Applied Biology 2

Course Standards/Objectives with Activities and Labs

Course Code: 3227

Course Description

Applied Biology 2 is a laboratory course that emphasizes problem solving, decision making, critical thinking, and applied learning. Applied Biology 1 and Applied Biology 2 are presented as two-year, consecutive, sequential courses that meet the state life science standards. Students explore the concepts and principles of biology and apply these concepts and principles to issues in the workplace, in society, and in personal experiences. Concepts developed in Applied Biology 2 include biological evolution, interdependence of organisms, and behavior and regulation. Investigative, hands-on lab activities that address the high school inquiry standards are an integral part of this course.

Applied Biology 2 is designed to be both academically rigorous and realistic for students pursuing technical careers and for students planning to continue their education at the technical or collegiate level. Students wishing to pursue careers in health and/or industrial fields should be encouraged to complete a two-year sequence of applied biology. Instructors are encouraged to work with occupational instructors and local businesses and industries to incorporate career and technology applications of life science.

Prerequisites: Successful completion of Applied Biology 1 and Mathematics for the Technologies 1.

Applied Biology Materials Correlated with the S.C. Science Curriculum Standards

II. Life Science

A. The Cell—*Continuity of Life; Animal Life Processes; Nutrition; Disease and Wellness; Microorganisms; Plant Growth and Reproduction*; (CORD and other resources.
B. The Molecular Basis of Heredity—*Continuity of Life; Microorganisms;*(CORD) and other resources.
C. Biological Evolution—*Continuity of Life; Disease and Wellness; Microorganisms; Natural Resources;* (CORD) and other resources.
D. Interdependence of Living Things—*Community of Life; Natural Resources; Waste and Waste Management; Plant Growth and Reproduction; Microorganisms;* (CORD) and other resources.
E. Matter, Energy, and Organization in Living Systems—*Plant Growth and Reproduction; Nutrition; Natural Resources; Waste and Waste Management;* (CORD) and other resources.
F. Behavior and Regulation—*Animal Life Processes* (CORD) and other resources.

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Science Standards

C. Biological Evolution
D. Interdependence of Organisms
F. Behavior and Regulation

Key to CORD Units in Suggested Strategies, Activities, and Labs

- Continuity of Life (CL)
- Animal Life Processes (ALP)
- Nutrition (N)
- Disease and Wellness (DW)
- Microorganisms (M)
- Plant Growth and Reproduction (PGR)
- Waste and Waste Management (W)
- Community of Life (COL)

It is recommended that the CORD units Plant Growth and Reproduction and Disease and Wellness be used to expand and enrich Applied Biology 2.

Supporting Strategies and Activities

The strategies and activities listed are provided as suggestions. Teachers are not limited to these resources, and they are encouraged to expand on these suggestions.

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Resource Materials

- CORD
  CORD Applications in Biology/Chemistry,
  CORD Communication, Waco, Texas
  1994
- CORD Supplemental Materials for each unit
  CORD Applications in Biology/Chemistry,
  CORD Communication, Waco, Texas
  1994
- CORD Videos
  CORD Applications in Biology/Chemistry,
  CORD Communication, Waco, Texas
  1994
- ITV Series, South Carolina Department of Education, Columbia, SC
- Jason Project, The Jason Foundation for Education, Needham Heights, MA, www.jasonproject.org
- Project Aquatic Wild, South Carolina Department of Wildlife, Columbia, SC
- Project Learning Tree, South Carolina Forestry Commission, Columbia, SC
- Project Wild, South Carolina Department of Natural Resources, Columbia, SC
- SC MAPS, South Carolina Department of Education, Columbia, SC
- www.AccessExcellence.com

Occupational Resources

- Activities by occupational area—CORD unit books, end of each sub-unit
- School-to-Work
- SCOIS
- Tech Prep Consortia Directors

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II. Life Science

C. Biological Evolution

1. Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources require for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, And Labs**
a. Demonstrate an understanding of the factors that affect evolution, such as the number of offspring, genetic variability, finite supply of resources, and environmental factors.	• Describe the adaptations of species to climate, soil, and other factors in various biological communities. • Describe the concept of survival of the fittest.	• Use Project Wild activities. • CORD (NR) Activity 6-4; Activity 6-5; Lab 9; Lab 10.
b. Demonstrate an understanding of the scientific evidence that establishes that change occurs over time.	• Distinguish between microevolution and macroevolution. • Compare and contrast analogous, homologous, and vestigial structures. • Describe how anatomy, embryology, and biochemistry are used to show relationships in evolutionary history.	• Simulate industrial melanism and the peppered moth. • CORD (CL) Lab 7. • Correlate events leading to bacterial resistance to antibiotics with Darwin's ideas. • Discover likenesses in amino acid sequences. • Determine homologous structures presented in a series of pictures or illustrations.

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II. Life Science

C. Biological Evolution

2. Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, and Labs**
a. Demonstrate an understanding of the process of natural selection and its consequences.	• Explain variations and how they come about. • Define the term species. • Compare and contrast natural selection and artificial selection. • Appraise the consequences of natural selection on our world (e.g., antibiotic resistant bacteria).	• Observe and describe variations in common organisms (beans, pine needles, human hands, and femurs of grasshoppers). • Correlate events leading to bacterial resistance to antibiotics with Darwin's ideas. • CORD (M) Activity 5-2; Lab 10
b. Infer how a fossil record can reveal evolutionary changes over time.	• Describe the formation of fossils. • Support evolutionary changes using the fossil record as evidence.	• Interpret fossil evidence as related to the evolution of the horse.
c. Discuss the various lines of scientific evidence that underlie our understanding of the evolution and diversification of life over time.	• Compare and contrast homologous and analogous structures in organisms. • List and explain vestigial structures. • Compare similarities and embryonic development. • Compare similarities in micromolecules.	• View videos and pictures which compare structures such as forelimbs. • Compare human skeletons with skeletons of other organisms. • View pig embryos and compare them with other types of embryos. www.pbs.org/wgbh/nova/odyseey/clips/ • Perform an amino acid sequencing lab.
d. Describe how carbon dating is utilized in the study of evolution.	• Explain two methods for dating fossils. Explain radioactive decay and half-life.	Find the age of fossils given half-life and location in rock strata.

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e. Discuss Charles Darwin's contribution to the study of evolution.	• Explain the purpose of the voyage to the Galapagos Islands and the role of the finches in Darwin's ideas. • Give the significance of Darwin's *The Origin of Species.* • Summarize Darwin's major points: overproduction, competition, variations, and natural selection. • .	• View, summarize, and discuss a video on the Galapagos Islands and Darwin's findings.

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II. Life Science

C. Biological Evolution

3. Biological classifications are based on how organisms are related.

S.C. Standard	Performance Objectives (Competencies)	Suggested Strategies, Activities, and Labs
a. Investigate the modern kingdom classification system, which is based on fossil record interpretation and similarities in structural and chemical make-up.	• Name and give examples of the kingdoms of living things. • Review the contributions of Linnaeus. • Explain why scientific names are more useful to scientists than common ones. • Explain how to write a scientific name correctly. • Describe the various types of information used to determine the classifications of organisms. • Determine the factors used to classify organisms. • Classify organisms using the modern kingdom classification system.	• Use a family tree to determine relationships among organisms. • Use a dichotomous key to identify an organism.
b. Demonstrate an understanding of how to classify organisms on the basis of structural adaptations, physiology, nutritional strategies, biochemical similarities, genetic similarities, embryological similarities, and methods of reproduction.	• Discuss some of the difficulties in establishing taxonomic relationships. • Use various relationships to classify organisms: prokaryote vs. eukaryote, other cell structures, heterotroph vs. autotroph, asexual vs. sexual reproduction, and unicellular vs. multicellular. • Explain how evolution (phylogeny) aids classification.	• Construct an original classification system.
c. Develop a working definition of "living things," and justify why many scientists group viruses in a category separate from living things.	• List and describe characteristics of living things. • Describe the general structure of viruses. • Describe viral replication (HIV, colds). • Explain how viral transmission occurs (especially HIV). • Defend the reasons why viruses are not classified in a kingdom.	• Make a model of a type of virus. • Conduct an investigation of an epidemic (disease transmission). • CORD (DW) Lab 4.

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II. Life Science

D. Interdependence of Organisms

1. The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere.

S.C. Standard	Performance Objectives (Competencies)	Suggested Strategies, Activities, and Labs
a. Demonstrate an understanding of how organisms interact with the biosphere as part of the geochemical cycles (e.g., carbon, nitrogen, phosphorous, water cycles).	• Describe and explain the C, N, P, and H_2O cycles. • Relate how organisms interact with biogeochemical cycles.	• Label and recognize the cycles. • Analyze a nature picture and determine which factors are biotic or abiotic. • CORD (PGR) Lab 2. • CORD (COL) Activity 5-2. • CORD (M) Activity 2-7.
b. Identify important nutrient cycles and evaluate how they affect ecosystems.	• Describe the importance of bacteria in the N cycle and the effects on plants. • Describe the importance of phosphorus to the growth of plants. • Identify the importance of nitrogen compounds in organisms. • Justify the importance of nutrient cycles in the ecosystem.	• Conduct an investigation involving pH. • Design an experiment to determine the effects of inappropriate amounts of minerals on plant growth. • CORD (PGR) Lab 4. • CORD (NR) Lab 8. • Interpret nutrient content of plant supplements. • CORD (PGR) Activity 4-6. • CORD (NR) Activity 5-9. • CORD (M) Lab 4.

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II. Life Science

D. Interdependence of Organisms

2. Energy glows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.

S.C. Standard	Performance Objectives (Competencies)	Suggested Strategies, Activities, and Labs
a. Demonstrate an understanding of the flow of energy, beginning with the sun, through various trophic levels.	• Relate the flow of energy to food webs and trophic levels in a community. • Distinguish between a food chain and a food web. • Describe the roles of scavengers and decomposers. • Describe the relationships of producers and consumers and levels of consumers. • Explain the flow of energy within a food chain and why energy transfer is not100%.	• Design a food web. • Construct an energy pyramid. • CORD (COL) Activity 1-1; Activity 1-2, Activity 4-11; Lab 5.
b. Assess the value of the carbon cycle to the flow of energy through the ecosystems.	• Justify the importance of photosynthesis, cellular respiration, and fossil fuels to the carbon cycle. • Describe the role that carbon plays in the flow of energy.	• Develop a concept map relating the processes of photosynthesis, cellular respiration, and the burning of fossil fuels. • CORD (NR) Activity 2-5; Lab 2.

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II. Life Science

D. Interdependence of Organisms

3. Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundred or thousands of years.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, and Labs**
a. Relate the concepts of cooperation and competition to organisms within an ecosystem.	• Analyze the predator-prey relationship. • Describe the roles of parasites. • Define symbiosis and distinguish between mutualism and commensalisms.	• Demonstrate predator-prey relationships through activities (Project Wild).
b. Evaluate how interrelationships and interdependencies of living things contribute to the homeostasis of ecosystems.	• Define homeostasis and explain its importance to the survival of a system. • Explain co-evolution and give an example. • Define the concept of a niche. • Explain how certain organisms are interdependent on one another. • Defend the idea that the interrelationships and interdependencies of living thing contribute to the homeostasis of ecosystems. •	• Construct a self-sustaining environment (Bottle Biology Ecocolumn). • CORD (COL) Lab 9. • Examine the relationship between pollinators and flowers from the standpoint of coevolution. • Debate the effects of the removal of a species from an ecosystem. • CORD (COL) Lab 1;, Lab 2;, Activity 1-3;, 1-4.
c. Demonstrate an understanding of how living things maintain their high level of order at the expense of increasing the disorder of their physical surroundings.	Discuss the effects of the physical environment of organisms' maintaining their high level order of existence.	Project Wild Activities related to population survival and its effects on the environment.

II. Life Science

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D. Interdependence of Organisms

4. Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

S.C. Standard	Performance Objectives (Competencies)	Suggested Strategies, Activities, and Labs
a. Describe and give examples of demographic characteristics of populations (e.g., birth and death rates, age structure, and sex ratio).	• Define population and give two examples. • Describe life expectancy and give factors which may affect this. • Define and explain carrying capacity. • Describe the factors that have affected the rate of human population growth throughout human history.	• Analyze changes in populations using pyramids, graphs, charts, and other methods. • CORD (COL) Activity 4-1; Activity 4-2; Activity 4-3; Activity 4-4; Activity 4-5; Activity 4-6; Lab 7.
b. Give examples and explain how limiting factors such as water, food, oxygen, and living space play a role in the stability of ecosystems.	• Explain limiting factor and give examples. • Explain how limiting factors affect a population. • Relate biotic and abiotic factors to density dependent and density independent limiting factors.	• Evaluate bacterial growth and limiting factors. • Conduct investigations from Project Wild such as “Oh Deer.”

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c. Predict how interactions among organisms, such as predation, competition, and parasitism, affect population growth.	• Describe the relationship between host and parasite and give examples. • Evaluate the role of predators in a population. • Discuss competition for resources among organisms.	• Classify the contents of owl pellets. • CORD (COL) Lab 8. • Invite guest speakers, such as a veterinarian or a public health official, to discuss host and parasite relationships.
d. Demonstrate an understanding of the characteristics, stages, and implications of succession on terrestrial ecosystems.	• Explain the role of a pioneer species. • Give the characteristics of a climax community. • Distinguish between primary and secondary succession.	• Label pictures of succession and interpret the changes. • CORD (COL) Activity 3-7.
e. Evaluate dynamic equilibrium as a result of checks and balances within populations, communities, and ecosystems.	• Explain the effects of immigration and emigration on a population. • Explain the relationship of carrying capacity to birth and death rates. • Explain the effect of climate on carrying capacity. • Distinguish between renewable and nonrenewable resources. • .	• Analyze population changes relating to climate changes, carrying capacity, and resources. • See CORD (COL) activities listed above. • Classify resources as renewable and nonrenewable. • CORD (NR) Activity 1-4; Lab 1.

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II. Life Science

D. Interdependence of Organisms

5. Humans beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, and Labs**
a. Identify events that lead to awareness of environmental concerns such as fish kills, destruction of the ozone layer, global warming, and decline of the bald eagle.	• Explain the relationship of DDT to the decline of the bald eagle. • Explain the relationship of CFCs to the destruction of the ozone layer. • Explain the relationships of pollution from industries, urban populations, and agricultural runoff to fish kills. • Relate the burning of fossil fuels to global warming and destruction of the rainforest.	• Debate the consequences of pollutants from various viewpoints (e.g., industrialists, farmers, environmentalists). • Evaluate the validity of the predictions of Rachel Carson. • CORD (NR) Activity 3-5; Activity 3-7; Activity 3-8; Activity 3-9; Activity 3-10. • CORD (NR) Lab 3. • CORD (COL) Activity 3-6. • CORD (W) Activity 2-6; Activity 2-7; Activity 2-9; Activity 3-1; Activity 3-2; Activity 3-3; Lab 3.
b. Discuss the conflicts that could occur between land developers and conservationists.	• Debate advantages of protecting natural resources, including the rainforest. • Explain the impact of erosion, deforestation, and waste management on land resources. • Identify several types of resources that land provides.	• Research the controversies of wetland protection in South Carolina. • Role play various interacting groups involved in the rainforest controversy. • CORD (NR) Activity 5-7; Activity 5-8; Activity 5-10.
c. Describe the effects of human overpopulation and activities on the survival of other species.	• Analyze the effects of human over-population on survival of species such as buffalo and whales. •	• Project Wild and Project Aquatic Wild activities. • View videos on effects of human over-population.

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d. Debate the consequences of extinction and introduction of species within ecosystems.	• Relate human activities that affect the environment to the rate at which extinction occurs. • Explain the results of species introduction into an ecosystem. • Distinguish between threatened, endangered, and extinct species, and give examples (include Carolina parakeet, red-cockaded woodpecker, and bald eagle). •	• Explain the *consequences* of species introduction, using the fire ant as an example. • Research the criteria for the designation of threatened and *endangered*, and give examples. • Research and present information on organisms that have become extinct. • CORD (NR) Activity 6-4; Activity 6-5.
e. Assess the consequences of acid rain on ecosystems.	• Explain how acid rain develops. • Review the pH scale and properties of acids and bases. • Evaluate the effects of acid rain on ecosystems. •	• Discuss the spruce trees in the Blue Ridge Mountains as an example. • Conduct a pH lab to investigate the effects of acid precipitation. • CORD (NR) Lab 9.
f. Give examples of how technology has advanced the study of environmental science.	• Relate the ability of planes and spacecrafts to photograph and use infrared to discover environmental problems. • Describe the information provided by computer simulation.	• Utilize SC MAPS activities.

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II. Life Science

F. Behavior and Regulation

1. Multicellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals and enable animals to monitor what is going on in the world around them.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, and Labs**
a. Demonstrate an understanding of how cells of multicellular animals communicate through signals conducted by a nervous system.	• Draw, label, and state functions of a neuron, including axon, dendrite, cell body, nucleus, and myalin sheath. • Explain the chemical and electrical components' role in the transmission of an electrical impulse by using an illustration of a synapse.	• Make a model of a neuron using household materials. • Role play transmissions of an electrical impulse.
b. Demonstrate an understanding of the adaptive value of the reflexes (e.g., blinking of the eye, opening/closing of the iris, responses to hot and cold).	• Draw and label a reflex arc. • Give examples of reflexes. • Discuss the value of reflexes.	• Analyze conditions that could interfere with transmission of an electrical impulse through a reflex arc. • Conduct experiments dealing with reflexes (example: catching of meter stick through fingers).

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c. Give examples of specialized cells in sense organs that detect stimuli (e.g., taste buds, touch receptors, rods and cones).	• Name and locate taste areas of mouth. • Name and locate touch receptors. • Explain function of rods and cones. • Identify structures and functions of the parts of the eye. • Determine how a human sense (sense of taste) evaluates information in one's surroundings. • Determine the relative density of touch receptors on different areas of a test subject.	• Investigate sensory receptors in the human body (touch, taste and colorblindness). • CORD (ALP) Activity 1-3; Activity 1-8; Lab 1; Lab 2. • Draw, label, and give the functions of the structures of the eye.

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III. Life Science

F. Behavior and Regulation

2. Organisms have behavioral responses to internal change and external stimuli. Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes; these responses can be either innate or learned. The broad patterns of behavior exhibited by animals have evolved to ensure reproductive success. Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change. Plants also respond to stimuli.

S.C. Standard	**Performance Objectives (Competencies)**	**Suggested Strategies, Activities, and Labs**
a. Investigate how different organisms maintain homeostasis.	• Compare how different organisms maintain homeostasis such as humans and one representative example of each kingdom.	• Create mini-posters representing homeostasis in humans and other organisms. • CORD (ALP) Activity 3-2; Activity 3-3; Lab 5. • CORD (CL) Activity 4-1; Activity 4-2; Activity 4-3; Activity 5-2.
b. Give examples of feedback mechanisms.	• Distinguish between positive and negative feedback. • Explain feedback mechanisms such as thyroid function; liver and pancreas relationship; estrogen and progesterone, interaction, and temperature regulation.	• Research human conditions (e.g., hyperthyroidism and hypothyroidism, diabetes, menopause) which involve malfunction of the feedback mechanism. • Analyze blood smear slides of normal red blood cells and abnormal blood cells (leukemia, sickle cell anemia, mononucleosis, etc.). • Summarize information from a guest speaker such as school nurse who will explain the importance of immunization and types of immunity. • CORD (ALP) Activity 6-8.
c. Identify pathogens and understand how organisms react to them.	• Define pathogen and give examples. • Explain how organisms react to pathogens,	• CORD (DW) Activity 1-5; Activity 2-4; Activity 2-5; Activity 2-6; Activity 2-8;

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	including the role of white blood cells, natural versus acquired immunity, and the human lines of defenses. • Explain how chemical substances can have positive effects (antibiotics, antidepressants, and tranquilizers). • Explain how chemical substances can have negative effects (alcohol, nicotine, and controlled substances).	Activity 2-10; Activity 2-12; Activity 2-13. • Research how chemical substances have been used historically to improve health conditions. • Analyze reactions of organisms such as Daphnia to various chemical substances. • CORD (DW) Activity 3-5. • CORD (DW) Activity 3-6; Activity 4-2; Activity 4-3; Activity 4-4; Activity 4-5; Activity 4-6; Activity 4-7; Activity 4-8; Activity 4-9; Activity 4-10; Activity 4-11; Lab 7.
d. Assess both the positive and negative effects of introducing chemical substances into the body.	• Explain that all chemicals introduced into the body can have a profound effect, especially in overdoses occur. This includes overdoses of prescribed chemicals. • Explain how alcohol, cocaine an crack cocaine, marijuana, ecstasy, oxycontin, inhalants, etc., affect the body and the short and long term effects of the abuse of these substances. • Assess the short and long-term effects of tobacco use in all forms.	• Effects of adrenaline, nicotine, or other substances on Daphnia. • NIH (National Institutes of Health) series on addition. • Guest speakers from local drug rehabilitation centers, school guidance counselor, emergency room personnel, etc. • Internet and library research put into group Power Point presentations, or video aimed at teenagers.
e. Give examples that illustrate innate behavior and learned behavior.	• Define and give examples of innate behavior. • Define and give examples of learned behavior	• After looking at videos of animal behaviors, identify behaviors that are innate and behaviors that are learned. • After looking at videos of animal behaviors, identify behaviors that are innate and behaviors that are learned.
f. Discuss tropisms in plants as responses to external stimuli.	• Define tropism. • Distinguish among geotropism, phototropism, thigmotropism, and hydrotropism.	• Draw pictures of plants exhibiting the different tropisms. • Design and perform experiments to illustrate various tropisms.

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II. Life Science

G. Behavior and Regulation

3. Like other aspects of an organism's biology, behaviors have evolved through natural selection. Behaviors often have an adaptive logic when viewed in terms of evolutionary principles.

(Standards relative to Behavior and Regulation are most appropriately addressed in Biology 2.)

II. Life Science

H. Behavior and Regulation

4. Behavioral biology has implications for humans, as it provides links to psychology, sociology, and anthropology.

(Standards relative to Behavior and Regulation are most appropriately addressed in Biology 2.)

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