AP BIOLOGY

Summit Public Schools
Summit, New Jersey

Grade Level: 10-12 / Content Area: Biology, AP level

Length of Course:
31 weeks of active teaching new material before the AP Examination
2 weeks of review before the AP Examination
4-5 weeks following the AP examination (special research projects)

Developed by Cynthia L. Vitale
Summit High School
2010
Curriculum

Course Description:
The AP Biology course is designed to be the equivalent of a two-semester college introductory biology course usually taken by science majors during their first year. The college course in biology differs significantly from the usual first high school course in biology with respect to the kind of textbook used, the range and depth of topics covered, the type of laboratory work done by students, and the time and effort required of students. The textbook used for AP Biology is used in college biology courses. The kinds of labs done by AP students are the equivalent of those done by college students. The AP Biology course aims to provide students with the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology.

Major Themes
I. Science as a Process
II. Evolution
III. Energy Transfer
IV. Continuity and Change
V. Relationship of Structure to Function
VI. Regulation
VII. Interdependence in Nature
VIII. Science, Technology, and Society

Topic Outline
Topics and percentages
I. Molecules and Cells. 25%
   A. Chemistry of Life. 7%
      Water
      Organic molecules in organisms
      Free energy changes
      Enzymes
   B. Cells. 10%
      Prokaryotic and eukaryotic cells
      Membranes
      Subcellular organization
      Cell cycle and its regulation
   C. Cellular Energetics. 8%
      Coupled reactions
      Fermentation and cellular respiration
      Photosynthesis
II. Heredity and Evolution. 25%
   A. Heredity. 8%
      Meiosis and gametogenesis
      Eukaryotic chromosomes
      Inheritance patterns
   B. Molecular Genetics. 9%
      RNA and DNA structure and function
      Gene regulation
      Mutation
      Viral structure and replication
      Nucleic acid technology and applications
   C. Evolutionary Biology. 8%
Early evolution of life
Evidence for evolution
Mechanisms of evolution

III. Organisms and Populations. 50%
   A. Diversity of Organisms. 8%
      Evolutionary patterns
      Survey of the diversity of life
      Phylogenetic classification
      Evolutionary relationships
   B. Structure and Function of Plants and Animals. 32%
      Reproduction, growth, and development
      Structural, physiological, and behavioral adaptations
      Response to the environment
   C. Ecology. 10%
      Population dynamics
      Communities and ecosystems
      Global issues

**5.1 Science Practices:** All students will understand that science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.

**Big Ideas:**

1. Understand Scientific Explanations: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.
2. Generate Scientific Evidence Through Active Investigations: Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.
3. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.
4. Participate Productively in Science: The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.

<table>
<thead>
<tr>
<th>Essential Questions</th>
<th>Enduring Understandings</th>
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<tbody>
<tr>
<td>What provocative questions will foster inquiry, understanding, and transfer of learning?</td>
<td>What will students understand about the big ideas?</td>
</tr>
<tr>
<td>1. What is science?</td>
<td>1a. Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.</td>
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<td>2. Why do we rely on science?</td>
<td>1b. Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.</td>
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<td>3. How does science ensure that knowledge is reliable?</td>
<td>1c. Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.</td>
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<td>4. How do we know that an idea has been tested properly?</td>
<td>2a. Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.</td>
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<tr>
<td>5. When is an idea accepted?</td>
<td>2b. Mathematical tools and technology are used to gather, analyze, and communicate results.</td>
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<tr>
<td>6. How do we know when an idea has been validated?</td>
<td>2c. Empirical evidence is used to construct and defend arguments.</td>
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<td>7. How does biology use the scientific method to develop understanding of life?</td>
<td>2d. Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.</td>
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<tr>
<td>8. How is inquiry used in the study of nature?</td>
<td>3a. Refinement of understandings, explanations, and models occurs as new evidence is incorporated.</td>
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<tr>
<th>Areas of Focus: Proficiencies (Cumulative Progress)</th>
<th>Examples, Outcomes, Assessments</th>
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<tr>
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<tr>
<td><strong>Indicators</strong></td>
<td><strong>Instructional Focus:</strong></td>
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<tr>
<td>Students will:</td>
<td>1. When making decisions, evaluate conclusions, weigh evidence, and recognize that all arguments may not have equal merit.</td>
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<tr>
<td>5.1.12.A.1 Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.</td>
<td>2. Assess the risks and benefits associated with alternative solutions.</td>
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<tr>
<td>5.1.12.A.2 Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories.</td>
<td>3. Engage in collaboration, peer review, and accurate reporting of findings.</td>
</tr>
<tr>
<td>5.1.12.A.3 Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence.</td>
<td>4. Select and use appropriate instrumentation to design and conduct investigations.</td>
</tr>
<tr>
<td>5.1.12.B.1 Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.</td>
<td>5. Show that experimental results can lead to new questions and further investigations.</td>
</tr>
<tr>
<td>5.1.12.B.2 Build, refine, and represent evidence-based models using mathematical, physical, and computational tools.</td>
<td>6. Understand, evaluate and practice safe procedures for conducting scientific investigations.</td>
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</tbody>
</table>

**Instructional Strategies include:**

1. **Interdisciplinary Connections**
   a. Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.
   b. Math: Use mathematical models to predict physical phenomena.
   c. Writing analysis of labs.
   d. Writing free responses.
   e. History: Examine the lives and
contributions of important scientists and engineers who effected major breakthroughs in our understanding of the natural world.

2. Technology Examples:
   a. All students will use technology, including computers, software, microscopes, and probeware.
   b. Select and apply appropriate technologies
   c. Recognize that technological problems often create a demand for new scientific knowledge, and cite present and past examples of the interrelationship and mutual influence of science, technology, and society.
   d. Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.

3. Global Perspectives
   a. Recognize the role of the scientific community in responding to changing social and political conditions and how scientific and technological achievement affect historical events.
   b. All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.

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<tr>
<th>5.1.12.B.3</th>
<th>Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories.</th>
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<tr>
<td>5.1.12.B.4</td>
<td>Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.</td>
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<tr>
<td>5.1.12.C.1</td>
<td>Reflect on and revise understandings as new evidence emerges.</td>
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<td>5.1.12.C.2</td>
<td>Use data representations and new models to revise predictions and explanations.</td>
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<td>5.1.12.C.3</td>
<td>Consider alternative theories to interpret and evaluate evidence-based arguments.</td>
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<tr>
<td>5.1.12.D.1</td>
<td>Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and</td>
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<td>Experiences.</td>
<td>5.1.12.D.2 Represent ideas using literal representations, such as graphs, tables, journals, concept maps, and diagrams.</td>
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<td>5.1.12.D.3 Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare.</td>
<td>The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.</td>
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5.3 A Life Science: Organization and Development

All students will understand that life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics. Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions.

**Big Ideas:**

1. Organization and Development: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions.
2. Matter and Energy Transformations: Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms.
3. Interdependence: All animals and most plants depend on both other organisms and their environment to meet their basic needs.
4. Heredity and Reproduction: Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction.
5. Evolution and Diversity: Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time.

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<tr>
<td>1. How is life organized from the organism to the biosphere? 2. Why is life complex? 3. Why is structure and function a major theme in biology? 4. How do matter and energy cycle through organisms and ecosystems? 5. How are all biological processes connected? 6. Why are all organisms dependent on each other? 7. How do humans impact ecosystems? 8. How is information encoded in DNA? 9. Why is evolution a common thread in biology?</td>
<td>1a. Cells are made of complex molecules that consist mostly of a few elements. Each class of molecules has its own building blocks and specific functions. 1b. Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes. 1c. Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions. 1d. Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell. 1e. Cell differentiation is regulated through the expression of different genes during the development of complex multicellular organisms. 1f. There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism. 2a. As matter cycles and energy flows through different levels of organization within living systems (cells, organs, organisms, communities), and between living systems and the physical environment, chemical elements are recombined into different products. 2b. Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.</td>
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2c. Continual input of energy from sunlight keeps matter and energy flowing through ecosystems.

2d. Plants have the capability to take energy from light to form sugar molecules containing carbon, hydrogen, and oxygen.

2e. In both plant and animal cells, sugar is a source of energy and can be used to make other carbon containing (organic) molecules.

2f. All organisms must break the high energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.

3a. Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.

3b. Stability in an ecosystem can be disrupted by natural or human interactions.

4a. Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.

4b. Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring’s success in its environment.

4c. Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.

5a. New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.

5b. Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.

5c. The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.

5d. Evolution occurs as a result of a combination of the following factors:
  • Ability of a species to reproduce
  • Genetic variability of offspring due to mutation and recombination of genes
  • Finite supply of the resources required for life
  • Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring

Areas of Focus: Proficiencies (Cumulative Progress Indicators) | Examples, Outcomes, Assessments
--- | ---
Students will: | Instructional Focus:
5.3.12.A.1 Represent and explain the relationship between the structure and function of each class of complex molecules using a | 1a. Identify and describe organisms that possess characteristics of living and nonliving things.
5.3.12.A.2 Demonstrate the properties and functions of enzymes by designing and carrying out an experiment.

5.3.12.A.3 Predict a cell's response in a given set of environmental conditions.

5.3.12.A.4 Distinguish between the processes of cellular growth (cell division) and development (differentiation).

5.3.12.A.5 Describe modern applications of the regulation of cell differentiation and analyze the benefits and risks (e.g., stem cells, sex determination).

5.3.12.A.6 Describe how a disease is the result of a malfunctioning system, organ, and cell, and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance).

5.3.12.B.1 Cite evidence that the transfer and transformation of matter and energy links organisms to one another and to their physical setting.

5.3.12.B.2 Use mathematical formulas to justify the concept of an efficient diet.

5.3.12.B.3 Predict what would happen to an ecosystem if an energy source was removed.

5.3.12.B.4 Explain how environmental factors (such as temperature, light intensity, and the amount of water available) can affect photosynthesis as an energy storing process.

5.3.12.B.5 Investigate and describe the complementary relationship (cycling of matter and flow of energy) between photosynthesis and cellular respiration.

5.3.12.B.6 Explain how the process of cellular respiration is similar to the burning of fossil fuels.

5.3.12.C.1 Analyze the interrelationships and interdependencies among different organisms, and explain how these relationships contribute to the stability of the ecosystem.

5.3.12.C.2 Model how natural and human-made changes in the environment will affect individual organisms and the dynamics of populations.

5.3.12.D.1 Explain the value and potential applications of genome projects.

5.3.12.D.2 Predict the potential impact on an organism (no impact, significant impact) given a change in a specific DNA code, and provide specific real world examples of conditions caused by mutations.

5.3.12.D.3 Demonstrate through modeling how the sorting and recombination of genes during sexual reproduction has an effect on variation in offspring (meiosis, fertilization).

5.3.12.E.1 Account for the appearance of a novel trait that arose in a given population.

5.3.12.E.2 Estimate how closely related species are, based on scientific evidence (e.g., anatomical similarities, similarities of DNA base and/or amino acid sequence).

5.3.12.E.3 Provide a scientific explanation for the history of life on Earth using scientific evidence (e.g., fossil record, DNA, protein structures, etc.).
5.3.12.E.4 Account for the evolution of a species by citing specific evidence of biological mechanisms.

2b. Describe how plants produce substances high in energy content that become the primary source of energy for animal life.
2c. Explain the importance of ATP and how it is formed.
2d. Students determine if light is necessary for the production of glucose or starch, using the leaves of plants such as the geranium or coleus.
2e. Write the balanced equation for photosynthesis.
2f. Diagram the light reaction within the membrane including all molecular compounds and processes.
2g. Diagram the dark reaction within the stroma including all molecular compounds and processes.
2h. Describe the interdependence of the light and dark reactions and state the reactants and products involved in each.
2i. Diagram a chloroplast and label where the light and dark reactions take place.
2j. Write the balanced equation for cellular respiration.
2k. Explain how energy is derived from glucose by the processes of glycolysis, the Kreb's cycle and electron transport.
2l. Quantitatively analyze the processes of cellular respiration for ATP production.
2m. Compare and contrast aerobic and anaerobic respiration.
2n. Compare and contrast lactic acid fermentation and alcoholic fermentation.
2o. Calculate the Rf values of the pigments found in leaves.
2p. Explore the connection between photosynthesis and cellular respiration using samples of elodea. Use computer lab interface devices or calculator probes to measure the pH, light intensity, and temperature of the medium).

3a. Compare and contrast the life cycles of living things as they interact with ecosystems.
3b. Evaluate importance of symbiotic relationships within an ecosystem.
3c. Evaluate the local environment for interrelationships among organisms and human impact.
3d. Understand how the interactions between organisms and the environment limit the distribution of species.
3e. Classify community interactions by whether they help, harm, or have no effect on the species involved.
3f. Describe how dominant and keystone species exert strong controls on community structure.
3g. Examine how natural and manmade disturbances affect species diversity and composition.
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<tbody>
<tr>
<td>3h.</td>
<td>Understand how pathogen life cycles cause human disease</td>
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<tr>
<td>3i.</td>
<td>Explain how human activities threaten earth’s biodiversity</td>
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<tr>
<td>4a.</td>
<td>List the contributions of various scientists to the discovery of the function and structure of DNA.</td>
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<tr>
<td>4b.</td>
<td>Describe the structure and function of DNA. Construct a model.</td>
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<td>4c.</td>
<td>Describe the molecular events and steps in semi-conservative DNA replication model</td>
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<td>4d.</td>
<td>Compare and contrast the structure and function of three types of RNA.</td>
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<td>4e.</td>
<td>Compare and contrast the structures and functions of RNA and DNA.</td>
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<tr>
<td>4f.</td>
<td>Illustrate the process of transcription and explain its purpose.</td>
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<tr>
<td>4g.</td>
<td>Illustrate the process of translation and explain its purpose.</td>
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<tr>
<td>4h.</td>
<td>Discuss the role of various enzymes in the processes of DNA replication, transcription and translation.</td>
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<tr>
<td>4i.</td>
<td>Describe the effects of mutations in the human genome on gene expression</td>
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<tr>
<td>4j.</td>
<td>Simulate the process of recombinant DNA and describe its importance</td>
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<tr>
<td>4k.</td>
<td>Analyze biological samples using gel electrophoresis technology</td>
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<tr>
<td>4l.</td>
<td>Simulate the process of DNA fingerprinting and evaluate the applications</td>
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<td>4m.</td>
<td>Analyze unknown DNA samples and compute the size of the various fragments</td>
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<tr>
<td>4n.</td>
<td>Explain the molecular significance of enzymes in the process of genetic engineering.</td>
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<tr>
<td>5a.</td>
<td>Describe the importance of Gregor Mendel’s research to the field of genetics.</td>
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<td>5b.</td>
<td>State the laws of segregation, independent assortment, and dominance.</td>
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<td>5c.</td>
<td>Mathematically determine the probability of genetic outcomes.</td>
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<td>5d.</td>
<td>Solve genetics problems using a Punnett Square, including monohybrid, dihybrid, sex-linked, ABO blood types, and codominance.</td>
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<td>5e.</td>
<td>Describe the nature and inheritance of a variety of genetic diseases.</td>
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<tr>
<td>5f.</td>
<td>Discuss relevant bioethical issues pertaining to genetics.</td>
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<tr>
<td>5g.</td>
<td>Analyze pedigrees for patterns of inheritance.</td>
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<tr>
<td>5h.</td>
<td>Analyze results of monohybrid, dihybrid and sex-linked crosses in <em>Drosophila melanogaster</em>.</td>
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<tr>
<td>5i.</td>
<td>Distinguish between relative and absolute dating.</td>
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<tr>
<td>5j.</td>
<td>Solve mathematical problems involving...</td>
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radioactive dating.
5k. Explain how fossils provide evidence of evolution.
5l. Describe how similarities in embryos, homologous structures, vestigial structures and biochemical similarities support the concept of common descent
5m. Describe the contributions of Darwin to the field of evolution.
5n. Discuss the political and social ramifications of Lamarck's and Darwin's theories of evolution.
5o. Simulate natural selection and discuss its value to the theory of evolution.
5p. Debate the theories of evolution.

Sample Assessments:
1. Chemistry pre-assessment
2. AP style tests on Units
   60% multiple choice, 40% free response
3. Performance, organization, data collecting, presentation of data, sources of error, relating to content, analysis, synthesis of key concepts to support conclusion

Instructional Strategies include:
1. Lecture accompanied with note taking
2. 12 College Board AP biology labs
3. Think, Pair, Share activities
4. Jigsaw activities
5. Collaborative activities acting out life processes
6. Creating media product based on research
7. Independent study on ecology/environmental unit
8. Additional reading to supplement content presented in class
9. Application of content through activities that include: evolution connections, scientific inquiry, thinking as a scientist, and tying together science, technology, and society
10. Interdisciplinary Connections
    a. History of people and events leading up to discovery of the cell
    b. Writing analysis of labs
    c. Writing free responses
    d. Reading science article, writing abstract (media literacy)
11. Technology Examples:
    a. Teacher created interactive website that includes syllabus, handouts, resources, etc.
    b. Student CD that includes games, practice tests, activities, etc.
12. Global Perspectives
   a. Exploring research around the world, through reading articles, and researching topics
   b. Discussions of cultural perspectives of science topics

The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.

21st Century Skills:
   Creativity and Innovation
   Critical Thinking and Problem Solving
   Communication and Collaboration
   Information Literacy
   Media Literacy
   Life and Career Skills

21st Century Themes (as applies to content area):
   Financial, Economic, Business, and Entrepreneurial Literacy
   Civic Literacy
   Health Literacy

5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.

**Big Ideas:**
1. History of Earth: From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes.
2. Properties of Earth Materials: Earth’s composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life.
4. Climate and Weather: Earth’s weather and climate systems are the result of complex interactions between land, ocean, ice, and atmosphere.
5. Biogeochemical Cycles: The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere,
atmosphere, or biosphere to another, are driven by Earth’s internal and external sources of energy, and are impacted by human activity.

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<td>1. How did the conditions of early earth result in the evolution of life?</td>
<td>1a. Explain how the evolution of life caused dramatic changes in the composition of Earth’s atmosphere, which did not originally contain oxygen gas.</td>
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<tr>
<td>2. How do natural and geologic processes impact evolution?</td>
<td>1b. Relative dating uses index fossils and stratigraphic sequences to determine the sequence of geologic events.</td>
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<tr>
<td>3. How is energy transferred from organism to organism?</td>
<td>1c. Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.</td>
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<tr>
<td>4. What is the correlation between climate and the organisms that live there?</td>
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<tr>
<td>5. How does human activity and natural phenomena affect the interdependent components of the environment?</td>
<td>2a. Soils are at the interface of the Earth systems, linking together the biosphere, geosphere, atmosphere, and hydrosphere.</td>
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<td>2b. The chemical and physical properties of the vertical structure of the atmosphere support life on Earth.</td>
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<td>3a. The Sun is the major external source of energy for Earth’s global energy budget.</td>
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<td>3b. Earth systems have internal and external sources of energy, both of which create heat.</td>
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<td>4. Climate is determined by energy transfer from the Sun at and near Earth’s surface. This energy transfer is influenced by dynamic processes, such as cloud cover and Earth’s rotation, as well as static conditions, such as proximity to mountain ranges and the ocean. Human activities, such as the burning of fossil fuels, also affect the global climate.</td>
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<td>5a. Natural and human-made chemicals circulate with water in the hydrologic cycle.</td>
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<td>5b. Natural ecosystems provide an array of basic functions that affect humans. These functions include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.</td>
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<td>5c. Movement of matter through Earth’s system is driven by Earth’s internal and external sources of energy and results in changes in the physical and chemical properties of the matter.</td>
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<td>5d. Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.</td>
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<td>5e. Human activities have changed Earth’s land, oceans, and atmosphere, as well as its populations of plant and animal species.</td>
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<td>5f. Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.</td>
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<td></td>
<td>5g. Earth is a system in which chemical elements exist in fixed amounts and move through the solid Earth, oceans, atmosphere, and living things as part of geochemical cycles.</td>
</tr>
</tbody>
</table>
**Areas of Focus: Proficiencies (Cumulative Progress Indicators)**

<table>
<thead>
<tr>
<th>Students will:</th>
<th>Instructional Focus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4.12.B.1 Trace the evolution of our atmosphere and relate the changes in rock types and life forms to the evolving atmosphere.</td>
<td>1a. Understand the structure, dynamics, and geophysical systems of the earth.</td>
</tr>
<tr>
<td>5.4.12.B.2 Correlate stratigraphic columns from various locations by using index fossils and other dating techniques.</td>
<td>1b. Investigate the impact of natural phenomena and physical processes, such as earthquakes, volcanoes, forest fires, floods, and hurricanes, on the environment of different regions of the United States and the world.</td>
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<tr>
<td>5.4.12.B.3 Account for the evolution of species by citing specific absolute dating evidence of fossil samples.</td>
<td>1c. Explain how the evolution of photosynthesis contributed oxygen to the atmosphere and enabled the diversity of life that exists today.</td>
</tr>
<tr>
<td>5.4.12.C.1 Model the interrelationships among the spheres in the Earth systems by creating a flow chart.</td>
<td>1d. Interpret the results of radioactive dating in determining the age of a fossil.</td>
</tr>
<tr>
<td>5.4.12.C.2 Analyze the vertical structure of Earth’s atmosphere, and account for the global, regional, and local variations of these characteristics and their impact on life.</td>
<td>2a. Illustrate and understand the biogeochemical cycles of the biosphere.</td>
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<tr>
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<td>2b. Evaluate the impact of natural resource use on the environment.</td>
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<tr>
<td></td>
<td>2b. Use data to analyze environmental risks and benefits associated with human activity and the use of natural resources.</td>
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<tr>
<td></td>
<td>3a. Trace all energy in organisms to the sun as the ultimate source of energy.</td>
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<td></td>
<td>3b. Investigate new theories of how and where life evolved.</td>
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<td></td>
<td>3c. Explain how energy flows through an ecosystem.</td>
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<tr>
<td></td>
<td>4a. Understand how the sun, atmosphere, and earth’s surface contribute to different climates.</td>
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<tr>
<td></td>
<td>4b. Evaluate how human activity impacts climate.</td>
</tr>
<tr>
<td></td>
<td>5a. Use scientific, economic, and other data to assess environmental risks and benefits associated with human activity.</td>
</tr>
<tr>
<td></td>
<td>5b. Apply the concept of ecosystems to understand and solve problems regarding environmental issues.</td>
</tr>
<tr>
<td></td>
<td>5c. Discuss the impact of various human activities and natural phenomena on different ecosystems.</td>
</tr>
<tr>
<td></td>
<td>5d. Apply the concepts of ecosystems to understand and propose solutions to problems regarding traditional and alternative</td>
</tr>
</tbody>
</table>
energy sources, land and soil management, waste management, and water and air quality.

Sample Assessments:
1. AP style tests on Units
   60% multiple choice, 40% free response
2. Performance, organization, data collecting, presentation of data, sources of error, relating to content, analysis, synthesis of key concepts to support conclusion

Instructional Strategies Include:
1. Independent research projects
2. Cooperative learning
3. Laboratory experiments
4. Problem-solving
5. Lecture-discussion
6. Lecture-demonstration
7. Independent practice and reading
8. Independent research
9. Interdisciplinary Connections
   a. Analyzing data on environmental issues
   b. Reading scientific articles and writing abstracts
   c. Learning the history of the universe, earth and life.
10. Technology Integration
    a. Researching problems and solutions for environmental concerns
    b. Teacher created interactive website that includes syllabus, handouts, resources, etc.
    c. Student CD that includes games, practice tests, activities, etc.
11. Global Perspectives- understanding international laws and treaties on environmental issues

5.4.12.E.1 Model and explain the physical science principles that account for the global energy budget.

5.4.12.E.2 Predict what the impact on biogeochemical systems would be if there were an increase or decrease in internal and external energy.

5.4.12.F.2 Explain how the climate in regions throughout the world is affected by seasonal weather patterns, as well as other factors, such as the addition of greenhouse gases to the atmosphere and proximity to mountain ranges and to the ocean.

5.4.12.G.1 Analyze and explain the sources and impact of a specific industry on a large body of water (e.g., Delaware or Chesapeake Bay).

5.4.12.G.2 Explain the unintended consequences of harvesting natural resources from an ecosystem.
| 5.4.12.G.3 Demonstrate, using models, how internal and external sources of energy drive the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles. |
| 5.4.12.G.4 Compare over time the impact of human activity on the cycling of matter and energy through ecosystems. |
| 5.4.12.G.5 Assess (using maps, local planning documents, and historical records) how the natural environment has changed since humans have inhabited the region. |
| 5.4.12.G.6 Assess (using scientific, economic, and other data) the potential environmental impact of large-scale adoption of emerging technologies (e.g., wind farming, harnessing geothermal energy). |
| 5.4.12.G.7 Relate information to detailed models of the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles, identifying major sources, sinks, fluxes, and residence times. |

The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.

21st Century Skills:
- Creativity and Innovation
- Critical Thinking and Problem Solving
- Communication and Collaboration
- Information Literacy
- Media Literacy
- Life and Career Skills

21st Century Themes (as applies to content area):
- Financial, Economic, Business, and Entrepreneurial Literacy
- Civic Literacy
- Health Literacy

Texts and Resources:
AP Biology 8th Edition, Campbell-Reece