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.

Unit One Focus: Organization
Life is organized at all levels from cells to biosphere.

Topics:
- Cell structure and Function
- Evolutionary History
- History of Life
- Classification of Kingdoms
- Ecosystem Structure
- Viruses

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

Unit Two Focus: Energy Transformations
Energy can be neither created nor destroyed but can be transformed from one form to another as it flows through organisms and ecosystems.

Topics:
- Chemistry of Life
- Function of Organic Molecules
- Photosynthesis
- Cellular Respiration
- Cycles of Matter
- Energy Flow
- Food Chains and Webs

Duration (Block): 22 days
Duration (Traditional): 7-9 weeks

Unit Three Focus: Growth and Heredity
Organisms must be able to grow and reproduce to ensure species survival.

Topics:
- Asexual and Sexual Reproduction
- Cell Growth
- Mendelian Genetics
- DNA and RNA Processes
- Chromosomes and Mutations
- Genetic Engineering
- DNA Technology and Cloning
- Biological Resistance
- Bioethics

Duration (Block): 22 days
Duration (Traditional): 7-9 weeks

Unit Four Focus: Equilibrium
Survival and stability require that living things maintain biological balance at all levels.

Topics:
- Cellular Transport
- Homeostasis
- Natural Selection
- Plant Adaptations
- Animal Adaptations and Behavior
- Succession
- Population Genetics

Duration (Block): 23 days
Duration (Traditional): 7-9 weeks
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.
**Growth/Heredity**

**Unit Understanding:**
Organisms must be able to grow and reproduce to ensure species survival.

**CELLS**

- The instructions for specifying the characteristics of an organism are carried in DNA, a large polymer formed from the subunits ATCG, located in the cell(s) of that organism. SB1a, SB2a,b
- Using the DNA code, cells manufacture needed proteins that determine an organism's phenotype. SB1a, SB2a,b
- Cells in sexually reproducing organisms contain two copies of each chromosome; therefore, two copies of each gene explain many features of heredity such as how variations that are hidden in one generation can be expressed in the next. SB1a, SB2b,c
- Sexual reproduction leads to diversity and asexual reproduction does not. SB2e

**ORGANISMS**

- Hereditary information, coded by DNA, is passed down from generation to generation in a predictable way. SB2c
- The development and use of technologies may cause social, moral, ethical, and legal issues. SB2f

**ECOLOGY**

- The reproductive patterns of organisms are affected by environmental conditions. SB2e, SB4d

**EVOLUTION**

- Changes in DNA occur spontaneously at low rates, some of these changes make no difference to the organism whereas others can change cells and organisms. SB2d
- Only mutations in germ cells can contribute to the variation that change an organism's offspring. SB2d, SB5e
- Favorable variations among individuals that increase the chance of survival tend to be passed onto successive generations. SB5d
## Content and Characteristics of Science for Growth and Heredity

<table>
<thead>
<tr>
<th>Content Standards</th>
<th>Characteristics of Science</th>
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<tr>
<td><strong>SB1. Students will analyze the nature of the relationships between structures and functions in living cells.</strong>&lt;br&gt;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><strong>SCSh1. Students will evaluate the importance of curiosity, honesty, and skepticism in science.</strong>&lt;br&gt;a. Exhibit the above traits in their own scientific activities.  &lt;br&gt;b. Recognize that different explanations often can be given for the same evidence.  &lt;br&gt;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><strong>SB2. Students will analyze how biological traits are passed on to successive generations.</strong>&lt;br&gt;a. Distinguish between DNA and RNA.  &lt;br&gt;b. Explain the role of DNA in storing and transmitting cellular information.  &lt;br&gt;c. Using Mendel’s laws, explain the role of meiosis in reproductive variability.  &lt;br&gt;d. Describe the relationships between changes in DNA and potential appearance of new traits including&lt;br&gt;• Alternations during replication.  &lt;br&gt;    ➢ Insertions  &lt;br&gt;    ➢ Deletions  &lt;br&gt;    ➢ Substitutions  &lt;br&gt;• Mutagenic factors that can alter DNA.  &lt;br&gt;    ➢ High energy radiation (x-rays and ultraviolet)  &lt;br&gt;    ➢ Chemical  &lt;br&gt;e. Compare the advantages of sexual reproduction and asexual reproduction in different situations.  &lt;br&gt;f. Examine the use of DNA technology in forensics, medicine, and agriculture.</td>
<td><strong>SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.</strong>&lt;br&gt;a. Follow correct procedures for uses of scientific apparatus.  &lt;br&gt;b. Demonstrate appropriate technique in all laboratory situations.  &lt;br&gt;c. Follow correct protocol for identifying and reporting safety problems and violations.</td>
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<td><strong>SCSh3. Students will identify and investigate problems scientifically.</strong>&lt;br&gt;a. Suggest reasonable hypotheses for identified problems.  &lt;br&gt;b. Develop procedures for solving scientific problems.  &lt;br&gt;c. Collect, organize and record appropriate data.  &lt;br&gt;d. Graphically compare and analyze data points and/or summary statistics.  &lt;br&gt;e. Develop reasonable conclusions based on data collected.  &lt;br&gt;f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.</td>
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### Georgia Performance Standards Framework for Science – Biology

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<th>SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.</th>
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<td>d. Assess and explain human activities that influence and modify the environment such as global warming, population growth, pesticide use, and water and power consumption.</td>
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<th>SB5. Students will evaluate the role of natural selection in the development of the theory of evolution.</th>
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<td>d. Relate natural selection to changes in organisms.</td>
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<td>e. Recognize the role of evolution to biological resistance (pesticide and antibiotic resistance).</td>
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<tr>
<th>SCSh4. Students use tools and instrument for observing, measuring, and manipulating scientific equipment and materials.</th>
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<tr>
<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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<th>SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.</th>
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<td>a. Trace the source on any large disparity between estimated and calculated answers to problems.</td>
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<td>b. Consider possible effects of measurement errors on calculation.</td>
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<td>c. Recognize the relationship between accuracy and precision.</td>
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<th>SCSh6. Students will communicate scientific investigation and information clearly.</th>
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<td>a. Write clear, coherent laboratory reports related to scientific investigations.</td>
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<td>b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.</td>
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<tr>
<td>c. Use data as evidence to support scientific arguments and claims in written or oral presentations.</td>
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<tr>
<td>d. Participate in group discussions of scientific investigation and current scientific issues.</td>
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<th>SCSh7. Students analyze how scientific knowledge is developed.</th>
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<td>Students recognize that:</td>
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<tr>
<td>a. The universe is a vast single system in which the basic principles are the same everywhere.</td>
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<td>b. Universal principles are discovered through observation and experimental verification.</td>
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<tr>
<td>c. From time to time, major shifts occur in the scientific view of how the world works.</td>
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</table>
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 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:**

- 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.

**Contextual Language:**
DNA, chromosome, sexual reproduction, RNA, allele, Mendel’s Laws, genes, inheritance, traits, genotype, cloning, phenotype, asexual reproduction, mutation, mutagenic factors, biological resistance, bioethics
Misconceptions for Growth and Heredity:

Students think that:
- All mutations are bad. Students should understand that mutations provide variations among individuals in a population. Sometimes those variations are favorable and are maintained in subsequent generations as adaptations.
- Changes in somatic (body) cells are inheritable. Students should understand that only sex cells contribute to genetic information in the next generation.
- Plants don’t reproduce sexually. Students should realize that plants reproduce both sexually and asexually.
- DNA in one organism is completely different from that in another organism. Students should understand that the basic structure of DNA is the same in all organisms. It is the sequence of nucleotides in the strands of DNA that result in different gene expressions in individuals.
- Cells within an organism have different DNA. Students should understand that the entire genetic code for an organism is identical in each and every cell of that organism.

Sample Culminating Performance Task(s):

ABC Book of Genetics

You are an author who has been asked to write an ABC children’s book about genetics. As you create this ABC book you must address:
* DNA technology
* Biological resistance
* Sexual and Asexual Reproduction
* Mendelian Genetics
* DNA & RNA processes
* Chromosomes & mutations

Requirements:
1. All letters of the alphabet must be used.
2. Each page must have a letter and a picture. The picture may be illustrated by hand or may be found on the Internet.
3. In addition to the letter and picture, each student must provide the information about genetics that is represented by that letter and be tied into one or more of the seven themes listed above.
4. DO NOT put more than one letter of the alphabet on a page.
5. You must include an example of the following in your book: DNA technology, biological resistance, chromosome mutation, point mutation, DNA translation and transcription, Mendelian genetics, asexual reproduction, and sexual reproduction.
### ABC Book of Genetics Rubric

<table>
<thead>
<tr>
<th>Evidence of Scientific Understanding</th>
<th>DNA Technology</th>
<th>Biological Resistance</th>
<th>Mutations</th>
<th>DNA Transcription and Translation</th>
<th>Mendelian Genetics</th>
</tr>
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<tbody>
<tr>
<td>Exceed Expectations</td>
<td>The student explains recombinant DNA, transgenic organisms, gene therapy, DNA fingerprinting, and gel electrophoresis; he/she also gives examples of each type of DNA technology.</td>
<td>The student explains how biological resistance is spread and how this can affect humans; he/she also gives examples of ways that humans can help to prevent biological resistance.</td>
<td>The student explains that a mutation is a change in the DNA sequence; he/she also explains the two types of mutations: chromosomal and gene mutations; one way to increase diversity.</td>
<td>The student explains that DNA transcription is the process of making a strand of mRNA from a strand of DNA; he/she also explains that translation is the process of synthesizing proteins. The student describes the steps of transcription and translation.</td>
<td>The student explains the Law of Segregation, Law of Independent</td>
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<tr>
<td>Meets Expectations</td>
<td>The student explains recombinant DNA, transgenic organisms, gene therapy, DNA fingerprinting, and gel electrophoresis.</td>
<td>The student explains how biological resistance is spread and how this can affect humans.</td>
<td>The student explains that a mutation is a change in the DNA sequence is one way to increase diversity.</td>
<td>The student explains that DNA transcription is the process of making a strand of mRNA from a strand of DNA; the student explains that translation is the process of synthesizing proteins.</td>
<td>The student explains a Punnett square and shows an example.</td>
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<tr>
<td>Does Not Meet Expectations</td>
<td>The student shows little or no evidence of an understanding of DNA technology.</td>
<td>The student shows little or no evidence of an understanding of biological resistance.</td>
<td>The student shows little or no evidence of an understanding of mutations.</td>
<td>The student shows little or no evidence of an understanding of mutations.</td>
<td>The student shows little or no evidence of</td>
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## Asexual / Sexual Reproduction

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<th>Assortment and the Law of Dominance and explains how a Punnett square is used to illustrate these laws.</th>
<th>an understanding of Mendelian genetics.</th>
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<tr>
<td></td>
<td>The student explains that asexual reproduction occurs in somatic cells, resulting from one cell (parent), and that the offspring is identical to the parent cell. The student gives examples of asexual reproduction (mitosis, binary fission, regeneration) and explains that sexual reproduction occurs when gametes come together and fuse to form an offspring that is different from the two parents. The student notes that meiosis from these gametes are used in sexual reproduction.</td>
<td>The student explains that asexual reproduction involves only one cell (parent) and that the offspring is identical to the parent cell. The student further explains that sexual reproduction involves two gametes and that the offspring is not exactly like either parent.</td>
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</tbody>
</table>

## Relevance and Relationships

|   | The letter, picture and statement are correctly related into more than one of the seven themes. | The letter, picture, and statement are correctly related to one of the seven themes. | The letter, picture, and statement are not correctly related to one of the seven themes. |
## Internet Resources for Growth and Heredity

Sample List of Appropriate Resources for Unit Growth and Heredity:

- [http://gslc.genetics.utah.edu/units/biotech/gel](http://gslc.genetics.utah.edu/units/biotech/gel)
- [http://www.actionbioscience.org/evolution/meade_callahan.html](http://www.actionbioscience.org/evolution/meade_callahan.html)
- [http://bioethicsweb.ac.uk/browse/mesh/D030342.html](http://bioethicsweb.ac.uk/browse/mesh/D030342.html)
- [http://learn.genetics.utah.edu/units/biotech/gel/](http://learn.genetics.utah.edu/units/biotech/gel/)