NGSS OVERVIEW

WEATHER AND CLIMATE

Performance Expectation MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

Performance Expectation MS-ESS2-6: Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Performance Expectation MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Performance Expectation MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Performance Expectation MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Talking It Over: Climate Change** In this activity, students are introduced to various scenarios that illustrate different aspects of climate change. The scenarios are used to develop student interest in the topic, uncover background knowledge and potential misconceptions, and set a stage for students to ask questions related to climate change— questions that they will answer during the course of the unit.	MS-ESS3.C MS-ESS3.D	Asking Questions and Defining Problems Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Stability and Change Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: SL.8.1
2. **Investigation: Investigating Local Weather** Students first collect 5 days of weather data. They use mathematics as they compute three kinds of averages to represent the data. Students then analyze seasonal weather data, comparing them to the daily averages previously calculated and looking for patterns in the data. They learn that daily weather data are more accurate for providing data about a particular day, but monthly and seasonal data are more accurate to use when comparing weather patterns.	MS-ESS2.C MS-ESS2.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data	Cause and Effect Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: MP.2 ELA/Literacy: SL.8.1
3. **Project: Local History of Severe Weather** Students design and conduct a survey to collect data about the history of severe weather events in the local area. They then collate, analyze, and graph the survey responses. Finally, they review data for evidence for recent changes in the frequency and/or intensity of severe weather. The next activity extends the concept of weather to climate and the patterns of Earth's climate zones.	MS-ESS2.C MS-ESS2.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Asking Questions and Defining Problems	Cause and Effect Patterns	ELA/Literacy: WHST.6-8.7

WEATHER AND CLIMATE (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
4. **Problem Solving: Climate Types and Distribution Patterns** Students extend their understanding of local weather by learning about regional climate. They use descriptions and maps of the major climate zones of North America and the world to find patterns in the distribution of climates that relate to an area's latitude, proximity to an ocean, and altitude. They also examine data indicating that the locations of climate zones have changed over time.	MS-ESS2.D MS-LS4.C	Analyzing and Interpreting Data Engaging in Argument from Evidence Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Systems and System Models Patterns Cause and Effect	Mathematics: MP.2 ELA/Literacy: SL.8.1 RST.6-8.7
5. **Problem Solving: Earth's Surface** Students develop and use a strategy for estimating the percent of Earth's surface covered by water. Students are also asked to consider whether, and how, the oceans might influence weather and climate. The next activity develops this idea further by comparing how water and land each respond to heat.	MS-ESS2.D	Using Mathematics and Computational Thinking Planning and Carrying Out Investigations Analyzing and Interpreting Data	Patterns	Mathematics: MP.2
6. **Laboratory: Heating Earth's Surfaces** In the previous activity, students learned that most of Earth's surface is covered by water. In this activity, they plan and carry out an investigation that shows how water responds to thermal energy in a different manner than land. They discover that water is slow to heat and cool. They are led to the conclusion that water has a strong ability to store thermal energy. Students are beginning to build an understanding that the oceans exert a major influence on weather and climate by absorbing energy from the Sun and releasing it over time. The next two activities develop this idea by revealing more about the behavior of water, including how ocean currents redistribute the energy of the Sun around the globe.	MS-ESS2.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Developing and Using Models	Systems and System Models Cause and Effect Patterns	ELA/Literacy: RST.6-8.3

WEATHER AND CLIMATE (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
7. **Problem Solving: Ocean Temperatures** Students create models to represent the variation of ocean temperatures around the world. In the previous activity, they learned that water stores thermal energy better than land. Here they detect the pattern of decreasing water temperature with increasing latitude, although they also see regional variations in this pattern. Over the next three activities, they will apply this knowledge as they learn the causes of the complex system of oceanic circulation and its effect on climate.	MS-ESS2.C MS-ESS2.D	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data Constructing Explanations and Designing Solutions	Systems and System Models Cause and Effect Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: MP.2 ELA/Literacy: RST.6-8.3 SL.8.1 SL.8.4
8. **Modeling: Investigating Water** Students model the movement of water in the ocean by carrying out a series of simple investigations using water and ice in cups. They interpret the patterns shown by their data to conclude that temperature and salinity affect whether water rises or sinks and that this is due to differences in density. Students are guided to consider the implications of this behavior in the ocean, especially in polar regions where sea ice forms or melts. The concept of global patterns of interconnected ocean currents is introduced in the next activity.	MS-ESS2.C MS-PS3.B	Developing and Using Models Planning and Carrying Out Investigations Analyzing and Interpreting Data Constructing Explanations and Designing Solutions	Systems and System Models Cause and Effect Patterns	ELA/Literacy: RST.6-8.3
9. **Role Play: Oceans and Climate** Students use what they have learned about how water temperature and salinity affect water density to understand the mechanisms by which ocean currents transfer energy and thus affect climates.	MS-ESS2.C MS-ESS2.D	Planning and Carrying Out Investigations Engaging in Argument from Evidence Constructing Explanations and Designing Solutions Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Energy and Matter Cause and Effect Patterns Connections to Engineering, Technology and Applications of Science: Interdependence of Science, Engineering, and Technology Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.9 SL.8.1

WEATHER AND CLIMATE (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
10. **Reading: The Causes of Climate** The role of the oceans in climate is further developed as students use maps as models to explain the causes of the global pattern of interconnected ocean currents. Students also learn that both local and regional geography influence climate.	MS-ESS2.C MS-ESS2.D MS-ESS3.D	Constructing Explanations and Designing Solutions	Energy and Matter Cause and Effect Systems and System Models Patterns	ELA/Literacy: RST.6-8.9
11. **Investigation: Worldwide Wind** Students are introduced to the concept of wind as they begin to learn about the role of the atmosphere on weather and climate. Students collect data to identify the most common wind direction in a particular location. They share their data with the class and first identify regional patterns before constructing a map of global wind patterns. In the next activity, students learn how to measure wind speed and direction.	MS-ESS2.C MS-ESS2.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Systems and System Models Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: RST.6-8.3
12. **Design: Measuring Wind Speed and Direction** Students use an engineering design process to design, build, and iteratively test wind- measurement instruments to collect wind data. They use the data collected from their optimized instruments as evidence for how winds moving around landforms affect weather patterns. The next activity extends their understanding of prevailing winds (introduced in the previous activity) as they examine a series of weather maps and observe how weather conditions often travel in the direction of the prevailing winds. This activity provides an opportunity to assess Performance Expectations MS-ETS1-3 and MS-ETS1-4.	MS-ETS1.B MS-ETS1.C MS-ESS2.C MS-ESS2.D	Developing and Using Models Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Using Mathematics and Computational Thinking Engaging in Argument from Evidence	Structure and Function Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.3 SL.8.1 SL.8.4

WEATHER AND CLIMATE (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
13. **Investigation: Forecasting Weather** Pairs of students work together to interpret a weather map of the United States for a specific day, construct a weather report, and then present their report to the class. Students use the information from all the reports and their understanding of prevailing winds to forecast the "next day's" weather. This activity provides an opportunity to assess Performance Expectation MS-ESS2-5.	MS-ESS2.C MS-ESS2.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Engaging in Argument from Evidence Developing and Using Models	Cause and Effect Systems and System Models Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: SL.8.1 SL.8.4
14. **Reading: Atmosphere and Climate** Students read about the relationships among Earth's atmosphere, its circulation patterns, weather, and climate. The Reading helps students make sense of the climate-related concepts they have studied in previous activities. This activity provides an opportunity to assess Performance Expectation MS-ESS2-6. In addition, the reading introduces the greenhouse effect and how changes in the amounts of atmospheric greenhouse gases can impact climate change. This is the focus of the remaining activities in the unit.	MS-ESS2.C MS-ESS2.D MS-ESS3.D	Developing and Using Models Obtaining, Evaluating, and Communicating Information	Stability and Change Energy and Matter Systems and System Models	ELA/Literacy: RST.6-8.7
15. **Investigation: History of Earth's Atmosphere** In the previous activity, students learned about some of the characteristics of Earth's atmosphere. In this activity, they analyze and interpret data related to changes in Earth's atmosphere over time. They see that Earth's atmosphere has changed dramatically over geologic time. They also learn how human activity is causing small but significant changes to the level of carbon dioxide in the modern atmosphere, a concept first introduced in the previous activity. In the next activity, students will investigate the link between human-caused increases in atmospheric carbon dioxide and global warming.	MS-ESS3.D	Planning and Carrying Out Investigations Analyzing and Interpreting Data Engaging in Argument from Evidence	Scale, Proportion, and Quantity Stability and Change	ELA/Literacy: SL.8.1

WEATHER AND CLIMATE (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
16. **Investigation: Global Warming** Throughout this unit, students have investigated the major factors that influence Earth's climate. In this activity, students look at historical data spanning the past 100 years to try to understand the causes of current global warming. They ask questions related to the data to figure out what the evidence indicates and to better understand how human activities relate to global warming. This activity provides an opportunity to assess Performance Expectation MS-ESS3-5.	MS-ESS3.D	Asking Questions and Defining Problems Analyzing and Interpreting Data Using Mathematics and Computational Thinking Engaging in Argument from Evidence Connections to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence	Stability and Change Cause and Effect Patterns Systems and System Models Connections to Nature of Science: Science Addresses Questions about the Natural and Material World	Mathematics: MP.4 ELA/Literacy: WHST.6-8.1 SL.8.1
17. **Talking It Over: People, Weather, and Climate** In this culminating activity, students analyze data for a fictional city. The data relate to local atmospheric, water, weather, and climate conditions. Students have an opportunity to apply their understanding of these topics as they attempt to determine whether humans are affecting local conditions and what can be done to mitigate any such impact.	MS-ESS3.D MS-ESS3.C MS-ESS3.A	Analyzing and Interpreting Data Using Mathematics and Computational Thinking Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	Patterns Cause and Effect Stability and Change Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World	ELA/Literacy: RST.6-8.7 SL.8.1 WHST.6-8.1