The following instructional plan is part of a GaDOE collection of Unit Frameworks, Performance Tasks, examples of Student Work, and Teacher Commentary. Many more GaDOE approved instructional plans are available by using the Search Standards feature located on GeorgiaStandards.Org.

Georgia Performance Standards Framework for Science – Biology

Biology Course Map

The attached document is part of a framework that was designed to support the major concepts addressed in the Biology Curriculum of the Georgia Performance Standards through laboratory experiences and field work using the processes of inquiry. This framework is a thematic approach that is divided into the four units outlined below. Within each unit, the unifying themes of cells, organisms, ecology and evolution reoccur. Concept maps are attached to each unit outlining the understandings derived from the standards that are addressed for each of the recurring topics. Whereas these units are written to be stand alone units that may be taught in any sequence, it is recommended that the organization unit be taught first and the equilibrium unit taught last.

<table>
<thead>
<tr>
<th>Unit One Focus: Organization</th>
<th>Unit Two Focus: Energy Transformations</th>
<th>Unit Three Focus: Growth and Heredity</th>
<th>Unit Four Focus: Equilibrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life is organized at all levels from cells to biosphere.</td>
<td>Energy can be neither created nor destroyed but can be transformed from one form to another as it flows through organisms and ecosystems.</td>
<td>Organisms must be able to grow and reproduce to ensure species survival.</td>
<td>Survival and stability require that living things maintain biological balance at all levels.</td>
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<thead>
<tr>
<th>Topics:</th>
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</thead>
<tbody>
<tr>
<td>Cell structure and Function</td>
<td>Chemistry of Life</td>
<td>Asexual and Sexual Reproduction</td>
<td>Cellular Transport</td>
</tr>
<tr>
<td>Evolutionary History</td>
<td>Function of Organic Molecules</td>
<td>Cell Growth</td>
<td>Homeostasis</td>
</tr>
<tr>
<td>History of Life</td>
<td>Photosynthesis</td>
<td>Mendelian Genetics</td>
<td>Natural Selection</td>
</tr>
<tr>
<td>Classification of Kingdoms</td>
<td>Cellular Respiration</td>
<td>DNA and RNA Processes</td>
<td>Plant Adaptations</td>
</tr>
<tr>
<td>Ecosystem Structure</td>
<td>Cycles of Matter</td>
<td>Chromosomes and Mutations</td>
<td>Animal Adaptations and Behavior</td>
</tr>
<tr>
<td>Viruses</td>
<td>Energy Flow</td>
<td>Genetic Engineering</td>
<td>Succession</td>
</tr>
<tr>
<td>Food Chains and Webs</td>
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<td>DNA Technology and Cloning</td>
<td>Population Genetics</td>
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</tbody>
</table>

Duration (Block): 23 days
Duration (Traditional): 7-9 weeks

Duration (Block): 22 days
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Duration (Block): 23 days
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Safety Issues:

Student safety in science education should always be foremost during instruction.

The Characteristics of Science curriculum standards increase the need for teachers to use appropriate precautions in the laboratory and the field. The guidelines for the safe use, storage and disposal of chemicals must be observed.

To ensure student and teacher safety in the science classroom, it is critical that appropriate safety policies and procedures be established in the classroom and that all students and teachers know and follow appropriate safety guidelines. The Internet and many science vendors can offer support for safety guidelines.

Teaching Strategies:

Lab notebook or Field sketchbook: A notebook that students use to record data, journal on assigned topics and complete assigned drawing activities.

Ticket Out the Door: A commonly used summarizing strategy that is effective as a formative assessment tool. Students are given a short writing assignment on the concept covered in class that is to be turned in as they leave the classroom. These brief glimpses into student understanding may be graded or not. The same strategy can be used as a Ticket In the Door to assess student understanding at the beginning of the class on a concept from the day before or as a check on a homework assignment.

KIM diagrams: A three column table where students can organize technical language to allow better understanding of how they relate to the topic of the day. On a KIM diagram, a key term is listed in the first column, an illustration of the key term in the second column and a student derived meaning written in the third column.

Jigsaw activities: An effective grouping strategy that teachers use to facilitate peer teaching in the classroom. Students are first grouped together to become experts on an assigned topic. Student groups are then reorganized in such a manner that new groups are formed containing one student from each of the expert groups. The experts on each topic then serve as a peer teacher to the other students in the newly formed group.

Cloze: A note taking strategy where students either provide missing terms to complete a paragraph using appropriate language for the topic being addressed, or where students generate a paragraph from a list of appropriate terms.

Gallery or Poster Walk: This is a peer assessment strategy. Students place their work on a wall or other location where it can be reviewed by their peers. Students provide written commentary on the posted work and the original creators are given the opportunity to revise their product. Teacher note: Students may require training to use appropriate feedback in their commentary.
Flapbook or Flipbook: A type of graphic organizer where students group information in order to see relationships within categories.

10-2 Lecture format: A strategy where teachers limit the introduction of material to a time frame of 10 minutes or less and then students are allowed a 2 minute opportunity to reflect on the material and share what they have learned with their peers.

Glaze the Doughnut: A type of organizer that allows teachers to pre-assess student knowledge or to monitor student progress that resembles a doughnut as one smaller circle is drawn inside another. The big idea is written inside the small circle and the doughnut is “iced” or “glazed” with what the students know about the topic. The information can then be reorganized into tables or organizers.

Name Jar: A strategy to ensure students are randomly selected to answer questions in class. Student names are placed on craft sticks and placed in a jar. During questioning the teacher selects sticks from the jar and the student identified must answer the question. Several blank sticks could be included in which the teacher must answer the questions when they are selected.

KWL: A pre and post assessment strategy often used in classrooms where, at the beginning of the lesson, teachers guide students to identify what they already know about a particular topic and what they need to know about the topic. Following the lesson, the teacher leads students to review what they have learned.

Acrostic: An activity for students to make connections between the language that often accompanies a particular topic. The key term is written vertically on paper and students write words or phrases that relate to that term using the letters that make up the key term.
Cells have particular structures that underlie their functions. **SB1a**

All cells are composed of many different molecules that are organized into specialized structures that carry out cell functions. **SB1c**

Multi-cellular organisms are formed as highly organized arrangements of differentiated cells. **SB3 b**

Cellular processes of prokaryotic and eukaryotic cells are similar in spite of their structural differences. **SB1 a**

Viruses are complex structures and their evolutionary relationship is still under investigation. **SB3 d**

Organisms carry out common life processes differently. **SB3b**

All organisms and systems are organized from simple parts into complex systems that must maintain homeostasis in order to survive. **SB3 b**

The millions of different species of plants, animals and microorganisms that live on earth today are related by descent from common ancestors. **SB5 b**

The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms. **SB5 b**

Modern classification systems are based upon biochemical and genetic evidence that indicates evolutionary relationships. **SB5 b**

Evolution explains the number of different life forms we see, similarities in anatomy and chemistry and sequence of changes in fossils formed over more than a billion years. **SB5 c**

Molecular evidence supports anatomical evidence from fossils about the sequence of descent. **SB5 c**

Patterns of ecological organization are similar to those of cells and organisms. **SB4 a**
## Content and Characteristics of Science Standards for Organization

<table>
<thead>
<tr>
<th>Content Standards</th>
<th>Characteristics of Science:</th>
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<tbody>
<tr>
<td><strong>SB1.</strong> Students will analyze the nature of the relationships between structures and functions in living cells.</td>
<td>SCSh1. Students will evaluate the importance of curiosity, honesty, and skepticism in science.</td>
</tr>
<tr>
<td>a. Explain the role of cell organelles for both prokaryotic and eukaryotic cells, including the cell membrane, in maintaining homeostasis and cell reproduction.</td>
<td>a. Exhibit the above traits in their own scientific activities.</td>
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<tr>
<td>c. Identify the function of the four major macromolecules (i.e. carbohydrates, proteins, lipids, nucleic acids).</td>
<td>b. Recognize that different explanations often can be given for the same evidence.</td>
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<tr>
<td><strong>SB3.</strong> Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.</td>
<td>c. Explain that further understanding of scientific problems relies on the design and execution for new experiments which may reinforce or weaken opposing explanations.</td>
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<tr>
<td>b. Compare how structures and function vary between the six kingdoms (Archaebacteria, Eubacteria, Protists, Fungi, Plants, and Animals).</td>
<td><strong>SCSh2.</strong> Students will use standard safety practices for all classroom laboratory and field investigations.</td>
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<tr>
<td>c. Examine the evolutionary basis of modern classification systems.</td>
<td>a. Follow correct procedures for uses of scientific apparatus.</td>
</tr>
<tr>
<td>d. Compare and contrast viruses with living organisms.</td>
<td>b. Demonstrate appropriate technique in all laboratory situations.</td>
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<tr>
<td><strong>SB4.</strong> Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.</td>
<td>c. Follow correct protocol for identifying and reporting safety problems and violations.</td>
</tr>
<tr>
<td>a. Investigate the relationships among organisms, populations, communities, ecosystems, and biomes.</td>
<td><strong>SCSh3.</strong> Students will identify and investigate problems scientifically.</td>
</tr>
<tr>
<td><strong>SB5.</strong> Students will evaluate the role</td>
<td>a. Suggest reasonable hypotheses for identified problems.</td>
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<td></td>
<td>b. Develop procedures for solving scientific problems.</td>
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<td>c. Collect, organize and record appropriate data.</td>
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<td>d. Graphically compare and analyze data points and/or summary statistics.</td>
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<td></td>
<td>e. Develop reasonable conclusions based on data collected.</td>
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<td>f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.</td>
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<td></td>
<td><strong>SCSh4.</strong> Students use tools and instrument for observing, measuring, and manipulating scientific equipment and materials.</td>
</tr>
<tr>
<td></td>
<td>a. Develop and use systematic procedures for recording and organizing information.</td>
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<td>b. Use technology to produce tables and graphs.</td>
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</table>
Georgia Performance Standards Framework for Science – Biology

of natural selection in the development of the theory of evolution.

| a. Trace the history of the theory. |
| b. Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution. |
| c. Explain how fossil and biochemical evidence support the theory. |

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

| a. Consider possible effects of measurement errors on calculation. |

SCSh6. Students will communicate scientific investigation and information clearly.

| a. Write clear, coherent laboratory reports related to scientific investigations. |
| b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data. |
| c. Use data as evidence to support scientific arguments and claims in written or oral presentations. |
| d. Participate in group discussions of scientific investigation and current scientific issues. |

SCSh7. Students analyze how scientific knowledge is developed.

Students recognize that:

| a. The universe is a vast single system in which the basic principles are the same everywhere. |
| b. Universal principles are discovered through observation and experimental verification. |
| c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications or prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group. |
| d. Hypotheses often cause scientists to develop new experiments that produce additional data. |
| e. Testing, revising, and occasionally rejecting new and old theories never ends. |

SCSh8. Students will understand important features of the process of scientific inquiry.

Students will apply the following to inquiry learning practices:

| a. Scientific investigators control the conditions of their |

Contextual Language:

prokaryote, eukaryote, organelle, nutrient, organization, evolution, cladogram, theory, belief, evidence, fossil record, biodiversity, classification structure, function, variation, ecological hierarchy, abiotic and biotic factors, speciation, gradualism, punctuated equilibrium, endosymbiosis, microorganism
experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9. Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas
   - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
   - Read both informational and fictional texts in a variety of genres and modes of discourse.
   - Read technical texts related to various subject areas.

c. Building vocabulary knowledge
   - Demonstrate an understanding of contextual vocabulary in various subjects.
   - Use content vocabulary in writing and speaking.
   - Explore understanding of new words found in subject area texts.

d. Establishing context
   - Explore life experiences related to subject area content.
   - Discuss in both writing and speaking how certain words are subject area related.
   - Determine strategies for finding content and contextual meaning for unknown words.
Misconceptions for Organization:

Students think that:
- Viruses are living cells. Students should understand that viruses are typically identified as intracellular obligate parasites that exhibit living characteristics only when they are functioning in a host cell.
- Only animals move. Students should understand that there are many organisms that are capable of free movement including bacteria and protists. They should also recognize that not all adult animal species are motile.
- All bacteria are harmful. Students should understand that the majority of bacterial species are beneficial. Many species play an essential role in nutrient cycling and some are involved in food production processes.
- All animals are vertebrates. Students should understand that all animals are not characterized by the presence or absence of a backbone.
- Humans are not animals. Students should understand that humans share the same basic characteristics that other animals possess.
- Mushrooms are plants. Students should understand that mushrooms are fungi because they have chitinous cell walls and are non-photosynthetic.
- Man came from monkeys. Students should understand that man is not a direct descendent of monkeys. Although evidence suggests that they share a common ancestor, the evolutionary pathway of man is still a major research topic among scientists.
- Evolution happens quickly. Students should understand that evolution generally occurs over long periods of time.
- Darwin was the only evolutionary theorist. Students should understand that many scientists have contributed to our understanding of the current theory of evolution.

Culminating Activity for Organization

Students choose from the following:
- Identification of a New Organism: Students will create a new organism. These organisms will need to have the following items addressed in an essay that will accompany the model or drawing:
  - Classify the organism into a kingdom (this will include cell type, complexity, life processes).
  - Create a cladogram to show the evolutionary history of a derived characteristic.
  - Identify this organism’s role in the environment (what would be its NICHE).
  - Provide it with a scientific name.
  - Provide a model or drawing depicting this organism.
- Outbreak at Central High School
  - Identify the organism that is responsible for the illness.
  - Classify organism into proper kingdom along with a brief description of the kingdoms evolutionary history.
Georgia Performance Standards Framework for Science – Biology

- Describe cell type and life processes.
- Describe best environment for this organism to thrive.
- A “press release” or CNN style breaking news story type format to submit findings.

Internet Resources for Organization

http://www.indiana.edu/~ensiweb/cladogen.html (This site provides background information as to the nature of cladograms.)
http://www.indiana.edu/~ensiweb/lessons/str.clad.pdf (This site provides examples of cladograms.)
http://www.indiana.edu/~ensiweb/lessons/zebra.html (This site provides a reading guide for an essay in Gould’s book Hen’s Teeth and Horse’s Toes.)
http://www.indiana.edu/~ensiweb/lessons/mclad.html#anchor95195 (This is an example of an activity for students to create a cladogram using the cytochrome c enzyme.)
http://biology.fullerton.edu/biol261/phylo/styles.html (This site provide background explanations of cladograms along with examples)
http://www.brooklyn.cuny.edu/bc/ahp/CLAS/CLAS.Clad.html (This site provides an explanation of cladograms along with a tutorial on making cladograms. This could be used as a classroom demonstration, tutorial or for make-up work.)
http://www.msnucleus.org/membership/html/k-6/1c/organ/6/lc6_3a.html (This site provides nice phylogenic tree examples and lecture notes)
http://www.sirinet.net/~jgjohnso/classification.html (This site is an explanation of the history of the taxonomy from Aristotle to modern 3 domains. It provides easy to understand descriptions of the kingdoms including derivatives of the names.)
http://www.biology.arizona.edu (This site provide a variety of activities and resources for teachers. These activities were created by individuals in the science education programs.)