Proposal

Bachelor of Arts/Bachelor of Science in Biochemistry

Institution: University of Southern Indiana
College: Science and Engineering
Department: Chemistry
Degree Program Title: Biochemistry
Form of Recognition to be Awarded/
Degree Code: Bachelor of Arts in Biochemistry/
Bachelor of Science in Biochemistry
Suggested CIP Code: 26.0202
Location of Program/Campus Code: Evansville
Projected Date of Implementation: Spring Semester, 2010
Date Proposal was Approved by
Institutional Board of Trustees: May 9, 2009

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Signature of Authorizing Institutional Officer

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Date

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Date Received by
Commission for Higher Education

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Commission Action

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Date
ABSTRACT
Bachelor of Arts/Bachelor of Science in Biochemistry
To be offered on-campus by the University of Southern Indiana, Evansville, Indiana

Objectives:
The two primary objectives of the proposed biochemistry program are to provide baccalaureate prepared biochemists for scientific careers in industries such as biotechnology, pharmacology, and environmental chemistry and to prepare students for graduate study or professional schools in medicine, pharmacy, and related fields.

The proposed program in biochemistry will provide students the opportunity to earn an interdisciplinary baccalaureate degree separate from the currently existing degrees in chemistry and biology. The field of biochemistry focuses on the scientific study of the chemistry of living systems, their fundamental chemical substances and reactions, and their chemical pathways and information transfer systems, with particular reference to carbohydrates, proteins, lipids, and nucleic acids.

Clientele to be Served:
The biochemistry program will serve both traditional and non-traditional students from Indiana, particularly southwest Indiana and the Tri-state region. Since no such program exists at a public higher education institution within a 120-mile radius of Evansville, this program also will attract students from western Kentucky and southern Illinois. Additionally, this program will provide further educational opportunities for graduates from two-year associate degree programs, especially biotechnology graduates from Ivy Tech Community College and transfer students from other two- and four-year biology and/or chemistry programs.

Currently, a chemistry 2+2 agreement exists with Ivy Tech Community College-Evansville. A biochemistry 2+2 agreement will be created allowing graduates with associate degrees in biotechnology from Ivy Tech Community College-Evansville to seamlessly transfer to the biochemistry program at the University of Southern Indiana.

The biochemistry program is intended for full-time students with the majority of upper-level classes offered during the daytime hours. A limited assortment of evening classes will be available.

Curriculum:
The Bachelor of Arts/Bachelor of Science in Biochemistry degree will be comprised of a minimum 124 semester hours. Depending on the degree option, American Chemical Society or non-American Chemical Society approved, the program will consist of 40-47 hours in chemistry and 11-25 hours in biology. The total hours required within the program is consistent with other interdisciplinary degree programs. In addition, there are several pre-requisite courses that include 8-10 hours in physics and 4-8 hours in calculus. The necessary 50 credit hours in the University’s core curriculum and elective courses complete the requirements. The program will require two hours of biochemistry related research, and students will be encouraged to participate in cooperative work assignments, internships, and research opportunities nationally.

<table>
<thead>
<tr>
<th>BA/BS – ACS Approved</th>
<th>BA/BS - non-ACS Approved</th>
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<tbody>
<tr>
<td>47 hours chemistry</td>
<td>40 hours chemistry</td>
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<tr>
<td>11 hours biology</td>
<td>23-25 hours biology</td>
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<tr>
<td>10 hours physics</td>
<td>8 hours physics</td>
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<tr>
<td>8 hours calculus</td>
<td>4 hours calculus</td>
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Employment Possibilities:
Graduates of the proposed program will be prepared for application to advanced degree programs such as medical, dental, or pharmacy schools or graduate programs in biochemistry, chemistry, or biology. Additionally, graduates will be prepared for immediate employment in medical, industrial, and government positions as scientists, lab technicians, research assistants, and chemists.

The expanding field of biotechnology and pharmaceutical research in Indiana will result in additional job opportunities for these graduates. In addition, anticipated growth in agriculture and bio-fuels industries will increase job opportunities for graduates. With the advances in biotechnology and the concomitant expansion of career opportunities in biotechnology, the proposed program will provide highly marketable graduates seeking such careers.
Program Description

1. Proposed Program and Its Objectives

The primary objectives of the proposed biochemistry program are to provide baccalaureate prepared biochemists for scientific careers in industries such as biotechnology, pharmacology, and environmental chemistry and to prepare students for graduate study or professional schools in medicine, pharmacy, and related fields.

The secondary objectives of the proposed biochemistry program are to provide a non-American Chemical Society option to the Bachelor of Arts/Bachelor of Science in Biochemistry degree that allows students the opportunity to include a larger biology component to their study in chemistry and to provide an “official” biochemistry title to the minor option under the current chemistry program, distinguishing this minor from the more traditional chemistry minor.

2. Admission Requirements, Anticipated Student Clientele, and Student Financial Support
   a. Admission Requirements. Admission to the proposed degree program will be consistent with the general admission policies of the University of Southern Indiana.
   
   b. Prerequisite Coursework or Degrees. High school graduates who have completed one or two years of high school chemistry, one or two years of high school biology, and three or four years of high school mathematics should be prepared for success in this program. One year of high school physics is strongly encouraged. Entering students who have taken high school chemistry but had low performance and those who have not taken high school chemistry may need to take the CHEM 175: Survey of Chemical Concepts course during their first term at the University of Southern Indiana. MATH 230: Calculus I is the first required mathematics course in the degree program. Students who have inadequate high school math skills and/or math placement scores may be required to enroll in lower-level mathematics courses to prepare for calculus and the technical nature of the curriculum.
   
   c. Student Clientele. The program is designed to allow well-prepared, full-time students to fulfill the degree requirements in four years. The proposed program will serve both traditional and non-traditional students in the Tri-state region. Since no such program exists at a public higher education institution within a 120-mile radius of Evansville, this program will attract students from western Kentucky and southern Illinois also. Additionally, this program will provide further education opportunities for graduates of two-year associate degree programs and transfer students.
   
   d. Enrollment Restrictions. No enrollment restrictions beyond those of the university are contemplated.
   
   e. Student Financial Support. USI Presidential Scholarships offer full four-year scholarships to qualified Indiana high school valedictorians and salutatorians. Other scholarships, grants, loans, and work-study programs are available through the University of Southern Indiana Office of Student Financial Assistance. Students may earn other scholarships and awards targeted for chemistry majors during their study at USI. These include the following:
• Departmental Scholarship
• John Logsdon Scholarship
• Brian and Tara Mullen Scholarship
• American Chemical Society Student Affiliate Scholarship
• American Chemical Society Indiana/Kentucky Border Section Sophomore and Senior Awards

3. Proposed Curriculum
  a. Requirements. The Bachelor of Arts/Bachelor of Science in Biochemistry degree will be comprised of a minimum 124 semester hours. Two years of foreign language credit distinguishes the Bachelor of Arts from the Bachelor of Science. The number of hours required in this program is consistent with other interdisciplinary programs. In addition to courses required to complete the 50 credit hours in the University Core Curriculum, the following illustrates the required science and math courses.

  American Chemical Society approved degree:
  chemistry - 47 hours
  biology - 11 hours
  physics - 10 hours
  calculus - 8 hours (required pre-requisite courses)

  Non-American Chemical Society approved degree:
  chemistry - 40 hours
  biology - 23-25 hours
  physics - 8 hours
  calculus - 4 hours (required pre-requisite courses)

Additionally, the program offers a minor in biochemistry, requiring 38 semester hours comprised of 27 hours of chemistry and 11 hours of biology.

The course listings by degree options are listed below.

Major – American Chemical Society Approved
Required Chemistry Courses – 47 credit hours
  CHEM 118-419: Chemistry Seminar sequence (eight 0.5 hour courses), 4 hours
  CHEM 261: General Chemistry I, 4 hours
  CHEM 262: General Chemistry II, 4 hours
  CHEM 321: Quantitative Analysis, 3 hours
  CHEM 353: Organic Chemistry I, 4 hours
  CHEM 354: Organic Chemistry II, 4 hours
  CHEM 421: Instrumental Analysis I, 3 hours
  CHEM 422: Instrumental Analysis II, 3 hours
  CHEM 431: Biochemistry I, 4 hours
  CHEM 432: Biochemistry II, 4 hours
  CHEM 441: Inorganic Chemistry, 4 hours
  CHEM 461: Physical Chemistry I, 4 hours
  CHEM 499: Introduction to Research or BIOL 492: Special Problems, 2 hours
Required Biology Courses – **11 credit hours**
- BIOL 141: Principles of Biology, 4 hours
- BIOL 334: Cell Biology, 3 hours
- BIOL 382: Genetics, 4 hours

Other Required Pre-requisite Courses – **18 credit hours**
- MATH 230: Calculus I, 4 hours
- MATH 330: Calculus II, 4 hours
- PHYS 205: Intermediate Physics I, 5 hours
- PHYS 206: Intermediate Physics II, 5 hours

**Major – non-American Chemical Society Approved**

Required Chemistry Courses – **40 credit hours**
- CHEM 118-419: Chemistry Seminar sequence (eight 0.5 hour courses), 4 hours
- CHEM 261: General Chemistry I, 4 hours
- CHEM 262: General Chemistry II, 4 hours
- CHEM 321: Quantitative Analysis, 3 hours
- CHEM 353: Organic Chemistry I, 4 hours
- CHEM 354: Organic Chemistry II, 4 hours
- CHEM 361: Survey of Physical Chemistry, 4 hours
- CHEM 421: Instrumental Analysis I, 3 hours
- CHEM 431: Biochemistry I, 4 hours
- CHEM 432: Biochemistry II, 4 hours
- CHEM 499: Introduction to Research (or BIOL 492 Special Problems), 2 hours

Required Biology Courses – **23-25 credit hours**
- BIOL 141: Principles of Biology, 4 hours
- BIOL 151: Botany, 3 hours
- BIOL 152: Zoology, 3 hours
- BIOL 334: Cell Biology, 3 hours
- BIOL 382: Genetics, 4 hours
  - And two courses from the following list (BIOL 375 and 376 count as one course)
- BIOL 333: Animal Physiology, 4 hours
- BIOL 336: Plant Physiology, 4 hours
- BIOL 375: Microbiology (with BIOL 376), 3 hours
- BIOL 376: Laboratory in Microbiology (with BIOL 375), 2 hours
- BIOL 378: Virology, 3 hours
- BIOL 422: Immunology, 3 hours
- BIOL 436: Molecular Biology Techniques, 4 hours
- BIOL 461: Developmental Biology, 4 hours
- BIOL 465: Plant Growth and Development, 4 hours
- BIOL 482: Molecular Biology, 3 hours

Other Required Pre-requisite Courses – **12 credit hours**
- MATH 230: Calculus I, 4 hours
- PHYS 175: General Physics I, 4 hours
- PHYS 176: General Physics II, 4 hours

**NOTE:** Additional electives in chemistry, biology, and math are required.
The course descriptions for the courses mentioned above are presented below. The course in italics is a newly developed course for the major.

Chemistry Courses

**CHEM 118/119: Freshman Chemistry Seminar I and II, .5 hour each totaling 1 hour**
This two-semester sequence is an introduction to chemical literature and career information. Students will conduct literature searches and prepare outlines, summaries, and reports on various topics.
118 Fall and 119 Spring

**CHEM 218/219: Sophomore Chemistry Seminar I and II, .5 hour each totaling 1 hour**
This two-semester sequence is a continuation of CHEM 118/119. A more in-depth study of the chemical literature will be presented. Seminar speakers will provide expertise in a variety of chemical disciplines. Students will be responsible for minor presentations in addition to preparation of summaries and reports on various topics. Prerequisites: CHEM 119, CHEM 218.
218 Fall and 219 Spring

**CHEM 261: General Chemistry I, 4 hours**
Systematic study of the essential nomenclature, hypotheses, theories, and laws of chemistry necessary for chemistry majors and minors. Some of the topics presented in the course include stoichiometry, atomic structure, thermochemistry, solutions, crystal structure, and gas laws. Prerequisite: MATH 111 or MATH 118 or CHEM 175 or consent of instructor.
(3 hours lecture - 1 hour laboratory) Fall, Spring, Summer

**CHEM 262: General Chemistry II, 4 hours**
A continuation of CHEM 261 with laboratory work in qualitative analysis. Some of the topics presented include kinetics, equilibrium, ionic equilibrium, thermodynamics, electrochemistry, nuclear and organic chemistry. Prerequisite: CHEM 261 or equivalent.
(3 hours lecture - 1 hour laboratory) Fall, Spring, Summer

**CHEM 318/319: Junior Chemistry Seminar I and II, .5 hour each totaling 1 hour**
Students will use online databases such as Dialog, Scifinder, and STN to research chemistry literature and patents in order to prepare scientific manuscripts, posters, and seminars. In addition, students will attend seminars by outside professionals and write reports on presentations. Prerequisites: CHEM 219, CHEM 318.
318 Fall and 319 Spring

**CHEM 321: Quantitative Analysis, 3 hours**
Principles and techniques of gravimetric, volumetric, spectrophotometric, and electrochemical analysis are developed in lecture and laboratory. Prerequisite: CHEM 262 or consent of instructor.
(2 hours lecture - 1 hour laboratory) Spring, Summer

**CHEM 341: Environmental Chemistry, 3 hours**
A combination field, lecture, demonstration, and laboratory course to study the collection, analysis, and effects of chemicals in the environment. Prerequisites: CHEM 321, CHEM 353 or consent of instructor.
(2 hours lecture - 1 hour laboratory) Fall, odd-numbered years
CHEM 351: Polymer Chemistry, 3 hours
A study of the physical chemistry of macromolecules; standard methods of polymer
synthesis; chemical kinetics; and characterization and processing methods. Prerequisites:
CHEM 354, CHEM 461 or consent of instructor.
(2 hours lecture - 1 hour laboratory) Spring, odd-numbered years

CHEM 353: Organic Chemistry I, 4 hours
Development of the fundamentals of aliphatic and aromatic organic chemistry with special
emphasis on structure and mechanism. Structure, nomenclature and physical properties of
all organic functional groups are included. Prerequisite: CHEM 262.
(3 hours lecture - 1 hour laboratory) Fall, Spring, Summer

CHEM 354: Organic Chemistry II, 4 hours
Continuation of CHEM 353 including alicyclic and aromatic compounds. Prerequisite:
CHEM 353.
(3 hours lecture - 1 hour laboratory) Fall, Spring, Summer

CHEM 361: Survey of Physical Chemistry, 4 hours --- New Course
Selected topics from applied chemical thermodynamics, kinetics, statistical mechanics and
quantum mechanics. Required expressions are developed from fundamental principles
utilizing calculus. Laboratory experience providing exercises in thermodynamics, kinetics
and spectroscopy is included. Biological applications are explored in lecture and
laboratory when appropriate. Prerequisites: MATH 230, PHYS 206 or PHYS 176, CHEM
321.
(3 hours lecture - 1 hour laboratory) Fall

CHEM 418/419: Senior Chemistry Seminar I and II, .5 hour each totaling 1 hour
Continuation of CHEM 318/319. In addition, students will prepare resumes and
applications and learn about selecting a graduate or professional school and interviewing
skills. Prerequisite: CHEM 319, CHEM 418.
418 Fall and 419 Spring

CHEM 421: Instrumental Methods of Analysis I, 3 hours
Introduction to the instruments and techniques currently used for chemical analysis.
Emphasis on spectrophotometric methods and chromatographic methods of analysis.
Laboratory work provides students with experience using the instrumental techniques
described in this course. Prerequisites: CHEM 321, CHEM 354, PHYS 206.
(2 hours lecture - 1 hour laboratory) Fall

CHEM 422: Instrumental Methods of Analysis II, 3 hours
Continuation of CHEM 421 with emphasis on electronics, electrochemical analysis, mass
spectrometry, and advanced instrumental methods. Laboratory work provides students
with experience using the instrumental techniques described in this course. Prerequisite:
CHEM 421.
(2 hours lecture - 1 hour laboratory) Spring
CHEM 431: Biochemistry I, 4 hours
Biochemistry of amino acids, proteins, nucleic acids, lipids, carbohydrates, and the actions of enzymes. Encompasses chemical properties and techniques involved in the study of these macromolecules and their monomeric units. Prerequisite: CHEM 354. (3 hours lecture - 1 hour laboratory) Fall

CHEM 432: Biochemistry II, 4 hours
Continuation of CHEM 431 including major metabolic pathways with emphasis on energy consideration and interrelationships of pathways; inorganic metabolism, acid-base balance and hormones. Prerequisite: CHEM 431. (3 hours lecture – 1 hour laboratory) Spring

CHEM 441: Inorganic Chemistry, 4 hours
Introduction to the chemistry of all the elements, developed from the principles governing atomic structure and bonding, with special emphasis on transition metal and organometallic chemistry. Prerequisites: CHEM 354, CHEM 461. (3 hours lecture – 1 hour laboratory) Spring

CHEM 453: Advanced Organic Chemistry, 3 hours
Advanced course in organic chemistry in which selected topics will be examined. Prerequisite: CHEM 354. (2 hours lecture - 1 hour laboratory) Spring, even years

CHEM 461: Physical Chemistry I, 4 hours
Introduction to kinetic molecular theory, chemical thermodynamics, and kinetics. Students will explore the development of these theories from fundamental principles using multivariable calculus. Selected results from statistical mechanics also will be included. Laboratory work is designed to engage students in practical application of these theories and to expand their understanding of formal scientific communication. Prerequisites: CHEM 321, MATH 330, PHYS 206. MATH 335 is recommended but not required. (3 hours lecture - 1 hour laboratory) Fall

CHEM 499: Introduction to Research, 1-2 hours
May be repeated up to 8 hours. Original problems in experimental and theoretical chemistry. Prerequisites: consent of instructor and approval of department chair. Fall, Spring, Summer

Biology Courses

BIOL 141: Principles of Biology, 4 hours
Introductory survey of the fundamental characteristics and processes of living organisms, including cell structure and function, energetics, genetics, development, evolution, and ecology. Laboratories include both didactic and investigative explorations of these processes. Prerequisites: Placement in ENG 100 or higher English writing course and C or better in MATH 100 or placement in higher level college math course, and science major or consent of instructor. (3 hours lecture – 1 hour laboratory) Fall, Spring, Summer
BIOL 151: Botany, 3 hours
Fundamentals of plant structure and function are explored in the context of plant diversity and evolution. Consideration is given to variation in plant morphological and physiological strategies for life in a different environment. Primarily for majors and minors in biology. Prerequisite: BIOL 141.
(2 hours lecture – 1 hour laboratory) Fall, Spring

BIOL 152: Zoology, 3 hours
Survey of the adaptations and taxonomic relationships of the major animal phyla with emphasis on evolutionary trends. Primarily for majors and minors in biology. Prerequisite: BIOL 141.
(2 hours lecture – 1 hour laboratory) Fall, Spring

BIOL 333: Animal Physiology, 4 hours
In-depth study of functional processes with selected comparisons of physiological phenomena in animals. Laboratory emphasis on experimental design. Prerequisite: BIOL 152, CHEM 241 or CHEM 353 or concurrently, or consent of instructor.
(2 hours lecture – 2 hours laboratory) Fall, Spring

BIOL 334: Cell Biology, 3 hours
Examination of the organization, functions, properties and processes of eukaryotic cells, with selected comparisons to prokaryotic cells. Topics include structure, flow, and expression of genetic information; the cell cycle; cellular energetics; membrane structure and function including cell signaling and transport; cell compartments and molecular trafficking; and the cytoskeleton and extra cellular structures. Prerequisites: BIOL 141, CHEM 241 or CHEM 353.
(3 hours lecture – No laboratory hours) Fall, Spring

BIOL 336: Plant Physiology, 4 hours
The course probes the major questions of plant physiologic and biochemical function at the subcellular, cellular, tissue, and whole-plant levels of organization. Attention also is paid to the role of plant physiological response to the biotic and abiotic environment. Lecture areas include photobiology, carbon balance, transport process, mineral nutrition and biochemical defense; laboratory investigations will combine classic demonstrations of plant physiological principles with modern and investigative studies. Prerequisite: BIOL 151, CHEM 241 or CHEM 353 or consent of instructor.
(1 hour lecture – 3 hours laboratory) Spring

BIOL 375: Microbiology, 3 hours
Study of the structure, physiology, identification, and significance of bacteria including an introduction to related organisms and immunology. Prerequisites: BIOL 151 or BIOL 152, CHEM 262, BIOL 376 concurrently.
(3 hours lecture – No laboratory hours) Fall
BIOL 376: Laboratory in Microbiology, 2 hours
Principles and laboratory techniques used in the isolation, cultivation, and identification of bacteria. Techniques in virology and immunology will be introduced. Prerequisite: BIOL 375 concurrently.
(No lecture hours – 2 hours laboratory) Fall

BIOL 378: Virology, 3 hours
Survey of the structural mechanisms of replication and pathogenic mechanisms of bacterial, plant, insect, and animal viruses. Prerequisite: BIOL 272 or BIOL 334 or consent of instructor.
(3 hours lecture – No laboratory hours) Fall

BIOL 382: Genetics, 4 hours
Cellular and molecular basis of gene transmission, expression, interaction, mutation, mapping, and regulation. Includes laboratory investigations using molecular and classical techniques. Prerequisites: BIOL 334, CHEM 241 or CHEM 253. BIOL 375 recommended but not required.
(3 hours lecture – 1 hour laboratory) Fall, Spring

BIOL 422: Immunology, 3 hours
Introduction to the concepts and applications of immunology. Emphasis on the structure, function, regulation, and development of the immune system. Serology and immunopathology are included. Prerequisites: BIOL 334, CHEM 354. BIOL 375 and BIOL 382 highly recommended but not required.
(3 hours lecture – No laboratory hours) Spring

BIOL 436: Molecular Biology Techniques, 4 hours
Project-oriented course focusing on the isolation, manipulation, analysis and expression of nucleic acids using molecular biology techniques. Techniques vary among projects and typically include DNA restriction, subcloning, PCR, primer design, DNA sequence analysis, blot analysis and introductory bioinformatics. Other techniques are used when appropriate. Prerequisite: BIOL 382, CHEM 354 or CHEM 241, or consent of instructor.
(2 hours lecture – 2 hours laboratory) On demand

BIOL 461: Developmental Biology, 4 hours
Study of the progressive changes that occur within cells, tissues, and organisms during their life span. Development will be studied from the molecular, biochemical, genetic, morphological, and physiological levels. Emphasis on experimental approaches to gene expression and its role in programming development. Prerequisites: BIOL 334, BIOL 382.
(3 hours lecture - 1 hour laboratory) Spring

BIOL 465: Plant Growth and Development, 4 hours
Examination of plant growth and development. Study of factors that affect development of the plant. Emphasis on the role of growth regulators, the environment, and genetics in plant growth regulation. Strong laboratory investigative component. Prerequisites: BIOL 151, BIOL 382.
(3 hours lecture – 1 hour laboratory) Fall, alternate years
BIOL 482: Molecular Biology, 3 hours
Advanced topics in gene structure, expression, regulation, maintenance, and modification. Examples selected from eucaryotic, prokaryotic, and viral systems. Topics include the mapping, analysis, and manipulation of genes; the organization, analysis, and expression of genomes; and molecular genetic applications in forensics, agriculture, and medicine. Prerequisites: BIOL 382, CHEM 241 or CHEM 354 or consent of instructor. (3 hours lecture – No laboratory hours) Spring, alternate years

BIOL 492: Special Problems in Biology, 1-3 hours
May be repeated up to four hours. Individual undergraduate research in an area of common interest to student and instructor. Prerequisite: consent of instructor.
Fall, Spring, Summer

b. Sample Curriculum
The two tables below represent a plan of study and course sequences for full-time students seeking an American Chemical Society approved biochemistry degree and a non-American Chemical Society approved biochemistry degree respectively.

4-Year Curriculum for American Chemical Society Approved Biochemistry Degree

Freshman Year
Fall Semester
CHEM 261: General Chemistry I, 4 hours
CHEM 118: Freshman Chemistry Seminar I, .5 hour
BIOL 141: Principles of Biology, 4 hours
MATH 230: Calculus I, 4 hours
ENG 101: Rhetoric and Composition I: Critical Thinking, 3 hours
Physical Education Fitness Course, 1 hour
Total = 16.5 hours

Spring Semester
CHEM 262: General Chemistry II, 4 hours
CHEM 119: Freshman Chemistry Seminar II, .5 hour
Elective, 3 hours
MATH 330: Calculus II, 4 hours
ENG 201: Rhetoric and Composition II: Argumentation, 3 hours
CMST 101: Introduction to Public Speaking, 3 hours
Total = 17.5 hours

Sophomore Year
Fall Semester
CHEM 353: Organic Chemistry I, 4 hours
CHEM 218: Sophomore Chemistry Seminar I, .5 hour
Elective, 3 hours
PHYS 205: Intermediate Physics I, 5 hours
Core Elective, 3 hours
Total = 15.5 hours
Spring Semester
CHEM 321: Quantitative Analysis, 3 hours
CHEM 354: Organic Chemistry II, 4 hours
CHEM 219: Sophomore Chemistry Seminar II, .5 hour
BIOL 334: Cell Biology, 3 hours
PHYS 206: Intermediate Physics II, 5 hours
Physical Education Fitness Course, 1 hour
Total = 16.5 hours

Junior Year
Fall Semester
CHEM 421: Instrumental Methods of Analysis I, 3 hours
CHEM 461: Physical Chemistry I, 4 hours
CHEM 318: Junior Chemistry Seminar I, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
Core Elective, 3 hours
Core Elective, 3 hours
Total = 14.5 hours

Spring Semester
CHEM 422: Instrumental Methods of Analysis II, 3 hours
Chemistry Elective, 3 hours
CHEM 319: Junior Chemistry Seminar II, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
BIOL 382: Genetics, 4 hours
Core Elective, 3 hours
Core Elective, 3 hours
Total = 17.5 hours

Senior Year
Fall Semester
CHEM 431: Biochemistry I, 4 hours
Chemistry Elective or Biology Elective, 3 hours
CHEM 418: Senior Chemistry Seminar I, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
Core Elective, 3 hours
Core Elective, 3 hours
Total = 14.5 hours

Spring Semester
CHEM 432: Biochemistry II, 4 hours
CHEM 441: Inorganic Chemistry, 4 hours
CHEM 419: Senior Chemistry Seminar II, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
Core Elective, 3 hours
Core Elective, 3 hours
Total = 12.5 hours
4-Year Curriculum for Non-American Chemical Society Approved Biochemistry Degree

**Freshman Year**

**Fall Semester**
CHEM 261: General Chemistry I, 4 hours  
CHEM 118: Freshman Chemistry Seminar I, .5 hour  
BIOL 141: Principles of Biology, 4 hours  
MATH 230: Calculus I, 4 hours  
ENG 101: Rhetoric and Composition I: Critical Thinking, 3 hours  
Physical Education Fitness Course, 1 hour  
Total = 16.5 hours

**Spring Semester**
CHEM 262: General Chemistry II, 4 hours  
CHEM 119: Freshman Chemistry Seminar II, .5 hour  
BIOL 151: Botany or BIOL 152: Zoology, 3 hours  
Core Elective, 3 hours  
ENG 201: Rhetoric and Composition II: Argumentation, 3 hours  
CMST 101: Introduction to Public Speaking, 3 hours  
Total = 16.5 hours

**Sophomore Year**

**Fall Semester**
CHEM 353: Organic Chemistry I, 4 hours  
CHEM 218: Sophomore Chemistry Seminar I, .5 hour  
BIOL 151: Botany or BIOL 152: Zoology, 3 hours  
PHYS 175: General Physics I, 4 hours  
Core Elective, 3 hours  
Core Elective, 3 hours  
Total = 17.5 hours

**Spring Semester**
CHEM 321: Quantitative Analysis, 3 hours  
CHEM 354: Organic Chemistry II, 4 hours  
CHEM 219: Sophomore Chemistry Seminar II, .5 hour  
BIOL 334: Cell Biology, 3 hours  
PHYS 176: General Physics II, 4 hours  
Physical Education Fitness Course, 1 hour  
Total = 15.5 hours

**Junior Year**

**Fall Semester**
CHEM 421: Instrumental Methods of Analysis I, 3 hours  
CHEM 361: Survey of Physical Chemistry, 4 hours  
CHEM 318: Junior Chemistry Seminar I, .5 hour  
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour  
Core Elective, 3 hours  
Core Elective, 3 hours
Total = 14.5 hours

Spring Semester
Biology Elective, 3 hours
Chemistry Elective, 3 hours
CHEM 319: Junior Chemistry Seminar II, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
BIOL 382: Genetics, 4 hours
Core Elective, 3 hours
Core Elective, 3 hours
Total = 17.5 hours

Senior Year
Fall Semester
CHEM 431: Biochemistry I, 4 hours
Biology Elective, 3 hours
Elective, 3 hours
CHEM 418: Senior Chemistry Seminar I, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
Core Elective, 3 hours
Total = 14.5 hours

Spring Semester
CHEM 432: Biochemistry II, 4 hours
Chemistry/Biology Elective, 3 hours
CHEM 419: Senior Chemistry Seminar II, .5 hour
CHEM 499: Chemistry Research or BIOL 492: Biology Research, 1 hour
Core Elective, 3 hours
Total = 11.5 hours

c. Existing Courses. Most existing required courses are offered every year with many of the 100-300 level courses offered both fall and spring semesters. There are several courses that are only offered in alternating years: BIOL 465 and CHEM 341 are only offered during the fall of alternating years; BIOL 482, CHEM 453, and CHEM 351 are only offered during the spring of alternating years; and BIOL 436 is only offered during semesters where student demand warrants the addition. CHEM 341, CHEM 351, and CHEM 453 serve as chemistry electives. BIOL 436, BIOL 465, and BIOL 482 are courses that may be selected to fulfill the requirements, but other routinely offered courses are available to the students. The specific course schedule as well as the course descriptions can be found in the Proposed Curriculum Requirements in section 3.a.

d. New Courses. The non-American Chemical Society approved degree option requires the development of one new course, CHEM 361: Survey of Physical Chemistry. This is a 4 credit hour course, 3 hours lecture - 1 hour laboratory, that covers most of the important concepts in physical chemistry but at a level that is less math intensive. This course may also serve as a preparatory course for students entering CHEM 461: Physical Chemistry I with poor math scores. This course will be offered every fall.
e. **Courses Delivered by Other Institutions.** None of the courses required for the proposed program will require delivery by another institution. However, many of the lower-level courses may transfer in from other institutions, and acceptance of upper-level courses will be assessed for transferability on a case-by-case basis.

4. **Form of Recognition**
   
a. **Type of Degree.** The appropriate form of recognition for completion of the proposed program is the Bachelor of Arts in Biochemistry or Bachelor of Science in Biochemistry, depending on the participation in foreign language courses.

b. **Suggested CIP Code.** The suggested CIP code is 26.0202.

c. **Student Diploma.** The diploma for a student meeting the university language requirement should state: Bachelor of Arts in Biochemistry; University of Southern Indiana; Evansville, Indiana.

The diploma for a student not meeting the university language requirement should state: Bachelor of Science in Biochemistry; University of Southern Indiana; Evansville, Indiana.

5. **Program Faculty and Administrators**
   
a. **Existing Faculty and Administration.** The Department of Chemistry and Department of Biology have faculty qualified to teach the required courses in chemistry and biology. This includes two new tenure-line chemistry faculty hired August 2008. The following table lists the name, rank, specialization, nature of appointment, and degree for the administrators and faculty directly involved in the program.

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<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>Areas of Specialization</th>
<th>Appointment</th>
<th>Degree</th>
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<tbody>
<tr>
<td>Dr. Scott Gordon</td>
<td>Professor</td>
<td>Biology/Mycology</td>
<td>Full-time, Tenured</td>
<td>Ph.D. Biology/Mycology</td>
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<td>Dr. Brent Summers</td>
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<td>Environmental Biology</td>
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b. **New Faculty Requirements.** No new faculty positions are required to offer the program.

6. **Learning Resources**
   a. **Available Learning Resources.** Holdings in the library such as handbooks, manuals, and journal publications as well as access to on-line journals and databases are sufficient to meet American Chemical Society accreditation requirements. No additional learning resources are required for the program.

b. **Additional Needed Learning Resources.**
   Both the Department of Chemistry and Department of Biology have sufficient laboratory space and major equipment to meet the needs of the program courses. Enrollment increases will warrant the purchase of glassware and chemicals to accommodate the addition of new laboratory sections. This expense is estimated at $17,200 and will be covered by laboratory fees from the additional courses and students. Renovations made to the Science Center during summer 2008 and 2009 in addition to renovations planned for summer 2010 will provide additional laboratory space to meet enrollment increases of 36-38 new students per year.
7. Other Program Strengths
   a. Special Features. The current biology and chemistry programs are both academically sound programs in preparing students for graduate and professional programs. USI students score at or above those at peer institutions on the Major Field Test in the respective subjects. On average 50-60 percent of our graduates attend a post-baccalaureate program such as medical or dental school or graduate programs in biology or chemistry. Of the students that apply, acceptance into these programs ranges from 80-90 percent. Within Indiana professional programs, we have had more than 40 students accepted in the past five years, with 36 students accepted to IU Medical School. In addition, two to four students are accepted annually into medical programs across the country.

   Many of our students participate in NSF funded undergraduate summer research experiences and similar programs across the country. Recently the Pott College has initiated the SwISTEM Early Undergraduate Research program, and twelve biology and chemistry students and one biotech student from Ivy Tech participated this past summer. The chemistry and biology programs have worked well together, with many students majoring in one discipline and receive a minor in the other. Both programs have outstanding, high achieving undergraduate students. Several students have received special awards including the President Medal, Student Trustee Award, and the nationally competitive Goldwater Scholarship.

   Geographically the nearest baccalaureate programs in Indiana are the biochemistry degree at Indiana State University in Terre Haute and Indiana University in Bloomington – both located more than two hours from Evansville. Thus, without competing with existing four-year programs in the state, the proposed program will provide regional students with both an opportunity to complete a four-year degree in biochemistry and prepare for a science based career in the southwest Indiana region and beyond.

   b. Collaborative Arrangements. Although the proposed program will require no collaborative agreements outside the university for delivery, it is imperative that the Department of Chemistry and Department of Biology collaborate for the success of this degree program. Faculty from both departments have contributed to this new program petition and the selection of required courses for the degrees within. Currently, a chemistry 2+2 agreement exists with Ivy-Tech Community College-Evansville. Once the program is approved, a biochemistry 2+2 agreement will be created allowing graduates with associate degrees in biotechnology from Ivy Tech Community College-Evansville to seamlessly transfer to the biochemistry program. Chemistry also has a 2+2 agreement with Vincennes University, but this will require modifications to incorporate the biochemistry degree. Additionally cooperative arrangements (2+2 programs) with Henderson Community College of Henderson, Kentucky; and the Illinois Eastern Community College System which includes Wabash Valley College and Southeastern Illinois College will be established.

Program Rationale

1. Institutional Factors
   a. Compatibility with Institutional Mission. The University strives to provide degree opportunities to meet the needs of the southwest Indiana region. The proposed program is
designed to create interdisciplinary biochemistry degree options that will prepare qualified graduates to gain employment in local industry and medical laboratories as well as prepare those choosing to continue in professional and graduate schools.

b. **Planning Process.** The proposed program developed from the Department of Chemistry’s program review processes initially in 1998 and recently in 2007. The initial plan to pursue the biochemistry program was delayed for several reasons which included limited number of faculty, limited laboratory space, and restructuring of the national American Chemical Society certification guidelines. With the addition of new faculty lines and added laboratory space with the construction of the new Science and Education Center and other renovations, the college is prepared to add the new program. Based on the increase in students choosing to major in the current biochemistry concentration within the chemistry degree, inquiries from prospective students seeking a biochemistry degree, and anticipated increases in employment opportunities within biochemistry related fields, it was determined that now is the appropriate time to act.

The timeline for the Bachelor of Arts/Bachelor of Science in Biochemistry program is listed below.

- **March 2008** Initial approval from Academic Planning Council
- **November 2008** Approval from University Curriculum Committee
- **December 2008** Approval from Faculty Senate
- **March 2009** Final approval from Academic Planning Council
- **May 2009** Approval from Board of Trustees
- **October 2009** Proposal submitted to Commission for Higher Education
- **January 2010** First students admitted to the program in spring semester, 2010

c. **Impact of the Proposed Program.** The proposed program will result in increased enrollment of freshmen and transfer students from two-year institutions. In addition to these new-to-campus students, on-campus transfers from current chemistry and biology majors are expected. It is anticipated 36-38 students will be admitted to the program each year. Of the 36 students admitted to the program in year one, 18 are expected to be on-campus transfer students. The projected number of on-campus transfer students is expected to decline to a total of 8 by year 5. The program is expected to reach steady state enrollment of 38 in each new cohort by year 4.

d. **Impact on Utilization of Existing Resources.** The primary impact on utilization of existing resources will be the increase in number of students in the existing chemistry and biology laboratories. These additional students will not exceed the capacity of existing laboratory facilities, but will require the addition of new laboratory sections, particularly in the entry-level courses.
2. Student Demand
   a. Derivation of Enrollment Projections. It is anticipated that a biochemistry program will increase student enrollment and graduates within the Department of Chemistry by attracting students who desire both biology and chemistry and have difficulty deciding between the two; students interested in the vast array of careers available in biochemistry; and students who might have enrolled at other universities with such programs. Enrollment in the biochemistry program is expected to come primarily from incoming freshmen, but it is also anticipated to be attractive to transfer students from two-year programs and current students in the existing chemistry and biology programs. The projections are based on discussions with area high school chemistry teachers, inquiries from prospective students, comments from students during Southern Hospitality Days, and analysis of PSAT major interest data for students from Indiana and surrounding areas of Kentucky and Illinois. Many of these students listed chemistry and biology as interest areas and it is likely that a good proportion will select the biochemistry program. It is expected that this will have little to no negative effect on the number of graduates in the current chemistry and biology programs.

   Graduation rates for students completing the biochemistry program are anticipated to meet or exceed the current graduation rate of the University’s first-time, full-time baccalaureate degree seeking freshmen. These graduation rates are anticipated because data has shown that transfer students from two-year associate degree programs have higher completion rates than the general student population. Also, it is anticipated that most of the on-campus transfer students will enter the program as juniors and seniors and thereby are more apt to complete the programs than first-time, full-time freshman.

   b. Enrollment and Completion Data. Table 1 contains enrollment and completion data based on the information and assumptions described in the preceding sections.

3. Transferability. Students in two-year biochemistry programs such as those at Ivy Tech Community College-Evansville and Vincennes University will transfer into the proposed program without loss of credit. As mentioned in previous sections, a biochemistry 2+2 agreement will be created allowing graduates with associate degrees in biotechnology from Ivy Tech Community College-Evansville to seamlessly transfer to the biochemistry program. Chemistry also has a 2+2 agreement with Vincennes University, but this will require modifications to incorporate the biochemistry degree. Additionally new agreements with Henderson Community College and the Illinois Eastern Community College System will permit additional transfers.

4. Access to Graduate and Professional Programs. Students who complete the program will be prepared for graduate programs in biochemistry, chemistry, or biology. Additionally, this degree program is well suited for students planning medical related professions, specifically those seeking entry into medical, dental, or pharmacy programs.

5. Demand and Employment Factors
Indiana, as listed in www.projectionscentral.com and the Occupational Supply Demand System (www.occsupplydemand.org), indicate an increased need, both within Indiana and nationally, for graduates in fields where biochemistry graduates are employed. Examples range from a low of a 6 percent increase for agricultural and food science technicians to over 20 percent increase for forensic science technicians. For chemical technicians, Indiana is down 4% while national trends indicate a growth of 6%. Indiana shows a 2% growth for chemists while nationally it is 9%. Data from the Indiana Workforce Development (www.hoosierdata.in.gov) supports the need for graduates with such skills.

For the various careers that are typically filled by biochemists, wages vary greatly with the type of position held and the amount of post-graduate experience garnered. This range is evident by a scan of the Long-term Indiana Occupational Projections data and the Hoosier Hot 50 jobs list. Such wage data reveals salary ranges of $32,000 to $45,000 for clinical laboratory technicians and clinical technologists to a range of $45,000 – $85,000 for chemical or biological technicians.

b. Review of Literature. With the rapidly advancing knowledge in the chemistry of biological systems, biochemistry has become a major interdisciplinary field of science. Existing industries, such as agriculture, food, medicine, and the newly developing industries involving biotechnology, biofuels, and enzyme catalysis have resulted in expanded opportunities for graduates with a degree in biochemistry.

As reported in the 2006 Strategic Skills Initiative Summary Report prepared by the Indiana Workforce Development, agri-science and chemical manufacturing technicians are emerging occupations associated with the expected growth in bio-fuel production. According to the U.S. Department of Labor, Bureau of Labor Statistics, a 16 percent growth is expected for biochemists and biophysicists and a 9 percent growth is expected in both chemists and agriculture and food scientists from 2006 to 2016. A quick search of chemistryjobs.acs.org/search/browse/, www.careers.com, and www.jobs.com using the key word biochemistry resulted in the listing of more than one hundred job ads posted within a thirty-day period in March 2008, but recently (October 2009) the job postings have declined considerably. Section 5.c. lists a few of the potential employers of graduates from this program.

Addition of the biochemistry program will not only provide students the opportunity to pursue careers in related fields, it will also provide the foundation for those students entering medical profession programs. The national occupation outlook (U.S. Bureau of Labor Statistics) predicts a 14 percent increase for physicians and surgeons and 9 percent increase for dentists. An independent study by Kerry Cheesman at Capital University in Columbus, Ohio reported that 12 percent of medical school students have undergraduate degrees in biochemistry or molecular biology.


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<td>Thermo Fisher – Indianapolis, IN</td>
<td>Dow AgroSciences – Indianapolis, IN</td>
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<td>Kelly Scientific – Indianapolis, IN</td>
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Romer Labs Inc. – Union, MO  
Procter & Gamble – Cincinnati, OH  
EMD Chemicals – Chicago, IL  
Meridian Bioscience – Cincinnati, OH

National Industry
Aerotek Scientific  
Cook Pharmica  
Kraft Foods  
Genentech  
Dow Chemical  
GE Healthcare  
Merck  
3M HCB

Local Industry – past listings (no current openings)
Bristol-Myers Squibb – Evansville, IN  
Covance Inc. – Evansville, IN  
Mead Johnson Nutritionals – Evansville, IN  
Bayer Cropscience – Owensboro, KY

Regional Industry – past listings (no current openings)
Monsanto – St. Louis, MO  
Dow AgroSciences – Indianapolis, IN  
Siemens – Elkhart, IN  
Lancaster Laboratories – Indianapolis, IN

Government Agencies
Environmental Protection Agency  
Center for Disease Control  
Food and Drug Administration  
National Institutes of Health

d. **Independent Needs Analysis.** Not Applicable.

e. **Program Experience.** The Department of Chemistry and Department of Biology have been teaching all but one course, CHEM 361: Survey of Physical Chemistry, for many years. Within the existing chemistry program, a biochemistry concentration has been available for more than five years. As stated previously, this program will provide the appropriate biochemistry title on students’ diplomas and the opportunity to earn a more interdisciplinary degree, the non-American Chemical Society approved degree.

6. **Regional, State, and National Factors**

a. **Comparable Programs in the Region and State.** This program is analogous to biochemistry degrees found at other institutions nationwide and meets or surpasses the requirements in biochemistry programs found at institutions used as benchmarks in developing the Pott College of Science and Engineering strategic plan. Geographically the nearest baccalaureate programs in Indiana are the biochemistry degree at Indiana State University in Terre Haute and Indiana University in Bloomington – both located more than two hours from Evansville.

b. **External Agencies.** The Department of Chemistry is accredited by the American Chemical Society, meeting requirements in course offerings, facilities and instrumentation, faculty work loads, and library holdings and on-line database access. One of the proposed biochemistry degree options will provide American Chemical Society certified graduates. In addition to the American Chemical Society approved degree, the proposed program will offer a non-American Chemical Society approved degree that provides flexibility for a greater mix of chemistry and biology courses that is otherwise limited by the stringent requirements within the chemistry and biology programs separately.
**Program Implementation and Evaluation**

Several years ago, the Department of Chemistry developed a biochemistry concentration within the existing chemistry program to establish the foundation to create a biochemistry program. Due to the existing courses, implementation of the proposed biochemistry program will begin immediately following approval such that juniors in the 2009-2010 academic year will have the option to earn a biochemistry degree. The one new course, CHEM 361: Survey of Physical Chemistry, will be first offered the second year following approval to allow time for course development and enrollment increases. This will not affect any new students in the program and current students will have the option to take CHEM 461: Physical Chemistry I. The Chemistry program will be modified to remove the degree track with the biochemistry concentration to avoid duplication. This does not prevent a student in the chemistry program from taking biochemistry related courses, as CHEM 431: Biochemistry I is still a required course in the American Chemical Society approved chemistry degree track. Under the new American Chemical Society guidelines for accreditation, there is the opportunity to offer a Bachelor of Arts/Bachelor of Science degree within the biochemistry program that will also meet the American Chemical Society accreditation.

Evaluation of the proposed program will be completed every five years through the USI Institutional Program Assessment Plan. For annual reviews, the chemistry program assessment plan (based on the ABET Assessment format) will be modified in collaboration with faculty in the Department of Biology. Many of the chemistry courses use American Chemical Society standardized exams to assess learning objectives. Assignments in courses and laboratories will provide additional assessment tools. Surveys of graduates and employers of graduates will be implemented after the first graduating class.

**Tabular Information**

1. **Table 1: Enrollment and Completion Data**
   Table 1, program enrollments and completions, is attached.

2. **Table 2A and 2B: Cost and Revenue Data**
   Table 2A, total direct program costs and sources of program revenues, is attached.

   Table 2B, detail on incremental or out-of-pocket program costs, is attached. No new faculty positions are required for this program. Glassware and chemical expenses of $17,200 per year will be covered by laboratory fees from additional courses and students. No additional library holdings are required for this program. Student recruitment expenses of $3,500 in year 1 of the program and $2,000 in subsequent years will be covered from existing departmental resources. No new state appropriation is requested for this program.

3. **Table 3: New Program Proposal Summary**
   Table 3, new academic program proposal summary, is attached.
Bachelor of Arts/Bachelor of Science in Biochemistry Proposal

Reference List*

ACS Guidelines for Bachelor Degree Programs. American Chemical Society. Retrieved July 10, 2009 from http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_SUPERARTICLE&node_id=1584&use_sec=false&sec_url_var=region1&__uuid=ef5d461c-bc1c-4cb9-b454-a221d0c4739f


Chemistry Degree Programs, Indiana State University biochemistry concentration. Retrieved July 10, 2009 from http://www.indstate.edu/chemistry/chemistry_programs.htm


Personal communication with Kerry Cheesman at Capital University in Columbus, Ohio. e-mail conversation, kcheesma@capital.edu, on March 25, 2008


University of Southern Indiana Bulletin. Existing USI courses and course descriptions were retrieved July 10, 2009 from the USI Bulletin available at http://www.usi.edu/newsinfo/bulletin/index.asp

*The web pages listed here were accessed prior to 2009, but have been updated for current links.