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**Advisor for Prehealth Professions Programs:**  
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**Advisor for Public Health Major:**  
David Wallace, Biology-Natural Resources 333, (435) 797-7155,  
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**Degrees offered:** Bachelor of Science (BS), Bachelor of Arts (BA), Master of Science (MS), and Doctor of Philosophy (PhD) in Biology; BS and BA in Composite Teaching—Biological Science; BS in Public Health; MS and PhD in Ecology; MS and PhD in Toxicology is available through the Interdepartmental Program in Toxicology.

**Undergraduate emphases:** *Biology BS, BA*—Biology, Cellular/Molecular, Ecology/Biodiversity, Environmental; *Public Health BS*—Industrial Hygiene, Environmental Health, Public Health Education

## Undergraduate Programs

### Learning Objectives

#### Biology

The Department of Biology offers programs leading to a Bachelor of Science or Bachelor of Arts degree. Majors will complete a core of courses which provide an understanding of biological principles. Upper-division courses provide integration, in-depth study, and an opportunity for specialization within the different degree emphases. Additional coursework in chemistry, physics, statistics, and mathematics provides knowledge and analytical skills in these important related fields. Most biology degrees provide a foundation for graduate work. Biology majors can add a minor area of study, such as business or chemistry, to enhance their employment opportunities.

#### Prehealth Professions Programs

The Department of Biology supervises premedical, pre dental, and other prehealth professions programs. These programs satisfy entrance requirements for most medical and dental schools in the United States and Canada and are recognized for the high-quality preprofessional preparation they provide. After four years, the student

receives a BS degree in Biology or another major. **Advisor:** D. M. Andy Anderson, Veterinary Science and Bacteriology 231.

#### Composite Teaching—Biological Science

This major combines content training in biology and related fields (including chemistry, physics, geology, mathematics, and statistics) with education courses. Graduates are licensed to teach at the secondary level. **Advisor:** Richard J. Mueller, Eccles Science Learning Center 245.

#### Public Health

The Department of Biology offers preprofessional training in public health. Individuals completing the BS degree have employment opportunities in such areas as environmental health, industrial hygiene, public health education, administration, nursing, nutrition, mental health, and social work. **Advisor:** David O. Wallace, Biology-Natural Resources 333.

The Department Head, the Director of Undergraduate Studies, and advisors in the Department of Biology are available to provide undergraduate majors with additional information regarding specific programs and career opportunities. The Biology Advising Center and the Director of Undergraduate Studies are located in BNR 101. Program requirements, advising information, and an “**Ask an Advisor**” e-mail service are on the Department of Biology web page at: <http://www.biology.usu.edu>

Students with majors in the Department of Biology should consult with their advisors regularly as they plan their course of study. Students have the responsibility to keep themselves aware of major requirements and course prerequisites. General requirements, specific course offerings, and the semesters that courses are taught may change.

Mathematics is an important and required skill to enhance one's success in the sciences. Proper course level placement in mathematics at the beginning of the degree program is essential. Students should consult with an advisor to determine the appropriate level to begin their mathematics studies for meeting requirements and completion of their major. For detailed information, obtain an official Major Requirement Sheet from the Biology Advising Center or online at: <http://www.usu.edu/ats/majorsheets/>

### Assessment

The primary mission of the Department of Biology is to discover and advance knowledge in the biological sciences, and to make that knowledge available to students through a diverse set of educational experiences. To achieve this, three specific areas are being targeted: (1) A core program in the life sciences is aimed at providing the skills and knowledge base needed for a wide variety of employment and educational opportunities in biological and biotechnology fields; (2) a premedical, pre dental, and prehealth program has the specific goal of guiding students with respect to opportunities in the health professions; and (3) a public health program provides pre-professional training in such subjects as environmental health, industrial hygiene, and public health education. For full details about Program Learning Objectives, Undergraduate Program Assessment, Data-based Decisions, and more, go to <http://www.biology.usu.edu>

### Undergraduate Research in Biology

The Department of Biology offers a broad array of undergraduate research opportunities. Undergraduate research allows students to

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have a real-life experience in a faculty research lab. Many students publish their research in scientific journals and present their research at national scientific meetings. Students may do undergraduate research work under the supervision of selected faculty members. To receive academic credit, a student must enroll in BIOL 5800, Undergraduate Research. Students doing Honors in Biology do undergraduate research and write a bachelor's thesis.

For complete information about undergraduate research, contact Linda Woertendyke, Biology Advisor, at lindaw@biology.usu.edu or (435) 797-2577.

## Requirements

### University Requirements

Students are responsible for meeting all University requirements for total credits, upper-division credits, credits of C- or better, and the University Studies Program. (See pages 46-58 in this catalog.)

### College of Science Requirements

All college requirements are met by completing the departmental degree requirements; no additional coursework is required.

### Departmental Admission Requirements

New freshmen admitted to USU in good standing qualify for admission to the Biology and Public Health majors. Transfer students from other institutions need a 2.25 transfer GPA, and students transferring from other USU majors need a 2.25 cumulative GPA for admission to the Biology and Public Health majors in good standing. Admission requirements differ for the Composite Teaching—Biological Science Major, as explained below.

### Admission Requirements for the Composite Teaching—Biological Science Major

New freshmen admitted to USU in good standing qualify for admission to this major. To qualify for admission to the Secondary Teacher Education Program (STEP), new freshmen must acquire a cumulative 2.75 GPA and 60 credits of coursework. Transfer students from other institutions or other USU majors need a cumulative 2.75 GPA and 60 credits of coursework to be admitted to the major and the STEP. For information on additional admission criteria, students should contact the Department of Secondary Education.

### GPA Requirement

To graduate, a candidate for any bachelor's degree offered by the Department of Biology must maintain a grade point average of 2.25 in all Department of Biology (BIOL or PUBH prefix) courses required for the major (Composite Teaching also requires a 2.75 cumulative GPA) and a grade of C- or better in BIOL 1210 and 1220. The *Pass-Fail* option is not acceptable for any course required for the degree, but *D* grades are permitted within the restrictions of the 2.25 GPA. The Composite Teaching—Biological Science Major requires a cumulative overall GPA of 2.75 for admission and graduation. The 2.25 GPA requirement applies to the Biology, Public Health, and BioMath minors.

### BS Degree in Biology

Four different emphases are available within the Biology degree. The **Biology Emphasis** is the most flexible option. Electives may be selected in any subdiscipline the student wishes to emphasize (e.g., botany, ecology, zoology, entomology, microbiology, etc.). The **Cellular/Molecular** and **Ecology/Biodiversity** emphases provide more directed training that is appropriate for research or other

technical employment in academic institutions, government agencies, and the private sector. They also provide excellent preparation for graduate work. The **Environmental Emphasis** prepares students in the biological and physical sciences as they relate to environmental problems and concerns. This degree serves as a foundation for graduate work and provides practical training for employment at the bachelor's degree level. Emphases will be listed on transcripts to indicate the student's specialization. The course requirements are as follows:

### Required Biology Courses (21-22 credits)

|  |        |
|--|--------|
| BIOL 1210 Biology I (F).....                           | 4      |
| BIOL 1220 (BLS) Biology II (Sp).....                   | 4      |
| BIOL 2220 General Ecology (F, Sp).....                 | 3      |
| BIOL 3200 (QI) Principles of Genetics (F, Sp, Su)..... | 4      |
| BIOL 3300 General Microbiology (F, Sp) (4 cr) or       |        |
| BIOL 5210 Cell Biology (F) (3 cr).....                 | 3 or 4 |
| BIOL 5250 (CI) Evolutionary Biology (F,Sp).....        | 3      |

### Field Course Requirement (2-3 credits)

Students must take one course from the following list:

|   |   |
|---|---|
| BIOL 2410 Plants and Fungi in the Field (Su).....   | 2 |
| BIOL 3220 (QI) Field Ecology (F).....               | 2 |
| BIOL 4500 Applied Entomology (Sp).....              | 3 |
| BIOL 5530 Insect Systematics and Evolution (F)..... | 3 |
| BIOL 5550 Freshwater Invertebrates (Sp).....        | 3 |
| BIOL 5560 Ornithology (Sp).....                     | 3 |
| BIOL 5570 Herpetology (Sp).....                     | 3 |

### Physiology Course with Lab Requirement (4-5 credits)

Students must take one upper-division physiology course with an integrated or separate laboratory from the following list:

### Courses with integrated laboratories:

|   |   |
|---|---|
| BIOL 4400 (QI) Plant Physiology (F).....      | 4 |
| BIOL 5300 (QI) Microbial Physiology (Sp)..... | 4 |

### Courses with separate lecture and lab; both must be taken to meet the requirement:

|  |   |
|--|---|
| BIOL 5600 Comparative Animal Physiology (F).....         | 3 |
| BIOL 5610 (QI) Animal Physiology Laboratory (F, Sp)..... | 2 |
| Or   |   |
| BIOL 5620 Medical Physiology (Sp) (Alt. Years).....      | 3 |
| BIOL 5610 (QI) Animal Physiology Laboratory (F, Sp)..... | 2 |

### Biology Electives (10 credits)

Students must select an additional 10 credits of 4000-level and above BIOL or PUBH prefix courses as electives. A maximum of 4 credits from the following courses may be included among the 10 elective credits.

|                                       |     |
|---------------------------------------|-----|
| BIOL 4250 Internship/Co-op.....       | 1-2 |
| BIOL 4710 Teaching Internship.....    | 1   |
| BIOL 5800 Undergraduate Research..... | 1-3 |
| Seminar courses.....                  | 1-2 |

### Required Physical Science Courses (26 credits)

|   |   |
|---|---|
| CHEM 1210 Principles of Chemistry I (F, Sp).....            | 4 |
| CHEM 1230 Chemical Principles Laboratory I (F, Sp).....     | 1 |
| CHEM 1220 (BPS) Principles of Chemistry II (F, Sp, Su)..... | 4 |
| CHEM 1240 Chemical Principles Laboratory II (F, Sp).....    | 1 |
| CHEM 2300 Principles of Organic Chemistry (F).....          | 3 |
| CHEM 2330 Organic Chemistry Laboratory I (F, Sp).....       | 1 |
| CHEM 3700 Introductory Biochemistry (Sp).....               | 3 |
| CHEM 3710 Introductory Biochemistry Laboratory (Sp).....    | 1 |

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|  |   |
|--|---|
| <b>PHYX 2110</b> The Physics of Living Systems I (F) (4 cr) <b>and</b>                           |   |
| <b>PHYX 2120 (BPS)</b> The Physics of Living Systems II (Sp) (4 cr)                              | 8 |
| <b>Or</b>  |   |
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I<br>(F, Sp, Su) (4 cr) <b>and</b> |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II<br>(F, Sp, Su) (4 cr)       | 8 |

## Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su)                | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) | 3 |

## Cellular/Molecular Emphasis

### Required Biology Courses (30 credits)

|  |   |
|--|---|
| <b>BIOL 1210</b> Biology I (F)                           | 4 |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp)                   | 4 |
| <b>BIOL 2220</b> General Ecology (F, Sp)                 | 3 |
| <b>BIOL 3200 (QI)</b> Principles of Genetics (F, Sp, Su) | 4 |
| <b>BIOL 5190</b> Molecular Genetics (Sp)                 | 3 |
| <b>BIOL 5210</b> Cell Biology (F)                        | 3 |
| <b>BIOL 5230</b> Developmental Biology (Sp)              | 3 |
| <b>BIOL 5250 (CI)</b> Evolutionary Biology (F, Sp)       | 3 |

### Choose one of the following Biotechnology courses:

|  |   |
|--|---|
| <b>BIOL 5160</b> Methods in Biotechnology: Cell Culture (Sp)                       | 3 |
| <b>BIOL 5240</b> Methods in Biotechnology: Protein Purification<br>Techniques (Sp) | 3 |
| <b>BIOL 5260</b> Methods in Biotechnology: Molecular Cloning (F)                   | 3 |

### Physiology Course with Lab Requirement (4-5 credits)

Students must take one upper-division physiology course with an integrated or separate laboratory from the following list:

#### Courses with integrated laboratories:

|   |   |
|---|---|
| <b>BIOL 4400 (QI)</b> Plant Physiology (F)      | 4 |
| <b>BIOL 5300 (QI)</b> Microbial Physiology (Sp) | 4 |

#### Courses with separate lecture and lab; both must be taken to meet the requirement:

|  |   |
|--|---|
| <b>BIOL 5600</b> Comparative Animal Physiology (F)         | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp) | 2 |
| <b>Or</b>  |   |
| <b>BIOL 5620</b> Medical Physiology (Sp) (Alt. Years)      | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F,Sp)  | 2 |

### Biology Electives (9 credits)

Students must select an additional 9 credits of 4000-level and above BIOL prefix courses as electives. BIOL 3300 (General Microbiology) may also be included toward these elective credits (even though it is a 3000-level course.) A maximum of 4 credits from the following courses may be included among the 9 elective credits:

|   |     |
|---|-----|
| <b>BIOL 4250</b> Internship/Co-op       | 1-2 |
| <b>BIOL 4710</b> Teaching Internship    | 1   |
| <b>BIOL 5800</b> Undergraduate Research | 1-3 |
| Seminar courses                         | 1-2 |

### Required Physical Science Courses (36 credits)

|   |   |
|---|---|
| <b>CHEM 1210</b> Principles of Chemistry I (F, Sp)            | 4 |
| <b>CHEM 1230</b> Chemical Principles Laboratory I (F, Sp)     | 1 |
| <b>CHEM 1220 (BPS)</b> Principles of Chemistry II (F, Sp, Su) | 4 |
| <b>CHEM 1240</b> Chemical Principles Laboratory II (F, Sp)    | 1 |
| <b>CHEM 2310</b> Organic Chemistry I (F)                      | 4 |
| <b>CHEM 2330</b> Organic Chemistry Laboratory I (F, Sp)       | 1 |
| <b>CHEM 2320</b> Organic Chemistry II (Sp)                    | 4 |
| <b>CHEM 2340</b> Organic Chemistry Laboratory II (F, Sp)      | 1 |

|   |   |
|---|---|
| <b>CHEM 5700</b> General Biochemistry I (F)           | 3 |
| <b>CHEM 5710</b> General Biochemistry II (Sp)         | 3 |
| <b>CHEM 5720</b> General Biochemistry Laboratory (Sp) | 2 |

|  |   |
|--|---|
| <b>PHYX 2110</b> The Physics of Living Systems I (F) (4 cr) <b>and</b>                           |   |
| <b>PHYX 2120 (BPS)</b> The Physics of Living Systems II (Sp) (4 cr)                              | 8 |
| <b>Or</b>  |   |
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I<br>(F, Sp, Su) (4 cr) <b>and</b> |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II<br>(F, Sp, Su) (4 cr)       | 8 |

## Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su)                | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) | 3 |

## Ecology/Biodiversity Emphasis

### Required Biology Courses (24 credits)

|  |   |
|--|---|
| <b>BIOL 1210</b> Biology I (F)                           | 4 |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp)                   | 4 |
| <b>BIOL 2220</b> General Ecology (F, Sp)                 | 3 |
| <b>BIOL 3200 (QI)</b> Principles of Genetics (F, Sp, Su) | 4 |
| <b>BIOL 3220 (QI)</b> Field Ecology (F)                  | 2 |
| <b>BIOL 3300</b> General Microbiology (F, Sp)            | 4 |
| <b>BIOL 5250 (CI)</b> Evolutionary Biology (F, Sp)       | 3 |

### Physiology Course with Lab Requirement (4-5 credits)

Students must take one upper-division physiology course with an integrated or separate laboratory from the following list:

#### Courses with integrated laboratories:

|   |   |
|---|---|
| <b>BIOL 4400 (QI)</b> Plant Physiology (F)      | 4 |
| <b>BIOL 5300 (QI)</b> Microbial Physiology (Sp) | 4 |

#### Courses with separate lecture and lab; both must be taken to meet the requirement:

|  |   |
|--|---|
| <b>BIOL 5600</b> Comparative Animal Physiology (F)         | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp) | 2 |
| <b>Or</b>  |   |
| <b>BIOL 5620</b> Medical Physiology (Sp) (Alt. Years)      | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp) | 2 |

### Clusters (8-10 credits)

Students must take one course from each of the following three clusters.

#### Plant Biology:

|   |   |
|---|---|
| <b>BIOL 2410</b> Plants and Fungi in the Field (Su) | 2 |
| <b>BIOL 4420</b> Plant Taxonomy (Sp)                | 3 |

#### Animal Biology:

|   |   |
|---|---|
| <b>BIOL 4500</b> Applied Entomology (Sp)              | 3 |
| <b>BIOL 5530</b> Insect Systematics and Evolution (F) | 3 |
| <b>BIOL 5550</b> Freshwater Invertebrates (Sp)        | 3 |
| <b>BIOL 5560</b> Ornithology (Sp)                     | 3 |
| <b>BIOL 5570</b> Herpetology (Sp)                     | 3 |
| <b>BIOL 5580</b> Mammalogy (F)                        | 3 |

#### Ecology/Evolution:

|   |   |
|---|---|
| <b>BIOL 4060 (CI)</b> Exploring Animal Behavior (Sp)        | 3 |
| <b>BIOL 5010</b> Biogeography (Sp)                          | 3 |
| <b>BIOL 5020 (QI)</b> Modeling Biological Systems (F)       | 3 |
| <b>BIOL 5380</b> Evolutionary Genetics (F)                  | 4 |
| <b>BIOL 5590</b> Animal Community Ecology (Sp) (Alt. Years) | 4 |
| <b>FRWS 4600</b> Conservation Biology (F)                   | 3 |

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## Electives (2-3 credits)

Students must take one additional course from this list or the clusters above or other upper-division courses approved by advisor.

|   |     |
|---|-----|
| <b>BIOL 4100</b> Genetics Laboratory (F)            | 2   |
| <b>BIOL 4410</b> Plant Structure (Sp)               | 3   |
| <b>BIOL 5310</b> Soil Microbiology (F) (Alt. Years) | 3   |
| <b>BIOL 5800</b> Undergraduate Research (F, Sp, Su) | 2-3 |

## Required Physical Science Courses (34 credits)

|  |   |
|--|---|
| <b>CHEM 1210</b> Principles of Chemistry I (F, Sp)                 | 4 |
| <b>CHEM 1230</b> Chemical Principles Laboratory I (F, Sp)          | 1 |
| <b>CHEM 1220 (BPS)</b> Principles of Chemistry II (F, Sp, Su)      | 4 |
| <b>CHEM 1240</b> Chemical Principles Laboratory II (F, Sp)         | 1 |
| <b>CHEM 2300</b> Principles of Organic Chemistry (F)               | 3 |
| <b>CHEM 2330</b> Organic Chemistry Laboratory I (F, Sp)            | 1 |
| <b>CHEM 3700</b> Introductory Biochemistry (Sp)                    | 3 |
| <b>CHEM 3710</b> Introductory Biochemistry Laboratory (Sp)         | 1 |
| <b>GEOL 1150 (BPS)</b> The Dynamic Earth: Physical Geology (F, Sp) | 4 |
| <b>SOIL 3000</b> Fundamentals of Soil Science (F, Sp)              | 4 |

|   |   |
|---|---|
| <b>PHYX 2110</b> The Physics of Living Systems I (F) (4 cr) <b>and</b>                        |   |
| <b>PHYX 2120 (BPS)</b> The Physics of Living Systems II (Sp) (4 cr)                           | 8 |
| Or  |   |
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I (F, Sp, Su) (4 cr) <b>and</b> |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II (F, Sp, Su) (4 cr)       | 8 |

## Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su)                | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) | 3 |

## Environmental Emphasis

### Required Biology Courses (24 credits)

|  |   |
|--|---|
| <b>BIOL 1210</b> Biology I (F)                           | 4 |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp)                   | 4 |
| <b>BIOL 2220</b> General Ecology (F, Sp)                 | 3 |
| <b>BIOL 3200 (QI)</b> Principles of Genetics (F, Sp, Su) | 4 |
| <b>BIOL 3220 (QI)</b> Field Ecology (F)                  | 2 |
| <b>BIOL 3300</b> General Microbiology (F, Sp)            | 4 |
| <b>BIOL 5250 (CI)</b> Evolutionary Biology (F, Sp)       | 3 |

### Plant Identification (2-3 credits)

Choose one of the following courses:

|   |   |
|---|---|
| <b>BIOL 2410</b> Plants and Fungi in the Field (Su) | 2 |
| <b>BIOL 4420</b> Plant Taxonomy (Sp)                | 3 |

### Physiology Course with Lab Requirement (4-5 credits)

Students must take one upper-division physiology course with an integrated or separate laboratory from the following list:

#### Courses with integrated laboratories:

|   |   |
|---|---|
| <b>BIOL 4400 (QI)</b> Plant Physiology (F)      | 4 |
| <b>BIOL 5300 (QI)</b> Microbial Physiology (Sp) | 4 |

#### Courses with separate lecture and lab; both must be taken to meet the requirement:

|  |   |
|--|---|
| <b>BIOL 5600</b> Comparative Animal Physiology (F)         | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp) | 2 |
| Or   |   |
| <b>BIOL 5620</b> Medical Physiology (Sp) (Alt. Years)      | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp) | 2 |

## Biology Elective Courses (12 credits)

Students must take 12 credits from the following list or others approved by advisor. Up to 3 credits of BIOL 5800 may be included.

|  |     |
|--|-----|
| <b>ADVS 5400</b> Environmental Toxicology (Sp)                     | 3   |
| <b>BIOL 4500</b> Applied Entomology (Sp)                           | 3   |
| <b>BIOL 5020 (QI)</b> Modeling Biological Systems (F)              | 3   |
| <b>BIOL 5310</b> Soil Microbiology (F) (Alt. Years)                | 3   |
| <b>BIOL 5320</b> Soil Microbiology Laboratory (F) (Alt. Years)     | 2   |
| <b>BIOL 5410</b> Introduction to Plant Pathology (F)               | 4   |
| <b>BIOL 5800</b> Undergraduate Research (F, Sp, Su)                | 1-3 |
| <b>CEE/SOIL 5620</b> Aquatic Chemistry (F)                         | 3   |
| <b>GEOL 1150 (BPS)</b> The Dynamic Earth: Physical Geology (F, Sp) | 4   |
| <b>PUBH 3610</b> Environmental Management (F)                      | 3   |
| <b>SOIL 3000</b> Fundamentals of Soil Science (F, Sp)              | 4   |

## Required Physical Science Courses (36 credits)

|   |   |
|---|---|
| <b>CHEM 1210</b> Principles of Chemistry I (F, Sp)            | 4 |
| <b>CHEM 1230</b> Chemical Principles Laboratory I (F, Sp)     | 1 |
| <b>CHEM 1220 (BPS)</b> Principles of Chemistry II (F, Sp, Su) | 4 |
| <b>CHEM 1240</b> Chemical Principles Laboratory II (F, Sp)    | 1 |
| <b>CHEM 2310</b> Organic Chemistry I (F)                      | 4 |
| <b>CHEM 2330</b> Organic Chemistry Laboratory I (F, Sp)       | 1 |
| <b>CHEM 2320</b> Organic Chemistry II (Sp)                    | 4 |
| <b>CHEM 2340</b> Organic Chemistry Laboratory II (F, Sp)      | 1 |
| <b>CHEM 3600 (QI)</b> Quantitative Analysis (F)               | 3 |
| <b>CHEM 3610</b> Quantitative Analysis Laboratory (F)         | 1 |
| <b>CHEM 3700</b> Introductory Biochemistry (Sp)               | 3 |
| <b>CHEM 3710</b> Introductory Biochemistry Laboratory (Sp)    | 1 |

|   |   |
|---|---|
| <b>PHYX 2110</b> The Physics of Living Systems I (F) (4 cr) <b>and</b>                        |   |
| <b>PHYX 2120 (BPS)</b> The Physics of Living Systems II (Sp) (4 cr)                           | 8 |
| Or  |   |
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I (F, Sp, Su) (4 cr) <b>and</b> |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II (F, Sp, Su) (4 cr)       | 8 |

## Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su)                | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) | 3 |

## BS Degree in Composite Teaching—Biological Science

The Composite Teaching—Biological Science Major leads to licensure to teach in secondary schools. Students who may wish to teach Integrated Science at the middle or junior high school level should talk to their advisor about completing the courses necessary for an Integrated Science endorsement. **Note:** Beginning in 2006, all USU teacher education candidates will be required to take and pass the content exam approved by the Utah State Office of Education in their major content area prior to student teaching. The course requirements are as follows:

### Required Courses (32 credits)

|  |   |
|--|---|
| <b>BIOL 1210</b> Biology I (F)                           | 4 |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp)                   | 4 |
| <b>BIOL 2000</b> Human Physiology (F, Sp, Su)            | 4 |
| <b>BIOL 2220</b> General Ecology (F, Sp)                 | 3 |
| <b>BIOL 3220 (QI)</b> Field Ecology (F)                  | 2 |
| <b>BIOL 3200 (QI)</b> Principles of Genetics (F, Sp, Su) | 4 |
| <b>BIOL 3300</b> General Microbiology (F, Sp)            | 4 |
| <b>BIOL 4100</b> Genetics Laboratory (F) (Alt. Years)    | 2 |
| <b>BIOL 5250 (CI)</b> Evolutionary Biology (F, Sp)       | 3 |
| <b>SCI 4300</b> Science in Society (F, Sp)               | 2 |

## Physiology Course with Lab Requirement (4-5 credits)

Students must take one upper-division physiology course with an integrated or separate laboratory from the following list:

### Courses with integrated laboratories:

|   |   |
|---|---|
| <b>BIOL 4400 (QI)</b> Plant Physiology (F).....       | 4 |
| <b>BIOL 5300 (QI)</b> Microbial Physiology (Sp) ..... | 4 |

### Courses with separate lecture and lab; both must be taken to meet the requirement:

|   |   |
|---|---|
| <b>BIOL 5600</b> Comparative Animal Physiology (F).....         | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp)..... | 2 |
| Or  |   |
| <b>BIOL 5620</b> Medical Physiology (Sp) (Alt. Years).....      | 3 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp)..... | 2 |

### Required Physical Science Courses (21 credits)

|   |   |
|---|---|
| <b>GEOL 1150 (BPS)</b> The Dynamic Earth: Physical Geology (F, Sp)..... | 4 |
| <b>CHEM 1110 (BPS)</b> General Chemistry I (F, Sp).....                 | 4 |
| <b>CHEM 1120 (BPS)</b> General Chemistry II (Sp) .....                  | 4 |
| <b>CHEM 1130</b> General Chemistry Laboratory (Sp).....                 | 1 |

**PHYX 2110** The Physics of Living Systems I (F) (4 cr) and  
**PHYX 2120 (BPS)** The Physics of Living Systems II (Sp) (4 cr)..... 8

Or

|   |   |
|---|---|
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I<br>(F, Sp, Su) (4 cr) and       |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II<br>(F, Sp, Su) (4 cr)..... | 8 |

### Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su).....                 | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) ..... | 3 |

### Required Courses for the Secondary Teacher Education Program (STEP) (35 credits)

#### Level 1:

|   |   |
|---|---|
| <b>INST 3500</b> Technology Tools for Secondary Teachers (F, Sp, Su).....           | 1 |
| <b>SCED 3100</b> Motivation and Classroom Management (F, Sp) .....                  | 3 |
| <b>SCED 3210 (CI/DSS)</b> Educational and Multicultural<br>Foundations (F, Sp)..... | 3 |
| <b>SCED 3300</b> Clinical Experience I (F, Sp) .....                                | 1 |
| <b>SCED 3400</b> Teaching Science I (F).....  | 3 |

#### Level 2:

|  |   |
|--|---|
| <b>SPED 4000</b> Education of Exceptional Individuals<br>(may be taken anytime) (F, Sp, Su)..... | 2 |
| <b>SCED 4200 (CI)</b> Reading, Writing, and Technology (F, Sp) .....                             | 3 |
| <b>SCED 4210</b> Cognition and Evaluation of Student Learning (F, Sp) .....                      | 3 |
| <b>SCED 4300</b> Clinical Experience II (F, Sp) .....  | 1 |
| <b>SCED 4400</b> Teaching Science II (Sp).....   | 3 |

#### Level 3:

|  |    |
|--|----|
| <b>SCED 5500</b> Student Teaching Seminar (F, Sp).....               | 2  |
| <b>SCED 5630</b> Student Teaching in Secondary Schools (F, Sp) ..... | 10 |

## BA Degrees in Biology and Composite Teaching—Biological Science

The student must complete the requirements for the BS (above) plus two years of a foreign language. (See page 55 of this catalog.)

## BS Degree in Public Health

A four-year program leading to the Bachelor of Science in Public Health is offered by the Department of Biology with options in either

environmental health, industrial hygiene, or public health education. Individuals completing the environmental health option are qualified to take the Registered Environmental Health Specialist/Sanitarian Examination. Those completing the industrial hygiene option are granted benefits toward both the Certified Industrial Hygienist and the Certified Safety Professional examinations. The Public Health degree requires a core of biology courses similar to that required for the biology degrees; additional biology and public health courses; and chemistry, physics, mathematics, statistics, and allied science and engineering courses appropriate to each emphasis. The course requirements are as follows:

### Industrial Hygiene Emphasis

#### Required Biology Courses (16 credits)

|   |   |
|---|---|
| <b>BIOL 1210</b> Biology I (F).....                 | 4 |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp).....         | 4 |
| <b>BIOL 2000</b> Human Physiology (F, Sp, Su).....  | 4 |
| <b>BIOL 3300</b> General Microbiology (F, Sp) ..... | 4 |

#### Required Physical Science Courses (30 credits)

|   |   |
|---|---|
| <b>CHEM 1210</b> Principles of Chemistry I (F, Sp) .....            | 4 |
| <b>CHEM 1230</b> Chemical Principles Laboratory I (F, Sp) .....     | 1 |
| <b>CHEM 1220 (BPS)</b> Principles of Chemistry II (F, Sp, Su) ..... | 4 |
| <b>CHEM 1240</b> Chemical Principles Laboratory II (F, Sp) .....    | 1 |
| <b>CHEM 2300</b> Principles of Organic Chemistry (F).....           | 3 |
| <b>CHEM 2330</b> Organic Chemistry Laboratory I (F, Sp) .....       | 1 |
| <b>CHEM 3600 (QI)</b> Quantitative Analysis (F).....                | 3 |
| <b>CHEM 3610</b> Quantitative Analysis Laboratory (F).....          | 1 |
| <b>CHEM 3700</b> Introductory Biochemistry (Sp) .....               | 3 |
| <b>CHEM 3710</b> Introductory Biochemistry Laboratory (Sp) .....    | 1 |

**PHYX 2110** The Physics of Living Systems I (F) (4 cr) and  
**PHYX 2120 (BPS)** The Physics of Living Systems II (Sp) (4 cr)..... 8

Or

|   |   |
|---|---|
| <b>PHYX 2210 (QI)</b> General Physics—Science and Engineering I<br>(F, Sp, Su) (4 cr) and       |   |
| <b>PHYX 2220 (BPS/QI)</b> General Physics—Science and Engineering II<br>(F, Sp, Su) (4 cr)..... | 8 |

### Mathematics and Statistics Requirement (7 credits)

|   |   |
|---|---|
| <b>MATH 1210 (QL)</b> Calculus I (F, Sp, Su).....                 | 4 |
| <b>STAT 3000 (QI)</b> Statistics for Scientists (F, Sp, Su) ..... | 3 |

### Required Program Courses (30 credits)

|  |   |
|--|---|
| <b>PUBH 3310</b> Occupational Health and Safety (F) .....                  | 3 |
| <b>PUBH 3610</b> Environmental Management (F).....                         | 3 |
| <b>PUBH 4040</b> Fundamentals of Epidemiology (Sp).....                    | 3 |
| <b>PUBH 4310</b> Industrial Hygiene Recognition of Hazards (F) .....       | 4 |
| <b>PUBH 4320</b> Industrial Hygiene Chemical Hazard Evaluation (Sp) .....  | 3 |
| <b>PUBH 4330</b> Industrial Hygiene Physical Hazards (Sp).....             | 3 |
| <b>PUBH 4380</b> Industrial Hygiene Internship (F, Sp, Su).....            | 3 |
| <b>PUBH 5330 (QI)</b> Industrial Hygiene Chemical Hazard Control (F) ..... | 3 |
| <b>PUBH 5500 (CI)</b> Public Health Management (F, Sp) .....               | 2 |
| <b>ADVS 5400</b> Environmental Toxicology (Sp).....                        | 3 |

### Elective Options (select 5 credits)

|  |   |
|--|---|
| <b>BIOL 3200 (QI)</b> Principles of Genetics (F, Sp, Su).....              | 4 |
| <b>CEE 5610</b> Environmental Quality Analysis (F) .....                   | 3 |
| <b>PUBH 4300</b> Industrial Hygiene Seminar (F) .....                      | 1 |
| <b>PUBH 4410</b> Industrial Safety (Sp).....                               | 3 |
| <b>PUBH 5340</b> Industrial Hygiene and Safety Programs (Sp).....          | 2 |
| <b>PUBH 5670</b> Hazardous Chemicals Handling and Safety (Sp).....         | 2 |
| <b>PUBH 5730</b> Analysis and Fate of Environmental Contaminants (Sp)..... | 3 |
| <b>PUBH 5790</b> Accident and Emergency Management (Sp).....               | 3 |

# Department of Biology

## Environmental Health Emphasis

### Required Biology Courses (19 credits)

|  |   |
|--|---|
| BIOL 1210 Biology I (F)                | 4 |
| BIOL 1220 (BLS) Biology II (Sp)        | 4 |
| BIOL 2000 Human Physiology (F, Sp, Su) | 4 |
| BIOL 2220 General Ecology (F, Sp)      | 3 |
| BIOL 3300 General Microbiology (F, Sp) | 4 |

### Required Physical Science Courses (22 credits)

|  |   |
|--|---|
| CHEM 1210 Principles of Chemistry I (F, Sp)            | 4 |
| CHEM 1230 Chemical Principles Laboratory I (F, Sp)     | 1 |
| CHEM 1220 (BPS) Principles of Chemistry II (F, Sp, Su) | 4 |
| CHEM 1240 Chemical Principles Laboratory II (F, Sp)    | 1 |
| CHEM 2300 Principles of Organic Chemistry (F)          | 3 |
| CHEM 2330 Organic Chemistry Laboratory I (F, Sp)       | 1 |

|  |   |
|--|---|
| PHYX 2110 The Physics of Living Systems I (F) (4 cr) and<br>PHYX 2120 (BPS) The Physics of Living Systems II (Sp) (4 cr) | 8 |
|--|---|

Or

|   |   |
|---|---|
| PHYX 2210 (QI) General Physics—Science and Engineering I<br>(F, Sp, Su) (4 cr) and<br>PHYX 2220 (BPS/QI) General Physics—Science and Engineering II<br>(F, Sp, Su) (4 cr) | 8 |
|---|---|

### Mathematics and Statistics Requirement (7 credits)

|  |   |
|--|---|
| MATH 1210 (QL) Calculus I (F, Sp, Su)                | 4 |
| STAT 3000 (QI) Statistics for Scientists (F, Sp, Su) | 3 |

### Required Program Courses (29 credits)

|  |   |
|--|---|
| PUBH 3310 Occupational Health and Safety (F)                   | 3 |
| PUBH 3610 Environmental Management (F)                         | 3 |
| PUBH 4000 Public Health Field Experience (F, Sp, Su)           | 3 |
| PUBH 4030 Communicable Disease Control (F)                     | 3 |
| PUBH 4040 Fundamentals of Epidemiology (Sp)                    | 3 |
| PUBH 4310 Industrial Hygiene Recognition of Hazards (F)        | 4 |
| PUBH 5000 Public Health Seminar (Sp)                           | 1 |
| PUBH 5500 (CI) Public Health Management (F, Sp)                | 2 |
| PUBH 5730 Analysis and Fate of Environmental Contaminants (Sp) | 3 |
| NFS 5110 (CI) Food Microbiology (Sp)                           | 4 |

### Required Electives (select 10 credits)

|   |   |
|---|---|
| ADVS 5400 Environmental Toxicology (Sp)             | 3 |
| BIOL 3220 (QI) Field Ecology (F)                    | 2 |
| BIOL 4420 Plant Taxonomy (Sp)                       | 3 |
| BIOL 5550 Freshwater Invertebrates (Sp)             | 3 |
| CHEM 3700 Introductory Biochemistry (Sp)            | 3 |
| CHEM 3710 Introductory Biochemistry Laboratory (Sp) | 1 |
| SOIL 3000 Fundamentals of Soil Science (F, Sp)      | 4 |
| SPCH 1050 (CI) Public Speaking (F, Sp)              | 3 |

## Public Health Education Emphasis

### Required Biology Courses (16 credits)

|  |   |
|--|---|
| BIOL 1210 Biology I (F)                | 4 |
| BIOL 1220 (BLS) Biology II (Sp)        | 4 |
| BIOL 2000 Human Physiology (F, Sp, Su) | 4 |
| BIOL 3300 General Microbiology (F, Sp) | 4 |

### Required Physical Science Courses (18 credits)

|   |   |
|---|---|
| CHEM 1210 Principles of Chemistry I (F, Sp)                             | 4 |
| CHEM 1230 Chemical Principles Laboratory I (F, Sp)                      | 1 |
| CHEM 1220 (BPS) Principles of Chemistry II (F, Sp, Su)                  | 4 |
| CHEM 1240 Chemical Principles Laboratory II (F, Sp)                     | 1 |
| CHEM 1120 (BPS) General Chemistry II (Sp)                               | 4 |
| PHYX 1200 (BPS) Introduction to Physics by Hands-on<br>Exploration (Sp) | 4 |

### Mathematics and Statistics Requirement (7 credits)

|  |   |
|--|---|
| MATH 1210 (QL) Calculus I (F, Sp, Su)                | 4 |
| STAT 3000 (QI) Statistics for Scientists (F, Sp, Su) | 3 |

### Required Program Courses (15 credits)

|  |   |
|--|---|
| PUBH 3120 Family and Community Health (Sp)           | 3 |
| PUBH 4000 Public Health Field Experience (F, Sp, Su) | 3 |
| PUBH 4030 Communicable Disease Control (F)           | 3 |
| PUBH 4040 Fundamentals of Epidemiology (Sp)          | 3 |
| PUBH 5000 Public Health Seminar (Sp)                 | 1 |
| PUBH 5500 (CI) Public Health Management (F, Sp)      | 2 |

### Required Supporting Courses (33 credits)

|  |   |
|--|---|
| HEP 2000 First Aid and Emergency Care (F, Sp, Su)                        | 2 |
| HEP 2500 Health and Wellness (F, Sp, Su)                                 | 2 |
| HEP 3000 Drugs and Human Behavior (F, Su)                                | 3 |
| HEP 3600 (CI) Introduction to Community Health (F)                       | 3 |
| HEP 3800 Grant Proposal Writing (Sp)                                     | 3 |
| HEP 3900 Social Marketing in Health Education (Sp)                       | 3 |
| HEP 4200 (QI) Planning and Evaluation for Health Education (F)           | 3 |
| NFS 1020 (BLS) Science and Application of Human<br>Nutrition (F, Sp, Su) | 3 |
| NFS 5210 Advanced Public Health Nutrition (Sp)                           | 2 |
| SOC 3330 Medical Sociology (F)   | 3 |
| SOC 3500 Social Psychology (F, Sp)                                       | 3 |
| SPCH 1050 (CI) Public Speaking (F, Sp)                                   | 3 |

## Biology Minor

The Biology minor requires completion of the following courses. A minimum cumulative GPA of 2.25 is required for these courses.

|   |    |
|---|----|
| BIOL 1210 Biology I (F)                                   | 4  |
| BIOL 1220 (BLS) Biology II (Sp)                           | 4  |
| Upper-division (3000-level and above) BIOL prefix courses | 12 |

**Note:** Although BIOL/NR 2220 is a lower-division course, it may be counted toward the 12 elective credits.

## BioMath Minor

This minor requires mathematics and quantitative biology courses beyond those required for the basic biology degrees. It is an excellent option for students considering graduate work. Biology majors may take this minor through the Mathematics and Statistics Department. Requirements for the BioMath minor include:

|   |   |
|---|---|
| BIOL 1210 Biology I (F)                                 | 4 |
| BIOL 1220 (BLS) Biology II (Sp)                         | 4 |
| MATH 1210 (QL) Calculus I (F, Sp, Su)                   | 4 |
| MATH 1220 (QL) Calculus II (F, Sp, Su)                  | 4 |
| MATH 2270 (QI) Linear Algebra (F)                       | 3 |
| MATH 2280 (QI) Ordinary Differential Equations (Sp)     | 3 |
| STAT 3000 (QI) Statistics for Scientists (F, Sp)        | 3 |
| MATH/BIOL 4230 (QI) Applied Mathematics in Biology (Sp) | 3 |

(Note: MATH 2250 may substitute for MATH 2270 and 2280.)

Biology majors must take one course from the biology electives (listed below), and two courses from the mathematics and statistics electives (listed below). Mathematics and Statistics majors must take two courses from the biology electives, and one course from the mathematics and statistics electives. All other majors must take two courses from each set of electives.

### Biology Electives:

|   |   |
|---|---|
| BIOL 3200 (QI) Principles of Genetics (F, Sp, Su) | 4 |
| BIOL 3220 (QI) Field Ecology (F)                  | 2 |
| BIOL 4400 (QI) Plant Physiology (F)               | 4 |
| BIOL 5020 (QI) Modeling Biological Systems (F)    | 3 |
| BIOL 5300 (QI) Microbial Physiology (Sp)          | 4 |

|  |   |
|--|---|
| <b>BIOL 5380</b> Evolutionary Genetics (F) .....                           | 4 |
| <b>BIOL 5610 (QI)</b> Animal Physiology Laboratory (F, Sp).....            | 2 |
| <b>BIOL 5800</b> Undergraduate Research (F, Sp, Su) (3 credits min.).....  | 3 |
| <b>BMET 5500</b> Land-Atmosphere Interactions (Sp) .....                   | 3 |
| <b>PUBH 5330 (QI)</b> Industrial Hygiene Chemical Hazard Control (F) ..... | 3 |

## Mathematics and Statistics Electives

|  |   |
|--|---|
| <b>MATH 4630</b> Computer Aided Math for Scientists and Engineers (Sp) ..                                | 3 |
| <b>MATH 5410</b> Methods of Applied Mathematics (F).....   | 3 |
| <b>MATH 5420</b> Partial Differential Equations (Sp) .....   | 3 |
| <b>MATH 5460</b> Introduction to the Theory and Application of Nonlinear<br>Dynamical Systems (Sp) ..... | 3 |
| <b>MATH 5610</b> Computational Linear Algebra and Solution of Systems<br>of Equations (F).....           | 3 |
| <b>MATH 5620</b> Numerical Solution of Differential Equations (Sp) .....                                 | 3 |
| <b>MATH 5710</b> Introduction to Probability (F, Sp) .....   | 3 |
| <b>MATH 5910</b> Directed Reading and Conference (F, Sp, Su)<br>(3 credits min.).....                    | 3 |
| <b>STAT 5100 (CI/QI)</b> Linear Regression and Time Series (F) .....                                     | 3 |
| <b>STAT 5110</b> Theory of Linear Models (F) .....   | 3 |
| <b>STAT 5120</b> Categorical Data Analysis (F) .....   | 3 |
| <b>STAT 5200</b> Design of Experiments (Sp).....   | 3 |
| <b>STAT 5300 (QI)</b> Statistical Process Control (Sp).....  | 3 |
| <b>STAT 5600 (CI)</b> Applied Multivariate Statistics (Sp) .....   | 3 |
| <b>STAT 5940</b> Directed Reading and Conference (F, Sp, Su)<br>(3 credits min.).....                    | 3 |

BIOL 5800, MATH 5910, and STAT 5940 must involve mathematical or statistical analysis of a biological problem.

## Public Health Minor

The Public Health minor requires completion of the following:

|   |    |
|---|----|
| <b>BIOL 1210</b> Biology I (F).....   | 4  |
| <b>BIOL 1220 (BLS)</b> Biology II (Sp).....                                   | 4  |
| Upper-division (3000-level and above) Public Health elective<br>courses ..... | 12 |

## Field Trips and Laboratory Fees

Many biology courses require field trips. Those enrolled are expected to dress appropriately for the conditions and observe any safety precautions issued by instructors. Many courses require modest laboratory fees.

## Financial Support

Scholarships, assistantships, grants-in-aid, and work-study programs are available from the University. Both the College of Science and the Department of Biology offer scholarships. Applications for departmental and college scholarships should be submitted during early spring semester. Contact the College of Science Office (ESLC 245) and the Biology Advising Center (BNR 101) for details.

## Departmental Honors

Students who would like to experience greater academic depth within their major are encouraged to enroll in departmental honors. Through original, independent work, Honors students enjoy the benefits of close supervision and mentoring, as they work one-on-one with faculty in select upper-division departmental courses. Honors students also complete a senior project, which provides another opportunity to collaborate with faculty on a problem that is significant, both personally and in the student's discipline. Participating in departmental honors enhances students' chances for obtaining fellowships and admission to graduate school.

An Honors Plan is available for students desiring a BS or BA degree "with Honors" in Biology. Departmental Honors requires the completion of 9 credits of Honors coursework in upper-division BIOL courses, BIOL 5800H, and a research-based Bachelor's Thesis. For details, students should contact: Kimberly A. Sullivan, (435) 797-3713, yejunco@biology.usu.edu.

## Additional Information

For more information about requirements for the majors and minors within the Biology Department, see major requirement sheets, available from the Biology Department, or online at: <http://www.usu.edu/ats/majorsheets/>

## Graduate Programs

### Admission Requirements

See general admission requirements on pages 93-94. To be recommended for matriculated status, an applicant must have earned a bachelor's degree (or equivalent) from an accredited institution, and a Biology faculty member must agree to serve as major professor for that applicant. The Department of Biology also considers these guidelines for admission: (1) the transcript should show a minimum GPA of 3.0 (B); and (2) the scores on the verbal and quantitative GRE should be above the 50th percentile and the analytical writing score should be 3.5 or above. Advanced GREs (especially biology) are also recommended. Applicants for whom English is not the primary language must have scored at least 575 on the TOEFL. The applicant's undergraduate program should be similar to that offered by the Department of Biology at Utah State University, which includes the following and their prerequisites: general biology, microbiology, genetics, ecology, physiology, cell biology, developmental biology, and evolution; general and organic chemistry; calculus; statistics; and physics. Other preparatory courses may be specified by the student's supervisory committee.

### Degree Programs

For those who have demonstrated strong academic capability as well as research interest, the Department of Biology offers the **Master of Science Degree** and the **Doctor of Philosophy Degree** in either Biology or Ecology. Graduate degrees in **Toxicology** are available through the Interdepartmental Program in Toxicology.

Undergraduate majors in Biology at USU with especially strong backgrounds and interest in research may apply for study of the Master of Science degree as **transitional students**. Acceptance as a transitional student allows undergraduates with advanced standing to integrate up to 9 credits of graduate work into the final semesters of their Bachelor of Science study. Acceptance into this program, as into all graduate programs in Biology, is closely regulated. Formal application through the School of Graduate Studies is required.

### Course Requirements

#### Biology MS and PhD Degrees

Course requirements are determined by the student's supervisory committee. They will vary depending on the research emphasis selected and the background of the student.

# Department of Biology

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## Ecology MS and PhD Degrees

For specific requirements, see the description of the Ecology Interdepartmental Program (pages 215-216).

## Research

The Department of Biology provides a dynamic and broad base for research and graduate study through a balanced program of basic and applied studies at ecosystem, population, organismal, cellular, and molecular levels. An outstanding variety of field sites; animal, plant, and microbe growth facilities; and modern well-equipped laboratories are available. Also, the Intermountain Herbarium, an excellent insect collection, the USDA/ARS U.S. National Pollinating Insects Collection, the Stable Isotope Laboratory, and the Center for Integrated BioSystems exist as research and support facilities.

Faculty members participate in and are supported by several interdepartmental programs, including the Ecology Center and the Center for Environmental Toxicology. In addition, many less formal contacts and interactions exist with colleagues in the colleges of Agriculture, Natural Resources, and Science.

Students are encouraged to carefully consider how their career goals match the faculty's research interests. Prospective students are strongly encouraged to contact faculty members with whom they are interested in working. Because of the combination of a diverse interdisciplinary base and excellent focused research programs, students have an opportunity to learn the philosophies and methods of many branches of biology.

## Financial Assistance

Research assistantships are available from the grants of major professors and from Utah Agricultural Experiment Station funds. Teaching assistantships are awarded annually. All awards are made on a competitive basis and specific teaching needs are considered in awarding teaching assistantships. Given satisfactory performance, MS students are supported for at least two years and PhD candidates for at least four years on teaching assistantships. The department may also recommend particularly qualified students for College of Science or University fellowships. Admission to the graduate program of the Department of Biology does not guarantee financial support; however, applicants will not normally be admitted without financial support.

## Career Opportunities

Completion of graduate degrees in Biology prepares students for careers in teaching and research in universities and colleges. Many graduates also find employment with private industry and state and national governmental agencies. Specific employment possibilities will depend on the nature of the graduate program pursued. The extensive background provided by a graduate degree also prepares students for eventual administrative responsibilities.

## Research Emphases

Research areas of departmental faculty are diverse. Areas of research currently include: **Cellular and Molecular Biology:** plant-microbial interactions; molecular neurobiology and biophysics; gene regulation and signal transduction; membrane transport; molecular virology; **Ecology and Behavior:** community and ecosystem ecology; insect ecology and behavior; pollination biology; plant-insect interactions; vertebrate behavioral ecology; mathematical and computer modeling;

soil microbiology; fungal ecology; biological control; integrated pest management (IPM); **Physiology and Comparative Biology:** toxicology and industrial hygiene; insect pathology; plant physiology and pathology; and **Systematics and Evolution:** systematics and evolution of plants, fungi, insects, reptiles, and amphibians; evolutionary quantitative genetics; biogeography; evolution of chemical defenses and resistance in microorganisms, insects, reptiles, and amphibians.

## Research and Teaching Facilities

### Herbarium

Graduate study in plant taxonomy offered in the Department of Biology utilizes the extensive facilities of the Intermountain Herbarium. The collection includes over 220,000 research specimens. About 50 percent are from the Intermountain Region, while most of the remainder are from other regions of North America.

### Insect Collection

Comprising over a million specimens, the insect collection is available to scientists and graduate students involved in taxonomic research and to those requiring identification of insects in various research projects. The collection primarily covers the Intermountain Region, but it also contains species from nearly all areas of the world. The BNR Building also houses the USDA/ARS U.S. National Pollinating Insect Collection.

### Laser Scanning Confocal Microscope

The Department of Biology has a BioRad 1024 Laser Scanning Confocal Microscope. This state-of-the-art technology utilizes highly tuned lasers to give detailed sectional views of the interior of intact structures such as cells and tissues, and greatly extends the advantages of fluorescence microscopy. This microscope is utilized by researchers campuswide, and is an indispensable tool for molecular and cellular studies.

### Center for Integrated BioSystems (CIB)

The CIB operates three service laboratories and a variety of research projects. The service laboratories provide essential biological resources for biotechnology research and development including: DNA sequencing, peptide synthesis, protein sequencing, antibodies, and fermentation.

## Biology Faculty

### Professors

*Anne J. Anderson*, microbiology and plant pathology  
*Edmund D. Brodie, Jr.*, behavior and evolution  
*E. W. "Ted" Evans*, insect ecology  
*James W. Haefner*, systems analysis  
*Joseph K.-K. Li*, virology  
*James A. MacMahon*, community ecology  
*Frank J. Messina*, insect biology  
*Keith A. Mott*, plant physiology  
*William J. Pependorf*, industrial hygiene  
*Peter C. Ruben*, neurobiology  
*Jon Y. Takemoto*, microbiology

### Associate Professors

*Brett A. Adams*, cell signaling  
*Diane G. Alston*, integrated pest management  
*Mary E. Barkworth*, plant systematics  
*Daryll B. DeWald*, cell biology  
*Timothy A. Gilbertson*, neurobiology

# Department of Biology

*Bradley R. Kropp*, mycology  
*Richard J. Mueller*, plant morphology  
*Gregory J. Podgorski*, developmental biology  
*John M. Stark*, microbial ecology and biogeochemistry  
*Kimberly A. Sullivan*, behavioral ecology  
*Carol D. von Dohlen*, insect biology  
*Dennis L. Welker*, molecular biology  
*Paul G. Wolf*, systematics and molecular biology

## Assistant Professors

*Michelle A. Baker*, aquatic ecology  
*Paul F. Cliften*, microbial functional genomics  
*S. K. Morgan Ernest*, spatial ecology  
*C. Kent Evans*, extension plant pathology  
*Michael E. Pfrender*, evolutionary quantitative genetics  
*Katarina Stroffekova*, physiology

## Professors Emeriti

*William A. Brindley*, entomology and toxicology  
*Donald W. Davis*, entomology and pest management  
*Keith L. Dixon*, ornithology and mammalogy  
*LeGrande C. Ellis*, endocrinology and reproductive physiology  
*James A. Gessaman*, vertebrate physiological ecology  
*Ting H. Hsiao*, insect physiology and biochemistry  
*Gene W. Miller*, plant biochemistry and physiology  
*Ivan G. Palmblad*, evolutionary ecology  
*Frederick J. Post*, aquatic microbiology and microbial ecology  
*Reed S. Roberts*, entomology  
*Richard J. Shaw*, vascular plant taxonomy  
*John R. Simmons*, biochemical genetics  
*John J. Skujins*, soil biochemistry and microbial ecology  
*Sherman V. Thomson*, plant pathology  
*Nabil N. Youssef*, cell biology and parasitology

## Associate Professors Emeriti

*David B. Drown*, environmental health  
*Wilford J. Hansen*, systematic entomology  
*Raymond I. Lynn*, algology and microbial ecology  
*George W. Welkie*, plant physiology and virology

## Research Professor

*Donald W. Roberts*, insect pathology

## Research Associate Professor

*Vijendra K. Singh*, immunology

## Research Assistant Professors

*Michelle A. Grilley*, molecular biology  
*Dane R. Hansen*, molecular biology, physiology, cell signaling  
*Joanne E. Hughes*, molecular genetics  
*Charles D. Miller*, plant pathology  
*Mark P. Miller*, genetics  
*James P. Pitts*, entomology

## Adjunct Professors

*James H. Cane*, bee biology  
*Noelle E. Cockett*, biotechnology  
*Robert Fogel*, mycology  
*William P. Kemp*, insect ecology  
*J. Russell Mason*, predation, ecology, and behavior  
*Darwin L. Sorensen*, aquatic microbiology  
*Rex S. Spindlove*, virology

## Adjunct Associate Professors

*John C. Bailey*, public health  
*Dale L. Barnard*, chemotherapy of viruses  
*Jay B. Karren*, entomology  
*Vincent J. Tepedino*, entomology

## Adjunct Assistant Professors

*Terry Griswold*, bee biology  
*Rosalind R. James*, entomology  
*Theresa L. Pitts-Singer*, entomology

## Principal Lecturer

*David M. "Andy" Anderson*, medical technology

## Lecturers

*John A. Flores II*, public health, industrial hygiene  
*Alice M. Lindahl*, invertebrate biology  
*David O. Wallace*, public health, industrial hygiene

## Course Descriptions

Biology (BIOL), pages 466-470  
Public Health (PUBH), pages 590-591