Core Knowledge® SCIENCE

Properties of Matter

solid

Teacher Guide

gas

liquid

solid water

Properties of Matter

Teacher Guide

Core Knowledge®

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Properties of Matter

Table of Contents

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Teacher Guide

Core Knowledge Science™ 2

UNIT 1

Introduction

About this Unit

The Big Idea

This unit focuses on the scientific concept that matter exists in different forms that possess different properties.

Children are exposed to describing objects by color, shape, and size from a very young age. However, they might not have been invited to examine the materials that make up different objects. A closer look at objects reveals that they are made of a diverse range of materials. These materials are also made up of parts that can be assembled, disassembled, and reassembled in a variety of useful ways.

In this unit, students learn that matter, the "stuff" of which everything is made, exists in many forms. Students will practice sorting and grouping materials by characteristics called properties and investigate how the properties of different types of matter make them useful for different tasks. Students will be introduced to the practice of taking measurements, which permit simple comparisons. They will explore matter, including the distinction between physical and chemical properties and changes, in Grade 5 Unit 1 *Investigating Matter*.

Students explore concepts that include the following:

- Different forms of matter exist and can be solid, liquid, or gas depending on the temperature.
- Matter can be described and classified by its observable and measurable properties.
- Different properties of matter are suited to different purposes.
- A variety of objects can be built up from a small set of pieces.
- Heating and cooling a substance may cause an observable change that may or may not be reversible.

Engineers and engineering designers use knowledge of the properties of matter as they use materials in design solutions to make things that are useful to people. This series of lessons incorporates learning goals that support the principles and practices of engineering design, such as defining problems, testing materials, and evaluating possible solutions.

Note to Teachers and Curriculum Planners

This unit introduces Grade 2 students to real-world examples and fundamental concepts of properties of matter, which will be explored in greater depth in later grades. Students will learn about observable properties of matter, including the basic states of matter; discover patterns and make predictions based on properties of matter; and explore how heating and cooling can change matter. The following are preliminary considerations for planning and instruction relative to this unit:

- While the unit engages Grade 2 students in investigating different materials to collect data and determine their properties, the only quantitative data collected is length. However, descriptive data such as color, strength, flexibility, texture, hardness, and absorbency can be collected.

Students will investigate matter and its properties again and in greater depth in Grade 5.

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, *Properties of Matter*, has been informed by the following Grade 2 Performance Expectations for the NGSS topic *Structure and Properties of Matter*. Students who demonstrate understanding can do the following:

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

2-PS1-4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

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.

Building Science Knowledge

What Students Should Already Know

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

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.

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. Introduction to Matter — SEGMENTS 1–5

- Define *matter*.
- Identify characteristics of solids, liquids, and gases.
- Explain properties of matter.
- Classify materials as solids, liquids, or gases.

Lesson 2. Heating and Cooling Matter — SEGMENTS 1–3

- Define *temperature*.
- Identify the effect of heating and cooling on matter.
- Classify changes as reversible or not reversible.

Lesson 3. Properties and Uses of Matter — SEGMENTS 1–2

- Define various properties of matter.
- Determine which materials have the properties that are best suited for an intended purpose.

Lesson 4. Building from Component Parts — SEGMENTS 1–3

- Identify the components that make up objects.
- Explain that parts of things have properties that make them useful.
- Describe how objects can be built up, torn down, and reassembled using the same parts.

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 *Properties of Matter* Student Book includes eight 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 Grade 2 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-five days and a maximum of thirty-seven days teaching the *Properties of Matter* unit so that you have time to teach the other units in the Grade 2 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:** Properties of Matter	**Big Question:** How are containers matched to the stuff they contain?
Lesson 1: Introduction to Matter (2-PS1-1)	**1.1** What Is in Our Backpacks?	**Lesson 1 Guiding Question:** How do we group different materials?
		1.1 What do our backpacks contain?
	1.2 Matter Takes Up Space (two class sessions)	**1.2** What is matter?
	1.3 How Do We Describe Things? (two class sessions)	**1.3** What are some properties that we can describe?
	1.4 Temperature and Matter	**1.4** How do temperature changes affect matter?
	1.5 **Lesson 1 Roundup:** Sorting and Grouping Matter (two class sessions)	**1.5** How do we group different materials?
Lesson 2: Heating and Cooling Matter (2-PS1-4)	**2.1** A Melty Mess (two class sessions)	**Lesson 2 Guiding Question:** How does temperature affect matter?
		2.1 How does heating and cooling matter affect how things are stored in containers?
	2.2 Changing the Temperature of Water	**2.2** How does temperature affect the three states of water?
	2.3 **Lesson 2 Roundup:** Investigating Changes to Matter (three class sessions)	**2.3** Can changes to matter caused by heating or cooling be reversed?

Lesson 3: Properties and Uses of Matter (2-PS1-2)	**3.1** How Materials Hold Water (two class sessions)	**Lesson 3 Guiding Question:** How can we tell which materials have the properties that make them useful for certain jobs?
		3.1 How can we move water from one place to another?
	3.2 **Lesson 3 Roundup:** What Properties Make Materials Useful? (two class sessions)	**3.2** How can we tell which materials have the properties that make them useful for certain jobs?
Lesson 4: Building from Component Parts (2-PS1-3)	**4.1** Pieces and Parts	**Lesson 4 Guiding Question:** How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?
		4.1 What are the pieces and parts that make up objects?
	4.2 What Are the Parts of a Ballpoint Pen? (two class sessions)	**4.2** How do the parts of a pen work together?
	4.3 **Lesson 4 Roundup:** Build It Up, Take It Down	**4.3** How can we make new objects out of the pieces from something else?
Unit Capstone	**Unit Capstone:** Properties of Matter	**Big Question:** How are containers matched to the stuff they contain?
Unit Supplement	Science in Action	Who are some people who work in this type of science, and what do they do?

Activity Pages

Activity Pages

AP UO.1
AP 1.1.1
AP 1.2.1
AP 1.3.1

Black line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 196–227. 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—See the Salt (AP UO.1)

Lesson 1—Container Scavenger Hunt (AP 1.1.1)

Lesson 1—Sort the Matter (AP 1.2.1)

Lesson 1—Properties of Matter Lab Sheet (AP 1.3.1)

Activity Pages

AP 1.4.1
AP 1.5.1
AP 2.1.1
AP 2.1.2
AP 2.2.1
AP 2.3.1
AP 2.3.2
AP 3.1.1
AP 3.2.1
AP 3.2.2
AP 3.2.3
AP 3.2.4
AP 3.2.5
AP 3.2.6
AP 4.1.1
AP 4.2.1
AP 4.2.2
AP 4.3.1

Lesson 1—Venn Diagram (AP 1.4.1)

Lesson 1—Investigate It (AP 1.5.1)

Lesson 2—Ice Cream Portrait (AP 2.1.1)

Lesson 2—Temperature Testers (AP 2.1.2)

Lesson 2—How Hot or Cold? (AP 2.2.1)

Lesson 2—What Does the Heat Do? (AP 2.3.1)

Lesson 2—Cool It Down (AP 2.3.2)

Lesson 3—Race to Move Water (AP 3.1.1)

Lesson 3—How Porous Am I? (AP 3.2.1)

Lesson 3—100-Gram Challenge (AP 3.2.2)

Lesson 3—Can It Crack the Candy? (AP 3.2.3)

Lesson 3—How Strong Am I? (AP 3.2.4)

Lesson 3—Which Texture Is Best? (AP 3.2.5)

Lesson 3—Let's Heat It Up! (AP 3.2.6)

Lesson 4—Pieces and Parts Scavenger Hunt (AP 4.1.1)

Lesson 4—Ballpoint Pen Diagram (AP 4.2.1)

Lesson 4—Parts That Make Up a House (AP 4.2.2)

Lesson 4—What Can We Make? (AP 4.3.1)

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 228–229.
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, and 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:

DCI PS1.A Structure and properties of matter

DCI PS1.B Chemical reactions

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 230–234, 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

- water (1–2 cups per group)
- watering cans or spray bottles (1 per group)
- salt (quarter cup per group)
- brown paper bags (1 per group)
- plastic containers (1 per group)
- cloth towels or tarps (1 per group)

Lesson 1 Introduction to Matter

Lesson 1.1

- backpack
- lunch box

Lesson 1.1, continued

- sandwich in a plastic bag
- clear food storage container with fruit inside
- cake in a plastic bag
- juice box
- pencil box
- water jug or bottle
- canned food

Lesson 1.2

- wooden craft sticks (1 per group)
- metal coins (1 per group)
- paper (1 sheet per group)

Lesson 1.2, continued

- markers (1 per group)
- bowls of water (1 per group)
- balloons (1 per group, inflated)
- poster paper
- black marker
- balloons (1 per group, deflated)
- plastic exercise hoops (1 per group)

Lesson 1.3

- wooden craft sticks (1 per group)
- plastic straws (1 per group)
- metal coins (1 per group)
- paper (1 sheet per group)
- markers (1 per group)
- bowls of water (1 per group)
- stuffed animal (1 for demonstration)
- spring scales (1 per pair)
- cookies (chocolate chip cookies, sandwich cookies, fig cookies, and vanilla wafers; 1 of each per pair)
- clear jars (1 per pair)
- rulers (1 per pair)
- rubber balloons (1 per pair)
- tall plastic or paper cups (1 per pair)
- short plastic or paper cups (1 per pair)
- calculators (1 per pair or enough to share)
- milk (can also use plant-based milk instead; 1–2 cups per pair)

Lesson 1.4

- clear bowls (2)
- flour
- bag of chocolate chips
- hot plate
- cookie mold or ice cube tray
- spatula
- oven mitt

Lesson 1.5

- scales (1 per group or enough for groups to share)

Lesson 1.5, continued

- rulers (1 per group)
- variety of containers (1–2 per group)
- balloons (1 per group)
- cups (various sizes, 2 per group)
- water (1 cup per group)
- spoons or stir sticks (1 per group)
- liquid glue (1 bottle per group)
- modeling clay (1 tablespoon per group)
- rocks (1 per group)
- powdered gelatin (half cup per group)
- large paper clips (1 per group)
- colorful candy melts (a few per group)
- bowls
- bucket of ice
- hot plate
- small metal pan
- oven mitt

Lesson 2 Heating and Cooling Matter

Lesson 2.1

- thermometers (1 per group)
- melted ice cream
- ice cream scoop
- freezer (or cooler filled with ice)
- foam cups (1 per group)
- water (1 cup per group)

Lesson 2.2

- thermometers (1 per group)
- foam cups (1 per group)
- water (1 cup per group)
- ice cubes (4–5 per group)
- plastic snack- or sandwich-size baggies (1 per group)
- hot plate
- pot for boiling water
- freezer or cooler
- chalk or dry-erase markers (1 per group)

Lesson 2.3

- hot plate
- freezer
- small metal pans (4)
- spatulas, spoons, or stir sticks (2)
- raw egg
- butter, solid (quarter stick)
- oven mitt
- paper (1 sheet)
- ice cubes (half cup)
- plant leaves (1 per pair)
- water (quarter cup per pair)
- paper or foam cups (1 per pair)

Lesson 3 Properties and Uses of Matter

Lesson 3.1

- bowl
- milk (1–2 cups)
- large rock
- paper towels (several sheets per student)
- containers (1 per group)
- water (4 cups per group)
- 2-cup graduated cylinders (1 per group)
- dry sponge, cut into 1-inch pieces (1 piece per group)
- cotton balls (1 per group)
- washcloths (1 per group)
- tissues (1 sheet per group)
- fabric (1 piece per group)
- wax paper (1 sheet per group)
- plastic toys (1 per group)
- pencils (1 per group)
- rubber erasers (1 per group)
- timer
- small glass jars with lids (1 per group)
- glycerin (2–3 tablespoons per group)
- spoons (1 per group)
- glitter and sequins (2–3 tablespoons per group)

Lesson 3.1, continued

- plastic figurines (1–2 per group)
- hot glue gun (for teacher use)

Lesson 3.2

Station 1:

- container with 4″ opening (1 per group)
- construction paper (1 5-inch square per group)
- cardstock (1 5-inch square per group)
- cloth (1 5-inch square per group)
- plexiglass (1 sheet per group)
- paper towels (1 sheet per group)
- shallow pans (1 per group)
- containers to pour water from (1 per group)
- water

Station 2:

- plastic rulers, 12″ (1 per group)
- chenille stems (1 per group)
- cardstock strips (1 per group)
- rope (1 6-inch piece per group)
- fabric measuring tapes (1 per group)
- 100-g weights (1 per group)
- heavy-duty tape
- thread

Station 3:

- modeling clay (1 package)
- sponges (1 per group)
- rocks (2–3 per group)
- rubber erasers (1 per group)
- large candy jawbreakers (several per group)

Station 4:

- wooden blocks (2 per station)
- tape to secure testing materials to blocks
- pennies or washers (100 per station)
- construction paper (1 sheet per group)
- fabric dish towels (1 per station)
- plexiglass (1 sheet per station)

Lesson 3.2, continued

Station 5:

- plastic or wooden block
- masking tape
- tray
- plastic ruler, 12" (1 per group)
- sandpaper (1 sheet)
- plexiglass or other glossy plastic (1 sheet)
- construction paper (1 sheet)
- velvet square or other soft material

Station 6:

- wooden spoons (1 per station)
- plastic spoons (1 per station)
- metal spoons (1 per station)
- butter
- craft beads (3 per station)
- hot plate
- kettle or pot
- water
- cereal bowl
- plastic knife

Lesson 4 Building from Component Parts

Lesson 4.1

- plastic baggies (1 per group)
- sliced sandwich bread
- tomato
- romaine lettuce (2–3 leaves)
- sandwich meat
- sandwich cheese
- mayonnaise
- knife
- plate or cutting board
- colored construction paper

Lesson 4.1, continued

- plastic baggies (1 per group)
- timer

Lesson 4.2

- ballpoint pens (1 per pair)
- paper (1 sheet per pair)
- paper plates (1 per pair)
- markers or colored pencils (assortment per pair)
- tweezers (1 per pair, optional)

Lesson 4.3

- colored interlocking plastic blocks (3–5 handfuls per group)
- baggies or small containers (1 per group)
- markers, assorted colors (1 box per group)
- wooden craft sticks (10)
- glue

Unit Capstone

- poster or roll paper (6–8 large sheets)
- pencil
- black marker
- markers, assorted colors (1 box per group)
- construction paper (several sheets per group)
- clips for hanging the sheets of paper

Unit Supplement

- assortment of coins (several per group)
- assortment of pom-poms (various colors per group)
- assortment of plastic or wooden blocks (various shapes and/or colors per group)
- assortment of buttons (various colors and sizes per group)
- construction paper (1 sheet per group)

Properties of Matter Pacing

_____'s Class

Note to Teacher: *Properties of Matter* is intended to be taught as the first unit of Grade 2 CKSci. As a general rule, we recommend that you spend a minimum of twenty-five days and a maximum of thirty-seven days teaching the *Properties of Matter* unit so that you have time to teach the other units in the Grade 2 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

UNIT 1

Properties of Matter

Overview

Big Question: How are containers matched to the stuff they contain?

Anchoring Phenomenon: People transport stuff in bags, boxes, bottles, and cans. The driving question we explore in this unit is "How are containers matched to the stuff they contain?" To answer this question in depth over the course of the unit, students will explore **matter and its properties** as designers in their classroom container company. In exploring the question, students investigate, describe, and classify materials by their observable properties, including changes brought about by heating and cooling. They recognize that certain materials have properties that make them suited for intended purposes. Students learn how materials, based on favorable properties, are used to make up parts that can be assembled, disassembled, and reassembled in a variety of useful ways.

Student Book storyline: Maya encounters the problem of her sidewalk salt dissolving in its paper bag in the rain. She learns about properties of materials as she investigates what happened and considers containers better suited to the job of holding salt.

Long-term project: Students will explore matter and its properties as designers in their classroom container company.

At a Glance

Introductory Class Session
The Disappearing Salt

Students work with an everyday item, salt, to see what happens when it is placed into a paper bag and becomes wet. Students will simulate raining on the paper bag filled with salt to follow the storyline of Maya. The experiences students gain in this introductory class session will lead into the lessons where they discover the properties of matter and the types of containers that are best suited to do certain jobs.

Unit Opener Objective

✓ Observe changes to materials.

NGSS References

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 2 Cause and Effect

Students observe and read about a water-soaked paper bag of salt as the unit's Anchoring Phenomenon.

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 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

- teacher Read Aloud
- student observation

Instructional Resources

Student Book

Ch. 1

Student Book, Chapter 1
"Where Did the Salt Go?"

Activity Page

AP UO.1

Activity Page
See the Salt (AP UO.1)

Materials and Equipment

- water (1–2 cups per group)
- watering cans or spray bottles (1 per group)
- salt (quarter cup per group)
- brown paper bags (1 per group)
- plastic containers (1 per group)
- cloth towels or tarps (1 per group)

Advance Preparation

- Read Chapter 1 of the Student Book in advance.
- Fill the watering cans or spray bottles with water before class. Each can or bottle should have at least one cup of water, eight fluid ounces, in it.

If weather permits, conduct the rain activity outside so you do not have to worry about the classroom floors getting wet. If you elect to complete the activity outside, students will need clipboards or another suitable writing surface on which to complete the Activity Page.

The Unit Opener

1. Introduce the Anchoring Phenomenon.

- As students gather into class, talk about a time when it rained in your community. **Ask students to share their experience of the rain.** You can use the following prompts:
  - Did you get wet?
  - How did you stay dry?
  - Were you stuck inside until the rain stopped?
  - Did you get to play in any puddles?
- Tell students that sometimes it rains a lot and that too much rain can become dangerous, especially if it is cold. Cold rain can turn into ice, and that gets slippery. If people walk on it, they can slip and fall. Explain that one way to keep sidewalks from getting slippery is to put salt on the sidewalk. (See **Know the Science**.)
- Have students form small groups of mixed ability. Tell them they are going to do an experiment in class. Pass out the following materials to each group:
  - watering can (filled with water)
  - salt
  - brown paper bag
  - plastic storage container (with lid)
  - towel

Activity Page

AP UO.1

- Distribute See the Salt (AP UO.1). Tell students to pour half of the salt into the paper bag and the other half of the salt into the plastic container. Emphasize to students that they are probably familiar with the materials in front of them. Many students likely bring their lunches in paper bags or use plastic containers for food at home or school.
- Have students draw a picture of the paper bag and the plastic container on AP UO.1. Later, they will draw pictures of how the paper bag and plastic container look after water has contacted them.
- Next, students will pretend it is raining. Have students lay the towels down on the floor, putting the paper bags and the plastic containers on top of them. Tell them to pour water from the watering cans over both the bags and containers. Then they will record what happens to the bags, containers, and the salt.

Know the Science

TEACHER DEVELOPMENT

Salting Sidewalks: As water on a sidewalk freezes due to cold temperatures, it can turn into ice. Salting sidewalks lowers the freezing point of the water. This causes ice and snow to melt and prevents rainwater from freezing.

2. Read together: "Where Did the Salt Go?"

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

Student Book

Ch. 1

Page 2

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 "Where Did the Salt Go?" and tell them to pay special attention to how the salt is moved from one place to another as you read.

Ask students to look at the picture on page 2. Talk about what they notice about the weather.


CHAPTER 1

Where Did the Salt Go?

It was a gloomy and chilly Saturday. Maya looked out the window. Rain was falling hard. Water ran down the sidewalk. It filled potholes in the street. She wished the rain would stop. She wanted to go outside and play.

2

SUPPORT—Point out that the weather outside looks gloomy and wet.

Page 3

Ask students to look at the picture on page 3. Explain that it shows Maya talking to her mother.

Maya's mom came into the room. "Maya, it is going to get cold later," she said. "The rain will turn to ice. The front walk will be slippery. Can you go to the shed and get some sidewalk salt? The salt will help keep the sidewalk from becoming icy and slippery."

Maya liked to help her parents. She put on her raincoat and boots. Then she headed outside into the rain.

3

Ask students the following questions:

LITERAL—What do you see on the television in the background?

» a weather report

SUPPORT—Point out that the weather report on the television shows cold temperatures and wintry precipitation (rain or snow).

INFERENTIAL—Why might someone want to know what the weather will be?

» Someone might plan what to do if it is too hot or too cold or if it is raining or snowing. They might decide to stay home instead of going out. They might want to prepare for a storm. They might want to know how to dress for the weather.

Page 4

Now ask students to look at the picture on page 4 as you read aloud. Talk about the big bucket of salt.

Maya found a bucket of sidewalk salt in the shed. She tried to lift it, but it was too heavy.

Maya looked around. She found a paper bag with handles. It would be easier for her to carry. She used a small shovel to fill the bag with salt. Then she carried the bag to the front sidewalk. She would check the weather again in a few hours.

4

Ask students the following questions:

LITERAL—What kind of container is the salt kept in?

» a container that is big; a container that is plastic; a container that is deep

LITERAL—What kind of container is Maya putting the salt into?

» a paper bag

SUPPORT—Point out that both the bucket of salt and the paper bag are types of containers.

INFERENTIAL—Do you think it is a good idea to put the salt into the paper bag?

» yes, because it will hold the salt; no, because the salt came from a different kind of container

Link the content on this page to the experiment students did at the beginning of class. Tell students that soon they will check on their salt to see if anything has happened to it.

Page 5

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

Later that afternoon, Maya looked outside again. She could tell it was getting colder. Snowflakes were mixing with the rain. It was time to spread the salt.

But when Maya got outside, she saw that the paper bag was very wet. It had turned to mush. The salt was almost gone, too. Maya wondered how this could have happened!

5

LITERAL—What happened to the paper bag?

» It got wet. It got ruined. It turned to mush.

SUPPORT—Point out that the water from the rain soaked through the paper bag. That got all the salt wet. When salt mixes with water, the water dissolves the salt. This is the reason there is not very much salt left.

LITERAL—What made the bag turn to mush?

» the water from the rain, the mixture of the water and the salt

3. Generate questions.

Ask students what they wonder about salt and why the paper bag doesn't look the same. Encourage students to talk about what they noticed in the pictures and what they heard as you read the story.

Start a cumulative questions wall chart. Add student questions to this chart as you work through this unit on the properties of matter. Over time, work to generate answers with students based on future learning, things that are discussed and observed in classroom sessions.

4. Continue the investigation.

Students took a break from their salt investigation to read Chapter 1. Now, it's time for students to check the results.

NGSS Elements

CCC 2
DCI PS1.A

Prompt students to examine the bag of salt. **Ask students to describe what they see.**

» The paper bag is mushy. The paper bag is wet. Some of the salt is gone.

Explain that because the bag got wet, the water soaked through the bag and got the salt wet. Some of the salt seems to have disappeared because of the water. (See **Know the Standards 1** and **2**.)

Now have students look at the plastic container. **Ask students to describe what they see.**

» It is the same as it was before. The plastic container did not change. The salt is still there.

Ask students which is better for salt, the paper bag or plastic container, and why.

» The plastic container. It keeps the water away from the salt.

Have students draw pictures of what the paper bag and plastic container look like now. Tell students to compare the drawings to their first drawings and discuss what they notice in their groups.

Know the Standards

TEACHER DEVELOPMENT

1. CCC 2 Cause and Effect: Students observe cause-and-effect relationship between the water and the paper bag and between the water and the salt.

2. DCI PS1.A Structure and Properties of Matter: Students gain practice in observing properties of matter by noticing what happened to the salt in the paper bag. They observe a change to matter, which allows them to identify the type of container that is better suited to keep the matter (salt) from changing or dissolving.

5. Check for understanding.

Formative Assessment

Have students summarize what they observed about water, salt, paper bags, and plastic containers. (See **Know the Standards 3**.)

Monitor Progress

Review student responses and drawings for See the Salt (AP UO.1) to determine student understanding of the following concepts:

- The water soaked through the paper bag.
- The water did not soak through the plastic container.
- The salt dissolved when it got wet.

Tie to the Anchoring Phenomenon

Students observed the effects on properties of matter in different types of containers. This activity will help set the stage for the investigations that students will carry out in this unit to help them answer the Big Question—**How are containers matched to the stuff they contain?**

Know the Standards

TEACHER DEVELOPMENT

3. Monitor Progress: Student progress should not be measured on artistic ability. Rather, check student work to ensure students can notice the differences between the paper bag before and after water came into contact with it. Students should also notice the differences between keeping matter dry inside the paper bag and inside the plastic container.

LESSON 1

Introduction to Matter

Overview

Guiding Question: How do we group different materials?

Lesson 1 Segments	Segment Questions	Advance Preparation
1.1 What Is in Our Backpacks? Students observe different kinds of containers, including ones they likely use every day: backpacks!	What do our backpacks contain?	Gather materials for the demonstration. See Materials and Equipment.
1.2 Matter Takes Up Space (2 days) Students are introduced to the definition of *matter* and the characteristics of the three states of matter—solids, liquids, and gases—in their Student Book, as Maya's story continues, and through lab observation.	What is matter?	Read Chapters 2 and 3 in the Student Book. Gather materials for student observation.
1.3 How Do We Describe Things? (2 days) Students learn that there are many different ways to describe matter. They practice making observations and recording descriptions.	What are some properties that we can describe?	Gather materials for student investigation. See Materials and Equipment.
1.4 Temperature and Matter Students are introduced to the effects that heating and cooling have on the states of matter. Students continue to build their knowledge of matter by learning how matter is measured in the Student Book.	How do temperature changes affect matter?	Gather materials for teacher demonstration. Read Chapter 4 in the Student Book.
1.5 Lesson 1 Roundup: Sorting and Grouping Matter (2 days) Students plan and carry out an investigation in which they look at the properties of various materials and classify them as solids or liquids.	How do we group different materials?	Gather materials for student investigation. See Materials and Equipment.

What's the Story?

Summary: In Lesson 1 (Segments 1–5), students explore the definition of *matter* and learn that different types of matter are made up of different materials. They are introduced to some properties of matter that help determine whether something is a solid, a liquid, or a gas (2-PS1-1). The developing

understanding of these phenomena in Lesson 1 prepares students for their work in Lesson 2, when they observe in more depth the effects of heating and cooling on various objects and their properties.

Learning Progression: Lesson 1 builds on student understandings from earlier grades, such as 1-PS4-1: *Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate*. Lesson 1 also builds toward the Grade 2 target of 2-PS1-1: *Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.*

Guiding Phenomenon: People use many types of containers in their day-to-day lives. Some containers are large, and others are very small. But the one thing containers have in common is that they are designed and built with an intended purpose. Containers have to be able to hold, store, and transport materials based on their individual properties (2-PS1-1).

Learning Objectives

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

- Define *matter*.
- Identify characteristics of solids, liquids, and gases.
- Explain properties of matter.
- Classify materials as solids, liquids, or gases.

NGSS Standards and Dimensions

Performance Expectation: 2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
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.	**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.	**1 Patterns** Patterns in the natural and human designed world can be observed.

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

What Is in Our Backpacks?

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How do we group different materials?

Today's Question: What do our backpacks contain?

Tie to the Anchoring Phenomenon: In this lesson, students learn that containers transport and hold different things. This lesson will help lay the foundation for understanding that containers need to be made out of materials that have properties that are suited for the intended purpose of the container.

At a Glance

Learning Objective

- ✓ Summarize that different containers hold different kinds of matter.
- ✓ Identify different types of containers.

Instructional Activities

- student observation
- student investigation
- class discussion

NGSS References

Performance Expectation: 2-PS1-1

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students will identify objects in the classroom that contain other materials and describe and differentiate them by their observable characteristics.

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.

container

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.

example **waterproof**

Instructional Resources

Activity Page

AP 1.1.1

Activity Page
Container Scavenger Hunt
(AP 1.1.1)

Materials and Equipment

- backpack
- lunch box
- sandwich in a plastic bag
- clear food storage container with fruit inside
- cake or other snack in a plastic bag
- juice box
- pencil box
- water jug or bottle
- canned food

Advance Preparation

- Before students arrive, make sure the following items can be easily found around the classroom: trash can, recycling bin, art supplies, storage containers/boxes, tissue box, any baskets or bowls that you use, canned food, and a water jug/bottle. **NOTE:** These items should already be found in your classroom, so the materials—except for the canned food and the water bottle—have not been included in the Materials and Equipment section.
- **SAFETY NOTE:** Be aware of and take proper precautions regarding possible food allergies among students who will be exposed to the suggested materials.

The Core Lesson 1.1

1. Introduce students to Lesson 1.

Have students collect their backpacks, and prompt them to take a seat at their desks. Draw their attention to your desk, where your materials from your backpack are laid out, and make sure they can see your backpack.

Ask a volunteer to read the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How are containers matched to the stuff they contain?**

Tell students that, before they can answer the unit's Big Question about containers, they first need to understand what containers are, what they are made of, and why the material matters. In Lesson 1, students will learn about matter and the observable properties of materials in order to apply their understanding to the Big Question. Write the Lesson 1 Guiding Question where students can see it:

How do we group different materials?

Tie to the Anchoring Phenomenon

As students work through Lesson 1, they will learn about the observable properties of matter, which they will later use when connecting this information to how containers are designed with an intended purpose.

Narrow the focus to Today's Question—**What do our backpacks contain?** Ensure that students understand that *contain* means "to have or hold inside." A container is a vessel or enclosure that holds some other material. Explain that you are about to pack your backpack for school, just like students do every morning. Show students all the things you have ready to pack in the backpack.

Ask students Who has ever used a backpack?

» All, or nearly all, students should raise their hands.

Ask students to tell you why having a backpack is helpful. Students should be able to tell you that backpacks help them carry the things they need.

Ask students to tell you the kinds of things they have in their backpacks. Students should name objects like books, notebooks, lunches/food/beverages, extra clothing, or art supplies.

- Emphasize that students might need a lot of stuff during the day! Explain that a backpack is a type of container. Tell students that a container is something that holds or stores (or contains) things. Review common types of containers that students may use or see every day, including but not limited to refrigerators, insulated bottles, art supply boxes, and garbage cans.
- Show students the lunch box on your desk. Tell students that the lunch box is another kind of container. It holds the food you are going to eat.
- Then show students the pencil box on your desk. Tell students that the pencil box is another type of container. It holds the pencils you are going to use to write with. Reiterate that the pencil box, the lunch box, and the backpack are all types of containers.
- Tell students that containers don't just store things; they also help people transport things. Perhaps students have seen baskets on bicycles. Those can help people transport things like flowers, cool rocks, or small toys from one place to another.

2. Turn and talk.

Have students work in pairs. Students will take turns looking for a container from their backpacks. (Most students will probably take out lunch boxes, water bottles, or pencil cases.) Encourage students to talk about what the container holds. (See **Know the Standards 1**.)

Language Arts Connection

Ask students Why is it important for some things to be in a container?

» so the things don't spill out; so it is easier to find the things

3. Demonstrate examples and guide discussion.

- Bring the class back together after each person has had a turn to share. Prompt students to look at the front of the classroom. Open your lunch box for students. Show students that you have the following items inside the lunch box:
  - a juice box
  - a sandwich in a plastic bag
  - a piece of cake in a plastic bag
  - a clear food storage container of fruit
- Point out that your food is in separate containers. Explain to students that you could put your cake in the same plastic bag as your sandwich.

Ask students What would happen to my cake if I did that?

» It might get smashed. It could start to smell like the sandwich.

- Focus student attention on the juice box. The juice is in its own container.

Ask students What would happen if I poured my juice into the container of fruit instead of keeping it in its own container?

» All of the fruit would get wet. You wouldn't really be able to drink it.

- Clarify that the juice needs to be in its own container (the juice box) so that the juice does not spill. This is because it is a liquid. Usually, people put liquids in containers that are separate from other food containers.

Know the Standards

TEACHER DEVELOPMENT

1. Class Discussion: Students satisfy a connection to the ELA standard CCSS.ELA-LITERACY.SL.2.1 by participating in a collaborative classroom discussion with partners regarding the containers they have in their backpacks.

4. Facilitate the activity.

Activity Page

AP 1.1.1

- Distribute Activity Page Container Scavenger Hunt (AP 1.1.1). Review the instructions for the activity. Students will walk around the classroom to look for different types of containers. They will draw examples of the containers they find. Students should look for as many containers as possible. (See **Know the Standards 2** and **3**.) **NOTE:** Students can go back to their desks to draw the pictures of containers, or they can draw their pictures wherever they are in the classroom.

Tie to the Anchoring Phenomenon

NGSS Elements

CCC 1

SEP 1

As students look for different examples of containers around the classroom, they begin to understand that containers are more commonplace than they may have thought. They will start to generate questions about how to tell whether something is a container and why or why not. They will also recognize that containers serve an intended purpose. These concepts will set students up for when they dive deeper into their role as designers for their classroom container company.

Differentiation

SUPPORT—Support students by having them tell you what a container does (it holds stuff in so things don't spill out). (See **Know the Standards 4**.)

CHALLENGE—Challenge students to find something in the classroom that should be inside of a container. Ask students to identify three or more different kinds of containers, and encourage them to explain what details they used to determine the types.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 1 Asking Questions: Students are participating in an activity that requires them to ask questions about objects in the classroom. As they look for examples of containers, they must ask themselves how different objects are used to identify whether something is a container. Students are observing the use/function of objects and then drawing pictures to document their findings. Documentation is an important step in the study of science. Scientists often draw pictures (or take photographs) when they make observations. This helps them be able to study things more closely and keep a record of their findings.

3. CCC 1 Patterns: Students look for patterns as they observe objects and determine whether something qualifies as a container. All containers will have the same intended purpose, which is to contain (or hold or store) something. Students will draw upon what they learned in the class session, as well as what they already know about containers, to decide whether an object fulfills the criteria to be considered a container.

4. Differentiation: Some students may need extra support when it comes to differentiating containers from noncontainers. It can be assumed that all students have used a container at some point in their lives. Help students understand the concept of a container by drawing on their experiences. You can ask questions like "Where do you throw out your garbage when you are at home or at the park?" and "Have you ever packed a bag to stay overnight at a friend's house? What did you pack? Why do you think your bag is considered a container?" As students roam around the classroom, reinforce the following ideas: containers hold stuff; there are many types of containers; containers can be different sizes and shapes; all containers have a purpose. If necessary, walk around the classroom with students, and ask whether something is a container as you point to it. If something is a container, discuss with the student what the container is holding. Assess student responses to see whether the student has a proper understanding of the concept of a container.

EXTEND—Have students come up with additional examples of containers that they see at home and in the community. They can draw pictures of the containers by memory or just write down the names of them.

- Let students know when they have a few minutes left to finish their drawings.

Tie to the Anchoring Phenomenon

Tell students that throughout the rest of the unit, they will pretend to be designers that work for a classroom container company. They will learn about the properties of materials to see which containers work best for storing which types of materials. And they will learn how containers are designed and made in a way that helps with an intended purpose.

6. Check for understanding.

Formative Assessment

Have students summarize what they learned about containers.

As students complete the activity, circulate the room, and check for student understanding. Students will show whether or not they grasp the concept of a container based on the objects they have chosen to draw on the Activity Page. If students do not have a proper understanding of a container, ask students individually or collectively to tell you what a container does. Alternatively, you can query students by taking a poll, asking questions such as the following:

- Who thinks a container is something that holds other things?
- Who thinks a container is something that must stay in one spot?
- Who thinks a container can be moved from one place to another?

Students' show of hands will give you a gauge of student comprehension.

Review student drawings in AP 1.1.1 to determine student understanding of the following concepts:

- Containers hold things.
- There are many different types of containers.

Monitor Progress

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

Tie to the Anchoring Phenomenon

By now, students should be familiar with the uses and some of the characteristics of a container. Students will be able to build from this knowledge as they learn about the properties of materials and the ways in which certain materials need to be stored.

- Remind students of Maya from Chapter 1 of the Student Book. **Ask students** What sort of characteristics should Maya's container have?
  - » Maya's container should keep water from mixing with the salt.

LESSON 1.2

Matter Takes Up Space

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How do we group different materials?

Today's Question: What is matter?

Tie to the Anchoring Phenomenon: Containers hold stuff, but what type of stuff do they hold? Containers can be made to hold and transport solids, liquids, and gases. In this lesson, students learn about matter: the things that go inside containers. They explore solids, liquids, and gases and begin to understand how these things are different. This will eventually lead students to the idea that certain containers are made to hold certain things.

- **Ask students** What types of containers might work best to hold Maya's salt?
  - » Containers that repel water might work best.

At a Glance

Learning Objectives

✓ Define *matter*.

✓ Identify the states of matter.

✓ Sort and categorize types of matter.

Instructional Activities (2 Days)

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

NGSS References

Performance Expectation: 2-PS1-1

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

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gas **liquid** **matter** **solid**

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observe **sort**

Instructional Resources

Student Book

Ch. 2
Ch. 3

Activity Page

AP 1.2.1

Student Book, Chapter 2
"What Is Matter?"

Student Book, Chapter 3
"What Are the Different Kinds of Matter?"

Activity Page
Sort the Matter (AP 1.2.1)

Materials and Equipment

- wooden craft sticks (1 per group)
- metal coins (1 per group)
- paper (1 sheet per group)
- balloons (1 per group, inflated)
- markers (1 per group)
- bowls of water (1 per group)
- poster paper
- black marker
- balloons (1 per group, deflated)
- plastic exercise hoops (1 per group)

The Core Lesson 1.2

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

What is matter? Begin with a review of what students learned about in the previous classroom session. Use the following prompts to help students recall the information and ensure proper understanding.

Ask students What did we learn and notice about containers?

» Containers hold stuff.

Ask students What do containers look like?

» They can look different or the same. They can be big or small.

Ask students Can you carry a container? What is a container that you can carry?

» yes, our backpacks (or lunch boxes)

Ask students Why are containers important?

» They keep our things from spilling out. They help us store things.

Ask students to tell you what else they wonder about containers. Guide students to wonder about the things that go into containers. Add their questions to the cumulative question wall chart. If necessary, use prompts such as the following:

- What do you wonder about the materials containers are made of?
- Why do you think some things leak out of containers and other things do not?
- Why do you think there are so many different types of containers?

Talk about how containers hold different types of objects and objects are made of different types of matter, or "stuff." Explain that today they are going to explore some objects to learn more about the materials that containers hold.

Tie to the Anchoring Phenomenon

It is important to keep students thinking about containers in order to weave the overarching storyline of being a designer for the classroom container company into the curriculum. This lesson focuses less on containers and more on materials and matter. Understanding materials and matter is an important starting point for learning about the types of things that containers hold and transport.

2. Facilitate the activity.

- Place students in small groups. Give each group the following materials:
  - wooden craft stick
  - metal coin
  - sheet of paper
  - inflated balloon
  - marker
  - bowl of water
- Tell students that they will have a few minutes to observe the items and talk about what they see with the others in their group.
- As students work in their groups, circulate around the room. Listen for the types of things that students are focusing on for their observations, and hold off on offering prompts at this point. Students may be commenting on obvious physical things, such as the names, colors, and sizes of the objects, or their intended purpose.

  » The pencil case is big enough to hold lots of pencils and pens. It has a latch to hold it closed. My pencil case is purple, but yours is blue.

3. Lead discussion.

- Leaving the students in their groups, bring the class back together after a few minutes. **Ask students to share what they noticed about the objects.** Use the poster paper and black marker to write down what the groups tell you. Students are likely to tell you how the objects look and what they are used for. Accept all responses.
- Tell students that the objects in front of them are made of different materials. (See **Know the Standards 1**.)
- Review the definition of *materials* with students. A material is the "stuff" something is made of. Explain that some things are made of only one material while other things are made of many different materials. (See **Know the Science 1**.)

Differentiation

SUPPORT—Review the objects one by one, and discuss what they are made of. Make associations with the materials and other things that students may already be familiar with. For instance, the marker is plastic. Discuss what other things are made of plastic, such as bottles of water or toys. The coin is made of metal. Many other things are made of metal, too, such as playground equipment.

CHALLENGE—Challenge students to name the types of materials for the objects they see in front of them. For instance, **ask students to tell you what the markers, coins, and craft sticks are made out of.** Students may be able to tell you that the marker is made of plastic, the coin is made of metal, and the craft stick is made of wood. Choose objects made of multiple materials to require students to think more carefully.

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation: Every object is made of a type of material. Use examples of common, everyday items that students are familiar with to establish relevancy and understanding. It may also help to discuss the properties of the materials as you review them. For instance, wood and plastic are hard materials. Cotton is a soft material. Observable properties may help some students better understand the concept of materials. At this grade level, it is not required for students to know the exact materials that make up various objects. The focus is that different objects are made of different materials. In this lesson, *we want students to walk away knowing that it is the properties of those materials that will ultimately impact the types of containers that are used to hold and transport those objects.*

Know the Science

TEACHER DEVELOPMENT

1. Materials and Their Properties: Each material has its own set of properties that can be observed and tested. These properties are often used to define and identify the material. Students will learn about properties later in this lesson. However, at this point, students may already be noticing some of the properties based on initial observations. For instance, students may mention that the metal coin is hard and associate metals as things that are hard. Try to avoid going too deep into a conversation about properties. The takeaway for this classroom session is that different objects are made up of materials with different properties.

EXTEND—If students can name the types of materials that the objects in front of them are made of, take the activity one step further, and **ask students to explain how they know the materials the objects are made of**. Students may be able to verbalize this based on observable properties, such as color, texture, and hardness.

4. Read together: "What Is Matter?"

Student Book

Ch. 2

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.

Read Aloud Support

Page 6

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 Matter?" and tell them to pay special attention to the different objects they see as you read.

CHAPTER 2

What Is Matter?

Look around your desk or table. What is on it? What is in it? You may have scissors, pencils, glue, and colored markers. All these objects look different. They feel different. They have different uses. But they all have one thing in common. They are made of something. They are made of stuff. Another word for stuff of any kind is matter.

6

CORE VOCABULARY—Explain that **matter** is anything that you can see, feel, and touch. Matter is anything that takes up space. This even includes things you cannot see, like air!

SUPPORT—Explain the difference between materials and matter. (See **Know the Science 2**.)

Page 7

Ask students to look at the pictures on page 7. Go through the pictures one by one.

Matter is the "stuff" that is all around you. It is anything that takes up space. Matter can be as small as a grain of sand. It can be as large as a tall tree. It can be as light as a feather or a cloud or even air. It can be as heavy as a boulder.

Sand is matter. People's hands are matter.

Tree leaves are matter. So are tree trunks and branches.

Feathers are matter. So is the air that you cannot see.

Rocks are matter. So are people and clothes.

7

Ask students the following question for each picture:

LITERAL—What matter do you see in the picture?

» hands, sand, a tree, grass, a feather, rocks/boulders, people

Know the Science

TEACHER DEVELOPMENT

2. Materials and Matter: In first grade, students were introduced to the word *materials* as it relates to what objects are made of. Be sure to not confuse materials with matter. Matter is anything that takes up space, even when you cannot see it. Materials are types of matter. *Matter* does not refer to the exact materials objects are made of.

Page 8

Now ask students to look at the picture on page 8. Discuss their answers to the prompt on the page: Name three things in this photo that are matter.

You can see and touch some kinds of matter. You can sometimes smell and taste it. You can measure matter. You can use different words to describe it.

Name three things in this photo that are matter. What are some words you can use to describe ice cream?

8

SUPPORT—Elicit a discussion about the types of things that take up space. Point out objects in the classroom. **Have students tell you whether or not each object takes up space**.

INFERENTIAL—Why might it be important to know about matter?

» Someone might want to know how much space something takes up.

Page 9

Ask students to look at the picture on page 9 as you read. Explain that even the things that are in the background of the picture are matter.

Can you think of some examples of matter from the story about Maya and her bag of salt?

Salt is matter. Rain, ice, and snow are matter. Sidewalks and houses are matter. Even Maya herself is matter!

All of these things take up space.

9

Ask students the following question:

LITERAL—The chapter says that salt, rain, sidewalks, houses, and Maya are examples of matter. What else do you see in the picture that is matter?

» person, snow, trees, road, coat

5. Support concepts with a game.

- Tell students that they are going to play a game. Place students in groups of three. Distribute one exercise hoop to each group.
- Instruct students to lay the hoop flat on the floor. Each student stands around the outside edge of the hoop.

Ask students Do you think you and I are matter? Do we take up space?

» Accept all answers.

- Tell students that you are going to test it out to see if people are matter.
- Have each group decide which students will be Student A, Student B, and Student C.
- Tell students to look at the hoop on the ground. **Ask students to tell you what they notice about it.**
  - » There is nothing inside the hoop. The hoop is round or a circle.
- Call out for all the Student As to stand inside the center of the hoop. **Ask students to tell you what they notice now about the amount of "space" in the hoop as people stand inside it.**
  - » Someone is standing inside the hoop. It has less space in it. The amount of open space is smaller.
- Call out for all the Student Bs to stand inside the center of the hoop. **Ask students to tell you what they notice now about the amount of "space" in the hoop as more people stand inside it.**
  - » There are two people standing inside the circle. The circle has even less space in it now. The space within the hoop is getting more crowded.
- Call out for all the Student Cs to stand inside the center of the hoop. **Ask students to tell you what they notice now.**
  - » There are three people standing inside the circle. We are taking up a lot of the space inside the hoop.

Tie to the Anchoring Phenomenon

As students participate in this introductory interaction, they are learning how to visualize the concept of space in support of a definition of *matter* as anything that takes up space. This is an important concept that will help them later design containers that have enough capacity to hold the materials that fill them.

6. Summarize and discuss.

Monitor Progress

Bring the class back together, and discuss what students learned in the activity. (See **Know the Standards 2**.) Review the facts with the students. The hoop started out on the floor. No one was standing in it. It had a lot of space inside of it. Then point out that each person took up space in the hoop. The more people that stood inside the hoop, the more of the space was taken up!

Know the Standards

TEACHER DEVELOPMENT

2. Monitor Progress: Students should walk away from this activity with a better understanding that "stuff takes up space" as they approach the concept that matter can take endless forms but is anything that takes up space. In the activity, students were able to visualize what space looks like when it becomes fuller. The hoop is a small-scale concept of space. However, space can apply to something as simple and small as a container or something as large as the universe.

Ask students What does this mean?

» People take up space. People are matter.

1. Day 2: Refocus student attention.

What is matter? Have students recall what they learned about matter. Students should explain that matter is anything that takes up space. If necessary, remind students of the hoop activity they did in the previous class session or the chapter they read, to jumpstart a conversation about matter.

- Now that students understand that matter is anything that takes up space, introduce the three main states of matter: solids, liquids, and gases. (See **Know the Science 3**.)
- Use props to help students visualize solids, liquids, and gases. Show students objects on your desk. Explain that these are solids. Show students the water you are drinking. Explain that the water is a liquid.
- After you have shown students several examples of states of matter, encourage them to join in the conversation.

Ask students What else is a solid?

» basketballs, notebooks, lunch boxes, tables

Ask students What else is a liquid?

» milk, juice, rain, swimming pool water, oceans, lakes

Differentiation

SUPPORT—Use different questions if students appear confused or stuck when it comes to understanding the differences between solids, liquids, and gases. It can be assumed that students have encountered all three states of matter in their lives, so draw on student experiences to help make the concept more relatable. For instance, you can ask students what their favorite thing is to drink and then talk about how that drink is a liquid. Then you can ask students what their favorite sport is and discuss why the things used to play that sport are solids. Draw a connection between how liquids are different from solids by focusing on observable characteristics.

Know the Science

TEACHER DEVELOPMENT

3. Matter: Matter exists as solids, liquids, and gases. One way to distinguish the three states is by understanding the motion of the particles that make up matter at the atomic or molecular level. The particles in a solid are tightly packed together. The particles may vibrate, but they do not move around from one place to another. The particles in a liquid have more space between them, so the particles can move or slide past each other. They can also vibrate. The particles in a gas are very spread apart. This allows them to move around at fast speeds. However, at this grade level, students only need to understand that there are three ways to categorize matter. Students will expand on this knowledge to learn about the observable and testable properties of matter and how solids, liquids, and gases behave in relation to containers.

- Explain to students that there are also some types of matter that you cannot see, touch, smell, or taste. Air is an example. Air is invisible! You cannot see it, touch it, smell it, or taste it, but you still know it is there.

2. Demonstrate concepts.

NGSS Elements

DCI PS1.A

- Help students grasp the concept of invisible matter through a demonstration using a balloon. Start with the deflated balloon, and show it to students. Explain that there is no air in the balloon. (See **Know the Standards 3**.)

Ask students to tell you what they notice about the balloon. They should tell you that the balloon is flat. Start to blow into the balloon until it is about halfway blown up.

Ask students to tell you what they notice now. They should tell you that they see the balloon starting to get bigger. Explain that this is because you are blowing air into it. Continue to blow air into the balloon until it is full.

Ask students how they know that this balloon is filled with air. They should tell you that it is because they can see the balloon getting bigger. Explain that the balloon is now filled with air but that they cannot see the air. Air is invisible. They only know it is in there because the balloon became bigger.

Ask students Does this mean that air takes up space?

» yes

Ask students If it takes up space, is air matter, even if you cannot see it?

» yes

Know the Standards

TEACHER DEVELOPMENT

3. DCI PS1.A Structure and Properties of Matter: Students learn that there are different types of matter and that matter can be considered a solid, a liquid, or a gas. At this point in the unit, students are not aware of how to distinguish between the states of matter or the specific properties of solids, liquids, and gases. Later, they will learn more about how the states of matter behave when placed in containers.

3. Facilitate the activity.

NGSS Elements

SEP 1

Language Arts Connection

Activity Page

AP 1.2 .1

- Have students rejoin the same groups they were in for the previous class session. Pass out the same materials to each group.
- Distribute Sort the Matter (AP 1.2.1). Students will work as a team to sort the matter into piles for solids, liquids, or gases. Students will then mark their answers on AP 1.2.1. (See **Know the Standards 4** and **5**.)

Tie to the Anchoring Phenomenon

As students complete this activity, they will become more aware of the fact that all things that take up space are matter. Students might also note that different containers are suited to hold different materials and for different reasons, such as keeping salt dry. This is an important concept for them to grasp before they can fulfill their roles as designers for the classroom container company. Students will build on this knowledge later, when they learn about the observable and testable properties of different types of matter.

4. Summarize and discuss.

Monitor Progress

After students have finished filling out their Activity Pages, bring the class back together for a whole-class discussion. (See **Know the Standards 6**.)

Ask students which objects were solids and which were liquids and gases.

» All of the objects were solid except for the water, which was liquid. The air in the balloons was gas.

Know the Standards

TEACHER DEVELOPMENT

4. SEP 1 Asking Questions: Students are participating in an activity that requires them to ask questions about objects that they are observing. Students must draw on what they learned about matter to decide if something is matter or not. As they study the objects, they must ask themselves whether something qualifies as a solid, a liquid, or a gas. Asking questions is an important part of science and can lead to new discoveries.

5. CCSS.ELA-LITERACY.SL.2.1: Students discuss the concept of matter with their group members as they work together on the activity. This collaborative conversation can help reinforce what they learned about matter.

6. Monitor Progress: Ensure all students understand that all the objects are types of matter. Reiterate that all the objects take up space. Make sure students are not confusing *materials* with *matter*. If necessary, ask students to tell you the difference between materials and matter or how they are related. Students should be able to explain that materials are what things are made of and matter is anything that takes up space.

5. Read together: "What Are the Different Kinds of Matter?"

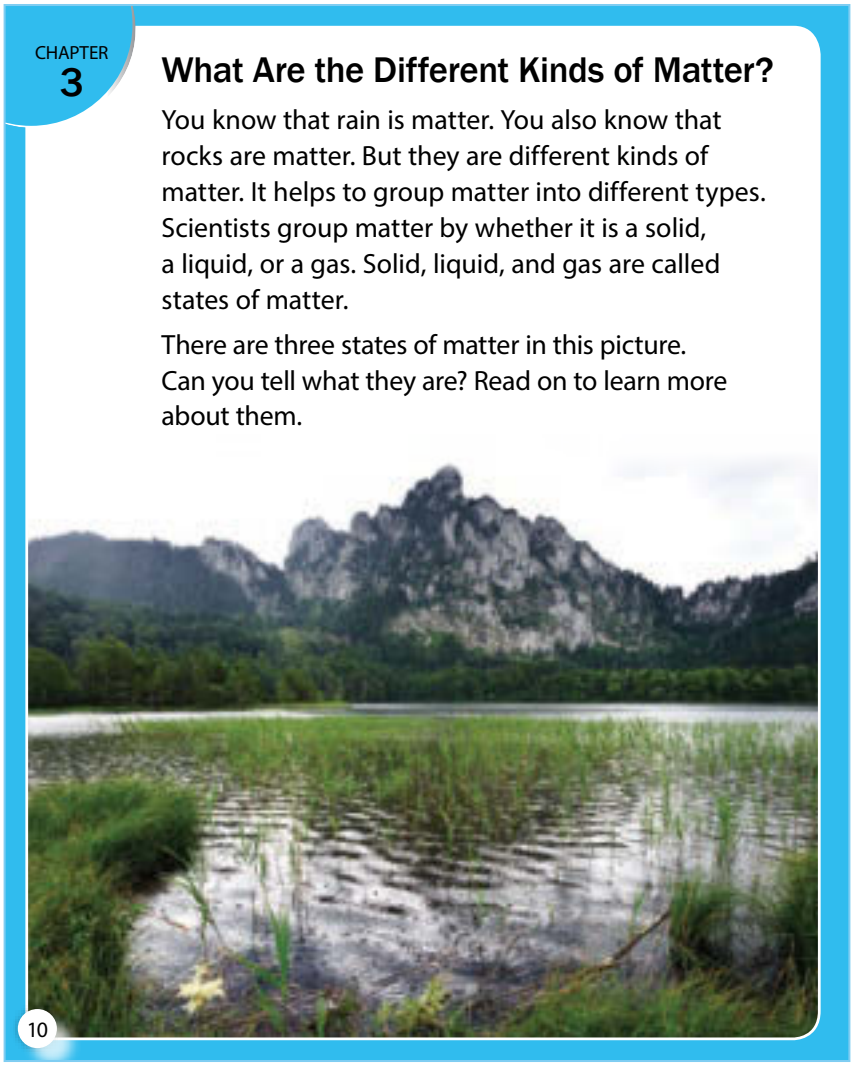
While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student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

Read Aloud Support

Page 10

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 "What Are the Different Kinds of Matter?" and tell them to pay special attention to examples of solids, liquids, and gases as you read.

Ask students to look at the picture on page 10. Read the last sentence together. Ask a volunteer to name the three kinds of matter shown in the picture.



CHAPTER 3

What Are the Different Kinds of Matter?

You know that rain is matter. You also know that rocks are matter. But they are different kinds of matter. It helps to group matter into different types. Scientists group matter by whether it is a solid, a liquid, or a gas. Solid, liquid, and gas are called states of matter.

There are three states of matter in this picture. Can you tell what they are? Read on to learn more about them.

10

SUPPORT—Use guiding questions to lead students to identify the three types of matter in the picture. For instance, ask students if the lake is a solid, a liquid, or a gas.

Page 11

NGSS Elements

CCC 1

Ask students to look at the pictures on page 11. Explain that all the objects in the pictures have something in common. (See **Know the Standards 7**.)

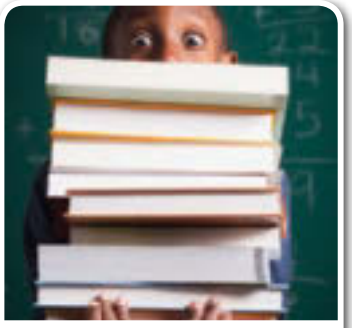
Solids

A solid is matter that has its own shape. If you put a solid in a container, such as a bucket or a bag, its shape will stay the same. It does not change shape to fill the container.

Wood is a solid. Logs stay the same shape whether they are in the container or not.

Wood blocks remain the same shape whether they are in a bucket or not.

An apple is a solid.



A book is a solid.

11

LITERAL—What do the objects have in common?

» They all keep their shape. They are all hard.

CORE VOCABULARY—Explain that a **solid** is matter that has its own shape. Its shape stays the same when it is inside a container or outside a container.

SUPPORT—Demonstrate for students the idea of a solid object keeping its shape. Use any object on your desk as an example. Place that object inside a container, and show students how the object still looks the same and hasn't changed its shape.

Know the Standards

TEACHER DEVELOPMENT

7. CCC 1 Patterns: As students look to see what the solid objects have in common, they are looking for patterns. Although properties of matter have not yet been discussed, students are starting to learn about them indirectly by looking for a pattern of characteristics that states of matter share. For instance, solid objects share certain properties, liquids share others, and gases share others still.

Page 12

Now ask students to look at the three pictures on page 12. Talk about the descriptor words *rough*, *smooth*, *shiny*, *dull*, *soft*, *hard*, *stiff*, *flexible*, *long*, *short*, *light*, and *heavy*.

Solids can be rough or smooth. They can be shiny or dull. They can be soft or hard. They can be stiff, or they can be easy to bend. They can be long, short, light, or heavy. Solids can be all different colors. They can be see-through.

What are some ways you can describe these solid objects?

12

Ask students the following questions:

LITERAL—What words would you use to describe the top picture? What about the middle? And the bottom?

» red, rubbery, round, spongy

» ridged, hard, multicolored, curved

» alive, soft, fluffy, hairy, fuzzy, furry, brown

INFERENTIAL—Why do you think someone would want to know how to describe objects?

» Someone might want to explain what they are looking at. Someone might want to tell something apart from something else.

Page 13

Now ask students to look at the three pictures on page 13. Talk about what students notice before reading the text on the page.

Liquids

A liquid is a type of matter that does not have its own shape. It will fill the inside shape of any container it is in. A liquid also flows, or spreads from one place to another. Water and oil are some liquids.

This honey takes the shape of the container it is poured into.

Honey poured onto pancakes flows into a different shape.

Olive oil is liquid. It flows and takes the shape of the bowl.

13

LITERAL—What is similar about the honey and olive oil?

» They can be poured; they are wet; they are liquids.

CORE VOCABULARY—Explain that a **liquid** is matter that does not have its own shape. This means liquids take the shape of the container they are in.

SUPPORT—Demonstrate this concept for liquids. Show students a water bottle filled with water. Tell them to notice how the water fills the shape of the water bottle. Now pour the water into a shallow bowl. Tell students to notice how the water fills the shape of the bowl. The water's shape now matches the shape of the bowl.

Page 14

Ask students to look at the two pictures on page 14. Discuss each picture, and ask students to describe what they see.

You can see through some liquids, like water. Other liquids, like dark oil, are hard to see through. Liquids can be thick or thin. They can be warm or cold. They can be any color. Some liquids have a smell. Others do not.

How would you describe the liquids that you see here?

14

SUPPORT—Help students come up with new ways to describe the liquids by reminding them of some other properties they may not have thought of or noticed. For instance, you might ask, "Is the liquid clear and see-through? Or does it have a color that makes it difficult to see through?"

Page 15

Now ask students to look at the picture on page 15. Remind them of the balloon demonstration they saw earlier in class.

Gases

Like a liquid, a gas does not have a fixed shape. A gas takes the shape of its container. But unlike a liquid, a gas can spread out in every direction. It can fill an entire container. A gas can even escape a container that is not closed.

The air that you breathe is a gas. It fills the space around you. The matter inside balloons is a gas. It spreads out to fill the inside of the balloons, no matter how they are shaped.

15

CORE VOCABULARY—Explain that a **gas** does not have a shape. It takes the shape of whatever container it is in. It can spread out in every direction and does not stay in a container unless the container is closed.

SUPPORT—Draw a Venn diagram on the board that compares a liquid to a gas. **Ask students to tell you the similarities between liquids and gases**. (They do not have a shape; they take the shapes of their containers.) **Then ask them to tell you what makes liquids and gases different**. (Liquids do not spread in every direction like gases.)

Page 16

Draw student attention to the two pictures on page 16. Explain that an odor is something that smells.

Many gases are invisible, like air. Some gases have an odor. Others do not smell at all. The bubbles are filled with air. Air is gas.

The gases that come out of a volcano smell awful! They are poisonous and dangerous to breathe.

16

SUPPORT—Relate this to an experience that students may have had. Depending on where you live, perhaps students have smelled the odor of a skunk. This is an example of a gas. Students cannot see the gas, but they can smell it. So, they know it is there. Another relatable experience could be to discuss the smell of car exhaust. **Ask students if they have ever smelled a stinky car driving by them.**

Ask students the following questions:

INFERENTIAL—How do you know that the bubbles have gas in them?

» We see the shape of the bubbles. They must be full of something.

INFERENTIAL—How do know that gas is coming out of the volcano?

» It has smoke coming out of it.

Emphasize to students that often gases are not directly visible but that we can look for other clues that they are present.

Page 17

Monitor Progress

Now ask students to think about the answers to the questions on page 17. Invite students to identify the solids, liquids, and gases in the story. (See **Know the Standards 8**.)

Now think again of the story about Maya and her bag of salt. What are some solids in the story? What are some liquids? What are some gases? Keep reading to help Maya solve the mystery of the disappearing salt!

17

Know the Standards

TEACHER DEVELOPMENT

8. Monitor Progress: Use the questions on page 17 of the Student Book to check student understanding of solids, liquids, and gases. Students should show progression from understanding that all objects are matter to understanding that objects are either solids, liquids, or gases.

6. Check for understanding.

Formative Assessment

Have students summarize what they learned about materials and matter. Ask guiding questions that will lead students to produce responses that differentiate the states of matter.

Connect the content covered in this classroom session with the concept of containers. Ask students to tell you what they think the relationship is between matter and containers. At this point, students may be able to say that matter is what goes into containers. At this point, they do not need to differentiate between the different types of containers for solids, liquids, and gases. This will come later in the unit. Make sure students are reminded of the anchoring phenomenon about the classroom container company. Help students see how they can apply what they know so far about matter to this scenario.

Review student tables in Sort the Matter (AP 1.2.1) to determine student understanding of the following concepts:

- Matter is anything that takes up space.
- Matter can be a solid, liquid, or gas.
- Most of the objects under investigation were solids. The water in the bowl is a liquid. The air in the balloon is a gas.

Monitor Progress

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

Tie to the Anchoring Phenomenon

Throughout this classroom session, students have had several opportunities to practice and apply what they learned about matter. Students will need to draw upon this preliminary information about matter as they work toward answering the Big Question—**How are containers matched to the stuff they contain?**

Ask students How can knowing about matter help you if you work at a container company?

» I can figure out what types of containers to put things in. Some containers will not hold in liquid or gas.

LESSON 1.3

How Do We Describe Things?

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How do we group different materials?

Today's Question: What are some properties that we can describe?

Tie to the Anchoring Phenomenon: As students learn about the properties of matter, they can use this information to help decide the best materials to use for making containers.

At a Glance

Learning Objectives

- ✓ Understand that matter has properties.
- ✓ Name some properties of matter.
- ✓ Explore and describe characteristics of solids, liquids, and gases.

Instructional Activities (2 days)

- student observation
- student investigation
- class discussion

NGSS References

Performance Expectation: 2-PS1-1

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students examine familiar small objects and materials to describe properties and classify types of matter.

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.

property

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.

describe

Instructional Resources

Activity Page

AP 1.3.1

Activity Page
Properties of Matter Lab Sheet (AP 1.3.1)

Materials and Equipment

Teacher Demonstration

- stuffed animal

Describe an Object

- wooden craft sticks (1 per group)
- plastic straws (1 per group)
- metal coins (1 per group)
- paper (1 sheet per group)
- markers (1 per group)
- bowls of water (1 per group)

Properties of Matter Lab

- spring scales (1 per pair) *
- cookies (chocolate chip cookies, sandwich cookies, fig cookies, and vanilla wafers; 1 of each per pair)**
- clear jars (1 per pair)
- rulers (1 per pair)
- rubber balloons (1 per pair)
- tall plastic or paper cups (1 per pair)
- short plastic or paper cups (1 per pair)
- calculators (1 per pair or enough to share)
- milk (can also use plant-based milk instead; 1–2 cups per pair)

*If there are not enough scales for each pair of students to have their own, then place as many scales as you can around the room and tell students to take turns using them throughout the investigations.

**Keep extra cookies nearby in case any break or crumble.

Advance Preparation (Day 2)

Prepare for Day 2 investigation in advance by labeling the tall cups *Cup A* and the short cups *Cup B* with a permanent marker.

SAFETY NOTE: Use proper precautions regarding students with food allergies.

The Core Lesson 1.3

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

What are some properties that we can describe? Open the classroom session by showing the stuffed animal and asking students to describe it. Model this for students by going first. Tell them a physical trait of the stuffed animal.

As students are called on, they will likely name something physical, such as "The dog has brown fur." If a student tries to give the stuffed animal a personality, such as "The dog is nice," redirect the discussion so that descriptions are more factual than opinion-based.

- When students have had a chance to share, reinforce the fact that they all just described traits about the stuffed animal.
- Relate this activity to the characteristics of matter. Tell students that all materials, like solids, liquids, and gases, have things that describe them, too. We call these things their properties. (See **Know the Science 1**.) Properties tell how matter looks, behaves, smells, feels, and tastes.

Differentiation

SUPPORT—If students have a challenging time understanding the word *properties*, use other words in its place, such as *traits* or *characteristics*. (See **Know the Standards 1**.)

CHALLENGE—Challenge students to tell the names of some types of properties that they already know, such as hardness, color, and texture, and give examples of each.

EXTEND—Have students work in small groups to research the names of properties that belong to matter. Students should write down the name of the property, along with what it means. For instance, flexibility is a property that relates to how easily an object can bend without breaking.

Know the Science

TEACHER DEVELOPMENT

1. Properties: Properties are the traits or qualities that belong to each kind of matter or material. There are many types of properties in science that are used to describe matter. These include but are not limited to the following:

- hardness
- texture
- color
- size
- magnetism
- flexibility
- smell
- shape
- density
- mass
- weight
- flammability
- conductivity
- melting point
- boiling point
- freezing point
- ability to rust
- porosity (how porous something is)
- absorbency (how well it can absorb, or soak up, liquid)

This classroom session serves to introduce students to the concept of properties and teach them some basic ones. Other properties will be introduced and tested throughout this unit.

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation: Students may have heard the multiple-meaning word *properties* used in everyday language, such as in the way of ownership. For example, a backpack is a student's personal property. A home is someone's property. You can call upon this familiarity with the word, but explain that in science, properties deal with things like physical appearances, observable qualities, and behaviors.

2. Facilitate the activity.

NGSS Elements

SEP 3

- Have students form small groups. Distribute the following materials to each group:
  - wooden craft stick
  - plastic straw
  - metal coin
  - sheet of paper
  - marker
  - bowl of water
- Tell students that by now they should be familiar with most of the materials in front of them. Remind them that during the last class, everyone agreed that all of the objects were types of matter. This is because they all take up space.
- Give the groups a few minutes to look at the objects closely. Tell them to focus on things like how the objects look and what the objects can do. (See **Know the Standards 2**.)
- After a few minutes, call on one group to describe one of the objects. After the group describes the object, ask the rest of the class if there are other ways to describe the same object. Use question prompts such as the following to get students to think more about the ways they can describe objects:
  - Does it bend?
  - Is it hard?
  - Does it look shiny?
  - Does it have a color?
  - Can you see through it?
- Repeat this until all the objects have been described.

NGSS Elements

CCC 1

- Record all the words that students use to describe the objects on the board. Ask students if they notice any patterns. Prompt students to look at the things that the objects have in common or the words that were used to describe them and how those words are similar. (See **Know the Standards 3**.)

  SAFETY NOTE: Taste is one of the senses that may come to mind when making observations. Do not allow students to taste the objects. Be aware that some students may have severe enough allergies that they cannot even touch certain substances.

Know the Standards

TEACHER DEVELOPMENT

2. SEP 3 Planning and Carrying Out Investigations: In this activity, students are getting initial exposure to planning and carrying out an investigation. The teacher is not telling them the specific properties to observe. Rather, students have to think about and come up with ideas for ways to observe and describe the properties of the matter on their own. This activity will serve as practice for when students must plan and carry out investigations later in the lesson.

3. CCC 1 Patterns: Students may be able to notice from this activity some patterns in the properties of matter. For instance, they may realize that solid objects are harder but that the water (liquid) is wet and does not have a fixed shape. They may start to see that hardness is a property that was used to describe the objects as either hard or soft. They may also notice that shapes and colors were used to describe the objects. All of this is practice for studying patterns related to identifying properties of matter.

Tie to the Anchoring Phenomenon

This activity serves as an introduction to the properties of matter. Students will later tie this information in with what they know about containers. Containers are made of certain materials that have properties that are well suited to contain specific objects. Students need to know the properties of matter as they play the role of designers of a classroom container company.

3. Preview the investigation.

CORE VOCABULARY—Tell students that what they were really doing in the last activity was describing the objects' properties. Give an example. For instance, say, "When you said that the coin was hard, you were observing a **property** of the coin, because coins are hard," or, "When you said that the wooden craft stick was smooth, you were observing the texture of the stick. Texture is a property."

Tell students that all matter and materials have properties. Let students know that they are about to explore more about the properties of solids, liquids, and gases in this upcoming activity.

4. Support the investigation.

- Place students into pairs. Tell them that they are going to work with a partner to investigate a type of solid matter: cookies. Explain that there are many different types of cookies.

Ask students What are some types of cookies that you know?

» chocolate chip, oatmeal, peanut butter, and so on

- Tell students that they will look at four different types of cookies and record what they notice. (See below **Know the Science 2**.) The thing that these cookies have in common is that they are all solid types of matter.

SAFETY NOTE: Although tempting, the cookies are not for eating. Remind students to not taste the cookies. Taste is not one of the senses they will use for their observations of matter.

- Tell students that you will read the instructions to them and that everyone will do the steps at the same time. Students can read along with you on the Properties of Matter Lab Sheet.

Know the Science

TEACHER DEVELOPMENT

2. Why cookies? Cookies are a relatable example of solid matter. This activity brings forward these common objects for students to examine in a new light. Bringing awareness to common, everyday things can help students start to imagine and realize that science exists all around them, even with common things, like cookies.

- Draw students' attention to the cookie tables on the Properties of Matter Lab Sheet. Model for students how they will use the tables.

NGSS Elements

3D Learning

3D Learning: In this activity, students are investigating the properties of matter through a series of observations and tests. As they make their observations, they look for patterns that tell them what is similar and/or different about the properties that belong to solid matter.

Activity Page

AP 1.3.1

- Distribute the Properties of Matter Lab Sheet (AP 1.3.1), and pass out the materials. Each pair should get:
  - 1 sandwich cookie
  - 1 chocolate chip cookie
  - 1 vanilla wafer
  - 1 fig cookie
  - 1 clear jar
  - 1 scale
  - 1 ruler

  SUPPORT—In the first chart, students may not understand what the word *texture* refers to. Tell students that texture is how something feels. Give examples of words that describe texture, such as *sharp*, *dull*, *rough*, *smooth*, *scratchy*, *bumpy*, *soft*, and so on.

- When everyone is ready, begin the activity. Circulate around the room, and provide support as needed. Check to see that students have completed each step before you read the next one. Make sure students also have enough time to fill in their tables. (See **Know the Standards 4**.)

Math Connection

  SUPPORT—Students work at different paces. If you notice that some students are working at a slower pace, it may be necessary to lend some additional support to that pair of students while others in the class continue to work on the rest of the steps. You can still read off the steps for the other groups while supporting students who are working at a different pace. (See **Know the Standards 5**.)

Differentiation

- When they get to Step 4, remind students that cookie jars are types of containers. They are containers that store cookies. Remind students that throughout this unit they are playing the role of designers at a container company. Tell them to keep cookie jars in mind as a type of container for later.
- Caution students to handle the cookies gently. Cookies crumble easily. If necessary, replace broken cookies.

Know the Standards

TEACHER DEVELOPMENT

4. Math Connection: As students measure the length of the cookies, they use rulers and gain practice in reading measurements for length.

5. Differentiation: Some students may need additional support for this activity. Students must read and listen to instructions and then carry out actions based on what they understand. If students do not have proper comprehension of the instructions, they will not be able to carry out the investigation properly and may miss out on the benefit of the experience.

Monitor Progress

- Let students know when they have a few minutes left to wrap up their investigations. (See **Know the Standards 6**.)

5. Summarize and discuss.

NGSS Elements

DCI PS1.A
CCC 1

- Ask students to summarize what they learned in their investigation of cookies. (See **Know the Standards 7**.) Use questions and discussion points to lead students toward the following conclusions:
  - Cookies are types of solid matter.
  - You can use a scale to measure cookies.
  - You can measure the length of cookies.
  - Cookies have a shape.
  - Cookies keep their shape when put in containers.
- Let students know that in the next class session, they will continue this investigation by looking at liquids and gases.
- Have students hold onto their Properties of Matter Lab Sheets.

1. Day 2: Refocus student attention.

What are some properties that we can describe? Review with students that in the last class they explored cookies, which are examples of solid matter. Tell students that today they will explore the properties of liquids and gases.

2. Support the investigation.

Place students back into the same pairs. Tell them that they are going to work with a partner to investigate a drink that some people think goes perfectly with cookies: milk.

Ask students by a show of hands who drinks milk (or plant-based milk, like almond milk or oat milk).

Know the Standards

TEACHER DEVELOPMENT

6. Monitor Progress: As you circulate around the room, scan students' tables on the Properties of Matter Lab Sheet. Review the way students are describing the properties of the cookies, checking for understanding. Look to see that students are using the scales and rulers correctly and that they are documenting their findings in the right places.

7. DCI PS1.A Structure and Properties of Matter and CCC 1 Patterns: Solids have certain properties that distinguish them from liquids and gases. For instance, they keep their shape when placed in containers, and they can be measured for size and weight. Solids have many properties, but students are exploring only some of them in this investigation. As students record what they notice about solids, they are beginning to realize the patterns in their properties.

SAFETY NOTE: Although tempting, the milk is not for drinking. Remind students to not drink the milk. Taste is not one of the senses they will use for their observations of matter.

NGSS Elements

3D Learning

3D Learning: In this activity, students are investigating the properties of matter through a series of observations and tests. As they make their observations, they look for patterns that tell them what is similar and/or different about the properties that belong to liquids and gases.

- Pass out the materials. Each pair should get:
  - 1–2 cups milk
  - tall cup
  - short cup
  - scale
  - calculator
  - balloon

NOTE: Students will save the balloon for their final investigation.

Activity Page

AP 1.3.1

- Have students take out Activity Page 1.3.1. Read the steps for the milk investigation together as a class. Tell students that you will read the steps as they perform them. Everyone will do the steps at the same time.
- Draw student attention to the milk chart on Activity Page 1.3.1. Model for students how they will use the chart.
- Begin the activity. Use Activity Page 1.3.1 as your guide. Read through one step at a time.

SUPPORT—If necessary, show students different ways to observe milk. They can touch it, smell it, swirl it around in the cup, look at it, and so on. Have paper towels nearby in case there are spills.

- Circulate around the room, and provide support as needed. Check to see that students have completed each step before reading the next one. Make sure students also have enough time to fill in their tables.

Differentiation
Monitor Progress
Math Connection

SUPPORT—Students may need additional support when it comes to weighing the liquid. Weighing liquid is a two-step process, as it involves taking the weight of the empty container first, before the liquid is added into it. Then, students have to use subtraction to solve for the difference of the starting and ending weights. If necessary, help students understand why all of these steps must be carried out, and guide students step-by-step through the use of the calculator. (See **Know the Science 3**.)

SUPPORT—Some students may need to use manipulatives to do the subtraction. Have connecting cubes or base-ten blocks for students to use, if needed. (See **Know the Standards 8** and **9**.)

Ask students What would happen if I just poured all the milk onto the scale and it wasn't in the cup?

» The milk would spill everywhere.

Ask students Would I be able to get a correct measurement of the milk?

» no

- Explain that this is why we measure the liquid in containers.

Know the Science

TEACHER DEVELOPMENT

3. Measurement: Measuring the weight of a liquid differs from measuring that of a solid. When students measured the weight of the solid cookies, all they needed to do was place the cookie onto the scale. To measure the weight of a liquid, students have to first take the weight of the cup when it is empty. Then, they add the liquid into the cup and measure it again. This time, the cup will weigh more. The increase represents the weight of the liquid. The increase does not represent the weight of the cup, because the weight of the actual cup does not change. It is only the volume of liquid added into the cup that causes the weight to change. Students will need to use their calculators to tell the difference between the starting and ending weights. That difference represents how much the liquid weighs.

Know the Standards

TEACHER DEVELOPMENT

8. Monitor Progress: As you circulate around the room, check to see that students are writing down the correct number on their tables for how much the milk weighs. The weight of the milk is not the weight of the cup with the liquid in it: it is the difference between the starting and ending weights that are taken. Students must complete this mathematical step to find the actual weight of the liquid.

9. Math Connection: Students take measurements and use subtraction to solve a word problem involving the weight of a liquid. The calculation requires multiple steps for students to solve for the liquid's weight. (2.OA.A.1)

3. Summarize and discuss.

NGSS Elements

DCI PS1.A

- After all the steps are complete and students have had a chance to finish recording their observations in their data tables, hold a quick discussion about their findings. (See **Know the Standards 10**.)

Ask students What did you notice about the milk?

» It was white. It was wet. It was smooth. It had a weight. It changed shape when we added it into the other cup.

4. Conclude the investigation.

Activity Page

AP 1.3.1

- For the last part of the investigation, students will observe properties of gases.
- Tell students they will only need balloons for this investigation. Explain that they will be blowing air into the balloons to see a gas in action.
- Take a quick moment to explain to students that balloons are containers. They contain gases that get blown into them. Emphasize the fact that containers are all around us. As designers for a classroom container company, it is important for us to be aware of the types of containers we see in the classroom, at home, and in the community.
- Specify that students are now working on Activity Page 1.3.1 (page 3) in the section titled "Gases." Read the steps for the gas investigation together as a class. Tell students that you will read the steps again as they perform them. Everyone will do the steps at the same time.
- Draw students' attention to the balloon table on the Properties of Matter Lab Sheet. Tell students how they will use the chart.
- Coach students to begin the activity, using the Properties of Matter Lab Sheet as their guide, and read through it one step at a time.
- Circulate around the room, and provide support as needed. This investigation may be a bit more confusing for students, since they do not have anything tangible and obvious in front of them to observe. Rather, they must accept and understand the fact that the air they are using to blow up the balloon is a gas and that even air has properties. (See **Know the Science 4**.)
- Assist with tying the balloons so they do not deflate.

Know the Standards

TEACHER DEVELOPMENT

10. DCI PS1.A Structure and Properties of Matter: Liquids have distinguishable properties that make them different from solids and gases. Students observe these properties in this investigation.

Know the Science

TEACHER DEVELOPMENT

4. Properties of Gas: The properties of a gas can be confusing, since a gas is not something that can be as easily observed, like solids and liquids. Gases are usually light, clear, and transparent or invisible. Because the particles move so freely and are so far apart from one another, this allows gas to fill any container that it is in. Often the change in volume of a container gives evidence of the amount of gas in it.

Tie to the Anchoring Phenomenon

Throughout this investigation, students have had a chance to explore the properties of solids (cookies), liquids (milk), and gases (air). Understanding the properties of matter is essential to students' roles as designers for a classroom container company. As students learn that different materials and matter have different properties, students will eventually be able to match those properties with the intended purpose of containers.

- **Ask students** How would knowing the properties of salt help Maya?
  - » Knowing how salt behaves with water and other materials might help Maya decide how strong the container would need to be.

5. Summarize and discuss.

- Use the end of class to summarize what students learned in their investigations about the properties of solids, liquids, and gases.
- Review with students the properties they examined, such as color, texture, and weight.
- **Ask students** What did you notice about solids? Liquids? Gases?
  - » Solids are hard, keep their shape, can be measured on the scale, and can be measured with a ruler. Liquids are wet, can be poured, take the shape of the container they are in, and can be weighed but not directly on the scale. You cannot see gas, but we know it is there because it filled up a balloon.

6. Check for understanding.

Formative Assessment

Monitor Progress

Students participated in a lot of hands-on activities over the past two classroom sessions as they observed matter. Make sure students have the correct understanding about the properties of matter. At this point, they should have a sense of how to tell the difference between solids, liquids, and gases, even though they have only investigated a couple basic properties of matter so far.

Activity Page

AP 1.3.1

Review student answers on the Properties of Matter Lab Sheet (AP 1.3.1) to determine student understanding of the following concepts:

- Solids, liquids, and gases have properties.
- Solids, liquids, and gases also have behaviors when it comes to containers.
- Solids keep their shape when you put them into containers.
- Liquids take the shape of containers.
- Gases fill up containers.

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

Tie to the Anchoring Phenomenon

Throughout this classroom session, students have had several opportunities to investigate the properties of solids, liquids, and gases. This is the stuff that goes into containers. Students will need to draw upon this preliminary information about matter as they work toward answering the Big Question—**How are containers matched to the stuff they contain?**

Ask students How can knowing about the properties of solids, liquids, or gases help you if you work at a container company?

» We can make containers that work well for different kinds of matter based on their properties.

LESSON 1.4

Temperature and Matter

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How do we group different materials?

Today's Question: How do temperature changes affect matter?

Tie to the Anchoring Phenomenon: As students learn about the properties of matter, they can use this information to help decide the best materials to use for making containers.

At a Glance

Learning Objective

✓ Explain how temperature can change matter.

✓ Identify some properties of liquids and solids.

Instructional Activities

- teacher Read Aloud
- vocabulary instruction
- student observation

NGSS References

Performance Expectation: 2-PS1-1

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students read, watch videos, and see live demonstrations to observe how temperature changes the state of familiar types of matter.

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.

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.

change **volume**

Instructional Resources

Student Book

Ch. 4

Student Book, Chapter 4
"You Can Measure Matter"

Activity Page

AP 1.4.1

Activity Page
Venn Diagram (AP 1.4.1)

Materials and Equipment

- clear bowls (2)
- flour
- bag of chocolate chips
- hot plate
- cookie mold or ice cube tray
- spatula
- oven mitt
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

Pour the flour into a clear bowl. Set the bowl on your desk or in an area where students can come up and inspect it.

SAFETY NOTE: Take proper precautions for students with food allergies.

The Core Lesson 1.4

1. Focus student attention on Today's Question.

How do temperature changes affect matter? Show students the bowl of flour that you have prepared. Tell students that you are having a difficult time telling whether flour is a solid or a liquid and that you need their help!

- Invite students to come up to the bowl and examine the flour. Students can touch the flour and move it around in the bowl to see how it behaves. Discourage students from removing the flour from the bowl, blowing on it, or eating it.
- When all students have had a chance to look at the flour, call on students to describe the flour.

Ask students How does the flour behave in the container? Does it take the shape of the container? Does it fill the container? Does it keep its shape?

» The flour moves around in the container. It can move up the sides or down into the middle. It keeps its shape.

2. Display a demonstration.

Online Resources

NGSS Elements

DCI PS1.A

Differentiation

- Tell students that the video they are about to watch might help them decide if flour is a solid or a liquid. See the Online Resources Guide for a link to the video: **www.coreknowledge.org/cksci-online-resources**
- Play the video for students. At the end, **ask students to tell you whether flour is a solid or a liquid and explain why.** Take a class poll with a show of hands, and write the results on the board. Encourage students to explain the properties of solids and liquids. Use this as an opportunity for a classroom discussion about the properties of solids and liquids. (See **Know the Standards 1**.)

  SUPPORT—If necessary, take a moment to remind students of the properties of solids, liquids, and gases that they explored in the previous class sessions.

3. Guide discussion and demonstrate examples.

- Tell students that they already learned about some properties of matter. But there is an important thing that can change the properties of matter.

Ask students Can anyone guess what can change the properties of matter?

» temperature

Differentiation

SUPPORT—If students do not guess the correct answer—temperature—then move right into the demonstration, and direct students to see if they can tell what changes the properties of matter. (See **Know the Standards 2**.)

Tie to the Anchoring Phenomenon

As students observe the changes in the chocolate chips, they will notice how matter can go from one state (solid) to another (liquid) because of temperature. Temperature is an important factor when it comes to designing containers. Containers need to be able to withstand certain temperatures so that they do not crack, melt, catch fire, freeze, or get damaged in some other way. This activity introduces the concept that temperature can change properties of matter. Students will gain more hands-on experience with this in Lesson 2.

Know the Standards

TEACHER DEVELOPMENT

1. DCI PS1.A Structure and Properties of Matter: In this introductory activity, students must recall what they know about the properties of matter to classify flour as a solid or a liquid.

2. Differentiation: Students explored some properties of solids, liquids, and gases, including hardness, texture, color, shape, and the ability of matter to keep or change its shape when placed into containers. If necessary, remind students of the types of containers they worked with in their investigations (cookie jars, cups, and balloons). Then prompt students to think about how the different materials behaved when in those containers. This can help them relate what they observed to the question about flour.

- Show students your bag of chocolate chips. Open the bag, and pour all of the chocolate chips into the other clear glass bowl. **Ask students to describe the sound they just heard.**
- Shake the chocolate chips around in the bowl. Show students that the chocolate chips kept their shape when poured from the bag to the bowl.
- Pick up some chocolate chips in your hand, and move them around. Tell students that the chocolate chips feel hard. Let them fall back into the bowl.

Ask students Do you think chocolate chips are solids, liquids, or gases?

» solids

- Place the glass bowl onto the hot plate. Use the spatula to mix the chocolate until it melts.

Ask students What do you notice about the chocolate chips?

» They are melting.

- Pour the melted chocolate into the cookie mold or ice cube tray. Emphasize that the chocolate is now taking the shape of the mold. Show students the results.

Ask students Do you think the chocolate chips are still solid? Or did they change?

» They changed.

Ask students What did they change into?

» a liquid

Ask students What changed them?

» the heat; the hot plate; the temperature

CORE VOCABULARY—Confirm for students that the thing that changed the property of matter was the act of heating it, which increased its **temperature**. Explain that the heat from the hot plate melted the chocolate. This turned the chocolate from a solid to a liquid.

- Discuss the properties that the chocolate had when it started out as a solid. It was hard, and it kept its shape. Then talk about the properties it had as a liquid. It was wet and gooey, and it took the shape of the new container it was poured into.

Differentiation

SUPPORT—If necessary, use sentence starters to help students arrive at the correct observations. You could say, "The chocolate started out as a solid, because it kept its _____ (shape) when I poured it into the glass bowl. We know it is a liquid now, because it changed its _____ (shape) when I poured it into the mold."

- Tell students that we know heat can melt things. **Ask students to tell you what cooling, lowering temperatures, can do.**

» freeze things

- **Ask students what they think would happen if you put the melted, gooey chocolate into the freezer.** Would it make the chocolate hard again?
  - » yes
- Summarize with students that heating and cooling can change matter. It can make materials melt, or it can make them freeze. Melting can turn things into liquid. Freezing can turn things into solids. (See **Know the Science**.)

Differentiation

CHALLENGE—If time permits and students are willing and able, challenge students to think of other ways that temperature changes can change matter. They may say that extreme heat (from fire) can burn things, like wood. Or they may say that extreme cold can crack things like plastic or glass.

EXTEND—Have students work in groups to research one way that heat changes the properties of matter and one way that cold changes the properties of matter. They must be examples that have not yet been discussed in class.

4. Read together: "You Can Measure Matter."

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.

Know the Science

TEACHER DEVELOPMENT

Temperature and Properties: Provide a simplified explanation for students. Be sure that they understand that materials must have certain properties that make them able to change in certain situations that relate to temperature. Not all materials will melt, and not all materials will freeze. Also, melting and freezing are not the only effects of heating and cooling on matter. Matter can do other things and change in other ways when heating and cooling. If students need examples of this, you can use the example of pine trees. Pine trees are found in places with a lot of snow. The wood of the pine tree does not freeze, even if it gets really, really cold. This is a property of wood. But wood can react to hot temperatures. If there is a fire, the wood of the pine tree can burn. It can turn to ashes. This is also a property of wood.

Read Aloud Support

Page 18

Ask students to turn to page 18 of the Student Book and look at the picture as you read aloud. Remind them that the title of this chapter is "You Can Measure Matter," and tell them to pay special attention to the different ways they measured solids and liquids in class as you read.

CHAPTER 4

You Can Measure Matter

You can observe matter to help you describe it. You can measure matter, too. You can find out how large or small it is. You can find out how light or heavy it is. You can find out how full or empty a container of matter is. Different tools measure different kinds of matter.

A ruler is too short to measure the length of this dog. What are the people using instead?

18

Ask students to look at the picture on page 18.

SUPPORT—Make sure students are clear on the difference between describing matter and measuring it. Guide students to name ways that they measure things. Hold up a standard ruler as a prop to stimulate thinking.

LITERAL—What are the people in the picture using to measure the dog?

» measuring tape

INFERENTIAL—Why can't they use a ruler to measure it?

» A ruler is too small.

Page 19

Ask students to look at the two pictures on page 19. Hold a discussion about the things that people can measure with a ruler. Remind students that a ruler is usually just twelve inches long.

Measuring Solids

There are many ways to measure solids. You can measure a solid's height to find out how tall it is. You can measure its weight to find out how heavy it is. You can measure a solid's width to find out how wide it is. Then you can use this information to help you describe it.

Rulers and measuring tapes are marked in inches and centimeters. They can tell you the height, length, and width of a solid object.

A scale shows pounds and ounces or grams. It measures weight. A scale tells you how light or heavy something is.

19

LITERAL—Can you measure a carrot with a ruler?

» Yes, it is a solid that holds its shape.

INFERENTIAL—Why would someone want to measure an object's length or width?

» Someone might want to see if an object can fit somewhere. Someone might want to see if an object is too big or too small to pack into something else.

Ask students if they have ever seen scales like this one at the grocery store. Tell them that this is called a scale and helps them measure the weight of fruits and vegetables. This is helpful because sometimes fruits and vegetables cost money depending on how much they weigh.

Page 20

Now ask students to look at the two pictures on page 20.

Measuring Liquids

Liquids flow. They do not have a shape. You cannot measure a liquid's length or width. Instead, you measure how much space a liquid takes up. This is called volume. Words that describe volume include liter, cup, pint, quart, and gallon.

This container measures in milliliters. One milliliter is a very small amount of liquid.

You can buy milk in pints, quarts, half-gallons, and gallons.

20

LITERAL—Can you use a container to measure a liquid?

» yes

Explain that volume is how much space matter takes up. Explain that there are many ways to describe volume of liquids. These include words like *pint* and *gallon*. For instance, a pint holds a smaller volume than a gallon. A milliliter is a smaller volume than a liter.

SUPPORT—Show students real-life examples of different-sized containers. The containers can be full or empty, but read the volumes so that students can visualize the difference between a pint, quart, half-gallon, and full gallon.

Have students look at the second picture on page 20, and ask the following questions:

LITERAL—Which container in the picture has the biggest volume? Which is the smallest?

» The gallon, which is the plastic jug, has the largest volume. The pint, which is the cardboard carton, has the smallest volume.

INFERENTIAL—Why might someone want to know the volume of a liquid?

» Someone might want to cook something, and they need the right amount of liquid.

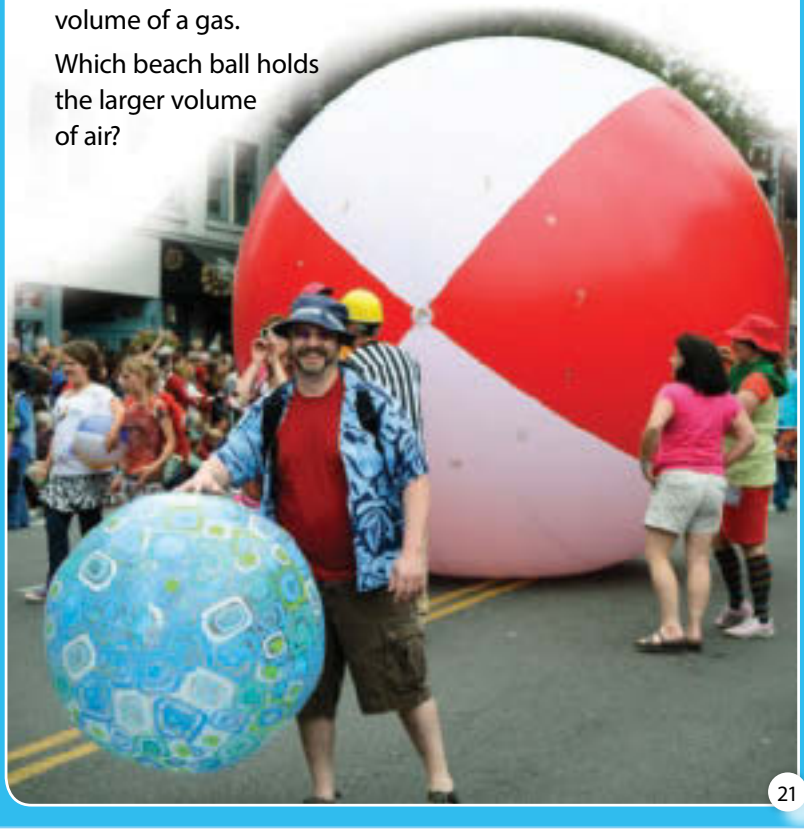
Page 21

Draw student attention to the picture on page 21.

Measuring Gases

Most gases are invisible. You are probably wondering how you can measure something you can't see or hold. Gases are measured the same way liquids are. They are measured by the amount of space they take up. This measurement is the volume of a gas.

Which beach ball holds the larger volume of air?



21

Ask students the following questions:

LITERAL—Can you pour a gas into a container to check its volume, like you can with a liquid? Why or why not?

» no, because the gas would escape from the container

Monitor Progress

INFERENTIAL—How do you know the balls in this picture are filled with gas?

» The balls are blown up all the way. The gas takes up space inside the balls, which is what makes them full and able to bounce down the street.

Ask students if temperature is another way to measure matter. Students should say yes. Explain that they will learn more about temperature and its effect on matter in the next lesson. (See **Know the Standards 3**.)

5. Support student modeling.

Activity Page

AP 1.4.1

NGSS Elements

DCI PS1.A

- Distribute Venn Diagram (AP 1.4.1). Tell students they will work in pairs to compare the properties of chocolate chips as a solid and the properties of chocolate chips as a liquid (melted). Model for students how to use a Venn diagram, including where the similarities go and where the differences go. Encourage them to write as many descriptions as they can think of. (See **Know the Standards 4**.)

6. Check for understanding.

Formative Assessment

Students participated in a lot of hands-on activities as they observed matter. Make sure students have the correct understanding about the properties of matter. At this point, they should have a basic sense for how heating and cooling change the properties of objects. Review student answers in Venn Diagram (AP 1.4.1) to determine student understanding of the following concepts:

- Solids, liquids, and gases have properties.
- Temperature can change properties of objects.

Monitor Progress

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

Know the Standards

TEACHER DEVELOPMENT

3. Monitor Progress: In asking students how they can tell that the balls are filled with gas, you can gauge student understanding of how they know matter exists even when they cannot see it. You can also gauge their understanding of the properties of a gas, which is that a gas fills up the container that it is in (and a ball is a type of container).

4. DCI PS1.A Structure and Properties of Matter: In performing this activity, students must draw upon knowledge of properties of solids and liquids to see how the same object is similar and different in two different states.

Tie to the Anchoring Phenomenon

Throughout this classroom session, students have had several opportunities to investigate the properties of solids, liquids, and gases. This is the stuff that goes into containers. Students will need to draw upon this preliminary information about matter as they work toward answering the Big Question—**How are containers matched to the stuff they contain?**

LESSON 1.5

Lesson 1 Roundup: Sorting and Grouping Matter

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How do we group different materials?

Today's Question: How do we group different materials?

Tie to the Anchoring Phenomenon: Students use what they learned about the properties of matter at certain temperatures to identify whether the materials they investigate are a solid, liquid, or gas. In doing so, students can start to think about the types of properties that containers would need to have in order to properly store these materials.

At a Glance

Learning Objectives

- ✓ Plan and carry out investigations.
- ✓ Classify materials based on their observable properties.

Instructional Activities (2 days)

- student investigation

NGSS References

Performance Expectation: 2-PS1-1

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 3 Planning and Carrying Out Investigations

Crosscutting Concept: 1 Patterns

Students plan and carry out an investigation in which they look at the properties of various materials and classify them as solids or liquids.

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.

matter

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.

classify **investigate** **observe**

Instructional Resources

Activity Page

AP 1.5.1

Activity Page
Investigate It (AP 1.5.1)

Materials and Equipment

- scales (1 per group or enough for groups to share)
- rulers (1 per group)
- variety of containers (1–2 per group)
- balloons (1 per group)
- cups (various sizes, 2 per group)
- water (1 cup per group)
- spoons or stir sticks (1 per group)
- liquid glue (1 bottle per group)
- modeling clay (1 tablespoon per group)
- rocks (1 per group)
- powdered gelatin (half cup per group)
- large paper clips (1 per group)
- colorful candy melts (a few per group)
- bowls
- bucket of ice
- hot plate (teacher use only)
- small metal pan (teacher use only)
- oven mitt

Advance Preparation (Day 2)

Set up an area where students can go to collect the tools they wish to use for their investigations. Not all groups will use the same tools, as it depends on the investigation plan that students come up with. At the area, have the following available:`

- scales
- rulers

- containers of various sizes and types
- spoons or stir sticks
- bowls
- cups
- bucket of ice
- electric burner or hot plate (teacher use only)
- small metal pan (teacher use only)

Make sure to have enough of each, in case more than one group wants to use the same tool.

SAFETY NOTE: Assist students when they request to use the ice for cooling or the hot plate for warming. Students should not handle the hot plate themselves.

The Core Lesson 1.5

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

How do we group different materials? Begin with a discussion to help students recall what they learned about and noticed about properties of matter so far.

Ask students What kinds of properties did we talk about?

» hardness, texture, shape, size, color, and changes or no changes when put into containers

Have students tell you the differences between solids, liquids, and gases, based on their properties.

NGSS Elements

SEP 6

CHALLENGE—Challenge students to provide you with the properties that solids, liquids, and gases also have in common. For instance, students may say that solids and liquids both can have colors and can be measured on a scale. (See **Know the Standards 1**.)

Know the Standards

TEACHER DEVELOPMENT

1. SEP 6 Constructing Explanations: It is important to allow students to arrive at the answers on their own as much as possible, instead of giving them the answers to the questions. This elicits deeper understanding, as students must call upon their experiential learning and apply it to scientific concepts. Students should not just be memorizing vocabulary terms and definitions. Rather, it is more beneficial for students to have hands-on experiences that allow them to make connections between scientific phenomena and real life.

EXTEND—Have students describe real-life examples of containers that are holding solids, liquids, or gases that they have seen at home or in the community. For instance, students might say that their milk container in the refrigerator holds milk (a liquid) or that the recycling bin has glass, plastic, and cardboard in it (solids).

2. Preview the investigation.

Activity Page

AP 1.5.1

Tie to the Anchoring Phenomenon

Remind students that the scenario for this unit is that they are designers for a classroom container company. For students to know what kinds of containers are best, they need to understand the properties of different materials, which is what they are doing in this investigation.

Ask students How can knowing about the properties of materials help you make good containers?

» Containers must be able to hold materials. Materials have different properties. Containers must be well suited for those properties.

- Tell students that in today's class they are going to investigate a variety of materials to determine whether they are solids or liquids. So far, students have had hands-on practice, have seen some demonstrations, and have read about properties of matter that will have prepared them for this investigation.

NGSS Elements

3D Learning

3D Learning: In this investigation, students plan and carry out investigations to classify materials as solids or liquids based on their properties. Students will need to look for patterns that are consistent with the properties of the different states of matter to help them classify the materials.

- Place students into small groups of mixed ability. Distribute Investigate It (AP 1.5.1), and review it together as a class. Even though students are working in groups for their investigations, they will complete their Activity Pages individually.
  - Tell students that each group will receive a variety of materials to investigate.
  - You are not going to tell them whether the objects are solids or liquids.
  - Each group will need to come up with a plan for how to investigate each object.
  - Then they will carry out those investigations. They will make observations, perform tests, take measurements, record data, and use what they notice to tell whether the object is a solid or liquid.

Differentiation

SUPPORT—If necessary, tell students that they have already completed investigations about the properties of matter. This time is different because you, the teacher, will not be giving them the steps to complete. Instead, students have to use what they learned and what they remember about their experiences so far to do the steps themselves.

CHALLENGE—Challenge students to identify properties that are the same for solids and liquids.

EXTEND—Have students come up with riddles or a list of clues for a certain object based on properties for other students to figure out.

3. Plan the investigation.

- Tell students that scientists plan their investigations before they study something. They figure out what they want to study and what they want to find out from their investigations. Prompt students to work as a group to plan their investigations.
- Circulate around the room, and assist groups as they work on their investigation plans. Listen and check that students are sharing their ideas with their peers and are equally participating in the planning process.
- As part of their investigations, students should identify materials that they will test and observe at different temperatures. Prompt students to look at the materials in front of them and pick one or two that they will either make hotter or make colder. Let students know that you will help them with the part of the investigation to make materials hotter or colder.
- Let students know that they can also add water to any of the materials they see. For instance, they might want to add water to the powder to see what happens and if it changes the properties of the powder.

NGSS Elements

SEP 3

Differentiation

Monitor Progress

SUPPORT—If necessary, differentiate for students how to perform observations and how to perform measurements. Put a T-chart on the board with a column for observable properties and measurable—or testable—properties. Call on students to give examples for each, and write them on the T-chart (e.g., observable properties can include color, shape, and odor, and measurable properties can include size, weight, and length). Then have students discuss what they could do to observe and measure the properties with other students. (See **Know the Standards 2**.)

1. Day 2: Refocus student attention.

How are containers matched to the stuff they contain? Open the class session by discussing with students where they left off the previous day. So far, students have planned their investigations. Today, they will carry out those investigations.

Know the Standards

TEACHER DEVELOPMENT

2. Monitor Progress: Different groups will conduct different types of observations and measurements. Some might try to do as many as they can, and other groups might just do one or two tests. The objective is for students to demonstrate understanding of how to make observations of materials in order to classify them as a solid or liquid. The number of tests that are performed is less important here.

2. Facilitate the investigation.

NGSS Elements

CCC 1
DCI PS1.A
SEP 7
Math Connection
Language Arts Connection

Activity Page

AP 1.5.1

- Have students review their investigation plans they made from the last session. Once students have reviewed and made any possible changes to their investigation plans, have each group collect the tools they want to use for their investigations.

SAFETY NOTE: Tell students that if they wish to use the ice or the hot plate, they should raise their hand when they are ready, and you will help them with those tools. Students should not operate the hot plate.

- When students reach the part of the Activity Page where they are asked "How do you know?" (AP 1.5.1 page 5, questions 1 and 2), explain that the question is really asking students to describe the evidence they collected that supports their classification of the material. (See **Know the Standards 3**.)
- Clarify for students that the "Container Test" column in the table can be answered in a yes/no format. The column is intended to capture data on if material kept its shape when put into a different container. (See **Know the Standards 4**.)
- Prompt students to wrap up their investigations when there are a few minutes left of class.

3. Summarize and discuss.

NGSS Elements

CCC 1

- Bring the class back together, and discuss the findings. Initiate a consensus discussion where students share how they classified each material. **Ask students to give you the evidence they collected to support their classifications.**

Ask students What patterns did you notice about the solids? About the liquids?

» The solid materials kept their shape. The liquids did not.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 7 Engaging in Argument from Evidence: Evidence is important in science. Scientists rely on evidence to support their claims, hypotheses, and findings. Evidence can take many forms. Data and observations are types of evidence that scientists often use to back up their arguments. This investigation gives students practice in finding and using evidence to support their classification of materials as solids or liquids.

4. Math Connection: At the end of Investigate It (AP 1.5.1), students are asked to put their data into a bar graph or picture graph. Model for students how to make graphs using data for length, weight, or container behaviors. For example, students can graph the measurements for length or weight, or they could do a yes/no picture graph for the container behavior data. Explain the importance of showing data. This gives students practice in doing something with the data that they collect, even though the data are not needed to decide whether the materials are solids or liquids. (MP.4; 2.MD.D.10)

4. Check for understanding.

Formative Assessment

Although it is important for students to correctly identify materials as solids or liquids based on their properties, it is more important that the investigation plan and outcomes represent student ideas with reasoning behind their answers. Pay attention to how students' thinking has changed over the course of the lesson.

Review student answers in Investigate It (AP 1.5.1) to determine student understanding of the following concepts:

- The properties of matter have patterns that help us identify them as solids or liquids (or gases).
- Properties of matter can be observed and measured.
- Properties of matter can change when there are temperature changes.

Monitor Progress

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

Tie to the Anchoring Phenomenon

As students work on their investigations, they are becoming more and more familiar with the properties of materials, including how materials behave. This information can later be applied to making the best containers for different materials so that students can answer the Big Question—**How are containers matched to the stuff they contain**?

LESSON 2

Heating and Cooling Matter

Overview

Guiding Question: How does temperature affect matter?

Lesson 2 Segments	Segment Questions	Advance Preparation
2.1 A Melty Mess (2 days) Students observe what happens to ice cream when it is heated, and practice using thermometers to measure the temperature of water and air.	How does heating and cooling matter affect how things are stored in containers?	Gather materials for the demonstration. See Materials and Equipment. Read Chapter 5 in the Student Book.
2.2 Changing the Temperature of Water Students observe how heating or cooling changes the temperature of water at three different states.	How does temperature affect the three states of water?	Gather materials for student observation.
2.3 Lesson 2 Roundup: Investigating Changes to Matter (3 days) Students carry out an investigation to see the effects of heating and cooling on objects, and whether those effects can be reversed.	Can changes to matter caused by heating or cooling be reversed?	Gather materials for student investigation. See Materials and Equipment. Read Chapter 6 in the Student Book.

What's the Story?

Summary: In Lesson 2 (Segments 1–3), students explore the cause-and-effect relationship of heating and cooling on matter. They learn and observe that heating and cooling can change certain materials and that these changes can either be reversible or not reversible (2-PS1-4). The developing understanding of these phenomena in Lesson 2 prepares students for their work in Lesson 3, when they observe the properties and uses of matter.

Learning Progression: Lesson 2 builds on student understandings about matter from Lesson 1 (2-PS1-1): *Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.* Lesson 2 also builds toward the Grade 2 target of 2-PS1-2: *Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

Guiding Phenomenon: Matter can change. Heating and cooling are among the many factors that can change matter. Containers are built with temperature limits in mind so that materials stored inside of them do not change as a result of temperature changes. Sometimes these changes can be reversed, and sometimes they cannot (2-PS1-4).

Learning Objectives

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

- Define *temperature*.
- Identify the effect of heating and cooling on matter.
- Classify changes as reversible or not reversible.

NGSS Standards and Dimensions

Performance Expectation: 2-PS1-4 Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concept
7 Engaging in Argument from Evidence Construct an argument with evidence to support a claim.	**PS1.B Chemical Reactions** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.	**2 Cause and Effect** Events have causes that generate observable 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

LESSON 2.1

A Melty Mess

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How does temperature affect matter?

Today's Question: How does heating and cooling matter affect how things are stored in containers?

Tie to the Anchoring Phenomenon: Students encounter a scenario in which observable properties change in response to temperature changes. Temperature is an important factor when it comes to designing containers that hold temperature-sensitive materials.

- **Ask students** What observable properties changed with Maya's salt?
  - » The bag got wet and turned soft. The salt dissolved with the water into a solution.

At a Glance

Learning Objectives

- ✓ Make a prediction about changes to matter.
- ✓ Observe how matter changes as its temperature changes.
- ✓ Use a thermometer to determine temperature.

Instructional Activities (2 days)

- student observation
- class discussion
- teacher Read Aloud

NGSS References

Performance Expectation: 2-PS1-4

Disciplinary Core Idea: PS1.B Chemical Reactions

Science and Engineering Practice: 7 Engaging in Argument from Evidence

Crosscutting Concept: 2 Cause and Effect

Students observe what happens to ice cream when it is heated and practice using thermometers to measure the temperature of water and air.

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.

prediction **property** **temperature** **thermometer**

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.

compare **container** **useful**

Instructional Resources

Student Book

Ch. 5

Activity Pages

AP 2.1.1

AP 2.1.2

Student Book, Chapter 5
"Matter Has Properties"

Activity Pages
Ice Cream Portrait (AP 2.1.1)
Temperature Testers (AP 2.1.2)
(one copy per group)

Materials and Equipment

- thermometers (1 per group)
- melted ice cream
- ice cream scoop
- freezer (or cooler filled with ice)
- foam cups (1 per group)
- water (1 cup per group)

Advance Preparation

If you are using a cooler, fill it with ice ahead of time.

The Core Lesson 2.1

1. Day 1: Introduce students to Lesson 2.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How are containers matched to the stuff they contain?**

Begin sharing with the class that you were going to eat some ice cream. But you left the ice cream outside on the counter for a while, and it melted! Now you just have a gooey, sloppy mess.

- Pass around several cups of melted ice cream, and allow students to make observations and gather in small groups to talk about what they see. Use the following prompts to initiate a discussion:
  - What do you notice about the ice cream?
  - Do you think the ice cream is a liquid or a solid? Why?

Tell students that, before they can answer the unit's Big Question about containers, they first need to learn more about temperature. In Lesson 2, they will learn about how changes in temperature make matter change in order to apply

their understanding to the Big Question. Write the Lesson 2 Guiding Question where students can see it:

How does temperature affect matter?

Tie to the Anchoring Phenomenon

Students observe a change to matter—the ice cream—as a result of heating it. They will learn that this change can be reversed so that melted ice cream can become hard ice cream again. This prepares students for learning about the properties of matter as they relate to containers.

2. Elicit student predictions.

Activity Page

AP 2.1.1

NGSS Elements

SEP 2
CCC 2

- Tell students that you were hoping that there would be a way to save the ice cream. You were thinking about putting it back into the freezer to see if that would change anything. **Ask students what they think will happen if you put the ice cream back in the freezer.**
- Record their responses on the board. Distribute Ice Cream Portrait (AP 2.1.1) to students. Explain that they will draw a picture of how the ice cream looks now and compare it to how the ice cream looks later. Tell them to draw their first pictures in the top box. (See **Know the Standards 1** and **2**.)
- Tell students that what they are doing is making a prediction. A prediction is like a guess about what you think will happen, but it's more than just a complete guess, because it is based on things you already know about a subject.
- Put the ice cream cups into the freezer (or cooler), and tell students that they will get to check on them in the next class session.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 2 Developing and Using Models: Students gain practice developing and using models by drawing before and after pictures of the materials under observation. Models, such as pictures, help scientists study things by recording how they look at one point in time, which can then be used to compare them to another point in time. Then, scientists can see how things changed or stayed the same over the span of that time frame. They can also study the factors that may have caused such changes (or no changes).

2. CCC 2 Cause and Effect: Students are using concepts of cause and effect to make a prediction about what they think will happen to the ice cream. Students are familiar with the fact that ice cream is a cold dessert, so they apply what they already know about ice cream to think about the effect of freezing it again. This serves as an entryway into the concept of reversible and nonreversible changes.

3. Guide discussion and show examples.

- Show students a thermometer. **Ask students what a thermometer is used for.** Emphasize that thermometers measure temperature. (See **Know the Science**.)

SUPPORT—If necessary, remind students that temperature is the measure of how hot or cold something is. Draw a connection back to the previous lesson, where students used tools to make materials hotter or colder. This was an example of changing temperature.

- **Ask students where they may have seen thermometers before.** Perhaps students have used thermometers when they were sick to tell if they had a fever. They may have also seen an adult use a thermometer in the kitchen for cooking. Or maybe they have seen thermometers in swimming pools to measure the temperature of the water. Special thermometers can even measure the temperature of air. Emphasize that thermometers are used for many purposes.

Differentiation

SUPPORT—If necessary, clarify for students that thermometers cannot change temperature. They only measure it.

CHALLENGE—Challenge students to make a table listing things with a temperature (e.g., food, air, people, water). Then have them indicate yes or no for whether thermometers can be used to measure those things.

EXTEND—If time permits, have students research different types of thermometers and what they are used for. Or have students put together a time line of how thermometers have changed over the years. Then have them share what they learn.

4. Facilitate the activity.

Activity Page

AP 2.1.2

- Place students into small groups. Distribute one copy per group of Temperature Testers (AP 2.1.2). Review it together. For this activity, students will practice taking temperatures with a thermometer by writing down the temperature for the water and the air inside the classroom.
- Pass out the materials. Each group will receive the following:
  - thermometer
  - cup of water

Know the Science

TEACHER DEVELOPMENT

Thermometers: There are different kinds of thermometers. Thermometers have two important parts that are necessary for telling the temperature: a sensor that picks up on temperature changes and a system for representing the temperature in numbers (such as a numerical scale).

- Demonstrate how to use a thermometer. Stick the thermometer into a cup of water, and read the temperature out loud. As you do this, model for students how you were able to find the number on the thermometer that represents the temperature. Explain that it is important to wait until the indicator on the thermometer has stopped moving before you read the result. If using a digital thermometer, explain to wait until the numbers have stayed constant for a few seconds.
- Show students the table where they will put the temperature data they collect. Make sure they understand where to record the numbers from the thermometer. Each student should take a turn taking the readings and adding theirs to the table.

Differentiation

SUPPORT—If necessary, help students read the numbers on the thermometer. The numbers can be very small, and some students may have visual limitations that make this activity difficult for them. Students who have shown a good understanding of how to read a thermometer can be the temperature checker and make sure the temperature read is accurate.

- Circulate around the room, and check for understanding.

5. Check for understanding.

Monitor Progress

There are not predetermined right and wrong answers when it comes to the temperatures of the water and air. Rather, it is important that students demonstrate understanding of how to carry out the steps and use the thermometers, as this will be a skill that is necessary for the remainder of the lesson.

Review student tables in Temperature Testers (AP 2.1.2) to determine student understanding of the following concepts:

- Thermometers measure temperature.
- Water and air have temperatures.

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

Tie to the Anchoring Phenomenon

Monitor Progress

In this activity, students gain practice in taking the temperature of water and air. Temperature is an important factor when it comes to containers. Certain materials—like ice cream—must stay at certain temperatures and cannot become too hot or cold or else it changes the properties of the materials. Containers must be designed and built with temperature in mind. This knowledge can help students answer the Big Question—**How are containers matched to the stuff they contain?**

1. Day 2: Refocus student attention.

How does heating and cooling matter affect how things are stored in containers? Remind students of what they did in the previous class session. They practiced using thermometers, and they observed a melted ice cream scenario. Tell students that today the ice cream will be taken out of the freezer to see what has happened to it.

2. Build on prior knowledge.

Monitor Progress

In Lesson 1, students learned about some properties of matter. Lesson 2 builds on that knowledge to help students make a connection between properties of matter and temperature.

Gauge student understanding of properties of matter by **asking them to recall how they can describe things.** Go around the classroom, and give each student a chance to name one way to describe something. (See **Know the Standards 3**.)

3. Read together: "Matter Has Properties."

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.

Student Book

Ch. 6

Read Aloud Support

Know the Standards

TEACHER DEVELOPMENT

3. Monitor Progress: As you work through this classroom session, pay attention to how students' understanding of temperature develops along the way. They start out by seeing melted ice cream in a cup and have to call upon their own experience of what ice cream looks like to understand how the ice cream must have melted. Although students may have seen or eaten melted ice cream before, they probably have not applied scientific concepts to this once-frozen treat. Students' understanding that temperature changes can have an effect on materials (in this case, ice cream) should progress throughout the session.

Page 22

Ask students to turn to page 22 of the Student Book and look at the picture as you read aloud. Remind them that the title of this chapter is "Matter Has Properties," and tell them to pay special attention to the different ways to describe things as you read.

CHAPTER 5

Matter Has Properties

How can you describe the materials used to make this snowman?

The snow is white and cold. The carrot is long and pointy. The scarf is red, white, blue, and soft. The mouth and arms are thin and brown.

These are properties. Properties of matter are details that you can observe. You can measure many properties.

22

Ask students to look at the picture on page 22. Explain that it shows a picture of matter (the snowman, the carrot nose, and all the things the snowman is wearing).

LITERAL—What are some ways you can describe this snowman?

- » The snowman is cold.
- » The snowman is white.
- » The snowman has a carrot nose.
- » The snowman is wearing a hat and a scarf.
- » The snowman has two stick arms.

CORE VOCABULARY—Explain that **properties** are the details that you notice about something.

Ask students the following questions:

LITERAL—Can you measure the temperature of the snowman?

» yes

LITERAL—What can measuring the temperature of the snowman tell you?

» if the snow is close to melting

SUPPORT—Show students a thermometer to remind them of how they used thermometers in the last class session. They used thermometers to test the temperature of water and air.

LITERAL—How is measuring with a thermometer a way to tell about the snowman's properties?

» Measuring with a thermometer will tell the temperature of the snowman.

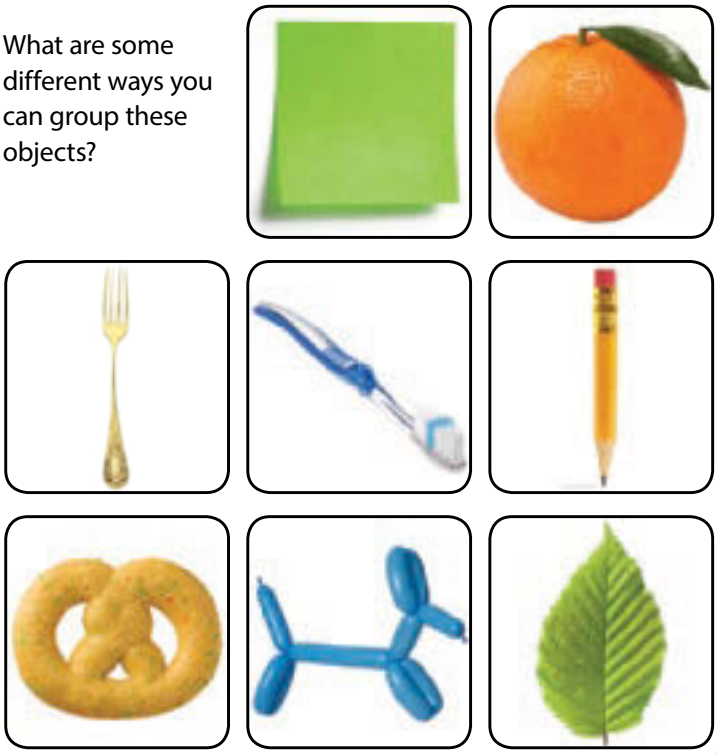
Page 23

Have students look at the eight pictures on page 23. Explain that they each show a picture of matter. Some of the things about the matter in the pictures are similar. Other things are different.

Weight is a property you can describe. Color is a property of matter. Size and shape are properties of matter. The way matter feels is a property, too.

You use your senses to observe matter. You can record data about matter. Then you can group matter by its properties.

What are some different ways you can group these objects?



23

LITERAL—How would you sort the pictures according to how the things are similar?

» The leaf and sticky note are small. The toothbrush and pencil have a similar shape. The pretzel and the orange are things you can eat. The balloon and the orange have the same shape. The metal fork and the toothbrush are the same size.

INFERENTIAL—Why might someone want to group things together?

» Someone might want to study them. Someone might want to easily see them.

Page 24

Ask students to look at the four pictures on page 24. Emphasize that properties make matter useful for certain things. We find these things in our homes, at school, and in the community. Go over the examples in the pictures on page 24, but expand the conversation to things that students are familiar with at home, at school, or in the community.


Properties make matter useful for certain things.

Water is wet. It can put out fires.

Glue is sticky. It is used to hold things together.

Glass is see-through. It is perfect for making lenses in eyeglasses.

Bricks and wood are hard and strong. They are used to build homes.

24

Tie to the Anchoring Phenomenon

The idea that certain properties make matter useful for certain things is important for students to learn as they start to make connections about how containers are made out of materials that have properties that can be used for certain things.

Ask students the following questions or similar questions:

LITERAL—The windows in a home are made of glass. Glass is see-through. What is the purpose of the windows being made of glass?

» It lets us see out of the window.

LITERAL—This glue is sticky. Why is that important?

» It holds things together.

SUPPORT—Make sure students understand the meaning of *useful*. Explain that when something is useful, it means it can be used for something important or that is needed. As examples, talk about objects in the classroom and how they are useful.

Page 25

Ask students to look at the four pictures on page 25. Explain that Maya did not pick the right material—the paper bag—to hold the salt. But there are better materials she could have picked that have properties that are better for storing salt outside.

Do you remember what happened to Maya's paper bag in the story? The bag got wet. Then it turned to mush. That is because paper is thin and soft. Water can leak through it and make it softer. Paper is not a good material for storing things outdoors.

Look at the containers below. What materials are they made of? Which ones could have been better to hold Maya's salt? What properties make a material a better choice?

25

LITERAL—Which other materials could she have picked that would work better?

» the milk carton, the plastic bucket, or the glass jar with lid

INFERENTIAL—Why isn't the cardboard box a good choice?

» It is like the paper bag. It could get ruined if it gets wet.

4. Summarize and discuss.

Activity Page

AP 2.1.1

NGSS Elements

DCI PS1.B
CCC 2

- Circle back to the scenario of your melted ice cream. Take the cups out of the freezer (or cooler), and pass them back out to the groups. Have students make observations. Tell them to focus on the properties of the ice cream. (See **Know the Standards 4**.)
- Have students take out Ice Cream Portrait (AP 2.1.1). Then have them draw what they see in the bottom box.
- Call on students to compare their drawings and share them with the class.

Ask students How did the ice cream change?

» It became hard; it froze; it became colder.

Ask students Why did this change take place?

» It was put in a place with a very cold temperature.

Ask students Does this mean that melted ice cream can be saved?

» yes

- Have students notice the container the ice cream is in. They can touch it and look at it. Explain that even though the ice cream was liquid when it was melted, it never ruined the container the way the rain ruined the bag of salt in Maya's story. (See **Know the Standards 5**.)

Ask students Is the ice cream container made from materials with properties that are useful for keeping things cold?

» yes

Know the Standards

TEACHER DEVELOPMENT

4. DCI PS1.B Chemical Reactions: Students witness a physical change by observing how cooling the ice cream can change its physical properties by making it colder and harder again. This example introduces the phenomenon that certain physical changes caused by cooling can be reversed (and others cannot).

5. CCC 2 Cause and Effect: Students observe a cause-and-effect phenomenon in which the ice cream started out as a liquid but cooling caused the ice cream to become a solid. Therefore, the ice cream can be saved (the change reversed).

5. Check for understanding.

Formative Assessment

As you work through this classroom session, pay attention to how students' understanding of properties develops along the way. Students' understanding that temperature changes affect materials (in this case, ice cream) should progress throughout the session.

Review student drawings in Ice Cream Portrait (AP 2.1.1) to determine student understanding of the following concepts:

- Changes of temperature can change materials.
- The temperature changed and the material (ice cream) changed, but the container stayed the same.

Monitor Progress

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

Tie to the Anchoring Phenomenon

Students observe how a container can be useful for a material (the ice cream) at different temperatures. This knowledge can help students work toward answering the Big Question—**How are containers matched to the stuff they contain**?

LESSON 2.2

Changing the Temperature of Water

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How does temperature affect matter?

Today's Question: How does temperature affect the three states of water?

Tie to the Anchoring Phenomenon: Students gain hands-on experience measuring the temperature of water at different states and observing how heating or cooling water changes its properties. Such properties are important for designing containers, since some containers need to be "temperature proof" so that the materials inside it do not get too hot or too cold.

At a Glance

Learning Objectives

- ✓ Compare and contrast different temperatures of water.
- ✓ Describe the cause-and-effect relationship between heating and cooling and freezing and melting water.

Instructional Activities

- student observation
- class discussion

NGSS References

Performance Expectation: 2-PS1-4

Disciplinary Core Idea: PS1.B Chemical Reactions

Science and Engineering Practice: 7 Engaging in Argument from Evidence

Crosscutting Concept: 2 Cause and Effect

Students observe how heating or cooling changes the temperature of water at three different states and use their observations as evidence to describe the cause-and-effect relationship between temperature and the physical state of 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.

matter **property** **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.

observe

Instructional Resources

Activity Page

AP 2.2.1

Activity Page
How Hot or Cold? (AP 2.2.1)

Materials and Equipment

- thermometers (1 per group)
- foam cups (1 per group)
- water (1 cup per group)
- ice cubes (4–5 per group)
- plastic snack- or sandwich-size baggies (1 per group)
- hot plate
- pot for boiling water
- freezer or cooler
- chalk or dry-erase markers (1 per group)

Advance Preparation

Fill the plastic bags with 4–5 ice cubes each before class begins, and secure them tightly. Store the bags with the ice cubes in a freezer or cooler so they do not melt prior to the activity.

Set up an area in the classroom where you will use the hot plate and pot to boil the water for students.

Clear the board so students have a place to draw their bar graphs at the end.

The Core Lesson 2.2

1. Focus student attention on Today's Question.

How does temperature affect the three states of water? Remind students that in the last class they took the temperature of water and air. Tell them that today they will look more closely at water, particularly the three states of water: water as a liquid, a solid (ice), and a gas (water vapor).

2. Turn and talk.

- Have students work with a partner. Ask what they wonder about when they think of the temperature of water. Have them share their ideas with each other.
- Use the following prompts to help initiate the discussion:

- What kinds of things do you use water for at home? At school? In the community?
- Is it important for the water to be cold, hot, or warm when you use it?
- Is there ever a time you want water to be hot? Or cold? Or neither?
- What do you do if water is too hot or too cold?

- Tell students that water can change its properties depending on temperature. (See **Know the Science**.) It can go from a liquid to a solid to a gas and back again.

Ask students How can we tell the temperature of water?

» Measure it with a thermometer.

Differentiation

SUPPORT—If necessary, remind students that water is matter, and that it can exist as a solid, liquid, or gas.

3. Preview the investigation.

Activity Page

AP 2.2.1

- Have students stay in their pairs, and distribute How Hot or Cold? (AP 2.2.1). Read through the steps together. Tell students that they will take the temperature of water three different ways: when the water is room temperature, when the water is cold (with ice added to it), and when the water is hot (invisible vapor as a result of boiling).
- Distribute the following materials to each group:
  - cup of water (room temperature)
  - plastic bag filled with ice cubes
  - thermometer
- Draw student attention to the chart on Activity Page 2.2.1. This is where they will record the temperatures. Make sure students understand which boxes they should record their data in.
- For the part where students take the temperature of water vapor, tell students that you will assist them with this part, since the water will be very hot. You will assist one group at a time.

Know the Science

TEACHER DEVELOPMENT

Water: Water is a good example of a type of matter that may be used to show how the addition or removal of heat can cause property changes, since water can take on liquid, gas, or solid forms. It exists as a solid when it freezes. Continued cooling will cause water to turn to ice. Water exists as a gas (water vapor) when water boils or evaporates. Evaporation is part of the water cycle, which is the cyclical movement of water between Earth and the atmosphere. Boiling water results from continually adding heat energy. In both cases, water changes from a liquid to a solid or a liquid to a gas because of the addition or removal of heat. Furthermore, water can move into and out of these states of matter continuously, even within minutes of each other.

- Tell students that each group will draw their final graphs on the board. When students are ready for this step, they should go up to the board, draw their graph, and then go back to their seats.
- Clarify that the graph should be drawn once all three temperatures have been taken.

4. Facilitate the investigation.

Math Connection
Differentiation

NGSS Elements

CCC 2

- Circulate around the room, and provide support to students as they work through the steps.

  SUPPORT—If necessary, help students read the numbers of the thermometer. You can read the number out loud and have the student fill it in on the table.

  SUPPORT—This activity can also be teacher demonstrated with students individually recording temperatures.

  CHALLENGE—This activity lays out all the steps for students to follow a linear investigation. However, if students have their own ideas for tracking the temperature of water at different states, then allow them to pursue those ideas. For instance, students might want to collect more data than what is asked for or take multiple measurements at each state. Students can add more columns onto their charts on Activity Page 2.2.1 or start their own scrap page for writing down temperatures.

  EXTEND—If time permits, have students take several temperatures of the ice water, adding one ice cube at a time. They can record the temperature after each ice cube to see how much the temperature changes and then graph the data to show how many ice cubes it takes to reach a certain temperature.

- Stay aware of when students are ready to take the temperature of water vapor. Remind students that water in the gas state cannot be seen, so they will take the temperature above the pot of water after it starts to boil. Put their water into the pot on your hot plate. Turn the hot plate on, and watch the water boil. Hold the thermometer over the pot. Students call out the number on the thermometer to you and then write it down.
- Remind students to not take up too much space on the board with their graphs. There needs to be room for all the groups to draw their graphs.
- If necessary, prompt students to label their graphs. For instance, the bars on the graph should indicate whether they represent the water as a liquid, as a solid, or as a gas. (See **Know the Standards 1**.)

Know the Standards

TEACHER DEVELOPMENT

1. Math Connection: Students will draw simple bar graphs that represent the data they collect for water temperatures. Their three-bar graphs should show the different temperatures when water is room temperature, cold, and hot. The hottest (highest) temperature should be associated with water in vapor form, and the coldest (lowest) temperature should be associated with water as ice. (2.MD.D.10)

5. Compare and contrast the temperatures.

NGSS Elements

DCI PS1.B

- Bring the class back together, and focus student attention on the graphs on the board. Invite students up to the board to discuss their graphs and what their graphs show. Graphs should show a hotter temperature when the water is a gas and a colder temperature when the water is icy. (See **Know the Standards 2**.)
- Use the following question prompts to discuss what students noticed:
  - Did the temperature go up or down when the water turned into water vapor?
  - Did the temperature go up or down when you added ice cubes into the water?
  - What did you notice about the water when it was the hottest?
  - What did you notice about the water when it was the coldest?
  - What else do you wonder about water and temperature?

6. Summarize and discuss.

NGSS Elements

SEP 7

Differentiation

Monitor Progress

- **Ask students whether they think temperature can change a substance.** As students answer, encourage them to use evidence from their activity today. (See **Know the Standards 3** and **4**.)

  SUPPORT—If necessary, use sentence starters to help students understand how to use evidence in their explanations. Emphasize that the use of the word *because* is a way to include evidence. For instance, "I know temperature can change water, *because* _____."

Know the Standards

TEACHER DEVELOPMENT

2. DCI PS1.B Chemical Reactions: As students complete this activity, they have seen water in different states. Their takeaway should be that heating or cooling a substance can cause changes that are observed through the measurement of temperature. Sometimes you can see these changes easily because the substance takes on a new form, shape, color, odor, size, or so on. Other times, the changes can only be observed by measuring them, such as taking the temperature of the water. In the next segment, students will learn about how heating and cooling can bring about reversible or permanent changes.

3. SEP 7 Engaging in Argument from Evidence: Students construct an argument to explain whether heating and cooling change a substance (in this case water), using the data they collect from the activity. Students should draw upon their temperature data to prove their points. Prompt students to look at the data they recorded and use the data to help with their evidence.

4. Monitor Progress: As you work through this classroom session, pay attention to how students' understanding of temperature develops along the way. By now they should start to see that some substances can change if they are heated or cooled. Soon, they will start to apply this to other materials besides water. Later, they will connect this information to what they know about containers.

7. Check for understanding.

Formative Assessment

Use the in-class activity as your basis for gauging how well students understand that heating or cooling a substance can make changes that can be observed. There are no right or wrong answers in this class session as they relate to the actual temperatures. Rather, check to see that students are participating and progressing in their knowledge of how substances are affected by heating or cooling.

Monitor Progress

See the Activity Page Answer Key for correct answers and sample student responses. Use this opportunity to gauge student understanding of containers and properties of matter. Students should start demonstrating understanding that different materials have different properties. For instance, water has different properties at different temperatures. Containers must meet the needs of the materials and their properties. Not all containers are the same or are made from the same things. They must be different, since materials are different.

Tie to the Anchoring Phenomenon

Some containers are built to hold water. They can be very, very large, or they can be small, like the water bottles we carry around and drink out of. Water can be a liquid, it can be a solid, and it can also be a gas.

Ask students if they think the same kind of container would work for water as a liquid, solid, and gas. Why or why not?

Ask students if they think a different container would be used for solid water than for liquid water.

The answers to these questions can help students answer the Big Question—**How are containers matched to the stuff they contain?**

LESSON 2.3

Lesson 2 Roundup: Investigating Changes to Matter

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How does temperature affect matter?

Today's Question: Can changes to matter caused by heating or cooling be reversed?

Tie to the Anchoring Phenomenon: Students participate in an investigation in which they heat and cool various materials to observe the effects that temperature has on their properties. As students attempt to reverse those changes to see whether the properties change back, students get a sense for how properly designed containers can help prevent changes related to temperature.

At a Glance

Learning Objectives

- ✓ Describe changes that occur in materials as a result of heating and cooling.
- ✓ Classify changes to matter from heating and cooling as reversible or not reversible.
- ✓ Describe why knowing whether changes caused by heating or cooling are reversible or not reversible is important when selecting containers.

Instructional Activities (3 Days)

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

NGSS References

Performance Expectation: 2-PS1-4

Disciplinary Core Idea: PS1.B Chemical Reactions

Science and Engineering Practice: 7 Engaging in Argument from Evidence

Crosscutting Concept: 2 Cause and Effect

Students carry out an investigation to collect evidence about the effects of heating and cooling on objects and whether those effects can be reversed.

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 **reversible** **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.

change **cooling** **description** **heating**

Instructional Resources

Student Book

Ch. 6

Student Book, Chapter 6
"Heating and Cooling Matter"

Activity Pages

AP 2.3.1
AP 2.3.2

Activity Pages
What Does the Heat Do? (AP 2.3.1)
Cool It Down (AP 2.3.2)

Materials and Equipment

- hot plate
- freezer
- small metal pans (4)
- spatulas, spoons, or stir sticks (2)
- raw egg
- butter, solid (quarter stick)
- oven mitt
- paper (1 sheet)
- ice cubes (half cup)
- plant leaves (1 per pair)
- water (quarter cup per pair)
- paper or foam cups (1 per pair)
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

SAFETY NOTE:

- Set up the hot plate in an area that is safe and away from flammable objects. There will need to be enough room near the hot plate area such that a group of students can stand around it to make observations but not be too close.
- Use proper food handling precautions with raw egg in the classroom.

For Day 2, pour a quarter cup of water into the cups that you will pass around to the groups.

The Core Lesson 2.3

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

Can changes to matter caused by heating or cooling be reversed? Remind students that in the last class they took the temperature of water at different states.

Monitor Progress

- Build on student prior knowledge about the effects of heating and cooling on water. **Ask students to tell what happens when water is heated. Then ask what happens when water is cooled.** Students should be able to explain that heated liquid water turns into water vapor and cooled water turns from a liquid into a solid.
- Explain that today they will build on what they learned about water to investigate other types of materials that are heated and cooled.

2. Cultivate predictions.

- Show students the materials that they are going to work with today. **Ask students if they have seen these things before:**
  - ice
  - egg (whole, raw)
  - stick solid butter
  - paper

NGSS Elements

CCC 2

- **Ask the class what they think will happen when you heat these objects.** Write down their ideas somewhere on the board. You will circle back to those later after students conduct the investigation and see whether students were right or not.

Differentiation

SUPPORT—If necessary, remind students of the melted ice cream scenario. Have students review the pictures they drew on Activity Page 2.1.1. Help them see the connection between how heating the ice cream made it melt and then cooling the ice cream in the freezer made it hard again. Relate this to the materials that they will be looking at today. (See **Know the Standards 1**.)

Know the Standards

TEACHER DEVELOPMENT

1. CCC 2 Cause and Effect: As students tell what they think will happen to the objects after being heated, they are making predictions based on cause-and-effect relationships.

3. Preview the heating investigation.

Activity Page

AP 2.3.1

- Place students into four groups of mixed ability. There should be the same number of groups as there are materials to be investigated on Day 1.
- Distribute What Does the Heat Do? (AP 2.3.1). Review the steps for the investigation together as a class. The investigation is broken down into two parts:
  - In Part 1, students will say what they notice about the materials before the investigation. They will heat the materials and record what they observe. There will be noticeable changes after the objects are heated. Students will record these changes.
  - In Part 2, students will see whether the changes caused by heating can be reversed (by cooling). They will look at those results on a different day, after the materials have had a chance to cool.
- Explain the process for conducting the investigation:
  - Each group will come to the area where the hot plate is located and assist in the investigation. Each group will get a chance to help with one of the materials as the rest of the class observes.
  - The students will describe the properties of the materials out loud to the rest of the class before they are heated.
  - You, the teacher, will be responsible for handling the hot plate and the hot materials.
  - The students in each group will stand and observe how the material changes. They will describe those changes out loud to the rest of the class.

  SAFETY NOTE: Discuss safety related to the use of hot plates. Continually remind students that they are not to touch the hot plate or the metal pans that are placed on the hot plate.
- Review with students where on Activity Page 2.3.1 they will write the before and after descriptions. In the "Reversible" column, tell students that they will circle the answer "yes" or "no."

4. Facilitate the heating investigation, Part 1.

- This investigation involves the use of a hot plate. Although the teacher is carrying out the physical act of heating the materials, student groups are driving the investigation by leading discussions, making descriptions, and talking about what they think will happen and eventually what they observe.
- Invite one group at a time up to the hot plate area. Identify the material they will look at. Show the material to the rest of the class.

- Prompt students in the group to observe the material before heating. They can touch it, smell it, move it, and look at it. **Have students in the group describe what they see to their classmates.** Emphasize to the groups how important it is that they give detailed descriptions about what they notice, as the rest of the class is counting on their descriptions.
  - When heating the paper, remove it from heat once the paper starts to brown. Continued exposure to heat could cause the paper to catch fire.
  - When heating the butter, remove it from heat once it starts melting and before it starts vaporizing, which will look like steam.

NOTE: When observing the raw egg, crack the egg into the metal pan first, making sure to use a stir stick to poke the yolk. Then have students observe it in its liquid form. Do not allow students to touch the raw egg with their bare hands.

Differentiation

SUPPORT—If necessary, provide the following to students as they describe the objects out loud to the rest of the class:

- What shape is it?
- Does it smell? What does it smell like?
- What color is it? Can you see through it?
- How big is it? What can you compare its size to?
- What does it feel like? What kind of texture does it have? Is it hard or soft? Sticky? Smooth or rough?

The goal is to have students notice as many things as they can about the materials.

Activity Page

AP 2.3.1

- Tell everyone in the class to take a couple of minutes to write down these beginning descriptions of the material in column 1 of the table on Activity Page 2.3.1, including the group at the front.

  SUPPORT—Alternatively, students can draw pictures of what the materials look like to keep track of the appearance before and after changes, instead of writing the descriptions.

- Place the material into the metal pan. You will use a new metal pan for each material.
- Heat the material on the hot plate. Use a spatula to stir the material to quicken the heating process.
- **Ask the students in the group what they notice happening to the item being heated.** Students will say what they observe visually.
- Prompt students to follow up on the same descriptions they noticed before heating the object, now that the object is heated. For instance, **ask students** Is the material still soft? Is it still a liquid? Is it still a solid? Is it still rough? They will need to give detailed descriptions of how the objects changed to the rest of their classmates.
- Do not allow students to reach their hands into the metal pan to touch the material while it is on the hot plate. Instead, have students watch as you use the spatula to move the material around. Describe some words as you are moving the material around.

- After the demonstration, prompt all students in the class to write down how the material changed in column 2 of the table on Activity Page 2.3.1.
- Hold a quick whole-class discussion about the descriptions before and after heating the material. Compare and contrast them. Then turn students' attention to the predictions they made earlier. (See **Know the Standards 2**.)

NGSS Elements

DCI PS1.B
CCC 2

Ask students Did the material change the way you thought it would?

» yes/no

- Repeat this process for all the materials so each group has a chance to go up and lead the investigation for the rest of the class.

5. Facilitate the heating investigation, Part 2.

- Tell students that the next part of their investigation involves seeing whether the changes made to the materials from heating can be reversed.
- Explain that you are going to put the materials into the freezer. During your next class, you will take them out of the freezer and look at them. You will see whether the materials changed back to how they were before they were heated.
- Start a new prediction discussion with the class. Have students say whether they think the changes can be reversed by cooling the materials. Write the predictions on the board.
- Place the materials into the freezer. On Day 2 you will take them out of the freezer and see if their states are reversed.

1. Day 2: Refocus student attention.

Can changes to matter caused by heating or cooling be reversed? Review with students what they did in the previous class session. Remind them that today they are going to look at the materials from the last class to see if their changes were reversed. Then tell them that they will also look at what cooling does to materials.

Know the Standards

TEACHER DEVELOPMENT

2. DCI PS1.B Chemical Reactions and CCC 2 Cause and Effect: Throughout the activity, students will observe the following: ice melts and becomes water, a liquid egg becomes a solid egg, butter melts and becomes a liquid, and paper browns. These are the noticeable changes brought about by heating the materials.

2. Review the results from Day 1.

Activity Page

AP 2.3.1

- Show students the materials from the freezer. Go through the materials one by one. Pass them around the classroom, or invite students up to the table to observe them.
- Have students record the characteristics of the materials in column 3 of the table on Activity Page 2.3.1. Then have them record whether the changes were reversible or not by circling "yes" or "no" in the final column of the table. (See **Know the Science 1**.) Discuss the results as a class.

NGSS Elements

SEP 7

Ask students How do you know that the changes were reversible or not reversible?

» The change is reversible if the material looks the same as it did before it was heated. If it does not look the same, then the change is not reversible.

- **Ask students if the evidence they cited is enough to prove that the changes were reversible or not reversible or whether additional evidence is needed.** If students say that additional evidence is needed, prompt them to share ideas for what kind of evidence they would want to see. (See **Know the Standards 3**.)
- Draw their attention to the predictions they made in the last class. See if any of the predictions were correct, and discuss.

Differentiation

EXTEND—If time permits, have students work in their groups to research whether or not heating other materials—such as glass, plastic, rock, or metal—can cause changes that are reversible or not reversible.

Know the Science

TEACHER DEVELOPMENT

1. Reversible or Irreversible: Students will be able to observe that liquid water becomes ice again after it is frozen and that the liquid butter becomes solid again but has a different shape than when it started. These materials have reversible changes. The cooked egg remains solid and cannot go back to being liquid again. This is an irreversible change. Paper that is scorched or has fully burned into ash cannot turn back into paper again. This is another irreversible change.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 7 Engaging in Argument from Evidence: In asking students how they know that the changes were reversible or not reversible, students are being asked to come up with the evidence to support their arguments. As students tell whether the changes were reversible or not reversible, they must draw upon the evidence that they collected to support their arguments. The evidence in this activity consists of their before and after observations and descriptions.

3. Preview the cooling investigation.

Activity Page

AP 2.3.2

- Tell students that now they will participate in an investigation where they cool materials and see if cooling them causes their properties to change. Then they will try to reverse those changes by warming the objects.
- Place students into pairs. Pass out the following materials to each pair:
  - quarter cup of water
  - plant leaf
- Distribute Cool It Down (AP 2.3.2). Review the steps together as a class. For this activity, students will work in pairs and will not need to come to the front of the class for a demonstration.

4. Facilitate the cooling investigation.

- Circulate around the room as students record their observations of the water and plant leaf. Encourage students to talk to each other about what they notice. Use question prompts if necessary, such as the following:
  - What do you see?
  - What does it feel like?
  - What color is it?
  - How big is it?
- Make sure students record the descriptions in column 1 of the table before any changes are made to the materials.

Differentiation

SUPPORT—Alternatively, allow students to draw pictures of the objects with as many details about them as possible.

NGSS Elements

CCC 2

- Once students have recorded their observations, collect the water and plant leaves from each group. Put them into the freezer. Tell students you will take them out during the next class session to see what kinds of changes happened.
- Elicit from students whether they think there will be any changes. Write their predictions on the board.

5. Reinforce understanding with additional examples.

Online Resources

- Show students a video about whether or not it is possible to "untoast" toast. See the Online Resources Guide for a link to the video:

  www.coreknowledge.org/cksci-online-resources

- After watching, have students turn to a neighbor and discuss what they saw. Prompt them to talk about why it is possible or not possible to "untoast" toast. **Ask students what they wonder about reversing changes to matter.**

1. Day 3: Refocus student attention

Can changes to matter caused by heating or cooling be reversed? Review with students what they did in the previous class session. Remind them that today they will see what happens when the water and leaf were cooled.

2. Review the results from Day 2.

Activity Page

AP 2.3.2

- Tell students to join their partners again, and pass out the cups of water and leaves from the freezer. Have students record the characteristics of the materials in column 2 of the table on Activity Page 2.3.2.
- Tell students that now they will try to reverse those changes by warming the ice and plant leaf back up.
- Ask a group to volunteer to share their ice and plant leaf with you. Warm the ice in a container that you set on the hot plate. Show students the melted ice (liquid water). Elicit a discussion about what they see. Repeat the same steps with the plant leaf.
- Have students record the characteristics of the materials in column 3 of the table on Activity Page 2.3.2. Then have them record whether the changes were reversible or not by circling "yes" or "no" in the final column of the table. (See **Know the Science 2** and **3**.) Discuss the results as a class.

NGSS Elements

SEP 7
Connection to
Life Science

Ask students How do you know that the changes were reversible or not reversible?

» The change is reversible if the material looks the same as it did before it was cooled. If it does not look the same, then the change is not reversible.

Know the Science

TEACHER DEVELOPMENT

2. Connection to Life Science: The plant leaves start out fresh and crisp when students observe them. Exposing leaves (non-evergreen) to freezing temperatures will damage their cell walls, thus damaging or killing the leaves. It will not be possible to reverse these changes, even once the leaves are thawed and warmed again.

3. Reversible or Irreversible: Students will observe that water becomes ice after it is frozen and that ice melts back into liquid water when it is heated. This is a reversible change. Students observe that after the plant leaf freezes, it does not come back to life or crisp back up. It will look wilted, faded, and soggy. This is an irreversible change.

- **Ask students if the evidence they cited is enough to prove that the changes were reversible or not reversible, or whether additional evidence is needed.** If students say that additional evidence is needed, prompt them to share ideas for what kind of evidence they would want to see. (See **Know the Standards 4**.)
- Draw their attention to the predictions they made in the last class. See if any of the predictions were correct and discuss.

CHALLENGE—Challenge students to talk about why a plant or plant leaf might die when it is completely frozen. Students can research different types of plants and talk about ones that are not acclimated to cold climates.

Differentiation

EXTEND—If time permits, have students work in their groups to research whether or not cooling other materials—such as glass, plastic, rock, or metal—can cause changes that are reversible or not reversible.

3. Read together: "Heating and Cooling Matter."

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.

Student Book

Ch. 6

Read Aloud Support

Ask students to turn to page 26 of the Student Book and look at the picture as you read aloud. Remind them that the title of this chapter is "Heating and Cooling Matter," and tell them to pay special attention to how properties of matter change because of heating or cooling as you read.

Know the Standards

TEACHER DEVELOPMENT

4. SEP 7 Engaging in Argument from Evidence: In asking students how they know that the changes were reversible or not reversible, students are being asked to come up with the evidence to support their arguments. As students tell whether a change was reversible or not reversible, they must draw upon the evidence that they collected to support their arguments. The evidence in this activity consists of their before and after observations and descriptions.

Page 26

Ask students to look at the picture on page 26. Explain that rain turns to snow when it is cold enough outside. The air temperature must be cold for it to snow.

CHAPTER 6

Heating and Cooling Matter

In the first part of the story, it was raining at Maya's house. Then it got colder. The rain started to turn to snow. A change in temperature caused this change. Temperature is a measure of how hot or cold something is. It snows when the temperature of the air is cold enough.

26

LITERAL—Which materials are solid?

» The tree, the car, the snow, the street, and the houses are solids.

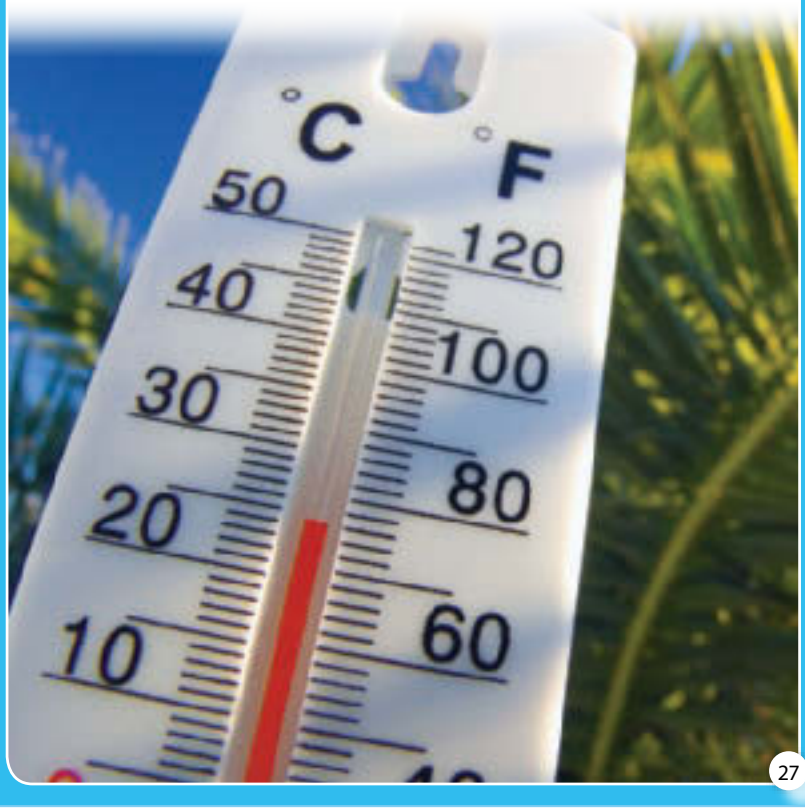
CORE VOCABULARY—Explain that a **temperature** is a measure of heat.

SUPPORT—Clarify for students that temperature is not a measurement that characterizes only how warm or hot something is. Temperature also tells how cold something is, like water or the air outside.

Page 27

Ask students to look at the picture on page 27. Explain that students used smaller thermometers. Emphasize that there are different kinds of thermometers. The one on the page is an analog thermometer. Go over the different parts of the thermometer that students see in the picture. The center is a glass tube that holds red liquid that moves up and down the tube with temperature changes. The white plate on this example displays marks on either side of the tube to tell the temperatures in different units.

Temperature is measured in degrees. You can measure it with a tool called a thermometer. This thermometer has two scales. One scale is degrees Celsius (°C). The other scale is degrees Fahrenheit (°F). What is the temperature in °F? What is the temperature in °C?



27

INFERENTIAL—Why might someone want to know the temperature?

» Someone might want to know how hot or cold it is outside. Someone might want to know how to dress for going outside. Someone might want to know what kinds of things they can do outside.

Page 28

Ask students to look at the three pictures on page 28. Remind students that they have observed melted ice cream already. Have students tell you what they recall from that observation. Go over each picture, one at a time. Talk about what is happening in each picture. (See **Know the Standards 5**.)

Making matter warmer or cooler causes changes to its properties. Warming can change matter from a solid to a liquid. Cooling can change matter from a liquid to a solid. Warming can change matter from a liquid to a gas.

28

NGSS Elements

CCC 2

SUPPORT—If necessary, remind students of the three states of matter: liquid, solid, and gas.

LITERAL—The icebergs in the second picture are frozen. They are solid water. What will happen to the icebergs if they become warmer?

» The icebergs will melt; they will turn back to liquid water.

Know the Standards

TEACHER DEVELOPMENT

5. CCC 2 Cause and Effect: Heating and cooling are factors that cause changes to matter. Students explore the cause-and-effect relationship between heating and cooling and changes to the properties of matter and build on this to understand whether or not those changes can be reversed.

INFERENTIAL—What is happening in the third picture? How is heat making a change?

» Heat is warming up the water. The water is turning into water vapor. It is going from a liquid to a gas.

Page 29

Now ask students to look at the three pictures on page 29. Have them draw upon their own experiences and observations from the investigation as they discuss what they see in the pictures.

Heating a solid can change it to a liquid. You can see this change when you melt butter in a pan.

Heating some liquids can change them to solids. You can see this change when you fry an egg or when you bake cake batter.

Heating a liquid can also change it to a gas. Steam above boiling water is a sign of this change.

29

Page 30

Have students look at the two pictures on page 30. Relate what they see in the first picture to the investigation they did with the cup of water in the freezer.

Changes happen when you cool matter, too. Cooling can change a liquid to a solid. You can see this change when you fill an ice cube tray with water. When you take it out of the freezer, the water is solid ice.

Icicles are solid water. They form when cold air changes the liquid water that drips from the roof.

30

LITERAL—What makes the water go from liquid to solid, like ice cubes and icicles?

» cooling the water

EVALUATIVE—Where else have you seen examples of this happening?

» at home in the freezer, outdoors during the winter

Page 31 **Ask students to look at the two pictures on page 31.**

Sometimes, changes are reversible. That means matter can go back and forth from one state to another. Heating can melt solid chocolate to a liquid. Cooling can change it back to solid chocolate again.

Sometimes changes cannot be reversed. A cooked pancake cannot be changed back to liquid batter.

31

Monitor Progress

CORE VOCABULARY—Explain that **reversible** means that something can go back and forth from one state to another. Have students recall what changes were reversible from the heating and cooling investigations.

4. Summarize and discuss.

- Bring the class together for a final discussion that summarizes their findings over the past three class periods. Begin with the materials that were heated. Have students describe to you the connection of reasoning behind the materials that were heated and had changes that could be reversed, as well as the reasoning behind the materials that could not be reversed. Then repeat this discussion with the materials that were cooled.
- Throughout the discussion, gauge student understanding of the investigations that they did and their ability to relate their observations to what they are reading about in Chapter 6.

Ask students, Do we want materials like ice cream to change because of the heat?

» no

- Emphasize that sometimes these changes caused by heating or cooling are unwanted. For instance, it isn't possible to drink frozen water. When paper gets so hot that it turns to ash and smoke, then the paper is no longer useful.

NGSS Elements

3D Learning

3D Learning: Students use evidence that they collected from their observations to make arguments about the fact that heating or cooling can make reversible or irreversible changes to a substance. They examine changes to conclude that temperature changes cause changes to the properties of matter.

5. Check for understanding.

Formative Assessment

Monitor Progress

- Remind students that the overarching phenomenon for this unit has to do with them being designers for a classroom container company.
- **Ask students to tell you why knowing whether changes caused by heating or cooling are reversible or not reversible is important when it comes to containers.**
- Make real-life connections for students. Ask students what kinds of things in their home or community could freeze or melt or be affected by temperature changes? Discuss common examples that they could relate to, such as wanting their food to stay hot but the food becomes cold because it is not stored in the proper container or wanting their water to stay cold on a hot day but the water gets warm if it is not in a proper container. Containers can help prevent unwanted changes to matter that are caused by outside conditions.
- Students should be able to connect what they learned about the changes caused by heating and cooling to everyday experiences involving containers. They have witnessed and observed how heating and cooling change materials and how sometimes those changes are not reversible. By now students should start to understand that if they don't want something, like ice or ice cream, to melt, they should keep it in a container that helps it stay cold, such as the freezer. Similarly, if they don't want something hot to become cold, it should be kept in a container that keeps the heat in well. (Students do not yet need to learn about the concept of insulation, which has to do with keeping warm things warm and cold things cold.)
- Emphasize for students that when people design containers, they usually must think about temperature.

Tie to the Anchoring Phenomenon

As students think about the connection between the changes caused by temperature and containers, they start to see that containers can help prevent unwanted temperature changes. These observations will help students answer the Big Question—**How are containers matched to the stuff they contain?**

LESSON 3

Properties and Uses of Matter

Overview

Guiding Question: How can we tell which materials have the properties that make them useful for certain jobs?

Lesson 3 Segments	Segment Questions	Advance Preparation
3.1 How Materials Hold Water (2 days) Students learn about the property of absorbency by participating in a group race in which they must use materials to absorb and move water from one container to another.	How can we move water from one place to another?	Gather materials for the race. See Materials and Equipment. Revisit Chapter 6 in the Student Book.
3.2 Lesson 3 Roundup: What Properties Make Materials Useful? (3 days) Students participate in a three-day investigation in which they rotate around various stations, testing the properties of different materials. For each station, students must identify the best material to use for the intended purpose of a scenario, based on the showcased property.	How can we tell which materials have the properties that make them useful for certain jobs?	Gather materials for student investigation. See Materials and Equipment.

What's the Story?

Summary: In Lesson 3 (Segments 1–2), students explore the different uses of matter. They learn and observe that different materials have properties that are better suited for some things but not others (2-PS1-2). The developing understanding of the properties and uses of matter in Lesson 3 prepares students for their work in Lesson 4, when they observe how different materials are made up of pieces and parts.

Learning Progression: Lesson 3 builds on student understandings about matter from Lessons 1 and 2: (2-PS1-1) *Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties;* (2-PS1-4) *Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.* Lesson 3 also builds toward the Grade 2 target of 2-PS1-3: *Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.*

Guiding Phenomenon: Matter can have different properties. Some properties are better suited for carrying out specific tasks. Containers are designed with an understanding of such properties, and manufacturers select and use certain materials based on their ability to best support the objects they will be containing (2-PS1-3).

Learning Objectives

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

- Define various properties of matter.
- Determine which materials have the properties that are best suited for an intended purpose.

NGSS Standards and Dimensions

Performance Expectation: 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
4 Analyzing and Interpreting Data Analyze data from tests of an object or tool to determine if it works as intended.	**PS1.A: Structure and Properties of Matter** Different properties are suited to different purposes.	**2 Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes.

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

How Materials Hold Water

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How can we tell which materials have the properties that make them useful for certain jobs?

Today's Question: How can we move water from one place to another?

Tie to the Anchoring Phenomenon: As students learn about absorbency, they build on their knowledge of properties of matter. Like the other properties, absorbency is an important property to understand when it comes to thinking about how containers work and why certain materials are better suited to be used for containers than others.

At a Glance

Learning Objectives

- ✓ Define *absorbency*.
- ✓ Classify materials as absorbent or not absorbent.

Instructional Activities (2 Days)

- student observation
- student investigation
- teacher Read Aloud

NGSS References

Performance Expectation: 2-PS1-2

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 2 Cause and Effect

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.

heating **matter** **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.

absorbency **absorption** **gas** **liquid**

solid

Instructional Resources

Student Book

Ch. 6

Student Book, Chapter 6
"Heating and Cooling Matter"

Activity Page

AP 3.1.1

Activity Page
Race to Move Water (AP 3.1.1)

Materials and Equipment

Teacher Demonstration

- bowl
- milk (1–2 cups)
- large rock

Race to Move Water

- paper towels (several sheets per student)
- containers (1 per group)
- water (4 cups per group)
- 2-cup graduated cylinders (1 per group)
- dry sponge, cut into 1-inch pieces (1 piece per group)
- cotton balls (1 per group)
- washcloths (1 per group)
- tissues (1 sheet per group)
- fabric (1 piece per group)
- wax paper (1 sheet per group)
- plastic toys (1 per group)
- pencils (1 per group)
- rubber erasers (1 per group)
- timer

Make Snow Globes

- small glass jars with lids (1 per group)
- glycerin (2–3 tablespoons per group)
- spoons (1 per group)
- glitter and sequins (2–3 tablespoons per group)
- plastic figurines (1–2 per group)
- hot glue gun (for teacher use)

Advance Preparation

Before class starts, pour the milk into the bowl for your demonstration.

For the race, you may want to line floors or surfaces with paper towels, towels, or a tarp since water may be spilled in the process.

The Core Lesson 3.1

1. Day 1: Introduce students to Lesson 3.

Ask a volunteer to state the Big Question that you'll be answering in this unit, which is posted somewhere in the room—**How are containers matched to the stuff they contain?**

Tell students that, before they can answer the unit's Big Question about matter and containers, they first need to understand more about the different properties of materials. In Lesson 3, they will learn about ways to measure different properties to apply their understanding to the Big Question. Write the Lesson 3 Guiding Question where students can see it:

How can we tell which materials have the properties that make them useful for certain jobs?

Tie to the Anchoring Phenomenon

As students learn how to test and measure different properties and materials, they build on their understanding of how some containers are better at holding certain types of materials than other containers are.

2. Focus student attention on the scenario.

Begin by telling the class that you spilled your cereal milk! You were about to make a big bowl of cereal for breakfast. You had your crunchy, yummy cereal, your banana slices to go on top, the bowl, and the spoon. Everything was ready, when—plop! You dropped the milk container, and the milk spilled on the counter.

So, you did what most people would do: you tried to clean up the spilled milk with a big rock.

- Stick the rock into the bowl of milk. Show students what happens. The milk moves in the bowl to make room for the rock.

Ask students Do you think the rock was able to help me clean up the spilled milk?

» no

Ask students How do you know?

» The milk moves in the bowl away from the rock. The rock cannot soak up the milk.

3. Turn and talk.

- Make a real-life connection. Have students turn to a classmate and talk about what they would do or use to clean up a spill like this.
- As they discuss, circulate around the room, and explain to students that they are discussing the property of absorbency. (See **Know the Science**.)

4. Preview the race to move water.

Activity Page

AP 3.1.1

- Place students in medium-sized groups of mixed ability. Distribute Race to Move Water (AP 3.1.1), and go over the instructions together. Student groups will have fifteen minutes to race against the other groups to see which group can move water from a container into the measuring bowl the fastest.
- Each group will be given a variety of materials to use. They can use whatever materials they want to move the water. They don't have to use the same material each time, although they can if they want to. Give students the following materials:
    - paper towels
    - container
    - 2 cups of water
    - 2-cup graduated cylinder
    - 1-inch piece of sponge
    - cotton ball
    - washcloth
    - fabric
    - tissue
    - wax paper
    - plastic toy
    - pencil
    - rubber eraser
- Students will try to soak up water from the bowl, carry it over to the measuring container, and then squeeze the water out. The measuring container will determine the winning group. The group that is able to move the most amount of water in fifteen minutes wins the race.

Know the Science

TEACHER DEVELOPMENT

Absorbency: Students are discussing the property of absorbency in this activity. Absorbency is the characteristic of soaking up a liquid. Things that are not absorbent cannot soak up liquids, whereas things that are absorbent can. Absorbency is an important property when studying containers, because containers often must be made from materials that are not absorbent. This way they do not soak up the matter inside them.

5. Conduct the race.

NGSS Elements

DCI PS1.A

Monitor Progress

Differentiation

Math Connection

- Set your timer for fifteen minutes. Circulate around the room, and provide assistance when necessary. (See **Know the Standards 1** and **2**.)

  SUPPORT—Some students may have physical limitations that prevent them from easily participating in this activity. Provide assistance to students as needed, or suggest the group select one or two members to do the physical moving and/or squeezing of the water.

  EXTEND—Conduct the same Race to Move Water activity, but have students record the amount of water that each material is able to absorb by squeezing the water out and writing down the number in milliliters from the graduated cylinder. Then, students can plot the data in a graph (Math Connection 2.MD.D.10).

- Refrain from telling students which materials are absorbent and which are not. At the end of the race, students will have an opportunity to discuss their findings. Then, they will conduct the race again, this time with a better understanding of what materials to use.
- Let students know when they have one minute left. Give students a final countdown of ten seconds before the timer goes off. Once the timer goes off, tell students to stop and not to squeeze any more water into the measuring container.

6. Record the findings.

- Prompt students to fill out Activity Page 3.1.1 individually, but allow them to discuss the answers in their groups.
- Have student groups sort the materials into two piles: one pile for absorbent materials and another for nonabsorbent materials.
- As students work on Activity Page 3.1.1 and as they sort their materials, circulate around the room, and record the measurements of water for each group on the board.
- Announce the winning group. **Ask that group to name the material that was the most absorbent and then name the one that was the least absorbent.**

Know the Standards

TEACHER DEVELOPMENT

1. DCI PS1.A Structure and Properties of Matter: As students carry out this activity, they will see that absorbency is a property of matter that is suited to carry out a specific purpose: soaking up liquid.

2. Monitor Progress: Gauge student understanding of the useful applications of absorbent versus nonabsorbent materials based on the data you collect from the graduated cylinders. If groups do not move a lot of water into the graduated cylinder, it may show that they had a difficult time understanding which materials to use based on the property of absorbing water. Groups that move more water likely demonstrate understanding of the behavior of absorbent material.

1. Day 2: Refocus student attention on the race results.

Differentiation

Remind students that in the previous class session they had a race to see who could move water the fastest.

- Hold a whole-class discussion. Ask students to look at their Activity Page 3.1.1 results and name the materials that are absorbent and the ones that are not absorbent. Make sure all students agree. (See **Know the Standards 3**.)

  CHALLENGE—Name a variety of other materials, such as brick, glass, metal, paper, polystyrene foam, and aluminum foil. Challenge students to say whether each is absorbent or not absorbent, based on what they observed from the activity from Day 1. (See **Know the Standards 4**.)

NGSS Elements

CCC 2

SEP 4

- Circle back to the scenario about the spilled cereal milk. (See **Know the Standards 5**.)

Ask students So which material should I have used to clean up the spilled milk?

» paper towels, sponges, washcloths

2. Read together: "Water Can Be a Solid, a Liquid, or a Gas."

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.

Know the Standards

TEACHER DEVELOPMENT

3. CCC 2 Cause and Effect: In the race activity, students were conducting a test to see which material(s) causes the most water to be absorbed. The absorbent materials include the sponge, cotton, washcloth, fabric, tissue, and paper towels. The nonabsorbent materials include the plastic toy, rubber eraser, wax paper, and pencil.

4. Differentiation: Prompt students to look for a pattern in the materials that are absorbent and the ones that are not. Then encourage students to apply what they know about absorbent materials to tell whether additional materials, such as brick, glass, metal, paper, polystyrene foam, and aluminum foil, are absorbent. Prompt students to notice properties, like texture, that the absorbent materials share.

5. SEP 4 Analyzing and Interpreting Data: Students use what they observed in the activity to answer the teacher's question about what material would work best for cleaning up the spilled milk. The answer of paper towels, washcloths, and sponges indicates that students understand how these materials are supposed to work and work as intended.

Student Book

Ch. 6

Read Aloud Support

Ask students to turn to page 32 of the Student Book and look at the picture as you read aloud. Remind them that the title of this chapter is "Heating and Cooling Matter," and tell them to pay special attention to the different states of water as you read the final two pages of the chapter.

Page 32

Ask students to look at the picture on page 32. Explain that the image shows water in two states of matter: solid and liquid. Remind students that they already know that heating and cooling can cause matter to change states. They learned about this in Lesson 2. Emphasize that water is one of the special types of matter that can change from one state to another due to temperature changes.

Water Can Be a Solid, a Liquid, or a Gas

Heating and cooling cause matter to change its state. Some matter changes states more easily than other matter. Water very easily changes among all three states. It changes and then can easily change back again.

32

Page 33

Ask students to look at the two pictures on page 33. Explain that the canal water is usually liquid but that the cold temperatures froze the water and turned it to a solid. Then explain that when the water gets warmer, it will melt. The water will become liquid water again, like shown in the image of the river with the people fishing.

When liquid water is heated, it changes to a gas called water vapor. When liquid water cools, it becomes a solid—ice. Ice changes back to liquid water when heat is added again.

This canal is ice now. In warmer temperatures, it will change to liquid water.

This river is liquid now. In colder temperatures it will change to solid ice.

33

SUPPORT—Remind students that a solid is matter that holds its shape and size without a container. A liquid is matter that takes the shape of the container it is in. A gas is a type of matter that takes up the whole container it is in. Containers gases are in need to be properly sealed so the gases will stay in the container. Liquids and gases take the shape of their containers.

Monitor Progress

SUPPORT—As students consider these pages, check to make sure that they are building on what they learned in Lessons 1 and 2. Students should understand that water can exist as a liquid, solid, or gas and that the changes to the states of water can be reversed with heating and cooling. Check student understanding of the word *reversible*. **Ask students if they think ice needs to be kept in the same container as liquid water.**

» No. Liquid water needs a container to hold it. Ice is a solid, so it can keep its shape. It doesn't need a container. But it does need a container if the temperature gets warmer and the ice starts to melt.

LITERAL—What does it mean if a change is reversible?

» It means something can change back to how it was before.

EVALUATIVE—What type of container do you think you should use for water in solid and liquid states?

» I think a solid container should be used for liquid water but a soft plastic bag can be used to hold ice.

3. Support the investigation.

Tie to the Anchoring Phenomenon

Students learned about liquid water in Chapter 6. They also talked about containers that water can be stored in. Now they will make snow globes. A snow globe is a type of container. It holds water and other decorative materials. In this hands-on activity, students will see how a certain type of container (glass) has properties that makes it work well for holding water.

- Place students in small groups. Pass out the following materials to each group:
  - small glass jar with lid
  - 2 cups water
  - glycerin
  - spoon
  - glitter and sequins
  - plastic figurines
- Tell students the following steps to make their snow globes:
  1. With the teacher's help, glue the figurine to the inside of the jar's lid.
  2. Add cold water to the jar (almost to the top).
  3. Add a couple spoonfuls of glitter and sequins.
  4. Use the spoon to stir it all together.
  5. Add a couple spoonfuls of glycerin.
  6. Stir the liquid in the jar again.
  7. Screw the lid onto the jar.
- Once students are done, have them shake the jar and turn it upside down to watch the glitter and sequins move around the plastic figurine.

4. Guide discussion.

- **Ask students why the glass jar is a good container for their snow globes.** Prompt them to consider the properties of the glass jar. Students should be able to identify that the water and glycerin (liquids) are well contained inside the glass jar. They may observe that the liquids do not leak out. They are kept in the container.
- **Ask students** What properties does the glass jar have that make it a good choice to use as a snow globe?
  - » The jar is hard; the jar is see-through; the jar does not let the liquid leak out.

5. Check for understanding.

Formative Assessment

Monitor Progress

It is more important for students to understand the concept of absorbency and which materials are absorbent than for them to win the race to move a lot of water. Focus on how students have progressed throughout the class session and whether they grasp this everyday concept of absorbent materials.

Have students summarize what they have learned about absorbency and containers for liquids.

Review student responses to Race to Move Water (AP 3.1.1), and use their responses during the discussion about the snow globes activity to determine student understanding of the following concepts:

- Absorbency is a property of some materials.
- Some materials are more absorbent than others.
- Not all materials can absorb liquid.
- Some materials make better containers for liquid than others.

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

Tie to the Anchoring Phenomenon

Absorbency is an important property when it comes to designing, building, and using containers. Students will use the information they learn about absorbency and apply it to the properties of materials that containers are made of, thus helping them answer the Big Question—**How are containers matched to the stuff they contain?**

LESSON 3.2

Lesson 3 Roundup: What Properties Make Materials Useful?

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How can we tell which materials have the properties that make them useful for certain jobs?

Today's Question: How can we tell which materials have the properties that make them useful for certain jobs?

Tie to the Anchoring Phenomenon: Students participate in multiple investigations at different stations in which they will test various properties to determine which materials are best suited for specific purposes.

At a Glance

Learning Objectives

- ✓ Identify the materials with properties best suited for intended purposes.
- ✓ Record and analyze data to compare properties of matter.

Instructional Activities (3 Days)

- student investigation
- class discussion
- data collection

NGSS References

Performance Expectation: 2-PS1-2

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 4 Analyzing and Interpreting Data

Crosscutting Concept: 2 Cause and Effect

Students participate in a three-day investigation in which they rotate around various stations, testing the properties of different materials. For each station, students must identify the best material to use for the intended purpose of a scenario, based on the showcased property.

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.

flexible **hardness** **porous** **strength**

texture

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 **evidence** **thermal conductivity**

Instructional Resources

Activity Pages

AP 3.2.1
AP 3.2.2
AP 3.2.3
AP 3.2.4
AP 3.2.5
AP 3.2.6

Activity Pages

How Porous Am I? (AP 3.2.1)
100-Gram Challenge (AP 3.2.2)
Can It Crack the Candy? (AP 3.2.3)
How Strong Am I? (AP 3.2.4)
Which Texture Is Best? (AP 3.2.5)
Let's Heat It Up! (AP 3.2.6)

Materials and Equipment

Station 1, How Porous Am I?:

- container with 4" opening (1 per group)
- construction paper (1 5-inch square per group)
- cardstock (1 5-inch square per group)
- cloth (1 5-inch square per group)
- plexiglass (1 sheet per group)
- paper towels (1 sheet per group)
- shallow pans (1 per group)
- containers to pour water from (1 per group)
- water

Station 2, 100-Gram Challenge:

- plastic rulers, 12" (1 per group)
- chenille stems (1 per group)

Station 2, *continued*

- cardstock strips (1 per group)
- rope (1 6-inch piece per group)
- fabric measuring tapes (1 per group)
- 100-g weights (1 per group)
- heavy-duty tape
- thread

Station 3, Can It Crack the Candy?:

- modeling clay (1 package)
- sponges (1 per group)
- rocks (2–3 per group)
- rubber erasers (1 per group)
- large candy jawbreakers (several per group)

Station 4, How Strong Am I?:

- pennies or washers (100 per station)
- wooden blocks (2 per station)
- tape to secure testing materials to blocks
- construction paper (1 sheet per group)
- fabric dish towels (1 per station)
- plexiglass (1 sheet per station)

Station 5, Which Texture Is Best?:

- plastic or wooden block
- masking tape
- tray
- plastic ruler, 12" (1 per group)
- sandpaper (1 sheet)
- plexiglass or other glossy plastic (1 sheet)
- construction paper (1 sheet)
- velvet square or other soft material

Station 6, Let's Heat It Up!:

- wooden spoons (1 per station)
- plastic spoons (1 per station)
- metal spoons (1 per station)
- butter
- craft beads (3 per station)
- hot plate
- kettle or pot
- water
- cereal bowl
- plastic knife

Advance Preparation

- This investigation spans three classroom days. Set up or rearrange the classroom for students to be able to rotate in groups around six different stations. Label the stations as follows:

  Station 1: Porosity

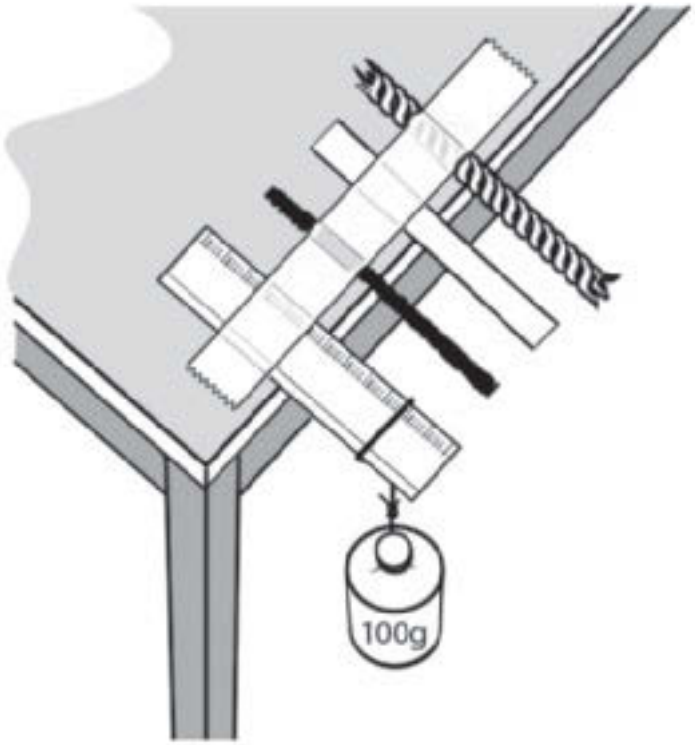
  Station 2: Flexibility

  Station 3: Hardness

  Station 4: Strength

  Station 5: Texture

  Station 6: Heat Transfer
- For the pieces of cardboard or cardstock at Station 1, consider cutting up a cardboard box or shoebox.
- For Station 1, the materials the students test for porosity need to be large enough to cover the mouth of the container.
- For Station 2, cut the rope into 6-inch pieces. Tape the plastic ruler, chenille stem, cardstock strip, and rope to the edge of the table so that most of the object sticks out over the table an equal length. Tie the thread through the 100 gram weight, making a loop at one end. Students will put the loop around each material on the table to see how much the object bends from the weight. See the following picture:



- At Station 4, the construction paper and fabric will need to be secured to the blocks using the tape.
- At Station 5, the materials to be tested can be secured to the tray so they all sit on the same rigid platform.
- At Station 6, have water in the kettle or pot, ready to boil. Keep the butter chilled so it does not melt too easily when first put on the spoons. Keep the hot plate away from flammable objects.

The Core Lesson 3.2

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

How can we tell which materials have the properties that make them useful for certain jobs? Students learned about absorbency in the previous class session. Hold a quick discussion to call on prior knowledge. **Ask students to tell which materials are absorbent and which materials are not.**

2. Preview the investigation.

NGSS Elements

3D Learning

3D Learning: Students investigate different materials, make observations, and record data obtained from their tests to determine which materials have the properties that are best suited for an intended purpose. They analyze data from their tests to see whether a material works as intended, based on different properties of matter, and use evidence to support or refute ideas about the best-suited materials.

- Tell students that over the next three days, they are going to rotate—in groups—around six stations. Each station will give them a chance to investigate a new property of matter. After all groups complete their investigations at a station, they will move to the next station. This will continue until all groups have been to all six stations. Groups should be able to complete two or three stations per day.
- Preview the stations with students. Introduce the property for each station. Give students a brief explanation of the meaning of the properties.
- Show students the materials they will be using. Review the Activity Page for that station. Give students a general idea of what they will do for their investigations, but remind them that you will go around to the different groups to assist as they carry out their investigations. Students can also find the steps to the investigations on the Activity Pages.

Tie to the Anchoring Phenomenon

At each station, students will read a scenario about designing a container. They will need to identify the best material to use for the container, based on the tests they perform and the data they collect.

3. Support the investigation.

- Place students in six groups of mixed ability. Start each group out at a different station.
- Have the Activity Pages available for students at each station, or pass them out as students arrive at their stations.
- Use the following teaching points and support for the six stations:

Station 1: Porosity

Activity Page

AP 3.2.1

Tie to the Anchoring Phenomenon

Porosity is a property that can be helpful or harmful when it comes to making containers. A porous container could cause matter, such as liquid, to leak out of it. Students will investigate how porous materials are not as good as nonporous materials when it comes to making certain kinds of containers.

- Distribute How Porous Am I? (AP 3.2.1) to the students at Station 1. Go over the scenario with them. Tell students that their job is to act as designers for a container company. Right now, they test a lot of different materials to see which one would make the best material for a cup to place liquid in for drinking.

- Remind students of the meaning of *porosity*. (See **Know the Science 1**.)

Differentiation

- Students will test one material at a time at the station. A student will place the container in the middle of the shallow pan. Another student will place the first material on top of the container that is in the shallow pan. The pan will collect any water that spills over. With the student lightly holding the material in place, another student will slowly pour water on the material. The student should try to pour the water over the area where the material is on the container. (See **Know the Standards 1** and **2**.)

NGSS Elements

DCI PS1.A

Monitor Progress

- Draw student attention to the table on Activity Page 3.2.1. After waiting at least three minutes and observing if the water goes through the material and into the container, students will mark the table.

  SUPPORT—For students without strong fine motor skills and who might pour the water too quickly, have a large dropper filled with water for them to use.

Math Connection

- Students write the names of the materials that are porous and not porous on the bottom of Activity Page 3.2.1. (See **Know the Standards 3**.)
- Emphasize to students that they must pour the water from the container back into their starting containers before testing each new material.
- Remind students to slowly pour the water on the material.
- **Ask students if materials that are more porous or less porous would make a good container for liquids.**

Know the Science

TEACHER DEVELOPMENT

1. Porosity: Porosity is the measure of how much a material will allow a gas or liquid to go through its surface. Paper, sponges, and cardboard are examples of porous materials. Glass, plastics, and metals are examples of nonporous materials. Porous materials allow liquids and gases to flow through them more easily. Nonporous materials keep liquids and gases in place.

Know the Standards

TEACHER DEVELOPMENT

1. Differentiation: Station 1 calls for the investigation of five materials. However, some groups may have a better time only investigating two or three materials. If limiting the materials, make sure one of those materials is the sheet of plexiglass, as this is the object that is the least porous.

2. DCI PS1.A Structure and Properties of Matter: As students carry out this activity, they will see that porosity is a property of matter that can determine whether or not a material is well suited to hold liquid and serve as a cup.

3. Monitor Progress: You will be able to gauge student understanding of porous and nonporous materials by observing students' reactions to the materials they are working with. Glance at their data tables to see what the results of their tests show to make sure they are on the right track.

Station 2: Flexibility

Activity Page

AP 3.2.2

Tie to the Anchoring Phenomenon

Flexibility is a property that can be good for some types of containers. Flexibility is good for keeping certain materials from breaking. But flexibility is not good for keeping objects firmly in place. Students will identify which material(s) is best suited for a particular purpose. (See **Know the Standards 4**.)

NGSS Elements

DCI PS1.A Connection to Engineering

- Distribute 100-Gram Challenge (AP 3.2.2) to the students at Station 2. Go over the scenario with them. Explain that they must design a packing container that will keep delicate objects from breaking. Their job is to find the best material that will bend a little with the delicate objects but will not break or cause the weight to fall off.
- Tell students that flexibility is a property of matter. (See **Know the Science 2** and **3**.)
- Show students how to loop the thread around the end of the materials and let the weight dangle. Students should use the fabric measuring tape to measure how much the material bends. They will record these data in the table on Activity Page 3.2.2.
- Advise students to refrain from trying to break any of the objects. If the objects do not give way, discourage students from pushing the object to the point of breakage. Let students know that objects that are not flexible are rigid. Rigid objects cannot bend, or they will break. For instance, glass is rigid. It will not bend when moved around.

Know the Standards

TEACHER DEVELOPMENT

4. DCI PS1.A Structure and Properties of Matter: Students observe the property of flexibility by examining a variety of different objects. They will see that the objects can bend and give without breaking, which is a desirable quality for some containers.

Know the Science

TEACHER DEVELOPMENT

2. Flexibility: Flexibility is the measure of how much a material can bend without breaking. In Grade 2, students do not need to know how to measure the flexibility of materials, and this is not an assessment requirement. However, they should be familiar enough with the meaning of the property so they can identify materials that are more flexible than others.

3. Engineering: In materials engineering, engineers work with something called a yield point. A yield point refers to the stress that is applied to an elastic material above which more stress will cause the material to lose its elasticity. Stress above a yield point can cause an object to become permanently deformed. Flexibility is different from yield points, but the property of flexibility can be studied and expanded on by engineers who need to identify the breaking points of certain materials.

Differentiation

SUPPORT—Help students read a fabric measuring tape. Explain that the measuring tape is read in inches and the smaller parts that make up the inch, such as $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, and so on. (See **Know the Standards 5**.)

CHALLENGE—Challenge students to come up with a list of other materials that are flexible and would possibly withstand the 100-gram challenge.

EXTEND—Have students research and explain the difference between flexibility and elasticity and give an example of an object that is both elastic and flexible. Elasticity has to do with how much a material is able to bounce back after being stretched. Rubber bands are both elastic and flexible.

Station 3: Hardness

Activity Page

AP 3.2.3

Tie to the Anchoring Phenomenon

Hardness is a property that is good for supporting objects. Hardness can be either a desirable property or an undesirable property when it comes to containers.

- Distribute Can It Crack the Candy? (AP 3.2.3) to the students at Station 3. Go over the scenario with them. Explain that they must design a container to carry eggs. The container must be sturdy but soft enough to protect the eggs, since eggs are delicate and their shells can crack easily.
- Make sure students understand that hardness is not the same thing as strength, which will be investigated at another station. (See **Know the Science 4**.)

Know the Standards

TEACHER DEVELOPMENT

5. Differentiation: Make sure students understand the difference between flexibility and other properties of matter. They have already looked at properties of matter such as size, color, shape, and so on, but flexibility is a property that needs to be tested, as it cannot only be visually observed.

Know the Science

TEACHER DEVELOPMENT

4. Hardness and Strength: Hardness and strength are not the same. Hardness has to do with the resistance of a material to abrasion or indentation. The hardness of an object can be determined by a scratch test. Strength has to do with the ability of an object to hold up a load that is added onto it.

NGSS Elements

CCC 2

- Encourage students to observe the materials at their station. Suggest that they touch them, move them around, and look at them. They will use each object to try to crack the jawbreaker candy. The object that cracks open the candy is the hardest material out of the bunch. Encourage each student to try using each object to crack the candy so students get to experience all the materials. (See **Know the Standards 6**.)

Station 4: Strength

Activity Page

AP 3.2.4

Tie to the Anchoring Phenomenon

Strength is a property that is good for building materials but can also be good for containers, especially if large cargo containers need to be stacked on top of each other. Students will investigate the strength of different objects to see which would be best suited for an intended purpose.

NGSS Elements

Connection to Engineering

- Distribute How Strong Am I? (AP 3.2.4) to the students at Station 4. Go over the scenario with them. Explain that they are testing the strength of different materials. They must figure out which material is best suited to use for a coin bank that holds a lot of coins.
- Students have likely heard of the words *strong* and *strength* before in everyday language. Clarify the meaning of *strong* for students in the context of science. (See below **Know the Science 5** and **6**.)

Know the Standards

TEACHER DEVELOPMENT

6. CCC 2 Cause and Effect: Objects that are hard can cause objects that are less hard to crack or break. Students will observe that the hardest object (the rock) causes the candy to break. But the other objects, which are much softer, will not have the same effect on the candy. The softer objects provide more protection to delicate items, like eggs.

Know the Science

TEACHER DEVELOPMENT

5. Strength: Strength has to do with the amount of force that is needed to break a material. Strong objects can hold up heavy loads. They can withstand a lot of pressure either pushing or pulling down on them. Engineers are often concerned with the strength of objects, because certain materials need to be able to withstand a certain amount of pressure being exerted on them for them to function as intended.

6. Engineering: Engineers are often concerned with the strength of objects. When designing things such as buildings, elevators, or tunnels, they must test materials to make sure they are strong enough to hold heavy loads, withstand stress, and endure pressure from various angles and points. Engineers then identify weak points in the materials and figure out ways to fix them. Sometimes, they must use different materials for their projects altogether.

- Begin with a quick conversation about what it means to be strong or to have strength. **Ask students to give you examples of things that are strong in their homes, at school, or in the community.** For instance, a bridge is strong. It can hold up a lot of cars on it.
- Students will test the strength of different materials by placing pennies (or washers) onto the materials. They will observe which material holds the most pennies without bending or breaking. (See **Know the Standards 7**.)
- Remind students to only add one penny onto the material at a time.

NGSS Elements

SEP 4

Differentiation

SUPPORT—If necessary, limit the investigation to only two materials: the construction paper and the plexiglass. For students who may not be able to place the pennies softly on the materials, have the students watch a teacher demonstration.

Station 5: Texture

Activity Page

AP 3.2.5

Tie to the Anchoring Phenomenon

Texture is a property of matter. Rough textures can be good for keeping objects in place inside containers. Smooth textures may cause objects to move around inside containers. Students will investigate the texture of different materials to see which would be best suited for an intended purpose.

- Distribute Which Texture Is Best? (AP 3.2.5) to the students at Station 5. Go over the scenario with them. Explain that they need to decide which material has the best texture for keeping a plastic block in place inside a container.
- Give examples of different textures, such as smooth, rough, sticky, slimy, and fuzzy.
- In this station, students place the plastic block onto each material, one at a time. When the plastic block is on the material, lift the tray slowly until the plastic block starts to move. The sandpaper will hold the plastic block in place the best. The plastic block will slide around on the other materials. Students should determine that the sandpaper works best for the intended purpose.

Differentiation

SUPPORT—Alternatively, do a teacher-guided demonstration discussing the movement of the block on each material. (See **Know the Standards 8**.)

Know the Standards

TEACHER DEVELOPMENT

7. SEP 4 Analyzing and Interpreting Data: Students use the data they collect on the number of pennies that the materials can hold to determine which material would make the best coin bank. Materials that were not able to hold the most pennies are the weaker materials.

8. Differentiation: The texture investigation at Station 5 relies more on observation and less on the collection of data or units of measure. If students have a difficult time describing what they saw, drawing pictures can be an alternative to help students communicate what they noticed about the materials.

Station 6: Heat Transfer

Tie to the Anchoring Phenomenon

Activity Page

AP 3.2.6

Thermal conductivity is a property of matter. The ability to transfer heat can be good for keeping objects warm or cold inside containers. Students will investigate the thermal conductivity of different materials to see which would be best suited for an intended purpose.

- Distribute Let's Heat It Up! (AP 3.2.6) to the students at Station 6. Go over the scenario with them. Explain that they need to find the material that would make the best type of bowl for keeping food hot.
- Make sure students understand the basic concept of thermal conductivity. (See **Know the Science 7**.) If necessary, use everyday examples of thermal conductivity that students would be familiar with, such as cooking with pots and pans on the stove.
- When setting up the spoons, make sure the bowl of each spoon sits outside the edge of the cereal bowl. This ensures that heat from the water melts the butter due to conductivity through the spoons rather than by convection as the heat from the boiling water rises toward the bowls of the spoons. The spoons can also be secured to the sides of the cereal bowl so they don't move around as water is added to the cereal bowl.
- Assist students by filling the kettle or pot with water. Place it on the hot plate, and bring the water to a boil. After it boils, pour the water into the bowl, being careful to not let the water disturb the spoons too much.

Differentiation

CHALLENGE—Challenge students to think about where they see examples of thermal conductivity in their community. For example, radiators conduct heat. Some people use heating pads, which conducts heat to the parts of our bodies that touch the pads. Roasting marshmallows over a campfire with a wire utensil can cause the utensil to become very hot and heat up your hand! (See **Know the Standards 9**.)

Know the Science

TEACHER DEVELOPMENT

7. Thermal Conductivity: Thermal conductivity has to do with how heat transfers through an object. Some materials have a lower or higher thermal conductivity than others. Metal has a high degree of thermal conductivity. In this investigation, students will find that the metal spoon works best for conducting heat from the bowl to the craft bead on the tip of the spoon.

Know the Standards

TEACHER DEVELOPMENT

9. Differentiation: Properties of matter exist in everyday life. It is a good idea to challenge students to identify where they see various properties being used for specific purposes. For instance, cardboard is sturdy and makes a good material for packing boxes. Ceramic, on the other hand, would not make a good material for packing boxes. But ceramic makes a good material for things like dishware and vases.

EXTEND—Have students do an investigation at home with adult supervision. The adult can help them handle and pour hot water (or tea, hot chocolate, soup) into different bowls (ceramic, plastic, glass, and metal) and see which bowl heats up the fastest.

1. Day 2: Refocus student attention.

Remind students of the question they are exploring—**How can we tell which materials have the properties that make them useful for certain jobs?**

Review which investigations students did at the different stations on Day 1.

2. Continue the investigations.

- Student groups will continue conducting their investigations on Day 2.
- Continue to circulate around the room and provide support at the different stations. Use the prompts and suggestions from Day 1. Make sure students follow the steps correctly, handle the objects properly, and are clear on where to record their findings.

1. Day 3: Refocus student attention.

Remind students of the question they are exploring—**How can we tell which materials have the properties that make them useful for certain jobs?**

Review which investigations students did at the different stations on Day 2. By now, students should have had a chance to complete all six investigations. If there are any more stations for students to visit, have them finish up those investigations at the beginning of class.

2. Check for understanding.

Formative Assessment

Hold a whole-class discussion about what students noticed at the stations. Talk about each of the stations, one at a time. Alternatively, assign each group a different station to talk about. That group can help lead the discussion about the findings from that station and address the questions that follow.

Use the following discussion points:

NGSS Elements

SEP 4

CCC 2

Station 1: Porosity

- Discuss some of the effects of water on the materials. **Ask students what caused the construction paper to become very wet and flimsy and fall apart. Then ask them why water did not have the same effect on the plexiglass.**

- **Ask students which material was the most porous.** (See **Know the Science 8**.) Have them tell you how they know which material was the most porous or the least porous.
- Invite groups to share the data they collected. **Ask groups to tell you which materials had more water go through them than others.** Record the answers on the board so students can start to see that some materials are more porous than others. After all the groups have had a chance to share their data, **ask students which material they recommend the container company to use to build a cup.** (See **Know the Standards 10**.)

Monitor Progress

- As you discuss the results of the porosity tests, listen for student responses, and determine student understanding of the following concepts:
  - Porosity has to do with how easily liquid can flow through a material.
  - Some materials are porous, and some are not. Some are more porous than others.
  - Paper, fabric, and cardstock are examples of materials that are porous.
  - Plexiglass is an example of a material that is not porous.
  - Porous materials would make bad cups for holding liquid. This is because the liquid would leak. Nonporous materials make better cups for holding liquid.

NGSS Elements

DCI PS1.A

Station 2: Flexibility

- **Ask students which material would be best suited for protecting a delicate object.**
  - » the plastic ruler
- Discuss how students know which material was the most flexible. Invite groups to share the data they collected.

Know the Science

TEACHER DEVELOPMENT

8. Porous and Nonporous Materials: The porous materials used in this activity include the paper, fabric/cloth, and cardstock. The nonporous material was the plexiglass. Students should be able to tell you which material was the most porous, because that would be the material that the water did go through. The material that was the least porous (the plexiglass) would not have water go through it. This is because nonporous materials can hold liquids better than porous materials.

Know the Standards

TEACHER DEVELOPMENT

10. SEP 4 Analyzing and Interpreting Data: Students use the observations of which materials had water go through them to determine the most porous and the least porous materials. From this, they can determine that the porous materials do not work as intended (as a cup) but that the nonporous materials do work as intended (would serve well as a material for a cup).

Monitor Progress

- As you discuss the results of the flexibility tests, listen for student responses, and determine student understanding of the following concepts:
  - Flexibility has to do with how easily an object bends without breaking.
  - Some materials make good containers because they bend very little.
  - Rigid materials do not give or bend and can be bad for storing delicate objects.
  - The plastic ruler was not the most flexible material that students investigated at Station 2. But it was the best option for protecting a delicate object. (See **Know the Standards 11**.)

Station 3: Hardness

- Discuss some of the effects that the objects had on the candy.
- **Ask students** Which object was the hardest? How do you know?
  - » The rock was the hardest. We know because it could crack the hard candy.
- Take a classroom poll of which material had the property best suited for the egg container. Record the votes on the board, and discuss the answers.
- Talk about what the other materials might be good for (the eraser, sponge, and modeling clay). Prompt students to think about those objects and the properties they have. For instance, the sponge is porous and can absorb water. So, what might a sponge be best used for? Or the modeling clay is flexible and soft. So, what might the modeling clay be best used for?

Monitor Progress

- As you discuss the results of the hardness tests, listen for student responses, and determine student understanding of the following concepts:
  - Hardness has to do with how well a material can resist being damaged or dented. Make sure students do not confuse this with strength.
  - Some materials are hard, and others are not.
  - The rock is hard. The eraser is not as hard. The sponge and modeling clay are not hard.

Know the Standards

TEACHER DEVELOPMENT

11. DCI PS1.A Structure and Properties of Matter: Students understand that different properties are suited to different purposes. Some of the materials they investigated were very flexible, such as the chenille stems. Others were less flexible. The idea here is not to identify the most flexible object, but to identify the object with the properties that are best suited for the given purpose. In this case, the plastic ruler is the best material, because it had a little bit of bend in it but was not so flexible that it would be unable to support a delicate object.

Station 4: Strength

NGSS Elements

CCC 2

- Discuss with students the results of the penny test. They should tell you that the plexiglass was able to hold the most pennies. **Ask students to tell you what happened when the pennies were added to the construction paper and the fabric.** Students should say that the construction paper broke and the fabric gave way and could not keep its shape. (See **Know the Standards 12**.)
- **Ask students which material would be best suited for making a coin bank that holds a lot of coins.**
  - » the plexiglass
- Hold a brief discussion about the intended uses for things that are not strong. For instance, cotton is not strong, but it is good for some things (clothing, pillowcases). Foil is not strong, but it is good for covering food. Focus on examples that students would see in their everyday lives.
- As you discuss the results of the strength tests, listen for student responses, and determine student understanding of the following concepts:
  - Strength has to do with how well a material can withstand a lot of pressure, load, or force being pushed down onto it (or pulling it down).

Monitor Progress

  - Some materials are strong, and others are not.
  - Strong materials are best suited for certain things, and materials that are not strong are good for other types of things.

Station 5: Texture

NGSS Elements

CCC 2

- Discuss with students the results of the texture test.
- **Ask students to describe the relationship between rough textures and their intended uses.**
  - » Rough textures can keep things in place better than smooth textures.
- Talk about real-life examples of textures being used for an intended purpose. For instance, things that are smooth can be good for sliding on. Ice-skating rinks are smooth. This lets ice skaters glide on the ice. If ice-skating rinks were

Know the Standards

TEACHER DEVELOPMENT

12. CCC 2 Cause and Effect: The weight of the pennies caused the construction paper to break or tear. This means that the construction paper has a low amount of strength compared to the other materials. The fabric held the pennies, but the weight of the pennies caused the fabric to give way and change its shape. Therefore, the fabric could not support the load. The plexiglass kept its shape and supported the pennies.

rough, skaters would not be able to glide or skate. (See **Know the Standards 13** and **14**).

- **Ask students what they noticed about the rough texture holding the plastic in place.**
  - » The plastic block did not move around as much. The plastic block was held in place better.

Monitor Progress

- As you discuss the results of the texture tests, listen for student responses, and determine student understanding of the following concepts:
  - Texture has to do with how something feels, such as if it is smooth or rough.
  - The sandpaper had the roughest texture. It was the best for holding the plastic block in place.

Station 6: Heat Transfer

NGSS Elements

DCI PS1.A

- Discuss with students the results of the thermal conductivity test.
- **Ask students which spoon conducted the most heat. Then ask how they know.**
  - » the metal spoon, because the bead slipped down the spoon first
- **Ask students which material has the properties best suited for cooling off a bowl of hot soup.**
  - » metal

Monitor Progress

- As you discuss the results of the thermal conductivity test, listen for student responses, and determine student understanding of the following concepts:
  - Thermal conductivity has to do with how heat is moved through objects.
  - The metal spoon had the most thermal conductivity.
  - Metal would make the best material to cool off a bowl of hot soup. (See **Know the Standards 15**.)

Know the Standards

TEACHER DEVELOPMENT

13. CCC 2 Cause and Effect: Students identify a cause-and-effect relationship between the texture and the plastic block. Certain textures cause the plastic block to slide around. Other textures (rough textures) are better at keeping the plastic block in place.

14. Texture and Friction: The idea that a rough texture is better at keeping certain materials in place is an introduction to the concept of forces, particularly friction. The friction between the rough surface and the object is what helps keep the object in place. Smooth surfaces have less friction than rough ones. These are very intuitive concepts. However, it is not necessary at this grade level to explicitly introduce students to friction.

15. DCI PS1.A Structure and Properties of Matter: Some materials have properties that allow them to conduct heat better than others. In this investigation, students find that metal is the material that is better for conducting heat than plastic or wood. Students can use what they notice in the investigation to conclude that metal would allow heat to reduce faster in soup.

LESSON 4

Building from Component Parts

Overview

Guiding Question: How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?

Lesson 4 Segments	Segment Questions	Advance Preparation
4.1 Pieces and Parts Students learn that objects are made up of smaller pieces and parts by doing an activity with paper shapes and then participating in a scavenger hunt around the classroom.	What are the pieces and parts that make up objects?	Gather materials for student investigation. See Materials and Equipment.
4.2 What Are the Parts of a Ballpoint Pen? (2 days) Students investigate the inner and outer parts of a ballpoint pen. They learn that parts must be made of materials that have properties that make the pen work.	How do the parts of a pen work together?	Gather materials for student investigation. See Materials and Equipment. Read Chapter 7 in the Student Book.
4.3 Lesson 4 Roundup: Build It Up, Take It Down Students participate in a group investigation where they build an object using plastic blocks, disassemble the object, and make a new object using the same pieces.	How can we make new objects out of the pieces from something else?	Gather materials for student investigation. See Materials and Equipment.

What's the Story?

Summary: In Lesson 4 (Segments 1–3), students explore how objects are made up of smaller parts. They learn and observe that objects can be made of smaller parts, disassembled, and then reassembled into new objects using the same parts (2-PS1-3).

Learning Progression: Lesson 4 builds on student understanding about matter from Lessons 1, 2, and 3: (2-PS1-1) *Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties;* (2-PS1-4) *Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot;* (2-PS1-2) *Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

Guiding Phenomenon: Objects are made up of smaller parts. Those objects can be taken apart and rebuilt using the same parts to make new objects. The new objects can have different characteristics, including different shapes, even though they are made using the same components (2-PS1-3).

Learning Objectives

By the end of Lesson 4, students will do the following:

- Identify the components that make up objects.
- Explain that parts of things have properties that make them useful.
- Describe how objects can be built up, torn down, and reassembled using the same parts.

NGSS Standards and Dimensions

Performance Expectation: 2-PS1-3 Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
6 Constructing Explanations and Designing Solutions Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.	**PS1.A Structure and Properties of Matter** Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces.	**5 Energy and Matter** Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

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

Pieces and Parts

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?

Today's Question: What are the pieces and parts that make up objects?

Tie to the Anchoring Phenomenon: Students learn that they can make something big out of small pieces and parts. This segment serves as an introduction to students learning how materials, based on favorable properties, are used to make up parts that can be assembled, disassembled, and reassembled in a variety of useful ways.

At a Glance

Learning Objectives

- ✓ Make something big out of smaller pieces and parts.
- ✓ Identify parts that make up an object.

Instructional Activities

- student observation

NGSS References

Performance Expectation: 2-PS1-3

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 5 Energy and Matter

Students learn that objects are made up of smaller pieces and parts by doing an activity with paper shapes and then participating in a scavenger hunt around the classroom.

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.

pieces and parts

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.

component

Instructional Resources

Activity Page

AP 4.1.1

Activity Page
Pieces and Parts Scavenger Hunt (AP 4.1.1)

Materials and Equipment:

- sliced sandwich bread
- tomato
- romaine lettuce (2–3 leaves)
- sandwich meat
- sandwich cheese
- mayonnaise
- knife
- plate or cutting board
- colored construction paper
- plastic baggies (1 per group)
- timer

Advance Preparation

Use a die-cut machine or decorative hole punch to cut shapes from construction paper, or cut them with a pair of scissors. Aim for a variety of shapes, such as circles, squares, and triangles, in different colors and of different sizes. Place a couple of handfuls of shapes into the plastic baggies.

Alternatively, you can conduct the shape activity using a variety of dry pastas (e.g., elbow macaroni, bow ties, spirals, penne, wheels, shells) instead of construction paper.

Set out your sandwich fixings on a table where students can easily see them.

The Core Lesson 4.1

1. Introduce students to Lesson 4.

Monitor Progress

Ask a volunteer to state the **Big Question** that you are exploring in this unit—**How are containers matched to the stuff they contain?**

Discuss with students what they have learned so far about matter. Students should be able to explain that matter is anything that takes up space, matter has different

properties, matter can change if it is heated or cooled, and matter is used for different purposes.

CORE VOCABULARY—Tell students that, before they can answer the unit's Big Question about containers, they first need to understand that many objects are made up of smaller components, or the **pieces and parts**. In Lesson 4, they will learn about the components that make up bigger objects in order to apply their understanding to the Big Question. Write the Lesson 4 Guiding Question where students can see it:

How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?

Tie to the Anchoring Phenomenon

Materials have favorable properties that make them useful for different things. Certain materials are good for certain things but not for others. In this lesson, students will learn how those materials and their properties are used to make up parts that can help serve as containers.

2. Introduce an example.

- Tell students that you want to make a sandwich. Point to all the ingredients that are out on the table, and say their names.
- **Ask students to tell you how to make the sandwich.** Start by placing the bread on the cutting board or plate. Then ask for the next step and the next. Follow students' lead, and carry out all the steps until you have assembled a sandwich.
- Emphasize that a sandwich is something that is made up of different components, or parts. **Ask students to tell you what the components are for the sandwich that you just put together. Then ask students what would happen if you wanted a salad instead?** You could take off the cheese and tomatoes and add them to lettuce. (See **Know the Standards 1**.)
- Talk about how a sandwich is an example of something that happens all around us that we may not even notice. Things are made up of different materials. In the sandwich, the pieces and parts were the ingredients.

NGSS Elements

CCC 5

Know the Standards

TEACHER DEVELOPMENT

1. CCC 5 Energy and Matter: As students observe the demonstration with the sandwich, they can see that objects—like a sandwich—can break into smaller pieces and be put together again. Removing the tomato or the cheese from the sandwich is an example of breaking an object into smaller pieces. It shows students that the sandwich is made up of different parts and that those parts can be taken out to disassemble the object.

3. Support student investigation of shapes.

- Have students form small groups of mixed ability. Distribute the following materials to each group:
  - plastic baggies filled with construction paper shapes
- Review the steps for this activity with the students. Tell students that they will take turns making something with the shapes. They will place the shapes flat on their workspace and arrange/rearrange them to make pictures or designs. Each student will have three minutes. Then they will undo what they made so the next student can make something different with the shapes. They will continue like this until all students in the group have had a chance to make something with the shapes. (See **Know the Standards 2**.)

NGSS Elements

DCI PS1.A

Differentiation

SUPPORT—Alternatively, you can give students prompts on what to make with their shapes. Offer ideas, such as "For this next round, make a castle," or "This time, use your shapes to make an umbrella."

SUPPORT—For students who may not have good fine motor skills, you could provide black-line outlines of common objects on paper for students to use to place the small pieces of paper on top.

- Circulate around the room. Remind students that the designs are not permanent and that they will all be undone when the next student makes something.
- Offer question prompts if students get stuck, such as "Can you make the outline of your favorite animal?" or "Can you make something with just the blue shapes?"
- After each timer goes off, host a brief discussion with the class. **Ask students what they made, whether they used all the shapes, and whether or not they think something new could be made with the same pieces.** Allow some time for students to answer before setting the timer for the next student.

Know the Standards

TEACHER DEVELOPMENT

2. DCI PS1.A Structure and Properties of Matter: The idea behind this activity is for students to realize that they can make many different types of designs using the same pieces and parts. Shapes could be used to make a giant square. Those same shapes could later be used to make the outline of a snake or butterfly. Students gain practice assembling things with their shapes and then disassembling them, only to reassemble them in a new and different way.

4. Facilitate a pieces and parts scavenger hunt.

Activity Page

AP 4.1.1

- Bring the students back together, and tell them that now they will do a scavenger hunt as a class.
- Distribute Pieces and Parts Scavenger Hunt (AP 4.1.1). Review the activity with students. Tell them that they will get to walk around the classroom to look for the pieces and parts that make larger things. Give an example using the zipper. Ask students where they might find a zipper. They may tell you on a pair of pants, on a jacket, or on a backpack. All these answers are correct. Emphasize that a zipper is a small part that makes up a larger object. Then ask students to describe a zipper. What kind of properties does a zipper have? Zippers can be hard. They can be made of metal or plastic. They are often silver or gold colored.
- Allow students to work independently or in pairs.

Differentiation

SUPPORT—It may be necessary to help students visualize how things are made up of small pieces and parts. Walk around with students, and lead them to make these discoveries on their own.

CHALLENGE—Challenge students to write the properties of the materials that they are looking for on the lines of Activity Page 4.1.1.

EXTEND—Students can conduct this activity in their homes or communities, outside of school. Give them a second copy of Activity Page 4.1.1, and allow them to take it home with them. When they bring it back, see what kinds of things students found in their homes and communities that are made up of smaller pieces and parts.

5. Check for understanding.

Formative Assessment

Monitor Progress

- Remind students that the overarching phenomenon for this unit has to do with them being designers for a classroom container company.
- **Ask students to tell you why knowing about the small pieces and parts that make up things is important when it comes to containers.** Guide students toward the conclusion that all of the smaller things that make up bigger things are matter and that all matter has properties that are good for some things and not so good for other things. The main takeaway point for students is that containers can be made up of pieces and parts that have properties that are good for the intended use of the container.
- Students should be able to identify pieces and parts based on their properties. The scavenger hunt activity builds on what students learned in Lessons 1–3 about matter and properties. Students apply their understanding of matter, such as texture, material, color, and shape, to look for pieces and parts that make up more complex objects.

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

Tie to the Anchoring Phenomenon

As students think about the connection between small pieces and parts and containers, they start to see that a lot of thought has to go into making containers, such as thinking about how the different materials will work together with their properties. These observations will help students answer the Big Question—**How are containers matched to the stuff they contain?**

Review student responses to Pieces and Parts Scavenger Hunt (AP 4.1.1) to determine student understanding of the following concepts:

- Some objects are made up of many smaller pieces and parts.
- Different pieces and parts have their own properties.

LESSON 4.2

What Are the Parts of a Ballpoint Pen?

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?

Today's Question: How do the parts of a pen work together?

Tie to the Anchoring Phenomenon: Ballpoint pens are containers that hold ink that we use to write. Students observe the inside and outside of ballpoint pens by taking them apart to see the different things they are made of. In doing so, students will be able to see the other possible uses for their pieces and parts.

At a Glance

Learning Objectives

- ✓ Describe component parts of a common object.
- ✓ Identify properties that help make materials useful.

Instructional Activities (2 Days)

- student investigation
- teacher Read Aloud
- class discussion

NGSS References

Performance Expectation: 2-PS1-3

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 5 Energy and Matter

Students investigate the inner and outer parts of a ballpoint pen. They learn that parts must be made of materials that have properties that make the pen work.

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

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pieces and parts

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component

Instructional Resources

Student Book

Ch. 7

Student Book, Chapter 7
"What Can We Make from Matter?"

Activity Pages

AP 4.2.1
AP 4.2.2

Activity Pages
Ballpoint Pen Diagram (AP 4.2.1)
Parts That Make Up a House (AP 4.2.2)

Materials and Equipment:

- ballpoint pens (1 per pair)
- paper (1 sheet per pair)
- paper plates (1 per pair)
- markers or colored pencils (assortment per pair)
- tweezers (1 per pair, optional)*
- internet access and the means to project images/video for whole-class viewing

*Note: Students do not need to use the tweezers for the investigation, but some of the internal pieces of the ballpoint pen are small, so some students may do better handling them with the tweezers instead of their fingers.

The Core Lesson 4.2

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

- **How do the parts of a pen work together?** As students gather into the classroom, place them in pairs. Distribute a ballpoint pen to each pair of students, along with a sheet of paper. Tell students to look at the pen.

Ask students if they have seen this type of pen before.

» yes/no

- Prompt students to take turns testing the pen out on the sheet of paper.

Ask students what they notice and wonder about the ballpoint pens. Write down their questions and ideas on the board. There are no right or wrong answers.

- Tell students that many people write with ballpoint pens. Explain to students why a pen is an example of a container.

2. Preview the investigation.

Activity Page

AP 4.2.1

- Distribute Ballpoint Pen Diagram (AP 4.2.1) to each student and the following materials to each pair:
  - ballpoint pen
  - assorted markers/colored pencils
  - paper plate
  - tweezers
- Go over the activity with students. Tell them that they will be looking at the outside of the pen to identify what types of components (pieces and parts) make up the pen.
- Review Activity Page 4.2.1 together as a class:
  - On page 1, students will draw a diagram of the outside parts of the pen. They will label the materials they observe. Then they will identify the properties that the parts have that make the ballpoint pen work.
  - Give students examples of some of the properties that they might notice and write down, such as hardness, texture, color, size, and shape.
  - Then, students will take the pen apart. They will keep all the tiny pieces and parts of the pen on the paper plate and examine them.
  - On page 2, students will draw another diagram of the pen, this time for the internal components.
- Tell students that they can choose to trace the parts on their paper for an exact size or just draw the parts the way they see them. Encourage students to make their diagrams colorful, assuring them that you will not be scoring them based on artistic ability.
- Remind students to focus on Today's Question—**How do the parts of a pen work together?**—as they work through this investigation.

3. Support the investigation.

Monitor Progress

- As students work on examining the outside of the pens, help students identify the parts and their materials on the pen, if they do not recognize them. Use the following prompts to inspire ideas and check student understanding. Tailor your questions to the specific pens you are using.
  - What is the shape of the pen? How does the shape help the pen do its job?
    - » The pen is a rounded shape. This shape makes it easy for people to hold the pen.
  - (If there is a grip:) Where do you grip the pen? What is that area made of?
    - » There is a rubber piece around the part you hold with your fingers.
  - What is the longest part of the pen made of?
    - » The longest part is plastic.

(If there is a clip:) What is the clip at the top of the pen made of? What is this part for? What properties does it have? Would it still work if the clip were made of something soft, like cotton?

» The clip is metal. It lets us connect the pen to our binder.

» The clip is hard and strong. It is shiny. No, the clip needs to be hard to hold onto another object. Something soft like cotton would not keep it in place.

NGSS Elements

SEP 1
SEP 2
DCI PS1.A

Monitor Progress

- Continue asking questions and prompting students to add to their diagrams for page 1. Encourage students to make connections between the materials, their properties, and the ways those properties help the pen work. (See **Know the Standards 1** and **2**.)
- Circulate around the room, and scan student diagrams to check for student understanding. (See **Know the Standards 3**.) Remind students that even though they are working as a pair, they each need to make their own diagrams.
- As students are ready, prompt them to move onto the next part of the investigation: taking apart the pen and noticing the parts, the materials, and the properties of those internal pieces. (See **Know the Standards 4**.)
- Let students know that they can handle the small pieces with the tweezers to better observe the pieces.
- This part of the investigation may be a little more challenging for students, in terms of identifying the parts and what they are made of. This is because most of the time students have not seen the inside of pens.
- Prompt students to place the internal components onto the paper plate so that they do not get lost or roll off the work surface.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 1 Asking Questions: As students observe the pens, they ask questions about their parts and the materials that make up those components. This leads to an exploration of what properties help make the pens work.

2. SEP 2 Developing and Using Models: Students practice using models as they make diagrams to represent and record their findings of the ballpoint pens' components. The diagrams allow students to depict the materials and their properties that make the pens work.

3. DCI PS1.A Structure and Properties of Matter: Students investigate the materials that make up the pen, along with the properties of each piece. This allows students to understand how materials have properties that support the pen's intended purpose.

4. Monitor Progress: See that students are labeling their pens correctly and identifying the right materials and properties associated with them on their diagrams.

- Use the following, or similar, questions to inspire ideas and conversations amongst student pairs. Tailor your questions to your specific materials.

Which part of the pen helps the button pop back up?

» spring

What is the spring made of?

» metal/wire

What kind of property makes this material good for making the pen work?

» It can spring back; it can hold its shape.

What is the ink kept in?

» a flexible tube

What is the tube made out of?

» plastic

Why is plastic a good material for helping the tube work in keeping in the ink?

» Plastic is not porous. It is not absorbent. It is also not heavy. The ink won't spill out.

What would happen if the tube were made of something porous? Or something absorbent?

» The ink would leak out of something porous. The ink would be soaked up by something absorbent.

What shape is the ball part of the pen? Why does this property help the pen work?

» Round; it helps because it lets the tip of the pen roll around on paper, which lets the ink come out.

Differentiation

SUPPORT—Alternatively, do this investigation along with the students, giving them step-by-step instructions and walking through the whole process together. Doing so allows you to observe the materials and properties of all the parts together as a class.

CHALLENGE—Challenge students to put the pens back together.

EXTEND—Conduct a gallery walk of the ballpoint pen diagrams. Hang the diagrams around the classroom and allow students to look at each other's work.

4. Check for understanding.

Monitor Progress

- Remind students that the overarching phenomenon for this unit has to do with them being designers for a classroom container company.
- Students should identify that pens are made up of smaller components that can be taken apart (and put back together again). They should build on their knowledge from previous lessons to identify types of materials and the properties that make them useful for an intended purpose.
- **Ask students to tell you how a ballpoint pen is an example of a container.**

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

Tie to the Anchoring Phenomenon

As students think about the connection between small pieces and parts and containers, they start to see that a lot of thought has to go into selecting the proper materials with desirable properties to help things work the way they are intended to. These observations will help students answer the Big Question—**How are containers matched to the stuff they contain?**

Review student diagrams on Ballpoint Pen Diagram (AP 4.2.1) to determine student understanding of the following concepts:

- Ballpoint pens are made up of different components.
- The components of the ballpoint pen have properties that make the pen work.

1. Day 2: Refocus student attention.

Remind students that in the previous class session, they looked at and took apart ballpoint pens.

Activate prior knowledge by **asking students what they learned from that investigation**. Students should show understanding of the following:

- Things are made up of smaller components (the pieces and parts).
- Those components are made of materials that have desirable properties that help things work the way they are intended to.

2. Read together: "What Can We Make from Matter?"

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.

Read Aloud Support

Page 34

Ask students to turn to page 34 of the Student Book and look at the pictures as you read aloud. Remind them that the title of this chapter is "What Can We Make from Matter?" and tell them to pay special attention to how larger things are made of smaller parts as you read.

CHAPTER 7

What Can We Make from Matter?

We use matter to make the things we use every day. Look at the pictures. Can you name some different kinds of matter each object is made from?

34

Ask students to look at the four pictures on page 34. Explain that they each show a picture of matter and that something about the matter in all four pictures is the same, even though the objects in each picture are very different.

LITERAL—What do these pictures have in common?

» They all show objects that are useful.

» They all show objects that have properties.

EVALUATIVE—Why do you think it is important for forks to be made of metal and not cotton?

» Metal is strong. Metal is hard. Metal is not porous. Metal does not absorb liquid. A cotton fork would absorb the liquid in food. It is not hard, so it would not hold a stiff shape.

SUPPORT—Guide students briefly to identify the materials they see in each picture. **Ask if they think the car is made up of more pieces than the pillow.**

Page 35

Ask students to look at the picture on page 35. Explain that the picture shows kids playing kickball.

The objects that we use every day have a purpose. Sometimes they help meet a need. Sometimes they help make a job easier. Sometimes they are just for fun. Engineers design things that people use. They choose matter that is best for each object's purpose.

Rubber makes this ball bounce. The ball works great for kickball!

35

LITERAL—Why is rubber a good material for the ball?

» It makes the ball kickable.

INFERENTIAL—What do you think would happen if someone wanted to play kickball with a glass ball? Or a ball made of paper?

» A glass ball would break. A paper ball would not bounce.

SUPPORT—Turn student attention to the part of the page that talks about engineers. Prompt students to think about their investigation of the ballpoint pens. Lead a discussion on whether they think engineers chose materials that were best suited for the pen's intended purpose.

Page 36

Ask students to look at the picture on page 36. Explain that a fish tank, or aquarium, is a type of container. It holds fish, plants, and decorations, as well as something the fish need to live: water! Before reading the text on page 36, **ask students the following questions:**

Some objects that people build and use are made with just one kind of matter. This tank is a home for fish. It must be see-through so that people can see inside. It must be strong so that it can hold a lot of water. The container cannot get soft when it is wet. Glass is matter that is best suited for a fish tank.

36

LITERAL—Fish tanks and even fishbowls are usually made of glass. Why do you think this is?

» You can see through glass. Glass is hard. Glass is strong.

INFERENTIAL—Why do you think someone would want to see into a fish tank?

» Someone might want to see all the fish inside of it.

Page 37

NGSS Elements

DCI PS1.A

Ask students to look at the picture on page 37. Call on a student to name all the parts of the tricycle, and the materials that make up those parts. Then hold a brief discussion to talk about why each material makes a good choice for making the tricycle work. (See **Know the Standards 5**.)

Other objects that people build and use are made from different kinds of matter. Some objects are made of many parts. Each part is made from matter that is best suited for its purpose. The different parts work together. They help the object work the way it is supposed to.

37

INFERENTIAL—What would happen if the tires were square instead of round?

» The tires would not be able to roll on the ground to move the tricycle. Square tires wouldn't go anywhere. Shape is an important property.

Know the Standards

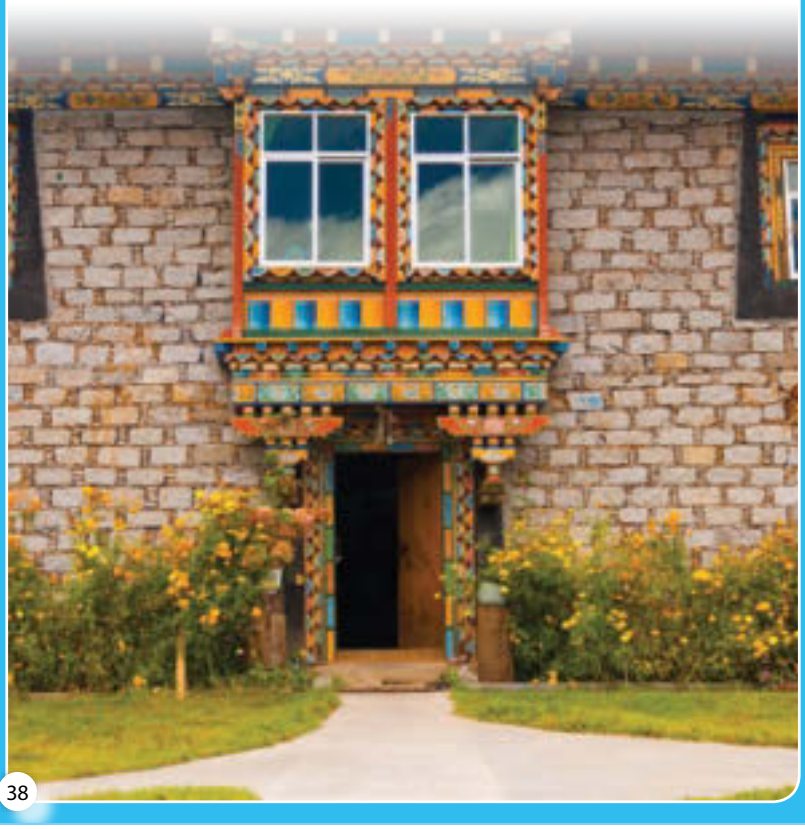
TEACHER DEVELOPMENT

5. DCI PS1.A Structure and Properties of Matter: Students read about how many different everyday objects are built up from a small set of pieces and that the pieces are made from materials with properties that are suited to different purposes.

Page 38

Ask students to look at the picture on page 38. Explain that a house is a good example of something that is made up of many smaller parts. Other buildings and spaces within buildings, like schools and classrooms, are made up of many parts, too.

When many small parts are put together, they can make something big. Sometimes these objects can be taken apart again. Sometimes they cannot. This house is big. It is made from many small bricks.



38

SUPPORT—Guide students in identifying the different parts that make up the classroom. You may want to start off the conversation by identifying that the rug and tiles are things that make up the floor or that the classroom has windows in it, cubbies, and a ceiling.

Page 39
NGSS Elements

CCC 5
Differentiation
Language Arts Connection

Ask students to look at the four pictures on page 39 as you read aloud. (See **Know the Standards 6** and **7**.)

Here are more objects that are made from many small parts. Compare them. Think about how they are the same. Contrast them. Think about how they are different.

What kinds of matter are the objects made from? Which objects can be taken apart and put back together again?




39

SUPPORT—Ask students if they have ever built a big tower or building out of blocks. Using the pictures on page 39 and asking students to recall their experiences, guide students to point out how each object is made up of smaller pieces and parts.

Know the Standards

TEACHER DEVELOPMENT

6. CCC 5 Energy and Matter: Students read about how objects can be broken down into smaller pieces and put back together again. They can be put back into the same object, or they can change shapes and designs.

7. Language Arts Connection: Students recall and draw on what they know about objects being made of pieces and parts using their experiences from what they see outside of school (ELA W.2.8).

LITERAL—Can the tower, book, fence, or quilt be taken apart and put back together again?

» The tower can be taken apart and put back together again. The book would be ruined if it were taken apart, but it is possible to glue or tape the pages back together again. The fence can be put back together again after it is taken apart. The quilt patches could be sewn together again.

CHALLENGE—Challenge students to think of other objects that are made up of pieces and parts that can be taken apart and put back together again. Write down their ideas on the board. If necessary, remind students of the colorful shapes they worked with on the first day of this lesson. Explain that they each made their own design and then took the designs apart and that other students made something different out of the same pieces and parts. Then remind students of the ballpoint pen. Explain that they took the pen apart to look at it. **Ask if it is possible to put the pen back together.**

EXTEND—Have students make a list of the objects that are made up of smaller parts that can be taken apart and put back together again that they find at home and in the community. The next day, students share their lists with each other.

3. Facilitate follow-up exploration.

Activity Page

AP 4.2.2

Differentiation

- Distribute Parts That Make Up a House (AP 4.2.2). Tell students that they will look at the picture carefully and circle all the different parts they can find on the house. Give them a few minutes to work. Then have students turn to a partner and share the things they circled.

SUPPORT—If necessary, demonstrate for students how to identify the different parts by working through an example as a class. Draw student attention to the bricks that make up the house. Tell students that bricks are small blocks that are put together to make the house strong and stand tall. Circle the bricks.

SUPPORT—Alternatively, you can have students do the whole activity in pairs.

CHALLENGE—Challenge students to write the names of the materials of the parts that they circled on Activity Page 4.2.2. Circulate around the room, and see whether students are identifying materials correctly. For instance, windows are made from glass, and the roof will be made from a hard and strong material, such as metal.

4. Demonstrate examples and guide discussion.

Online Resources

- The materials that everything is made of must have the right properties to perform certain tasks. And many things are made up of systems of smaller parts of different materials. This extends to living things as well as built objects. Tell students they are going to watch a video that has to do with our bodies to see some examples. See the Online Resources Guide for a link to the video:

www.coreknowledge.org/cksci-online-resources

NGSS Elements

Connection to Life Sciences

- Watch the video all the way through. Then students work with a partner to discuss the smaller parts that make up our bodies. Have students relate this to what they read about in Chapter 7. Bodies are made up of many different things, from skin to bone to cells to hair. **Ask students if they think all these things are made up of materials that help them do their jobs.** Guide students to discuss the example of bones and the example of skin. Explain that our skin has elasticity. This allows our skin to stretch and grow. (See **Know the Standards 8**.)

Ask students What would happen if our skin were made up of hard bone?

» It wouldn't be able to stretch and grow. It would be too hard.

Then ask students What would happen if our bones were made of skin?

» They would not be able to support us.

- Summarize the discussion with a conclusion that bones are hard and skin is soft and stretchy. These are properties of our bones and skin that help them do their jobs.

5. Check for understanding.

Monitor Progress

Formative Assessment

Have students summarize what they learned about objects being made up of smaller parts. Students should identify that houses are made up of smaller components that can be taken apart and put back together again. They should build on their knowledge from previous lessons to identify types of materials and the properties that make them useful for an intended purpose.

Review student diagrams on Parts That Make Up a House (AP 4.2.2) to determine student understanding of the following concept:

- Many objects are made up of different parts.

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

Tie to the Anchoring Phenomenon

As students think about the connection between small pieces and parts and containers, they start to see that a lot of thought has to go into selecting the proper materials with desirable properties to help things work the way they are intended to. These observations will help students answer the Big Question—**How are containers matched to the stuff they contain?**

Know the Standards

TEACHER DEVELOPMENT

8. Connection to Life Science: Something else that is very important to each of us is made up of small pieces and parts—our bodies! Cells are the smallest building blocks of life. Our bodies are made up of millions of cells. Similar cells work together to make tissues, and groups of tissue work together to make organs. We depend on our cells, our tissues, and our organs to carry out functions and processes that are essential to life.

LESSON 4.3

Lesson 4 Roundup: Build It Up, Take It Down

Big Question: How are containers matched to the stuff they contain?

Lesson Guiding Question: How are materials used to make up parts that can be put together, taken apart, and reassembled into something new?

Today's Question: How can we make new objects out of the pieces from something else?

Tie to the Anchoring Phenomenon: Students will use what they learned about matter, properties, and pieces and parts to investigate how objects made of small pieces can be taken apart and made into new objects. Students make observations and construct evidence-based accounts of this process along the way.

At a Glance

Learning Objectives

- ✓ Explain how different objects can be made from the same pieces.
- ✓ Record observations to show that objects can break into smaller pieces.

Instructional Activities

- student investigation
- class discussion

NGSS References

Performance Expectation: 2-PS1-3

Disciplinary Core Idea: PS1.A Structure and Properties of Matter

Science and Engineering Practice: 6 Constructing Explanations and Designing Solutions

Crosscutting Concept: 5 Energy and Matter

Students participate in a group investigation where they build an object using plastic blocks, disassemble the objects, and make new objects using the same pieces.

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.

pieces and parts

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.

component

Instructional Resources

Activity Page

AP 4.3.1

Activity Page
What Can We Make? (AP 4.3.1)

Materials and Equipment

- colored interlocking plastic blocks (3–5 handfuls per group)
- baggies or small containers (1 per group)
- markers, assorted colors (1 box per group)
- wooden craft sticks (10)
- glue

Advance Preparation

The day before class, build something using five wooden craft sticks. Glue the sticks in place so the structure will not fall apart when you pass it around to show to students. Then, take the remaining five wooden craft sticks, and build something totally different. Glue those pieces together as well. Make sure to use all five sticks for each structure.

Place three to five handfuls of interlocking plastic blocks into plastic bags or containers. Have them ready to pass out to the groups.

The Core Lesson 4.3

1. Focus student attention on Today's Question.

How can we make new objects out of the pieces from something else?

- As students gather into the classroom, place them in small groups of even numbers (such as four or six students per group). If there is an odd number of students, then this activity will still work.

- Once they are settled in their groups, tell students that you had some fun building things. Show them the two structures you made of the wooden craft sticks. Pass the two structures around so each group has a chance to observe them.
- Guide a brief discussion about how both structures are made with five sticks. However, they look very different. Explain that this is because there are different things you can make out of the same pieces.

2. Preview the investigation.

Activity Page

AP 4.3.1

- Distribute What Can We Make? (AP 4.3.1) to each student and the following materials to each group:
  - interlocking plastic blocks
  - markers
- Go over the activity with students.
  - Tell them that half of the students in the group will work on building something with the blocks. All the students in the group will draw a picture of what that structure looks like in the left box on Activity Page 4.3.1.
  - Then, the other half of the students in the group will take that structure apart and use the same pieces to build something different. All the students in the group will draw a picture of what the new structure looks like in the right box on Activity Page 4.3.1.
  - Finally, everyone will compare the pictures to see what is similar and different. Then your group will describe the characteristics of the two structures.

3. Support the investigation.

NGSS Elements

3D Learning
DCI PS1.A
CCC 5

3D Learning: Students observe firsthand that objects can be built up from a set of pieces and then disassembled and reassembled in a new way using the same components. The new object may have a different shape or be a different size. (See **Know the Standards 1** and **2**.)

- Give students a couple of minutes to decide who will be in the first group and who will be in the second group.

Know the Standards

TEACHER DEVELOPMENT

1. DCI PS1.A Structure and Properties of Matter: This investigation will show students how different blocks can be used to build a structure. Remind students of the wooden craft sticks that you made into two separate structures, even though you used the same number of sticks.

2. CCC 5 Energy and Matter: As students disassemble the first structure, they will see that objects can be built up from small pieces, as well as broken into small pieces. As the new objects are built out of the same blocks, students will also see how objects can change shapes even if they are made with the same components.

- Set the timer for ten minutes. Students making the first structure will need to work together. Remind students that working together as a team will give them more time to build.
- Circulate around the room, and provide support as necessary. Cue students when their time is almost up.
- When the timer goes off, hold a brief discussion. **Ask students if they used all the blocks. Have students describe what they made.**
  - **NOTE:** If students did not use all the blocks, have them put the blocks they did not use back into the plastic bags or containers so that the next group of students does not use them.
- Give students time to draw a picture of the first structure. Tell them to make their pictures as accurate and colorful as possible.
- Prompt students to take apart the first structure. Remind students that the next group has to use the very same pieces to make their own object. So do not misplace any of the pieces.
- Set the timer for another ten minutes. The second group of students will start planning and building their new object.
- Circulate around the room, and remind students that the second structure should look different from the first one.
- When the timer goes off, hold a brief discussion. **Ask students if they used all the blocks. Have students describe what new structures they made.**
- Give students time to draw a picture of the second structure. Tell them to make their pictures as accurate and colorful as possible.

Differentiation

SUPPORT—Place a few ideas of objects to build with the blocks on different index cards. If needed for time, give students an index card of what to build. Examples may include staircases, bridges, buildings, or gates.

CHALLENGE—Challenge students to use two groups of blocks to build another structure. Then have them compare the structure they made with one group of blocks to the structure made with two groups of blocks.

EXTEND—Have students draw the pictures of the two structures on a group poster board. Then, post the boards around the classroom when the activity is finished, and have students do a gallery walk to look at each other's work.

4. Summarize and discuss.

NGSS Elements

SEP 6
Monitor Progress

- Now that students are done with their buildings and drawings, prompt students to write their answers and statements at the bottom of Activity Page 4.3.1.
- Circulate around the room, and provide support as needed. If students need ideas for ways to describe the objects they built, tell them they can describe the size, shape, or arrangement of the parts.

- Bring the class together, and hold a discussion that summarizes what students observed. Review the answers to their questions on Activity Page 4.3.1. (See **Know the Standards 3**.)
- As a class, write a statement that summarizes what students noticed about pieces and parts from this investigation. You can use sentence frames to guide the statement, such as:
    - An object can be made of _____. Objects can be _____ and then _____ using the same parts. The new object has different characteristics. We know this because _____.

5. Check for understanding.

Formative Assessment

Monitor Progress

Have students summarize what they have learned about matter and its components. Students should demonstrate progression in their understanding of how objects are made up of pieces and parts that have properties that help them serve a special purpose. Although students are not scored or evaluated on artistic ability, their pictures should help establish their understanding of the scientific phenomena.

Review student responses to What Can We Make? (AP 4.3.1) to determine student understanding of the following concepts:

- Objects are made of smaller components.
- Objects can be disassembled, and the same parts can be reassembled to make new objects.
- Objects made of the same parts can have different characteristics.

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

Tie to the Anchoring Phenomenon

Containers can be made of different parts. As students learned in this classroom session, pieces and parts can be rearranged to make new objects with different characteristics. Containers are examples of the types of objects that people can make with various components.

Know the Standards

TEACHER DEVELOPMENT

3. SEP 6 Constructing Explanations and Designing Solutions: Students call on the evidence they observed and collected in the form of pictures to make a class statement about how objects can be made of small pieces, disassembled, and then made into something new.

UNIT CAPSTONE

Properties of Matter

Big Question: How are containers matched to the stuff they contain?

Tie to the Anchoring Phenomenon: Students use what they learned about the properties of matter, how matter can change, and how certain materials are best suited for intended purposes to write the final chapter in Maya's story.

At a Glance

Learning Objective

✓ Identify the best materials for an intended purpose, based on their properties.

Instructional Activities

- class discussion
- student writing

NGSS References

Performance Expectations: 2-PS1-1, 2-PS1-2, 2-PS1-3, 2-PS1-4

Disciplinary Core Ideas: PS1.A Structure and Properties of Matter; PS1.B Chemical Reactions

Science and Engineering Practices: 6 Constructing Explanations and Designing Solutions; 3 Planning and Carrying Out Investigations; 4 Analyzing and Interpreting Data; 7 Engaging in Argument from Evidence

Crosscutting Concepts: 5 Energy and Matter; 1 Patterns; 2 Cause and Effect

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.

matter **property**

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.

container **evidence** **pieces and parts**

Materials and Equipment

- poster or roll paper (6–8 large sheets)
- pencil
- black marker
- markers, assorted colors (1 box per group)
- construction paper (several sheets per group)
- clips for hanging the sheets of paper

Advance Preparation

- The idea for this activity is that you are picking up in the story about Maya where the Student Book left off. Style the large sheets of paper like the pages in a book. Place page numbers in circles at the bottom of the sheets of paper, and add titles to the top of each sheet of paper.
- Use the following, or similar, prompts to write sentence frames on each sheet of paper to complete the story about Maya. The sentence frames should be on the sheets of paper, which you will read together. Be sure to include blank lines on the paper where students will help you finish the sentences. The suggestions are mapped out on six sheets of paper, but it may require more sheets, depending on the length of text added to the sentence frames. The words that are in bold below are suggestions for where you could include blank lines:
    - **Sheet 1:** Maya just got back from playing outdoors. Her mother had called her inside. She told Maya that the weather is going to get bad again. It will get very cold, and it will rain. She wants Maya to **go back to the shed to get the salt**.
    - **Sheet 2:** Maya goes to get the salt. She remembers what happened last time. She **took the salt out of a container**. Then she **put the salt into a paper bag**, but the bag got wet, and **all the salt dissolved**! Maya doesn't want that to happen again! This time, she knows more about containers, so she won't make the same mistake.
    - **Sheet 3:** Maya learned that everything, even salt, is made up of **matter**. Matter has a lot of different **properties**. Some types of properties are **color, shape, size, and texture**, among others. Maya wants to use a different container for the salt. She needs to think about what the container is **made out of** and what kinds of **properties** it has.

- **Sheet 4:** Maya also learned that matter can change if it is **heated** or **cooled**. Rain can turn to **snow** or **ice** when it gets very cold. Then it can melt into a **liquid**. Maya knows that the **rain** got her bag of salt wet. This is what caused the bag to get ruined and the salt to **dissolve**!
- **Sheet 5:** All of this has taught Maya that different materials have properties that **make them good for intended purposes**. She knows that **paper** is not the best material for getting wet outside. Maya decides that the best kind of material for transporting the salt is **plastic, metal,** or **glass**. This is because **these materials will not get ruined from the rain if they get wet**.
- **Sheet 6:** Maya does not have a **container** to use to transport the salt. But she can make one! She knows that things are made up of **smaller pieces and parts**. All she needs to do is put some **parts** together to make a container. The parts Maya uses must have the **properties** that will **help the container work**. She finds some **metal** cans and scraps of **plastic**. "These will be perfect!" she says.

- Use a pencil to map out your sentence frames to make sure you have enough space on the sheets of paper. Then trace over them with black marker.
- Prepare an area in the classroom where you can hang the large sheets of paper, as well as hang construction paper that students will draw on. The students will make a gallery of the pages and their illustrations.

1. Focus student attention on the Big Question.

Monitor Progress

Ask a volunteer to state the Big Question that you answered in this unit, which is posted somewhere in the room—**How are containers matched to the stuff they contain?**

Discuss with students what they have learned about matter in this unit. Students should be able to tell that matter is anything that takes up space; matter has different properties; matter can change if it is heated or cooled; matter is used for different purposes; and objects are made up of smaller pieces and parts.

Remind students of the story they read about Maya and the salt. Tell students that today they will work together as a class to write the end of the story.

2. Preview the activity.

- Show students the pages of the story that you prepared. The sheets of paper should have the page numbers, titles, and sentence frames already on them. Explain that you are going to read through part of a sentence and students will have to help you fill in the rest.
- Tell students that they should raise their hands (rather than blurting things out) and you will call on them to give their suggestions for completing the sentences.

3. Facilitate the activity.

NGSS Elements

CCC 2

DCI PS1.A

- Read through the sentences that you prepared. When you get to one of the blank lines, open it up for discussion. Get some suggestions and input from various students about what to write on the line. Make sure the class agrees on the best suggestion to complete the sentences. (See **Know the Standards 1** and **2**.)
- Aim for variety. Try to call on different students to offer their ideas. If students are reluctant to raise their hands, call on volunteers randomly. Encourage participation.
- Since you have already mapped out the sentence frames, you already know the best responses for each of the blank lines. Guide students toward the correct responses to make sure they stay on track with the unit phenomenon. Use question prompts to help guide students, if necessary.

NGSS Elements

SEP 7

3D Learning

Differentiation

Ask students what evidence they have that the paper bag was not a good choice for transporting and storing the salt.

» The bag turned mushy and came apart when it got wet, and the salt dissolved.

3D Learning: Students use what they learned about the properties of matter to examine cause-and-effect relationships between materials and their intended purposes. They use evidence to support their claims on what the best materials are for transporting and storing salt in the rain.

SUPPORT—If necessary, limit the number of words students need to fill in for the sentence frames. For instance, instead of requiring them to come up with phrases, have them come up with one or two words that show an understanding of the main point.

CHALLENGE—Alternatively, you can equally pass out the sheets with the sentence frames to groups of students and have them complete the sentences in their groups. Then, have all of the groups display their sheets of paper in order of the page numbers. Finally, read through the sheets of the story from the beginning to see what Maya learns.

Know the Standards

TEACHER DEVELOPMENT

1. CCC 2 Cause and Effect: As students work on filling in the sentences to complete Maya's story, they review what they learned about the cause-and-effect relationship with matter. Particularly, students recall that the rain getting inside and making the paper bag wet was what caused the salt to dissolve. If the paper bag were a different material, such as plastic, this might not have happened.

2. DCI PS1.A Structure and Properties of Matter: Students must draw on what they learned throughout the unit about the properties of matter. Matter has many different properties, including the fact that some matter can change if it is heated or cooled. Students must take these properties into consideration—recalling the various investigations they performed—to think about the best materials that Maya could use for transporting the salt.

EXTEND—Write down story prompts on pages that you can make copies of, and distribute to students. The prompts should be related to Maya's story and what you think students should cover on the different pages. Have students take the pages home and finish writing the stories themselves. You can also ask students to draw pictures that go along with the last pages of the story.

4. Illustrate the pages.

Language Arts Connection

Monitor Progress

- Place students in small groups. There should be the same number of groups as there are sheets of pages that you just wrote on. It's okay if there are a different number of students in each group. (See **Know the Standards 3** and **4**.)
- Distribute the following materials to each group:
  - one sheet of paper from the Maya story
  - markers
  - construction paper
- Explain that each group was given a page from the final pages of Maya's story. Now, students will work as illustrators. As a group they will draw a picture or pictures to summarize the big idea of that page. They will draw their pictures on the construction paper.
- Model for students how they should conduct this activity. Start by reading the page out loud. Then demonstrate how to figure out the big idea from the page. For instance, the big idea of one page may be that the paper bag was not a good material for transporting the salt or that matter has different properties. Once groups identify the big idea, they can come up with an idea for an illustration that would work for that page.
- Circulate around the room, and assist. If necessary, guide students to figure out the big idea of the page they are working with, or help them come up with artistic ideas for the illustrations. Remind them that they are working with the pages of a story and that many stories have illustrations that help readers imagine what is happening in the story. Encourage creativity!

Know the Standards

TEACHER DEVELOPMENT

3. Language Arts Connection: Students work as a group to ask and answer questions related to the key details on the page in order to know what to draw for their story illustrations (ELA RI.2.1).

4. Monitor Progress: As you circulate the room, review students' ability to identify the big ideas on the pages and relate these to what they learned about matter throughout the unit. The story pages are not presenting any new information; rather, this is all information that students have already learned, experienced, and investigated. This can serve as a good gauge to see what students have retained from the lessons in the unit.

5. Do a gallery walk.

- When groups are done illustrating their pages, have them hang the sheets of paper and their illustrations in order according to page numbers in the area of the room that you prepared.
- Have students conduct a gallery walk to see what their classmates came up with for illustrations to finish Maya's story.

6. Check for understanding.

Formative Assessment

Monitor Progress

Have students summarize Maya's story, focusing on the parts that deal with the properties of matter.

Review student illustrations to see that they depict proper understanding of the following concepts:

- Matter has many different properties.
- Matter can change when heated or cooled.
- Objects can be made up of many pieces and parts.
- Objects are made up of materials. Materials have properties that are for intended purposes.

Tie to the Anchoring Phenomenon

Throughout the unit, students learned about the properties of matter as they relate to containers. In this final unit activity, students can use what they learned to conclude what the best material will be for Maya to use to transport and store the salt that she gets from the shed.

UNIT SUPPLEMENT

Science in Action
Meeting a Materials Scientist

Tie to the Anchoring Phenomenon: Students join Maya as she discovers more about the properties of matter.

At a Glance

Learning Objective

✓ Sort materials according to their properties.

Instructional Activities (2 Days)

- teacher Read Aloud
- student activity

NGSS References

Science and Engineering Practice: 1 Asking Questions

Understandings About the Nature of Science: Scientific Investigations Use a Variety of Methods; Scientific Knowledge Is Open to Revision in Light of New Evidence;
Science Is a Human Endeavor

Crosscutting Concept: 1 Patterns

Connections to Engineering, Technology, and Applications of Science: Influence of Engineering, Technology, and Science on Society and the Natural World

Students read about the role of scientists in investigating matter and then act as materials scientists to sort and classify materials.

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 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 **sort** **property**

Instructional Resources

Student Book

Ch. 8

Student Book, Chapter 8
"Science in Action: Meeting a Materials Scientist"

Materials and Equipment

- assortment of coins (several per group)
- assortment of pom-poms (various colors per group)
- assortment of plastic or wooden blocks (various shapes and/or colors per group)
- assortment of buttons (various colors and sizes per group)
- construction paper (1 sheet per group)

1. Day 1: Introduce the topic.

Remind students that they read about Maya and the bag of salt that got wet. Explain that today they will read more about why the bag turned to mush and how scientists study these sorts of things.

2. Read together: "Science in Action: Meeting a Materials Scientist."

Student Book

Ch. 8

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 40

Ask students to turn to page 40 of the Student Book and look at the picture as you read aloud. Remind them that the title of this chapter is "Science in Action: Meeting a Materials Scientist," and tell them to pay special attention to the types of matter that are discussed as you read.

Ask students to look at the picture on page 40. Talk about what they notice about the paper bag. Remind students that properties are the traits that something has, or the details about it.

CHAPTER 8

Science in Action

Meeting a Materials Scientist

At school, Maya tells her teacher about the dissolving salt and the soggy paper bag. Mr. Prine asks the class, "Why did the paper turn to mush? Where did the salt go?"

Mr. Prine explains that salt and paper have properties that make water affect them in different ways. He says, "When paper gets wet, it turns to mush. Water breaks salt down into very small bits. How do people figure out what different materials will do in different situations?"

40

SUPPORT—Invite students to name some properties of objects around the classroom. Encourage them to give examples, including color, size, texture, length, and hardness.

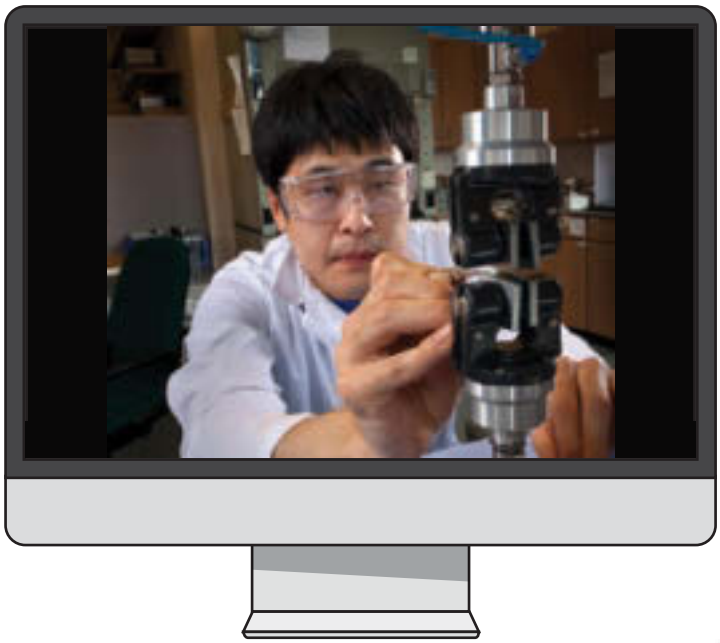
LITERAL—What happens to salt when it gets wet?

» It breaks down into very small bits.

Page 41 **Ask students to look at the picture on page 41.**

Mr. Prine asks his friend, Dr. Zhou, to talk with the class on a video call.

The class watches Dr. Zhou. He is a materials scientist. He explains, "Materials scientists study the properties of all types of matter. We investigate different materials to figure out how they can be useful. We also design new materials that work for special tasks. We design materials to solve problems and meet needs."



41

LITERAL—What kind of scientist is Dr. Zhou?

» a materials scientist

Explain that a materials scientist is a scientist that studies the properties of all types of matter.

INFERENTIAL—What do you think materials scientists try to do?

» They try to figure out how different materials can be useful. They also design new materials that work for specific tasks.

SUPPORT—Emphasize the concept of a problem. Explain that there are many problems that occur in nature. Give students some examples, including the problem of the mushy paper bag when it got wet.

Page 42

Ask students to look at the two pictures on page 42. Talk about what students see in the first picture. Explain that it is a pile of garbage, or a landfill. The second picture shows a plastic bottle in the soil that has been there for a long time. (See **Know the Standards 1**.)

Dr. Zhou tells the class that he studies plastics to find ways to keep Earth safe. When people throw plastic away, it stays in landfills for a very long time. Dr. Zhou wants to design a plastic that can break down quickly. He wants to design a material that will not pollute Earth the way plastic does.

Dr. Zhou explains that the new material must feel and look like plastic. It must be able to be used like plastic. But it also has to be easily broken down by tiny living things in soil. Dr. Zhou tells the class that he will design and test his solutions until he finds one that works.

42

NGSS Elements

Influence of Engineering, Technology, and Science on Society and the Natural World

Ask students to describe plastic in their own words. Explain that plastic is a type of sturdy material that is used to make many different things.

Teach students that a landfill is a place where garbage is thrown away.

SUPPORT—Invite students to give examples of things that they use or see that are made of plastic.

Know the Standards

TEACHER DEVELOPMENT

1. Influence of Engineering, Technology, and Science on Society and the Natural World: Plastic is a human-made material that solves many problems in society. It often serves as a material used for storing, carrying, or transporting things. It also offers convenience to people who use it. However, plastic has a negative impact on the environment, since it does not easily break down and can stay in landfills and oceans for many years. The buildup of plastics in landfills, as well as out in nature on land and in the ocean, can be bad for many organisms.

LITERAL—What happens to plastic after it is thrown away?

» It stays in a landfill for a very long time.

LITERAL—What does Dr. Zhou want to design?

» He wants to design a plastic that will break down more quickly.

Page 43

Ask students to look at the picture on page 43. Help the class pronounce Dmitri Mendeleev's name out loud. (See **Know the Standards 2** and **3**.)

Dr. Zhou explains that many scientists before him have been studying types of matter for a very long time. He builds on what he has learned from their work. Scientists long ago started by learning about the different types of matter found in nature.

Dr. Zhou tells the students that his work depends on what he learned from the earlier work of a scientist named Dmitri Mendeleev /de*mee*tree/men*de*lae*ev/. Mendeleev was one of the first people to sort and group types of matter called elements in a way that made them easy to understand.

43

Know the Standards

TEACHER DEVELOPMENT

2. CCC 1 Patterns: Dmitri Mendeleev observed patterns in the properties of elements. Patterns can lead to predictability and more information about the natural world.

3. Scientific Investigations Use a Variety of Methods: Scientists investigate the natural world and build on the observations and findings of other scientists before them. Dimitri Mendeleev was not the first scientist to observe different types of matter, but he built on what was learned from other scientists to make new discoveries and observations.

NGSS Elements

Scientific Investigations Use a Variety of Methods

LITERAL—What does Dr. Zhou look for in his science work?

» He looks for more new ways to combine matter to make new things.

LITERAL—Was Dr. Zhou the first scientist to discover matter?

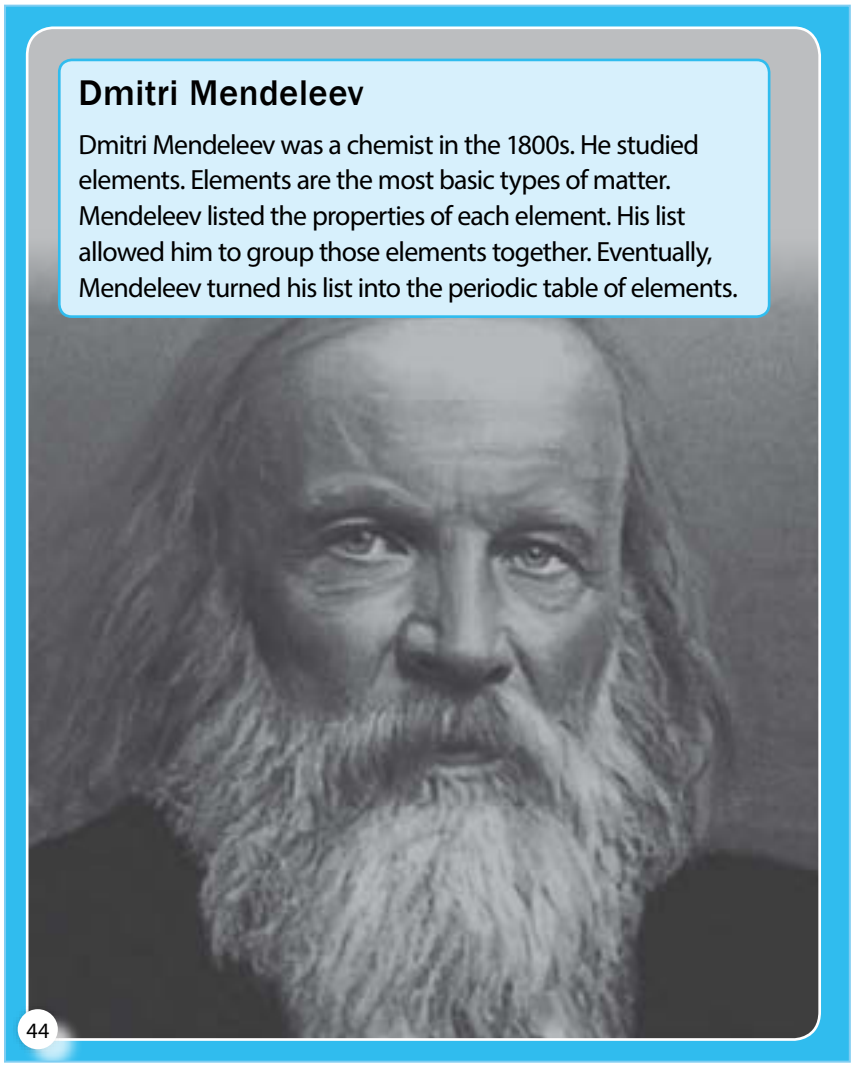
» no

LITERAL—What was Dmitri Mendeleev the first person to do?

» He was the first person to sort and group types of matter in a useful way.

Page 44

Ask students to look at the picture on page 44. Emphasize the fact that Dmitri Mendeleev lived a long time ago but that even back then people were studying science and making new discoveries about the natural world. (See **Know the Standards 4**.)



Know the Standards

TEACHER DEVELOPMENT

4. Science Is a Human Endeavor: People have practiced science for a long time. Dmitri Mendeleev was a Russian scientist who practiced during the late 1800s. Encourage students to think about how much science and our knowledge of the natural world must have changed between the 1800s and today!

NGSS Elements

CCC 1

Science Is a Human Endeavor

Teach students that an element is the most basic, or pure, type of matter. Elements can be combined to make different types of matter. Use the analogy of different ingredients being used in different recipes to make many different types of food. Note that students should not be assessed on their ability to define *element* at this grade level. The term is merely introduced to help simplify the explanation about usefulness of displaying things in groups based on common details. This is a brief and informal introduction to the concept of classification, the practice of sorting and grouping.

LITERAL—How did Mendeleev display the elements?

» He showed them in a table of rows (side to side) and columns (top to bottom).

INFERENTIAL—Why can it be helpful to organize a long list of things in a table like this?

» It can group together items with similarities.

Page 45

Ask students to look at the pictures on page 45. Explain that the colorful blocks are a table called the periodic table of the elements.

The periodic table is a chart. It displays elements in rows and columns instead of as one long list. The arrangement groups elements by their similar properties. The types of matter in the same color on this table have something in common. For example, all the types of matter colored gold on the table are metal. Gold and silver are two types of matter in that bunch.

People around the world today still use the periodic table to understand types of matter. It now contains 118 elements. How many groups of different colors can you count?

45

NGSS Elements

Scientific Knowledge is Open to Revision in Light of New Evidence

Explain that the periodic table of the elements is a chart. It shows elements in rows and columns. The elements are grouped by similar properties. (See **Know the Standards 5**.)

LITERAL—What can you tell from the periodic table of the elements?

» You can tell which elements have something in common.

INFERENTIAL—Why do you think Mendeleev grouped types of matter together according to their properties on his periodic table?

» Grouping things can help you study them and how they are alike.

1. Day 2: Facilitate the activity.

NGSS Elements

CCC 1

- Remind students that they previously read about scientists Dr. Zhou and Dmitri Mendeleev, who study materials and matter. Tell them that today they will work on an activity where they get to act like materials scientists.
- Show students the picture of the periodic table of the elements from the Student Book on page 45. Remind students of how the periodic table of the elements is organized.
- Have students form small groups, and distribute the materials to each group. Explain that students have an assortment of materials in front of them. They also have several sheets of construction paper. They must do the following:
  - Sort/group the items according to their similar observable properties (e.g., hardness, texture, size, color, shape, etc.).
  - Come up with a way to number all of the items in their pile in a way that makes sense so that they can make their own periodic table of the elements. They can write or draw this on the construction paper to keep track of which number is assigned to each object. (See **Know the Standards 6**.)
  - For example, the number one could represent the hardest material, so students might sort their items from hardest to softest. Or the number one could represent the material that is the most yellow. As the numbers increase, the materials become softer or less and less yellow.

Know the Standards

TEACHER DEVELOPMENT

5. Scientific Knowledge Is Open to Revision in Light of New Evidence: Dmitri Mendeleev was the first person to come up with the periodic table of the elements. However, at the time that he created the table, he had not discovered all of the elements that we know of today. Since Mendeleev's time, new elements have been identified by modern scientists and added to the periodic table of the elements, which supports the concept that information in science is always evolving.

6. CCC 1 Patterns: Students number the items that they sort in a way that reveals a repeating pattern. Examples of patterns could be that lesser numbers are harder than greater numbers or that greater numbers are more circular in shape than lesser numbers.

NGSS Elements

SEP 1

Differentiation

- Circulate around the room as students work. Prompt them to think about the properties of the materials. Remind them that there are different ways they can sort the objects. Reinforce scientific concepts, such as the importance of asking questions and looking for patterns. (See **Know the Standards 7**.)

  SUPPORT—Limit the number of items that you give to students so they have less to sort/group.

  CHALLENGE—Challenge students to draw their own periodic table of the elements based on the materials and numbering that they came up with.

  EXTEND—Have students practice using the periodic table of the elements to search for certain elements.

2. Check for understanding.

Review the ways in which students sort the objects, and ensure they have a numbering system that reveals a pattern.

Know the Standards

TEACHER DEVELOPMENT

7. SEP 1 Asking Questions: Scientists begin their studies with a question. Encourage students to think about or verbalize the question that they want to answer in this activity.

UNIT 1

Teacher Resources

Activity Pages

Name _____ Date _____

Activity Page UO.1 Use with Unit Opener

See the Salt

Record your observations below.

1. Draw the paper bag and the plastic container before it "rains" on them.

paper bag	**plastic container**

2. Draw the paper bag and the plastic container after it "rains" on them.

paper bag	**plastic container**

3. Describe what you notice about the paper bag.

_____

4. Describe what you notice about the plastic container.

_____

Name _____ Date _____

Activity Page 1.1.1 Use with Lesson 1.1

Container Scavenger Hunt

Look around the classroom for containers. Draw and label the containers you see. Find at least one container.

Name _____ Date _____

Activity Page 1.2.1 Use with Lesson 1.2

Sort the Matter

Look at the objects. Decide if the object is a solid, liquid, or gas. Put an X in the correct box.

Object	Solid	Liquid	Gas
wooden craft stick			
metal coin			
sheet of paper			
balloon of air			
marker			
bowl of water			

1. Write something that you know about solid matter.

_____

_____

_____

2. Write something that you know about liquid matter.

_____

_____

_____

3. Write something that you know about matter that is gas.

_____

_____

_____

Name _____ Date _____

Properties of Matter Lab Sheet

Read the steps aloud as a class. Then do the steps with your partner.

Solids

STEP 1: Look carefully at each cookie. What do you notice? Write what you see in the table.

Cookie	Texture	Shape	Color
Chocolate chip			
Sandwich cookie			
Vanilla wafer			
Fig cookie			

STEP 2: Use the ruler. Measure the length of the middle of each cookie. Measure where the cookie looks longest from one edge to the opposite edge. Write it in the table.

Cookie	Length
Chocolate chip	
Sandwich cookie	
Vanilla wafer	
Fig cookie	

STEP 3: Put each cookie on the scale. Write the measurement of each cookie in the table.

Cookie	Weight
Chocolate chip	
Sandwich cookie	
Vanilla wafer	
Fig cookie	

Name _____ Date _____

STEP 4: Put each cookie into the jar. What do you notice? Does the cookie change its shape? Write "Yes" or "No."

Cookie	Change shape?
Chocolate chip	
Sandwich cookie	
Vanilla wafer	
Fig cookie	

Liquids

STEP 1: Look at the milk in the cup. What do you notice? Write what you see in the table.

Liquid	Texture	Shape	Color
Milk			

STEP 2: Measure the empty Cup B on the scale. Write the measurement in the table.

Liquid	Weight
Cup B, empty	

STEP 3: Pour the milk from Cup A into Cup B.

STEP 4: What did you notice? Does the milk take the shape of the new cup? Write "Yes" or "No."

Liquid	Change shape?
Milk	

STEP 5: Measure Cup B on the scale again. Write the measurement in the table.

Liquid	Weight
Cup B, with milk	

Name _____ Date _____

STEP 6: How much does the milk weigh? Let's find out.

What is the first weight of Cup B? _____

What is the second weight of Cup B? _____

Subtract the first weight from the second weight. Show your work.

What do you get? _____

How much does the milk weigh? _____

Gases

STEP 1: Look carefully at the balloon. Write what you notice.

_____

STEP 2: Describe the shape of the balloon.

Gas	Shape
balloon, no air	

STEP 3: Have one person blow up the balloon.

STEP 4: Tie the balloon closed.

STEP 5: Describe the shape of the balloon again.

Gas	Weight
balloon, with air	

STEP 6: Gently squeeze the balloon.

Describe the way the balloon feels. _____

What happens to the shape of the balloon? _____

STEP 7: Stop squeezing the balloon.

What happens to the shape of the balloon? _____

How would a solid feel if you squeezed it? _____

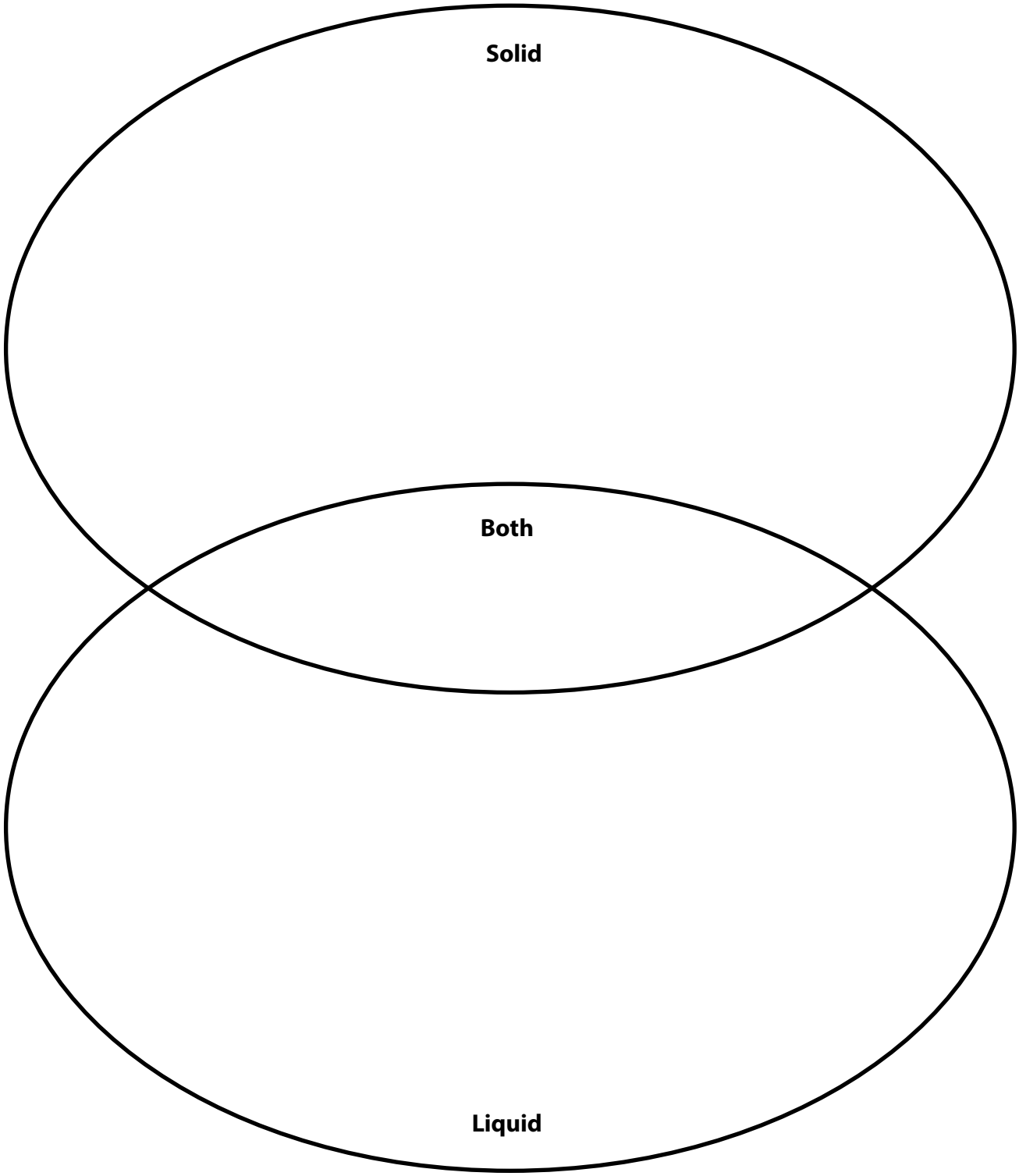
How would a liquid feel if you squeezed it? _____

Name _____ Date _____

Activity Page 1.4.1 Use with Lesson 1.4

Venn Diagram

Compare solid and liquid chocolate chips.



Name _____ Date _____

Investigate It

Plan your investigation.

1. What is the purpose of this investigation?

_____

2. What materials are you investigating?

_____

3. What properties are you looking for?

_____

4. How will you observe the properties of the materials?

_____

5. How will you measure the properties of the materials?

_____

6. What tools will you use to measure the materials?

_____

7. Which materials will be measured at different temperatures?

_____

8. What will you use to heat or cool them? How will you measure them?

_____

9. How will you group the materials?

_____

Name _____ Date _____

Do the investigation. Answer the questions.

Material 1:

1. What material are you investigating?

_____

2. What properties are you looking at?

_____

3. What kinds of tests did you do? Did you make it hotter or colder?

_____

4. What did you notice? What are its properties?

_____

Material 2:

1. What material are you investigating?

_____

2. What properties are you looking at?

_____

3. What kinds of tests did you do? Did you make it hotter or colder?

_____

4. What did you notice? What are its properties?

_____

Name _____ Date _____

Material 3:

1. What material are you investigating?

2. What properties are you looking at?

3. What kinds of tests did you do? Did you make it hotter or colder?

4. What did you notice? What are its properties?

Material 4:

1. What material are you investigating?

2. What properties are you looking at?

3. What kinds of tests did you do? Did you make it hotter or colder?

4. What did you notice? What are its properties?

Name _____ Date _____

Material 5:

1. What material are you investigating?

_____

2. What properties are you looking at?

_____

3. What kinds of tests did you do? Did you make it hotter or colder?

_____

4. What did you notice? What are its properties?

_____

Material 6:

1. What material are you investigating?

_____

2. What properties are you looking at?

_____

3. What kinds of tests did you do? Did you make it hotter or colder?

_____

4. What did you notice? What are its properties?

_____

Name _____ Date _____

Summarize the findings.

1. Which materials were solids?

Material 1 Material 2 Material 3 Material 4 Material 5 Material 6

How do you know?

_____

2. Which materials were liquids?

Material 1 Material 2 Material 3 Material 4 Material 5 Material 6

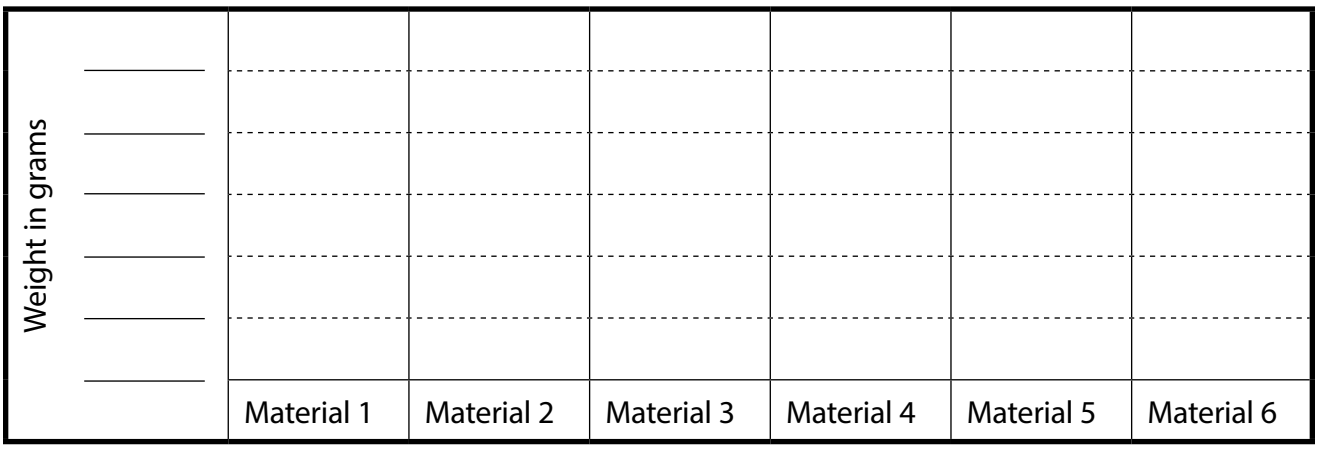
How do you know?

_____

3. Place your data in the chart below.

Material	**Length (in centimeters)**	**Weight (in grams)**	**Container Test (Did it keep its shape?)**
Material 1			
Material 2			
Material 3			
Material 4			
Material 5			
Material 6			

4. Complete the bar graph that displays the weights of the materials. Color in the bar for each material to show its weight.



Name _____ Date _____

Activity Page 2.1.1 Use with Lesson 2.1

Ice Cream Portrait

Draw how the ice cream looks at first.

Draw how the ice cream looks now.

Date _____

Activity Page 2.1.2 Use with Lesson 2.1

Temperature Testers

Record your names in the left column. Take the temperatures. Write them in the table.

Student Name	Temperature of Water	Temperature of Air

Name _____ Date _____

Activity Page 2.2.1 Use with Lesson 2.2

How Hot or Cold?

Write the temperatures in the table.

STEP 1: Take the temperature of the water in the cup.

STEP 2: Add ice cubes to the cup. Wait ten seconds. Now take the temperature again.

STEP 3: Pour the water and ice cubes into the pot. Boil the water. Take the temperature of the water vapor.

	STEP 1: Water	STEP 2: Ice Water	STEP 3: Water Vapor
Temperature			

STEP 4: Complete the bar graph that displays the temperatures you recorded. Color in the bar for each material to show its temperature.

Temperature in Degrees Fahrenheit			
225°			
200°			
175°			
150°			
125°			
100°			
50°			
50°			
25°			
0°			
	Water	Ice Water	Water Vapor

Name _____ Date _____

Activity Page 2.3.1 Use with Lesson 2.3

What Does the Heat Do?

Write what you notice about the materials.

Material	**What I notice before heating**	**What I notice after heating**	**What I notice after cooling**	**Is the change reversible? Circle Yes or No.**
Paper				Yes No
Ice				Yes No
Butter				Yes No
Egg				Yes No

Name _____ Date _____

Activity Page 2.3.2 Use with Lesson 2.3

Cool It Down

Write what you notice about the materials.

Material	**What I notice before cooling**	**What I notice after cooling**	**What I notice after heated**	**Is the change reversible? Circle Yes or No.**
Water				Yes No
Plant leaf				Yes No

Name _____ Date _____

Activity Page 3.1.1 Use with Lesson 3.1

Race to Move Water

Record what you notice about the materials. Place an X in the column for Absorbent or Not Absorbent.

Material	Absorbent	Not Absorbent
Sponge		
Pencil		
Plastic toy		
Eraser		
Paper towel		
Tissue		
Washcloth		
Fabric		
Wax paper		
Cotton		

Name _____ Date _____

Activity Page 3.2.1 Use with Lesson 3.2

How Porous Am I?

You and your group are designers of a container company. You must test different materials. See which one makes the best material to use for a drinking cup.

STEP 1: Place the container in the pan.

STEP 2: One at a time, a group member will hold the material on top of the container.

STEP 3: Another group member will slowly pour water on top of the material.

STEP 4: Wait and observe the material with water on it at least three minutes before moving to the next material.

STEP 5: Make an X under Yes or No next to the material to show if it is porous or not porous.

How Porous Am I?		
Material	**Yes**	**No**
Construction paper		
Cardstock		
Fabric		
Plexiglass		
Paper towel		

Which objects are porous?

_____

Which objects are not porous?

_____

Name _____ Date _____

Activity Page 3.2.2 Use with Lesson 3.2

100-Gram Challenge

Your company is designing a packing container. It needs to keep delicate objects from breaking. Find the best material. It should bend a little to support the delicate objects.

STEP 1: Loop the thread around each material.

STEP 2: Let the weight hang down.

STEP 3: Use the tape measure to see how much the material bends.

STEP 4: Record it in the table.

Object	**How much does it bend (inches)?**
Chenille stem	
Plastic ruler	
Cardstock	
Rope	

1. Which material bends the most?

_____

2. Which material bends the least?

_____

3. Which material would be best for a container that holds something delicate?

_____

Name _____ Date _____

Activity Page 3.2.3 Use with Lesson 3.2

Can It Crack the Candy?

Your company is designing a container to carry eggs. Eggs are delicate. Their shells can crack easily. The container must be soft but sturdy enough to protect the eggs.

Use each object to try to crack the candy.

Object	Did it crack the candy?	How many tries did it take?
Eraser	Yes No	
Sponge	Yes No	
Modeling clay	Yes No	
Rock	Yes No	

1. Which type of material has properties that would make the best container for eggs?

_____

2. How do you know? Explain what you noticed.

_____

Name _____ Date _____

Activity Page 3.2.4 Use with Lesson 3.2

How Strong Am I?

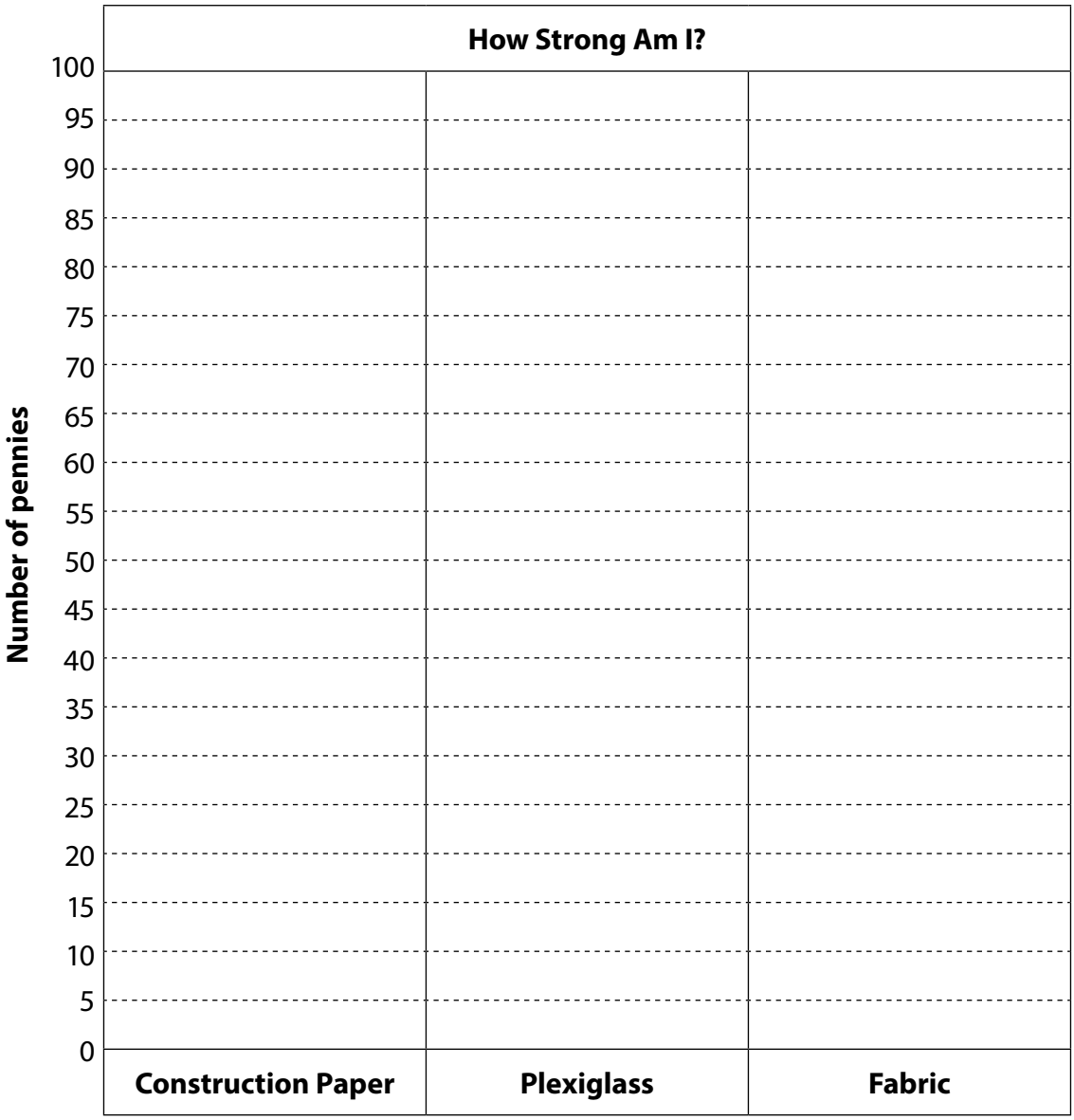
You are designing a coin bank. Test the strength of the materials. Figure out which material would make the best coin bank.

STEP 1: One student holds the object in place.

STEP 2: Another student adds pennies onto the object. Add one penny at a time.

STEP 3: See how many pennies the object can hold.

STEP 4: Color each column up to the number that you mark to make a bar graph.



Name _____ Date _____

Activity Page 3.2.5 Use with Lesson 3.2

Which Texture Is Best?

Your company is designing a packing box. The box must keep objects in place. This is so they do not slide around and break. Find the material that is the best suited for keeping things in place.

STEP 1: Place the plastic block on each material.

STEP 2: Lift one side of the tray up slowly until the block starts to move.

STEP 3: Use the ruler to record how far up the side of the tray was lifted when the block moved.

Material	Tray Height	Write about what you notice.	Did the plastic block stay in place?
Sandpaper			Yes No
Plexiglass			Yes No
Fabric			Yes No
Paper			Yes No

Which material has properties that are best suited for holding the plastic block in place?

_____

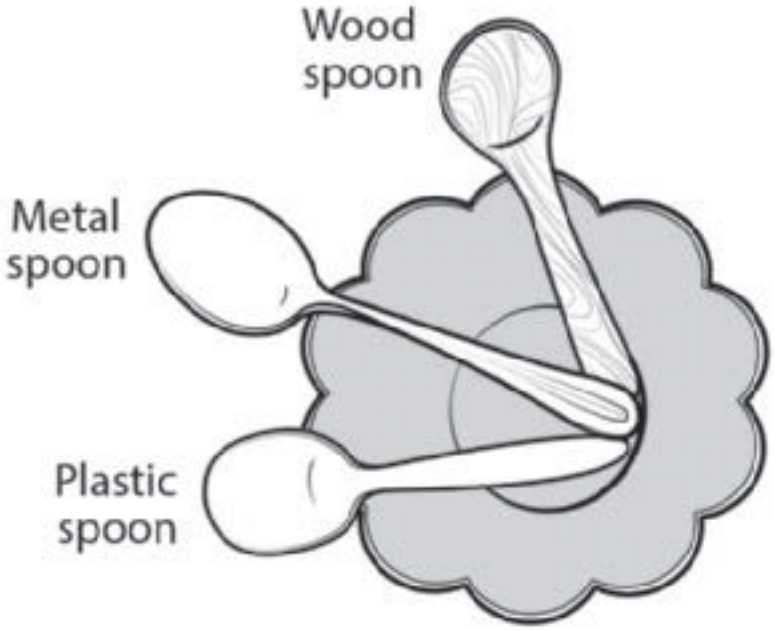
Name _____ Date _____

Activity Page 3.2.6 Use with Lesson 3.2

Let's Heat It Up!

Your company is designing a bowl. The bowl should keep food hot. Find the material that would make the best bowl.

STEP 1: Place the three spoons into the bowl. The round part of the spoon should stick out.



STEP 2: Place a bead onto the dab of butter. Make sure the bead is held in place.

STEP 3: Your teacher will add the hot water into the bowl.

STEP 4: Wait and watch.

1. What happens to the beads?

_____

2. Which spoon moved the heat to the top of the spoon the fastest?

_____

3. Which material is best suited for cooling off hot food?

_____

Name _____ Date _____

Activity Page 4.1.1 Use with Lesson 4.1

Pieces and Parts Scavenger Hunt

Find the things listed below. Write down where you find them.

Find something that is made with:

1. a zipper _____

2. a button _____

3. a piece of metal _____

4. a piece of rubber _____

5. a piece of plastic _____

6. something that has a rough texture _____

7. something that is soft _____

8. something round _____

9. something flat _____

10. something red _____

Name _____ Date _____

Ballpoint Pen Diagram

Draw the pieces and parts of the outside of the pen. Label your drawing. Name the materials and their properties.

Name _____ Date _____

Activity Page 4.2.1 (Page 2 of 2) Use with Lesson 4.2

Draw the pieces and parts of the inside of the pen. Label your drawing. Name the materials and their properties.

Name _____ Date _____

Activity Page 4.2.2 Use with Lesson 4.2

Parts That Make Up a House

Circle all the separate parts that make up the house.

Write words to name the parts you circled.

Name _____ Date _____

Activity Page 4.3.1 Use with Lesson 4.3

What Can We Make?

Make something with the blocks. Then break it down, and make something else. Draw pictures of the objects to record your work.

First Object	Second Object

Answer the questions below.

1. What did the first object look like?

Size _____

Shape _____

Arrangement of the parts _____

2. Did you use the same pieces to make the new object? Circle Yes or No. **Yes** **No**

3. What did the second object look like?

Size _____

Shape _____

Arrangement of the parts _____

Activity Pages Answer Key: *Properties of Matter*

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.

See the Salt (AP UO.1) (page 196)

1. Students should draw approximations that distinguish the two different types of containers. Accept all drawings showing key characteristics.

2. Drawings should show no change to the plastic container, but represent wetness affecting the paper bag.

3. Possible observations: The color got darker as it got wet. The paper got softer and less crinkly.

4. It stays the same. Water makes the outside of the plastic wet, but it does not change the material.

Container Scavenger Hunt (AP 1.1.1) (page 197)

Answers will vary. Accept all responses that accurately reflect objects in the classroom that contain some other object(s) or material.

Sort the Matter (AP 1.2.1) (page 198)

Solid: wooden craft stick, metal coin, sheet of paper, marker (also accept balloon and bowl)

Liquid: (bowl of) water (also accept marker if students correctly discern the ink as liquid)

Gas: (Balloon of) air

Sample answers (reasonable observations that students are likely to make):

1. Solids are hard. Solids do not spill.

2. Liquids are runny and wet.

3. Gas is invisible.

Properties of Matter Lab Sheet (AP 1.3.1) (pages 199–201)

Sample answers (reasonable observations that students are likely to make):

Solids

STEP 1: Chocolate chip: bumpy, round, light and dark brown; Sandwich cookie: rough, round, dark brown; Vanilla wafer: smooth, round, light golden brown; Fig cookie: smooth, rectangular, light brown

STEP 2: Verify measurements against your selected samples.

STEP 3: Verify weights against your selected samples.

STEP 4: no (for all)

Liquids

STEP 1: runny, wet or slick; shaped like the inside of the cup, and flat on the top surface; white

STEP 2: Verify weight against your selected cup.

STEP 4: yes

STEP 5: Verify collective weight of cup and milk sample.

STEP 6: Units should be reported as the nearest whole number. Evaluate and support students' execution of the math problem in alignment with your current math classroom practice.

Gases

STEP 1: It is round with a longer end with a hole. It is flat, red (for example), and shiny.

STEP 2: round, flat, egg-shaped, with a long end

STEP 5: bigger, and fully round, not flat

STEP 6: It feels tight but squeezable, bouncy. It gets dents in it where it is squeezed, and it swells out away from where it is pressed on.

STEP 7: It returns to its round shape without the dents. A solid would feel harder. A liquid would feel squishier.

Venn Diagram (AP 1.4.1) (page 202)

Solid: separate little blob shapes, hard

Liquid: gooey, running together

Both: brown

Investigate It (AP 1.5.1) (pages 203–207)

Sample answers (plan should be student-derived):

Plan

1. To see what different types of matter are like when they get warmer or cooler.

2, 3. Answers will vary based on student selections.

4. by looking at the objects, by touching the objects

5. by how long or thick or heavy it is, or by how much there is

6. a ruler, scale, or measuring cup

7. Answers will vary based on student selections.

8. the hot plate with the teacher or the bucket of ice; with a thermometer

9. by whether they are solid, liquid, or gas; by their properties

Investigation

Materials 1–6: Answers will vary depending on materials selected. Look for accurate student observations of the selected materials, procedures, and outcomes.

Summary of Findings

1, 2. Answers will vary based on materials and samples selected.

3. Measurements depend on samples. Verify student measurements. Solids keep their own shape; liquids fill into the shape of their containers.

4. Help students fill in the units of measure in the left column of the table, which becomes the horizontal axis of a simple bar graph when they color the column (bar) for each material. Check for correct representation in the graph of the weights students measured.

Ice Cream Portrait (AP 2.1.1) (page 208)

The before-and-after drawings should show the ice cream as solid, spherical scooped shapes, and as melting glob shapes of reduced size and puddling liquid.

Temperature Testers (AP 2.1.2) (page 209)

Verify student measurements against classroom conditions.

How Hot or Cold? (AP 2.2.1) (page 210)

STEP 1: Temperature depends on sample and classroom conditions.

STEP 2: Temperature will be near 0°C/32°F

STEP 3: Measurable temperature above the pot will vary depending on classroom conditions, but will be substantially higher (approaching the 100°C/212°F boiling point of the water).

STEP 4: Students should color the columns in the table to the height of the temperature closest to that measured.

What Does Heat Do? (AP 2.3.1) (page 211)

Paper: flat, white, solid; burnt, brow patches; remains burnt; no

Ice: cubes, clear, hard; melted to liquid; frozen solid again; yes

Butter: soft solid, yellow; liquid, darker yellow; soft solid again; yes

Egg: clear liquid around yellowish orange glob; liquid becomes stiff and white, yolk becomes hard; keeps cooked shape and color; no

Cool It Down (AP 2.3.2) (page 212)

Water: clear liquid; clear solid ice; melted to liquid water again; yes

Plant leaf: bright green, crisp but flexible; crisp, cold, and brittle; darker green, limp and slippery; no

Race to Move Water (AP 3.1.1) (page 213)

Absorbent: sponge, paper towel, tissue, washcloth, fabric, cotton

Nonabsorbent: pencil, plastic toy, eraser, wax paper

How Porous Am I? (AP 3.2.1) (page 214)

Porous: construction paper, fabric, paper towel (and possibly cardstock)

Not porous: plexiglass (and possibly cardstock)

100-Gram Challenge (AP 3.2.2) (page 215)

STEP 4: The chenille stem will likely bend fully to a right angle. The cardstock may also, but could bend less if your sample is heavy. The ruler may bow a bit, but will not bend.

1. the chenille stem (and possibly the cardstock, depending on the sample thickness)

2. the plastic (ruler)

3. of these three choices, plastic

Can It Crack the Candy? (AP 3.2.3) (page 216)

Eraser, no; Sponge, no; Clay, no; Rock, no

1. Probably something like the eraser.

2. Eggs need a material stiff enough to protect them from something pressing on them, but not hard like a rock that can break the shells.

How Strong Am I? (AP 3.2.4) (page 217)

The number of pennies the construction paper will hold will vary depending on sample. The other materials should hold all of the pennies.

Which Texture Is Best? (AP 3.2.5) (page 218)

Sandpaper and fabric, with their rougher textures will allow the tray to be elevated to the steepest angle without the block moving. Paper and glass, with smooth textures, will allow the block to slide at a less steep incline.

Let's Heat It Up! (AP 3.2.6) (page 219)

1. They fall out of the butter as the butter gets soft and melts.

2. metal

3. The metal bowl would cool off hot soup best, because the heat can move best through the metal bowl.

Pieces and Parts Scavenger Hunt (AP 4.1.1) (page 220)

Sample answers that all might be found in the classroom:

1. a jacket; **2.** a shirt; **3.** a door knob; **4.** a wagon wheel; **5.** a chair seat; **6.** carpet; **7.** a knit hat; **8.** a ball; **9.** a notebook; **10.** an apple

Ballpoint Pen Diagram (AP 4.2.1) (pages 221–222)

Specific parts that students draw depend on sample pens selected.

Outside: tube, rolling ball, grip, cap, clip; (These parts are likely plastic and metal, hard, rigid.)

Inside: ink tube, ink, spring; (The tube is likely flexible plastic, the ink liquid, and spring flexible wire.)

Parts That Make Up a House (AP 4.2.2) (page 223)

Students should single out bricks, window parts, door parts, roof parts, etc.

What Can We Make? (AP 4.3.1) (page 224)

Student drawings should represent key identifiable features of what they build.

1. Descriptive details should match the first drawing.

2. yes

3. Descriptive details should differentiate the second structure from the first.

Appendix A

Glossary

Blue words and phrases are Core Vocabulary for the unit. **Bold-faced words and phrases** are Language of Instruction, additional vocabulary terms related to the unit that you should model for students during instruction. Vocabulary words are not intended for use in isolated drill or memorization.

A

absorb, v. to soak up

absorbency, n. the property of being able to absorb a gas or liquid

absorbent, adj. describing a material that can soak up a liquid easily

absorption, n. the process of one thing taking in another substance, typically a liquid

C

change, v. to become different; to make something different (n. a difference from something's former condition)

classify, v. to arrange things in a group based on shared qualities

compare, v. to examine characteristics of two things for similarities, particularly looking for similarities

component, n. a part that combines with other parts to make up a larger whole

container, n. an object used to hold other objects or materials

cooling, n. the process of lowering temperature

D

data, n. information that is observed or measured and recorded

describe, v. to express details about something

description, n. an expression of the details that characterize a thing

E

evidence, n. a detail that supports a claim or helps prove an idea is true

example, n. a sample of something that shows what the whole is like

F

flexible, adj. describing the ability of something to bend easily without breaking

G

gas, n. matter that does not have a shape or a fixed volume and that spreads out to take the shape of whatever container it is in

H

hardness, n. the condition of being hard and resistant to scratches and indentation

heating, n. the the process of raising or rising temperature

I

investigate, v. to observe and study something to collect information

L

liquid, n. matter that does not have its own shape but retains its volume

M

materials, n. matter that makes up different things

matter, n. anything that takes up space, even when you cannot see it

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

pieces and parts, n. smaller things that combine to make bigger things

porous, adj. having very tiny holes or spaces that liquid and air can pass into or through

prediction, n. a statement of something that is expected to happen

property, n. a detail about matter that helps describe it

R

reversible, adj. describing something that can be undone

S

solid, n. matter that keeps its own size and shape without a container

sort, v. to separate, arrange, and group items based on their properties or characteristics

strength, n. the condition of being strong and able to withstand a great amount of force

T

temperature, n. measure of how hot or cold something is

texture, n. the feel and appearance of a substance

thermal conductivity, n. a material's ability to conduct heat

thermometer, n. an instrument that measures temperature

U

useful, adj. describing something that can be used for a specific purpose

V

volume, n. how much space matter takes up

W

waterproof, adj. describing materials that do not absorb water nor allow it to pass through them

Appendix B

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

Appendix C

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.

Appendix D

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.

Appendix E

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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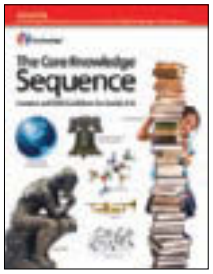

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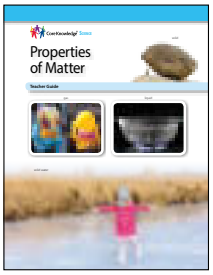

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