



Weather Patterns

Teacher Guide



cloudy and warm



seasons



severe weather

Weather Patterns

Teacher Guide



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Weather Patterns

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Weather Patterns Teacher Guide

Core Knowledge Science™ K

Introduction

ABOUT THIS UNIT

The Big Idea

This unit focuses on the scientific concept that weather conditions vary.

Students' earliest understanding of weather might be from being told, "It is nice enough to go outside," or, "It's too rainy today to play outside." Students will start by learning the role of the sun, sunlight, and shade on Earth's surface and different materials. Students will act as engineers to define a problem and brainstorm solutions related to needing more shade. Students will observe temperatures and other weather conditions with the goal of learning to establish patterns based on the data they observe. Students will build on establishing patterns to learn how to interpret seasonal patterns and how those patterns are used to report the weather.

In this unit, students learn about daily, weekly, and seasonal weather and how weather occurs in patterns that can be used to plan activities. Students learn about severe weather conditions and how to collect information related to severe weather. Students will investigate what types of severe weather may occur in their area and how people communicate warnings related to severe weather. Students then develop plans to prepare for severe weather emergencies.

Students will further investigate weather and how different regions experience weather in Grade 3 Unit 4 *Weather and Climate*. Students will further investigate weather interactions with Earth in Grade 5 Unit 3 *Modeling Earth's Systems*.

Students explore concepts that include the following:

- Sunlight from the sun warms Earth's surface. Different earth materials warm up differently as a result of sunlight. Areas covered by shade created by shadows are cooler than areas in direct sunlight.
- The effects of sunlight on materials can be reduced through the use of shade. Engineers build and test models to find out if their designs will work in the real world. Data can be collected and analyzed as part of the testing process. Other engineers can help identify strengths and weaknesses of a design.
- Weather observations recorded over time can be analyzed and used to notice patterns in the weather. Weather data can be observed, collected, and analyzed over months and seasons for use in predicting monthly and seasonal patterns. Daily, weekly, monthly, and seasonal weather patterns can be used to forecast weather.

- Weather can be severe. People can respond to severe weather warnings and plan ahead in the event of severe weather.

Note to Teachers and Curriculum Planners

This unit introduces Kindergarten students to the sun and sunlight as a source of heat on Earth as well as effects caused by this heating, such as weather and weather patterns. Students will learn about effects of sunlight on earth materials, engage in the design process to develop ways to reduce the heating effect of sunlight, learn to identify weather and weather patterns, and predict types of severe weather. The following are preliminary considerations for planning and instruction relative to this unit:

- While the unit engages Kindergarten students in investigating sunlight, weather, weather patterns, and design solutions, the only quantitative data collected are related to whole numbers. Students will be exposed to temperature readings but are only expected to develop an understanding of relative temperatures, such as warmer and cooler.

Students will investigate weather and climate in greater depth in Grade 3.

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, students benefit not just from reading about concepts and ideas, but from 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 *Core Knowledge 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 learn more about the changes and to access resources for this unit, please use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit 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

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

This unit, *Weather Patterns*, has been informed by the following Grade K Performance Expectations for the NGSS topic *Earth and Human Activity*. Students who demonstrate understanding can do the following:

K-PS3-1 Make observations to determine the effect of sunlight on Earth's surface.

K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.

K-ESS2-1 Use and share observations of local weather conditions to describe patterns over time.

K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

Online Resources



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

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.

A Special Note to Kindergarten Teachers Before Starting This Unit

Why Study Science in Kindergarten?

For many Kindergarten teachers, the suggestion that science should be a part of the Kindergarten curriculum may seem questionable. For many teachers, the instructional time is devoted to teaching reading and math fundamentals to students.

The study of science in Kindergarten, however, is consistent with the Core Knowledge approach to learning. Learning science provides students with the experiences necessary to accelerate an almost innate sense of excitement and wonder about the natural world around them. Now is the time they can begin to develop a more precise language, one that allows them to describe the living and non-living environment they encounter every day.

Albert Einstein said, “Curiosity has its own reason for existing.” It is the nature of children to be curious about the world around them, and Kindergarten is the right time to witness, promote, and accelerate that curiosity in a systematic way.

Teaching science to young children affords them the opportunity to take a deeper look at the world around them. Most young students’ scientific knowledge is derived from their personal experiences, that is, from interactions with the air, water, land, and other matter around them. All these lead to a student’s wonder about life, Earth, space, and physical science.

Before Starting *Weather Patterns*

Students come to Kindergarten classrooms across the country with a wide range of prior experiences. Some students have attended preschool, while others have not. Some have grown up in cities away from nature. Others have grown up in the country, intimately involved in nature.

Some have had teachers and/or family members who have been reading aloud and sharing the wonderful world of animals and plants with them for several years, while others have not. Some have traveled to other cities, states, and countries, while others may know only their own family and neighborhood.

Draw out students. Give them the opportunity to express what they know about the natural world, about rocks, the stars, motion, giraffes, or matter. You can assess the prior knowledge students have about science and since science deals with everything around a child the wealth of their background in science should not be underestimated.

Weather Patterns is one of four units in the Kindergarten CKSci series that we encourage teachers to use over the course of the school year. Kindergarten teachers who begin the year with a unit will have time to complete all four of the Kindergarten CKSci units in an academic year. Additional guidance regarding pacing is provided in each CKSci Teacher Guide.

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 segment throughout the unit. NGSS References, including Performance Expectations, Disciplinary Core Ideas, and Crosscutting Concepts, are included at the start of each lesson segment as appropriate.

Lesson 1. Sunlight

SEGMENTS 1–3

- Identify the sun as an object visible in the daytime sky that gives off light.
- Investigate the effect of sunlight on earth materials.
- Describe patterns of relative warmth of an earth material in sunlight versus shade.
- Explain that sunlight warms Earth's surface.
- Infer that objects that provide shade reduce the sun's warming effect on materials.

Lesson 2. Designing for Sunlight

SEGMENTS 1–4

- Define a problem and explain what a solution should be able to do (related to reducing warming caused by the sun).
- Ask questions based on prior observations to gather information about the problem and the desired outcome.
- Generate solution ideas that use only the provided materials and tools.
- Collaborate to build a structure to reduce warming over a certain area by making shade.
- Explain how the materials and their shapes affect their functions.
- Test designs.
- Use a chart to communicate results of tests and compare performance results using cause and effect language.
- Communicate about solutions by comparing their strengths and weaknesses and decide which one solved the problem.

Lesson 3. Patterns of Weather

SEGMENTS 1–4

- Review that weather is what the air is like outside at any one time and place.
- Compare the air temperature at different times of day.
- Organize weather observations.
- Identify patterns in weather data.
- Describe the work of weather scientists.
- Describe and share weather patterns that occur across days, months, and seasons.

- Describe types of severe weather and the damage they can cause.
- Ask questions about local severe weather threats and warnings.
- Obtain information about local severe weather patterns.
- Describe advantages of the ability to predict severe weather.
- Identify the technologies used to communicate severe weather warnings.
- Explain how people can use severe weather warnings to stay safe.

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, as well as connections to relevant math and reading language arts standards.

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

USING THE STUDENT BOOK

Student Book



The *Weather Patterns* Student Book includes seven chapters, intended to be read aloud by the teacher as the students look at images on each page.

As you will note when you examine the Student Book, minimal text is included on each page. Instead, colorful photos and engaging illustrations dominate the Student Book pages. The design of the Student Book in this way is intentional because students in Kindergarten through Grade 2 are just learning to read. At these grade levels, students are learning how to decode written words, so the complexity and amount of text that these young students can actually read is quite limited.

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

The intent of the Grades K–2 CKSci lessons is to build students' understanding and knowledge of science concepts, as well as of associated practices and skills. It is for this very reason that in Grades K–2 CKSci, the core content of each lesson is reinforced to students using a teacher Read Aloud, accompanied by example

images and diagrams. Cognitive science research has clearly documented the fact that students' listening comprehension far surpasses their reading comprehension well into the late elementary and early middle school grades. Said another way, students are able to understand and grasp far more complex ideas and text that they hear read aloud than they would ever be able to read or comprehend when they read to themselves. For a more thorough discussion of listening and reading comprehension and the underlying cognitive science research, teachers may want to refer to Appendix A of the Common Core State Standards for English Language Arts, noting in particular the Speaking and Listening section of the appendix.

Use this link to download the CKSci Online Resources for this unit, where the specific link to this appendix can be found:

www.coreknowledge.org/cksci-online-resources

USING THE TEACHER GUIDE

Pacing

To meet NGSS Performance Expectations we encourage teachers to complete all Kindergarten CKSci units during the school year. To be sure all NGSS standards and dimensions are addressed, each Core Lesson segment should be completed. Each lesson segment requires thirty to forty-five minutes of instruction time. The time it takes to complete a full lesson depends on class size and individual circumstances.

Within the Teacher Guide, each Core Lesson is composed of multiple numbered segments, generally four to six. Each segment concludes with a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this unit Introduction, you will find a blank Pacing Guide on pages 17–18, which you may use to plan how you might pace the lessons. We strongly recommend that you preview the unit in full before beginning and create your pacing guide before teaching the first lesson segment. As a general rule, we recommend that you spend a minimum of twenty-four days and a maximum of thirty-six days teaching the *Weather Patterns* unit so that you have time to teach the other units in the Kindergarten CKSci series.

The Core Lessons

- Lesson time: Most Core Lesson segments constitute one classroom session of thirty to forty-five minutes. However, some segments cover two or three days of instruction, and some single-day activities and performance tasks will require setting aside a longer block of time.
- Lesson order: The lesson segments are coherently sequenced to build from one to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

Unit Opener: Introduction to the Unit Phenomenon and Problem	Unit Opener: Weather Patterns (two class sessions)	Big Question: How do we know when to take an umbrella with us? Focusing Question: What can we notice about what it's like outside?
Lesson 1: Sunlight (K-PS3-1)	1.1 The Sun and Sunlight	Lesson 1 Guiding Question: How does sunlight affect Earth's surface? 1.1 What does sunlight do?
	1.2 Investigating Sunlight and Shade on Earth Materials	1.2 How do sunlight and shade affect the warmth of sand, soil, and water?
	1.3 Sunlight on Earth's Surface	1.3 What does an umbrella do to light?
Lesson 2: Designing for Sunlight (K-PS3-2)	2.1 Defining the Problem and Brainstorming Solutions	Lesson 2 Guiding Question: How can we reduce the warming effect of sunlight on an area? 2.1 How can we use materials to reduce warming from sunlight?
	2.2 Building a Model Structure	2.2 What do people design to reduce warming from sunlight?
	2.3 Testing Student Models	2.3 How well does our plan to reduce warming from sunlight work?
	2.4 Comparing Solutions	2.4 How can we reduce the warming effect of sunlight on an area?
Lesson 3: Patterns of Weather (K-ESS2-1)	3.1 Observing Temperature Patterns in a Day (three class sessions)	Lesson 3 Guiding Question: What patterns can we find by collecting observations about the weather? 3.1 What can we notice about air temperature at different times of day?
	3.2 Organizing Weather Observations	3.2 How can organizing our observations help us describe the weather?
	3.3 Interpreting Seasonal Patterns	3.3 How does this month's weather compare with weather in other seasons?
	3.4 Predicting the Weather (two class sessions)	3.4 What do television meteorologists do?

Lesson 4: Severe Weather (K-ESS3-2)	4.1 Observing Severe Weather	Lesson 4 Guiding Question: What should we do when severe weather is likely?
		4.1 What problems are caused by severe weather?
	4.2 Collecting Information About Severe Weather Patterns	4.2 What kinds of severe weather are more likely where we live?
	4.3 How Are Weather Warnings Communicated?	4.3 How do weather forecasters warn us that severe weather might happen soon?
	4.4 Responding to Weather Warnings (two class sessions)	4.4 What should we do when severe weather is likely?
Unit Capstone	Unit Capstone: Weather Patterns	Big Question: How do we know when to take an umbrella with us?
Unit Supplement	Science in Action (two class sessions)	Who are some people who work in this type of science, and what do they do?

Activity Pages

Activity Pages



AP UO.1
AP UO.2
AP UO.3
AP 1.1.1
AP 1.2.1
AP 1.3.1
AP 2.1.1
AP 2.1.2
AP 2.3.1
AP 2.4.1
AP 2.4.2

Black-line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 177–206. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced. The Activity Pages can be organized into a learning portfolio for each student to demonstrate their progress relative to NGSS expectations and as student work products.

Make sufficient copies for your students in advance of each lesson segment.

Unit Opener, Day 1—Taking an Umbrella on a Sunny Day (AP UO.1)

Unit Opener, Day 2—Weather Observation Chart (AP UO.2)

Unit Opener, Day 2—Measuring Weather (AP UO.3)

Lesson 1—Our Investigation Plan (AP 1.1.1)

Lesson 1—How Does Sunlight Affect Sand, Soil, and Water? (AP 1.2.1)

Lesson 1—Words for Your Drawing (AP 1.3.1)

Lesson 2—Sheep and Shade (AP 2.1.1)

Lesson 2—Saving Our Ice Cube (AP 2.1.2)

Lesson 2—Testing Our Structure (AP 2.3.1)

Lesson 2—Engineering Fair Badges (AP 2.4.1)

Lesson 2—Engineering Fair Visitor Card (AP 2.4.2)

Activity Pages



AP 3.1.1

AP 3.1.2

AP 3.2.1

AP 3.3.1

AP 3.3.2

AP 3.4.1

AP 3.4.2

AP 4.1.1

AP 4.2.1

AP 4.2.2

AP 4.2.3

AP 4.3.1

AP 4.4.1

AP 4.4.2

AP 4.4.3

AP UC.1

AP US.1

Lesson 3—How Does the Air Feel? (AP 3.1.1)

Lesson 3—How Does Air Temperature Change over a Day? (AP 3.1.2)

Lesson 3—How Many Days of Each Kind of Weather? (AP 3.2.1)

Lesson 3—Rainy or Snowy Days (AP 3.3.1)

Lesson 3—Sunny Days in _____ (AP 3.3.2)

Lesson 3—What Should I Wear Today? (AP 3.4.1)

Lesson 3—Today's Weather Around the USA (AP 3.4.2)

Lesson 4—Comparing Severe Weather (AP 4.1.1)

Lesson 4—Are Hurricanes Likely Where We Live? (AP 4.2.1)

Lesson 4—Are Tornadoes Likely Where We Live? (AP 4.2.2)

Lesson 4—Are Blizzards Possible Where We Live? (AP 4.2.3)

Lesson 4—Where Can We Use Severe Weather Warning Tools? (AP 4.3.1)

Lesson 4—Plan a Go Bag (AP 4.4.1)

Lesson 4—Choose Ten Things for a Go Bag (AP 4.4.2)

Lesson 4—Safety in Severe Weather (AP 4.4.3)

Unit Capstone—Weather and People (AP UC.1)

Unit Supplement—Tomorrow's Weather (AP US.1)

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

The Online Resources Guide also links to lists of additional recommended children's books that support the content of this unit.

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 driving questions.

The unit is governed by a Big Question, related to the unifying phenomenon. Each multipart lesson is built around a lesson Guiding Question. And then at the beginning of each Teacher Guide lesson segment, you will find a driving 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 driving 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.

During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Through scaffolded questioning, 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 Language of Instruction, 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 and Language of Instruction definitions in the Glossary on pages 207–208.

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.

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 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.

Instructional Design

The unit is composed with several integrated features that support three-dimensional learning for all students and development for teachers. Within each lesson, notations appear in the column to the left to indicate certain features in the instructional support.

Differentiation

Adjustments to instruction appear in the text, indicated by **SUPPORT**, **EXTEND**, and **CHALLENGE** notations.

SUPPORT—Reading, writing, listening, and/or speaking alternatives appear for students who are English language learners, have special needs, or read below the grade level. Extra support is suggested for students who struggle to meet targeted expectations.

EXTEND—Extensions are suggested for students with high interest or who have already met the performance expectations.

CHALLENGE—Additional, relevant, and interesting exercises are suggested for students to explore that exercise math, reading, or science skill/comprehension that pushes beyond the grade level.

Teacher Development

Information in the instructional text, Know the Science boxes, and Know the Standards boxes is provided to support ongoing teacher development with regard to both content and the teaching process.

Monitor Progress

Opportunities for formative assessment appear throughout the instructional support. These instances are most consistently noted in a Check for Understanding that concludes each lesson segment.

Math Connection

Connections to math standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.

Language Arts Connection

Connections to reading and language arts standards are highlighted in the instructional text and in Know the Standards boxes. Where alphanumeric identification codes are shown, they reference connections to the Common Core State Standards.

Building Progressions

Prior expected student learning and how the prior learning will be built upon are explained throughout the instructional support and in Know the Standards boxes.



DCI
SEP
CCC
PE

Opportunities for students to develop and use specific elements of NGSS Disciplinary Core Ideas (DCI), Science and Engineering Practices (SEP), and Crosscutting Concepts (CCC) are highlighted throughout the instructional support text.

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

Icon Key:

ESS3.A Natural resources

ESS3.B Natural hazards

ESS2.D Weather and climate

DCI PS1.A Structure and properties of matter

DCI PS3.B Conservation of energy and energy transfer

SEP 1 Asking questions (for science) and defining problems (for engineering)

SEP 2 Developing and using models

SEP 3 Planning and carrying out investigations

SEP 4 Analyzing and interpreting data

SEP 5 Using mathematics and computational thinking

SEP 6 Constructing explanations (for science) and designing solutions
(for engineering)

SEP 7 Engaging in argument from evidence

SEP 8 Obtaining, evaluating, and communicating information

CCC 1 Patterns

CCC 2 Cause and effect

CCC 3 Scale, proportion, and quantity

CCC 4 Systems and system models

CCC 5 Energy and matter: flows, cycles, and conservation

CCC 6 Structure and function

CCC 7 Stability and change

3D Learning

Student performance in a given task related to making sense of a phenomenon or designing a solution requires integrated elements of the SEPs, CCCs, and DCIs. At certain points of instruction, the Teacher Guide identifies when all three dimensions are integrated for student learning and as support for the teacher.

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 209–213, 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:

www.coreknowledge.org/cksci-online-resources

MATERIALS AND EQUIPMENT

The unit, like all hands-on science, requires a large 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.

- Roll paper, poster board, or a bulletin board should be dedicated at the beginning of the unit to serve as a question board to cumulatively document and return to student questions. The question board is referred to in the materials for lesson segments in which it is used but is not repeated in the materials listed here.
- Internet access and the means to project images/videos for whole-class viewing is also required in many lesson segments but is not repeated below.

Unit Opener

(Day 1)

- shallow bowls (1 per group)
- room-temperature water (1 quart)
- droppers (1 per group)
- large marker
- sticky notes (1 pack)

(Day 2)

- chart paper (1 sheet per week)
- weather thermometer
- rolled cotton (1 box)

Unit Opener, continued

- blue construction paper (1 sheet per student)
- paste (1 teaspoon per student)

Lesson 1 Sunlight

Lesson 1.1

- clear plastic cups (1 per student)
- ice cubes (1 per student)
- light-colored dry sand (1/2 cup)
- dark-colored dried soil (1/2 cup)
- water (1/2 cup)

Lesson 1.1, continued

- crayons or colored pencils (1 set per team)

Lesson 1.2

- clear plastic cups (6 per team)
- light-colored sand (1 cup per team)
- dark-colored dried soil (1 cup per team)
- water (1 cup per team)
- grease pencils or other materials for labeling the plastic cups (1 set per team)
- paper towels (6 sheets per team)
- digital thermometers (1 per team)

Lesson 1.3

- large sheets of drawing paper (1 per student)
- crayons or markers (1 set per student)
- scissors (1 per student)
- paste or glue (1 bottle per pair)

(For the Challenge activity)

- clear plastic cups (3)
- light-colored sand (1 cup)
- dark-colored dried soil (1 cup)
- water (1 cup)
- paper towels (3 sheets)
- digital thermometer

(For the Extend activity)

- shallow boxes (2)
- white pebbles (to fill 1 box)
- black pebbles (to fill 1 box)

Lesson 2 Designing for Sunlight

Lesson 2.1

- zippered plastic snack or sandwich bag
- ice cube

Lesson 2.1, continued

- black paper, 9 by 12 inches (2 sheets per team)
- white paper, 9 by 12 inches (2 sheets per team)
- wood sticks (6 per team)
- tape (1 roll per team)
- paper towels (2 sheets per team)
- straws (6 per team)
- paper plates (1 per team)
- cloth squares (1 per team)
- scissors (1 per team)

Lesson 2.2

- zippered plastic snack or sandwich bag
- ice cube
- white poster board, 12 by 12 inches (1 per team)
- black paper, 9 by 12 inches (2 sheets per team)
- white paper, 9 by 12 inches (2 sheets per team)
- wood sticks (6 per team)
- tape (1 roll per team)
- paper towels (2 sheets per team)
- straws (6 per team)
- paper plates (1 per team)
- cloth squares (1 per team)
- scissors (1 per team)

Lesson 2.3

- zippered plastic snack or sandwich bags (2 per team)
- ice cubes (2 per team)
- white poster board, 12 by 12 inches (1 per team)
- insulated cooler or bag to carry ice cubes in

Lesson 2.4

- masking tape loops (1 per student)

Lesson 3 Patterns of Weather

Lesson 3.1

- weather thermometer
- construction paper (9 by 12 inches 1 sheet per student)
- scissors (1 per student)
- tape or glue (1 roll or bottle per pair)

Lesson 3.2

- weekly weather charts from this unit
- colored pencils, crayons, or markers

Lesson 3.3

- colored markers or crayons

Lesson 3.4

- colored markers or crayons
- toy microphone (optional)

Lesson 4 Severe Weather

Lesson 4.1

- scissors (1 per student)
- paste or glue (1 bottle per student)

Lesson 4.2

- yellow highlighters (1 per student)

Lesson 4.4

- scissors (1 per student)
- paste or glue (1 bottle per student)

Unit Capstone

- child-sized umbrella

WEATHER PATTERNS PACING

_____’s Class

Note to Teacher: *Weather Patterns* is intended to be taught as the first unit of Grade K CKSci. As a general rule, we recommend that you spend a minimum of twenty-four days and a maximum of thirty-six days teaching the *Weather Patterns* unit so that you have time to teach the other units in the Kindergarten CKSci series.

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

--	--	--	--	--

Week 6

Day 26

Day 27

Day 28

Day 29

Day 30

--	--	--	--	--

Week 7

Day 31

Day 32

Day 33

Day 34

Day 35

--	--	--	--	--

Week 8

Day 36

Day 37

Day 38

Day 39

Day 40

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UNIT 4

Weather Patterns

OVERVIEW

Big Question: How do we know when to take an umbrella with us?

Anchoring Phenomenon: School is canceled during a heat wave, which leads Hanna to explore the effects of weather. The driving question in this unit is “How do we know when to take an umbrella with us?”

To answer this question over the course of the unit, students will observe weather and collect data over the course of a week, investigate the effects of sun on materials, design structures to create shade, and get answers to their questions about weather forecasting and severe weather. Students will observe that weather can be sunny, cloudy, rainy, windy, hot, cold, snowy, or stormy. Students will discover that weather observations can reveal patterns and that weather can be predicted, though not precisely. Students develop an understanding that weather forecasting gives people information needed to prepare for severe weather.

Student Book storyline: Hanna’s school is closed today due to excessively hot weather. She spends most of the day indoors, with air conditioning, doing fun activities with her grandmother. Later, they decide to go for a short walk to a farmers market. Hanna puts on a hat and takes a water bottle. But why does Grandma decide to take along an umbrella on such a sunny day?

Long-term project: Students will collect weather data and use the data to identify patterns over short and long periods of time. Students will use these data to determine the usefulness of having an umbrella in various weather conditions.

AT A GLANCE

NGSS References

Disciplinary Core Idea: PS3.B Conservation of Energy and Energy Transfer

Science and Engineering Practices: 1 Asking Questions and Defining Problems; 3 Planning and Carrying Out Investigations; 6 Constructing Explanations and Designing Solutions; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 2 Cause and Effect

Connection to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology

Students observe and listen to reading the effects of sunlight and heat. Students then investigate evaporation.

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

www.coreknowledge.org/cksci-online-resources

Introductory Class Session

Keeping Cool on a Hot Day

Students follow a story about what a girl and her grandmother do on a day when school is canceled due to hot weather. To help explain one part of the story, students test the effect of putting room-temperature water on their skin. To access students' prior knowledge, they draw their ideas about weather and umbrellas. (See **Know the Science** on the following page.)

Unit Opener Objectives

- ✓ Clarify the unit anchoring phenomenon.
- ✓ Investigate the cooling effects of putting water on their skin and letting it evaporate.

Language of Instruction

The Language of Instruction consists of terms not considered a part of Core Vocabulary that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

observe

Instructional Activities

- class discussion
- teacher Read Aloud
- student investigation
- question generation

Instructional Resources

Student Book



Ch. 1

Student Book, Chapter 1
"The Heat Is On"

Activity Page



AP UO.1

Activity Page
Taking an Umbrella on a Sunny Day (AP UO.1)

Materials and Equipment

- shallow bowls (1 per group)
- room-temperature water (1 quart)
- droppers (1 per group)
- question board
- large marker
- sticky notes (1 pack)
- internet access and the means to project images/video for whole-class viewing

1. Introduce the Anchoring Phenomenon.

NGSS Elements



SEP 6
DCI ESS3.B

Explain to the students that a heat wave is hotter-than-usual weather lasting more than two days. Heat waves are dangerous because if the body heats up too much, it can make people sick. Students are likely to ask if there are heat waves where they live. Many places can have a heat wave, and they occur from time to time.

When school is canceled, the school notifies families so that they can plan where their children will go during the school day.

Online Resources



Show students a website that explains heat waves and why school gets canceled during a heat wave.

See the Online Resources Guide for a link to the recommended website:

www.coreknowledge.org/cksci-online-resources

Ask students the following:

- What would you like to do to stay cool during a heat wave?
 - » Accept all reasonable answers. Examples include going swimming, staying indoors with air conditioning, making lemonade, and playing video games.
- What are some things you should not do during a heat wave?
 - » outside sports and games that make you feel hot
- What happens when a heat wave ends?
 - » School will open, and we can go back to playing outside.

Know the Science

TEACHER DEVELOPMENT

Why Does Putting Water on Your Skin Cool You off on a Hot Day? The human body works to maintain a constant core temperature. On a hot day, the body attempts to lower its temperature through sweating. This works because energy is needed to change matter, in this case water, from a liquid to a gas. Heat is transferred away from the body, and you feel cooler. Putting water on your body or clothes would also cause it to evaporate in the hot sun. The process of this water evaporating would cool the body.

2. Read together: “The Heat Is On.”

Student Book



Ch. 1

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 2

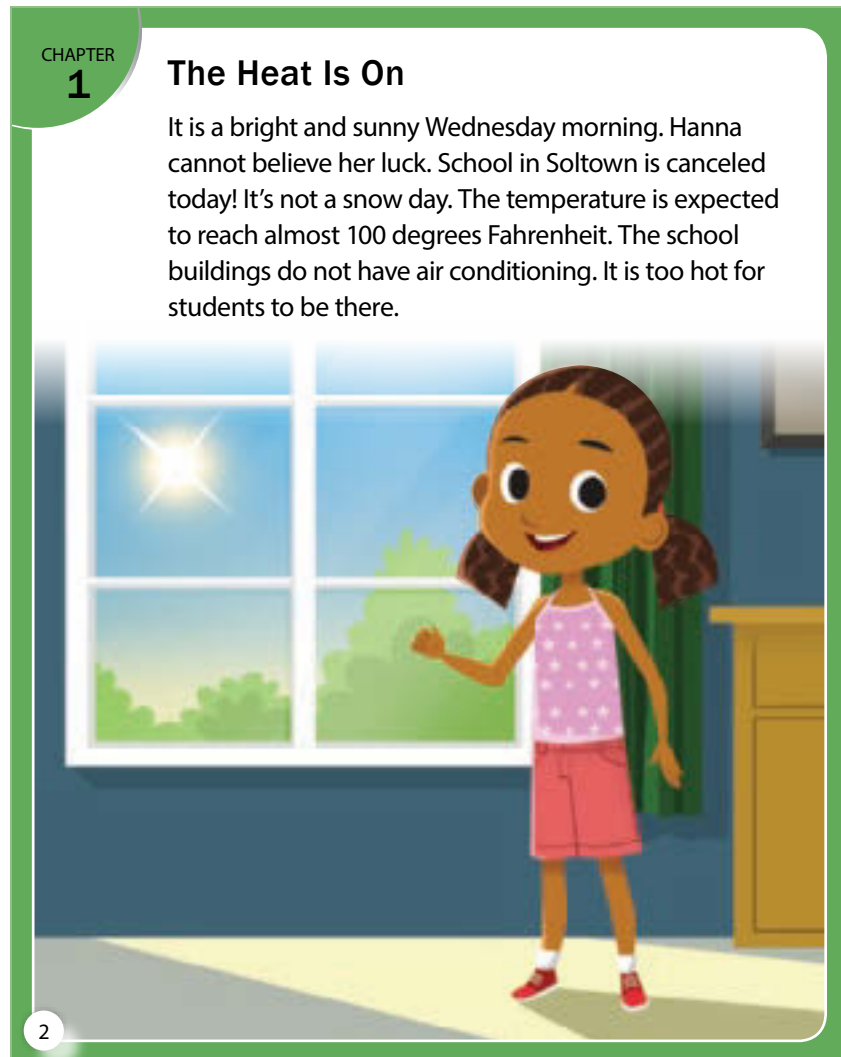
NGSS Elements



DCI ESS3.B

Differentiation

Ask students to turn to page 2 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “The Heat Is On,” and tell them to pay special attention to where it is hot in the story.



Ask students to look at the picture on page 2. Explain that this is Hanna and that she goes to Kindergarten.

Ask students the following questions:

LITERAL—Why is school canceled today?

» because it is too hot for students to stay in the school building

SUPPORT—Depending on where students live, they may not have experienced 100-degree weather. Show students a thermometer that has been resting in your classroom. Have students count up from the room temperature (usually around 70 degrees) until they reach 100. Explain that for each number students counted, they should think about the room getting hotter. (See **Know the Standards.**)

INFERENTIAL—Why do you think Hanna feels lucky?

» Sample answer: because she can play all day, instead of doing schoolwork

INFERENTIAL—Why might Hanna also feel a little sad about school being canceled?

» Sample answer: because she will not see her friends and teacher today

Page 3

Ask students to look at the picture on page 3.

NGSS Elements



Differentiation

Hanna's parents have to work. She is spending the day with her grandmother. It is too hot to do anything outside. They stay inside where there is air conditioning. They play card games. They make snacks. They watch a show on television. Soon, Hanna is bored. "Can we go outside?" she asks her grandmother. "I know it's hot. But maybe we can go out for just a few minutes."



3

Know the Standards

TEACHER DEVELOPMENT

Number Names and Counting: Having students count from room temperature to 100 degrees supports Kindergarten mathematics standard CCSS.Math.Content.K.CC.A.2 (*Count forward beginning from a given number within the known sequence [instead of having to begin at 1]*).

Ask students the following questions:

LITERAL—What three activities do Hanna and her grandmother do indoors?

» play a card game, make snacks, and watch television

INFERENTIAL—What does an air conditioner do to indoor air?

» It makes it feel cooler.

SUPPORT—For students who do not live in hot climates or have not experienced a heat wave, explain that very hot weather can be dangerous to people's health because their bodies may get hotter than they should be. For this reason, people can feel dizzy or get headaches and can get sick enough to need to go to a hospital.

Page 4

NGSS Elements



DCI ESS3.B

CCC 2

Ask students to look at the picture on page 4 as you read aloud. Explain that a farmers market is an outdoor space where farmers set up tables to sell the fruits and vegetables they grow, as well as eggs and cheese from their farm animals.

Grandma thinks for a minute. "I have an idea," she says. She explains to Hanna that there is a farmers market in the town square. It is just a few blocks away. It would be a short walk. "We can pick up some vegetables to have with dinner," Grandma says. "It will be nice to get some fresh air." They will make sure to walk slowly and take plenty of water.



4

Ask students the following questions:

LITERAL—Why does Grandma think it would be nice to take a walk?

» They will be able to get some vegetables for dinner.

INFERENTIAL—How will walking slowly and taking along water help?

» When you walk slowly and drink plenty of water, your body doesn't get too hot.

INFERENTIAL—What time of day do you think it is at this part of the story? Explain.

» It may be late afternoon because the sun is still in the sky but Hanna and her grandmother have finished at least three other activities.

Page 5

Ask students to look at the picture on page 5 as you read aloud.

NGSS Elements



DCI ESS3.B
CCC 2

Hanna fills a large bottle with water and ice. She puts on her baseball cap to protect her face from the sun. Just as they are about to leave, Grandma grabs her umbrella from the closet. Hanna is confused. It is not raining outside. There are not even any clouds. It is one of the brightest, sunniest days she has ever seen! Why would Grandma need an umbrella?



5

Ask students the following questions:

LITERAL—What is Hanna taking on the walk?

- » a hat and a bottle filled with water and ice

INFERENTIAL—How will the hat and water help Hanna when she goes on the walk?

- » The hat will make her face feel cooler, and the cold water will cool her mouth and throat.

INFERENTIAL—Why does Hanna look confused?

- » She cannot understand why her grandmother thinks she needs an umbrella on a sunny day.

INFERENTIAL—What are some reasons that Grandma might be carrying an umbrella?

- » Sample answers: to use as a sunshade, to use as a cane or walking stick, to keep air conditioners from dripping water on them as they walk next to buildings

3. Investigate the effect of water on skin.

NGSS Elements



SEP 3

SEP 6

CCC 2

Put students into small groups, and give each group a shallow bowl of room-temperature water with a dropper. Have the students take turns using the dropper to put a small volume of water on the back of one hand resting on the desk so that the water does not run off. **Ask students**, How does your hand feel with the water on it?

- » cooler

Next, challenge students to plan a way to get the water to evaporate (disappear) quickly. Possible ideas are to fan their hands, blow on them, or hold them in the sun. **Ask students**, How does your hand feel as the water evaporates?

- » even cooler

Finally, have students formulate cause-and-effect statements to tell Hanna why she should put a little of the water from her bottle on her skin as she walks to the farmers market with her grandmother.

4. Generate questions.

NGSS Elements



SEP 1

DCI PS3.B

CCC 2

Write the **Big Question** with a marker in large letters at the top of the question board: **How do we know when to take an umbrella with us?**

Invite volunteers to restate the question, making sure that the meaning is accessible to all students.

Ask students, What do we have to find out before we can answer this question? Restate each student response as a question, write the question on a sticky note, and affix it to the question board.

Explain to students that the class will revisit the question board, adding more student questions and thinking about answers, throughout this unit about weather patterns.

5. Check for understanding.

NGSS Elements



SEP 6

SEP 8

DCI ESS3.B

CCC 2

Monitor Progress

Activity Page



AP UO.1

Give each student a copy of Taking an Umbrella on a Sunny Day (AP UO.1). Read aloud the directions, and encourage students to think about causes and effects before drawing. Circulate among students, and assist those who need help spelling the words for their labels.

Save the students' work as a pre-assessment that assesses prior knowledge about the effects of sunlight and shade on people. Review student labeled drawings (models) to determine their prior knowledge of the following concepts:

- Science explanations can be conveyed through drawings with labels.
- Sunlight warms surfaces, and the warm surfaces can make people feel hot.
- Events have causes that result in patterns that can be predicted.

Tie to the Anchoring Phenomenon

Through reading, discussion, investigating, and asking questions, students put themselves in the place of Hanna and her grandmother. Students begin to consider how weather affects people and how people can respond to keep themselves safe and healthy.

UNIT 4

Weather Patterns

Big Question: How do we know when to take an umbrella with us?

Today's Question: What can we notice about what it's like outside?

Tie to the Anchoring Phenomenon: Through making observations and recording data, students begin to understand that weather conditions vary. Students will later apply that understanding to explaining why school is sometimes canceled due to heat waves and other severe weather.

AT A GLANCE

Learning Objectives

- ✓ Define *weather*.
- ✓ Describe weather conditions that can be observed.
- ✓ Report weather data.

Instructional Activities

- teacher Read Aloud
- student observation
- class discussion
- student investigation

NGSS References

Disciplinary Core Idea: ESS2.D Weather and Climate

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

fair measure weather

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

observe observation temperature thermometer

Instructional Resources

Student Book



Ch. 2

Student Book, Chapter 2
“What Is Weather?”

Activity Pages



AP UO.2
AP UO.3

Activity Pages
Weather Observation Chart
(AP UO.2)
Measuring Weather (AP UO.3)

Materials and Equipment

- chart paper (1 sheet per week)
- weather thermometer
- rolled cotton (1 box)
- blue construction paper (1 sheet per student)
- paste (1 teaspoon per student)
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Use Activity Page UO.2 as a template for making a large wall weather chart for your class.

THE CORE LESSON

1. Focus student attention on Today’s Question.

NGSS Elements



DCI ESS2.D
CCC 1

What can we notice about what it’s like outside?

Ask students to explain how they know what kinds of clothes to wear outdoors each morning. **Ask**, What can you notice by looking out a window?

- » if it is sunny, cloudy, raining, snowing, or windy

Then ask, How can you find out if it is hot or cold outside?

- » Sample answers: use a weather app, go outside and feel the air, listen to a television weather report, look for signs out the window such as ice or rain

Explain to students that, as a class, they will investigate the weather each day. Then students will use what they find out to describe weather patterns and weather changes.

Tie to the Anchoring Phenomenon

By collecting data about weather conditions, students learn that weather varies from day to day. Students will use patterns identified in a month’s worth of temperature data to help explain why, despite school being closed for excessive heat, many schools do not have air conditioning.

2. Introduce weather elements.

Activity Page



AP UO.3

NGSS Elements



DCI ESS2.D

CCC 1

Differentiation

Teacher
Development

Give each student a copy of Measuring Weather (AP UO.3). Explain that each day, students will use these pictures to report their weather observations.

Have students look at the first column. Explain that the pictures represent how the sky looks:

- sunny and clear, without clouds
- some clouds and some sun
- clouds blocking the sun and the sky covered in clouds

Go over the second column of pictures that represent precipitation, and invite students to share their experience with each:

- rain
- snow
- mixed rain and snow
- fog

For the temperature pictures, explain that temperature is how hot or cold it is. Discuss with students that they can describe how hot or cold the air is by how it feels on their skin, using comparing words such as the following (see **Know the Science**):

- cold
- cool
- warm
- hot

Ask students the following:

- What kinds of clothing do you need to wear to go outside if the air is cold?
 - » a thick jacket, a knitted cap, mittens, and boots
- What kinds of clothing do you need to wear to go outside if the air is cool?
 - » a thinner jacket and a baseball cap
- What kinds of clothing do you need to wear to go outside if the air is warm?
 - » shorts or short-sleeved shirt

Know the Science

TEACHER DEVELOPMENT

How Can Both Numbers and Descriptive Words Be Used to Record Air Temperature? You might decide to use quantitative (numerical) measures in addition to qualitative (adjectives) on your weather charts. To align the two kinds of measurements, you will have to select a range of degree equivalents for each of the four temperature words (*cold*, *cool*, *warm*, *hot*). First, use online resources to find climate data for the zip code of your school. Next, find the highest and lowest temperatures for all twelve months. Divide that range into four groups that will best work for your local weather.

- What kinds of clothing do you need to wear to go outside if the air is hot?
 - » shorts and a T-shirt or a bathing suit

For the wind pictures, point out that people cannot see the wind but that they can see evidence that the wind is blowing. Have students compare the three pictures of the flag on the flagpole. **Ask the following:**

- How do you know by looking at a flag that there is no wind at all?
 - » when the flag hangs down alongside the pole and does not move
- How do you know when the wind is blowing very hard?
 - » when the flag stands straight out from the pole
- How do you know when the wind is blowing lightly or gently?
 - » when the flag flutters back and forth but does not stand out from the pole

SUPPORT—English language learners will benefit from a video that gives visual clues when using words that describe weather. Show the video a couple of times, and then invite students to sing along.

Online Resources



See the Online Resources Guide for a link to a recommended video.

www.coreknowledge.org/cksci-online-resources

3. Begin daily weather observations.

NGSS Elements



SEP 3

DCI ESS2.D

Display the wall-sized version of the weekly weather chart that you have prepared in advance based on Activity Page UO.2.

Take the class outdoors with the weather thermometer, and guide students in making weather observations as follows:

- Observe and describe the sky covering. **SAFETY NOTE:** Warn students not to look directly at the sun.
- Note if there is any precipitation (rain, snow, sleet, or a wintry mix).
- Observe how the air feels on students' skin—cold, cool, warm, or hot. You may also want to read the thermometer now and tell them the temperature measured in degrees Fahrenheit.
- Take students to where they can see a flag on a flagpole. Have students describe the position and motion of the flag (no wind, light wind, very windy).

Return to the classroom, and record students' observations on the large weather chart. Identify the day of the week, and write the date. Also record the time the class made observations.

Have one student cut up a copy of Measuring Weather (AP UO.3) and glue the appropriate icons with labels onto the chart.

Repeat these weather observations, preferably at the same time each day, for the rest of the week. Make another wall chart for the second week, and continue recording the weather until the end of the unit (about four weeks). Save all the charts so that, later, students can analyze the data over time to find patterns.

4. Read together: “What Is Weather?”

NGSS Elements



DCI ESS2.D
CCC 1

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

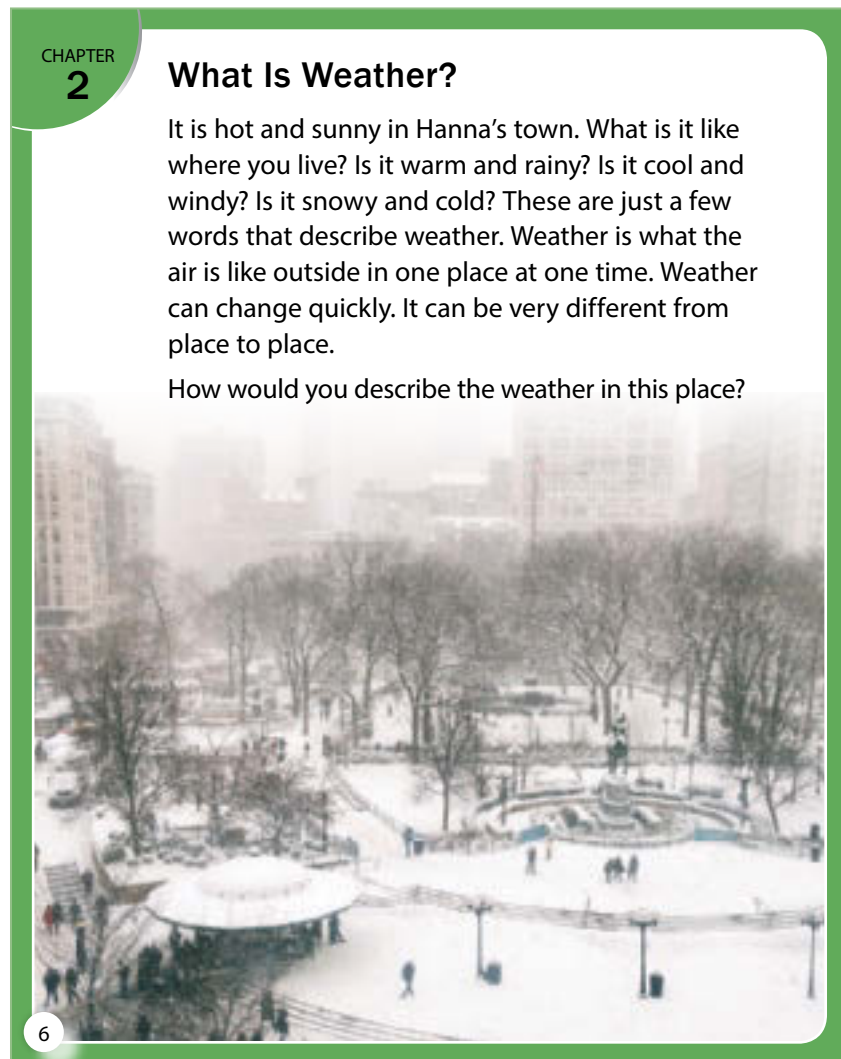
Page 6

Student Book



Ch. 2

Ask students to turn to page 6 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “What Is Weather?” and tell them to pay special attention to words that describe the weather.



Ask students to look at the picture on page 6. Explain that this picture shows a winter weather scene in a big city.

Ask students the following questions:

CORE VOCABULARY—Explain that **weather** is what the air is like outside in one place and at one time.

INFERENTIAL—How would you describe the weather in this city at the time the picture was taken?

» It looks like it just stopped snowing. The sky is very cloudy, and it is very cold.

EVALUATIVE—Do you think it is fun to live in a place where it is cold and snowing in the winter? Explain.

» Sample answer: yes, because it is fun to play in the snow

Page 7

Ask students to look at the pictures on page 7 as you read aloud. Have students think to themselves of words that describe the weather.

NGSS Elements



DCI ESS2.D
Differentiation
Language Arts
Connection

We use different words to describe different kinds of weather. You can use different words to describe the weather, too. Try it! What are three words you can use to describe the weather today?

The weather here is sunny, clear, and cold.



This weather is cloudy and warm.



It can even be rainy and windy at the same time!



7

Ask students the following questions:

INFERENTIAL—What are words that describe the weather in these pictures?

» snowy, cold, wet, cloudy

INFERENTIAL—What are three words that describe our weather today?

» Answers will vary. Students may use some of the words recorded on the weekly weather chart hanging on the wall.

CHALLENGE—Obtain a copy of the collection of poetry called *Weather Report*, selected by Jane Yolen and illustrated by Annie Gusman (Boyds Mills, 1993). The poems are organized by weather conditions, for example, rain, sun, snow, and fog. Some of the poems were written for adults, but many, including those by Yolen, were written for children. Tell your students to listen for words that describe the weather as you read selected poems.

Page 8

Ask students to look at the pictures on page 8 as you read aloud. Have students think about how the kinds of clouds differ.

NGSS Elements



DCI ESS2.D
Differentiation

Clouds can give you clues about the weather. Not all clouds mean it will rain.



White, puffy clouds may mean that the weather will be fair.



High, streaky clouds may mean a change in weather is on the way.



Low, gray clouds may mean lots of rain or snow is about to fall.



Tall clouds that are gray on the bottom may mean thunderstorms are coming.

8

Ask students the following questions:

CORE VOCABULARY—Explain that **fair** weather is weather that is sunny with calm winds and no rain or snow.

INFERENTIAL—What kinds of activities are good to do in fair weather?

» playing, soccer, hiking, picnicking

LITERAL—What can you learn about weather from watching clouds?

» that a change in weather is coming, such as rain, snow, or a thunderstorm

SUPPORT—Many students will benefit from a modeling activity comparing and contrasting the appearance of clouds. Give students small amounts of rolled cotton, and have them pull it apart to model the four kinds of clouds shown in the photos. Have them fold a sheet of blue paper into four quadrants and paste their model of each type of cloud in one quadrant.

Page 9

Ask students to look at the pictures on page 9 as you read aloud. Have students think about the work weather scientists do.

NGSS Elements



DCI ESS2.D

Scientists collect and record information about the weather. They measure how hot or cold the air is. They measure how fast the wind blows. They check the direction the wind is blowing. They measure how much rain or snow falls. They measure how much moisture is in the air. These data help scientists predict what the weather may be like in the future. Scientists use a special balloon to get information about the weather.



Scientists use computers to record and analyze data.



9

Ask students the following questions:

CORE VOCABULARY—Explain that to **measure** means to use numbers or words to describe things.

INFERENTIAL—How do you think a balloon might help scientists get information about weather?

» It must carry tools for measuring weather.

Online Resources



Show students a video of a National Weather Service weather balloon launch. See the Online Resources Guide for a link to a recommended video.

www.coreknowledge.org/cksci-online-resources

Pause the video to ask questions or answer them. Make sure students understand that the air around them at ground level extends upward from Earth's surface for several miles. **Ask students**, What is the job of the helium balloon?

» to carry the box of weather tools and instruments high into the air

Explain that the balloon carries the box of weather instruments and that measurements are taken as the box drops through the air.

5. Check for understanding.

NGSS Elements



DCI ESS2.D

CCC 1

Monitor Progress

Teacher
Development

The goal of this unit opener segment is to elicit students' prior knowledge about weather conditions and weather patterns and for the class to begin collecting local weather data. Later in the unit, students will have an opportunity to refine their concept of what weather is and identify patterns in the data they collected.

Call attention to Today's Question—**What can we notice about what it's like outside?** As students answer, look for their prior knowledge of the following concepts:

- Weather varies from day to day.
- Weather describes how hot or cold the air is, how windy it is, if it is raining or snowing, and how the sky looks.
- There are different kinds of clouds in the sky on different days.
- Scientists use tools such as balloons and computers to understand weather.
- Certain words can also describe the temperature of the air.

Tie to the Anchoring Phenomenon

Through reading, discussion, and collecting weather data, students are building the understandings needed to explain that weather varies and that certain types of weather, such as excessive heat, are not common events.

LESSON 1

Sunlight

OVERVIEW

Guiding Question: How does sunlight affect Earth's surface?

Lesson 1 Segments	Segment Questions	Advance Preparation
1.1 The Sun and Sunlight Students investigate and discuss the effect of sunlight and heat on ice cubes. Students then plan their investigation of the effect of sunlight on sand, soil, and water.	What does sunlight do?	Arrange a place to store ice cubes until you are ready for them in Step 2. If needed, dry the soil needed for Step 3, and store the materials for this step in a cool, dark place. See Materials and Equipment.
1.2 Investigating Sunlight and Shade on Earth Materials Students use their plans to investigate the effect of sunlight and shade on sand, soil, and water.	How do sunlight and shade affect the warmth of sand, soil, and water?	Identify indoor or outdoor locations where students can place three cups in direct sunlight and three cups in nearby shade. See Materials and Equipment.
1.3 Lesson 1 Roundup: Sunlight on Earth's Surface Students engage with a song about the sun and then reinforce what they heard with a read aloud and discussion. Students review what they have learned throughout the lesson.	What does an umbrella do to light?	Read Chapter 3 in the Student Book See Materials and Equipment.

Lesson 1: What's the Story?

Summary: In Lesson 1 (Segments 1–3), students engage with the idea that sunlight interacts with Earth and its inhabitants. Students investigate sunlight's effect on earth materials (soil, sand, and water) by comparing their relative temperatures to the same materials placed in the shade. Students identify patterns in their results, construct explanations, and reflect on how they worked like scientists (K-PS3-1).

Learning Progression: Lesson 1 builds on students' prior experiences learning and playing in the sun and shade outdoors. It also builds on earlier science units in Kindergarten, such as in Unit 1, *Pushes and Pulls*, where students are planning and carrying out investigations and applying the Crosscutting Concept of Cause and Effect.

Guiding Phenomenon: Sunlight warms Earth's surface. Sunlight also warms other objects on Earth's surface. Students should be familiar with the sensation of being warmed when sitting in the sun for a few minutes and can apply this understanding to interpreting the results of their investigations of earth materials.

Learning Objectives

By the end of Lesson 1, students will do the following:

- Identify the sun as an object visible in the daytime sky that gives off light.
- Investigate the effect of sunlight on earth materials.
- Describe patterns of relative warmth of an earth material in sunlight versus shade.
- Explain that sunlight warms Earth's surface.
- Infer that objects that cast shade reduce the sun's warming effect on materials.

NGSS Standards and Dimensions

Performance Expectation: K-PS3-1 Make observations to determine the effect of sunlight on Earth's surface.

Science and Engineering Practices	Disciplinary Core Ideas
1 Asking Questions and Defining Problems Ask questions based on observations to find more information about the natural and/or designed world(s).	PS1.A Structure and Properties of Matter Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
2 Developing and Using Models Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	PS3.B Conservation of Energy and Energy Transfer Sunlight warms Earth's surface.
6 Constructing Explanations and Designing Solutions Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.	Crosscutting Concepts
3 Planning and Carrying Out Investigations <ul style="list-style-type: none">• With guidance, plan and conduct an investigation in collaboration with peers.• Make predictions based on prior experiences.• Make observations (firsthand or from media) to collect data that can be used to make comparisons.	2 Cause and Effect Events have causes that generate observable patterns.
8 Obtaining, Evaluating, and Communicating Information Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).	1 Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
	3 Scale, Proportion, and Quantity Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).
	Connection to Nature of Science Scientific Investigations Use a Variety of Methods Scientists use different ways to study the world.

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

www.coreknowledge.org/cksci-online-resources

LESSON 1.1

The Sun and Sunlight

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How does sunlight affect Earth's surface?

Today's Question: What does sunlight do?

Tie to the Anchoring Phenomenon: In this lesson segment, students prepare to carry out an investigation showing that materials warm more in direct sunlight than in shade. This knowledge can be directly applied to making inferences about how some schools may heat up so much that school must be canceled.

AT A GLANCE

Learning Objectives

- ✓ Identify the sun as an object in the sky that produces sunlight.
- ✓ Explain that sunlight causes Earth's surface to warm.
- ✓ Describe a plan to test the effects of sunlight on different earth materials.
- ✓ Make predictions about the investigation results.

Instructional Activities

- class discussion
- student investigation

NGSS References

Disciplinary Core Ideas: PS1.A Structures and Properties of Matter; PS3.B Conservation of Energy and Energy Transfer

Science and Engineering Practices: 1 Asking Questions and Defining Problems; 3 Planning and Carrying Out Investigations

Crosscutting Concept: Cause and Effect

Connection to Nature of Science: Scientific Investigations Use a Variety of Methods

Students investigate the effect of sunlight and heat on ice cubes. Students then plan an investigation of the effect of sunlight on sand, soil, and water.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

Earth sunlight temperature

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

materials observation surface

Instructional Resources

Activity Page



AP 1.1.1

Activity Page

Our Investigation Plan (AP 1.1.1)

Materials and Equipment

- clear plastic cups (1 per student)
- ice cubes (1 per student)
- light-colored dry sand (1/2 cup)
- dark-colored dried soil (1/2 cup)
- water (1/2 cup)
- crayons or colored pencils (1 set per team)

THE CORE LESSON 1.1

1. Introduce students to Lesson 1.

Read the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How do we know when to take an umbrella with us?**

Tell students that before they can answer the Big Question, they will need to find out more about what happens to Earth when it is a sunny day.

Explain that the sun causes students' days to be sunny. Point out that the sun is an object in space separate from Earth, another object in space. Unlike Earth, the sun gives off light (sunlight). While the nature of the sun is not the focus of this unit, students may have questions about it that can be answered by going to the library or searching online.



Write the Lesson 1 Guiding Question where students can see it:

How does sunlight affect Earth's surface?

Draw a K-W-L wall chart (as shown). List what students already know about the sun, sunlight, and Earth's surface in the first column. Have students ask supporting questions, and record these in the second column. (See **Know the Science**.)

How does sunlight affect Earth's surface?		
We Know ...	We Want to Know ...	We Learned ...

Tie to the Anchoring Phenomenon

Through discussion of their investigation plan, students develop a framework for exploring the effects of sunlight on materials on Earth's surface, including a school that gets too hot for school to be in session.

Know the Science

TEACHER DEVELOPMENT

How Does Solar Energy Interact with Earth Materials? Energy from the sun—solar energy—is carried through space to Earth in the form of light, where it may be reflected, absorbed, or transmitted by the materials it strikes. Solar energy is all types of energy in the electromagnetic spectrum, such as infrared and ultraviolet light. The atmosphere absorbs some solar energy, but most of it is transmitted through the air to Earth's solid or liquid surfaces. These earth materials are warmed because absorbed infrared energy from sunlight is transformed into thermal energy. Shiny and smooth materials, such as water, reflect more light than dull or rough surfaces, such as rocks and soil. Materials that reflect less light absorb more energy. It is the infrared part of the electromagnetic spectrum that is the wavelength that causes matter to heat up.

2. Describe the phenomenon.

NGSS Elements



SEP 3

DCI PS1.A

DCI PS3.B

CCC 2

Teacher
Development

Monitor Progress

3D Learning

3D Learning: Students make observations to infer that sunlight causes ice to warm and melt.

On a sunny day, take students outside, and give each student an ice cube in a clear plastic cup. (You may need to adjust your scheduled teaching day for this activity based on the weather.) Break the class up into two larger groups, one of which will be tasked with getting their ice cube to melt faster and the other of which will be tasked with getting their ice cube to melt slower. Have the smaller groups then set about finding a location where their ice cube will melt faster or slower, depending on their larger group assignment.

This investigation anticipates physical science core idea PS1.A (*Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties*), which is fully explored in Grade 2. In this Kindergarten lesson, it taps students' prior experiences with melting ice but is not generalized to all kinds of matter.

After a few minutes, have students compare their ice cubes and **answer the following questions:**

- How did you decide where to place your ice cube?
 - » Answers will vary. Some students may say that they put them in the sun and others that they put them in the shade. Others may say they put them on a particular type or color of material. Some may hold the cups in their warm hands or place the cup and cube where no light or heat could get to it.
- What made the ice cubes melt faster?
 - » heat or warmth from the sun or from a warm object
- What made the ice cubes melt slower?
 - » being away from heat or warmth
- What would happen to the ice cubes on a cloudy day?
 - » They might not melt as fast as on a sunny day.
- Where should you stand if you want an ice pop you are eating outdoors to last a long time?
 - » in the shade, out of the sun

SUPPORT—The last two questions require inferential thinking. If students are having trouble answering them, support them by asking, “What clues can help you answer this question?”

3. Discuss the investigation question and purpose.

Activity Page



AP 1.1.1

NGSS Elements



SEP 3

DCI PS3.B

CCC 2

Differentiation
Math Connection

Give each student a copy of Our Investigation Plan (AP 1.1.1), and read aloud the directions. Then, show the students the three earth materials that they will test. **Ask the following:**

- Where on Earth's surface is sand found?
 - » at ocean, lake, or river beaches
- Where on Earth's surface is soil found?
 - » in forests, grasslands, gardens, farms
- Where on Earth's surface is water found?
 - » in the ocean, rivers, lakes

CHALLENGE—Explain to students that ice is frozen water. Show students images of where ice exists on Earth's surface, such as Greenland and Antarctica. Remind students of their test of the melting ice cube, and guide them to infer that sunlight also warms large areas of ice on Earth's surface.

Have students draw the sun on their Activity Pages and show how sunlight will reach each cup in the first row. Have students draw an object over the cups in the second row, such as a tree or building, that makes shade. Then guide students to complete the sentence describing the purpose of the investigation.

Explain to students that temperature is how hot or cold a material is. Explain that students will observe the temperature of the materials in the cups by feeling them with their hands.

SUPPORT—To help English language learners build vocabulary associated with temperature, create cards for words that mean warm or hot (*warm, hot, burning, boiling, red-hot, sizzling*), cool or cold (*cool, cold, freezing, chilly, icy, polar, frosty*), or somewhere in between (*mild, nice, just right*). Have students add a picture to each card that will help them remember what the word means or how to use it.

Make a "We Predict" chart, and ask students to predict, based on their investigation with the ice cube, what will happen to the earth materials. List all reasonable answers.

3. Check for understanding.

NGSS Elements



SEP 3

DCI PS3.B

CCC 2

Differentiation
Teacher
Development

Ask students to think about their science work today. **Then ask Today's Question—What does sunlight do?**

Ask students clarifying questions:

- How are you going to test what sunlight does to Earth?
 - » We are going to put sand, soil, and water in the sun and see if they warm up.
- How will you measure the warming?
 - » by feeling them with our hands

- Why will you compare your team's results with those of other teams?
 - » to find out if our materials warmed in the same ways (patterns)

EXTEND—For students who will enjoy more advanced learning about the sun and have a sense of humor, read aloud *The Sun Is Kind of a Big Deal* (Scholastic, 2019). This nonfiction picture book, written and illustrated by Nick Seluk, is informative and funny at the same time. (See **Know the Standards**.)

Review student drawings on Activity Page 1.1.1 to determine student understanding of targeted concepts:

- The cups should contain equal volumes of the materials.
- The sun shines light on Earth's surface.
- Some objects block the sun from shining on Earth's surface.

See the Activity Page Answer Key for correct answers.

Tie to the Anchoring Phenomenon

By now, students should be comfortable with the investigation phenomenon—the sun warms Earth's surface—and ready to carry out their investigation of three earth materials.

- **Ask students,** What kinds of materials are schools made from?
 - » They can be made from bricks, stone blocks, or wood.
- **Ask students,** What effect do you think the sun has on these materials?
 - » It warms them.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: While learning that the sun warms Earth's surface addresses a Kindergarten Disciplinary Core Idea (PS3.B), reading trade books about the sun is likely to discuss Grade 1 Disciplinary Core Ideas ESS1.A (*Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted*) and ESS1.B (*Seasonal patterns of sunrise and sunset can be observed, described, and predicted*).

LESSON 1.2

Investigating Sunlight and Shade on Earth Materials

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How does sunlight affect Earth's surface?

Today's Question: How do sunlight and shade affect the warmth of sand, soil, and water?

Tie to the Anchoring Phenomenon: By establishing through investigation that three earth materials all get warmer in the sun than in the shade, students can make inferences about how other materials, including school roofing materials, get warm in the sun.

AT A GLANCE

Learning Objectives

- ✓ Test materials to collect data.
- ✓ Describe patterns of relative temperatures of an earth material.
- ✓ Use evidence from data to support a claim.

Instructional Activities

- student investigation
- class discussion

NGSS References

Performance Expectation: K-PS3-1

Disciplinary Core Idea: PS3.B Conservation of Energy and Energy Transfer

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concepts: 2 Cause and Effect; 3 Scale, Proportion, and Quantity

Connection to Nature of Science: Scientific Investigations Use a Variety of Methods

Students investigate the effect of sunlight and shade on sand, soil, and water.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cooler shade sunlight warmer

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

claim evidence measure pattern

Instructional Resources

Activity Page



AP 1.2.1

Activity Page

How Does Sunlight Affect Sand, Soil, and Water?
(AP 1.2.1)

Materials and Equipment:

- clear plastic cups (6 per team)
- light-colored sand (1 cup per team)
- dark-colored dried soil (1 cup per team)
- water (1 cup per team)
- grease pencils or other materials for labeling the plastic cups (1 set per team)
- paper towels (6 sheets per team)
- digital thermometers (1 per team)

Advance Preparation

Plan to carry out this investigation on a sunny day. Decide where your students should place their two sets of cups holding earth materials. A windowsill and shelf away from the window inside your classroom will work. Or choose outdoor spaces. If it is impossible to place the cups in the sun, place them under a desk lamp with a 60-watt or greater incandescent bulb. Plan to leave the cups in place for at least fifteen minutes.

THE CORE LESSON 1.2

1. Focus student attention on Today's Question.

NGSS Elements



SEP 3
DCI PS3.B

How do sunlight and shade affect the warmth of sand, soil, and water? Begin with a review of the purpose of the investigation, as discussed in the last lesson session.

Ask students, What are the three materials found on the surface of Earth that we will test?

» sand, soil, and water

Ask students, What is the purpose of placing each material in the sun?

» to find out if the sun warms them

Ask students, What is the purpose of placing another group of these materials in the shade, where there is no sunlight? (See **Know the Science.**)

» to find out if they warm the same way that the materials in the sun do

Tie to the Anchoring Phenomenon

The anchoring phenomenon for this unit is that schools can be closed due to severe weather called a *heat wave*. Keep students thinking about this idea by pointing out that schools sit on Earth's surface and that the sun shines on them as well as the soil, sand, and water.

2. Facilitate the investigation.

NGSS Elements



PE K-PS3-1

SEP 2

SEP 3

DCI PS3.B

Differentiation

Language Arts

Connection

3D Learning

3D Learning: Students make observations to infer that sunlight causes earth materials to warm.

On a sunny day, tell students that they are now going to carry out the investigation that they planned and discussed in the last lesson segment. Put students into teams.

1. Give each team six cups. Have teams label their cups with a team number, letter, or icon.
2. Have each team put $\frac{1}{2}$ cup of dry sand in each of two cups, $\frac{1}{2}$ cup of dry soil in each of two cups, and $\frac{1}{2}$ cup of water in each of two cups.
3. Give each team six sheets of paper toweling to place under the cups.
4. Show students where to place three cups in the sun and three cups in the shade, each with a paper towel under it.
5. Have students insert a thermometer into each pair of material to find the temperature before placing them in the sun or shade and then again after some time in the sun or shade. Explain to students that the higher the number, the

Know the Science

TEACHER DEVELOPMENT

What Causes Earth Materials to Heat Unevenly? A property of substances, called *heat capacity* or *specific heat capacity*, is responsible for this phenomenon. The heat capacity of a substance is the amount of energy needed to raise a one-gram sample of the substance one degree Celsius. Water has a higher heat capacity than most other earth materials. Therefore, it takes more energy from the sun to raise its temperature compared to other earth materials. The substances that make up sand and soil have lower heat capacities than water and, therefore, heat up faster.

warmer the material. Students can develop math skills by counting on from one measure to another and comparing numbers to determine which is greater or lesser. (See **Know the Standards 1** and **2**.)

6. After fifteen minutes or more, have students retrieve the two cups holding the same material and feel the contents to observe their relative temperatures. It is not possible to accurately observe differences in temperature between different materials by feeling them. Don't attempt to explain why this happens, but do apply the results to a discussion of how different materials feel on a sunny day. For example, metal and blacktop may feel much hotter than light-colored concrete and grass.

SUPPORT—The words *warmer* and *cooler* have relative meanings and may need clarification for students. Act out some scenarios where students can say you would feel warmer (*I've made a campfire; I'm holding a cup of cocoa*) or cooler (*I have opened the freezer door; I am licking an ice pop*) until they are comfortable with describing relative temperatures with these words. (See **Know the Standards 3**.)

Activity Page



AP 1.2.1

7. Give each student a copy of How Does Sunlight Affect Sand, Soil, and Water? (AP 1.2.1), and have the students find the pictures to match the cups they have in front of them. Have them circle a temperature word under the cup in the sun and under the cup in the shade. Make sure students understand that they are comparing the two cups to observe which is warmer or cooler than the other.
8. Have each team repeat steps 6 and 7 for the remaining two materials.
9. Give students cleanup instructions, making sure each material is disposed of properly. **SAFETY NOTE:** Have students wash their hands with warm water and soap after cleaning up.

Know the Standards

TEACHER DEVELOPMENT

1. Common Core Mathematics: Counting the numbers on a thermometer scale supports Kindergarten math standard CCSS.Math.Content.K.CC.A.1: *Count to 100 by ones and by tens.*

2. Scale, Proportion, and Quantity: In Grades K–2, students are to use relative scales for measurements other than length (*Relative scales allow objects and events to be compared and described [e.g., bigger and smaller; hotter and colder; faster and slower]*).

3. Differentiation: This support strategy is aligned with English language arts Vocabulary Acquisition and Uses standards CCSS.ELA-Literacy.L.K.5.b (*Demonstrate understanding of frequently occurring verbs and adjectives by relating them to their opposites [antonyms]*) and CCSS.ELA-Literacy.L.K.5.c (*Identify real-life connections between words and their use [e.g., note places at school that are colorful]*).

3. Guide discussion.

NGSS Elements



PE K-PS3-1

SEP 3

DCI PS3.B

CCC 2

3D Learning

3D Learning: Students make observations to infer that sunlight causes earth materials to warm.

Have students look at their results on their Activity Pages as you **ask the following questions:**

- How did the cups of sand compare in temperature?
 - » The sand in the sun should have felt warmer, and the sand in the shade should have felt cooler.
- How did the cups of soil compare in temperature?
 - » The soil in the sun should have felt warmer, and the soil in the shade should have felt cooler.
- How did the cups of water compare in temperature?
 - » The water in the sun should have felt warmer, and the water in the shade should have felt cooler.

If students did not notice a difference in the water temperatures, leave those cups in the sun and shade for more time.

Poll the teams to determine that all teams got the same results.

Remind students of the purpose of the investigation, stated at the top of Activity Page 1.2.1—to answer the question **How does sunlight affect sand, soil, and water?** Discuss how evidence from their investigation can help support a claim that will answer the question. **Ask the following:**

- If all the cups in the shade were cooler than the cups in the sun, what does that mean about sunlight?
 - » Sunlight warms materials on Earth's surface.

SUPPORT—Some children will need guidance and supporting questions for this discussion. First have students work in their teams to make a claim that will answer the question. Explain that evidence can be what they observed during their investigation. **Ask,** What evidence do you have that your claim is true? **Then ask a guiding question, such as,** When something is in the shade, what is it not getting?

- » sunlight

4. Check for understanding.

NGSS Elements



SEP 3

DCI PS3.B

CCC 2

Connection to
the Nature of
Science

Teacher
Development

Return to the “We Predict” chart you made with students in Lesson 1.1. Go over the statements on the chart, and have students tell you which ones were found to be true based on their investigation. Place check marks by these. Cross out any predictions for which there was no evidence. Point out to students that scientists make predictions that turn out to be false. Knowing what ideas are not true is helpful in understanding the world.

Review student responses on Activity Page 1.2.1 to determine student understanding of the following concept:

- Earth materials that sit in sunlight feel warmer than materials that sit in the shade.

Ask students to think about their science work today. **Then ask Today’s Question—How do sunlight and shade affect the warmth of sand, soil, and water?**

Ask students clarifying questions:

- What test did we do to answer this question?
 - » We put sand, soil, and water in the sun and in the shade and then checked their temperatures.
- How did you measure the warming?
 - » by feeling with our skin/hands
- What pattern did you find by listening to the other teams’ answers?
 - » We found a pattern that all teams found materials in sunlight warmed the most.

Tie to the Anchoring Phenomenon

By now, students should be comfortable providing evidence that the sun warms at least three materials on Earth’s surface (sand, soil, and water). Encourage students to use their observations to predict how other materials on Earth’s surface are affected by sunlight:

- **Ask students,** How do you think rocks are affected by sunlight?
 - » Rocks probably warm, too.
- **Ask students,** How do you think the material our school is made of is affected by sunlight?
 - » It will also be warmed.

LESSON 1.3

Lesson 1 Roundup: Sunlight on Earth's Surface

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How does sunlight affect Earth's surface?

Today's Question: What does an umbrella do to light?

Tie to the Anchoring Phenomenon: The Student Book provides additional examples that the sun's energy causes Earth's surface, along with living things and their structures, to warm.

AT A GLANCE

Learning Objectives

- ✓ Identify patterns caused by sunlight on Earth.
- ✓ Communicate through drawing observations of how sunlight warms Earth's surface.

Instructional Activities

- sing-along
- teacher Read Aloud
- drawing

NGSS References

Disciplinary Core Idea: PS3.B Conservation of Energy and Energy Transfer

Science and Engineering Practices:

2 Developing and Using Models; 6 Constructing Explanations and Designing Solutions; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts: 2 Cause and Effect; 1 Patterns

Connection to Nature of Science: Scientific Investigations Use a Variety of Methods

Students read about how the sun heats Earth. Students then discuss experiences with that phenomenon.

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

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Core Vocabulary and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cooler **warmer**

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

Earth **heat wave** **materials** **shade**
star **surface**

Instructional Resources

Student Book



Ch. 3

Student Book, Chapter 3
"The Sun Heats Earth"

Activity Page



AP 1.3.1

Activity Page
Words for Your Drawing
(AP 1.3.1)

Materials and Equipment

- large sheets of drawing paper (1 per student)
- crayons or markers (1 set per student)
- scissors (1 per student)
- paste or glue (1 bottle per pair)
- question board
- internet access and the means to project images/video for whole-class viewing

For the Challenge activity:

- clear plastic cups (3)
- light-colored sand (1 cup)
- dark-colored dried soil (1 cup)
- water (1 cup)
- paper towels (3 sheets)
- digital thermometer

For the Extend activity:

- shallow boxes (2)
- white pebbles (to fill 1 box)
- black pebbles (to fill 1 box)

THE CORE LESSON 1.3

1. Focus student attention on Today's Question.

NGSS Elements



SEP 6

DCI PS3.B

CCC 2

3D Learning

3D Learning: Students construct explanations about other materials based on patterns found in their observations.

What does an umbrella do to light? Begin with a review of students' observations during their investigation in Lesson 1.2. Use the following prompts to guide the discussion:

- **Ask students,** What did you observe about sand, soil, and water placed in the sun and shade?
 - » The materials in the sun warmed up, and the ones in the shade did not warm as much.
- **Ask students,** What do you think would happen to other materials placed in the sun or shade?
 - » Probably the same thing would happen. Materials placed in the sunlight would warm more than the same materials in the shade.

Online Resources



Show students a brief music video of "Sun/Space Song." Have them sing along with the video as you point to the words on the screen.

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

- **Ask students,** How do you feel when the sun shines down on you?
 - » warm
- **Ask students,** What would Earth be like without the sun?
 - » dark and freezing cold

Remind students that you read in the Student Book how Hanna's school was closed because it was too hot inside. Explain that in Chapter 3, they will read about what the sun is and how it affects other things on Earth's surface.

Tie to the Anchoring Phenomenon

As you read and discuss Chapter 3 with students, reinforce the concept that the air around us is warmed as Earth's surface is warmed by the sun. Sometimes that warming makes the air much hotter than usual, resulting in a heat wave.

2. Read together: "The Sun Heats Earth."

Student Book



Ch. 3

While some advanced students may be able to read the Student Book fluidly, as a rule, students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

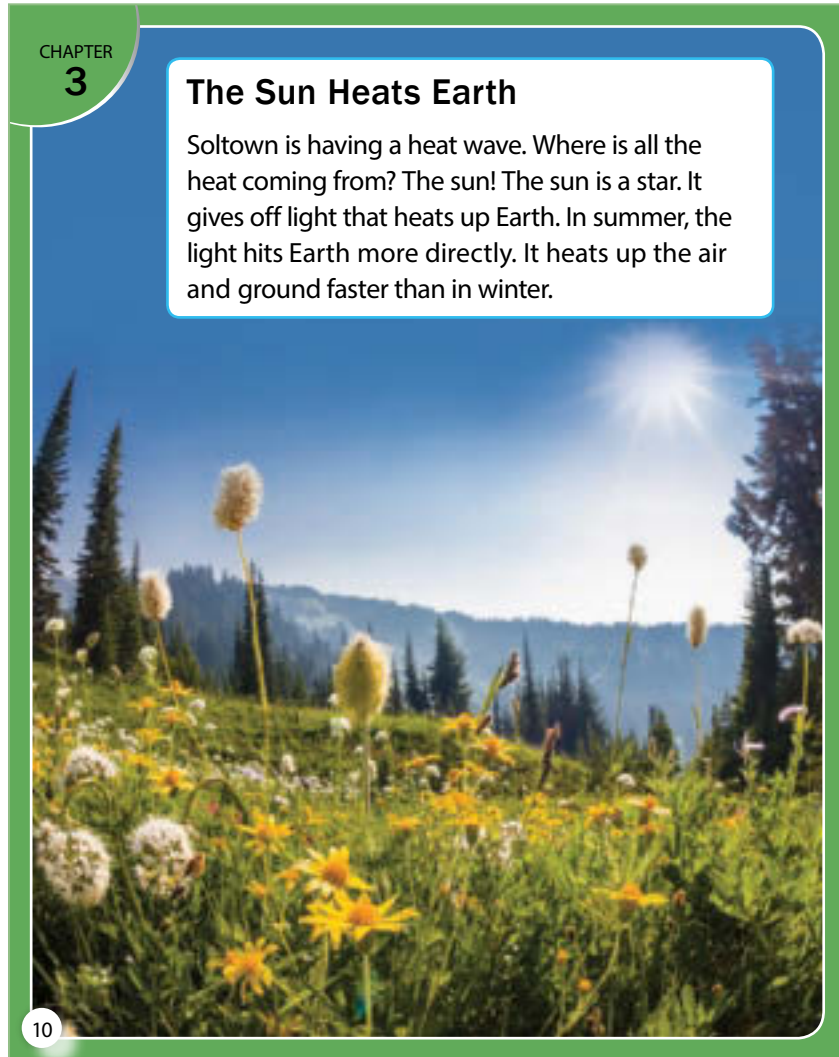
Page 10

NGSS Elements



SEP 8
DCI PS3.B
CCC 2

Ask students to turn to page 10 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “The Sun Heats Earth,” and tell them to pay special attention to how the sun affects Earth’s surface.



CORE VOCABULARY—Remind students that a **heat wave** is hot weather that lasts for two or more days.

Explain to students that a **star** is a hot object in space that gives off its own light.

CORE VOCABULARY—Remind students that **Earth** is the planet we live on. It is an object in space that does not give off its own light.

LITERAL—What kind of object in space is the sun?

» It is a star.

LITERAL—What objects in the picture are warmed by the sun?

» grasses, flowers, trees, mountains

INFERENTIAL—What materials that you cannot see in the picture are also warmed by the sun?

» soil and air

Page 11

NGSS Elements



SEP 3

SEP 8

DCI PS3.B

Differentiation

Ask students to continue to look at the pictures on page 11 as you read aloud.

The sun is the closest star to Earth. It appears in the eastern sky every morning. It sets in the western sky every night.



Sometimes clouds block the sun. You cannot see the sun on cloudy days, but it is there. Some of its light is strong enough to get through the clouds. You can still tell that it is daytime.



11

LITERAL—Which is the closest star to Earth?

» the sun

INFERENTIAL—Why do you think the sun looks so much bigger than other stars?

» because it is closer

SUPPORT—Modeling the comparison of the sun’s location to other stars will help students with this concept. Take students into a school corridor with two identical flashlights. Give one student a flashlight, and send them to the end of the corridor to point the light toward you and the rest of the class. Have another student stand only a few feet away and shine the flashlight toward the rest

of the class. Guide students to compare the brightness of the two lights and explain that one looks brighter because it is closer.

INFERENTIAL—Where is the sun in the picture of a cloudy day?

» It is above/on the other side of the clouds.

Page 12

NGSS Elements



SEP 8
DCI PS3.B
CCC 1
Teacher
Development

Ask students to look at the pictures on page 12 as you read aloud.

The sun warms materials on Earth's surface.



It warms dirt, sand, and rock.



It warms the grass under your feet.



It warms water in lakes, oceans, and ponds.



It warms the air all around you.

12

CORE VOCABULARY—Remind students that **materials** are what things are made of.

LITERAL—What materials on Earth's surface are warmed by the sun?

» dirt, sand, rock, grass, water

INFERENTIAL—If the children in the photos were to lie down on the grass or sand, would they be warmed by the sun, too?

» yes

Ask students, When does the air feel warmer, in the morning when you go to school or in the afternoon when you leave school? (See **Know the Science.**)

» in the afternoon; accept other reasonable answers

Page 13

NGSS Elements



SEP 3

SEP 8

DCI PS3.B

CCC 1

Differentiation

3D Learning

3D Learning: Students use information from their own experiences and investigations to find temperature patterns.

Ask students to look at the pictures on page 13 as you read aloud.

Materials become warmer in sunlight than they do in shade. Shade is an area where sunlight is blocked. When an object blocks sunlight, a shadow forms. Blocking sunlight keeps objects in the shade cooler.



13

Know the Science

TEACHER DEVELOPMENT

Why Does the Air Temperature Often Feel Warmest in Late Afternoon? The temperature of the air above Earth's surface depends in part on how much heat Earth reflects back into the atmosphere. Air temperatures are usually lowest in the morning around 7 a.m. and highest in the afternoon around 4 p.m. After the sun rises, sunlight warms the part of the planet where you are. Sunlight continues to warm Earth's surface all day until the sun sets. At night, Earth's surface slowly cools and has lost the most amount of heat right before sunrise.

CORE VOCABULARY—Remind students that **shade** is an area where sunlight is blocked and that they can find patterns in how warm objects are in the shade or sun.

Ask students, Where can we find shade near our school?

- » Sample answers: next to a school wall, under a climbing gym, under a picnic table, under a tree

CHALLENGE—Guide students to plan an investigation to find out how the temperature of materials left in the sun changes beyond the fifteen minutes or so they already observed in Lesson 1.2. Place one or more of the earth materials back in the sun, and use a digital thermometer to check their temperatures every ten to fifteen minutes over the course of an hour.

LITERAL—Why are we cooler in the shade than in the sun?

- » because shade blocks the sun that makes us warmer

INFERENTIAL—If you could not go in the water at the beach in the picture but wanted to be cooler at the beach, where would you sit?

- » under an umbrella or shade cover

3. Demonstrate examples and guide discussion.

NGSS Elements



SEP 2

SEP 6

DCI PS3.B

CCC 2

Differentiation

3D Learning

3D Learning: Students develop models to explain how the sun causes materials on Earth's surface to warm.

Refresh student understanding of how the sun interacts with Earth's surface and objects on it by having students develop models in the form of labeled drawings. Give each student a large sheet of paper to show the sun's effect on Earth's surface. Encourage students to draw what they did during their investigation in Lesson 1.2 and what happens to their own school, home, and community in the sunlight and shade.

EXTEND—Place white pebbles in a shallow box or on a plate, and place black pebbles on another plate. Have students feel the starting temperatures by placing one hand on each set of pebbles. (They should feel about the same temperature.) Place both containers in the sun for an hour or more, and have students observe the temperatures again. (The dark pebbles should feel warmer than the white pebbles.) Have students discuss their observations using cause-and-effect language.

4. Check for understanding.

NGSS Elements



SEP 6

DCI PS3.B

CCC 2

Teacher
Development

Activity Page



AP 1.3.1

In this lesson segment, students summarize their understanding of Performance Expectation K-PS3-1 (*Make observations to determine the effect of sunlight on Earth's surface*), developed over the course of three lesson segments.

Remind students of the music video they saw at the beginning of the lesson. Point out that the sun was addressed as “Mr. Sun” but that the sun is not a boy or girl—it is a star.

Give each student a copy of Words for Your Drawing (AP 1.3.1). Read the words aloud, and then have students cut them out and use as many as they can to label their drawings.

SUPPORT—For English language learners and other students, preteach the words on Activity Page 1.3.1. Before students cut out the words, play a “find the word” game where you give hints about one of the words. Include the sound of the first letter, and act out the meaning of the word. When students find the word on their sheets, have them place a counter on it or color it with a crayon. Have students say the word they have identified three times, and then continue the game for another word. (See **Know the Standards**.)

Call attention to Today's Question—**What does an umbrella do to light?** Invite volunteers to show their labeled drawings that answer the question. Look for evidence and discuss that students know that materials warm less in shade than in the direct sunlight. Reinforce the idea that students are acting as scientists when they draw and write about their investigations and explain how the world works.

Formative Assessment

Review student drawings to determine student understanding of the following concepts:

- People can carry out investigations to answer questions about sunlight and earth materials.
- Patterns identified in investigations can be used to explain the natural world.
- Sunlight warms Earth's surface.

Direct student attention to the K-W-L chart begun in Lesson 1.1. Invite students to dictate sentences to complete the We Learned column.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading the chapter and talking about the sun might answer or relate to any of those questions.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: This Support strategy addresses Kindergarten Vocabulary Acquisition and Uses standard CCSS.ELA-Literacy.L.K.6 (*Use words and phrases acquired through conversations, reading and being read to, and responding to texts*) by reinforcing terms students were exposed to in the Student Book.

Tie to the Anchoring Phenomenon

By now, students should be comfortable with the concept that the sun warms Earth's surface, including sand, soil, water, buildings, and living things. From this knowledge, students should be able to explain that the materials school buildings are made from and all the people and objects inside those buildings are warmed by the sun—sometime too much.

- **Ask students,** What might happen if sunlight warms our school too much?
 - » It might get so hot that people must go home to be safe.

LESSON 2

Designing for Sunlight

OVERVIEW

Guiding Question: How can we reduce the warming effect of sunlight on an area?

Lesson 2 Segments	Segment Questions	Advance Preparation
2.1 Defining the Problem and Brainstorming Solutions Students engage with the lesson phenomenon, reducing the warming effect of sunlight, then define the problem, and choose materials to use.	How can we use materials to reduce warming from sunlight?	Gather materials students will select from for the engineering design project. See Materials and Equipment.
2.2 Building a Model Structure Students read along, gather materials, plan and build their solutions to solve the problem of reducing warming by the sun.	What do people design to reduce warming from sunlight?	Read Chapter 4 in the Student Book. Locate a video or book for the story <i>The Three Little Pigs</i> . Gather materials for student investigation. See Materials and Equipment.
2.3 Testing Student Models Students test their structures and use a chart to display and analyze data.	How well does our plan to reduce warming from sunlight work?	Watch weather forecasts for a sunny day. Have students bring sun hats to wear. Gather materials for student investigation. See Materials and Equipment.
2.4 Lesson 2 Roundup: Comparing Solutions Students share results in an “engineering fair,” evaluate the designs, and decide which designs solved the problem.	How can we reduce the warming effect of sunlight on an area?	If you plan to invite visitors to your class engineering fair, send invitations in advance. Cut apart Activity Page 2.4.1 to make student badges.

What’s the Story?

Summary: In Lesson 2 (Segments 1–4), students collaborate to solve the problem of how to provide shade to prevent a certain area from warming by sunlight. Students apply their learning from Lesson 1 to understand the problem, ask clarifying questions, and relate the problem to the unit’s anchoring phenomenon: *School is canceled during a heat wave*. Students collaborate to build and test model

structures using the methods of engineering design, including analyzing their test results to discuss the strengths and weaknesses of their models. The lesson culminates in an engineering fair in which students share and discuss their structures (K-PS3-2, K-2-ETAS1-1, K-2-ETS1-2, K-2-ETS1-3).

Learning Progression: Lesson 2 guides students to successfully meet Performance Expectation K-PS3-2. As noted by NGSS, this Performance Expectation provides an opportunity to integrate engineering. It builds on student understandings of engineering design from earlier units in Kindergarten, developed in the units *Pushes and Pulls* (K-PS2-2) and *Changing Environments* (K-ESS3-3).

Guiding Phenomenon: Using an umbrella helps people feel cooler on a hot, sunny day.

Learning Objectives

By the end of Lesson 2, students will do the following:

- Define a problem and explain what a solution should be able to do (related to reducing warming caused by the sun).
- Ask questions based on prior observations to gather information about the problem and the desired outcome.
- Generate solution ideas that use only the provided materials and tools.
- Collaborate to build a structure to reduce warming over a certain area by making shade.
- Explain how the materials and their shapes affect their functions.
- Test their designs.
- Use a chart to communicate results of tests and compare performance results using cause-and-effect language.
- Communicate about their solutions by comparing their strengths and weaknesses and decide which one solved the problem.

NGSS Standards and Dimensions

Performance Expectation:

K-PS3-2 Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.

*Supports Engineering Design:

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

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

K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices

3 Planning and Carrying Out Investigations

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

6 Constructing Explanations and Designing Solutions

Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem.

1 Asking Questions and Defining Problems

Ask questions based on observations to find more information about the natural and/or designed world.

Define a simple problem that can be solved through the development of a new or improved object or tool.

2 Developing and Using Models

Develop a simple model based on evidence to represent a proposed object or tool.

8 Obtaining, Evaluating, and Communicating Information

Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).

Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

4 Analyzing and Interpreting Data

Analyze data from tests of an object or tool to determine if it works as intended.

6 Constructing Explanations and Designing Solutions

Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.

Generate and/or compare multiple solutions to a problem.

Disciplinary Core Ideas

PS3.B Conservation of Energy and Energy Transfer

Sunlight warms Earth's surface.

ETS1.A Defining and Delimiting Engineering Problems

A situation that people want to change or create can be approached as a problem to be solved through engineering.

Asking questions, making observations, and gathering information are helpful in thinking about problems.

Before beginning to design a solution, it is important to clearly understand the problem.

ETS1.B Developing Possible Solutions

Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

ETS1.C Optimizing the Design Solution

Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

ESS3.A Natural Resources

Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.

Crosscutting Concepts

2 Cause and Effect

Events have causes that generate observable patterns.

6 Structure and Function

The shape and stability of structures of natural and designed objects are related to their function(s).

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

www.coreknowledge.org/cksci-online-resources

LESSON 2.1

Defining the Problem and Brainstorming Solutions

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How can we reduce the warming effect of sunlight on an area?

Today's Question: How can we use materials to reduce warming from sunlight?

Tie to the Anchoring Phenomenon: School is canceled, and anyone who must go outdoors should stay in the shade. Start students thinking about ways people seek shade outdoors.

AT A GLANCE

Learning Objective

- ✓ Define a problem about making a shade structure.

Instructional Activities

- class discussion
- student investigation

NGSS References

Performance Expectation: K–2-ETS1-1

Disciplinary Core Ideas: PS3.B Conservation of Energy and Energy Transfer; ETS1.A Defining and Delimiting Engineering Problems; ESS3.A Natural Resources

Science and Engineering Practice: 1 Asking Questions and Defining Problems

Crosscutting Concepts: 2 Cause and Effect; 6 Structure and Function

Students discuss how animals use shade to stay cool. Students then start to identify materials to use to keep an ice cube from melting.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cool shade sunlight warm

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

design problem solution

Instructional Resources

Activity Pages



AP 2.1.1
AP 2.1.2

Activity Pages

Sheep and Shade (AP 2.1.1)
Saving Our Ice Cube (AP 2.1.2)

Materials and Equipment

Collect or prepare the following items:

- zippered plastic snack or sandwich bag
- ice cube
- black paper, 9 by 12 inches (2 sheets per team)
- white paper, 9 by 12 inches (2 sheets per team)
- wood sticks (6 per team)
- tape (1 roll per team)
- paper towels (2 sheets per team)
- straws (6 per team)
- paper plates (1 per team)
- cloth squares (1 per team)
- scissors (1 per team)
- question board

Advance Preparation

Place an ice cube in a zippered plastic snack or sandwich bag, and store it in a freezer or insulated bag with an ice pack until just before this class session.

THE CORE LESSON 2.1

1. Introduce students to Lesson 2

NGSS Elements



SEP 6

DCI PS3.B

CCC 2

Monitor Progress

Ask a volunteer to state the **Big Question** that the class will answer in this unit—
How do we know when to take an umbrella with us?

Remind students that they learned about how sunlight affects materials on Earth's surface in Lesson 1:

- **Ask students,** What happened to the soil, sand, and water you placed in the sunlight?
 - » They were warmed.
- **Ask students,** What happened to the soil, sand, and water you placed in the shade?
 - » They did not warm up as much as in the sun.

Tell students that they may have some ideas about one way to answer the Big Question now but will have more details at the end of this lesson. Invite students to share their ideas.

Write the **Lesson 2 Guiding Question** where students can see it:

How can we reduce the warming effect of sunlight on an area?

Tie to the Anchoring Phenomenon

As students work through Lesson 2, they will solve an engineering problem related to reducing the effects of the sun's energy on ice cubes, which they will later connect to severe weather conditions such as heat waves.

Narrow the focus to **Today's Question—How can we use materials to reduce warming from sunlight?** Explain that the students will build something to do a job. Ask students to share other examples of when they or their family have built a structure for a purpose, such as building a birdhouse, building a doghouse, or putting up a tent for camping.

Explain that today students will decide what materials to use to build a shelter to protect an ice cube from sunlight.

2. Connect to life sciences.

Activity Page



AP 2.1.1

3D Learning: Students construct evidence-based accounts of what causes sheep to move to places where there is less warming sunlight.

Give each student a copy of Sheep and Shade (AP 2.1.1). Read aloud the directions, and have students use the space to the right of each photo to draw arrows and write labels.

NGSS Elements



SEP 6

DCI PS3.B

DCI ESS3.A

CCC 2

Differentiation

Teacher Development

3D Learning

Look for understanding of cause-and-effect relationships—sheep move into shady places so that they will not get too warm in the sun.

SUPPORT—Allow English language learners to dictate to you how to label the photos and other students to spell the words in their labels phonetically. Alternately, provide a word list that students can choose from, including *shade*, *sunlight*, *sheep*, *tree*, *cave*, *house*, *warmer*, and *cooler*. (See **Know the Standards**.)

- **Ask students,** What did you observe in your investigation with the cups of sand, soil, and water that helps you explain why the sheep are in these places?
 - » We observed that sunlight warms all those materials, so it probably warms the sheep, too. Maybe sheep do not like being warm, so they look for shade.
- **Ask students,** How are the sheep meeting their needs in these pictures?
 - » They are meeting their needs for shelter by finding shade to protect them from sunlight.

3. Guide students in defining the problem.

NGSS Elements



SEP 1

DCI PS3.B

DCI ETS1.A

CCC 2

3D Learning

3D Learning: Students ask questions about how certain materials will function to clarify the problem.

Show students a small zippered plastic snack or sandwich bag with an ice cube inside. Remind students to think about the results of their investigations with sand, soil, water, and ice in Lesson 1.

- **Ask students,** What will happen to this ice cube if we place the bag in sunlight?
 - » It will melt quickly.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: Taking dictation for students who are emerging English learners will support Kindergarten writing standards, including CCSS.ELA-Literacy.W.K.2 (*Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic*). Spelling words phonetically supports Kindergarten language standard CCSS.ELA-Literacy.L.K.2.d (*Spell simple words phonetically, drawing on knowledge of sound-letter relationships*).

- **Ask students,** What will happen to this ice cube if we place the bag in the shade compared to in sunlight?
» It will melt more slowly than in the sunlight.

Guide students to state the engineering problem by showing them a table set up with samples of materials they can use.

- **Ask students,** What could you build to save your ice cube from melting very fast outside?
» We could make something that will make shade over the ice.
- **Ask students,** How could you use these materials to build this?
» We could make a plan and choose the materials we want to use.

Activity Page



AP 2.1.2

Give each student a copy Saving Our Ice Cube (AP 2.1.2). Have students fill in the blanks with words that complete the sentence to state the problem. Explain that this is the problem students will solve in teams over the next couple of class sessions.

Invite students to ask questions about the problem. Questions can be about students' previous investigations of earth materials in sunlight and shade, about the materials they will be allowed to use to solve the problem, about the ice, and so on.

Answer questions yourself, but also refer students to local experts or librarians. Or take students online to research their questions.

4. Set up teams and guide materials selection.

NGSS Elements



SEP 6

DCI PS3.B

DCI ETS1.A

CCC 2

CCC 6

3D Learning

Teacher Development

Arrange students into teams of two or three students.

Read aloud the directions for step 2 on Activity Page 2.1.2. Have students discuss the materials listed in their teams and check off the ones they would like to use to solve the problem. Explain that students can change their minds once they get started building. Circulate among the teams, and encourage collaboration. (See **Know the Science.**)

Know the Science

TEACHER DEVELOPMENT

What Does It Mean to Think Scientifically About Materials? Materials science is a field of science related to chemistry and engineering. Materials scientists describe the molecular and atomic structure of materials (such as ceramics, metals, polymers, or composites) and explain how their structure affects the properties of the material and how those properties can be used to solve a problem. Kindergarteners are beginning to act as materials scientists when they think about the properties of the materials you have offered them (paper, wood, adhesives, etc.) and how they can use them to solve the problem of how to build a structure to shade an ice cube.

SUPPORT—If there are students who are not sure how to begin, give them a sentence starter that elicits cause-and-effect thinking about structures and their functions: *If we use _____, our structure will be able to _____.*

CHALLENGE—Explain to students that *inventor* is a word for someone who solves a problem by creating an invention—a device or a process. Have students ask questions about who invented devices or processes that interest them. List the questions on a chart titled “Who invented . . . ?” Choose a few of the questions to answer by doing online searches or taking the questions to a librarian for help in researching.

5. Check for understanding.

In addition to meeting the Performance Expectation K-PS3-2, which connects physical science to engineering, this lesson segment also addresses the K–2 engineering design Performance Expectation K–2-ETS1-1 (*Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool*). There are two more K–2 engineering standards that describe the engineering process. In Lesson 2.2, students will demonstrate understanding of K–2-ETS1-2, and in Lesson 2.3, they will demonstrate understanding of K–2-ETS1-3.

NGSS Elements



SEP 1

DCI PS3.B

CCC 6

Differentiation

Return to Today’s Question, and ask students, How can we use materials to reduce warming from sunlight? Guide students to understand that their teams will only be allowed to use the materials and tools displayed and listed on their Activity Page.

Call attention to the question board. Revisit the questions recorded there so far, and ask students if today’s lesson may help to answer some of them. Allow students to suggest revisions or additions to the questions on the question board.

Formative Assessment

Review student responses on Sheep and Shade (AP 2.1.1) to determine student understanding of the following concepts:

- Sunlight warms Earth’s surface.
- Natural (trees and caves) and human-designed structures (houses) block sunlight and make shade that living things can use to keep cool.

Summative Assessment

Review students’ completed sentences on Activity Page 2.1.2, where they defined the problem.

Review the questions students asked earlier about the problem they will solve. Ask students to choose the question that they think is most important to being successful and explain why.

Look for understanding of the following concepts:

- Shade slows down heating.
- Some problems can be solved by building objects.

- People can ask questions to better understand a problem.
- It also helps to think and talk about the problem before trying to make the object.

EXTEND—Consider integrating this lesson with language arts and the life science domain by reading aloud a poetry book for early elementary school students called *A Place to Start a Family: Poems about Creatures That Build* by David L. Harrison and illustrated by Giles Laroche (Charlesbridge, 2018). Selected as a 2019 Outstanding Trade Book for Students K–12 by the National Science Teaching Association, each poem describes how one kind of animal builds its shelter and other structures that attract mates. Students will learn what materials the animal uses, its method of building, and how the structures function.

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

Tie to the Anchoring Phenomenon

By now, students have learned that defining a problem and choosing materials are parts of the engineering process for solving problems. Ask students how the problem of building a structure to slow the warming of an ice cube is related to why Hanna’s grandmother took an umbrella with her when they went for a walk on a hot day.

LESSON 2.2

Building a Model Structure

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How can we reduce the warming effect of sunlight on an area?

Today's Question: What do people design to reduce warming from sunlight?

Tie to the Anchoring Phenomenon: In this lesson, students learn about some structures people have designed to reduce the warming effects of sunlight. Then students will design their own structures to do the same. This lesson helps lay a foundation for understanding that people can take actions to protect themselves from extreme weather, including heat waves.

AT A GLANCE

Learning Objectives

- ✓ Discuss and generate solutions that use provided materials to solve a problem.
- ✓ Collaborate in designing and building a structure to reduce warming from sunlight.

Instructional Activities

- teacher Read Aloud
- class discussion
- student investigation

NGSS References

Performance Expectations: K-PS3-2, K-2-ETS1-2

Disciplinary Core Ideas: PS3.B Conservation of Energy and Energy Transfer; ETS1.B Developing Possible Solutions

Science and Engineering Practices:

2 Developing and Using Models; 6 Constructing Explanations and Designing Solutions; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts: 2 Cause and Effect; 6 Structure and Function

Students read about how people work together to develop solutions. Students then build their designs to keep the ice cube from melting.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

materials structure

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

design solution

Instructional Resources

Student Book



Ch. 4

Student Book, Chapter 4
"People Work Together to Find Solutions"

Activity Page



AP 2.1.2

Activity Page
Saving Our Ice Cube (AP 2.1.2)

Materials and Equipment

- zippered plastic snack or sandwich bag
- ice cube
- white poster board, 12 by 12 inches (1 per team)
- black paper, 9 by 12 inches (2 sheets per team)
- white paper, 9 by 12 inches (2 sheets per team)
- wood sticks (6 per team)
- tape (1 roll per team)
- paper towels (2 per team)
- straws (6 per team)
- paper plates (1 per team)
- cloth square (1 per team)
- scissors (1 per team)
- question board

For the Extend activity:

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

Advance Preparation

Have the Saving Our Ice Cube (AP 2.1.2) Activity Pages students completed in the previous lesson segment ready for when they build their designs in this lesson segment.

THE CORE LESSON 2.2

1. Focus student attention on Today's Question.

NGSS Elements



SEP 6
DCI PS3.B
DCI ETS1.B
CCC 2

What do people design to reduce warming from sunlight? Begin with a review of what students learned in Lesson 2.1. Use the following prompts to guide the discussion.

- **Ask students,** What did you learn by looking at pictures of sheep?
 - » Sheep look for places in the shade to rest and stay cooler than in the sun.
- **Ask students,** What problem will we try to solve with the materials you saw?
 - » We will try to slow down the melting of an ice cube by making a structure that blocks sunlight from hitting it.
- **Ask students,** What do you think it means to design something?
 - » Accept all reasonable responses.

SUPPORT—For students who want to stretch to master new vocabulary, explain that the word *design* can be used as a verb or a noun. The verb form means “to make or create a plan or an object.” The noun form means “the plan or the object that was planned or created.” A design can also mean a pattern, such as in a drawing or doodle. Consider making *design* your “word of the week,” using it as often as possible in instruction and inviting students to use it, too. Encourage students to use appropriate affixes with each part of speech. (See **Know the Standards 1**.)

Remind students that they listened in the story to how Hanna’s grandma carried an umbrella on their walk to the farmers market. Explain that in Chapter 4, students will hear about other ways people make shade to keep cool.

Tie to the Anchoring Phenomenon

As you read and discuss Chapter 4 with students, reinforce the concept that people can design structures and other solutions for reducing the effects of sunlight on Earth’s surface during a heat wave.

Know the Standards

TEACHER DEVELOPMENT

1. English Vocabulary Acquisition: This strategy addresses Vocabulary Acquisition and Uses standard CCSS.ELA-Literacy.L.K.4 (*Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on kindergarten reading and content*) and CCSS.ELA-Literacy.L.K.4.b (*Use the most frequently occurring inflections and affixes [e.g., -ed, -s, re-, un-, pre-, -ful, -less] as a clue to the meaning of an unknown word*).

2. Read together: “People Work Together to Find Solutions.”

Student Book



Ch. 4

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 14

NGSS Elements



SEP 8
DCI PS3.B
CCC 2

Ask students to turn to page 14 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “People Work Together to Find Solutions,” and tell them to pay special attention to the things people do when solving a problem.

CHAPTER
4

People Work Together to Find Solutions

Hanna was confused about why Grandma wanted to use an umbrella on a warm, sunny day. Now she understands! The umbrella blocks the sun. It helps Grandma feel cooler.

Blocking sunlight keeps it from warming objects on Earth’s surface. What are some ways you stay cool in hot weather?



LITERAL—What made Grandma feel cooler on a warm, sunny day?

» Her umbrella blocked the sun.

LITERAL—What happens to objects on Earth’s surface when sunlight is blocked?

» Objects are not warmed as fast as in the sun.

INFERENTIAL—What are some of your favorite ways you like to stay cool in hot weather?

» Sample answers: wear sleeveless shirts and shorts, go swimming, eat ice pops, play under a sprinkler, stay indoors in air conditioning, use a fan, sit under a tree, wear a big hat

Page 15

NGSS Elements



SEP 6

SEP 8

DCI PS3.B

DCI ETS1.B

CCC 6

Ask students to look at the pictures on page 15 as you read aloud.

People can work together to design solutions to solve problems caused by weather. They use materials to build their solutions. Then they test them to see whether they work. People designed these solutions to provide shade in warm, sunny places.

Cloth stretched over a playground keeps the place cooler for children.



People can enjoy a picnic in a cool space under this shelter.

Players can rest in the shade while they wait to play.



15

Explain to students that to **design** is to plan how to make something new.

Remind students that **solutions** are ways that people solve problems.

CORE VOCABULARY—Remind students that **materials** are the objects and other supplies that people use to build solutions.

Discuss with students the materials that were used to build the structures in each picture. Point out the cloth sails, the wood and metal roofing, and the cloth tent or awning.

Remind students that they will be testing their own designs when they take them outside and place them over an ice cube in a bag.

INFERENTIAL—What do all three structures in the pictures do to make people feel cooler?

» They make shade for people to sit in.

INFERENTIAL—What activities can people do comfortably on a hot, sunny day if under these structures?

» play and climb, eat a picnic, sit and rest

3. Facilitate designing and building structures.

NGSS Elements



SEP 2

DCI PS3.B

DCI ETS1.B

CCC 6

Differentiation

3D Learning

Teacher Development

3D Learning: Students discuss the function of materials and parts while developing solutions to solve the problem of reducing the warming effect of sunlight.

Show students an ice cube in a zippered plastic snack or sandwich bag again. Explain that the structures they design will have to cover the bag to shade the ice from the sun.

Have students form the same teams as in the previous session. Give each team a piece of 12-inch by 12-inch white poster board. Explain that their structure must fit on top of the white board and have room to place a bag with an ice cube under the structure. (See **Know the Science.**)

Activity Page



AP 2.1.2

Give students back their materials checklists on Saving Our Ice Cube (AP 2.1.2). Allow the teams about five minutes to talk about possible designs and to develop a plan using the materials on their list.

Invite one student from each team to go to the materials table to pick up the items on their list. Reassure students that they can get more items later if their design changes.

Then tell students they can begin building their model structures, making sure that the structures fit on the white board and allow a space to place the ice in the bag. The building should take about fifteen minutes.

Know the Science

TEACHER DEVELOPMENT

What Is the Purpose of Using a White Card? When students go outdoors to test their structures, they will be putting them on a variety of surfaces. Some of these will be darker or lighter than others. Dark-colored materials absorb more sunlight than light-colored materials and, therefore, warm faster. By placing the white card down on the ground first and the bag with ice on top of it, students will have a control for one variable in their tests.

SUPPORT—For inclusive team interactions, group English language learners with English-proficient students, students with whom they are friendly, and students with whom they share a common home language. Provide language support as needed to help English language learners in communicating with teammates.

Ask students, What do you expect your structure to be able to do?

» It should make shade to slow the warming of an ice cube.

CHALLENGE—If there are two teams that finish quickly, have them compare their two designs by using measurable attributes such as height (*Which one is taller/shorter?*) and by counting and comparing the number of different materials they used to make their structures. (See **Know the Standards 2.**)

4. Check for understanding.

NGSS Elements



SEP 2

SEP 6

DCI PS3.B

CCC 2

CCC 6

Call attention to Today's Question—**What do people design to reduce warming from sunlight?** Invite volunteers to answer the question based on reading Chapter 4 in the Student Book and their work designing model structures. Look for evidence that students know that structures, both large and small, can be designed to cast shade on the ground.

EXTEND—Show students a video for kids about people who design buildings to serve a function. Before showing the video, introduce the word *architect*, and explain that an architect is someone who designs buildings. Allow students to search online for interesting buildings architects have designed.

Online Resources



See the Online Resources Guide for a link to a recommended video.

www.coreknowledge.org/cksci-online-resources

Formative and Summative Assessment

The following set of discussion questions provides a formative assessment for K-PS3-2 and a summative assessment for K-2-ETS1-2. Have each team share the model they developed to solve the problem of shading an ice cube in a bag:

- **Ask students,** What is the shape of your team's structure? (K-2-ETS1-2)
- **Ask students,** What materials did you use to build it? (K-PS3-2)

Know the Standards

TEACHER DEVELOPMENT

2. Differentiation: This strategy may be a challenge if you have the teams work without any instruction from you. It addresses math measurement and data standards CCSS.Math.Content.K.MD.A.2 (*Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.*) and CCSS.Math.Content.K.MD.B.3 (*Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.*)

- **Ask students,** What job (function) does each part of your structure do? (K-2-ETS1-2)

Monitor Progress

Look for evidence in answers that there are parts that support and parts that provide shape.

- **Ask students,** What do you expect your structure to do? (K-PS3-2, K-2-ETS1-2)
- **Ask students,** How did the investigation in which you placed soil, sand, and water in the sun help you solve the problem? (K-PS3-2)

Have each team write a team number or letter on the white card and use it to carry the model to a location where it can stay until the next class session in which it is sunny enough to test it.

Tie to the Anchoring Phenomenon

By now, students should understand that people can solve problems related to too much sunshine on Earth's surface. Heat waves are but one example of severe weather. As the unit progresses, students can begin to think about applying their problem-solving skills to other kinds of weather.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading the chapter and talking about the sun might answer or relate to any of those questions.

LESSON 2.3

Testing Student Models

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How can we reduce the warming effect of sunlight on an area?

Today's Question: How well does our plan to reduce warming from sunlight work?

Tie to the Anchoring Phenomenon: In this lesson, students test their structures designed to reduce the warming effects of sunlight. This activity reinforces understanding that people use data when deciding how to react to extreme weather, such as heat waves.

AT A GLANCE

Learning Objectives

- ✓ State design expectations.
- ✓ Test design solutions.
- ✓ Record performance data.

Instructional Activity

- student investigation

NGSS References

Performance Expectations: K-PS3-2

Disciplinary Core Ideas: PS3.B Conservation of Energy and Energy Transfer; ETS1.C Optimizing the Design Solutions

Science and Engineering Practices: 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 2 Cause and Effect; 6 Structure and Function

Students test their shade structures and then compare data to find if there are any patterns related to the effects of shading from sunlight.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

melt pattern

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

severe weather

Instructional Resources

Activity Page



AP 2.3.1

Activity Page

Testing Our Structure (AP 2.3.1)

Materials and Equipment

- zippered plastic snack or sandwich bags (2 per team)
- ice cubes (2 per team)
- white poster board, 12 by 12 inches (1 per team)
- insulated cooler or bag to carry ice cubes in
- question board

Advance Preparation

To control variables, use ice cubes from the same source, and store them in the same way.

For each team, place one ice cube in each of two plastic bags, and zip them up. Place all the bags in a freezer, and transfer them to a cooler just before class.

Have teams gather their structures before heading out for testing.

THE CORE LESSON 2.3

1. Focus student attention on Today's Question.

NGSS Elements



SEP 3

DCI PS3.B

DCI ETS1.C

CCC 2

3D Learning

Teacher Development

3D Learning: Students plan an investigation to test how well their structures function to prevent warming from sunlight.

Kindergarteners may find the language of engineering (*problem, solution, design, structure, strengths, weaknesses*) challenging, but the actual “doing” should feel like playtime activities involving building blocks, sand tables, and arts and crafts projects. In this lesson segment, focus on the concept of testing to provide students with evidence supporting how well a solution solves the problem. Reduce competition and frustration by explaining that even tests that show something does not work are useful in planning what to build next.

How well does our plan to reduce warming from sunlight work? Begin with a review of what students learned in Lesson 2.2. Use the following prompts to guide the discussion:

- **Ask students,** What kinds of shade structures were shown in Chapter 4?
 - » a shade shelter with sail-like parts, one with a roof like a house, and one that resembles a box with fence sides
- **Ask students,** What was the hardest part of designing and building your structures?
 - » Answer will vary but may include agreeing as a group on the design, making the parts fit together, or fixing tears and breaks.

Describe to students that they will test how well their structure keeps an ice cube from melting. Explain that students will place one ice cube in the sunlight and the other under their structure.

- **Ask students,** What do you expect your structure to do for the ice cube?
 - » We expect our structure to slow the ice cube under it from melting.
- **Ask students,** How will your structure slow the ice from melting?
 - » It will make shade to keep the warm sunlight from hitting the ice.

Tie to the Anchoring Phenomenon

As students get ready to test the performance of the structures they designed, reinforce the concept that people can design solutions for dealing with all kinds of severe weather.

2. Guide testing of students' structures.

NGSS Elements



SEP 3

DCI PS3.B

DCI ETS1.C

CCC 2

CCC 6

Differentiation

3D Learning

Teacher Development

3D Learning: Students carry out an investigation to test a structure's function to reduce warming by sunlight.

The three dimensions of this Performance Expectation were met in the previous lesson segment. However, the evidence statement implies that students will test the performance of their structures. That is the purpose of this activity.

On a sunny day, have all student teams carry their structures and poster board bases outdoors to a location in the sun. Bring with you the cooler holding two ice cube bags for each team.

Give each team a second piece of 12-inch by 12-inch white poster board to place near the one they place their structure on.

Give each team two ice cube bags. Have students place one bag in the shade of their structure and the other bag on top of the white board that has no shade over it.

SUPPORT—The structures students have built may cast solid or partial shade and large or small areas of shade. Circulate among the teams, and make sure students have placed their ice in the largest area of deep shade. Depending on the time of day and angle of the sunlight, this may be to the side of their structure rather than under it.

SAFETY NOTE: Have students wear sun hats or stand in a nearby shady spot to avoid getting sunburned.

EXTEND—Invite students to design and build visors to wear in the sun while testing their shade structures. Give each student a paper plate and pencil to draw a half-moon shape on the plate. Next, have students use scissors to cut along the line. Then, give each student a cut large rubber band, or two ribbons. Help students fasten them to the points on the visor with hole punches or a stapler, depending on the materials you choose. Have students try on the visors to test their fit and make changes as needed to improve the design. When finished, allow students to use art materials to decorate their visors.

Explain to students that they are to watch their ice cubes until one melts completely. While students are waiting, guide a discussion to make sure they understand what they can learn from their test:

- **Ask students,** Based on what you know about shade and sunlight, which ice cube do you expect will melt first?
 - » the one that is in the sunlight, without shade
- **Ask students,** What made it hard about using only the materials and tools I gave you?
 - » Sample answer: We might have been able to build a bigger and better shade structure with wood and hammers.

Have each team announce when one ice cube melts completely. When all teams have made their observations, pick up all the materials, and return to class. Tell students how to dispose of the bags, and have teams store their structures for the next session.

Set up a large table for the class data as shown below.

Team	Which ice cube melted first?	
	Under the Structure	In Open Sunlight
A		
B		
C		
D		

3. Guide use of data charts to find patterns.

NGSS Elements



SEP 4

SEP 6

DCI PS3.B

DCI ETS1.C

CCC 2

Differentiation

3D Learning

Teacher Development

3D Learning: Students discuss the function of materials and parts while developing solutions to solve the problem of reducing the warming effect of sunlight.

Have each team report which of their two ice cubes melted first, the one under their structure or the one in the sun. Make an X in either the second or third column to record students' data.

Guide a discussion that requires students to analyze the data, look for patterns, and decide if their structures met their expectations: (See **Know the Science**.)

- **Ask students,** If the ice cube melted slower under your structure, what does it mean about how your structure worked?
 - » It means our structure kept the ice cube under it cooler so it did not melt as fast.
- **Ask students,** What pattern do you see in the table? Where are most of the X's, and what does that mean?
 - » Sample answer: Most of the X's are in the column for "In Open Sunlight." That means that most of the structures worked.

Know the Science

TEACHER DEVELOPMENT

What Makes Ice Melt? The temperature of a home or school freezer is typically about 0° F. This means that ice cubes stored there for a few hours are also about 0° F. Ice (frozen water) melts at 32° F or above. When you move the ice from the freezer to a cooler to take it outdoors, the ice may warm slightly but should still be well below its melting point when you hand it to your students. As the ice sits on the white poster board squares, energy from sunlight, the card, the ground, and the air is transferred into the ice cube, causing it to increase in temperature and melt. Under most weather conditions, direct sunlight striking the ice provides the most energy and causes the ice to melt faster than the other sources such as the surrounding air.

- **Ask each team in turn,** Did your structure work as you planned?
 - » Sample answer: Yes, we hoped it would make things under it less warm, and it did.

SUPPORT—Invite English language learners and other students to come up to the table and point to the labels and data to help them in communicating answers to the questions.

4. Check for understanding.

Activity Page



AP 2.3.1

NGSS Elements



PE K-PS3-2

SEP 2

SEP 6

DCI PS3.B

CCC 2

CCC 6

Differentiation

Monitor Progress

Call attention to **Today's Question**—**How well does our plan to reduce warming from sunlight work?** Ask each team to reflect on how well its structure worked. If some teams were not satisfied that their structure worked well, ask them to explain how they might change their design. Changing a design is called optimizing.

Summative Assessment

To assess Performance Expectation K-PS3-2, give each student a copy of Testing Our Structure (AP 2.3.1). Read aloud the directions, and have students draw their structure in Box A. Have students label their drawings, indicating in which setup the ice cube warmed the most (melted fastest). Review and discuss student responses to determine student understanding of the following concepts:

- Testing a design helps determine how well it solves the problem.
- The purpose of their structure was to make shade for an ice cube.
- Structures that solve the problem cause less warming by the sun.

CHALLENGE—For students who like an informative picture book that they can return to over and over as they get older, introduce them to *So You Want to Be an Inventor?* written by Judith St. George and illustrated by David Small (Philomel Books, 2002). The book has amusing descriptions of inventors and their inventions and positive messages for children about following their dreams.

Tie to the Anchoring Phenomenon

By now, students should be developing confidence that they can solve problems by designing structures. Remind students that if they were to make their structure big enough for people to get under, they would help keep people cool on a hot, sunny day.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading the chapter and talking about the sun might answer or relate to any of those questions.

LESSON 2.4

Lesson 2 Roundup: Comparing Solutions

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: How can we reduce the warming effect of sunlight on an area?

Today's Question: How can we reduce the warming effect of sunlight on an area?

Tie to the Anchoring Phenomenon: In this lesson, students compare structures designed to reduce the warming effects of sunlight. This activity reinforces understanding that people compare and analyze data when deciding how to react to evaluate design solutions.

AT A GLANCE

Learning Objective

- ✓ Use cause-and-effect statements to describe how well students' structures performed when tested.

Instructional Activity

- student investigation

NGSS References

Performance Expectation: K-2-ETS1-3

Disciplinary Core Ideas: PS3.B Conservation of Energy and Energy Transfer; ETS1.C Optimizing the Design Solutions

Science and Engineering Practices: 1 Asking Questions and Defining Problems; 4 Analyzing and Interpreting Data

Crosscutting Concepts: 2 Cause and Effect; 6 Structure and Function

Students discuss and then hold an engineering fair to show their shade structures and to evaluate other designs.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

engineer

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

pattern

Instructional Resources

Activity Pages



AP 2.4.1
AP 2.4.2

Activity Pages

Engineering Fair Badges
(AP 2.4.1)

Engineering Fair Visitor Card
(AP 2.4.2)

Materials and Equipment

- masking tape loops (1 per student)
- question board

THE CORE LESSON 2.4

1. Focus student attention.

NGSS Elements



SEP 4

DCI PS3.B

DCI ETS1.C

CCC 2

3D Learning

Teacher Development

3D Learning: Students analyze data of a test to determine patterns in how well their structures functioned to prevent warming from sunlight.

Begin with a review of what students learned in Lesson 2.3. Use the following prompts to guide the discussion:

- **Ask students,** What test did you do to find out how well your structure worked?
 - » We took our structures outside in the sun and put an ice cube in the shade we made. We also put an ice cube in the sun. Then we watched to see which melted first.
- **Ask students,** What pattern did you find in how fast the ice cube melted?
 - » Most structures should have slowed the melting of the ice cubes under them.

Explain to students that they will participate in an engineering fair to share their structures with other teams, explain what happened when they tested them outside, and tell how they might like to make their structure work better. Point out to students that people who are engineers may either control the engine on a train or solve problems by designing machines, building structures, and inventing other objects. (See **Know the Science** on the following page.)



SUPPORT—*Engineer* is a big word for Kindergarteners, but research shows that, with repeated exposure, they can become familiar with it and even use it themselves. Showing students videos that showcase engineers and engineering will help all students, but especially English language learners, master this new vocabulary.

See the Online Resources Guide for a link to recommended resources.

www.coreknowledge.org/cksci-online-resources

Tie to the Anchoring Phenomenon

As students get ready for their engineering fair, reinforce the idea that this is not a competition but a way to share what they learned. Point out that many shelters they have seen or made have just a roof but no walls. Contrast this with a building with walls, and explain that such buildings can get hot inside even though their roofs shade people under them.

2. Hold an engineering fair.

Activity Pages



AP 2.4.1

AP 2.4.2

NGSS Elements



SEP 1

DCI PS3.B

DCI ETS1.C

CCC 2

CCC 6

Differentiation

3D Learning

Language Arts
Connection

Teacher Development

3D Learning: Students ask questions and communicate explanations about how their structures function to prevent warming from the sun.

Set up your classroom or a long hallway so that each team can display its structure and white poster board.

Welcome students and any visitors to the engineering fair. Give each person a welcome badge from Engineering Fair Badges (AP 2.4.1). Have students write their name and the name of their team on it and attach it to their shirt with a tape loop.

Assign each student in a team a number—1, 2, 3, and so on. Explain that when their number is called, those students should walk around and visit the other teams. Those who remain at the stations will talk to the visitors and answer their questions.

Give each student and visitor a copy of Engineering Fair Visitor Card (AP 2.4.2). Read aloud the directions, and explain that students are scoring how well they understand the purpose of the structure, how it works, and how well it solved the problem of using a given set of materials to build a structure that slows down the melting of an ice cube.

Know the Science

TEACHER DEVELOPMENT

What Is an Engineering Fair? The engineering fair in this lesson is inspired by school science fairs, the difference being that engineering fairs showcase the work of people who design useful things rather than do science research. Most fairs for K–12 students combine science and engineering. Possibly the oldest science and engineering fair in the United States, called the Science Talent Search, was founded in 1942 by the Society for Science & the Public. The first corporate sponsor was Westinghouse, and more recently the fair has been sponsored by Intel and Regeneron.

SUPPORT—English language learners may need to be paired with an English-proficient buddy or need you to model how to start a conversation with the teams they visit. Accompany these students to the first team they visit, and model simple question starters, such as, “How did you . . . ?” “What happened when . . . ?” and “How well did . . . ?” (See **Know the Standards 1.**)

Have the students with the number 1 circulate among the displays, ask questions, listen to explanations, and complete the Activity Page. Repeat until all students have had a chance to visit each station.

3. Check for understanding.

NGSS Elements



PE K–2–ETS1–3

SEP 4

DCI PS3.B

DCI ETS1.C

CCC 2

CCC 6

Differentiation

Language Arts
Connection

Monitor Progress

Summative Assessment

To assess Performance Expectation K–2–ETS1–3, have students review their completed Engineering Fair Visitor Card (AP 2.4.2), and have them summarize how well they understand the solutions displayed in the fair by answering the following questions:

- **Ask students,** How well did you understand what each structure was designed to do?
 - » Answers will vary, but all teams should have explained that they were designed to reduce warming by the sun.
- **Ask students,** How well did you understand what happened when the structures were tested?
 - » Answers will vary, but students should know that structures probably varied in how well they met expectations.
- **Ask students,** Which structures seem to best solve the problem of making shade to keep things cool?
 - » Answers will vary, but students should know that some have more strengths than weaknesses.

Return to the Lesson 2 Guiding Phenomenon, *Using an umbrella helps people feel cooler on a hot, sunny day*. Invite students to explain this phenomenon and use supporting information from the specific problem they solved.

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation: Students who participate in talking with the teams at the engineering fair will have practice in meeting speaking and listening standards CCSS.ELA-Literacy.SL.K.3 (*Ask and answer questions in order to seek help, get information, or clarify something that is not understood*) and CCSS.ELA-Literacy.SL.K.6 (*Speak audibly and express thoughts, feelings, and ideas clearly*).



CHALLENGE—Show students a video read aloud of a book called *Umbrella* by Taro Yashima (Puffin Books, 1977), which tells the story of a preschooler who is attached to her umbrella. Have students pay attention to Momo’s ideas for how to use an umbrella. Ask students what they could tell Momo about how to use her umbrella on a hot day. (See **Know the Standards 2.**)

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

Return to the Guiding Question for Lesson 2—**How can we reduce the warming effect of sunlight on an area?** Look for understanding of the following in student answers:

- Blocking sunlight reduces warming of objects on Earth’s surface.
- People can design structures that block sunlight and keep people cool outdoors.

Next, ask students, How are other shade structures alike and different from an umbrella? In a discussion, look for understanding of the following concepts:

- All shade structures are designed to block sunlight.
- Objects designed to solve the same problem can look different.
- Objects designed to solve the same problem can be compared by their strengths and weaknesses.

EXTEND—Take students “shopping” online for beach sun shelters. Have students compare the different ones they find by size, shape, or features and discuss their strengths and weaknesses for protecting people from sun and rain.

Tie to the Anchoring Phenomenon

By now, students should understand that communicating about problems and solutions is important for understanding how well they work. Explain to students that when school is canceled due to weather, people can solve problems to make themselves safe and comfortable in that weather.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading the chapter and talking about the sun might answer or relate to any of those questions.

Know the Standards

TEACHER DEVELOPMENT

2. Differentiation: Some students will just listen to the story reader, but others may be able to read along with the video or the book from a library. Asking students questions about literature supports reading literature standards CCSS.ELA-Literacy.RL.K.1 (*With prompting and support, ask and answer questions about key details in a text*) and CCSS.ELA-Literacy.RL.K.10 (*Actively engage in group reading activities with purpose and understanding*).

LESSON 3

Patterns of Weather

OVERVIEW

Guiding Question: What patterns can we find by collecting observations about the weather?

Lesson 3 Segments	Segment Questions	Advance Preparation
3.1 Observing Temperature Patterns In a Day (3 days) Students engage with the lesson phenomenon, develop fluency using relative temperature vocabulary, and observe air temperatures over the course of a day.	What can we notice about air temperature at different times of day?	Continue to make class weather observations using Activity Page UO.3 for weather symbols to add to your chart. Gather materials for the student investigation. See Materials and Equipment.
3.2 Organizing Weather Observations Students reorganize the weather data the class has collected and analyze them to find short-term patterns.	How can organizing our observations help us describe the weather?	Continue to make class weather observations using Activity Page UO.3 for weather symbols to add to your chart. Preview the video recommended in Step 1. See Materials and Equipment.
3.3 Interpreting Seasonal Patterns Students analyze and interpret weather data collected over a month and a year, looking for monthly and seasonal patterns.	How does this month's weather compare with weather in other seasons?	If your class has made weather observations for an extended period, collect those charts for Step 3. See Materials and Equipment.
3.4 Lesson 3 Roundup: Predicting the Weather (2 days) Students follow the Read Aloud of Chapter 5 and role-play being a television meteorologist.	What do television meteorologists do?	Read Chapter 5 in the Student Book. Find an online video of a local weather report for today to show in Step 1. See Materials and Equipment.

What's the Story?

Summary: In Lesson 3 (Segments 1–4), students continue to collect daily local weather data (begun at the beginning of this unit) and collect temperature data over the course of a day. Students interpret both sets of data to identify short-term patterns. Then students analyze weather data for a year to identify seasonal patterns and explore the concept of weather reporting to learn about forecasting severe weather in Lesson 4 (K-ESS3-2).

Learning Progression: Lesson 3 guides students to successfully meet Performance Expectation K-ESS2-1: *Use and share observations of local weather conditions to describe patterns over time.* It builds understanding about natural patterns needed to prepare for the Grade 1 target of 1-ESS1-2: *Make observations at different times of the year to relate the amount of daylight to the time of year* and the Grade 3 target of 3-ESS2-1: *Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.*

Guiding Phenomenon: Heat waves usually take place in the summer.

Learning Objectives

By the end of Lesson 3, students will do the following:

- Review that weather is what the air is like outside at any one time and place.
- Compare the air temperature at different times of day.
- Organize weather observations.
- Identify patterns in weather data.
- Describe the work of weather scientists.
- Describe and share weather patterns that occur across days, months, and seasons.

NGSS Standards and Dimensions

Performance Expectation: K-ESS2-1 Use and share observations of local weather conditions to describe patterns over time.

<p>Science and Engineering Practices</p> <p>2 Developing and Using Models</p> <p>Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).</p> <p>3 Planning and Carrying Out Investigations</p> <p>Make observations (firsthand or from media) to collect data that can be used to make comparisons.</p> <p>4 Analyzing and Interpreting Data</p> <p>Use observations (firsthand or from media) to describe patterns and/or relationships in the natural world in order to answer scientific questions and solve problems.</p> <p>6 Constructing Explanations and Designing Solutions</p> <p>Use information from observations (firsthand and from media) to construct an evidence-based account for natural phenomena.</p> <p>8 Obtaining, Evaluating, and Communicating Information</p> <p>Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).</p>	<p>Disciplinary Core Idea</p> <p>ESS2.D Weather and Climate</p> <p>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.</p>	<p>Crosscutting Concepts</p> <p>3 Scale, Proportion, and Quantity</p> <p>Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).</p> <p>1 Patterns</p> <p>Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.</p> <p>Connection to Nature of Science</p> <p>Science Knowledge Is Based on Empirical Evidence</p> <p>Scientists look for patterns and order when making observations about the world.</p>
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For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

LESSON 3.1

Observing Temperature Patterns in a Day

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What patterns can we find by collecting observations about the weather?

Today's Question: What can we notice about air temperature at different times of day?

Tie to the Anchoring Phenomenon: School is canceled because of some hot weather conditions. Ask students if they think people knew about this in advance. Have students think about how people can know what kind of weather to expect.

AT A GLANCE

Learning Objectives

- ✓ Develop fluency using words for relative temperatures.
- ✓ Collect and record relative temperature data.
- ✓ Interpret data to identify a pattern in morning and afternoon temperatures.

Instructional Activity (3 days)

- student investigation

NGSS References

Disciplinary Core Idea: ESS2.D Weather and Climate

Science and Engineering Practices:

2 Developing and Using Models; 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 3 Scale, Proportion, and Quantity; 1 Patterns

Students develop a vocabulary for describing weather and record temperatures. Students then look at their data to find patterns to the 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cold cool hot warm

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

pattern

Instructional Resources

Activity Pages



AP 3.1.1
AP 3.1.2

Activity Pages

How Does the Air Feel?
(AP 3.1.1)

How Does Air Temperature
Change over a Day? (AP 3.1.2)

Materials and Equipment

- weather thermometer
- construction paper (9 by 12 inches, 1 sheet per student)
- scissors (1 per student)
- tape or glue (1 per pair)
- question board

Advance Preparation

Plan to repeat the air temperature observations in Step 4 on two additional days.

THE CORE LESSON 3.1

Day 1: 1. Introduce students to Lesson 3.

NGSS Elements



SEP 6
CCC 6

Monitor Progress

Invite a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How do we know when to take an umbrella with us?**

Have students recall that they designed structures to reduce warming by sunlight on Earth's surface in Lesson 2.

- **Ask students,** If these structures were large, how could they be used in hot, sunny weather?
» People could sit under one and stay cooler than if they were in the sun.
- **Ask students,** What idea did making shelters give you for how to use an umbrella in hot, sunny weather?
» It gave us an idea to use the umbrella as a shade structure to keep cool while walking in the sun.

Tell students that in this lesson they will explore how to know which days to take an umbrella when they go out walking.

Write the **Lesson 3 Guiding Question** where students can see it:

What patterns can we find by collecting observations about the weather?

Tie to the Anchoring Phenomenon

As students work through Lesson 3, they will begin to understand that the likelihood that school will be closed due to a heat wave is greater in summer months.

Narrow the focus to **Today's Question—What can we notice about air temperature at different times of day?** Remind students that they learned that weather is what the air is like outside in one place and at one time and have been recording the weather once a day for many days. Explain that today students will observe the temperature in the morning and afternoon.

2. Act out relative temperatures.

Activity Page



AP 3.1.1

NGSS Elements



SEP 2

DCI ESS2.D

CCC 3

Differentiation

Language Arts
Connection

Teacher
Development
3D Learning

3D Learning: Students model a relative temperature scale to describe the weather.

Give each student a copy of How Does the Air Feel? (AP 3.1.1). Review the relative temperature words *cold*, *cool*, *warm*, and *hot* by having students join you in acting out how they feel and what they might do under each condition.

- For *cold*, shiver and act out putting on a hat, a long scarf, and jacket, rubbing your hands together to get warm, and putting on gloves.
- For *cool*, take off the hat and scarf, turn up a collar, and rub your arms lightly.
- For *warm*, take off a sweater, roll up your sleeves, and lightly fan your face.
- For *hot*, take off your shoes and put on sandals, put on a bathing suit, and jump into a swimming pool.

SUPPORT—Invite English language learners to share words in their first language that correspond to *cold*, *cool*, *warm*, and *hot*. Allow students to draw pictures to show personal experiences when they were cold, cool, warm, or hot. One drawing activity all students will enjoy is to sort foods they like to eat into four categories: foods they eat cold, cool, warm, or hot. (See **Know the Standards 1.**)

3. Have students order words for comparing temperature.

Activity Page



AP 3.1.1

NGSS Elements



DCI ESS2.D

CCC 3

Differentiation

Teacher

Development

Language Arts

Connection

Math Connection

Give students scissors and a sheet of construction paper. Have students cut apart the four boxes on How Does the Air Feel? (AP 3.1.1) and place them in order from left to right, coldest to hottest, on the construction paper held in landscape orientation.

Circulate among the students, and when they show you the correct order of the words, allow them to paste them in place. Use the product as a reference when students go outdoors to report relative temperatures in the next step. (See **Know the Standards 2.**)

SUPPORT—For students who would benefit from phonics support, discuss the different sounds that the letter *o* makes in *cold*, *cool*, and *hot*. The word *cold* uses the long vowel sound. The short vowel sound is used in *hot*. The double vowel in *cool* uses the long *oo* sound. (See **Know the Standards 3.**)

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation Progress: In addition to the English language learner support strategy, this entire step of the lesson contains suitable teaching strategies for English language learners and supports all students in building vocabulary. For example, associating temperature words with choosing clothing supports CCSS.ELA-Literacy.L.K.5.c (*Identify real-life connections between words and their use [e.g., note places at school that are colorful]*), and sorting foods addresses CCSS.ELA-Literacy.L.K.5.a (*Sort common objects into categories [e.g., shapes, foods] to gain a sense of the concepts the categories represent*).

2. Comparing Objects: Having students compare relative temperatures supports Math Measurement & Data standard CCSS.Math.Content.K.MD.A.2: *Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference*. For example, directly compare the heights of two children and describe one child as taller/shorter.

3. Differentiation: Direct instruction of phonics addresses the Reading Foundational Skills standard CCSS.ELA-Literacy.RF.K.3.b (*Associate the long and short sounds with the common spellings [graphemes] for the five major vowels*).

4. Guide temperature observations in morning and afternoon.

Activity Page



AP 3.1.2

NGSS Elements



SEP 3

DCI ESS2.D

CCC 3

Differentiation

Teacher
Development

3D Learning

3D Learning: Students make observations of air temperature using a relative scale.

As early in the morning as possible, take students and the weather thermometer outside to a place in the shade. Ask students to describe the air temperature using one of the words they have on their construction paper: *cold*, *cool*, *warm*, *hot*. Since these are comparison words, have students think about how the air feels now, compared to when they went home from school the day before. You may also wish to share with students the temperature in degrees Fahrenheit, as measured with the weather thermometer.

Give each student a copy of How Does Air Temperature Change over a Day? (AP 3.1.2). Have students use pencils to write the temperature word that they choose in the early morning box. Optionally, have students also record the temperature as measured with the weather thermometer.

As late in the day as possible, take students out again to stand in the shade and observe the air temperature. Back in class, have students write a temperature word in the afternoon box. Discuss how these words are used to compare one temperature to another:

- **Ask students,** Was the temperature warmer or cooler than this morning?
 - » The temperature was likely warmer.
- **Ask students,** How did you choose one of the two words to show it was warmer—*warm* or *hot*?
 - » Sample answer: I chose *warm* because I still wanted to wear long sleeves and pants.

CHALLENGE—For students who are ready, have them write the day of the week and the date (month and day number) in the first column.

Days 2 and 3: Continue temperature observations.

Repeat the class observations and recording of the air temperatures in morning and afternoon for at least two more days. (See **Know the Science.**)

Know the Science

TEACHER DEVELOPMENT

What Causes the Pattern of Cool Mornings and Warm Afternoons? The air temperature changes in a pattern over each twenty-four-hour day. The most obvious change is that temperatures are warmer in the daytime when the sun is shining and cooler at night after sunset. However, the highest temperatures of the day usually are not at noon when the sun's light shines most directly on Earth's surface. The highest air temperatures occur later in the afternoon, typically around 4 p.m. The air is hotter this time of day because Earth's surface materials have absorbed energy all day long and are releasing some of it as heat.

Day 3: 1. Guide a discussion of patterns.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 6

3D Learning

3D Learning: Students analyze data to identify patterns in air temperature changes over the course of a day.

After recoding observations on three days, have students look at their data on Activity Page 3.1.2:

- **Ask students,** How did the air temperature change from morning to afternoon on the first day?
 - » It started cooler and got warmer.
- **Ask students,** How did the air temperature change from morning to afternoon on the second day?
 - » It started cooler and got warmer.
- **Ask students,** How did the air temperature change from morning to afternoon on the third day?
 - » It started cooler and got warmer.
- **Ask students,** What is the word for something which repeats in the same way?
 - » a pattern

Have students write to complete the sentence at the bottom of Activity Page 3.1.2.

Ask students, What evidence do you have to support this sentence?

- » We made observations and wrote them down in the chart above the sentence.

Point out to students that they are acting as scientists when they look for patterns about the weather where they live.

2. Check for understanding.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 6

Differentiation

Formative Assessment

Return to Today's Question—**What can we notice about air temperature at different times of day?** Guide a discussion, looking for understanding of the following concepts related to Performance Expectation K-ESS2-1.

- People can make observations of the weather to answer questions.
- The air temperature changes at different times of day.
- The air is usually cooler in the morning and warmer in the afternoon.
- This forms a pattern that we can observe every day.

Call attention to the question board. Revisit the questions recorded there so far, and ask students if today's lesson may help to answer some of them. Allow students to suggest revisions or additions to the questions on the question board.

EXTEND—Use a digital weather thermometer to quantify the changes in temperature from early morning until late afternoon. If possible, mount the thermometer outside in the shade where it can easily be read. Have students read the temperature each hour and record the number of degrees in a table. Have students compare the numbers for the day and describe the trend from morning to afternoon.

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

Tie to the Anchoring Phenomenon

By now, students have a good understanding that weather conditions change from day to day and hour to hour. Point out to students that it is a good idea to check the weather frequently so that they know what clothes to wear outdoors, whether to carry an umbrella, and if dangerous weather, such as a heat wave, is on the way.

LESSON 3.2

Organizing Weather Observations

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What patterns can we find by collecting observations about the weather?

Today's Question: How can organizing our observations help us describe the weather?

Tie to the Anchoring Phenomenon: Through analyzing data on weather charts and transferring them to a graphic that makes it easier to answer “how many” questions, students will come to understand that some weather conditions occur with greater frequency than others. These activities will support students’ understanding that heat waves or other severe weather events are usually rare.

AT A GLANCE

Learning Objectives

- ✓ Count and record weather conditions on a chart.
- ✓ Compare the number of days of different weather conditions.
- ✓ Identify patterns in local weather.

Instructional Activity

- ✓ student investigation

NGSS References

Disciplinary Core Idea: ESS2.D Weather and Climate

Science and Engineering Practices: 4 Analyzing and Interpreting Data; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 3 Scale, Proportion, and Quantity; 1 Patterns

Students organize weather observations to identify weather patterns 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cloudy rainy snowy sunny windy

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

meteorologist

Instructional Resources

Activity Page



AP 3.2.1

Activity Page

How Many Days of Each Kind of Weather? (AP 3.2.1)

Materials and Equipment

- weekly weather charts from this unit
- colored pencils, crayons, or markers
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Continue to make class weather observations using Activity Page UO.3 for weather symbols to add to your chart.

THE CORE LESSON 3.2

1. Focus student attention on Today's Question.

Online Resources



How can organizing our observations help us describe the weather? Show students a video about a young person who loves investigating weather.

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

After viewing, spark a discussion with the following prompts:

- **Ask students,** What kinds of weather does this young person like?
 - » snowy, windy, lightning, hurricanes, blizzards, clouds
- **Ask students,** What kind of job does a meteorologist do?
 - » Sample answer: A meteorologist observes the weather using weather tools.

Point out that a meteorologist is a kind of scientist and that meteorologists organize their observations and look for patterns in the weather. Explain that, today, the class will also reorganize their observations from the charts they used over the past few weeks. (See **Know the Science** on the following page.)

NGSS Elements



DCI ESS2.D

Tie to the Anchoring Phenomenon

Explain to students that, while heat waves that close schools are unusual weather, some places experience hot weather frequently. Tell students that today they will look at their weather charts and notice how often there was hot weather or other kinds of weather where they live.

2. Count and record data on a graphic.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 3

Differentiation

Math Connection

Activity Page



AP 3.2.1

Display your class's observed weather charts in a row on the wall. Explain to students that they will organize the information on them in a new way.

Give each student a copy of How Many Days of Each Kind of Weather? (AP 3.2.1). Point out the weather condition words along the top of the graphic. Explain that each box represents one day. Guide students in counting the number of days of each kind of weather (listed below) across all the weekly weather charts and filling in that number of boxes on the Activity Page graphic, starting at the bottom row marked "Day 1." Have students review the weekly weather charts you made to count the numbers of days of each kind of weather and color in that number of boxes in the graphic:

- sunny, clear days
- partly cloudy or very cloudy days
- rainy or snowy days
- light wind or very windy days
- no wind days
- cold or cool days
- warm or hot days

SUPPORT—For those who struggle with math, provide interlocking-cube manipulatives. Have students use the cubes to count the number of days of a weather condition and then snap the cubes together to make a rod. Demonstrate how to stand the rod on their desk vertically and to count again from the cube at the bottom of the rod. Show them how this corresponds to the boxes they will color in on Activity Page 3.2.1.

Know the Science

TEACHER DEVELOPMENT

What Else Do Meteorologists Do? Your students are not too young to learn about careers in science. Explain to students that some of the people who talk about the weather on television are meteorologists, but not all. A professional meteorologist goes to college for at least four years and must learn math and science. Many, when they graduate, do not work in television. They are outdoors and in laboratories investigating weather and climate and analyzing data to make forecasts that are needed by farmers, ship captains, space agencies, and school principals. All these people depend on weather and climate forecasts to make critical decisions.

3. Guide interpreting data.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 1

Differentiation

3D Learning

3D Learning: Students compare the relative number of observed days of different types of weather.

Have students use the graphic they just completed to answer questions about the time during which your class has made weather observations. Point out that this is the same kind of work meteorologists do:

- **Ask students,** Were there more sunny or cold days?
» Answers will vary.
- **Ask students,** Were there more sunny and clear days or days when it rained or snowed?
» Answers will vary.
- **Ask students,** Were there more windy or no wind days?
» Answers will vary.
- **Ask students,** Were there more cold and cool days or warm and hot days?
(See **Know the Standards.**)
» Answers will vary.

SUPPORT—For each question, have students point to the two columns on Activity Page 3.2.1 that they need to compare and identify the column that is taller.

If your class has not yet made weather observations for an extended period (twenty school days), continue recording them on weekly charts and transferring the data to the graphic on Activity Page 3.2.1.

CHALLENGE—For students who are eager to think longer range, challenge them to predict patterns in weather over the course of a year. Ask students how the numbers of cold/cool days and warm/hot days would compare in different months. For example, students might know that in July and August there may be more hot days and that in December and January there will be more cold days. Explain that the entire class will work on these types of “patterns” questions in the next lesson segment.

Know the Standards

TEACHER DEVELOPMENT

Math Connection: In this activity, students are comparing two objects with common measurable attributes (K.MD.A.2) and identifying whether objects are greater than, less than, or equal to objects in another group (K.CC.C.6), addressing CCSS.Math.Content.K.MD.A.2: *Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.* This activity also addresses CCSS.Math.Content.K.CC.C.6: *Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.*

4. Check for understanding.

NGSS Elements



SEP 6

DCI ESS2.D

CCC 1

Differentiation

Monitor Progress

Teacher
Development

Call attention to Today's Question—**How can organizing our observations help us describe the weather?** Invite volunteers to answer the question based on their work with their weather charts and graphics. Look for evidence of understanding of the following concepts:

- Weather conditions, such as relative air temperatures, can be counted and the numbers compared.
- Some weather conditions occur more frequently than others.
- Organizing observations in charts and graphics makes it easier to answer questions about our world.
- Meteorologists are scientists who investigate the weather.

EXTEND—Read aloud the picture book *Cloudy with a Chance of Meatballs*, written by Judi Barrett and illustrated by Ron Barrett (Atheneum Books for Young Readers, 1982). This tall tale is a modern classic and a perfect tie to the topic of observing and forecasting the weather. Make sure your students get the pun in the town's name, *Chewandswallow*.

Formative Assessment

Review students' data displays on Activity Page 3.2.1 for accuracy. See the Activity Page Answer Key for sample student responses.

Tie to the Anchoring Phenomenon

By now, students should understand that they can compare the frequency of weather conditions. Point out that heat waves that close schools are infrequent events.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how reading the chapter and talking about the sun might answer or relate to any of those questions.

LESSON 3.3

Interpreting Seasonal Patterns

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What patterns can we find by collecting observations about the weather?

Today's Question: How does this month's weather compare with weather in other seasons?

Tie to the Anchoring Phenomenon: Students will analyze data to look for patterns in weather during a month and throughout the year. These investigations will contribute to understanding that some weather events, such as heat waves, are more likely to occur at certain times of the year than others.

AT A GLANCE

Learning Objectives

- ✓ Answer questions about differences in weather in one place for two different months.
- ✓ Identify patterns in local weather in different months.

Instructional Activities

- class discussion
- student investigation

NGSS References

Performance Expectation: K-ESS2-1

Disciplinary Core Idea: ESS2.D Weather and Climate

Science and Engineering Practices: 4 Analyzing and Interpreting Data; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts: 3 Scale, Proportion, and Quantity; 1 Patterns

Students compare weather patterns over short periods of time and move on to identifying patterns of weather over monthly and yearly periods.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

month pattern rainy snowy

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

season

Instructional Resources

Activity Pages



AP 3.3.1

AP 3.3.2

Activity Pages

Rainy or Snowy Days (AP 3.3.1)

Sunny Days in _____ (AP 3.3.2)

Materials and Equipment

- colored markers or crayons
- question board
- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 3.3

1. Focus student attention on Today's Question.

Online Resources



3D Learning: Students use media to determine patterns in weather from season to season.

How does this month's weather compare with weather in other seasons? Show students a video about weather and seasons.

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

After viewing, invite a discussion with the following prompts:

- **Ask students,** What is winter weather like where Wendy lives?
» cold and snowy
- **Ask students,** What is spring weather like where Wendy lives?
» getting warm with spring showers (rain)
- **Ask students,** What is summer weather like where Wendy lives?
» hot and sunny
- **Ask students,** What is fall weather like where Wendy lives?
» chilly and windy

Replay the video to have students focus on the clothing Wendy wears in each season. Explain that the weather in each season differs from place to place. Discuss

NGSS Elements



SEP 8

DCI ESS2.D

CCC 1

3D Learning

Teacher

Development

with students the clothing they wear in each season in your region and compare it to what they saw in the video. (See **Know the Science.**)

Tie to the Anchoring Phenomenon

Ask students to think about the seasons where they live and predict which season is most likely to have a heat wave. In most regions, this will be summer, but for a few, such as the immediate Bay Area of California, fall weather may be hotter than summer weather.

2. Compare rainy/snowy weather in different months.

NGSS Elements



K-ESS2-1

SEP 4

DCI ESS2.D

CCC 1

Differentiation
Math Connection

Activity Page



AP 3.3.1

Tell students they are now going to find out what the weather is like on a fictional street. Give each student a copy of *Rainy or Snowy Days?* (AP 3.3.1). Explain that each box represents one of the twelve months in a year. Have students notice the pictures showing rain and snow falling. Explain that the number in each box tells how many rainy or snowy days there usually are in that month. Have students use the data to answer the following questions:

SUPPORT—Practice naming the months of the year by having students point to each box on Activity Page 3.3.1 as you say the name.

- **Ask students,** Which months have the same number of rainy or snowy days as December?
 - » February, June, and August
- **Ask students,** Which months have more rainy or snowy days than December?
 - » January, March, April, May, and July
- **Ask students,** Which months have fewer rainy or snowy days than December?
 - » September, October, and November
- **Ask students,** Which two months would be best for friends on the street to plan an outdoor party? Explain.
 - » September or October would be best because those two months have the least number of rainy or snowy days. So, they will have the most clear days.

Know the Science

TEACHER DEVELOPMENT

What Factors Affect Differences in Seasonal Weather from Place to Place? The climate of a place is its average weather over at least thirty years. Climate data is reported by the month of the year, making it easy to look at three-month seasons and notice differences. Some factors that affect a region's climate include its distance north or south of the equator (latitude), its distance above sea level (altitude), and its location relative to the ocean, large lakes, or mountain ranges.

SUPPORT—Since Common Core Math standards only require Kindergarteners to compare numbers between 1 and 10, support students by providing counters. Have students compare the numbers by lining up the counters in a one-to-one correspondence and seeing which has more counters than the other.

3. Compare the number of local sunny days in different months.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 1

Math Connection

Differentiation

3D Learning

Math Connection

3D Learning: Students use data to answer questions about patterns in the number of sunny days in different months.

If your class has recorded weather conditions over an extended period, you can have students compare the total number of sunny, clear days in different months in your local area. To do this, do the following:

- Count the number of sunny days students observed in any one month.
- Count the number of sunny days students observed in any second month.
- Compare the two numbers to determine which is greater.
- **Ask students,** What is the pattern of sunny days in these months?
 - » There are more sunny days in X month than Y month.

Online Resources



If your class has not yet made local observations for two or more months, you can use quantitative data from government websites. To obtain seasonal climate data for your location, visit a NOAA webpage called “Comparative Climatic Data.”

See the Online Resources Guide for a link to recommended resources.

www.coreknowledge.org/cksci-online-resources

Activity Page



AP 3.3.2

Choose the link to “Cloudiness - Mean Number of Days (Clear, Partly Cloudy, Cloudy).” Then find the closest city to your school in the first column. Highlight the entire row to view the number of clear (CL), partly cloudy (PC), and cloudy (CD) days in each month. Write the number of clear (CL) days for each month on Activity Page 3.3.2. Then, make copies for your students.

Give each student a copy of Activity Page 3.3.2 and have them write the name of your community in the title above the graphic. Guide a discussion of weather patterns that answers the following questions:

- **Ask students,** Which month(s) has (have) the most sunny days?
 - » Answer will vary.
- **Ask students,** Which month(s) has (have) the fewest sunny days?
 - » Answer will vary.
- **Ask students,** How do these patterns help you plan outdoor activities?
 - » We should plan to have outdoor activities in the months with the most days of sunny weather.

CHALLENGE—Explain to students that the top row in the graphic shows winter months, the second row shows spring months, the third row shows summer

months, and the bottom row shows fall months. Ask students to use evidence from the graphic to decide if one season has more rainy or snowy days than the other three seasons. Provide students with counters or suggest they count on to help them solve the problem. (See **Know the Standards.**)

4. Check for understanding.

Lesson 3.3 completes the learning experiences begun in Lessons 3.1 and 3.2 that fulfill Performance Expectation K-ESS2-1. The final segment in this lesson will give students an opportunity to expand on, summarize, and share their learning.

Call attention to Today's Question—**How does this month's weather compare with weather in other seasons?** Remind students that they have been comparing weather in different months of the year. Look for understanding of the following concepts:

- Some months have more of some kinds of weather than other months.
- People can notice patterns in weather.
- Patterns can be used to answer questions about the world around us.

EXTEND—Read aloud a book about the seasons, such as *Every Season*, written by Shelley Rotner and Anne Love Woodhull with photographs by Shelley Rotner (Roaring Brook Press, 2007). Your students can explore the photos and lyrical text to learn what the authors love about nature in each of the four seasons.

Summative Assessment

Review students' responses on Activity Pages 3.3.1 and 3.3.2 for accuracy. See the Activity Page Answer Key for sample student responses.

Tie to the Anchoring Phenomenon

By now, students should understand that they can look for patterns in weather across the seasons. Point out that heat waves, like the one that closed Hanna's school, occur in summer in most places.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how finding patterns in weather might answer or relate to any of those questions.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: Depending on the data students have and the strategies they devise, comparing the number of sunny days in two months may address CCSS.Math.Content.K.CC.C.7: *Compare two numbers between 1 and 10 presented as written numerals* or Grade 1 standard CCSS.Math.Content.1.NBT.B.3: *Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols $>$, $=$, and $<$.* If students use a counting on strategy to add the numbers for each season, they will address CCSS.Math.Content.K.CC.A.1: *Count to 100 by ones and by tens.*

NGSS Elements



SEP 4

DCI ESS2.D

CCC 1

Differentiation

Language Arts
Connection

Monitor Progress

Teacher
Development

LESSON 3.4

Lesson 3 Roundup: Predicting the Weather

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What patterns can we find by collecting observations about the weather?

Today's Question: What do television meteorologists do?

Tie to the Anchoring Phenomenon: Students will explore the roles of meteorologists in identifying weather patterns. Point out that they have important jobs, especially when warning communities that dangerous weather, such as a heat waves, are occurring.

AT A GLANCE

Learning Objectives

- ✓ Compare weather patterns from season to season.
- ✓ Demonstrate the kinds of information television meteorologists communicate.

Instructional Activities (2 days)

- ✓ class discussion
- ✓ teacher Read Aloud
- ✓ role play

NGSS References

Disciplinary Core Idea: ESS2.D Weather and Climate

Science and Engineering Practices:

2 Developing and Using Models; 4 Analyzing and Interpreting Data; 8 Obtaining, Evaluating, and Communicating Information; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 1 Patterns

Connection to the Nature of Science: Science Knowledge Is Based on Empirical Evidence

Students learn about how weather changes season to season and then determine what type of clothing they should wear during each season's 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

fall month pattern snowy

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

data predict season spring
summer temperature winter

Instructional Resources

Student Book



Ch. 5

Activity Pages



AP 3.4.1
AP 3.4.2

Student Book, Chapter 5

“Weather Changes from Season to Season”

Activity Pages

What Should I Wear Today?
(AP 3.4.1)

Today’s Weather Around the USA (AP 3.4.2)

Materials and Equipment

- colored markers or crayons
- toy microphone (optional)
- question board
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Research and bookmark appropriate weather forecasts in your local area for use in Step 1 and elsewhere.

THE CORE LESSON 3.4

Day 1: 1. Focus student attention on Today’s Question.

Online Resources



NGSS Elements



DCI ESS2.D
CCC 1

Connection to
Nature of Science

What do television meteorologists do? Show students a video of a local television weather report for today. Search via local station websites. After viewing, invite a discussion with the following prompts:

- **Ask students,** What parts of the weather does the report include?
 - » Possible answers: air temperature, sunny/cloudy, wind, rainy/snowy
- **Ask students,** What kind of work does a meteorologist (weather scientist) do?
 - » observe and record the weather, look for patterns in the weather, report to people what the weather is and what it will be

Tie to the Anchoring Phenomenon

Have students develop an argument to support the claim that meteorologists have important jobs in their community. To spark the conversation, ask students to consider how the school officials decide to cancel school for a heat wave.

2. Read together: “Weather Changes from Season to Season.”

NGSS Elements



SEP 8

DCI ESS2.D

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 16

Student Book



Ch. 5

NGSS Elements



SEP 8

DCI ESS2.D

CCC 1

Ask students to turn to page 16 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Weather Changes from Season to Season,” and tell them to pay special attention to the patterns of weather in each of the seasons.

CHAPTER
5

Weather Changes from Season to Season

When the sun sets at night, it no longer warms Earth’s air or ground. The temperature gets cooler. When the sun rises the next morning, the air begins to warm again. This is a pattern. It happens every day.



16

CORE VOCABULARY—Remind students that **temperature** is how hot or cold something is.

LITERAL—What happens to the air temperature after the sun sets at night?

» It gets cooler.

LITERAL—What happens to the air temperature after the sun rises in the morning?

» It gets warmer.

Remind students of their observations of the air temperature in the morning and afternoon from Lesson 3.1.

INFERENTIAL—How do you think the air would feel if you went outside before sunrise?

» It would feel cooler than in the daytime.

CORE VOCABULARY—Remind students that a **pattern** is something that repeats, and explain that to be sure there is a pattern to how the air temperature changes in the daytime and nighttime, they would have to observe the changes a few times.

Page 17

Ask students to look at the picture on page 17 as you read aloud.

NGSS Elements



SEP 6

DCI ESS2.D

CCC 1

Patterns of weather can also take longer to repeat. For example, heat waves like Hanna is experiencing only happen in the summertime where she lives. The weather is usually cooler where she lives. But when summer comes around again, so do the hot temperatures.



17

Before reading, invite students to retell the storyline from Chapter 1 about Hanna and the heat wave. If necessary, remind students that Hanna's school was canceled because the weather is too hot for students to be there.

LITERAL—At what times of the year do heat waves happen where Hanna lives?

» only in the summer

INFERENTIAL—What are some clues from the picture that it is summer now where Hanna lives?

» She is dressed in shorts and a tank top—hot weather clothes.

Pause in the reading, and have students compare what they wore to go outside this morning to what Hanna is wearing.

EVALUATIVE—Do you think Hanna likes to wait a whole year for the hot weather to come again? Explain.

» Sample answer: No, she would like it to be hot all year so she can play under the sprinkler all the time.

Page 18

Ask students to look at the pictures on pages 18–19 as you read aloud.

NGSS Elements



SEP 6

DCI ESS2.D

CCC 1

Teacher
Development

Patterns of weather happen year after year. These are seasons. Different seasons have different kinds of weather. The different seasons do not look just like these pictures in all places. But all places do have their own yearly patterns of seasons.



CORE VOCABULARY—Remind students that **seasons** are times of the year with certain weather patterns and that the names of the seasons are *winter*, *spring*, *summer*, and *fall*.

CORE VOCABULARY—Explain to students that **winter** is the season of the year that includes December, January, and February and that **spring** is the season that includes March, April, and May. (See **Know the Science**.)

LITERAL—How does the air temperature change when the season changes to spring?

» It gets warmer.

INFERENTIAL—Why do you think the trees have flowers on them in the spring picture but not the winter picture?

» because trees cannot flower when the air is too cold

Know the Science

TEACHER DEVELOPMENT

What Is the Difference Between Astronomical and Meteorological Seasons? Astronomical seasons are identified by changes in the apparent position of the sun in the sky at noontime throughout the year. Astronomical winter begins on about December 21, spring on about March 21, summer on about June 21, and fall on about September 21. Meteorological seasons in most of the United States are identified by grouping the twelve months of the year into threes based on air temperature patterns. The usual winter months are December, January, and February. The spring months are March, April, and May. The summer months are June, July, and August. The fall months are September, October, and November. This lesson segment focuses on meteorological seasons.



Winter months have the coolest days. Winter where you live might not be cool enough to snow, but it is cooler than summer. The days start to become warmer in spring. Summer has the warmest days. The days start to become cooler again in fall.



LITERAL—What is the air temperature like in winter?

» Cooler than other times of year

CORE VOCABULARY—Explain to students that **summer** is the season that includes the months June, July, and August and that **fall** is the season that includes September, October, and November.

LITERAL—Which season is warmer: summer or fall?

» summer

INFERENTIAL—Why does the Student Book say the word *again* in “The days start to become cooler again in fall”?

» because the seasons repeat themselves, making a pattern



Give each student a copy of What Should I Wear Today? (AP 3.4.1) and crayons or markers. Have students draw over the outlines of the children the clothes to wear outdoors in each season where they live. Suggest to students that they include headwear and footwear. Then help students label their page with the location.

SUPPORT—If you have any students who have moved recently from another climate, allow them to draw the clothing they used to wear in their former homes.

Page 20

Ask students to look at the pictures on page 20 as you read aloud.

NGSS Elements



SEP 6

DCI ESS2.D

CCC 1

Differentiation

Language Arts
Connection

Teacher
Development

Changing weather affects living things. In the fall in a lot of places, trees lose their leaves. Plants turn brown and stop growing. In the spring, new leaves grow on the trees. Plants turn green and grow new leaves. Flowers bloom. Many animals become inactive in colder weather. Young are born in the spring as weather warms.



20

LITERAL—What happens to some trees in the fall?

» They lose their leaves.

EXTEND—Point out to students that fall has another, older name, *autumn*. The newer name, *fall*, should remind them of what happens to some leaves in that season. Have students use the word *fall* twice in a sentence, each time with a different meaning. For example, “I see the leaves fall in the fall.” (See **Know the Standards**.)

Know the Standards

TEACHER DEVELOPMENT

Differentiation: Inviting students to use one word with two meanings addresses Vocabulary Acquisition and Use standard CCSS.ELA-Literacy.L.K.4.a: *Identify new meanings for familiar words and apply them accurately (e.g., knowing duck is a bird and learning the verb to duck).*

INFERENTIAL—What kind of weather do plants need to grow new leaves and make flowers?

» They need warmer weather.

INFERENTIAL—Look at the picture of the baby birds. Why is it important that they are hatched in warm weather?

» They do not have feathers to keep them warm.

Page 21

NGSS Elements



SEP 4

SEP 6

DCI ESS2.D

CCC 1

3D Learning

Connection
to Nature of
Science

3D Learning: Students analyze weather data to identify patterns.

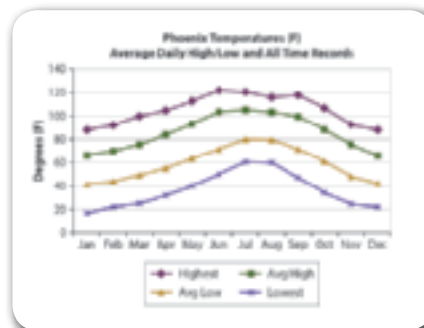
Ask students to look at the pictures on page 21 as you read aloud.

How do scientists predict what the weather might be like tomorrow? They keep track of the weather over many days and look for patterns. The information they record is called data. These data are displayed on maps and graphs. Looking at data that way helps patterns show up. Patterns help scientists predict what weather will be like tomorrow and in the future.

Weather forecasting can help people plan. Which day do you think would be best for a trip to the park?



Which months were warmest? Which were coolest?



21

Explain to students that *data* is another word for the observations they made when doing investigations, such as observing the weather every day for the last few weeks.

Explain that to predict is to tell what will happen in the future. Point out that the weather chart in the picture was shown on TV on a Thursday and that Friday is the next day. Therefore, the chart is predicting what weather there will be over the next seven days.

EVALUATIVE—Have students answer the first question in the text and explain their reasoning: Which day do you think would be best for a trip to the park?

- » The best day would be Tuesday because there will be more sun than clouds and no rain.

INFERENTIAL—Have students answer the second and third text questions and explain their reasoning: Which months were warmest? Which were coolest?

- » June, July, and August were warmest because these three months had the highest number of degrees. January and December were coolest because these two months had the lowest number of degrees.

Day 2: 1. Lead a television meteorologist game.

Activity Page



AP 3.4.2

NGSS Elements



DCI ESS2.D

CCC 1

Differentiation

Give each student a copy of Today's Weather Around the USA (AP 3.4.2). Have students cut out the four cards on the Activity Page. Explain that each card shows today's weather for a different place in the United States.

SUPPORT—Practice reading the names of the cities with students. Point out that each name begins with a different letter.

Remind students that a scientist who studies the weather is called a *meteorologist*. Invite students to take turns acting out the role of a television meteorologist. Invite volunteers to secretly choose one of their city cards and stand before the class holding the toy microphone and the card they have chosen. Have students deliver their television report for tomorrow's weather. When the report is finished, ask the rest of the class to guess which of the four cities the report was about and hold up the appropriate card. Repeat the game for as many students who wish to give a weather report.

2. Check for understanding.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 1

Differentiation

Language Arts
Connection

Monitor Progress

Teacher
Development

Lesson 3.4 gives students an opportunity to recap their learning of Performance Expectation K-ESS2-1, with a focus on the Connection to Nature of Science: Scientific Knowledge Is Based on Empirical Evidence: *Scientists look for patterns and order when making observations about the world* in Grades K–2. In the class discussion, look for evidence that students understand what a new use of the word *patterns* may be—patterns in scientific observations.

Call attention to Today's Question—**What do television meteorologists do?** Remind students that they have just played the role of a meteorologist, or weather scientist. Look for understanding of the following concepts in their answers to the question:

- Weather is a combination of sky conditions, whether it is raining or snowing, air temperature, and wind speed in a particular place.
- The weather on any one day can vary from place to place.
- Scientists look for patterns in their observations.

EXTEND—Read aloud to students *Freddy the Frogcaster*, a picture book about a frog who loves observing the weather, written by television meteorologist Janice Dean and illustrated by Russ Cox (Regnery Kids, 2013). If your students like the story, there are more books in the series.

Review students' responses on Activity Page 3.4.1 for accuracy. Depending on where they live, students should accurately portray the appropriate clothing for each of the four seasons.

Tie to the Anchoring Phenomenon

By now, students should understand that scientists look for patterns in weather observations and that unusually hot weather ordinarily occurs in the summer.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how finding patterns in weather might answer or relate to any of those questions.

LESSON 4

Severe Weather

OVERVIEW

Guiding Question: What should we do when severe weather is likely?

Lesson 4 Segments	Segment Questions	Advance Preparation
4.1 Observing Severe Weather Students engage with the lesson phenomenon, observe different kinds of severe weather, and generate questions about problems caused by severe weather.	What problems are caused by severe weather?	Decide which forms of local severe weather your class should focus on and then choose the appropriate Activity Pages. Preview the recommended online videos. See Materials and Equipment.
4.2 Collecting Information About Severe Weather Patterns Students interpret maps to find answers to their questions about local patterns of severe weather.	What kinds of severe weather are more likely where we live?	Locate an online severe weather map for Step 1 and consider making a screenshot of it to show your students. See Materials and Equipment.
4.3 How Are Weather Warnings Communicated? Students collect information on how scientists use weather warning tools and classify the tools by where they can be used.	How do weather forecasters warn us that severe weather might happen soon?	If your class has made weather observations for a few months, collect those charts for Step 3. Preview and download the video of an emergency siren. See Materials and Equipment.
4.4 Lesson 4 Roundup: Responding to Weather Warnings (2 days) Students recap their learning by following the Read Aloud of Chapter 6, explore how people respond to severe weather warnings, and choose items for a severe weather emergency backpack.	What should we do when severe weather is likely?	Read Chapter 6 in the Student Book. See Materials and Equipment.

What's the Story?

Summary: In Lesson 4 (Segments 1–4), students observe and ask questions about several kinds of severe weather. Students interpret maps to determine what types of severe weather are likely where they live. Students explore severe weather forecast and warning systems and collaborate to plan actions families can take to keep safe in severe weather (K-ESS3-2).

Learning Progression: At the completion of Lesson 4, students will have fully addressed Performance Expectation K-ESS3-2: *Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* This lesson also builds the understanding about how people use technologies to help solve weather-related problems that will prepare students for the Grade 3 target of 3-ESS3-2: *Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*

Guiding Phenomenon: In one city, outdoor sirens are tested every first Saturday of the month at 1 p.m.

Learning Objectives

By the end of Lesson 4, students will do the following:

- Describe types of severe weather and the damage they can cause.
- Ask questions about local severe weather threats and warnings.
- Obtain information about local severe weather patterns.
- Describe advantages of the ability to predict severe weather.
- Identify the technologies used to communicate severe weather warnings.
- Explain how people can use severe weather warnings to stay safe.

NGSS Standards and Dimensions

Performance Expectation: K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

*Integrated with engineering through a practice or disciplinary core idea.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1 Asking Questions and Defining Problems Ask questions based on observations to find more information about the designed world. 6 Constructing Explanations and Designing Solutions Generate and/or compare multiple solutions to a problem. 7 Engaging in Argument from Evidence Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. 8 Obtaining, Evaluating, and Communicating Information Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).	ESS3.B Natural Hazards Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. ETS1.A Defining and Delimiting Engineering Problems Asking questions, making observations, and gathering information are helpful in thinking about problems.	1 Patterns Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. 2 Cause and Effect Events have causes that generate observable patterns. Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World People depend on various technologies in their lives; human life would be different without technology. Interdependence of Science, Engineering, and Technology People encounter questions about the natural world every day.

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

www.coreknowledge.org/cksci-online-resources

LESSON 4.1

Observing Severe Weather

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What should we do when severe weather is likely?

Today's Question: What problems are caused by severe weather?

Tie to the Anchoring Phenomenon: In this lesson segment, students will learn that there are several other kinds of severe weather in addition to heat waves.

AT A GLANCE

Learning Objectives

- ✓ Use media to obtain information about severe weather.
- ✓ Describe kinds of severe weather.
- ✓ Ask questions about the problems caused by severe weather.

Instructional Activities

- student observation
- question generation

NGSS Standards and Dimensions

Disciplinary Core Ideas: ESS3.B Natural Hazards; ETS1.A Defining and Delimiting Engineering Problems

Science and Engineering Practices: 1 Asking Questions and Defining Problems; 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concept: 2 Cause and Effect

Connection to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology

Students observe different types of severe weather and ask and answer questions related to each type of severe 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

blizzard heat wave hurricane tornado

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

severe weather

Instructional Resources

Activity Pages



AP 4.1.1

AP UO.3

Activity Pages

Comparing Severe Weather
(AP 4.1.1)

Measuring Weather (AP UO.3)

Materials and Equipment

- scissors (1 per student)
- paste or glue (1 per pair)
- question board
- internet access and the means to project images/video for whole-class viewing

For the Challenge activity:

- tall narrow clear plastic bottle with cap
- dish liquid (2–3 drops)
- glitter or food dye (half teaspoon or 2–3 drops)

Advance Preparation

- Preview the severe weather online videos to make sure they are appropriate for your students.
- Reuse the Activity Page from the unit opener. If you wish students to cut and paste the labeled icons from Measuring Weather (AP UO.3), you will have to make extra copies of this sheet because some icons are needed more than once.

THE CORE LESSON 4.1

1. Introduce students to Lesson 4.

NGSS Elements



DCI ESS3.B

CCC 1

Monitor Progress

Invite a volunteer to state the **Big Question** that you'll be answering in this unit, which is posted somewhere in the room—**How do we know when to take an umbrella with us?**

Remind students that they learned in Lesson 3 that some kinds of weather are more likely in one season or another:

- **Ask students,** What season is most likely to have snowy weather?
 - » winter
- **Ask students,** What season is most likely to have heat waves?
 - » summer

Point out to students that, in some kinds of weather, it is not safe to go out, even with an umbrella. Tell students that in this lesson they will explore how people deal with dangerous, or severe, weather.

Write the **Lesson 4 Guiding Question** where students can see it:

What should we do when severe weather is likely?

Tie to the Anchoring Phenomenon

As students work through Lesson 4, remind them that heat waves are not the only types of weather events that might cause school to be canceled.

Narrow the focus to Today's Question—**What problems are caused by severe weather?** Explain to students that the word *severe* means that the weather can be dangerous to people.

Online Resources



Play the video of the testing of outdoor sirens. Explain that sirens like this are very loud and are made to be heard for miles. In this video, the siren is being tested as they do every month. **Ask,** Why might people use a siren like this outdoors?

Why would people test the siren every month?

- » to make sure it works

Why would the siren need to be heard from miles around?

- » so people can hear from far away if severe weather is coming close

Elicit prior knowledge by asking students, What kinds of weather do you think are severe?

- » Accept all reasonable answers, reminding students that the weather in the story about Hanna and her grandmother is a type of severe weather.

2. Observe and ask questions about heat waves.

Activity Pages



AP 4.1.1
AP UO.3

Give each student a copy of Comparing Severe Weather (AP 4.1.1) to use as their recording sheet for Steps 2–5. Also give students copies of Measuring Weather (AP UO.3) to use as a reference for completing the table on Activity Page 4.1.1. You may wish to have students draw and write their own labels on Activity Page 4.1.1, or you can make extra copies of Activity Page UO.3 so that students can cut and paste them into the chart on Activity Page 4.1.1.

NGSS Elements



DCI ESS3.B
DCI ETS1.A
CCC 2
Teacher
Development

Remind students that, in Chapter 1, they read about the heat wave where Hanna lives. It was hot that day and one of the sunniest days she had ever seen. (See **Know the Science 1.**)

Then, show an online video about heat waves. Have students complete the first row of the table in Activity Page 4.1.1 by discussing and recording the weather conditions during heat waves in the four boxes as follows: (See **Know the Science 2.**)

- Sunny or Cloudy: sunny, clear
- Rainy or Snowy: no rain or snow
- Air Temperature: hot
- Windy or Calm: any wind conditions

Online Resources



3D Learning: Students ask questions about the effects of natural hazards.

NGSS Elements



SEP 1
SEP 8
CCC 2
3D Learning

Invite students to ask science questions about heat waves. Use the following sentence starters to guide students to include questions about forecasts and avoiding serious impacts of heat waves. Explain that science questions are ones that can be answered by investigating, reading online and in books, or asking an expert. Write the science questions on a poster page titled, “Our Questions About Heat Waves.”

- What kinds of problems are caused by _____?
» heat waves

Know the Science

TEACHER DEVELOPMENT

1. Are All Heat Waves the Same? No! Since a heat wave is two or more days with temperatures hotter than average expected temperatures, heat waves vary from place to place. For example, the average high temperature in Burlington, Vermont, in July is 81°F. So a few days above 91° would be considered a heat wave. On the other hand, the July average high in Phoenix, Arizona, is 106°F. So, a heat wave there might have average high temperatures around 110°F.

2. What Causes Heat Waves? Heat waves can occur when a warm, and sometimes humid, high-pressure air mass sits without moving over a region. The high air pressure restricts warm air near Earth’s surface from rising, so the air near the surface gets hotter day after day. If there are large cities in the region, a heat wave will be worse there due to a phenomenon called the *urban heat island effect*. Urban areas do not cool off at night as well as rural areas, so cities tend to be warmer in general but also during a heat wave.

- Is it likely that we _____?
» experience a heat wave where we live
- How can meteorologists let people know that _____?
» a heat wave is coming
- What can families plan to _____?
» be ready for a heat wave

SUPPORT—For students who seem reluctant to ask questions, try drawing them out by asking, “Has anyone ever been in a heat wave?” This may elicit prior knowledge English language learners have that students who were born in your community may not have. (See **Know the Standards.**)

3. Observe and ask questions about hurricanes.

Online Resources



Show an online video about hurricanes.

SUPPORT—If the video you show about hurricanes includes satellite images, help students understand the perspective in these images. Show students an Earth globe and how a satellite circles it in space. Explain that some satellites have cameras that take pictures of Earth’s surface, capturing images of the swirling clouds in hurricanes from above.

NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Connections to
Engineering,
Technology,
and
Applications of
Science

3D Learning

Differentiation

Have students complete the second row in Activity Page 4.1.1 by discussing and recording the weather conditions during a hurricane in the four boxes as follows:

- Sunny or Cloudy: very cloudy
- Rainy or Snowy: heavy rain
- Air Temperature: warm
- Windy or Calm: very windy

Know the Standards

TEACHER DEVELOPMENT

Differentiation: This strategy supports English language learners in meeting English Speaking and Listening standard CCSS.ELA-Literacy.SL.K.3: *Ask and answer questions in order to seek help, get information, or clarify something that is not understood.*

NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Connections to
Engineering,
Technology,
and
Applications of
Science
3D Learning

3D Learning: Students ask questions about the effects of natural hazards.

Invite students to ask science questions about hurricanes. Use the following sentence starters to guide students to include questions about forecasts and avoiding serious impacts. Write the science questions on a poster page titled, “Our Questions About Hurricanes.”

- What kinds of problems are caused by _____?
- Is it likely that we _____?
- How can meteorologists let people know that _____?
- What can families plan to _____?

4. Observe and ask questions about tornadoes.

NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Show an online video about tornadoes. Have students complete the third row in AP 4.1.1 by discussing and recording the weather conditions during a tornado in the four boxes as follows:

- Sunny or Cloudy: very cloudy
- Rainy or Snowy: not inside the tornado, but there can be rain nearby
- Air Temperature: any temperature
- Windy or Calm: very, very windy

Online Resources



NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Connections to
Engineering,
Technology,
and
Applications of
Science
3D Learning

3D Learning: Students ask questions about the effects of natural hazards.

Invite students to ask science questions about tornadoes. Use the following sentence starters to guide students to include questions about forecasts and avoiding serious impacts. Write the science questions on a poster page titled, “Our Questions About Tornadoes.”

- What kinds of problems are caused by _____?
- Is it likely that we _____?
- How can meteorologists let people know that _____?
- What can families plan to _____?

CHALLENGE—Help students to better visualize the unusual motion of the winds in a tornado by using a model. Add water to a tall clear water bottle until it is three-quarters filled. Add a couple of drops of dish soap and a little food dye or glitter. Tightly cap the bottle. Place the bottle on a tabletop, and move it in a circular motion. Students should be able to observe the moving water forming a tightly spinning vortex. This is the same motion that winds make in a tornado.

5. Observe and ask questions about blizzards.

Online Resources



Show an online video about blizzards.

See the Online Resources Guide for a link to a recommended video.

www.coreknowledge.org/cksci-online-resources

Have students complete the fourth row in Activity Page 4.1.1 by discussing and recording the weather conditions during a blizzard in the four boxes as follows:

- Sunny or Cloudy: very cloudy
- Rainy or Snowy: very snowy
- Air Temperature: very cold
- Windy or Calm: very windy

NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Connections to
Engineering,
Technology,
and

Applications of
Science

3D Learning

3D Learning: Students ask questions about the effects of natural hazards.

Invite students to ask science questions about blizzards. Use the following sentence starters to guide students to include questions about forecasts and avoiding serious impacts. Write the science questions on a poster page titled, “Our Questions About Blizzards.”

- What kinds of problems are caused by _____?
- Is it likely that we _____?
- How can meteorologists let people know that _____?
- What can families plan to _____?

6. Check for understanding.

Online Resources



NGSS Elements



SEP 1

SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Differentiation
Monitor Progress

In this lesson segment, students asked questions about severe weather. In following lesson segments, they will obtain scientific information to answer their questions (Obtaining, Evaluating, and Communicating Information) and learn how weather forecasts can help people prepare for severe weather (ESS3.B).

Formative Assessment

Return to Today’s Question—**What problems are caused by severe weather?** To answer the question, students may refer to the videos they saw, class discussions, and what they read about Hanna’s school in Chapter 1. Look for understanding of the following concepts related to Performance Expectation K-ESS3-2:

- Heat waves, hurricanes, tornadoes, and blizzards are forms of severe weather and can be dangerous for people.
- Online media can provide information about severe weather.
- Asking questions is helpful in thinking about how to solve the problems severe weather causes.

EXTEND—Download, print, and send home with students copies of “Prepare with Pedro.” This coloring book is designed for families with young children. It extends the discussion of severe weather to other forms of natural hazards, including earthquakes and floods, with a focus on family preparedness.

See the Online Resources Guide for a link to the recommended resource.

www.coreknowledge.org/cksci-online-resources

Call attention to the question board. Revisit the questions recorded there so far, and ask students if today’s lesson may help to answer some of them. Allow students to suggest revisions or additions to the questions on the question board.

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

Tie to the Anchoring Phenomenon

Up until this lesson, students have been discussing the heat wave that caused school to be canceled. In this lesson, students developed understanding that heat waves are one form of severe weather. Ask students if school might have to be canceled in communities when a hurricane, tornado, or blizzard occurs. Emphasize that any type of severe weather is dangerous and could result in school cancellations.

LESSON 4.2

Collecting Information About Severe Weather Patterns

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What should we do when severe weather is likely?

Today's Question: What kinds of severe weather are more likely where we live?

Tie to the Anchoring Phenomenon: Students have learned that there are several kinds of severe weather that can cause problems for people. But which ones are a threat in their region? By obtaining information to answer students' questions, they will find that some types of severe weather are more prevalent in some regions than in others.

AT A GLANCE

Learning Objectives

- ✓ Analyze information about local severe weather patterns.
- ✓ Identify types of severe weather that are more likely locally.

Instructional Activities

- ✓ class discussion
- ✓ student investigation

NGSS References

Disciplinary Core Ideas: ESS3.B Natural Hazards; ETS1.A Defining and Delimiting Engineering Problems

Science and Engineering Practice: 8 Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Students read severe weather maps and use them to determine what types of severe weather they might experience.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

blizzard hurricane tornado

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

observe

Instructional Resources

Activity Pages



AP 4.2.1

AP 4.2.2

AP 4.2.3

Activity Pages

Are Hurricanes Likely Where We Live? (AP 4.2.1)

Are Tornadoes Likely Where We Live? (AP 4.2.2)

Are Blizzards Possible Where We Live? (AP 4.2.3)

Materials and Equipment

- yellow highlighters (1 per student)
- question board

For the Support and Extend activities:

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

THE CORE LESSON 4.2

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS3.B

What kinds of severe weather are more likely where we live? Remind students that they saw videos and asked questions about four kinds of severe weather in the last lesson segment—heat waves, hurricanes, tornadoes, and blizzards.

Point out that heat waves are a kind of severe weather than can happen in any community. Then, explain that hurricanes, tornadoes, and blizzards are more likely to happen in some places than in others. Tell students that today they will be reading maps to find out how likely these storms are in their own states.

Build on student prior knowledge by asking students to recall, from personal experience or stories from their families, which of these types of storms occur in their community. Also invite students who have recently moved to your community to share the kinds of storms that occur where they used to live.

Tie to the Anchoring Phenomenon

Make sure students understand that school can be canceled for heat waves in any community but that school can also be canceled for other types of severe weather.

2. Facilitate a hurricane map activity.

Activity Page



AP 4.2.1

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

3D Learning

Give each student a copy of Are Hurricanes Likely where We Live? (AP 4.2.1). Help students locate the state in which you live and highlight that state in yellow..

Explain that the shaded parts of the map show states that are likely to experience hurricanes. Read the prompts on the Activity Page and coach students to circle yes or no to answer the questions. Use the following prompts to discuss patterns:

- What kind of pattern do you see in states that get hurricanes?
 - » They are all touching one another and on only one side of our country.
- Is our state likely to get hurricanes?
 - » Answers will vary.

3D Learning: Students obtain information from maps to find patterns in the locations of severe weather.

Return to the poster page from Lesson 4.1 called “Our Questions About Hurricanes.” Ask students if today’s mapping activity may help to answer some of the questions. Record any answers on the poster page.

Invite students to ask more questions about hurricanes. (See **Know the Science 1.**)

Know the Science

TEACHER DEVELOPMENT

1. Why Do Hurricanes Strike U.S. States Along the Eastern and Gulf Seaboards? There are two reasons. Hurricanes are huge, swirling, high-wind storms that form over large bodies of warm water. Those that form in the Atlantic Ocean move toward North America. Hurricanes that form along the U.S. coast of the Pacific tend to slide south to Mexico or rarely make US landfall due to the temperatures and airflows of the climate in the Pacific Ocean.

3. Facilitate a tornado map activity.

Activity Page



AP 4.2.2

Give each student a copy of *Are Tornadoes Likely Where We Live?* (AP 4.2.2). Have students again highlight in yellow the state where they live. (See **Know the Science 2.**)

Explain that the map has a number for each state that tells how many tornadoes might happen in one year. Then have students read and compare the number of tornadoes in their state to some of the surrounding states. Read the prompts on the Activity Page and coach students to circle yes or no to answer the question. Use the following prompts to discuss local patterns: (See **Know the Standards.**)

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

Differentiation

Math

Connection

3D Learning

- How many tornadoes may there be in our state each year?
- How does that number compare with the states touching our state?
- How does our state compare with some states that are far away?
- Which part of the map has the highest numbers of tornadoes?

SUPPORT—Depending on the state, students may need to compare numbers larger than 10. Support this Grade 1 mathematical thinking by providing a number line from 0 to 150. Explain to students that numbers to the right are greater than numbers to the left. Use the number line to find and compare the numbers on the tornado map in this way.

3D Learning: Students obtain information from maps to find patterns in the locations of severe weather.

Return to the poster page from Lesson 4.1 called “Our Questions About Tornadoes.” Ask students if today’s mapping activity may help to answer some of the questions. Record any answers on the poster page.

Know the Science

TEACHER DEVELOPMENT

2. How Do Tornadoes Form? When a cold front and a warm front collide, the heavier cold air can be pushed on top of the warm air. The warm air will then start to rise into and through the cold air, creating what is known as an *updraft*. If there are strong winds, the updraft can start to spin, forming a tornado.

Know the Standards

TEACHER DEVELOPMENT

Math Connection: Students compare the numbers of tornadoes among states that surround theirs to determine if there are more, less, or the same number of tornadoes. Kindergarten students are beginning to compare numbers, but many of the numbers representing quantities of tornadoes are values beyond the grade level (CC.C.7).

4. Facilitate a blizzard map activity.

Activity Page



AP 4.2.3

Give each student a copy of *Are Blizzards Possible Where We Live?* (AP 4.2.3). Have students highlight in yellow the state where they live. Remind students that blizzards are a type of severe weather with lots of blowing snow. (See **Know the Science 3** on the following page.)

Explain to students that the map on their Activity Page shows which states have experienced blizzards in the past. Have students run their fingers over states on the map that are lightly shaded. Explain that these states have some blizzards. Then have students point to the states with darker shading. Explain that these states get the most blizzards.

Use the following prompts to discuss local, regional, and national patterns:

- Does our state get blizzards?
 - » Answers will vary.
- Do the states touching our state get blizzards?
 - » Answers will vary.
- Which states get the most blizzards?
 - » Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Wyoming, Kansas, and Colorado.
- Are blizzards a kind of weather our community should plan for?
 - » probably only if you live in one of the states that get the most blizzards
- If so, what season of the year are blizzards possible?
 - » winter (and rarely late fall or early spring)

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

3D Learning

3D Learning: Students obtain information from maps to find patterns in the locations of severe weather.

Return to the poster page from Lesson 4.1 called “Our Questions About Blizzards.” Ask students if today’s mapping activity may help to answer some of the questions. Record any answers on the poster page.

SUPPORT—Especially in regions that do not get much snow, a video or book can evoke the experience of a blizzard. Read aloud to students the picture book *Blizzard*, written and illustrated by John Rocco (Disney-Hyperion, 2014). In this first-person true tale, the hero is a ten-year-old boy who experiences a 1978 blizzard that lasted for two days and dropped forty inches of snow on his Rhode Island community. Consider also showing the online book trailer that previews the story for students and gives a good sense of what a heavy snowfall looks like.

Online Resources



See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

5. Check for understanding.

Lesson 4 focuses on Performance Expectation K-ESS3-2. In the first two lesson segments, students focused on learning about the different kinds of severe weather and their frequency where they live. In the last two lesson segments—coming up—students will focus on understanding the technologies used to forecast and warn of storms and what their families can do to plan for local severe weather.

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

Differentiation

Call attention to Today's Question—**What kinds of severe weather are more likely where we live?** Invite volunteers to answer the question based on their work with the severe weather maps. Look for evidence of understanding of the following concepts:

- Hurricanes, tornadoes, and blizzards are more likely in some places than others.
- Gathering information about the kinds of severe weather that are likely locally can be helpful in planning.
- Maps can help people answer questions and describe patterns in severe weather.

EXTEND—Droughts—periods of below normal precipitation that can cause water shortages—are another form of severe weather. Unlike heat waves, hurricanes, tornadoes, and blizzards, droughts are long-term weather events. Take students online to view a map showing how likely each state is to experience droughts. Have students find their state, and use the key to explain to them how likely droughts are in their state.

Online Resources



See the Online Resources Guide for a link to the recommended resource.

www.coreknowledge.org/cksci-online-resources

Formative Assessment

Review students' completed sentences on Activity Pages 4.2.1 through 4.2.3 for accuracy, based on where they live.

Tie to the Anchoring Phenomenon

Make sure students understand that schools in any state can be canceled due to a heat wave but that other types of severe weather may not occur in all states. Ask students if, based on their map activities, it is likely or unlikely that school would be canceled for a hurricane, tornado, or blizzard.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how their work reading severe weather maps might answer or relate to any of those questions.

Know the Science

TEACHER DEVELOPMENT

3. What Weather Conditions Are Associated with Blizzards? Blizzards are storms with large quantities of blowing snow, low visibility, winds over thirty-five miles per hour, and which last for three or more hours. These storms are most likely to occur in the upper Midwest and plains states and do not occur along the California or Gulf of Mexico coastlines.

LESSON 4.3

How Are Weather Warnings Communicated?

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What should we do when severe weather is likely?

Today's Question: How do weather forecasters warn us that severe weather might happen soon?

Tie to the Anchoring Phenomenon: Point out to students that, when people are warned before severe weather occurs, they can make decisions about their activities, including deciding if schools should be closed to keep people safe.

AT A GLANCE

Learning Objectives

- ✓ Describe technologies used to warn people of severe weather.
- ✓ Explain that people depend on weather warnings to stay safe.

Instructional Activities

- ✓ student observation
- ✓ class discussion

NGSS References

Disciplinary Core Ideas: ESS3.B Natural Hazards; ETS1.A Defining and Delimiting Engineering Problems

Science and Engineering Practices: 8 Obtaining, Evaluating, and Communicating Information; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Connection to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World

Students read a severe weather forecast map and complete a think-pair-share about weather warning technologies.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

emergency siren severe weather smartphone weather radio

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

forecast

Instructional Resources

Activity Page



4.3.1

Activity Page

Where Can We Use Severe Weather Warning Tools?
(AP 4.3.1)

Materials and Equipment

- pencils and erasers
- question board

Advance Preparation:

- Locate an online severe weather map for Step 2, and consider making a screenshot of it to show your students.
- Preview and download the video of an emergency siren.

THE CORE LESSON 4.3

1. Focus student attention on Today's Question.

NGSS Elements



DCI ESS3.B
DCI ETS1.A
CCC 1

How do weather forecasters warn us that severe weather might happen soon?

Remind students that, in the last lesson, they read maps to find out what kinds of severe weather are likely where they live.

Build on student prior knowledge by **asking students**, Is the place we live likely to get hurricanes, tornadoes, or blizzards?

» Answers will vary with location.

Point out that there is another type of severe weather that occurs in many places—thunderstorms. Explain that thunderstorms have wind, heavy rain, and lightning and can cause flooding. All of these can be dangerous to people.

Explain that today the class will learn about the tools weather scientists and communities use to alert people that severe weather is about to start.

Tie to the Anchoring Phenomenon

Explain to students that heat waves are a “slow” kind of severe weather but that some kinds of severe weather can occur suddenly and that people need to be warned quickly.

2. Facilitate reading a severe weather map.

Online Resources



3D Learning: Students obtain information from maps to find patterns in the locations of severe weather.

Go online to a weather service severe weather page showing a forecast map.

See the Online Resources Guide for a link to recommended resources.

www.coreknowledge.org/cksci-online-resources

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

3D Learning

Differentiation

Teacher
Development

- Click on the whole-screen symbol on the map to enlarge the image.
- Zoom in to show only the lower forty-eight states of the United States. Point out to students that some of the colored areas on the map show severe weather and that some show unusual weather that some people, such as sailors and farmers, should know about.
- Click on the various colored areas of the map, and read aloud the information in the pop-up windows that tells the location and type of weather.
- If your county is in a colored zone, zoom in to determine what kind of severe weather is forecast.

SUPPORT—Be aware that some students may have color vision deficiencies that prevent them from distinguishing certain colors. The most common example is a red-green deficiency. To accommodate these students, de-emphasize the colors used on the map for active regions of severe weather, and refer to them as *lighter* or *darker* areas or by their shapes.

Guide a discussion of how weather scientists communicate forecasts with severe weather maps using the following prompts:

- **Ask students,** What patterns do you see in where severe weather is forecast today?
 - » Answer will vary. Students may say that all the severe weather is in one part of the country, that it is evenly sprinkled throughout the country, or that there is no severe weather at all.
- **Ask students,** How can a school or families find a severe weather map like this one?
 - » They can go online with a home computer, tablet, or smartphone.
- **Ask students,** How might the head of schools in Hanna’s town use a map like this?
 - » The head of schools might have read the map and seen that a heat wave was coming. They might have used that information to cancel school.

- **Ask students,** How can knowing severe weather is coming help a family stay safe?
 - » If the school or family knows bad weather is coming, they can get ready to make sure everyone is safe by getting to a planned shelter.

Point out to students that using weather websites is usually an indoor activity. Explain that there are other indoor ways to find out about severe weather, such as television or radio news channels or by using a battery-operated radio that only gives weather alerts. (See **Know the Science.**)

Then ask students, What if people are outdoors? Is there a way to find out severe weather is on its way?

- » Accept all reasonable answers, such as checking your phone for emergency alerts.

3. Play an emergency siren.

Online Resources



3D Learning: Students obtain information from videos to think about events and their causes.

Play an online video that demonstrates an outdoor emergency siren.

See the Online Resources Guide for a link to the recommended video.

www.coreknowledge.org/cksci-online-resources

NGSS Elements



SEP 8

DCI ESS3.B

DCI ETS1.A

CCC 2

Influence
of Science,
Engineering,
and Technology
on Society and
the Natural
World

3D Learning

Differentiation

Allow students to ask questions about the siren. Then play the video again, and see if any of students' questions are answered. Guide the discussion using the following prompts:

- **Ask students,** What does the sound of the siren mean?
 - » There is an emergency.
- **Ask students,** What should people do if they hear an emergency siren?
 - » Get indoors to a safe place, and use radio, TV, or internet to learn more.
- **Ask students,** How does having a siren make people safer?
 - » It warns them when severe weather is coming so they will not get injured.

Know the Science

TEACHER DEVELOPMENT

What Are NOAA Weather Alert Radios? U.S. federal safety agencies recommend that all homes have a weather alert radio, as they do smoke alarms. NOAA (National Oceanic and Atmospheric Administration) weather radios are permanently tuned to NOAA Weather Radio broadcasts and provide up-to-the-minute forecasts on impending severe weather. The radios will announce alerts when the device is either on or off. Weather alert radios always include backup batteries and sometimes have solar panels and hand-cranked generators. These kinds of radios can be taken wherever a family needs to go to be safe.

EXTEND—Public emergency siren systems are organized on a regional or local basis. Find out if your school’s community has such a system, when it is tested, and for what types of emergencies it is sounded. Gather questions from the students, and submit them to the siren manager for answers. Or, arrange for an expert to visit your class by teleconferencing or in person to answer students’ questions about severe weather warnings.

4. Facilitate a think-pair-share.

Activity Page



AP 4.3.1

NGSS Elements



SEP 6

DCI ESS3.B

DCI ETS1.A

Connections to
Engineering,
Technology,
and
Applications of
Science

Differentiation

Give each student a copy of Where Can We Use Severe Weather Warning Tools? (AP 4.3.1).

- Read aloud the directions. Then, have students think individually about what they have learned and what they know about the four tools shown and how they can be used.
- Next, pair students so that they can compare ideas about the tools and where they can be used.
- Finally, invite pairs of students to share their ideas with the entire class.

SUPPORT—Pair English language learners with native-English speakers, giving them speaking practice in a nonthreatening situation. Review rules for discussions, including how to listen and take turns speaking. Circulate among the pairs to make sure that all students are getting a chance to speak and ask clarifying questions. (See **Know the Standards**.)

During the pair presentations and a class discussion, correct any misconceptions, and have students edit their Activity Pages as needed.

5. Check for understanding.

In this segment of Lesson 4, students focus on the connection of K-ESS3-2 to engineering and technology by thinking about how weather warning tools help solve the problem of keeping people safe when severe weather is expected. In the next, and final, segment of this lesson, students will address how people plan for severe weather, which results in students fully meeting the Performance Expectation.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: This think-pair-share activity supports speaking and listening development standards CCSS.ELA-Literacy.SL.K.1: *Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups* and CCSS.ELA-Literacy.SL.K.1.a: *Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).*

Call attention to Today's Question—**How do weather forecasters warn us that severe weather might happen soon?** Invite volunteers to answer the question based on their exploration of various weather warning technologies today. Look for evidence of understanding of the following concepts:

- Weather scientists generate severe weather forecasts to warn communities.
- Tools such as online maps, sirens, radios, and TV are used to warn people when severe weather is on the way.
- Gathering information about severe weather helps people stay safe.

CHALLENGE—Read aloud to students the Caldecott Honor Book *Bartholomew and the Oobleck*, written and illustrated by Dr. Seuss (Random House Books for Young Readers, 1949). In this story, a king is bored with regular weather patterns and requests something new. The result is that green gloppy oobleck falls from the sky and causes all kinds of problems.

Review students' completed Activity Page 4.3.1 for accuracy, and use their presentations during the think-pair-share to determine student understanding that some weather warning technologies can be used only indoors, some only outdoors, and some both indoors and outdoors.

Tie to the Anchoring Phenomenon

By now, students should be able to explain that a heat wave may not be the kind of severe weather that warrants a siren but that fast-moving weather, such as tornadoes, do.

Have students look over the poster pages from Lesson 4.1 with their questions about heat waves, hurricanes, tornadoes, and blizzards to decide if any of the questions were answered in this lesson segment.

Call attention to the question board. Revisit the questions recorded there so far, and ask students how learning about tools used to warn people about severe weather might answer or relate to any of those questions.

LESSON 4.4

Lesson 4 Roundup: Responding to Weather Warnings

Big Question: How do we know when to take an umbrella with us?

Lesson Guiding Question: What should we do when severe weather is likely?

Today's Question: What should we do when severe weather is likely?

Tie to the Anchoring Phenomenon: Point out to students that the head of Hanna's school decided to cancel school due to a heat wave. Ask them to think about what families can do when they know there might be severe weather.

AT A GLANCE

Learning Objective

- ✓ Explain what people can do in response to severe weather warnings.

Instructional Activities

- ✓ teacher Read Aloud
- ✓ class discussion

NGSS References

Performance Expectation: K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

Disciplinary Core Ideas: ESS3.B Natural Hazards; ETS1.A Defining and Delimiting Engineering Problems

Science and Engineering Practices: 1 Asking Questions and Defining Problems; 8 Obtaining, Evaluating, and Communicating Information; 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 1 Patterns

Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World

Students learn about how people prepare in the event of severe weather. Students then develop a plan for what they would prepare.

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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

severe weather

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

blizzard	drought	evacuate	forecast	hail	heat wave
lightning	pattern	thunder	thunderstorm	tornado	

Instructional Resources

Student Book



Ch. 6

Activity Pages



AP 4.4.1

AP 4.4.2

AP 4.4.3

Student Book, Chapter 6
“Weather Can Be Severe”

Activity Pages

Plan a Go Bag (AP 4.4.1)

Choose Ten Things for a
Go Bag (AP 4.4.2)

Safety in Severe Weather
(AP 4.4.3)

Materials and Equipment

- scissors (1 per student)
- paste or glue (1 bottle per student)
- question board

THE CORE LESSON 4.4

1. Focus student attention on Today’s Question.

NGSS Elements



SEP 1

DCI ESS3.B

DCI ETS1.A

CCC 1

Connection to
Engineering,
Technology, and
Applications of
Science

What should we do when severe weather is likely? Remind students that, earlier in Lesson 4, they read maps showing severe weather patterns and explored some tools for warning people about severe weather.

- **Ask students,** What kinds of severe weather are likely where we live?
 - » Answers will vary with location.
- **Ask students,** What are some tools that scientists use to warn people that severe weather is coming?
 - » online severe weather maps, weather radios, television, smartphone apps, and emergency sirens

Build on student prior knowledge by **asking students**, What do people need to do when they are warned of severe weather?

» Accept all reasonable answers.

Explain that today the class will learn about ways people can plan for severe weather.

Tie to the Anchoring Phenomenon

Chapter 1 of the Student Book was not explicit about how far in advance Hanna's school was canceled due to a heat wave, but remind students that school was canceled before the students arrived in the morning. Discuss the advantages of closing school early in the morning or the night before.

- **Ask students**, How would canceling school the night before help families?
 - » They can plan who will care for their young children while their parents or guardians go to work.
- **Ask students**, How would canceling school the night before help students stay safe?
 - » The students would not have to go to school on a very hot day and feel sick or walk home in the heat.

2. Read together: "Weather Can Be Severe."

NGSS Elements



SEP 8
DCI ESS2.D

While some advanced students may be able to read the Student Book fluidly, as a rule, students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Student Book



Ch. 6

Page 22

NGSS Elements



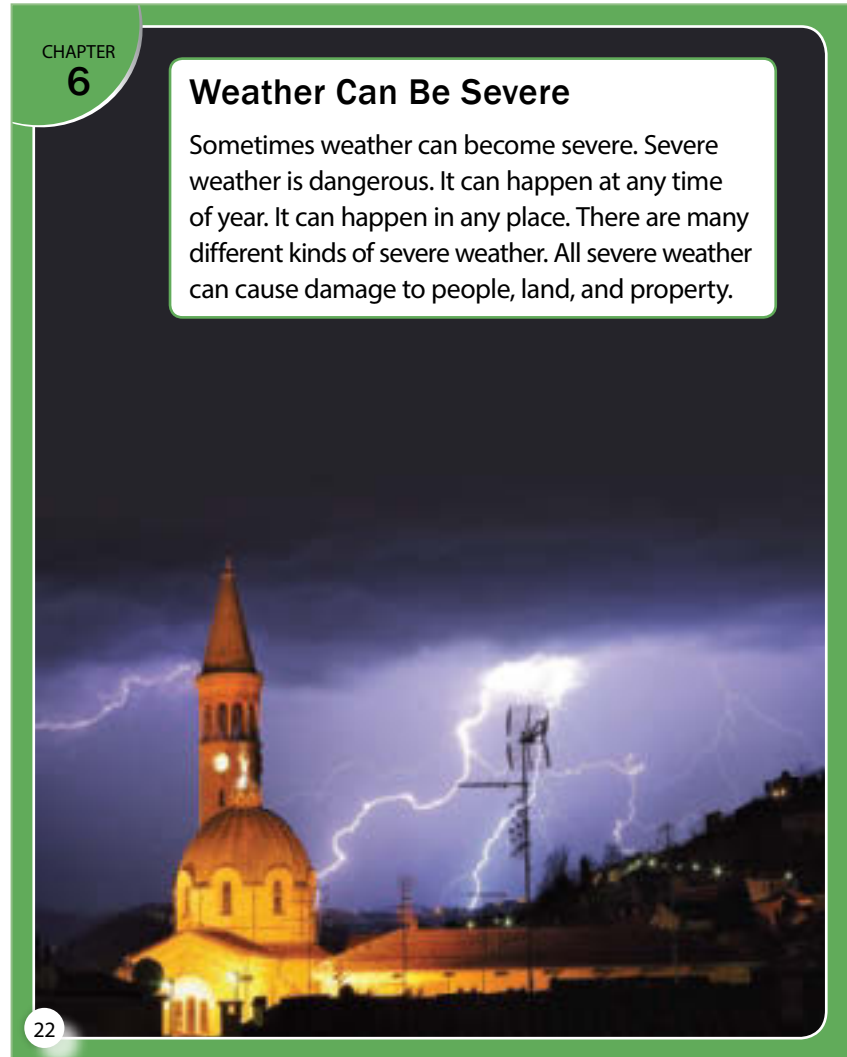
SEP1

SEP 8

DCI ESS3.B

CCC 1

Ask students to turn to page 22 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Weather Can Be Severe,” and tell them to pay special attention to the kinds of weather patterns caused by each type of severe weather.



CORE VOCABULARY—Clarify for students that **severe weather** is weather that is dangerous to people and can damage their property.

INFERENTIAL—What kinds of severe weather have you already learned about?

» heat waves, thunderstorms, hurricanes, tornadoes, and blizzards

INFERENTIAL—What evidence of severe weather do you see in the picture?

» dark clouds and lightning

INFERENTIAL—Why is this a night people should be indoors?

» because lightning storms can hurt people

Ask students, What kinds of questions do you think will be answered in this chapter? List their questions on a chart that you can refer to as you read each page.

Page 23

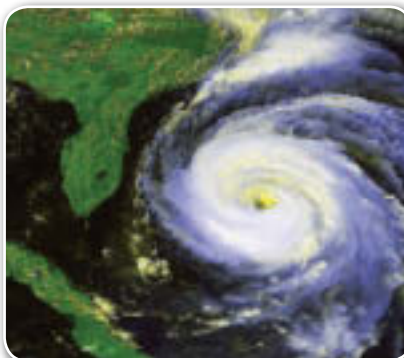
Ask students to look at the pictures on page 23 as you read aloud.

NGSS Elements



SEP 8
DCI ESS3.B
CCC 1

Some kinds of severe weather are common in certain areas. Hurricanes are storms that form over the ocean and can move to land. In the United States, they are most common in areas along the Atlantic and Caribbean coast.



Hurricanes have very strong winds and heavy rain. They can damage buildings, trees, and land.



23

Clarify with students that a hurricane is a large storm with strong winds and heavy rain clouds that forms over ocean water.

LITERAL—Where do hurricanes begin?

» over the ocean

Pause in the reading, and explain to students that this picture was taken using cameras up in space and pointed down toward Earth.

Point out the green area in the photo showing land. Display alongside it a map of the United States so that students can identify the land as the states of Florida, Georgia, South Carolina, and North Carolina.

INFERENTIAL—What does the other photo tell you about the effects of hurricanes?

» It shows that houses and trees can be knocked down or damaged.

NGSS Elements



SEP 8
DCI ESS3.B
CCC 1

Tornadoes are rotating columns of air that move over land. They are dangerous storms that can destroy anything in their path. Tornadoes can happen anywhere. They are most common in the midwestern and southeastern parts of the United States.



Thunderstorms contain rain and thunder. Many produce lightning and hail. Lightning is electricity. It can strike anything on the ground—even people. It is important to stay inside during a thunderstorm.

24

Clarify for students that a tornado is a narrow twisting column of very fast winds that moves over land.

Point out that tornadoes are much smaller than hurricanes but that they cause a lot of damage in the small areas they touch.

INFERENTIAL—How could strong wind cause damage?

- » It could blow buildings and trees down. Flying objects blown in the wind can crash into things.

Remind students that a thunderstorm is a kind of severe weather that has dark clouds, heavy rain, thunder, and lightning.

Point out that where there is thunder, there is lightning because lightning causes thunder. Lightning is like a big spark, similar to the sparks students might

see when they reach out to touch a doorknob or when they pull off a wool sweater. (See **Know the Science 1.**)

INFERENTIAL—What two things does the spark connect?

» the clouds to the ground or a tree

Page 25

Ask students to look at the pictures on page 25 as you read aloud.

NGSS Elements



SEP 8

DCI ESS3.B

CCC 1

Differentiation

Blizzards are severe storms that are most common in the winter. They have heavy snow and strong winds. Trees and power lines can fall during blizzards. Roads and sidewalks become covered with snow. People have trouble getting from place to place.



25

Know the Science

TEACHER DEVELOPMENT

1. How Does Lightning Form, and When Does It Strike? Lightning is a flash of light from a giant electrical discharge. Tall thunderstorm clouds often have positive electric charges at the top of the cloud and negative charges at the bottom of the cloud. As the negative charges are attracted to the ground's positive charges, electrical energy flows between the cloud and the ground and also from the ground to the clouds. As the spark moves through the air, the air is heated, creating a vacuum and then causing a shock wave as the air comes back together, making the sounds we hear as thunder. Lightning is associated with several kinds of severe weather, including tornadoes, thunderstorms, and blizzards.

Clarify for students that a blizzard is a winter storm with heavy snow, strong winds, and below-freezing temperatures.

INFERENTIAL—What could cause the snow to form mounds, as in the second picture?

» It collects as it falls until it piles up and becomes deep.

INFERENTIAL—Why should people not drive cars in a blizzard?

» because the snow piles up so fast that the cars cannot move safely through it

SUPPORT—Many students in the United States have never experienced a blizzard. Reinforce the idea that people should stay indoors during a blizzard. Then show a video of the aftermath of one of these storms and how people try to exit their homes and begin to clean up. Discuss how snow may look light and fluffy when it falls but that moving the snow piled up on the ground is difficult because of its heavy weight.

See the Online Resources Guide for a link to a recommended video.

www.coreknowledge.org/cksci-online-resources

Online Resources



Page 26

Ask students to look at the pictures on page 26 as you read aloud.

NGSS Elements



SEP 8
DCI ESS3.B
CCC 1

The heat wave that happened in Hanna's town is a kind of severe weather, too. Heat is dangerous for anyone who is outside. People find ways to stay cool during a heat wave. Heat and lack of rain also can lead to drought. Drought happens when an area stays very dry for a long time. Droughts can affect plants and animals.



Remind students that a heat wave is a weather event in which the air temperatures are hotter than usual for more than two days.

Explain to students that a drought occurs when there is less rain or snow than usual and there is not enough water for people, farms, factories, and wildlife.

INFERENTIAL—How does going under spraying water make people feel on a hot day?

- » cooler

INFERENTIAL—What did the plants in the picture look like before the drought?

- » They were probably green and taller.

INFERENTIAL—What rules might a community have for water use during a drought emergency?

- » Sample answer: People might not be allowed to use sprinklers or wash cars. They might have to take fewer showers or baths.

EVALUATIVE—What would be the best way to warn everyone in a community about a heat wave—an online map, a siren, a weather radio, television, or a smartphone app? Explain your reasoning.

- » Sample answer: A siren is not needed because people do not have to go indoors right away. Some people might check weather maps. Many people listen to the radio, but not all. Not everyone has a smartphone, and those who do may not have a weather app on their phone. Most homes have a television, so that might be the best way.

NGSS Elements



SEP 8

DCI ESS3.B

CCC 2

Teacher
Development

Looking at patterns in weather data helps scientists predict, or forecast, when severe weather will happen. Weather forecasting can help people plan. It can help people know when to move to a safe place. Does your family have a safety plan for severe weather?



People can build shelters to stay safe during severe storms. Early-warning systems help people know if a tornado is approaching. When a storm is near, people can go into underground shelters to stay safe.



27

Remind students that a pattern is something that repeats.

Remind students that to forecast is to predict what will happen.

Have students look at the picture of the National Hurricane Center and discuss the tools scientists use—computers, maps, and satellite photos from space.

INFERENTIAL—Why is it important to predict a hurricane at least a few days before it happens?

» so people can get ready for the storm

Explain to students that getting ready may include covering up windows, buying extra food and drinking water, buying gasoline for cars, and—for homes in flood zones—deciding to evacuate (move a family and pets to a safer location).

When students look at the picture of the tornado shelter, have them recall reading the map showing where tornadoes are likely. **Ask students,** Are tornadoes likely in our state?

» Answers will vary with location. (See **Know the Science 2.**)

INFERENTIAL—What signals should people listen for to know when to enter a tornado shelter?

» an emergency siren or other early warning system such as on a severe weather radio or weather app

3. Guide packing a severe weather go bag.

Activity Pages



AP 4.4.1

AP 4.4.2

NGSS Elements



SEP 7

DCI ESS3.B

DCI ETS1.A

CCC 1

Differentiation

Teacher
Development

Give each student a copy of Plan a Go Bag (AP 4.4.1). Explain that a go bag is a small bag or backpack that has all the important items needed when someone has to evacuate their home during an emergency. Reassure students that this does not happen often but that it is always a good idea to be prepared.

Have students turn to a partner and brainstorm what a child's go bag should contain when they leave home before or during severe weather.

Then give each student a copy of Choose Ten Things for a Go Bag (AP 4.4.2). Have students count the number of items on the page and compare that number to the number of blank circles on Activity Page 4.4.1. Make sure students understand that they will choose the most important ten items for their go bag and that two will be left out.

SUPPORT—Some students will benefit from using manipulatives to understand that taking ten from twelve is a form of subtraction. Pose the word problem to students as, *If we have twelve items and only have room for ten in our bag, how many will be left behind?* Write the word problem as a subtraction equation. Then give students counters to show how to solve the problem. (See **Know the Standards.**)

Know the Science

TEACHER DEVELOPMENT

2. How Do Tornado Shelters Work? Tornadoes can be strong enough to uproot trees, tear apart houses, and flip over cars. Since the winds do not go below the ground, tornado shelters are usually underground. The doorways are as flat to the ground as possible, with stairs leading downward to an enclosed room-like space. The shelter will also have a fresh-air ventilation system. While safer when built away from other structures, they are sometimes designed as part of a home's basement.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: Use this activity as an opportunity to support advanced math learning. Working with numbers greater than ten in a subtraction problem addresses Grade 1 standard CCSS.Math.Content.1.OA.A.1: *Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.*



3D Learning: Students support arguments about planning for severe weather.

Give students scissors to cut out the items on Activity Page 4.4.2, and have them place ten of them on the circles on Activity Page 4.4.1. Invite students to make claims explaining how each item would/would not be useful when they leave their home in severe weather. Have students support each claim with evidence from the lesson and their understanding of how the item functions. Sample discussion points follow:

- » warm sweatshirt—can keep you warm at night if there are no blankets
- » water bottle—There may not be water to drink or cups to use where your family finds shelter.
- » whistle—makes a loud noise if you need to call for help
- » stuffed toy—something to snuggle when you are away from home
- » snack bars—food you like to eat that does not need to be kept in a refrigerator
- » umbrella—If there are strong winds, leave it at home. If it is a heat wave and is sunny, take it for shade.
- » weather radio—maybe not for a heat wave, but important for hurricanes, thunderstorms, tornadoes, and blizzards
- » bandages—If someone gets a cut or scrape on their way to shelter, these are good to have.
- » blow-dryer—Leave it home if it is just for your hair, though it could be used to dry wet clothing if there is electric power in the shelter.
- » flashlight—can use it to find your way when the lights are out or to signal for help
- » flowerpot—Leave flowers at home.
- » sturdy shoes—important for protecting feet if the wind has left many objects on the ground to step over; not as important in a heat wave

Then, give students paste or glue so that they can affix their final choices to Activity Page 4.4.1.

Online Resources



CHALLENGE—Families that have pets or farm animals also need to prepare to keep the animals safe. Give students copies of the *Pet Emergency Kit Checklist* from the U.S. Centers for Disease Control and Prevention. Go over the checklist with students, and discuss how it can be used to make a go bag for a pet if the family will evacuate because it is no longer a safe place to be.

See the Online Resources Guide for a link to the recommended resource.

www.coreknowledge.org/cksci-online-resources

4. Check for understanding.

NGSS Elements



SEP 6

DCI ESS3.B

DCI ETS1.A

CCC 2

Differentiation

Language Arts
Connection

Teacher
Development

With successful completion of this final segment of Lesson 4, students will have fulfilled the Performance Expectation K-ESS3-2. Students have developed understandings about natural hazards using a problem-solution approach that included asking questions, obtaining answers from media, and considering the technologies that are used to forecast and warn people about weather events. In Grade 3, students will explore severe weather again but focus on evaluating solutions that reduce the direct effects of water, wind, lightning, and excess heat (3-ESS3-1: *Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard*).

Remind students that they asked many questions about severe weather in this lesson. Display and review the questions, and as a class, determine which ones they now can answer.

Summative Assessment

Activity Page



AP 4.4.3

Call attention to Today's Question, which is also the **Lesson Guiding Question**—**What should we do when severe weather is likely?** Give each student a copy of Safety in Severe Weather (AP 4.4.3). Use the following prompts to summarize what students have learned about each kind of severe weather:

- **Ask students,** What is the weather like during this kind of severe weather?
 - » Hurricane: heavy rain, strong winds, flooding
 - » Tornado: very strong winds
 - » Thunderstorm: heavy rain, thunder and lightning
 - » Blizzard: heavy snow, cold temperatures, strong winds
 - » Heat wave: sunny and unusually hot temperatures for more than two days
- **Ask students,** Should pets be brought inside or objects such as chairs and bicycles be brought in or tied down?
 - » Hurricane: yes (check mark in the table)
 - » Tornado: yes (check mark in the table)
 - » Thunderstorm: yes (check mark in the table)
 - » Blizzard: yes (check mark in the table)
 - » Heat wave: yes (check mark in the table), though objects do not have to be tied down
- **Ask students,** Should people go inside and stay inside?
 - » Hurricane: yes (check mark in the table)

- » Tornado: yes (check mark in the table)
- » Thunderstorm: yes (check mark in the table)
- » Blizzard: yes (check mark in the table)
- » Heat wave: yes (check mark in the table), though people can go outdoors for a short while if they have shade and carry water, as Hanna and her grandmother did
- **Ask students,** Should people listen to scientists' weather warnings on television, radio, internet, or weather apps?
 - » Hurricane: yes (check mark in the table)
 - » Tornado: yes (check mark in the table)
 - » Thunderstorm: yes (check mark in the table)
 - » Blizzard: yes (check mark in the table)
 - » Heat wave: yes (check mark in the table)
- **Ask students,** Should all the members of a family have a go bag that they can take if their home is no longer safe during severe weather?
 - » Hurricane: yes (check mark in the table)
 - » Tornado: yes (check mark in the table)
 - » Thunderstorm: yes (check mark in the table)
 - » Blizzard: yes (check mark in the table)
 - » Heat wave: yes (check mark in the table)

Remind students that the guiding phenomenon for this lesson was *In one city, outdoor sirens are tested every first Saturday of the month at 1 p.m.* Assess students' understanding of this lesson by having them explain the phenomenon. In the discussion, look for the following concepts:

- All communities can experience severe weather, but some kinds of severe weather are more likely in some communities than others.
- Sirens are used to let people who are outdoors know that there is a severe weather emergency.
- The sirens are important and can save lives or prevent injuries, so it is important to know that they work properly.
- People who hear the siren should go indoors and prepare for severe weather.
- Once indoors, they can use other tools, such as television, radio, internet, and weather apps, to get more information and to answer their questions.

Tie to the Anchoring Phenomenon

By now, students should be able to explain that a heat wave is but one of many kinds of severe weather that might cause school to be canceled. Have students name some other kinds of severe weather that might cause schools to close. Students should also be able to explain some of the actions families can take to prepare for severe weather.

Call attention to the question board. Revisit the questions, and ask students how reading the chapter and talking about ways to prepare for severe weather might answer or relate to any of those questions.

EXTEND—Some students may still have questions about severe weather that have not been answered in this unit. Collect some nonfiction books for a reading corner that students can visit whenever they have time during the school day. Ask a librarian to select books for primary students, such as *National Geographic Readers: Storms* by Miriam Busch Goin (National Geographic Children's Books, 2009).

Weather Patterns

Big Question: How do we know when to take an umbrella with us?

Tie to the Anchoring Phenomenon: Students use what they learned about sunlight, making shade structures, weather patterns, and severe weather forecasts and warnings to make decisions about when to carry an umbrella and explain why schools are sometimes canceled due to weather.

AT A GLANCE

Learning Objectives

- ✓ Describe patterns in weather data over time.
- ✓ Explain how weather conditions affect the use of umbrellas and school cancellations.

Instructional Activities

- class discussion
- role play

NGSS References

Performance Expectations: K-PS3-1; K-ESS3-2; K-ESS2-1; K-ESS3-2

Disciplinary Core Ideas: PS3.B Conservation of Energy and Energy Transfer; ESS2.D Weather and Climate; ESS3.B Natural Hazards; ETS1.A Defining and Delimiting Engineering Problems

Science and Engineering Practices: 4 Analyzing and Interpreting Data; 6 Constructing Explanations and Designing Solutions

Crosscutting Concepts: 1 Patterns; 2 Cause and Effect

Understandings About the Nature of Science: Scientific Investigations Use a Variety of Methods; Science Knowledge Is Based on Empirical Data

Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology; Influence of Science, Engineering, and Technology on Society and the Natural World

Students discuss the weather data and patterns they have generated over the course of the unit. Students then act out how to dress for different types of 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 and Language of Instruction

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization

cloudy heat wave hurricane rainy
snowy sunlight tornado wind

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 any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

cancel pattern

Instructional Resources

Activity Page



UC.1

Activity Page
Weather and People (AP UC.1)

Materials and Equipment

- child-sized umbrella

Advance Preparation

Collect the weather observation charts from all four weeks of this unit, and make sure they are titled with the month and days they represent. Prepare an area in the classroom where you can display all the charts, in chronological order, allowing space for students to come up to the charts to count.

1. Focus student attention on the Big Question.

NGSS Elements



SEP 6

DCI PSS3.B

DCI ESS2.D

DCI ESS3.B

DCI ETS1.A

CCC 1

Monitor Progress

Ask a volunteer to state the Big Question for this unit, which is posted somewhere in the room—**How do we know when to take an umbrella with us?**

Discuss with students what they have learned about sunlight and weather patterns in this unit. Students should be able to explain, and cite evidence from their investigations and explorations, that sunlight warms Earth’s surface and objects on Earth’s surface; that structures that block sunlight keep them cooler than those in sunlight; that weather is described by how sunny or cloudy the sky is, by whether it is raining or snowing, by how windy it is, and by how warm or cool the air is; and that people can use tools to gather information from weather scientists about severe weather and the problems it causes.

Tell students that today they will look for patterns in their weather charts and act out when to use and not to use an umbrella.

2. Lead a discussion of weather patterns over time.

NGSS Elements



SEP 4

DCI ESS2.D

CCC 1

3D Learning

Differentiation

Math Connection

3D Learning: Students analyze firsthand data to identify patterns in weather conditions over time.

Conduct a whole-class discussion of the weekly weather data charts you have displayed on a wall. Have students look for patterns over the four weeks of data with the following discussion questions:

- Were there more sunny or cloudy days in the four weeks?
- Were there more days with rain or snow or without rain or snow?
- Were there more warm or cool days in some weeks than others?
- Were most days not windy, lightly breezy, or very windy?
- Did any of the weeks have more of one kind of weather than the others?

SUPPORT—Provide students who would benefit from using manipulatives with interlocking cubes. As the rest of the class counts the number of days aloud, have these students also count cubes. When done counting one kind of weather, have students snap the cubes together to make a rod. Then have students do the same for the kind of weather they want to compare. Students can now compare the lengths of the rods to answer which was more. (See **Know the Standards.**)

3. Facilitate an act-it-out.

NGSS Elements



SEP 6

DCI PS3.B

DCI ESS2.D

CCC 2

3D Learning

Teacher Development

3D Learning: Students use information from media observations to decide whether certain solutions are appropriate for certain weather conditions.

Explain to students that they will show their understanding of weather conditions by acting out getting ready for different kinds of weather. Show students the child's umbrella, and tell them that they need to decide if they will use the umbrella as a prop.

Sunny, Warm Weather: Start with a warm-up activity in which the entire class participates in an act-it-out. Have students stand, and lead them in acting out getting ready to go outside on a sunny, warm day. Narrate as you go—pulling on shorts and a T-shirt, sneakers, a wide-brimmed hat for the sun, wearing sunglasses, and adding sunscreen to exposed skin.

- **Ask students,** Should we use the umbrella for sunny, warm weather, and why?
 - » Yes, we can use it to make shade so that we will not get as warm as in the sunlight.

Know the Standards

TEACHER DEVELOPMENT

Differentiation: Counting the number of days is an opportunity to support Kindergarten math standard CCSS.Math.Content.K.CC.B.4.c: *Understand that each successive number name refers to a quantity that is one larger.* Comparing the numbers for two days using manipulatives addresses Kindergarten standard CCSS.Math.Content.K.CC.C.6: *Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.*

- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» No, sunny, warm weather is not dangerous to people inside a building.

Rainy, Warm Weather: Invite volunteers to stand and act out getting ready to go outside on a rainy, warm day. Have students narrate as they are putting on shorts, a T-shirt, a rain jacket with a hood, and rain boots.

- **Ask students,** Should we use the umbrella for rainy, warm weather, and why?
» Yes, we can use it to keep the rain off our face and legs.
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» No, rainy, warm weather is not dangerous to people.

Snowy, Cold Weather: Invite new volunteers to stand and act out getting ready to go outside on a snowy, cold day. Have students narrate as they are putting on snow pants, a heavy jacket, a warm hat, mittens, and snow boots.

- **Ask students,** Should we use the umbrella for snowy, cold weather, and why?
» Sample answer: Sometimes, the snow is very wet and soaks our clothes, so maybe the umbrella can be useful.
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» maybe, if the snow makes roads slippery and dangerous for the school buses

Rainy, Very Windy Weather: As students act out getting ready to go out, have them narrate putting on rain boots and a rain jacket.

- **Ask students,** Should we use the umbrella for rainy, very windy weather, and why?
» Sample answer: no, because the wind could break the umbrella or blow it away
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» no, because the school buses can travel in this weather

Hurricane: If students act out getting ready to go outdoors, quickly redirect them with the questions below:

- **Ask students,** How should people get ready if they know a hurricane is coming?
» They should stay indoors and listen to weather warnings on television, a weather radio, or a smartphone app.

- **Ask students,** Will you need an umbrella for a hurricane, and why?
» no, because we will need to stay indoors
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» Yes, people need to stay home because a hurricane can have dangerous winds and flooding.

Tornado: If students act out getting ready to go outdoors, quickly redirect them with the questions below:

- **Ask students,** How should people get ready if they know there might be a tornado nearby?
» They should stay indoors and listen to weather warnings on television, a weather radio, or a smartphone app.
- **Ask students,** Will you need an umbrella for a tornado, and why?
» no, because we will need to stay indoors
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» Sample answer: Yes, people need to stay home because tornado winds are very dangerous. (See **Know the Science.**)

Heat Wave: If students act out getting ready to go outdoors, they should put on light clothing, wear a hat that blocks sunlight, and grab a water bottle. They may also act out staying indoors where there is air conditioning.

- **Ask students,** Will you take an umbrella outdoors for a heat wave, and why?
» Yes, if you go out, an umbrella would make shade to keep you cooler.
- **Ask students,** Is this the kind of weather that might cause school to be canceled, and why?
» Yes, if the school gets too hot, it is not safe for people to be there.

Know the Science

TEACHER DEVELOPMENT

How Do Most Schools Handle Tornado Warnings and Watches? The policy of many school districts is to keep schools open during tornado watches (issued for large regions where conditions for tornado formation exist). If a tornado warning (issued when a tornado has been detected on radar or is imminent) is announced, schools that are in session move students to the safest part of the school building. If the warning continues past dismissal time, schools hold students until the warning is lifted. Schools may be canceled after tornadoes hit, to allow communities to clean up and provide emergency services.

4. Check for understanding.

Activity Page



AP UC.1

NGSS Elements



SEP 6

DCI PS3.B

DCI ESS2.D

CCC 2

Review students' responses for accuracy. Look for evidence that students have retained understanding of the key concepts from this unit:

- Sunlight warms Earth's surface and structures, and objects that block sunlight keep objects on Earth's surface cooler (K-PS3-1, K-PS3-2).
- Conditions—including sun, wind, rain, and air temperature—are used to describe weather patterns (K-ESS2-1).
- Severe weather is dangerous to people, and communities have tools and systems to prepare for it (K-ESS3-2).

Give students a copy of Weather and People (AP UC.1). Read aloud the directions, and have students complete the table based on the discussions during the act-it-out activity. Circulate around the room, and use active questioning to challenge thinking, as needed. See the Activity Page Answer Key for correct answers.

Tie to the Anchoring Phenomenon

Throughout the unit, students learned about the effect of sunlight on Earth's surface, that weather changes often, and that some kinds of weather are dangerous to people and property. By now, students should be comfortable answering the question, Which kinds of weather could cause school to be canceled?

» severe weather such as hurricanes, tornadoes, heat waves, and blizzards

Science in Action: Meeting a Weather Scientist

Tie to the Anchoring Phenomenon: Students join Hanna as she learns more about the weather from a meteorologist.

AT A GLANCE

Learning Objectives

- ✓ Read about what meteorologists do.
- ✓ Predict tomorrow's weather based on patterns.

Instructional Activities (2 Days)

- teacher Read Aloud
- student activity

NGSS References

Understandings About the Nature of Science: Scientific Investigations Use a Variety of Methods; Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Crosscutting Concept: 1 Patterns

Connections to Engineering, Technology, and Applications of Science:

Influence of Engineering, Technology, and Science on Society and the Natural World; Interdependence of Science, Engineering, and Technology

Students read about meteorologists and the tools they use to predict weather. Students then track the weather and attempt to establish a weather pattern that will allow them to predict the 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

Language of Instruction

The Language of Instruction consists of terms that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves.

hurricane	instrument	meteorologist	pattern
pilot	predict	public	weather

Instructional Resources

Student Book



Ch. 7

Student Book, Chapter 7
“Science in Action: Meeting a Weather Scientist”

Activity Page



AP US.1

Activity Page
Tomorrow’s Weather (AP US.1)

Materials and Equipment

- none needed

1. Day 1: Introduce the topic.

Remind students that they read about Hanna and the heat wave in her town. Let students know that today they will read about what happens when Hanna meets a weather scientist.

2. Read together: “Science in Action: Meeting a Weather Scientist.”

Student Book



Ch. 7

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

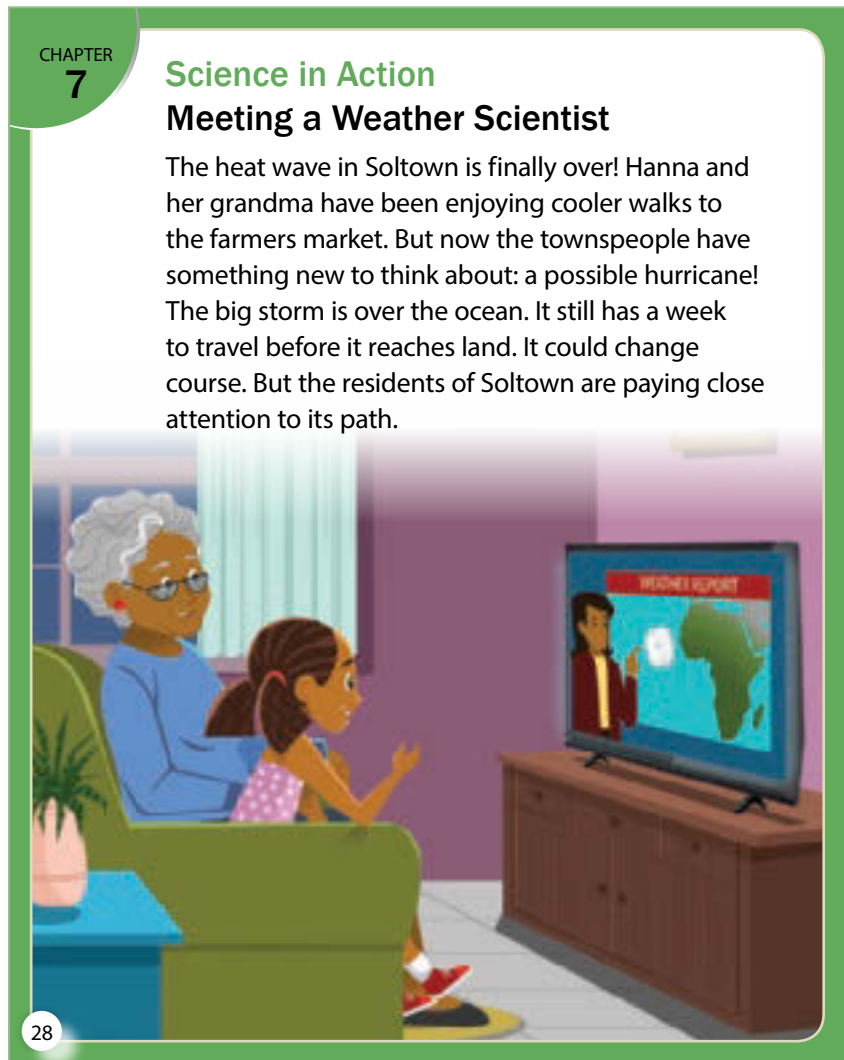
Page 28

NGSS Elements



Influence of Engineering, Technology, and Science on Society and the Natural World

Ask students to turn to page 28 of the Student Book and look at the image as you read aloud. Remind them that the title of this chapter is “Science in Action: Meeting a Weather Scientist,” and tell them to pay special attention to the different things you can see in the pictures as you read.



Ask students to look at the picture on page 28. Explain that the picture shows Hanna and her grandmother watching the weather report on TV. (See **Know the Standards 1.**)

Remind students that a hurricane is a severe storm that brings a lot of strong rain and wind.

Know the Standards

TEACHER DEVELOPMENT

1. Influence of Engineering, Technology, and Science on Society and the Natural World:

Technology allows people to better plan for and respond to weather conditions, such as severe storms (hurricanes). Studying the natural world and understanding how to trace the movement and changes of storms around the globe help scientists and engineers develop these types of technologies.

LITERAL—Where does the weather map show a possible hurricane?

- » Have students point to or describe the hurricane symbol that they see off the western coast of Africa.

INFERENTIAL—Why are the residents unsure of the situation with the weather?

- » They might get the hurricane, or they might not.

Page 29

NGSS Elements



Influence of
Engineering,
Technology,
and Science on
Society and the
Natural World

Ask students to look at the picture on page 29. Explain that the picture shows a scientist working at the National Hurricane Center. Tell students that this is a place where hurricanes are tracked and studied. Talk about what students notice in the picture. (See **Know the Standards 2.**)

Hanna's teacher wants to help her students learn more about hurricanes. She explains to them that she has scheduled a video chat with a meteorologist named Noah. A meteorologist is a scientist who studies weather. Noah specializes in hurricanes.



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Know the Standards

TEACHER DEVELOPMENT

2. Influence of Engineering, Technology, and Science on Society and the Natural World: Discuss with students how something as “simple” as video chat technology has a significant impact on human life. Talk about being able to meet with people from all over the world without coming face to face and the advantages that this has on things like health, convenience, and the environment (reducing resources used to travel).

Explain that meteorologists are scientists who study the weather.

LITERAL—What kind of weather does Noah specialize in?

» hurricanes

INFERENTIAL—Why do you think meteorologists need to have so many computer and television screens around them?

» They need them to look at different things at the same time.

Page 30

NGSS Elements



Interdependence
of Science,
Engineering,
and Technology

Ask students to look at the two pictures on page 30. Talk about what students see. Explain that the airplane they see in the first picture is a specialized plane that is used for flying into and out of hurricanes. The crew of this plane collects storm data. (See **Know the Standards 3** on the following page.)

Noah tells the class that he is also called a “hurricane hunter.” The children giggle. How can you hunt a hurricane? Noah explains that he flies with a pilot high above a hurricane and close to the quiet area in the center of the storm. When he flies near the hurricane, he is “hunting” for information.



30

Explain that pilots are people who fly airplanes or helicopters.

INFERENTIAL—Why does Noah call himself a “hurricane hunter”?

» because he flies into hurricanes and looks/hunts for information.

LITERAL—How does Noah fly into a hurricane?

» He flies high above it and goes into the quiet part of the storm.



Ask students to look at the picture on page 31. Explain that the information that is collected in flights of hurricane-hunter planes helps meteorologists predict how and when a storm over the water might move onto land.

The picture shows the likely path of the storm. The red color shows where scientists think the storm will be the strongest. The yellow colored path shows where the storm will be less severe when it hits. (See **Know the Standards 4.**)

The plane that Noah is in has special instruments. They measure the hurricane's wind and rain. The measurements tell scientists how weak or strong the hurricane is.

Noah makes these flights several times per day. He compares the data from each flight. He uses the data to predict which way the hurricane will move. Meteorologists like Noah predict when and where the storm will reach land. They help people know if they need to prepare.

Noah says he became a weather scientist because he read about a famous meteorologist from the past.



31

Know the Standards

TEACHER DEVELOPMENT

3. Interdependence of Science, Engineering, and Technology: Scientists have questions about hurricanes, like how they form and how they travel. The more they can find out about these storms, the more scientists can work to predict where they will occur to help people be better prepared to respond to them. Airplanes like the one shown can help scientists fly to the center of the storm to get information that can help answer questions.

4. Scientific Investigations Use a Variety of Methods: There are different ways for scientists to study nature. Some scientists study things in labs. Other scientists go out into the field to get the information they need. Noah is an example of such a scientist. He and other scientists like him collect data straight from the source using the instruments on their planes. This is a dangerous but important task!

Remind students that an instrument is a type of tool that scientists use.

LITERAL—What do the instruments on Noah’s planes measure?

» They can measure the hurricane’s wind and rain.

LITERAL—What does this information help meteorologists determine?

» It tells them which way the hurricane will move or when it will reach the land.

INFERENTIAL—Why is it important to know this?

» so people on the land can prepare for the hurricane

Page 32

NGSS Elements



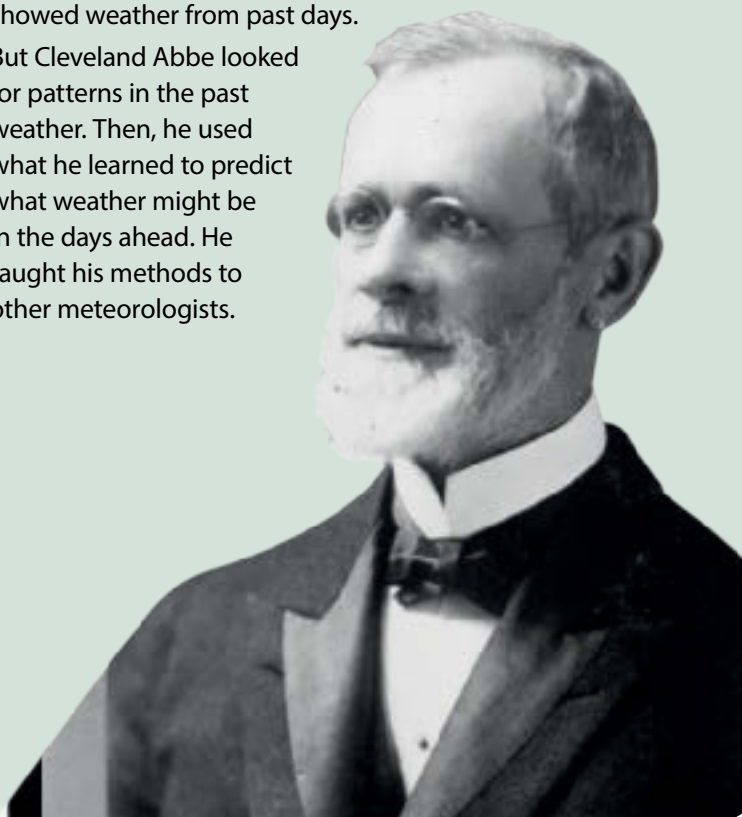
Scientific
Knowledge
Assumes an Order
and Consistency in
Natural Systems

Ask students to look at the picture on page 32. Explain that the picture shows Cleveland Abbe. (See **Know the Standards 5.**)

Cleveland Abbe

In the 1800s, scientists did not have planes or computers. They did not use observations to predict weather and share predictions with the public. They only made maps that showed weather from past days.

But Cleveland Abbe looked for patterns in the past weather. Then, he used what he learned to predict what weather might be in the days ahead. He taught his methods to other meteorologists.



32

Know the Standards

TEACHER DEVELOPMENT

5. Scientific Knowledge Assumes an Order and Consistency in Natural Systems: Cleveland Abbe was an American scientist who studied patterns in the weather. Patterns are events that are repeated, and they can be used to tell what will happen in the future. By studying patterns related to weather, Abbe was able to tell whether skies would be sunny, windy, rainy, or something else.

LITERAL—What kinds of tools did scientists use back in the 1800s to show the weather?

» They used maps.

Remind students that a pattern is something that is repeated in nature and can be predicted. Weather events, like hurricanes, have patterns that can be detected when they are studied closely.

LITERAL—What did Cleveland Abbe use patterns to do?

» He used patterns to make predictions about what the weather would be in the days ahead.

Page 33

Ask students to look at the picture on page 33. Explain that the picture shows some things that people do to stay safe during a hurricane. These measures help protect people and their homes from water/rain and wind damage. The wood the men are putting up in front of the windows will prevent debris such as trees from breaking the windows.

The National Weather Service shares weather information with the public. Today, meteorologists warn about severe weather before it happens. People in the path of hurricanes can prepare their homes. They have time to get to a safe place. The National Weather Service was formed in 1871. Cleveland Abbe was its first lead meteorologist.



33

LITERAL—What does the National Weather Service do?

» It shares weather information with the public.

The word *public* refers to all the people in a society.

LITERAL—When was it formed?

» 1871

1. Day 2: Facilitate the activity.

Activity Page



AP US.1

NGSS Elements



CCC 1

Remind students that they previously read about how scientists can study the weather to tell what the weather will be in the future. Tell students that today they will work on an activity where they get to act as a scientist!

- Have students form small groups. Explain that each group will act as a team of scientists studying the weather to make a weather forecast. Remind students that a forecast is a prediction of the weather. If necessary, briefly discuss the following:
 - how we get the weather forecast (e.g., news, social media, smartphones)
 - what we use the weather forecast for, such as knowing what to wear and knowing what we can do outside
- Distribute Tomorrow's Weather (AP US.1) to each student, and review the table:
 - Explain that there are four columns in the table.
 - In the first column are pictures of weather. Review the types of weather listed in the first column.
 - The second column is where students will mark what kind of weather they had yesterday. Students can check the box next to the type of weather.
 - The third column is where students will mark what kind of weather there is today. They will check the box for the weather in this column, too.
 - Finally, students will predict what the weather will be tomorrow. They will check the box in the third column.
- Tell students that they can check more than one box in each column. For instance, it is possible for it to be sunny and windy or to be cloudy and rainy.
- Circulate around the room as students work on their activity. Remind students that they need to use the data from yesterday and today to tell what tomorrow's weather will be like.
- Prompt students to think really hard about what the weather was like yesterday. Encourage them to talk to their teammates about what each of them remembers. If your classroom has windows, allow students to look out the window to see the weather, or take students outside for a brief amount of time so they can experience the weather firsthand.

- If necessary, model for students how to fill out the table. As you circulate around the room, ensure students are filling out the boxes correctly.
- When groups are finished, invite each group to share what they think the weather will be for tomorrow, using the sentence frame: "Tomorrow's weather will be _____." or "Tomorrow's weather will be _____ and _____."

NGSS Elements



Differentiation

SUPPORT—Give students yesterday's weather data, as well as today's weather data. Have students make a prediction for tomorrow's weather data based on the information they are given.

CHALLENGE—Challenge students with an activity that gives them a week's worth of weather data, which they will use to make a prediction about tomorrow's weather.

EXTEND—Set students up on the computer to access the National Weather Service website, and preselect a national temperature map for them to observe. Have students tell what they see, and ask them to identify the hottest and coldest places in the country.

2. Check for understanding.

Review the tables on Activity Page US.1. Check that students are marking the boxes in the tables correctly and that they have a general understanding of patterns to make a reasonable weather prediction. (See **Know the Standards 6.**)

Know the Standards

TEACHER DEVELOPMENT

6. CCC 1 Patterns: In this activity, students use patterns from two sets of data to make a prediction about the weather. Patterns are used in science to identify repeated events that can help scientists know more about nature and find better ways to prepare others for severe weather.

Teacher Resources

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Activity Pages Answer Key: <i>Weather Patterns</i>	205–206

Name _____

Date _____

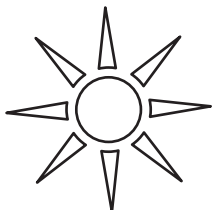
Activity Page UO.1

Use with Unit Opener

Taking an Umbrella on a Sunny Day

Hanna's grandmother is taking an umbrella for their walk.

Draw and label to explain why.



Name _____

Date _____

Weather Observation Chart

Our Weather						
Date	Time	Sunny or Cloudy	Rainy or Snowy	Temperature	Feels Like	Windy or Calm
Monday _____				° _____		
Tuesday _____				° _____		
Wednesday _____				° _____		
Thursday _____				° _____		
Friday _____				° _____		

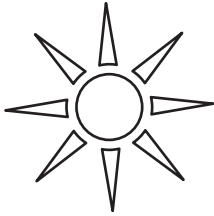
Name _____

Date _____

Activity Page UO.3

Use with Unit Opener

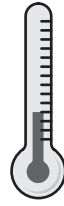
Measuring Weather



Sunny, clear



Rainy



Cold



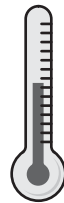
No wind



Partly cloudy



Snow



Cool



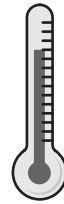
Light wind



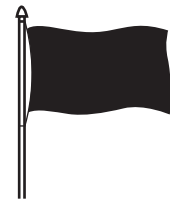
Very cloudy



Rain and snow



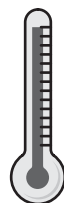
Warm



Very windy



Fog



Hot

Name _____

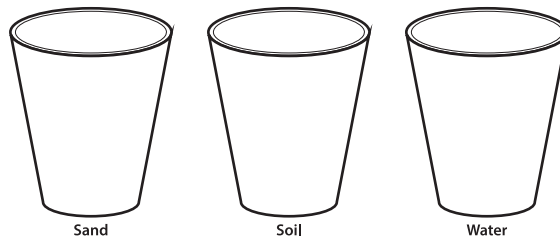
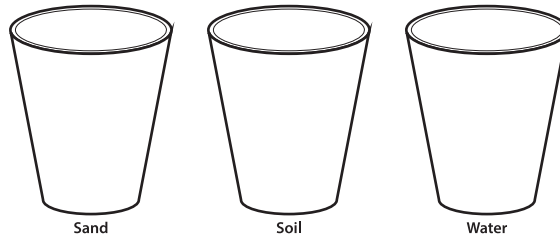
Date _____

Activity Page 1.1.1

Use with Lesson 1.1

Our Investigation Plan

1. Draw what you will put in each cup.
2. Draw the sun and where it will shine on the first three cups.
3. Draw something that makes shade over the second three cups.
4. Write the purpose of our investigation.



We will find out how _____ affects how warm sand, soil, and water feel.

Name _____

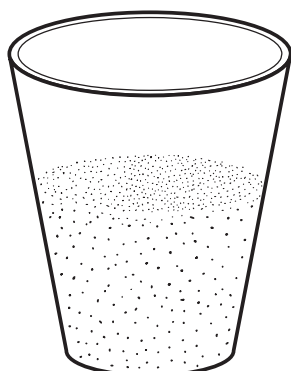
Date _____

Activity Page 1.2.1

Use with Lesson 1.2

How Does Sunlight Affect Sand, Soil, and Water?

Put each material in the sun and shade. Later, feel inside the two cups. Circle the words to tell how they compare.



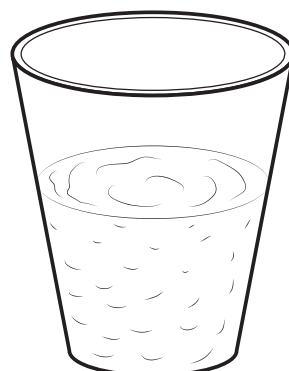
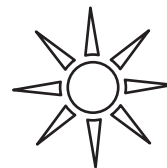
Sand

Cooler Warmer



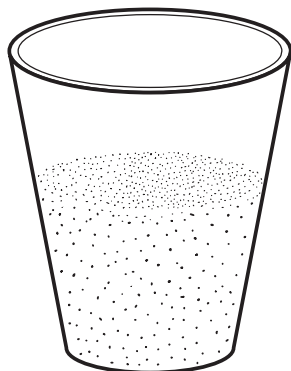
Soil

Cooler Warmer



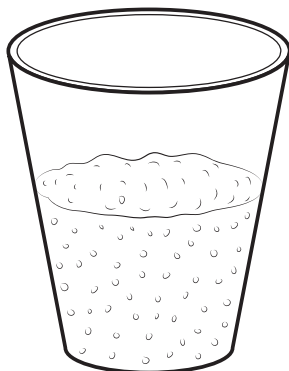
Water

Cooler Warmer



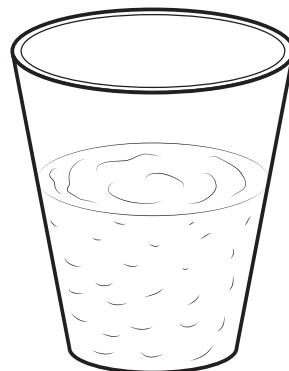
Sand

Cooler Warmer



Soil

Cooler Warmer



Water

Cooler Warmer

Words for Your Drawing

Cut out the words. Add the ones you need to your drawing.



sun	Earth’s surface	sunlight
warming	soil	sand
water	buildings	plants
shade	warmer	cooler
warmer	cooler	umbrella

Name _____

Date _____

Activity Page 2.1.1

Use with Lesson 2.1

Sheep and Shade

Add arrows and labels. Tell what the sheep are doing and why.



Name _____

Date _____

Activity Page 2.1.2


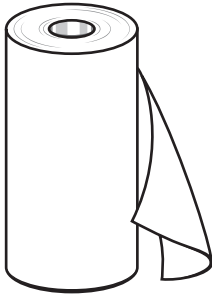
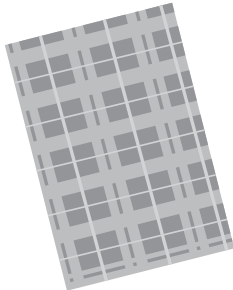
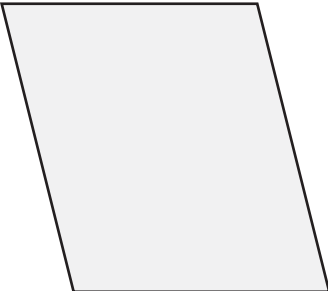
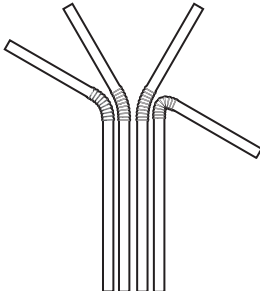
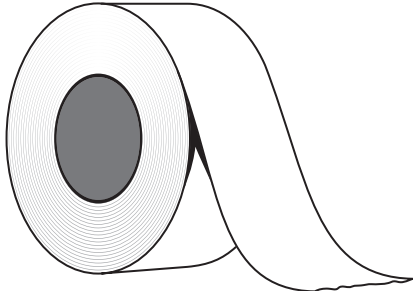
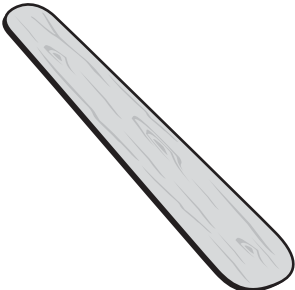
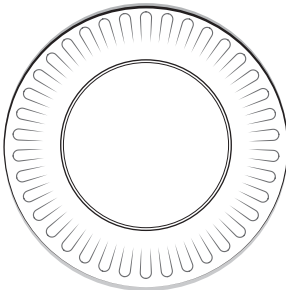
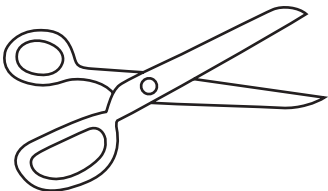
Use with Lesson 2.1

Saving Our Ice Cube

1. Say the words to complete the sentence that your teacher reads.

How can we use the materials _____ gives us to build a _____ that will make our _____ last longer?

2. Talk about the tools and materials with your team. Check the ones your team wants to use.

black paper 	paper towels 	cloth 
white paper 	straws 	tape 
wood sticks 	paper plates 	scissors 

Name _____

Date _____

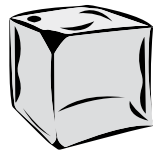
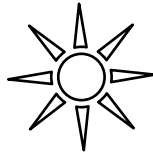
Activity Page 2.3.1

Use with Lesson 2.3

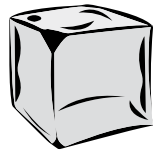
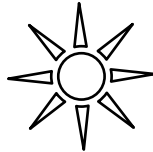
Testing Our Structure

1. Draw the ice cube in open sunlight on picture A.
2. Draw your structure and what happens to the ice cube in picture B.

A



B



Engineering Fair Badges

<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>	<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>
<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>	<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>
<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>	<p>Welcome to the Engineering Fair!</p> <p>My name is</p> <p>_____</p> <p>My team is</p> <p>_____</p>

Name _____

Date _____

Activity Page 2.4.2

Use with Lesson 2.4

Engineering Fair Visitor Card

Team Name	How well did I understand the team's solution?		
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3
	1	2	3

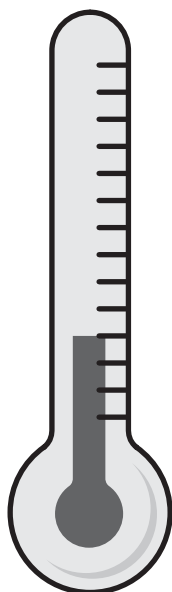
Name _____

Date _____

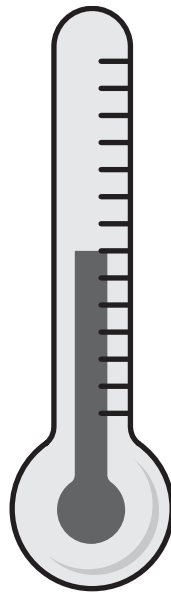
Activity Page 3.1.1

Use with Lesson 3.1

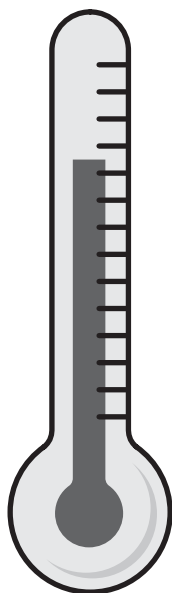
How Does the Air Feel?



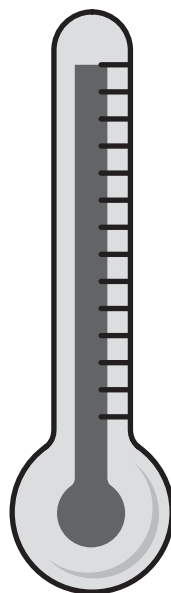
Cold



Cool



Warm



Hot

Name _____

Date _____

Activity Page 3.1.2

Use with Lesson 3.1

How Does Air Temperature Change over a Day?








	Early Morning	Afternoon
Day 1:		
Day 2:		
Day 3:		

I see a pattern. It is _____ in morning and _____ in the afternoon.

Name _____

Date _____

How Many Days of Each Kind of Weather?

Days		Sunny 	Cloudy 	Rainy, Snowy 	Windy 	No Wind 	Cold, Cool 	Warm, Hot 
	20							
	19							
	18							
	17							
	16							
	15							
	14							
	13							
	12							
	11							
	10							
	9							
	8							
	7							
	6							
	5							
	4							
	3							
	2							
	1							

Name _____

Date _____

Activity Page 3.3.1

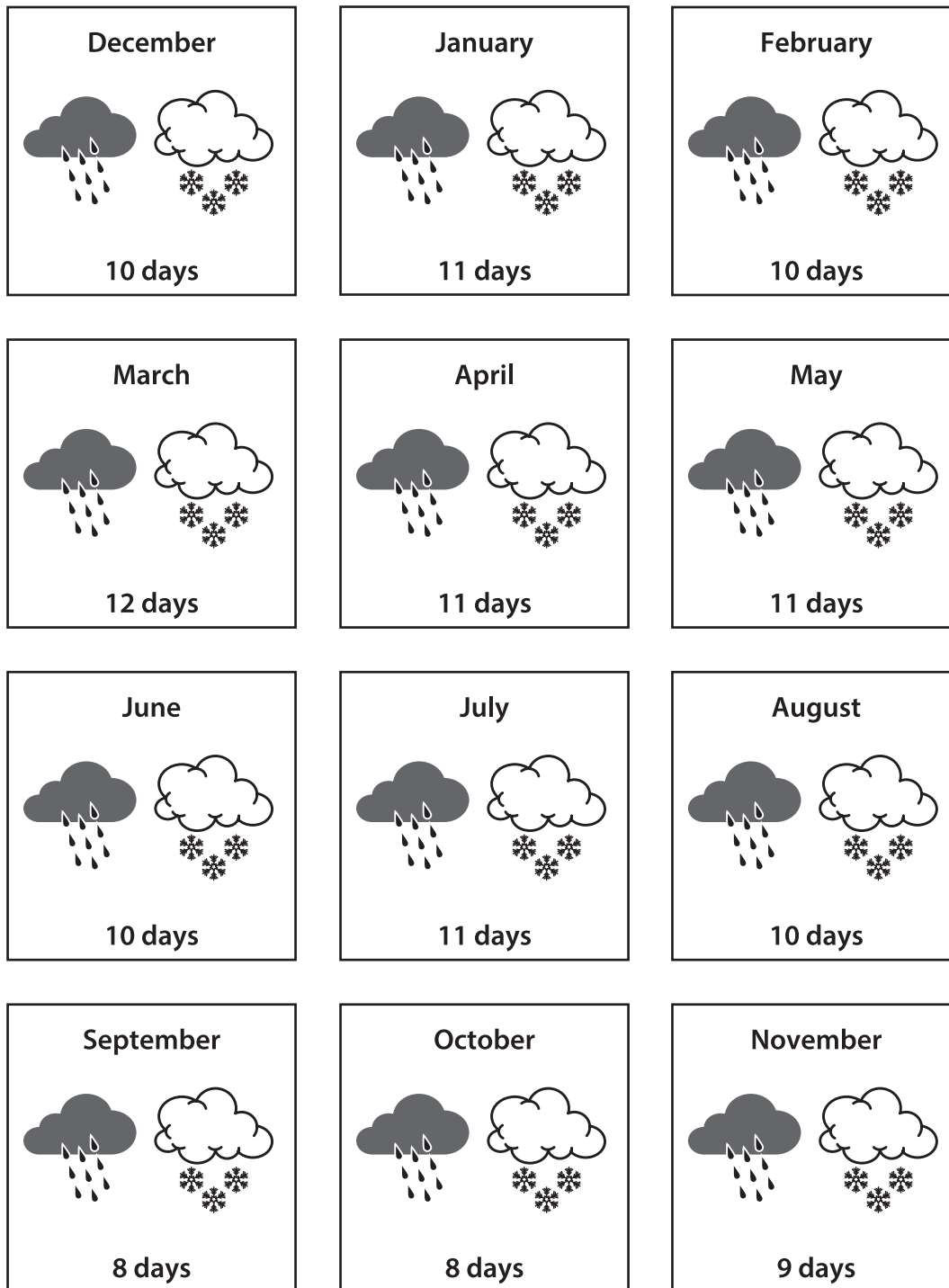
Use with Lesson 3.3

Color the month with the greatest number of rainy or snowy days yellow.

Color the months with the least number of rainy or snowy days blue.

Write "Party" next to the two months that would be best for an outdoor party.

Rainy or Snowy Days



Name _____

Date _____

Activity Page 3.3.2

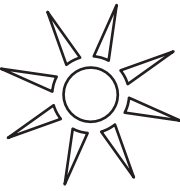
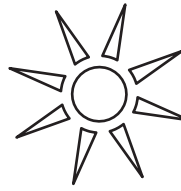
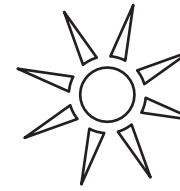
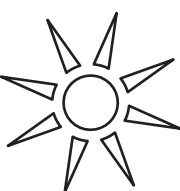
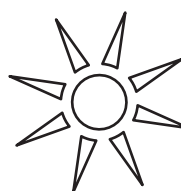
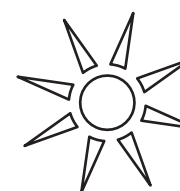
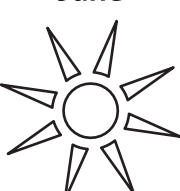
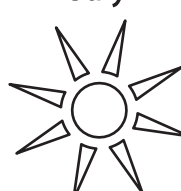
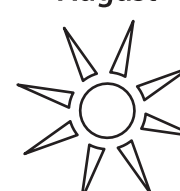



Use with Lesson 3.3

Color the month with the most sunny days yellow.

Color the month with the fewest number of sunny days blue.

Circle the row of three months that is best for outdoor activities.

Sunny Days in _____

<p>December</p>  <p>_____ days</p>	<p>January</p>  <p>_____ days</p>	<p>February</p>  <p>_____ days</p>
<p>March</p>  <p>_____ days</p>	<p>April</p>  <p>_____ days</p>	<p>May</p>  <p>_____ days</p>
<p>June</p>  <p>_____ days</p>	<p>July</p>  <p>_____ days</p>	<p>August</p>  <p>_____ days</p>
<p>September</p>  <p>_____ days</p>	<p>October</p>  <p>_____ days</p>	<p>November</p>  <p>_____ days</p>

Name _____

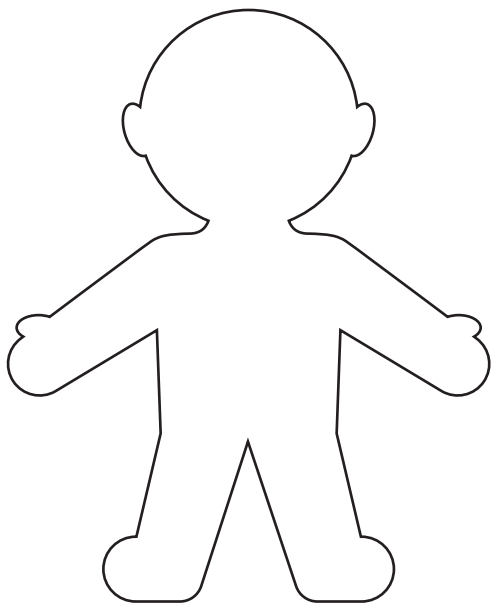
Date _____

Activity Page 3.4.1

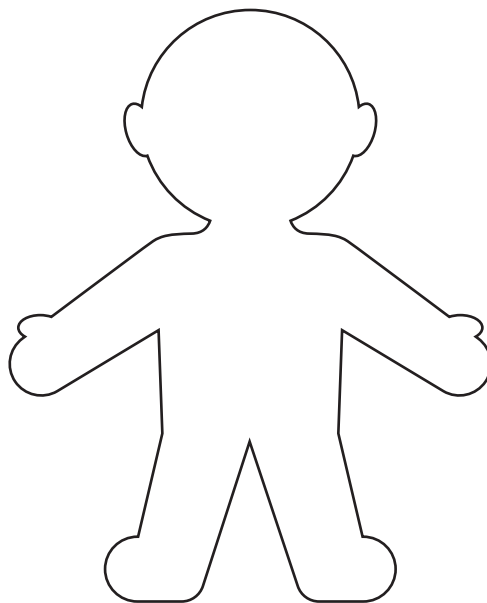
Use with Lesson 3.4

What Should I Wear Today?

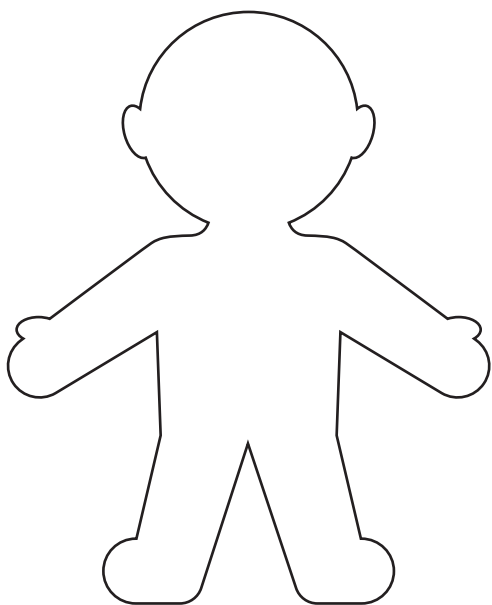
Draw outdoor clothing for each season.



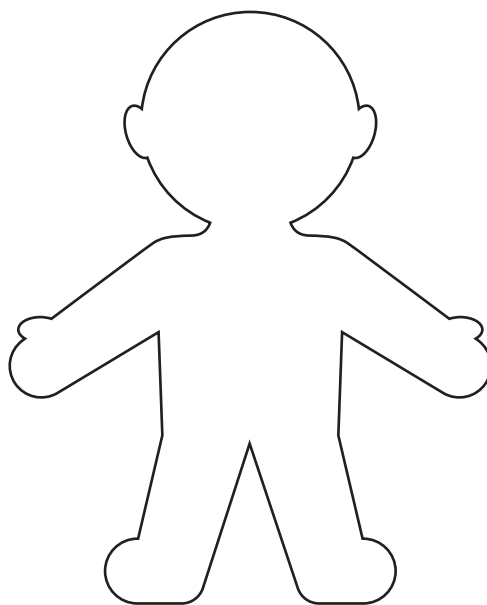
Winter



Spring



Summer



Fall

Name _____

Date _____

Activity Page 3.4.2

Use with Lesson 3.4

Today's Weather Around the USA

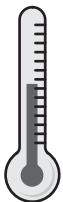
New York City



Very cloudy



Rainy



Cool



Light wind

Denver, Colorado



Very cloudy

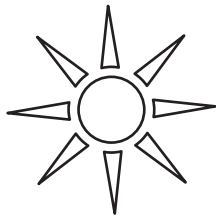


Cold

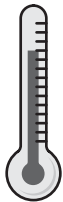


No wind

Tucson, Arizona



Sunny, clear

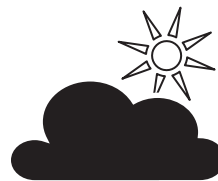


Warm



No wind

Chicago, Illinois



Partly cloudy



Cool



No wind

Comparing Severe Weather

Paste the weather icons in the table to describe each kind of weather.

Severe Weather	Sunny or Cloudy?	Rainy or Snowy?	Air Temperature	Windy or Calm?
Heat Wave				
Hurricane				
Tornado				
Blizzard				

Name _____

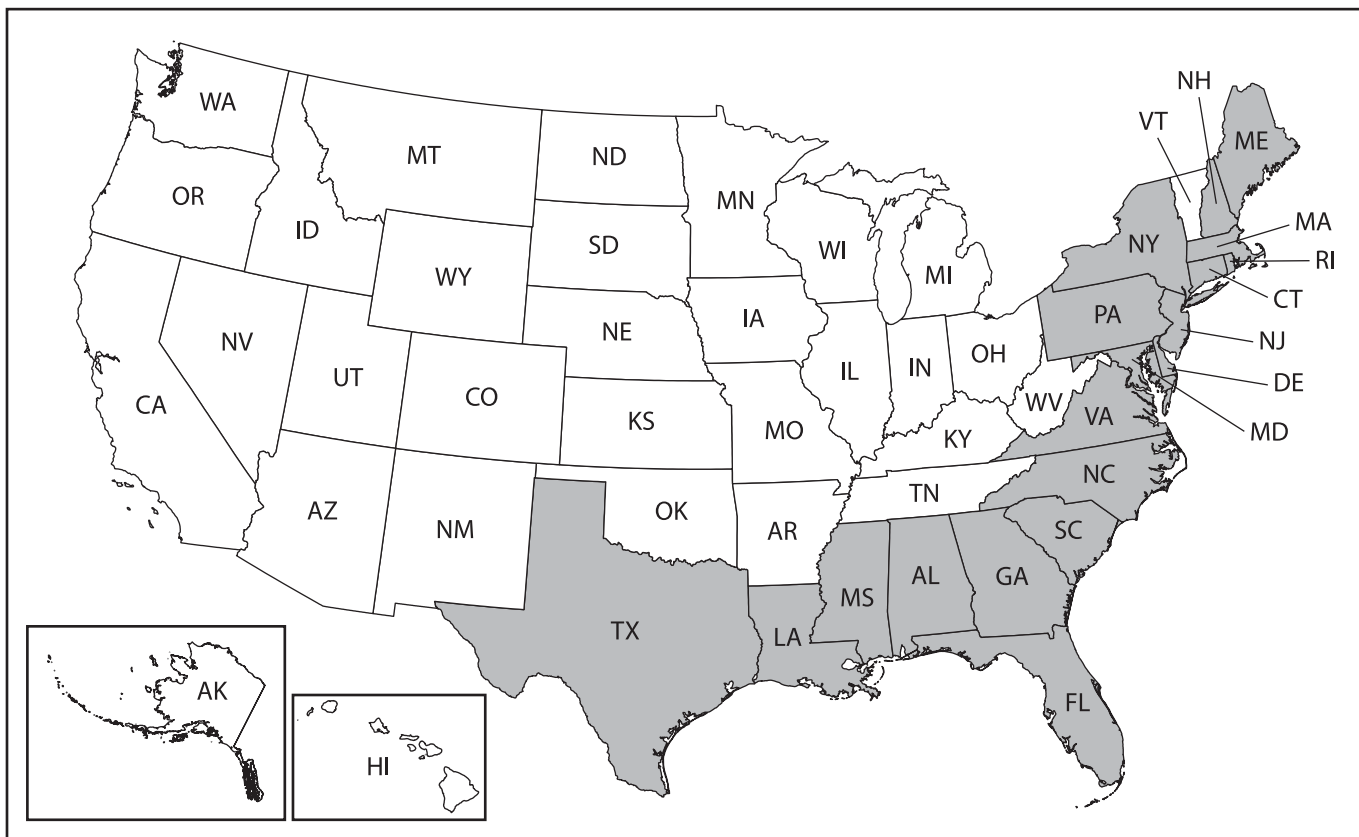
Date _____

Activity Page 4.2.1

Use with Lesson 4.2

Are Hurricanes Likely Where We Live?

Highlight your state.



Is your state in the shaded area? Circle **Yes** or **No**.

Yes

No

Are hurricanes likely to happen where you live? Circle **Yes** or **No**.

Yes

No

Name _____

Date _____

Activity Page 4.2.2

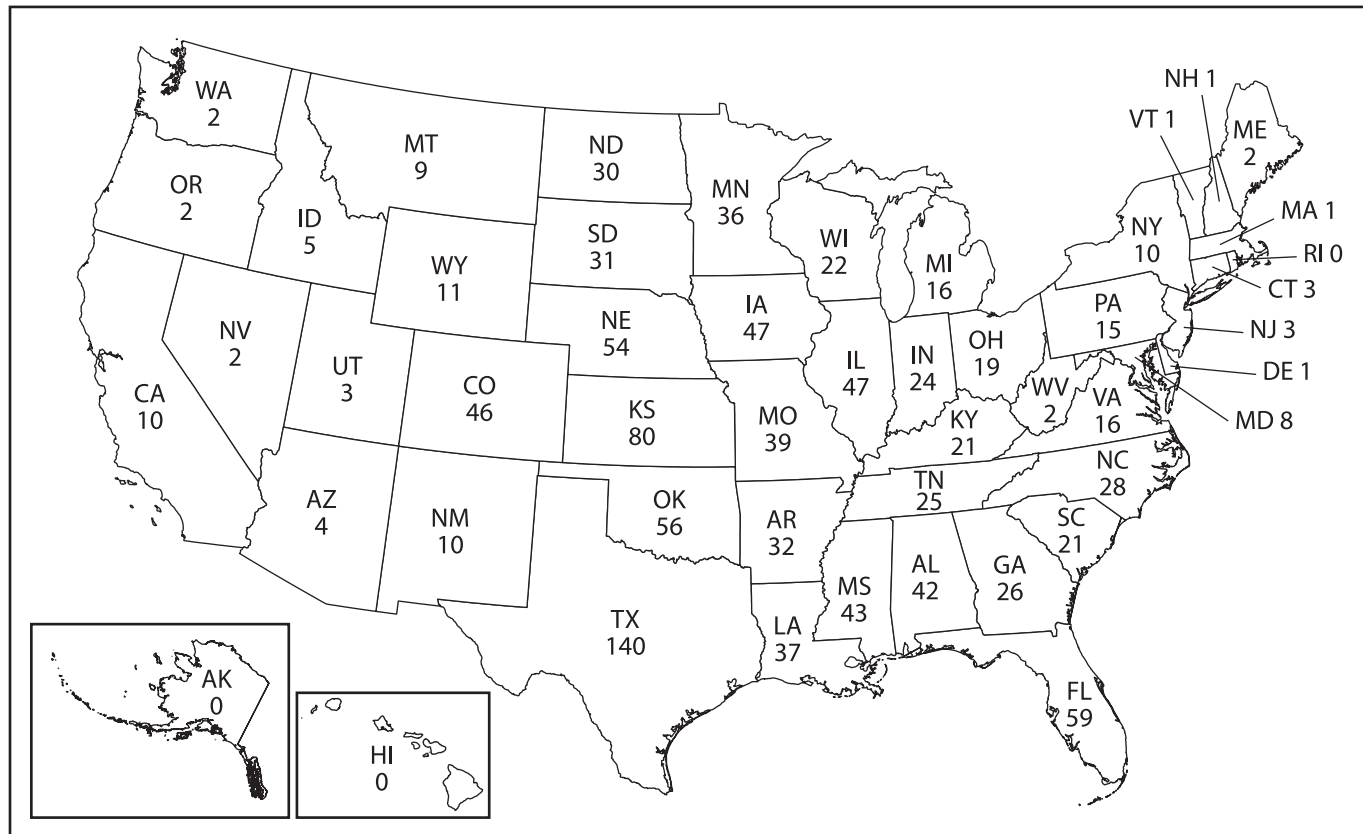
Use with Lesson 4.2

Are Tornadoes Likely Where We Live?

Highlight your state.

Look at the number of tornadoes in your state.

Look at the numbers of tornadoes in nearby states.



Does your state have 10 or more tornadoes in a year? Circle **Yes** or **No**.

Yes

No

Name _____

Date _____

Activity Page 4.2.3

Use with Lesson 4.2

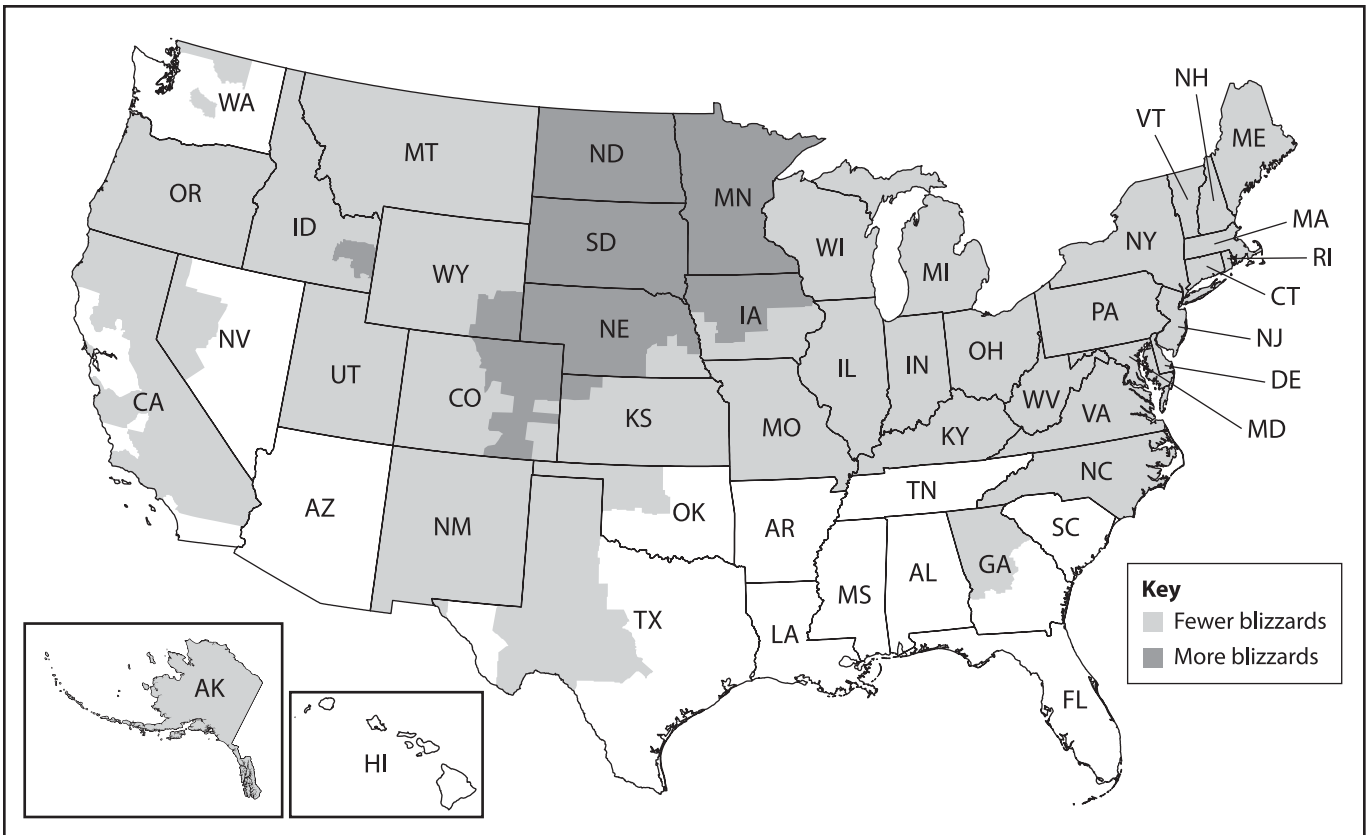
Are Blizzards Possible Where We Live?

Highlight your state.

Find the states with some blizzards.

Find the states with the most blizzards.

Complete the sentence.



Is a blizzard likely to ever happen where you live? Circle **Yes** or **No**.

Yes

No

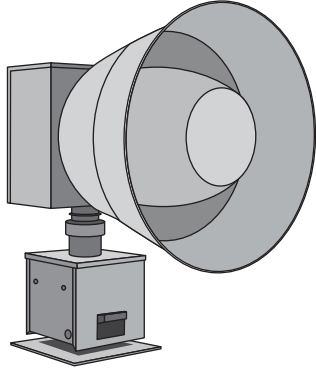

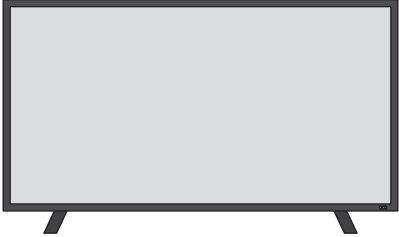

Name _____

Date _____

Activity Page 4.3.1

Use with Lesson 4.3

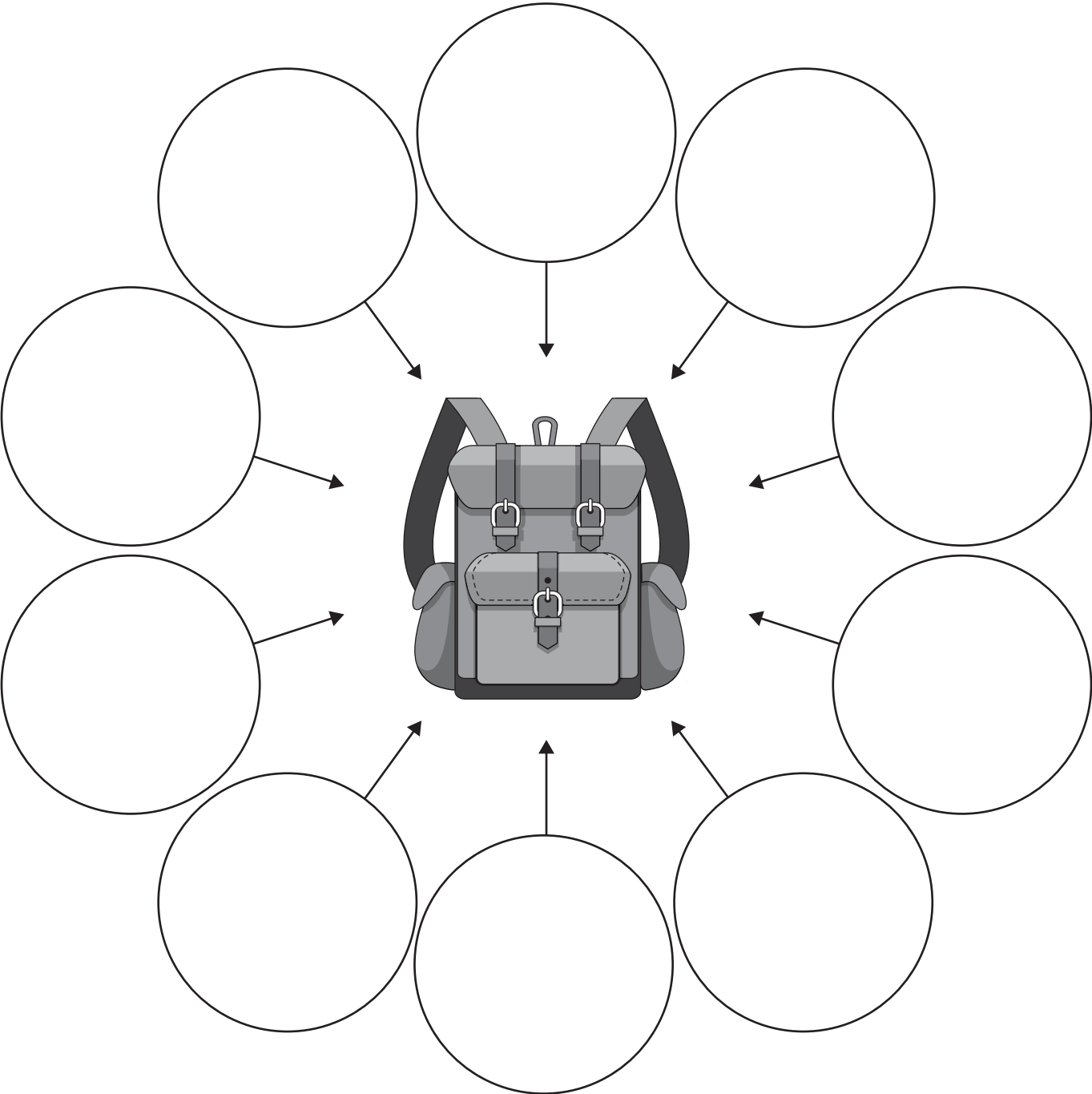
Where Can We Use Severe Weather Warning Tools?

	<input type="checkbox"/> indoors	<input type="checkbox"/> outdoors
	<input type="checkbox"/> indoors	<input type="checkbox"/> outdoors
	<input type="checkbox"/> indoors	<input type="checkbox"/> outdoors
	<input type="checkbox"/> indoors	<input type="checkbox"/> outdoors

Plan a Go Bag

Choose ten things to pack in a severe-weather go bag.

Paste them in the circles.



Name _____

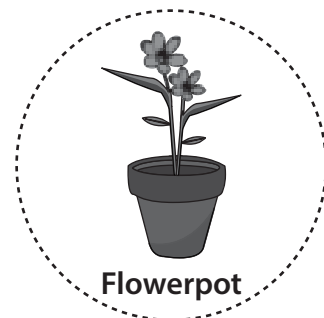
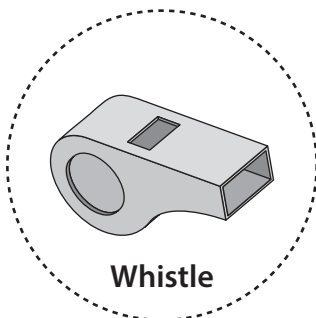
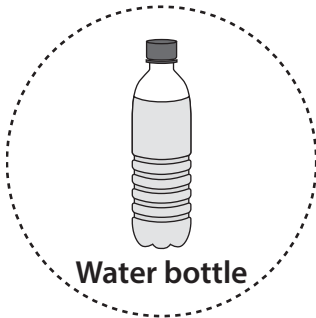
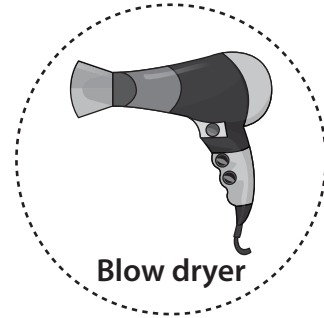
Date _____

Activity Page 4.4.2

Use with Lesson 4.4

Choose Ten Things for a Go Bag

Have students cut out ten things to paste on Activity Page 4.4.1 for a go bag and be ready to support the choices.



Name _____

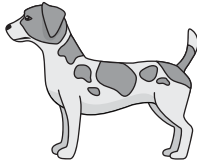



Date _____

Activity Page 4.4.3

Use with Lesson 4.4



Safety in Severe Weather

Have students check the boxes to show what their families should do to stay safe.

Kind of Severe Weather	Bring in pets or objects that the wind can move 	Go indoors and stay inside 	Listen to weather warnings 	Pack a go bag, in case your home is no longer safe 
Hurricane				
Tornado				
Thunderstorms and Flooding				
Blizzard				
Heat Wave				

Weather and People

Write Yes, No, or Maybe for each type of weather.

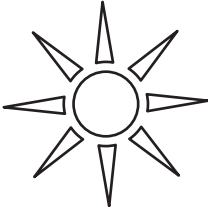



Kind of Weather	Take an Umbrella 	School Is Canceled 
Sunny, Warm		
Rainy, Warm		
Snowy, Cold		
Rainy, Very Windy		
Hurricane		
Tornado		
Heat Wave		

Name _____

Date _____

Tomorrow's Weather

Check the box next to the type of weather for each day.

	Yesterday	Today	Tomorrow
			
			
			
			

Activity Pages Answer Key: *Weather Patterns*

This answer key offers guidance to help you assess your students' learning progress. Here you will find descriptions of the expected key understandings, correct answers, and desired observations for each Activity Page of this unit. At this grade level, students' written responses are not expected to reflect the specificity shown here, and students should not be evaluated on refined drawing ability. Use the answers below, not as direct models for ideal student responses, but as keys to what to look for in evidence of student learning.

Taking an Umbrella on a Sunny Day (AP UO.1) (page 177)

Student drawings should include an umbrella and a person.

Weather Observation Chart (UO.2) (page 178)

Answers will vary based on conditions in your area.

Our Investigation Plan (AP 1.1.1) (page 180)

Student drawings should show equal volumes of the materials in each cup, sunlight shining on the first three cups, and some sunlight being blocked over the second three cups.

How Does Sunlight Affect Sand, Soil, and Water? (AP 1.2.1) (page 181)

Students should circle "warmer" for each material in the sun and "cooler" for the same material in the shade.

Sheep and Shade (AP 2.1.1) (page 183)

- Students should add arrows and labels to show the sheep, the tree, shade from the tree, and how the sheep sit in the shade to stay cool.
- Students should add arrows and labels to show the sheep, the cave, shade from the cave, and how the sheep sit in the shade to stay cool.
- Students should add arrows and labels to show the sheep, the building, shade from the building wall, and how the sheep sit in the shade to stay cool.

Saving Our Ice Cube (AP 2.1.2) (page 184)

Students should write in their teacher's name; structure/covering/shade; ice cube. Students should then check the tools and materials they will use.

Testing Our Structure (AP 2.3.1) (page 185)

Picture A should show more warming and melt.

Picture B should show the structure, shade, and less melt.

Engineering Fair Visitor Card (AP 2.4.2) (page 187)

Students should fill out the card with each team name and the level of understanding of each team's solution.

How Does Air Temperature Change over a Day? (AP 3.1.2) (page 189)

Students should note that it is cooler in the morning and warmer in the afternoon.

How Many Days of Each Kind of Weather? (AP 3.2.1) (page 190)

Student data should accurately reflect the local weather.

Rainy or Snowy Days (AP 3.3.1) (page 191)

Students should note:
March had the most rainy/snowy days.
September and October had the fewest rainy/snowy days.

September and October would be the best choices for an outdoor party.

Sunny Days in _____ (AP 3.3.2)
(page 192)

Student answers will vary but should match the data.

What Should I Wear Today? (AP 3.4.1)
(page 193)

Student answers will vary depending on region but should reflect proper seasonal clothing.

Comparing Severe Weather (AP 4.1.1)
(page 195)

Student charts should match the weather event to these weather conditions:

Heat Wave: sunny, clear; no snow or rain; hot; no wind

Hurricane: very cloudy; raining; warm; very windy

Tornado: very cloudy; no rain or snow; any temperature; very windy

Blizzard: very cloudy; snowing; cold; very windy

Are Hurricanes Likely Where We Live? (AP 4.2.1)
(page 196)

Students should circle “Yes” if their state is shaded or “No” if their state is not shaded.

Are Tornadoes Likely Where We Live? (AP 4.2.2)
(page 197)

Students should circle “Yes” if their state has 10 or more tornadoes and “No” if it has less than 10.

Are Blizzards Possible Where We Live? (AP 4.2.3)
(page 198)

Students should circle “Yes” if a blizzard is likely to happen in their state or “No” if not.

Where Can We Use Severe Weather Warning Tools? (AP 4.3.1)
(page 199)

Students should mark the check box to indicate that the siren, radio, and weather app can be used outdoors. The radio, TV, and app can be used indoors.

Plan a Go Bag (AP 4.4.1)
(page 200)

Students should leave out items that are less useful, such as the blow dryer, flowerpot, or umbrella.

Safety in Severe Weather (AP 4.4.3)
(page 202)

Students should check all boxes.

Weather and People (AP UC.1)
(page 203)

Kind of Weather	Take an Umbrella	School Is Canceled
Sunny, Warm	yes	no
Rainy, Warm	yes	no
Snowy, Cold	maybe	maybe
Rainy, Very Windy	no	no
Hurricane	no	yes
Tornado	no	maybe
Heat Wave	yes	maybe

Tomorrow’s Weather (AP US.1)
(page 204)

Students should check each box as appropriate to the weather.

Glossary

Green words and phrases are Core Vocabulary for the unit, and Student Book 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 Book, and these latter terms do not have specific page numbers listed. Vocabulary words are not intended for use in isolated drill or memorization.

B

blizzard, n. a severe snowstorm with high winds

C

cancel, v. to decide that an event will not take place (canceled, adj. called off)

claim, n. a statement of something one believes to be true

cloudy, adj. the appearance of the sky when it contains a lot of clouds

cold, adj. at a low temperature

cool, adj. of or at a fairly low temperature (cooler, adj. at a lower temperature than something else)

D

data, n. information that is observed or measured and recorded

design, n. a plan to show how something is made or how a process should work (v. to develop a plan for a device or a solution to a problem)

E

Earth, n. the planet on which we live

emergency siren, n. a device that makes a loud sound to alert people in an area about danger

engineer, n. a person who uses science to design solutions to problems, especially by constructing tools or devices (v. to design and build)

evidence, n. a detail that supports a claim or helps prove an idea is true

F

fair, adj. pleasant, not stormy or foul

fall, n. the season of the year between summer and winter when temperature starts to cool

forecast, n. a data-based prediction of future conditions

H

heat wave, n. a long period of weather that is hotter than normal

hot, adj. having a high degree of heat

hurricane, n. a tropical storm with winds greater than seventy-four miles an hour usually accompanied by rain, thunder, and lightning

I

instrument, n. a tool for doing scientific work

M

materials, n. matter that makes up different things

measure, v. to determine the amount of something

melt, v. to change from a solid to liquid state

meteorologist, n. a weather forecaster; a scientist who studies weather and climate

month, n. a unit of time on Earth that is about thirty days long

O

observe, v. to watch something and notice details about it (observation, n. the process of noticing details or a specific detail that is noticed)

P

pattern, n. a reliable system of traits or a set of repeating details

pilot, n. a person who flies an aircraft

predict, v. to say that something is expected to happen

problem, n. a condition that falls short of satisfying a want or a need

public, n. all people together as a whole group

R

rainy, adj. describing a time or place in which rain is falling

S

season, n. a three-month part of the year determined by the weather and daylight hours

severe weather, n. weather that can cause damage

shade, n. an area in shadow from direct sunlight

smartphone, n. a mobile phone with computer-level functions and internet connectivity

snowy, adj. describing a time or place during or after snowfall

solution, n. a process, action, or device that fixes a problem

spring, n. the season of the year between winter and summer when temperature starts to warm

star, n. an object in space that gives off its own light

structure, n. the way in which something is made and the parts it is made of

summer, n. the season of the year between spring and fall when days are longer and temperature is warm or hot

sun, n. the star that Earth moves around and that provides Earth with light and heat

sunlight, n. light from the sun

sunny, adj. having an amount of sunlight

surface, n. the outside part or uppermost layer of an object

T

temperature, n. the measure of how hot or cold something is

thermometer, n. an instrument that measures temperature

tornado, n. a spinning, funnel-shaped column of air that extends from the clouds down toward the ground

W

warm, adj. at a comfortably high temperature (v. to increase in temperature)

warmer, adj. describing material at a slightly higher temperature in comparison with something else

weather, n. the condition of the air outside at a given place and time

weather radio, n. a special type of radio designed to receive weather information and severe weather alerts

wind, n. the movement of air from one place to another

windy, adj. describing a time or place with wind blowing

winter, n. the season of the year between fall and spring when days are shorter and temperature is cooler or cold

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:

- Be aware of students who have food allergies, and adjust related activities or make materials substitutions as necessary. Check the ingredients of all food to make sure known allergies are not listed. Students with food allergies can still be affected even if they do not ingest the food item. Some common food allergies are peanuts, tree nuts (e.g., almonds, walnuts, hazelnuts, etc.), and cow's milk (rice milk is a good nut-free alternative).
- 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. Have a read-along, and have students agree to the expectations for students when engaged in science activities prior to the start of the first unit.

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 do the following:

- 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 student 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, do the following:

- 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, such as food allergies, 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, do the following:

- 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, do the following:

- 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.

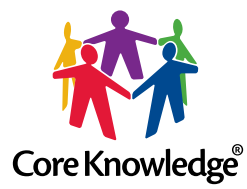
What to Do When Activities Don't Give Expected Results

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 segment's guiding 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 to figure out why something happened will help them to develop a better sense of how to do science.



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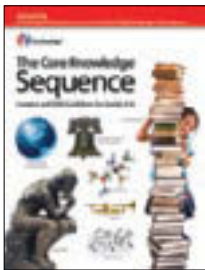
E.D. Hirsch Jr.

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