

Weather and Climate



Wind speed and direction

Teacher Guide

Wet and cold climate



Collecting weather data

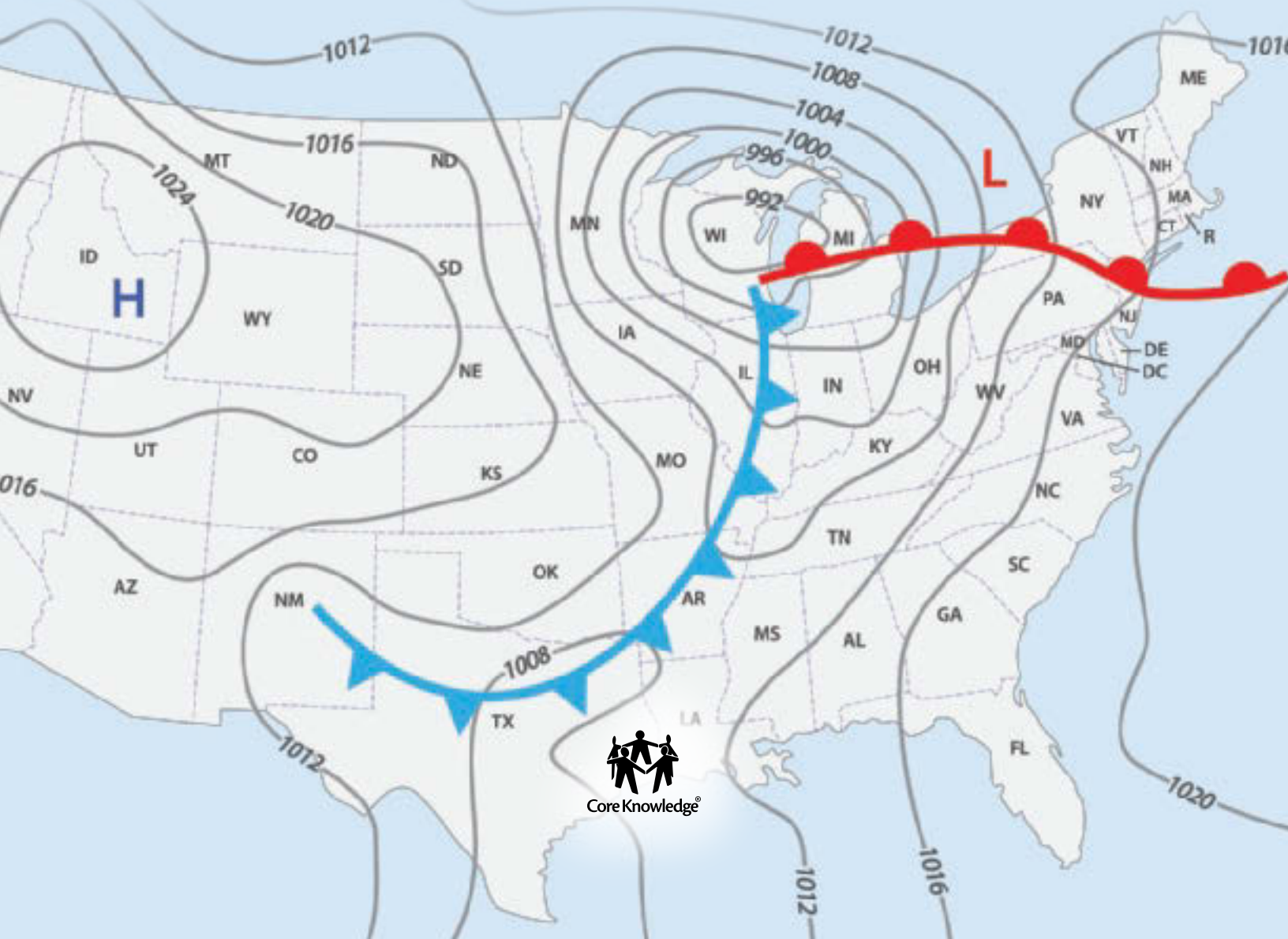


Severe weather



Weather and Climate

Teacher Guide



Core Knowledge®

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Weather and Climate

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Weather and Climate
Teacher Guide
Core Knowledge Science™ 3

Introduction

ABOUT THIS UNIT

The Big Idea

Any location on Earth is affected by its current weather and the long-term climate patterns found there.

This unit focuses on the causes and effects of weather and climate. Students work to describe patterns in atmospheric conditions across time and location, and investigate how predictions about the weather are made.

What causes changes in the weather? What is the relationship between weather and climate? These questions are central to big-picture investigations of these phenomena. This unit starts by looking at Earth's atmosphere, the mixture of gases surrounding the planet. The oxygen we need makes up only about twenty percent of the atmosphere. Another important gas in the air is water vapor, which—through evaporation, condensation, and precipitation—plays a big part in weather. Meteorologists and climatologists study patterns of weather over different scales of time.

Data on wind speed and direction are important to meteorologists because they demonstrate predictable patterns. Meteorologists also use other kinds of information to forecast the weather. Climatologists study patterns over longer time periods using much of the same data.

Students also learn that some forms of weather can be severe and hazardous, such as a hurricane, a tornado, or a lightning storm. People can design solutions to prepare for hazardous weather and to minimize risks.

Note to Teachers and Curriculum Planners

This unit introduces Grade 3 students to real-world examples and fundamental concepts that will be explored in greater depth in later grades. Students will learn about observable weather patterns, factors that produce weather conditions, and long-term weather patterns that establish climate. The following are preliminary considerations for planning and instruction relative to this unit:

- While the unit engages Grade 3 students with data in tables and graphical displays, assessment of graphical displays is limited to pictographs and bar graphs.
- Students will compare and contrast different climate conditions, but assessment does not include explanations about climate change.

- Students are asked to evaluate solutions intended to reduce the impact of weather hazards. Examples of such solutions include barriers to prevent flooding, wind-resistant roofs, and lightning rods.
- Knowledge gained during this unit will be applied during future units, such as within Grade 4 Unit 4 *Processes That Shape Earth* and Grade 5 Unit 3 *Modeling Earth's Systems*.

Note to Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, in particular, students benefit from not just reading about concepts and ideas, but also hands-on experiences. Following the release of the Next Generation Science Standards (NGSS), the Core Knowledge Foundation used this opportunity to update and enhance the science portion of the *2010 Core Knowledge Sequence*. The result of this effort is the revised *2019 Core Knowledge Science Sequence*.

While there have been some shifts in the grade levels at which certain topics are recommended, the fundamental principles of pedagogy inherent to the Core Knowledge approach, such as the importance of building a sequential, coherent and cumulative knowledge base, have been retained.

Online Resources



To download the *2019 Core Knowledge Science Sequence* use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit, aligned to the *2019 Core Knowledge Science Sequence* and informed by NGSS, embodies Core Knowledge's vision of best practices in science instruction and knowledge-based schooling, such as the following:

- building students' knowledge of core ideas in life, physical, and Earth sciences, as well as engineering design
- developing scientific practices that give students firsthand experience in scientific inquiry, engineering, and technology
- connecting scientific learning to concepts across various disciplines, such as mathematics and literacy

To see how you can continue to use your current Core Knowledge materials with the 2019 CKSci curriculum, please see below an example of how this unit compares to the *2010 Core Knowledge Sequence*.

Examples of content retained from the 2010 Core Knowledge Sequence	Examples of Core Knowledge content in this CKSci Unit
Meteorology (Grade 4 and review from Grade 2) <ul style="list-style-type: none"> • The water cycle and cloud types • The atmosphere: <ul style="list-style-type: none"> ◦ Layers of the atmosphere ◦ The sun and the earth heat the atmosphere • Air movement: wind direction and speed, prevailing winds, air pressure, air masses • Cold and warm fronts: thunderheads, lightning and electric charge, thunder, tornadoes, hurricanes • Forecasting the weather: barometers, weather maps, weather satellites • Weather and climate 	Earth's Atmosphere <ul style="list-style-type: none"> • Air: a mixture of gases—air is matter <ul style="list-style-type: none"> ◦ The most common gases in the atmosphere are nitrogen and oxygen. ◦ Water in the atmosphere: humidity • The relationship between wind and air pressure Weather and Climate <ul style="list-style-type: none"> • Weather: the conditions in the lowest layer of the atmosphere at a particular time and place • Climate: the pattern of weather conditions in an area over a long period of time • Protecting people from severe weather
For a complete look at how CKSci relates to the 2010 Sequence, please refer to the full Correlation Charts available for download using the Online Resources Guide for this unit: www.coreknowledge.org/cksci-online-resources	

What are the relevant NGSS Performance Expectations for this unit?*

This unit, *Weather and Climate*, has been informed by the following Grade 3 Performance Expectations for the NGSS topic *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.

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.

Online Resources



For detailed information about the NGSS references, follow the links in the Online Resources Guide for this unit. Use the following link to download any of the CKSci Online Resources Guides:

www.coreknowledge.org/cksci-online-resources

*NEXT GENERATION SCIENCE STANDARDS (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and their endorsement is not implied.

Sources:

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

National Research Council. 2012. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K–12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

What Students Should Already Know

The concept of progressions, articulated in the National Research Council's *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, is very much aligned to the Core Knowledge principle of building new knowledge on prior knowledge. According to the NRC, students build “progressively more sophisticated explanations of natural phenomena” over the course of many years of schooling. “Because learning progressions extend over multiple years, they can prompt educators to consider how topics are presented at each grade level so that they build on prior understanding and can support increasingly sophisticated learning.” In schools following NGSS recommendations, teachers can build on the “prior understandings” captured in the following summaries of NGSS Disciplinary Core Ideas:

PS1.A: Structure and Properties of Matter

- Grades K–2**
- Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured.

PS1.B: Chemical Reactions

- Grades K–2**
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible (e.g., melting and freezing), and sometimes they are not (e.g., baking a cake, burning fuel).

PS2.B: Types of Interactions

- Grades K–2**
- When objects touch or collide, they push on one another and can change motion.

PS3.B: Conservation of Energy and Energy Transfer

- Grades K–2**
- Sunlight warms Earth's surface.

ESS1.B: Earth and the Solar System

- Grades K–2**
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

ESS2.A: Earth Materials and Systems

- Grades K–2**
- Wind and water can change the shape of the land. The resulting landforms, together with the materials on the land, provide homes for living things.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Grades K–2**
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.

ESS2.D: Weather and Climate

- Grades K–2**
- 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.

ESS3.B: Natural Hazards

- Grades K–2**
- 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.

ETS1.A: Defining Engineering Problems

- Grades K–2**
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

What Students Need to Learn

For this unit, the *Core Knowledge Science Sequence* specifies the following content and skills. Specific learning objectives are provided in each lesson throughout the unit. NGSS References, including Performance Expectations, Disciplinary Core Ideas, and Crosscutting Concepts, are included at the start of each lesson as appropriate.

A. Earth's Atmosphere

LESSONS 1–3

- Use a model to demonstrate that air is matter.
- Describe characteristics of the air and Earth's atmosphere.
- Organize data relating to the composition of Earth's atmosphere.
- Identify the two most common gases in Earth's atmosphere.
- Explain the relationship between warmer or cooler temperature and lower or higher air pressure.
- Describe differences between evaporation and condensation.
- Identify different forms of precipitation.

B. Wind: The Movement of Air

LESSONS 4–6

- Identify the sun as the source of energy that warms air.
- Define *wind* as the movement of air.

- Create tables and graphs that represent wind data.
- Identify and describe patterns in wind direction over time.
- Compare data of wind speed and direction at different locations over time.

C. Weather and Climate

LESSONS 7–10

- Describe what a meteorologist does.
- Differentiate between weather and climate.
- Collect and organize weather data for a single location by season.
- Use tables, graphs, and maps to describe yearly patterns of weather for a single location.
- Citing evidence, predict the typical weather you might expect during an upcoming season in one location.
- Compare the seasonal weather patterns of your location with the seasonal patterns of another location.
- Describe the climate of the region where you live.
- Gather and communicate information about a region with a different climate than your own.
- Citing evidence, describe the changes in climate that have occurred in an area over time.

D. Reducing the Impacts of Hazardous Weather

LESSONS 11–13

- Describe examples of extreme weather conditions.
- Relate the causes of an extreme weather condition to its destructive effects.
- Identify ways to avoid danger and protect yourself during weather hazards.
- Plan a solution to minimize the destruction from a severe weather event.
- Evaluate the effectiveness of a solution intended to reduce the effects of a weather-related hazard.

What Teachers Need to Know

Supportive information on the content standards and the science they address is provided throughout the lessons at points of relevance:

Know the Standards: These sections, found later in this Teacher Guide, explain what to teach and why, with reference to NGSS and Core Knowledge expectations.

Know the Science: These sections provide supporting, adult-level, background information or explanations related to specific examples or Disciplinary Core Ideas.

USING THE STUDENT READER

Student Reader



The *Weather and Climate* Student Reader has eight chapters and a student Glossary providing definitions to Core Vocabulary words. Engaging text, photographs, and diagrams encourage students to draw upon their own experiences and the world around them to understand scientific concepts. In addition to Core Vocabulary, the Student Readers include a feature called Word to Know, which provides background information to help students understand key terms, and may sometimes include additional informational boxes, such as Think About.

Explore, then read: In the CKSci program, lessons are sequenced to provide active engagement before reading. First, students explore phenomena through hands-on investigations or teacher demonstrations, accompanied by active questioning and analysis; then, students study the informational text provided in the Student Readers. The icon, shown above, will signal Core Lesson segments that focus on Student Reader chapters.

CKSci Student Readers extend, clarify, and confirm what students have learned in their investigations. The text helps students develop a sense of the language of science, while images, diagrams, charts, and graphs deepen conceptual understanding. Use of the CKSci Student Readers supports the Science and Engineering Practice “Obtaining, Evaluating, and Communicating Information” as described in *A Framework for K–12 Science Education*.

Independent reading or group read-aloud: While the text in the Student Readers is written for independent reading, we encourage group read-alouds and engagement with the text. The Teacher Guide provides Guided Reading Supports to prompt discussion, clarify misconceptions, and promote understanding in relation to the Big Questions.

USING THE TEACHER GUIDE

Pacing

The *Weather and Climate* unit is one of four units in the Grade 3 CKSci series. To meet NGSS Performance Expectations we encourage teachers to complete all units during the school year. To be sure all NGSS Performance Expectations are met, each Core Lesson should be completed, and each requires thirty to forty-five minutes of instruction time. The time it takes to complete a lesson depends on class size and individual circumstances.

Within the Teacher Guide, the Core Lessons are divided into numbered segments, generally five or six, with approximate times listed per segment. The final segment is always a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this unit Introduction, you will find a Sample Pacing Guide on page 14 and a blank Pacing Guide on pages 15–16, which you may use to plan how you might pace the lessons, as well as when to use the various other resources in this unit. We strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson. As a general rule, we recommend that you spend no more than twenty days teaching the *Weather and Climate* unit so that you have time to teach the other units in the Grade 3 CKSci series.

The Core Lessons

- Lesson time: Each Core Lesson constitutes one classroom session of up to forty-five minutes. Understanding that teachers may have less instructional time, we show a time range of thirty to forty-five minutes per lesson. Teachers may choose to conduct all Core Lesson segments, totaling forty-five minutes; may choose to conduct a subset of the lesson segments; or may choose to spend less time per segment.
- Lesson order: The lessons are coherently sequenced to build from one lesson to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

PART	LESSON	BIG QUESTION
A. Earth's Atmosphere	1. The Atmosphere and Air Pressure	What is the atmosphere, and what is weather?
	2. Water in the Atmosphere	How does water move into and out of air?
	3. Investigating Air Pressure and Precipitation	How does temperature affect air pressure and precipitation?
B. Wind: The Movement of Air (3-ESS2-1)	4. Investigating Wind	How can I observe and describe moving air?
	5. Wind	What is wind?
	6. Working with Wind Data (two class sessions)	How can I use data to discover wind patterns?
C. Weather and Climate (3-ESS2-1, 3-ESS2-2)	7. Using Weather Data to Predict Weather	What do meteorologists do?
	8. Patterns of Weather: Seasons and Climate (two class sessions)	What is the difference between weather and climate?
	9. Working with Weather Data (two class sessions)	How can I use weather data to reveal patterns?
	10. Working with Climate Data (two class sessions)	How can I use climate data to reveal patterns?
D. Reducing the Impacts of Hazardous Weather (3-ESS3-1)	11. Extreme Weather	What are extreme weather hazards?
	12. Engineering for Extreme Weather	How do engineers design solutions for extreme weather hazards?
	13. Evaluating Extreme Weather Solutions (two class sessions)	How can we evaluate design solutions to weather hazard problems?
Unit Review and Assessment	Unit Review: Weather-Related Technology	Who are some inventors of weather-related technology?
	Unit Assessment	What have I learned about weather and climate?

Activity Pages and Unit Assessment

Activity Pages



Black line reproducible masters for Activity Pages and a Unit Assessment, as well as an Answer Key, are included in Teacher Resources on pages 106–157. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced.

Students' achievement of the NGSS Performance Expectations is marked by their completion of tasks throughout the unit. However, a combined Unit Assessment is provided as a summative close to the unit.

Lesson 1—Patterns in the Atmosphere (AP 1.1)

Lesson 2—How Water Moves (AP 2.1)

Lesson 3—Elements of Weather Observations (AP 3.1)

Lesson 4—Measuring Wind (AP 4.1)

Lesson 5—Air Masses and Wind (AP 5.1)

Lesson 6—Looking for Patterns in Wind Data (AP 6.1)

Lesson 6—Comparing Wind Speed (AP 6.2)

Lesson 7—Finding Temperature Change Patterns (AP 7.1)

Lesson 7—Meteorologist Job Description (AP 7.2)

Lesson 8—Using Temperature Patterns to Describe Climate (AP 8.1)

Lesson 9—Deciding When to Hold a Carnival (AP 9.1)

Lesson 9—Draw a Graph to Show Your Reasoning (AP 9.2)

Lesson 9—Write a Letter to Your Principal (AP 9.3)

Lesson 9—Help Another School Choose When to Hold a Carnival (AP 9.4)

Lesson 9—Write a Letter to Your Pen Pal (AP 9.5)

Lesson 9—Self-Evaluation Checklist (AP 9.6)

Lesson 10—Join the Famous Ten World Parks Club! (AP 10.1)

Lesson 10—Find the Climate of a Park (AP 10.2)

Lesson 10—Ten World Parks Club Passport Stamp Sheet (AP 10.3)

Lesson 10—Self-Evaluation Checklist (AP 10.4)

Lesson 10—Climate Fact Sheets: World National Parks (AP 10.5–10.14)

Lesson 11—Extreme Weather: Cause and Effect (AP 11.1)

Lesson 12—Lesson 12 Check (AP 12.1)

Lesson 13—Evaluations and Claims (AP 13.1)

Unit Review—Design a Weather-Related Technology (AP UR.1)

Unit Review—Vocabulary Crossword Puzzle (AP UR.2)

Unit Review—Vocabulary Review (AP UR.3)

AP 1.1

AP 2.1

AP 3.1

AP 4.1

AP 5.1

AP 6.1

AP 6.2

AP 7.1

AP 7.2

AP 8.1

AP 9.1

AP 9.2

AP 9.3

AP 9.4

AP 9.5

AP 9.6

AP 10.1

AP 10.2

AP 10.3

AP 10.4

AP 10.5–10.14

AP 11.1

AP 12.1

AP 13.1

AP UR.1

AP UR.2

AP UR.3

Online Resources for Science

Online Resources



For each CKSci unit, the Teacher Guide includes references to online resources (including external websites and downloadable documents) to enhance classroom instruction. Look for the icon on the left.

Use this link to download the CKSci Online Resources for this unit:

www.coreknowledge.org/cksci-online-resources

Teaching Strategies

Start with the familiar.

Lead with an experience. Begin each lesson with a demonstration, activity, or question about a phenomenon to engage students and focus their attention on the topic. Start with the familiar. Every science topic introduced to students relates in some way to their known world and everyday experiences. The purpose of every lesson is to build a bridge between what is familiar to students and broader knowledge about the way the world works.

Ask the Big Question.

At the beginning of each Teacher Guide lesson, you will find a Big Question and Core Lesson segment devoted to encouraging students to think about this question as they are introduced to new science content. Use this opportunity to engage students in conversation, to think about how their own real-world experiences relate to the topic, or to participate in a demonstration that relates to the Big Question.

Encourage scientific thinking.

Approach the lessons with students not as learning about science but as learning about the world with a scientific mind. Science learning models science practice.

Throughout the lessons, encourage students to ask questions about what they observe, do, and read. Record relevant questions in a prominent place in the classroom. Guide students back to these questions as opportunities to answer them emerge from readings, demonstrations, and activities.

Use continuous Core Vocabulary instruction.

As a continuous vocabulary-building strategy, have students develop a deck of vocabulary cards, adding a card for each Core Vocabulary term as it is introduced. Students can add illustrations and examples to the cards as their comprehension of terms expands. During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Students will be given the opportunity to preview Core Vocabulary words early in the lessons and to engage in Word Work activities toward the end of the lessons. Encourage students to come up with definitions in their own words and to use the words in their own sentences.

Core Vocabulary words for each lesson, as well as other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary definitions in the Word Work lesson segments, as well as in the Glossary on pages 160–161.

Emphasize observation and experience.

Lessons employ various ways for students to learn, including watching, listening, reading, doing, discussing, and writing. To meet the NGSS Performance Expectations, which are multidimensional standards, students must not only gain factual knowledge associated with Disciplinary Core Ideas, but also *use* the content knowledge they acquire.

Use science practices.

Give students opportunities to discover new content knowledge through investigation and to use their new knowledge both in problem-solving exercises and as evidence to support reasoning. Students learn what science and engineering practices are by engaging in those same practices as they learn.

Core Lesson segments are designed to reinforce the idea of science as an active practice, while helping students meet NGSS Performance Expectations. Each lesson segment is introduced by a sentence emphasizing active engagement with an activity.

Make frequent connections.

Use a combination of demonstrations and reading materials, rich with examples, to help students recognize how the science concepts they are learning apply in their everyday lives. Prompt students to relate lesson content to their own experiences, to relate the new and unfamiliar to the familiar, and to connect ideas and examples across disciplines. Refer to the Crosscutting Concepts cited in the lessons, often included in the NGSS References listed at the start of each lesson.

Monitor student progress.

Use verbal questioning, student work, the Check for Understanding assessments at the end of each lesson, and the Unit Assessment at the end of the unit (see pages 150–153) to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.

Effective and Safe Classroom Activities

Online Resources



Conducting safe classroom demonstrations and activities is essential to successful elementary science education. The following resources provide Core Knowledge's recommendations for developing effective science classroom activities.

These resources, included at the back of the Teacher Guide on pages 162–166, consist of the following:

- Classroom Safety for Activities and Demonstrations
- Strategies for Acquiring Materials
- Advance Preparation for Activities and Demonstrations
- What to Do When Activities Don't Give Expected Results

These resources may also be accessed within the CKSci Online Resources Guide for this unit, available at

www.coreknowledge.org/cksci-online-resources

MATERIALS AND EQUIPMENT

The unit requires a variety of materials to support various ways of learning (including doing, discussing, listening, watching, reading, and writing). Prepare in advance by collecting the materials and equipment needed for all the demonstrations and hands-on investigations.

Part A: Earth's Atmosphere

Lesson 1

- water
- playing card
- large test tube or small beaker
- bucket or wash pail
- paper towels
- small pieces of clay rolled into ball shapes (2)
- several textbooks
- index cards for student vocabulary deck (3 per student)

Lesson 2

- hot plate
- pot of water
- pot of ice
- index cards for student vocabulary deck (5 per student)

Lesson 3

- shallow dish or pie pan (a glass dish is best)
- water
- food coloring
- candle and matches or lighter
- beaker
- balloon slightly inflated and tied
- plastic cup
- piece of newspaper
- bucket of water
- glass of ice water
- dropper of water

Part B: Wind: The Movement of Air

Lesson 4

- paper plate (1 per group)
- marker (1 per group)
- ruler (1 per group)
- straw (1 per group)
- tissue paper streamers (1 per group)
- tape (1 roll per group or enough for efficient sharing)
- compass (1 per group or enough for efficient sharing)
- sharp pencil (1 per group)
- pinwheel
- candle
- piece of clay
- picture of a hot-air balloon and a windsurfer
- internet access and the means to project images for whole-class viewing

Lesson 5

- cup or pan of warm water with a cover (1 per group)
- index cards for student vocabulary deck (5 per student)

Lesson 6

- internet access
- colored pencils

Part C: Weather and Climate

Lesson 7

- ruler
- yardstick

Lesson 7, continued

- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (3 per student)

Lesson 8

- electric table lamp
- large grapefruit
- small sticker
- bamboo skewer
- blue, green, pink, and yellow highlighter pens
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

Lesson 9

- highlighters in four colors
- internet access and the means to project images/video for whole-class viewing

Lesson 10

- stapler
- scissors
- stamp(s) and ink pad, or stickers
- internet access and the means to project images/video for whole-class viewing

Part D: Reducing the Impacts of Hazardous Weather

Lesson 11

- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (2 per student)

Lesson 12

- index cards for student vocabulary deck (3 per student)

Lesson 13

- internet access
- classroom computers

Unit Review

- internet access and the means to project images/video for whole-class viewing

SAMPLE PACING GUIDE

The sample Pacing Guide suggests use of the unit’s resources across a twenty-day period. However, there are many ways that you may choose to individualize the unit for your students, based on their interests and needs. You may elect to use the blank Pacing Guide on pages 15–16 to reflect alternate activity choices and alternate pacing for your class. If you plan to create a customized pacing guide for your class, we strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson.

Online Resources



For a yearlong pacing guide, please use the link found in the Online Resources Guide for this unit. This yearlong view of pacing also includes information about how this CKSci unit relates to the pacing of other programs, such as CKLA and CKHG in the *Core Knowledge Curriculum Series™*.

www.coreknowledge.org/cksci-online-resources

TG–Teacher Guide; SR–Student Reader; AP–Activity Page

Week 1

Day 1	Day 2	Day 3	Day 4	Day 5
<i>The Atmosphere and Air Pressure</i> TG Lesson 1 SR Chapter 1 AP 1.1	<i>Water in the Atmosphere</i> TG Lesson 2 SR Chapter 2 AP 2.1	<i>Investigating Air Pressure and Precipitation</i> TG Lesson 3 AP 3.1	<i>Investigating Wind</i> TG Lesson 4 AP 4.1	<i>Wind</i> TG Lesson 5 SR Chapter 3 AP 5.1

Week 2

Day 6	Day 7	Day 8	Day 9	Day 10
<i>Working with Wind Data</i> DAY 1 TG Lesson 6 AP 6.1, 6.2	<i>Working with Wind Data</i> DAY 2 TG Lesson 6 AP 6.1, 6.2	<i>Using Weather Data to Predict Weather</i> TG Lesson 7 SR Chapter 4 AP 7.1, 7.2	<i>Patterns of Weather: Seasons and Climate</i> DAY 1 TG Lesson 8 SR Chapter 5 AP 8.1	<i>Patterns of Weather: Seasons and Climate</i> DAY 2 TG Lesson 8 SR Chapter 5 AP 8.1

Week 3

Day 11	Day 12	Day 13	Day 14	Day 15
<i>Working with Weather Data</i> DAY 1 TG Lesson 9 AP 9.1–9.6	<i>Working with Weather Data</i> DAY 2 TG Lesson 9 AP 9.1–9.6	<i>Working with Climate Data</i> DAY 1 TG Lesson 10 AP 10.1–10.14	<i>Working with Climate Data</i> DAY 2 TG Lesson 10 AP 10.1–10.14	<i>Extreme Weather</i> TG Lesson 11 SR Chapter 6 AP 11.1

Week 4

Day 16	Day 17	Day 18	Day 19	Day 20
<i>Engineering for Extreme Weather</i> TG Lesson 12 SR Chapter 7 AP 12.1	<i>Evaluating Extreme Weather Solutions</i> DAY 1 TG Lesson 13 AP 13.1	<i>Evaluating Extreme Weather Solutions</i> DAY 2 TG Lesson 13 AP 13.1	<i>Weather-Related Technology</i> TG Unit Review SR Chapter 8 AP UR.1, UR.2, UR.3	Unit Assessment AP Unit Assessment

PACING GUIDE

Twenty days have been allocated to the *Weather and Climate* unit to complete all Grade 3 science units in the *Core Knowledge Curriculum Series™*. If you cannot complete the unit in twenty consecutive days of science instruction, use the space that follows to plan lesson delivery on an alternate schedule.

Week 1

Day 1	Day 2	Day 3	Day 4	Day 5

Week 2

Day 6	Day 7	Day 8	Day 9	Day 10

Week 3

Day 11	Day 12	Day 13	Day 14	Day 15

Week 4

Day 16	Day 17	Day 18	Day 19	Day 20

Week 5**Day 21****Day 22****Day 23****Day 24****Day 25**

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Week 6**Day 26****Day 27****Day 28****Day 29****Day 30**

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Week 7**Day 31****Day 32****Day 33****Day 34****Day 35**

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Week 8**Day 36****Day 37****Day 38****Day 39****Day 40**

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PART A

Earth's Atmosphere

OVERVIEW

Lesson	Big Question	Advance Preparation
1. The Atmosphere and Air Pressure	What is the atmosphere, and what is weather?	Gather materials for a demonstration. (See Materials and Equipment, page 12.) Read Student Reader, Chapter 1.
2. Water in the Atmosphere	How does water move into and out of air?	Gather materials for a demonstration. (See Materials and Equipment, page 12.) Read Student Reader, Chapter 2.
3. Investigating Air Pressure and Precipitation	How does temperature affect air pressure and precipitation?	Gather materials for a student investigation. (See Materials and Equipment, page 12.)

Part A: What's the Story?

Earth's atmosphere plays an important role in weather and climate. Although students may fundamentally understand that weather, such as precipitation, comes from the sky, it can be difficult to explain the processes, components, and phenomena involved in making weather and climate possible.

In Lesson 1, we begin simply by engaging students through demonstrations that represent how air pressure works. The goal is to get students to understand what the atmosphere is made of and to explain the relationship between temperature and air pressure.

In Lesson 2, we introduce students to water in the atmosphere by discussing precipitation, evaporation, and condensation. While students intuitively understand that precipitation, such as rain and snow, comes from the sky, the goal here is to develop deeper understanding that water is an important part of the atmosphere and that it continually cycles through the atmosphere, down to earth, and back into the atmosphere again.

In Lesson 3, students build on their understanding of the atmosphere by doing a hands-on investigation of air pressure and precipitation. The goal is for students to understand how temperature affects air pressure and precipitation, including what happens to air pressure when there are warmer or cooler temperatures.

So, to repeat, **Earth's atmosphere is made up of gases. Water is a component of the air and temperatures affect air pressure.** The key concept for students to grasp is that weather is based on temperatures and the amount of water that is in the atmosphere, among other factors.

LESSON 1

The Atmosphere and Air Pressure

Big Question: What is the atmosphere, and what is weather?

AT A GLANCE

Learning Objectives

- ✓ Describe characteristics of the air and Earth's atmosphere.
- ✓ Identify the two most common gases in Earth's atmosphere.
- ✓ Explain the relationship between warmer or cooler temperature and lower or higher air pressure.

Lesson Activities

- teacher demonstration
- student observation
- reading and discussion
- vocabulary instruction

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concepts: Patterns; Scale, Proportion, and Quantity

Patterns are important to this lesson because students will identify patterns in air pressure, such as that there is more pressure at lower altitudes and less pressure at higher altitudes. They will also make connections in weather patterns and air pressure when learning that low pressure often causes cloudy weather and precipitation and that high pressure often results in good weather.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 160–161 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

air pressure

atmosphere

weather

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 1

Activity Page



AP 1.1

Student Reader, Chapter 1

“The Atmosphere and Air Pressure”

Activity Page

Patterns in the Atmosphere (AP 1.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- water
- playing card
- large test tube or small beaker
- bucket or wash pail
- paper towels
- small pieces of clay rolled into ball shapes (2)
- several textbooks
- index cards for student vocabulary deck (3 per student)

NOTE—The large test tube or small beaker should have an opening small enough that the playing card will fit over it.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What is the atmosphere, and what is weather? Open this lesson with a teacher demonstration to invite questions about air pressure. Gather students so that they can see the demonstration. You will need the following materials: large test tube or small beaker, water, a playing card, a bucket/container, and some paper towels to help clean any small spills.

Follow these steps:

- Fill the test tube/beaker all the way to the top with water.
- Place the playing card flat over the opening of the tube.
- Hold the tube/beaker of water over the bucket.

Have students turn to a partner to answer the following question:

- What do you think will happen when I turn this container of water upside down? (*Ideas may vary.*)

After students have made their predictions, tell them to observe carefully, and complete the next steps of the demonstration:

- Hold the playing card tightly to the tube or beaker.
- Turn it upside down quickly, and then let go of the card.

The card should “stick” to the test tube and prevent the water from coming out of it. (See **Know the Science 1** for further analysis.) Ask students to describe what they think is going on and why the card is sticking to the test tube.

SUPPORT—You may wish to practice this demonstration ahead of time. Be sure that the playing card is not bent and lies flat over the opening of the test tube.

2. Read and discuss: “The Atmosphere and Air Pressure.”

15 MIN

Student Reader



Ch. 1

Read together, or have students read independently, “The Atmosphere and Air Pressure,” Chapter 1 in the Student Reader. The selection introduces, describes, and explains the terms *weather*, *atmosphere*, and *air pressure*.

Preview Core Vocabulary Terms

Before students read, write these terms on the board. Encourage students to pay special attention to these terms as they read.

air pressure

atmosphere

weather

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 1

After students have read the page, have them look outside through a window or door. Ask the following:

- » What is the weather like right now? (*Accept all reasonably accurate observations.*)
- » What was the weather yesterday?
- » How quickly can weather change? (*It can change by the minute or hour.*)
Ask students to provide examples from your local area.
- » What are some examples of different kinds of weather that occur in the atmosphere? (*Answers may vary but should include recognition of different temperatures, different amounts of precipitation, and possibly severe weather events.*)

Explain that, though the atmosphere surrounding Earth is made up of five layers, it isn’t very thick. The entirety of the atmosphere is often referred to as “thin” because it is only about seventy miles thick, very small compared to the size of Earth itself, which is close to 8,000 miles (or 13,000 kilometers) thick. Hence, the atmosphere is referred to as thin.

Know the Science

1. Why does the card stick to the test tube? Pressure! Explain that air pressure causes the card to “stick” to the test tube. There is pressure from the water pushing down and also from the air pushing up on the card and the water. As a result, the card “sticks” to the test tube.

Page 2 After reading this page, have students go back and identify the gases listed on the page that the atmosphere contains. (*nitrogen, oxygen*)

Review the word *matter* and its meaning, anything that has mass and takes up space. Ask the following:

- » What types of matter does the atmosphere contain? (*gases, such as water vapor, dust*)
- » What is the force that pulls all matter toward the center of Earth? (*gravity*)

Page 3 After students read the first paragraph, pause and remind them that they saw a demonstration of air pressure at the beginning of class.

SUPPORT—If necessary, spend more time discussing air pressure and ways that students may be able to relate to it experientially. (See **Know the Science 2.**)

After reading the rest of the page, discuss the location of your community relative to sea level.

Page 4 After reading this page, make a T-chart on the board or chart paper. Write “cool air” on one side and “warm air” on the other side.

cool air	warm air

Ask students to describe warm air and cool air using information that they just read in the article. Record their responses on the T-chart.

Review the meaning of the word *temperature*, the measure of how warm or cool something is. Ask the following:

- » How do we know if something is hot or cool? (*We measure the temperature.*)
- » What tool is used to measure temperature? (*a thermometer*)

Know the Science

2. Where have we experienced air pressure? Ask students if they have ever been on a plane or underwater and had their ears “pop.” Explain that as you increase or decrease your altitude in the air, or even as you dive deep underwater, pressure of the matter that surrounds you changes. These changes create pressure inside the ear. A small tube opens to let the air trapped inside the ear come out. This causes the “pop” and allows the pressure to become equal inside and outside the ear.

SUPPORT—If necessary, discuss the difference between temperature and weather. Temperature is how hot or cold a place is at any given time. Weather is what the air outside is like in a place at any given time.

Have students underline how air pressure affects the weather in a place.

3. Demonstrate more examples.

5 MIN

Cultivate further learning about the atmosphere and air pressure by doing an additional demonstration. You will need the following materials:

- small ball-shaped pieces of clay (2)
- textbooks

Follow these steps to carry out the demonstration:

- Place one small ball-shaped piece of clay on a table where students can see it.
- Place several textbooks on top of it.
- Place another ball-shaped piece of clay on top of the stack of books.

Ask students to point to the ball of clay that has the most pressure on it. (*They should point to the clay under the stack of books.*) Ask students to point to the ball of clay that has the least amount of pressure on it. (*They should point to the ball of clay on top of the stack of books.*) Ask the following:

- » What do the books represent in this model? (*air*)
- » What does the clay represent? (*any matter*)
- » How did the pressure change the closer to the surface you placed the clay? (*Pressure increases as altitude decreases.*)

4. Look for patterns.

10 MIN

Activity Page



AP 1.1

Distribute Patterns in the Atmosphere (AP 1.1). Tell students they will answer questions about air pressure based on what they have learned so far in this lesson. Go over the directions in each of the questions with students. Explain that the patterns that they describe on this Activity Page will help them prepare for the next few lessons, where they will learn to analyze weather data to find patterns and make graphs. (See **Know the Standards.**)

Know the Standards

How are weather predictions made? By understanding patterns! Finding patterns in weather allows people to make predictions. For example, when the air pressure drops, people can predict that it will rain. When air pressure rises, people can predict that the weather will be sunny and clear. Predicting weather is important for many reasons. If time permits, discuss some reasons with the class.

SUPPORT—If needed, help students refer back to page 2 in the Student Reader where they read about the gases contained in the atmosphere, page 3 where they read about where air pressure is greatest, and page 4 where they underlined the types of weather caused by high and low pressure. Students may work alone, with a partner, or in a group to complete the Activity Page.

Lead a discussion about the answers on the Activity Page. Have students share their answers to the completed Activity Page with one another.

5. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed earlier in the lesson). Have students write each term in the upper left corner of an index card and underline it (one term per card).

air pressure

atmosphere

weather

Word Work

Have students write the definition of each term in their own words on the front of its index card, below where they wrote each word, to review what they learned in this lesson. Instruct students to draw a quick sketch on the back of each index card to further explain the meaning of the Core Vocabulary term.

- **air pressure:** (n. the weight of air as it presses on objects below or within it)
- **atmosphere:** (n. the layer of air that surrounds Earth)
- **weather:** (n. what the air outside is like at any given time and place)

Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add to the deck and refer back to it in later lessons.

6. Check for understanding.

5 MIN

Activity Page



AP 1.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed Patterns in the Atmosphere (AP 1.1). Scan the questions to see that the answers are correct. Address any misconceptions that students may have at this time.

LESSON 2

Water in the Atmosphere

Big Question: How does water move into and out of air?

AT A GLANCE

Learning Objectives

- ✓ Organize data relating to the composition of Earth's atmosphere.
- ✓ Describe differences between evaporation and condensation.
- ✓ Identify different forms of precipitation.

Lesson Activities

- reading and discussion
- vocabulary instruction
- demonstration and observation
- discussion and drawing

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data is important to this lesson because students will find out how scientists collect data about the amount of water in the air to learn about different types of weather and make weather predictions.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

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condensation
condense

evaporate
evaporation

humidity
precipitation

vapor
water vapor

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green above.

Instructional Resources

Student Reader



Ch. 2

Activity Page



AP 2.1

Student Reader, Chapter 2
“Water in the Atmosphere”

Activity Page

How Water Moves (AP 2.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- hot plate
- pot of water
- pot of ice
- index cards for student vocabulary deck (5 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How does water move into and out of air? To build on what students learned in Lesson 1 and activate background knowledge, open this lesson by asking students to name some different types of weather. Ask the following:

- » Which types of weather need water to happen? (*rain, snow, hail, fog*)
- » Where does the water that makes these types of weather come from? (*clouds in the sky*)

Explain to students that in this lesson, they will learn how water gets into the atmosphere and the different ways it comes back to Earth’s surface.

2. Read and discuss: “Water in the Atmosphere.”

15 MIN

Student Reader



Ch. 2

Read together, or have students read independently, “Water in the Atmosphere,” Chapter 2 in the Student Reader. The selection reinforces the idea that water on Earth is constantly cycling and that movement causes different types of weather to happen.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to pay special attention to these terms as they read.

condense
evaporate

humidity
precipitation

water vapor

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 5

After students have read the page, explain that all living things depend on water. Ask the following:

- » Have you ever forgotten to water a plant at your house? What happened? *(The plant began to turn brown or droop.)*
- » Explain that most plants get water by absorbing it out of the soil with their roots. How does water get in the soil? *(It soaks into it when it rains.)*
- » What happens to water that does not soak down into the soil? *(It flows to rivers or oceans or evaporates back into the air.)*

Page 6

After reading the page, have students find and circle the four types of precipitation. Ask the following:

- » What makes the types of precipitation that fall so different? *(the temperature)*
- » How can the amount of precipitation that falls to the ground be measured? *(by measuring the height with a ruler)*

SUPPORT—If necessary, relate precipitation in your area so students can call upon experiences with it. For instance, if your area gets a lot of rain or snow, ask students about this weather, and prompt them to recognize that it is an example of precipitation.

Page 7

Review the definition of the term *evaporate* after reading this page. Ask students to turn and talk to a partner to explain how they can know that water has evaporated if they cannot see it. Ask them to describe some evidence they can look for to know that water has evaporated. *(The amount of water has decreased; you can feel the moisture in the air; there is an increase in the amount of clouds.)* Call on pairs of students to briefly share the ideas they discussed with the class. Address any misunderstandings about evaporation. (See **Know the Science**.)

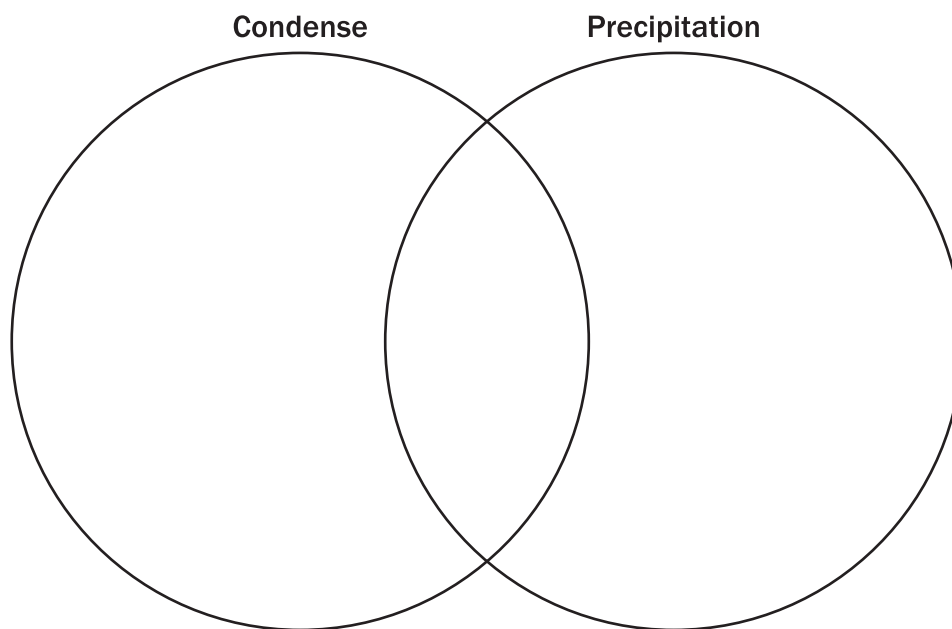
SUPPORT—Tell students to think about what happens to the air in the bathroom after they get out of a hot bath or shower. Ask them to think about how the mirror and the air change.

Page 8

After reading this page, make a Venn diagram on the board to compare the words *condense* and *precipitation*. Explain to students how a Venn diagram works. Tell them that in each circle, you write the differences that make something unique. Then, in the middle where the two circles overlap, you write something that is similar about them.

Know the Science

Does water have to boil to evaporate? No! Water does not have to boil to evaporate. Evaporation happens any time that particles near the surface of a liquid get enough energy to break free of the liquid and go into the air. The liquid becomes a gas. Water becomes water vapor and rises into the atmosphere. Energy transfer and phase change happens more quickly on a warm day or when it is windy. These conditions make it easier for water to become vapor.



Ask students to explain the difference in these two terms. Record their ideas on the two circles of the diagram. Then have students identify what is similar about these two terms. Record their ideas in the center where the circles overlap. (*Students should be able to identify that the similarity is that both condensation and precipitation occur in the atmosphere.*)

3. Demonstrate more examples.

5 MIN

For this demonstration, you will need the following materials:

- pot of water
- hot plate
- pot of ice

SUPPORT—Prepare the demonstration ahead of time by having the large pot of water already heating on the hot plate. Consider heating the water as you lead the reading and discussion section of the lesson.

Direct students' attention to the pot of boiling water. Ask: Do you see something coming out of the pot? Explain that this is steam. What is steam? (*Steam is droplets of liquid water.*)

Hold the pot of ice over the pot of boiling water. After a few minutes, students should see water cling to the pot. After a few more minutes, they should see the water drip off the pot. Ask the following:

- » What is the water that is on the outside of the pot? (*condensation*)
- » What is the water that is dripping off the pot? (*precipitation*)

Relate student observations to real weather. Explain that scientists study the amount of moisture, or water, in the air in order to learn about weather patterns that can help them make weather predictions. (See **Know the Standards.**)

4. Summarize and discuss.

10 MIN

Activity Page



AP 2.1

Distribute How Water Moves (AP 2.1) to each student. Tell students they will draw a diagram to explain each of these ways that water changes as it moves through the atmosphere. Go over the directions with students.

SUPPORT—If needed, help students by having them act out each of the ways water changes by using hand motions. Direct them to pages 6, 7, and 8 in the Student Reader, and show where they can revisit the information about precipitation, evaporation, and condensation. Reread the information if necessary.

Circulate throughout the room, and provide support for students as they make their diagrams. Encourage students to add details and labels to their drawings.

Once students are finished with their drawings, bring the class back together, and lead a discussion about the diagrams that students drew. Ask students to show their diagrams to a neighbor. Ask: How are your diagrams the same? How are they different?

Point out that even though some students may have drawn a puddle, a river, the ocean, or a pot or cup of water, water evaporates from all of those places.

5. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed earlier in the lesson). Have students write the terms in the upper left corner of each index card and underline them.

condense

humidity

water vapor

evaporate

precipitation

Know the Standards

How do scientists know what typical weather conditions are expected during a season?

Scientists look for patterns! Scientists measure the water in the air, or humidity, and the amount of precipitation and observe the types of clouds in the sky. They use these data and analyze them to find patterns. They compare these patterns to data that have been collected in the past. This is how scientists make predictions about weather.

Word Work

Prompt students to add notes to their cards to define the terms in their own words.

- **water vapor:** (n. the gas form of water) Have students underline the word *vapor*. Tell students to write the state of matter of water vapor. (*gas*)
- **condense:** (v. to change from gas to liquid) Have students write the state of matter that water comes from and goes to when it condenses. (*from gas to liquid*)
- **evaporate:** (v. to change from liquid to gas) Have students underline the word part *vapor*. Tell students to write the state of matter that water comes from and goes to when it evaporates. (*from liquid to gas*)
- **precipitation:** (n. water that falls from the sky in the form of rain, snow, sleet, or hail) Have students write the four types of precipitation and draw a sketch of each if time permits.
- **humidity:** (n. a measure of the amount of water vapor in the air)

Ask students if clouds are more likely to form in air with high or low humidity. (*high*)

Have students add these cards to the rest of the vocabulary deck and store them safely until the next lesson.

6. Check for understanding.

5 MIN

Activity Page



AP 2.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed How Water Moves (AP 2.1). Scan the diagrams that students made. If any contain inaccurate information, engage in further discussion, emphasizing the parts that are missing or incorrect.

LESSON 3

Investigating Air Pressure and Precipitation

Big Question: How does temperature affect air pressure and precipitation?

AT A GLANCE

Learning Objectives

- ✓ Use a model to demonstrate that air is matter.
- ✓ Explain the relationship between warmer or cooler temperature and lower or higher air pressure.
- ✓ Describe differences between evaporation and condensation.
- ✓ Identify different forms of precipitation.

Lesson Activities

- teacher demonstration
- observation and discussion
- student investigation

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Science and Engineering Practices: Analyzing and Interpreting Data

Crosscutting Concept: Patterns

Analyzing and Interpreting Data is important to this lesson because students will be observing demonstrations and learning stations to gain an understanding about the elements of weather in order to make graphical displays in future lessons.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

air pressure

condensation

evaporation

Instructional Resources

Activity Page



AP 3.1

Activity Page

Elements of Weather
Observations (AP 3.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

Teacher Demonstration

- shallow dish or pie pan (a glass dish is best)
- water
- food coloring
- candle and matches or lighter
- beaker

Student Investigation

- balloon slightly inflated and tied
- plastic cup
- piece of newspaper (wedged into the bottom of the cup)
- bucket of water
- glass of ice water
- dropper of water

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

Activity Page



AP 3.1

How does temperature affect air pressure and precipitation? To build on what students read in previous lessons, open this lesson with a brief demonstration to show how temperature affects air pressure.

Distribute Elements of Weather Observations (AP 3.1). Tell students that the Activity Page is divided into two parts. The first part will be filled out after students watch a teacher demonstration. The second part will be filled out as students participate in their own investigations. Let students know that they will watch a demonstration about temperature and its relation to air pressure. You will prompt students when it is time for them to fill out the first section of their Activity Pages.

To conduct the demonstration, follow these steps:

1. Fill the shallow dish with water.
2. Add a few drops of food coloring so that students can see the water.
3. Place a candle in the center of the dish, and light the candle.

Ask students what they think will happen when you place the beaker over the candle. (*Students may say that the candle will go out.*)

Tell students to observe closely as you cover the candle.

Ask: What did you observe? (*The candle went out, and the water rose up inside the beaker.*)

If students did not observe the water rising into the beaker, repeat the demonstration.

Then use the following questions to prompt discussion:

- » What happened inside the beaker to cause the candle to go out?
(*The oxygen was used up.*)
- » What happened to the temperature inside the beaker? (*It increased because of the fire.*)

Explain that the temperature started high with the lit candle and then dropped with the extinguished candle. The rapid drop in temperature and, in turn, pressure caused a rise in the water.

Prompt students to draw arrows with the text on Activity Page 3.1 to show that the higher the temperature, the higher the air pressure and the lower the temperature, the lower the air pressure. Give students a couple of minutes to fill out the top section of the Activity Page.

2. Preview the investigation.

5 MIN

Tell students that they will participate in an investigation that is split up into stations. Let students know that they will fill out the second section of their Activity Pages as they work through each station.

Explain and model what students will do at each learning station.

- Station 1:** Students will place a drop of water on the back of their hand and wait for it to dry up. Students will record their observations on the Activity Page.
- Station 2:** Students will observe the outside of the glass of ice water without picking it up. Students will record their observations on the Activity Page.
- Station 3:** Students will squeeze one end of the balloon and observe what happens. Students will record their observations on the Activity Page. Remind students to squeeze the balloon gently.
- Station 4:** Have students turn the cup with the newspaper (wedged into the bottom of the cup) upside down and submerge it in the bucket of water. Warn them not to tilt the cup but to push it straight down to the bottom of the bucket of water and pull it straight up and out.

3. Support the investigation.

20 MIN

Activity Page



AP 3.1

Place students into small groups to complete the learning stations. Students can complete the learning stations in any order.

Circulate throughout the classroom as students make their observations at each station and record them on the Activity Page. Answer any questions that students may have as they rotate through each of the learning stations.

SUPPORT—Set a timer for students to rotate to a different station every five minutes. Remind students to complete their Activity Page with their observations while they are at each of the learning stations.

4. Summarize and discuss.

10 MIN

After students complete their observations at each of the learning stations, bring the class back together for a discussion to summarize what students discovered. Call on each group of students to present their observations from each of the stations.

Elicit the following responses from each group of students:

- Station 1:** The water was a liquid and became a gas. This process is known as evaporation. Ask: What causes evaporation to occur? (*When the temperature increases, water evaporates.*)
- Station 2:** Students should report that they observed water droplets on the outside of the glass. This is because water vapor in the air changes from a gas to a liquid. This process is known as condensation. Ask the following:
- » What else do you know that forms by condensation? (*dew, clouds*)
 - » What happens to the water after the condensation becomes too heavy to remain in the atmosphere? (*It will begin to precipitate.*)
 - » How does temperature affect precipitation? (*Sometimes precipitation will be liquid, and sometimes it will be frozen, depending on the temperature.*)
- Station 3:** Students should report that the air moved away from the place where they squeezed and that air moves from high pressure to low pressure. Ask: What did you do when you squeezed the balloon? (*increased the pressure*)
- Station 4:** Students should report that the newspaper in the cup remained dry when the cup was pushed under the water. They should explain that there was no room for water to enter the cup because the cup was already full of air. Ask: What would have happened if you had tilted the cup? (*You would have let the air out of the cup and let water into the cup.*)

5. Check for understanding.

5 MIN

Activity Page



AP 3.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed Elements of Weather Observations (AP 3.1) that you have just checked with the class. Check for student understanding of air pressure:

- For Station 1, students should explain that the water was a liquid and became a gas. This process is known as evaporation.
- For Station 2, students should report that they observed water droplets on the outside of the glass. This is because water vapor in the air changes from a gas to a liquid. This process is known as condensation.
- For Station 3, students should report that the air moved away from the place where they squeezed and that air moves from high pressure to low pressure.
- For Station 4, students should report that the newspaper in the cup remained dry when the cup was pushed under the water. They should explain that there was no room for water to enter the cup because the cup was already full of air.

PART B

Wind: The Movement of Air

OVERVIEW

Lesson	Big Question	Advance Preparation
4. Investigating Wind	How can I observe and describe moving air?	Gather materials for student activity. (See Materials and Equipment, page 12.)
5. Wind	What is wind?	Read Student Reader, Chapter 3.
6. Working with Wind Data (2 days)	How can I use data to discover wind patterns?	Gather materials for student activity. (See Materials and Equipment, page 12.)

Part B: What's the Story?

Students have already learned about Earth's atmosphere in Part A. In Part B, students will build on what they learned to explore more about one of the atmosphere's big components: wind. Although students instinctively understand what wind is, they may not yet fully grasp the concept of how or why air moves.

In Lesson 4, we start by engaging students to look at how air moves by making and then observing the action of wind vanes. The goal is for students to recognize that wind can be described based on the direction it blows from.

In Lesson 5, students continue to explore the idea of wind. In the Student Reader, students are exposed to examples of how wind works with the sun as the source of energy that warms air. Students will learn about air masses and what characterizes them.

In Lesson 6, students use two class sessions to conduct investigations on wind data. The goal of this lesson is for students to understand air masses, patterns of wind, and how wind speed and direction change at different locations over time.

So, to repeat, **wind is the movement of air, which is a component of Earth's atmosphere**. The key concept for students to grasp is that wind displays patterns in terms of its location and direction.

LESSON 4

Investigating Wind

Big Question: How can I observe and describe moving air?

AT A GLANCE

Learning Objectives

- ✓ Define wind as the movement of air.
- ✓ Create tables and graphs that represent wind data.

Lesson Activities

- teacher demonstration
- student activity and discussion
- collect and analyze data

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data is important to this lesson because students will construct a wind vane to collect data about wind direction.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

wind

wind vane

Instructional Resources

Activity Page



AP 4.1

Activity Page

Measuring Wind (AP 4.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

- internet access and the means to project images/video for whole-class viewing

Student Investigation

- paper plate (1 per group)
- marker (1 per group)
- ruler (1 per group)
- straw (1 per group)
- tissue paper streamers (2 per group)
- tape (1 roll per group or enough for efficient sharing)
- compass (1 per group or enough for efficient sharing)
- sharp pencil (1 per group)

Teacher Demonstration

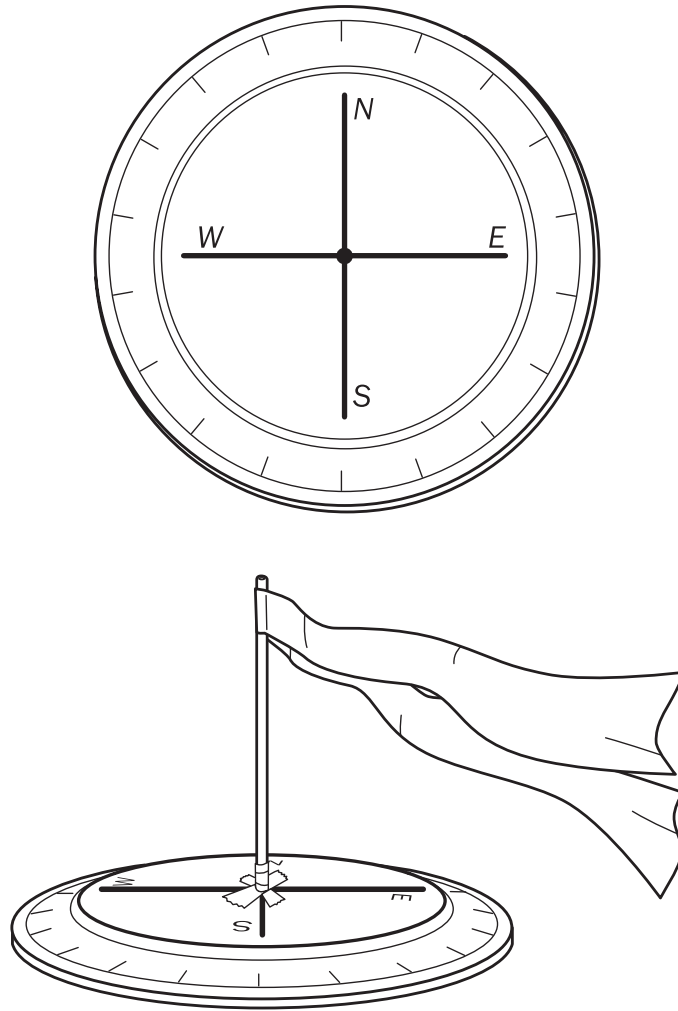
- pinwheel
- candle
- piece of clay
- picture of a hot-air balloon and a windsurfer

Advance Preparation

Prepare for the success of the activity by considering the following:

- To save time, premark the paper plates with a large cross, and punch a hole where the two lines cross. Cut tissue paper into lengths one foot long by one-half inch wide. Cut enough so that each pair or group of students will have two streamers.
- Determine an outdoor location where the wind blows freely without being blocked by buildings or other obstacles.
- Check the weather forecast to ensure suitable conditions for the activity. Postpone in the event of precipitation or if the wind is so strong that the wind vanes may be carried away. If outdoor wind conditions in your area are not suitable, consider trying the activity in the classroom with a fan set on different speeds and placed in different locations in the room.
- Assemble one wind vane as a model for students to follow for their own assembly.

This is what the final product should look like:



THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

10 MIN

How can I observe and describe moving air? Open this lesson with a teacher demonstration that shows that warm air rises. This will act as background knowledge for students to build on when describing how wind forms, how air masses move, how fronts form, and other weather phenomena.

Complete the demonstration by following these steps. (Test the setup ahead of time. Warn students to use caution around the candle flame and remain in their seats.)

1. Light the candle, and place it on a clear, flat surface where students can observe it.
2. Place the pinwheel into the piece of clay so that the pinwheel is standing upright. The heat from the candle should heat the air, causing it to rise, and the pinwheel should begin to spin.

Ask the following questions about the demonstration:

- » What caused the pinwheel to turn? (*rising air*)
- » Why did the air rise? (*It was heated by the candle.*)

Online Resources



SUPPORT—Show students a photo of a hot-air balloon. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found: www.coreknowledge.org/cksci-online-resources

Explain that hot air causes the balloon to rise. (See **Know the Science**.) Explain that when the riders in the balloon want to come back down to the ground, they let the hot air out of the top of the balloon. Explain that air in the atmosphere is warmed in the same way that air in a hot-air balloon is heated.

Have students keep the demonstration in mind as they go through the remainder of the lesson. They will be asked to draw a diagram later in the lesson to describe how air moves.

Remind students that moving air is known as wind. Ask the following:

- » Can you see wind? (*No, but you may see those things that wind causes to move.*)
- » What evidence can help you know that wind is there? (*You can see evidence of it in objects that are moving or by feeling it on your skin.*)

Explain that a wind vane is used to determine the direction that wind blows from. Tell students that in a moment they will be making a wind vane. Be sure that students understand that wind direction is expressed as the direction from which the wind blows, not where it is blowing to.

Online Resources



SUPPORT—Show students an image of a person windsurfing or kitesurfing. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found: www.coreknowledge.org/cksci-online-resources

Ask them to identify which way the rider's board will move and which way the wind is coming from. Be sure that students understand that these will be opposite directions. The wind direction is recorded as the direction that the air is coming from.

Know the Science

Why does warm air rise? When air is heated, the particles move faster and spread out. The air becomes less dense and rises above cooler, denser air. The process of warm air rising and cold air sinking is known as convection and is responsible for patterns of wind around the globe.

2. Facilitate the investigation.

30 MIN

Activity Page



AP 4.1

Begin by dividing students into pairs or small groups and distributing a paper plate, ruler, straw, tape, sharp pencil, streamers and marker to each group. Guide students with the following steps to make their wind vane:

1. Draw a compass rose on the board, and instruct students to label their plate like yours. Quickly review the cardinal directions (N, S, E, W) and the ordinal directions (NE, NW, SE, SW).
2. Have students use the sharp pencil to punch a small hole in the center of the plate where the lines cross.
3. Next, have students attach the streamers to one end of the straw with tape and push the other end of the straw into the hole in the middle of the paper plate. Students can secure the straw to the plate with tape if needed.

After students have built their wind vanes, take the class outside to a windy area.

First, give each group a compass, and have students use it to determine which direction is north. Students should next align their paper plate to match that of the compass.

Finally, students should observe the direction that the wind is blowing from. Tell students to remember the direction because they will record this data point on Activity Page 4.1 when they return to the classroom. When weather reports mention a northerly wind, they mean a wind blowing from the north.

Take students back into the classroom, and distribute Measuring Wind (AP 4.1). Have students complete the data table with their results and answer the questions that follow. Give students time to complete this task. After students complete the data table and questions, use the Answer Key to discuss the answers together. Call on students to share with the class their diagrams of how air moves.

3. Check for understanding.

5 MIN

Activity Page



AP 4.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed Measuring Wind (AP 4.1). Scan the diagrams that students made of how air moves. If diagrams contain missing labels, engage in further discussion. Also check that students correctly described that the surface of Earth is heated by the sun.

LESSON 5

Wind

Big Question: What is wind?

AT A GLANCE

Learning Objectives

- ✓ Define wind as the movement of air.
- ✓ Identify the sun as a source of energy that warms air.
- ✓ Identify and describe patterns in wind direction over time.

Lesson Activities

- reading and discussion
- student investigation and observation

NGSS References

Performance Expectation 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data is important to this lesson because students will learn about the type of data that can be collected to describe wind and air masses.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 160–161 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

air mass
prevailing winds

wind
wind direction

wind speed

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 3

Activity Page



AP 5.1

Student Reader, Chapter 3
“Wind”

Activity Page
Air Masses and Wind (AP 5.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- cup or pan of warm water with a cover (1 per group)
- index cards for student vocabulary deck (5 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What is wind? To build on what students learned in Lesson 4, open this lesson by having students look outdoors. Ask the following:

- » What does wind look like? (*It doesn't look like anything, but you can see objects that are moving in the wind.*)
- » Is it windy outside today? How can you tell? (*Answers will vary.*)

If time allows, have students quickly take the wind vane that they constructed in the previous lesson outdoors to measure the wind direction again. They can record it in the data table on Measuring Wind (AP 4.1), or you can keep track of the data on a piece of chart paper displayed in the classroom.

2. Read and discuss: “Wind.”

20 MIN

Student Reader



Ch. 3

Read together, or have students read independently, “Wind,” Chapter 3 in the Student Reader. The selection describes what wind is, how it can be measured with different tools, and how understanding wind patterns can help scientists predict the weather.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to pay special attention to these terms as they read.

air mass
prevailing winds

wind
wind direction

wind speed

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 9

After students have read this page, ask them to describe wind using some of their senses. Ask the following:

- » Can you smell wind? (*No, but wind can carry odors.*)
- » What causes the wind to make sounds? (*When it blows through the trees or along leaves or loose sand, it causes them to vibrate, and this causes a sound.*)
- » How does wind cause changes? (*It can move things or wear them down [such as rocks].*)

Discuss the evidence of wind that students see in the pictures on this page.

Page 10

Draw a T-chart on the board. Label one side "warm air" and one side "cool air."

warm air	cool air

Instruct students to underline or circle the descriptions of the two types of air/air masses as you read the page aloud.

Call on students to describe each type of air and record their answers on the chart. Discuss ways that warm air and cool air are different.

Page 11–12

After reading these two pages, ask the following:

- » How can wind be measured? (*by finding how fast it moves and the direction it comes from*)
- » What tools can be used to measure wind? (*anemometer, wind vane*)

Ask students to observe the tool on page 11, called an anemometer. Explain that its function is to measure wind speed. Have students describe the structure to one another and make guesses as to how it works to determine the speed of wind. Call on students to share their ideas with the class. (See **Know the Science.**)

Know the Science

What affects the temperature of an air mass? *Sunlight!* The temperature of an air mass depends on the temperature of the area where it formed. If it formed over a cold area that does not receive strong or direct sunlight, the air mass will feel cold. If it formed over a warm place, where sunlight is more direct, the air mass will be warm.

Point out the definition of *prevailing winds* on page 12 to students. Ask the following:

- » Why are prevailing winds easy to predict? (*They always blow in certain directions.*)
- » Describe how wind causes changes in weather. (*It moves different air masses from one place to another.*)

3. Facilitate investigation and discussion.

10 MIN

Activity Page



AP 5.1

Divide the class into small groups for the investigation. Each group will need one cup or pan of warm water with a cover

Distribute Air Masses and Wind (AP 5.1). Explain to students that they will conduct an investigation to closely study one type of air mass. Then they will draw a diagram to show what they have learned about air masses. Students will complete the Activity Page based on what they have learned so far in this lesson, but they can also use what they learned in previous lessons as well. Go over the directions and questions with students before they begin.

Place the pan/cup of warm water in front of each group of students. Tell them not to remove the cover until everyone has their hand ready to feel the air above the water.

SUPPORT—If needed, count to three, and have all students remove the lid and place their hand over the water at the same time. Be sure students understand not to put their hand in the water. They are only feeling the air above the warm water. You may wish to model this for students.

Circulate through the classroom as students complete the questions and draw a sketch of the air mass they observed on the Activity Page. Be available for any questions that students may have as they work.

After students have completed the investigation, lead a discussion about the diagram of the warm air mass that students drew on their Activity Page. Ask volunteers to share their sketches. Point out that student drawings are similar because all the air in each container behaved in the same way. It was heated and rose. Ask the following:

- » What are some places where a warm air mass such as this may form? (*Answers will vary.*)
- » Predict what would happen to the warm air mass if it met cold air. (*It would push it and climb over it as it rises.*)
- » Why did you need to feel the air quickly? (*The warm air rises, so it will not stay over the water when the cover is removed.*)

4. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Ask students to write each term in the upper left corner of an index card and underline it (one term per card):

air mass
prevailing winds

wind
wind direction

wind speed

Word Work

Instruct students to refer back to the chapter to add definitions to their cards for each term.

- **wind:** (n. the movement of air)
- **air mass:** (n. a large body of air in the atmosphere)
- **wind speed:** (n. a measure of how fast wind blows)
- **wind direction:** (n. the direction from which air moves when wind blows)
- **prevailing winds:** (n. regular patterns of winds that blow from one direction)

Have students draw a quick sketch to show how *wind speed* and *wind direction* are measured on the back of each of these index cards.

Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add to the deck in later lessons.

5. Check for understanding.

5 MIN

Activity Page



AP 5.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed Air Masses and Wind (AP 5.1). Scan the diagrams that students drew. If diagrams contain missing labels, engage in further discussion, emphasizing the parts that are missing.

Scan the questions quickly to see that they are answered correctly.

LESSON 6

Working with Wind Data

Big Question: How can I use data to discover wind patterns?

AT A GLANCE

Learning Objectives

- ✓ Create tables and graphs that represent wind data.
- ✓ Identify and describe patterns in wind direction over time.
- ✓ Compare wind speed data from different locations over time.

Lesson Activities (2 days)

- student investigation
- data analysis and graphing
- discussion and writing

NGSS References

Performance Expectation 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data is important to this two-day lesson because students will gather data about wind speed and direction, create tables and graphs, identify patterns in the data, and compare data from different locations and over time.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

data

graph

pattern

Instructional Resources

Activity Pages



AP 6.1

AP 6.2

Activity Pages

Looking for Patterns in
Wind Data (AP 6.1)

Comparing Wind Speed (AP 6.2)

Make sufficient copies for your
students prior to conducting
the lesson.

Materials and Equipment

Collect or prepare the following items:

- internet access
- colored pencils

THE CORE LESSON TWO DAYS, 45 MIN EACH

1. Day 1: Focus student attention on the Big Question.

10 MIN

How can I use data to discover wind patterns? Begin by having students take out their Core Vocabulary deck. Ask students to review the definitions of *wind*, *wind speed*, and *wind direction*. Ask the following:

- » What causes wind? (*Air moves from high pressure to low pressure.*)
- » What is the difference between wind speed and wind direction? (*Speed is how fast the wind is blowing, and direction is the place from which the wind blows.*)

If weather permits, have students take the wind vane that they constructed in Lesson 4 outside to measure the wind direction. Students can add the data to the data table on Measuring Wind (AP 4.1), or you can record the wind direction on a class data table on a piece of chart paper.

SUPPORT—To save time, consider placing one wind vane in a place that can be easily viewed in the classroom and checked twice throughout the day. Keep track of the data on a table displayed in the classroom.

- Explain that data are measurements. Tell students that they will record data to describe wind on data tables.
- A graph is a way to display data so that it is easy to see how it compares. Tell students that they will be creating a graph to compare wind data.
- Patterns are relationships between data. Explain that students will examine data and graphs to look for and describe patterns that they observe.

2. Support data collection.

30 MIN

Activity Page



AP 6.1

Access the National Weather Service website, and show students how to see the weather data for their area. (See the Online Resources for a link to the website.) Show them how to click on the map to bring up the wind speed for where they live.

Distribute a copy of Looking for Patterns in Wind Data (AP 6.1) to each student or pair of students. Tell students they will record the wind speed for the past five days in their city based on information from the National Weather Service website. Then they will make a graph to display and compare the information.

SUPPORT—You may choose to have students work individually or with a partner for this portion of the lesson. If possible, have students take turns looking for the data on the website. Be sure all students complete the data table with the dates and wind speed for their location. You may also choose to simply collect this information ahead of time and display it for students to copy onto their data table.

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

3. Review and discuss.

5 MIN

Lead a discussion about any patterns that students found in the wind data. Invite students to discuss with a partner patterns they observe. Call on partners to share with the class what they observed. Ask the following:

- Do you think that higher wind speed is associated with a certain type of weather? (*There can be higher wind speeds when weather is stormy, but it can blow strongly on clear days as well.*)

1. Day 2: Refocus student attention on the Big Question.

5 MIN

Remind students that in the previous class session, they collected data on the wind in their city over the past five days.

- Ask students if they have any questions about the first part of the investigation that they completed. Students may have thought of a new pattern in the data. If so, have them share their ideas with the class.
- Go over the Big Question again: **How can I use data to discover wind patterns?** Ask the following:
 - » Why do you think it is important to find patterns in the data? (*so that predictions can be made from them*)
- Tell students that today they will create a graph to compare wind data from two cities. Explain that one city is on the east coast of the United States and one city is on the west coast of the United States. The data in the table is from the same five-day period.

2. Support the graphing exercise.

30 MIN

Activity Page



AP 6.2

Distribute Comparing Wind Speed (AP 6.2) to each student or pair of students. Ask: What parts does a bar graph need to have? (*title, labels, bars, key*)

Explain that students will be using the data in the data table to complete the graph as a double bar graph.

Explain that the graph has been started for them. Distribute colored pencils. Each student pair will need two different colors for the activity.

Instruct students to begin by choosing two colors to represent each of the two cities. Have them shade in the boxes on the key with each color.

Model how a double bar graph is created by shading in the wind speeds for the first day side by side.

Give students time to complete the rest of the bar graph as you circulate throughout the classroom assisting students as they work. Remind students to include all parts, labels, and a title on their graphs.

3. Review and discuss.

5 MIN

Have students share their completed graph with a partner or group. Have students discuss any patterns they observe in the data. Call on each group or pair of students to show their graph to the class and tell about any patterns that they observed.

Ask students to compare the data from these locations with the data from where they live.

4. Check for understanding.

5 MIN

Activity Pages



AP 6.1

AP 6.2

Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 6.1 and 6.2) for correct answers and sample student responses.

Collect the Activity Pages after students have completed them.

Glance quickly over the graphs that the students created to see that all parts have been included. Provide additional guidance for students who need more support.

PART C

Weather and Climate

OVERVIEW

Lesson	Big Question	Advance Preparation
7. Using Weather Data to Predict Weather	What do meteorologists do?	Read Student Reader, Chapter 4.
8. Patterns of Weather: Seasons and Climate (2 days)	What is the difference between weather and climate?	Read Student Reader, Chapter 5.
9. Working with Weather Data (2 days)	How can I use weather data to reveal patterns?	Gather materials and sources for guided research. (See Materials and Equipment, page 13.)
10. Working with Climate Data (2 days)	How can I use climate data to reveal patterns?	Gather materials and sources for guided research. (See Materials and Equipment, page 13.)

Part C: What's the Story?

By now in this unit, students have learned about Earth's atmosphere and how wind is the movement of air. This next series of lessons leads students through readings, discussions, and research on the ways in which data can be used to study and predict weather and climate patterns.

Lesson 7 introduces students to the important job of a meteorologist. Students may already be familiar with meteorologists, having seen them on television or heard them on the news. This lesson dives into how weather data can be used to predict the weather and explores the importance of knowing the weather on a daily basis in a reading selection.

Lesson 8 extends the concept of the weather by introducing the definition of *climate* and distinguishing between weather and climate. Students will differentiate the terms. Students will read about and discuss weather and climate patterns that occur seasonally. It is the goal of this lesson to focus on climate changes have occurred on Earth over time.

In Lesson 9, students build on their understanding of the weather by performing guided research to find patterns in weather data. Students will have two days to use resources to extract weather data on a location and use that information to explain how weather can be predicted in the future. They do this in the context of planning an outdoor carnival.

In Lesson 10, students build on their understanding of climate by performing guided research to find patterns in climate data. Students will have two days to use resources to extract climate data on a location and use that information to explain how the climate has changed over time. They do this in the context of joining a club centered around famous world parks.

So, to repeat, **people can use weather data and climate data to reveal patterns and make predictions**. The key concept for students to grasp is that there is a difference between weather and climate, though both can provide useful information about how the weather and climate changes over time.

LESSON 7

Using Weather Data to Predict Weather

Big Question: What do meteorologists do?

AT A GLANCE

Learning Objective

- ✓ Describe what a meteorologist does.

Lesson Activities

- optional video
- reading and discussion
- demonstration
- analyzing data activity
- job description writing activity

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data requires that students represent data in graphical displays to look for patterns. In Lesson 6, students collected and displayed wind data. In this lesson, students learn how meteorologists use tables, graphs, and maps to identify patterns in temperature and fronts. In Lesson 8, students will have more practice in representing data themselves to identify patterns from season to season.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

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data **front** **meteorologist** prediction

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 4

Activity Pages



AP 7.1

AP 7.2

Student Reader, Chapter 4

“Using Weather Data to Predict Weather”

Activity Pages

Finding Temperature Change Patterns (AP 7.1)

Meteorologist Job Description (AP 7.2)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- ruler
- yardstick
- index cards for student vocabulary deck (3 per student)
- internet access and the means to project images/video for whole-class viewing

Before class, preview the weather prediction video you plan to show to students.

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What do meteorologists do? Explain to students that there are many kinds of scientists, each investigating a limited number of phenomena. For example, chemists investigate matter, paleontologists investigate fossils, and planetologists investigate planets.

Have students identify the common suffix to all three examples (-ist). Explain that this suffix means “one who specializes.” Students may predict that a meteorologist specializes in investigating meteors. While that is not true, it is very close. The root of the word comes from a French word (*meteoron*) meaning “something high up.”

Show students an online video about the work of meteorologists.

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

2. Read and discuss: “Using Weather Data to Predict Weather.”

15 MIN

Student Reader



Ch. 4

Read together, or have students read independently, “Using Weather Data to Predict Weather,” Chapter 4 in the Student Reader. This chapter describes how meteorologists use tools to measure weather conditions and display the data in ways that allow people to see patterns.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to use the terms frequently as they discuss what they read.

front **data** **meteorologist**

Establish a Scientific Mindset

Lead a discussion about making predictions. Prompt students to think about why making predictions is an important skill in science. Draw attention to real-life examples of ways that scientists use predictions. Tell students that a prediction is more than a random guess; a prediction is based on what you already observed and know about something and can also be based on evidence and data that have been collected. In other words, there is a reason for the prediction that is made.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 13

Make sure students understand what is meant by the word *data*. Point out that data are facts or information about the natural world that scientists collect and share. Explain that when speaking or writing, the word *data* is plural, though people do tend to use it as a singular word. Ask the following:

- » Based on what you have learned so far in this unit, what kinds of data do you think meteorologists collect? *(Remind students of earlier lessons, when they learned about air temperature, air pressure, wind speed, and wind direction. Meteorologists can collect data about all of these weather conditions.)*
- » How does using data help meteorologists make reasonable predictions? *(Guide students to express that if scientists know what happened in the past, they can use that information to suggest what is likely to happen in the future. In other words, data are used as evidence in arguments and explanations.)*

Pages 14–15

After reading pages 14–15, explain to students that there are land-based weather stations all over the world. Each station includes tools similar to the ones shown. Most of the U.S. weather stations collect data automatically and continuously and send it to computers so that meteorologists can review it anywhere. (See **Know the Science** on the following page.)

Have a volunteer demonstrate using a ruler to measure the depth of snow. Make sure the zero end of the ruler is touching and held perpendicular to the ground. Then show students a yardstick. Ask: When would a yardstick be a better choice than a ruler? *(when the snow is deeper than twelve inches)*

Pages 16–17

Explore the data table with students, asking guiding questions requiring them to analyze and interpret data:

- » How did the temperature change from noon to 5 p.m. each day? *(It increased.)*
- » Did the temperature ever go down between noon and 5 p.m.? *(no)*

Make Cross-Curricular Connections

Help students reason abstractly and quantitatively by asking the following: Did the temperature always increase the same number of degrees each day? *(Show students how to subtract the noon temperature from the 5 p.m. temperature and compare the results to find that the number of degrees the temperature changed each day varied.)*

Explore the double bar graph with students. Ask: What pattern did the temperatures show for the five days? *(From Monday to Wednesday it got warmer, and from Wednesday to Friday it got cooler.)*

Page 18

Remind students that they learned about high-pressure and low-pressure areas in Chapter 1. Have them point to the places on the weather map with symbols for highs (H) and lows (L).

Give students time to analyze the data in the temperature table on page 16 so that they can answer the text question, “What kind of front moved in on Wednesday night?” *(a cold front)*

Then focus discussion on the job of the meteorologist. Ask the following:

- » What does a meteorologist explain with a map? *(How the weather prediction relates to the highs, lows, fronts, and other symbols on the map.)*
- » What might a meteorologist say about the weather on either side of the blue-colored cold front? *(that cooler weather is behind the cold front and will bring cool weather wherever the front moves)*

Know the Science

How do meteorologists get weather data? *From scientific tools and with the help of volunteers!*

Land surface weather stations are located all over North America. There are two main systems of automatic land-based weather stations. The newer system is called Automated Surface Observation System (ASOS), which operates over 900 weather stations that report data by the minute. An older system, called the Automated Weather Observation System (AWOS), is controlled by the Federal Aviation Administration (FAA), and its stations mostly report every twenty minutes. These stations are mostly located at airports and transmit their data by radio. In addition to the automated stations, about 10,000 human volunteers in the Cooperative Observer Program (COOP) maintain weather stations on farms, in parks, and in urban areas to collect and send weather data once every twenty-four hours electronically to the National Weather Service. A computer system collects data from these varied sources and distributes it worldwide using a reporting system that can be understood internationally.

CHALLENGE—Allow students who show interest in interpreting data on maps to search online for weather maps. Have them identify warm and cold fronts. Point out that the half circles on the warm front point in the direction the front is traveling. Likewise, the blue triangles on a cold front line show the direction the cold front is traveling.

3. Teach Core Vocabulary.

5 MIN

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Ask students to write each term in the upper left corner of an index card and underline it (one term per card):

meteorologist **data** **front**

Word Work

Coach students to add definitions in their own words and examples to their Core Vocabulary Cards.

- **meteorologist:** (n. a scientist who studies weather conditions and patterns) Explain that *meteorologist* is the name of a profession.
- **data:** (n. information that is observed or measured and recorded) Remind students that in Lesson 6 they looked at data in the form of weather measurements.
- **front:** (n. the place where two air masses meet) Allow students to tell how they use the word *front* to positions or parts of objects. Point out that it has a specific meaning in weather science.

4. Identify patterns of change in data.

5 MIN

Activity Page



AP 7.1

Distribute Finding Temperature Change Patterns (AP 7.1). Explain that the graphs contain real data collected from weather stations by the U.S. government in 2018. Tell students that they will be using the data to answer questions.

Know the Standards

Weather and Climate: The focus of this lesson is on the Disciplinary Core Idea ESS2.D Weather and Climate, stating “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” in conjunction with the Crosscutting Concept Patterns, stating “patterns of change can be used to make predictions.” By understanding that weather changes from hour to hour and from day to day, students develop prerequisite knowledge for building understanding of the concept of climate. After students see in this lesson what scientists do to collect and display data, they will be prepared for representing data themselves in Lessons 8–10.

Read the directions with students, and if needed, review how to read a bar graph. Then have students work in pairs or small groups to discuss and answer the questions. (See **Know the Standards** on the previous page.)

SUPPORT—Drawing bar graphs and solving problems using data from bar graphs are math skills developed in Grades 2 and 3 (Common Core State Standards). For those students who need support reading this type of graph, review its parts. Explain that each graph represents a twenty-four-hour day with a bar for each hour and that each horizontal line represents ten degrees. Demonstrate how to compare the heights of the bars to decide which represent higher or lower temperatures.

5. Refocus student attention on the Big Question.

10 MIN

Activity Page



AP 7.2

What do meteorologists do? Introduce this activity by explaining that people deciding on what kind of job to prepare for or looking for a new job need to carefully read a job description to decide if they are suited for the position.

Distribute Meteorologist Job Description (AP 7.2). Tell students that they will be describing the job of a meteorologist.

Have students work individually or in pairs to complete the Activity Page. When students are done writing, invite volunteers to read their paragraphs to the class.

6. Check for understanding.

5 MIN

Activity Pages



AP 7.1

AP 7.2

Answer Key

Formative Assessment Opportunity

See the Activity Pages 7.1 and 7.2 Answer Keys for correct answers and sample student responses.

- Collect the completed Finding Temperature Change Patterns (AP 7.1). Scan the answers to the questions for accuracy and completeness.
- Collect the completed Meteorologist Job Description (AP 7.2). Read the paragraphs for accuracy and completeness, including use of correct spelling, correct punctuation, and a concluding sentence.
- Choose one or two examples that students struggled with to discuss with the class. Use the discussion to reinforce the main ideas and correct misconceptions. Allow students to make corrections as needed.

LESSON 8

Patterns of Weather: Seasons and Climate

Big Question: What is the difference between weather and climate?

AT A GLANCE

Learning Objectives

- ✓ Differentiate between weather and climate.
- ✓ Describe the climate of the region where you live.
- ✓ Compare the seasonal weather patterns of your location with the seasonal patterns of another location.

Lesson Activities (2 days)

- optional video
- reading and discussion
- demonstration
- representing data activity

NGSS References

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data; Developing and Using Models; Obtaining, Evaluating, and Communicating Information

Developing and Using Models for Grades 3–5 requires students to develop or use models to describe phenomena. In this two-day lesson, the class will use a model to show how Earth’s axis tilts in relation to the sun at different seasons of the year.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 160–161 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

climate ice age seasonal

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 5

Activity Page



AP 8.1

Student Reader, Chapter 5
“Patterns of Weather: Seasons and Climate”

Activity Page
Using Temperature Patterns to Describe Climate (AP 8.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- electric table lamp
- large grapefruit
- small sticker
- bamboo skewer
- blue, green, pink, and yellow highlighter pens
- internet access and the means to project images/video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

Advance Preparation

Before class on Day 1, preview the video you plan to show to the class.

Prepare in advance for Day 1 by doing the following:

- Insert the bamboo skewer into the grapefruit until it protrudes out the other side of the fruit.
- Position the sticker nearer to one end of the skewer than the other.
- Try the demonstration in advance to plan how to use the lamp safely in the classroom.

THE CORE LESSON TWO DAYS, 45 MIN EACH

1. Day 1: Focus student attention on the Big Question.

5 MIN

What is the difference between weather and climate? Pose a hypothetical problem to the class: Suppose we all won a vacation trip to Alaska or Hawaii. In which season should we go? Show students an online video about the best season of the year to visit Alaska. (See the Online Resources for a link to a suggested video.) Preview the following questions before showing the video. Then stop and restart the video to find the answers. Ask the following:

- » Which season is best to visit Alaska for most visitors? (*summer*)
- » Which months are the warmest in Alaska? (*June, July, and August*)
- » Which part of the year has the most hours of daylight? (*June/summer*)
- » In which months can you see bears fishing for salmon in the Alaska rivers? (*June, July, and August*)



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found.

www.coreknowledge.org/cksci-online-resources

2. Read and discuss: “Patterns of Weather: Seasons and Climate.” 25 MIN



Read together, or have students read independently, “Patterns of Weather: Seasons and Climate,” Chapter 5 in the Student Reader. This chapter describes how seasonal weather patterns can be analyzed to describe the climate of a region.

Preview Core Vocabulary Term

Before students read, write **climate** on the board or chart paper. Encourage students to use the term frequently as they discuss what they read.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Ask the following questions, and use the following prompts:

Pause in reading to give students a chance to answer the questions posed by the text. Focus on the seasons where you live. For example, some regions have distinct rainy and dry seasons, and others have rain or snowfall throughout the year.

Focus students on the table and graph. Go around the room, and ask questions quickly in a “lightning round” for students to answer. These questions will guide students to analyze and interpret data:

- » Which three months have the lowest low temperatures? (*January, February, and December*)
- » What season of the year is that? (*winter*)
- » Which three months have the highest high temperatures? (*June, July, and August*)
- » What season of the year is that? (*summer*)
- » Which three months have the most precipitation in Omaha? (*May, June, and July*)
- » Which seasons of the year are those months in? (*spring and summer*)
- » Which three months have the least precipitation? (*January, February, and December*)
- » What season of the year is that? (*winter*)

After reading page 20, set up a model as a demonstration. You will need the following materials:

- electric table lamp
- large grapefruit
- small sticker
- bamboo skewer

Place a table or floor lamp without a shade in the middle of the room. Turn on the light, and tell students that this represents the sun.

Show students the grapefruit with the skewer through it. Explain that, in this model, the grapefruit represents Earth and the skewer represents the imaginary line through Earth called its *axis*.

SUPPORT—Students have likely heard of the North Pole and South Pole, so point out that those are the two places where the axis touches the surface of the planet.

Disregarding the tilt of the axis for now, have one student hold the model Earth and walk in a circle around the model sun. Explain that this motion models Earth's path through space in one year. Ask: What do you notice about where "sunlight" hit "Earth" in this model? (*It only hits the side of Earth facing the sun.*)

Have students look at the diagram in the Student Reader. Ask: What does the diagram show about the position of Earth's axis? (*It remains tilted in the same direction all the time. Therefore, as Earth travels to different sides of the sun, the tilt orients the North Pole either toward or away from the sun in a cycle.*)

Have a student hold the grapefruit so that the axis is tilted toward a distant object in the class, such as one corner of the room where the ceiling and wall meet. Place a sticker on the model Earth so that it lies in the upper half (the Northern Hemisphere). Tell the student to walk around the sun, keeping the axis aimed at that distant point. (See **Know the Science**.)

Know the Science

What do scientists know about the planets and seasons? Planets with tilted axes have seasons!

Scientists know that all the planets in our solar system have seasons. Earth's axis is tilted at a 23.5-degree angle from the plane on which its orbital path sits in space. As Earth circles the sun, the tilt does not change. Consequently, the North Pole sometimes points toward the sun and sometimes away from the sun. The closer the angle of sunlight hitting Earth is to perpendicular, the more concentrated the energy is and the warmer that location will be. While all planets in our solar system have tilted axes, they do not all tilt at the same angle. For those planets that have pronounced elliptical orbits, a planet's distance from the sun will vary greatly at different times of the year. This will affect the amount of sunlight those planets receive and therefore affect their seasons. For a planet with a nearly circular orbital path, such as Earth, the planet is about the same distance from the sun throughout the year. So, distance from the sun is not a factor in causing Earth's seasons.

Students should be able to observe that the sunlight shines more directly and intensely on the top half of Earth where the sticker is located on part of its trip around the sun. On the other part of its trip around the sun, the lower half of Earth receives more direct sunlight. Ask the following:

- » At which point in Earth's trip around the sun would a person living where the sticker is feel warm weather? (*when the axis of Earth is pointing toward the sun*)
- » Which season do you think that is? (*summer*)
- » At which point in Earth's trip around the sun would a person living where the sticker is feel cold weather? (*when the axis of Earth is pointing away from the sun*)
- » Which season do you think that is? (*winter*)

Page 21

Have students obtain information from the table to answer the questions in the text. Ask the following:

- » How do the number of hours of sunlight in a day compare by season? (*There are fewer hours of sunlight in the winter, a medium amount in the spring and fall, and the most hours in the summer.*)
- » How does the pattern of hours of sunlight relate to the pattern of high temperatures? (*Temperatures are higher when there are more hours of sunlight.*)

Pages 22–23

Make sure students understand the difference between weather and climate. Ask the following:

- » What is the weather today where we live? (*Answers will vary.*)
- » What will the weather here be on this date next year? (*We don't know exactly, but we can predict based on the climate for this season of the year.*)

CHALLENGE—For students ready to work with more statistical concepts, teach the concept of average, or mean. Demonstrate with temperature or precipitation examples how a set of values can be used to arrive at a single value, called the average or mean. Explain that climate data is usually expressed as average values. For example, find the total of all the amounts of rainfall for each of the days in a week, and then divide the total by the number of days.

Word Work

Have students prepare a Core Vocabulary Card for **climate**. (n. the weather patterns in a place over a long period of time) Instruct them to write a sentence that tells the difference between climate and weather and underline *climate* in the sentence.

Compare and contrast the two data tables with students. Then use the data to answer the questions on page 23:

- » What is the wettest season in San Jose? How do you know? (*Fall—I compared the average precipitation for all three years.*)
- » What is the driest season in San Jose? How do you know? (*Winter—I compared the average precipitation for all three years.*)
- » What is the coldest season in Fairbanks? How do you know? (*Winter—I compared the average high temperatures for all three years.*)

- » What is the warmest season in Fairbanks? How do you know? (*Summer—I compared the average high temperatures for all three years.*)
- » What is the best time of year to visit San Jose if you like warm, dry weather? How do you know? (*The best time is winter, because the temperatures are nearly as warm as all other months and there is less than one inch of precipitation in winter.*)

Page 24

Direct students' attention to the image. Point out to students that at times when Earth's climate was much colder, animals called woolly mammoths existed. These animals look much like Asian elephants alive today, except that they had very long, thick hair and their tusks were very long.

3. Support student analysis of data.

15 MIN

Explain that scientists have strong evidence that Earth's climate was once colder than it is now. One type of evidence comes from fossils. Scientists have found fossils of woolly mammoths, like the ones shown on Student Reader page 24, in the southern parts of the United States. Those places have very warm climates now. Mammoths, with their long, shaggy coats, were adapted to live in a much colder climate.

Online Resources



Show students images of huge glacial erratics. (See the Online Resources for links to suggested images.) Explain that the rocks were found sitting on the ground and are unlike any other rocks nearby. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found.

www.coreknowledge.org/cksci-online-resources

Explain that this rock is called a glacial erratic. Its name explains how it got here. *Glacial* refers to a glacier or a large block of moving ice that covers the land. *Erratic* means wanderer. This rock was able to move from far away because it was stuck in the large block of moving ice. When the glacier melted, the rock was left on the ground in a place far from where it came from. Refer to images of glacial erratics. Ask: How do these rock look out of place? (*The rest of the picture shows a flat plain with no other rocks. Some of them are oddly sitting on top of other rocks.*) Point out that these rocks have been sitting where they are for thousands of years. Although people existed then, they would not have been able to move the rocks. Only a huge block of moving ice could carry rocks such as these. This is evidence that many parts of Earth once had huge, thick moving ice covering them.

1. Day 2: Refocus student attention on the Big Question.

5 MIN

What is the difference between weather and climate? Remind students that in the previous classroom session, they read about seasonal weather patterns and climate and observed a demonstration in class. Tell students that today they will continue to explore weather data to reveal patterns.

2. Represent data to reveal patterns.

25 MIN

Activity Page



AP 8.1

Distribute Using Temperature Patterns to Describe Climate (AP 8.1). Tell students that they will be using data to answer questions related to weather. Explain that these tables have the same data as on pages 22–23 in their Student Reader. Have them discuss the difference between weather and climate.

Have students read and follow the directions for Step 1 to highlight the temperature data by season. Make highlighters or colored pencils available to small groups of students. Circulate among students, and make sure they are using the same color for each season in the two tables.

Read the directions for Step 2 with students, and if needed, demonstrate how to transfer the data from the table to the bar graph. If students are confused about how to represent 0°F on the graph, show them how to draw a thin line directly on the 0 line of the graph.

SUPPORT—Drawing a scaled bar graph in which each square can represent either one whole number or a range of numbers is part of the Common Core State Standards for math taught in Grade 3. For those students who need support, show them how to identify the locations of whole numbers on the graph's y-axis, find their way to the correct column, and then mark the height of the column correctly. Demonstrate how to compare the heights of the bars to decide which represent higher or lower temperatures. Review students' bar graphs for accuracy, and troubleshoot as needed. Then, have students work individually to answer the questions on the fourth page.

3. Support the investigation.

10 MIN

Have students discuss and describe the seasonal patterns for their local region. Make a chart listing the four seasons, and record their answers there. Ask the following:

- » How does the temperature change each season where we live? (*Answers will vary.*)
- » How does the amount of precipitation change each season where we live? (*Answers will vary.*)

Students' descriptions of their local climate are likely to be qualitative. You can access quantitative data from government websites.

NOTE—Since the data involve decimal values, you may wish to obtain the data before class and convert the values to the nearest whole numbers.

To obtain season climate data for your location, visit a NOAA webpage called "Data Tools: 1981–2010 Normals." Choose the tab "Annual/Seasonal Normals." Then click

on your state and the nearest weather station to your school. The data will appear in a table displaying precipitation, minimum temperature, average temperature, and maximum temperature. Focus student attention on precipitation and average temperatures by season. (See **Know the Standards.**) Ask the following:

- » How does our climate compare to that of San Jose, Costa Rica? (*Answers will vary.*)
- » How does our climate compare to that of Fairbanks, Alaska? (*Answers will vary.*)

4. Check for understanding.

5 MIN

Activity Page



AP 8.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page 8.1 Answer Key for correct answers and sample student responses.

- Collect the completed Using Temperature Patterns to Describe Climate (AP 8.1). Scan the bar graphs and answers to the questions for accuracy and completeness.
- Choose one or two concepts that students struggled with to discuss with the class. Use the discussion to reinforce the main ideas and correct misconceptions. Allow students to make corrections as needed.

Know the Standards

Obtaining, Evaluating, and Communicating Information: Paired with Performance Expectation 3-ESS2-2, this Science and Engineering Practice focuses on obtaining and combining information from reliable sources to explain phenomena. With this activity, students begin to learn that scientific data can be retrieved from trusted online sources. Then they compare their local data with data provided in their Student Readers. Over Grades 3–5, this practice is developed in several ways, including by reading grade-appropriate informational texts; using data from tables, diagrams, and charts; and communicating scientific information by speaking and writing. Many of these skills are closely aligned to English language arts standards for reading informational texts, speaking, and writing.

LESSON 9

Working with Weather Data

Big Question: How can I use weather data to reveal patterns?

AT A GLANCE

Learning Objectives

- ✓ Collect and organize weather data for a single location by season.
- ✓ Citing evidence, predict the typical weather you might expect during an upcoming season in one location.
- ✓ Use tables, graphs, and maps to describe yearly patterns of weather for a single location.

Lesson Activities (2 days)

- self-evaluation checklist preview
- data collection and representation activity
- writing arguments supported by data
- self-evaluation checklist activity

NGSS References

Performance Expectation 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Analyzing and Interpreting Data

Analyzing and Interpreting Data will be important in this two-day lesson as students represent data in various graphic displays and explain relationships by identifying patterns.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

climate
data
graph

maximum
minimum
pattern

precipitation
season

temperature
weather

Instructional Resources

Activity Pages



AP 9.1
AP 9.2
AP 9.3
AP 9.4
AP 9.5
AP 9.6

Activity Pages

Deciding When to Hold a Carnival (AP 9.1)

Draw a Graph to Show Your Reasoning (AP 9.2)

Write a Letter to Your Principal (AP 9.3)

Help Another School Choose When to Hold a Carnival (AP 9.4)

Write a Letter to Your Pen Pal (AP 9.5)

Self-Evaluation Checklist (AP 9.6)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- highlighters in four colors
- internet access and the means to project images/video for whole-class viewing

Before class, preview the recommended NOAA climate data website and practice obtaining data sets by choosing the month or season.

THE CORE LESSON TWO DAYS, 45 MIN EACH

1. Day 1: Focus student attention on the Big Question.

5 MIN

How can I use weather data to reveal patterns? Pose this problem-solving scenario, which will be the basis for this entire performance assessment lesson:

*Suppose our school wanted to raise money for a local animal shelter. An outdoor carnival might be a good idea! The school could sell tickets for each game at the carnival. Our class's task is to decide what time of year to hold a carnival. How can we choose the best time of year for an all-day outdoor event? (See **Know the Science** on the following page.)*

2. Preview the investigation.

5 MIN

Activity Page



AP 9.6

Tell students that in this two-day lesson, they will be collecting data on the weather to plan when the best time is to hold an outdoor carnival at their school.

Distribute Self-Evaluation Checklist (AP 9.6). Review the items on the checklist with the class, making sure students understand that these are their goals for the performance assessment that they will complete after the second day of the lesson. Have students hold onto Activity Page 9.6, and let them know that they will use it at the end of the second day of this lesson.

Tell students that they will be looking at weather data by season and month to look for patterns. These patterns can be used to figure out the best time of the school year to hold the carnival. Let students know that once they collect their weather data, they will draw a graph and write about their findings.

Support students' understanding of these potentially unfamiliar terms:

- Explain that *maximum* means the greatest number or value, or the largest number.
- Point out that the word *minimum* is the opposite of *maximum*. *Minimum* means the least number or value, or the smallest number.

3. Support the investigation.

20 MIN

Activity Page



AP 9.1

Distribute Deciding When to Hold a Carnival (AP 9.1), and read the introductory paragraph with students. Tell students that they will use this Activity Page as a guide to collect information on weather data for each season in their area.

As a class, go to the NOAA website called "Data Tools: 1981–2010 Normals."

Online Resources



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found.

www.coreknowledge.org/cksci-online-resources

On the website, click the tab for "Annual/Seasonal Normals." Follow the Activity Page directions in Step 1, selecting your state and the closest weather station to your school. Use an online mapping application to decide which weather station is closest.

Know the Science

How are weather data useful in decision-making? In many ways that profoundly affect humans!

Weather data are essential for decision-making at all levels of society. Agricultural agencies use weather data to recommend what crops to plant in certain regions and when to plant the crops and to predict the sizes of harvests. International agencies use the data to identify vulnerable human populations and predict the likelihood of famines and the needs of refugees. Government regulators use weather data to set engineering design standards for structures, electrical grids, roads, and emergency services that can withstand predicted weather emergencies. Individuals and families use weather data to make decisions about where to live, whether to buy flood insurance, budgeting for heating costs, and planning travel.

The data results on the NOAA website should include a table displaying precipitation, minimum temperature, average temperature, and maximum temperature. For this activity, you may disregard the average temperature data.

NOTE: *You will need to convert the decimals to whole numbers for your students.*

CHALLENGE—Common Core State Standards for mathematics introduce decimal notation in Grade 4, but some of your students may be ready to work with decimals now. Explain that decimals represent parts of a whole and have equivalent fractions. Show students how to read the first place to the right of the decimal point as tenths (for example, $0.3 = 3/10$). Allow these students to use the decimals in their tables and on the graph.

Have students transfer the data they need to the table on their Activity Page. Make sure that they also title the table with the name of the local weather station. You may wish to have students discuss their predictions in pairs before choosing the best month for the carnival. Next, have students follow the directions for Step 2 to predict the weather conditions by month and recommend the best month for the school carnival.

4. Support student writing and graphing.

15 MIN

Activity Pages



AP 9.2

AP 9.3

Distribute Draw a Graph to Show Your Reasoning (AP 9.2). This Activity Page gives you the option to assess students' skills at representing data in bar graphs. Read the directions with students, and have them use the online precipitation data to draw vertical bars for each month of the year. Distribute colored highlighters, and suggest that students use the same color for all the months in one particular season. For instance:

- winter (December, January, February): blue
- spring (March, April, May): pink
- summer (June, July, August): yellow
- fall (September, October, November): orange

Allow volunteers to share their graphs and explain how they can be used to choose the best month for a rain- or snow-free outdoor event.

SUPPORT—Even after completing bar graphs in Lesson 8, some students may need support for this activity. Have these students use light pencil marks to determine the height of each bar based on the data. That way, you can check their work and suggest corrections before they use highlighters to color the bar.

Distribute Write a Letter to Your Principal (AP 9.3). Tell students that they will be using the information they collected to convince the principal of the school of the best time to hold the outdoor carnival. Read the directions with the class. Then have students write their letters individually. Remind students that a formal letter should include a salutation and a closing.

1. Day 2: Refocus student attention on the Big Question.

5 MIN

How can I use weather data to reveal patterns? Remind students that in the previous class session, they collected weather data to figure out when the best time would be to hold an outdoor carnival at their school. Tell students that today they will be using more weather data to solve a related problem.

2. Support student problem-solving.

20 MIN

Activity Page



AP 9.4

Pose a related problem-solving scenario to your students: Can schools anywhere hold outdoor events in the same seasons and months as our school? In what month(s) should schools in other places hold outdoor events?

Distribute *Help Another School Choose When to Hold a Carnival* (AP 9.4). Read the introduction, and give students time to write their answers and explanations.

As a class, take students back online to the NOAA website “Data Tools: 1981–2010 Normals.” Have students follow the directions, complete the climate by season and climate by month tables, and answer the questions. Instead of getting data for Plainfield, Vermont, you might select any location in the United States that has climate patterns very different from your own. This will make the task more interesting for students. (See **Know the Standards.**)

3. Support student writing.

10 MIN

Activity Page



AP 9.5

Distribute *Write a Letter to Your Pen Pal* (AP 9.5). Read the directions with the class. Allow students to discuss in pairs what they plan to write. Then have them write their letters individually. Remind students again that a formal letter should include a salutation and a closing.

4. Support student self-evaluation.

5 MIN

Activity Page



AP 9.6

Prompt students to take out their Self-Evaluation Checklist (AP 9.6). Remind students that they had a chance to look at this checklist at the beginning of Day 1 of this lesson. Now, each student will complete the checklist individually. Explain that you will also use the checklist to evaluate students’ work.

Know the Standards

Analyzing and Interpreting Data: This Science and Engineering Practice is also developed in two other units in Grade 3. In Unit 3, *Habitats and Change*, students analyze and interpret data from fossils (Performance Expectation 3-LS4-1), and in Unit 2, *Life Cycles, Traits, and Variations*, students analyze and interpret data about traits and variation among traits. Reminding students of how they use the same practice in different contexts will reinforce understanding that Science and Engineering Practices are essential for all scientists and engineers.

5. Check for understanding.

5 MIN

Activity Pages



AP 9.1-9.6
Answer Key

Summative Assessment Opportunity

See the Activity Pages Answer Keys for sample student responses.

- Collect the completed Deciding When to Hold a Carnival (AP 9.1). Make sure the data tables are complete and accurate. Look at students' predictions for the season and months that have the best weather for an outdoor event.
- Collect the completed Write a Letter to Your Principal (AP 9.3), and review students' answers. Offer suggestions for improvements, and give students a chance to edit and revise their work.
- Collect the completed Draw a Graph to Show Your Reasoning (AP 9.2), and compare the completed graphs to the monthly climate data on the NOAA website for your local weather station. Allow students to make corrections as needed.
- Collect the completed Help Another School Choose When to Hold a Carnival (AP 9.4), and review students' answers. Offer suggestions for improvements, and give students a chance to edit and revise their work.
- Collect the completed Write a Letter to Your Pen Pal (AP 9.5), and review students' answers. Offer suggestions for improvements, and give students a chance to edit and revise their work.
- Complete your own version of the evaluation checklist for each student, and calculate the total scores.

LESSON 10

Working with Climate Data

Big Question: How can I use climate data to reveal patterns?

AT A GLANCE

Learning Objective

- ✓ Gather and communicate information about a region with a different climate than your own.

Lesson Activities (2 days)

- self-evaluation checklist preview
- collecting information from reference sources and analyzing data
- virtual tour of ten world parks
- self-evaluation checklist completion

NGSS References

Performance Expectation 3-ESS2-2: Obtain and combine information to describe climates in different regions of the world.

Disciplinary Core Idea ESS2.D: Weather and Climate

Crosscutting Concept: Patterns

Science and Engineering Practices: Obtaining, Evaluating, and Communicating Information; Engaging in Argument from Evidence

Obtaining, Evaluating, and Communicating Information will be important in this two-day lesson as students use books, fact sheets, and other library media to collect climate data for a national park. Then, they will evaluate the data needed to make decisions about when to visit each park. Finally, students will communicate their predictions and understandings about climate regions.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

climate

maximum

pattern

season

climate zone

minimum

precipitation

temperature

data

Instructional Resources

Activity Pages



AP 10.1
AP 10.2
AP 10.3
AP 10.4
AP 10.5–10.14

Activity Pages

Join the Famous Ten World Parks Club! (AP 10.1)

Find the Climate of a Park (AP 10.2)

Ten World Parks Club Passport Stamp Sheet (AP 10.3)

Self-Evaluation Checklist (AP 10.4)

Climate Fact Sheets (ten parks) (AP 10.5–10.14)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- stapler
- scissors
- stamp(s) and ink pad, or stickers
- Photos of ten parks around the world from slides (provided in Online Resources)
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

If possible, provide the list of ten parks to a children's librarian, and ask for books, encyclopedias, and other media to locate relevant climate information. Have these resources set aside for students in your classroom or when they go to the library. Students may want to look at these sources to learn the general climate of a park but will also need to use the temperature and precipitation data available on the Climate Fact Sheets provided with this lesson.

The photos are provided for each park on slides. Print the photos, and affix students' research on Activity Page 10.2 to the back of each one for use during the virtual tour.

1. Day 1: Focus student attention on the Big Question.

5 MIN

Activity Pages



AP 10.1

AP 10.4

How can I use climate data to reveal patterns? Pose the problem-solving scenario that will be the basis for this entire performance assessment lesson: *You can join an exclusive club. To qualify as a member, you must complete a journey to visit ten national parks around the world. At each park, you will get your passport stamped, but only after you use climate data to make a prediction.* Brainstorm with students:

- » Where can you find the climate data for each park? (*from books, encyclopedias, websites*)
- » How can you use it to predict which month is best for visiting each park? (*by using the climate data and looking for patterns*)

Allow students to ask additional questions.

Distribute Join the Famous Ten World Parks Club! (AP 10.1) Review the Activity Page together, and tell students how they will go about joining the Ten World Parks Club. Go over the eight steps, and tell students to check off each step as they complete it over the two-day lesson.

Distribute Self-Evaluation Checklist (AP 10.4). Review the items on the list with the class, making sure students understand that these are their goals for the performance assessment.

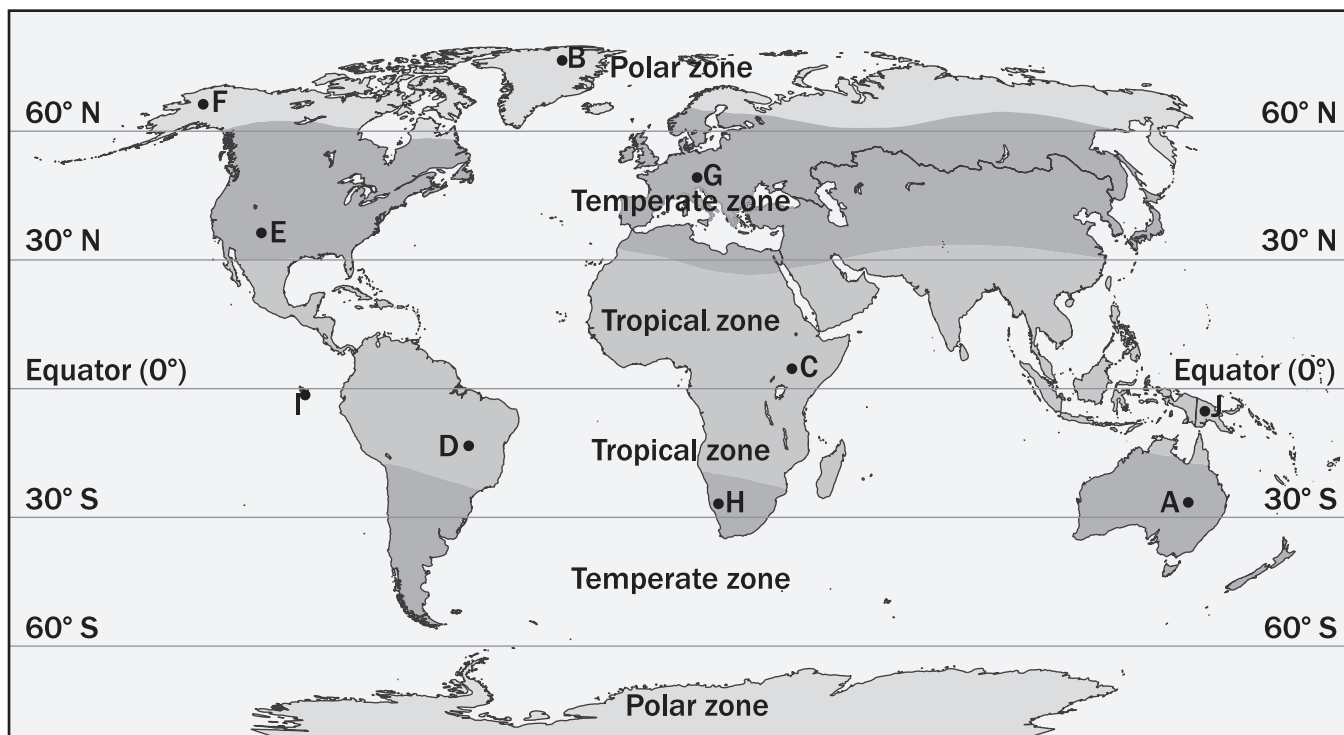
2. Support student research.

40 MIN

Show students the world map provided on a slide. Identify the equator, and explain that regions near this line generally have the warmest climates on Earth. Point to the Arctic and Antarctic Circles. Point to the areas around the North and South Poles, and explain that these parts of Earth generally have the coldest climates. Explain that lands between the lines for 60 and 30 degrees generally have medium temperatures. Tell students that these large areas you have pointed out are referred to as climate zones. (See **Know the Science.**)

Know the Science

How do scientists classify Earth's major climate zones? *In many ways, depending on the specificity needed.* Several factors affect the climate of a place, including latitude, elevation, nearby landforms and bodies of water, ocean currents, and patterns of air movement. Many geographers and scientists use the Köppen climate classification system to describe the climate of a place. This system has five main zones (tropical, dry, temperate, continental, and polar) with ten subgroups among them. Köppen was a botanist, so this system is particularly useful for predicting the types of plants that thrive in a region. For the purposes of this lesson, three zones are identified, based solely on latitude. They are called the polar, temperate, and tropical zones. The tropical zone extends 30 degrees north and south of the equator and is the warmest zone. The temperate zone extends from 30 degrees north and south to about 60 degrees north and south and generally has medium temperatures. The polar zone extends from 60 degrees north and south to the poles and is the coldest zone.



CHALLENGE—Some students may be eager to go further and learn the names for these three climate zones. Invite them to make vocabulary cards for the tropical climate zone, the temperate climate zone, and the polar climate zone. Encourage them to use these terms to classify each park and add this information to Activity Page 10.2.

Activity Pages



AP 10.2
AP 10.5–10.14

Using the map provided on the slide and the slides with photos of each park, point out the ten parks that will be the focus of this lesson, lettered A–J.

Parks and Nature Preserves:

- A.** Uluru-Kata Tjuta National Park, Australia
- B.** Northeast Greenland National Park, Greenland
- C.** Serengeti National Park, Tanzania
- D.** Pantanal Matogrossense National Park, Brazil
- E.** Grand Canyon National Park, Arizona, United States
- F.** Denali National Park and Preserve, Alaska, United States
- G.** Black Forest National Park, Germany
- H.** Namib-Naukluft National Park, Namibia
- I.** Galápagos National Park, Ecuador
- J.** Komodo National Park, Indonesia



Show students the slides with a photo of each park. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found.

www.coreknowledge.org/cksci-online-resources

Assign each student to one of the ten parks, and have the students group themselves accordingly.

Distribute one copy of Find the Climate of a Park (AP 10.2) to each group, along with the Climate Fact Sheets (AP 10.5–10.14), depending on which park is assigned to each group.

Read the directions to Activity Page 10.2 first with students, and then make the reference materials, including the relevant Climate Fact Sheets with temperature and precipitation data, available to them so that they can record data in the table. Explain that the Climate Fact Sheets are there to provide information on the climates in each of the areas around the world.

Circulate around the room as students complete the climate tables using reference materials and the Climate Fact Sheets.

SUPPORT—If students struggle using library sources, have them focus on the monthly data on the Climate Fact Sheets. Guide them to use data from one month in each season (such as January for winter, April for spring, July for summer, and October for fall) when entering data in the table.

If some students need guidance interpreting the Climate Fact Sheet data, work with them in small groups. Make sure they can read the tables/graphs and compare whole numbers, fractions, and mixed numbers.

1. Day 2: Refocus student attention on the Big Question.

5 MIN

How can I use climate data to reveal patterns? Remind students of the Big Question, and review what was covered in Day 1 of this lesson. Make sure students still have their Activity Pages 10.1 and 10.2, as they will need to refer to these during today's lesson.

2. Support the investigation.

25 MIN

Activity Page



AP 10.3

Distribute Ten World Parks Club Passport Stamp Sheet (AP 10.3). Tell students that they will be making passports to show where they travel around the world. They will need scissors and staplers for this activity.

SUPPORT—If necessary, explain to students what a passport is.

Guide students through Activity Page 10.3 following these steps:

- Have students cut out the passport pages on the dashed lines.
- Model how to stack the pages to make a booklet with the word *Passport* on the cover.

- Then have students staple along the left side of the booklet to form a binding.
- Model how to staple closely to the edge of the paper so that they can read each page.

Collect Find the Climate of a Park (AP 10.2) from each group. Affix this sheet to the back of the photo of that park. Place the photo at a station in the classroom or in a hallway.

Prompt students to follow Steps 4–7 on Join the Famous Ten World Parks Club! (AP 10.1). Direct students to act out traveling in small groups around the world, with their passports and a pencil or pen, to visit each park. At each station, have them write the following in their passport:

- the name of the park
- the best season to visit
- the weather to expect when someone visits

Encourage students to discuss in their groups when the best season to visit each park is, based on the data on the back of the photo. Make sure they understand that they should be using evidence to support their arguments. (See **Know the Standards.**)

Provide materials at each station so that students can stamp their passports. Stamps can be made using ink pads or stickers or by having students draw a symbol that you provide.

3. Support student self-evaluation.

10 MIN

Now that they have completed all the steps for the activity, have students return to their Self-Evaluation Checklist (AP 10.4) and go over the list again. Allow them to score themselves on each skill by checking “Always,” “Sometimes,” or “Never.” Discuss how they used each skill over the course of the two-day lesson. Explain that you will also use the checklist to evaluate students’ work.

Know the Standards

Engaging in Argument from Evidence: In Grades 3–5, this Science and Engineering Practice requires students to use evidence to support arguments, compare and refine arguments, distinguish between judgements based on facts versus speculation (opinion), evaluate claims and explanations, and make claims about the merits of engineering design solutions. Such scientific argument is core to designing investigations and reaching conclusions based on results. Developing the habit of asking questions such as “How do you know?” can help students engage in argument from evidence in every science lesson.

4. Check for understanding.

5 MIN

Activity Pages



Summative Assessment Opportunity

- Collect the completed Find the Climate of a Park (AP 10.2), and review students' answers using the Answer Key for sample student responses.
- Have students get out their Ten World Parks Club Passport Stamp Sheet (AP 10.3) and discuss their answers as a class. Students may disagree on the best season to visit, but they should be able to support their arguments with climate data evidence. Offer suggestions for improvements, and give students a chance to edit and revise their work. Possible answers:

Park	Best Season to Visit*	Argument from Evidence
Uluru-Kata Tjuta National Park, Australia	Spring	Not too rainy and warm, but not hot.
Northeast Greenland National Park, Greenland	Summer	Cold, but not freezing cold. Very low precipitation all year.
Serengeti National Park, Tanzania	Summer	Temperatures are the same all year, but it is driest in summer.
Pantanal Matogrossense National Park, Brazil	Summer	It is cooler and less rainy in July and August.
Grand Canyon National Park, Arizona, United States	Spring	Low chance of rain, and temperatures are cool but not cold.
Denali National Park and Preserve, Alaska, United States	Summer	Too cold in other seasons.
Black Forest National Park, Germany	Summer	Warmest temperatures, and it rains about the same all year.
Namib-Naukluft National Park, Namibia	Summer	Coolest temperatures and almost no rain.
Galápagos National Park, Ecuador	Summer	Coolest temperatures and very little rain.
Komodo National Park, Indonesia	Summer	Least amount of rain. Temperature doesn't matter because it is the same all year.

*Presumably students will use their "home" seasons (in North America) as points of reference, calling June, July, and August summer. The seasons are reversed in the Southern Hemisphere, though reversal of the labels for this exercise is not necessary for Grade 3.

- Collect the completed Self-Evaluation Checklist (AP 10.4). Complete your own version of the evaluation checklist for each student, and calculate the total scores.

PART D

Reducing the Impacts of Hazardous Weather

OVERVIEW

Lesson	Big Question	Advance Preparation
11. Extreme Weather	What are extreme weather hazards?	Read Student Reader, Chapter 6.
12. Engineering for Extreme Weather	How do engineers design solutions for extreme weather hazards?	Read Student Reader, Chapter 7.
13. Evaluating Extreme Weather Solutions (2 days)	How can we evaluate design solutions to weather hazard problems?	Gather materials and sources for an investigation. (See Materials and Equipment, page 13.)

Part D: What's the Story?

By now in this unit, students have already learned about weather and its patterns. This next series of lessons leads students through readings, discussions, and investigations that focus on extreme and hazardous forms of weather and how we protect ourselves from them.

Lesson 11 introduces students to the idea of extreme weather conditions. Students have already learned about weather in general and will build on their understanding to learn about how weather becomes destructive. Students may already be familiar with some types of extreme weather, such as tornadoes and hurricanes. It is important to use sensitivity when discussing extreme weather, as some students may have experienced these conditions firsthand. The reading will also cover the importance of staying safe during hazardous situations.

Lesson 12 extends the concept of hazardous weather by introducing students to the idea that certain types of engineers specialize in designing solutions to help people stay safe during hazardous weather. In this lesson, students will read about the fact that weather hazards cannot be prevented but that people can improve their ability to predict them and prepare for them by implementing designs that are intended to reduce destruction and devastation.

In Lesson 13, students build on their understanding of design solutions for extreme weather by evaluating the effectiveness of a solution that is intended to reduce the effects of a weather-related hazard. Students will address the criteria and constraints of a given solution and assess whether they think the solution would help reduce destruction and devastation caused by extreme weather.

So, to repeat, **extreme weather is hazardous, and engineers strive to come up with designs to minimize the impact of these conditions. These designs can be evaluated.** The key concept for students to grasp is that extreme weather cannot be prevented but that people can prepare for it and help mitigate its destructive nature.

LESSON 11

Extreme Weather

Big Question: What are extreme weather hazards?

AT A GLANCE

Learning Objectives

- ✓ Describe examples of extreme weather conditions.
- ✓ Relate the causes of an extreme weather condition to its destructive effects.
- ✓ Identify ways to avoid danger and protect yourself during weather hazards.

Lesson Activities

- reading and discussion
- vocabulary instruction
- demonstration and observation
- cause-and-effect graphic organizer

NGSS References

Disciplinary Core Idea ESS3.B: Natural Hazards

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Engaging in Argument from Evidence

Cause-and-Effect relationships will be explored during this lesson as students read about and discuss extreme forms of weather and the effects they can have on people and areas. Students will read about how certain types of extreme weather cause dangerous conditions, and they will study the effects of those hazards on people and the communities in which they live. Students will also complete a cause-and-effect graphic organizer, which will help them better understand natural hazards, as they work through their reading selection.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 160–161 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

drought

hazard

weather

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 6

Activity Page



AP 11.1

Student Reader, Chapter 6
“Extreme Weather”

Activity Page
Extreme Weather: Cause and Effect (AP 11.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- index cards for student vocabulary deck (2 per student)
- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

What are extreme weather hazards? To build on what students learned in this unit so far and activate background knowledge, open this lesson by asking students to name some different types of weather. Ask the following:

- » What is weather? (*the state of the atmosphere at a certain place and time*)
- » What kinds of things does weather include? (*temperature, precipitation, humidity, wind*)
- » Does weather always stay the same, or does it change from one day to the next? (*It changes.*)
- » Can you study weather data to look for patterns in weather over time? (*yes*)

Explain to students that in this lesson, they will learn about extreme weather, which is weather that is dangerous to people, communities, and nature.

2. Encourage student questions.

5 MIN

Lead a discussion about cause-and-effect relationships. Prompt students to think about why studying cause-and-effect relationships is an important skill. Draw attention to real-life examples of cause and effect as it relates to weather. For example, ask students what they do when it rains (*stay indoors, take an umbrella outside, wear rain boots*) or what they do when it is very hot outside (*stay indoors, wear shorts and T-shirts, put on sunscreen*). Then have students identify the cause and the effect in the examples. Elicit from students that the weather causes us to change our behaviors or make certain decisions every day.

3. Read and discuss: “Extreme Weather.”

15 MIN

Student Reader



Ch. 6

Activity Page



AP 11.1

Read together, or have students read independently, “Extreme Weather,” Chapter 6 in the Student Reader. The selection introduces various types of extreme weather and the types of hazardous conditions that they cause.

Distribute Extreme Weather: Cause and Effect (AP 11.1). Tell students that they will fill out the graphic organizer on the Activity Page as they read each page of the Student Reader. Review the Activity Page together as a class, and make sure students understand how to complete the graphic organizer.

SUPPORT—If needed, help students understand how the fishbone diagram works. Explain that the types of extreme weather have already been filled in. All students need to do is write the effects of each type on the blank lines under the heading. Let students know that they do not have to have three effects for each type of weather. Some types may have more or less.

Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper. Encourage students to pay special attention to these terms as they read.

drought

hazard

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 25

After students have read the page, explain that extreme weather and weather hazards can occur anywhere in the world. Check understanding of the Core Vocabulary by asking: What does it mean when something is hazardous? (*It is dangerous.*)

SUPPORT—If needed, prompt students to think about everyday things or activities that may be hazardous, such as not looking both ways before crossing the street or playing with fire. Use familiar examples based on your students’ experiences so that concepts are easier to grasp and discuss.

Let students know that they will fill out their Activity Pages starting with page 26.

Page 26

After reading the page, have students find the things that thunderstorms cause (*lightning, high winds, heavy rain, floods*). Prompt students to complete the graphic organizer on the Activity Page. Ask: What are some of the effects of thunderstorms? (*fires, injuries, floods*)

SUPPORT—If applicable, talk about a recent thunderstorm that occurred in your area. Ask students to describe what they remember about the storm, such as whether the school had to be closed down due to flooding. If your area does not commonly experience thunderstorms, discuss examples from other places

that may have been severe enough to appear on the local news, or ask students where they have seen thunderstorms and their effects in the movies.

NOTE: – Be aware that some students may have lived through a dangerous thunderstorm and experienced trauma as a result. Be sensitive to their needs and any issues that may arise. This note may be applied to other hazards mentioned throughout the remainder of this lesson as well.

Page 27

After reading the page, ask the following:

- » What are some hazards caused by tornadoes? (*destructive winds, power outages*)
- » Why can hail be dangerous? (*If it is large, it can damage objects or hurt people.*) (See **Know the Science.**)

Discuss with students that there are different categories of tornadoes. Categories that are assigned a lower number usually have weaker winds and are smaller in size than categories assigned a higher number. All categories can be dangerous, though higher categories tend to be more destructive.

Prompt students to complete the graphic organizer on the Activity Page.

Page 28

After reading this page, prompt students to complete their graphic organizers on the Activity Page. Ask the following:

- » Where do hurricanes form? (*over large bodies of water*)
- » What parts of land do hurricanes threaten the most? (*coastal areas*)

Have students turn to a neighbor to discuss the following questions:

- » How are thunderstorms, tornadoes, and hurricanes similar?
- » How are thunderstorms, tornadoes, and hurricanes different?

Cue students to look back through the pages of the Student Reader chapter to describe the characteristics of each form of extreme weather that they have learned about so far.

Page 29

Explain to students that snow and ice are not always hazardous in small amounts. For instance, sometimes it snows, but the snow does not stick to the ground. Therefore, this is not very dangerous. Make sure students understand what causes

Know the Science

Why do thunderstorms cause hail? *Because of the fast movements and currents of air.* Hail is a solid form of precipitation and looks like balls, or pellets, of ice falling down from the sky. It forms when water vapor and rain are pushed high up into cumulonimbus clouds as part of an updraft. At these extreme heights, the air temperature drops to below freezing, causing the water vapor to condense and freeze. This can happen over and over, leading to concentric layers of ice that make up a ball of hail. When they get heavy enough or are part of a downdraft, they start to fall back toward Earth. There are many factors that play a role in the production and size of hail, including wind speed. Faster winds cause larger-sized hail. This is why the winds that form during thunderstorms can bring about hailstorms.

snow and ice to become hazardous and the difference between snowing and a blizzard. Include in this discussion the fact that a blizzard occurs when wind speeds reach thirty-five miles per hour or more for a prolonged period during a severe snowstorm.

SUPPORT—Depending on where you live, some students may or may not be familiar with snow and snowy conditions. If you live in an area that receives a lot of snow and blizzards, discuss with students what happens on these days. Students may recall that there are “snow days” on which the school is closed. If you live in an area that does not receive snow, help paint a picture for students of what it is like to live somewhere snowy.

Prompt students to complete their graphic organizers on the Activity Page.

Page 30

After reading the page, call on a volunteer to explain why a drought is different from the other types of extreme weather that students have read about so far. *(It does not happen suddenly or end quickly, like the other types of extreme weather normally do.)*

SUPPORT—If you live in an area that experiences droughts, discuss what kinds of things happen in your community as a result of drought. For example, some states on the West Coast may have had to conserve water by asking everyone in a household to use less water during the day.

CHALLENGE—If time permits, have students think about more examples of the effects that droughts can have. For example, droughts that last a long time can make it difficult for certain plants to survive those dry conditions. Animals in the wild may need to relocate to find water sources so they can stay alive. Long droughts can have long-term effects on communities and environments.

Prompt students to complete their graphic organizers on the Activity Page.

4. Show examples and guide discussion.

10 MIN



Online Resources

Show students videos of extreme weather in action. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to these resources may be found:

www.coreknowledge.org/cksci-online-resources

- Show a video of a hurricane. Ask what students can observe about hurricanes.
 - » What kinds of destructive things did you see in the video that were caused by the hurricane? *(flooding, a roof being torn apart, large structures being broken)*
- Show a video of a tornado. Ask what students can observe about tornadoes.
 - » What did you notice about the tornado? *(debris flying, high winds, that the tornado was moving/traveling, lightning)*

- Show a video of lightning. Ask what students can observe from the video.
 - » Is lightning dangerous? (yes)
 - » Why is lightning dangerous? (*It is a bolt of electricity that can kill people.*)
 - » What should you do if there is lightning? (*stay indoors, avoid isolated trees*)

5. Teach Core Vocabulary.

5 MIN

Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Ask students to write each term in the upper left corner of an index card and underline it (one term per card):

hazard **drought**

Word Work

Prompt students to add definitions in their own words to both cards.

- **hazard:** (n. a dangerous condition that can cause damage) Share with students that the adjective form of the word is *hazardous*. Clarify that many circumstances can be hazardous, not just weather (traffic, for example). But this lesson specifically focuses on weather conditions that can be hazardous.
- **drought:** (n. a long period of weather with less precipitation than normal) Assist students with pronunciation given this term's challenging spelling.

6. Check for understanding.

5 MIN

Activity Page



AP 11.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Collect the completed Extreme Weather: Cause and Effect (AP 11.1). Scan the graphic organizers that students filled out. If any contain inaccurate information, engage in further discussion, emphasizing the parts that are missing or incorrect.

LESSON 12

Engineering for Extreme Weather

Big Question: How do engineers design solutions for extreme weather hazards?

AT A GLANCE

Learning Objective

- ✓ Evaluate the effectiveness of a solution intended to reduce the effects of a weather-related hazard.

Lesson Activities

- reading and discussion
- vocabulary instruction

NGSS References

Disciplinary Core Idea ESS3.B: Natural Hazards

Crosscutting Concept: Cause and Effect

Science and Engineering Practices: Engaging in Argument from Evidence

Cause-and-Effect relationships will be explored during this lesson as students read about and discuss the various designs and devices that are engineered in response to extreme forms of weather. Students will read about how certain types of designs work to prevent or minimize the damages that can be caused by natural hazards. They will also practice evaluating solutions based on criteria and constraints.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Core Vocabulary words are shown in green below. During instruction, expose students repeatedly to these terms, which are not intended for use in isolated drill or memorization.

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 160–161 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

constraint
criteria

engineering design process
evaluate

optimize
problem
solution

Core Vocabulary Deck: As a continuous vocabulary instruction strategy, have students develop a deck of vocabulary cards that will be used in various activities across this unit as a part of Word Work. The deck will include the Core Vocabulary terms designated in green on the previous page.

Instructional Resources

Student Reader



Ch. 7

Activity Page



AP 12.1

Student Reader, Chapter 7

“Engineering for Extreme Weather”

Activity Page

Lesson 12 Check (AP 12.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- index cards for student vocabulary deck (3 per student)

THE CORE LESSON 45 MIN

1. Focus student attention on the Big Question.

5 MIN

How do engineers design solutions for extreme weather hazards? To build on what students learned in the previous lesson and activate background knowledge, open this lesson by asking students to name some different types of extreme weather.

- » What are some types of extreme weather that involve a lot of rain? (*thunderstorms, hurricanes*)
- » What are some types of extreme weather that involve a lot of wind? (*thunderstorms, hurricanes, tornadoes*)
- » What are some types of extreme weather that involve periods of dryness? (*droughts*)
- » What are some types of extreme weather that involve snow? (*blizzards and ice storms*)

Tell students that although extreme weather cannot be prevented, there are ways for people to prevent or minimize the damages that are caused by them. There are also ways for extreme weather hazards to be predicted in advance, which gives people more time to prepare for them.

Explain to students that in this lesson, they will learn about the different engineering designs that help solve problems related to extreme weather.

Preview Core Vocabulary Terms

Prepare students to approach the reading by drawing their attention to terms they will use as they explore ways that people respond to extreme weather.

Before students read, write these terms on the board or chart paper. Encourage students to pay special attention to these terms as they read:

criteria

constraint

engineering design process

Have students write just the terms in the upper left corner of new Core Vocabulary cards. They will revisit the cards later in the lesson to add notes about what they mean.

2. Read and discuss: “Engineering for Extreme Weather.”

25 MIN

Student Reader



Ch. 7

Read together, or have students read independently, “Engineering for Extreme Weather,” Chapter 7 in the Student Reader. The selection introduces various types of design solutions that engineers have come up with in response to extreme weather.

Establish a Scientific Mindset

Discuss with students examples of designs within the framework of problems and solutions. Draw attention to page 31. Point out the engineering design diagram, and walk through the steps with students. Tell students that every design that has been created began with identifying a problem that needed to be solved. Explain that engineers use their knowledge about the world, as well as scientific and mathematical concepts, to come up with and support their solutions to problems.

SUPPORT—If necessary, practice identifying problems and solutions by picking out random objects in the classroom and discussing how their design came to be. For example, ask students about the front board: Why do you think someone designed a large board to sit in the front of the classroom? What problem do you think the person was trying to solve? (*making a board where information could be seen by everyone in the classroom*)

CHALLENGE—If time permits, have students work with a neighbor to discuss any design they can think of and work backward to figure out how that design solves a problem. For example, the design of a bus solves the problem of transporting many people at one time to various destinations along a certain route. It also solves the problem of minimizing pollution because it reduces the number of cars on the road.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 31

After students have read the page, ask: What is the engineering design process?

SUPPORT—If needed, prompt students to think about what engineers do. Explain that there are many steps involved in the engineering design process

but that testing problems and solutions and changing them to be improved are just a couple of steps in the process. (See **Know the Standards 1.**)

Pages 32–33

Ask volunteers to summarize what they read about solutions to flooding. Ask the following:

- » What are the criteria and constraints of using sandbags?
- » What are the criteria and constraints of building levees and seawalls?

CHALLENGE—If time permits, challenge students to think about how sandbags, levees, and seawalls can be tested to see whether they are effective solutions to solve the problem of flooding. Ask: How do you think an engineer tests whether a seawall works? (*An engineer can create a model of a seawall and reenact a flood to see whether the seawall really does keep the water away from the shore.*)

Page 34

After reading the page, ask the following:

- » What is the problem caused by hurricanes? (*They can destroy homes and buildings.*)
- » What are engineers trying to solve? (*ways for homes and buildings to stay safe during hurricanes*)
- » What are some solutions that engineers can try? (*They can design buildings to be a certain shape or size; they can design buildings to be made out of certain materials.*)

Page 35

After reading the page, ask the following:

- » What problem is solved by lightning rods? (*lightning striking buildings and causing damage*)
- » How does a lightning rod work? (*It draws energy from lightning into it.*)
- » How does a lightning rod keep people safe? (*By drawing energy into it, that energy does not harm people or property.*)

Know the Standards

1. What are the steps of the engineering design process? There are usually five main steps in the engineering design process. (1) The engineering design process begins by identifying the problem and coming up with the needs (criteria) or the limitations (constraints). Once these have been identified, engineers perform research to better understand the problem they are trying to solve. As they learn about the problem and collect data and information, the next step (2) involves developing possible solutions. This is where engineers get to be creative, but they still have to work within the constraints that they identified early in the process, as well as any new constraints that come up. After several solutions are identified, a primary solution is chosen to focus on. (3) Engineers will build a prototype or model of the solution and (4) test and evaluate it to see how well it works. (5) They will then evaluate the solution to see whether it needs to be redesigned and improved. A prototype to the solution will be reworked as many times as is necessary until it is effective and successful when tested.

After reading the page, ask students how they might consider whether an idea for a solution to a problem is good or not. Use the example of snow fences from the page, but welcome students to discuss all the designs mentioned so far in the reading selection. Explain to students that the engineering design process not only involves identifying a problem that needs to be solved, but also involves asking and answering questions about what would make the best solution based on what the engineers have to work with. (See **Know the Standards 2.**)

3. Teach Core Vocabulary.

5 MIN

Return to Core Vocabulary Cards

Direct student attention to the Core Vocabulary cards that they started prior to reading the chapter.

criteria**constraint****engineering design process**

Word Work

- **criteria:** (n. the requirements of a design for it to be a success) Discuss criteria as being the requirements that a design needs to have. Suggest examples of types of criteria, such as a design being a certain size, a certain speed, or a certain weight. Other examples of criteria in the engineering design process could include things such as being user friendly or portable. Have students choose another example of criteria for a design solution that they see in everyday life and write the example on their card.
- **constraint:** (n. the limitation of a design) Ask students to write in their own words one sentence that uses the word *constraint*. (*The constraint for the design was that it could not be more than four feet long.*)
- **engineering design process:** (n. the steps that engineers take to solve a problem) Ask students to share what they understand about the engineering design process. Have students write one or two sentences on their card for this term. Instruct students to use the words *criteria*, *constraint*, *problem*, and *solution*.

Know the Standards

2. Prerequisites to Evaluating Solutions: In the lesson that follows, Lesson 13, students will evaluate a design solution and make a claim about the merit of the solution that reduces the impacts of a weather-related hazard. In this lesson, students gained some practice identifying problems that warrant solutions. However, identifying the problems is just the first step in the engineering design process. Evaluating the solutions requires consideration of the requirements and limitations (criteria and constraints), as well as looking at any evidence as to whether the design solution works. In this way, students can start to think about solutions in terms of “good ideas” and “bad ideas.”

4. Refocus student attention on the Big Question.

5 MIN

How do engineers design solutions to extreme weather problems? Write the following list on the board or chart paper:

1. They need to define the problem they are trying to solve. They need to know what the criteria and constraints are. In this case, they need to learn about the extreme weather.
2. They need to plan a solution. They do this by studying designs that worked or did not work in the past and making new designs.
3. They then build a model of their new designs.
4. They need to test their designs.
5. They need to improve their designs.

Quickly go around the room in a “lightning round,” and have each student answer one of the following questions, based on what have they read in the reading selection:

- » What problem does a sandbag solve? (*flooding*)
- » How does a lightning rod work? (*It transfers the energy from the lightning down to the ground.*)
- » What is a seawall? (*a structure that blocks water from getting onto shore*)
- » What does a levee prevent? (*flooding*)
- » How can a snow fence help during strong snowstorms? (*It prevents snow from blowing onto the road.*)

5. Check for understanding.

5 MIN

Activity Page



AP 12.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key for correct answers and sample student responses.

Have students complete Lesson 12 Check (AP 12.1). Collect the assessment, and check students' answers to identify concepts with which students may be struggling. See the Activity Page Answer Key for correct answers and sample student responses.

Evaluating Extreme Weather Solutions

Big Question: How can we evaluate design solutions to weather hazard problems?

AT A GLANCE

Learning Objective

- ✓ Evaluate the effectiveness of a solution intended to reduce the effects of a weather-related hazard.

Lesson Activities (2 days)

- research and analysis
- student evaluation
- student writing
- classroom debate

NGSS References

Performance Expectation 3-ESS3-1: Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

Disciplinary Core Idea ESS3.B: Natural Hazards

Crosscutting Concepts: Cause and Effect; Influence of Engineering, Technology, and Science on Society and the Natural World; Science Is a Human Endeavor (Connections to Nature of Science)

Science and Engineering Practices: Engaging in Argument from Evidence

Engaging in Argument from Evidence is important to this two-day lesson because students will research weather hazard solutions and perform an evaluation to determine whether they think the solution is effective in addressing the extreme weather problem based on criteria and constraints, evidence, and benefits and risks that may impact society once the solution is implemented.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Core Vocabulary

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. No new Core Vocabulary terms are introduced in this lesson.

claim

evaluation

evidence

Instructional Resources

Activity Page



AP 13.1

Activity Page

Evaluations and Claims
(AP 13.1)

Make sufficient copies for your students prior to conducting the lesson.

Materials and Equipment

Collect or prepare the following items:

- internet access
- classroom computers

Advance Preparation

Day 1: For this lesson, students will need access to Student Reader Chapter 7 to refer to the design solutions for extreme weather problems.

Day 2: Prepare the room in advance by setting up tables and chairs to represent a conference panel or debate room.

THE CORE LESSON TWO DAYS, 45 MIN EACH

1. Day 1: Focus student attention on the Big Question.

10 MIN

How can we evaluate design solutions to weather hazard problems? Begin by having students take out their Core Vocabulary deck. Ask students to review the definitions of *hazard*, *problem/solution*, *criteria*, *constraints*, and *evaluate*. Ask the following:

- » What makes something a hazard? (*It is dangerous.*)
- » What are some examples of weather hazards? (*blizzards, tornadoes, hurricanes, thunderstorms, droughts*)
- » What is the difference between criteria and constraints? (*Criteria are needs or wants, and constraints are limitations or restrictions.*)
- » What is the difference between a problem and a solution? (*A problem is something that is wrong or needs to be fixed, and the solution is the thing that will fix the problem.*)
- » How can we evaluate whether a solution works? (*We can test the solution to see if it works. If it does not, we can make changes to it and test it again. We can do this over and over until it works.*)

SUPPORT—If needed, explain to students that solutions can take many forms. Sometimes a solution is a process, such as following a certain procedure. Give students an example of a process-based solution. For example, perhaps someone is fixing a device that has malfunctioned, but one step in the solution is missing. If the person follows the process, he or she will not fix the problem without that step. However, if that step is added, the person will be able to fix the problem. Other times, a solution is a device that an engineer designs. Give students an example of a device-based solution. For example, perhaps someone needs to communicate with someone else across a long distance. A cell phone is a device solution that fixes the problem. The cell phone was designed by an engineer.

Remind students that in the previous lesson, they learned about things that engineers design to help solve problems caused by extreme weather. Invite students to work with a neighbor to recall the types of problems that people can experience, or go around the classroom and call on students to name one kind of problem. Students should be able to recall problems such as fires, flooding, and destruction from the wind.

2. Preview the activity.

5 MIN

Activity Page



AP 13.1

Introduce Evaluations and Claims (AP 13.1). Tell students that during today's session, they will be evaluating different solutions to extreme weather problems and making a claim as to whether or not those solutions are effective or helpful to people and society. They will use the Activity Page to guide their research. During the next classroom session, students will present their solutions to the class as if they were engineers, and there will be a lively discussion about the features of their design solutions and why they work (or don't work).

Review the Activity Page as a class. Model for students how to complete the Activity Page by going through the questions. Let students know that they can use their Student Readers to review the types of design solutions that engineers have come up with. Encourage them to study the engineering design process diagram on page 31 carefully. Students can also perform internet research on classroom computers if enough computers are available.

3. Support student research.

25 MIN

Prompt students to review Student Reader Chapter 7 and select a design solution to focus on. If computers and internet access are available, let students know that they can also research some different design solutions that were not discussed in the chapter.

As students work on their Activity Page, circulate around the room and provide support. When students get to the questions about benefits and risks, make sure students understand that these refer to benefits and risks to society.

SUPPORT—Tell students that all design solutions can pose some kind of benefit and/or risk when they are implemented. Give students an example of a solution that is beneficial but has some risks associated with it. For example, cars are devices that help move people from one place to another relatively quickly. However, cars sometimes break down, leaving their drivers stranded. Prompt students to think about benefits by asking themselves, “How does this solution help people?” Then prompt students to think about risks by asking themselves, “What are some possible ways that this solution could be harmful to people or the environment?”

Ask students what types of things they need to think about when evaluating solutions or making claims. Remind students to use evidence based on evaluations when writing their claims. Evidence can be based on things such as whether or not the solution meets the criteria and constraints, as well as whether or not the solution poses any benefits or risks to society when it is implemented. (See **Know the Standards 1.**)

SUPPORT—If needed, remind students that a claim is a statement that is made based on what someone thinks or believes. Claims can be supported by evidence, facts, or proof.

4. Check for understanding.

5 MIN

Activity Page



AP 13.1 and
Answer Key

Formative Assessment Opportunity

Allow students to keep Activity Page 13.1, since they will need it the next day. However, encourage them to ask any questions they may still have about design solutions and criteria and constraints. Allow other students to answer any questions to which they know the answers.

1. Day 2: Refocus student attention on the Big Question.

5 MIN

Remind students that in the previous class session, they evaluated design solutions to weather problems and wrote a claim about whether or not the solution works.

- Ask students if they have any questions about the first part of the activity that they completed. Students may have had difficulty coming up with evidence to support their claims.
- Go over the big question again: **How can we evaluate design solutions to weather hazard problems?** Ask: Why do you think that it is important to evaluate design solutions? (*so that the best solutions can be used; so that we can improve solutions if they do not work*)

Know the Standards

1. Making claims supported by evidence is an important skill in science. Good scientific explanations are based on claims that can be supported by facts, observations, and proof. Making claims supports the Performance Expectation as a means of addressing the influence of design solutions on society and the natural world.

Tell students that today they will present the features of their solutions and participate in a lively discussion/debate about whether or not their solution works.

2. Guide discussion.

30 MIN

Tell students that they will be playing the roles of engineers who are in charge of coming up with solutions designed to address weather-related problems and hazards. As part of this activity, they must address how their solutions were evaluated.

Arrange desks (or tables) and chairs in a circular shape around the room so that all students can see each other. Tell students that in engineering meetings, engineers sit around tables in a similar way that allows them all to see other designs and talk face to face. This also gives them an opportunity to evaluate other people's solutions and have other people evaluate theirs.

Have students take out their Activity Page 13.1. Let students know that they can use these as a reference during the discussion. Remind students that they can also refer to the engineering design process diagram on page 31.

Initiate the discussion by randomly calling on the first student to present his or her design solution. Start by asking the student which design solution he or she focused on. Then ask the rest of the class if there are other students who focused on the same design. Chances are, multiple students chose to work on the same design for their research. When there are multiple students with the same design, allow them to participate in the discussion at the same time, but split up the questions so that different students are asked to discuss different things. For example:

- Ask Student A: What are some of the benefits of your design solution?
- Ask Student B: What are some of the risks associated with your design solution?
- Ask Student C: What are some of the criteria and constraints of your design solution?

After each student has had a chance to discuss the features of his or her solution, ask the rest of the class to weigh in and evaluate whether the solution is a "good solution." Call on students to explain why they think it works well. Call on other students to explain why they think it does not work well. If students believe it does not work well, ask: What are some things that can be done to improve the design? (See **Know the Standards 2.**)

Know the Standards

2. Asking students to think about how designs can be improved supports the Connections to Engineering, Technology, and Applications of Science. Engineers improve existing technologies or develop new ones to increase their benefits to society and to decrease the risks associated with certain solutions. The improvement process is continuous, as engineers are always looking for ways to make things work better. Improving a design does not necessarily mean that a design is flawed; it means that there are alternative ways to meet societal demands that may make better use of things such as resources, funding, usability, and availability.

SUPPORT—Help students think of factors to be considered when it comes to improving designs, such as the following:

- Is this solution expensive to make? If so, can it be improved in a way that reduces the cost of making it?
- Does this solution cause any risks to society or nature, such as pollution? If so, can it be improved in a way that reduces these risks?
- Is this solution easy to use? If not, can it be improved in a way that makes it more user friendly?
- Is this solution easily accessible or available? If not, how can it be redesigned in a way that allows more people to be able to use it/access it?

Repeat the process until all students have had a chance to play the role of the engineers presenting their solutions and evaluations.

3. Summarize and discuss.

5 MIN

Bring the class back together after students finish their discussions. Allow students to ask questions, and address any misconceptions. Make sure the focus is on how students evaluated their solutions before making a claim.

4. Check for understanding.

5 MIN

Activity Page



AP 13.1 and
Answer Key

Formative Assessment Opportunity

See the Activity Page Answer Key (AP 13.1) for correct answers and sample student responses.

Collect the completed Activity Pages at the end of Day 2.

Glance quickly over the questions that students answered to check for completeness as well as proper understanding. Provide additional guidance for students who need more support.

UNIT REVIEW

Weather-Related Technology

Big Question: Who are some inventors of weather-related technology?

AT A GLANCE

Learning Objective

- ✓ Fluently discuss weather and climate.

Lesson Activities

- unit review
- reading and discussion
- vocabulary instruction
- drawing activity

NGSS References

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.

For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

The Big Idea

Interactions between matter and energy at Earth's surface produce constantly changing conditions in the lower atmosphere, weather. This lesson introduces students to types of weather conditions and the factors that contribute to their formation. The lesson emphasizes the collection and representation of data as the means to recognize patterns of weather. Then the lesson extends the examination of data to long-term patterns that describe climate.

Students work with data to reveal patterns, make predictions, and inform and defend problem-solving decisions. They also examine the role of technology in observing weather and in minimizing risks associated with weather hazards.

Core Vocabulary

Language of Instruction: During instruction, remind students of their prior exposure to the following terms:

air mass	criteria	hazard	water vapor
air pressure	data	humidity	weather
atmosphere	drought	meteorologist	wind
climate	engineering design process	precipitation	wind direction
condense	evaporate	prevailing winds	wind speed
constraint	front		

Core Vocabulary Deck: Students should refer to their full set of Core Vocabulary cards during the review discussion.

Instructional Resources

Student Reader



Ch. 8

Activity Pages



AP UR.1

AP UR.2

AP UR.3

Student Reader, Chapter 8
“Weather-Related Technology”

Activity Pages
Design a Weather-Related
Technology (AP UR.1)

Vocabulary Crossword Puzzle
(AP UR.2)

Vocabulary Review (AP UR.3)

Make sufficient copies for your
students prior to conducting
the lesson.

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project
images/video for whole-class viewing

1. Focus student attention on the Big Question.

10 MIN

Who are some inventors of weather-related technology? Review with students what they have learned about throughout this unit:

- weather and climate
- atmosphere and air pressure
- water in the atmosphere
- precipitation and wind
- finding weather patterns
- making weather predictions
- working with weather and climate data
- extreme forms of weather
- engineering for extreme weather conditions
- problems and solutions
- criteria and constraints

Ask students what they think it would be like if people did not know much about weather and climate. Use the following questions:

- » What do you think life would be like if we did not have the technology to study weather data? (*Sample answer: We wouldn't know what the temperature would be or if it would rain today.*)
- » Is it helpful for us to have technology that lets us study the weather and collect weather data? (yes)
- » How can studying weather data keep people safe? (*Sample answer: Weather data can tell us whether a location is in danger of extreme weather or weather hazards.*)

Explain that in 1900, a hurricane struck the city of Galveston, a city on the Texas coast. The hurricane was so powerful that it left thousands of people dead and much damage in its wake. At the time, scientists' ability to predict bad weather was much more limited than it is today. They did not have access to the kinds of machines that we have now to study past weather patterns or see how future weather is shaping up. As a result, people were caught off guard and could not prepare in advance for the bad weather. This resulted in greater damage and loss of life. Use this example to help students understand why studying weather data is so important.

Tell students that today they will read about inventors who came up with important weather-related design solutions used to study the weather as well as predict extreme weather conditions.

2. Read and discuss: “Weather-Related Technology.”

20 MIN

Student Reader



Ch. 8

Read together, or have students read independently, “Weather-Related Technology,” Chapter 8 in the Student Reader. This chapter introduces inventors who had an important impact by designing weather-related technologies that people use today to predict the weather and identify weather patterns.

Review Core Vocabulary Terms

Before students read, have students flip through their decks of Core Vocabulary cards. Remind students that by now they have had a lot of exposure to these terms throughout the unit. Tell students to keep these terms and other terms that are associated with them in mind as they read through the Student Reader. Encourage them to use the terms frequently as they discuss what they read.

Guided Reading Supports

When reading aloud together as a class, always prompt students to follow along. Pause for discussion. Include suggested questions and prompts:

Page 37

Focus on developing student understanding of technology. Reiterate that technology can be anything that is considered useful. Select random examples of technology, and ask students whether or not they think it is considered technology and why. For example, ask: Are the lights in this classroom considered technology? (yes) Why? (*because someone invented them and they help us to see in the classroom*)

SUPPORT—If necessary, address any misunderstanding that technology only applies to electronics or computers. Emphasize that technology takes many forms, including machines, assembly lines, and simple inventions such as pencils and erasers.

Page 38

After reading the page, have students turn to a neighbor and discuss the importance of knowing the air pressure through the use of a barometer. Prompt students to recall the meaning of *air pressure* and then ask: How can this help us know or predict the weather?

SUPPORT—If necessary, hold a whole-class review of the meaning of *air pressure*, or prompt students to refer to their Core Vocabulary card.

If time permits, show students a photograph of what current barometers look like. (See the Online Resources for a link to a suggested image.) Have them compare Torricelli’s barometer to a present-day barometer and describe what they see, including similarities and differences.



Page 39

Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

After reading the page, ensure students understand the meaning of the term *deflect*. Ask: What do you think it means that lightning is deflected away from an object? (*It means that it is redirected away from the object.*)

SUPPORT—Draw on what students learned in previous lessons about problems and solutions. Ask: What kind of problem is Benjamin Franklin’s technology trying to solve? (*preventing homes and buildings from getting damaged from lightning*)

Explain that Benjamin Franklin’s experiments with electricity were very dangerous, since getting struck with electricity or lightning can be harmful or even fatal. If time permits, show students a video of Benjamin Franklin’s lightning experiment. (See the Online Resources for a link to a suggested video.)



Page 40

Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Direct student attention to the image of the Enhanced Fujita scale on the page. Ask: Which level of a tornado is worse, an EF0 or an EF5? (*EF5*) How do you know? (*The winds are faster, which means that the tornado will do more damage.*)

SUPPORT—If necessary, help students make the connection between faster winds and more destruction. Explain that faster winds are more powerful and can therefore do things such as tear down structures, blow away cars and cattle, and rip trees out of the ground.

CHALLENGE—If time permits, discuss with students in more detail tornado destruction ratings. Show them the scale by pulling it up online. (See the Online Resources for a link to a suggested website.) Challenge students to analyze what they see by asking prompting questions such as

- Which is the worst category of tornado? (*EF5*)
- What does the abbreviation SM mean on the scale? (*strip mall*)

Click on one of the Numbers in the Enhanced F Scale Damage Indicators table, and discuss what you see. For example, if you select the link for #28, you will see a description of the degree of damage done to softwood trees. Ask students more prompting questions, such as the following:

- If the degree of damage for a softwood tree is 4, what will you expect to see? (*trees with their trunks snapped*)
- What is the worst kind of damage that can be done to trees? (*They can be debarked with only the stubs of the largest branches remaining in place.*)



Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

www.coreknowledge.org/cksci-online-resources

Page 41

After reading the page, call on a volunteer to explain why windshield wipers are considered a type of technology. (*They were invented to help people stay safe while driving.*) Ask another volunteer to summarize why this type of technology is useful to society. (*It helps people stay safe while driving through rain or snow so they can see through the windshield.*)

Page 42

After reading the page, explain that Simpson used to go on long airplane flights to tropical regions and would film videos of the clouds. She used this footage to draw cloud maps that focused on the formation of tropical clouds. The information she discovered led to more knowledge about the role that tropical clouds play in global atmospheric circulation.

SUPPORT—If needed, help students understand the concept of atmospheric circulation and the fact that clouds form in certain ways depending on various factors. By studying cloud behavior, scientists can look for patterns to help predict weather such as tropical storms.

3. Design a weather-related technology.

10 MIN

Activity Page



UR.1

Distribute Design a Weather-Related Technology (AP UR.1). Tell students that they will work with a partner to design a new type of technology that will help them with some kind of issue related to extreme weather. Review the Activity Page with students, and model how to answer the questions.

Let students know that although they can work together in pairs, each student must turn in his or her own Activity Page with answers and drawings.

As students work on their Activity Pages, circulate around the room and provide support as needed.

SUPPORT—Remind students that they worked on evaluating design solutions for extreme weather in the previous lesson. Prompt them to recall some of the things one considers when evaluating a design solution.

4. Review take-home activities.

5 MIN

Activity Pages



UR.2

UR.3

Answer Key

For additional vocabulary reinforcement prior to administering the Unit Assessment, distribute Vocabulary Crossword Puzzle (AP UR.2) and Vocabulary Review (AP UR.3) as take-home assignments.

Teacher Resources

Activity Pages

• Patterns in the Atmosphere (AP 1.1)	106
• How Water Moves (AP 2.1)	107
• Elements of Weather Observations (AP 3.1)	108
• Measuring Wind (AP 4.1)	109–110
• Air Masses and Wind (AP 5.1)	111
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Name _____

Date _____

Activity Page 1.1

Use with Lesson 1.

Patterns in the Atmosphere

1. What type of gas makes up most of the air in the atmosphere? Circle your answer.

nitrogen

oxygen

other gases

water vapor

2. How does air pressure change with altitude?

3. Write the correct amount of air pressure next to the type of weather or temperature it causes.

cloudy _____

sunny _____

clear _____

rainy _____

snowy _____

Name _____

Date _____

Activity Page 2.1

Use with Lesson 2.

How Water Moves

How does water move into and out of the atmosphere? Draw a diagram to explain each of these ways that water changes as it moves. Be sure to include labels showing the state of matter (solid, liquid, or gas) of the water.

Precipitation

Evaporation

Condensation

Name _____

Date _____

Activity Page 3.1

Use with Lesson 3.

Elements of Weather Observations

Teacher Demonstration

What causes the temperature to change during the demonstration?

What else changes as a result of the temperature change?

Student Investigation

Station 1:

- a. The water that was on your hand changed from a _____ to a _____.
- b. This process is known as _____.

Station 2:

- a. What do you observe on the outside of the glass? _____
- b. This happens because water vapor in the air changes from a _____ to a _____.
- c. What is this process known as? _____

Station 3:

- a. What did you observe when you gently squeezed the balloon? _____
- b. Air in the balloon moves from _____ pressure to _____ pressure.

Station 4:

- a. What did you observe when you pushed the cup underwater? _____
- b. Water did not go into the cup because the cup was already full. What was the cup full of? Explain.

Name _____

Date _____

Activity Page 4.1 (Page 1 of 2)

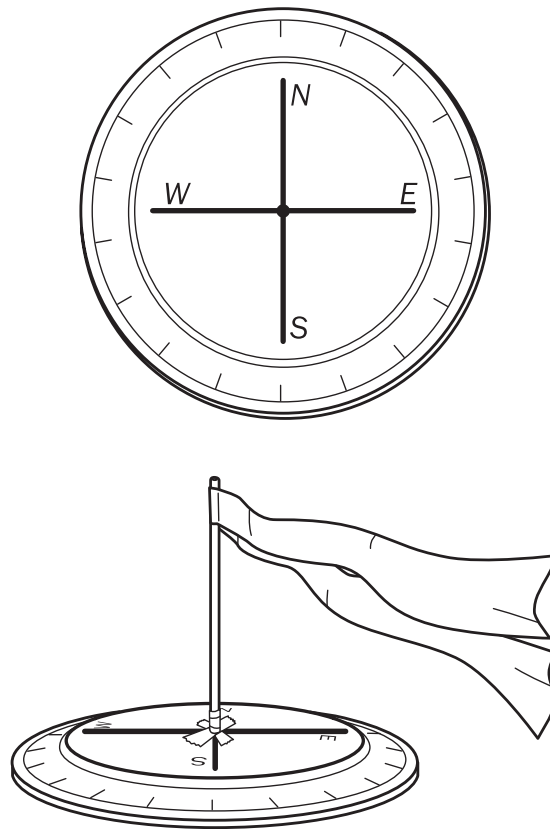
Use with Lesson 4.

Measuring Wind

Make your wind vane by following these steps:

1. Make a compass rose on the paper plate with the ruler and marker.
2. Poke a hole in the center of the plate with a sharp pencil.
3. Tape the streamers to one end of the straw, and poke the other end of the straw into the hole in the center of the plate. Secure the straw with tape if needed.

The wind vane should look like this:



Measure the wind by following these steps:

1. Determine which direction is north by using the compass. Place the wind vane on the ground so that the directions face the same way as the compass.
2. Observe the streamers. Which way is the wind blowing from?

Record the results on the data table:

Date	Time	Wind direction

Answer the questions with your group or on your own:

What is wind?

How does air get heated?

Draw a diagram to show what happens when air is heated.

Name _____

Date _____

Activity Page 5.1

Use with Lesson 5.

Air Masses and Wind

An air mass is a large body of air in the atmosphere. In this investigation, you will observe one type of air mass.

Directions:

When your group is ready, you will remove the cover from the cup/pan of water that the teacher has placed in front of you.

First, predict how the air above the water will feel.

Now, remove the cover.

How did the air above the water feel on your hand?

Explain why it felt this way.

Draw a diagram to show the air mass before and after the cover was removed. Label the parts.

Air mass with cover on	Air mass with cover off

Name _____

Date _____

Activity Page 6.1

Use with Lesson 6.

Looking for Patterns in Wind Data

Day 1

1. Record the wind speed for your location for the past five days on the data table.

Date	Wind speed at your location

2. How has the wind speed changed?

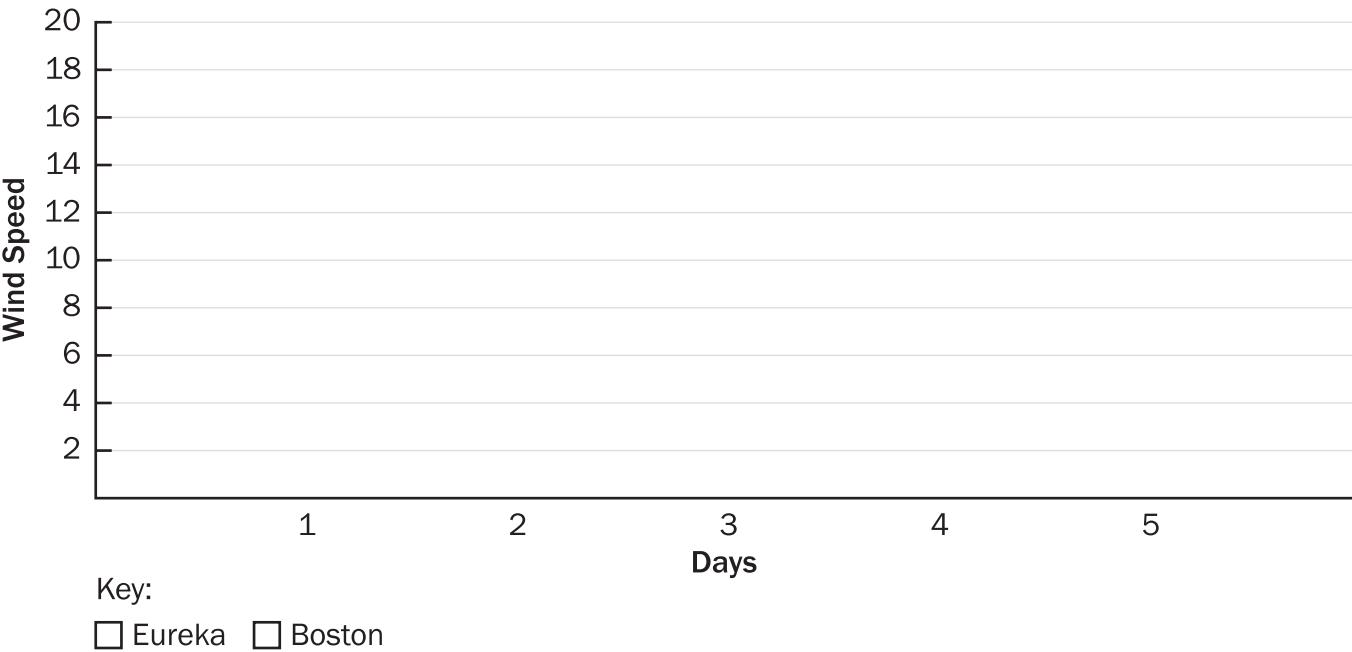
3. Examine the wind direction data that you collected on Activity Page 4.1. Can you find a pattern between the wind direction and the wind speed?

Comparing Wind Speed

Examine the wind speed from two locations recorded in the data table.

Wind speed	Location 1: Eureka, CA	Location 2: Boston, MA
Day 1	4	17
Day 2	3	11
Day 3	4	9
Day 4	4	11
Day 5	5	12

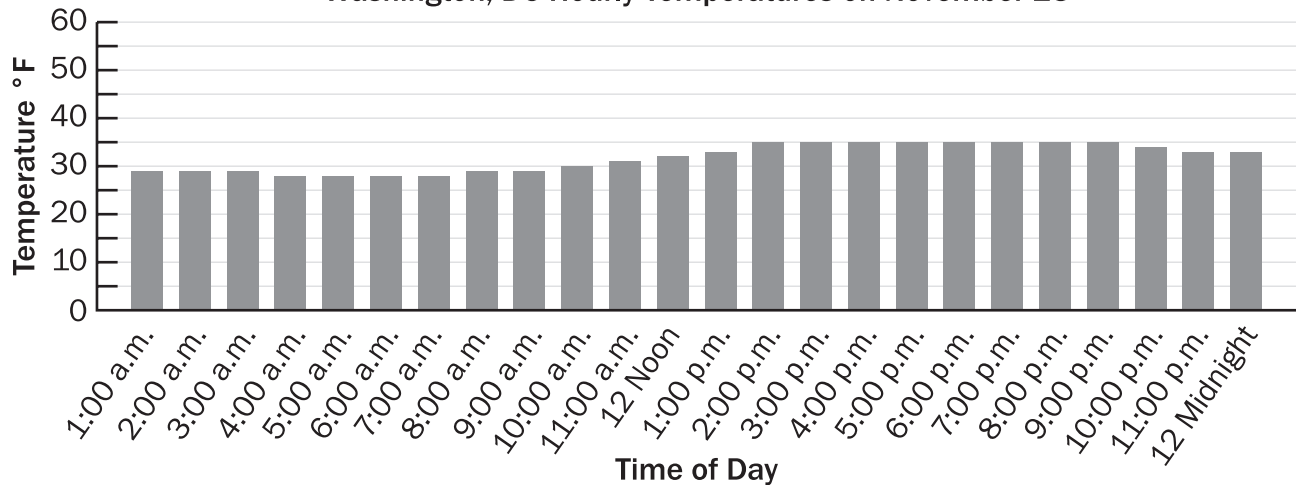
Make a graph to record the wind speed in the two locations.



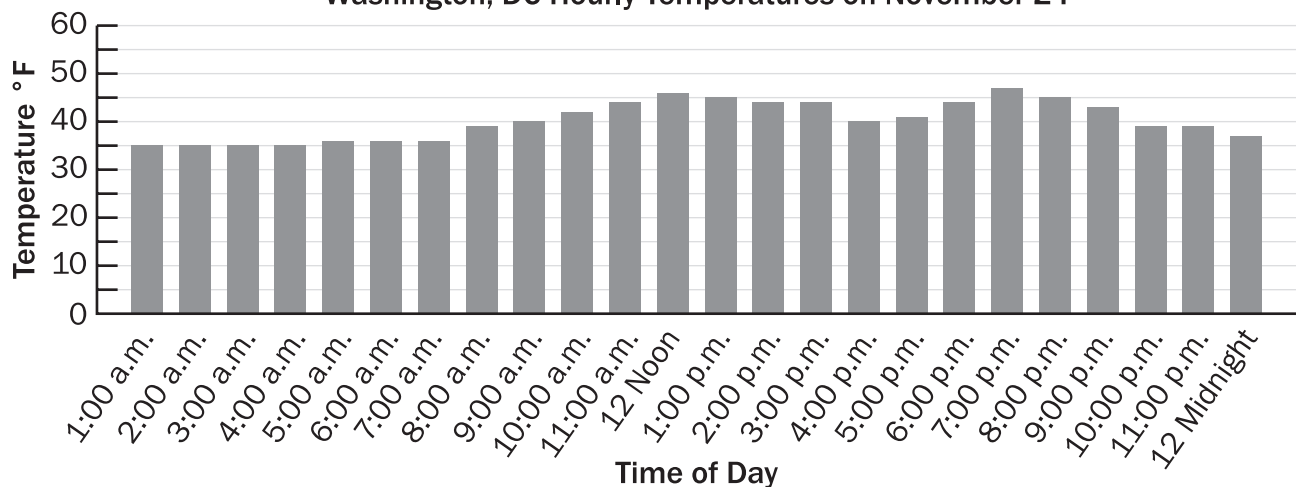
Finding Temperature Change Patterns

Answer the questions to show what you can learn from weather data.

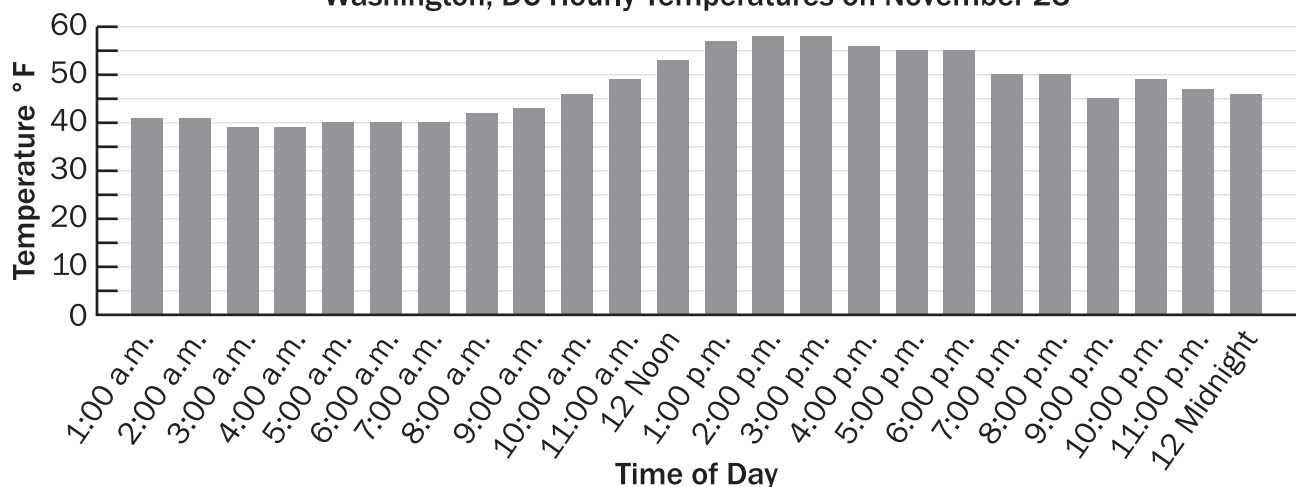
Washington, DC Hourly Temperatures on November 23



Washington, DC Hourly Temperatures on November 24



Washington, DC Hourly Temperatures on November 25



1. What season do these three graphs represent?

2. Which hours of each day have the lowest temperatures?

3. What can you say about the hour from 2 p.m. to 3 p.m. each day?

4. Describe the pattern of change each day. Use words such as *morning*, *afternoon*, *evening*, and *overnight*.

5. What is your prediction for temperature changes on November 26?

Meteorologist Job Description

Write a paragraph to describe the job of a meteorologist. Include these details:

- how the job helps other people
- parts of the job that take place outdoors or indoors
- how using computers is important
- in addition to science, school subjects that a person should like to do this job
- a conclusion sentence to help people make their decision

Name _____

Date _____

Activity Page 8.1 (Page 1 of 4)

Use with Lesson 8.

Using Temperature Patterns to Describe Climate

STEP 1: These data tables are from your Student Reader. Use your highlighters or colored pencils. Color the winter high temperature table cells light blue. Color the spring high temperature table cells light green. Color the summer high temperature table cells light pink. Color the fall high temperature table cells yellow.

STEP 2: Use the highlighted data to complete the bar graphs. Use the same color highlighters to draw the bars.

STEP 3: Answer the questions.

San Jose, Costa Rica						
	2014		2015		2016	
	Average high temperature	Average precipitation	Average high temperature	Average precipitation	Average high temperature	Average precipitation
Winter	73°F	less than ¼ inch	73°F	less than ¼ inch	75°F	½ inch
Spring	76°F	3 inches	75°F	1 inches	77°F	3 inches
Summer	75°F	4 inches	75°F	5 inches	75°F	6 inches
Fall	74°F	9 inches	75°F	8 inches	73°F	6 inches

Fairbanks, Alaska						
	2014		2015		2016	
	Average high temperature	Average precipitation	Average high temperature	Average precipitation	Average high temperature	Average precipitation
Winter	1°F	6 inches	0°F	7 inches	4°F	6 inches
Spring	32°F	5 inches	37°F	4 inches	38°F	5 inches
Summer	58°F	5 inches	60°F	5 inches	61°F	4 inches
Fall	26°F	7 inches	27°F	8 inches	25°F	6 inches

Average High Temperatures in San Jose, Costa Rica													
Temperature in Degrees Fahrenheit													
100°F													
95°F													
90°F													
85°F													
80°F													
75°F													
70°F													
65°F													
60°F													
55°F													
50°F													
45°F													
40°F													
35°F													
30°F													
25°F													
20°F													
15°F													
10°F													
5°F													
0°F													
	Winter 2014	Winter 2015	Winter 2016	Spring 2014	Spring 2015	Spring 2016	Summer 2014	Summer 2015	Summer 2016	Fall 2014	Fall 2015	Fall 2016	

Average High Temperatures in Fairbanks, Alaska													
Temperature in Degrees Fahrenheit													
100°F													
95°F													
90°F													
85°F													
80°F													
75°F													
70°F													
65°F													
60°F													
55°F													
50°F													
45°F													
40°F													
35°F													
30°F													
25°F													
20°F													
15°F													
10°F													
5°F													
0°F													
	Winter 2014	Winter 2015	Winter 2016	Spring 2014	Spring 2015	Spring 2016	Summer 2014	Summer 2015	Summer 2016	Fall 2014	Fall 2015	Fall 2016	

1.

How does the temperature change in San Jose from season to season?
2.

What is the coldest season in Fairbanks?
3.

What is the warmest?
4.

What is the best time of year to visit San Jose if you like warm weather?
5.

Using the temperature data, when would you choose to visit Fairbanks? Explain your choice.
6.

Looking at temperatures, how do the climates of San Jose and Fairbanks compare?

Deciding When to Hold a Carnival

Your school wants to raise money for the local animal shelter. Everyone thinks an outdoor carnival is a great idea. Each class will help plan the event. Your class’s first task is to decide when to hold the carnival. How can you choose the best time of year for an all-day outdoor event? Use weather data!

Step 1:

- **Write the weather station name as the title of the table below.**
- **List the four seasons.**
- **Find weather data for each season on the NOAA website.**
- **Record the data in your own table. Your teacher will help you change the measurements into whole numbers.**

Season	Precipitation (Inches)	Minimum Temperature (°F)	Maximum Temperature (°F)

Minimum means the lowest temperature in that season. *Maximum* means the highest temperature in that season.

You want a day with dry weather that is not too cold or too hot to enjoy outdoors. Predict which season will be best for the carnival. Explain why this is the best choice.

Once you have chosen a season for the carnival, it is time to pick the month. What are the months of the year in the best season for a carnival?

Step 2:

- **Cross out any months your school is not open.**
- **Write the remaining months in the table below.**
- **Use the NOAA website to find weather data by month.**
- **Find the months on your list by their numbers. For example, month “01” is January.**
- **Your teacher will help you change into whole numbers the data for precipitation and minimum and maximum temperature. Then record them in the table below.**

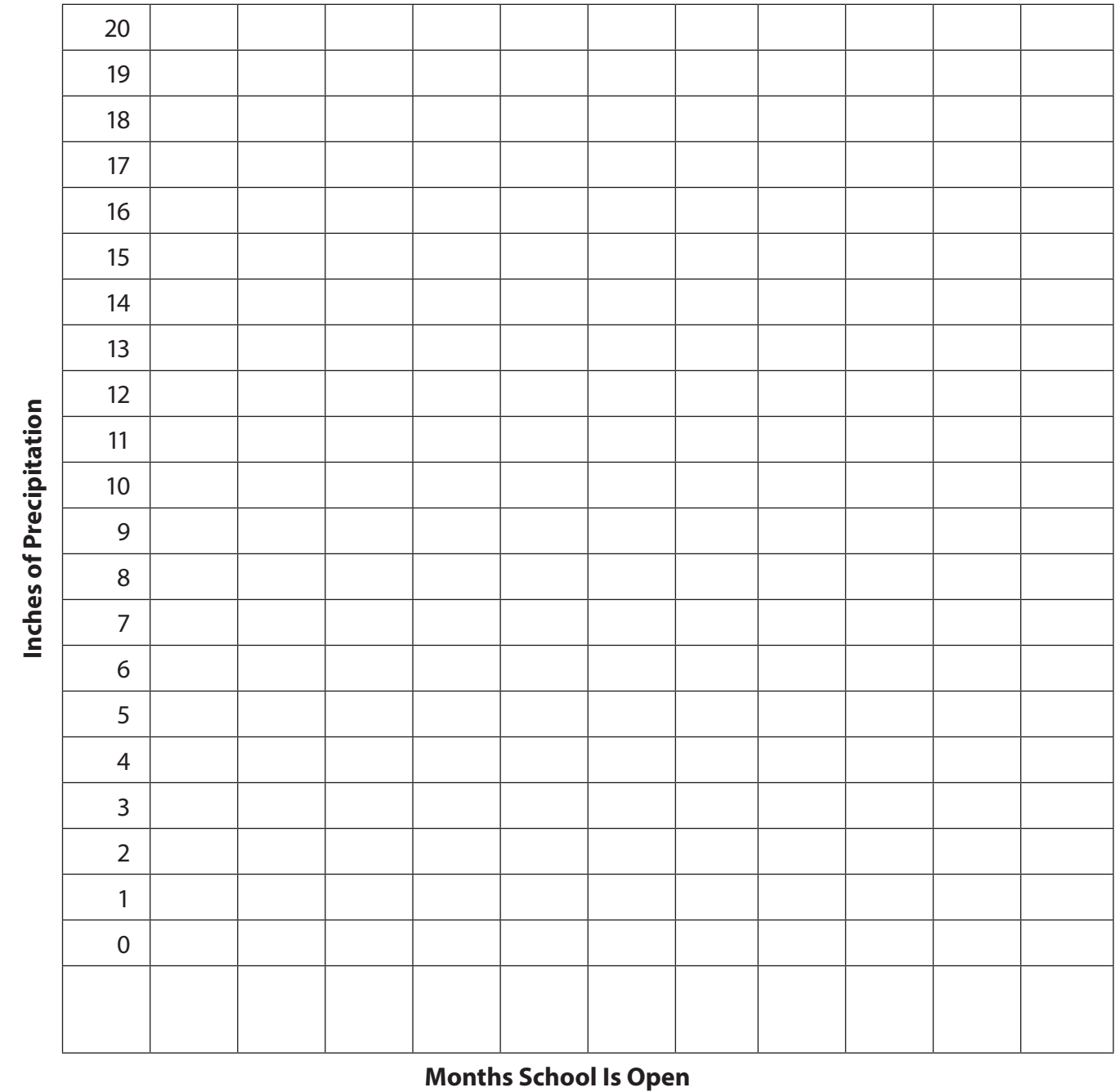
Months	Precipitation (Inches)	Minimum Temperature (°F)	Maximum Temperature (°F)

Remember: you want a day with dry weather that is not too cold or too hot to enjoy outdoors. Predict which month will be best for the carnival.

Draw a Graph to Show Your Reasoning

Use the weather data by month for your local station. Draw a precipitation graph to support your argument. Write the months school is open along the bottom of the graph. Draw a bar for each month.

Precipitation by Month near Our School



Name _____

Date _____

Activity Page 9.3

Use with Lesson 9.

Write a Letter to Your Principal

Write a letter to your school principal. Give your opinion about which season and month are best for an outdoor carnival. Give reasons for your prediction. Write about the graph you made.

[illegible]

Help Another School Choose When to Hold a Carnival

Your school has a pen pal school in Plainfield, Vermont. You wrote to your pen pals about raising money for an animal shelter. Now your pen pals want to raise money for a shelter near their school. They want to have their carnival on the same day as yours. Is that a good idea? Explain why or why not.

Help the school in Plainfield, VT, plan when to hold their carnival. Follow the same steps as you did for your school using Activity Page 9.1. Use the NOAA website to find weather data by season. Record whole numbers in the table below.

Plainfield, VT			
Season	Precipitation (Inches)	Minimum Temperature (°F)	Maximum Temperature (°F)

Which season is most likely to have a dry day that is not too cold or too hot?

Schools are open in Plainfield from August through May. What are the months of the year in the season you chose?

If you listed June or July, cross them off your list. Then, use the NOAA website to find climate by month. Find the data for the months on your list. Record the data in the table below.

Months	Precipitation (Inches)	Minimum Temperature (°F)	Maximum Temperature (°F)

Name _____

Date _____

Activity Page 9.5

Use with Lesson 9.

Write a Letter to Your Pen Pal

Write a letter to your pen pals. Give your opinion about which season and month are best for an outdoor carnival where they live. Give reasons for your recommendation.

[illegible]

Self-Evaluation Checklist

Your school wants to hold an outdoor carnival. How can you decide when is the best time to hold the event?

Read this checklist before you begin. **Complete this checklist** at the end of this lesson. Think about how you did. Check "Always," "Sometimes," or "Never."

Self-Evaluation Checklist			
	Always (2 points)	Sometimes (1 point)	Never (0 points)
I read weather data by season.			
I read weather data by the month.			
I look at patterns in data.			
I support my predictions by explaining patterns in data.			
I am careful when drawing a bar graph.			
I write clearly to tell others how I decided when to hold an outdoor carnival.			
I can talk about how climate is different from place to place.			
I use science vocabulary accurately.			

Name _____

Date _____

Activity Page 10.1

Use with Lesson 10.

Join the Famous Ten World Parks Club!

The Ten World Parks Club is not easy to join. To become a member, you have to travel around the world and visit all ten parks. These parks are famous for their scenery and wildlife.

Your task is to plan and take a virtual tour of all the parks. Part of your planning will be to find patterns in climate data. This way, you can decide which season is best to visit each park. And you can plan to bring the right clothes for your trip!

Steps

1. Your teacher will assign one park to you. Write the park name here.

2. Use fact sheets, books, and other sources to complete the Activity Page called Find the Climate of a Park for your park.
3. Use the Ten World Parks Club Passport Stamp Sheet Activity Page to make your passport. Write your name on the cover.
4. Now you are ready to act out your world tour! Get a classmate as a traveling companion. Move around your classroom with your partner to visit each park.
5. First, look at the photo of the park. What clues do you see about the climate of this park? Talk it over with your partner.
6. Turn over the photo to read the data table. Use the data to decide which season will likely have the best weather to visit the park. Write the name of the park and season you think others should travel there.
7. Show your teacher your passport, and get it stamped as you complete each park.
8. Congratulations! You are now a member of the Ten World Parks Club!

Find the Climate of a Park

Your teacher will assign a park to you.

Mark the location of the park on the map.

Use books and other sources to find information about the climate of this park.



Park Name: _____

Climate Zone (circle one): polar temperate tropical

	Low Temperature Pattern	High Temperature Pattern	Precipitation Pattern
Winter			
Spring			
Summer			
Fall			


Name _____

Date _____

Activity Page 10.3

Use two copies with Lesson 10.

Ten World Parks Club Passport Stamp Sheet

Park: _____	Park: _____
Best season to visit: _____	Best season to visit: _____
Weather to expect: _____	Weather to expect: _____
Stamp: _____	Stamp: _____
Park: _____	Park: _____
Best season to visit: _____	Best season to visit: _____
Weather to expect: _____	Weather to expect: _____
Stamp: _____	Stamp: _____
Park: _____	TEN WORLD PARKS CLUB PASSPORT
Best season to visit: _____	
Weather to expect: _____	This passport belongs to:
Stamp: _____	_____

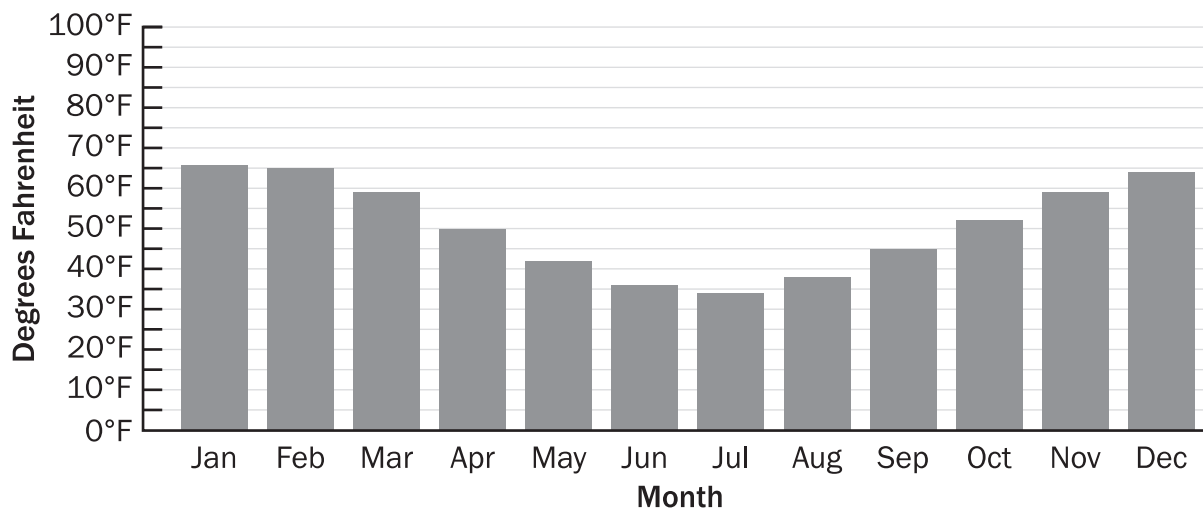
Self-Evaluation Checklist

To become a member of the Ten World Parks Club, you have to know how to find and communicate weather and climate data. **Read this checklist** before you begin. **Complete this checklist** at the end of this lesson. Think about how you did. Check “Always,” “Sometimes,” or “Never.”

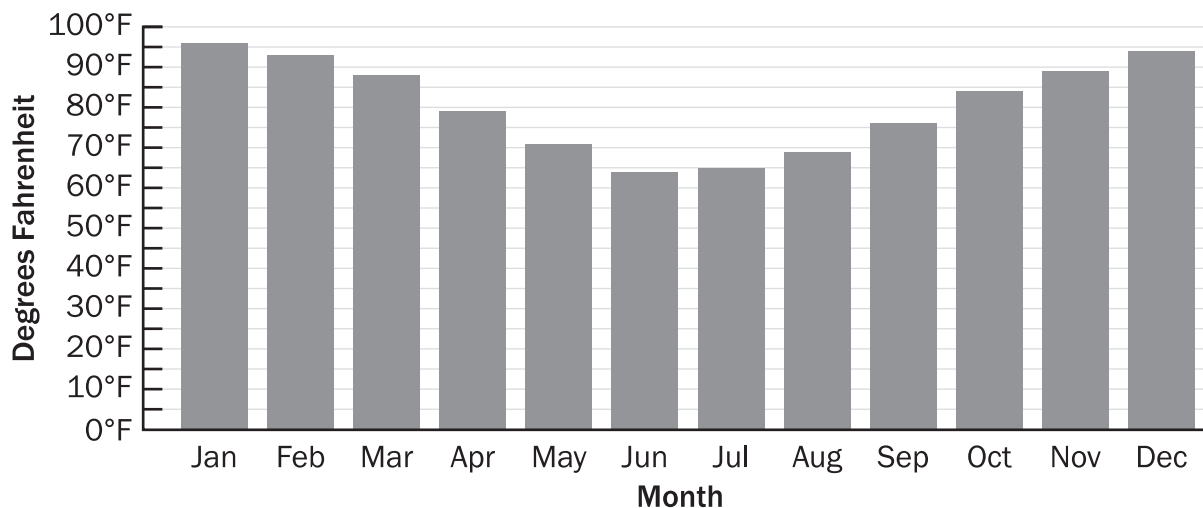
Self-Evaluation Checklist			
	Always (2 points)	Sometimes (1 point)	Never (0 points)
I can use a map to talk about climate zones on Earth.			
I can use books and other sources to find climate information.			
I can combine climate information in a table.			
I can use science words to describe climates (examples: <i>temperature, precipitation, climate zone</i>).			
I can make predictions about the weather of a place at a certain time of year using climate data.			
I can support my predictions by explaining patterns in data.			
I can communicate about the climates of parks around the world.			

Climate Fact Sheet: Uluru-Kata Tjuta National Park, Australia

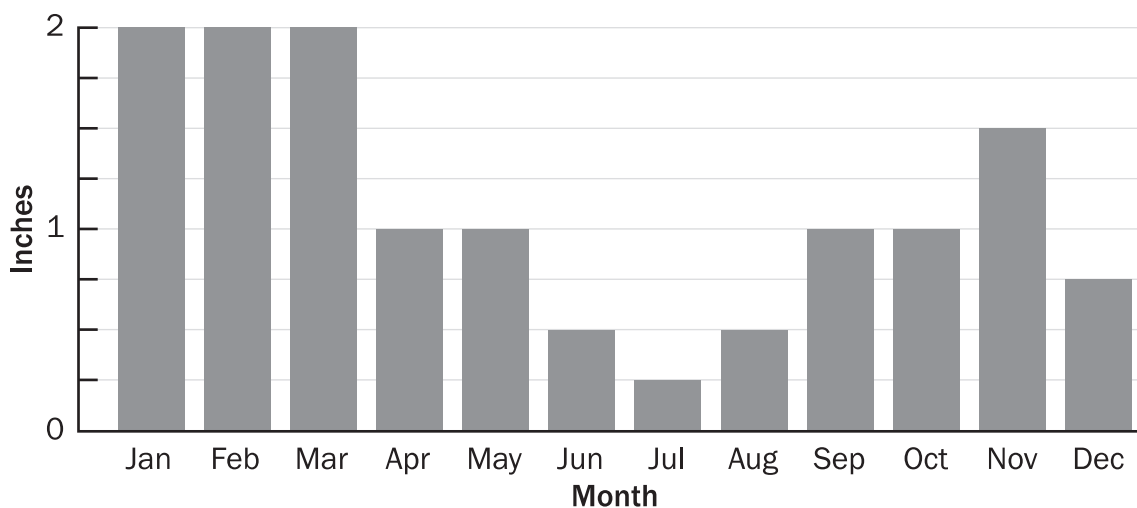
Low Temperature by Month



High Temperature by Month

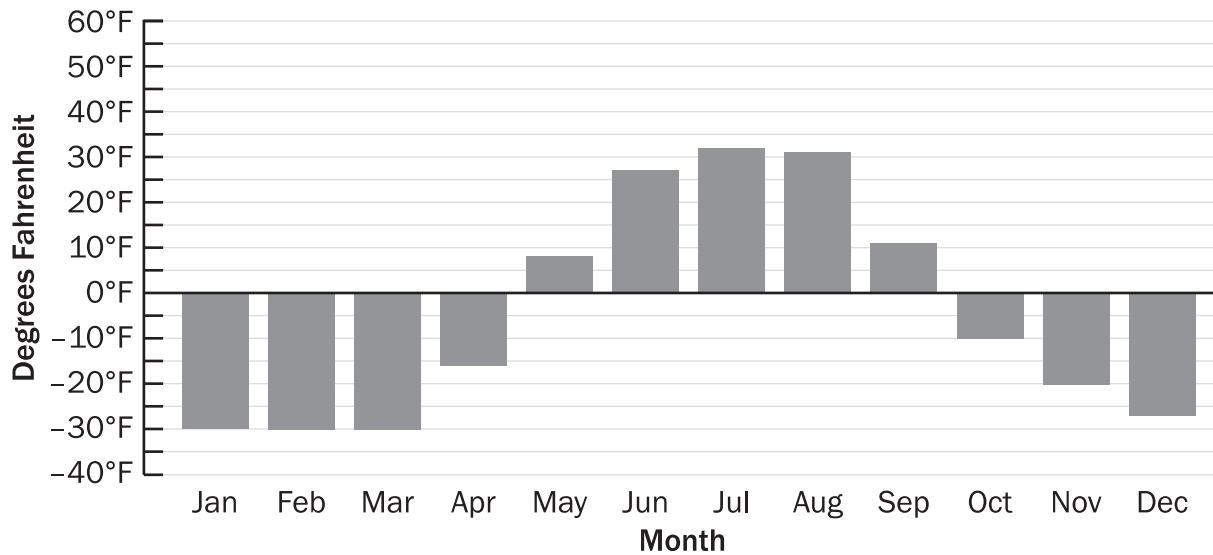


Precipitation

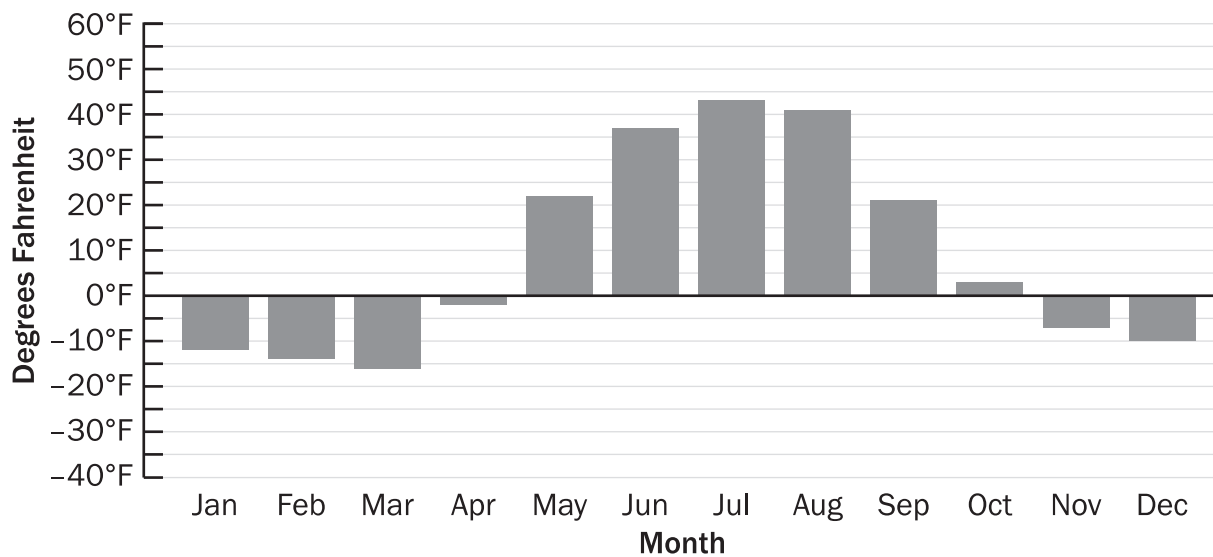


Climate Fact Sheet: Northeast Greenland National Park, Greenland

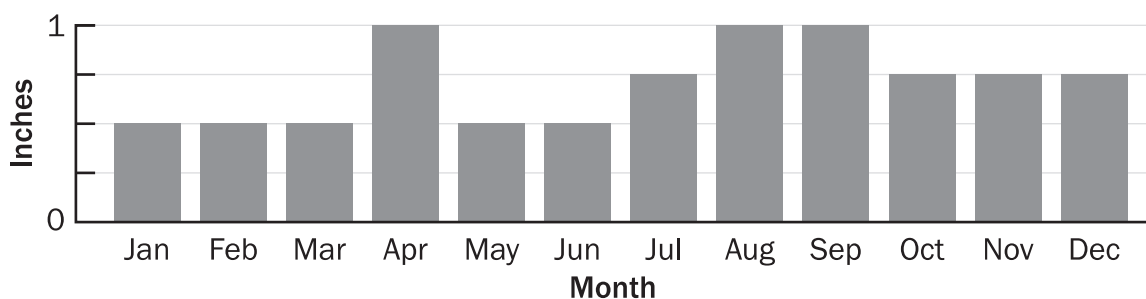
Low Temperature by Month



High Temperature by Month

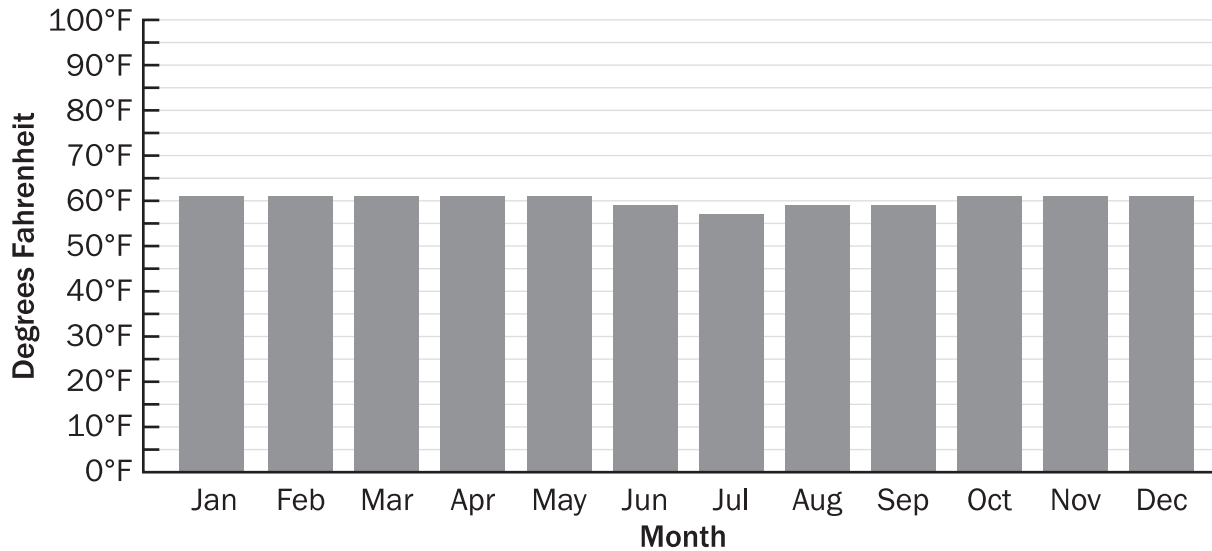


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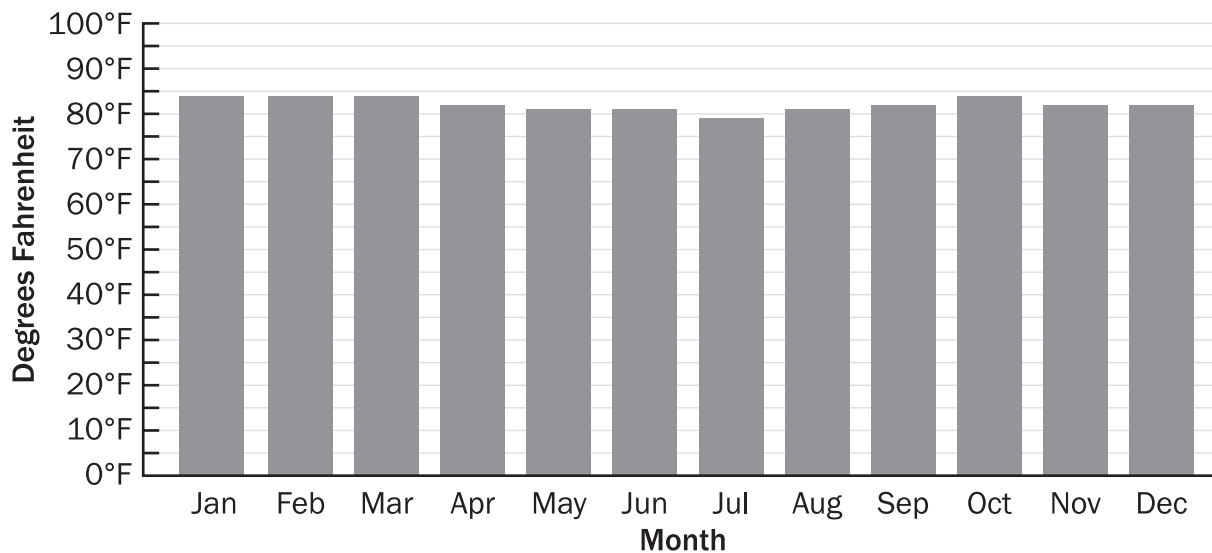


Climate Fact Sheet: Serengeti National Park, Tanzania

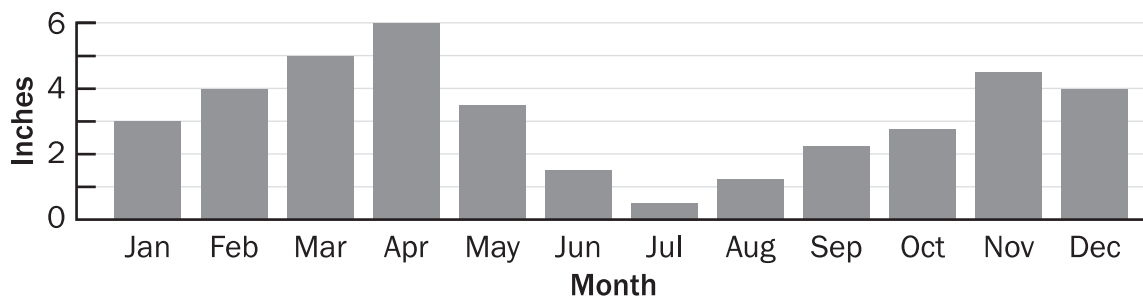
Low Temperature by Month



High Temperature by Month

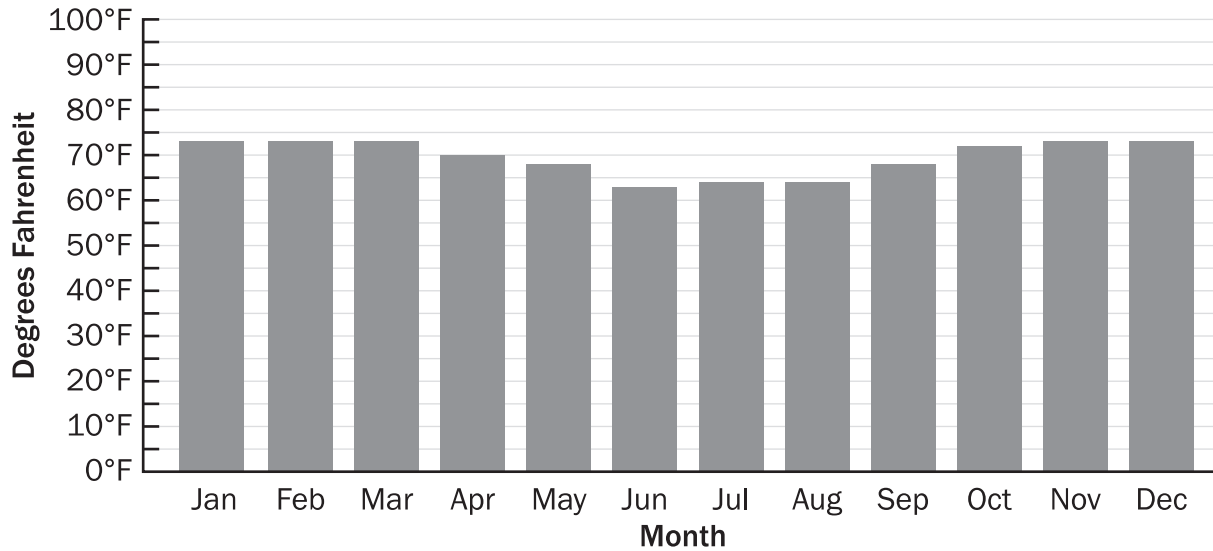


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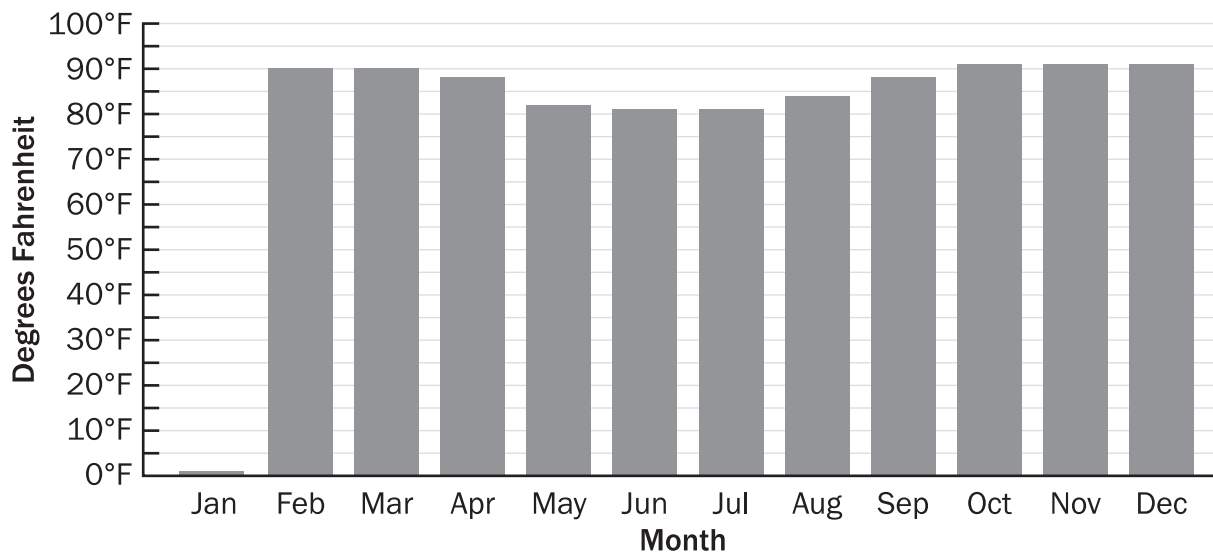


Climate Fact Sheet: Pantanal Matogrossense National Park, Brazil

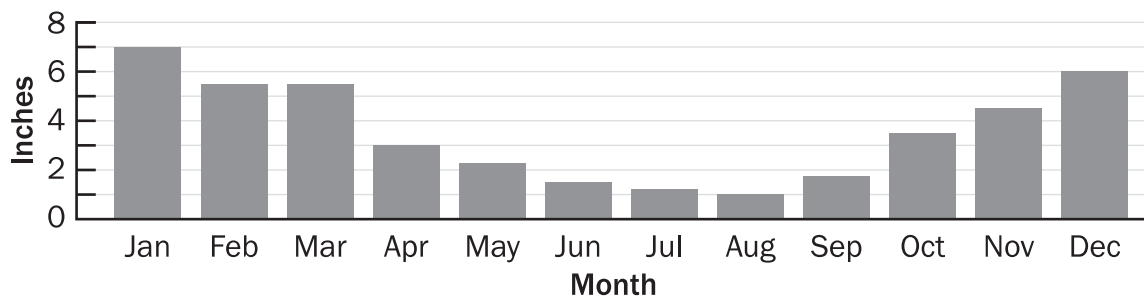
Low Temperature by Month



High Temperature by Month

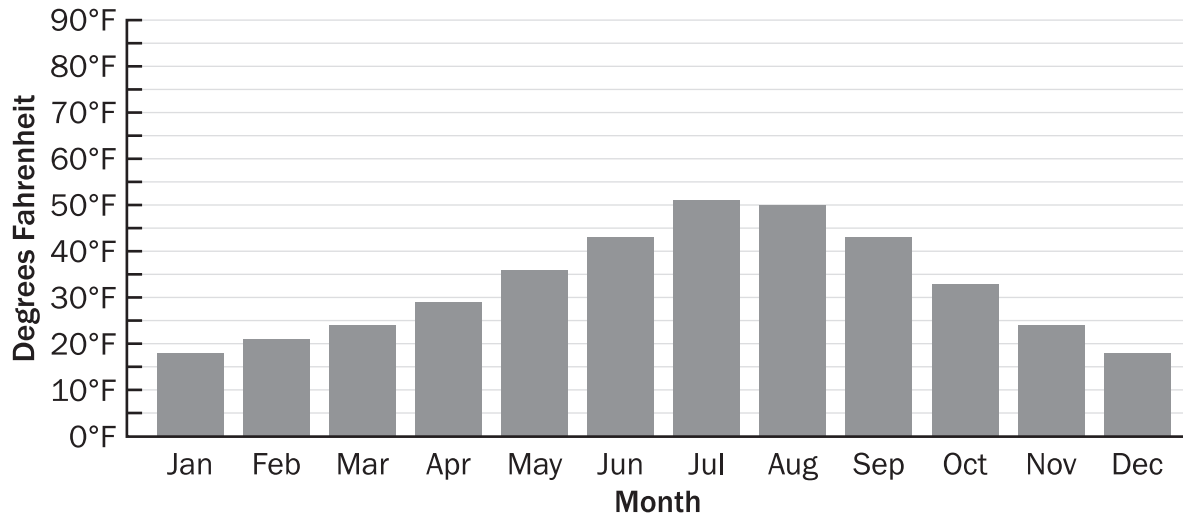


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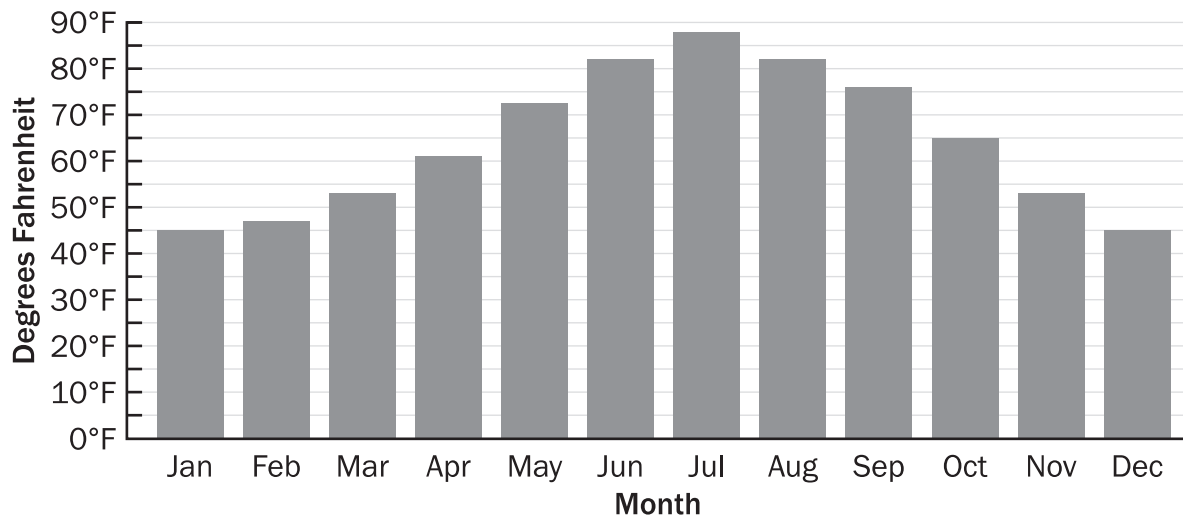


Climate Fact Sheet: Grand Canyon National Park, Arizona, United States

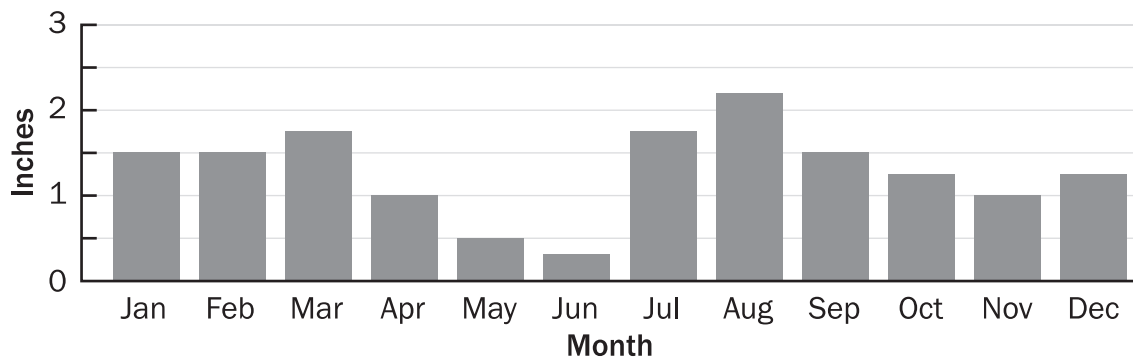
Low Temperature by Month



High Temperature by Month

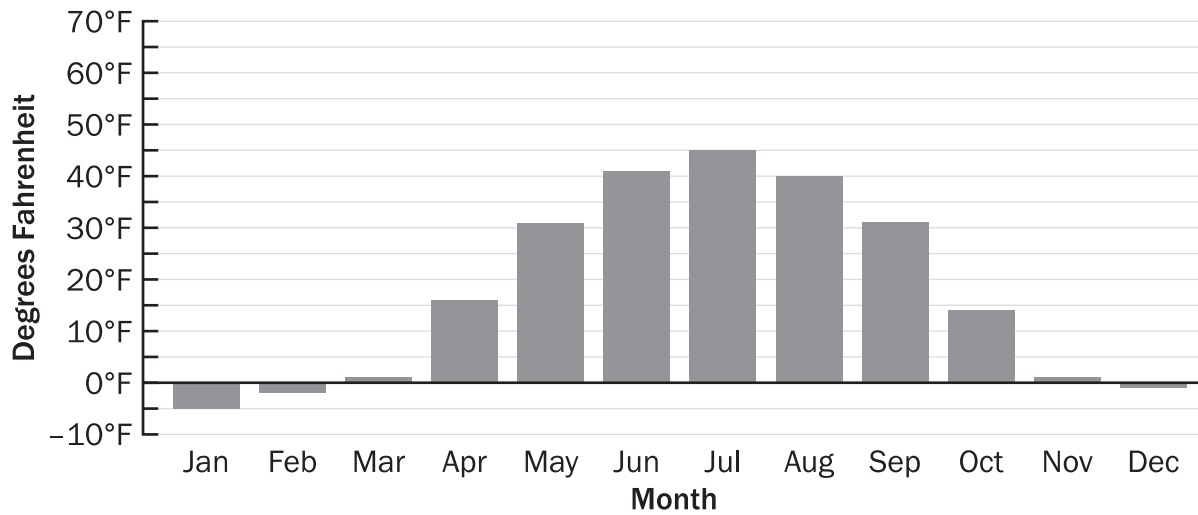


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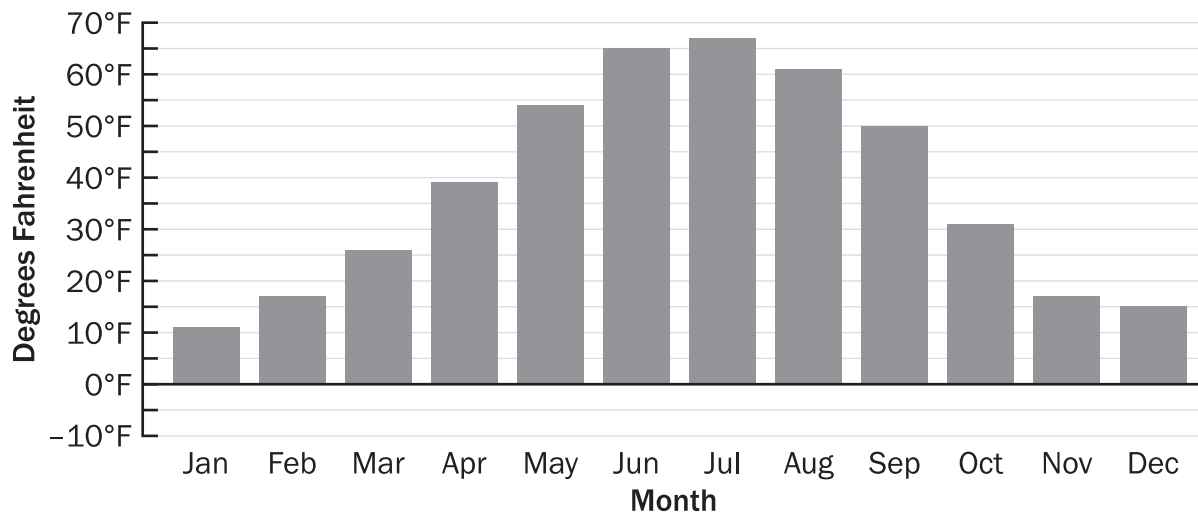


Climate Fact Sheet: Denali National Park and Preserve, Alaska, United States

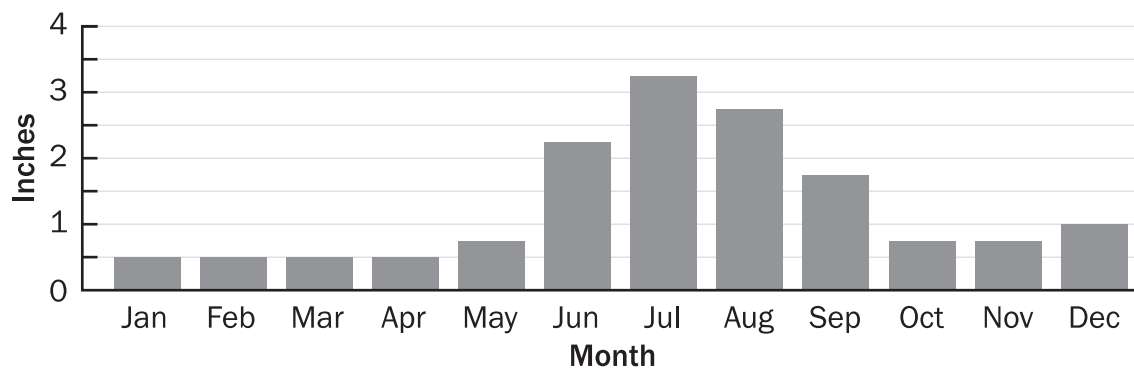
Low Temperature by Month



High Temperature by Month

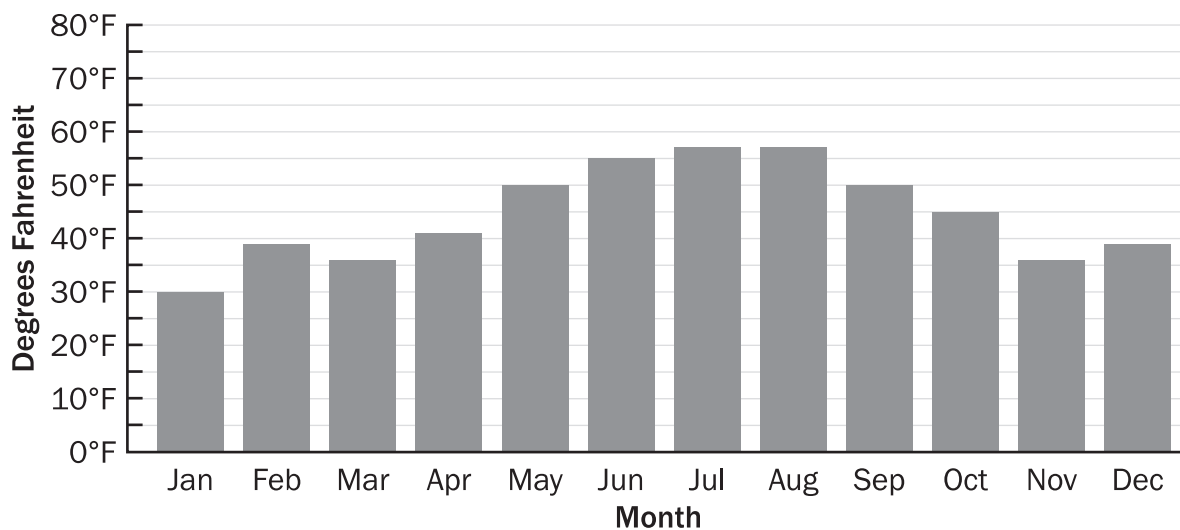


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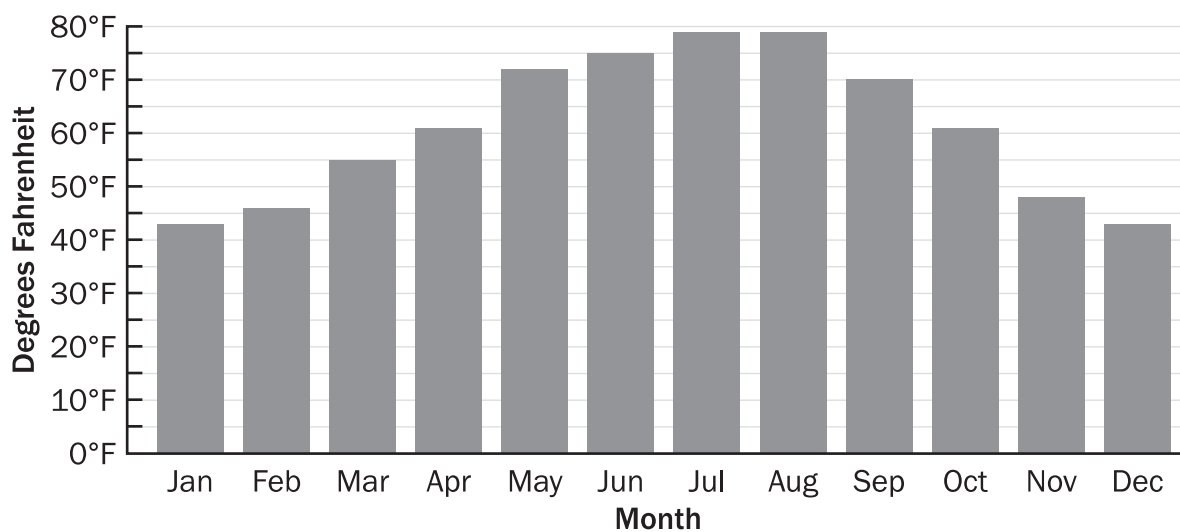


Climate Fact Sheet: Black Forest National Park, Germany

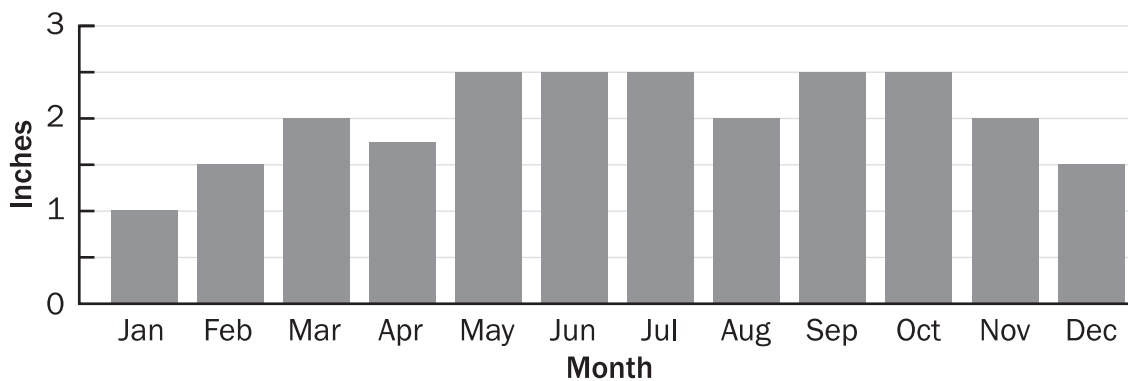
Low Temperature by Month



High Temperature by Month

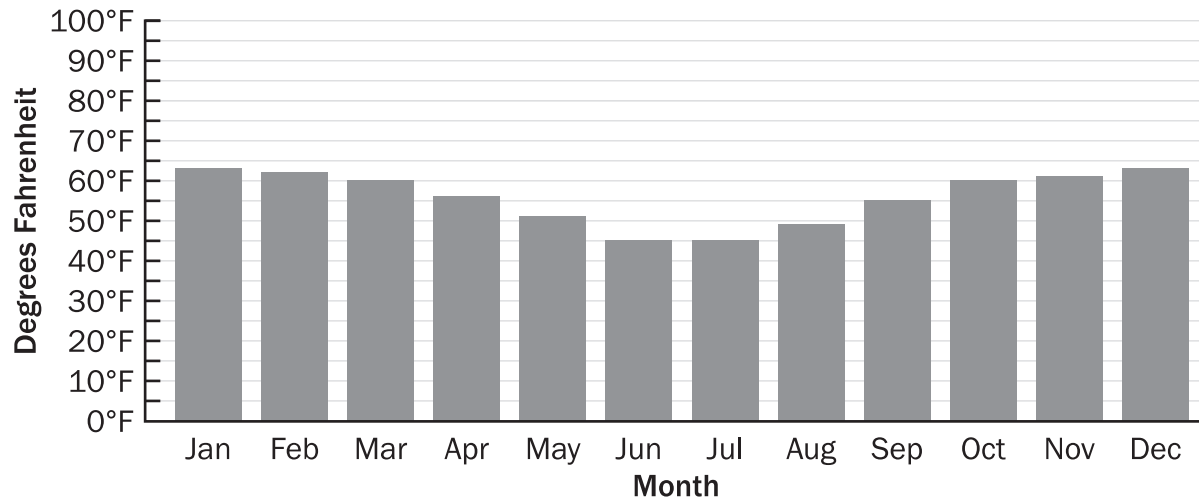


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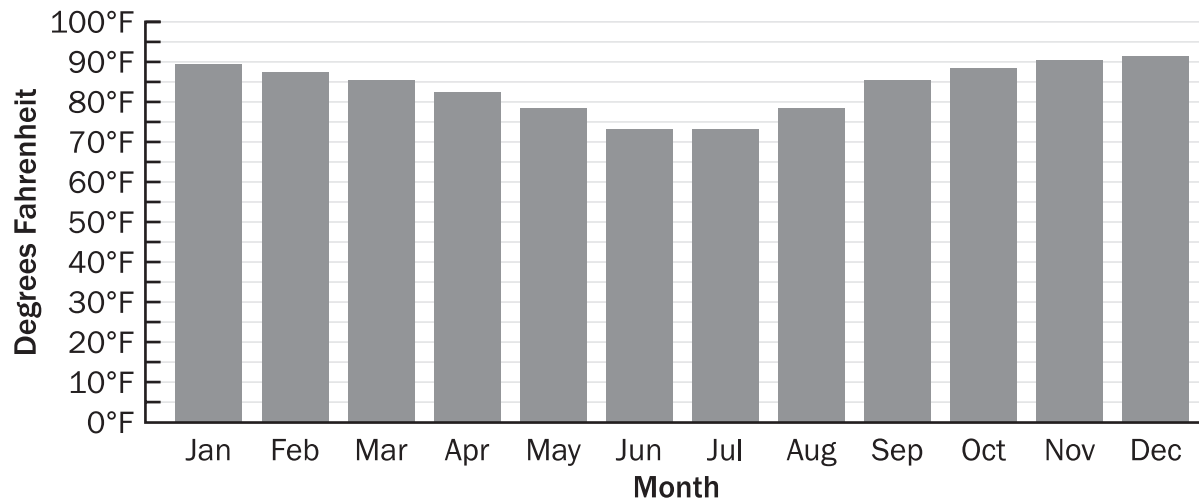


Climate Fact Sheet: Namib-Naukluft National Park, Namibia

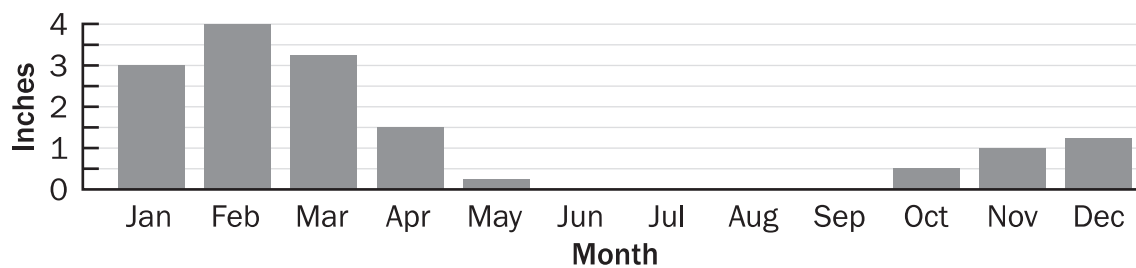
Low Temperature by Month



High Temperature by Month

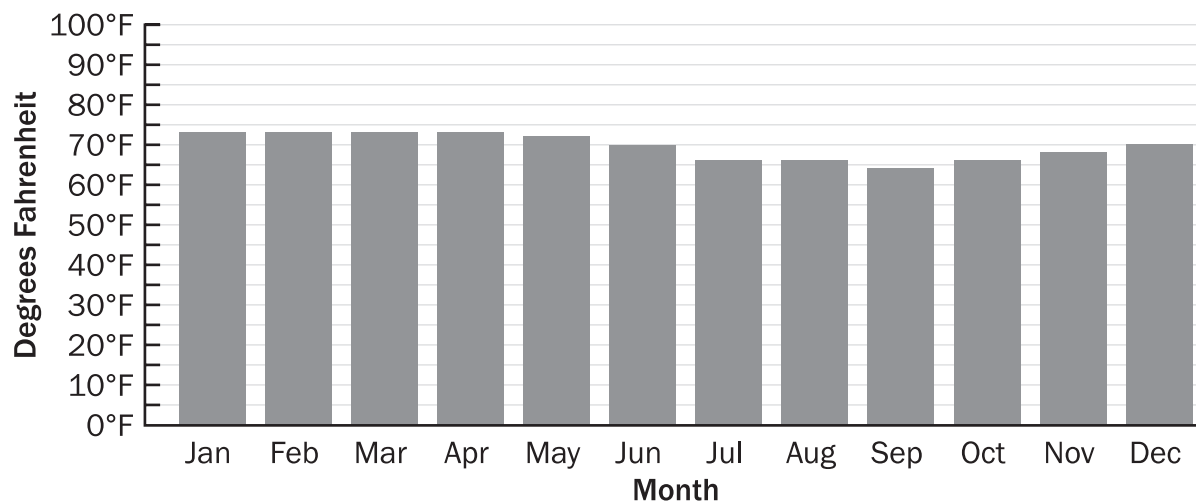


Precipitation

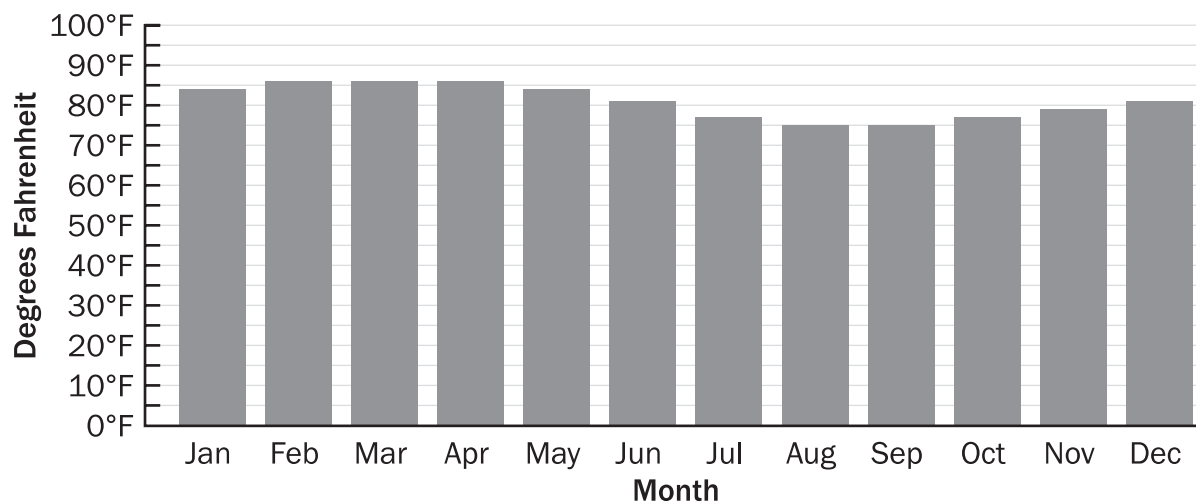


Climate Fact Sheet: Galápagos National Park, Ecuador

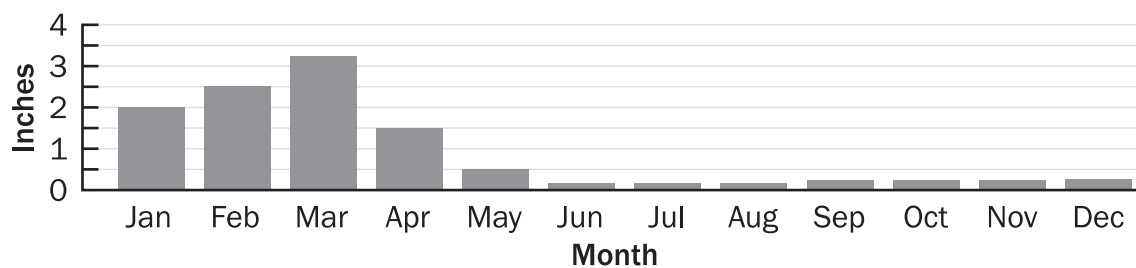
Low Temperature by Month



High Temperature by Month

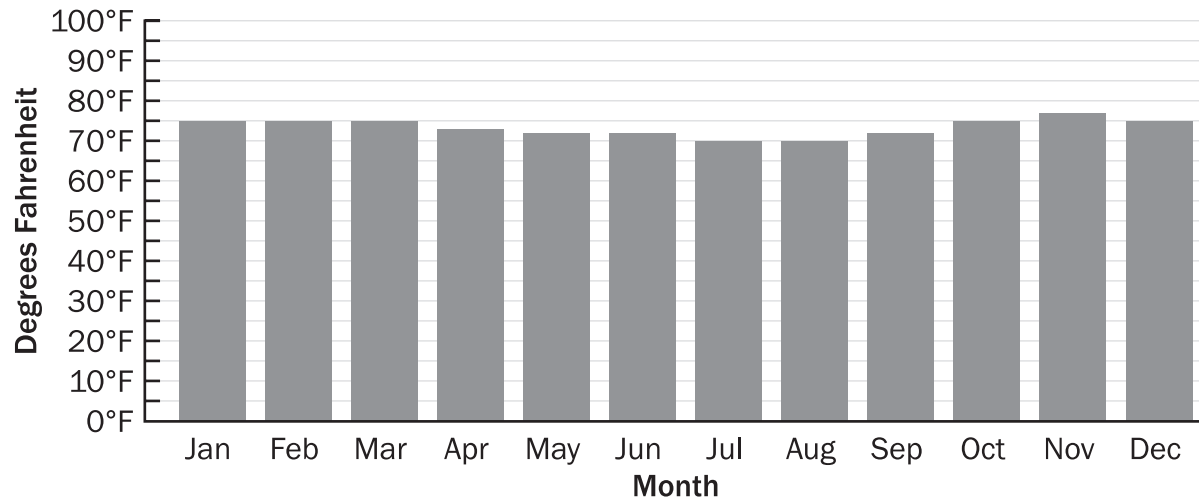


Precipitation

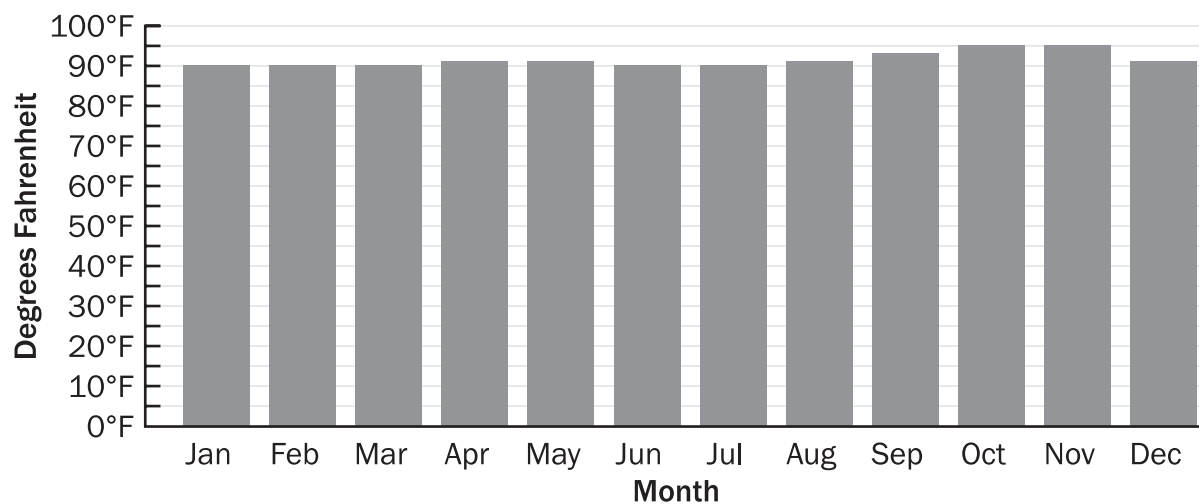


Climate Fact Sheet: Komodo National Park, Indonesia

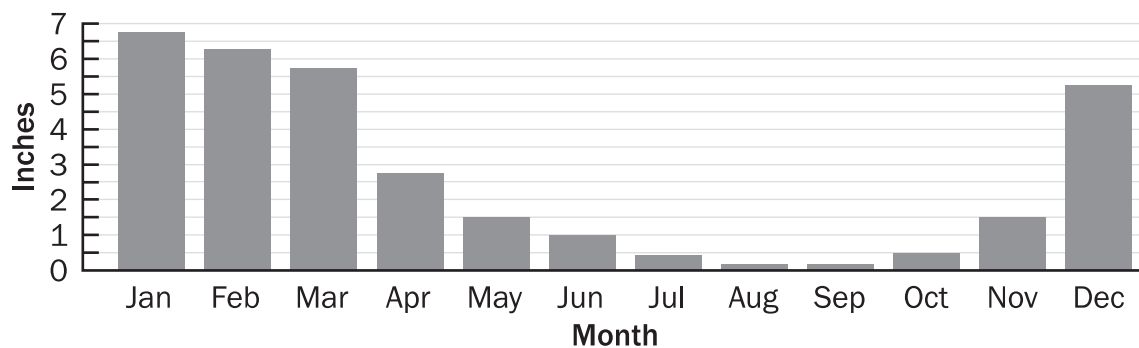
Low Temperature by Month



High Temperature by Month



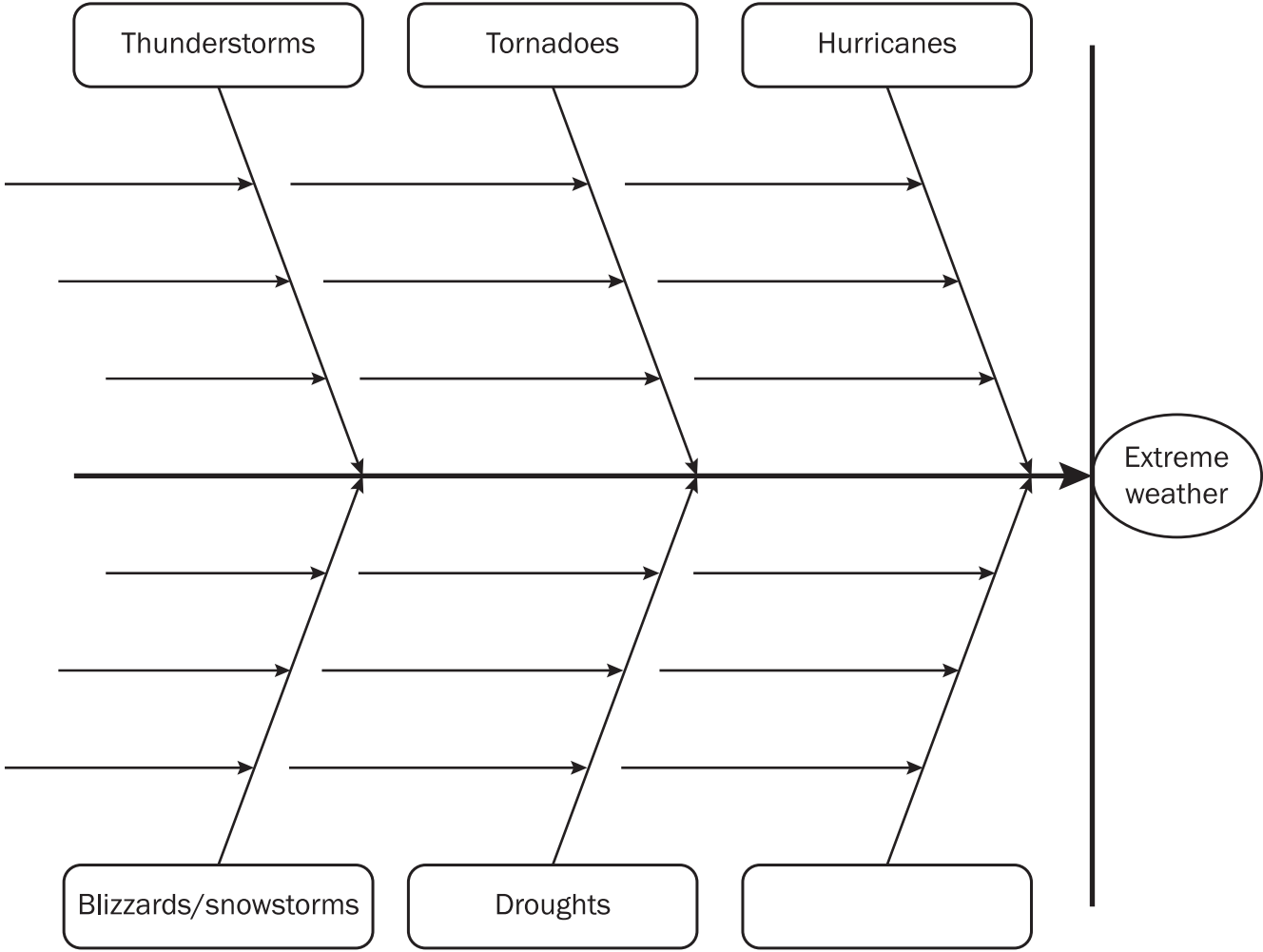
Precipitation



Extreme Weather: Cause and Effect

Extreme weather can cause serious effects for people, communities, and nature.

Complete the cause-and-effect chart below based on the types of extreme weather you read about.



Name _____

Date _____

Activity Page 12.1

Use with Lesson 12.

Lesson 12 Check

Answer the questions based on what you have read.

1. In a design solution, the need or want can also be called what?
 - a) criteria
 - b) constraint
 - c) levee
 - d) problem
2. In a design solution, a limitation is known as what?
 - a) criteria
 - b) constraint
 - c) solution
 - d) improvement
3. Which of the following is an example of a design that can help solve the problem of flooding?
Select all that apply.
 - a) snow fence
 - b) lightning rod
 - c) seawall
 - d) levee
4. True or False: Extreme weather can be stopped.
 - a) true
 - b) false
5. True or False: People can design solutions to minimize the damage done by extreme weather.
 - a) true
 - b) false

Name _____

Date _____

Activity Page 13.1 (Page 1 of 2)

Use with Lesson 13.

Evaluations and Claims

Answer the questions below to evaluate the design solution and form a claim.

1. What is the design solution you chose to focus on?

2. What weather-related hazard does this solution address?

3. What is the specific problem that the solution tries to solve?

4. How does the solution work? How does it address the problem?

5. What are the criteria of the solution?

6. What are the constraints of the solution?

7. Does the solution meet the criteria and constraints?

8. What are the benefits of using this solution?

9. What are the risks of using this solution?

10. Write a claim that explains whether or not you think this is a good solution to reduce the impact of the weather-related hazard.

Name _____

Date _____

Activity Page UR.1

Use with Unit Review.

Design a Weather-Related Technology

Work with a partner to design a piece of technology that would help in an extreme weather condition. Answer the questions below.

1. Describe your technology idea.

2. What kind of problem will it help solve?

3. How does your design work?

Draw a picture of your technology in the box below.



Name _____

Date _____

Activity Page UR.2 (Page 1 of 2)

Use with Unit Review.

Vocabulary Crossword Puzzle

Review the cards in your Core Vocabulary deck before you begin.

Use the words in the Word Bank to complete the crossword puzzle.

air mass	air pressure	altitude	atmosphere	climate	condensation
data	dew point	evaporation	front	humidity	ice age
precipitation	seasonal	wind			

*No spaces between words are included in the puzzle.

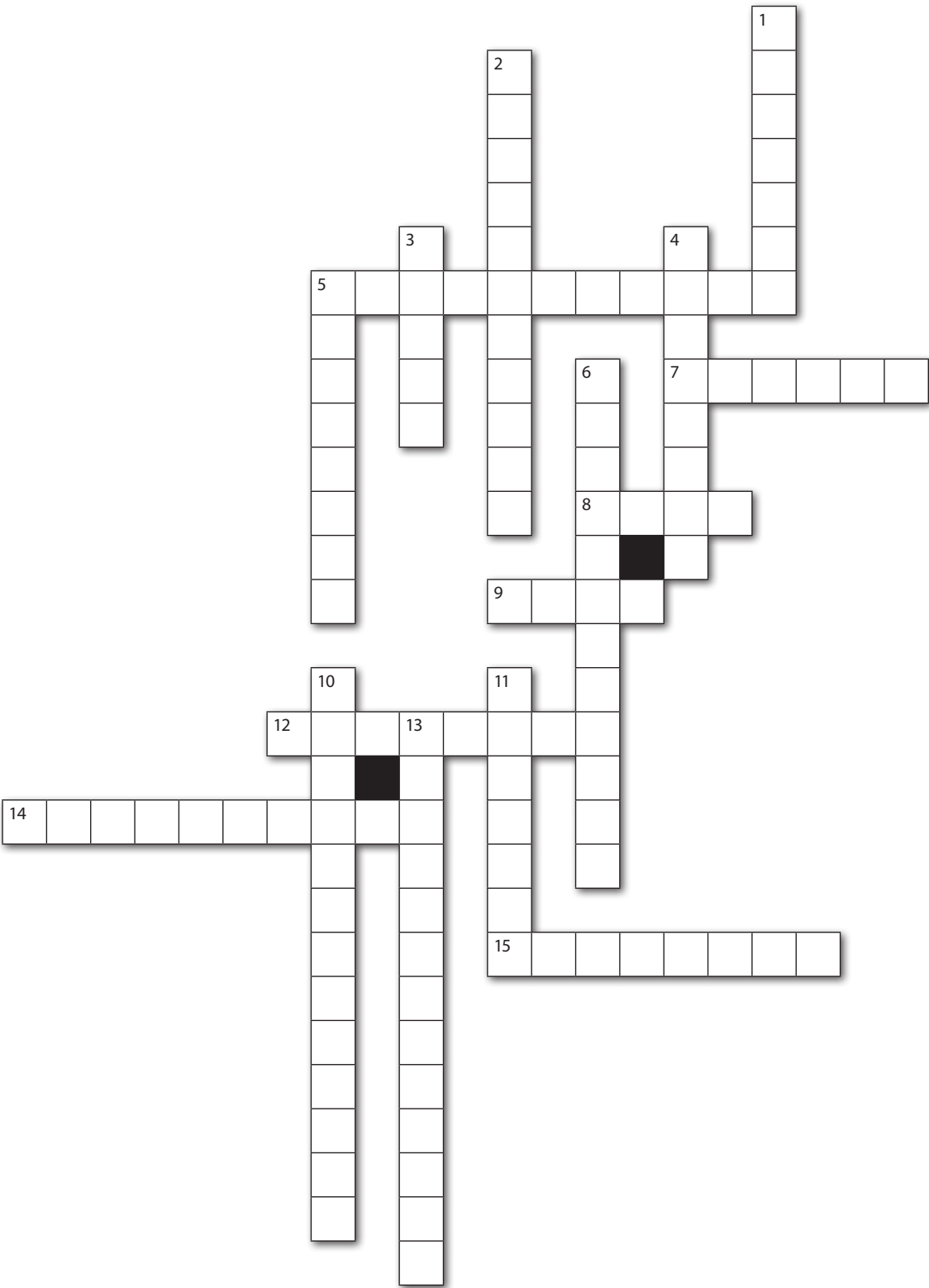
Across

5. the weight of the atmosphere pressing down onto Earth
7. a long period of time in which Earth was cold and frozen over
8. information based on facts and numbers
9. the movement of air
12. the temperature of the atmosphere at which droplets condense to form dew
14. the layer of air that surrounds Earth
15. relating to a certain time of the year

Down

1. the pattern of weather in a place over centuries
2. the process of changing liquid into gas
3. a boundary that separates two air masses
4. a term that describes how much water vapor is in the air
5. the height of a place in relation to sea level or ground level
6. the collection of water droplets when the air is humid (or the process of gas changing to liquid)
10. a person who studies the atmosphere and forecasts the weather
11. a large body (or dome) of air with similar temperature and water vapor content
13. rain, sleet, and snow are examples

Vocabulary Crossword Puzzle, *continued*



Name _____

Date _____

Activity Page UR.3

Use with Unit Review.

Vocabulary Review

Complete each sentence with the correct term or phrase. Not all terms will be used. Review the cards in your Core Vocabulary deck before you begin.

air mass	air pressure	altitude	atmosphere	climate	condensation
data	dew point	evaporation	front	humid	ice age
precipitation	seasonal	wind			

1. When you see water droplets form on blades of grass in the morning, you are looking at _____.
2. _____ is the movement of air and is necessary for days when you want to fly a kite.
3. Examples of _____ are rain, snow, and hail.
4. The _____ is the layer of gases that surrounds the Earth.
5. A scientist who studies weather patterns and makes weather predictions is called a _____.
6. Certain types of weather are _____, meaning they happen at certain times of the year.
7. The pattern of weather over a long time is known as _____.
8. A _____ is an invisible boundary that separates two air masses.
9. Scientists study _____ to learn more about weather patterns and make weather predictions.
10. When there is a lot of water vapor in the air, you can say that it is _____ outside.
11. Liquid water changes into water vapor through a process known as _____.
12. The weight of the atmosphere pressing down onto Earth is called _____.
13. A location on a mountain has a higher _____ than a location on a beach.

Name _____

Date _____

Unit Assessment: What Have I Learned About Weather and Climate?

Answer the items below to show what you have learned.

1. Write the letter *w* on the line if the phrase describes weather. Write the letter *a* on the line if the phrase describes the atmosphere.

_____ contains mostly nitrogen

_____ rain and strong winds

_____ ice and blowing snow

_____ contains much oxygen

_____ presses down on Earth

_____ drought and dry wind

2. Which of these things happens during the formation of clouds?

Air temperature cools.

Air temperature rises.

Water vapor condenses into droplets of liquid water.

Liquid water droplets evaporate into water vapor.

3. Which are the effects of moving air? Circle all the correct answers.

a) a cool breeze

b) a car moving

c) tree leaves rustling

d) water rippling in one direction

e) shadows changing position

f) rain blowing sideways

g) clouds moving across the sky

4. On the lines below, describe how wind happens.

5. A wind vane is used to determine wind direction at a single time. Name another thing that can help you identify patterns in wind direction over time. Then explain why this might be important.

6. What do meteorologists do?

7. Write the letter *s* if the phrase describes a seasonal weather pattern. Write the letter *c* if the phrase describes a climate. Then answer the question that follows.

_____ fall
_____ summer
_____ temperate
_____ winter
_____ tropical
_____ spring

How are seasonal weather patterns and climate different?

8. Think about what the weather has been like in your area over the past five days. Describe the weather on the line that follows each day. Then make a prediction about what the weather will be like tomorrow.

Day 1 _____

Day 2 _____

Day 3 _____

Day 4 _____

Today _____

Predict: Tomorrow _____

9. This is weather over a few days, but how would you figure out the climate in your area?

10. Draw a line to connect each extreme weather hazard to its effect.

Extreme Weather Hazard	Effect
hurricane	destructive funnel cloud
tornado	electrical discharge
lightning	heavy, blinding snow
flood	wind, rain, and lightning
thunderstorm	dry conditions
blizzard	strong winds, rain, and rising sea level
drought	rain and rising water

11. Describe one way to protect yourself from each weather hazard.

hurricane _____

tornado _____

lightning _____

flood _____

thunderstorm _____

blizzard _____

drought _____

12. How can engineers test design solutions to weather hazards? Why would they want to?

Activity Pages Answer Key: Weather and Climate

This answer key offers guidance to help you assess your students' learning progress. Here you will find descriptions of the expectations and correct answers for each Activity Page of this unit.

Patterns in the Atmosphere (AP 1.1) (page 106)

1. Nitrogen
2. Sample answer: As altitude increases, air pressure decreases. This is because gravity pulls objects, including particles in the gases that make up air, toward the center of Earth. The result is that those gases are thicker the closer you get to Earth's surface. The weight of all those particles press down on Earth and the things on it, creating pressure. The higher you go into the atmosphere, the fewer particles and gases there are, making the atmosphere thinner, with less pressure.
3. cloudy: low pressure; sunny: high pressure; clear: high pressure; rainy: low pressure; snowy: low pressure

How Water Moves (AP 2.1) (page 107)

Precipitation: Student diagrams should show that precipitation falls from the sky in the form of liquid water or solid snow or ice.

Evaporation: Student diagrams should show that heat energy from the sun evaporates water in a gas vapor, which then rises in the atmosphere.

Condensation: Student diagrams should show that water vapor forms clouds.

Elements of Weather Observations (AP 3.1) (page 108)

Teacher Demonstration:

- the candle
- air pressure

Station 1: a. liquid, gas; b. evaporation

Station 2: a. drops of water; b. gas, liquid; c. condensation

Station 3: a. the air moved away from where it was squeezed; b. high, low

Station 4: a. the newspaper did not get wet; b. the cup was already full of air, the air took up room in the cup so the water could not fit

Measuring Wind (AP 4.1) (pages 109–110)

2. Students should note the wind is blowing from the opposite direction as the streamer is being blown.

Table: Accept reasonable data from student data tables.

- the movement of air
- by the sun
- Student diagrams should show that air expands and rises as it is heated.

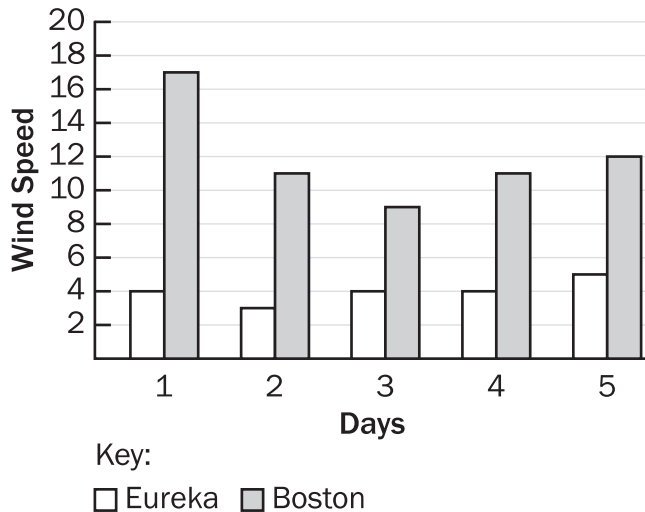
Air Masses and Wind (AP 5.1) (page 111)

- Accept all reasonable student predictions.
- The air above the water felt warm.
- Some of the water rises out of the pan as a vapor which is also warm.
- Student diagrams should show the air mass with the cover on as trapped under the cover and with the cover off as rising beyond the confines of the pan.

Looking for Patterns in Wind Data (AP 6.1) (page 112)

1. Answers will vary depending on setting. Verify that students have properly recorded available data.
2. Student response should accurately reflect the change in wind speeds.
3. Accept reasonable patterns students note from their data from Activity Page 4.1.

Comparing Wind Speed (AP 6.2) (page 113)



Finding Temperature Change Patterns (AP 7.1) (pages 114–115)

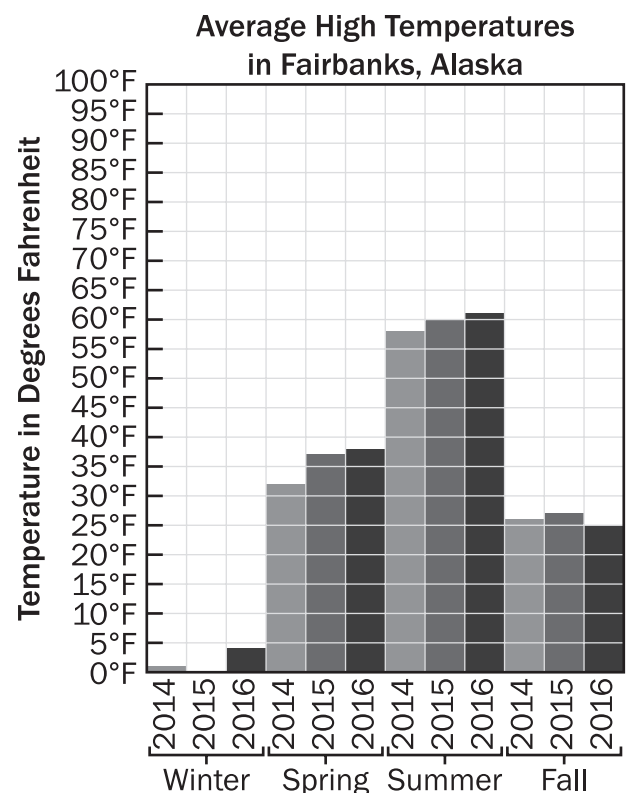
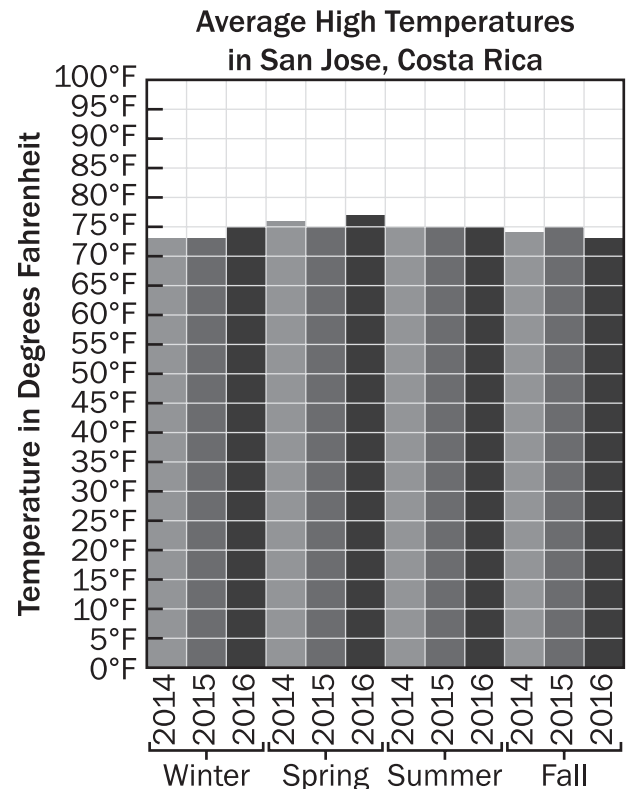
1. fall
2. generally, from 1 AM to 6 or 7 AM
3. This hour had the highest temperature all three days.
4. The temperature is coolest in the overnight hours, warms in the late morning, reaches the highest temperature in the afternoon, and cools in the late evening.
5. It will follow a similar pattern of cooler overnight, warming during the day, and cooling in the evening.

Meteorologist Job Description (AP 7.2) (page 116)

- Evaluate student paragraphs based on their satisfaction of the bulleted criteria and your school's expected writing standards for the grade level. Provide corrective and constructive feedback.
- Sample answer: Being a meteorologist is an important job. That is because everyone needs to know the weather in order to plan their day. As a meteorologist, you will have to work outdoors with weather tools. You may even launch weather balloons! You also have to work indoors, using computers to make predictions. A meteorologist should like math to use all the numbers in the data. You also should like social studies to use the maps. So, if you like doing a job that helps people, doing outdoor and indoor work, and working with numbers and maps, you should become a meteorologist.

Using Temperature Patterns to Describe Climate (AP 8.1) (pages 117–120)

STEP 2:



AP 8.1, continued

STEP 3:

1. It hardly changes at all.
2. winter
3. summer
4. anytime
5. Sample answer: I would choose to go in the spring because I like temperatures that are cold but not too cold.
6. Sample answer: San Jose has a warm climate all year round and Fairbanks has a climate that is warm in the summer, cold in spring and fall, and very cold in winter.

Deciding When to Hold a Carnival (AP 9.1) (pages 121–122)

STEP 1: Tables should be filled out with the weather station name, seasons, and accurate local data.

- Answer should reflect student’s understanding of what temperatures would be comfortable for a day of outdoor games and that a day without rain or snow would be preferred.

STEP 2: Tables should be filled out with the weather station name, months, and accurate local data.

- Accept reasonable student predictions.

Draw a Graph to Show Your Reasoning (AP 9.2) (page 123)

Students should label in the bottom row the months of August through June. The column/bar shaded for each month should reflect local data.

Write a Letter to Your Principal (AP 9.3) (page 124)

Evaluate student letters based on your school’s expected writing standards for the grade level. Look for an opinion and reasons for a prediction and reference to the associated graph. Provide corrective and constructive feedback.

Help Another School Choose When to Hold a Carnival (AP 9.4) (page 125)

- That may not be a good idea because they likely have a different climate.

AP 9.4, continued

- Tables should show heavier rain in spring and fall with warmer temperatures in spring and cooler throughout the rest of the year.
- Spring
- April and May
- Tables should be filled out with the weather station name, months, and accurate local data.

Write a Letter to Your Pen Pal (AP 9.5) (page 126)

Evaluate student letters based on your school’s expected writing standards for the grade level. Look for an opinion and plausible reasons for the recommendation. Provide corrective and constructive feedback.

Self-Evaluation Checklist (AP 9.6) (page 127)

Accept reasonable student self-evaluations.

Self-Evaluation Checklist (AP 10.4) (page 131)

Accept reasonable student self-evaluations.

Extreme Weather: Cause and Effect (AP 11.1) (page 142)

Student cause-and-effect charts should be based on information from the Student Reader.

Lesson 12 Check (AP 12.1) (page 143)

1. d
2. b
3. c, d
4. false
5. true

Evaluations and Claims (AP 13.1) (pages 144–145)

1. Accept plausible student design solutions.
2. Students should identify the weather-related hazard.
3. Students should identify a specific problem.
4. Students should have a rough explanation of how their design solution will work, including showing how it addresses the problem.

AP 13.1, continued

5. The criteria should be the standards which will be used to evaluate the solution.
6. The constraints should be the limits or restrictions of the design solution.
7. Student solutions should meet the criteria and constraints.
8. Students should identify at least two benefits of their solution.
9. Students should identify at least two risks of their solution.
10. Student claims should include their reasoning for why their solution works, including how it reduces the impact of the weather-related hazard.

Design a Weather-Related Technology (AP UR.1)
(page 146)

1. Accept plausible student ideas.
2. Students should have a clearly defined weather-based problem their technology idea will be applied to.
3. Students should have a short explanation of how the device works.
- Student pictures should match to the student ideas. Accept any changes to the design as they develop from an idea to a picture.

Vocabulary Crossword Puzzle (AP UR.2)
(pages 147–148)

ACROSS:

5. air pressure
7. ice age
8. data
9. wind
12. dew point
14. atmosphere
15. seasonal

DOWN:

1. climate
2. evaporation
3. front
4. humidity
5. altitude
6. condensation
10. meteorologist
11. air mass
13. precipitation

Vocabulary Review (AP UR.3)
(page 149)

1. condensation
2. wind
3. precipitation
4. atmosphere
5. meteorologist
6. seasonal
7. climate
8. front
9. data
10. humid
11. evaporation
12. air pressure
13. altitude

Unit Assessment: Teacher Evaluation Guide

The Unit Assessment on pages 150–153 is designed as a fifty-point test. Through this assessment, students demonstrate their overall learning of the unit’s Learning Objectives. CKSci Unit Assessments typically range from ten to fifteen questions in the upper elementary grades, which can be answered in a longer, single classroom session or administered in two sittings.

Items with simpler answers that assess knowledge but not the deeper understandings of the content, such as multiple choice or short answers, are weighted differently and are worth fewer points. Assessment items that require more complex thinking and a deeper understanding of the content, such as writing explanations or identifying multiple relationships, are worth more points. Items that require synthesis of content and other student knowledge are weighted with more points as well. Some test items encourage students to use their Core Vocabulary decks as a reference source for terminology and concepts related to the test item.

Expected Answers and Model Responses

1. a, w, w, a, a, w (5 points)
2. Air temperature cools. Water vapor condenses into droplets of liquid water. (2 points)
3. a, c, d, f, g (5 points)
4. Sample answer: When atmospheric pressure changes, air begins to move. When there is a difference in atmospheric pressure, air moves to the area of less pressure. The bigger the difference between the two areas, the faster the air moves. The moving air is called wind. (4 points)
5. Sample answer: Data maps or graphs can show wind patterns in specific places over time. By studying wind patterns, we can be prepared when winds change speed or direction or become dangerous. (3 points)
6. Sample answer: They study weather patterns and data. They then make predictions about future weather. (2 points)
7. s, s, c, s, c, s; Sample answer: Seasonal weather patterns are weather patterns that occur at specific times of the year. Climate is the weather patterns in an area over a long period of time. (5 points)

8.

Above Average	Student response details the weather every day for five days and offers a logical prediction, based on the weather patterns over those five days, of what the weather will be like on the next day.
Average	Student response details the weather for most of the five days and offers a logical prediction, based on the weather patterns that were detailed, of what the weather will be like on the next day.
Adequate	Student response details the weather for only one or two days. He or she offers a prediction, but it seems inconsistent with the details offered for the previous day or two.
Inadequate	Student does not detail the weather patterns for any of the days and offers no prediction for what the weather will be like on the next day.

(5 points)

9. Sample answer: I could make observations every day about the weather in my area. I could do this for many years. Then I could look at the patterns to see what the climate is like here.

(3 points)

10. Students should draw lines from *hurricane* to *strong winds, rain, and rising sea level*; from *tornado* to *destructive funnel cloud*; from *lightning* to *electrical discharge*; from *flood* to *rain and rising water*; from *thunderstorm* to *wind, rain, and lightning*; from *blizzard* to *heavy, blinding snow*; from *drought* to *dry conditions*.

(7 points)

11. Sample answers:

hurricane: move to higher ground or into a structure built to withstand hurricane winds; tornado:

move into a tornado shelter or take shelter in a bathtub or central room inside your home;

lightning: stay indoors, away from windows and electrical devices, and avoid metal; flood: move

to higher ground, stay indoors, and avoid high waters; thunderstorm: remain indoors; blizzard:

remain indoors with plenty of food, water, and blankets; drought: stay indoors, remain hydrated,

and conserve water

(6 points)

12. Sample answer: Engineers can test design solutions by building models and then applying forces to them similar to the weather hazards. They do this to build solutions that can keep people safe in the real world.

(3 points)

Glossary

Green words and phrases are Core Vocabulary for the unit, and Student Reader page numbers are listed in parentheses. **Bold-faced words and phrases** are additional vocabulary terms related to the unit that you should model for students during instruction and that are often used within the Student Reader, and these latter terms do not have specific page numbers listed. Vocabulary words are not intended for use in isolated drill or memorization.

A

air mass, n. a large body of air in the atmosphere (10)

air pressure, n. the weight of air as it presses on objects below or within it (3)

atmosphere, n. the layer of air that surrounds Earth (1)

C

claim, n. an assertion (or v. to assert)

climate, n. the weather patterns in a place over a long period of time (22)

climate zone, n. a large region of Earth's surface with an ongoing pattern of similar climate conditions

condensation, n. the process of changing from gas to liquid

condense, v. to change from gas to liquid (8)

constraint, n. the limitation of a design (33)

criteria, n. the requirements of a design for it to be a success (33)

D

data, n. information that is observed or measured and recorded (13)

drought, n. a long period of weather with less precipitation than normal (30)

E

engineering design process, n. the steps that engineers take to solve a problem (31)

evaluate, v. to examine the details of something and determine the value or effectiveness of it

evaluation, n. the process of evaluating or the outcome of the process

evaporate, v. to change from liquid to gas (7)

evaporation, n. the process of changing from liquid to gas

evidence, n. a detail that provides a supporting clue or furnishes proof of a claim

F

front, n. the place where two air masses meet (18)

G

graph, n. a diagram that represents variations in data

H

hazard, n. a dangerous condition that can cause damage (25)

humidity, n. a measure of the amount of water vapor in the air (7)

I

ice age, n. a prolonged period during which large regions of Earth's surface were covered in ice and/or snow

M

maximum, n. the highest value in a data set

meteorologist, n. a scientist who studies weather conditions and patterns (13)

minimum, n. the lowest value in a data set

P

pattern, n. a repeating sample of data, events, or observable characteristics

precipitation, n. water that falls from the sky in the form of rain, snow, sleet, or hail (6)

prediction, n. a declaration of an expected outcome

prevailing winds, n. regular patterns of winds that blow from one direction (12)

problem, n. a condition that falls short of satisfying a want or a need

S

seasonal, adj. occurring in a pattern related to the seasons

solution, n. a process, action, or device that solves or remedies a problem

T

temperature, n. the measure of thermal energy in a quantity of matter

V

vapor, n. gas

W

water vapor, n. the gas form of water (6)

weather, n. what the air outside is like at any given time and place (1)

wind, n. the movement of air (9)

wind direction, n. the direction from which air moves when wind blows (12)

wind speed, n. a measure of how fast wind blows (11)

wind vane, n. an instrument that determines wind direction

Classroom Safety for Activities and Demonstrations

In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- Report and treat any injuries immediately.
- Check equipment prior to usage, and make sure everything is clean and ready for use.
- Clean up spills or broken equipment immediately using the appropriate tools.
- Monitor student behavior to ensure they are following proper classroom and activity procedures.
- Do not touch your eyes, ears, face, or mouth while engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances, such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page, for students to read and agree to prior to the start of the first unit, so students are aware of the expectations when engaged in science activities.

Online Resources



For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

When doing science activities, I will

- Report spills, breakages, or injuries to the teacher right away.
- Listen to the teacher for special instructions and safety directions. If I have questions, I will ask the teacher.
- Avoid eating or drinking anything during the activity unless told to by my teacher.
- Review the steps of the activity before I begin. If I have questions I will ask the teacher.
- Wear safety goggles when working with liquids or things that can fly into my eyes.
- Be careful around electric appliances, and unplug them, just by pulling on the plug, when a teacher is supervising.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ / ____ / ____ /

Student signature and date

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your daughter or son and sign this contract. If you have any questions, please feel free to contact me.

_____ / ____ / ____ /

Parent or guardian signature and date

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles, but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned, and will last for more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

Consider some of the following as methods for acquiring the science materials:

- **School Supply Drive**—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- **Open Houses**—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- **Parent Teacher Organizations**—Reach out to the local PTO for assistance with acquiring materials.
- **Science Fair Drive**—Consider adding a table to your science fair as part of a science materials drive for future units.
- **College or University Service Project**—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- **Local Businesses**—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or for examples of how their sponsorship will benefit students.

Remember: If your school is public it will be tax exempt, so make sure to have a Tax Identification Number (TIN) when purchasing materials. If your school is private, you may need proof of 501(c)(3) status to gain tax exemption. Check with your school for any required documentation.

Advance Preparation for Activities and Demonstrations

Being properly prepared for classroom activities and demonstrations is the first step to having a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class:

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher's Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

While engaged in the activity or demonstration:

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration:

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and x-rays are just some of the discoveries made when people were practicing science and something did NOT go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity doesn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence or they missed a step when performing the activity. Review and provide feedback on students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson's Big Question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly, a measurement was made in error, such as a wrong unit of measure or quantity, or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but guiding them through the problem and figuring out *why* something happened will help them to develop a better sense of how to do science.



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