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Mr. Patrick Gallagher, ACHS Science Teacher
Ms. Diane MacKay, ACHS Science Teacher
Mr. Timothy Simmons, ACHS Vice Principal
INTRODUCTION:

Perhaps as never before, the average person, by the nature of the society in which we live, is now required to possess an ever-increasing level of scientific literacy. From employers who demand an ever more knowledgeable workforce, to personal decisions regarding health and family from the beginning of life to its end, to active participation as citizens; all call for an individual who is able to understand and evaluate complex issues of a scientific nature.

To this end, it is the role of the school to provide a science education program that provides both a foundation in the wealth of scientific knowledge that has been acquired over the years, as well as developing values, habits of thought and skills that will serve the student long after his formal training has concluded. The rapid pace of new discovery and invention dictate that a student learn how to acquire, analyze and apply new information throughout his or her lifetime. Just as thirty to fifty years ago, we cannot foresee all the changes that will occur over the next thirty to fifty years. Our students must be given the skills necessary to adapt to those changes as they arise.

This collection of unit plans and assessments for biology courses taught at Abraham Clark High School is part of the effort of the Roselle school district to equip and prepare the students in our charge with the necessary biological knowledge and skills they will need as they prepare for college, work and life. As such, it has been prepared with the view to present students of various levels of ability with the opportunity to experience biology as the dynamic, vital field of endeavor that it is. Through classroom and laboratory experiences, projects and case studies, with integration of technology, the student encounters many of the more challenging topics and issues in biology. As they proceed, they are encouraged to reach their own conclusions about a host of controversial and problematic issues facing the world today. Regardless of whether they pursue a career in science or not, the goal is to provide a rich background that will serve the student well into the future.

The units that follow each deal with a particular topic pertinent to this goal, and include pre and post assessments. Unit one serves as a foundation for the rest of the course, with emphasis on scientific methodology and biochemical basis of life. Unit two places life in the context of the environment at large, and addresses many of the current threats posed by human activity. Unit three details the role of the cell in life’s numerous functions, while unit four addresses how characteristics are passed from one generation to the next. Finally unit five presents evidence to support the idea that organisms change over time, and how this concept unifies much of what we understand about life.

The truest test of this work will be in the application of it to the day-to-day instruction in the classes and laboratories of Abraham Clark High School. It is presented with confidence that it will contribute to the good of our students.

Philosophy and Rationale:

According to A Framework for K-12 Science Education Science Education must reflect the interconnected nature of science as it is practiced and experienced in the real world (2011, The National Academies Press). The Roselle school district's Science Curriculum is designed based on a vision for science education in which students, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of science and to acquire the 21st Century Skills to become highly competitive in the global economies.
Given the importance of science and engineering in the 21st century, students require a sense of contextual understanding with regard to scientific knowledge, how it is acquired and applied, and how science is connected through a series of concepts that help further our understanding of the world around us. Performance expectations thereby focus on understanding and application.

There are two key points that distinguish our district’s curriculum from other traditional curriculum: Instructional focus and coherence. The district’s science curriculum reflects instructional focus on concept development and real-life applications via integration of engineering and technology into the structure of science education. This integration is achieved by raising engineering design to the same level as scientific inquiry in classroom instruction when teaching science disciplines at all levels and by treating core ideas of engineering and technology as instructional focus.

The district’s science curriculum provide a more coherent progression. This progression focuses on overall scientific habits and minds with curricular priority on student development of concept, skills, and modeling, and application of science practices and inquiry learning skills to deepen student understanding and integration of STEAM concept. These practices and integration prevail through promoting essential questions, big ideas and/or enduring understanding through integrating Instructional Focus, 21st Century Skills, and Science Frameworks with real life situations.

Curricular Goals and Alignment:

The District’s Science Curriculum is designed to prepare students for college, career, and citizenship. Never before has our world been so complex and science knowledge so critical to making sense of it all. When comprehending current events, choosing and using technology, or making informed decisions about one’s healthcare, understanding science is the key. Science is also at the heart of our ability and mission to continue to innovate, lead, and create the jobs of the future. By focusing on hands-on learning, data collection and analysis, modeling, problem solving, and critical thinking and inquiry-based learning this curriculum will help our students become critical thinker, independent problem solver, effective communicator, and global leader in this 21st Century global economies.

Therefore, in light of this vision of excellence and global leadership, the District’s Science Curriculum is aligned with the 2009 NJ Core Curriculum Content Standards, the NGSS (Next Generation Science Standards), the Common Core State Standards (English Language Arts and Mathematics) and the PARCC Frameworks for 21st Century Learning and Skills development that reflect on Roselle’s Mission and Visions of Educational Excellence in preparing our students for College, Work, and Life.
Content

BIOLOGY PRE-TEST

Unit 1: Introduction to Biology / Biochemistry
   Unit 1 Benchmark Assessment

   Unit 2: Ecology
   Unit 2 Benchmark Assessment

Unit 3: Cell Structure and Function
   Unit 3 Benchmark Assessment

   Unit 4: Genetics
   Unit 4 Benchmark Assessment

   Unit 5: Evolution
   Unit 5 Benchmark Assessment

BIOLOGY POST-TEST
BIOLOGY PRE-TEST

Part One: Multiple Choice

1. One characteristic of all living things is that they
   A. develop organ systems
   B. produce identical offspring
   C. maintain internal stability
   D. synthesize only inorganic matter

2. A bird-watcher sees an unusual bird at a feeder. He takes careful notes on the bird's color, shape, and other physical features and then goes to a reference book to see if he can identify the species. What aspect of scientific thinking is most apparent in this situation?
   A. observation
   B. inference
   C. hypothesis formation
   D. controlled experimentation

3. Which of the following substances is needed by all living things?
   A. Oxygen
   B. Carbon Dioxide
   C. Water
   D. Sodium Chloride

4. Which characteristic of a geographic region would have the greatest impact on the type of ecosystem that forms in that region?
   A. ratio of autotrophs to heterotrophs
   B. concentration of atmospheric oxygen
   C. number of food chains
   D. climatic conditions
5. Which of the following is a possible consequence of global warming?

A. Rising sea levels
B. Loss of polar habitats
C. Changes in weather patterns worldwide
D. All of the above

6. An animal that feeds solely on plants is a(n)

A. Producer
B. Herbivore
C. Carnivore
D. Omnivore

7. Which substance can enter a cell by diffusion without having to be digested?

A. water
B. protein
C. starch
D. fat

8. During the process of photosynthesis, energy from the Sun is converted into

A. chemical energy in the bonds of inorganic molecules
B. chemical energy in the bonds of organic molecules
C. enzymes used to produce inorganic molecules
D. enzymes used to produce organic molecules

9. The process of cell division results in

A. sister chromatids
B. mitosis
C. two daughter cells
D. unregulated cell growth
10. Changing one base in a gene could have the most direct effect on the

   A. function of the membrane of the cell  
   B. sequence of building blocks of a protein found in a cell  
   C. number of mitochondria in a cell  
   D. type of carbohydrates synthesized by a cell

11. Which statement best describes the relationship between DNA, proteins and cells?

   A. DNA is produced from protein absorbed by the cell.  
   B. Protein is composed of DNA that is produced by a cell.  
   C. DNA controls the production of proteins in the cell.  
   D. Cells make DNA by digesting proteins.

12. Hereditary information is stored inside the

   A. ribosomes, which have chromosomes that contain many genes.  
   B. ribosomes, which have genes that contain many chromosomes.  
   C. nucleus, which has chromosomes that contain many genes.  
   D. nucleus, which has genes that contain many chromosomes.

13. Many scientists suggest that, billions of years ago, life on Earth began with

   A. simple, single-celled organisms  
   B. simple, multi-celled organisms  
   C. complex, single-celled organisms  
   D. complex, multi-celled organisms

14. In order for new species to develop, there must be a change in the

   A. temperature of the environment  
   B. migration patterns within a population  
   C. genetic makeup of a population  
   D. rate of succession in the environment
15. A key idea in Darwin’s theory of evolution is that members of a population

   A. are always identical
   B. compete for limited resources
   C. all get to reproduce and pass on their traits
   D. are all equally well-adapted to the environment

**Part Two: Short Constructed Response:**

1. Explain how a controlled experiment works.

2. List some of the characteristics of water that make it such a unique substance

3. How has human activity had an impact on both local and global environmental systems?

4. How would the removal of a predator affect the prey and producer populations of an ecosystem?

5. What would you expect to happen if you placed a typical cell in freshwater?

6. How do cells produce new cells?

7. Why is it more difficult to study the inheritance of traits in humans than in other species?

8. What evidence do we have that organisms have undergone change throughout the Earth’s history?

**Part Three: Open Ended Questions:**

1. How would you determine if a person was alive or dead?

2. How is matter recycled by the environment?

3. Compare and contrast photosynthesis and respiration.

4. How is genetic information passed from one generation to the next?

5. Identify the sequence of observations that make up Darwin’s theory of evolution by natural selection
PART ONE: MULTIPLE CHOICE QUESTIONS:


PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. Responses should include that a controlled experiment allows for comparison of results to determine effect of variable being tested.

2. Responses should include water's role as the universal solvent, its high specific heat, its density as ice, adhesion, cohesion, etc.

3. Responses can include deforestation, habitat destruction, global warming, ozone depletion or any other manmade environmental issue; may also cite positive effects such as protection of endangered species or conservation efforts.

4. Removing a predator may result in an increase in prey species (not being eaten), fewer producers (increase in prey leads to more producers being eaten) and an increase of other predator populations (less competition for food). Response should conclude with a new equilibrium being established eventually.

5. If you placed a typical cell in freshwater, you would expect water to flow into the cell and cause it to swell and either burst (animal cell) or stiffen (plant cell).

6. Response should include binary fission for prokaryotes and mitosis and cytokinesis for eukaryotes.

7. Response should include long time between generations, inability to control mating, and ethical problems with human experimentation.

8. Response should include fossil record, similarities and differences between species, such as homologous structures, vestigial structures, embryological and biochemical similarities.
PART THREE: OPEN-ENDED QUESTIONS:

1. Responses should include checking for a pulse, breathing, movement, etc.

2. Responses should cite the steps of the various biogeochemical cycles (water, carbon, nitrogen, phosphorus, etc.)

3. Comparison should include chemical equations for each, reactants, products and place of energy in each process.

4. In prokaryotes, genetic information is passed on by the cell replicating a single chromosome. Then the cell divides, producing two identical daughter cells. In multicellular eukaryotic organisms, specialized cells called gametes are produced, which contain half the parent’s genetic information. When fertilization occurs, a new combination of genes is passed on to the next generation.

5. All species overreproduce. Because of limited resources, not all offspring can survive. This leads to competition. As there is variation of traits within a population, some of these traits increase the likelihood of an individual’s survival. The environment determines which traits offer a survival advantage. Those individuals with certain traits are more likely to survive long enough to reproduce and pass their traits on to the next generation, as well as produce more offspring over time. The result over many generations is the development of new species.
## Unit 1: Introduction to Biology / Biochemistry

**Total Number of Days:** 10  
**Grade/Course:** College Prep Biology

### Essential Questions

1. What processes, skills, and habits of mind do scientists employ to study nature, discover new information, answer questions, and solve problems?

2. What characteristics distinguish organisms from non-living matter?

3. How do the properties of water make it essential for all living things, and how does the structure of carbon allow it to form so many biologically essential compounds?

4. Why is attention to proper procedures and safety concerns important in a laboratory setting?

### Enduring Understandings

1. Scientists make careful observations, ask questions based on their observations, form hypotheses, conduct experiments, and analyze data. They communicate their findings to other scientists for review and try to avoid bias.

2. Organisms can be distinguished from nonliving matter in that living things grow, reproduce, maintain a stable internal environment, respond to environmental stimuli, and have a limited lifespan.

3. Water’s ability to form solutions, its high specific heat, and its density at the freezing point allow chemical reactions to take place and provide stability, while carbon’s ability to bond with other carbon atoms to form chains, rings, and branches, as well as single, double, and triple bonds, permits carbon to form the basis of organic compounds that are necessary for living things (i.e., carbohydrates, lipids, proteins, and nucleic acids).

4. Attention to detail in the laboratory setting is vital to produce valid, reliable data, and prevent damage to equipment. It is also important to prevent injury to the individual performing the experiment, as well as others in the laboratory.

### Pacing, Content, Skills, Standards, Resources, Learning Activities/Assessments

<table>
<thead>
<tr>
<th>PACING</th>
<th>CONTENT</th>
<th>SKILLS</th>
<th>STAND. (CCCS/NGSS)</th>
<th>RESOURCES</th>
<th>LEARNING ACTIVITIES/ASSESSMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 days</td>
<td>1.1,2 Scientific Method</td>
<td>State the essential steps in a scientific investigation by analyzing and designing an experiment</td>
<td>5.1.12.A.2</td>
<td>Chain Reaction: <a href="http://www.teachersdomain.org/resource/nat08.living.reg.behav.lpchain/">http://www.teachersdomain.org/resource/nat08.living.reg.behav.lpchain/</a></td>
<td>UNIT PRETEST</td>
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<td></td>
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<td>CP/ADV Gecko article <a href="http://www.biologyjunction.com/Unraveling%20the%20Mystery%20of%20Geckos">http://www.biologyjunction.com/Unraveling%20the%20Mystery%20of%20Geckos</a></td>
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<tr>
<td>Laboratory Safety and Equipment</td>
<td>Metric System</td>
<td>Reporting findings</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Laboratory Safety and Equipment</strong></td>
<td>Demonstrate comprehension of safe laboratory procedures and use of laboratory equipment by following proper lab protocols.</td>
<td>5.1.12.D.3 SE p. A12-A13</td>
<td>LabWrite: <a href="http://www.ncsu.edu/labwrite/">http://www.ncsu.edu/labwrite/</a></td>
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<tr>
<td><strong>Metric System</strong></td>
<td>Make accurate measurements using metric units, converting as necessary</td>
<td>5.1.12.B.2 SE p. A10</td>
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**1 day**

| 1.3 Characteristics of Living Things | Differentiate between living and nonliving things by identifying and utilizing the characteristics and needs shared by all living things. | 5.3.4.A.1 SE p. 17-19 | Characteristics of living things concept map [http://www.biologyjunction.com/conceptmap-life.html](http://www.biologyjunction.com/conceptmap-life.html) |

**TEST – PROCESS OF SCIENCE**

- B/CP Lab equipment ID [http://www.biologyjunction.com/metric_measurement_lab.htm](http://www.biologyjunction.com/metric_measurement_lab.htm)
- Life the final frontier [http://sciencecases.lib.buffalo.edu](http://sciencecases.lib.buffalo.edu)
| Hierarchy | Sequence the levels of organization of living things from the atomic to the global level. | 5.3.12.A.6 HS-LS1-2 | /cs/collection/detail.asp?case_id=567&id=567
|---|---|---|---|
| 1 day | 2.1 Atoms and Molecules | Explain how organisms are made of matter and use energy. | 5.2.8.B.2 MS-PS1-2
| | Chemical Bonds | Explain how atoms combine to form compounds. | 5.2.12.B.1 MS-PS1-1
| | Atomic models | Construct and use atomic models to predict the behavior of atoms in interactions | 5.3.12.B.1
| | 1.5 days | Properties of Water Solutions and Suspensions | 5.3.12.B.1 SE p.40-42
| | Acids and Bases | Explain why water is considered the single most important compound in living things by listing and describing its properties and creating a molecular model to demonstrate its polar nature. | 5.2.12.A.6 SE p. 43-44
| |  | Relate pH scale to the concentrations of various acids and bases. | Properties of Water table Solution Demo
| |  | | CP pH Lab
|  |  | TEST - BASIC CHEMISTRY |
| 2 days | REVIEWS AND ASSESSMENTS | | | | Black History Poster Women’s History Poster UNIT POSTTEST |
This unit begins with the process of science. Through application of the scientific method, students will plan and carry out investigations that will produce valid data that they can then analyze and use in making decisions, skills that they will need as the course progresses. They will then compare and contrast organisms and nonliving objects to determine the characteristics common to all living things. Organisms will be placed in a continuum that ranges from atoms to the biosphere. The remainder of the unit details how nonliving matter (atoms, molecules) combine to form the structures of living things and how the properties of these materials allow living things to function. Particular emphasis is given to water and the various carbon molecules.

<table>
<thead>
<tr>
<th><strong>NJBCT FRAMEWORK/ASSESSMENT</strong></th>
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<tr>
<td><strong>5.3 Life Science:</strong> 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.</td>
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<td><strong>5.3.A. Organization and Development:</strong> 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.</td>
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**Instructional Focus:**
- Modeling (using physical or digital tools) the four major categories of organic molecules (carbohydrates, fats, proteins, and nucleic acids) using unique characteristics and primary functions
- Determining how and why each major category of organic molecule is essential to life
- Identifying the six elements most common to biological organisms: carbon, hydrogen, oxygen, nitrogen, phosphorous and sulfur

**Sample Biology EOC Assessment Item:**
Lemurs’ bodies are adapted to efficiently store energy for times when food is scarce. This adaptation may help to explain how lemur ancestors survived the trip across the Mozambique Channel from mainland Africa to Madagascar. Which of the following types of molecules are primarily used for long-term energy storage in the lemur?

A. Lipids  
B. Monosaccharides  
C. Nucleic acids  
D. Proteins

**Sample Integration of Science Practices and Core Content:**
Your friend and biology lab partner sits down next to you at lunch with only a bottle filled with a lemonade, cayenne pepper and honey mixture. She is in her fifth week of completing this liquid-cleansing diet, and she looks pale and very weak. You and your friends have tried to convince her to stop the diet, but because she is losing weight quickly, she refuses to stop. Use your knowledge of essential biomolecules to explain to your friend the type of damage she is doing to her body. Create a quick five-minute explanation of what is happening to her muscles and other body systems due to the lack of nutrients to share with her during study hall. (Correlations: 5.1.12.A.1, 5.1.12.D.2 and 5.3.12.A.1)

**Instructional Focus:**
- Analyzing and explaining how cells carry out a variety of chemical transformations that allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones
- Assessments will not include the molecular basis of enzyme function
- Recognizing that most chemical transformations are made possible by protein catalysts called enzymes
- Identifying enzymes as proteins, and determining how they catalyze biochemical reactions
- Assessments will not include the molecular basis of enzyme catalysis
- Conducting experiments to demonstrate that the activities of enzymes are affected by the temperature, ionic
Sample Biology EOC Assessment Item:
Which of the following best explains why enzymes are necessary for many cellular reactions?

A. Enzymes supply the oxygen necessary for the reactions.
B. Enzymes change reactants from solid to liquid during the reactions.
C. The reactions take up too much space in the cell if enzymes are missing.
D. The reactions are too slow to meet the needs of the cell if enzymes are missing.

Sample Integration of Science Practices and Core Content:
You are a biochemist working for a company that wishes to develop an organic laundry detergent. Conduct independent investigations to determine the optimal conditions (temperature, pH, enzyme/substrate concentration) for maximum efficiency of enzyme function. When your investigation is completed, create a consumer label identifying the chemical composition of the detergent and directions for use. (Correlations: 5.1.12.B.1, 5.1.12.B.2 and 5.3.12.A.2)

Sample Integration of Science Practices and Core Content:
You are an agricultural scientist studying the effects of global warming on crop production. While high temperatures can cause plants like rice, corn and wheat to grow faster, they can reduce plant fertility and grain production. Using existing models, predict the impact that a global temperature gain of 2°C may have on commercially important crops in the United States and worldwide. Some models suggest that average global temperatures will continue to rise, and peaks will occur during prime crop-growing seasons. The hardest-hit areas will be the tropics and subtropics, which encompass about half the world’s population and include Africa, much of India, China and South America. Select a region, and conduct independent experiments using simulated regional climate conditions to determine possible strategies to increase plant growth at higher temperature levels. Use statistical analyses to determine if your findings fit one of the existing climate change models, and if climate change will impact crop yield significantly. (Correlations: 5.1.12.A.2, 5.1.12.C.2 and 5.3.12.B.4)

5.1 Science Practices: 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.

5.1.A. 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.

Instructional Focus:
- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world
- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data
- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1.B. 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.

Instructional Focus:
Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
Using tools of data analysis to organize data and formulate hypotheses for further testing
Using existing mathematical, physical, and computational models to analyze and communicate findings
Making claims based on the available evidence
Explaining the reasoning, citing evidence, behind a proposed claim
Connecting the claim to established concepts and principles
Analyzing experimental data sets using measures of central tendency
Representing and describing mathematical relationships among variables using graphs and tables
Using mathematical tools to construct and evaluate claims

5.1.C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Instructional Focus:
- Reflecting on the status of one’s own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges
- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely
- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1.D. 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.

Instructional Focus:
- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others’ claims, evidence and reasoning
- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others’ literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations
- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.1 Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.5 Assume a leadership position in guiding the thinking of peers in a direction that leads to the successful completion of a challenging task or project.
9.1.12.D.1 Interpret spoken and written communication within the appropriate cultural context.
9.1.12.E.2 Generate digital media campaigns in support or opposing a current political, social, or economic issue.
9.1.12.F.2 Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.
9.1.12.F.6 Relate scientific advances (e.g., advances in medicine) to the creation of new ethical dilemmas.
9.4.12.O.1 Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.2 Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.3 Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.4 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

Examples:
1. **Laboratory Exercises** In each activity, students assume roles on a rotating basis, providing each student with the opportunity to serve as leader in turn. They utilize critical thinking and problem solving skills to the problem at hand, communicate data effectively, and apply language arts, mathematics, and scientific knowledge. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.C.5, 9.4.12.O.1, 9.4.12.O.2, 9.4.12.O.3, 9.4.12.O.4

2. **Product nutritional claims** in analyzing such claims, students gather pertinent data and work together to evaluate the validity of such claims, as well as the possible benefits and risks associated with use of such products. 9.1.12.A.1, 9.1.12.C.5

**MODIFICATIONS/ACCOMMODATIONS**

**Modifications:**
1. Less complex reading level
2. Shortened assignments
3. Different goals
4. IEP modifications for summative and formative assessments

**Accommodations:**
1. Preferential seating
2. Have students work in pairs
3. Assistive technologies
4. Reduced number of options on multiple choice exams
5. Larger print
6. Fewer problems on each page
7. More time
8. Test administered in a quieter setting
9. Tests read orally
10. Chunking of assignments or assessments into smaller segments
11. Taping of lectures or providing a peer note-taker

**Extensions:**
1. Alternative assignments
2. Independent studies
3. Mentoring of other students
# APPENDIX
(_teacher resource extensions_)

## Next Generation Science Standards:

**HS-LS1-2** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

**HS-LS1-3** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

**HS-LS1-6** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

**MS-PS1-1** Develop models to describe the atomic composition of simple molecules and extended structures.

**MS-PS1-2** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

**HS-PS1-2** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

## Crosscutting Concepts:

1. **Patterns.** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and effect: Mechanism and explanation.** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. **Scale, proportion, and quantity.** In considering phenomena, it is critical to realize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. **Systems and system models.** Defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. **Energy and matter: Flows, cycles and conservation.** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems possibilities and limitations.

6. **Structure and function.** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and change.** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study

## Three-Point Essays Biology

**HOW TO WRITE 3-POINT ESSAYS**

- **PARAGRAPH 1 - INTRODUCTION** - Tells what the paper is about and what three points will be discussed

- **PARAGRAPH 2 - POINT 1** - States and explains the first point explained in the article and gives supporting evidence

- **PARAGRAPH 3 - POINT 2** - States and explains the second point explained in the article and gives supporting evidence

- **PARAGRAPH 4 - POINT 3** - States and explains the third point explained in the article and gives supporting evidence

- **PARAGRAPH 5 - CONCLUSION** - Restates the subject and summarizes the main points

**HOW TO SET UP YOUR PAPER**

- **Upper RIGHT-HAND CORNER --- Write your NAME and PERIOD**

- **TOP LINE --- Write the TITLE of the ARTICLE**
Write the OUTLINE of your paper:
I. Introduction
II. (Write your 1st point)
III. (Write your 2nd point)
IV. (Write your 3rd point)
V. Conclusion

Additional Website Resources:

National Science Teachers Association (NSTA)  www.nsta.org
National Association of Biology Teachers (NABT)  www.nabt.org
NASA (astrobiology)  www.nasa.gov
Biology Corner (biology resources for teachers)  www.biologycorner.com
Biology Junction (biology resources for teachers)  www.biologyjunction.com
NClark (Science resources for teachers)  www.nclark.net/Biology
New York Biology Regents  www.nysedregents.org/livingenvironment
Miller and Levine (textbook authors’ site)  www.millerandlevine.com
Pearson (textbook publisher)  www.biology.com
Baylor College of Medicine (biochemistry resources)  www.bioedonline.org
Biochemistry  www.biology.arizona.edu

Notes to teacher (not to be included in your final draft):

4 Cs
Creativity: projects
Critical Thinking: Journal

Three Part Objective
Behavior
Condition
Collaboration: Teams/Groups/Stations  
Demonstration of Learning (DOL)  
Communication – Powerpoints/Presentations
UNIT BENCHMARK ASSESSMENT
UNIT ONE - INTRODUCTION/BIOCHEMISTRY

PART ONE: MULTIPLE CHOICE QUESTIONS:

1. One characteristic of all living things is that they
   A. develop organ systems
   B. produce identical offspring
   C. maintain internal stability
   D. synthesize only inorganic matter

2. The presence of four electrons in the outermost energy level of a carbon atom enables
   A. carbon to form four covalent bonds with atoms of other elements
   B. carbon to form covalent bonds with other carbon atoms
   C. carbon to form double bonds
   D. all of the above

3. In describing lipids, which of the following statements is true?
   A. Saturated fats are healthier because they have less hydrogen
   B. Polyunsaturated fats are the least healthy
   C. Saturated fats have the most double bonds
   D. Polyunsaturated fats are healthier because they have more double bonds

4. An enzyme speeds up a reaction by
   A. lowering the activation energy
   B. raising the activation energy
   C. releasing energy
   D. absorbing energy

5. The function of a nucleic acid is related to
   A. energy release
   B. enzyme formation
   C. transmission of genetic information
6. A bird-watcher sees an unusual bird at a feeder. He takes careful notes on the bird’s color, shape, and other physical features and then goes to a reference book to see if he can identify the species. What aspect of scientific thinking is most apparent in this situation?

A. observation  
B. inference  
C. hypothesis formation  
D. controlled experimentation

7. A biologist collected data shown in the table below

<table>
<thead>
<tr>
<th>Type of organism</th>
<th>Number of Organisms in a Field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>May</td>
</tr>
<tr>
<td>Grasshoppers</td>
<td>100</td>
</tr>
<tr>
<td>Birds</td>
<td>25</td>
</tr>
<tr>
<td>Spiders</td>
<td>75</td>
</tr>
</tbody>
</table>

Which statement is supported by the data in the table?

A. populations do not vary from month to month  
B. the populations are highest in September  
C. the grasshoppers increased in length in July  
D. seasonal variations may affect populations

8. A chicken bone was placed in a graduated cylinder containing 100 milliliters of water. The diagram to the right illustrates to the new level of water. What is the volume of the chicken bone?

A. 41 ml  
B. 141 ml  
C. 42 ml  
D. 142 ml
9. Lemurs’ bodies are adapted to efficiently store energy for times when food is scarce. This adaptation may help explain how lemur ancestors survived the trip across the Mozambique Channel from mainland Africa to Madagascar. Which of the following types of molecules are primarily used for long-term energy storage in the lemur?

A. Lipids  
B. Monosaccharides  
C. Nucleic acids  
D. Protein

10. Which of the following substances is needed by all living things?

A. Oxygen  
B. Carbon Dioxide  
C. Water  
D. Sodium Chloride

11. A solution has a pH of 7. This makes it

A. a strong acid  
B. a strong base  
C. a weak acid  
D. neutral

12. In the event of an accident in the laboratory, what is the first thing you should do?

A. Notify the teacher  
B. Try to clean up the mess yourself  
C. Run out of the room  
D. Start the experiment over

13. Which of the following characteristics of living things is not necessary for the survival of the individual organism?

A. Metabolism  
B. Growth, maintenance and repair  
C. Respond to stimuli  
D. Reproduction
14. Cells make up tissues, and tissues make up
   A. Systems
   B. Organs
   C. Organisms
   D. Ecosystems

15. Which of the following can be used to represent experimental data?
   A. Graphs
   B. Tables
   C. Pictures
   D. All of the above
PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. List some of the characteristics of water that make it such a unique substance.

2. Explain how a controlled experiment works.

3. Compare and contrast the four types of organic compounds in terms of their structures and functions.

4. Why is it important to follow proper laboratory procedures?

5. What characteristics distinguish living things from nonliving things?

PART THREE: OPEN-ENDED QUESTIONS:

1. An experiment was carried out to determine how competition for living space affects plant height. Different numbers of plants were grown in three pots A, B, and C. All three pots were the same size. The data collected is shown in the table below:

<table>
<thead>
<tr>
<th>Average daily Plant Height (mm)</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot A - 5 plants</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Pot B - 10 plants</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Pot C - 20 plants</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Analyze the experiment that produced the data shown in the table. In your answer be sure to:
- State a hypothesis for the experiment
- Identify one factor, other than pot size, that should have been kept the same in each experimental group
- Identify the dependent variable
- State whether the data supports or fails to support your hypothesis and justify your answer

2. How does the atomic structure of carbon allow it to form many different molecules?

3. How would you determine if a person was alive or dead?

4. How do atoms combine to form the substances of life?

5. How do enzymes interact only with specific substrates?
PART ONE: MULTIPLE CHOICE QUESTIONS:


PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. Responses should include water’s role as the universal solvent, its high specific heat, its density as ice, adhesion, cohesion, etc.

2. Responses should include that a controlled experiment allows for comparison of results to determine effect of variable being tested.

3. Responses should include:
   - Carbohydrates – energy source
   - Lipids – long term energy storage
   - Proteins – structural materials and enzymes
   - Nucleic acids – genetic information

4. Responses should include safety of self and others, prevent damage to equipment, and validity of results and conclusions.

5. Responses should include cells, needs for energy and water, growth, maintenance and repair; response to stimuli, metabolism, homeostasis, reproduction and limited lifespan.

PART THREE: OPEN-ENDED QUESTIONS:

1. Responses should include a valid hypothesis related to scenario presented, a factor to be changed, identification of plant size as the dependent variable and a conclusion that speaks to the hypothesis.

2. Responses should include carbon’s four outermost electrons allow it to form molecules with chains, rings, and branches both with other carbon atoms and atoms of other elements.
3. Responses should include checking for a pulse, breathing, movement, etc.

4. Responses should include covalent and ionic bonds, sharing and transferring electrons; may also include solutions and other mixtures.

5. Responses should include a description of the lock and key model of enzyme function.
## Unit 2: Ecology

**Total Number of Days:** 15  **Grade/Course:** College Prep Biology

### ESSENTIAL QUESTIONS

1. How do organisms affect other organisms and/or their environment, and how do they affect them in turn?

2. How has human activity had, and continues to have, an impact on both local and global environmental systems?

3. How do the various feeding relationships within an ecosystem determine what organisms, and in how great a number, can survive in the ecosystem?

### ENDURING UNDERSTANDINGS

1. The survival of organisms is affected by interactions with each other and the environment, and can be altered by human manipulation.

2. The meeting of human needs and wants has led to environmental impacts such as habitat destruction, climate change and the introduction of toxins to the environment.

3. Feeding relationships between organisms creates an interdependence between populations as organisms attempt to obtain (or avoid becoming) food places limits on population size in an ecosystem.

### PACING | CONTENT | SKILLS | STAND. (CCCS/NGSS) | RESOURCES | LEARNING ACTIVITIES/ASSESSMENTS
--- | --- | --- | --- | --- | ---
1 day | 3.1 Ecology Levels of Organization | Describe how organisms are affected by their environment, and affect the environment in turn. | 5.3.12.C.1 | SE p. 64-65 | Exploring Environmental Change: [http://www.teachersdomain.org/resource/echo07/sci.life.coast.html](http://www.teachersdomain.org/resource/echo07/sci.life.coast.html)
| Abiotic v. Biotic Factors | Compare and contrast living and nonliving parts of the environment | 5.3.6.C.2 | SE p. 66-67 | |

.5 days | Ecological Methods | Identify various methods used to study the environment | 5.1.12.A.1 | SE p. 68 | Random Sampling Capture/Recapture Method

**UNIT PRETEST**

*Brainstorm definition of ecology*

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Content</th>
<th>Standard Code</th>
<th>Page</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day</td>
<td>3.2</td>
<td>Producers, Consumers, Decomposers</td>
<td>5.3.8.C.1</td>
<td>SE p. 69-72</td>
<td><em>Food Web lab</em></td>
</tr>
<tr>
<td>1.5 days</td>
<td>3.3</td>
<td>Energy Flow in Ecosystems, Trophic Levels</td>
<td>5.3.12.B.1</td>
<td></td>
<td></td>
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<tr>
<td>1 day</td>
<td>3.4</td>
<td>Water Cycle, Carbon Cycle, Nitrogen Cycle, Phosphorus Cycle, Nutrient Limitation</td>
<td>5.3.12.B.2</td>
<td>MS-LS2-3</td>
<td><em>B/CP Biogeochemical cycle posters</em></td>
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<td></td>
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<td>Demonstrate, using models, how internal and external sources of energy drive the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles.</td>
<td></td>
<td>HS-LS2-5</td>
<td><em>TEST - BIOSPHERE</em></td>
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<td>MS-ESS2-4</td>
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<td>HS-ESS2-6</td>
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<td></td>
<td>HS-ETS1-1</td>
<td></td>
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<tr>
<td>.5 days</td>
<td>4.1</td>
<td>Climate, Greenhouse Effect, Global Warming</td>
<td>5.3.12.C.2</td>
<td>MS-ESS3-5</td>
<td><em>Global Climate Change - Understanding the Greenhouse Effect:</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model how natural and man-made changes in the environment will affect individual organisms and the dynamics of populations</td>
<td></td>
<td>HS-ESS3-5</td>
<td><a href="http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/pages/ModelEcosystems.html">http://www.mhhe.com/biosci/genbio/virtual_labs_2K8/pages/ModelEcosystems.html</a></td>
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<td>Standard</td>
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<tr>
<td>1 day</td>
<td>4.2</td>
<td>Niche</td>
<td>Define the concept of an organism’s niche, and explain how the environment and the presence of other organisms affect it.</td>
<td>5.3.8.C.1</td>
<td>SE p. 99-104</td>
</tr>
<tr>
<td>.5 days</td>
<td>4.3</td>
<td>Succession</td>
<td>Describe how organisms change their environment over time.</td>
<td>5.3.6.C.3</td>
<td>SE p. 106-109</td>
</tr>
<tr>
<td>1 day</td>
<td>4.5</td>
<td>Aquatic Ecosystems</td>
<td>Identify each type of aquatic ecosystem and define each in terms of depth and salinity.</td>
<td>5.3.12.C.1 MS-LS2-2 MS-ESS2-4</td>
<td>SE p. 117-121</td>
</tr>
<tr>
<td>Day(s)</td>
<td>Section</td>
<td>Topic</td>
<td>Activity/Description</td>
<td>Standards</td>
<td>Resources</td>
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<tr>
<td>.5 days</td>
<td>5.3</td>
<td>Human Population Growth</td>
<td>Compare, over time, the impact of human population growth on the environment.</td>
<td>5.3.6.C.1 MS-ESS3-3 MS-ESS3-4 HS-ETS1-3 SE p. 136, 142-145</td>
<td>Deer Population Growth Cycle of Yeast LMA p. 35-38</td>
</tr>
<tr>
<td>.5 days</td>
<td>6.1</td>
<td>Effect of Human Activity Sustainable</td>
<td>Identify ways in which resources can be conserved and human impact on the environment can be reduced</td>
<td>5.3.12.C.2 HS-LS2-7 MS-ESS3-4 SE p. 154-165</td>
<td>Deforestation in Bolivia: <a href="http://www.">http://www.</a></td>
</tr>
<tr>
<td>.5 days</td>
<td>6.3 Biodiversity</td>
<td>Define biodiversity and explain why it is critical to ecosystem stability.</td>
<td>5.3.12.C.1 MS-LS2-5 HS-LS2-2 HS-LS2-6 SE p. 166-179</td>
<td>Predator/Prey graph activity</td>
<td></td>
</tr>
<tr>
<td>2 days</td>
<td>REVIEWS AND ASSESSMENTS</td>
<td></td>
<td></td>
<td>UNIT POSTTEST</td>
<td></td>
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</tbody>
</table>

**INSTRUCTIONAL FOCUS OF UNIT**

This unit describes how organisms interact with their environment. Students will investigate the relationships that exist between organisms and the nonliving components of their surroundings, as well as organisms of both the same species and different species. Students will trace the flow of matter and energy as they pass through various ecosystems. They will consider how change in one part of an ecosystem can have considerable and often unforeseen impacts on other components of the system. Of considerable concern is the role of human activity on ecosystems, both on the local and global scales.

**NJBCT FRAMEWORK/ASSESSMENT**

**5.3 Life Science:** 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.

**5.3.B 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.

**Instructional Focus:**
- Tracing the cycling of atoms and molecules on Earth among the living and nonliving components of the biosphere
- Explaining how molecules are used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats)
- Assessments will not include the representations of specific detailed steps of synthesis and decomposition (intermediate steps and molecules, details of dehydration synthesis)
- Following the transfer of matter (molecules) from one organism to another repeatedly and between organisms and their physical environment
- Identifying how the total amount of matter in a system remains constant, even though its form and location change

**Sample Biology EOC Assessment Item:** The figure below represents the flow of food energy through a system.

```
GRAIN ➔ CHICKENS ➔ WOLVES
```

In an experiment, chickens were fed grain that contained a chemical marker in its proteins. The presence of the marker can be detected in organisms. Which of the following is the most reasonable prediction from this experiment?

A. The marker will only be found in the grain.
B. Both chickens and wolves will have the marker.
C. Wolves will have the marker, but chickens will not.
D. The marker will only be found in the animals' wastes.

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**Sample Integration of Science Practices and Core Content:**
You are a zookeeper at a nationally recognized zoo. You care for the largest mixed-species exhibit at the zoo, which features a wide variety of organisms from the Amazonian rainforest. When cleaning the exhibit, you have noticed that the soil contains far fewer worms and termites than earlier in the year. Express your concern for the lack of “soil engineers” in terms of the energy flow and matter cycling in the exhibit. Prepare a memo to the zoo director highlighting your concerns in order to request emergency funds, explaining why all of the species living in the exhibit are at risk. To bolster your argument, use evidence and data from appropriate peer-reviewed journal articles. (Correlations: 5.1.12.A.2, 5.1.12.B.4 and 5.3.12.B.1)

**Instructional Focus:**
- Explaining how food webs are limited and how pyramidal relationships exist
- Recognizing that all matter tends toward more disorganized states, and that living systems require a continuous input of energy to maintain their chemical and physical organizations
- Recognizing that the chemical bonds of food molecules contain energy, which is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed
- Assessments will not include the representations of specific detailed steps of synthesis and decomposition (intermediate steps and molecules, details of dehydration synthesis)
- Calculating the trends in production, use and transfer of energy from one trophic level to another using data

**Sample Integration of Science Practices and Core Content:**
Your friend is a vegan who excludes the use of animal products for any lifestyle purpose. When discussing his vegan diet, you tell him that it is not healthy because it does not allow for a balanced diet. He claims that it is a much more energy-efficient diet and has less of an impact on the ecosystem. Use scientific evidence to either support or debunk that claim. (Correlations: 5.1.12.B.2, 5.1.12.B.4 and 5.3.12.B.2)
Instructional Focus:
- Tracing the path that energy entering ecosystems as sunlight follows when being transferred by producers into chemical energy through photosynthesis, and then being passed from organism to organism through food webs
- Assessments will not include the representations of specific detailed steps of photosynthesis and respiration (intermediate steps and products of the Calvin cycle, Krebs/citric acid cycle, and glycolysis)
- Recognizing that living systems require a continuous input of energy to maintain their chemical and physical organizations and also understanding that with death (the cessation of energy input), living systems rapidly disintegrate.

Sample Biology EOC Assessment Item:
Which of the following would most likely happen if grasses and shrubs were removed from a rural New Jersey ecosystem?
A. There would be an increase in consumers in the ecosystem.
B. There would be an increase of photosynthesis in the ecosystem.
C. There would be a decrease in food energy produced by the ecosystem.
D. There would be a decrease of carbon dioxide available to the ecosystem.

Sample Integration of Science Practices and Core Content:
You are a conservation biologist interested in studying the impact of tourism on the coral reef ecosystems. You are concerned primarily with importance of symbioses to energy flow in reefs. Write a research proposal to the International Union for the Conservation of Nature to request funds to study a reef of your choice. In the proposal, explain why the reef is essential to its marine ecosystem from an energy perspective. Evaluate and critically select data and evidence from published journal studies to support your proposal. (Correlations: 5.1.12.A.3, 5.1.12.B.3 and 5.3.12.B.3)

Sample Integration of Science Practices and Core Content:
You are an agricultural scientist studying the effects of global warming on crop production. While high temperatures can cause plants like rice, corn and wheat to grow faster, they can reduce plant fertility and grain production. Using existing models, predict the impact that a global temperature gain of 2°C may have on commercially important crops in the United States and worldwide. Some models suggest that average global temperatures will continue to rise, and peaks will occur during prime crop-growing seasons. The hardest-hit areas will be the tropics and subtropics, which encompass about half the world's population and include Africa, much of India, China and South America. Select a region, and conduct independent experiments using simulated regional climate conditions to determine possible strategies to increase plant growth at higher temperature levels. Use statistical analyses to determine if your findings fit one of the existing climate change models, and if climate change will impact crop yield significantly. (Correlations: 5.1.12.A.2, 5.1.12.C.2 and 5.3.12.B.4)

Sample Integration of Science Practices and Core Content:
You work for an eco-friendly toy company interested in designing and marketing a desktop-sized self-contained ecosystem. You are asked to include active microorganisms, red shrimp and green algae, and filtered seawater. The living organisms within the sealed ecosystem must utilize their resources without overpopulating or contaminating the environment. Research the system, then conduct a series of experiments to determine the appropriate ratios and types of plants, animals and amount of external light for this delicate balance to occur. (Correlations: 5.1.12.B.1, 5.1.12.C.2, 5.1.12.D.3 and 5.3.12.B.5)

Sample Integration of Science Practices and Core Content:
In your biology class yesterday, there was a discussion about climate change. You learned that human activities are changing the composition of Earth's atmosphere, and that levels of greenhouse gases like carbon dioxide (CO₂) have been increasing since pre-industrial times. Your teacher stated that the atmospheric buildup of CO₂ and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels. One student in your class disagreed. He said that the increase in human populations worldwide is causing the higher level of CO₂. His argument is that as people exhale, they release CO₂ from cellular respiration; more people, more CO₂. Your class erupted in discussion, and your teacher has asked that you choose a side and research the argument. Working in small groups, create short documentary (3-5 minutes) about how respiration and fossil fuel burning are similar processes. Use data and evidence from peer-reviewed sources to make a claim regarding whether or not one (or both) of these processes can be the root cause of climate change. (Correlations: 5.1.12.C.1, 5.1.12.D.2 and 5.3.12.B.6)

5.3.C. Interdependence: All animals and most plants depend on both other organisms and their environment to meet
their basic needs.

Instructional Focus:

- Analyzing the interactions between organisms that result from the ability to produce populations of infinite size in an environment where resources are finite
- Providing evidence of how organisms both cooperate and compete in ecosystems
- Using evidence to explain why interrelationships and interdependencies of organisms may generate stable ecosystems

Sample Integration of Science Practices and Core Content:
You are a conservation biologist for the U.S. Fish and Wildlife Service and you have been assigned to launch a plan to protect a single species in a threatened habitat in the United States (wetland, forest, prairie, kelp forest, etc.) with high biodiversity. Conduct research to determine which individual species provides the most essential ecosystem services to the ecosystem; with their removal, the ecosystem might collapse. Construct your species survival plan based on your research, and create a presentation to share your point of view. (Correlations: 5.1.12.A.2, 5.1.12.B.4 and 5.3.12 C.1)

Instructional Focus:

- Identifying situations where humans intentionally and unintentionally modify ecosystems as a result of population growth, technology, and consumption
- Providing evidence of how human destruction of habitats threatens current local and global ecosystem stability
- Predicting how direct harvesting, pollution, atmospheric changes, and other factors will affect population dynamics in a given ecosystem based on data and accepted mathematical models
- Predicting how natural disasters such as hurricanes, floods, volcanoes will affect population dynamics in a given ecosystem based on data and accepted mathematical models

Sample Integration of Science Practices and Core Content:
You are a wetland ecologist who is working to preserve the wetlands of the Mississippi Delta. In order to understand how to proceed with conservation efforts, you must study the human-induced changes to the delta from the past 100 years. Create an interactive digital timeline that illustrates how humans have altered the ecosystem, specifically describing the impact on the physical terrain and, ultimately, living systems. (Correlations: 5.1.12.B.2, 5.1.12.C.2 and 5.3.12.C.2)

5.1 Science Practices: 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.

5.1.A. 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.

Instructional Focus:

- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world
- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data
- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1.B. 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.
**Instructional Focus:**
- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings
- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles
- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

5.1.C. **Reflect on Scientific Knowledge:** *Scientific knowledge builds on itself over time.*

**Instructional Focus:**
- Reflecting on the status of one’s own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges
- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely
- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1.D. **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.*

**Instructional Focus:**
- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others’ claims, evidence and reasoning
- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others’ literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations
- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically
21ST CENTURY SKILLS
(4Cs & CTE Standards)

9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.1 Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.5 Assume a leadership position in guiding the thinking of peers in a direction that leads to the successful completion of a challenging task or project.
9.1.12.D.1 Interpret spoken and written communication within the appropriate cultural context.
9.1.12.E.2 Generate digital media campaigns in support or opposing a current political, social, or economic issue.
9.1.12.F.2 Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.
9.1.12.F.6 Relate scientific advances (e.g., advances in medicine) to the creation of new ethical dilemmas.
9.4.12.O.1 Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.2 Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.3 Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
9.4.12.O.4 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

Examples:
1. Environmental Issues In investigating various environmental issues, students determine the causes and effects of each issue, as well as their own ability to have an impact in the problem through personal action and public advocacy. Each student prepares a presentation on their issue, and tries to persuade others of the validity of their conclusions. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.E.2

2. Biome Brochure Project in researching the various types of biomes, students identify the climatic conditions, native species and the importance of each ecosystem to mankind, as well as the threats posed to each by human activity. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.E.2

3. Deer Population Changes By investigating historical data relative to changes in the deer population of the Kaibab Plateau, students critically consider the unintended consequences of human actions on the deer population over time, and consider other possible cases of similar results. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.E.2

MODIFICATIONS/ACCOMMODATIONS

Modifications:
5. Less complex reading level
6. Shortened assignments
7. Different goals
8. IEP modifications for summative and formative assessments

Accommodations:
12. Preferential seating
13. Assistive technologies
14. Reduced number of options on multiple choice exams
15. Larger print
16. Fewer problems on each page
17. More time
| 18. Test administered in a quieter setting |
| 19. Tests read orally |
| 20. Chunking of assignments or assessments into smaller segments |
| 21. Taping of lectures or providing a peer note-taker |

**Extensions:**

- 4. Alternative assignments
- 5. Independent studies
- 6. Mentoring of other students

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**APPENDIX**

*(Teacher resource extensions)*

**Next Generation Science Standards:**

**MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

**MS-LS2-2** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

**MS-LS2-3** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

**MS-LS2-4** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

**MS-LS2-5** Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

**HS-LS2-1** Use mathematical and/or representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

**HS-LS2-2** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

**HS-LS2-3** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

**HS-LS2-4** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

**HS-LS2-5** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere.

**HS-LS2-6** Evaluate the claims, evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

**HS-LS2-7** Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

**MS-ESS2-4** Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.

**MS-ESS3-3** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

**MS-ESS3-4** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems.

**MS-ESS3-5** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

**HS-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

**HS-ESS3-5** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth’s systems.

**HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

**HS-ETS1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

**Crosscutting Concepts:**

1. **Patterns.** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and effect: Mechanism and explanation.** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and
explain events in new contexts.

3. Scale, proportion, and quantity. In considering phenomena, it is critical to realize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. Systems and system models. Defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. Energy and matter: Flows, cycles and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems possibilities and limitations.

6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

**Three-Point Essays Biology**

**HOW TO WRITE 3-POINT ESSAYS**

- PARAGRAPH 1 - **INTRODUCTION** - Tells what the paper is about and what three points will be discussed

- PARAGRAPH 2 - **POINT 1** - States and explains the first point explained in the article and gives supporting evidence

- PARAGRAPH 3 - **POINT 2** - States and explains the second point explained in the article and gives supporting evidence

- PARAGRAPH 4 - **POINT 3** - States and explains the third point explained in the article and gives supporting evidence

- PARAGRAPH 5 - **CONCLUSION** - Restates the subject and summarizes the main points

**HOW TO SET UP YOUR PAPER**

- Upper RIGHT-HAND CORNER --- Write your NAME and PERIOD
- TOP LINE --- Write the TITLE of the ARTICLE
- SKIP ONE LINE
- Write the OUTLINE of your paper:
  I. Introduction
  II. (Write your 1st point)
  III. (Write your 2nd point)
  IV. (Write your 3rd point)
  V. Conclusion
- SKIP ONE LINE and BEGIN WRITING YOUR PAPER

**Additional Website Resources:**

National Science Teachers Association (NSTA)  [www.nsta.org](http://www.nsta.org)

National Association of Biology Teachers (NABT) [www.nabt.org](http://www.nabt.org)

NASA (astrobiology) [www.nasa.gov](http://www.nasa.gov)
Biology Corner (biology resources for teachers) www.biologycorner.com

Biology Junction (biology resources for teachers) www.biologyjunction.com

NClerk (Science resources for teachers) www.nclerk.net/Biology

New York Biology Regents www.nysedregents.org/livingenvironment

Miller and Levine (textbook authors’ site) www.millerandlevine.com

Pearson (textbook publisher) www.biology.com

Environmental Protection Agency (EPA) www.epa.gov

Aurum Science (Environmental site) www.aurumscience.com/env_science.htm

Notes to teacher (not to be included in your final draft):

**4 Cs**

Creativity: projects
Critical Thinking: Journal
Collaboration: Teams/Groups/Stations
Communication – Powerpoints/Presentations

**Three Part Objective**

Behavior
Condition
Demonstration of Learning (DOL)
PART ONE: MULTIPLE CHOICE QUESTIONS:

1. The diagram below represents interactions between organisms in a stable ecosystem.

Which statement correctly describes organisms in this ecosystem?

A. Organisms in level B obtain their energy directly from the sun.
B. Organisms in level C obtain their nutrients directly from organisms in level D.
C. Organisms in level A are herbivores.
D. Organisms in level D are heterotrophs

2. Due to overfishing, the number of fish in the ocean could drastically decrease. This will cause

A. an increase in the stability of the oceans
B. an increase in the salt content of the ocean
C. a decrease in the stability of the ocean
D. a decrease in the amount of oxygen available in the ocean

3. Which characteristic of a geographic region would have the greatest impact on the type of ecosystem that forms in that region?

A. ratio of autotrophs to heterotrophs
B. concentration of atmospheric oxygen
C. number of food chains
D. climatic conditions
4. Which statement best describes bat populations in a stable ecosystem?

   A. they are held in check by environmental factors
   B. they are producers that rely indirectly on other producers
   C. they are not limited by natural predators
   D. they are not dependent on other species

5. When two different bird species temporarily occupy the same niche, they would most likely

   A. change their nesting behaviors
   B. not affect one another
   C. interbreed to form a new species
   D. compete with one another

6. In which row in the chart below is a human action correctly paired with its environmental impact?

<table>
<thead>
<tr>
<th>Row</th>
<th>Human Action</th>
<th>Environmental Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Deforestation</td>
<td>Increased biodiversity</td>
</tr>
<tr>
<td>B</td>
<td>Population growth</td>
<td>Increased number of species</td>
</tr>
<tr>
<td>C</td>
<td>Industrialization</td>
<td>Increased global temperature</td>
</tr>
<tr>
<td>D</td>
<td>Overharvesting</td>
<td>Increased mineral resources</td>
</tr>
</tbody>
</table>

7. How do decomposers benefit an ecosystem?

   A. By returning nutrients to the soil
   B. By manufacturing energy from sunlight
   C. By removing excess nutrients from the soil
   D. By removing predators from the ecosystem

8. If a population grows larger than the carrying capacity, the

   A. death rate may rise
   B. death rate may fall
   C. birth rate may rise
   D. birth rate may fall
9. Which of the following best describes human population growth?

A. the growth rate has remained constant over time  
B. growth continues to increase at the same rate  
C. growth has been exponential in the last few hundred years  
D. birthrate equals death rate

10. Which of the following most likely happen if grasses and shrubs were removed from a rural New Jersey ecosystem?

A. There would be an increase in consumers in the ecosystem  
B. There would be an increase of photosynthesis in the ecosystem  
C. There would be a decrease in food energy produced by the ecosystem  
D. There would be a decrease of carbon dioxide available to the ecosystem

11. Which of the following is a possible consequence of global warming?

A. Rising sea levels  
B. Loss of polar habitats  
C. Changes in weather patterns worldwide  
D. All of the above

12. Which of the following is not a type of symbiotic relationship?

A. Parasitism  
B. Commensalism  
C. Mutualism  
D. Uniformitarianism

13. Which of the following factors defines a terrestrial biome?

A. Average temperature  
B. Yearly precipitation  
C. Native organisms  
D. All of the above
14. Which of the following ecosystems has the highest level of biodiversity?

   A. Tropical rainforest  
   B. Desert  
   C. Tundra  
   D. Prairie

15. An animal that feeds solely on plants is a(n)

   A. Producer  
   B. Herbivore  
   C. Carnivore  
   D. Omnivore
PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. When a nonnative species is imported into a new ecosystem, the population sometimes runs wild. Explain why this might be the case.

2. What are biomes, and how do they differ from one another?

3. How has human activity had an impact on both local and global environmental systems?

4. How would the removal of a predator affect the prey and producer populations of an ecosystem?

5. How do ecosystems change over time? Give examples.

PART THREE: OPEN-ENDED QUESTIONS:

1. How are organisms affected by their environment, and vice versa?

2. How is matter recycled by the environment?

3. Which of the following types of organisms is the most important to the functioning of an ecosystem: producers, consumers or decomposers? Explain your reasons for your choice.

4. Why are there always fewer predators than prey in an ecosystem?

5. Why do problems like global warming, ozone depletion and air and ocean pollution require international cooperation to deal with them?
UNIT BENCHMARK ASSESSMENT
UNIT TWO- ECOLOGY
ANSWER KEY

PART ONE: MULTIPLE CHOICE QUESTIONS:


PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. Nonnative species often have no native predators or outcompete native species.
2. Biomes are large scale ecosystems defined in terms of precipitation, temperature and organisms.
3. Responses can include deforestation, habitat destruction, global warming, ozone depletion or any other manmade environmental issue; may also cite positive effects such as protection of endangered species or conservation efforts.
4. Removing a predator may result in an increase in prey species (not being eaten), fewer producers (increase in prey leads to more producers being eaten) and an increase of other predator populations (less competition for food). Response should conclude with a new equilibrium being established eventually.
5. Responses should include the sequences of events in primary succession (bare soil to forest), aquatic succession (lake to meadow) and/or island succession (development of new species). Answer should include details about both biotic and abiotic factor changes.

PART THREE: OPEN-ENDED QUESTIONS:

1. Answers will vary. Possible responses include organisms change their environment through respiration, growth, soil formation, affect temperature, etc., while the environment affects organisms on a daily basis and determines which organisms can survive in a given set of conditions.
2. Responses should cite the steps of the various biogeochemical cycles (water, carbon, nitrogen, phosphorus, etc.)
3. Responses will vary and the reasons given are primary; responses may note that producers are important for energy for the rest of the food chain, or decomposers are important because they return nutrients to the environment, or consumers because they support the other two in some way.

4. There are always fewer predators than prey because only approximately 10% of energy and biomass is passed on to the next trophic level. The other 90% is used by the prey themselves or end up going to decomposers.

5. Responses may include the interconnectedness of the atmosphere and the oceans, the global effect of each problem, the inability of single nations to deal with these problems by themselves. Accept all reasonable responses.
## Unit 3: Cell Structure and Function

**Total Number of Days:** 20  
**Grade/Course:** College Prep Biology

### ESSENTIAL QUESTIONS

1. How are respiration and photosynthesis related?

2. How do the structures that comprise a cell allow it to perform the processes necessary to sustain life and, in the case of multicellular organisms, specific tasks?

3. How does the process of cell division relate to the growth, repair and maintenance of an organism, as well as diseases such as cancer?

### ENDURING UNDERSTANDINGS

1. Respiration releases energy stored in chemical bonds, and results in the production of CO₂ and H₂O, which are used in photosynthesis to store energy from light in the form of chemical bonds.

2. The structures of the cell allow it to control what enters and leaves the cell, to move, to release energy and produce cell products. The structure of cells in multicellular organisms allow for coordinated actions such as movement and transmission of information and resources.

3. Cell division allows unicellular organisms to reproduce and multicellular organisms to grow, replace damaged cells and maintain stability. Cancer occurs when cell division occurs rapidly and without restraint.

### PACING

<table>
<thead>
<tr>
<th>Days</th>
<th>CONTENT</th>
<th>SKILLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>7.1</td>
<td>Explain how the invention of the microscope led to the discovery of cells.</td>
</tr>
<tr>
<td></td>
<td>Discovery of the Cell Microscopes</td>
<td>5.1.12.A.1 MS-LS1-1 SE p. 190-192</td>
</tr>
<tr>
<td></td>
<td>Prokaryote v. Eukaryote</td>
<td>Distinguish between prokaryotes and eukaryotes by constructing charts and cellular models.</td>
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<td></td>
<td>Animal v. Plant Cell</td>
<td>Compare and contrast plant and animal cells.</td>
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<tr>
<td>1.5</td>
<td>7.2</td>
<td>Identify and describe the structures and functions of major cell organelles by utilizing cellular models and</td>
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<td></td>
<td>Cell Structure Organelles</td>
<td>5.3.6.A.2 MS-LS1-2 SE p. 196-205</td>
</tr>
</tbody>
</table>

### STAND. (CCCS/NGSS)

- 5.1.12.A.1 MS-LS1-1
- 5.3.8.A.1 MS-LS1-3
- 5.3.6.A.2 HS-LS1-1
- 5.3.6.A.2 MS-LS1-2

### RESOURCES

- **TEXT:**
  - SE p. 190-192
  - SE p. 193-194
  - SE p. 206-207
- **OTHER (e.g., tech):**
  - Antony Van Leeuwenhoek: [http://www.ump.berkeley.edu/history/leeuwenhoek.html](http://www.ump.berkeley.edu/history/leeuwenhoek.html)

### LEARNING ACTIVITIES/ASSESSMENTS

- **UNIT PRETEST**
  - B/CP/ADV Using a Compound Microscope
<table>
<thead>
<tr>
<th>Time</th>
<th>Grade</th>
<th>Topic</th>
<th>Description</th>
<th>Reference</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>.5 days</td>
<td>7.3</td>
<td>Cell Transport</td>
<td>Discuss and demonstrate the processes of diffusion, osmosis, facilitated diffusion and active transport by investigating and simulating a cell’s response to a given set of environmental conditions.</td>
<td>5.3.12.A.3</td>
<td>Transport Across a Membrane Animations: [<a href="http://highe">http://highe</a> red.mcgraw-hill.com/sites/0072437316/student_view0/chapt er6/animations.html#](<a href="http://highe">http://highe</a> red.mcgraw-hill.com/sites/0072437316/student_view0/chapt er6/animations.html#)</td>
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<td></td>
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<td>Egg Osmosis lab <a href="http://www.biologyjunction.com/osmosis_diffusion_in_egg_lab.htm">http://www.biologyjunction.com/osmosis_diffusion_in_egg_lab.htm</a></td>
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<td>Osmosis is serious business [<a href="http://sciencecases.lib.buffalo.edu/cs/collectio">http://sciencecases.lib.buffalo.edu/cs/collectio</a> n/detail.asp?case_id=283&amp;id=283](<a href="http://sciencecases.lib.buffalo.edu/cs/collectio">http://sciencecases.lib.buffalo.edu/cs/collectio</a> n/detail.asp?case_id=283&amp;id=283)</td>
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<tr>
<td>.5 days</td>
<td>7.4</td>
<td>Homeostasis</td>
<td>Explain why it is important for a cell to maintain a stable internal environment.</td>
<td>5.3.12.A.3</td>
<td>B/CP Gummibear Osmosis</td>
</tr>
<tr>
<td>1 day</td>
<td>8.1</td>
<td>ATP Heterotroph v. Autotroph</td>
<td>Compare organisms in terms of how they obtain the energy they need.</td>
<td>5.3.12.A.1</td>
<td>CP/ADV Nutritional Analysis Day Trip activity</td>
</tr>
<tr>
<td>2.5 days</td>
<td>8.2, 3</td>
<td>Photosynthesis</td>
<td>Explain where plants and some microorganisms obtain the energy they need to produce food by discussing how the</td>
<td>5.3.12.B.4</td>
<td>Chromatography / Chlorophyll</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light dependent v. Light Independent (Calvin Cycle)</td>
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<td>HS-LS1-1</td>
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<td>HS-LS1-5</td>
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<td>5.3.12.B.4</td>
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<td>SE p. 226-228</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Grade</td>
<td>Topic</td>
<td>Details</td>
<td>Reference</td>
<td>Notes</td>
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<tr>
<td>.5 days</td>
<td>9.3</td>
<td>Fermentation, Lactic Acid v. Alcoholic</td>
<td>Differentiate between the two forms of fermentation by demonstrating the applications of each process</td>
<td>SE p. 262-265</td>
<td>Muscles and Mitochondria: <a href="http://www.teachersdomain.org/resource/tdc02.sci.life.cell.lip.mitochon/">http://www.teachersdomain.org/resource/tdc02.sci.life.cell.lip.mitochon/</a> Marathon Mouse: <a href="http://www.teachersdomain.org/resource/nsn09.sci.life.stru.lpmouse/">http://www.teachersdomain.org/resource/nsn09.sci.life.stru.lpmouse/</a></td>
</tr>
<tr>
<td>.5 days</td>
<td>10.1</td>
<td>Limits to Cell Size</td>
<td>Calculate how the different rates of growth in surface area</td>
<td>SE p. 274-</td>
<td>B Cell size cubes: <a href="http://www.biologyjunction.com/cell_size.htm">http://www.biologyjunction.com/cell_size.htm</a></td>
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<td></td>
<td>Song of the Cell Cycle Modeling the Phases of the Cell Cycle</td>
<td></td>
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<tr>
<td></td>
<td>1 day</td>
<td>10.3 Regulation of Cell Cycle Cancer</td>
<td>Explain how cancer is the result of a breakdown of the cell cycle, allowing rapid, uncontrolled cell growth to occur.</td>
<td>5.3.12.A.6 SE p. 286-290</td>
<td>Cell Replication and Cancerous Cells: <a href="http://www.teachersdomain.org/resource/tdc02.sci.life.celllp_divide/">http://www.teachersdomain.org/resource/tdc02.sci.life.celllp_divide/</a></td>
</tr>
</tbody>
</table>
Discuss the significance of cell specialization in multicellular organisms by creating analogies and describing modern applications of the regulation of cell differentiation and analysis of the benefits and risks.

5.3.12.A.5 SE p. 292-297


Stem Cells: [http://learn.genetics.utah.edu/content/tech/stemcells/](http://learn.genetics.utah.edu/content/tech/stemcells/)

### INSTRUCTIONAL FOCUS OF UNIT

This unit details how the various activities needed to sustain life are all based on the structures and functions of cells. Students will examine cells under magnification to observe how various cells differ, and relate these differences to their functions. They will determine how cells allow organisms to obtain energy and needed materials, to grow and repair damage, and to reproduce. Of particular notice is the role of cell regulation of the process of differentiation plays in both the origin of cancer and the promise of stem cell research.

### NJBCT FRAMEWORK/ASSESSMENT

**5.3 Life Science:** 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.

**5.3.A. 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.

**Instructional Focus:**
- Modeling how processes are regulated both internally and externally by environments in which cells exist
- Explaining how the fundamental life processes of organisms depend on a variety of chemical reactions that occur in specialized areas of the organism's cells
- Assessments will not include the identification of cellular organelles
- Modeling how cells are enclosed within semi-permeable membranes that regulate their interaction with their surroundings, including the transport of materials into and out of the cell
- Assessments will not include the molecular basis of membrane transport

**Sample Biology EOC Assessment Item:**
If an animal cell is placed in distilled water, it will swell and burst. The bursting of the cell is a result of which biological process?
A. active transport
Sample Integration of Science Practices and Core Content:
You are the trainer for your high school’s sports teams. During a hot and humid day at summer training camp, a football player comes into the training room. His symptoms include nausea, dizziness, severe headache and blurred vision. He reports that he had a breakfast of eggs, toast and two cups of coffee. He also has consumed several quick-energy drinks during practice. You know that coffee and energy drinks are loaded with caffeine, which is a strong diuretic. Use your understanding of cellular regulation to determine the underlying cause of his symptoms and suggest immediate treatment. (Correlations: 5.1.12.A.1, 5.1.12.B.3 and 5.3.12.A.3)

Instructional Focus:
Explaining how the many cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions
Tracing the general process where the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism
Assessments will not include the details or graphic demonstration of each stage in mitosis
Present evidence that supports the concept that complex multicellular organisms are formed as a highly organized arrangement of differentiated cells
Providing examples of how different parts of the genetic instructions are influenced by the cell’s environment.

Sample Biology EOC Assessment Item:
Frog experiments have shown that cells that are more differentiated than others are __________ produce fully developed adults.
A. unable to
B. less likely to
C. more likely to
D. always able to

Sample Integration of Science Practices and Core Content:
After biology class one day, you explain to a friend who isn’t in your biology class that all humans start out as a single cell. Your friend is doubtful, so you decide to create a time-lapse video using digital images of a fertilized egg developing into a human being to prove your point. Narrate the video, explaining the specific changes that occur between each developmental stage. You can also mention those certain stages where errors can occur in human development. (Correlations: 5.1.12.A.1, 5.1.12.D.2 and 5.3.12.A.4)

Instructional Focus:
- Recognizing the process of photosynthesis as providing a vital connection between the sun and the energy needs of living systems
- Describing how plants capture energy by absorbing light and use it to form strong chemical bonds between the atoms of carbon-containing molecules
- Assessments will not include the representations of specific detailed steps of photosynthesis (intermediate steps and products of the light-dependent and light-independent reactions)
- Designing independent investigations to determine the effects of changing environmental factors on photosynthesis

Instructional Focus:
Analyzing and describing how the process of photosynthesis provides a vital connection between the sun and the energy needs of living systems
Explaining how plants and many microorganisms use solar energy to combine molecules of carbon dioxide and water into complex, energy rich organic compounds and release oxygen to the environment
Assessments will not include the representations of specific detailed steps of photosynthesis and respiration (intermediate steps and products of the Calvin cycle, Krebs/citric acid cycle, and glycolysis)
Sample Biology EOC Assessment Item:
In one of the steps of the carbon cycle, a person exhales a molecule of carbon dioxide (CO₂) into the atmosphere. Which of the following is most likely to happen next to the atom of carbon in this molecule?

A. It may be used as part of a sugar in a plant.
B. It may become part of a protein in an animal.
C. It may be consumed as a fossil fuel is burned
D. It may be decomposed into carbon and oxygen by a bacterium.

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Instructional Focus:
- Examining how the breakdown of some food molecules enables the cell to store energy in specific molecules that are used to carry out the many functions of the cell
- Tracing the process in which nutrients are transported to cells to serve as building blocks for the synthesis of structures and as reactants for cellular respiration
- Assessments will not include the representations of specific detailed steps of respiration (intermediate steps and products of the Krebs/citric acid cycle and glycolysis)
- Recognizing that food molecules are taken into cells and react to provide the chemical constituents needed to synthesize other molecules, and knowing that the breakdown and synthesis are made possible by enzymes
- Assessments will not include the representations of specific detailed steps of synthesis and decomposition (intermediate steps and molecules, details of dehydration synthesis)

5.1 Science Practices: 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.

5.1.A. 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.

Instructional Focus:
- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world
- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data
- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1.B. 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.

Instructional Focus:
- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings
- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles
- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

5.1.C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Instructional Focus:
- Reflecting on the status of one’s own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges
- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1.D. 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.

Instructional Focus:
- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others’ claims, evidence and reasoning
- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others’ literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations
- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically

21ST CENTURY SKILLS (4Cs & CTE Standards)

9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.1 Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.5 Assume a leadership position in guiding the thinking of peers in a direction that leads to the successful completion of a challenging task or project.
9.1.12.D.1 Interpret spoken and written communication within the appropriate cultural context.
9.1.12.E.2 Generate digital media campaigns in support or opposing a current political, social, or economic issue.
9.1.12.F.2 Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences
9.1.12.F.6 Relate scientific advances (e.g., advances in medicine) to the creation of new ethical dilemmas.
9.4.12.O.1 Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.2 Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.3 Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.4 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

Examples:
1. Cancer Study Students investigate the various types of cancers, their causes, mortality rates and treatments available for each. Each student presents their findings, and discuss their personal risk of developing cancer, as well steps they can take to reduce their risks of doing so. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.D.1, 9.1.12.F.6
2. Stem Cells Students investigate the promise and possible ethical considerations relative to stem cell research and application. Students can debate for and against stem cell research on the basis of their findings. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.D.1, 9.1.12.F.6

MODIFICATIONS/ACCOMMODATIONS

Modifications:
9. Less complex reading level
10. Shortened assignments
11. Different goals
12. IEP modifications for summative and formative assessments

Accommodations:
22. Preferential seating
23. Assistive technologies
24. Reduced number of options on multiple choice exams
25. Larger print
26. Fewer problems on each page
27. More time
28. Test administered in a quieter setting
29. Tests read orally
30. Chunking of assignments or assessments into smaller segments
31. Taping of lectures or providing a peer note-taker

Extensions:
7. Alternative assignments
8. Independent studies
9. Mentoring of other students

APPENDIX
(Teacher resource extensions)

Next Generation Science Standards:

MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
MS-LS1-3 Use argument supported by evidence for how a body is a system of interacting subsystems composed of groups of cells.
MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

HS-LS1-1 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen are broken and the bonds of new compounds are formed resulting in a net transfer of energy.

Crosscutting Concepts:
1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. Scale, proportion, and quantity. In considering phenomena, it is critical to realize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. Systems and system models. Defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. Energy and matter: Flows, cycles and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems possibilities and limitations.

6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Three-Point Essays Biology

HOW TO WRITE 3-POINT ESSAYS

- PARAGRAPH 1 - INTRODUCTION - Tells what the paper is about and what three points will be discussed

- PARAGRAPH 2 - POINT 1 - States and explains the first point explained in the article and gives supporting evidence

- PARAGRAPH 3 - POINT 2 - States and explains the second point explained in the article and gives supporting evidence

- PARAGRAPH 4 - POINT 3 - States and explains the third point explained in the article and gives supporting evidence

- PARAGRAPH 5 - CONCLUSION - Restates the subject and summarizes the main points

HOW TO SET UP YOUR PAPER

- Upper RIGHT-HAND CORNER --- Write your NAME and PERIOD
- TOP LINE --- Write the TITLE of the ARTICLE
- SKIP ONE LINE
- Write the OUTLINE of your paper:
  I. Introduction
  II. (Write your 1st point)
  III. (Write your 2nd point)
  IV. (Write your 3rd point)
  V. Conclusion
Additional Website Resources:
National Science Teachers Association (NSTA)  www.nsta.org
National Association of Biology Teachers (NABT)  www.nabt.org
NASA (astrobiology)  www.nasa.gov
Biology Corner (biology resources for teachers)  www.biologycorner.com
Biology Junction (biology resources for teachers)  www.biologyjunction.com
NClark (Science resources for teachers)  www.nclark.net/Biology
New York Biology Regents  www.nysedregents.org/livingenvironment
Miller and Levine (textbook authors’ site)  www.millerandlevine.com
Pearson (textbook publisher)  www.biology.com
American Society for Cell Biology  www.ascb.org
Stem Cell Resources  www.stemcellresources.org

Notes to teacher (not to be included in your final draft):

4 Cs
Creativity: projects
Critical Thinking: Journal
Collaboration: Teams/Groups/Stations
Communication – Powerpoints/Presentations

Three Part Objective
Behavior
Condition
Demonstration of Learning (DOL)
UNIT BENCHMARK ASSESSMENT
UNIT THREE– CELLS

PART ONE: MULTIPLE CHOICE QUESTIONS:

1. Which substance can enter a cell by diffusion without having to be digested?
   A. water
   B. protein
   C. starch
   D. fat

2. A single celled organism is represented below:

   ![Cell Image]

   The black circle in the center of the cell carries out a function most similar to what structure in a human?
   A. lung
   B. brain
   C. ovary
   D. heart
3. The diagram below represents an activity that occurs in the human body.

This diagram best illustrates.

- A. active transport
- B. maintenance of homeostasis
- C. synthesis of nutrients
- D. differentiation

4. During the process of photosynthesis, energy from the Sun is converted into

- A. chemical energy in the bonds of inorganic molecules
- B. chemical energy in the bonds of organic molecules
- C. enzymes used to produce inorganic molecules
- D. enzymes used to produce organic molecules

5. A pesticide that kills an insect by interfering with the production of proteins in the insect would most directly affect the activity of

- A. ribosomes
- B. minerals
- C. chloroplasts
- D. mitochondria
6. The diagram below represents a cycling of materials.

Which row in the chart below shows the substances represented by X and Y?

<table>
<thead>
<tr>
<th>Row</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>OXYGEN</td>
<td>CARBON DIOXIDE</td>
</tr>
<tr>
<td>B</td>
<td>GLUCOSE</td>
<td>OXYGEN</td>
</tr>
<tr>
<td>C</td>
<td>CARBON DIOXIDE</td>
<td>OXYGEN</td>
</tr>
<tr>
<td>D</td>
<td>AMINO ACIDS</td>
<td>CARBON DIOXIDE</td>
</tr>
</tbody>
</table>

7. In examining a picture taken with an electron microscope, a student observes that the cell has a nucleus and a cell membrane, but not a cell wall. The student can correctly assume that the cell probably comes from a (n)

A. moss  
B. plant  
C. fungus  
D. animal

8. Athletes want a drink to help them maintain constant cellular respiration during their game. To accomplish this, the drink should contain

A. ATP  
B. lipids  
C. glucose  
D. proteins
9. What cellular process in plants makes them useful to animals as a source of energy?
   A. ATP production
   B. DNA replication
   C. cellular respiration
   D. glucose production

10. The maximum size to which a cell can grow is mainly limited by the cell's
    A. shape
    B. surface area
    C. function
    D. internal organization

11. The process of cell division results in
    A. sister chromatids
    B. mitosis
    C. two daughter cells
    D. unregulated cell growth

12. Uncontrolled cell division occurs in
    A. cancer
    B. mitosis
    C. cytokinesis
    D. cyclin

13. A human zygote is produced from two gametes that are identical in
    A. size
    B. genetic composition
    C. method of locomotion
    D. chromosome number
14. In periods of hot, dry weather, the pores on the leaf surfaces of most plants close in order to reduce water loss during the day. When these pores are closed, plants cannot take in carbon dioxide. As a direct result, the rate of which of the following processes decreases?

A. Cellular respiration  
B. Mitosis  
C. Nitrogen fixation  
D. Photosynthesis

15. Despite differences in size and shape, at some point all cells have DNA and a

A. cell wall  
B. cell membrane  
C. mitochondrion  
D. nucleus

PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. What would you expect to happen if you placed a typical cell in freshwater?

2. Explain how a sprinter gets energy during a 30-second race. Is the process aerobic or anaerobic? How does it compare to a long-distance runner getting energy during a 5-kilometer race?

3. Explain why careful regulation of the cell cycle is important to multicellular organisms

4. Why would muscle cells have numerous mitochondria, while fat cells have very few?

5. How do cells produce new cells?
PART THREE: OPEN-ENDED QUESTIONS:

1. How is cellular respiration similar to the burning of fossil fuels? How is it different?

2. Compare and contrast photosynthesis and respiration.

3. Briefly describe the endosymbiont hypothesis as it relates to chloroplasts and mitochondria.

4. Explain how the various cell parts allow it to carry out all the processes necessary for life.

5. How does the microscope influence our understanding of organisms?
UNIT BENCHMARK ASSESSMENT
UNIT THREE- CELLS
ANSWER KEY

PART ONE: MULTIPLE CHOICE QUESTIONS:


PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. If you placed a typical cell in freshwater, you would expect water to flow into the cell and cause it to swell and either burst (animal cell) or stiffen (plant cell).

2. The sprinter uses aerobic respiration, which releases more energy and produces CO₂ as a waste product, while a long distance runner utilizes anaerobic respiration, which produces lactic acid which accumulates and is eventually metabolized.

3. Response should cite cancer and the need to replace damaged or dead cells over time.

4. Mitochondria provide energy, and muscle cells have a high need for energy, while fat cells do not.

5. Response should include binary fission for prokaryotes and mitosis and cytokinesis for eukaryotes.
PART THREE: OPEN-ENDED QUESTIONS:

1. Both use oxygen to break down organic material; burning fossil fuel occurs faster and releases more heat.

2. Comparison should include chemical equations for each, reactants, products and place of energy in each process.

3. The endosymbiont hypothesis proposes that mitochondria and chloroplasts began as free living organisms which moved inside other cells. Evidence cited should include that mitochondria and chloroplasts have their own genetic material that is different from the cell's genetic material.

4. Response should pair at least five organelles with their functions.

5. The invention of the microscope led to the discovery of microorganisms and cells, which in turn led to greater understanding of how organisms function and how to prevent and treat disease. Accept any other acceptable answers.
# Unit 4: Genetics

**Total Number of Days:** 25  **Grade/Course:** College Prep Biology

<table>
<thead>
<tr>
<th>ESSENTIAL QUESTIONS</th>
<th>ENDURING UNDERSTANDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How is genetic information passed on from one generation to the next?</td>
<td>1. There are predictable patterns of inheritance, and the variation that exists within a species is related to its mode of reproduction (asexual or sexual).</td>
</tr>
<tr>
<td>2. How does the structure of the DNA molecule enable it to regulate the functions of the cell?</td>
<td>2. The complementary strands of a DNA molecule, with their sequences of nucleotides, allow it to make copies of itself, to produce RNA molecules to transfer the information stored, and through RNA, direct the production of proteins. These proteins, in turn, make up the structural components of the cell, and regulate chemical reactions within and outside of the cell.</td>
</tr>
<tr>
<td>3. What ethical and societal issues must be considered regarding genetic issues and technology?</td>
<td>3. Considerations include benefit versus risk assessment, the propriety of human research, and the possibility of unforeseen consequences of genetic interventions (i.e., gene therapy, genetically modified organisms, etc.). Thought must also be given to differences of opinion within society about such issues.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>PACING</th>
<th>CONTENT</th>
<th>SKILLS</th>
<th>STAND. (CCCS/NGSS)</th>
<th>RESOURCES</th>
<th>LEARNING ACTIVITIES/ASSESSMENTS</th>
</tr>
</thead>
</table>
| 2.5 days | 11.1 Mendel’s Experiments Laws of Inheritance | Explain how Mendel’s use of probability and statistics allowed him to develop his laws of heredity. | 5.3.6.D.3 | Heredity & Traits: [http://learn.genetics.utah.edu/content/begin/traits/](http://learn.genetics.utah.edu/content/begin/traits/) | UNIT PRETEST  
Dihybrid crosses  
Child characteristics |
| | | Summarize the laws of heredity and discuss the consequences of each law. | 5.3.6.D.3  
MS-L3-2 | Chromosome Tutorial: [http://www.johnkyrk.com/chromosome/structure.swf](http://www.johnkyrk.com/chromosome/structure.swf)  
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MS-L3-2 | Chromosome Tutorial: [http://www.johnkyrk.com/chromosome/structure.swf](http://www.johnkyrk.com/chromosome/structure.swf)  
What is a Chromosome: [http://learn.genetics.utah.edu/content/begin/tour/](http://learn.genetics.utah.edu/content/begin/tour/) | | |

| | | | SE p. 308-309 | | |
| | | | SE p. 310-312 | | |
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2.5 days | 11.1 Mendel’s Experiments Laws of Inheritance | Explain how Mendel’s use of probability and statistics allowed him to develop his laws of heredity. | 5.3.6.D.3 | Heredity & Traits: [http://learn.genetics.utah.edu/content/begin/traits/](http://learn.genetics.utah.edu/content/begin/traits/) | UNIT PRETEST  
Dihybrid crosses  
Child characteristics |
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<p>| | | | SE p. 308-309 | | |
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<tr>
<td>1 day</td>
<td>11.4 Meiosis</td>
<td>Summarize the events of meiosis by constructing models.</td>
<td>5.3.12.D.3 HS-LS3-2</td>
<td>SE p. 323-325</td>
<td>Modeling Meiosis LMA p. 67-72, SE p. 330 Calculating Haploid and Diploid Numbers SE p. 327 Mitosis v. Meiosis Venn diagram Crossing Over lab</td>
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<td>Gene Linkage</td>
<td>5.3.12.D.3</td>
<td>SE p. 328-329</td>
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<td>1 day</td>
<td>12.1 Discovery of genetic material Griffith, Avery and</td>
<td>Explain how scientific discoveries identified DNA as the nucleic acid that stores and transmits genetic information from one generation to another</td>
<td>5.3.12.D.1 HS-LS3-1</td>
<td>SE p. 338-343</td>
<td>DNAi - Timeline: <a href="http://www.dnai.org/timeline/index.html">http://www.dnai.org/timeline/index.html</a> DNAi – Finding DNA Poster (scientists who contributed to DNA structure) Classic experiments in molecular biology</td>
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<td>Day</td>
<td>12.1</td>
<td>RNA Transcription Introns v. Exons</td>
<td>Compare and contrast the three types of RNA by creating Venn diagrams and developing real-life analogies.</td>
<td>5.3.12.D.1</td>
<td>SE p. 362-365</td>
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<td>1 day</td>
<td>13.2</td>
<td>Translation Protein</td>
<td>Compare and contrast the structure and function of DNA</td>
<td>5.3.12.D.1</td>
<td>SE p. 366-384</td>
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<td>1 day</td>
<td>12.3</td>
<td>Replication</td>
<td>Summarize the process of DNA replication by constructing models.</td>
<td>5.3.12.D.1</td>
<td>SE p. 350-353</td>
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<td>1 day</td>
<td>13.3</td>
<td>Mutations</td>
<td>Explain how changes to the sequence of nucleotides occur and what are the possible consequences of such changes</td>
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<td>1 day</td>
<td>13.4</td>
<td>Gene Regulation</td>
<td>Discuss the ways in which the functions of genes are controlled</td>
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<td>1.5 days</td>
<td>14.1</td>
<td>Human Chromosomes</td>
<td>Identify techniques used by scientists to study genetic disorders in humans by constructing and analyzing karyotypes and pedigrees.</td>
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<td>.5 days</td>
<td>14.2</td>
<td>Genetic Disorders</td>
<td>Give relevant information about specific genetic disorders by creating a presentation.</td>
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</table>

**Synthesis Codons**
and RNA by utilizing models.
Summarize the overall process of protein synthesis (transcription and translation) by performing simulation activities.

| 5.3.12.D.1 | 371 |


**5.3.12.D.2** MS-LS3-1
What Makes a Firefly Glow: [http://learn.genetics.utah.edu/content/begin/dna/firefly/](http://learn.genetics.utah.edu/content/begin/dna/firefly/)

**5.3.12.D.2** SE p. 372-376

**B/CP Virtual Lab – Sex-linked Traits**

**5.3.12.D.2** SE p. 377-383

**B/CP Virtual Lab – Knocking Out Genes**

**TEST - DNA AND RNA**

**5.3.12.D.3** SE p. 392-397

Make a Karyotype: [http://learn.genetics.utah.edu/content/begin/traits/karyotype/](http://learn.genetics.utah.edu/content/begin/traits/karyotype/)
Using Karyotypes to Predict Genetic Disorders: [http://learn.genetics.utah.edu/content/begin/traits/predictdisorder/](http://learn.genetics.utah.edu/content/begin/traits/predictdisorder/)

**karyotypes** [http://www.biologyjunction.com/karyotype_lab.htm](http://www.biologyjunction.com/karyotype_lab.htm)
pedigree lab [http://www.biologyjunction.com/pedigree_lab.htm](http://www.biologyjunction.com/pedigree_lab.htm)

**Genetic Disorders brochures**

<table>
<thead>
<tr>
<th>Time</th>
<th>Lab</th>
<th>Description</th>
<th>Standard</th>
<th>Reference</th>
<th>URL</th>
<th>Additional References</th>
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<tr>
<td></td>
<td></td>
<td>Describe how humans have produced desirable plants and animals through selective breeding for specific traits</td>
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<td>1 day</td>
<td>15.2</td>
<td>Recombinant DNA Transgenic Organisms Cloning</td>
<td>5.3.12.D.2</td>
<td>SE p. 421-427</td>
<td>DNA Extraction Virtual Lab: <a href="http://learn.genetics.utah.edu/content/labs/extraction/">http://learn.genetics.utah.edu/content/labs/extraction/</a></td>
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<td>Discuss how modern genetic technology and procedures can be used in medicine, industry and law enforcement.</td>
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<td>DNA Fingerprinting Using DNA to Identify Human Remains</td>
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<td>LMA p. 81-87, SE p. 410 Inserting Genetic Markers</td>
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<tr>
<td>.5 days</td>
<td>15.4</td>
<td>Ethics</td>
<td>Present the pros and cons of a particular genetic technology, with consideration to societal values and ethical issues.</td>
<td>Ethical Issues in the Human</td>
<td>Genetic Ethics Questions Discussion</td>
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</table>

| 1.5 days | 15.3 | Applications of Genetic Engineering | Present the pros and cons of a particular genetic technology, with consideration to societal values and ethical issues. | 5.1.12.C.1 SE p. 428-439 | Bioengineered Food: [http://www.teachersdomain.org/resource/tcd02-sci-life-gen hploengfood/](http://www.teachersdomain.org/resource/tcd02-sci-life-gen hploengfood/)  
Gene Therapy: [http://learn.genetics.utah.edu/content/tech/genetherapy/](http://learn.genetics.utah.edu/content/tech/genetherapy/)  
Torn at the genes (GMOs) [http://sciencecases.lib.buffalo.edu/collection/detail.asp?case_id=423&id=423](http://sciencecases.lib.buffalo.edu/collection/detail.asp?case_id=423&id=423) |
This unit covers how characteristics are passed from one generation to the next. From the experiments of Gregor Mendel, to the discovery of the structure of DNA by James Watson and Francis Crick, to the decoding of the human genome, students will learn how our knowledge of heredity has increased over time. Students will investigate the role of genes and chromosomes in the inheritance of traits, as well as the promise of emerging technologies.

### NJBCT FRAMEWORK/ASSESSMENT

#### 5.3 Life Science: 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.

#### 5.3.A. 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.

#### Instructional Focus:
- Identifying genes as a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism
- Assessments will not include the names and structures of nucleotides or the individual detailed steps of the processes of transcription and translation
- Relating the specialization of cells in multicellular organisms to the different patterns of gene expression rather than to differences of the genes themselves
- Applying these understandings to analyze, support and/or critique current and emerging biotechnologies
- Assessments will not include the mechanisms of biotechnologies such as PCR, electrophoresis

#### Sample Integration of Science Practices and Core Content:
A local politician has learned that your biology class has been studying cell differentiation and discussing the possible applications in health and biotechnology. She is particularly interested in gaining support from young people, so she has requested that you share your thoughts on embryonic and adult stem cell research. Because stem cell research is a topic embroiled in much controversy, you have decided to hold a town hall debate to share your diverse thoughts about the topic as a group. Divide into groups based on your class’ positions (pro vs. con, pro-adult stem cells vs. con-adult stem cells, pro-embryonic stem cells vs. con-embryonic stem cells, etc.) and conduct research. Both sides should seek out and use specific data and scientific evidence to support their claims about how stem cell research has or has not led to improved therapies or disease prevention efforts. Each group should also consider the moral, ethical, and political questions related to stem cell research. Engage in the town hall discussion, inviting elected officials and the community to take part in the event. (Correlations: 5.1.12.B.3, 5.1.12.C.3, 5.1.12.D.)

#### Instructional Focus:
- Describing the relationships within multi-cellular organisms, where cells perform specialized functions as parts of sub-systems (e.g., tissues, organs, and organ systems), which work together to maintain optimum conditions for the benefit of the whole organism
- Assessments will not include the identification of specific tissues, organs or body systems
Recognizing that certain chemicals, pathogens, and high-energy radiation can seriously impair normal cell functions and the health of the organism
Assessments will not include the specific mechanisms of action of mutagens
Identifying emerging biotechnology that shows promise in preventing and treating disease
Assessments will not include the mechanisms of biotechnologies such as PCR, electrophoresis or the molecular actions of specific treatments

Sample Biology EOC Assessment Item:
A young patient is diagnosed with the genetic disorder lactose intolerance, which results in the inability to digest milk products due to a missing enzyme called lactase. What is most likely the cause of lactose intolerance in this patient?

A. The patient is allergic to milk
B. The patient stopped consuming milk products
C. A disease destroyed the lining of the patient’s small intestine
D. A mutation occurred in the gene that is responsible for producing lactase

Sample Integration of Science Practices and Core Content:
As a class, you have been asked to create an online digital library of genetic disorder profiles. Working in small groups, each selects a disorder of interest. Conduct research on the disorder, including a general description of the disorder, health-related resources provided by appropriate sources such as the National Institutes of Health (NIH), links to accurate sites for organizations and support groups, diagnostic or genetic testing information, clinical trials for patients, and other miscellaneous web resources. The profile’s centerpiece is a digital slide show of the mechanism of action for the disorder, beginning from the DNA error. In this digital presentation, trace the effects on the human body over time, focusing on the relationships among the DNA, cell, tissue, organ and systems affected. Post the complete profiles online for others to view. (Correlations: 5.1.12.D.2 and 5.3.12.A.6)

5.3.D. 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.

Instructional Focus:
- Recognizing that the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (adenine, thymine, guanine, and cytosine)
- Assessments will not include the identification of the structure of specific nucleotides or the nature of bonding between DNA strands
- Explaining how the chemical and structural properties of DNA allow for genetic information to be both encoded in genes and replicated
- Assessments will not include the individual detailed steps of the processes of transcription and translation
- Identifying that hereditary information is contained in genes, located in the chromosomes of each cell, and each gene carries a single unit of information
- Providing specific examples of how an inherited trait of an individual can be determined by one or many genes and a single gene can influence more than one trait
- Analyzing the current and potential impact of genome projects on human health (e.g. pathogenic bacteria or disease vectors) or species with commercial importance (e.g. livestock and crop plants)

Sample Biology EOC Assessment Item:
Fireflies produce light inside their bodies. The enzyme luciferase is involved in the reaction that produces the light. Scientists have isolated the luciferase gene. A scientist inserts the luciferase gene into the DNA of cells from another organism. If these cells produce light, the scientist knows that which of the following occurred?

A. The luciferase gene mutated inside the cells.
B. The luciferase gene was transcribed and translated.
C. The luciferase gene destroyed the original genes of the cells.
D. The luciferase gene moved from the nucleus to the endoplasmic reticulum.

Sample Integration of Science Practices and Core Content:
You are a genetic counselor working in the obstetrics department of a local hospital. A number of couples have recently requested pre-implantation genetic diagnosis to select the gender of their first-born child. Write a position statement for the hospital’s website outlining the department’s policies regarding this technology; explain when and why gender selection might later have an effect on the health of the child. Select those heredity conditions that are linked (either directly or indirectly) to the sex of an individual. Determine the frequency of genetic conditions using the Autosomal Disease Calculator. Predict, using the calculator, how sex selection might change the prevalence of these diseases in the population, if at all. (Correlations: 5.1.12.A.1, 5.3.12.C.2 and 5.3.12.D.1)

Instructional Focus:
- Recognizing that changes in DNA (mutations) occur spontaneously at low rates, and some of these changes make no difference to the organism, whereas others can change cells and organisms
- Explaining that only mutations in germ cells can create the variation that changes an organism’s offspring
- Assessments will not include the specific detailed steps of meiosis
- Tracing the progression of conditions that result from genetic mutation in a variety of different organisms

Sample Biology EOC Assessment Item:
Which of the following best describes the result of a mutation in an organism’s DNA?
A. The mutation may produce a zygote.
B. The mutation may cause phenotypic change.
C. The mutation causes damage when it occurs.
D. The mutation creates entirely new organisms.

Instructional Focus:
- Explaining the process where an egg and sperm unite to begin the development of a new individual, and how that new individual receives genetic information from its parents
- Assessments will not include the specific detailed steps of meiosis, fertilization and early embryological development
- Explaining how sexually produced offspring are never identical to either of their parents
- Understanding how new heritable characteristics can result from new combinations of existing genes in reproductive cells
- Recognizing how heritable characteristics can strongly influence what capabilities an organism will have, therefore influencing how likely it is to survive and reproduce

Sample Integration of Science Practices and Core Content:
You have been commissioned to work with the Joint United Nation Programme on HIV/AIDS. You know that while HIV does not mutate into other forms of the virus, it mutates to escape detection by the immune system, making it difficult to develop vaccines. Study the replication cycle for HIV and compare the average rates of mutation throughout this time. Graph your findings and determine which cycle stage would be the best to target for drug design. You decide to initiate a global digital public health campaign explaining why an HIV vaccine is so difficult to create, explaining specifically how the virus mutates at such a rapid rate. Create a universally accessible brochure (using pictures and symbols) that explains why HIV is able to mutate so quickly, and why re-infection and super-infection can be so dangerous to someone already living with HIV. (5.1.12.B.3, 5.1.12.D.2 and 5.3.12.D.2)

5.1 Science Practices: 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.

5.1.A. 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.

Instructional Focus:
- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world
- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data
- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1.B. 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.

Instructional Focus:
- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings
- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles
- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

5.1.C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Instructional Focus:
- Reflecting on the status of one’s own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges
- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely
- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1.D. 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.

Instructional Focus:
- Seeing oneself as an effective participant and contributor in science
Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus

Developing a sense of appropriate trust and skepticism when evaluating others’ claims, evidence and reasoning

Constructing literal representations from empirical evidence and observations

Presenting and defending a scientific argument using literal representations

Evaluating others’ literal representations for consistency with their claims, evidence and reasoning

Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations

Selecting and using appropriate instrumentation to design and conduct investigations

Understanding, evaluating and practicing safe procedures for conducting science investigations

Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)

Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically

**21ST CENTURY SKILLS**
(4Cs & CTE Standards)

9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.1 Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.
9.1.12.C.5 Assume a leadership position in guiding the thinking of peers in a direction that leads to the successful completion of a challenging task or project.
9.1.12.D.1 Interpret spoken and written communication within the appropriate cultural context.
9.1.12.E.2 Generate digital media campaigns in support or opposing a current political, social, or economic issue.
9.1.12.F.2 Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences
9.1.12.F.6 Relate scientific advances (e.g., advances in medicine) to the creation of new ethical dilemmas.
9.4.12.O.1 Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.2 Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.3 Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities
9.4.12.O.4 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

Examples:

1. Genetic Counseling Students research various heritable disorders, share their findings, and use their knowledge through role play to counsel couples who may potentially pass such disorders on to their offspring. 9.1.12.A.1, 9.1.12.B1, 9.1.12.D.1, 9.1.12.F.6

2. Ethical Issues in Genetics Students research and debate the ethical considerations raised by such issues as cloning, gene therapy and genetically modified foods. 9.1.12.A.1, 9.1.12.B1, 9.1.12.D.1, 9.1.12.F.6

**MODIFICATIONS/ACCOMMODATIONS**

Modifications:
13. Less complex reading level
14. Shortened assignments
15. Different goals
### IEP modifications for summative and formative assessments

**Accommodations:**
- Preferential seating
- Assistive technologies
- Reduced number of options on multiple choice exams
- Larger print
- Fewer problems on each page
- More time
- Test administered in a quieter setting
- Tests read orally
- Chunking of assignments or assessments into smaller segments
- Taping of lectures or providing a peer note-taker

**Extensions:**
- Alternative assignments
- Independent studies
- Mentoring of other students

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### APPENDIX

*(Teacher resource extensions)*

### Next Generation Science Standards:

**MS-LS3-1** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and result in harmful, beneficial, or neutral effects on the structure and function of the organism.

**MS-LS3-2** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

**HS-LS3-1** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

**HS-LS3-2** Make and defend a claim based on evidence that heritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication and/or (3) mutations caused by environmental factors.

**HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

### Crosscutting Concepts:

1. **Patterns.** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and effect: Mechanism and explanation.** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. **Scale, proportion, and quantity.** In considering phenomena, it is critical to realize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. **Systems and system models.** Defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. **Energy and matter: Flows, cycles and conservation.** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems possibilities and limitations.

6. **Structure and function.** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and change.** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.
Three-Point Essays Biology

HOW TO WRITE 3-POINT ESSAYS

- PARAGRAPH 1 - INTRODUCTION - Tells what the paper is about and what three points will be discussed
- PARAGRAPH 2 - POINT 1 - States and explains the first point explained in the article and gives supporting evidence
- PARAGRAPH 3 - POINT 2 - States and explains the second point explained in the article and gives supporting evidence
- PARAGRAPH 4 - POINT 3 - States and explains the third point explained in the article and gives supporting evidence
- PARAGRAPH 5 - CONCLUSION - Restates the subject and summarizes the main points

HOW TO SET UP YOUR PAPER

- Upper RIGHT-HAND CORNER --- Write your NAME and PERIOD
- TOP LINE --- Write the TITLE of the ARTICLE
- SKIP ONE LINE
- Write the OUTLINE of your paper:
  I. Introduction
  II. (Write your 1st point)
  III. (Write your 2nd point)
  IV. (Write your 3rd point)
  V. Conclusion
- SKIP ONE LINE and BEGIN WRITING YOUR PAPER

Additional Website Resources:

National Science Teachers Association (NSTA) www.nsta.org

National Association of Biology Teachers (NABT) www.nabt.org

NASA (astrobiology) www.nasa.gov

Biology Corner (biology resources for teachers) www.biologycorner.com

Biology Junction (biology resources for teachers) www.biologyjunction.com

NClark (Science resources for teachers) www.nclark.net/Biology

New York Biology Regents www.nysedregents.org/livingenvironment
Notes to teacher (not to be included in your final draft):

**4 Cs**
- Creativity: projects
- Critical Thinking: Journal
- Collaboration: Teams/Groups/Stations
- Communication – Powerpoints/Presentations

**Three Part Objective**
- Behavior
- Condition
- Demonstration of Learning (DOL)
UNIT BENCHMARK ASSESSMENT
UNIT FOUR–GENETICS

PART ONE: MULTIPLE CHOICE QUESTIONS:

1. Changing one base in a gene could have the most direct effect on the
   A. function of the membrane of the cell
   B. sequence of building blocks of a protein found in a cell
   C. number of mitochondria in a cell
   D. type of carbohydrates synthesized by a cell

2. An alteration of genetic information is shown below.
   
   \[
   \text{A-G-T-A-C-C-G-A-T} \rightarrow \text{A-G-T-G-A-T}
   \]

   This type of alteration of the genetic information is an example of
   A. deletion
   B. insertion
   C. substitution
   D. recombination

3. A scientist claimed that he had cloned a guinea pig to produce two offspring, a male and a female. The claim is not valid because
   A. guinea pigs can reproduce both asexually and sexually
   B. the two offspring are not identical copies of the original guinea pig
   C. each of the offspring had half the genetic information of the original guinea pig
   D. none of the genetic information came from the original guinea pig

4. Which situation results in a characteristic that is inheritable?
   A. a limb is lost when two marine organisms fight
   B. a puppy learns to beg for food by watching an older dog perform tricks
   C. a gene is inserted into a bacterium, allowing the organism to produce insulin
   D. a random mutation causes the immediate death of a microbe
5. Curly hair in humans, white fur in guinea pigs, and needlelike spines in cacti all partly describe each organism’s

A. alleles
B. chromosomes
C. genotype
D. phenotype

6. A mutation occurs in the liver cell of a field mouse. Which statement correctly describes the spread of the mutation through the mouse population?

A. It will spread because it is beneficial.
B. It will spread because it is a dominant gene
C. It will not spread because it is not in a gamete
D. It will not spread because it is a recessive gene

7. Which statement best describes the relationship between DNA, proteins and cells?

A. DNA is produced from protein absorbed by the cell.
B. Protein is composed of DNA that is produced by a cell.
C. DNA controls the production of proteins in the cell.
D. Cells make DNA by digesting proteins.

8. If a woman has Type O blood and her husband has Type AB blood, what is the chance that their children’s blood types will match either parent?

A. 0%
B. 25%
C. 50%
D. 100%

9. A young patient is diagnosed with the genetic disorder lactose intolerance, which results in the inability to digest milk products due to a missing enzyme called lactase. What is the most likely cause of lactose intolerance in this patient?

A. The patient is allergic to milk
B. The patient stopped consuming milk products
C. A disease destroyed the lining of the patient’s small intestine
D. A mutation occurred in the gene that is responsible for producing lactase
10. Fireflies produce light inside their bodies. The enzyme luciferase is involved in the reaction that produces the light. Scientists have isolated the luciferase gene. A scientist inserts the luciferase gene into the DNA of cells from another organism. If these cells produce light, the scientist knows that which of the following has occurred?

A. The luciferase gene mutated inside the cells  
B. The luciferase gene was transcribed and translated  
C. The luciferase gene destroyed the original genes of the cell  
D. The luciferase gene moved from the nucleus to the endoplasmic reticulum

11. In humans, freckles are encoded by a dominant allele. An individual woman is heterozygous for freckles. According to the law of segregation, which of the following would apply to a child of this woman?

A. The child must inherit the dominant allele for freckles.  
B. The child must inherit the recessive allele for freckles.  
C. The child has an equal chance of inheriting the dominant allele or the recessive allele for freckles from her mother  
D. The child has a greater chance of inheriting the dominant allele than the recessive allele for freckles from her mother.

12. In pea plants, the allele for purple flowers (P) is dominant to the allele for white flowers (p). A plant that is heterozygous for purple flowers is crossed with a plant with white flowers. What percentage of the offspring plants is expected to have purple flowers?

A. 25%  
B. 50%  
C. 75%  
D. 100%

13. Hemophilia is an X-linked recessive condition in which blood does not clot properly. Queen Victoria of England had one allele for hemophilia. Which of the following statements describes the most likely pattern for the occurrence of hemophilia in Queen Victoria’s descendants?

A. All of Queen Victoria’s children had hemophilia.  
B. None of Queen Victoria’s children had hemophilia.  
C. Female descendants of Queen Victoria could not pass on the gene for hemophilia.  
D. More male descendants than female descendants of Queen Victoria had hemophilia
14. Which statement explains how two organisms can have the same phenotype but different genotypes for the same trait?

   A. One is homozygous dominant and the other is heterozygous
   B. Both are heterozygous
   C. One is homozygous dominant and the other is homozygous recessive.
   D. Both are homozygous dominant

15. Hereditary information is stored inside the

   A. ribosomes, which have chromosomes that contain many genes.
   B. ribosomes, which have genes that contain many chromosomes.
   C. nucleus, which has chromosomes that contain many genes.
   D. nucleus, which has genes that contain many chromosomes
PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. Explain why meiosis allows organisms to maintain their chromosome numbers from one generation to the next.

2. Describe how eukaryotic cells are able to keep such large amounts of DNA in the small volume of the cell nucleus.

3. Explain how the allele for sickle cell disease, which is a harmful allele when a person is homozygous, can be beneficial when a person is heterozygous.

4. If you cross an individual with a dominant trait with an individual with a recessive trait, all the offspring will have the dominant trait. Explain in terms of Mendel’s laws of heredity.

5. Why is it more difficult to study the inheritance of traits in humans than in other species?

PART THREE: OPEN-ENDED QUESTIONS:

1. How is genetic information passed from one generation to the next?

2. What impact will emerging genetic technologies have on human life?

3. How and why do scientists manipulate DNA in living cells?

4. How does the structure of DNA enable it to control cell functions?

5. What effect can a change in an individual’s genes or chromosomes have on the individual and/or their offspring?
UNIT BENCHMARK ASSESSMENT
UNIT FOUR – GENETICS
ANSWER KEY

PART ONE: MULTIPLE CHOICE QUESTIONS:


PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:

1. Meiosis produces four cells, each with half the number of chromosomes as the parent organism. When fertilization takes place, each gamete has half the number of chromosomes, so the original number is restored. If meiosis did not halve the number of chromosomes, with fertilization, the number of chromosomes would double each generation.

2. Between cell divisions, the genetic material is uncoiled into chromatin. When the cell prepares to divide, the chromatin coils into chromosomes.

3. Having one gene for sickle cell anemia appears to give the individual some resistance to malaria.

4. Recessive traits are only expressed when the individual has two copies of the gene for the trait. If you cross an individual with the recessive trait with an individual with the dominant trait, two possible outcomes exist: either the dominant individual has two gene for the trait, which would result in all possible offspring having the dominant trait, or the dominant individual has one gene for the dominant trait and one gene for the recessive, which could produce recessive individuals 25% of the time.

5. Response should include long time between generations, inability to control mating, and ethical problems with human experimentation.

PART THREE: OPEN-ENDED QUESTIONS:

1. In prokaryotes, genetic information is passed on by the cell replicating a single chromosome. Then the cell divides, producing two identical daughter cells. In multicellular eukaryotic organisms, specialized cells called gametes are produced, which contain half the parent’s genetic information. When fertilization occurs, a new combination of genes is passed on to the next generation.
2. Answers will vary. Responses could include improvements in the treatment, detection and prevention of disease, improved/increased food supply, advances only available to parts of population, potential risks of child selection on basis of gender and/or defects, mutations, GMOs, etc.

3. To test hypotheses, to identify genes, to address problems and to try to improve organisms by adding additional traits such as insulin production by bacteria.

4. The sequence of nucleotides in DNA allows it to code for proteins, which in turn regulate cell functions.

5. Changes to an individual’s genes or chromosomes can be beneficial, harmful, lethal or neutral. If the change occurs in somatic cells, it affects only the individual, while if it occurs in the gametes, it does not affect the individual, but it can be passed on to the offspring and affect future generations.
**Unit 5: Evolution**

**Total Number of Days:** 20  
**Grade/Course:** College Prep Biology

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<thead>
<tr>
<th>ESSENTIAL QUESTIONS</th>
<th>ENDURING UNDERSTANDINGS</th>
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<tr>
<td>1. What evidence do we have that organisms have undergone change throughout the Earth’s history?</td>
<td>1. Evidence of change over time includes the fossil record, structural and biochemical similarities between species.</td>
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<td>2. How do scientists account for the variety of organisms that have lived on Earth over time, and how they have changed?</td>
<td>2. Changes in the environment have altered the conditions faced by organisms over time. As evidenced by the fossil record, many species have gone extinct, while others have either remained relatively unchanged or have evolved into new species that are better suited to survive in a changed environment.</td>
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<td>3. How does natural selection encourage intra- and inter-specific diversity over time?</td>
<td>3. The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce and pass those traits to offspring.</td>
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<tr>
<th>PACING</th>
<th>CONTENT</th>
<th>SKILLS</th>
<th>STAND. (CCCS/NGSS)</th>
<th>RESOURCES</th>
<th>LEARNING ACTIVITIES/ASSESSMENTS</th>
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| .5 days | 16.1 Darwin's Voyage on The HMS Beagle – Observations | Analyze the pattern Darwin observed among organisms of the Galapagos Islands by investigating and simulating their various adaptations. | S.3.12.E.3  
MS-LS4-4  
MS-LS4-6  
Bird Selection Lab  

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<thead>
<tr>
<th>TEXT</th>
<th>OTHER (E.g., tech)</th>
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<tr>
<td>Bird Selection Lab</td>
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<td>Natural selection</td>
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<td>Hand adaptations</td>
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<td>Antipodal mystery (platypus)</td>
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<td>2 days</td>
<td>19.3</td>
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### INSTRUCTIONAL FOCUS OF UNIT

This unit covers the idea that species change over time. Students will consider the logical arguments that make up Charles Darwin’s theory of evolution by natural selection, as well as the evidence that supports it. Students will examine evolution as an ongoing process, analyzing data and making predictions based on it. Through the lens of evolutionary theory, students will follow the history of life on this planet, as it changes along with the planet itself.

#### NJBCT FRAMEWORK/ASSESSMENT

**5.3 Life Science:** 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.

**5.3.E. 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.

#### Instructional Focus:
- Recognizing how heritable characteristics can strongly influence how likely an individual is to survive and reproduce
- Describing how evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism
- Analyzing natural selection simulations and use the data generated to describe how environmentally favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction
Sample Biology EOC Assessment Item:
Thousands of years ago, giraffes with short necks were common within giraffe populations. Nearly all giraffe populations today have long necks. This difference could be due to:

A. giraffes stretching their necks to keep their heads out of reach of predators
B. giraffes stretching their necks so they could reach food higher in the trees
C. a mutation in genetic material controlling neck size occurring in some skin cells of a giraffe
D. a mutation in genetic material controlling neck size occurring in the reproductive cells of a giraffe

Sample Integration of Science Practices and Core Content:
You are a primatologist who studies lemurs, and you focus on the nocturnal aye-aye. The aye-aye has a number of traits that set it apart from other primates and allow it to exploit different niches than other lemurs. In the mid-1800’s, Richard Owen used the aye-aye as an example of an animal that natural selection did not act upon. Compare the aye-aye to other lemurs, documenting which traits they share and do not share with other lemurs. Describe their unique niche and justify the claim that natural selection did act on the aye-aye, and use scientific evidence to describe how it fits its niche in Madagascar. Prepare a digital poster for a primatology conference. (Correlations: 5.1.12.A.3, 5.3.12.C.3 and 5.3.12.E.1)

Instructional Focus:
- Identifying, explaining and demonstrating how technology can be used to determine evolutionary relationships among species (gel electrophoresis, DNA/amino acid sequences)
- Assessments will not include the mechanisms of biotechnologies such as PCR, electrophoresis
- Integrating scientific information from a variety of disciplines to provide evidence for the relatedness of species
- on Earth (geology, comparative anatomy, biochemistry, and taxonomy)

Sample Biology EOC Assessment Item:
Scientists have concluded that snakes evolved from an ancestor with legs. Which of the following statements provides the best evidence for this conclusion?

A. Most species of snakes live on land.
B. Snakes move extremely fast to catch their prey.
C. Snakes have a well-developed backbone and muscular system.
D. Some species of snakes have limb buds during their embryonic development.

Sample Integration of Science Practices and Core Content:
You are a geneticist studying the relatedness of cichlid fish endemic to the African Great Lakes. You are conducting molecular analyses of cichlid DNA to determine relatedness between species. The fish in each of the lakes exhibit high levels of diversity in terms of morphology, ecology, and behavior. However, in some instances, species of cichlid fish that appear very different from one another turn out to be almost genetically identical. A number of people falsely believe that DNA alone can distinguish between species. Create a nature-inspired documentary explaining how scientists base their determination of species upon multiple forms of scientific evidence: anatomical similarities, similarities of DNA base and/or amino acid sequence, and even behavioral similarities to distinguish between species. Also address how, despite this evidence, ideas of species delineations can be changed by new findings. (Correlations: 5.1.12.A.2, 5.1.12.B.4, 5.1.12.C.1 and 5.3.12.E.2)

Instructional Focus:
- Recognizing that a change in a species over time does not follow a set pattern or timeline
- Explaining how the millions of different species on Earth today are related by common ancestry using evidence
- Using natural selection and its evolutionary consequences to provide a scientific explanation for the fossil record of ancient life forms, and the molecular similarities observed among the diverse species of living organisms
- Assessments will not include the classification of organisms in taxa
Sample Biology EOC Assessment Item: Which of the following best explains how the fossil record provides evidence that evolution has occurred?

A. It indicates that forms of life existed on Earth at least 3.5 billion years ago.
B. It indicates the exact cause of structural and behavioral adaptations of organisms.
C. It shows how the embryos of many different vertebrate species are very similar.
D. It shows that the form and structure of groups of organisms have changed over time.

Sample Integration of Science Practices and Core Content:
You are an anthropologist working on identifying patterns in primate evolution. Obtain data and evidence (i.e. amino acid differences in proteins between certain primate species, anatomical structures, chromosome comparisons, etc.) and work in a small group to build a matrix of differences between the primate species. From the matrix of differences, construct a simple cladogram of the groups. Use this information to create a virtual interactive museum exhibit for other high school students that explores the evolutionary relationships between primates and their evolutionary relatives. (Correlations: 5.1.12.A.2, 5.1.12.B.2 and 5.3.12.E.3)

Instructional Focus:
- Discussing how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process
- Predicting possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, pollution)

Sample Integration of Science Practices and Core Content:
You are an evolutionary biologist studying salamanders, and focus on the ring species Ensatinaeschscholtzii. Two distinct forms of the species, differing dramatically in color, coexist in southern California and are not successful at interbreeding. These two forms of salamanders are connected by a series of salamander populations with a gradient of varying color patterns, which encircle the Central Valley of California. A contractor is planning to purchase and develop the habitat of the salamander, and you are concerned that this species provides a unique opportunity to study evolution in situ. Develop a conservation campaign, stressing why these species must be saved for us to study and better understand the processes and mechanisms of evolution. Write and deliver a speech to be given to the California Department of Fish and Game’s Environmental Review and Permitting Program officers. Focus not only on the need to conserve habitat, but stress the importance of preserving a model study species. (Correlations: 5.1.12.A.1, 5.1.12.D.1 and 5.3.12.E.4)

5.1 Science Practices: 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.

5.1.A. 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.

Instructional Focus:
- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world
- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data
- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

5.1.B. 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.
Instructional Focus:

- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings
- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles
- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

5.1.C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Instructional Focus:

- Reflecting on the status of one’s own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges
- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely
- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

5.1.D. 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.

Instructional Focus:

- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others’ claims, evidence and reasoning
- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others’ literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations
- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically
<table>
<thead>
<tr>
<th>21ST CENTURY SKILLS (4Cs &amp; CTE Standards)</th>
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<tbody>
<tr>
<td>9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.</td>
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<td>9.1.12.B.1 Present resources and data in a format that effectively communicates the meaning of the data and its implications for solving problems, using multiple perspectives.</td>
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<td>9.1.12.C.5 Assume a leadership position in guiding the thinking of peers in a direction that leads to the successful completion of a challenging task or project.</td>
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<td>9.1.12.D.1 Interpret spoken and written communication within the appropriate cultural context.</td>
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<td>9.1.12.E.2 Generate digital media campaigns in support or opposing a current political, social, or economic issue.</td>
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<td>9.1.12.F.1 Demonstrate a positive work ethic in various settings, including the classroom and during structured learning experiences.</td>
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<td>9.1.12.F.6 Relate scientific advances (e.g., advances in medicine) to the creation of new ethical dilemmas.</td>
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<td>9.4.12.O.1 Demonstrate language arts knowledge and skills required to pursue the full range of postsecondary education and career opportunities.</td>
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<td>9.4.12.O.2 Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.</td>
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<tr>
<td>9.4.12.O.3 Demonstrate science knowledge and skills required to pursue the full range of postsecondary education and career opportunities.</td>
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<td>9.4.12.O.4 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.</td>
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Examples:

1. **Intelligent Design Controversy** Students research arguments for and against teaching creationism/intelligent design in schools. Students consider court cases, advocacy groups for both sides and reasons for and against intelligent design as a scientific explanation for the development of life on Earth. 9.1.12.A.1, 9.1.12.B.1, 9.1.12.D.1, 9.1.12.F.6

2. **Using biochemical similarities to classify organisms** students will compare DNA and protein similarities and differences between various species, and evaluate whether this data can be used as evidence of an evolutionary relationship between species. 9.1.12.A.1, 9.1.12.B.1, 9.4.12.O.1, 9.4.12.O.2, 9.4.12.O.3, 9.4.12.O.4

**MODIFICATIONS/ACCOMMODATIONS**

**Modifications:**
- 17. Less complex reading level
- 18. Shortened assignments
- 19. Different goals
- 20. IEP modifications for summative and formative assessments

**Accommodations:**
- 42. Preferential seating
- 43. Assistive technologies
- 44. Reduced number of options on multiple choice exams
- 45. Larger print
- 46. Fewer problems on each page
- 47. More time
- 48. Test administered in a quieter setting
- 49. Tests read orally
- 50. Chunking of assignments or assessments into smaller segments
- 51. Taping of lectures or providing a peer note-taker

**Extensions:**
- 13. Alternative assignments
- 14. Independent studies
- 15. Mentoring of other students
APPENDIX
(Teacher resource extensions)

Next Generation Science Standards:

MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

MS-LS4-3 Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.

MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.

MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-3 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptations of populations.

HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6 billion-year-old history.

HS-ESS-2-7 Construct an argument based on evidence about the simultaneous coevolution of the Earth’s systems and life on Earth.

Crosscutting Concepts:

1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. Scale, proportion, and quantity. In considering phenomena, it is critical to realize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. Systems and system models. Defining the system under study – specifying its boundaries and making explicit a model of that system – provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. Energy and matter: Flows, cycles and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems possibilities and limitations.

6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Three-Point Essays Biology

HOW TO WRITE 3-POINT ESSAYS

- PARAGRAPH 1 - INTRODUCTION - Tells what the paper is about and what three points will be discussed
PARAGRAPH 2 - POINT 1 - States and explains the first point explained in the article and gives supporting evidence

PARAGRAPH 3 - POINT 2 - States and explains the second point explained in the article and gives supporting evidence

PARAGRAPH 4 - POINT 3 - States and explains the third point explained in the article and gives supporting evidence

PARAGRAPH 5 - CONCLUSION - Restates the subject and summarizes the main points

HOW TO SET UP YOUR PAPER

- Upper RIGHT-HAND CORNER --- Write your NAME and PERIOD
- TOP LINE --- Write the TITLE of the ARTICLE
- SKIP ONE LINE
- Write the OUTLINE of your paper:
  I. Introduction
  II. (Write your 1st point)
  III. (Write your 2nd point)
  IV. (Write your 3rd point)
  V. Conclusion
- SKIP ONE LINE and BEGIN WRITING YOUR PAPER

Additional Website Resources:

National Science Teachers Association (NSTA)  www.nsta.org

National Association of Biology Teachers (NABT)  www.nabt.org

NASA (astrobiology)  www.nasa.gov

Biology Corner (biology resources for teachers)  www.biologycorner.com

Biology Junction (biology resources for teachers)  www.biologyjunction.com

NClark (Science resources for teachers)  www.nclark.net/Biology

New York Biology Regents  www.nysedregents.org/livingenvironment

Miller and Levine (textbook authors’ site)  www.millerandlevine.com

Pearson (textbook publisher)  www.biology.com

Evolution  www.evolution.berkeley.edu
PART ONE: MULTIPLE CHOICE QUESTIONS:

1. Parrots are tropical birds. However, in some areas of New York City, some parrots have been able to survive outdoors year-round. These parrots survive, while others cannot, due to

   A. overreproduction of offspring
   B. extinction of previous species
   C. asexual reproduction of parrots with a mutation
   D. a variation that allows these parrots to live in colder climates

2. The table below shows adaptations in two organisms.
<table>
<thead>
<tr>
<th>Organism</th>
<th>Environment</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert rat</td>
<td>Hot and dry</td>
<td>Comes out of burrow only at night</td>
</tr>
<tr>
<td>Arctic poppy plant</td>
<td>Cold and windy</td>
<td>Grows low to the ground next to rocks</td>
</tr>
</tbody>
</table>

The presence of these adaptations is most likely the result of

A. reproductive technology  
B. natural selection  
C. asexual reproduction  
D. human interference

3. Characteristics that are harmful to a species tend to decrease in frequency from generation to generation because these characteristics usually

A. have a high survival value for the species  
B. have a low survival value for the species  
C. are inherited by more individuals  
D. affect only the older members of the population

4. Many scientists suggest that, billions of years ago, life on Earth began with

A. simple, single-celled organisms  
B. simple, multi-celled organisms  
C. complex, single-celled organisms  
D. complex, multi-celled organisms

5. In order for new species to develop, there must be a change in the

A. temperature of the environment  
B. migration patterns within a population  
C. genetic makeup of a population  
D. rate of succession in the environment
6. Many related organisms are found to have the same kinds of enzymes. This suggests that

A. enzymes only work on specific substrates.
B. enzymes act as catalysts in biochemical reactions
C. organisms living in the same environment require identical enzymes
D. these organisms probably share a common ancestry

7. Scientists believe that three species of lizards living on the Canary Islands descended from a common ancestor. Similarities in which of the following most strongly support the scientists’ theory?

A. body size
B. main diet
C. population sizes
D. amino acid sequences

8. A key idea in Darwin’s theory of evolution is that members of a population

A. are always identical
B. compete for limited resources
C. all get to reproduce and pass on their traits
D. are all equally well-adapted to the environment

9. A mutation in an allele in an individual newt gave the newt faster reflexes. It is found that after many generations, most of the newt population has the new allele. Which of the following most likely caused this change?

A. The newt gave its mutated allele to other adult newts
B. Other newts learned to copy the strategies of the mutated newt
C. The same mutation occurred in other newts as a result of environmental conditions
D. Newts with the mutation are better able to survive and reproduce than newts without the mutation

10. Thousands of years ago, giraffes with short necks were common within giraffe populations. Nearly all giraffe populations today have long necks. This difference could be due to:

A. giraffes stretching their necks to keep their heads away from predators
B. giraffes stretching their necks so they could reach food higher in the trees
C. a mutation in genetic material controlling neck size occurring in some skin cells of giraffes
D. a mutation in genetic material controlling neck size occurring in the reproductive cells of a giraffe

11. A researcher is comparing amino acid sequences for the protein hemoglobin from several primate species. What does the degree of similarity in sequences among the primate species indicate about these species?

A. how closely related they are  
B. how frequently they interbreed  
C. how rapidly they can evolve in the future  
D. how efficient their circulatory systems are

12. Scientists recovered the body of a woolly mammoth from the frozen soil of Siberia. The DNA sequence of the woolly mammoth was very similar to the DNA sequence of the African elephant. Which of the following conclusions is best supported by this information?

A. African elephants evolved directly from woolly mammoths.  
B. The woolly mammoth and the African elephant have a common ancestor  
C. Woolly mammoths had the same number of chromosomes as African elephants  
D. The woolly mammoth and the African elephant should be classified as the same species.

13. Odontomachusbauri is a species of ant that has a trap jaw that shuts rapidly. This jaw system evolved from basic mouthparts that all ants have, but the jaw is longer, the joint is a different shape, and the muscles are larger. Which of the following statements best explains why this trap-jaw trait evolved?

A. The trap jaw increases the ants’ body mass.  
B. The trap jaw allows the ants to eat only one kind of food.  
C. The trap jaw is the ants’ only means of species recognition.  
D. The trap jaw increases the ants’ chances of survival and reproduction.

14. A change in the frequency of any mutant allele in a population most likely depends on the

A. size of the organisms possessing the mutant allele.  
B. adaptive value of the trait associated with the mutant allele  
C. degree of dominance of the mutant allele  
D. degree of recessiveness of the mutant allele
15. Which is an example of evidence of evolution based on comparative biochemistry?
   A. Sheep insulin can be substituted for human insulin.
   B. The structure of a whale's flipper is similar to that of a human hand.
   C. Human embryos have tail during early stages of their development.
   D. Both birds and bats have wings.

**PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:**

1. Compare and contrast the processes of artificial selection and natural selection.

2. How does the process by which sedimentary rock forms allow scientists to determine the relative ages of fossils?

3. What evidence do we have that organisms have undergone change throughout the Earth's history?

4. How do scientists account for the variety of organisms that have lived on Earth over time, and how they have changed?

5. How does natural selection encourage intra- and inter-specific diversity over time?

**PART THREE: OPEN-ENDED QUESTIONS:**
1. How do biochemical similarities indicate evolutionary relationships between species?

2. Identify the sequence of observations that make up Darwin’s theory of evolution by natural selection.

3. Why are most of the species that ever existed now extinct?

4. Explain how the different species of finches on the Galapagos Islands may have evolved.

5. Explain how natural selection is related to phenotypes and genotypes.

UNIT BENCHMARK ASSESSMENT
UNIT FIVE – EVOLUTION
ANSWER KEY

PART ONE: MULTIPLE CHOICE QUESTIONS:

1. D  6. D  11. A
5. C  10. D  15. A

PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:
1. In artificial selection, people control the breeding of plants or animals on the basis of certain desirable traits over several generations. This process produces various breeds, strains and varieties. In natural selection, environmental factors determine which traits are an advantage to have, and which are not. For example, the colder the climate, the more a thick coat of fur helps one to survive. Over the course of many generations, the favored traits become more abundant in the population. As natural selection occurs over a much longer timeframe, it can lead to individuals that are different enough to qualify as a new species.

2. As sediments settle to the bottom of a body of water, they cover and preserve the remains of organisms. As time goes by, additional layers of sediments cover additional remains. As the older sediments are on the bottom, and the newer sediments are near the top, scientists can use the relative position of a fossil, with an estimate of the rate of sedimentation, to determine the comparative ages of fossils found in a sample of sedimentary rock.

3. Response should include fossil record, similarities and differences between species, such as homologous structures, vestigial structures, embryological and biochemical similarities.


5. As organisms migrate to new locations, and environmental conditions change over time, changes in the genetic makeup of a population, with the concurrent change in traits, encourages a diversity of life forms and change as individuals and species compete for limited resources.

**PART THREE: OPEN-ENDED QUESTIONS:**

1. The greater the number of biochemical similarities, the more closely related two species are, and the more recent their common ancestor.

2. All species overreproduce. Because of limited resources, not all offspring can survive. This leads to competition. As there is variation of traits within a population, some of these traits increase the likelihood of an individual’s survival. The environment determines which traits offer a survival advantage. Those individuals with certain traits are more likely to survive long enough to reproduce and pass their traits on to the next generation, as well as produce more offspring over time. The result over many generations is the development of new species.

3. Life is fragile and can only survive within a specific range of conditions. Species change over time; as environmental conditions change, species may adapt to the new conditions given sufficient time. If the changes are too great or too sudden, a species cannot adapt quickly enough and may go extinct. In addition, there have been several catastrophic events in earth’s history that have killed off many species in a relatively short period of time. Mass extinction events include marine invertebrates, dinosaurs and many species in the present day.
4. When the finches reached the islands, they became isolated from the finches on the mainland. To survive, the finches over time began to fill various niches, which reduced competition. Those that had certain types of beaks could feed on seeds, others nuts, and still others cactus. Each food source favored a particular beak shape.

5. Phenotype refers to the heritable outward appearance, physiological characteristics and behaviors of the individual. This determines how well an individual can obtain food, avoid becoming food and secure a mate. Camouflage, mating rituals, resistance to disease, all are traits that can provide a survival advantage to an individual. Genotype refers to the genetic makeup of an individual. Only those characteristics which are carried on one’s genes can be passed on to the next generation and affect the species over time.

**BIOLOGY POST TEST**

**Part One: Multiple Choice**

1. One characteristic of all living things is that they
   - A. develop organ systems
   - B. produce identical offspring
   - C. maintain internal stability
   - D. synthesize only inorganic matter

2. A bird-watcher sees an unusual bird at a feeder. He takes careful notes on the bird’s color, shape, and other physical features and then goes to a reference book to see if he can identify the species. What aspect of scientific thinking is most apparent in this situation?
   - A. observation
3. Which of the following substances is needed by all living things?

A. Oxygen  
B. Carbon Dioxide  
C. Water  
D. Sodium Chloride

4. Which characteristic of a geographic region would have the greatest impact on the type of ecosystem that forms in that region?

A. ratio of autotrophs to heterotrophs  
B. concentration of atmospheric oxygen  
C. number of food chains  
D. climatic conditions

5. Which of the following is a possible consequence of global warming?

A. Rising sea levels  
B. Loss of polar habitats  
C. Changes in weather patterns worldwide  
D. All of the above

6. An animal that feeds solely on plants is a(n)

A. Producer  
B. Herbivore  
C. Carnivore  
D. Omnivore

7. Which substance can enter a cell by diffusion without having to be digested?

A. water  
B. protein  
C. starch  
D. fat
8. During the process of photosynthesis, energy from the Sun is converted into

- A. chemical energy in the bonds of inorganic molecules
- B. chemical energy in the bonds of organic molecules
- C. enzymes used to produce inorganic molecules
- D. enzymes used to produce organic molecules

9. The process of cell division results in

- A. sister chromatids
- B. mitosis
- C. two daughter cells
- D. unregulated cell growth

10. Changing one base in a gene could have the most direct effect on the

- A. function of the membrane of the cell
- B. sequence of building blocks of a protein found in a cell
- C. number of mitochondria in a cell
- D. type of carbohydrates synthesized by a cell

11. Which statement best describes the relationship between DNA, proteins and cells?

- A. DNA is produced from protein absorbed by the cell.
- B. Protein is composed of DNA that is produced by a cell.
- C. DNA controls the production of proteins in the cell.
- D. Cells make DNA by digesting proteins.

12. Hereditary information is stored inside the

- A. ribosomes, which have chromosomes that contain many genes.
- B. ribosomes, which have genes that contain many chromosomes.
- C. nucleus, which has chromosomes that contain many genes.
- D. nucleus, which has genes that contain many chromosomes

13. Many scientists suggest that, billions of years ago, life on Earth began with
A. simple, single-celled organisms
B. simple, multi-celled organisms
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14. In order for new species to develop, there must be a change in the
   A. temperature of the environment
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   C. genetic makeup of a population
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15. A key idea in Darwin's theory of evolution is that members of a population
   A. are always identical
   B. compete for limited resources
   C. all get to reproduce and pass on their traits
   D. are all equally well-adapted to the environment

Part Two: Short Constructed Response:

1. Explain how a controlled experiment works.

2. List some of the characteristics of water that make it such a unique substance

3. How has human activity had an impact on both local and global environmental systems?

4. How would the removal of a predator affect the prey and producer populations of an ecosystem?

5. What would you expect to happen if you placed a typical cell in freshwater?

6. How do cells produce new cells?
7. Why is it more difficult to study the inheritance of traits in humans than in other species?

8. What evidence do we have that organisms have undergone change throughout the Earth's history?

**Part Three: Open Ended Questions:**

1. How would you determine if a person was alive or dead?

2. How is matter recycled by the environment?

3. Compare and contrast photosynthesis and respiration.

4. How is genetic information passed from one generation to the next?

5. Identify the sequence of observations that make up Darwin's theory of evolution by natural selection

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**BIOLOGY POST TEST**

**ANSWER KEY**

**PART ONE: MULTIPLE CHOICE QUESTIONS:**


**PART TWO: SHORT CONSTRUCTED RESPONSE QUESTIONS:**

1. Responses should include that a controlled experiment allows for comparison of results to determine effect of variable being tested.
2. Responses should include water’s role as the universal solvent, its high specific heat, its density as ice, adhesion, cohesion, etc.

3. Responses can include deforestation, habitat destruction, global warming, ozone depletion or any other manmade environmental issue; may also cite positive effects such as protection of endangered species or conservation efforts.

4. Removing a predator may result in an increase in prey species (not being eaten), fewer producers (increase in prey leads to more producers being eaten) and an increase of other predator populations (less competition for food). Response should conclude with a new equilibrium being established eventually.

5. If you placed a typical cell in freshwater, you would expect water to flow into the cell and cause it to swell and either burst (animal cell) or stiffen (plant cell).

6. Response should include binary fission for prokaryotes and mitosis and cytokinesis for eukaryotes.

7. Response should include long time between generations, inability to control mating, and ethical problems with human experimentation.

8. Response should include fossil record, similarities and differences between species, such as homologous structures, vestigial structures, embryological and biochemical similarities.

**PART THREE: OPEN-ENDED QUESTIONS:**

1. Responses should include checking for a pulse, breathing, movement, etc.

2. Responses should cite the steps of the various biogeochemical cycles (water, carbon, nitrogen, phosphorus, etc.).

3. Comparison should include chemical equations for each, reactants, products and place of energy in each process.

4. In prokaryotes, genetic information is passed on by the cell replicating a single chromosome. Then the cell divides, producing two identical daughter cells. In multicellular eukaryotic organisms, specialized cells called gametes are produced, which contain half the parent’s genetic information. When fertilization occurs, a new combination of genes is passed on to the next generation.

5. All species overreproduce. Because of limited resources, not all offspring can survive. This leads to competition. As there is variation of traits within a population, some of these traits increase the likelihood of an individual’s survival. The environment determines which traits
offer a survival advantage. Those individuals with certain traits are more likely to survive long enough to reproduce and pass their traits on to the next generation, as well as produce more offspring over time. The result over many generations is the development of new species.