General Honors Course (must have 3 hours credit for General Honors.)

PHYS 442 — Physics Research II
1-3 hours
A continuation of PHYS 441.

PHYS 443 — Physics Research III
1-3 hours
A continuation of PHYS 442.

PHYS 444 — Independent Studies (Topic)
1-5 hours (each topic)
This course provides flexibility for students who are in need of or desire special coursework. Requires the approval of the supervising faculty member.

PHYS 445 — Advanced Physics Seminar
1 hour
Independent and in-depth investigation of a specific topic in physics or related to physics. This course serves as the

capstone course for students in the Physics BA program. Prerequisites: grade of "C" or better in PHYS 251, PHYS 275, PHYS 382, and junior or senior status.

PHYS 482 — Electricity and Magnetism
3 hours (offered spring)
A rigorous mathematical treatment of electrostatics, magnetostatics, and electrodynamics. Additional topics, such as radiation and special theory of relativity may be covered. Prerequisites: grade of "C" or better in MATH 365, PHYS 275, and PHYS 382. NOTE: General Honors Course.

PHYS 486 — Thermodynamics and Statistical Mechanics
3 hours (offered spring)
Advanced treatment of thermodynamic systems; thermodynamic cycles; absolute scales of temperatures; entropy; thermodynamic potentials; fundamentals of statistical mechanics; microcanonical, canonical, and grand canonical ensembles with applications to classical and quantum systems. Prerequisites: grade of "C" or better in PHYS 251, PHYS 275, PHYS 382, and MATH 264. NOTE: General Honors Course.

PHYS 490 — Senior Research I
3 hours (offered fall)
Students will work closely with a faculty member on an independent project, culminating in an external presentation and a final paper in which you will present your results. This is the first of a two-semester capstone required for the BS in physics. Prerequisites: grades of "C" or better in PHYS 251, PHYS 275, PHYS 382, PHYS 388.

PHYS 491 — Senior Research II
1 hour (offered spring)
Students will work closely with a faculty member on an independent project, culminating in an external presentation and a final paper in which you will present your results. This is the second of a two-semester capstone required for the BS in physics. Prerequisite: PHYS 490.

PHYS 518 — Advanced Topics (Topic)
1-5 hours (each topic) (offered spring)
An in-depth study of selected science topics presented under formal classroom organization (not intended for individualized study). Prerequisites: Grade of "C" or better in PHYS 251, PHYS 275, PHYS 351, and PHYS 382.

PHYS 580 — Quantum Mechanics
3 hours (offered fall)
Quantum Mechanics is the physics of the very small. A system is described using a wave function, which evolves in time according to the Schrödinger Equation. Students will learn to interpret the wave function and how to expand it in terms of states of well-defined energy. These techniques will be applied to various systems in one and three dimensions, and the concepts of quantized angular momentum, intrinsic spin, and identical particles will be explored. Prerequisites: grades of "C" or better in PHYS 251, PHYS 275, and PHYS 382. NOTE: General Honors Course.

PHYS 581 — Introduction to Solid State Physics
3 hours
The physical properties of solids. Topics include crystal structure, thermal and magnetic properties, band theory, and semiconductors. Prerequisites: grade of "C" or better in PHYS 251, PHYS 275, and PHYS 382.

FACULTY CREDENTIALS

Note: Date in parentheses indicates year of employment at Truman. *Indicates Biology graduate faculty.

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