Unit 1: Weather and Climate

Instructional Days: 15

Unit Summary
What is the typical weather near our home? ***How can we protect people from weather-related hazards?*** 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 the *influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for these disciplinary core ideas. Students demonstrate grade-appropriate proficiency in a*sking questions and defining problems, analyzing and interpreting data, engaging in argument from evidence*, and *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on 3-ESS2-1, 3-ESS2-2, 3-ESS3-1, and 3-5-ETS1-1.
Student Learning Objectives
Develop a model using an analogy, to describe how weather and climate are related**. (ESS2.D)** *[Note: This SLO is based on the disciplinary core ideas found in the Framework. It is intended to serve as a scaffold to 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.]* **(3-ESS2-1)**
Obtain and combine information to describe climates in different regions of the world. (3-ESS2-2)
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.]* **(3-ESS3-1)**

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3-ESS2-1	Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season
3-ESS2-2	Obtain and combine information to describe climates in different regions of the world
3-ESS3-1	Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard
ESS2.D	Develop a model using an analogy, to describe how weather and climate are related**.**
ESS3.B	A variety of natural hazards result from natural processes

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Enduring Understandings
• The weather is just the state of the atmosphere at any time, including things such as temperature, precipitation, air pressure and cloud cover. Daily changes in the weather are due to winds and temperatures. • Seasonal changes are due to the Earth revolving around the sun. • Weather patterns repeat themselves at certain time of the year and studying these patterns helps us predict future weather patterns. • Animals, plants, and wind patterns can help predict the weather.
Essential Questions
• How can recording weather patterns at different times help scientists make predictions for what kind of weather might happen next? • How does a range of climate affect an area over time? • How can we prevent or reduce the damage and impact that extreme weather can have on our environment? Why do some areas survive and recover from natural hazards while other areas do not? • What is the relationship between natural processes and natural hazards? • What can you learn from testing possible solutions? How are they impacted by time, cost or materials?

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Unit Sequence	
Part A: *Can we predict the kind of weather that we will see in the spring, summer, autumn, or winter?*	
Concepts	**Formative Assessments**
• Patterns of change can be used to make predictions. • People record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.	*Students who understand the concepts can:* • Make predictions using patterns of change. • Represent data in tables, 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

Unit Sequence	
Part B: *How can climates in different regions of the world be described?*	
Concepts	**Formative Assessments**
• 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.	*Students who understand the concepts can:* • Make predictions using patterns of change. • Obtain and combine information from books and other reliable media to explain phenomena.

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Unit Sequence	
Part B: *How can we protect people from natural hazards such as flooding, fast wind, or lightening?*	
Concepts	**Formative Assessments**
• 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 (e.g., *flooding, fast wind, or lightening).* • 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.	*Students who understand the concepts can:* • 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.

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What It Looks Like in the Classroom
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-

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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.

Connecting with English Language Arts/Literacy and Mathematics

English Language Arts/Literacy

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.

Mathematic

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.

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Modifications
(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities. • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

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Research on Student Learning
N/A

Prior Learning
Kindergarten Unit 3: Weather • Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the 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 the communities can prepare for and respond to these events. • Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary)*

Future Learning
Grade 4 Unit 1: Weathering and Erosion • 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. **Grade 4 Unit 5: Transfer of Energy** • 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. **Grade 4 Unit 7: Using Engineering Design with Force and Motion Systems** • 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. *(secondary)* **Grade 5 Unit 5: Earth Systems**

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- 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.

Connections to Other Units

The Disciplinary Core Ideas in this unit are not related to other units in this grade.

Sample of Open Education Resources

Weather Science content for Kids and Teens: The National Weather Service has several education resources available at this website.

NOAA Education Resources: The National Oceanic and Atmospheric Administration (NOAA) provides education resources at this website.

(Note: Students in grades Kindergarten, 4, and 5 make sense of weather and climate. Each model science unit related to Weather and Climate will include these two websites. Therefore, it is important that teachers of science in these grades to collaborate to prevent redundancy in the K-5 weather and climate curriculum.)

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Teacher Professional Learning Resources
Teaching NGSS in Elementary School—Third Grade Carla Zembal-Saul, Professor of Science Education at Penn State University, Mary Starr, Executive Director of Michigan Mathematics and Science Centers Network, Kathy Renfrew, K-5 Science Coordinator for VT Agency of Education and Kimber Hershberger, co-author of "What's Your Evidence?" introduced an overview of the NGSS for Third Grade. The web seminar began with explaining how to unpack the performance expectations. It continued with a focus on scientific practices in relation to the specific standard and performance expectations. Science talk - what it looks like and sounds like, and how to use it in the classroom, as well as claims, evidence and reasoning strategies were discussed. Visit the resource collection. Continue discussing this topic in the community forums. **NSTA Web Seminar: Teaching NGSS in K-5: Constructing Explanations from Evidence** Carla Zembal-Saul, Mary Starr, and Kathy Renfrew, provided an overview of the *NGSS* for K-5th grade. The web seminar focused on the three dimensional learning of the *NGSS*, while introducing CLAIMS-EVIDENCE-REASONING (CER) as a framework for introducing explanations from evidence. The presenters highlighted and discussed the importance of engaging learners with phenomena, and included a demonstration on using a KLEWS chart to map the development of scientific explanations of those phenomena. To view related resources, visit the resource collection. Continue discussing this topic in the community forums. **NGSS Core Ideas: Earth's Systems** The presenter was Jill Wertheim from National Geographic Society. The program featured strategies for teaching about Earth science concepts that answer questions such as "What regulates weather and climate?" and "What causes earthquakes and volcanoes?"

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Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about changes in the way *NGSS* addresses these ideas compared to previous common approaches. Participants had the opportunity to submit questions and share their feedback in the chat.

Continue the discussion in the community forums.

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Appendix A: NGSS and Foundations for the Unit		
Develop a model using an analogy, to describe how weather and climate are related**.** **(ESS2.D)** *[Note: This SLO is based on the disciplinary core ideas found in the Framework. It is intended to serve as a scaffold to 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.]* **(3-ESS2-1)**		
Obtain and combine information to describe climates in different regions of the world. (3-ESS2-2)		
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.]* **(3-ESS3-1)**		
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**
Planning and Carrying Out Investigations • Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1),(2-LS2-1) **Analyzing and Interpreting Data** • 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) • Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)	**Patterns** • Patterns of change can be used to make predictions. (3-ESS2-1),(3-ESS2-2) **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1) --- ***Connections to Engineering,***

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Engaging in Argument from Evidence • 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) **Obtaining, Evaluating, and Communicating Information** • Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)	**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.)*	***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)

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English Language Arts	Mathematics
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.3.1** Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) **RI.3.9** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1) **W.3.1** Conduct short research projects that build knowledge about a topic. (3-ESS3-1) **W.3.7** 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) **W.3.9**	Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2),(3-ESS3-1) **MP.2** Model with mathematics. (3-ESS2-1),(3-ESS2-2), (3-ESS3-1) **MP.4** Use appropriate tools strategically. (3-ESS2-1) **MP.5** 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.A.2** 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) **3.MD.B.3**

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Common Vocabulary	
Area	Surface
Prediction	Volcanic eruption
Space	Continent
Precipitation	Region
Flow	Volume
Glacier	Air movement
Ocean	Atmosphere
Planet	Celsius
Climate	Characteristics of air
Cycle	Rotation\typical
Fahreheit	Weather condition
Glacial	
Ocean current	