Grade 3 Science, Unit 1

Weather and Climate

Overview

Unit abstract

In this unit of study students organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. The crosscutting concepts of patterns, cause and effect, 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 third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, analyzing and interpreting data, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

Essential questions

- What is typical weather in different parts of the world and during different times of the year?
- How can the impact of weather-related hazards be reduced?

Written Curriculum

Next Generation Science Standards[1]

3. Weather and Climate

Students who demonstrate understanding can:

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include 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
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. ▪ Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)	**ESS2.D: Weather and Climate** ▪ Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)	**Patterns** ▪ Patterns of change can be used to make predictions. (3-ESS2-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.ESS2.D** (3-ESS2-1); **4.ESS2.A** (3-ESS2-1); **5.ESS2.A** (3-ESS2-1); **MS.ESS2.C** (3-ESS2-1); **MS.ESS2.D** (3-ESS2-1)

Common Core State Standards Connections:

Mathematics –

MP.2 Reason abstractly and quantitatively. (3-ESS2-1)

MP.4 Model with mathematics. (3-ESS2-1)

MP.5 Use appropriate tools strategically. *(3-ESS2-1)*

3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-ESS2-1)*

3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)

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3. Weather and Climate		
Students who demonstrate understanding can: **3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.**		
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 **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. ▪ Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)	**Disciplinary Core Ideas** **ESS2.D: Weather and Climate** ▪ Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)	**Crosscutting Concepts** **Patterns** ▪ Patterns of change can be used to make predictions. (3-ESS2-2)
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-levels: **MS.ESS2.C** (3-ESS2-2); **MS.ESS2.D** (3-ESS2-2)		
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-ESS2-2)* **RI.3.9** Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) **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-ESS2-2) *Mathematics –* **MP.2** Reason abstractly and quantitatively. (3-ESS2-2) **MP.4** Model with mathematics. (3-ESS2-2)		

3. Weather and Climate		
Students who demonstrate understanding can: **3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]		
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 world(s). ▪ 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-ESS3-1)	**ESS3.B: Natural Hazards** ▪ A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*	**Cause and Effect** ▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1) ------------------------------------- ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Engineering, Technology, and Science on Society and the Natural World** ▪ Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3-ESS3-1) ------------------------------------- ***Connections to Nature of Science*** **Science is a Human Endeavor** ▪ Science affects everyday life. (3-ESS3-1)
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-levels: **K.ESS3.B** (3-ESS3-1); **K.ETS1.A** (3-ESS3-1); **4.ESS3.B** (3-ESS3-1); **4.ETS1.A** (3-ESS3-1); **MS.ESS3.B** (3-ESS3-1)		
Common Core State Standards Connections: *ELA/Literacy –* **W.3.1** Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-ESS3-1)* **W.3.7** Conduct short research projects that build knowledge about a topic. *(3-ESS3-1)* *Mathematics –* **MP.2** Reason abstractly and quantitatively. *(3-ESS3-1)* **MP.4** Model with mathematics. *(3-ESS3-1)*		

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:

- Weather is the combination of sunlight, wind, snow, or rain and temperature of a particular region at a particular time. People measure these conditions to describe and measure weather and to notice patterns over time.
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that communities can prepare for and respond to these events.

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.

Progression of current learning

Driving question 1

How can typical weather conditions in a particular season be described?

Concepts	Practices
• Patterns of change can be used to make predictions. • Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	• Make predictions using patterns of change. • Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. • Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. (Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.) Examples of data could include: – Average temperature – Precipitation – Wind direction

Driving question 2

How can climates in different regions of the world be described?

Concepts	Practices
• Patterns of change can be used to make predictions. • Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over years.	• Make predictions using patterns of change. • Obtain and combine information from books and other reliable media to explain phenomena.

Driving question 3

In what ways can weather-related hazards be reduced?

Concepts	Practices
• Cause-and-effect relationships are routinely identified, tested, and used to explain change. • Science affects everyday life. • People's needs and wants change over time, as do their demands for new and improved technologies. • A variety of natural hazards result from natural processes. • Humans cannot eliminate natural hazards but can take steps to reduce their impacts. • Engineers improve technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). • 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 criteria for success or how well each takes the constraints into account.	• Identify and test cause-and-effect relationships to explain change. • 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. • Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. Examples of design solutions to weather-related hazards could include: – Barriers to prevent flooding – Wind-resistant roofs – Lightning rods • Define a simple design problem that can be solved through the development of an object, tool, process, or system and include several criteria for success and constraints on materials, time, or cost. • Define a simple design problem reflecting a need or a 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 organize and use data to describe typical weather conditions expected during a particular season. They notice patterns as they analyze and interpret weather data, and they use this data to determine cause-and-effect relationships. By applying their understanding of weather-related hazards, students make claims about the merit of a design solution that reduces the impacts of such hazards, using evidence to support their claims.

Initially, students learn that scientists record patterns of weather across different times and locations in order to make predictions about future weather conditions. To understand how scientists use weather data, students need time, tools, and resources (both print and digital) to collect weather data. They can use a variety of tools (e.g., thermometers, anemometers, rain gauges) to collect firsthand data and multiple resources (e.g., Weather Bug, NOAA) to gather weather data that has been collected over longer periods of time. Multiple units of measurement (e.g., m, cm, °C, km/hr) should be used when recording weather conditions such as temperature, types and amounts of precipitation, and wind direction and speed. To organize the data they collect, students create graphical displays (bar graphs and pictographs) and tables. Once a sufficient amount of data is collected, students need opportunities to analyze data, looking for patterns of change that can be used to make predictions about typical weather conditions for a particular region and time of year. As they collect and analyze data over time, students learn that certain types of weather tend to occur in a given area and that combinations of weather conditions lead to certain types of weather (e.g., it is always cloudy when it rains or snows, but not all types of clouds bring precipitation).

Weather is a combination of sunlight, wind, precipitation, and temperature in a particular region at a particular time. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over the years. After learning to analyze and use data to make weather predictions, students use long-term patterns in weather to describe climates in a variety of regions around the world. To accomplish this, students use books and other reliable media to obtain information and weather data collected over a long period of time for a variety of regions. With guidance, students analyze the available data and information in order to describe the climate (e.g., average temperatures, average precipitation, average amount of sunlight) in each region.

Science affects everyday life. Whenever people encounter problems, engineers use scientific knowledge to develop new technologies or improve existing ones to solve our day-to-day problems.

After studying weather and climate, students investigate how weather-related hazards can be reduced. Students learn that there are a variety of natural hazards that result from severe weather. Severe weather, such as high winds, flooding, severe thunderstorms, tornados, hurricanes, ice or snowstorms, dust storms, or drought, has the potential to disrupt normal day-to-day routines and cause damage or even loss of life. While humans cannot eliminate natural hazards, they can take steps to reduce their impact. Students can use trade books and media resources to research types of severe weather hazards and their effects on communities and find examples of how communities solve problems caused by severe weather. As a class, students determine the types of severe weather that are common to the local area and discuss the effects on the community. (Define the problem.) In pairs or small groups, students can research ways that the community reduces the effects of severe weather. (Determine ways in which the problem is solved.) Given criteria, groups can determine how well each solution reduces the effects of severe weather. Groups can also prepare a presentation that

- Describes the solution that the group thinks is best for reducing the effects of a given type of weather hazard,
- Lists evidence to support their thinking, and
- Lists at least one possible constraint, such as materials, time, or cost.

Integration of engineering

Engineering is integrated into this unit of study as students define a simple design problem reflecting the need to reduce the affects of severe weather. Students discuss criteria that could be used to determine the success of existing design solutions and determine possible constraints on material, time, or cost. After conducting research, teams of students make claims about the merit of design solutions that reduce the impacts of a weather-related hazard and cite evidence of how the solutions meet the criteria and constraints of the problem.

Integration of and English language arts and mathematics

Mathematics

As students engage in the science described in this unit of study, they use books and other reliable media resources to collect weather and climate information for a given region. They compare information found in two different texts and use information to answer questions about weather and climate. To integrate writing, students can take brief notes as they conduct research and sort evidence into provided categories. Opinion pieces and short research projects should be included to build knowledge about weather and climate.

English language arts

Like literacy, mathematics is integrated in a variety of ways. Students use appropriate tools and units of measure when collecting and recording weather and climate data. They model with mathematics when organizing data into scaled bar graphs, pictographs, and tables. Throughout the unit, students reason abstractly and quantitatively as they analyze and compare weather data. They will use that information to answer questions and solve multistep problems.

Future learning

By the end of grade 4, students know that:

- 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, soil, and sediments into smaller particles and move them around.
- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.

By the end of grade 5, students know that:

- Earth's major systems are the geosphere (solid and molten rock, soil, and 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 climate. 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.

By the end of middle school, students know that:

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as via downhill flows on land.

- The complex patterns of the changes and movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Global movements of water and its changes in form are propelled by sunlight and gravity.
- Variations in density in the ocean due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- Water movements—both on land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.
- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events.
- The more precisely a task's criteria and constraints can be defined, the more likely it is that the design 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 all kind are important for testing solutions.

Number of Instructional Days

Recommended number of instructional days: 12 (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.