

BIOLOGICAL SCIENCES

School of Life Sciences and Technologies

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CURRICULUM

The School of Life Sciences at Irvine Valley College offers a wide range of courses in the biological sciences as well as a course in environmental studies. Introductory courses focus on theories and concepts in five primary areas: cellular and molecular biology, genetics, evolution, ecology, and whole organism biology. More specialized courses examine extensions of these basic principles as they relate to a variety of specific areas of study, including botany, zoology, human anatomy, human physiology, cellular biology, microbiology, natural history, and marine biology. Students may complete courses within the department in order to fulfill general education requirements, to satisfy prerequisites for health-related programs such as nursing, to meet graduation requirements at prospective transfer institutions, or to complete the Associate in Arts degree with a major in biology or health sciences.

MAJOR

The requirements for majors in the life sciences are intended to provide a solid foundation for the student who wishes to pursue further study at the baccalaureate or graduate level, or enter a preprofessional or professional program in a health-related field. The faculty strongly recommends that students without a firm foundation in basic biological principles complete one of the two introductory sequences in biology (Biology 1/1L or Biology 94/94L) in preparation for the more specialized courses. In addition to the core courses for the major or health-related fields,

an introduction to other sciences is usually recommended and necessary for more advanced study. The biology faculty therefore suggests that students complete appropriate courses in chemistry, physics, and mathematics concurrently with biology core courses. Students should refer to the requirements of prospective institutions or seek advice from a member of the biology faculty or a counselor before choosing electives.

CAREER OPTIONS

An A.A. degree in biology will prepare students for entry into certificate or technical training programs in:

- Nursing
- Biotechnology
- Dental Assisting
- Dental Hygiene
- Emergency Medical Technology
- Paramedic Training
- Laboratory Research

An A.A. degree in biology will also allow students to continue their education at a four-year institution, where earning a B.A. degree in biological sciences can prepare them for careers in:

- Public Health
- Nutrition
- Biotechnology
- Laboratory and Field Research
- Pharmaceutical Sales
- Land Management
- Environmental Studies
- Entry into professional schools that provide training in medicine, dentistry, pharmacy, optometry, physician's assistant, and veterinary medicine

ASSOCIATE DEGREE

- **Associate in Arts Degree in Biology**
- **Associate in Arts Degree in Health Sciences**

Students must complete a minimum of 60 units of credit, including the courses in the major ("Major Requirements") and general education requirements (pages 43-49), with an overall GPA of 2.0 or better, and a grade of "A," "B," "C," or "P" in all courses to be counted toward the major. A minimum of 12 units must be completed at Irvine Valley College. See pages 33-34 for further information.

TRANSFER PREPARATION

Courses that fulfill major requirements for an associate degree at Irvine Valley College may not be the same as those required for completing the major at a transfer institution offering a bachelor's degree. Students who plan to transfer to a four-year college or university should schedule an appointment with an IVC counselor to develop a plan of study before beginning their program. It may be helpful to meet with the department faculty at IVC.

**ASSOCIATE IN ARTS DEGREE
MAJOR REQUIREMENTS: BIOLOGY**

Complete the following courses: **Units**

BIO 2	Principles of Botany	4
BIO 5	Principles of Zoology	4
BIO 6	Cellular Biology	3
BIO 6L	Cellular Biology Laboratory	1

OR

BIO 93	Integrated Biology: From DNA to Organisms	4
BIO 94	From Organisms to Ecosystems	3
BIO 94L	From Organisms to Ecosystems Laboratory	1
BIO 97	Genetics and Evolutionary Biology	3
BIO 99	Molecular Biology and Biochemistry	3
BIO 99L	Molecular Biology Laboratory	1

Select 3–6 units from the following courses to complete a total of 18 units.

No more than 2 units may be selected from field courses/lab research courses:

BIO 4	Evolutionary Ecology	3
BIO 11	Human Anatomy	4
BIO 12	Human Physiology	4
BIO 15	General Microbiology	5
BIO 19	Marine Biology	4
BIO 30	California Wildlife and Wild Places	3
BIO 44	Biology of Human Sexuality	3
BIO 13	Lab Research	2
BIO 101	Field Biology: Coastal Marine Ecosystems	1
BIO 103	Field Biology: Mountain Ecosystems	1
BIO 104	Field Biology: Desert Ecosystems	1
BIO 110	Field Biology: Ecology and Natural History of National Parks	2/4
BIO 140	Lab Research in Geological and Biological Sciences	1.5
CHEM 1A	General Chemistry I	5
CHEM 1B	General Chemistry II	5
TOTAL UNITS:		18

**ASSOCIATE IN ARTS DEGREE
MAJOR REQUIREMENTS: HEALTH SCIENCES**

This major is appropriate for students who plan to enter training in one of the health professions, including nursing, physical therapy, occupational therapy, dental hygiene, physician assisting, and health sciences.

Complete the following courses: **Units**

BIO 11	Human Anatomy	4
BIO 12	Human Physiology	4
BIO 15	General Microbiology	5

Complete a minimum of 6 units from the following courses. Select one chemistry course:

BIO 10	Biochemistry for Health Sciences	4
BIO 201	Biochemistry for Health Sciences	2
CHEM 4	Introduction to General & Organic Chemistry & Biochemistry	5
† CHEM 108	Introduction to General, Organic and Biochemistry	4
PSYC 1	Introduction to Psychology	3
SOC 1	Introduction to Sociology	3
TOTAL UNITS:		19

† Course offered only at Saddleback College

COURSES

**BIO 1: PRINCIPLES OF BIOLOGY:
CELLS TO ECOSYSTEMS**

3 Units

3 hours lecture

Transfers: CSU, UC credit proviso (see UC course list)

This course is an integrated survey of the major principles of biology. Lectures focus on cellular and molecular biology, biochemistry, reproduction, genetics, organic evolution, population biology, and ecology. This course is recommended for students seeking to fulfill the general education requirement in life sciences or as an introductory course for students pursuing advanced study in the life sciences. UC credit proviso (see UC course list). NR

**BIO 1L: PRINCIPLES OF BIOLOGY:
CELLS TO ECOSYSTEMS
LABORATORY**

1 Unit

3 hours lab

Transfers: CSU, UC

Prerequisite: Prior completion of or concurrent enrollment in Bio. 1

This is a laboratory survey of the major principles of biology. It is the recommended course to accompany Biology 1. Topics include the application of laboratory equipment and procedures to the investigation of biological systems at the biochemical, cellular, organismal, population, and community levels. This course does not include animal dissections. Students may take Bio. 1L independently or concurrently with the Bio. 1 lecture, but not prior to it. Field trips may be required to fulfill the course objectives. NR

BIO 2: PRINCIPLES OF BOTANY

4 Units

3 hours lecture, 3 hours lab

Transfers: CSU, UC

Prerequisite: Bio. 1 or Bio. 94 and Math 253

This course provides a survey of plants, algae, fungi, and prokaryotes. Lectures focus on the structure, function, genetics, classification, evolution, ecology and natural history of these major groups. Field trips may be required to fulfill course objectives. (CAN BIOL 6; Bio. 6+6L+5+2: CAN BIOL SEQ A) NR

BIO 4: EVOLUTIONARY ECOLOGY**3 Units****3 hours lecture****Transfers: CSU, UC****Prerequisite: Bio. 94**

This course examines the interactions between organisms and their abiotic and biotic environments from an ecological and evolutionary perspective. The focus is on global and local climatology; adaptations to the physical environment; energy production and utilization; food chains and food web analysis; niche theory; biology of populations, including population growth and its regulation, and interactions between and within populations; analysis of community structure and functions; life history; natural and sexual selection, adaptation and genetics; mating systems; problems of spatial and temporal scale; and game theory. This course assumes some knowledge of organismal biology and evolutionary theory. NR

BIO 5: PRINCIPLES OF ZOOLOGY**4 Units****3 hours lecture, 3 hours lab****Transfers: CSU, UC****Prerequisite: Math 253**

This course is a survey of protozoans and animals. Lectures focus on the structure, function, development, classification, evolution, ecology and natural history of major animal and protozoan groups. Field trips may be required to fulfill the course objectives. (CAN BIOL 4; Bio. 6+6L+5+2: CAN BIOL SEQ A) NR

BIO 6: CELLULAR BIOLOGY**3 Units****3 hours lecture****Transfers: CSU, UC****Prerequisite: Bio. 1, Chem. 1B and Math 253**

This course presents an analysis of living systems at the cellular level. It examines the structure and function of prokaryotic and eukaryotic cells and their organelles; the energetics and biochemistry of metabolism; the processes of intracellular transport; and the process of protein synthesis. (Bio. 6+6L: CAN BIOL 2; Bio. 6+6L+5+2: CAN BIOL SEQ A) NR

BIO 6L: CELLULAR BIOLOGY LABORATORY**1 Unit****3 hours lab****Transfers: CSU, UC****Prerequisite: Prior completion of or concurrent enrollment in Bio. 6**

This course is the laboratory companion to the Biology 6 lecture course. It is designed to introduce students to the techniques of modern cell biology as they relate to the study of intracellular structure and function, genetic expression and transmission, and cell-environment interactions. Techniques may include organelle and macromolecule isolation and purification; chromatography; electrophoresis; Western blots; spectrophotometry; enzymology; histology; cytochemistry; gene transfer; polymerase chain reaction; DNA fingerprinting; immunology and cell culture and cloning. Biology 6L is also listed as Biology 99L; credit will be given in either area, not both. (Bio. 6+6L: CAN BIOL 2; Bio. 6+6L+5+2: CAN BIOL SEQ A) NR

BIO 10: BIOCHEMISTRY FOR HEALTH SCIENCES**4 Units****3 hours lecture, 3 hours lab****Transfers: CSU, UC**

This course addresses the application of chemical principles to biological systems, especially at the cellular level of structure and function. Essential topics include the nature of biologically important solutions and colloids; structure, functions and interactions of biological macromolecules; interactions of biological molecules in formation and functions of biological membranes; intracellular metabolism and enzyme functions; and genetic control of biological functions. The course is intended for health science students who have no previous background in sciences. Biology 10 was formerly offered as Biology 108. NR

BIO 11: HUMAN ANATOMY**4 Units****2 hours lecture, 6 hours lab****Transfers: CSU, UC**

This course presents an analysis of human structure integrating cellular, tissue, organ, and organ system levels of structure and relates structure to function. Laboratory emphasis is on histology and gross anatomy. The course is designed for pre-professional students and biology majors. (CAN BIOL 10; Bio. 11+12: CAN BIOL SEQ B) NR

BIO 12: HUMAN PHYSIOLOGY**4 Units****3 hours lecture, 3 hours lab****Transfers: CSU, UC****Prerequisite: Bio. 11 and either Bio. 10, Chem. 4, Chem. 12A, or Chem. 108***Recommended Preparation: Chem. 4, Wr. 1 and Math 253*

This course applies an integrated systems approach to the study of function in the human body. Emphasis is on major organ systems, their negative feedback controls, and their significance in maintaining homeostasis of the whole body. Each system is analyzed at the molecular, cellular, tissue and organ levels of function. The lab component of the course emphasizes experimental design, data collection and analysis, and evaluation and interpretation of experimental results. (CAN BIOL 12; Bio. 11+12: CAN BIOL SEQ B) NR

BIO 12D: HUMAN PHYSIOLOGY-DISCUSSION**1 Unit****1 hour lecture****Transfers: CSU, UC credit proviso (see UC course list)****Corequisite: Bio. 12**

This discussion course affords students enrolled in Biology 12, Human Physiology, the opportunity to discuss, analyze, and exchange ideas concerning human function. Discussions focus on negative feedback control systems and other key topics covered in Biology 12, as well as background information not generally covered in the lecture. Biology 12D is offered on a pass/no-pass basis only. NR

BIO 13: LAB RESEARCH**2 Units****1 hour lecture, 3 hours lab****Transfers: CSU, UC****Prerequisite: Bio. 1, 2, 4, 5, 6, 11, 12, 15, 94, 97 or 99***Recommended Preparation: Chem. 1A/1B or Bio. 201; at least one other Biology course*

This course provides laboratory and field experience for advanced students of biological sciences. It focuses on experimental design; equipment use and care; data collection, analysis, and interpretation; and both verbal and written presentation of results. R-E-3

BIO 15: GENERAL MICROBIOLOGY
5 Units**3 hours lecture, 6 hours lab****Transfers: CSU, UC***Recommended Preparation: Bio. 11 and Bio. 201*

This course is an examination of the fundamental biological concepts as they apply to viruses, bacteria, fungi, and protozoans. Theoretical as well as practical applications are discussed in such topics as bacterial morphology, metabolism, genetics, chemotherapy, and antibiotics. Also discussed are resistance and immunity, health and disease, and the role of microorganisms in the environment. Laboratory work will reinforce topics covered in lecture. Field trips may be required to fulfill course objectives. (CAN BIOL 14) NR

BIO 19: MARINE BIOLOGY**4 Units****3 hours lecture, 3 hours lab****Transfers: CSU, UC***Recommended Preparation: Bio. 1 or Bio. 94*

This course presents the biology and natural history of marine organisms within an ecological context. A habitat approach emphasizes the physical features of each marine environment, the community structure of the habitat and adaptations of the constituent organisms. Emphasis is on California marine life. The laboratory component of the course emphasizes observation and experimentation. Experiments address general biological/ecological principles in the context of the marine environment. Students study the classification, anatomy, physiology and behavior of marine organisms. Field trips, an integral part of the course, focus on the structure of marine ecosystems. NR

BIO 30: CALIFORNIA WILDLIFE AND WILD PLACES**3 Units****3 hours lecture****Transfers: CSU, UC**

This non-major lecture course introduces students to the natural history of California plants and animals in the context of the many ecosystems found in the state. The course presents both ecological and evolutionary perspectives as it examines the role of the environment, species interactions, and adaptation in creating California's surprising biodiversity. The course includes prehistorical and historical changes to California wildlands and the role humans have played in shaping the current landscape. Field trips may be required to fulfill course objectives. NR

BIO 43: WILD ANIMAL BEHAVIOR: THE SCIENCE OF ETHOLOGY**3 Units****3 hours lecture****Transfers: CSU, UC**

This course offers an integrated analysis of the biological, ecological and evolutionary (i.e., adaptive) bases of animal behavior (ethology) in the wild. The course considers in detail the psychobiological, ecological, ontological and sociobiological determinants of animal behavior, stressing historical and evolutionary contexts. Field trips may be required to fulfill course objectives. NR

BIO 44: BIOLOGY OF HUMAN SEXUALITY**3 Units****3 hours lecture****Transfers: CSU, UC**

This course provides a thorough introduction to the development and practice of sexuality in humans. It is organized into three units: (1) biochemical function, (2) developmental and sexual differentiation from fertilization through the age of 18 months, and (3) psycho-sexual and physiological development from birth through adulthood. Field trips may be required to fulfill the objectives of this course. NR

BIO 93: INTEGRATED BIOLOGY: FROM DNA TO ORGANISMS**4 Units****4 hours lecture****Transfers: CSU, UC****Prerequisite: Math 253***Recommended Preparation: High school biology or chemistry*

This course integrates four broadly defined levels of organismal structure and function into a coherent framework. Biochemistry, cell biology, genetics, and organismal structure and function (with emphasis on organ systems) are woven together using basics themes of structural/functional hierarchy, energetics, and information flow. NR

BIO 94: FROM ORGANISMS TO ECOSYSTEMS**3 Units****3 hours lecture****Transfers: CSU, UC**

This course is a comprehensive survey of life's diversity. Students examine representatives of the kingdoms of organisms within the context of biological classification, biological nomenclature, and evolutionary history. The course integrates principles of genetics, organic evolution and ecology to provide a common rubric within which students may explore the unity and diversity of life. Field trips may be required to fulfill objectives of this course. NR

BIO 94L: FROM ORGANISMS TO ECOSYSTEMS LABORATORY**1 Unit****3 hours lab****Transfers: CSU, UC****Prerequisite: Prior completion of or concurrent enrollment in Bio. 94**

This laboratory course is a comprehensive survey of life's diversity. The course examines representatives of the kingdoms of organisms within the context of biological classification, biological nomenclature, environmental adaptation and evolutionary history. Students survey living specimens, museum specimens, herbarium specimens and microscope slides representing each of the major taxa. Field trips may be required to fulfill the course objectives. NR

BIO 97: GENETICS AND EVOLUTIONARY BIOLOGY**3 Units****3 hours lecture****Transfers: CSU, UC****Prerequisite: Chem. 1B and either Bio. 1 or Bio. 94**

This course is a comprehensive survey of the processes and products of genetics. Through a review of experimental evidence, students evaluate the basic tenets of molecular, transmission, and population genetics, and use the science of genetics to appraise the relationship of genetics to the processes and products of microevolution and macroevolution. The philosophy and methods of science well as the theory of evolutionary thought are integrated throughout. The course assumes prior knowledge of evolutionary theory, classification and taxonomy, and ecology. NR

BIO 99: MOLECULAR BIOLOGY AND BIOCHEMISTRY**3 Units****3 hours lecture****Transfers: CSU, UC****Prerequisite: Bio. 97 and Chem. 12A**

This course focuses on the structure and functions of major classes of intracellular macromolecules; the metabolic pathways for the synthesis, degradation, and interconversion of carbohydrates, lipids, and proteins; and the molecular mechanisms which control and direct intracellular metabolic processes. Concepts and theories of molecular evolution are also considered. The course assumes prior knowledge of the structure and expression of genetic information. NR



BIO 99L: MOLECULAR BIOLOGY LABORATORY

1 Unit

3 hours lab

Transfers: CSU, UC

Prerequisite: Prior completion of or concurrent enrollment in Bio. 99

This course is the laboratory companion to the Biology 99 lecture course. It is designed to introduce students to the techniques of modern cell biology as they relate to the study of intracellular structure and function, genetic expression and transmission, and cell-environment interactions. Techniques may include organelle and macro- molecule isolation and purification; chromatography; electrophoresis; Western blots; spectrophotometry; enzymology; histology; cytochemistry; gene transfer; polymerase chain reaction; DNA fingerprinting; immunology and cell culture and cloning. Biology 99L is also listed as Biology 6L; credit will be given in either area, not both. NR

BIO 121: HUMAN ANATOMY AND PHYSIOLOGY

4 Units

3 hours lecture, 3 hours lab

Transfers: CSU

Recommended Preparation: High school biology and eligibility for college-level writing

This basic course shows the interrelationships between the anatomical and physiological systems of humans. The course presents an analysis that integrates cellular, tissue, organ, and organ system levels of structure and relates structure to function. Laboratory emphasis is on the histology, gross anatomy, and physiology of major systems. This course does not meet the requirements of either anatomy or physiology for nursing students or biology majors. NR

BIO 140: LAB RESEARCH IN GEOLOGICAL AND BIOLOGICAL SCIENCES

1.5 Units

.5 hour lecture, 2.5 hours lab

Transfers: CSU

This course provides laboratory and field experience for students of geological and biological sciences. It focuses on experimental design; equipment use and care; data collection, analysis, and interpretation; and verbal and/or written presentation of results. Biology 140 is also listed as Geology 140; credit will be given in either area, not both. R-E-3

BIO 200: HUMAN PROSECTON

2 Units

1 hour lecture, 3 hours lab

Prerequisite: Bio. 11

This course focuses on the gross anatomy of major organs and organ systems of the human body. The course presents detailed regional dissections using human cadaveric specimens. Emphasis is placed on dissection techniques. R-E-3

BIO 201: BIOCHEMISTRY FOR HEALTH SCIENCES

2 Units

2 hours lecture

Recommended Preparation: Math 251 strongly recommended

Biology 201 addresses the application of chemical principles to biological systems, especially at the cell level of structure and function. The essential topics include the nature of biologically important solutions and colloids; structure, functions and interactions of biological macromolecules; interactions of biological molecules in the formation and functions of biological membranes; intracellular metabolism and enzyme functions; and genetic control of biological functions. The course is intended for health science students who have no previous background in the sciences. NR

BIOLOGY FIELD STUDIES

BIO 101: FIELD BIOLOGY: COASTAL MARINE ECOSYSTEMS

1 Unit

.5 hours lecture, 1.5 hours lab

Transfers: CSU

Limitation: Students must be able to traverse rocky intertidal habitats and camp (tents, sleeping bags, cooking, limited showers)

Recommended Preparation: An introductory college-level biology course and Wr. 1

This field course introduces students to interrelationships among plant/animal communities and physical environments that characterize coastal marine habitats. Topics will include natural history, biology and ecology of the flora and fauna and community structure and analysis. Introductory lectures complement direct field observations and field experiments, as well as the collection, analysis and interpretation of data. The course is taught entirely in the field. It is intended for both science majors and non-majors. A required course fee must be paid at or prior to the orientation session. R-E-3

BIO 103: FIELD BIOLOGY: MOUNTAIN ECOSYSTEMS

1 Unit

.5 hours lecture, 1.5 hours lab

Transfers: CSU

Limitation: Students must be able to hike narrow mountain trails and camp (tents, sleeping bags, cooking, limited showers)

Recommended Preparation: An introductory college-level biology or geology course and Wr. 1

This field course introduces students to interrelationships among plant/animal communities and physical environments that characterize mountain habitats. Topics will include natural history, biology and ecology of the flora and fauna, and community structure and analysis. Introductory lectures complement direct field observations and field experiments, as well as the collection, analysis and interpretation of data. The course is taught entirely in the field. It is intended for both science majors and non-majors. A required course fee must be paid at or prior to the orientation session. R-E-3

**BIO 104: FIELD BIOLOGY:
DESERT ECOSYSTEMS****1 Unit****.5 hours lecture, 1.5 hours lab****Transfers: CSU*****Limitation: Students must be able to hike narrow desert trails and camp (tents, sleeping bags, cooking, limited showers)******Recommended Preparation: An introductory college-level biology course and Wr. 1***

This field course introduces students to interrelationships among plant/animal communities and physical environments that characterize desert habitats. Topics will include natural history, biology and ecology of the flora and fauna and community structure and analysis. Introductory lectures complement direct observations and field experiments, as well as the collection, analysis and interpretation of data. The course is taught entirely in the field. It is intended for both science majors and non-majors. A required course fee must be paid at or prior to the orientation session. R-E-3

**BIO 109: FIELD BIOLOGY: A 21ST
CENTURY LOOK AT THE AMERICAN
WEST****2 or 4 Units****1 hour lecture, 3 hours lab; or****2 hours lecture, 6 hours lab****Transfers: CSU*****Limitation: Students must be able to hike cross-country/narrow trails and camp (tents, sleeping bags, cooking, limited showers).******Recommended Preparation: Introductory college-level biology courses and Wr. 1***

This field course introduces students to the flora and fauna of selected natural sites that have been the focus of influential natural history writers over the last 200 years. The course is taught as an expedition, as students plan and implement a trek to these sites, compare the flora and fauna of today to that described in historical books and essays, and prepare their own natural history journals. Introductory lectures in natural history, biology, ecology, and community structure complement direct field experiences. The course is taught entirely in the field. It is intended for both science majors and non-majors. A required course fee must be paid at or prior to the orientation session. R-E-3

**BIO 110: FIELD BIOLOGY:
ECOLOGY AND NATURAL HISTORY
OF NATIONAL PARKS****2 or 4 Units****1 hour lecture, 3 hour lab; or****2 hours lecture, 6 hours lab****Transfers: CSU*****Limitation: Students must be able to hike cross-country on narrow trails and camp (tents, sleeping bags, cooking, limited showers)******Recommended Preparation: Introductory college-level biology and geology courses and Wr. 1***

This field course introduces students to interrelationships among plant/animal communities and the physical environment characteristic of selected national parks and monuments. Topics include natural history, biology and ecology of the flora and fauna, and community structure and analysis. Introductory lectures complement direct field observations and field experiments, data collection, and data analysis and interpretation. The course is taught entirely in the field. It is intended for both science majors and non-majors. A required course fee must be paid at or prior to the orientation session. R-E-3

**ENVIRONMENTAL
STUDIES****ENV 1: INTRODUCTION TO
ENVIRONMENTAL STUDIES****3 Units****3 hours lecture****Transfers: CSU, UC**

This introductory course emphasizes an interdisciplinary approach to environmental science. It includes topics in biology, chemistry, geology, economics, health, and politics. Field trips will acquaint students with the local environment and the political process. NR

**ENV 6: ENVIRONMENTAL AND
RESOURCE ECONOMICS****3 Units****3 hours lecture****Transfers: CSU, UC*****Recommended Preparation: Wr. 1 and Math 253.***

This introductory environmental and resource economics course focuses on resource, agricultural, and environmental issues and related policy analysis. The course applies microeconomic principles, models and analytical tools to problems of natural resource use and environmental quality caused by human populations. Students examine and evaluate policies to remedy the market failure of inefficient resource use, environmental degradation, and pollution, both nationally and internationally. Environmental Studies 6 is also listed as Economics 6; credit will be given in one area, not both. NR