Grade 3 Science, Unit 7

Using Evidence to Understand Change in Environments

Overview

Unit abstract

In this unit of study, students are expected to develop an understanding of the types of organisms that lived long ago and also about the nature of their environments. Third graders are expected to develop an understanding of the idea that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. The crosscutting concepts of systems and system models; scale, proportion, and quantity; and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, analyzing and interpreting data, and engaging in argument from evidence. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential questions

- How are plants, animals, and environments of the past similar or different from current plants, animals, and environments?
- What happens to organisms when their environment changes?

Bristol–Warren, Central Falls, Cranston, Tiverton, and Woonsocket, with process support from The Charles A. Dana Center at the University of Texas at Austin

Written Curriculum

Next Generation Science Standards

3. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: Moved from K–2)* (3-LS4-1)
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

Crosscutting Concepts

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods. (3-LS4-1)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems. (3-LS4-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **4.ESS1.C** (3-LS4-1); **MS.LS2.A** (3-LS4-1) **MS.LS4.A** (3-LS4-1); **MS.ESS1.C** (3-LS4-1); **MS.ESS2.B** (3-LS4-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS4-1)*

RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS4-1)*

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS4-1)*

W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-LS4-1)*

W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS4-1)*

W.3.9 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-LS4-1)*

MP.4 Model with mathematics. *(3-LS4-1)*

MP.5 Use appropriate tools strategically. *(3-LS4-1)*

3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS4-1)*

3. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

3-LS4-4. **Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. *** [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds. ▪ Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** ▪ When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary to 3-LS4-4)* **LS4.D: Biodiversity and Humans** ▪ Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)	**Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (3-LS4-4)

Connections to other DCIs in third grade: **3.ESS3.B** (3-LS4-4)

Articulation of DCIs across grade-levels: **K.ESS3.A** (3-LS4-4); **K.ETS1.A** (3-LS4-4); **2.LS2.A** (3-LS4-4); **2.LS4.D** (3-LS4-4); **4.ESS3.B** (3-LS4-4); **4.ETS1.A** (3-LS4-4); **MS.LS2.A** (3-LS4-4); **MS.LS2.C** (3-LS4-4); **MS.LS4.C** (3-LS4-4); **MS.ESS1.C** (3-LS4-4); **MS.ESS3.C** (3-LS4-4)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS4-4)*

RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3LS4-4)*

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS4-4)*

W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-LS4-4)*

W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS4-4)*

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS4-4)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-LS4-4)*

MP.4 Model with mathematics. *(3-LS4-4)*

3-5. Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)	**Influence of Science, Engineering, and Technology on Society and the Natural World** ▪ People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4

Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1)

Common Core State Standards Connections:

ELA/Literacy –

W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1)*

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-5-ETS1-1)*

MP.4 Model with mathematics. *(3-5-ETS1-1)*

MP.5 Use appropriate tools strategically. *(3-5-ETS1-1)*

3-5.OA Operations and Algebraic Thinking *(3-5-ETS1-1)*

Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study.

By the end of kindergarten, students know that:

- Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.

By the end of the K–2 grade span, students know that:

- A situation that people want to change or create can be approached as a problem that can be solved through engineering. Such problems may have many acceptable solutions.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

By the end of Grade 2, students should know that:

- Plants depend on water and light to grow.
- Plants depend on animals for pollination or to move their seeds around.
- There are many different kinds of living things in any area, and they exist in different places on land and in water.

Progression of current learning

Driving question 1
How can we learn about organisms and environments from long ago using fossils?

Concepts	Practices
• Observable phenomena exist from very short to very long periods of time. • Science assumes consistent patterns in natural systems. • Some kinds of plants and animals that once lived on Earth are no longer found anywhere. • Fossils provide evidence about the types of organisms that lived long ago, and also about the nature of their environments.	• Observe that phenomena exist from very short to very long periods of time. • Analyze and interpret data to make sense of phenomena using logical reasoning. • Analyze and interpret data from fossils (e.g., type, size, distributions of fossil organisms) to provide evidence of the organisms and the environments in which they lived long ago. (Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.) Examples of fossils and environments could include: – Marine fossils found on dry land; – Tropical plant fossils found in Arctic areas; – Fossils of extinct organisms.

Driving question 2
What happens to plants and animals as the environment changes?

Concepts	Practices
• A system can be described in terms of its components and their interactions. • People's needs and wants change over time, as do their demands for new and improved technologies. • Populations live in a variety of habitats, and change in those habitats affects the organisms living there. • When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, others move into the transformed environment, and some die. • Possible solutions to a problem are limited by available materials and resources (constraints). • The success of a designed solution is determined by considering the desired features of a solution (criteria). • Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	• Describe a system in terms of its components and interactions. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of a problem. • Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. (Assessment is limited to a single environmental change and does not include the greenhouse effect or climate change.) Examples of environmental changes could include changes in – Land characteristics, – Water distribution, – Temperature, – Food, – Other organisms. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and that includes several criteria for success and constraints on materials, time, or cost. • Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.

Integration of content, practices, and crosscutting concepts

In this unit of study, students gather evidence from fossils to learn about the types of organisms that lived long ago and the nature of their environments. As they learn about organisms from long ago, they come to understand that when the environment changes, some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.

To begin the progression of learning in this unit, students need multiple opportunities to study fossils. If actual fossils are not available, pictures and diagrams found in books and other media sources can be used. Students should observe fossils of a variety of organisms, both plant and animal, and they should observe diagrams of fossils within layers of rock. As students examine each fossil, they should be asked to identify whether the organism lived on land or in water and to give evidence to support their thinking. As students examine diagrams of fossils in layers of rock, they should be asked to identify the type of environment that existed

when the layers of rock were formed. Students should consider the types of organisms that are fossilized in the rock layers in order to provide evidence to support their thinking.

If the type of environment in which the fossil was found is different from the type of environment that might have existed when the organism lived (e.g., marine fossils found on dry land, or tropical plant fossils found in Arctic areas), this would provide the opportunity to ask students to think about the types of changes that might have occurred in the environment and what effects these changes might have had on the organisms that lived in the environment as it changed over time. As students observe and analyze fossils, they learn that fossils provide evidence about the types of organisms that lived long ago and the nature of their environments. They also learn that some kinds of plants and animals that once lived on Earth are no longer found anywhere, and that this could be a result of changes that occurred in the environment.

During this unit, students also learn that populations of organisms live in a variety of habitats, and change in those habitats affects the organisms living there. When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms will survive and reproduce, some will move to new locations, others will move into the transformed environment, and others will die. Students will need the opportunity to engage in a portion of the ***engineering design process*** in order to investigate the merit of solutions to problems caused when the environment changes. This process should include the following steps:

- Students brainstorm a list of environmental changes that might affect the organisms that live in the environment. This could include changes in
  - Land characteristics,
  - Water distribution,
  - Temperature,
  - Food,
  - Other organisms.
- As a class or in small groups, students define a problem that occurs when the environment changes. For example, if the distribution of water changes, the available water may no longer support the types of organisms that are found in the environment.
- As a class, determine criteria that can be used to weigh a possible solution's viability. For example, the response (solution) to the problem should not result in the extinction of a species.
- Small groups conduct research, using books and other reliable media sources, to determine possible solutions/ways in which organisms can solve the problem. For example, if the available water supply is no longer adequate for the organisms in the environment, there are a number of ways in which organisms respond (i.e., solve the problem); these include:
  - Plants do not grow as large as before (shorter plant, smaller or fewer leaves);
  - Fewer seeds germinate, thereby resulting in a smaller population;
  - Herd animals may move to another environment where the water supply is adequate;
  - Populations of some species may decrease, either through lower rate of reproduction or death;
  - Some populations completely die out; or
  - Other organisms (plants and animals) that require less water to survive may move into the environment.
- Students make claims about the merit of each of the various responses (solutions) by organisms based on how well the responses meet criteria; students use research data as evidence to support their thinking.

At every stage, communicating with peers is an important part of the design process. Students should identify cause-and-effect relationships throughout the process and use these relationships to explain the changes that might occur in the environment and in the populations of organisms that live there.

Integration of engineering

In this unit, students will study fossils or organisms that lived long ago. Students will use that understanding to make a claim about the merit of a solution to problem created by some environmental change. (Assessment is limited to one change.) Additionally, they will learn that solutions are limited by available resources (constraints), and that the success of a solution is determined by considering the desired features of a solution (criteria). This process is outlined in greater detail in the previous section.

Integration of DCI from prior units within this grade level

In Unit 1, Weather and Climate, students learned that a variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards, but can take steps to reduce their impacts. In Unit 6, Organisms and the Environment, students learned that organisms and their habitats make up a system in which environmental factors affect the growth and survival of every type of organism, and organisms in turn affect the environment.

In this unit, students use their understanding of environmental factors and their effect on an organism's ability to survive to investigate organisms that lived long ago and the nature of the environments in which they lived.

Integration of English language arts and mathematics

English language arts

In order to connect the CCSS for English language arts, students use content-specific print and digital sources such as books, articles, and other reliable media to observe and analyze fossils, and they use their observations to describe the types of organisms that lived in the past and characteristics of the environments in which they lived. When using these types of resources, students should determine the main idea and key details and use this information as evidence to support their thinking. They should take notes as they read and observe and use their notes as they write opinion and/or informational/explanatory pieces that convey information and ideas about organisms, both past and present, and their environments. As students discuss and write about the effects of a changing environment on organisms, they should ask and answer questions to demonstrate understanding and should cite evidence from their observations or from texts to support their thinking. Third graders should also have the opportunity to use their work to report on their findings about the effects of a changing environment on organisms living today, as well as those that lived in the past. Students should use appropriate facts and relevant descriptive details as they report out, speaking clearly at an understandable pace.

Mathematics

In order to connect the CCSS for mathematics, students generate measurement data using appropriate tools, such as rulers marked with halves and fourths of an inch, and show the data by making a line plot where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. For example, students could make a line plot to show the length of a variety of fossils, then use that data, as well as other observational data, to make comparisons to modern-day organisms and to support their thinking. Questions such as the ones below might be used to guide students' analysis of data.

- Do any of the fossilized organisms resemble organisms that we see today? In what ways?
- Can you make any inferences about a fossilized organism's way of life based on size, body style, external features, or other similarities to modern-day organisms? (Where might it have lived? What might it have eaten? How might it have moved? Could it have been part of a group?)

Students would also reason abstractly and quantitatively when analyzing and interpreting data, such as the type, size, and distribution of fossil organisms found in a given area, or when looking at data collected by scientists over time. Students could model with mathematics when creating scaled models of fossils or when comparing past organisms to present-day organisms.

Future learning

The following disciplinary core ideas are future learning for the concepts in this unit of study.

By the end of Grade 4, students know that:

- Local, regional, and global patterns of rock formations reveal changes over time due to Earth's forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.
- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate hazards but can take steps to reduce their impacts.
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of the designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

By the end of middle school, students know that:

- Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.
- Growth of organisms and population increases are limited by access to resources.
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in its populations.
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.
- The collection of fossils and their placement in chronological order (e.g., through the location of sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
- Anatomical similarities and differences between various organisms living today, and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.
- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully formed anatomy.

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes to environmental conditions. Traits that support successful survival and reproduction in the new environment become more common, and those that do not become less common. Thus the distribution of traits in a population changes.
- The geological timescale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
- Tectonic processes continually generate new ocean sea floor at ridges, and destroy old sea floor at trenches.
- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.
- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge likely to limit possible solutions.
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.
- Models of any kind are important for testing solutions.

Number of Instructional Days

Recommended number of instructional days: 15 (1 day = approximately 45–60 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.