Grade 2 Science, Unit 5

Changes to Earth's Land

Overview

Unit abstract

In this unit of study, students are able to apply their understanding of the idea that wind and water can change the shape of land to compare design solutions to slow or prevent such change. The crosscutting concepts of stability and change; structure and function; and 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 second grade performance expectations, students are expected to demonstrate grade-appropriate appropriate proficiency in asking questions and defining problems, developing and using models, and constructing explanations and designing solutions. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential question

- How does land change and what are some things that cause it to change?

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

2. Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

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
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)	**ESS1.C: The History of Planet Earth** ▪ Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)	**Stability and Change** ▪ Things may change slowly or rapidly. (2-ESS1-1)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **3.LS2.C** (2-ESS1-1); **4.ESS1.C** (2-ESS1-1); **4.ESS2.A** (2-ESS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. *(2-ESS1-1)*

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1)

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(2-ESS1-1)*

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1)

SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. (2-ESS1-1)

Mathematics –

MP.4 Model with mathematics. *(2-ESS1-1)*

2.NBT.A Understand place value. (2-ESS1-1)

2. Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. *** [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

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
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Compare multiple solutions to a problem. (2-ESS2-1)	**ESS2.A: Earth Materials and Systems** ▪ Wind and water can change the shape of the land. (2-ESS2-1) **ETS1.C: Optimizing the Design Solution** ▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. *(secondary to 2-ESS2-1)*	**Stability and Change** ▪ Things may change slowly or rapidly. (2-ESS2-1) --- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Developing and using technology has impacts on the natural world. (2-ESS2-1) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** ▪ Scientists study the natural and material world. (2-ESS2-1)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (2-ESS2-1); **4.ESS2.A** (2-ESS2-1); **4.ETS1.A** (2-ESS2-1); **4.ETS1.B** (2-ESS2-1); **4.ETS1.C** (2-ESS2-1); **5.ESS2.A** (2-ESS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. *(2-ESS2-1)*

RI.2.9 Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-ESS2-1)*

MP.4 Model with mathematics. *(2-ESS2-1)*

MP.5 Use appropriate tools strategically. *(2-ESS2-1)*

2.MD.B.5 Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. *(2-ESS2-1)*

K-2. Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

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 K–2 builds on prior experiences and progresses to simple descriptive questions. ▪ Ask questions based on observations to find more information about the natural and/or designed world. (K-2-ETS1-1) ▪ Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) ▪ Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) ▪ Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)	N/A

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

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

Common Core State Standards Connections:
ELA/Literacy –
RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (K-2-ETS1-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-1)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1)
Mathematics –
MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1)*
MP.4 Model with mathematics. *(K-2-ETS1-1)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(K-2-ETS1-1)*

K-2. Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

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
Developing and Using Models Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. ▪ Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)	**ETS1.B: Developing Possible Solutions** ▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)	**Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

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

Common Core State Standards Connections:
ELA/Literacy –
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

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 the K-2 grade span, students know that:

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- 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.
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Progression of current learning

Driving question 1
What evidence can we find to prove that Earth events can occur quickly or slowly?

Concepts	Practices
• Some events happen very quickly; others occur very slowly over a time period much longer than one can observe. • Things may change slowly or rapidly.	• Make observations from several sources to construct an evidence-based account for natural phenomena. • Use information from several sources to provide evidence that Earth events can occur quickly or slowly. (Assessment does not include quantitative measurements of timescales.) Some examples of these events include: – Volcanic explosions – Earthquakes – Erosion of rocks.

Driving question 2
In what ways do humans slow or prevent wind or water from changing the shape of the land?

Concepts

- Things may change slowly or rapidly.
- Developing and using technology has impacts on the natural world.
- Scientists study the natural and material world.
- The shape and stability of structures of natural and designed objects are related to their function(s).
- Wind and water can change the shape of the land.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- 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.
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

Practices

- Compare multiple solutions to a problem.
- Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Examples of solutions could include:
  - Different designs of dikes and windbreaks to hold back wind and water
  - Different designs for using shrubs, grass, and trees to hold back the land.
- Ask questions based on observations to find more information about the natural and/or designed world.
- Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- Define a simple problem that can be solved through the development of a new or improved object or tool.
- Develop a simple model based on evidence to represent a proposed object or tool.
- Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Integration of content, practices, and crosscutting concepts

In this unit of study, students will use evidence from several sources to develop an understanding that Earth events can occur quickly or slowly. Because some events happen too quickly too observe, and others too slowly, we often rely on models and simulations to help us understand how changes to the surface of the Earth are caused by a number of different Earth events. For example,

- Volcanic eruptions are Earth events that happen very quickly. As volcanic eruptions occur, ash and lava are quickly emitted from the volcano. The flow of lava from the volcano causes immediate changes to the landscape as it flows and cools.
- Flooding can happen quickly during events such as hurricanes and tsunamis. Flooding can cause rapid changes to the surface of the Earth.

- Rainfall is an event that recurs often over long periods of time and will gradually lead to the weathering and erosion of rocks and soil.

In order to gather information to use as evidence, students need to make observations. They can easily look for evidence of changes caused by rain, flooding, or drought. However, actually observing Earth events as they happen is often not possible; therefore, students will need opportunities to observe different types of Earth events using models, simulations, video, and other media and online sources. At this grade level, quantitative measurements of timescales are not important. Students do need to see the kinds of changes that Earth events cause, and whether the changes are rapid or slow.

Engaging in engineering design helps students understand that a situation that people want to change or create can be approached as a problem to be solved through engineering. Asking questions, making observations, and gathering information are helpful in clearly understanding the problem. Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. In this unit of study, students need the opportunity to engage in the ***engineering design process*** in order to generate and compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Students are not expected to come up with original solutions, although original solutions are always welcome. The emphasis is on asking questions, making observations, and gathering information in order to compare multiple solutions designed to slow or prevent wind or water from changing the land. This process should include the following steps:

- As a class, with teacher guidance, students brainstorm a list of natural Earth events, such as a volcanoes, earthquakes, tsunamis, or floods. The class selects one Earth event to research in order to gather more information.
- As a class or in small groups, with guidance, students conduct research on the selected Earth event using books and other reliable sources. They gather information about the problems that are caused by the selected event, and gather information on the ways in which humans have minimized the effects of the chosen earth event. For example,
  - Different designs of dikes or dams to hold back water,
  - Different designs of windbreaks to hold back wind, or
  - Different designs for using plants (shrubs, grass, and/or trees) to hold back the land.
- Next, students look for examples in their community of ways that humans have minimized the effect of natural Earth events. This can be accomplished through a nature walk or short hike around the schoolyard, during a field trip, or students can make observations around their own neighborhoods. If available, students can carry digital cameras (or other technology that allows them to take pictures) in order to document any examples they find.
- Groups select one solution they have found through research and develop a simple sketch, drawing, or physical model to illustrate how it minimizes the effects of the selected Earth event.
- Groups should prepare a presentation using their sketches, drawings, or models, and present them to the class.

Integration of engineering

In this unit of study, students learn that a situation that people want to change or create can be approached as a problem to be solved through engineering. Before beginning to design a solution, it is important to clearly understand the problem, and asking questions, making observations and gathering information are helpful in thinking about and clarifying problems. Students learn that designs can be conveyed through sketches, drawings, or physical models, and that these representations are useful in communicating ideas for a problem's solutions to other people. As outlined in the narrative above, students will develop simple sketches or drawings showing how humans have helped minimized the effects of a chosen Earth event.

Integration of DCI from other units within this grade level

Other connections to disciplinary core ideas within this grade level are found in engineering design. These connections can be found in Unit 1, Relationships in Habitats, and Unit 2, Properties of Matter.

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- 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.
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Integration of English language arts and mathematics

English language arts

In order to integrate the CCSS for English language arts into this unit, students participate in shared research to gather information about Earth events from texts and other media and digital resources. They will use this information to answer questions and describe key ideas and details about ways in which the land can change and what causes these changes. Students should also have opportunities to compose a writing piece, either independently or collaboratively with peers, using digital tools to produce and publish their writing. Students should describe connections between Earth events and the changes they cause, and they should include photographs, videos, poems, dioramas, models, drawings, or other visual displays of their work, when appropriate, to clarify ideas, thoughts, and feelings.

Mathematics

The CCSS for mathematics can be integrated into this unit in a number of ways. Students have multiple opportunities to reason abstractly and quantitatively as they gather information from media sources. Students can organize data into picture graphs or bar graphs in order to make comparisons. For example, students can graph rainfall amounts. Students can use the data to solve simple addition and subtraction problems using information from the graphs to determine the amount of change that has occurred to local landforms. For example, a gulley was 17 inches deep before a rainstorm and 32 inches deep after a rainstorm. How much deeper is it after the rainstorm? Students must also have an understanding of place value as they encounter the varying timescales on which Earth events can occur. For example, students understand that a period of thousands of years is much longer than a period of hundreds of years, which in turn is much longer than a period of tens of years. In addition, teachers should give students opportunities to work with large numbers as they describe length, height, size, and distance when learning about Earth events and the changes they cause. For example, students might write about a canyon that is 550 feet deep, a river that is 687 miles long, or a forest that began growing about 200 years ago.

Future learning

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

By the end of Grade 3, students will know that:

- 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.

By the end of Grade 4, students will 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.
- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

By the end of Grade 5, students will know that:

- Earth's major systems are the geosphere (solid and molten rock, soil, sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climates. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

By the end of the 3–5 grade span, students will know that:

- 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.
- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of a design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Number of Instructional Days

Recommended number of instructional days: 30 (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.