Biology

Overview

What do Ebola, hemophilia, DNA fingerprinting, sequoias, cuttlefish, intertidal zones, and global climate change have in common? These are a few examples of the diverse topics that are explored in Biology, which is the scientific study of living organisms including their structure, function, evolution, and interactions with other organisms and with the environment. The CRC Biology Department offers a variety of courses that are organized into the following three areas:

- General education courses for non-science majors who want to gain an understanding of the biological world (BIOL 300, 307, 310, 342, 350, 352, 390 and 485).
- Clinically related courses for students pursuing careers in nursing and allied health (BIOL 100, 102, 430, 431, 439 and 440).
- The first two years of a Biology major for those transferring to Bachelor Degree programs in fields related to the life sciences (BIOL 400, 410, and 420).

Students who transfer to four-year universities report a very high level of satisfaction with the education they received at CRC.

Program Maps

Biology, A.S. Degree (/crc/main/doc/programs/program-maps/biol-as-degree-ho.pdf)
Biology, A.S.-T Degree (/crc/main/doc/programs/program-maps/biol-as-t-degree-ho.pdf)
Biology, A.S.-T Degree, IGETC (/crc/main/doc/programs/program-maps/biol-as-t-degree-ho-igetc.pdf)
Biology, Concentration, A.S. Degree (/crc/main/doc/programs/program-maps/biol-conc-as-degree-ho.pdf)
Biology, Pre-Nursing, A.S. Degree (/crc/main/doc/programs/program-maps/biol-pre-nsg-as-degree-ho.pdf)

Asso. Dean Banafsheh Amini (/about-us/contact-us/faculty-and-staff-directory/banafsheh-amini)
Department Chair Sarah Pollock (/about-us/contact-us/faculty-and-staff-directory/sarah-pollock)
Phone (916) 691-7204
Email AminiB2@crc.losrios.edu (mailto:AminiB2@crc.losrios.edu)

Associate Degrees for Transfer

A.S.-T. in Biology

The Associate in Science in Biology for Transfer Degree is designed to prepare students for a seamless transfer into the CSU system to complete a baccalaureate degree in Biology or a similar major. Students with this degree will receive priority admission with junior status to the California State University system. The Associate in Science in Nutrition and Dietetics for Transfer is comprised of lower division coursework typically required by CSU institutions. Students must complete the following Associate Degree for Transfer requirements (Pursuant to SB1440, §66746):

- Completion of 60 semester units or 90 quarter units that are eligible for transfer to the California State University.
- The Intersegmental General Education Transfer Curriculum (IGETC) pattern.
- A minimum of 18 semester units or 27 quarter units in a major or area of emphasis, as determined by the community college district.
- Obtainment of a minimum grade point average of 2.0.
- A grade of "C" or better in all courses required for the major or area of emphasis.

Completion of the AS-T degree may not prepare students to transfer to University of California biology programs that may have different requirements. If a student intends to transfer to University of California, additional courses in chemistry, physics, and math may be required.

Note to Transfer Students:
The Associate Degree for Transfer program is designed for students who plan to transfer to a campus of the California State University (CSU). Other than the required core, the courses you choose to complete this degree will depend to some extent on the selected CSU for transfer. In addition, some IGETC requirements can also be completed using courses required for this associate degree for transfer major (known as “double-counting”). Meeting with a counselor to determine the most appropriate course choices will facilitate efficient completion of a student's transfer requirements. For students wishing to transfer to other universities (UC System, private, or out-of-state), the Associate Degree for Transfer may not provide adequate preparation for upper-division transfer admissions, because many universities require more lower division courses than those in this degree. Even the CSUs that accept this transfer degree may likely require additional lower division courses to achieve the Bachelor degree. It is critical that students meet with a CRC counselor to select and plan the courses for the major, as programs vary widely in terms of the required preparation.

Catalog Data: June 1, 2020

Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 400</td>
<td>Principles of Biology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 410</td>
<td>Principles of Botany</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Principles of Zoology</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 400</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
</tbody>
</table>
The Associate in Science in Biology for Transfer (AS-T) degree may be obtained by completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program, and (b) the Intersegmental General Education Transfer Curriculum for Science, Technology, Engineering, and Mathematics (IGETC for STEM).

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- DEMONSTRATE UNDERSTANDING OF THE PROCESSES OF SCIENCE, THE SCIENTIFIC METHOD, AND THE RELATIONSHIP BETWEEN SCIENTIFIC RESEARCH AND ESTABLISHED KNOWLEDGE. This includes the ability to: • Elucidate the way in which research leads to generally accepted conclusions and the integration of new research data with the building of a body of scientific knowledge. • Recognize that the information presented in science textbooks and other established authorities is the result of research conducted in the field or the lab and is based on an accumulation of data. • Design a scientific inquiry, including use of proper controls and analyses • Demonstrate critical thinking skills by the analysis of data sets, recognition of the implications of perturbations to biological systems, and synthesis of information to draw conclusions.
- EXPRESS ONE'S SELF CLEARLY WHEN WRITING OR SPEAKING ABOUT BIOLOGY, DEMONSTRATING KNOWLEDGE OF BASIC BIOLOGICAL TERMINOLOGY AND UNDERSTANDING OF MAJOR BIOLOGICAL CONCEPTS. This includes the ability to produce: • Laboratory reports which address background information, procedures, results, and analysis of data developed during a laboratory exercise or inquiry project. • Essays explaining biological processes in clear and concise terms. • Reports and term papers which clearly explain biological processes and elucidate current theories explaining biological phenomena.
- DEMONSTRATE BOTH CONTENT KNOWLEDGE AND TEST TAKING SKILLS WHEN COMPLETING ESSAY, OBJECTIVE, AND MULTIPLE CHOICE EXAMS. This includes the ability to: • Demonstrate problem-solving abilities in the major content areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution. • Analyze the logic of a multiple-choice question about biology and select the correct response from among related items. • Write clear responses to essay question prompts without including extraneous information or omitting information necessary to provide a clear answer. • Utilize test-taking skills such as critical analysis of information, test-time management and focused writing. • Demonstrate content knowledge in the broad areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution.
- CHOOSE AND UTILIZE APPROPRIATE LABORATORY TECHNIQUES PROFICIENTLY. Biology majors' lab techniques include: • Measurement (use of metric measures) • Microscopy • Pipetting • Gel electrophoresis • Dissection • Basic biochemical techniques such as pH testing, Biuret test, Benedict's test, etc. • Ability to design a laboratory experiment, including the use of adequate controls and choice of analyses used to examine data, etc. Additional laboratory techniques relevant to biology majors can be found in the SLOs for the chemistry and physics courses required for this major.
- EVALUATE BIOLOGICAL DATA, DRAW REASONABLE CONCLUSIONS, RECOGNIZE THE ETHICAL IMPLICATIONS OF THESE CONCLUSIONS, AND APPLY THESE CONCLUSIONS TO PERSONAL, COMMUNITY, AND SCIENTIFIC PROBLEMS. This includes the ability to: • Choose what data to collect in order to address a specific hypothesis. • Collect data and keep organized records. • Conduct basic graphical and statistical analysis of data. • Reach and clearly express logical conclusions based on biological data. • Relate, in presentations and/or in written reports, how biological information is relevant to personal and community issues. • Recognize the ethical implications of biological research and the responsibility to use knowledge wisely.
- EMPLOY INFORMATION-GATHERING TOOLS TO INVESTIGATE BIOLOGICAL IDEAS. This includes the ability to: • Use the Internet in order to gather scientific information, including the ability to recognize the relevance and scientific validity (or lack thereof) of information when found. • Use the library in order to gather scientific information, including the ability to recognize the relevance and scientific validity (or lack thereof) of information when found.

Career Information

Research, Teaching, or Industrial Laboratory Careers in Molecular Biology, Microbiology, Biotechnology, Genetics, Wildlife Biology, Marine Biology, Pharmacy, Nutrition, Medicine, Dentistry, Veterinary, Optometry, etc. Some career options require more than two years of college study. Classes beyond the associate degree may be required for some career options or to fully prepare students for transfer to a university program.

Associate Degrees

A.S. in Biology: Pre-Nursing Option

CRC's Biology, Pre-nursing option offers courses which satisfy general education requirements in Life Sciences, are prerequisites for a degree in Veterinary Technology, Medical Assisting, Health Information Technology, and Nursing, and prepare students for transfer opportunities to four-year programs in nursing, physical therapy, and programs leading to careers in allied health fields.

Highlights of the program include:

- Extensive laboratory experience
- Day and evening sections of pre-nursing classes
- A friendly faculty who have studied biology in South America, the Galapagos Islands, Africa and North America
- A Mathematics, Engineering and Science Achievement (MESA) program

Note: This degree is designed for students intending to transfer to a nursing program at a 4-year college or university. It does not prepare the student for immediate employment as a nurse. Students earning a nursing degree will need to complete several lower division nursing classes after transferring.

Catalog Date: June 1, 2020

Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 440</td>
<td>General Microbiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 430</td>
<td>Anatomy and Physiology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 431</td>
<td>Anatomy and Physiology</td>
<td>5</td>
</tr>
<tr>
<td>[ CHEM 305</td>
<td>Introduction to Chemistry (5)</td>
<td>5 - 10</td>
</tr>
<tr>
<td>and CHEM 306</td>
<td>Introduction to Organic and Biological Chemistry (5)</td>
<td></td>
</tr>
<tr>
<td>or CHEM 309</td>
<td>Integrated General, Organic, and Biological Chemistry (5)</td>
<td></td>
</tr>
</tbody>
</table>
COURSE CODE    COURSE TITLE  UNITS
NUTRI 300    Nutrition            3
FCS 324     Human Development: A Life Span 3
PSYC 300    General Principles (3) 3
or PSYC 320    Social Psychology (3) 3

Total Units: 28 - 33

Note: This degree is designed for students intending to transfer to a nursing program at a 4-year college or university. It does not prepare the student for immediate employment as a nurse. Students earning a nursing degree will need to complete several lower division nursing classes after transferring.

The Biology: Pre-Nursing Option Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See CRC graduation requirements.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- Demonstrate understanding of the processes of science, the scientific method, and the relationship between scientific research and established knowledge. This includes the ability to...
- Elucidate the way in which research leads to generally accepted conclusions and the integration of new research data with the building of a body of scientific knowledge.
- Recognize that the information presented in science textbooks and other established “authorities” is the result of research conducted in the field or the lab and is based on an accumulation of data.
- Design a scientific inquiry, including use of proper controls and analyses
- Demonstrate critical thinking skills by the analysis of data sets, recognition of the implications of perturbations to biological systems, and synthesis of information to draw conclusions.
- Express themselves clearly when writing or speaking about biology, demonstrating knowledge of basic biological terminology and understanding of major biological concepts. This includes the ability to produce:
  - Laboratory reports which address background information, procedures, results, and analysis of data developed during a laboratory exercise or inquiry project
  - Essays explaining biological processes in clear and concise terms
  - Reports and term papers which clearly explain biological processes and elucidate current theories explaining biological phenomena
- Demonstrate both content knowledge and test-taking skills when completing essay, objective, and multiple choice exams. This includes the ability to:
  - Demonstrate problem-solving abilities in the major content areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution.
  - Analyze the logic of a multiple-choice question about biology and select the correct response from among related items.
  - Write clear responses to essay question prompts without including extraneous information or omitting information necessary to provide a clear answer.
  - Utilize test-taking skills such as critical analysis of information, test-time management and focused writing.
- Demonstrate content knowledge in the broad areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution.
- Use appropriate laboratory techniques proficiently. Pre-nursing majors lab techniques include:
  - Measurement (use of metric measures)
  - Microscopy (including histology)
  - Identification of unknown microorganisms
  - Staining of bacteria
  - Use of equipment used to gather physiological data on humans
  - Additional laboratory techniques relevant to pre-nursing majors can be found in the SLOs for the chemistry courses required for this career option.
- Evaluate biological data, draw reasonable conclusions, recognize the ethical implications of these conclusions, and apply these conclusions to personal, community, and scientific problems. This includes the ability to:
  - Choose what data to collect in order to address a specific hypothesis
  - Collect data and keep organized records
  - Conduct basic graphical and statistical analysis of data
  - Reach and clearly express logical conclusions based on biological data

Career Information

Nursing, Physician’s Assistant, Physical Therapy, etc. Some career options require more than two years of college study. Classes beyond the associate degree may be required for some career options or to fully prepare students for transfer to a university program.

A.S. in Biology

What do antibiotic resistance, hemophilia, DNA fingerprinting, sequoias, cuttlefish, intertidal zones, and global climate change have in common? These are a few examples of the diverse topics that are explored in biology, which is the scientific study of living organisms including their structure, function, evolution, and interactions with other organisms and with the environment.

Highlights of the program include:

- Extensive hands-on learning approach in laboratory courses that provide students with opportunities to use modern equipment and techniques.
- Small class sizes taught by enthusiastic biology professors who set high standards but who demonstrate how to achieve those standards.
- A high level of satisfaction with the education received at CRC is reported by students who transfer to 4-year universities.
- A Mathematics, Engineering and Science Achievement (MESA) program to help students develop academic and leadership skills.

Note to Transfer Students:

This degree is intended to prepare students for transfer to a University of California campus or other four-year institutions. It is critical that you meet with a counselor from your desired transfer institution to select and plan the courses for your major. Some UC programs may require calculus-based (not trigonometry based) physics with lab before graduation. Additionally, some UC programs may require statistics prior to graduation.

Colleges and universities vary widely in their requirements for degrees. The courses that CRC requires for an Associate’s degree may be different from the requirements for a Bachelor’s degree. Therefore, you are strongly encouraged to meet with both a CRC counselor and a counselor from your desired transfer institution in order to understand the lower division requirements for the program at the college or university you plan to attend.

Catalog Data: June 1, 2020

Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 400</td>
<td>Principles of Biology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 410</td>
<td>Principles of Botany</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Principles of Zoology</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 400</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 401</td>
<td>General Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>UNITS</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>CHEM 420</td>
<td>Organic Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 421</td>
<td>Organic Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>[ MATH 350</td>
<td>Calculus for the Life and Social Sciences I (3)</td>
<td>6 - 10</td>
</tr>
<tr>
<td>and MATH 351</td>
<td>Calculus for the Life and Social Sciences II (3)</td>
<td></td>
</tr>
<tr>
<td>or [ MATH 355</td>
<td>Calculus for Biology and Medicine I (4)</td>
<td></td>
</tr>
<tr>
<td>and MATH 356]</td>
<td>Calculus for Biology and Medicine II (4)</td>
<td></td>
</tr>
<tr>
<td>or [ MATH 400</td>
<td>Calculus I (5)</td>
<td></td>
</tr>
<tr>
<td>and MATH 401]</td>
<td>Calculus II (5)</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units:** 41 - 45

The Biology Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See CRC graduation requirements.

**Student Learning Outcomes**

Upon completion of this program, the student will be able to:

- **DEMONSTRATE UNDERSTANDING OF THE PROCESSES OF SCIENCE, THE SCIENTIFIC METHOD, AND THE RELATIONSHIP BETWEEN SCIENTIFIC RESEARCH AND ESTABLISHED KNOWLEDGE.** (PSLO 1)
  - Elucidate the way in which research leads to generally accepted conclusions and the integration of new research data with the building of a body of scientific knowledge.
  - Recognize that the information presented in science textbooks and other established “authorities” is the result of research conducted in the field or the lab and is based on an accumulation of data.
  - Design a scientific inquiry, including use of proper controls and analyses.
  - Demonstrate critical thinking skills by the analysis of data sets, recognition of the implications of perturbations to biological systems, and synthesis of information to draw conclusions.
  - **EXPRESS ONE’S SELF CLEARLY WHEN WRITING OR SPEAKING ABOUT BIOLOGY, DEMONSTRATING KNOWLEDGE OF BASIC BIOLOGICAL TERMINOLOGY AND UNDERSTANDING OF MAJOR BIOLOGICAL CONCEPTS.** (PSLO 2)
  - Produce laboratory reports which address background information, procedures, results, and analysis of data developed during a laboratory exercise or inquiry project.
  - Produce essays explaining biological processes in clear and concise terms.
  - Produce reports and term papers which clearly explain biological processes and elucidate current theories explaining biological phenomena.
  - **DEMONSTRATE BOTH CONTENT KNOWLEDGE AND TEST TAKING SKILLS WHEN COMPLETING ESSAY, OBJECTIVE, AND MULTIPLE CHOICE EXAMS.** (PSLO 3)
  - Demonstrate problem-solving abilities in the major content areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution.
  - Analyze the logic of a multiple-choice question about biology and select the correct response from among related items.
  - Write clear responses to essay question prompts without including extraneous information or omitting information necessary to provide a clear answer.
  - Utilize test-taking skills such as critical analysis of information, test-time management and focused writing.
  - Demonstrate content knowledge in the broad areas of biology including cell biology, anatomy, physiology, genetics, ecology, and evolution.
  - **CHOOSE AND UTILIZE APPROPRIATE LABORATORY TECHNIQUES PROFICIENTLY.** (PSLO 4)
  - Demonstrate proficient use of measurement (use of metric measures).
  - Demonstrate proficient use of microscopy.
  - Demonstrate proficient use of pipetting.
  - Demonstrate proficient use of gel electrophoresis.
  - Demonstrate proficient use of dissection.
  - Demonstrate proficient use of basic biochemical techniques such as pH testing, Biuret test, Benedict’s test, etc.
  - Demonstrate the ability to design a laboratory experiment, including the use of adequate controls and choice of analyses used to examine data, etc.
  - **EVALUATE BIOLOGICAL DATA, DRAW REASONABLE CONCLUSIONS, RECOGNIZE THE ETHICAL IMPLICATIONS OF THESE CONCLUSIONS, AND APPLY THESE CONCLUSIONS TO PERSONAL, COMMUNITY, AND SCIENTIFIC PROBLEMS.** (PSLO 5)
  - Choose what data to collect in order to address a specific hypothesis.
  - Collect data and keep organized records.
  - Conduct basic graphical and statistical analysis of data.
  - Reach and clearly express logical conclusions based on biological data.
  - Relate, in presentations and/or in written reports, how biological information is relevant to personal and community issues.
  - Recognize the ethical implications of biological research and the responsibility to use knowledge wisely.
  - **EMPLOY INFORMATION-GATHERING TOOLS TO INVESTIGATE BIOLOGICAL IDEAS.** (PSLO 6)
  - Use the Internet in order to gather scientific information, including the ability to recognize the relevance and scientific validity (or lack thereof) of information when found.
  - Use the library in order to gather scientific information, including the ability to recognize the relevance and scientific validity (or lack thereof) of information when found.

**Career Information**

Research, Teaching, or Industrial Laboratory Careers in Molecular Biology, Microbiology, Biotechnology, Genetics, Wildlife Biology, Marine Biology, Pharmacy, Nutrition, Medicine, Dentistry, Veterinary, Optometry, etc. These career options require more than two years of college study. Classes beyond the associate degree may be required for career options or to fully prepare students for transfer to a university program.

**A.S. in General Science**

Areas of Study include:
Eighteen (18) units of transfer level course work in science is required. Two laboratory courses must be included: one in the physical sciences and one in the biological sciences. Courses may be selected from astronomy, biology, chemistry, geology, physical geography, physical anthropology, and physics. The student, in consultation with a counselor, should choose science courses to meet his or her program, transfer, or general education requirements.

Students interested in transferring to a four-year university with a science major are encouraged to complete a science AS or AS-T degree such as Anthropology, Biology, Chemistry, Engineering, Geography, Geology, or Physics. This General Science degree may not include the majors-level transfer courses needed for many science majors. Students are strongly recommended to see a counselor for guidance.

**Catalog Date:** June 1, 2020

### Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Life Science with Lab: A minimum of 4 units from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANTH 300</td>
<td>Biological Anthropology (3)</td>
<td></td>
</tr>
<tr>
<td>and ANTH 301</td>
<td>Biological Anthropology Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>BIOL 307</td>
<td>Biology of Organisms (4)</td>
<td></td>
</tr>
<tr>
<td>BIOL 310</td>
<td>General Biology (4)</td>
<td></td>
</tr>
<tr>
<td>BIOL 400</td>
<td>Principles of Biology (5)</td>
<td></td>
</tr>
<tr>
<td>BIOL 410</td>
<td>Principles of Botany (5)</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Principles of Zoology (5)</td>
<td></td>
</tr>
<tr>
<td>BIOL 430</td>
<td>Anatomy and Physiology (5)</td>
<td></td>
</tr>
<tr>
<td>BIOL 431</td>
<td>Anatomy and Physiology (5)</td>
<td></td>
</tr>
<tr>
<td>BIOL 440</td>
<td>General Microbiology (4)</td>
<td></td>
</tr>
<tr>
<td>B. Physical Science with Lab: A minimum of 3 units from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTR 300</td>
<td>Introduction to Astronomy (3)</td>
<td></td>
</tr>
<tr>
<td>and ASTR 400</td>
<td>Astronomy Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>CHEM 300</td>
<td>Beginning Chemistry (4)</td>
<td></td>
</tr>
<tr>
<td>CHEM 305</td>
<td>Introduction to Chemistry (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 306</td>
<td>Introduction to Organic and Biological Chemistry (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 309</td>
<td>Integrated General, Organic, and Biological Chemistry (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 322</td>
<td>Environmental Chemistry Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>and CHEM 321</td>
<td>Environmental Chemistry (3)</td>
<td></td>
</tr>
<tr>
<td>CHEM 400</td>
<td>General Chemistry I (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 401</td>
<td>General Chemistry II (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 420</td>
<td>Organic Chemistry I (5)</td>
<td></td>
</tr>
<tr>
<td>CHEM 421</td>
<td>Organic Chemistry II (5)</td>
<td></td>
</tr>
<tr>
<td>GEOG 301</td>
<td>Physical Geography Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>and GEOG 300</td>
<td>Physical Geography: Exploring Earth's Environmental Systems (3)</td>
<td></td>
</tr>
<tr>
<td>GEOL 301</td>
<td>Physical Geology Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>and GEOL 300</td>
<td>Physical Geology (3)</td>
<td></td>
</tr>
<tr>
<td>GEOL 306</td>
<td>Earth Science Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>and GEOL 305</td>
<td>Earth Science (3)</td>
<td></td>
</tr>
<tr>
<td>GEOL 311</td>
<td>Historical Geology Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>and GEOL 310</td>
<td>Historical Geology (3)</td>
<td></td>
</tr>
<tr>
<td>ENGR 304</td>
<td>How Things Work (3)</td>
<td></td>
</tr>
<tr>
<td>PHYS 350</td>
<td>General Physics (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 360</td>
<td>General Physics (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 370</td>
<td>Introductory Physics - Mechanics and Thermodynamics (5)</td>
<td></td>
</tr>
<tr>
<td>PHYS 380</td>
<td>Introductory Physics - Electricity and Magnetism, Light and Modern Physics (5)</td>
<td></td>
</tr>
<tr>
<td>PHYS 411</td>
<td>Mechanics of Solids and Fluids (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 421</td>
<td>Electricity and Magnetism (4)</td>
<td></td>
</tr>
<tr>
<td>PHYS 431</td>
<td>Heat, Waves, Light and Modern Physics (4)</td>
<td></td>
</tr>
<tr>
<td>C. Additional Science Courses: A minimum of 11 units from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANTH 300</td>
<td>Biological Anthropology (3)</td>
<td></td>
</tr>
<tr>
<td>ANTH 301</td>
<td>Biological Anthropology Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>ASTR 300</td>
<td>Introduction to Astronomy (3)</td>
<td></td>
</tr>
<tr>
<td>ASTR 400</td>
<td>Astronomy Laboratory (1)</td>
<td></td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>UNITS</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>BIOL 100</td>
<td>Introduction to Concepts of Human Anatomy and Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 300</td>
<td>The Foundations of Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 307</td>
<td>Biology of Organisms</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 310</td>
<td>General Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 342</td>
<td>The New Plagues: New and Ancient Infectious Diseases Threatening World Health</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 350</td>
<td>Environmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 352</td>
<td>Conservation Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 390</td>
<td>Natural History Field Study</td>
<td>0.5 - 4</td>
</tr>
<tr>
<td>BIOL 400</td>
<td>Principles of Biology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 410</td>
<td>Principles of Botany</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Principles of Zoology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 430</td>
<td>Anatomy and Physiology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 431</td>
<td>Anatomy and Physiology</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 440</td>
<td>General Microbiology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 462</td>
<td>Genetics in Contemporary Human Society</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 300</td>
<td>Beginning Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 305</td>
<td>Introduction to Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 306</td>
<td>Introduction to Organic and Biological Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 309</td>
<td>Integrated General, Organic, and Biological Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 321</td>
<td>Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 322</td>
<td>Environmental Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 400</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 401</td>
<td>General Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 420</td>
<td>Organic Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 421</td>
<td>Organic Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>ENGR 304</td>
<td>How Things Work</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 300</td>
<td>Physical Geography: Exploring Earth's Environmental Systems</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 301</td>
<td>Physical Geography Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOG 305</td>
<td>Global Climate Change</td>
<td>3</td>
</tr>
<tr>
<td>GEOG 306</td>
<td>Weather and Climate</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 300</td>
<td>Physical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 301</td>
<td>Physical Geology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 305</td>
<td>Earth Science</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 306</td>
<td>Earth Science Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 310</td>
<td>Historical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 311</td>
<td>Historical Geology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 330</td>
<td>Introduction to Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 390</td>
<td>Field Studies in Geology</td>
<td>1 - 4</td>
</tr>
<tr>
<td>PHYS 310</td>
<td>Conceptual Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 350</td>
<td>General Physics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 360</td>
<td>General Physics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 370</td>
<td>Introductory Physics - Mechanics and Thermodynamics</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 380</td>
<td>Introductory Physics - Electricity and Magnetism, Light and Modern Physics</td>
<td>5</td>
</tr>
<tr>
<td>PHYS 411</td>
<td>Mechanics of Solids and Fluids</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 421</td>
<td>Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 431</td>
<td>Heat, Waves, Light and Modern Physics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Total Units:** 18

Courses used in A or B above will not count towards C, except units exceeding the 4 or 3 unit minimum in A and B. For example, a student completing the 5 unit CHEM 309 under B could apply 2 of those units towards C. A total of 18 science units is required.

The General Science Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See CRC graduation requirements.

**Student Learning Outcomes**

Upon completion of this program, the student will be able to:

- explain the core perspectives of the scientific method and apply it to at least one scientific discipline. (SLO 1)
- solve introductory problems of a conceptual and/or numerical nature of at least one scientific discipline. (SLO 2)
- accurately apply the basic vocabulary and concepts of at least one scientific discipline verbally and in writing. (SLO 3)
- recognize the use and misuse of scientific concepts in society including politics and the media. (SLO 4)

**Biology (BIOL) Courses**

**BIOL 100 Introduction to Concepts of Human Anatomy and Physiology**
This introductory course provides an overview of the basic anatomy and physiology of all body systems. It is designed as a non-transferable course for the Medical Assisting Programs and other related programs, and may be useful for other health-related technologies and for strengthening or developing a vocabulary in human anatomy and physiology.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO 1: EXPLAIN THE BASIC STRUCTURE OF CELLS AND TISSUES AND THE RELEVANCE OF THIS STRUCTURE TO HUMAN PHYSIOLOGY**
  - illustrate how pH, ions, and concentration gradients influence physiological processes
  - compare and contrast the anatomy of cells in various tissues in order to understand the physiology of different organ systems
  - apply knowledge of tissues to organs and organ systems

- **SLO 2: DEMONSTRATE A FUNDAMENTAL UNDERSTANDING OF HOMEOSTASIS AND FEEDBACK LOOPS**
  - describe the mechanisms by which the human can self-regulate
  - compare and contrast positive and negative feedback loops
  - explain how homeostatic mechanisms involve multiple organ systems

- **SLO 3: IDENTIFY ANATOMICAL STRUCTURES**
  - describe the anatomical position and demonstrate the ability to use directional terms
  - utilize proper anatomical terms to name structures in various organ systems

- **SLO 4: DETERMINE GENERAL PHYSIOLOGY OF A STRUCTURE BASED ON ANATOMICAL OBSERVATIONS**
  - analyze structural distinctions and apply concepts of cellular physiology to organs and organ systems
  - determine functional relationships among various organ systems based upon their anatomical proximity or similarity
  - recognize and understand the principles of the scientific method and how they relate to the study of physiological processes

---

**BIOL 102 Essentials of Human Anatomy and Physiology**

Units: 4

Hours: 54 hours LEC; 54 hours LAB

Prerequisite: None.

General Education: AA/AS Area IV

Catalog Date: June 1, 2020

This introductory course provides an overview of the basic anatomy and physiology of all body systems. It is designed as a non-transferable course and meets the minimum requirements for Medical Assisting, Health Information Technology, Emergency Medical Technician, Pharmacy Technology, Licensed Vocational Nursing, and other health-related technologies. It is also useful for strengthening or developing a vocabulary in human anatomy and physiology.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO 1: EXPLAIN THE BASIC STRUCTURE OF CELLS AND TISSUES AND THE RELEVANCE OF THIS STRUCTURE TO HUMAN PHYSIOLOGY**
  - illustrate how pH, ions, and concentration gradients influence physiological processes
  - compare and contrast the anatomy of cells in various tissues in order to understand the physiology of different organ systems
  - apply knowledge of tissues to organs and organ systems

- **SLO 2: DEMONSTRATE A FUNDAMENTAL UNDERSTANDING OF HOMEOSTASIS AND FEEDBACK LOOPS**
  - describe the mechanisms by which the human can self-regulate
  - compare and contrast positive and negative feedback loops
  - explain how homeostatic mechanisms involve multiple organ systems

- **SLO 3: IDENTIFY ANATOMICAL STRUCTURES**
  - describe the anatomical position and demonstrate the ability to use directional terms
  - utilize proper anatomical terms to name structures in various organ systems

- **SLO 4: DETERMINE GENERAL PHYSIOLOGY OF A STRUCTURE BASED ON ANATOMICAL OBSERVATIONS**
  - analyze structural distinctions and apply concepts of cellular physiology to organs and organ systems
  - determine functional relationships among various organ systems based upon their anatomical proximity or similarity
  - apply the principles of the scientific method to test hypotheses regarding physiological processes based on laboratory observations

---

**BIOL 295 Independent Studies in Biology**

Units: 1 - 3

Hours: 54 - 162 hours LAB

Prerequisite: None.

Catalog Date: June 1, 2020

An independent studies project involves an individual student or small group of students in study, research, or activities beyond the scope of regularly offered courses. See the current catalog section of "Special Studies" for full details of Independent Studies.
BIOL 299 Experimental Offering in Biology

Units: 0.5 - 4
Prerequisite: None.
Catalog Date: June 1, 2020

BIOL 300 The Foundations of Biology

Units: 3
Hours: 54 hours LEC
Prerequisite: None.
Advisory: Eligibility for ENGWR 300
Transferable: CSU; UC (Transfer Credit Limitations: 1) BIOL 300, 307, 308, and 310 combined: maximum transfer credit is one course; 2) No credit for BIOL 300, BIOL 307, BIOL 308 or BIOL 310 if taken after BIOL 400, BIOL 420, BIOL 430 or BIOL 431)
General Education: AA/AS Area IV; CSU Area B2; IGETC Area 5B
Catalog Date: June 1, 2020

This course is a survey of major topics in the biological sciences for the non-science major with an emphasis on human biology. Units covered include cell structure and chemistry, metabolism, Mendelian and molecular genetics, genetic engineering, anatomy and physiology of humans, evolution, and ecology. Students interested in a general elective biology course are strongly advised to take either BIOL 300, BIOL 307, BIOL 308, or BIOL 310 since some transfer institutions will provide credit for only one of the four courses. 300-level biology courses may not be accepted by your transfer institution if taken after a 400-level biology course.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: EXPLAIN THE BASIC MECHANISMS BY WHICH ORGANISMS MAINTAIN HOMEOSTASIS
- distinguish the major cellular processes (e.g. cell membrane function, cellular respiration), and explain them using the correct biological terminology.
- diagram major structures of human anatomy and explain the basic functioning of major human organ systems.
- analyze the impact of damage to organs or organ systems on homeostasis and the health of individuals.
- SLO 2: DESCRIBE THE BASIC PROCESSES OF GENETICS
- solve simple Mendelian genetic problems and discuss the implications of transmission genetics for families.
- describe the basic processes of molecular genetics and the implications of these processes for society.
- evaluate issues in modern biology such as genetic engineering, biotechnology, and reproductive technologies
- describe the cellular basis of reproduction, including meiosis.
- SLO 3: ELUCIDATE THE BASIC PRINCIPLES OF EVOLUTION AND BIODIVERSITY
- explain the basic processes of evolution and the overall mechanism by which natural selection works.
- describe the major types of organisms and the characteristics by which they are classified and draw conclusions about the relatedness of organisms from evolutionary data.
- SLO 4: EVALUATE THE IMPACTS OF HUMANS ON ECOSYSTEMS
- assess the interactions of humans with the environment and other organisms.
- evaluate the implications of human-environment interactions for local and regional communities.
- analyze environmental data and draw reasonable conclusions.
- SLO 5: APPRAISE THE IMPORTANCE OF THE SCIENTIFIC METHOD AND THINK CRITICALLY ABOUT BIOLOGICAL INFORMATION RELEVANT TO PERSONAL AND COMMUNITY ISSUES.
- choose terminology correctly and accurately define biological terms.
- appraise biological information from a variety of sources and evaluate its validity.
- construct examples of the relevance of biology to specific personal and community issues.
- demonstrate an understanding of the scientific method as applied to current issues.
- draw reasonable conclusions from biological data and evaluate conclusions presented by others as having a scientific basis.

BIOL 307 Biology of Organisms
This is a general biology course focusing on a survey of the plant and animal kingdoms with an emphasis on evolution and biodiversity. The course covers the general principles of biology including: methods of science, cell organization, genetics, evolution, ecology, biodiversity, and anatomy. These principles are explored in more depth through the examination of additional topics which may include: disease and epidemiology, physiological ecology, biotechnology, population growth and regulation, ecosystem ecology, and conservation biology. The course is designed for non-science majors and is especially useful for liberal studies, elementary education, environmental studies, recreation, and similar majors. Students interested in a general elective biology course are strongly advised to take either BIOL 300, BIOL 307, BIOL 308, or BIOL 310 since some transfer institutions will provide credit for only one of the four courses. 300-level biology courses may not be accepted by your transfer institution if taken after a 400-level biology course.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: ARTICULATE THE IMPORTANCE OF THE DIVERSITY OF ORGANISMS TO ECOSYSTEM FUNCTIONING.
- elucidate the characteristics used to classify organisms into major taxonomic groups.
- compare and contrast the roles of fungi, plants, and animals in communities and ecosystems.
- SLO 2: EXPLAIN THE BASIC MECHANISMS BY WHICH ORGANISMS SURVIVE, REPRODUCE, AND EVOLVE.
- analyze the basic processes and components of prokaryotic and eukaryotic cells.
- compare and contrast the ways in which fungi, plants and animals solve physiological problems.
- describe the processes by which organisms maintain homeostasis.
- solve Mendelian genetic problems using Punnett squares, pedigrees, and similar methods.
- describe the basic processes of molecular genetics.
- explain the process of evolution by natural selection.
- SLO 3: UTILIZE THE SCIENTIFIC METHOD AND EVALUATE THE SCIENTIFIC VALIDITY OF INFORMATION PRESENTED BY THE MEDIA AND OTHER SOURCES
- utilize and correctly interpret the vocabulary of biology.
- assess the results of scientific investigations into biological questions.
- construct and conduct simple scientific inquiries into biological questions.
- draw reasonable conclusions from biological data.
- SLO 4: APPRAISE THE IMPORTANCE OF BIOLOGY TO PERSONAL AND COMMUNITY ISSUES AND BE ABLE TO GATHER, AND THINK CRITICALLY ABOUT, BIOLOGICAL INFORMATION RELEVANT TO ONE'S LIFE.
- evaluate the implications of genetic biotechnology and other developing biological techniques for modern life.
- articulate the value of biological knowledge to human populations.
- construct examples of the relevance of biology to personal interests and community issues.
- assess the impact of environmental processes on human communities and vice versa.

BIOL 308 Contemporary Biology

Units: 3
Hours: 54 hours LEC
Prerequisite: None.
Transferable: CSU; UC (Transfer Credit Limitations: 1) BIOL 300, 307, 308, and 310 combined: maximum transfer credit is one course; 2) No credit for BIOL 300, BIOL 307, BIOL 308 or BIOL 310 if taken after BIOL 400, BIOL 420, BIOL 430 or BIOL 431)
General Education: AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C
Catalog Date: June 1, 2020

This course is a survey of biological science intended to equip the student to think and act intelligently with respect to contemporary issues in biology. Biological topics are introduced in a framework of natural selection. The course is for those not intending to major in biological sciences, particularly liberal studies majors. Genetics is a significant focus of the course, as are origin of cellular life, cellular physiology, and diversity of organisms. An optional laboratory illustrating these introduced principles is offered as a separate, one-unit course (Biol 309).

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: UTILIZE THE SCIENTIFIC METHOD AND EVALUATE SCIENTIFIC DATA.
- Construct simple scientific inquiries into biological questions, demonstrating an understanding of the scientific method and experimental design.
- Develop reasonable conclusions after analyzing biological data.
- Evaluate the validity of scientific information presented by the media and other sources.
- SLO 2: EXPLAIN THE BASIC BIOCHEMICAL, CELLULAR, STRUCTURAL, AND PHYSIOLOGICAL MECHANISMS BY WHICH ORGANISMS MAINTAIN HOMEOSTASIS.
- Demonstrate knowledge of biologically important atoms and molecules.
- Identify major components of eukaryotic and prokaryotic cells.
- Give an overview of major cellular processes (e.g. osmosis, cellular respiration, photosynthesis, and cell division) underlying the physiological responses of organisms.
- Describe the processes by which organisms respond to disease, with particular reference to human health and disease processes.
- Delineate the basics of the anatomy and physiology of major human organ systems.
SLO 3: DELINEATE THE BASIC PROCESSES OF GENETICS, REPRODUCTION, AND DEVELOPMENT.
- Solve Mendelian genetics problems using Punnett squares, pedigrees, and similar methods.
- Describe the basic processes of molecular genetics, such as DNA replication, transcription, and translation.
- Describe key processes of human reproduction and development.

SLO 4: ELUCIDATE THE BASIC PRINCIPLES OF EVOLUTION, BIODIVERSITY, AND ECOLOGY.
- Explain the process of evolution by natural selection.
- Describe the major types of organisms (e.g. the kingdoms of living things).
- Evaluate the impact of environmental processes on human communities and vice versa.

SLO 5: APPRAISE THE IMPORTANCE OF, AND THINK CRITICALLY ABOUT, BIOLOGICAL INFORMATION RELEVANT TO ONE'S LIFE.
- Utilize the basic vocabulary of biology.
- Evaluate the implications of genetic biotechnology and other developing biological techniques for modern life.
- Articulate the value of biological knowledge to human populations.
- Access biological information from a variety of sources.

BIOL 309 Contemporary Biology Laboratory

**Units:** 1  
**Hours:** 54 hours LAB  
**Prerequisite:** None  
**Corequisite:** BIOL 308; BIOL 308 may be taken during a previous semester. Grade of "C" or better required if taken previously.  
**Advisory:** ESLR 320 and ESLW 310, OR ESL 325 with a grade of C or better; OR eligibility for ENGRD 310 AND ENGWR 101.  
**Transferable:** CSU; UC  
**General Education:** CSU Area B3 (effective Fall 2020); IGETC Area 5C (effective Fall 2020)  
**Catalog Date:** June 1, 2020

This course is an optional laboratory accompaniment to BIOL 308. The sessions will illustrate biological phenomena and their relationship to contemporary concerns and discoveries in biology.

**Student Learning Outcomes**

Upon completion of this course, the student will be able to:
- **SLO 1: UTILIZE THE SCIENTIFIC METHOD AND EVALUATE SCIENTIFIC DATA.**
- Make observations and formulate testable hypotheses.
- Construct and conduct simple scientific inquiries into biological questions, demonstrating an understanding of the scientific method and experimental design.
- Present results in the format of graphs and tables.
- Develop reasonable conclusions after analyzing biological data.

- **SLO 2: UTILIZE STANDARD BIOLOGICAL LABORATORY TECHNIQUES AND EQUIPMENT.**
- Understand the importance and application of the microscope to view living organisms at the cellular level.
- Use the appropriate equipment and/or tools to record measurements in the metric system.

- **SLO 3: INTEGRATE CONCEPTS FROM "CONTEMPORARY BIOLOGY" INTO THE HANDS-ON EXPERIENCE OF THE BIOLOGICAL LABORATORY.**
- Explore basic biochemical, cellular, structural and physiological mechanisms.
- Delineate the processes of genetics, reproduction, and development.
- Elucidate the principles of evolution, biodiversity, and ecology.

- **SLO 4: APPRAISE THE IMPORTANCE OF, AND THINK CRITICALLY ABOUT, BIOLOGICAL INFORMATION RELEVANT TO ONE'S LIFE.**
- Utilize the basic vocabulary of biology.
- Evaluate the implications of genetic biotechnology and other developing biological techniques for modern life.
- Articulate the value of biological knowledge to human populations.
- Access biological information from a variety of sources.

BIOL 310 General Biology

**Units:** 4  
**Hours:** 54 hours LEC; 54 hours LAB  
**Prerequisite:** None  
**Advisory:** Eligibility for ENGRW 300  
**Transferable:** CSU; UC (Transfer Credit Limitations: 1) BIOL 300, 307, 308, and 310 combined: maximum transfer credit is one course; 2) No credit for BIOL 300, BIOL 307, BIOL 308 or BIOL 310 if taken after BIOL 400, BIOL 420, BIOL 430 or BIOL 431)  
**General Education:** AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C  
**Catalog Date:** June 1, 2020

This is a survey of biological science with an emphasis on human biology. This course is intended for non-science majors. Topics covered include scientific inquiry, cell structure, transmission and molecular genetics, major organ systems, evolution, and ecology. Major biological principles are explored in each topic, but an emphasis is placed on human issues. The laboratory activities are designed to further investigate and illuminate each topic area. Students interested in a general elective biology course are strongly advised to take either BIOL 300, BIOL 307, BIOL 308, or BIOL 310 since some transfer institutions will provide credit for only one of the four courses. 300-level biology courses may not be accepted by your transfer institution if taken after a 400-level biology course.

**Student Learning Outcomes**

Upon completion of this course, the student will be able to:
SLO1: EXPLAIN THE BASIC BIOCHEMICAL, CELLULAR, STRUCTURAL, AND PHYSIOLOGICAL MECHANISMS BY WHICH HUMANS MAINTAIN HOMEOSTASIS.

- demonstrate knowledge of biologically important atoms and molecules.
- identify major components of eukaryotic cells.
- give an overview of major cellular processes (e.g., osmosis, cellular respiration, and cell division) underlying the physiological responses of organisms.
- describe the processes by which organisms respond to disease, with particular reference to human health and disease processes.
- delineate the basics of the anatomy and physiology of major human organ systems.

SLO2: DELINATE THE BASIC PROCESSES OF GENETICS, REPRODUCTION, AND DEVELOPMENT.

- solve simple transmission (Mendelian) genetics problems.
- describe the basic processes of molecular genetics, such as DNA replication, transcription, and translation.
- examine current issues in modern biology, such as genetic engineering, biotechnology, reproductive technologies, stem cells, etc.
- describe key processes of human reproduction and development.

SLO3: ELUCIDATE THE BASIC PRINCIPLES OF EVOLUTION, BIODIVERSITY, AND ECOLOGY.

- explain the mechanism of natural selection.
- describe the major types of organisms (e.g., the kingdoms of living things).
- evaluate the impact of humans on the environment and on other organisms.

SLO4: UTILIZE THE SCIENTIFIC METHOD AND EVALUATE SCIENTIFIC DATA.

- conduct simple scientific investigations into biological questions, demonstrating an understanding of the scientific method and experimental design.
- develop reasonable conclusions after analyzing biological data.
- evaluate the validity of scientific information presented by the media and other sources.

SLO5: APPRAISE THE IMPORTANCE OF, AND THINK CRITICALLY ABOUT, BIOLOGICAL INFORMATION RELEVANT TO ONE'S LIFE.

- utilize the basic vocabulary of biology.
- access biological information from a variety of sources.
- construct examples of the relevance of biology to specific personal and community issues.

BIOL 342 The New Plagues: New and Ancient Infectious Diseases Threatening World Health

Units: 3
Hours: 54 hours LEC
Prerequisite: None.
Advisory: ENGRD 312 and ENGWR 300
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B2; IGETC Area 5B
Catalog Date: June 1, 2020

This course will cover general biological concepts and the epidemiology and pathology of selected pathogens such as prions, viruses, bacteria, protozoa, and helminthes threatening public health on a global scale. The course explores the influence of human behavior and activities on the emergence of new infectious agents and the re-emergence of ancient plagues.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO #1: Examine the biology, pathogenesis, and transmission of infectious agents threatening global health.
- Analyze the structure and function of bacteria, viral particles, fungi, helminths, protozoa, and prions.
- Compare and contrast the overall cell structure of prokaryotes and eukaryotes.
- SLO #2: Analyze how the human immune system responds to infectious agents.
- Assess the function and importance of skin, mucous membranes and normal flora.
- Evaluate the characteristics of non-specific immunity.
- Compare and contrast humoral and cell mediated immunity.
- SLO #3: Evaluate the factors leading to the emergence or re-emergence of infectious diseases worldwide.
- Compare mechanisms of genetic recombination in bacteria.
- Analyze the relevance of behavioral and social changes to the incidence of global infectious disease.
- SLO #4: Assess the various methods of control of infectious agents, including vaccination, antimicrobial therapy, behavioral, and social changes.
- Evaluate the effectiveness and discuss the history of various types of vaccinations.
- Compare and contrast the function and effectiveness of antibiotic, antiviral, antifungal and antiprotozoal therapy.
- SLO #5: Appraise the importance of the scientific method and think critically about biological and community issues.
- Assess biological information from a variety of sources and evaluate its validity.
- Construct examples of the relevance of biology to specific personal and community issues.
- Demonstrate an understanding of the scientific method as applied to current issues.
- Draw reasonable conclusions from biological data and evaluate conclusions presented by others as having a scientific basis.
- Choose terminology correctly and accurately define biological terms.

BIOL 350 Environmental Biology
This course provides an overview of ecosystems and natural resources. Major topics covered include ecological principles, ecosystem functioning, conservation biology, resource use and management, pollution and other human-caused environmental impacts. This course provides the background needed to understand major global and regional issues such as acid rain, global warming, hazardous waste disposal, deforestation and endangered species recovery. This course is especially useful for Environmental Science, Ecology, Recreation, and Political Science majors. Field trips, attendance at public meetings and/or a semester project may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO #1-APPLY THE PRINCIPLES OF ECOLOGY TO THE ANALYSIS OF INDIVIDUAL ADAPTATION, POPULATIONS, COMMUNITIES, AND ECOSYSTEMS.** This includes the ability to:
  - delineate the major processes involved in ecosystem structure and stability.
  - utilize the basic vocabulary of ecology.
  - analyze community processes, including community stability and processes involving interactions between species (e.g. mutualism, commensalism, competition, and predation).
  - construct graphs describing exponential and logistic population growth and assess the factors affecting each type of population growth.
- **SLO #2-EVALUATE THE IMPACTS OF INTERACTIONS OF HUMAN POPULATIONS WITH OTHER SPECIES.** This includes the ability to:
  - analyze the components of effective resource management.
  - appraise the impacts of pollution on populations, communities, ecosystems, and global processes.
  - provide examples of the relevance of environmental biology to personal interests and community issues.
- **SLO #3-USE THE SCIENTIFIC METHOD TO POSE QUESTIONS AND INTERPRET DATA RELEVANT TO ENVIRONMENTAL PROBLEMS.** This includes the ability to:
  - assess the results of scientific investigations into biological questions.
  - construct reasonable conclusions from ecological data.
  - outline how the study of paleoclimatology helps scientists predict future changes.
  - diagram feedback loops involving atmospheric carbon dioxide and other greenhouse gases, albedo, photosynthesis, temperature, cloud cover, pollution, and other related variables.
  - discuss the reasons why it is difficult to predict future climate change.
- **SLO #4: APPLY SCIENTIFIC REASONING TO ASSESS THE EVIDENCE FOR HUMAN-INDUCED CLIMATE CHANGE.**
  - determine the geographic distribution of the principal biomes.
  - outline how increasing atmospheric carbon dioxide levels may affect the acidity of oceans and the structure of marine communities.
- **SLO #5: UNDERSTAND HOW CLIMATE CHANGE MAY AFFECT THEIR LIVES AND THE FUTURE OF LIFE ON EARTH.**
  - outline effective short term and long term strategies for mitigating the effects of climate change.

BIOL 351 Global Climate Change

**Same As:** GEOG 305  
**Units:** 3  
**Hours:** 54 hours LEC  
**Prerequisite:** None.  
**Transferable:** CSU; UC  
**General Education:** AA/AS Area IV; CSU Area B2; IGETC Area 5B

This interdisciplinary course explores the natural and human factors causing the Earth's climate to change. Whether alarmed, skeptical, or just curious about climate change, this course will provide the scientific tools to analyze the evidence that climate change is a looming threat. Through lectures, readings, discussions and projects, students will examine the Earth's present and past climates as well as the influence of climate on the geographical distribution of plants, animals and human societies. This course is the same as GEOG 305, and only one may be taken for credit.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO 1:** DEemonstrate an understanding of the physical factors affecting climate and the resulting geographic variation of energy receipt, temperature, precipitation, and biomes.  
  - Diagram the global energy balance, accounting for major sources of input and outputs, heat exchange and absorption.  
  - Describe the various layers of the atmosphere and explain their role in producing the Greenhouse Effect and anthropogenic global warming.
  - Apply knowledge of meteorology as well as global oceanic circulation to hypothesize how terrestrial and marine biotic communities may be impacted by climate change.
- **SLO 2:** Demonstrate an understanding of how climate influences the distribution of living organisms.  
  - Outline effective short term and long term strategies for mitigating the effects of climate change.
  - Diagram feedback loops involving atmospheric carbon dioxide and other greenhouse gases, albedo, photosynthesis, temperature, cloud cover, pollution, and other related variables.
  - Discuss the reasons why it is difficult to predict future climate change.
- **SLO 3:** Apply scientific reasoning to assess the evidence for human-induced climate change.  
  - Determine the geographic distribution of the principal biomes.
  - Discuss the importance of physiological tolerance and species interactions in the structure, diversity, and stability of communities.  
  - Use data from paleoclimatology to demonstrate how the geographic ranges of organisms may be affected by climate shifts.
  - Outline how increasing atmospheric carbon dioxide levels may affect the acidity of oceans and the structure of marine communities.
- **SLO 4:** Analyze the complexities and difficulties in constructing climate change models.  
  - Describe the major principles of the Kyoto accord and discuss why it has failed to be adopted by major nations.
  - Identify how global warming may affect weather extremes, incidence of wildfires, availability of water, agriculture, human disease patterns, settlement patterns, economic, political stability, and other aspects of human society.
- **SLO 5:** Understand how climate change may affect their lives and the future of life on Earth.  
  - Outline effective short term and long term strategies for mitigating the effects of climate change.

BIOL 352 Conservation Biology
This introductory course covers biological and ecological principles involved in understanding and analyzing environmental problems and exploring scientifically sound conservation techniques. Major topics include the nature of science, basic principles of ecology, genetics and evolution, patterns of biodiversity and extinction, and the interdependence between humans and our environment. This course places emphasis on scientific processes and methodology and the application of science to conservation issues. Field trips and/or a semester project may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: APPLY BASIC PRINCIPLES OF ECOLOGY, GENETICS, AND EVOLUTION TO THE ANALYSIS OF CONSERVATION ISSUES. THIS INCLUDES THE ABILITY TO...
  - Utilize the vocabulary of biological sciences effectively.
  - Explain the basic concepts of population, community, and ecosystem ecology and apply these to the analysis of conservation issues.
  - Apply the basic concepts of population genetics and natural selection to the analysis of conservation issues.

- SLO 2: EXAMINE BIODIVERSITY IN TERMS OF THE STRUCTURE AND FUNCTION OF BIOLOGICAL SYSTEMS. THIS INCLUDES THE ABILITY TO...
  - Calculate measures of genetic and species diversity in the analysis of conservation issues.
  - Appraise patterns of community diversity and community stability.
  - Define the elements of landscape diversity and their importance for conservation.

- SLO 3: ANALYZE THE RELATIONSHIPS BETWEEN HUMAN POPULATIONS AND ECOSYSTEMS AS IT APPLIES TO THREATS TO BIODIVERSITY AND THE REDUCTION OF THOSE THREATS. THIS INCLUDES THE ABILITY TO...
  - Appraise the most common human impacts on species, communities and ecosystems.
  - Discuss aspects of economics, law, and resource consumption as these relate to impacts on conservation.
  - Evaluate the use of protected areas and ex situ conservation strategies in species conservation.

- SLO 4: USE THE SCIENTIFIC METHOD TO POSE QUESTIONS, ANALYZE INFORMATION AND INTERPRET SCIENTIFIC DATA AS APPLIED TO ENVIRONMENTAL PROBLEMS. THIS INCLUDES THE ABILITY TO...
  - Assess the results of scientific investigation into biological questions.
  - Construct reasonable conclusions from biological data.
  - Analyze conservation case studies and evaluate the effectiveness of conservation strategies.

BIOL 390 Natural History Field Study

- Units: 0.5 - 4
- Hours: 3 - 24 hours LEC, 18 - 144 hours LAB
- Prerequisite: None.
- Transferable: CSU; UC
- Catalog Date: June 1, 2020

This course will study the ecology and natural history covered in the field. Animals, plants and geology will be studied and their interrelationships investigated. The course will be offered in the appropriate area (mountains, desert or seashore and ocean). Assignments, field notes and appropriate exams/quizzes will be an integral part of the course. Lodging or campsites and some camping equipment will be provided. Students must provide their own food and some additional camping equipment. This course is ideal for future teachers, parents, resource management majors and those interested in the biological sciences.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- APPLY BASIC PRINCIPLES OF BIOLOGY TO OBSERVATIONS IN THE FIELD (SLO #1).
  - develop observational skills in the field.
  - explain the relationships among organisms, and between organisms and their physical environment.
  - explain roles of select organisms in specific ecosystems.

- UTILIZE INVESTIGATIONS, OBSERVATIONS AND READINGS TO DEVELOP A GREATER DEPTH OF UNDERSTANDING OF BIOLOGICAL PRINCIPLES (SLO #2).
  - compare knowledge gained from readings and lectures to field investigations and observations.
  - utilize appropriate information sources to increase knowledge of the course topic.

- COMMUNICATE KNOWLEDGE GAINED IN THE COURSE EFFECTIVELY IN ORAL AND WRITTEN FORM. (SLO#3)

BIOL 400 Principles of Biology

- Units: 5
- Hours: 54 hours LEC; 108 hours LAB
- Prerequisite: Chem 400 OR Chem 305 with a grade of “C” or better AND Intermediate Algebra (Math 120 or Math 125 with a grade of “C” or better, or equivalent skills demonstrated through the assessment process)
- Advisory: Eligibility for ENGWR 300
- Transferable: CSU; UC (1) No credit for BIOL 300 or 307 if taken after BIOL 400, 420, 430, or 431; 2) No credit for BIOL 310 if taken after BIOL 400; 3) No transfer credit for BIOL 462, if taken after BIOL 400)
- General Education: AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C
- C-ID: C-ID BIOL 190; Part of C-ID BIOL 135S
- Catalog Date: June 1, 2020
This course introduces universal biological principles, including biological molecules, enzymes, cell structure and function, biochemistry, Mendelian and molecular genetics, ecology and evolution. BIOL 400 is recommended for science majors and students in pre-professional programs.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO 1: DEMONSTRATE ABILITY TO ACQUIRE, SYNTHESIZE, EVALUATE AND PRESENT INFORMATION IN BIOLOGY.**
- demonstrate understanding of the scientific method by formulating testable hypotheses, designing experiments with appropriate controls and choices of data to collect, appropriately analyzing data including use of basic statistical analyses, and formulating conclusions supported by data.
- demonstrate ability to use common laboratory techniques and equipment, such as measurement, light microscopes, spectrophotometers, electrophoresis, centrifuges, field sampling, and identification.
- demonstrate understanding of appropriate use of correlational studies to gather data and to formulate conclusions when scientific experimentation is not possible.
- present written and/or oral reports which address background information, procedures, results, and interpretation of data acquired during laboratory or field activities.
- distinguish interpretations that are better supported from those that are less well supported.
- acquire and synthesize information from print and electronic sources, and evaluate the information for quality, scientific validity, relevance, and bias.
- recognize that research leads to generally accepted conclusions that gradually build a body of scientific knowledge and that the information presented in science textbooks and other established “authorities” is the result of research.
- demonstrate the ability to respond to questions in a variety of formats (multiple choice, short-answer, essay prompts, etc.) with accurate, complete, and relevant information.
- recognize the use and misuse of scientific concepts in society, including politics and the media.

- **SLO 2: DEMONSTRATE KNOWLEDGE OF AND CRITICAL THINKING ABOUT BIOLOGY AT THE CELL AND MOLECULAR LEVEL.**
- apply chemistry concepts to recognize and describe the structure of biological molecules (such as DNA, RNA, proteins, carbohydrates, and lipids) and relate their structures to their functions.
- demonstrate an understanding of basic cellular structures and functions in prokaryotes and eukaryotes.
- analyze how the chemical composition of cell membranes leads to their specific cellular functions.
- solve problems related to the movement of water and solutes through cell membranes.
- solve conceptual problems in cell and molecular biology such as the evaluation of the cell and molecular basis of disease, and the mechanisms of drug action.

- **SLO 3: DEMONSTRATE KNOWLEDGE OF AND CRITICAL THINKING ABOUT BIOENERGETICS AND METABOLISM.**
- integrate chemical concepts to explain how cells obtain and transform energy.
- explain how cells use enzymes, coenzymes and ATP to conduct and regulate metabolic pathways.
- compare and contrast electron transport and the synthesis of ATP in mitochondria and chloroplasts.
- compare and contrast cellular respiration and photosynthesis, emphasizing the flow of carbon, electrons and energy and the roles of mitochondria and chloroplasts.
- solve conceptual problems such as evaluation of the effects of perturbations to metabolic systems as they might apply to agriculture, nutrition or disease.

- **SLO 4: DEMONSTRATE KNOWLEDGE OF AND CRITICAL THINKING ABOUT GENES AND INHERITANCE AT THE MOLECULAR, CELLULAR, ORGANISMAL AND POPULATION LEVELS.**
- relate the structure of DNA to its ability to function as a molecule of inheritance and as a molecule that directs protein synthesis.
- compare and contrast the organization and regulation of genes in viruses, prokaryotes and eukaryotes.
- compare and contrast mechanisms that lead to genetic change.
- solve problems of inheritance involving 2 genes, a variety of dominance patterns, simple gene interactions, and linkage.
- explain the fundamental cellular processes involved in cell reproduction and the production of sex cells.
- solve conceptual problems such as evaluation of the effects of perturbations to genetic systems as they might apply to agriculture, nutrition or disease.

- **SLO 5: CONSTRUCT RATIONAL ARGUMENTS THAT SHOW HOW THE THEORY OF BIOLOGICAL EVOLUTION EXPLAINS THE DIVERSITY, SIMILARITY AND ADAPTATION OF ORGANISMS.**
- examine critically the evidence that life has evolved.
- explain how genetic variation is produced and maintained in populations.
- compare and contrast mechanisms of evolutionary change including natural selection, genetic drift and non-random mating.
- show how evolutionary mechanisms lead to adaptation, diversity and similarity.
- solve problems requiring the application of principles of population genetics.
- solve conceptual problems by applying evolutionary theory to explain antibiotic resistance, patterns of human diversity, extinction, etc.

- **SLO 6: EXPLAIN HOW ABIOTIC AND BIOTIC FACTORS INFLUENCE THE DISTRIBUTION AND ABUNDANCE OF ORGANISMS.**
- evaluate mathematical models that explain the factors that influence the distribution of organisms and their potential for population growth.
- apply knowledge of species interactions to the structure and stability of communities.
- analyze how principles of energy and nutrient flow through ecosystems influence the abundance and distribution of organisms.
- apply ecological principles to assess the impact of human activities on ecosystems, communities and populations.

**BIOL 410 Principles of Botany**

<table>
<thead>
<tr>
<th>Units:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours:</td>
<td>54 LEC; 108 LAB</td>
</tr>
<tr>
<td>Prerequisite:</td>
<td>BIOL 400 with a grade of “C” or better</td>
</tr>
<tr>
<td>Advisory:</td>
<td>Eligibility for ENGWR 300</td>
</tr>
<tr>
<td>Transferable:</td>
<td>CSU; UC</td>
</tr>
<tr>
<td>General Education:</td>
<td>AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C</td>
</tr>
<tr>
<td>C-ID:</td>
<td>C-ID BIOL 155; Part of C-ID BIOL 130S; Part of C-ID BIOL 135S</td>
</tr>
<tr>
<td>Catalog Date:</td>
<td>June 1, 2020</td>
</tr>
</tbody>
</table>

This course is intended for science majors and builds upon and applies concepts developed in cell and molecular biology (BIOL 400). This is an introduction to the diversity, taxonomy, life cycles, and evolutionary trends of cyanobacteria, algae, fungi, and plants. Emphasis is on the comparative anatomy, morphology, physiology, development, systematics, evolution, and ecology of plants. Field trips may be required.
Student Learning Outcomes

Upon completion of this course, the student will be able to:

- ACQUIRE, SYNTHESIZE, EVALUATE, AND PRESENT SCIENTIFIC INFORMATION. (SLO 1)
- Use the scientific method to devise testable hypotheses, and design and conduct experiments to scientifically test these hypotheses.
- Analyze botanical data by using basic statistical analyses and formulate appropriate conclusions supported by data.
- Acquire and utilize botanical information from a variety of scholarly sources.
- Present written and/or oral reports that include relevant background information, procedures, results, and interpretation of data acquired through scientific observation and/or experimentation.
- Evaluate the usefulness of correlations in scientific investigations.
- ANALYZE MAJOR BOTANICAL TAXA INCLUDING THEIR MOLECULAR COMPOSITION, STRUCTURE, PHYSIOLOGY, AND RELEVANCE TO ECOSYSTEMS AND HUMANS. (SLO 2)
- Identify major anatomical and morphological structures (including cells, tissues, and organs) of botanical taxa microscopically and/or macroscopically.
- Relate structures to their functions using scientific principles.
- Classify organisms into their major botanical taxa (especially domain, kingdom and phylum) based upon their major characteristics.
- Compare and contrast the major molecular composition, anatomy, morphology, physiology, and sexual life cycles of algae, fungi, and plants.
- Analyze the basic cellular processes involved in plant physiology including photosynthesis (C3, C4, and CAM), cellular respiration, inorganic nutrient uptake, transport mechanisms, water balance, and hormonal regulation of growth and development.
- Analyze the roles of cyanobacteria, algae, fungi, and plants in natural ecosystems, and assess the relevance of these organisms to humans.
- EVALUATE THE SIMILARITIES, DIVERSITY, AND ADAPTATIONS OF ORGANISMS. (SLO 3)
- Provide evidence for evolution in plants and analyze evolutionary trends among algae, fungi, and plants, especially survival strategies of organisms including the adaptation of plants to land.
- Analyze how similarities of organisms are related to similarities in their ecological niches and evolutionary adaptations.
- Use basic principles of taxonomy, systematics, and cladistics to understand the similarities and differences among cyanobacteria, algae, fungi, and plants.
- Solve transmission and population genetics problems involving angiosperms and C-ferns.
- Describe different mechanisms for speciation, especially the roles of pollinators and polyploidy in reproductive isolation in angiosperms.
- Analyze current developments in plant biotechnology, and evaluate the implications for its use.

BIOL 420 Principles of Zoology

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: BIOL 400 with a grade of "C" or better
Advisory: Eligibility for ENGWR 300
Transferable: CSU; UC (If no credit for BIOL 300 and 307 if taken after BIOL 400, 420, 430, or 431)
General Education: AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C
C-ID: C-ID BIOL 150; Part of C-ID BIOL 130S; Part of C-ID BIOL 135S
Catalog Date: June 1, 2020

This course is an introduction to zoology with particular emphasis on comparative anatomy and physiology of vertebrates and invertebrates. The basic principles of evolution, taxonomy, embryology, morphology, physiology, behavior and ecology will be covered. A field trip may be required.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: DEMONSTRATE ABILITY TO ACQUIRE, SYNTHESIZE, EVALUATE, AND PRESENT INFORMATION IN ZOOLOGY.
- apply the perspective of the scientific method to gathering and evaluating biological information by formulating testable hypotheses, designing experiments with appropriate controls and choices of data to collect, appropriately analyzing data including use of basic statistical analyses, and formulating conclusions supported by data.
- demonstrate ability to use common laboratory techniques such as measurement, light microscopes, dissection, field sampling, and identification.
- present written and/or oral reports that address background information, procedures, results, and interpretation of data acquired during laboratory or field activities.
- distinguish interpretations that are better supported from those that are less well supported.
- acquire and synthesize information from print and electronic source, and evaluate the information for quality, scientific validity, relevance, and bias.
- develop ability to tolerate the ambiguity and uncertainty associated with science.
- recognize that research leads to generally accepted conclusions that gradually build a body of scientific knowledge and that the information presented in science textbooks and other established “authorities” is the result of research.
- demonstrate the ability to respond to questions in a variety of formats (multiple choice, short-answer, essay prompts, etc.) with accurate, complete, and relevant information using appropriate subject-matter vocabulary.
- recognize the use and misuse of scientific concepts in society, including politics and the media.
- SLO 2: ANALYZE PATTERNS AND CAUSES OF THE DIVERSITY OF ANIMAL LIFE.
- explain the contributions of natural selection, genetic drift, mutation, and gene flow to the diversity, unity and history of animal life.
- apply concepts of population genetics to detecting evolution in populations.
compare and contrast different mechanisms for speciation.

discuss macroevolutionary concepts such as how complex features evolve, adaptive radiation, and the occurrence and causes of extinction.

analyze evolutionary trends in animals, especially the evolution of early animal life, the origins of the major animal body plans and the transition of key groups to land.

outline the principles and methods biologists use to construct phylogenies.

integrate patterns of animal development and gene expression and show how these factors may have played major roles in animal evolution.

compare and contrast the anatomical, developmental and physiological characteristics of major animal phyla and use them to test proposed evolutionary relationships.

SLO 3: ANALYZE PATTERNS IN THE DISTRIBUTION AND ABUNDANCE OF POPULATIONS.

describe the major terrestrial and aquatic biomes, and explain environmental factors that influence them.

discuss the short-term and long-term effects of species interactions such as mutualism, competition, and predation.

analyze how principles of energy and nutrient flow through ecosystems influence the abundance and distribution of animals.

discuss the factors that influence the structure and stability of communities.

apply principles of community ecology to assessing species abundance.

SLO 4: IDENTIFY ANATOMICAL STRUCTURES AND EXPLAIN THEIR PHYSIOLOGICAL FUNCTIONS AND ADAPTIVE VALUES.

identify major anatomical and morphological structures microscopically and dissection.

relate basic principles of biochemistry, cell biology and physics to understanding animal structure and function.

compare and contrast the major anatomical and physiological features of major animal phyla.

identify the characteristics of the specific ecological niches and the adaptations required by species to succeed there.

analyze how anatomical, physiological, and behavioral characteristics of animals are related to their ecological niches and evolutionary history.

BIOL 430 Anatomy and Physiology

Units: 5
Hours: 54 hours LEC; 108 hours LAB
Prerequisite: CHEM 305, 309, or 400 with a grade of "C" or better
Transferable: CSU; UC (Transfer Credit Limitations: No credit for BIOL 300 and 307 if taken after BIOL 400, 420, 430, or 431)
General Education: AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C
C-ID: Part of C-ID BIOL 115S
Catalog Date: June 1, 2020

This is the first course in a two-course sequence. It is an introductory course in which the basic principles of human anatomy and physiology are presented in an integrated fashion. This course covers anatomical terminology, basic organic chemistry, histology, and the integumentary, skeletal, muscular and nervous systems. Both BIOL 430 and BIOL 431 must be taken to study all of the major organ systems.

Upon completion of this course, the student will be able to:

SLO 1: APPLY PRINCIPLES OF CHEMISTRY AND PHYSICS TO HUMAN PHYSIOLOGY

- demonstrate knowledge of basic organic and inorganic chemistry as it relates to human cells, tissues, and organs
- apply principles of electricity to membrane potentials, nervous system transmission, and muscle contraction physiology
- illustrate how pH, ions, concentration gradients, and electrical gradients influence physiological processes
- apply principles of force and load to muscle physiology

SLO 2: DEMONSTRATE A FUNDAMENTAL UNDERSTANDING OF HOMEOSTASIS AND FEEDBACK LOOPS

- describe the mechanisms by which the human can self-regulate
- compare and contrast positive and negative feedback loops
- explain how homeostatic mechanisms can involve multiple organ systems
- assess the impact of pathologies on the maintenance of homeostasis
- evaluate clinical examples and deduce physiological mechanisms involved

SLO 3: IDENTIFY ANATOMICAL STRUCTURES

- utilize proper anatomical vocabulary to identify structures in the integumentary, skeletal, muscular, and nervous systems
- demonstrate the use of a light microscope to distinguish cells and tissues
- analyze three dimensional relationships between anatomical structures (using models, cadaver prosections, and organ dissection)
- integrate lab experiences and anatomical understanding to apply knowledge of specific organ systems to human physiology

SLO 4: DETERMINE GENERAL PHYSIOLOGY OF A STRUCTURE BASED ON ANATOMICAL OBSERVATION AND EXPERIMENTATION

- analyze structural distinctions and apply concepts of cellular physiology to organs and organ systems
- determine functional relationships among various organ systems based upon their anatomical proximity or similarity
- use the scientific method to develop hypotheses that can be tested in the laboratory, collect and analyze data, and apply the concepts to course content, broader physiological principles, and real-world applications

BIOL 431 Anatomy and Physiology
This is the second course in a two-course sequence, and is an introductory course in which the basic principles of human anatomy and physiology are presented in an integrated fashion. This course covers the cardiovascular, respiratory, lymphatic/immune, digestive, urinary, endocrine and reproductive systems. Both BIOL 430 and BIOL 431 must be taken to study all of the major organ systems.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- SLO 1: APPLY PRINCIPLES OF CHEMISTRY, PHYSICS, AND CELL BIOLOGY TO HUMAN PHYSIOLOGY
  - demonstrate knowledge of basic organic and inorganic chemistry as it relates to human cells, tissues, and organs
  - apply principles of electricity to membrane potentials, nervous system transmission, and muscle contraction physiology within various organs
  - illustrate how pH, ions, concentration gradients, and electrical gradients influence physiological processes
  - relate pressure gradients to physiological processes
  - combine methods of membrane transport to explain functional capability and/or limitations within an organ system

- SLO 2: ANALYZE VARIOUS CONTROL SYSTEMS UTILIZING THE CONCEPT OF HOMEOSTASIS
  - diagram positive feedback loops and negative feedback loops to describe control systems
  - integrate various control mechanisms (i.e. nervous system, endocrine system, autoregulation, etc.) within an organ system
  - diagram the relationships between multiple organ systems as they apply to regulation
  - assess the impact of pathologies on the maintenance of homeostasis
  - evaluate clinical examples and deduce physiological mechanisms involved

- SLO 3: IDENTIFY ANATOMICAL STRUCTURES
  - compare and contrast tissues using the light microscope
  - utilize proper anatomical vocabulary to name structures of the cardiovascular, respiratory, lymphatic, immune, digestive, urinary, endocrine and reproductive systems
  - analyze three dimensional relationships between anatomical structures (using models, cadaver prossections, and organ dissection)
  - integrate lab experiences and anatomical understanding to apply knowledge of specific organ systems to human physiology

- SLO 4: DETERMINE GENERAL PHYSIOLOGY OF A STRUCTURE BASED ON ANATOMICAL OBSERVATIONS AND EXPERIMENTATION
  - analyze structural distinctions and apply concepts of cellular physiology to organs and organ systems
  - determine functional relationships among various organ systems based upon their anatomical proximity or similarity
  - use the scientific method to develop hypotheses that can be tested in the laboratory, collect and analyze data, and apply the concepts to course content, broader physiological principles, and real-world applications

BIOL 439 Human Cadaver Dissection

Units: 1
Hours: 12 hours LEC; 18 hours LAB
Prerequisite: None.
Advisory: BIOL 420 or 430 with a grade of "C" or better
Transferable: CSU; UC
Catalog Date: June 1, 2020

The Human Cadaver Dissection course is a one-unit, intensive course for nursing, medical, physical therapy, sonography, chiropractic, or other health-related majors. Using a regional approach, students will study the structure of the human body through the dissection of cadavers. Students will gain experience in dissection techniques, more fully understand relationships between organs, and discuss physiological concepts as they pertain to anatomy. Maintaining a detailed lab notebook is an integral part of the course. This course may be taken one time for credit.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- SLO 1: DEVELOP DISSECTION TECHNIQUES
  - identify and utilize appropriate dissection tools
  - perform advanced dissections to prepare the specimens for study in other Biology courses

- SLO 2: IDENTIFY ANATOMICAL FEATURES AND EXPLORE RELATIONSHIPS AMONG STRUCTURES
  - investigate the anatomy of the human from superficial to deep
  - discuss physiological concepts based on anatomical relationships

BIOL 440 General Microbiology

Units: 4
Hours: 54 hours LEC; 72 hours LAB
Prerequisite: CHEM 305, 309, or 400 with a grade of "C" or better
Transferable: CSU; UC
General Education: AA/AS Area IV; CSU Area B2; CSU Area B3; IGETC Area 5B; IGETC Area 5C
Catalog Date: June 1, 2020
This course introduces the concepts of microbiology with an emphasis on forms, modes of growth, cell specialization, mutual, commensal and parasitic relationships of bacteria, fungi, molds, protozoans and viruses. Topics will be correlated with medical and health applications to animals and human beings.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO #1—Evaluate the cellular structure and function of microorganisms.
- Compare and contrast the overall cell structure of prokaryotes and eukaryotes.
- Differentiate between gram positive and gram negative bacterial cell structure.
- Analyze the structure and function of viral particles and prions.
- Demonstrate proper staining techniques and microscope use in the laboratory.
- SLO #2—Explain the basic mechanisms of microbial growth, metabolism and genetics.
- Assess how microbial growth is affected by physical and chemical agents.
- Evaluate the overall function of metabolic pathways.
- Categorize the various energy production mechanisms among organisms according to carbon source, mechanism of carbohydrate catabolism and ATP generation.
- Verify how DNA is replicated and how protein synthesis occurs.
- Compare mechanisms of genetic recombination in bacteria.
- Set up and analyze biochemical tests in the laboratory using aseptic technique.
- SLO #3—Evaluate host pathogen interactions.
- Assess the function and importance of normal flora.
- Analyze the mechanisms that microorganisms use to cause disease.
- Evaluate the characteristics of non-specific immunity.
- Compare and contrast humoral and cell mediated immunity.
- SLO #4—Apply microbiological concepts to historical and current health issues.
- Survey important milestones in the history of microbiology.
- Evaluate the significance of microbiology to the techniques of biotechnology.
- Apply microbiological concepts concerning infectious disease to clinical practice problems and case studies.
- Using principles of the scientific method, design and complete laboratory activities based on epidemiological concepts.

BIOL 462 Genetics in Contemporary Human Society

This course introduces students to the principles of modern genetics, especially as they apply to human health and society. Rapid advances in scientists’ knowledge of what genes are and how they work impact the daily life of people through genetically modified foods, DNA fingerprinting, therapies for human disease and a variety of reproductive technologies. This course includes the study of Mendelian inheritance, the roles of chromosomes and genes in human disease, how genes direct development, the relationship between genes, environment and behavior, and the contribution of genes to human diversity. Ethical, legal and social issues will be explored through class discussions and written reports. This course is primarily intended for non-biology majors; however, biology majors may enjoy the opportunity to explore human genetics in greater depth than is possible in BIOL 400.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: SOLVE GENETICS PROBLEMS BY APPLYING PRINCIPLES OF INHERITANCE.
- Solve genetics problems by applying Mendelian principles to single and two gene problems with and without dominance.
- Solve genetics problems involving sex linkage.
- SLO 2: INTEGRATE MOLECULAR GENETICS AND CELL BIOLOGY TO EXPLAIN THE BASIS OF HUMAN GENETIC TRAITS.
- Relate the functions of cellular organelles to specific human genetic disorders.
- Describe the structure and functions of DNA, RNA and proteins.
- Relate DNA, RNA and proteins to the development of human characteristics.
- Examine the interaction between genes and the environment.
- Use relevant genetic concepts to assess the contribution of genetic variation and environmental variation to variation in human phenotypes.
- Review genetic data describing human variation and explaining human origins.
- SLO 3: GATHER RELEVANT INFORMATION AND USE IT TO EVALUATE THE SCIENTIFIC VALIDITY OF INFORMATION PRESENTED BY THE MEDIA AND OTHER SOURCES.
- Distinguish between scientific hypotheses, inferences, and speculation.
- Identify and analyze the scientific basis of modern genetic technologies.
- Examine current ethical and social issues in human genetics.

BIOL 485 Honors Seminar in Genetics
This course offers honors students the opportunity to study, critique, and discuss advanced topics in genetics such as genetically modified foods, whole-genome rapid sequencing, gene therapies for human disease, and a variety of reproductive technologies. Furthermore, this course includes the study of Mendelian inheritance, the roles of chromosomes and genes in human disease, how genes direct development, the relationship between genes, environment and behavior, and the contribution of genes to human diversity. Students will engage with each other to discuss ethical, legal and social issues during class discussions, and analyze scientific literature in written reports. Enrollment is limited to Honors students. Details about the Honors Program can be found in the Catalog and on the CRC website. This course is the same as HONOR 385. This course, under either name, may be taken a total of one time for credit.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO 1: SOLVE GENETICS PROBLEMS BY APPLYING PRINCIPLES OF INHERITANCE.
- Solve genetics problems by applying Mendelian principles to single and two gene problems with and without dominance.
- Solve genetics problems involving sex linkage.
- SLO 2: INTEGRATE MOLECULAR GENETICS AND CELL BIOLOGY TO EXPLAIN THE BASIS OF HUMAN GENETIC TRAITS.
- Relate the functions of cellular organelles to specific human genetic disorders.
- Describe the structure and functions of DNA, RNA and proteins.
- Relate DNA, RNA and proteins to the development of human characteristics.
- Examine the interaction between genes and the environment.
- Use relevant genetic concepts to assess the contribution of genetic variation and environmental variation to variation in human phenotypes.
- SLO 3: RECOGNIZE THE IMPORTANCE OF GENE THERAPY, GENETIC ENGINEERING, AND BIOTECHNOLOGY ON HUMAN HEALTH.
- Describe the role of genes in human diseases (like cancer).
- Communicate how advances in recombinant DNA technology and biotechnology (e.g. gene therapy and genetic engineering) can be used to treat genetic diseases in humans, and modify other organisms for human use.
- Understand how modern DNA sequencing and genome databases are being used to change medical practices and better human health.
- SLO 4: GATHER RELEVANT INFORMATION AND USE IT TO EVALUATE THE SCIENTIFIC VALIDITY OF INFORMATION PRESENTED BY THE MEDIA AND OTHER SOURCES.
- Distinguish between scientific hypotheses, inferences, and speculation.
- Identify and analyze the scientific basis of modern genetic technologies.
- Review current scientific literature, and evaluate the effectiveness of the research.
- Present written and/or oral reports which address background information, procedures, results, and interpretation of data from scientific literature.
- Examine current ethical and social issues in human genetics.

BIOL 495 Independent Studies in Biology

Upon completion of this course, the student will be able to:

- SLO #1: Actively engage in intellectual inquiry beyond that required in order to pass a course of study (College Wide Learning Outcome – Area 4).
- Discuss and outline a proposal of study (that can be accomplished within one semester term) with a supervising instructor qualified within the discipline.
- Design an independent study (to be completed individually or by collaboration of a small group) to foster special knowledge, skills, and experience that are not available in any one regularly scheduled course.
- Use information resources to gather discipline-specific information.
- SLO #2: Utilize modes of analysis and critical thinking to apply theoretical perspectives and/or concepts in the major discipline of study to significant problems and/or educational activities (College Wide Learning Outcome – Area 3).
- Analyze and apply the knowledge, skills and experience that are involved in the independent study to theoretical perspectives and/or concepts in the major discipline of study.
- Explain the importance of the major discipline of study in the broader picture of society.
- SLO #3: Communicate a complex understanding of content matter of the major discipline of study (College Wide Outcome – Area 3).
- Demonstrate competence in the skills essential to mastery of the major discipline of study that are necessary to accomplish the independent study.
- SLO #4: Identify personal goals and pursue these goals effectively (College Wide Outcome – Area 4).
- Utilize skills from the "academic tool kit" including time management, study skills, etc., to accomplish the independent study within one semester term.

BIOL 498 Work Experience in Biology
This course provides students with opportunities to develop marketable skills in preparation for employment in their major field of study or advancement within their career. It is designed for students interested in work experience and/or internships in transfer level degree occupational programs. Course content includes understanding the application of education to the workforce; completion of required forms which document the student's progress and hours spent at the work site; and developing workplace skills and competencies. Appropriate level learning objectives are established by the student and the employer. During the semester, the student is required to participate in a weekly orientation and 75 hours of related paid work experience, or 60 hours of unpaid work experience for one unit. An additional 75 or 60 hours of related work experience is required for each additional unit. Work Experience may be taken for a total of 16 units when there are new or expanded learning objectives. Only one Work Experience course may be taken per semester.

**Student Learning Outcomes**

Upon completion of this course, the student will be able to:

- DEMONSTRATE AN UNDERSTANDING AND APPLICATION OF PROFESSIONAL WORKPLACE BEHAVIOR IN A FIELD OF STUDY RELATED ONE'S CAREER.(SLO 1)
- Understand the effects time, stress, and organizational management have on performance.
- Demonstrate an understanding of consistently practicing ethics and confidentiality in a workplace.
- Examine the career/life planning process and relate its relevancy to the student.
- Demonstrate an understanding of basic communication tools and their appropriate use.
- Demonstrate an understanding of workplace etiquette.
- DESCRIBE THE CAREER/LIFE PLANNING PROCESS AND RELATE ITS RELEVANCY TO ONE'S CAREER.(SLO 2)
- Link personal goals to long term achievement.
- Display an understanding of creating a professional first impression.
- Understand how networking is a powerful job search tool.
- Understand necessary elements of a résumé.
- Understand the importance of interview preparation.
- Identify how continual learning increases career success.
- DEMONSTRATE APPLICATION OF INDUSTRY KNOWLEDGE AND THEORETICAL CONCEPTS AS WRITTEN IN LEARNING OBJECTIVES IN PARTNERSHIP WITH THE EMPLOYER WORK SITE SUPERVISOR.(SLO 3)

**BIOL 499 Experimental Offering in Biology**

Units: 0.5 - 4
Prerequisite: None
Transferable: CSU, UC (Credit for variable topics courses is given only after a review of the scope and content of the course by the enrolling UC campus)
Catalog Data: June 1, 2020

**Biology - Field Studies (BIOLFS) Courses**

Mohamed Aly
Adjunct Biology Professor

- Office: CRC Main, SCI 501
- Email: Mohamed.Aly@crc.losrios.edu
- Phone: (916) 691-7204
- Web: Mohamed Aly's Profile Page (/about-us/contact-us/faculty-and-staff-directory/mohamed-aly)

Rachel Aptekar
Adjunct Biology Professor

- Office: CRC Main, SCI 501
- Email: AptekaR@crc.losrios.edu
- Phone: (916) 691-7204
- Web: Rachel Aptekar's Profile Page (/about-us/contact-us/faculty-and-staff-directory/rachel-aptekar)

Eli Carlisle
Biology Professor

- Office: CRC Main, SCI 205
- Email: carlise@crc.losrios.edu
- Phone: (916) 691-7039

Tamyra Carmona
Biology Professor

- Office: CRC Main, Science, SCI 219
- Email: carmont@crc.losrios.edu
- Phone: (916) 691-7905
- Web: Tamyra Carmona's Profile Page (/about-us/contact-us/faculty-and-staff-directory/tamyra-carmona)

Todd Drybread
Adjunct Biology Professor

- Office: CRC Main, SCI 501
- Email: DrybreT@crc.losrios.edu
- Phone: (916) 691-7204
- Web: Todd Drybread's Profile Page (/about-us/contact-us/faculty-and-staff-directory/todd-drybread)

Vanessa Dunne
Adjunct Biology Professor

- Office: CRC Main, SCI 501
- Email: DunneV@crc.losrios.edu
- Phone: (916) 691-7204
- Web: Vanessa Dunne's Profile Page (/about-us/contact-us/faculty-and-staff-directory/vanessa-dunne)
Kimberly Fouad
Assistant Professor
Office: CRC Main, SCI, 305
Email: fouadk@crc.losrios.edu
Phone: (916) 691-7080
Web: Kimberly Fouad's Profile Page (/about-us/contact-us/faculty-and-staff-directory/kimberly-fouad)

Robert Grahn
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: GrahnR@crc.losrios.edu
Phone: (916) 691-7204
Web: Robert Grahn's Profile Page (/about-us/contact-us/faculty-and-staff-directory/robert-grahn)

Amy Kaufmann
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: KaufmaA@crc.losrios.edu
Phone: (916) 691-7204
Web: Amy Kaufmann's Profile Page (/about-us/contact-us/faculty-and-staff-directory/amya-kaufmann)

Eric King
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: kinge@crc.losrios.edu
Phone: (916) 691-7204
Web: Eric King's Profile Page (/about-us/contact-us/faculty-and-staff-directory/eric-king)

Patra Manomita
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: manomip@crc.losrios.edu
Phone: (916) 691-7204
Web: Patra Manomita's Profile Page (/about-us/contact-us/faculty-and-staff-directory/patra-manomita)

Eric Neff
Biology Professor
Office: CRC Main, SCI, 218
Email: neffe@crc.losrios.edu
Phone: (916) 691-7598
Web: Eric Neff's Profile Page (/about-us/contact-us/faculty-and-staff-directory/eric-neff)

Ann Oliver-Graybill
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: OliverA@crc.losrios.edu
Phone: (916) 691-7204

Julie Oliver
Biology Professor
Office: CRC Main, SCI, 220
Email: oliverj@crc.losrios.edu
Phone: (916) 691-7581
Web: Julie Oliver's Profile Page (/about-us/contact-us/faculty-and-staff-directory/julie-oliver)

Jason Patterson
Biology Professor
Office: CRC Main, SCI, 209
Email: patterj2@crc.losrios.edu
Phone: (916) 691-7004
Web: Jason Patterson's Profile Page (/about-us/contact-us/faculty-and-staff-directory/jason-patterson)

Sarah Pollock
Biology Professor
Office: CRC Main, SCI, 202
Email: pollocs@crc.losrios.edu
Phone: (916) 691-7219
Web: Sarah Pollock's Profile Page (/about-us/contact-us/faculty-and-staff-directory/sarah-pollock)

Jena Trench
Biology Professor
Office: CRC Main, SCI, 204
Email: trenchj@crc.losrios.edu
Phone: (916) 691-7585
Web: Jena Trench's Profile Page (/about-us/contact-us/faculty-and-staff-directory/jena-trench)

Cody Watters
Adjunct Biology Professor
Office: CRC Main, SCI, 501
Email: watterc@crc.losrios.edu
Phone: (916) 691-7204
Web: Cody Watters's Profile Page (/about-us/contact-us/faculty-and-staff-directory/cody-watters)

More about the Program

BIOLOGY DEPARTMENT ➔ (/ACADEMICS/BIOLOGY)