

# Life Science

Students know and understand the characteristics and structure of living things, the processes of life and how living things interact with each other and their environment.

## Prepared Graduates

The preschool through twelfth-grade concepts and skills that all students who complete the Colorado education system must master to ensure their success in a postsecondary and workforce setting.

### Prepared Graduate Competencies in the Life Science standard:

- Analyze the relationship between structure and function in living systems at a variety of organizational levels, and recognize living systems' dependence on natural selection
- Explain and illustrate with examples how living systems interact with the biotic and abiotic environment
- Analyze how various organisms grow, develop, and differentiate during their lifetimes based on an interplay between genetics and their environment
- Explain how biological evolution accounts for the unity and diversity of living organisms

**Content Area: Science**  
**Standard: 2. Life Science**

<b>Prepared Graduates:</b> ➤ Explain and illustrate with examples how living systems interact with the biotic and abiotic environment	
<b>Grade Level Expectation: High School</b>	
<b>Concepts and skills students master:</b> 1. Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem	
<b>Evidence Outcomes</b> <b>Students can:</b> <ol style="list-style-type: none"> <li>Analyze how energy flows through trophic levels (DOK 1-2)</li> <li>Evaluate the potential ecological impacts of a plant-based or meat-based diet (DOK 2)</li> <li>Analyze and interpret data from experiments on ecosystems where matter such as fertilizer has been added or withdrawn such as through drought (DOK 1-3)</li> <li>Develop, communicate, and justify an evidence-based scientific explanation showing how ecosystems follow the laws of conservation of matter and energy (DOK 1-3)</li> <li>Define and distinguish between matter and energy, and how they are cycled or lost through life processes (DOK 1-2)</li> <li>Describe how carbon, nitrogen, phosphorus, and water cycles work (DOK 1)</li> <li>Use computer simulations to analyze how energy flows through trophic levels (DOK 1-2)</li> </ol>	<b>21<sup>st</sup> Century Skills and Readiness Competencies</b> <b>Inquiry Questions:</b> <ol style="list-style-type: none"> <li>How does a change in abiotic factors influence the stability or progression of an ecosystem?</li> <li>What happens when the cycling of matter in ecosystems is disrupted?</li> <li>What energy transformations occur in ecosystems?</li> <li>How does the process of burning carbon-rich fossil fuels compare to the oxidation of carbon biomolecules in cells?</li> </ol> <b>Relevance and Application:</b> <ol style="list-style-type: none"> <li>When the matter or energy flow in an ecosystem is disturbed, there are measurable effects such as the eutrophication of water.</li> <li>Matter and energy are cycled in natural systems such as wetlands in both similar and different ways than in human-managed systems such as waste water treatment plants.</li> </ol> <b>Nature of Science:</b> <ol style="list-style-type: none"> <li>Address differences between experiments where variables can be controlled and those where extensive observations on a highly variable natural system are necessary to determine what is happening – such as dead zones in the Gulf of Mexico.</li> <li>Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists. (DOK 2-3)</li> <li>Design ecological experiments in a closed system. (DOK 2-4)</li> </ol>

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<b>Prepared Graduates:</b> ➤ Explain and illustrate with examples how living systems interact with the biotic and abiotic environment
<b>Grade Level Expectation: High School</b>

**Concepts and skills students master:**

2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem

**Evidence Outcomes**

**Students can:**

- a. Analyze and interpret data about the impact of removing keystone species from an ecosystem or introducing non-native species into an ecosystem (DOK 1-3)
- b. Describe or evaluate communities in terms of primary and secondary succession as they progress over time (DOK 1-2)
- c. Evaluate data and assumptions regarding different scenarios for future human population growth and their projected consequences
- d. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate ecosystem interactions (DOK 1-2)

**21<sup>st</sup> Century Skills and Readiness Competencies**

**Inquiry Questions:**

1. How do keystone species maintain balance in ecosystems?
2. How does the introduction of a non-native species influence the balance of an ecosystem?
3. How is the succession of local organisms altered in an area that is disturbed or destroyed?

**Relevance and Application:**

1. Earth's carrying capacity is limited, and as the human population grows, we must find ways to increase the production of resources all people need to live.
2. The extraction of resources by humans impacts nature ecosystems.

**Nature of Science:**

1. Critically evaluate scientific explanations in popular media to determine if the research methodology and evidence presented are appropriate and sufficient to support the claims. (DOK 2-3)

**Content Area: Science**  
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<p><b>Prepared Graduates:</b></p> <ul style="list-style-type: none"> <li>➤ Explain how biological evolution accounts for the unity and diversity of living organisms</li> </ul>	
<p><b>Grade Level Expectation: High School</b></p>	
<p><b>Concepts and skills students master:</b></p> <p>9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment</p>	
<p><b>Evidence Outcomes</b></p>	<p><b>21<sup>st</sup> Century Skills and Readiness Competencies</b></p>
<p><b>Students can:</b></p> <ol style="list-style-type: none"> <li>Develop, communicate, and justify an evidence-based scientific explanation for how Earth's diverse life forms today evolved from common ancestors (DOK 1-3)</li> <li>Analyze and interpret multiple lines of evidence supporting the idea that all species are related by common ancestry such as molecular studies, comparative anatomy, biogeography, fossil record and embryology</li> <li>Analyze and interpret data suggesting that over geologic time, discrete bursts of rapid genetic changes and gradual changes have resulted in speciation (DOK 1-3)</li> <li>Analyze and interpret data on how evolution can be driven by three key components of natural selection – heritability, genetic variation, and differential survival and reproduction (DOK 1-3)</li> <li>Generate a model – an evolutionary tree – showing how a group of organisms is most likely diverged from common ancestry (DOK 2-3)</li> </ol>	<p><b>Inquiry Questions:</b></p> <ol style="list-style-type: none"> <li>How do subtle differences among closely-related fossil species provide evidence of environmental change and speciation?</li> <li>How does studying extinct species contribute to our current understanding of evolution?</li> <li>How can patterns of characteristics shared among organisms be used to categorize life's diversity according to relatedness?</li> <li>How does modern agriculture affect biodiversity?</li> </ol> <p><b>Relevance and Application:</b></p> <ol style="list-style-type: none"> <li>Resistance can occur when antibiotics and pesticides are overused or abused.</li> <li>Human activities can generate selective pressures on organisms, such as breeding new kinds of dogs and improving livestock.</li> </ol> <p><b>Nature of Science:</b></p> <ol style="list-style-type: none"> <li>Understand that all scientific knowledge is subject to new findings and that reproducible, corroborated, and converging lines of data yield a scientific theory. (DOK 1)</li> <li>Differentiate among the use of the terms "hypothesis," "theory," and "law" as they are defined and used in science compared to the usage of these terms in other disciplines or everyday use. (DOK 1-2)</li> </ol>