Fall 2012  
B.S. in Chemical and Biological Engineering  
*Examples of minors and interdisciplinary studies programs with choices of bioscience and technical electives*

For each of the minors and interdisciplinary studies programs (ISPs) listed below, suggested choices are listed for the bioscience, engineering, and technical electives. These are in addition to the required CBE courses (such as CHEM 345, MATH 160, and BC 351). To earn the minor or ISP, all of the courses listed must be taken. However, even if you don’t complete the minor or ISP requirements you will still gain knowledge of that particular subject area.

In all cases, you should contact the department sponsoring the minor or ISP to obtain the most current information and a checksheet.

**Biochemistry minor (21 credits total)**  
*NOTE: for this minor, you will replace BC 351 (4) with BC 401 (3), 403 (3) and 404 (2)*

Bioscience elective: LIFE 201B (3) + LIFE 203 (2)  
Engineering elective: any (does not count toward this ISP); CBE 504 is a good choice  
Technical electives: LIFE 210 (3) + LIFE 212 (2)  
BC 401 (3) + BC 403 (3) + BC 404 (2)  
BC 493 (1)  
Plus BC 411 (4) or BC 463 (3) or BC 465 (3)

Credits beyond CBE requirements: 9/8

**Biomedical Engineering ISP (21 credits total)**

Bioscience elective: BMS 300 (4)  
Engineering elective: BIOM 470 (3)  
Technical electives: 13 credits from an approved list (BC351 (4) and Chem 341/345 (3/4) are on the list and count towards those 13 credits.

Credits beyond CBE requirements: 1

**Biomedical Sciences minor (21 credits total)**

Bioscience elective: BMS 300 (4)  
Engineering elective: any (does not count toward this ISP); BIOM 470 is the most relevant  
Technical electives: BMS 301 (5) or BMS 305 (4) or BMS 330 (4)  
BMS 325 (3) or BMS 345 (4) or BMS 365 (3)  
plus 8-10 credits from an approved list of BMS and BZ courses

Credits beyond CBE requirements: 10

**Business minor (24 credits)**

Bioscience elective: any  
Engineering elective: any  
Technical electives: any  
AUCC: choose ECON 202 for Category 3C  
21 credits of specified business courses

Credits beyond CBE requirements: 21
Chemistry minor (24-26 credits total)
Bioscience elective: any
Engineering elective: any (does not count toward this ISP); CBE 514 is the most relevant
Technical electives: 7 credits of chemistry from their list – including at least 1 lab
Credits beyond CBE requirements: 0

Computer Science minor (28 credits total)
Bioscience elective: any
Engineering elective: any
Technical electives: CS 160 (4)
CS 161 (4)
CS 200 (4)
CS 270 (4)
plus 12 credits of CS courses numbered 300 or higher
Credits beyond CBE requirements: 21

Environmental Engineering minor (21 credits total)
Bioscience elective: MIP 300 (3)
Engineering elective: ENVE 438 (4)
Technical electives: CIVE 440
3 credits from the ENVE list (that are also on the CBE list)
Credits beyond CBE requirements: 3 (CIVE 439 (3))

Food Science/Safety ISP (24 credits total)
Bioscience elective: MIP 300 (3)
Engineering elective: any (does not count toward this ISP); CBE 504 is the most relevant
Technical electives: MIP 334 (3)
8 credits from an approved list (with constraints)
Credits beyond CBE requirements: 4

Global and Environmental Sustainability minor (21 credits total)
Bioscience elective: LIFE 320
Engineering elective: any
Technical Elective: EHRS 448 (3) and MATH 348 (3)
Plus 1 additional credit of tech elective from the CBE list
Credits beyond CBE requirements: 9 (AGRI 116 should be chosen for AUCC3E or GR100 for AUCC 3C)

Mathematics minor (23 credits total)
Bioscience elective: any
Engineering elective: any
Technical electives: 7 credits of MATH electives
Credits beyond CBE requirements: none
Microbiology minor (21 credits total)
Bioscience elective: MIP 300 (3)
Engineering elective: any (does not count toward this ISP); CBE 504 is the most relevant
Technical electives: MIP 302 (1)
MIP 342 (4)
MIP 351 (3) or MIP 420 (4)
MIP 443 (4) or MIP 450 (3)
plus 4-6 credits from an approved list of MIP courses
Credits beyond CBE requirements: 10

Physics minor (22 credits total)
Bioscience elective: any
Engineering elective: any
Technical electives: PH 314 (4)
plus 8 credits from an approved list of AA and PH courses
Credits beyond CBE requirements: 5

Pre-Med (general requirements for medical programs; neither minor nor ISP)
See the CASA Pre-Professional Advising Office for more information:
http://www.casa.colostate.edu/Pre-Professional/
General recommendations:
Bioscience elective: LIFE 103 (special permission)
Engineering elective: any (does not count toward this goal); BIOM 470 is the most relevant
Technical electives: STAT 315 (3)
BMS 300 (4) or BMS 360 (4)
BMS 301 (5)
MIP 300 (3) and 302 (2)
AUCC electives: consider CO 300/301 (Category 2B) or E 140 (Category 3B)
Credits beyond CBE requirements: 10

Pre-Vet (general requirements for veterinary programs; neither minor nor ISP)
See the CASA Pre-Professional Advising Office for more information:
http://www.casa.colostate.edu/Pre-Professional/
General recommendations:
Bioscience elective: LIFE 103 (special permission)
Engineering elective: any (does not count toward this goal); BIOM 470 is the most relevant
Technical electives: STAT 315 (3)
BMS 300 (4) or BMS 360 (4)
SOCR 330 (3) or MIP 450 (3) or BZ 350 (4) or BC 463 (3)
Credits beyond CBE requirements: 3-4
Chemical and Biological Engineering

Example Focus Areas

The following lists provide suggestions for your choices of bioscience, engineering, and technical electives and are not necessarily complete. Also, you should check the prerequisites required for each course.

Agricultural biotechnology

Do you have an interest in agricultural applications, such as developing new ways to improve crops and their yields?

**Bioscience elective:** Principles of Genetics (SOCR 330)

**Engineering elective:** Soil and Water Engineering (CIVE 425)

**Technical electives:** Entomology (BSPM 302), Fundamentals of Pesticides (BSPM 310), Elements of Plant Pathology (BSPM 361), Plant-Microbe Interactions (BSPM 450), Plant Physiology (BS 440), Plant Ecology (BZ 450), Ecology (LIFE 320), Soil Science (SOCR 240), Soil Microbiology (SOCR 455), Theory and Practice of Animal Biotechnology (BMS 560)

Biochemical engineering and Bioprocessing

Do you have interest in the production of chemicals, pharmaceuticals, and fuels through biotechnology?

**Bioscience elective:** General Microbiology (MIP 300)

**Engineering elective:** Biochemical Engineering (CBE 504)

**Technical electives:** Bioseparation Processes (CBE 522), Fundamentals of Environmental Biotechnology (CBE 540), Industrial Microbiology (MIP 436), Microbial Physiology (MIP 443), Eukaryotic Cell Biology (LIFE 210, 211, 212), Food Microbiology (MIP 334, MIP 335), Topics in Biotechnology (BTEC 450), Statistics for Engineers and Scientists (STAT 315)

Biomedical engineering

Do you have an interest in biomedical engineering, such as developing new artificial organs and medical devices?

**Bioscience elective:** Principles of Human Anatomy and Physiology (BMS 300)

**Engineering elective:** Biomedical Engineering (BIOM 470)

**Technical electives:** Cell and Tissue Engineering (CBE 525), Polymer Science and Engineering (CBE 514), Cell Biology (BZ 310), Biomedical Clinical Practicum (BIOM 468), Biomechanics (BIOM 571), Structure and Function in Biomaterials (BIOM 573), Cardiopulmonary Physiology (BMS 420), Cancer Biology (ERHS 510), Introduction to Engineering Materials (ME 331), Statistics for Engineers and Scientists (STAT 315)
Data analysis and experimental design

*Do you have an interest in advanced data analysis techniques and efficient experimental design?*

**Bioscience elective:** Ecology (LIFE 320), Genetics (BZ 350, MIP 350), or other

**Engineering elective:** Linear Programming and Network Flows (ENGR 510)

**Technical electives:** Statistics for Engineers and Scientists (STAT 315), Design of Experiments (STAT 350), Multiple Regression Analysis (STAT 340), Sampling Techniques (STAT 305), Probability and Mathematical Statistics (STAT 420, 430), Design and Data Analysis for Researchers (STAT 511, 512)

Environmental science and engineering

*Do you have an interest in environmental applications, such as understanding the role of chemicals in the environment and helping to reduce their negative impact?*

**Bioscience elective:** Ecology (LIFE 320) or General Microbiology (MIP 300)

**Engineering elective:** Pollution Control Engineering (CIVE 438)

**Technical electives:** Bioremediation (CBE 524), Environmental Biotechnology (CIVE 540), Soil Microbiology (SOCR 455), Wastewater Treatment (CIVE 536), Aqueous Chemistry (CIVE 538), Nonpoint Source Pollution (CIVE 440), Basic Hydrology (ENVE 322), Water and Wastewater Characterization (ENVE 441), Air Pollution (ATS 555, 560), Statistics for Engineers and Scientists (STAT 315), Environmental Toxicology (ERHS 446)

Materials science and engineering

*Do you have an interest in the application of physics, chemistry, and engineering towards the fabrication and characterization of new materials?*

**Bioscience elective:** General Microbiology (MIP 300)

**Engineering elective:** Polymer Science and Engineering (CBE 514)

**Technical electives:** Polymer Chemistry (CHEM 515), Solid State Chemistry (CHEM 511), Chemistry of Electronic Materials (CHEM 517), Structure and Function in Biomaterials (BIOM 573), Introduction to Engineering Materials (MECH 331), Surface Chemistry (CHEM 577), Materials Engineering (MECH 331), Metals and Alloys (MECH 431)

Mathematical modeling, with applications to physical and biological systems

*Do you have an interest in theoretical and computational modeling and advanced mathematics applied to physical and biological systems?*

**Bioscience elective:** General Microbiology (MIP 300) or Principles of Human Anatomy and Physiology (BMS 300)

**Engineering elective:** Linear Programming and Network Flows (ENGR 510)

**Technical electives:** Mathematical Modeling for Chemical Engineers (CBE 521), Partial Differential Equations (MATH 332), Introduction to Complex Variables (MATH 419), Discrete Models of Physical Systems (MATH 531), Partial Differential Equations (MATH 545, 546), Mathematical Methods for Physicists I (PH 571, 572), Algorithms and Data Structures (CS 2000), Analysis of Algorithms (CS 420)
Medical applications

Do you have an interest in medicine?

**Bioscience elective:** Principles of Human Anatomy and Physiology (BMS 300)

**Engineering elective:** Biomedical Engineering (BIOM 470)

**Technical electives:**
- Human Gross Anatomy (BMS 301)
- Lab in Principles in Physiology (BMS 300)
- Introductory Genetics (LIFE 201B)
- Introductory Genetics Lab (LIFE 203)
- Immunology (MIP 342)
- Immunology Lab (MIP 343)
- Medicinal Bacteriology (MIP 351)
- Medicinal Bacteriology Lab (MIP 352)
- Biomechanical Principles of Human Movement (HES 307)
- Neuromuscular Principles of Human Movement (HES 319)
- Clinical Chemistry (CHEM 433)

Optical and electronic devices

Do you have an interest in the physics of optical and electronic devices and their applications?

**Bioscience elective:** Any

**Engineering elective:** Introduction to Engineering Materials (MECH 331)

**Technical electives:**
- Electricity and Magnetism PH (351)
- Optics and Waves (PH 353)
- Introduction to Lasers (PH 521/522)
- Instrumental Analysis (CHEM 431)
- Chemistry of Electronic Materials (CHEM 517)
- Introduction to Modern Physics (PH 314/315)

Pharmaceuticals: design, development, and production

Do you have an interest in working in the pharmaceutical industry, such as working to understand the effects and safety of newly developed drugs?

**NOTE:** for this focus area, you will replace BC 351 (4) with BC 401 (3), 403 (3) and 404 (2)

**Bioscience elective:** Comprehensive Biochemistry I (BC 401)

**Engineering elective:** Biochemical Engineering (CBE 504)

**Technical electives:**
- Comprehensive Biochemistry II (BC 403)
- Comprehensive Biochemistry Lab (BC 404)
- Pharmacology (BMS 450)
- Bioseparation Processes (CBE 522)
- Eukaryotic Cell Biology (LIFE 210)
- Fundamentals of Physiology (BMS 310)
- Pharmacology (BMS 450)
- Instrumental Analysis (CHEM 431)
- Clinical Chemistry (CHEM 433)
- Microbial Physiology (MIP 443)
- Industrial Microbiology (MIP 436)
- Statistics for Engineers and Scientists (STAT 315)