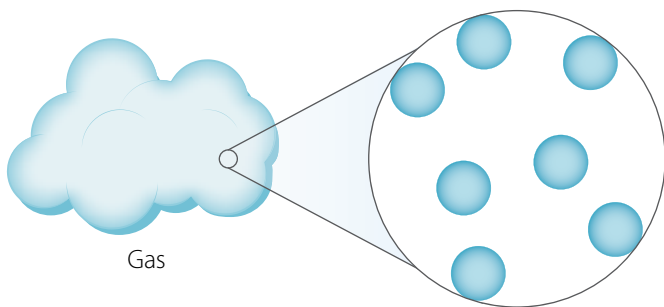


# Investigating Matter

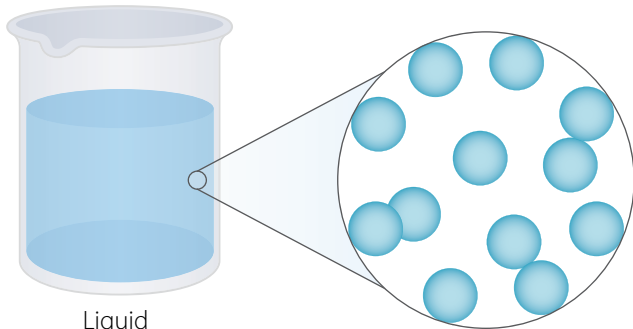
## Teacher Guide



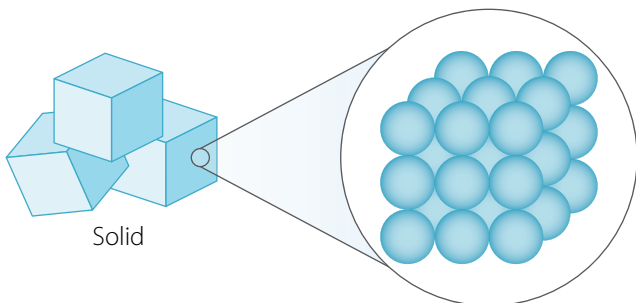
States of matter



Gas



Liquid



Solid

Chemical change



Properties of matter







# Investigating Matter

Teacher Guide



Core Knowledge®

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ISBN: 978-1-68380-535-9



# Investigating Matter

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# **Investigating Matter**

## **Teacher Guide**

Core Knowledge Science™ 5

# Introduction

## ABOUT THIS UNIT

### The Big Idea

This unit focuses on the scientific concept that matter is made up of tiny particles and that the arrangement and behavior of those particles account for matter's properties.

Matter is all around us. The things we see—a tree, a window—and even things we can't see—air, the smell of a rose—are all made up of matter. We can describe and identify matter in terms of properties, such as color, hardness, and whether a material conducts electricity or responds to magnetism.

Matter can exist in different states: as a solid (ice), a liquid (water), or a gas (water vapor). Matter can be mixed to form solutions, such as salt water, or mixtures, such as cement or granite.

Students will model the concept that matter is made of particles too small to be seen. Later in the unit they will learn that atoms bond together in various ways to make more complex forms of matter.

Matter undergoes physical changes when a characteristic of the matter changes but the chemical nature remains the same (for example, baking soda dissolved in water). Matter undergoes chemical changes when two types of matter interact to form a new substance (for example, when vinegar is poured into a cup of baking soda). Whether the change is physical or chemical, the amount of matter remains the same.

### Note to Teachers and Curriculum Planners

This unit introduces Grade 5 students to real-world examples and fundamental concepts of matter, which will be explored in greater depth in later grades. Students will learn about properties, structures, and interactions of matter as well as the basics of the language of chemistry. The following are preliminary considerations for planning and instruction relative to this unit:

- This unit does not assess students on their ability to differentiate between *mass* and *weight*, though both terms are introduced.
- Teachers should correct the misconception that only solid objects have weight. Examples of liquids and gases are explored through firsthand experiences to support learning about various states of matter.
- The term *atom* is introduced only after the concept is established that matter is composed of particles too small to be seen. The use of the term continues to be introductory in Grade 5.
- Students are not expected to differentiate between chemical and physical changes but are introduced to these terms relative to observing properties before and after change. Students are not expected to explain chemical reactions but to note that the total amount of matter stays the same when matter changes.



## Note to Longtime Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, in particular, students benefit from not just reading about concepts and ideas, but 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 *2010 Core Knowledge Sequence*. The result of this effort is the revised *2019 Core Knowledge Science Sequence*.

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

### Online Resources



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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

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

- 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; and
- connecting scientific learning to concepts across various disciplines, such as mathematics and literacy.

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

Examples of content retained from the <i>2010 Core Knowledge Sequence</i>	Examples of Core Knowledge content in this CKSci Unit
<b>Chemistry: Basic Terms &amp; Concepts (Grade 4)</b> <ul style="list-style-type: none"><li>• All matter is made up of particles too small for the eye to see, called atoms.</li><li>• Properties of matter, including mass and volume</li><li>• Most things are made up of a combination of elements.</li></ul> <b>Chemistry: Matter &amp; Change (Grade 5)</b> <ul style="list-style-type: none"><li>• Chemical change results in a new substance with a new molecular structure.</li><li>• Physical change changes only certain properties, but does not change what the substance is made up of.</li></ul>	<b>Properties of Matter</b> <ul style="list-style-type: none"><li>• Matter is made of particles too small to be seen.</li><li>• Basic properties of matter, including mass and volume</li></ul> <b>Changes in Matter</b> <ul style="list-style-type: none"><li>• Physical changes occur when a physical characteristic of the matter is changed but the type of matter remains the same.</li><li>• A chemical change occurs when two types of matter interact to form a new substance.</li></ul> <b>Introduction to the Language of Chemistry</b> <ul style="list-style-type: none"><li>• Atoms can join to form molecules or compounds.</li></ul>
For a complete look at how CKSci relates to the <i>2010 Sequence</i> , please refer to the full Correlation Charts available for download using the Online Resources Guide for this unit: <a href="http://www.coreknowledge.org/cksci-online-resources">www.coreknowledge.org/cksci-online-resources</a>	

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

---

This unit, *Investigating Matter*, has been informed by the following Grade 5 Performance Expectations for the NGSS topic *Structures and Properties of Matter*. Students who demonstrate understanding can:

**5-PS1-1** Develop a model to describe that matter is made of particles too small to be seen.

**5-PS1-2** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

**5-PS1-3** Make observations and measurements to identify materials based on their properties.

**5-PS1-4** Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

### Online Resources



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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

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

### Sources:

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

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

### What Students Should Already Know

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

#### PS1.A: Matter and Its Interactions

- Grades K–2**
- Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces (e.g., blocks, construction sets). Objects or samples of a substance can be weighed, and their sizes can be described and measured.

#### PS1.B: Chemical Reactions

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

### What Students Need to Learn

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



## A. Properties of Matter

LESSONS 1–3

- Matter is anything that has mass.
- Basic properties of matter include
  - Mass: the amount of matter in an object
  - Weight: the force exerted on an object by gravity
  - Volume: a measure of the amount of space an object takes up
- Materials can be described in terms of many properties (including color, hardness, reflectivity, density, electrical conductivity, response to magnetism, ability to dissolve).
- Materials can be identified by observing and measuring their specific properties.

## B. Structure of Matter

LESSONS 4–5

- Matter is made of particles too small to be seen.
- Real-world examples that demonstrate and model that matter is made of particles:
  - Dissolve sugar cubes in water
  - Expand a balloon by blowing air into it
  - Evaporate salt water by boiling or leaving it open to the air

## C. Physical Changes in Matter

LESSONS 6–7

- Physical changes occur when a physical characteristic of the matter is changed but the type of matter remains the same.
- Changing states of matter:
  - Solid matter has definite shape and volume.
  - Liquid matter has definite volume but indefinite shape.
  - Gases have no definite shape and no definite volume.
- The example of water: when changing states, it remains water.
- Other physical changes:
  - Dividing an object into pieces
  - Dissolving a substance
  - Mixing two substances (for example, sand and iron filings, or a sedimentary rock)
- When substances undergo physical change, no matter is gained or lost—the total weight of matter is conserved.
  - Example: Put ice in a beaker, and weigh it. Let the ice melt, and then weigh it again—it weighs the same.
  - Example: Dissolve sugar in water, boil water away, and sugar remains.
  - Example: Use a magnet to separate small pieces of iron from sand.

- A chemical change occurs when two types of matter interact to form a new substance.
- Evidence that a chemical change has occurred includes changes in odor, color, or temperature or formation of a gas.
- Examples of chemical changes:
  - Burning an object
  - Rusting metal
  - Digesting food
- When substances undergo chemical change, no matter is gained or lost—the total weight of matter is conserved.
  - Example: When burning an object, all the gases and ashes will weigh the same as the original object.

## E. Introduction to the Language of Chemistry

## LESSONS 11–12

- Chemistry: the scientific study of what matter is made of and how matter changes
- Matter is made of particles too small to be seen, called atoms.
- Matter made up of only one kind of atom is called an element.
- Atoms can bond together to form molecules.
  - How common molecules may be modeled: water, carbon dioxide, ammonia, methane

## What Teachers Need to Know

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

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

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

## USING THE STUDENT READER

Student Reader



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

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

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

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

## USING THE TEACHER GUIDE

### Pacing

The *Investigating Matter* unit is one of five units in the Grade 5 CKSci series. To meet NGSS Performance Expectations we encourage teachers to complete all units during the school year. To be sure all NGSS Performance Expectations are met, each Core Lesson should be completed, and each requires thirty to forty-five minutes of instruction time. The time it takes to complete a lesson depends on class size and individual circumstances.

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

At the end of this Unit Introduction, you will find a Sample Pacing Guide on page 15 and a blank Pacing Guide on pages 16–17, which you may use to plan how you might pace the lessons, as well as when to use the various other resources in this unit. We strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson. As a general rule, we recommend that you spend no more than twenty days teaching the *Investigating Matter* unit so that you have time to teach the other units in the Grade 5 CKSci series.



## The Core Lessons

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

PART	LESSON	BIG QUESTION
<b>A. Properties of Matter</b> (5-PS1-3)	<b>1.</b> Introduction to Matter (two class sessions)	What is matter?
	<b>2.</b> Properties of Matter	What properties can I use to describe matter?
	<b>3.</b> Applying Properties of Matter (three class sessions)	How can I use properties as evidence to identify matter?
<b>B. Structure of Matter</b> (5-PS1-1)	<b>4.</b> Particles of Matter	What evidence suggests that matter is made of smaller particles?
	<b>5.</b> Too Small to Be Seen	How do models help to explain that matter is made of small particles?
<b>C. Physical Changes in Matter</b> (5-PS1-2)	<b>6.</b> Ice to Water and Back (two class sessions)	How can one type of matter change?
	<b>7.</b> How Matter Changes	Does the amount of matter change during a physical change?
<b>D. Interactions of Matter</b> (5-PS1-4)	<b>8.</b> Changing the Type of Matter	How can combining matter form a new substance?
	<b>9.</b> Matter Can Change Chemically (two class sessions)	Why do some interactions of matter result in new substances?
	<b>10.</b> Investigating Chemical Change (two class sessions)	Does the amount of matter change during a chemical change?
<b>E. Introduction to the Language of Chemistry</b>	<b>11.</b> The Language of Chemistry	What are atoms, elements, and molecules?
	<b>12.</b> Comparing Models of Different Molecules	How are molecules of different matter similar and different?
<b>Unit Review and Assessment</b>	Matter Review Game	What have I learned about matter?
	Unit Assessment	What have I learned about matter?

## Activity Pages and Unit Assessment

### Activity Pages



Black line reproducible masters for Activity Pages and a Unit Assessment, as well as an Answer Key, are included in Teacher Resources on pages 111–156. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced.

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

AP 1.1

Lesson 1—Observing Matter (AP 1.1)

AP 2.1

Lesson 2—What's the Matter? (AP 2.1)

AP 3.1

Lesson 3—Identifying Matter: Investigation Guide (AP 3.1)

AP 3.2

Lesson 3—Identifying Matter: Conclusions from Evidence (AP 3.2)

AP 3.3

Lesson 3—Identifying Matter: Investigation Wrap-Up—Solving a Problem (AP 3.3)

AP 4.1

Lesson 4—Observation Sheet (AP 4.1)

AP 4.2

Lesson 4—Lesson 4 Check (AP 4.2)

AP 5.1

Lesson 5—Balloon Model (AP 5.1)

AP 6.1

Lesson 6—Ice and Water Investigation (Day 1) (AP 6.1)

AP 6.2

Lesson 6—Ice and Water Investigation (Day 2) (AP 6.2)

AP 7.1

Lesson 7—Matter Conservation (AP 7.1)

AP 8.1

Lesson 8—Chemical Changes Observation Sheet (AP 8.1)

AP 9.1

Lesson 9—What Kind of Change Will Happen? (AP 9.1)

AP 9.2

Lesson 9—Chemical Changes Finder (AP 9.2)

AP 9.3

Lesson 9—Lesson 9 Check (AP 9.3)

AP 10.1

Lesson 10—Investigating Chemical Change (AP 10.1)

AP 11.1

Lesson 11—What Is Matter Made Of? (AP 11.1)

AP 12.1

Lesson 12—Comparing Molecules (AP 12.1)

AP UR. 1

Unit Review—Matter Review Game (AP UR.1)

AP UR. 2

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

AP UR. 3

Unit Review—Matter Vocabulary Review (AP UR.3)

## Online Resources for Science

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### 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](http://www.coreknowledge.org/cksci-online-resources)

## Teaching Strategies

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### Start with the familiar.

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

### Ask the Big Question.

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

### Encourage scientific thinking.

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

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

### Use continuous Core Vocabulary instruction.

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

Core Vocabulary words for each lesson, as well as other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary definitions in the Word Work lesson segments, as well as in the Glossary on pages 157–158.



**Emphasize observation and experience.**

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

**Use science practices.**

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

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

**Make frequent connections.**

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

**Monitor student progress.**

Use verbal questioning, student work, the Check for Understanding assessments at the end of each lesson, and the Unit Assessment at the end of the unit (see pages 144–150) to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.

## Effective and Safe Classroom Activities

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 159–163, 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

Online Resources



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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## MATERIALS AND EQUIPMENT

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

### Part A: Properties of Matter

#### Lesson 1

- station signs (for stations 1–6)
- 4 graduated beakers
- 2 small rocks
- sugar cubes (6 or more)
- deflated balloon
- partially inflated balloon
- foam cup
- metal cup
- ice (for both cups)
- 3 pieces of chalk
- sheets of colored paper
- aluminum foil
- plastic nuts and bolts
- metal nuts and bolts
- magnet
- water
- 1 cup sugar
- 1 cup salt
- tablespoon
- 2 glass jars
- masking tape
- marker
- note card/index card

#### Lesson 2

- medium-sized container
- water
- small balloon
- medium-sized rock
- piece of chalk
- list of various objects in your classroom (for quick reference)
- various objects that will sink or float in a container of water (such as rocks, foam blocks, plastic blocks, oil, etc.)

#### Lesson 2, continued

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

#### Lesson 3

- small boxes (e.g., shoeboxes; 1 per pair of students)
- flour
- table salt
- sugar (white, granulated)
- plaster powder
- baking soda
- plastic spoons
- water
- vinegar
- droppers
- stir sticks
- black construction paper
- hand magnifying lens
- marker
- clear plastic cups (12 per pair of students, plus 22 for stations)
- table cards (for 12 stations and object labels)
- paper clips
- aluminum wire (such as craft wire)
- magnet
- penny
- rock
- ceramic tile
- nail
- conductivity tester
- index cards for student vocabulary deck (2 per student)

## Part B: Structure of Matter

### Lesson 4

- hot plate
- beakers (2 of equal volume and size)
- sugar cubes (3 or more)
- stirrer
- press-and-seal bags (2)
- heavy spoon (or hammer; for crushing cubes)
- water (warm and at room temperature)
- ice cubes
- bucket (for discarding water)
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

### Lesson 5

- clear tubing, approximately 12 inches in length
- duct tape
- press-and-seal bags (2)
- balloon
- pinwheel
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (5 per student)

## Part C: Physical Changes in Matter

### Lesson 6

- eye goggles
- tongs
- hot plate
- scale, accurate to tenths of a gram
- freezer (or access to a freezer)
- beaker
- ice cubes
- small paper cups, 10 oz.
- marker
- plastic tray
- calculators
- acetic acid (vinegar)
- graduated cylinder

### Lesson 6, continued

- sodium bicarbonate (baking soda)
- small paper cup
- teaspoon

### Lesson 7

- index cards for student vocabulary deck (7 per student)

## Part D: Interactions of Matter

### Lesson 8

- clear bowl
- whisk
- tablespoon
- borax
- nitrile gloves
- white glue
- water
- measuring cup
- food coloring (assorted colors)
- match and matchbook
- candle
- glow sticks
- clear cup
- bleach
- clear liter bottle
- vegetable oil
- bubbling acid tablet
- index cards for student vocabulary deck (2 per student)

### Lesson 9

- pad of steel wool, any grade of coarseness
- scissors
- acetic acid (vinegar)
- small cup
- paper towel
- gloves and eye protection
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (4 per student)

## Lesson 10

- safety goggles (1 pair per student)
- gallon-size press-and-seal bags (1 per group)
- thermometers, glass bulb (1 per group)
- vinegar (acetic acid)
- baking soda
- paper cups (1 per group)
- plastic bottle caps (1 per group)
- tablespoons (1 per group)
- scales (1 per group)
- small pieces of sturdy cardboard (1 per group)

## Part E: Introduction to the Language of Chemistry

### Lesson 11

- index cards for student vocabulary deck (5 per student)

### Lesson 12

- modeling clay (three colors: red, yellow, blue)
- toothpicks

### Unit Review

- whiteboard or chart paper
- sticky notes (variety of colors)
- markers
- question and answer cards/sheet
- timer



## SAMPLE PACING GUIDE

The sample Pacing Guide suggests use of the unit's resources across a twenty-day period. However, there are many ways that you may choose to individualize the unit for your students, based on their interests and needs. You may elect to use the blank Pacing Guide on pages 16–17 to reflect alternate activity choices and alternate pacing for your class. If you plan to create a customized pacing guide for your class, we strongly recommend that you preview this entire unit and create your pacing guide before teaching the first lesson.

### Online Resources



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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

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

### Week 1

Day 1	Day 2	Day 3	Day 4	Day 5
Introduction to Matter DAY 1 TG Lesson 1 AP 1.1	Introduction to Matter DAY 2 TG Lesson 1 AP 1.1	Properties of Matter TG Lesson 2 SR Chapter 1 AP 2.1	Applying Properties of Matter DAY 1 TG Lesson 3 SR Chapter 2 AP 3.1	Applying Properties of Matter DAY 2 TG Lesson 3 AP 3.1, 3.2

### Week 2

Day 6	Day 7	Day 8	Day 9	Day 10
Applying Properties of Matter DAY 3 TG Lesson 3 AP 3.2, 3.3	Particles of Matter TG Lesson 4 AP 4.1, 4.2	Too Small to Be Seen TG Lesson 5 SR Chapter 3 AP 5.1	Ice to Water and Back DAY 1 TG Lesson 6 AP 6.1	Ice to Water and Back DAY 2 TG Lesson 6 AP 6.1, 6.2

### Week 3

Day 11	Day 12	Day 13	Day 14	Day 15
How Matter Changes TG Lesson 7 SR Chapter 4 AP 7.1	Changing the Type of Matter TG Lesson 8 AP 8.1	Matter Can Change Chemically DAY 1 TG Lesson 9 SR Chapter 5 AP 9.1	Matter Can Change Chemically DAY 2 TG Lesson 9 SR Chapter 5 AP 9.2, 9.3	Investigating Chemical Change DAY 1 TG Lesson 10 AP 10.1

### Week 4

Day 16	Day 17	Day 18	Day 19	Day 20
Investigating Chemical Change DAY 2 TG Lesson 10 AP 10.1	The Language of Chemistry TG Lesson 11 SR Chapter 6 AP 11.1	Comparing Models of Different Molecules TG Lesson 12 AP 12.1	Matter Review Game TG Unit Review AP UR.1, UR.2, UR.3	Unit Assessment AP Unit Assessment

## PACING GUIDE

Twenty days have been allocated to the *Investigating Matter* unit to complete all Grade 5 science units in the *Core Knowledge Curriculum Series™*. If you cannot complete the unit in twenty consecutive days of science instruction, use the space that follows to plan lesson delivery on an alternate schedule

### Week 1

Day 1	Day 2	Day 3	Day 4	Day 5

### Week 2

Day 6	Day 7	Day 8	Day 9	Day 10

### Week 3

Day 11	Day 12	Day 13	Day 14	Day 15

### Week 4

Day 16	Day 17	Day 18	Day 19	Day 20

**Week 5**

**Day 21**

**Day 22**

**Day 23**

**Day 24**

**Day 25**

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**Week 6**

**Day 26**

**Day 27**

**Day 28**

**Day 29**

**Day 30**

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**Week 7**

**Day 31**

**Day 32**

**Day 33**

**Day 34**

**Day 35**

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**Week 8**

**Day 36**

**Day 37**

**Day 38**

**Day 39**

**Day 40**

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## PART A

# Properties of Matter

### OVERVIEW

Lesson	Big Question	Advance Preparation
1. Introduction to Matter (2 days)	What is matter?	Gather materials for the group stations and the teacher demonstration. (See Materials and Equipment, page 12.)
2. Properties of Matter	What properties can I use to describe matter?	Read Chapter 1 in the Student Reader.
3. Applying Properties of Matter (3 days)	How can I use properties as evidence to identify matter?	Gather materials for the hands-on investigation. (See Materials and Equipment, page 12.)

### Part A: What's the Story?

Any type of matter has properties that make it different from any other type of matter. This series of lessons supports students as they learn about different properties of matter through observation. Knowing these properties enables students to identify different matter and helps them accurately describe all the matter around them.

**In Lesson 1**, students begin by making observations of matter while rotating through six stations across two days. Students are not required to identify the matter at each station; rather, they familiarize themselves with observable physical characteristics of matter. The goal is to get students to see that everything has characteristics, or properties, that help us to describe it. They also discuss why and how scientists and engineers use knowledge of different types of matter to solve problems.

**In Lesson 2**, students read about specific properties that can be used to describe and identify matter, including color, hardness, reflectivity, thermal conductivity, and solubility. We do not expect students to distinguish between weight and mass at this level or expect them to understand the concept of density. Guided discussion also helps students understand the importance of specific properties to engineering solutions in the real world, extending knowledge from Lesson 1.

**In Lesson 3**, students perform a three-day investigation to observe examples, record properties, and use those properties to identify specific kinds of matter. On Day 3, they use what they have learned to solve a problem. The goal is for students to understand that properties serve as evidence for differentiating one kind of matter from another and that knowing about matter can help engineers solve problems.

So, to repeat, **matter has specific properties that can be used to describe or identify it**. Scientists and engineers use their knowledge of matter to design technology that solves problems. Help your students grasp these two concepts, and you will help them to meet or exceed the NGSS Performance Expectation 5-PS1-3, and you will lay the groundwork for meeting the expectations addressed in later parts of this unit.



## LESSON 1

# Introduction to Matter

**Big Question:** What is matter?

## AT A GLANCE

### Learning Objectives

- ✓ Describe, measure, and compare different examples of matter.
- ✓ Identify basic properties of matter (such as weight, volume, and other observable characteristics).

### Lesson Activities (2 days)

- student observation
- teacher demonstration
- discussion

### NGSS References

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

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Planning and Carrying Out Investigations

**Scale, Proportion, and Quantity** and **Planning and Carrying Out Investigations** are important to this lesson because they introduce students to the ways in which physical qualities can be observed, described, and measured. Throughout this two-day lesson, students observe examples of matter that have properties.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

evidence  
mass

**matter**  
measure

observe  
**property**

volume  
weight

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

## Instructional Resources

Activity Page



AP 1.1

### Activity Page

Observing Matter (AP 1.1)

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

## Materials and Equipment

Collect or prepare the following items:

- station signs (for stations 1–6)
- **Station 1:** 2 graduated beakers with water, small rock, sugar cubes (6 or more)
- **Station 2:** deflated balloon, partially inflated balloon
- **Station 3:** foam cup, metal cup, ice for both
- **Station 4:** small rock, pieces of chalk, sheets of colored paper
- **Station 5:** aluminum foil, sheet of paper
- **Station 6:** plastic nuts and bolts, metal nuts and bolts, magnet
- **Mystery Powders** (Day 2): 2 graduated beakers (or liquid measuring cups), 2 cups water, 1 cup sugar, 1 cup salt, tablespoon, 2 glass jars, masking tape, marker, note card/index card

### Preparation and Rationale

Set up six stations around the classroom where students will make observations about matter over the course of two days:

#### Station 1

Prepare two beakers with equal amounts of water. Add a small rock to one of the beakers. Add a sugar cube to the other beaker. (See **Know the Science 1.**)

- Prepare this station in advance to allow about two minutes for the sugar cube to partially dissolve by the time students arrive at the station.
- As students rotate through stations, you may need to add new cubes to the water to get the desired “partially dissolved” state of the cube in water.

## Know the Science

**1. Solubility** Certain materials have the ability to dissolve, known as solubility. Although students do not need to memorize this term at Grade 5, it is an important and unique property of matter to demonstrate. In this station, students will compare and contrast two types of matter in which one has the property of solubility and will be dissolving.

- Station 2** Place a deflated balloon on the table. Next to the balloon, place a partially inflated balloon. (See **Know the Science 2.**)
- Station 3** Fill a foam cup and a metal cup with the same amount of ice. (See **Know the Science 3.**)
- Station 4** Place a medium-sized rock on the table next to a piece of blank paper. Place a piece of chalk on the table next to another piece of blank paper. (See **Know the Science 4.**)
- Station 5** Set up a piece of aluminum foil next to a piece of paper. (See **Know the Science 5.**)
- Station 6** Place the metal and plastic nuts and bolts on the table in random order. Set the magnet on the other side of the table, and label it “Magnet.” (See **Know the Science 6.**)

## Know the Science

**2. Elasticity and Gas** The deflated balloon has elasticity and can be stretched. The partially inflated balloon contains gas, which is matter that takes up space but cannot be seen. Students should be able to understand that matter takes up the space inside the partially inflated balloon but that there is much less air in the deflated balloon.

**3. Thermal Conductivity** Objects can transfer their heat energy to other objects through a phenomenon known as thermal conductivity. Different kinds of matter conduct heat differently. In this station, students will observe that the ice cube is insulated inside the polystyrene cup. As a result, there is little thermal conductivity (heat energy transfer) occurring through the walls of the polystyrene cup. However, thermal conductivity occurs more rapidly with the metal cup, as the metal cup will feel cold to the touch. (This is because the molecules of metal in the cup slow down when they are in contact with the ice.)

**4. Hardness** Some materials are hard, and others are soft. This station allows students to compare the hardness of a rock to the hardness of a piece of chalk. Students can scrape the rock and the chalk against the piece of paper to see what happens when each one rubs against another surface. Students will see and describe that the rock is harder and the chalk is softer. The chalk may even break.

**5. Reflectivity** Objects have the ability to reflect light. This is known as the property of reflectivity. In this station, students compare a piece of paper (nonreflective) to aluminum foil (reflective) with as much scientific accuracy as they can. Both the aluminum foil and paper are thin and pliable, but one is more reflective than the other.

**6. Magnetism** Certain materials are attracted to magnets, and other materials are not. Students have the opportunity to make observations about objects that have a similar shape but different properties, which make some (such as certain metal nuts and bolts) magnetic and others (such as plastic nuts and bolts) nonmagnetic.

## Instructional Notes

This lesson will require two class sessions, approximately forty-five minutes each, for students to rotate through all six observation stations and to complete Observing Matter (AP 1.1). Each student or group should be able to get through three stations each day. You may want to randomly or purposefully assign students to one of six groups and cue the whole class when it is time to move from one station to the next (approximately five to ten minutes per station).

**Prior Knowledge** Students should already be familiar with the following concepts:

- Matter is anything that has mass (and takes up space).
- Matter can be solid, liquid, or gas.
- Matter exists as different substances that have observably different properties.
- Different properties are suited to different purposes.
- Objects can be built from smaller parts.
- Heating and cooling matter can change it (sometimes reversibly, sometimes not).

The lessons in this unit will build upon this prior knowledge. Students will apply their knowledge to the activity as they make observations about matter.

## THE CORE LESSON TWO DAYS, 45 MIN EACH

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

5 MIN

Activity Page



AP 1.1

**What is matter?** Go over the directions for Observing Matter (AP 1.1). Let students know that they will be traveling to different stations and observing familiar objects to begin their investigations of the structures and properties of matter. At each station, examples of matter are provided that are similar in some ways but different in other ways. Students will need to record their observations of matter based on the properties that they can see, feel, smell, or measure. Let students know that there is not one set of correct answers for this Activity Page. Instead, the goal is to write down as many observations as possible. Prompt students to make close observations of the objects at the stations, including such things as color, smell, size, shape, etc., and to look for differences between the objects.

### Preview Core Vocabulary

Display the Core Vocabulary words **matter** and **property** on the board or chart paper. Tell students that all the objects and materials they will examine are made of matter and that all the details they observe about the objects and materials are properties. Students will complete cards for their Core Vocabulary deck for these terms in the next lesson.

## 2. Preview the investigation.

5 MIN

Show students that there are six stations set up around the room. Explain that they will visit each station to observe different objects. Point out that the stations are numbered, so students should make sure they are looking at the correct station number on their Observing Matter (AP 1.1) to complete the Activity Page correctly.

Tell students that as they arrive at each station, they should observe the objects in as many ways as possible. For example, prompt them that they can do the following:

- Pick up and touch the objects.
- Smell the objects.
- Note the color of the objects.
- Inspect the hardness of the objects.
- Compare the objects for similarities and differences. Remind students to smell the materials only when specifically instructed to do so by a teacher and to gently waft air from materials to detect odors.

### Safety Note

Do not allow students to taste any of the objects.

## 3. Support the investigation.

25 MIN

Circulate around the room as students conduct their observations.

**SUPPORT**—Use guiding questions to help students focus their work, such as the following:

- What does the matter feel like?
- How does it smell?
- Can you describe what you see?
- How does this object compare with that object?
- What is happening to the object?

Avoid telling students what they should observe at each station or what the correct properties are for each of the objects.

## 4. Encourage student questions.

5 MIN

Tell students that they should ask and answer each other's questions about what they observe at each station. Asking questions is essential to making good observations, as questions can help people learn more about science.



## 5. Monitor student progress.

5 MIN (PER DAY)

Review the types of things students are recording, and check for understanding of the prompts on Observing Matter (AP 1.1) to determine if students seem to be missing important concepts of this activity. (See **Know the Standards 1.**)

**SUPPORT**—Provide assistance by starting with more basic observations using guiding prompts, such as the following:

- What colors are the materials?
- What sort of smells do the materials have?
- What texture does each material have?
- How are the materials the same?
- How are the materials different?

## 1. Day 2: Continue the investigation.

20 MIN

Facilitate students' rotation through the three stations they did not visit in the previous class session. Refer back to Day 1, Steps 1–5, for instructional support.

### Instructional Notes

Before the end of Day 2, you will need to gather and prepare the materials listed below for the culminating teacher demonstration and discussion. After students finish the last of their six stations, prompt students to return to their seats/tables for a whole-class demonstration. Be sure not to tell students what each of the mystery powders is.

Prepare the demonstration by doing the following:

- Place 1 cup sugar into a glass jar, and label the jar "Mystery Powder 1."
- Place 1 cup salt into the other glass jar, and label the jar "Mystery Powder 2."
- Label two empty beakers in the same way.

Have the following materials ready for your teacher demonstration:

- water (enough to fill each beaker  $\frac{3}{4}$  full)
- tablespoon

## Know the Standards

**1. Structure and Properties of Matter** Students should be able to identify the purpose of the investigation, which is to observe the different properties of matter to identify or organize information about materials. At this level, students are not expected to understand density or distinguish between mass and weight. However, they should start to recognize that materials can be identified based on their properties, which can be observed and/or measured.

## 2. Demonstrate more examples.

15 MIN

The purpose of this interaction is to orient students to approach problems with a scientific mindset at the beginning of the unit. Additionally, you will be modeling basic lab practices in the measurement of the materials, a skill that students will apply throughout the activities in the unit. Finally, in this demonstration students will also be asked to develop and apply critical thinking skills that will be used throughout the unit and beyond.

Tell students that you are going to prepare two mixtures of mystery powders and water. Explain what you do for each step:

- Show students an empty graduated beaker. Explain that there are markings on the side of the beaker for measuring liquid volume, the amount of space a liquid takes up, in milliliters.
- Fill each beaker with the same amount of water. (Liquid measuring cups can be substituted for the graduated beakers if beakers are not available. Be sure to know and understand the units used on the graduated beakers or the measuring cups.)
- Take 1 tablespoon of sugar from the Mystery Powder 1 glass jar, but do not tell students what it is. Pour the tablespoon into the beaker with the corresponding label.
- Take 1 tablespoon of salt from the Mystery Powder 2 glass jar, but do not tell students what it is. Pour the tablespoon into the beaker labeled Mystery Powder 2.
- Ask: How could you safely determine what each powder is?

Emphasize to students that the same amount of water was added to each beaker and that the same amount of powder was added to the water. Next, model how you measure and record the volume of the mixtures in each beaker on an index card.

Set the beakers in an area of the classroom where they will not be disturbed, and place the index cards with the original measurements in front of the beakers. Tell students that they will return to these beakers in a couple of days. Record student ideas for future reference, and support their thinking of how to safely determine the identity of each powder. (See **Know the Standards 2.**) After a couple days, the water should start to evaporate. Placing the beakers on a warm and/or sunny surface will speed up the evaporation. As the water evaporates, the beaker with Mystery Powder 2 (salt) will start to have a white residue of salt. The beaker with Mystery Powder 1 (sugar) will have a clearer residue of sugar.

## Know the Standards

**2. Volume** In Lesson 3, students will measure the volume of water in each beaker as evaporation proceeds. By setting up this evaporation test now, we are allowing more time for the evaporation to become more obvious. Using their investigation charts that they will receive in Lesson 3, students will study the beakers and use the measurement of volume as evidence to identify the mystery white powders based on their observable properties.

### 3. Guide discussion.

5 MIN

Scientists study the properties of matter because they can help solve engineering problems. For example, dissolving certain matter in water can create different kinds of mixtures with different properties. Salt water conducts electricity much better than a mixture (solution) of sugar and water. Have students think about the properties of other kinds of matter, such as wood, metal, and concrete. Ask the following:

- » Which kind of matter do you think would provide the best building material for a bridge? Why? *(Possible answer: Concrete would make the best bridge because it is durable and strong.)*
- » Which one do you think would provide the best building material for a tall office building? Why? *(Possible answer: Metal such as steel would make the best tall building because it can be formed into beams that can be bolted together in endless combinations.)*
- » Which one do you think would provide the best building material for a canoe? Why? *(Possible answer: Wood would make the best canoe because it can be shaped to keep water out and float.)*

Scientists and engineers consider the cost and the criteria when they work to design bridges, buildings, and even canoes. Support students as they identify possible criteria for the designs of each of the three examples. *(Bridges must be strong enough to support weight as vehicles cross; Tall buildings must be solid enough to resist weather patterns in the area; Canoes are intended to float; etc.)* Also help students to consider that some materials are more expensive than others and that selecting materials that fit a certain budget (a constraint) is also taken into consideration by designers.

### 4. Check for understanding.

5 MIN

Activity Page



Answer Key

#### Formative Assessment Opportunity

See the Activity Page Answer Key (AP 1.1) for correct answers and sample student responses. Evaluate students' completed Activity Pages to identify gaps in understanding or misconceptions to address as the unit progresses.

Prompt students to express any questions they may have about how scientists and engineers describe matter. Discuss strategies for answering their questions, and preview the remainder of the unit, particularly Lessons 2 and 3.

## LESSON 2

# Properties of Matter

**Big Question:** What properties can I use to describe matter?

## AT A GLANCE

### Learning Objectives

- ✓ Identify basic properties of matter (such as weight, volume, and other observable characteristics).
- ✓ Use specific properties (such as color, hardness, reflectivity, etc.) to compare and identify different samples of matter.

### Lesson Activities

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

### NGSS References

**Disciplinary Core Idea:** Structure and Properties of Matter

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Scale, Proportion, and Quantity** is important to this lesson because it teaches students that physical qualities can be observed, described, and measured. Students will read about properties of matter, identify examples, and discuss why certain materials are chosen to be included in certain design solutions created by scientists and engineers.

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

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## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

evidence  
mass

**matter**  
measure

observe  
**property**

volume  
weight

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

## Instructional Resources

Student Reader



Ch. 1

Activity Page



AP 2.1

**Student Reader, Chapter 1**  
“Properties of Matter”

### Activity Page

What’s the Matter? (AP 2.1)

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

## Materials and Equipment

**Collect or prepare the following items:**

- medium-sized container
- water
- small balloon
- medium-sized rock
- piece of chalk
- list of various objects in your classroom (for quick reference)
- various objects that will sink or float in a container of water (such as rocks, foam blocks, plastic blocks, oil, etc.)
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (2 per student)

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 2.1

**What properties can I use to describe matter?** Introduce the directions for What’s the Matter? (AP 2.1). Let students know that they will be listing examples of matter in the classroom and describing what they observe to answer the questions “What are examples of matter?” and “How can I describe matter?” Discuss the example provided on AP 2.1, demonstrating how you might observe a piece of chalk and record your ideas on the page. Let students know that there is not one set of correct answers for this Activity Page.

**SUPPORT**—Prompt students to make close observations using a variety of senses by asking them questions such as “What color is it?”, “Does it feel hard or soft?”, and “Can it bounce, or would it break?” Give students time to find examples around the classroom to make and record their observations.

Remind them that they are observing and describing physical qualities of matter—such as proportion and quantity—and that these qualities can be measured using different kinds of equipment, such as scales, rulers, etc.



## Safety Note

Do not allow students to taste any of the objects. Remind students that smelling tests should only be conducted for materials that teachers have determined to be safe and involve short sniffs, not deep breaths.

## 2. Encourage student questions.

5 MIN

Lead a discussion about the examples of matter that students recorded. Draw attention to the types of observations that students describe, and record any key words used by students without prompting on the board or chart paper. For example, students may already feel comfortable describing matter in terms of “hard,” “soft,” “colors,” and possibly even “reflection.”

**CHALLENGE**—If time allows, challenge students to recall different properties that they explored across the stations in Lesson 1, and encourage them to expand on their responses to AP 2.1.

Make a note whether there are any similarities between student responses, such as a general focus on just a few properties. Discuss other types of observations and properties that can be considered by telling students that they can ask questions such as the following:

- Does it feel heavy or light?
- Does it feel warm or cold?
- Does it have a smell?
- Can it change shape?
- Do you think it would sink or float in water?

Draw students’ attention back to the Big Question, and introduce Chapter 1 of the Student Reader.

## 3. Read and discuss: “Properties of Matter.”

15 MIN

Student Reader



Ch. 1

Read together, or have students read independently, “Properties of Matter,” Chapter 1 in the Student Reader. This selection reinforces the definition of *matter* as anything that has mass and discusses its different properties, such as weight and volume.

### Preview Core Vocabulary Terms

Before reading, write the following terms on the board or chart paper.

**matter**                      **property**

Ask students to pay particular attention to these words as they read. Tell students that you will stop and discuss the meaning of each term in context as they read this first chapter.

## Guided Reading Supports

When reading together, pause for discussion of the key terms and questions found in the text to check for understanding. Include suggested questions and prompts:

### Page 1

After reading page 1, ask students to consider this question: Is there anything on this planet that is NOT matter? (See **Know the Science 1.**)

**SUPPORT**—If needed, prompt students to reread the section that says matter can be things we cannot see or touch, such as air or some odor we smell.

Ask students to share their thinking as they identify more examples of matter that seem invisible to the human eye.

### Page 2

Prompt students to share how they know (or how they might predict) how much something weighs. Discuss familiar terms that students use in their daily lives, such as whether something is *heavy* or *light*. Ask students whether they think something that is small can weigh more than something that is large. Then, ask them to explain why or how this is possible. (See **Know the Standards 1, Know the Science 2.**)

## Know the Science

**1. What is matter? Matter is anything that has mass and takes up space.** This includes anything that can be seen, touched, smelled, and tasted. All solids are matter, as are all liquids and gases. When students smell something, what they are smelling are invisible particles in the air. Even though they are too small to be seen, those particles have mass and take up space. Even the air itself is matter, since air is made up of gases and all gases are made up of small particles usually invisible to the naked eye.

## Know the Standards

**1. Making Observations and Measurements We introduce fifth graders to the term *mass*, but it is not expected for students, at this grade level, to distinguish between mass and weight.** The NGSS Performance Expectation 5-PS1-3 does not expect students to be able to differentiate the two, nor are they expected to understand the relationship between these two properties. Similarly, teachers may model the word *density* in the classroom relative to whether objects will sink/float in water (the property of buoyancy), but density as a property of matter is not to be assessed in this lesson. For additional information about the Assessment Boundaries for 5-PS1-3, please refer to the Online Resources Guide for this unit:

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Encourage Scientific Thinking

Discuss real-world connections between examples of matter and the practice of Using Mathematics and Computational Thinking. For example, scientists and engineers often use very precise amounts of matter and have only certain amounts of space that can be used to solve a problem. Ask students to identify examples of matter that cannot be too big or too small, or too light or too heavy.

**SUPPORT**—If needed, prompt students to reread the example of the bread being squished into a ball. Ask students to describe the changes to the bread as specifically as possible. Prompt student-to-student discussion by asking questions such as: Is the bread still bread after you roll it into a ball? Have you added to or taken anything away from the bread when you do this? What *has* changed about the bread after you squish it? (*size/volume, possibly color, etc.*)

### Page 3

Ask students to partner with a classmate and identify other examples of two substances that look similar but have different properties. Then, after giving the pairs time to generate a list and write down similarities and differences, ask volunteers to share their examples with the whole class to discuss the properties of and differences between each substance.

### Pages 4–6

Review with students the following terms: *color, hardness, reflectivity, bouyancy, conductivity* (whether electricity or heat can flow through something), *magnetism*, and *solubility* (the ability to dissolve). Make the point to students that they are learning these specific words about properties to be able to communicate what they observe about matter. Students should also understand that clear communication between scientists and engineers is important. For this reason, they use specific words to convey meanings and communicate ideas. Using clear and concise language helps engineers know which materials are best for a design solution, which reduces the risk of problems in the future.

## Know the Science

**2. What are mass and weight? *Specific properties of matter that can be measured!*** Mass is a measure of the amount of matter in an object. Weight is a measurement of the force exerted on that matter by gravity. The two measurements are related, given a single object, but they are distinctly *different properties*. Think about this: An object still has mass even if it is weightless in the void of space. Research has shown that the difference between mass and weight can confuse many collegiate and adult learners, often leading to hard-to-break misconceptions. For this reason, this unit recommends exposure to the terms to support language development but models instruction that does not assess the difference between them.

## 4. Demonstrate examples and guide discussion.

5 MIN

Choose one of the following, or a similar example, to stimulate further discussion. (If time permits, use both.) For each example, identify and analyze with students 1) the different types of matter observed in the “system” and 2) properties of each type of matter. (See **Know the Standards 2.**)

- Blow up a small balloon, and ask students to predict whether the balloon will sink or float in a container of water. Encourage students to cite evidence/patterns of past experience to support their answers. Repeat this, asking students to support their predictions about whether other objects, such as a rock, will sink or float, using evidence and patterns. Ask what students can observe in this demonstration. (See **Know the Science 3.**)
  - » What happens to the rock when it is placed in the water? (*It sinks.*)
  - » What happens to the balloon when it is placed in the water? (*It floats.*)
  - » Model for students the term *buoyancy*. For example, “Whether something sinks or floats in water is what is known as the property of buoyancy. A blown-up balloon is more buoyant than a rock.”
  - » What other objects do you know that float? That sink? (*Sample answers: Ice cubes and ducks float. Coins sink.*)

### Online Resources



- Show a video of buoyancy as a property that can help identify and study matter. Ask what students can observe about matter in relation to buoyancy:
  - » What is buoyancy?
  - » How can you tell whether an object is buoyant?

## Know the Standards

**2. Structure and Properties of Matter** This lesson introduces students to the basic concept that matter has properties. Buoyancy and density are two such properties; however, these are outside the Performance Expectations for Grade 5. Nonetheless, the phenomenon of sinking and floating is likely very familiar to and easily explored by Grade 5 students. The explanations of *why* something sinks/floats (density) is not the purpose of this lesson. Instead, this lesson models how the property of buoyancy can be explored as an engaging phenomenon using one or both of the following demonstrations.

## Know the Science

**3. What are we showing by putting rocks and balloons in water? Buoyancy!** The property of sinking or floating is called buoyancy. Density is a property of matter that affects an object’s buoyancy and may indicate why it sinks or floats. (See also **Know the Standards 2.**) A rock is denser than the water, so it sinks, or is less buoyant. An air-filled balloon is less dense than the water, so it will be buoyant, or float. Density can be determined by using the formula  $\text{density} = m/v$ , that is, density is mass divided by volume.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection.

- Did you write any observations on your Activity Page that are similar to the rock and balloon demonstration?
- How are these examples similar?
- Encourage students to ask their own questions and answer each others' questions during the discussion.

**CHALLENGE**—If there is time, challenge students to explain or demonstrate how they would test an object to determine whether it would sink or float.

## 5. Teach Core Vocabulary.

5 MIN

### Prepare Core Vocabulary Cards

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

**matter**

**property**

### Word Work

- **matter:** (n. anything that has mass and takes up space) Point out that *matter* is a noun. Have students write the definition of *matter*, along with an example of *matter* that is different from examples discussed in the Student Reader. Then write a sentence on the board or chart paper: *Matter takes up space.* Ask volunteers to explain how they know *matter* is a noun in this sentence.
- **property:** (n. a quality, trait, or detail used to describe something) Explain that students may have heard the term *property* before in everyday language. In day-to-day life, we talk about property as something that people own. (*The backpack is his personal property; or, The art supplies are school property.*) In science, *properties* refer to characteristics or traits. Have students write a sentence as you dictate it: "I can identify materials by their properties." Then have them write their own sentence using the word *properties*. Ensure that they are writing about the correct meaning of the term. There are many types of properties, such as color and texture.

**SUPPORT**—Ask the class to help you, or a partner next to them, to compose a single sentence using both words, *matter* and *properties*, to help assess their understanding of these two terms.

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

## 6. Check for understanding.

5 MIN

Activity Page



Answer Key

### Formative Assessment Opportunity

As students finish the Core Vocabulary task, collect their completed What's the Matter? (AP 2.1). Scan the observations that students made, and review the questions that they had about their examples. Refer to the Activity Pages Answer Key for sample responses.

Choose one or two questions posed in students' work to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions. For example, some students may believe that matter is only something they can see and touch. However, matter is anything that takes up space, including invisible gases, liquids, and solids.



## LESSON 3

# Applying Properties of Matter

**Big Question:** How can I use properties as evidence to identify matter?

## AT A GLANCE

### Learning Objectives

- ✓ Investigate and record the properties of different samples of matter.
- ✓ Use evidence from observations and measurements to support a scientific argument.
- ✓ Identify samples as particular types of matter based on their properties.

### Lesson Activities (3 days)

- hands-on investigation
- observation
- reading and discussion

### Instructional Resources

Student Reader



Ch. 2

Activity Pages



AP 3.1

AP 3.2

AP 3.3

**Student Reader, Chapter 2**  
“Applying Properties of Matter”

#### Activity Pages

Identifying Matter: Investigation Guide (AP 3.1)

Identifying Matter: Conclusions from Evidence (AP 3.2)

Identifying Matter: Investigation Wrap-Up—Solving a Problem (AP 3.3)

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

### NGSS References

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

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Planning and Carrying Out Investigations, Engaging in Argument from Evidence

**Planning and Carrying Out Investigations** is important to this lesson as students learn how to identify the phenomenon under investigation. On the first day of this three-day lesson, students will be introduced to the investigation plan and will be given the materials needed to identify their samples of matter. Observation and investigation will continue on the second day, and students will have an opportunity to record and analyze their data relative to the problem they are trying to solve. On the third day, students **engage in argument from evidence** by developing a claim and supporting it with evidence. Specifically, students make a claim about which of the unidentified samples would best solve a design problem and why.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

**design process**

**solution**

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

## Materials and Equipment

**Collect or prepare the following items:**

- small boxes (e.g., shoeboxes; 1 per pair of students)
- flour
- table salt
- sugar (white, granulated)
- plaster powder
- baking soda
- plastic spoons
- water
- vinegar
- droppers
- stir sticks
- black construction paper
- hand magnifying lens
- marker
- clear plastic cups (12 per pair of students, plus 22 for stations)
- table cards (for 12 stations and object labels)
- paper clips
- aluminum wire (such as craft wire)
- magnet
- penny
- rock
- ceramic tile
- nail
- conductivity tester
- index cards for student vocabulary deck (2 per student)

## Know the Standards

**1. Structure and Properties of Matter** Each student will test unidentified white powders. The powders are similar in color and form, representing the fact that some types of matter share some properties that are immediately identifiable, such as color or shape. Students will soon find that each powder has other properties that are unique. These can be identified under close inspection (such as when each is mixed with water or vinegar).

- The magnifying lens allows students to visually inspect the shape, color, and texture of the powders.
- The black construction paper serves as contrast for students to better inspect the granules of powder.
- The water and vinegar are added to the powders to show different ways the powders react when mixed with other substances.
- The liquids are presented to students in unidentified cups so that each student has to make observations about the liquid—color, odor, etc.—to show that properties help to identify it.

Students are not expected to identify the type of change (e.g., chemical, physical) that is occurring; they only need to observe what happens during those changes to help them identify the matter.

## Advance Preparation

**Advance preparation for this lesson will require more time than in previous lessons.** Students will conduct their investigations in pairs. Prepare for this lesson by setting up a materials box that each pair of students will receive on the first day of Lesson 3. The materials can be placed into small boxes so that students can take them out and put them back in easily. (See **Know the Standards 1** on the previous page and **Know the Science 1**.) Each materials kit should contain the following:

- 12 stir sticks
- hand magnifying lens
- 12 clear plastic cups
- plastic spoon
- piece of black construction paper
- conductivity tester

To prepare, set up twelve stations around the classroom. Be sure to label each station with tent cards that identify the station number and materials to test, such as “Powder 1,” “Liquid 1,” etc. Set up and label the following stations:

### Station 1

- Materials: aluminum craft wire, paper clips, magnet (See **Know the Standards 3** and **Know the Science 3** on page 44.)

### Station 2

- Materials: 2 plastic cups with water, salt, sugar
- Label one cup “Powder 2,” and stir in a spoonful of salt. Label the other cup “Powder 3,” and stir in a spoonful of sugar.
- Review the instructions that come with the conductivity tester on how to use it. You may wish to modify the activity and have students test solids such as nails, coins, and the graphite in a pencil. (See **Know the Standards 4** and **Know the Science 4** on page 44.)

## Know the Science

**1. Why are students testing different powders? *Unique properties!*** The variety of white powders that students are working with have unique properties. They look somewhat different and produce different effects when combined with water or vinegar. Flour, baking soda, and plaster are fine, dull white powders; these look different from sugar and salt, which are crystalline with shiny particles. When water is mixed with baking soda, it turns a milky color and becomes sticky. Sugar and salt dissolve in water. Flour becomes doughy and pasty. Plaster absorbs water and hardens. When vinegar is mixed with each powder, the vinegar rolls off the flour; baking soda foams, bubbles, and makes noise; sugar partially dissolves; plaster bubbles, melts, and then hardens again; and salt shows no change in vinegar. Each of these are evidence that allows us to distinguish between types of matter based on their different properties.

- Station 3**
- Materials: 2 plastic cups, flour, water
  - Label one cup "Powder 1," and fill with flour. Label the other cup "Liquid 1," and fill with water.
- Station 4**
- Materials: 2 plastic cups, salt, water
  - Label one cup "Powder 2," and fill with salt. Label the other cup "Liquid 1," and fill with water.
- Station 5**
- Materials: 2 plastic cups, sugar, water
  - Label one cup "Powder 3," and fill with sugar. Label the other cup "Liquid 1," and fill with water.
- Station 6**
- Materials: 2 plastic cups, plaster, water
  - Label one cup "Powder 4," and fill with plaster. Label the other cup "Liquid 1," and fill with water.
- Station 7**
- Materials: 2 plastic cups, baking soda, water
  - Label one cup "Powder 5," and fill with baking soda. Label the other cup "Liquid 1," and fill with water.
- Station 8**
- Materials: 2 plastic cups, flour, vinegar
  - Label one cup "Powder 1," and fill with flour. Label the other cup "Liquid 2," and fill with vinegar.
- Station 9**
- Materials: 2 plastic cups, salt, vinegar
  - Label one cup "Powder 2," and fill with salt. Label the other cup "Liquid 2," and fill with vinegar.
- Station 10**
- Materials: 2 plastic cups, sugar, vinegar
  - Label one cup "Powder 3," and fill with sugar. Label the other cup "Liquid 2," and fill with vinegar.
- Station 11**
- Materials: 2 plastic cups, plaster, vinegar
  - Label one cup "Powder 4," and fill with plaster. Label the other cup "Liquid 2," and fill with vinegar.
- Station 12**
- Materials: 2 plastic cups, baking soda, vinegar
  - Label one cup "Powder 5," and fill with baking soda. Label the other cup "Liquid 2," and fill with vinegar.

### Instructional Notes

This lesson will require three class sessions, 30–45 minutes each. On Days 1 and 2, students will have a student reading and conduct their investigations from Identifying Matter: Investigation Guide (AP 3.1). On Day 3, students will have a discussion of their investigation and wrap up their investigation as it relates to the design problem posed at the start of the first day to guide the day’s activities.

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

5 MIN

**How can I use properties as evidence to identify matter?** Remind students that in the previous lesson, they learned about properties of matter. In this lesson, students will investigate and apply what they learned in their investigation to answer a design problem. Pose this problem to students:

- Suppose there were an accident and your bedroom wall ended up with a hole in it. How might you fix the hole?
- What properties of matter would the design problem need to have?

The investigation for this lesson is written with a specific design problem in mind, the repair of a hole in a wall. You may wish to use a different design problem that utilizes other properties of matter such as separating different types of materials out, like in a scrap yard, or creating a good insulator.

## 2. Read and discuss: “Applying Properties of Matter.”

20 MIN

Student Reader



Chapter 2

Read together, or have students read independently, “Applying Properties of Matter,” Chapter 2 in the Student Reader. This chapter introduces students to the design process without using topic-specific terminology. The reading also relates the consideration of properties of matter as they apply to the design process and solutions.

### Preview Core Vocabulary Terms

Before reading, write the following terms on the board or chart paper. Have students identify the words as they read. Stop and discuss the meaning of each term in context.

**design process**

**solution**

### Guided Reading Support

When reading together, pause for discussion of key terms and questions to check for understanding. Include suggested questions and prompts:

After reading, ask: Why would the chain need to be replaced? (*The chain is rusty and wearing out.*)

### Pages 8–9

As the class goes over the design process, stop at each stage, and ask students how they would apply what they are learning about the stage to the design process. Make sure students are also considering the properties of matter each solution would have.

### Page 10

Encourage students to identify other properties of the chain, criteria, and constraints that could go in the table. Write student responses on the board or chart paper. Then consider how each would apply to the three possible solutions suggested. If time allows, have students suggest other possible solutions.

## 3. Teach Core Vocabulary.

5 MIN

### Prepare Core Vocabulary Cards

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

**design process**

**solution**

### Word Work

**design process:** (n. a plan that is used to find and develop solutions to a problem) Instruct students to add a sentence or two to their Core Vocabulary card to explain what the design process is.

**solution:** (n. a way to solve a problem) Clarify to students that sometimes a solution is a product or device. In some cases a solution is a process. Encourage them to note an example of each type of solution on their Core Vocabulary card for the term *solution*.

## 4. Preview the investigation.

15 MIN

Activity Page



AP 3.1

Distribute and review Identifying Matter: Investigation Guide (AP 3.1) with students to familiarize them with the way the Activity Pages are structured and formatted. Explain that students will be working through twelve investigation stations and recording their observations. Once they have finished an investigation station, they should move to the next station. The stations are intended to be done over the first two days of the lesson. At the end of the second day, students will have time to discuss what they have observed and complete the wrap-up of the investigation.

With students observing, do the demonstration with the ceramic tile, nail, penny, and rock. Scratch the nonglazed side of the tile with one of the materials. Ask students to observe what has happened and record it in the table in the Activity Pages. (See **Know the Standards 2** and **Know the Science 2** on the following page.)

**SUPPORT**—Prompt students to consider what each material was like before and after as well as what changes they observed.



Once the demonstration is done, assign a pair of students to each station, and have them follow the directions for their station.

- Review safe lab practices with students, reminding them to never consume any materials, even if the materials are edible. Students should only smell materials when specifically instructed to do so and should use their hands to lightly wave the odor from above the materials to their noses.
- Remind students to not play with the materials at the stations.
- Remind students to take time to observe the materials at the stations rather than just rushing to complete the steps of the investigation.
- Prompt students to record as many observable features as they can about the materials, including things such as color, smell, size, and feel.
- If students mix up their powders by accident, forget which powder is from which cup, or spill the powders, make them a new cup of powder to use.
- Encourage students to label their white powders when they put them on the black construction paper. This can help avoid any mix-ups.

You may want to cue pairs of students on when they can go to each station and move from one station to the next. This will help address possible overcrowding at the stations.

## 1. Day 2: Facilitate the investigation.

20 MIN

Activity Page



AP 3.1

On Day 2, go back over the Big Question. Then have students return to the next station they are due to complete. Students should work through every station by the end of the second day. Let students know that the stations are numbered, so they should make sure they are looking at the correct station number on their Identifying Matter: Investigation Guide (AP 3.1) to fill out the Activity Page correctly.

## Know the Standards

**2. Hardness** Hardness is a property of matter that can be observed through the investigation. Here you will demonstrate scratching a ceramic tile with a nail, a penny, and a rock. The nail will scratch the tile because it is harder than the tile, but the penny and rock may only leave a color on the tile but not a scratch, depending on the hardness of the tile and the rock.

## Know the Science

**2. Why are we using a nail, a penny, and a rock? To see similarities and differences!** Each material tested will leave a different type of impression on the ceramic tile. Each material will also leave some sort of color on the ceramic tile. Hardness is a property that is often used in science to identify and/or categorize materials such as minerals.

## 2. Encourage discussion.

5 MIN

Review the evidence students have gathered in their investigation. Ask the following:

- » How were the scratch marks different in the demonstration? *(They were different colors, and some left scratches in the tile.)*
- » What evidence does this provide about the materials? *(It provides evidence that they have different hardnesses.)*
- » What happened at Station 1 when you placed the magnet over the different wires? *(The magnet attracted the paper clip but not the other wire.)*
- » What evidence does this provide about the materials? *(It provides evidence that some metals are attracted to magnets but not all metals.)*
- » What happened at Station 2 when you placed the conductivity tester in the cup with Powder 2? *(The tester showed that electricity moved through it easily.)*
- » What happened at Station 2 when you placed the conductivity tester in the cup with Powder 3? *(The tester showed that electricity did not move through it as easily.)*
- » What evidence does this provide about the materials? *(It proves that electricity moves through different materials differently.)*

## 3. Encourage student questions.

10 MIN

Tell students that they should ask and answer each other's questions about what they observe during their investigations. Asking and answering questions can help students work together to make better observations of the properties of matter.

## 4. Summarize and discuss.

10 MIN

At the end of Day 2, when students have completed their investigations and finished filling out Identifying Matter: Investigation Guide (AP 3.1), allow time for a whole-class discussion to summarize the activities. Ask whether students have any questions about what they observed.

Activity Page



AP 3.2

Distribute student copies of Identifying Matter: Conclusions from Evidence (AP 3.2). Tell students they will be using the evidence they collected in conjunction with the chart on the second page of AP 3.2 to identify the five powders and two liquids they investigated. Students should write in the name of the powder once they believe they have identified it and include evidence that supports their conclusion.

If time permits, discuss the concept of engineering and design and the properties of materials that make them useful for certain purposes. Begin with the questions “Why do pencils work?” and “What is it about the properties of their materials that makes them a good design solution to the problem (want or need) of marking paper?” Explain that when students draw a line with a pencil, what is happening isn’t really the pencil acting on the paper but the surface of the paper acting on the tip of the pencil. The property of the wood part of the pencil is that it is durable enough to hold the soft, brittle graphite together during handling but soft enough that it can be shaved off incrementally to access more of the graphite.

Preview the next day’s activity by telling students that on Day 3 they will apply what they have learned to an engineering problem. By considering the properties of the various white powders, they will solve a problem in the same way that engineers solve problems.

## Know the Standards

**3. Magnetism (Station 1)** Magnetism is a property of matter that can help students identify materials. Certain objects may look similar but have different magnetic properties. The force of magnetism acts on certain types of materials, such as the paper clips, but not others, such as the aluminum wire. In this station, students are testing different materials to see which one is magnetic and which one is not to identify the metal.

**4. Conductivity (Station 2)** One property of matter is conductivity. Conductivity is how well a material conducts electricity. In this experiment, the lamp on the tester will shine brightly for solutions that strongly conduct electricity, less brightly for solutions that weakly conduct electricity, and not at all for solutions that do not conduct electricity.

## Know the Science

**3. Why are we using aluminum wire and paper clips? *They look the same but act differently with magnets!*** Paper clips and aluminum wire are the selected materials in this investigation because they look similar in that they are both types of metals and have similar coloring, but they have different magnetic properties. Aluminum is not a magnetic material, but paper clips are attracted to magnets.

**4. Why did we use sugar water and salt water? *Conductivity!*** Because there are no ions in a solution of sugar water, the sugar water does not conduct electricity. However, there are ions in a solution of salt water, resulting in the solution conducting electricity. When the electrodes of the tester are placed into the salt water, negative chloride ions move to the positive electrode. Positive sodium ions, on the other hand, move to the negative electrode. As a result, electric current passes through the solution.

## 1. Day 3: Refocus student attention on the Big Question.

5 MIN

Activity Pages



AP 3.2

AP 3.3

**How can I use properties as evidence to identify matter?** Go over the directions for the final page of Identifying Matter: Investigation Wrap-Up—Solving a Problem (AP 3.3). Point out to students that they will now put to use what they have learned on the previous two days. Provide them with the following scenario:

- You have accidentally knocked a hole in your bedroom wall. You need to fix it. You must fill the hole, but it must ultimately be the same state of matter as the material surrounding the hole.

Tell students that the Key that appears on AP 3.2 has a number of solutions to the problem but that only one works effectively. They are tasked to read each solution, consider the result, and decide whether it would or would not fix the hole. Then, based on what they have learned, they must explain why by presenting a well-crafted science and engineering argument based on their previous investigations.

## 2. Introduce scientific arguments.

10 MIN

Introduce students to the practice of making scientific arguments by explaining that a good scientific argument has three pieces to its structure.

- **Scientific idea:** This is what is being tested or studied or investigated. A scientific idea can be accurate or inaccurate. Hold up a ball and say, “My scientific idea is that there is a force that pulls all objects to the center of Earth.”
- **Expectations:** Expectations are behaviors and phenomena that may be predicted by the scientific idea. Ask students the following:
  - » What can we predict will happen if our scientific idea that there is a force that pulls things down is accurate? (*The ball will fall down toward the center of Earth.*)
- **Observations:** Observations are ways to gather evidence to support or refute a scientific idea. Ask students to observe what happens when you release the ball.

A scientific argument will incorporate all three pieces, and they can be in any order. You could start with the expectation that the ball will drop if released, then observe what happens, and then lead students through developing a scientific idea based on their expectations and observations. You could also start with the observation of what happens when you release a ball, then have students develop a scientific idea based on their observations, and then apply the expectations by having students test their idea with other objects.

If time allows, break students into small groups, and have them construct a scientific argument.

### 3. Encourage student questions.

5 MIN

Before continuing with the activity, remind students about the three primary states of matter on Earth. Ask the following:

- » What are the three states of matter? (*solid, liquid, and gas*)
- » How can these states help identify matter? (*Some properties of matter—such as hardness, buoyancy, and so on—have to do with their state. Examples might include the fact that ice floats but many other kinds of solids sink in water or that a substance's melting point can be used to help distinguish it from other kinds of matter.*)
- » Can matter change state? (yes) If so, give examples. (*Solid ice can become liquid water.*)

Have students go back over the Activity Pages from the previous two days. Then ask the following question prompts to get them thinking about a solution:

- » Which state of matter is your bedroom wall? (*solid*)
- » Which state of matter should the solution be in when it enters the hole? (*The matter is pasty or doughy. It is neither fully liquid nor solid.*)
- » What state of matter should the solution become after it is placed in the hole? (*solid*)

Allow students to ask questions and to discuss their questions with each other. Do not answer the questions for them.

### 4. Support the investigation.

15 MIN

Activity Page



AP 3.3

Have students complete the Activity Page. Because there are many possible solutions that students need to consider, give them the allotted time to complete the activity. Circulate among them, monitoring their progress.

**SUPPORT**—If students have questions, guide them to the correct answer rather than giving them the correct answer outright.

### 5. Encourage discussion.

5 MIN

Remind students that engineers need to know the properties of matter to solve problems. In this case, the students acted as engineers to solve the problem of the hole in their bedroom walls. Ask the following:

- » How did knowing the properties of matter help solve the problem of the hole in the wall? (*Sample answer: It helped identify the right material to fix the hole.*)
- » What are other ways that engineers can use the properties of matter to solve problems? (*Whenever devices need to be strong, flexible, lightweight, waterproof, and so on, there are materials that have the right properties to build them that way.*)

**SUPPORT**—If students struggle to answer the second question, allow them to revisit previous lessons as a refresher.

## 6. Check for understanding.

5 MIN

Activity Page



Answer Key

Look for these overall observable features of students' performance during the investigation and on their completed *Identifying Matter* Activity Pages to meet the Performance Expectation:

- Students are able to identify the phenomenon under investigation (the observable and measurable properties of materials).
- Students are able to identify the purpose of the investigations (collecting data to serve as the basis for evidence to explain the concept that materials can be identified based on their properties).
- Students are able to describe the evidence from their data and how the observations and measurements will provide the data necessary to address the purpose of the investigation.
- Students are able to describe how the data are collected (e.g., quantitative measurements, observations of properties, determination of magnetic vs. nonmagnetic materials).
- Students are able to describe how the observations and measurements they make will allow them to identify materials based on their properties.

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

## PART B

# Structure of Matter

### OVERVIEW

Lesson	Big Question	Advance Preparation
4. Particles of Matter	What evidence suggests that matter is made of smaller particles?	Gather materials for teacher demonstration. (See Materials and Equipment, page 13.)
5. Too Small to Be Seen	How do models help to explain that matter is made of small particles?	Read Chapter 3 in the Student Reader. Gather materials for student investigation. (See Materials and Equipment, page 13.)

### Part B: What's the Story?

All matter is made up of smaller particles. This concept may seem simple or obvious to people with background knowledge in science, but it can be tricky for many young students who may not understand that some particles are too small to be seen with the unaided eye. This section engages students with the idea that particles are still present even when they are not visible. Students return to examples introduced in previous lessons, including closer investigations of sugar dissolved in water, and explore changing states of matter (liquids, solids, and gases) to experience macroscopic evidence of our unseen world. At this grade level, students do not use the terms *atom* or *molecules* as they focus on the concept of the nature of matter.

**In Lesson 4**, students begin by making claims about and discussing two teacher demonstrations: 1) a close look at sugar cubes dissolving in water and 2) the ways particles of water change as water is moved through different states. These demonstrations build up to suggest that matter still exists even when it cannot be seen. The goal is to get students to recognize that when matter changes physically—such as through solubility (dissolving) or evaporation—it often breaks down into smaller parts that are too small to be seen.

**In Lesson 5**, we introduce students to an article that explains how changes in matter—observable phenomena such as those in the article—are used as evidence that matter is made up of smaller particles. Students also explore the concept of scientific models/modeling to meet the NGSS Performance Expectation 5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen. Student thinking and modeling are developed with the help of balloons in various states of fullness. Students then investigate the effects of releasing air on various objects, citing their observations as evidence that air is matter and made up of particles they cannot see but know are there.

So, to repeat, **matter is made up of particles too small to be seen**. Help your students to understand this concept, and you will lay the groundwork for meeting the NGSS expectations addressed in later parts of this unit.



## LESSON 4

# Particles of Matter

**Big Question:** What evidence suggests that matter is made of smaller particles?

## AT A GLANCE

### Learning Objective

- ✓ Observe and discuss ways that matter can change when mixed, separated, heated, and cooled.

### Lesson Activities

- student observation
- teacher demonstration
- discussion
- writing
- vocabulary instruction

### NGSS References

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

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Developing and Using Models

**Scale, Proportion, and Quantity** is important to this lesson as students make claims about the nature of unseen matter. Specifically, students discuss examples that demonstrate how matter can be dispersed and separated to the point that it is not visible, but evidence exists that the matter remains. Students begin by observing examples of matter changing. They then explore examples as evidence that all different types of matter are made of particles too small to be seen with the naked eye.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

dissolve  
evaporate

expand  
matter

**particles**

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

## Instructional Resources

Activity Pages



AP 4.1  
AP 4.2

### Activity Pages

Observation Sheet (AP 4.1)

Lesson 4 Check (AP 4.2)

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

## Materials and Equipment

### Collect or prepare the following items:

- hot plate
- beakers (2 of equal volume and size)
- sugar cubes (3 or more)
- stirrer
- press-and-seal bags (2)
- heavy spoon (or hammer; for crushing cubes)
- water (warm and at room temperature)
- ice cubes
- bucket (for discarding water)
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (1 per student)

## Advance Preparation

Pick a spot in the classroom to set up the hot plate. Prepare for the in-class demonstrations on a flat, sturdy surface, such as a table. Make arrangements for the entire class to closely observe your demonstrations, directly, by making use of a camera/projector and/or by asking student volunteers to help describe what they observe during the demonstrations to their classmates.

## 1. Focus student attention on the Big Question.

5 MIN

Activity Page



AP 4.1

**What evidence suggests that matter is made of smaller particles?** Open class by telling students that you are going to perform three demonstrations of changing matter for them. Ask students to observe the demonstrations carefully and record their findings in the provided Observation Sheet (AP 4.1).

Introduce the Activity Page, modeling for students how to complete a few sections of the chart. Tell them that they will make some observations about matter before the demonstrations, and they will record their ideas in the second column of the table. After the demonstrations write down what they observed during/after the demonstration in the last column. Let students know that there is not one set of correct answers for this Activity Page. Instead, the goal is for students to write down as many observations as they have and to hone their skills as scientific observers.

## 2. Demonstrate examples and guide discussion.

15 MIN

Draw student attention to the part of the room where you will perform the demonstrations.

**Instructional Note:** Each of the three demonstrations and subsequent discussions should take approximately five minutes.

**Demonstration 1:** Fill one beaker with water, and place it on top of the hot plate. Fill a second beaker with an equal amount of water, and set it to the side of the hot plate.

- Turn the hot plate on to warm the water, but do not boil it. When the water is warm, turn the hot plate off.
- Show students the sugar cube.
- Ask students to write down what they observe about the sugar cube on their Activity Page. Allow several volunteers to come up and examine the sugar cube and share their observations with the whole group.

**SUPPORT**—If students simply say, “It’s a sugar cube,” prompt them to describe how they know this to be true. Promote scientific thinking by asking for evidence and posing scientific questions.

## Know the Science

**1. Why are we adding sugar cubes to water? To watch them dissolve.** When you add a sugar cube into the beaker filled with water, the cube will sink to the bottom. Students should observe tiny bubbles that surround the sugar cube as the sugar begins to dissolve in the water and trapped gases are released. Eventually, the sugar cube breaks apart and dissolves/disappears completely. Warming the water with the hot plate first will help the sugar cube dissolve more quickly than when placing it into cold water.

- Add a sugar cube to the first beaker of water. Add a sugar cube to the second beaker of water. (See **Know the Science 1.**)
- Tell students to observe what happens to the sugar cube and record it on their charts.
- Ask prompting questions, such as the following:
  - » How would you describe the sugar cubes before they went into the water? (*solid, white, square, dry*)
  - » What happened to the sugar cubes after they went into the water? (*They sank and began to crumble apart.*)
  - » Where did the sugar go? Is there still sugar in the water? How do you know? (*The sugar stayed in the water. I could see it gradually dissolve.*)
  - » What is one way that you could prove that there is still sugar in the water? (*You could evaporate the water and see what is left in the beaker.*)
- Discard the water from both beakers.

**Demonstration 2:** Fill one beaker with new water, and place it on top of the hot plate. Fill a second beaker with an equal amount of water, and set it to the side of the hot plate.

- Turn the hot plate on to warm the water, but do not boil it. When the water is warm, turn the hot plate off.
- Show students another sugar cube. Place a sugar cube into each of the press-and-seal bags. Make sure the bag is tightly sealed. Crush each sugar cube with the back of a spoon or a hammer. (See **Know the Standards 1** and **Know the Science 2.**)
- After the sugar cubes are crushed into granules, show students the bags of sugar. Ask questions to stimulate thinking, such as the following:
  - » Is this still sugar? How do you know? (*Nothing was added to or removed from the “system” inside the bag.*)
  - » Is this sugar still made up of the same things as the cube? (*yes*)
  - » If someone didn’t see me crush these cubes, how could you prove (or disprove) that this is still sugar? (*by examining its properties*)
- Add a bag of sugar to each beaker of water. Use a stirrer to stir the sugar into the water.

## Know the Standards

**1. Observing Matter** This demonstration supports the NGSS Performance Expectation evidence statement for examining the matter by looking at macroscopic observable matter. The sugar cube represents a larger piece of matter, made up of particles too small to be seen. Crushing the cube into sugar granules represents smaller pieces of matter. A crushed sugar cube may dissolve faster because it has more direct contact with the water. Both the sugar cube and the sugar crystals will dissolve in water because they have the same properties. The sugar cube is what scientists call bulk matter, which changes when dissolved in water. Solubility, the property of how well matter dissolves, is an observable phenomenon involving bulk matter. These demonstrations present a conceptual model to students that matter is made up of tiny particles that are too small to be seen. Although students can no longer see the sugar once it dissolves, smaller particles are still in the water.

- Tell students to observe what happens to the sugar and record it on their charts.
- Ask prompting questions, such as the following:
  - » What happened to the sugar in the water? *(It dissolved, or broke apart into tiny pieces and spread out.)*
  - » Is this the same as what happened to the sugar cube? Explain your thinking. *(Yes, the process appeared to be the same.)*
  - » Did the sugar disappear faster when it was in a cube or when it was crushed into granules? How could we investigate this to prove your idea? *(The sugar probably dissolves faster when it is crumbled. We could time the process to find out.)*

**Demonstration 3:** Discard any water from the beakers.

- Take ice cubes out of the ice chest, and show them to students. Explain that these are ordinary ice cubes made of water.
- Place three to five ice cubes into one beaker. Fill the other beaker with more ice cubes so that the beaker is halfway full. Seal the half-filled beaker of ice with a piece of plastic wrap and a rubber band.
- Set the beaker with three to five ice cubes on the hot plate. Set the second beaker to the side of the hot plate.

## Know the Science

**2. Why are we crushing sugar cubes? To show it is made of smaller particles.** Crushing the sugar cube engages students to think about the “smaller parts” of the cubes. Thousands of tiny granules of sugar come together to make one sugar cube. Adding the small granules of sugar to the water has the same effect as the cube placed in the water because they are made of the same particles. Warming the water with the hot plate first will help the sugar cube dissolve more quickly than when placing it into cold water.

- Turn the hot plate on, and watch as the ice cubes melt and change form. (The goal for this demonstration is for the water to begin to boil, so be extra careful as the temperature of the water rises.) (See **Know the Standards 2** and **Know the Science 3**.)
- Have students write down their observations of the ice cubes.
- As the ice melts, ask students the following prompts to consider as they fill in their charts:
  - » What happened to the ice cubes on the hot plate? (*They melted.*)
  - » What is different about the ice cubes after they have melted? (*They changed from solid to liquid.*)
  - » Were the ice cubes water before they melted? How could you prove this to be true? (*Yes, I could refreeze the water back into ice.*)
- As the melted ice cubes continue to heat up and boil away, turn student attention to the beaker half filled with ice.

## Know the Standards

**2. Observing Changes** This demonstration supports the NGSS Performance Expectation evidence statement by looking at macroscopic observable matter (liquid water and condensation). Evaporating liquid water and condensing water vapor are everyday examples of how matter changes. Students get to see the ice cubes changing as they turn into a liquid, but the matter is technically still the same. Students also get to see water vapor condensing on the side of a beaker, but the matter is still the same if in a gas, liquid, or solid form. The evidence statement for this lesson does not require you to introduce states of matter yet; however, these are observable examples that can assist students to think about and explore the conceptual model being presented.

## Know the Science

### **3. Why are we watching water boil and condense? To show properties and changes of matter.**

Ice cubes and water vapor are made up of particles that are too small to be seen. Let students start with that assumption. If the assumption is correct, there might be evidence to support it.

When ice is added to the beaker, the heat from the hot plate will make it melt. This causes the ice to change form while still maintaining the same properties and particles that originally made it up. When water vapor from the air comes in contact with the cold beaker, it condenses onto the surface of the beaker. This causes the water vapor to change form while still maintaining the same properties and particles that originally made it up. In both instances, students cannot see those particles because they are too small, but they are still there. Do not focus on changing states of matter, as states of matter will be covered later in the unit.

- As water vapor condenses on the beaker, ask students the following prompts to consider as they fill in their charts:
    - » Where does the water come from on the outside of the beaker? Explain your thinking. *(It must come out of the surrounding air.)*
    - » Has the amount of water changed inside the beaker? *(no)*
    - » How could you investigate this phenomenon to explain your answer? *(weigh the beaker several times during the process)*
  - Turn student attention back to the beaker on the hot plate.
  - As the water evaporates, ask students the following prompts to consider as they fill in their charts:
    - » What happened to the water in the heated beaker? *(It changed into an invisible gas.)*
    - » What happens to the water when it evaporates? *(It disperses into the surrounding air.)*
    - » What is different about the water after it evaporates? *(It is gas instead of liquid.)*
- CHALLENGE**—Have students think of the ice cubes and beaker together as a system. What properties would the system have that the individual parts in the system do not have? How does thinking about the matter as a system change how you think about it?

Give students time to complete their charts.

### 3. Encourage student questions.

5 MIN

Lead a discussion about what students observed. Use question prompts to get students to realize that all matter is made up of tiny particles too small to be seen without telling this to them outright:

- » When the sugar was mixed with the water, did the sugar disappear? Was it still part of the water? *(The sugar was not visible, but it was still in the water, spread throughout.)*
- » Could you see the sugar before it was added to the water? *(yes)*
- » Could you see the sugar after it mixed into the water? *(for a short time, yes, but then, no)*
- » How do you know the sugar was still in the water? *(We did nothing to separate the sugar from the water. It had to remain there.)*
- » Why can't you see the sugar in the water? *(It dissolved.)*
- » Considering all three demonstrations, what do your observations suggest to you about the nature of matter? *(It is made of smaller particles. These particles are too small to be seen individually.)*

Encourage students to ask questions about matter that they cannot always see.



## 4. Demonstrate examples and guide discussion.

10 MIN

### Online Resources



Show a video of a real-world example that demonstrates that matter is made up of particles, such as a video about evaporating salt water by boiling it. Analyze with students 1) the properties of the matter shown and 2) how matter changes:

- Use this as an opportunity to teach students about the vocabulary term *evaporate*. Ask what changes students can observe in the video.
  - » How does the water change? (*It changes state.*)
  - » Does the water still have the same particles? (*yes*)
  - » How do you know that particles are in the water? (*The water still exists. It just spreads out into particles too small to be seen.*)
  - » What happens to the particles when the water evaporates? (*They disperse into the surrounding air.*)

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

**SUPPORT**—Use additional guiding questions to help students link details in their analysis back to the demonstration at the beginning of class.

- » How is this example similar to the demonstration at the beginning of class? (*It shows matter becoming no longer visible.*)
- » What is common to all matter? (*It is all made of tiny particles.*)

Encourage students to ask their own questions and answer each other's questions during the discussion.

## 5. Teach Core Vocabulary.

5 MIN

### Word Work

Direct student attention to the Core Vocabulary word. Have students write the term **particles** in the upper left corner of an index card and underline it.

**particles:** (n. tiny pieces of matter that are too small to be seen) Ask students to describe what a particle of dust is. Prompt students to give other examples of how and when they may have heard the term *particle* before. Have students write the definition for *particles* as “tiny pieces of matter” on their Core Vocabulary card. Explain that they saw a demonstration that can be used to argue that all matter is made of tiny particles in the sugar cube demonstration. The sugar cube dissolved into particles too small to be seen in the water, but the sugar particles were still there. Explain that some particles are too small to be seen. Ask the following:

- » If a particle is too small to be seen, does it mean it isn't there? (*All matter is made up of tiny particles too small to be seen.*)

- » Do particles take up space? What evidence can you use to support your answer? (*Particles take up space. When you fill a balloon with air, the air takes up space in the balloon.*)

Have students write an example sentence that uses a form of the term *particle*. Ask volunteers to read their sentences aloud. (*Sugar cubes are made up of particles of sugar.*)

Have students safely store their deck of Core Vocabulary cards in alphabetical order. They will add to the deck and use these cards for additional activities during later lessons.

## 6. Check for understanding.

5 MIN

### Formative Assessment Opportunity

Activity Pages



AP 4.2 and  
Answer Key

As students finish the Core Vocabulary task, collect their completed Observation Sheet (AP 4.1). Scan the observations that students made of the three demonstrations, and review the questions that they posed. If time allows, select one or two questions that students have to spur additional discussion and thinking.

Have students complete the Lesson 4 Check (AP 4.2) at the end of class. Before the next lesson, review their answers for proper understanding, and plan accordingly to address any misconceptions.

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

## LESSON 5

# Too Small to Be Seen

**Big Question:** How do models help to explain that matter is made of small particles?

## AT A GLANCE

### Learning Objective

- ✓ Create a model with supporting evidence to explain that matter is made of particles too small to be seen.

### Lesson Activities

- teacher demonstration
- student observation
- reading, writing, discussion

### NGSS References

**Performance Expectation 5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen.

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

**Science and Engineering Practices:** Developing and Using Models

**Developing and Using Models** is important to this lesson as students engage with diagrams and other representations of a typically unseen part of our world. Students consider evidence that matter is made up of particles too small to be seen, specifically by using illustrative models and then developing their own models. Evidence from these models is used to either support or refute the claim that small particles exist, even when invisible to the naked eye.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

dissolve  
evaporate

evidence  
expand

models  
particles

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

## Instructional Resources

Student Reader



Ch. 3

Activity Page



AP 5.1

**Student Reader, Chapter 3**  
"Too Small to Be Seen"

**Activity Page**  
Balloon Model (AP 5.1)

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

## Materials and Equipment

**Collect or prepare the following items:**

- clear tubing, approximately 12 inches in length
- duct tape
- press-and-seal bags (2)
- balloon
- pinwheel
- index cards for student vocabulary deck (5 per student)
- internet access and the means to project video for whole-class viewing

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

5 MIN

**How do models help to explain that matter is made of small particles?**

Introduce the lesson through an engaging demonstration of matter. Put one end of the clear tubing in a bag. Press and seal the bag as close to the tube as you can, and then use the duct tape to seal. Tape the bag anywhere air could get out if the bag opens unexpectedly. Blow air into the bag through the tube to test if it is sealed. Leave that first bag as inflated as possible, and add the second bag at the other end, deflated, sealing the connection between the tube and bag with duct tape.

This demonstration is an example of an experiential model that demonstrates evidence. The experience/evidence supports the idea that, although there are particles of matter that cannot be seen, the particles still exist. The particles are seen as moving from one place to another, which causes a change. (See **Know the Science 1** for support.)

Make sure that students can see both bags. Prompt students to observe what happens to one bag when you press down on the other. Ask students to consider the following string of questions:

- » What is making the second bag inflate? (*air being forced out of the first bag*)
- » Can you see anything inside either bag? (*no*)
- » What evidence can you point out that proves matter has moved from one place to another? (*One bag is inflated when the other is not. Something that takes up space [air] clearly moves from one bag to the other.*)

## 2. Read and discuss: “Too Small to Be Seen.”

20 MIN

Student Reader



Ch. 3

Read together, or have students read independently, “Too Small to Be Seen,” Chapter 3 in the Student Reader. The selection introduces additional scientific models that help people to describe and understand the tiny particles of matter that we cannot see, whether they are part of a solid, a liquid, or a gas.

### Preview Core Vocabulary Terms

Before students read, write these terms on the board or chart paper, and remind students of the Core Vocabulary card that they already made during Lesson 4 for the word *particles*. Encourage students to pay special attention to these terms as they read:

**dissolve**  
**evaporate**

**evidence**  
**expand**

**models**  
**particles**

## Know the Science

**1. What are models? *Models are ways to describe the real world.*** When objects or ideas are too big, too small, or too complex, we use models to explain and represent phenomena that we cannot otherwise see. Models make things simpler to understand. Models can be symbols, pictures, diagrams, or explanations. For example, a globe is a model of Earth. Weather maps are models of our atmosphere that show us trends, such as where a storm is likely to head next. Any model is only as good as its evidence. If a model can explain the facts and information that people gather with a great deal of confidence and consistency, then the model can be used to support other claims itself.

## Guided Reading Supports

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

### Page 11

After reading this page, ask: What are some kinds of evidence that can help us understand matter? Prompt students to think about examples of scientific claims. Ask students to make a claim about how/why something occurs, such as why unbalanced forces move objects or why energy is transferred in collisions.

**SUPPORT**—If needed, prompt students to think about the properties of matter that they learned about several class sessions ago, such as color, texture, etc. Remind students that properties of matter help scientists and engineers to understand and use matter to solve particular problems.

### Pages 12–13

Prompt students to think about examples of models that they have seen inside or outside of the classroom. (*weather maps/simulations*) Ask: What kinds of tools and technology can help you to see things that are too big or too small for you to see with your naked eye? (*cameras, videos, microscopes, etc.*)

**SUPPORT**—Prompt students to create a whole-class list of other examples of objects or systems that are too big, too small, too complex, or even too far away to be observed firsthand. Record student answers on the board or chart paper. If time allows, help students to identify models that help to describe and represent these things. (*object/phenomenon → model: planets → models of the solar system; internal organs in your body → drawings/pictures of parts of the body; cycles/processes that take a long time → flow charts and time-lapse videos; etc.*)

### Pages 14–15

Prompt students to think about where rain comes from. Ask: If rain comes from clouds, what kind of matter makes up a cloud? (*Clouds are made of water vapor that becomes visible when droplets of water condense but stay suspended in the atmosphere.*) Ask: Where does snow come from? What is the difference between snow and rain? (*Snow also comes from clouds, but it snows when it is colder. Water vapor condenses and freezes quickly enough to create water crystals.*) Have students look at the picture of frost on the window, and ask: What would cause water vapor to turn to ice on a window? (*The cold temperatures make the particles of water gather and freeze on the window, causing the once-invisible water vapor to become visible crystals on the glass.*)

## Pages 16–17

Challenge students to develop a class list of properties that each ingredient—the sugar, lemon juice, and water—has. Have students compare which properties are shared by each, such as mass/quantity used, and which properties are specific to each material (taste, smell, etc.). Then, ask students to brainstorm ways to use these properties as evidence that support the claim that particles of sugar and lemon juice are still in the water. One option would be to use the property of mass. Weigh each material before mixing and then weigh the lemonade. Accept all other plausible student ideas as they brainstorm possible evidence that supports the claim.

The illustrated model of solubility on page 17 considers a solid dissolving into a liquid. Help students understand the model and the process of dissolving by asking them to note how the contents of the beaker change in each example. Ask: How is the cube changing from the first drawing to the second? (*The first cube is breaking into smaller cubes, which are also spreading out.*) What other changes do you note? (*The cubes are getting smaller in each drawing.*) Have students think about what it means to dissolve. Ask: If something dissolves in a liquid, does the matter disappear? What happens to it? (*The matter breaks down into smaller and smaller particles until they can't be seen.*)

### Online Resources



Show a video of convection moving matter in a solution. Use this link to download the CKSci Online Resources Guide for this unit, where a specific link to this resource may be found:

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

Ask students how what they see in the video supports what they have learned about how heat affects matter:

- » What happens to the water as it heats up? (*It starts moving.*)
- » What effect does this have on the matter in the beaker? (*The matter starts to break up into smaller and smaller pieces. The matter also starts to move around.*)

Invite students to come up with rules on how both stirring and heating matter affect the way matter dissolves.

**SUPPORT**—If needed, prompt students to draw parallels between what they saw in the demonstration in Lesson 4 and the model on the page.



### 3. Demonstrate examples and guide discussion.

10 MIN

Activity Page



AP 5.1

Distribute Balloon Model (AP 5.1) to students, and tell them that they will complete this page individually as they watch your demonstration. Explain that the diagram looks similar to a comic strip. Their role is to draw and fill in the diagram with evidence of particles. Let them know that you will tell them when it's time to work on the different parts of the diagram.

Prepare for the teacher demonstration by setting out the balloon and pinwheel. (See **Know the Science 2.**) Complete the demonstration:

1. Barely blow into the balloon. The balloon should be droopy and stay relatively uninflated.
2. Based on what students learned in the Student Reader, ask them to draw and describe a representation of the particles in the barely inflated balloon. Ask students to predict the amount of air in the balloon and what they think the particles in the balloon look like.
3. Blow the balloon up so it is halfway inflated.
4. Ask students to draw and describe the particles and the amount of air in the balloon now.
5. Blow the balloon up so it is inflated fully.
6. Prompt students to draw and describe the particles and the amount of air in the balloon now.
7. Ask for a volunteer to hold the pinwheel.
8. Aim the opening of the balloon at the pinwheel, and let all the air out of the balloon. The pinwheel will start to spin.
9. Ask students to fill out the rest of their Balloon Model (AP 5.1) to answer the questions.

## Know the Science

**2. What does the balloon and pinwheel demonstration show? *Particles.*** Matter is made up of particles that are too small to be seen. We can suggest this is true by inflating and deflating a balloon. When you inflate a balloon, you can see the evidence that particles might be added into the balloon because the balloon starts to change its shape. If air were not made of matter, the balloon would not change. The balloon gets bigger and more stretched out as more air is added. When that air is released, the balloon shrinks. Another way to show the release of air is to have the air blow onto a pinwheel to cause an even more obvious example of change. As the air leaves the balloon, it will turn the pinwheel to suggest that there are, in fact, particles of matter that are leaving the balloon, even if these particles are too small to be seen. None of this is absolute proof, but this is evidence that supports a conceptual model of matter.

## 4. Teach Core Vocabulary.

5 MIN

### Word Work

- **particles:** Point out that *particle* is a noun because it is a thing. Ask volunteers to use a form of *particle* in a sentence. Encourage sentences that use *particle* in relation to things that are too small to be seen. (*Air has particles too small to be seen.*) Write a sentence on the board or chart paper: *Particles can be big, but they can also be too small to be seen.* Have students copy the sentence on their card, created during Lesson 4, and underline the word *particles*. Direct student attention to the remaining Core Vocabulary words. Have students write each term in the upper left corner of an index card (one card for each) and underline it. Instruct students to add definitions to their Core Vocabulary cards for each of the remaining terms. Encourage students to first write definitions in their own words and then refer back to the Student Reader to check their understanding and revise if necessary.
- **evidence:** (n. information that helps answer a question, support a claim, or solve a problem)
- **models:** (n. pictures, symbols, or physical examples that help explain something that we cannot directly observe)
- **expand:** (v. to grow bigger)
- **dissolve:** (v. to separate and spread out particles of matter into another substance)
- **evaporate:** (v. to change form from liquid to gas)

## 5. Check for understanding.

5 MIN

### Formative Assessment Opportunity

Activity Page



Answer Key

See the Activity Page Answer Key for correct answers and sample student responses on Balloon Model (AP 5.1).

- As students finish working on their Balloon Model (AP 5.1) questions, scan their answers to check for understanding. Students should show knowledge of the amount of particles within each of the balloons.
  - The partially inflated (left frame) balloon should show fewer particles.
  - The halfway-inflated (middle frame) balloon should show more particles.
  - The fully inflated (right frame) balloon should show very many particles.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas about correct misconceptions related to particles that make up solids, liquids, and gases.

## PART C

# Physical Changes in Matter

### OVERVIEW

Lesson	Big Question	Advance Preparation
6. Ice to Water and Back (2 days)	How can one type of matter change?	Gather materials for student investigation. (See Materials and Equipment, page 13.)
7. How Matter Changes	Does the amount of matter change during a physical change?	Read Chapter 4 in the Student Reader.

### Part C: What's the Story?

Matter can change from one state to another. The three main states of matter are solid, liquid, and gas (or vapor). This concept is explored through various activities where students observe matter changing from one state into another. Students also investigate what is unchanged when matter is mixed with other matter and/or when a sample of matter changes state. Students begin to explore examples of mixtures and adding heat to samples to explore the weight of matter (which does not change unless the “system” itself changes) and that the matter can remain classified as itself (e.g., ice is still water, and water vapor can be changed back to ice).

**In Lesson 6**, students spend two days exploring what happens when matter mixes with other matter. The important concept is that, although the matter changes, the weight of the matter stays the same because the amount of matter remains constant. This means that there is no matter added and no matter taken out of the “system.” This concept will be emphasized using scales to measure the matter before and after a change for comparison.

**In Lesson 7**, students extend their concept of the conservation of matter through examples in a reading selection. Students explore and discuss evidence that matter can change but that it is conserved during the change.

So, to reiterate, **matter changes from one state to another and can be mixed with other matter to create changes**. Help your students grasp this concept, and you will lay the groundwork for meeting the NGSS Performance Expectation 5-PS1-2 and additional expectations addressed in later parts of this unit.

## LESSON 6

# Ice to Water and Back

**Big Question:** How can one type of matter change?

## AT A GLANCE

### Learning Objectives

- ✓ Describe examples of physical changes of matter in everyday life.
- ✓ Measure and graph the total weight of matter before and after a substance is heated or cooled to show that the total weight remains the same.

### Lesson Activities (2 Days)

- hands-on investigation

### NGSS References

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

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Using Mathematics and Computational Thinking

**Using Mathematics and Computational Thinking** is important to this two-day lesson, as students will take the weight measurements of water and ice to investigate the changes that do and do not occur when matter changes temperature. Students begin this lesson by observing examples of a change in matter, and then they investigate other examples on their own.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

conserve  
evidence  
gas

liquid  
phase  
physical change

solid  
states of matter

## Instructional Resources

### Activity Pages



AP 6.1

AP 6.2

### Activity Page

Ice and Water Investigation  
(Day 1) (AP 6.1)

Ice and Water Investigation  
(Day 2) (AP 6.2)

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

## Materials and Equipment

### Collect or prepare the following items:

- eye goggles
- tongs
- hot plate
- scale, accurate to tenths of a gram
- freezer (or access to a freezer)
- beaker
- ice cubes
- small paper cups, 10 oz.
- marker
- plastic tray
- calculators
- acetic acid (vinegar)
- graduated cylinder
- sodium bicarbonate (baking soda)
- small paper cup
- teaspoon

### Advance Preparation

If materials are scarce, you can set up stations around the room for some materials, such as using the scale or, under close supervision, the hot plate.

Before starting Day 1 with your students, be sure to review the student investigation guide, Ice and Water Investigation (Day 1) (AP 6.1).

Before starting Day 2 with your students, be sure to review the student investigation guide, Ice and Water Investigation (Day 2) (AP 6.2).

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

10 MIN

**How can one type of matter change?** Have students offer examples of a form of matter changing, including a description of the matter before and after the change. Accept all plausible examples. (*We chopped the logs. One log became many small pieces.*) (See **Know the Science 1.**)

Explain that when substances undergo changes, the total weight of the matter stays the same depending on the system. In a closed system, matter doesn't move into or out of the system and the amount of matter does not change. In an open system, matter can move into and out of the system. (See **Know the Science 2.**)

Return to the student examples of changing matter, and have them identify if the system described in the change of matter was an open or closed system. Model use of the word *conserve* and the term *conservation of mass* during your discussion with students.

## 2. Facilitate the investigation.

5 MIN

Activity Page



AP 6.1

Distribute Ice and Water Investigation (Day 1) (AP 6.1). Review the pages with students, and model how to complete the investigation guide.

## Know the Science

**1. What types of changes can matter undergo? Physical or chemical changes.** Matter can undergo either a physical or a chemical change. A physical change is a change that does not affect the properties of the matter, such as splitting an apple in two or splitting a log into smaller pieces. A chemical change is a change that affects the properties of the matter, such as when an apple interacts with the air, causing the apple to turn brown over time, or wood changes from brown to black and gets smaller as it burns. Students are not expected to distinguish between physical and chemical changes at this point.

**2. What are open and closed systems?** Closed systems are systems which have no interaction with their surrounding environment. Energy may move into and out of a closed system, but mass cannot. A sealed box is a good example. The inside is isolated from its surroundings. Open systems are systems that interact with their environment. Both energy and mass can move into and out of an open system. A campfire is a good example. As the wood burns, energy in the form of heat and light leaves the fire, as well as mass in the form of ash from the burning wood. Scientists and engineers often seek to analyze a system based on the inputs and outputs that define it as well as whether the system they are considering is open or closed.

Place students into small groups, and distribute the materials that they will use, including one paper cup per group. Give each group a number, such as Group 1, Group 2, and so on. Prompt them to label their paper cups with their number before the cups are placed in the freezer overnight.

- Review safe lab practices with students, reminding them to never consume any materials during a science investigation, even if the materials are edible.

**SUPPORT**—Review with students how to zero out the scale before they start their weight measurements. On Day 2, AP 6.2 will require students to measure sodium bicarbonate into a paper cup. Students should zero out or use the tare function to ensure they do not include the weight of the paper cup in their measurements.

- Students may have small discrepancies in their starting and final weights throughout the course of Day 1 of the investigation. This can be due to small spills, drops of water left in the beaker, and evaporation of the water as it freezes.

### 3. Support the investigation.

25 MIN

Circulate around the room as students conduct their investigations, lending support and modeling scientific language and mindset where necessary. For example:

- Make sure students record all of their “before” weights, and help them recognize that the purpose of these measurements is to determine the amount of change (if any) that occurs across the investigation.
- Help students calculate the weight of the ice cubes. To do this, subtract the weight of the empty beaker from the weight of the beaker with the ice cubes.
- Supervise students using the hot plate(s).
- Remind students to label their paper cups with their group number before putting them into the freezer.

As students work through their investigation plans, place the plastic tray out in the front of the room where students will set their water cups after recording all measurements. Then, move the tray into the freezer once all groups have set their water cups down.

### 4. Check for understanding.

5 MIN

At the end of Day 1, when students have completed the first parts of their investigations and finished filling out the Activity Page, allow time for a whole-class discussion to summarize the activity. Ask if students have any questions about what they observed. Provide question prompts, such as the following:

- What was the purpose of this investigation? (See **Know the Standards** on the following page.)
- What did you notice about changing ice into melted water?

Inform students that in the next class session, they will continue their investigations to see what happens when water changes to ice.



## 1. Day 2: Focus student attention on the Big Question.

5 MIN

Activity Pages



AP 6.1

AP 6.2

**How can one type of matter change?** Review with students what they observed and completed in the previous class session. Explain that they started an investigation to look closely at what happens when solid water (ice) changes from one state to another.

Tell students that today they will finish their work from Day 1 and extend their investigation into what happens to the weight of matter when matter changes. Distribute Ice and Water Investigation (Day 2) (AP 6.2). Review the pages with students, and model how to complete the investigation guide.

## 2. Support the investigation.

25 MIN

Ask students to pull out their Activity Page 6.1 for reference as they start work on Ice and Water Investigation (Day 2) (AP 6.2). Organize students into their same small groups as Day 1, and pass out the frozen cups of water to each group. The only other material that students will need for this part of the investigation is a scale.

Once students have completed their work on Activity Page 6.1, have them start on Activity Page 6.2 by measuring out two leveled teaspoons of sodium bicarbonate into a paper cup. Remind them to zero out their scale or use the tare function to ensure they do not include the weight of the paper cup in their measurements.

As students complete their investigations, circulate around the room, and check for understanding. Leave enough time for students to complete their investigations and finish filling out their Activity Pages. Reserve time at the end for cleanup.

Student results may vary, but their data should show that roughly 0.2 grams of matter is unaccounted for in the reaction. (See **Know the Science 3** on the following page.)

**NOTE:** Day 2 of this lesson introduces students to how matter is lost when it changes. This early experience is intended to prompt student thinking about the difference between physical and chemical changes. In Lesson 10, students will be mixing acetic acid and sodium bicarbonate again, with the focus at that point to explore how one effect of chemical changes is to affect the properties of the chemicals in the reaction, sometimes causing gases to be released from an open system.

## Know the Standards

The purpose of this investigation is to show students that matter can change but that the total weight of the matter stays the same because matter has not been lost or gained. Students are not expected to distinguish between physical and chemical changes at this point.

### 3. Summarize and discuss.

10 MIN

Once students have had time to conduct their investigations and complete their Activity Page, bring the class back together, and hold a whole-class discussion to summarize what students discovered. Students should be able to explain their observations and support them with evidence.

Ask students to describe the similarities and differences in the results of their labs. (*Similarities: Matter was changed in both labs. Differences: On Day 1, no matter was lost, and on Day 2, some matter was lost.*)

- » What happened to the water in terms of states of matter on Day 1? (*They changed as we melted the ice and froze the water.*)
- » What happened to the weight of the water on Day 1? (*It stayed the same regardless of the state of matter.*)
- » What happened to the matter on Day 2? (*It foamed up when we mixed the chemicals together.*)
- » What happened to the weight of the matter on Day 2? (*It changed as the chemicals reacted.*)

### 4. Check for understanding.

5 MIN

Activity Page



Answer Key

#### Formative Assessment Opportunity

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

- To prepare for lessons later in this unit and to help summarize student learning, prompt students to help you to construct a basic bar graph on the board or chart paper that demonstrates that the weight did not change as the ice melted and then refroze. Later in this unit, students will be expected to construct similar graphs independently using their data. This series of activities (Lessons 6 and 7) will help students to meet or exceed the Performance Expectation 5-PS1-2, which sets the expectation that students will measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

## Know the Science

**3. Where did the additional matter go? Into the air.** The beaker and chemicals are part of an open system. In an open system, energy and matter can leave the system. Per the law of conservation of mass, this matter is not lost. The chemical reaction releases carbon dioxide gas, which has mass but rises out of the beaker.

## LESSON 7

# How Matter Changes

**Big Question:** Does the amount of matter change during a physical change?

## AT A GLANCE

### Learning Objective

- ✓ Use evidence to explain that the total amount of matter does not change after a physical change.

### Lesson Activities

- reading, discussion, writing
- vocabulary instruction

### NGSS References

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

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Using Mathematics and Computational Thinking

**Using Mathematics and Computational Thinking** is important to this lesson because students will evaluate whether measurements of matter, before and after mixing, change or remain the same.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

condense  
conserve

evaporation  
gas

liquid  
physical change

solid  
states of matter

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

## Instructional Resources

Student Reader



Ch. 4

Activity Page



AP 7.1

**Student Reader, Chapter 4**  
“How Matter Changes”

**Activity Page**  
Matter Conservation (AP 7.1)

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

## Materials and Equipment

**Collect or prepare the following items:**

- index cards for student vocabulary deck (7 per student)

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

5 MIN

**Does the amount of matter change during a physical change?** Ask students to recap their investigations and their learning from Lesson 6, “Ice to Water and Back.” Tell students that they will read about what happens to matter when it changes and some additional examples of what this looks like in the real world around them. Revisit the examples students mentioned earlier throughout the unit.

### 2. Read and discuss: “How Matter Changes.”

25 MIN

Student Reader



Ch. 4

Read together, or have students read independently, “How Matter Changes,” Chapter 4 in the Student Reader. The selection is a summary of the states of matter and introduces students to the term *physical changes*.

#### Preview Core Vocabulary Terms

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

**condense**  
**conserve**

**evaporation**  
**gas**

**liquid**  
**physical change**

**solid**  
**states of matter**

#### Guided Reading Supports

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

**Page 19**

Prompt students to think of other types of matter that are made up of smaller particles, such as food or a piece of paper. Ask: If you were to change the size or shape of the example, such as by breaking it, what would happen to it? (*It would still be the same amount of matter, just in a different form.*)

## Pages 20–23

Have students think of other examples of changing states of matter besides pure water. Juice, for example, can be frozen and eaten as an ice pop. Ice cream starts off as a liquid, and then it becomes solid when it is frozen (and becomes liquid again when it melts). Ask: Have you ever seen water evaporate from a sidewalk or playground or grassy lawn? After the water evaporated, what happened to it? (See **Know the Science**.)

Ask students to describe the difference between the arrangement of particles of a gas, liquid, and solid. If time allows, invite students to come up to the board or chart paper and draw what gas, liquid, or solid particles would look like if you could see them up close. (*Generally students should model particles in all three states of matter as the same size but should have the arrangement of particles and space between them as the difference in states of matter.*)

## Pages 24–26

Prompt students to come up with other examples besides metal and coins of matter being conserved during a physical change.

**SUPPORT**—If needed, help students think of various types of physical changes, such as cutting, carving, erosion, melting, and so on.

Activity Page



AP 7.1

Distribute Matter Conservation (AP 7.1), and ask students to complete it independently. Once they are finished, as a class, review the student answers, and correct any misconceptions or errors.

## 3. Teach Core Vocabulary.

10 MIN

### Prepare Core Vocabulary Cards

Direct student attention to the Core Vocabulary words (displayed on the board or chart paper earlier in the lesson). Instruct students to locate the Core Vocabulary card they have already prepared for the term **evaporate** and add to it **evaporation**. Have students write each term in the upper left corner of an index card and underline it (one term per card):

**condense**  
**conserve**

**gas**  
**liquid**

**physical change**  
**solid**

**states of matter**

## Know the Science

**Why does ice float in water?** *Because it has lower density than liquid water.* Density is a measure of how much matter is in a given volume. In the case of ice, it is lighter than water and will, therefore, float in water. Similarly, steam (water vapor) rises out of a boiling pot of water because its density is lower (or less) than that of the water.

## Word Work

- **states of matter:** (n. the different physical forms of matter) Point out that gases, liquids, and solids are states of matter. Ask volunteers to use *states of matter* in a sentence. Encourage sentences that use this term in relation to a type of matter that can undergo a physical change, such as water. Recognize other contexts in which the words *states* and *matter* may be used based on students' background knowledge but that may not apply to this lesson. (*We live in the state of \_\_\_\_\_ ; What's the matter?*) Help students to understand that a "state" in science is a "state of being," or a property of matter. Have students copy the sentences on their cards and underline the term.
- **gas:** (n. matter with indefinite volume and shape, in which the particles move around freely and expand to fill any container)
- **liquid:** (n. matter with definite volume but indefinite shape, in which the particles move around each other freely but do not expand to fill any container)
- **solid:** (n. matter with definite shape and volume, in which the particles are rigidly arranged in place)

Help students understand the meaning of these terms by having them write down real-world examples of these on their vocabulary cards. Then, ask volunteers to use *gas*, *liquid*, and *solid* in a sentence. (*Water can be found as liquid water, solid ice, and steam as a gas.*)

- **condense:** (v. to change state from gas to liquid) Refer students to their Core Vocabulary card for the term *evaporate*, and ask them what would be the opposite of that process. Have them then define *condense* on its own card.
- **physical change:** (n. a change that occurs when matter changes form (shape, size) but no new type of matter is formed) Point out that both evaporation and condensation change the state of matter without changing the type of matter. Instruct students to note a different example of physical change on their Core Vocabulary card.
- **conserve:** (v. to maintain a constant quantity) Instruct students to write a sentence about evaporating or condensing matter that uses some form of the word *conserve*.

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

## 4. Check for understanding.

5 MIN

Activity Page



Answer Key

### Formative Assessment Opportunity

See the Activity Page Answer Key (AP 7.1) for correct answers and sample student responses.

- As students finish the Core Vocabulary task, collect their completed Activity Pages. Scan the questions that students answered regarding matter changes.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas about mixing matter and correct misconceptions.

## PART D

# Interactions of Matter

## OVERVIEW

Lesson	Big Question	Advance Preparation
8. Changing the Type of Matter	How can combining matter form a new substance?	Gather materials for teacher demonstrations. (See Materials and Equipment, page 13.)
9. Matter Can Change Chemically (2 days)	Why do some interactions of matter result in new substances?	Read Chapter 5 in the Student Reader.
10. Investigating Chemical Change	Does the amount of matter change during a chemical change?	Gather materials for student investigation. (See Materials and Equipment, page 14.)

## Part D: What's the Story?

Matter can undergo physical changes, but it can also undergo chemical changes. In the previous section, students learned about physical changes of matter. Now, they will learn about chemical changes, in which the mixtures and interactions of matter form new substances.

**In Lesson 8**, students begin by observing simple interactions of matter demonstrated by the teacher, specifically looking for evidence that certain interactions result in new, sometimes unexpected properties. The goal is for students to understand that the interaction of two or more types of matter can, in many cases, form a new substance and that when this happens, it is called a chemical change.

**In Lesson 9**, over the course of this two-day lesson, students delve more deeply into chemical change by reading an article on the subject. We do not include, or teach, the term *reaction* at this point, as students will learn more about the term later during Lessons 11 and 12. However, students will extend their understanding of ways to identify evidence of a chemical change, such as odor, color, or temperature changes.

**In Lesson 10**, students apply what they have learned so far across this unit and perform an investigation of chemical changes. The goal is for students to construct an argument as to whether the amount of matter changes during a chemical change. They will use a given investigation plan to carry out an experiment in which they mix two substances (baking soda and vinegar) and record their findings. The concepts of conservation of matter and proof of chemical changes will be emphasized.

So, to reiterate, **chemical changes can occur when different types of matter are mixed**. Making sure students understand and examine the properties of matter before and after different materials are made to interact can support their arguments as to whether a chemical change has occurred or not. Help your students grasp this concept, and you will prepare your students to meet or exceed the Performance Expectation **5-PS1-2**. You will also lay the groundwork for meeting the NGSS expectations addressed in the next and final section of this unit.



## LESSON 8

# Changing the Type of Matter

**Big Question:** How can combining matter form a new substance?

## AT A GLANCE

### Learning Objective

- ✓ Identify the causes and effects of combining substances that result in a new kind of matter.

### Lesson Activities

- teacher demonstration
- student observation
- discussion and writing

### NGSS References

**Disciplinary Core Idea PS1.B:** Chemical Reactions

**Crosscutting Concept:** Cause and Effect

**Science and Engineering Practices:** Planning and Carrying Out Investigations

**Cause and Effect** is important to this lesson because chemical change (the effect) is the result of the interaction (the cause) of two or more types of matter together. In this lesson, students see examples of chemical change to understand that chemical changes are occurring all around them all the time.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

change  
chemical change  
chemical reaction

**data**  
interact

investigate/investigation  
**substance**

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

## Instructional Resources

Activity Page



AP 8.1

### Activity Page

Chemical Changes Observation Sheet (AP 8.1)

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

## Materials and Equipment

**Collect or prepare the following items:**

- clear bowl
- whisk
- tablespoon
- borax
- nitrile gloves
- white glue
- water
- measuring cup
- food coloring (assorted colors)
- match and matchbook
- candle
- glow sticks
- clear cup
- bleach
- clear liter bottle
- vegetable oil
- bubbling acid tablet
- index cards for student vocabulary deck (2 per student)

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

5 MIN

**How can combining matter form a new substance?** Ask students to summarize their learning about physical changes from Lessons 6 and 7 (Part C) "Physical Changes in Matter." Prompt them to extend their discussion by observing a brief example, mixing sand and rocks together to form a mixture. Support students as they describe the properties of the two substances before and after the change. Tell students that they will watch you perform several demonstrations showing a different type of change, chemical change. Explain that the word *chemical* is another term for a specific type of matter.

**SUPPORT**—To reinforce what chemicals are, have students give examples of chemicals they know from their daily lives. (They may identify rubbing alcohol, ethanol, water, table salt, sugar, and so on).



In this activity, students will record their observations of new substances created as a result of chemical interactions. Distribute and review Chemical Changes Observation Sheet (AP 8.1) to help students understand how to fill out the table as they observe your demonstrations and answer the related questions about cause and effect. They will complete these sheets independently at their desks. Make sure to leave time for students to fill out their Activity Page after each demonstration.

## 2. Teach Core Vocabulary.

10 MIN

### Prepare Core Vocabulary Cards

Display the Core Vocabulary words on the board or chart paper, and direct student attention to them. Have students write the following terms in the upper left corner of an index card and underline them:

**data**      **substance**

### Word Work

- **data:** (n. recordable details or measurements) Explain that *data* can refer to different types of information and that many words are used to refer to data, including *facts*, *figures*, *statistics*, and *details*. Point out to students that *data* is, in fact, plural. If time allows at the end of class, challenge students to identify the singular form of the word *data*. (*datum*) Ask volunteers to use *data* in a sentence. (*Scientists use data to form conclusions about their experiments.*) Write the sentences on the board or chart paper, and have students copy the sentences onto their card and underline the word *data*.
- **substance:** (n. a type of matter that is the same throughout) Point out that the word *substance* is another word for *matter*, which means a substance is anything that has mass and takes up space. Have students develop a working definition on their vocabulary card. Encourage students to think about what it means when a new substance is generated from a reaction. (*A different type of matter is created with different properties than the original substance.*)

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

## 3. Demonstrate examples and guide discussion.

25 MIN



Review classroom safety procedures in the Online Resources Guide. These resources may also be accessed within the CKSci Online Resources Guide for this unit, available at the address below.

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

Choose at least four of the following activities to demonstrate to students. If time permits, perform all the demonstrations. Allow students time to record

their observations in the corresponding space available on Chemical Changes Observation Sheet (AP 8.1). As you discuss each example, guide students to note the following:

- what changes occur
- what causes the changes
- what new matter results

**SUPPORT**—During any or all of these demonstrations, remind students of the causes and effects they are seeing. For example, lighting the candle is the cause; light, heat, sound, and odor are the effects. In some cases, before performing the task, ask students what they think the cause and effect will be, and then have them observe to see whether their predictions come true.

### Safety Note

These demonstrations require (at a minimum) the use of protective eyewear, safety gloves, and other utensils, such as tongs for safety. You will also require a container to dispose of the substances after each demonstration is completed.

**Demonstration 1** Light a candle with a match. (See **Know the Science 1**.)

**Demonstration 2** Show students a glow stick. Turn the lights off, and break the interior of the glow stick to start the chemical change. (See **Know the Science 2**.) Teacher's Choice: If you have the available materials and time, pass out a glow stick to each student, and have them participate in the demonstration so they can experience this chemical change for themselves. Be sure to ask students to observe this example closely to describe what caused the change to occur.

## Know the Science

**1. What is happening with the candle? *Chemical change of light and heat.*** When heat is applied to the “system” (the candle), the candle wax changes into carbon dioxide and water, giving off light and heat, both of which are indications of chemical changes. Another chemical change that occurred in this demonstration is that of the match striking against the matchbook. When the match strikes against the matchbook, it gives off an odor. Odors are also signs of chemical changes.

**2. What is happening with the glow stick? *Chemical change of light.*** A glow stick works by mixing different solutions of chemicals together. The resulting mixing causes a chemical reaction to create the glowing light. Glow sticks can only be used once and cannot be turned off. The chemicals start out in separate casings, but when the glow stick is “broken,” the solutions mix and the glowing light appears. One casing usually contains hydrogen peroxide, and the other contains more complex compounds along with a dye that gives the glow stick its color.

- Demonstration 3** Put on the nitrile gloves. Pour glue into the clear bowl. Fill the empty glue bottle with water. Secure the top on tight, and shake it up. Then pour the water into the bowl. This will allow you to have a 1:1 ratio of glue and water. Use a whisk to mix the solution of glue water. Add food coloring, and mix again. Fill a measuring cup with 4 ounces of water. Add 1 tablespoon borax into the water. Mix well to combine. Pour the borax mixture into the clear bowl. Continue to mix (use your gloved hands!) until it forms slime. (See **Know the Science 3**.)
- Demonstration 4** Pour water into a clear cup, and add drops of food coloring. Then pour some bleach into the water to cause a clear change in color. (See **Know the Science 4**.)
- Demonstration 5** Fill a clear liter bottle halfway with vegetable oil. Then add water. Add a few drops of food coloring. Put the cap on the bottle, and shake up the mixture. Then, after opening the lid, drop in a bubbling acid tablet. (See **Know the Science 5**.)

## 4. Check for understanding.

5 MIN

### Formative Assessment Opportunity

Activity Page



Answer Key

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

- As students finish writing their observations, scan their responses to check for understanding.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas about chemical changes and correct misconceptions.

## Know the Science

**3. What is happening with the slime? *Chemical change of precipitate formation.*** A precipitate is what you get when a solid is formed from a solution of two liquids. Here, we are making slime to show students how a variety of solutions can create a solid (slime) that is moldable and fun to play with. It is the specific combination of these solutions that creates the chemical reaction.

**4. What is happening with the bleach? *Chemical change of color.*** The bleach will cause the color of the water to lighten and disappear. Bleach is a common household item that people use for laundry. Bleach breaks down the parts of the food coloring molecule that give food coloring its color. This is why adding bleach can remove the color from stains or cups of colored water.

**5. What is happening with the bubbling acid tablet? *Chemical change of gases.*** Bubbling acid tablets are made of sodium bicarbonate and citric acid. Once the tablet is dropped into water, the tablet starts to dissolve, and a fizzing and bubbling reaction begins to take place. This is because carbon dioxide gas is being created. In this demonstration, the gas rises through the oil to provide a colorful display. The release of a gas is an indication of chemical change.

## LESSON 9

# Matter Can Change Chemically

**Big Question:** Why do some interactions of matter result in new substances?

## AT A GLANCE

### Learning Objective

- ✓ Describe examples of chemical changes of matter in everyday life.

### Lesson Activities (2 days)

- teacher demonstration
- reading, discussion, writing
- vocabulary instruction

### NGSS References

**Disciplinary Core Idea PS1.B:** Chemical Reactions

**Crosscutting Concept:** Cause and Effect

**Cause-and-Effect** relationships are explored in this two-day lesson within the context of understanding chemical changes. Students will read about how chemical changes cause new substances to form (the 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](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

**Language of Instruction:** The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about and explaining any concepts in this lesson. The intent is for you to model the use of these words without the expectation that students will use or explain the words themselves. A Glossary on pages 157–158 lists definitions for both Core Vocabulary and Language of Instruction terms and the page numbers where the Core Vocabulary words are introduced in the Student Reader.

change  
chemical

chemical change  
interact

mixture  
precipitate

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

## Instructional Resources

Student Reader



Ch. 5

Activity Pages



AP 9.1

AP 9.2

AP 9.3

### Student Reader, Chapter 5

“Matter Can Change Chemically”

### Activity Pages

What Kind of Change Will Happen? (AP 9.1)

Chemical Changes Finder (AP 9.2)

Lesson 9 Check (AP 9.3)

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

## Materials and Equipment

### Collect or prepare the following items:

- 1 pad of steel wool, any grade of coarseness
- scissors
- acetic acid (vinegar)
- small cup
- paper towel
- gloves and eye protection
- internet access and the means to project video for whole-class viewing
- index cards for student vocabulary deck (4 per student)

It is recommended that you wear gloves while handling the steel wool, as it is both sharp and coarse.

OPTIONAL: Expand on this demonstration by placing a thermometer in the dry steel wool in one beaker and placing a thermometer in the wet steel wool in another beaker. As part of their observations, students should be directed to note changes in color, temperature, and odor.

## THE CORE LESSON TWO DAYS, 45 MIN EACH

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

10 MIN

Activity Page



AP 9.1

**Why do some interactions of matter result in new substances?** Distribute What Kind of Change Will Happen? (AP 9.1). Split the steel wool in half, and have students write their observations of the steel wool. Place one half in the cup. Tell students that you will add acetic acid to the steel wool in the cup, and ask them to record their predictions of what will happen. Fill the cup with acetic acid, and let it sit for three to five minutes. (See **Know the Science 1** below.)

## Know the Science

**1. What is going on with the steel wool? Chemical change.** The acetic acid reacts with the iron in the steel wool and changes it chemically. Then oxygen can react with the iron to produce rust.





Then, present a video that shows a chemical change taking place. (See the Online Resources for a link to a suggested video.) Ask what students can observe in the video.

How would you describe the properties of this matter before and after it is combined?

- » Do you think the liquid in the dropper is the same as the liquid in the tube? (*no*)
- » How do you know? (*A change occurs when they interact.*)
- » What changes do you observe? (*The reaction may show a color change or the formation of a precipitate.*)
- » Is a new type of matter formed? How do you know? (*Color changes are an indicator that new matter has formed due to a chemical change.*)

Remove the steel wool from the cup, and place it on the paper towel, lightly tapping it to shake out the excess acetic acid. Place the dry steel wool next to it so students can compare the two throughout the rest of the lesson. Discuss their predictions, present the two pieces of steel wool, and compare their descriptions.

**Note:** Students will complete the rest of AP 9.1 after reading Chapter 5 in the Student Reader. Ask the following questions:

- » What type of changes have you seen so far with the steel wool? (*It is changing color.*)
- » Did this match your predictions, or did something unexpected happen? (*Answers will vary depending on predictions.*)
- » Do you think new matter was formed by adding the acetic acid to the steel wool? Why or why not? (*Yes, the color change provides evidence.*)

## 2. Identify examples and guide discussion.

20 MIN

Discuss where we can observe evidence of chemical changes in everyday life. For example, cooking is an activity that involves taking ingredients and changing them chemically by adding heat to create something new. The changes can occur solely by the action of heat, such as when a cake bakes, and also by chemical reactions, such as when yeast and sugar interact to create air bubbles.

### Activity Page



AP 9.2

- Introduce Chemical Changes Finder (AP 9.2). Let students know that they will be thinking of chemical changes they encounter all the time. Provide students approximately five to ten minutes to answer the question “What are examples of chemical changes in everyday life?”
- Lead a discussion about the examples students recorded on their Activity Page. Draw attention to similar examples that different students have identified. In every case, have the students describe why they think this is a chemical change.

**SUPPORT**—If needed, help students use terms such as *color*, *odor*, *light*, *temperature*, etc. to describe the chemical changes.

### 3. Revisit the demonstration.

10 MIN

Activity Page



AP 9.1

Return to the steel wool, and have students compare their predictions against what they now see. The wet steel wool will have undergone three chemical changes. Hold up the two pieces of steel wool, or ask students to gather around the two pieces, and ask:

- How have the two pieces of steel wool changed? (*The wet steel wool is rusting. The dry steel wool looks the same.*)
- What type of change is this an example of? (*The rusting steel wool is evidence of a chemical change.*)
- Was matter gained or lost in the chemical change? (*Neither; there is the same amount, but it has changed into other matter, such as rust and gas.*)

### 4. Check for understanding.

5 MIN

Use the following example or a similar example to stimulate further discussion about chemical changes. (If time permits, use more than one example to help students connect chemical changes to their everyday lives.) Support students as they identify and analyze 1) how the chemical change occurs, 2) how to tell whether a chemical change has occurred, and 3) why matter is not gained or lost in the process. Use additional guiding questions to help students link details in this discussion back to the Activity Page and the reading selection:

- Did you write any examples of chemical changes in the Chemical Changes Finder (AP 9.2) that are like the examples we read about in the Student Reader?
- How are these examples similar?

### 1. Day 2: Read and discuss: “Matter Can Change Chemically.”

25 MIN

Student Reader



Ch. 5

Read together, or have students read independently, “Matter Can Change Chemically,” Chapter 5 in the Student Reader. The selection reinforces the idea that matter can change when different chemicals are combined (during a chemical reaction) and presents examples showing when a chemical change has occurred.

#### Preview Core Vocabulary Terms

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

**chemical**  
**chemical change**

**mixture**  
**precipitate**

## Guided Reading Support

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

### Page 27

After reading, discuss other examples of mixtures. Examples of food mixtures can include cereal or trail mix. Then, discuss what is added to the ingredients for bread to cause the desired chemical change. (*Heat is added to bake the bread, making the dough rise.*)

**SUPPORT**—Ask students to give two or three examples of different kinds of matter interacting with one another. Help students as they recall examples from previous instruction, such as the demonstrations from Lesson 8.

### Page 28

Refresh student understanding of what constitutes a chemical (see **Know the Science 2**). Prompt students to think about the example of the chain. Ask: What evidence proves a chemical change took place in the chain? (*The rust is evidence of a change. Rust has different properties than the metal and oxygen that interact to form it.*)

**SUPPORT**—If needed, remind students of the different properties of matter and how matter changes in response to things such as temperature. Also, ask students to recall their working definitions of the term *substance*, which was first introduced in Lesson 8.

### Page 29

Prompt students to think about the car exhaust example. Remind them that they witness this every day on their way to school. The cars and buses they ride in or see while walking give off exhaust. Then, have them think about the baked bread example. When food is being cooked, it starts to smell. Ask them to give other examples of the change or formation of an odor as an indicator of chemical change.

### Page 30

Ask students to identify examples of matter that change color and explain why this occurs. (See **Know the Science 3**.)

### Page 31

Ask students if they have ever seen a lightning bug. Explain that lightning bugs don't have off/on switches for their lights. Rather, the light is a response to chemical reactions that occur within the insect's body.

## Know the Science

**2. What is a chemical? Any substance made of one form of matter.** A chemical can be a pure substance, such as carbon. A chemical can also be a mixture, something made of two or more elements, such as a gas such as carbon dioxide; a compound such as sugar, which has carbon in it; or a solution such as salt water, with a compound (sodium chloride) dissolved in a solvent (water). Chemicals can be found in nature, or they can be made artificially.

**3. How is a color change proof of a chemical change? It's all about light.** Color change occurs in a chemical reaction because the substances change structure. Because the structure has changed, the substance might reflect light differently so you see different colors. But not all chemical changes produce a change in color. Mixing baking soda and vinegar won't change the color of the two substances, but the gas emitted is proof of a chemical change.

Prompt students to think of other examples of chemical changes that they see in their everyday lives. Discuss why each is a chemical change and how matter is conserved.

**SUPPORT**—Review the concept of open and closed systems with students. Then, have students go through the examples of chemical change shown. Ask students to identify the type of system, if the system could be changed from one system to the other, and how it could be changed.

## 2. Teach Core Vocabulary.

15 MIN

### Prepare Core Vocabulary Cards

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

**chemical**  
**chemical change**

**mixture**  
**precipitate**

### Word Work

- **chemical:** (n. a specific type of matter made of particles of the same type) Tell students that *chemical* is a noun but that it can also be an adjective, such as in the term *chemical substance*. A type of matter is generally referred to as a chemical in the context of how the matter behaves and interacts during changes. Have students define *chemical* in their own words.

**SUPPORT**—For students just initially being exposed to the study of chemistry, the definition of *chemical* is necessarily vague and not specifically tied to substances obtained by chemical processes. The definition of *chemical* at this level is intended to help students understand that all matter is composed of particles that can interact in various ways and produce matter with a new identity. The gist is to shift thinking about matter from objects to the materials objects are made of and, further, to the makeup and behavior of those materials.
- **chemical change:** (n. the result when two or more types of matter interact to form a new type of matter) Instruct students to write an example of a chemical change and tell how they know it is not a physical change.
- **mixture:** (n. a combination of different types of matter that can usually be separated back into its original parts) Point out that the reason mixtures can often be separated into their original components is that the combination of matter did not involve chemical change. Have students locate the definition for the term in their Student Reader and write it on their Core Vocabulary card.
- **precipitate:** (n. a solid formed from a chemical change) Have students locate the definition for the term in their Student Reader and write it on their Core Vocabulary card.

### 3. Check for understanding.

5 MIN

Activity Pages



AP 9.3 and  
Answer Key

#### Formative Assessment Opportunity

Have students summarize what they have learned about chemical changes, asking them to consider the Big Question: **Why do some interactions of matter result in new substances?** Have them use information from the Student Reader as evidence.

Distribute Lesson 9 Check (AP 9.3), and ask students to complete it independently. Once they are finished, collect the assessment, and before the start of Lesson 10, check students' answers to identify concepts that need further clarification and to provide the support needed.

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

## LESSON 10

# Investigating Chemical Change

**Big Question:** Does the amount of matter change during a chemical change?

## AT A GLANCE

### Learning Objectives

- ✓ From a given plan, conduct an investigation of a chemical change that occurs when two substances interact.
- ✓ Collect and record data about the substances before and after a chemical reaction.
- ✓ Describe the weight of substances before and after a chemical reaction.

### Lesson Activities

- student investigation
- student observation
- discussion and writing

### NGSS References

**Disciplinary Core Idea PS1.B:** Chemical Reactions

**Crosscutting Concepts:** Systems, Cause and Effect

**Science and Engineering Practices:** Planning and Carrying Out Investigations

**Systems** is important to this lesson because students will investigate chemical changes in a closed system. In earlier lessons, students explore chemical changes in an open system, and here they investigate the differences of a chemical reaction in a closed system.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

change  
chemical

chemical change  
interact

mixture  
precipitate

## Instructional Resources

Activity Page



AP 10.1

### Activity Page

Investigating Chemical Change  
(AP 10.1)

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

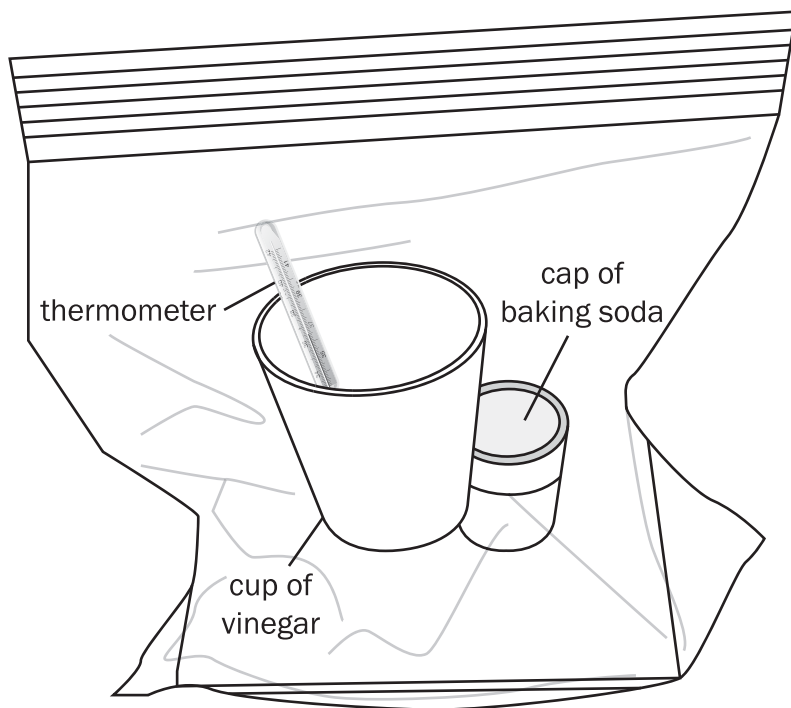
## Materials and Equipment

### Collect or prepare the following items:

- safety goggles (1 pair per student)
- gallon-size press-and-seal bags (1 per group)
- thermometers, glass bulb (1 per group)
- vinegar (acetic acid)
- baking soda
- paper cups (1 per group)
- plastic bottle caps (1 per group)
- tablespoons (1 per group)
- scales (1 per group)
- small pieces of sturdy cardboard (1 per group)

### Advance Preparation

- Set students in small groups of two to four.
- You may wish to have students collect the vinegar and baking soda from a common area rather than distributing it to each group.
- Prepare an example of the complete bag with materials inside so students have a reference. The cup with thermometer in it will be unstable, so model for students how one student should hold the thermometer from the top to keep it stable.





## 1. Focus student attention on the Big Question.

5 MIN

**Does the amount of matter change during a chemical change?** Ask students to consider the examples of chemical changes that they have learned so far, including rusting metal and the baking of bread. Challenge students to think of ways to determine if any matter is actually lost. Tell students that they will conduct a hands-on investigation on matter that goes through a chemical change. Prompt students to think about the question “How can I tell that a chemical change is taking place?” as they go through this lesson. Remind them that they learned about the signs of a chemical reaction in the previous lesson.

## 2. Preview the investigation.

5 MIN

Review the explanation of open and closed systems from Lesson 6. Ask the following:

- » Last time you mixed baking soda and vinegar, what type of system was that? *(an open system)*
- » What made it that type of system? *(The gas from the chemical change could escape from the cup.)*
- » This investigation will use a sealed bag. What type of system does that make? *(a closed system)*

Discuss how this investigation plan is intended to help “close” the system under investigation. To help students understand, discuss open systems and how they might be closed.

## 3. Facilitate the investigation.

15 MIN

Activity Page



AP 10.1

Distribute Investigating Chemical Change (AP 10.1). Explain that students will be conducting an experiment that involves mixing vinegar and baking soda and recording their observations of what happens when these materials combine.

### Safety Note

Make sure students are wearing their safety goggles before beginning this activity.

Students should only smell materials when specifically instructed to do so and should then use their hands to lightly wave the odor from above the materials to their noses.

Review the instructions with students, and model for them how to complete the different parts of the sheet. Show students the last question on the Activity Pages—the essay question—and let them know that there will be time at the end of class for each student to answer it individually.

Place students into groups to prepare for the investigation. Pass out materials to each group.

## 4. Support the investigation.

15 MIN

Circulate around the room as students conduct their investigations, and lend support where necessary. (See **Know the Science.**) For example:

- Make sure students collected all of their “before” weights.
- Remind students to complete all the parts of the Activity Pages.
- Assist students with carefully placing the contents into the bags or mixing the baking soda and vinegar.
- Help with any spills of the vinegar or the baking soda.

**SUPPORT**—As students work through their investigations, ask them if a chemical change occurred. Have them tell you why or why not, but do not indicate if they are correct or incorrect. Prompt them to think about any evidence of a chemical change.

## 5. Check for understanding.

5 MIN

Activity Page



Answer Key

### Formative Assessment Opportunity

See the Activity Page Answer Key (AP 10.1) for correct answers and sample student responses.

- As students finish their Activity Pages, scan their responses to check for understanding.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas about chemical changes and correct misconceptions.

## Know the Science

**What is happening inside the plastic bag? *Chemical change.*** A chemical change occurs by mixing vinegar and baking soda. When these materials are mixed together, students will observe fizzing and the inflation of the plastic bag as new gas is given off (a production of a new form of matter). After the chemical change, the vinegar will have less of an odor, and the cup of vinegar will feel cold to the touch. Students should recall from the previous lesson that odor and temperature change, as well as the production of a new type of matter, are signs of chemical changes. As students take the ending weight of the plastic bag with its contents, they will find that the total weight remains the same, proving that the weight of substances before and after a chemical change remains the same. Any gas that is released (there may be some if the bags aren't sealed well) will have some weight, so if there is a weight discrepancy, ask students how the weight of the gas affects the “after” weight.

## PART E

# Introduction to the Language of Chemistry

### OVERVIEW

Lesson	Big Question	Advance Preparation
11. The Language of Chemistry	What are atoms, elements, and molecules?	Read Student Reader, Chapter 6.
12. Comparing Models of Different Molecules	How are molecules of different matter similar and different?	Gather materials for modeling activity. (See Materials and Equipment, page 14.)

### Part E: What's the Story?

This section introduces students to a foundation of chemistry terminology. Students take what they have learned in the previous sections and assign introductory chemistry terms to concepts to deepen their understanding of matter.

**In Lesson 11**, students read a biography of John Dalton and learn the definitions of the following science terms: *atom*, *element*, *bond*, and *molecule*. The goal is for students to understand that what we know about matter is the result of centuries of incremental work and discovery. Students will also learn about theories and models and apply terminology to what they have learned so far through this unit.

**In Lesson 12**, students participate in a modeling activity in which they construct and use models to compare and contrast a molecule of ammonia to a molecule of methane. The goal of this activity is for students to reinforce that different types of matter are made of different tiny particles and to explore the different combinations of small particles that result in observable phenomena at the macro scale.

So, to reiterate, **introductory chemistry terminology can be helpful for students to better grasp concepts related to matter**. Help your students apply these terms to their learning, and you will lay the groundwork for meeting the NGSS expectations addressed in later grades.

## LESSON 11

# The Language of Chemistry

**Big Question:** What are atoms, elements, and molecules?

## AT A GLANCE

### Learning Objective

- ✓ Use the terms *atoms*, *elements*, and *molecules* when discussing matter.

### Lesson Activities

- observation
- reading
- discussion
- vocabulary instruction

### NGSS References

**Disciplinary Core Idea:** Structure and Properties of Matter

**Crosscutting Concept:** Scale, Proportion, and Quantity

**Science and Engineering Practices:** Obtaining, Evaluating, and Communicating Information

**Scale, Proportion, and Quantity** is important to this lesson because it teaches students that physical qualities are important to atoms, elements, and molecules. Quantity and proportion determine what kind of properties a molecule will have. Students will read about atoms and molecules and see examples of them. The Student Reader highlights **Obtaining, Evaluating, and Communicating Information** in telling the story of prominent scientists whose studies built to the language we use in chemistry today.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Core Vocabulary

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

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atom  
bond

chemistry  
element

molecule

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

### Instructional Resources

Student Reader



Ch. 6

**Student Reader, Chapter 6**  
"The Language of Chemistry"

Activity Page



AP 11.1

**Activity Page**  
What Is Matter Made Of?  
(AP 11.1)

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

### Materials and Equipment

**Collect or prepare the following item:**

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

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

10 MIN

Activity Page



AP 11.1

**What are atoms, elements, and molecules?** Go over the directions for What Is Matter Made Of? (AP 11.1). Explain to students that they should keep the Activity Page with them as they go through the Student Reader. Any time they come across an example of an atom, an element, or a molecule, they should write it down in the table. Encourage them to listen closely during discussions and to write down any examples that are discussed but not included in the Student Reader.

## 2. Encourage student questions.

5 MIN

Remind students that they have done activities that indicated to them that all matter is made up of smaller particles. Have students identify items in the room and name what the smallest part of the items they can see is. Then explain that no matter how small an item or its parts are that we can see, there are always smaller parts. Let them know, however, that there is always one particle in every kind of matter that is the smallest particle of all. This particle is so small that no human can see it with the unaided eye. Ask volunteers to try to name this particle.

**SUPPORT**—Let students know that there is not one set of correct answers for their observations of items in the classroom. Prompt students to make close observations by asking questions such as “What parts does this item have?”, “Which part of the item is the smallest that I can see?”, and “Are there smaller parts that I cannot see?” Give students time to wander around the classroom to make and record their observations.

## 3. Read and discuss: “The Language of Chemistry.”

20 MIN

Student Reader



Ch. 6

Read together, or have students read independently, “The Language of Chemistry,” Chapter 6 in the Student Reader. This selection reinforces the definitions of the words *atom*, *molecule*, and *bond* and explains the relationship between them.

### Preview Core Vocabulary Terms

Before reading, write the following terms on the board or chart paper. Have students identify the words as they read. Stop and discuss the meaning of each term in context.

**atom**  
**bond**

**chemistry**  
**element**

**molecule**

### Guided Reading Supports

When reading together, pause for discussion of key terms and questions to check for understanding. Include suggested questions and prompts:

#### Page 33

After reading, ask: What is the smallest thing you have seen? Prompt students to understand that no matter how small the smallest thing they have seen is, it is made up of even smaller particles that they cannot see. Ask: What is the name that the ancient Greeks gave for the smallest part of matter? (*atom*)

#### Page 34

Explain to students that in science, scientists come up with ideas and then test them to see if they are true. Point out that sharing what they learn and evaluating what others have shared is central in the work of science. Discuss the scientific definition of *theory*: an idea based on a collection of facts that have been repeatedly tested and found to be true. Prompt students to name some theories in science that they may be familiar with.

**SUPPORT**—If students are confused by what atomic theory is, have them reread the page and make a list of each fact about atoms they find. For example, atoms are too small to be seen. Then explain how these facts support atomic theory.

### Page 35

Make sure that students know the difference between an atom and an element. An atom is one particle of matter. An element is matter that is made of million of atoms, all of the exact same type. A single atom of gold is an atom; millions of atoms of gold make up the element called gold. (See **Know the Science 1.**)

### Online Resources



If time permits, display for students the periodic table of the elements to add context for the way that matter is classified.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

### Page 36

After reading, display the chemical symbol of water ( $H_2O$ ) on the board or chart paper. Have students explain what each letter stands for, what the 2 means, and why they are placed together with no spaces. (*H = hydrogen; O = oxygen; 2 = the number of hydrogen atoms. They are placed together with no spaces to represent the fact that they are bonded.*) Ask: How many atoms of oxygen are there in water? How do we know? (*When there is no number following the symbol for an element, it has only one atom. Because there is no number following the O, we know that oxygen has only one atom for every two hydrogen atoms.*)

### Page 37

After reading, ask students to explain how water has different properties from hydrogen or oxygen. Prompt them by asking what they do with oxygen that's different from what they do with water.

**SUPPORT**—If students struggle to identify the differences between oxygen and water, ask: What do we do with oxygen in the air? (*breathe it*) What do we do with water? (*drink it, wash things with it, place it on plants to make them grow, etc.*) Can we do the same things with oxygen alone that we can do with water? (*no, because they have different properties*)

### Page 38

Have students keep in mind what they have learned about water molecules on page 36 and models on this page, as they will use that information in Lesson 12.

## Know the Science

**1. Are atoms really the smallest particles? No!** At this grade level, educators agree that introducing atoms as the smallest particles is the correct thing to do. After all, they are the building blocks of elements, molecules, and ionic compounds. (We do not discuss ionic compounds in this lesson.) However, atoms are not what physicists call “fundamental” particles. Electrons are fundamental particles and are not made of smaller entities. Protons and neutrons are each made of fundamental particles called quarks. Because this concept is advanced, we do not discuss it here. The idea of atoms as the smallest particles of matter is a good starting point for this advanced learning later.



## 4. Teach Core Vocabulary.

5 MIN

### Prepare Core Vocabulary Cards

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

<b>atom</b>	<b>chemistry</b>	<b>molecule</b>
<b>bond</b>	<b>element</b>	

### Word Work

- **chemistry:** (n. the science of what matter is made of and how matter changes) Supply students with the definition to write on their Core Vocabulary card.
- **atom:** (n. a small particle of chemical matter) Point out that *atom* is a noun. Have students write the definition of *atom*. Then write a sentence on the board or chart paper: *Everything is made up of atoms.* Ask a volunteer to read the sentence aloud and explain how the volunteer knows the word *atoms* is a noun in this sentence. Then ask if there are any ways that adding a suffix or prefix to *atom* can change it from a noun to a verb or adjective. (*Adding the suffix -ize to atom, atomize, turns it into a verb meaning to demolish. Adding the suffix -ic to atom, atomic, turns it into an adjective that means the word it is describing is related to the word atom.*)
- **element:** (n. a substance made of a single type of atom) Explain to students that they may have heard the term *element* in everyday language as something that makes up something else. For example, learning about multiplication is an element of math. After reading the Student Reader Chapter 6, ask volunteers to use *element* in a sentence. Encourage sentences that use *element* in relation to chemistry. (*An element is made up of one kind of atom.*) Have students write on their card a definition of *element* in their own words.
- **molecule:** (n. a substance made of one or more kinds of atoms joined together by chemical bonds) Have students describe molecules. (*the same type of atoms bonded together or different types of atoms bonded together*). Then have students use the word *molecule* in a sentence. (*Water is a molecule that is made up of two hydrogen atoms and one oxygen atom.*)

## Know the Science

**2. Ionic compounds!** The idea of ionic compounds is not presented in Grade 5. These are compounds such as table salt and all salts. Technically they are not molecules because the bond between them is an ionic (electrical attraction) bond and not covalent (shared electrons). At this grade level, just present the idea of molecules as combinations of atoms, and in later grades ionic bonds will be added to this knowledge.

- **bond:** (n. a connection that holds atoms together) Instruct students to write a sentence about a water molecule that includes some form of the word *bond*.

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

## 5. Check for understanding.

5 MIN

### Formative Assessment Opportunity

Activity Page



Answer Key

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

- As students finish the Core Vocabulary task, collect their completed What Is Matter Made Of? (AP 11.1). Scan the observations that students made about atoms, elements, and molecules, and review the questions that they had about their examples. Look for evidence of understanding as to the differences between atoms, elements, and molecules.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas and correct misconceptions.

## LESSON 12

# Comparing Models of Different Molecules

**Big Question:** How are molecules of different matter similar and different?

### AT A GLANCE

#### Learning Objective

- ✓ Compare a molecule of ammonia to a molecule of methane.

#### Lesson Activities

- student investigation
- student observation
- writing, discussion

#### NGSS References

**Science and Engineering Practices:** Developing and Using Models

**Developing and Using Models** is important to this lesson because students must find creative ways to demonstrate knowledge of molecules. In this lesson, students make models of an ammonia molecule and a methane molecule, and they compare them to show that different types of matter are made of different small particles in different combinations.

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

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

#### Core Vocabulary

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

atom  
bond

element  
molecule

## Instructional Resources

Activity Page



AP 12.1

### Activity Page

Comparing Molecules (AP 12.1)

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

## Materials and Equipment

### Collect or prepare the following items:

- modeling clay (three colors: red, yellow, blue)
- toothpicks

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

5 MIN

**How are molecules of different matter similar and different?** Tell students that they will conduct a hands-on activity in which they will build models of two types of molecules: ammonia and methane.

Tell them that ammonia has one nitrogen atom bonded to three hydrogen atoms,  $\text{NH}_3$ . Ammonia is a colorless gas with a very powerful smell. Ammonia gas occurs widely in living things, and it is used for many industrial purposes.

Tell students that methane has one carbon atom bonded to four hydrogen atoms,  $\text{CH}_4$ . Methane is a gas that is released into the air by bacteria. It is also found as “swamp gas” that bubbles up from bacterial action from the bottoms of lakes and ponds. Methane is the main component of natural gas, and it is used to heat homes.

Prompt students to think about the question “How can I show that matter is made of tiny particles?” as they go through this lesson. Remind students that they learned about the terms *atoms*, *elements*, and *molecules* in the previous lesson. (See **Know the Science 1.**)

### 2. Preview the investigation.

10 MIN

Activity Page



AP 12.1

Distribute Comparing Molecules (AP 12.1). Explain that students will be making models of ammonia and methane molecules to compare and contrast them. Review the instructions with students, and model for them how to complete the different parts of the sheet. Show students the materials they will use to build their models.

Separate students into pairs to prepare for the activity. Pass out the materials to each group.

## Know the Science

### 1. What is the difference between atoms, elements, and molecules? *What they are made of!*

An atom is the smallest unit of matter. An element is matter made up of only one kind of atom. Similar or different atoms bond, or join together by a chemical bond, to make up molecules.

### 3. Support the investigation.

25 MIN

Circulate around the room as students build their models, lending support where necessary. For example:

- Make sure students are using the key correctly.
- Remind students to complete all the parts of the Activity Pages.
- Ask prompting questions to stimulate further thinking depending on where students are in the activity, such as the following:
  - » When you smell ammonia in a household cleaner, can you see the ammonia molecules? (*no*)
  - » Can you see molecules of methane in the air? (*no*)
- Reinforce understanding that these molecules exist at levels that are too small for people to see with the unaided eye.

When all students have finished making their models and answering the questions on the Activity Pages, invite volunteers to share their models with the class and to explain them.

### 4. Check for understanding.

5 MIN

Activity Page



Answer Key

#### Formative Assessment Opportunity

See the Activity Page Answer Key (12.1) for correct answers and sample student responses.

- As students finish their hands-on activities, scan their responses on the Activity Pages to check for understanding.
- Choose one or two questions to present to the class for a brief closing discussion. Use the discussion as an opportunity to reinforce main ideas about molecules and correct misconceptions.

# Matter Review Game

**Big Question:** What have I learned about matter?

## AT A GLANCE

### Learning Objective

- ✓ Fluently discuss types of matter and how they can change.

### Lesson Activities

- review discussion
- vocabulary game

### NGSS References

The following Performance Expectations are addressed in the unit and revisited during this lesson:

**5-PS1-1** Develop a model to describe that matter is made of particles too small to be seen.

**5-PS1-2** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

**5-PS1-3** Make observations and measurements to identify materials based on their properties.

**5-PS1-4** Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

The Unit Review is intended to support students as they summarize their learning about these PEs and prepare for the Unit Assessment. For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## The Big Idea

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Engineers use knowledge of matter as they develop solutions to problems and build things that are useful to people. Therefore it is important to pay attention to properties of matter and how matter can change. Students can see concrete examples of matter all around them and should be encouraged to routinely consider the following:

- what objects are made of
- how the properties of matter make it suitable for particular uses
- how matter can change, physically and chemically
- that properties of matter and the ways that matter can change provide evidence that matter is made of smaller particles

## Core Vocabulary

---

**Language of Instruction:** During the review, remind students of their prior exposure to the following terms.

atom  
bond  
chemical  
chemical change  
chemistry  
condense  
conserve

data  
design process  
dissolve  
element  
evaporate  
evidence  
expand

gas  
liquid  
matter  
mixture  
models  
molecule  
particles

physical change  
precipitate  
property  
solid  
solution  
states of matter  
substance

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

## Instructional Resources

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Activity Pages



AP UR.1  
AP UR.2  
AP UR.3

### Activity Pages

Matter Review Game (AP UR.1)

Matter Vocabulary Crossword  
Puzzle (AP UR.2)

Matter Vocabulary Review  
(AP UR.3)

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

## Materials and Equipment

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### Collect or prepare the following items:

- whiteboard or chart paper
- sticky notes (variety of colors)
- markers
- question and answer cards/sheet
- timer



## Advance Preparation

Create the game board grid on the whiteboard or chart paper. Draw a giant table with the following column categories:

- Properties of Matter
- Particles of Matter
- Physical Changes
- Chemical Changes
- Intro to Chemistry

Place five sticky notes under each category. It works best if you can use different color sticky notes for each category, but this is not mandatory. Use your marker to write the number of points on each sticky note. For example:

**Matter Review Game Board**

Properties of Matter	Particles of Matter	Physical Changes	Chemical Changes	Intro to Chemistry
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Write your questions and answers for the game. Assign each question to a specific category and number of points. Keep your questions and answers on cards or on a sheet, and have them ready to read when you play the game with the class. Students will not get to see the questions in advance. Questions should be a variety of vocabulary-based questions and concepts-based questions from information covered in the unit. As the points get higher, the questions become more difficult.

## Sample Review Game Questions

### Properties of Matter

100 points—Anything that has mass and takes up space is known as what? (*matter*)

200 points—People can use \_\_\_\_\_ to describe and identify matter. (*properties*)

300 points—Describe solubility. (*the ability of a substance to dissolve*)

400 points—Name three properties of matter. (*Acceptable answers include color, hardness, reflectivity, electrical conductivity, thermal conductivity, magnetism, and solubility.*)

500 points—Explain how evidence can be used to describe matter. (*Students should describe how observations or quantitative measurements of physical properties of matter can be used as evidence to describe types of matter.*)

### Particles of Matter

100 points—What is matter made up of? (*smaller particles*)

200 points—What is a characteristic of particles? (*They are too small to be seen.*)

300 points—What is an example of a particle that makes up matter? (*A sample answer is air.*)

400 points—Blowing up a balloon can be used as a \_\_\_\_\_ to show that particles exist. (*model*)

500 points—What is an example of evidence that can be used to explain that matter is made of particles too small to be seen? (*Acceptable answers include inflating a balloon, evaporating liquids, and dissolving a substance.*)

### Physical Changes

100 points—Cutting a piece of paper is an example of a \_\_\_\_\_ change. (*physical*)

200 points—During a physical change, the total \_\_\_\_\_ of matter is conserved. (*weight or mass*)

300 points—What are the three states of matter? (*liquid, gas, solid*)

400 points—In your own words, describe a physical change. (*Sample answer: A type of matter can change physically while remaining the same type of matter.*)

500 points—How can you prove that the total weight of matter is conserved during a physical change? (*measure the matter before and after the change occurs*)

## Chemical Changes

100 points—When two or more different substances are mixed, a new substance may be formed. This is called a \_\_\_\_\_ change. (*chemical*)

200 points—When a chemical change occurs, the total weight of matter does what? (*stays the same/is conserved/no matter is gained or lost*)

300 points—What is an example of a chemical change? (*Sample answers may include cooking or baking, rusting, burning paper, rotting a banana, etc.*)

400 points—How do you know when a chemical change has occurred? (*Sample answers include formation of gas, change in color, change in odor, change in temperature, emission of light, and formation of a precipitate.*)

500 points—What kind of evidence of a chemical change would you expect to find when you burn a match? (*Accept either change in temperature or emission of light.*)

## Intro to Chemistry

100 points—The scientific study of what matter is made of and how it changes is known as what? (*chemistry*)

200 points—Matter is made up of particles too small to be seen. These are called what? (*atoms*)

300 points—Matter made up of a single type of atom is called a what? (*element*)

400 points—All of the atoms of an element are what? (*identical*)

500 points—Describe a molecule. (*Molecules form when atoms join together with other atoms.*)

## THE CORE LESSON 45 MIN

### 1. Focus student attention on the Big Question.

5 MIN

**What have I learned about matter?** Review with students what they learned throughout this unit:

- examples of matter
- properties of matter
- ways to identify matter
- particles of matter
- physical changes of matter
- mixing matter
- chemical changes of matter
- atoms, elements, molecules

## 2. Preview the exercise.

5 MIN

Activity Page



UR.1

Tell students that you will play a game as a class using the Core Vocabulary cards they made throughout the unit. Have students take out their Core Vocabulary cards. Place students in small groups, and explain that each group will perform as a team. Distribute Matter Review Game (AP UR.1). Review the game rules and instructions together.

## 3. Facilitate the review.

35 MIN

Assign each team a number, and write the team numbers on the board or chart paper. This is where you will keep score of the game points.

Use a fair, random method to determine which team will go first.

To play, the team will select the category and the number of points for the question they wish to answer. Read the corresponding question, and use your timer to give the team thirty seconds to answer. Call on the next team that raises a hand first, and give them a chance to answer the question.

If the team gets the answer wrong, give the class one more chance to answer it correctly. If neither team answers correctly, nobody gets the point, and the second team gets to choose the next question.

As teams select the questions, remove the sticky notes from the poster board so teams can no longer choose that same question.

Activity Pages



AP UR.2

AP UR.3

Assign points to the appropriate teams by marking the front board or chart paper. The team with the most points at the end of the game wins.

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

# Teacher Resources

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 1.1

Use with Lesson 1.

**Observing Matter**

Matter is all around you! Matter has specific properties that can be labeled and defined. Observe the objects at each station. Look for things that could help you to describe and identify the matter. When you make an observation, that means you notice the details about an object or event.

**Complete the table below by describing the matter at each station.**

<b>Station</b>	<b>Object(s)</b>	<b>Observations</b>	<b>What scientific questions will you ask about these examples of matter?</b>
<b>Station 1</b>	Beaker 1: Beaker 2:	Details and descriptions:	Why do some things dissolve in water and others do not?
<b>Station 2</b>			
<b>Station 3</b>			
<b>Station 4</b>			
<b>Station 5</b>			
<b>Station 6</b>			



What’s the Matter?

Matter is all around you! Explore the classroom to identify five examples of matter.

**Complete the table below to describe each example of matter.**

In the Description column, list three or more properties that describe each example. The first example has been done for you.

Example of Matter	Description
A piece of chalk	White; solid but powdery; comes off on my hands; no smell

**Write two questions that you have about your examples of matter.**

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page 3.1 (Page 1 of 3)

Use with Lesson 3.

## Identifying Matter (Days 1 and 2)

### Investigation Guide

You started this lesson by discussing a problem that needed a solution. In this activity, you will investigate different samples of matter and record your observations about their properties. At the end of the investigation, you will use the evidence you recorded to identify the matter that could help solve the problem.

Write the design problem you have to solve.

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Make a list of properties of matter you have learned about so far.

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What type of properties should your material have to help solve the design problem?

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**After the teacher demonstration, you will go from one station to the next to investigate the properties of matter. Follow the directions below as you visit the stations.**

**Station 1:** Test the metals using a magnet.

**Station 2:** Place 2 droppers full of water into each of 2 cups. Add a spoonful of Powder 2 to one cup. Add a spoonful of Powder 3 to the other cup. Stir the contents of each cup. Use the conductivity tester to test the conductivity of the solution inside each cup.

**Stations 3 through 12:** Place 2 full droppers of liquid in a cup. Add a spoonful of powder. Stir, and observe what happens. Save the cup to observe what happens to the materials inside the cup the next day.

Evidence Table

Station	Material Observations	What happens?	What kind of evidence does this provide?
DEMO	Nail: Penny: Rock:		
1	Wire: Paper clip:		
2	Powder 2: Powder 3:		
3	Powder 1: Liquid 1:		
4	Powder 2: Liquid 1:		
5	Powder 3: Liquid 1:		

## Evidence Table

6	Powder 4: Liquid 1:			
7	Powder 5: Liquid 1:			
8	Powder 1: Liquid 2:			
9	Powder 2: Liquid 2:			
10	Powder 3: Liquid 2:			
11	Powder 4: Liquid 2:			
12	Powder 5: Liquid 2:			

Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page 3.2 (Page 1 of 2)

Use with Lesson 3.

## Identifying Matter (Day 2)

### Conclusions from Evidence

Use the evidence you collected and the White Powders Key on the next page to identify each powder and each liquid.

#### **Powder 1:**

**Evidence that supports your conclusion:**

#### **Powder 2:**

**Evidence that supports your conclusion:**

#### **Powder 3:**

**Evidence that supports your conclusion:**

#### **Powder 4:**

**Evidence that supports your conclusion:**

#### **Powder 5:**

**Evidence that supports your conclusion:**

#### **Liquid 1:**

**Evidence that supports your conclusion:**

#### **Liquid 2:**

**Evidence that supports your conclusion:**

**Identifying Properties to Solve a Problem** You have accidentally knocked a hole in your bedroom wall. Which solution can you use to fix it? Look at the properties shown in the White Powders Key below. Then complete the table. Write *yes* or *no* in the last column, and explain your answer.

If...	Then...	Solution: Would this type of matter fix your wall? Why or why not?
If the powder is fine and dull, becomes pasty, and smells like dough when liquid is added,	then the powder is flour, and the liquid is water.	
If the powder is fine and dull and causes the liquid to roll off it,	then the powder is flour, and the liquid is vinegar.	
If the powder is fine and dull and bubbles and fizzes when liquid is added,	then the powder is baking soda, and the liquid is vinegar.	
If the powder is fine and dull and turns a milky color and becomes sticky when liquid is added,	then the powder is baking soda, and the liquid is water.	
If the powder is fine and dull and hardens when liquid is added to it,	then the powder is plaster, and the liquid is water.	
If the liquid sinks into the fine, dull powder, instead of mixing with it,	then the powder is plaster, and the liquid is vinegar.	
If the powder has a crystal shape with a crystalline sheen and dissolves in liquid,	then the powder is sugar, and the liquid is water.	
If a large bead of liquid forms on top of the powder, which has a crystal shape with a crystalline sheen,	then the powder is sugar, and the liquid is vinegar.	
If the powder has a cube shape with a crystalline sheen and dissolves in liquid,	then the powder is salt, and the liquid is water.	
If the powder has a cube shape with a crystalline sheen and sticks together with wetness when liquid is added,	then the powder is salt, and the liquid is vinegar.	

Name \_\_\_\_\_

Date \_\_\_\_\_

**Identifying Matter (Day 3)**

**Investigation Wrap-Up—Solving a Problem**

**Review the design problem from the start of this lesson.**

What would you do to solve the problem?

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What specific properties would your material need to help solve the design problem?

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Make an argument for what type of material should be used to solve the design problem. Use the evidence you have from the investigation to support your argument.

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 4.1

Use with Lesson 4.

**Observation Sheet**

Matter has different properties. Some types of matter are liquids, and some types of matter are solids. When you start to mix and combine different types of matter, you might see some interesting things!

**Record your observations of the teacher demonstrations in the table below.**

Item	Describe its properties.	What happens to the item?
<b>Sugar cube</b>		
<b>Crushed sugar</b>		
<b>Ice cubes and Beaker #1</b>		
<b>Ice cubes and Beaker #2</b>		

**Write two questions that you have about the demonstrations that you saw.**

1. \_\_\_\_\_  
\_\_\_\_\_

2. \_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page 4.2

Use with Lesson 4.

### Lesson 4 Check

1. Use one of the following vocabulary terms to complete this sentence.

weight	particle	volume	energy
--------	----------	--------	--------

A tiny bit of matter is called a \_\_\_\_\_.

2. True or False? If particles are too small to be seen, then the particles do not exist.

\_\_\_\_\_

3. Which statements are true based on what you learned from the demonstrations?

- a) Particles only sometimes take up space.
- b) Particles take up space even if you can't see them.
- c) Matter can be a solid, a liquid, or a gas.
- d) Matter is visible only in one form.

4. Use the sketch box below to draw a picture of what happens when sugar cubes dissolve in water. Explain your thinking using labels, arrows, and a written caption on your drawing.



Name \_\_\_\_\_

Date \_\_\_\_\_

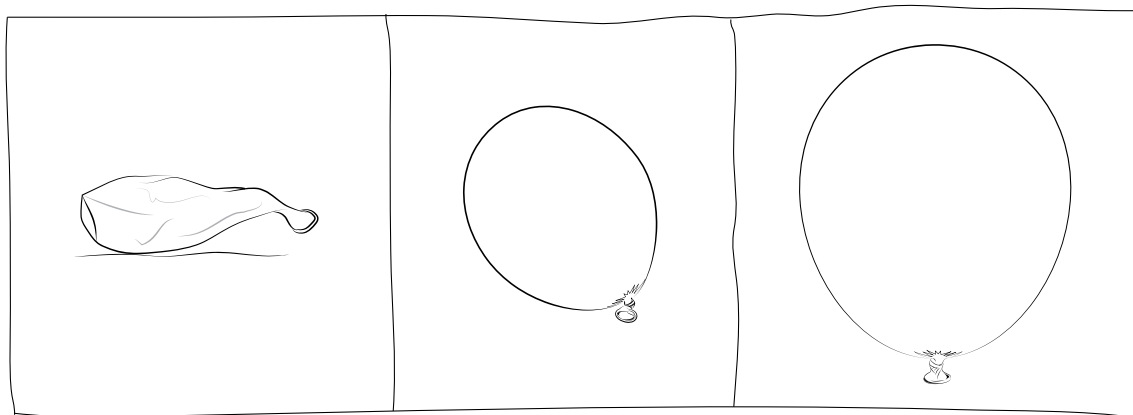
Activity Page 5.1

Use with Lesson 5.

## Balloon Model

Matter is all around you. Many types of matter are invisible to the eye, but there is evidence that it still exists.

**Complete the diagrams below by drawing a model of the amount of particles in each balloon. Use the lines below each frame to describe each balloon. Then answer the questions that follow.**



How do you know that air filled up the balloon?

\_\_\_\_\_

\_\_\_\_\_

What happened when the balloon was pointed at the pinwheel and opened?

\_\_\_\_\_

\_\_\_\_\_

What evidence supports the claim that particles of air were inside the balloon?

\_\_\_\_\_

\_\_\_\_\_

What would happen if the air in one of the balloons were heated up? Draw a model on the back of this page, and explain what would happen to the balloon.

\_\_\_\_\_

\_\_\_\_\_

Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 6.1 (Page 1 of 2)

Use with Lesson 6.

**Ice and Water Investigation (Day 1)**

**Physical Change:** In this part of the activity you will carry out an investigation and record your observations of a physical change. As you go through the investigation, complete the table below.

Object	Starting Weight (g)	Ending Weight (g)
Beaker (empty)		
Beaker with ice cubes		
Ice cubes		
Beaker (with water)		
Paper cup (empty)		
Paper cup (with water)		
Paper cup (with ice)		

**STEP 1:** Weigh and record the weight of the beaker (empty) on the scale.

**STEP 2:** Place the ice cubes into the beaker. Weigh and record the weight of the beaker with the ice cubes.

**STEP 3:** Calculate the weight of the ice cubes. Record the weight in the table. (You may need to use your calculator for this.)

**STEP 4:** Place the beaker with the ice cubes on top of the hot plate. Turn the hot plate on, and wait for the ice cubes to melt.

1. Predict what will happen to the weight of the ice after it melts. Will it change or stay the same?

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**STEP 5:** Once the ice cubes have melted, use the tongs to remove the beaker from the hot plate. Place the beaker back onto the scale. Record the weight.

**STEP 6:** Label your group's small paper cup with your group number. Place the empty paper cup onto the scale, and record the weight.

**STEP 7:** Pour the water from the graduated cylinder into a small paper cup. Place the cup back on the scale, and record the weight.

2. How did your prediction compare with the actual weight of the water?

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3. What happens to the weight when ice melts into water?

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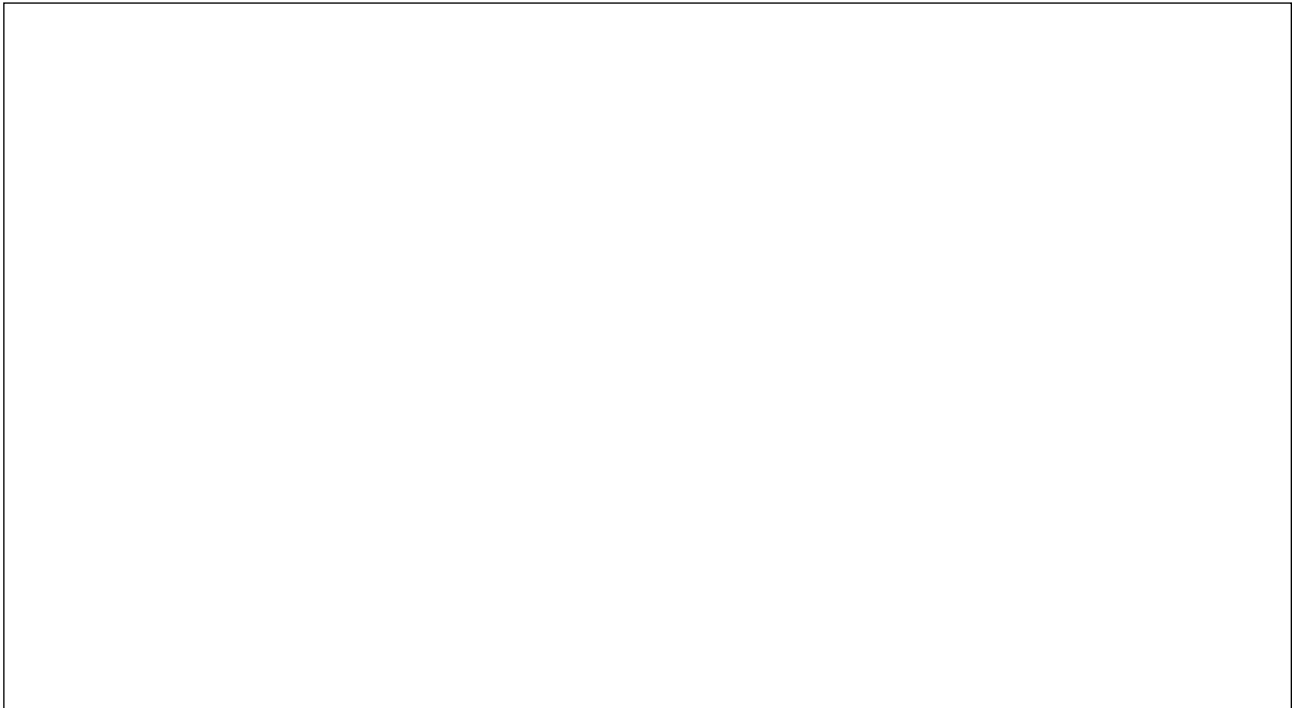
**STEP 8:** Bring your cup of water over to the tray, or tell your teacher that you are ready for it to be picked up.

4. What do you predict will happen to the weight of the water when it is frozen again?

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5. Draw the system made up of the hot plate, beaker, and ice. Use labels and arrows to show the movement of matter and energy in the system. Finally, identify the system as an open or closed system.



Ice and Water Investigation (Day 2)

**Physical Change (continued):** In this part of the activity you will complete your investigation using the table from Day 1.

**STEP 1:** Place your cup of ice onto the scale, and record the weight in the table.

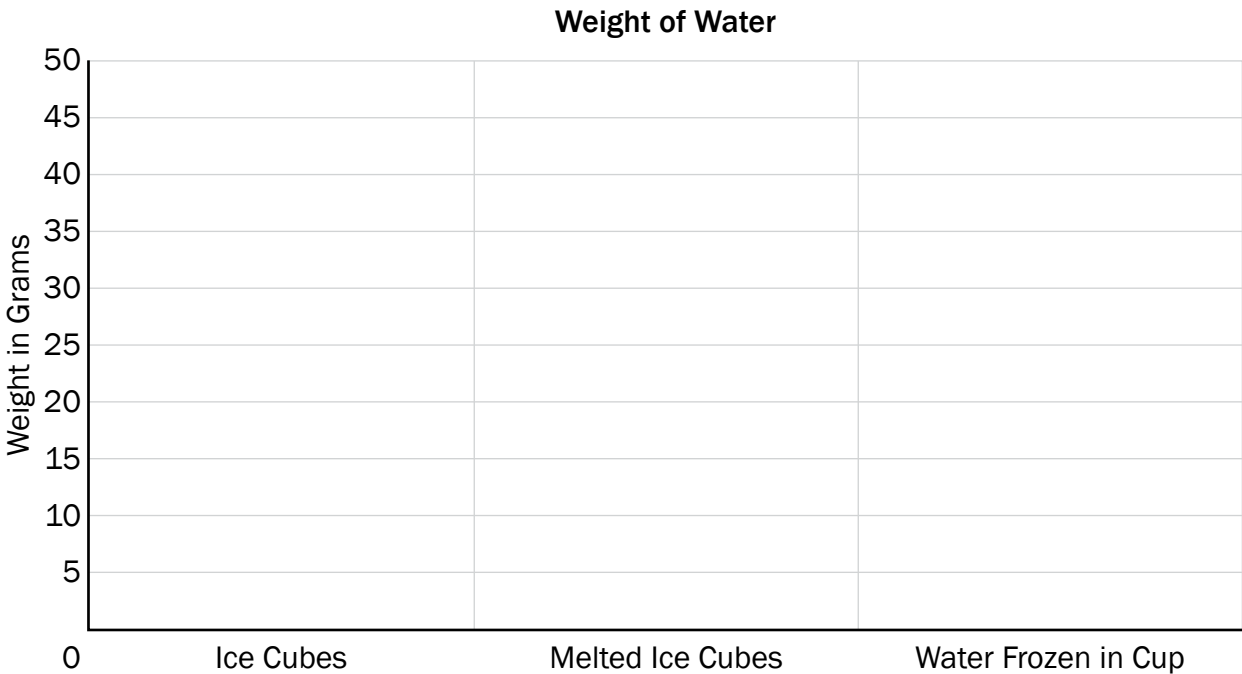
**STEP 2:** Compare the starting weight of the water in the cup and the weight of the ice in the cup.

1. Did the weight of the water change when it turned into ice? Why or why not?

\_\_\_\_\_

\_\_\_\_\_

2. Make a bar graph of the measured quantities of water from your table.



3. How did moving from one state to another affect the water? Support your answer with evidence from your graph.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Chemical Change:** In this part of the activity, you will carry out an investigation and record your observations of a chemical change. As you go through the investigation, complete the table below.

Object	Weight (g)
Beaker (empty)	
20 mL of acetic acid	
Sodium bicarbonate	
Total weight	

Weight of beaker with contents after reaction	
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**STEP 1:** Weigh and record the weight of the beaker (empty) on the scale. Leave the beaker on the scale.

**STEP 2:** Measure out 20 mL of acetic acid into a graduated cylinder. Pour the acetic acid into the beaker.

**STEP 3:** Use the measurements of the empty beaker and beaker with acetic acid to calculate the weight of the acetic acid. Set the beaker off the scale.

**STEP 4:** Weigh and record the weight of two leveled teaspoons of sodium bicarbonate. Use the paper cup to hold the weighed sodium bicarbonate.

1. Predict what will happen to the weight of the materials after they have been added together. Will it change or stay the same?

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**STEP 5:** Place the beaker on the scale. Pour the sodium bicarbonate into the beaker.

2. Describe your observations of what happened when you added the sodium bicarbonate to the contents of the beaker.

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**STEP 6:** Record the weight of the beaker and its contents.

3. Describe the difference between the total weight and the weight of the beaker with contents after the reaction.

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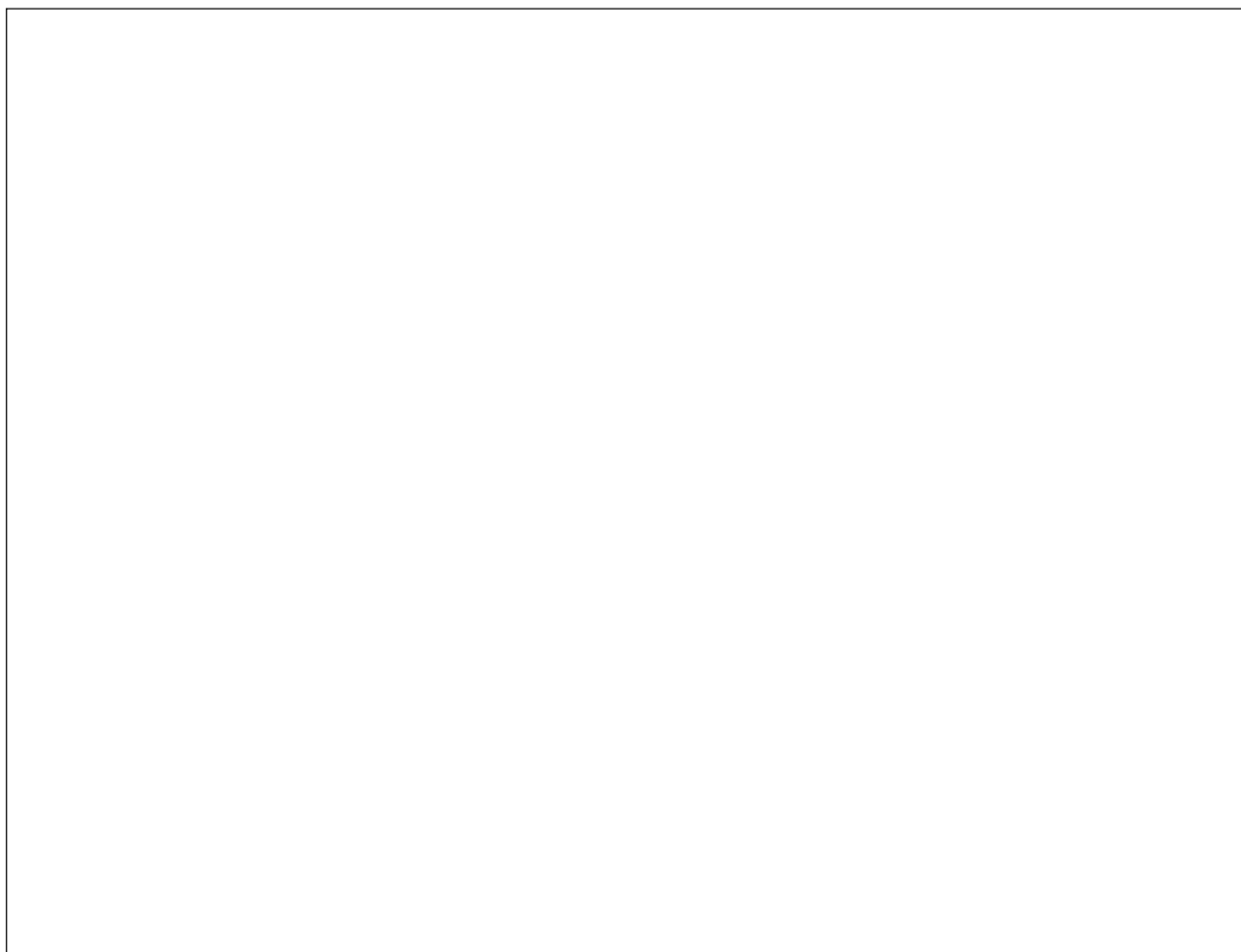
4. Identify the system as an open or closed system. Explain.

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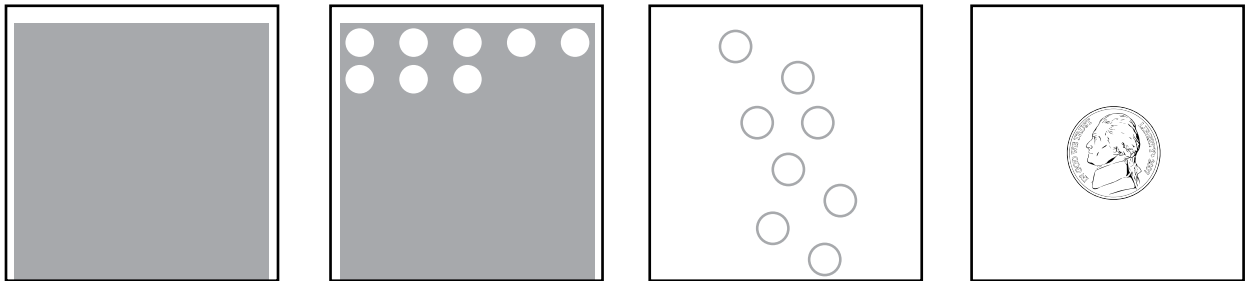
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5. Draw the system made up of the beaker, sodium bicarbonate, and acetic acid. Use labels and arrows to show the movement of matter and energy in the system.



Matter Conservation

1. Let’s look at how nickels are made and how matter is conserved when they are made.



A nickel weighs 5 grams. At a real mint, the blanks are made from giant rolls of metal. Suppose the metal strip they are made from is 30 centimeters wide and 30 centimeters long. Each strip that size weighs 1309 grams. A total of 144 nickels can be made from that sheet.

**Calculate the total weight of the nickels:**

\_\_\_\_\_ × \_\_\_\_\_ = \_\_\_\_\_ grams of nickels

The rest of the metal, the sheet with all the holes from where the blanks were punched out, is scrap and can’t be used to make more nickels.

**Calculate the total weight of the scrap:**

1309 grams – \_\_\_\_\_ = \_\_\_\_\_ grams of scrap

Now use what you have done above to complete the table. Remember what it means to conserve matter as you make your calculations.

	Starting Weight of Roll	Weight of Coins	Weight of Scrap
Pennies		640 grams	180 grams
Nickels	1309 grams	720 grams	
Dimes	835 grams		180 grams

2. If just the pennies were heated enough to turn into liquid metal, how much would they weigh? Explain your thinking.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. You have a cup with six ice cubes in it. The ice cubes each weigh 20 grams. How much will the water from the melted ice cubes weigh? Explain your thinking.

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4. The cup gets heated, and the ice cubes evaporate, turning into water vapor. How much will the water vapor from the evaporated water weigh? Explain your thinking.

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 8.1 (Page 1 of 2)

Use with Lesson 8.

**Chemical Changes Observation Sheet**

In this activity you will observe demonstrations of chemical changes.

**Complete the activity table below based on your observations.**

Demonstration	What evidence is there that a change occurred?	What caused the changes to occur?	Describe the new matter.
Candle			
Glow stick			
Slime			
Bleach			
Bubbling acid tablet			

**1. Which changes were similar? Explain what you think caused the change.**

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**2. Which changes were different? Explain what you think caused the change.**

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**3. Based on these examples, make a claim about the effects of all chemical changes.**

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Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page 9.1

Use with Lesson 9.

## What Kind of Change Will Happen?

1. Describe the two pieces of steel wool.

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2. Predict how the piece of steel wool will change when acetic acid is added.

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**Complete this step at the end of Day 1.**

3. How has the steel wool changed?

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4. Using the vocabulary you have learned, explain what happened to the steel wool.

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 9.2

Use with Lesson 9.

**Chemical Changes Finder**

Chemical changes occur all around you! **Think of some examples of where you see chemical changes, and then write them in the table.** The first example has been done for you.

Example	Description
<i>Rusting</i>	<b>What is it?</b> <i>Rust is a reddish-brownish substance that forms on metals.</i>  <b>Where have you seen it?</b>
	<b>What is it?</b>  <b>Where have you seen it?</b>
	<b>What is it?</b>  <b>Where have you seen it?</b>
	<b>What is it?</b>  <b>Where have you seen it?</b>

## Lesson 9 Check

Answer the items below to show what you have learned.

1. Which kinds of changes are evidence that a chemical change has occurred? Circle all that apply.

- a. color
- b. temperature
- c. weight
- d. light
- e. odor

2. Underline the correct words or phrases to complete each sentence below.

When substances undergo chemical changes, the total weight of matter is [ lost | conserved ].

A chemical change occurs when two types of matter interact to form a [ new | similar ] substance based on its properties.

After a chemical change, the new chemical(s) [ are easy to separate | cannot be easily separated | may or may not be easily separated ].

3. Mark an X in the box to identify the evidence that a chemical change has occurred. Some examples may have more than one type of evidence.

Example	Color	Odor	Gas	Precipitate	Light emission	Temperature
Baking cookies						
Glow sticks						
Slime						
Lighting a match						

4. Water, snow, slush, and salt from snow plows splash over and under cars in places that have snowy winters and have salt on the roads. The cars often rust. Explain why this happens using what you have learned in this lesson.

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 10.1 (Page 1 of 3)

Use with Lesson 10.

## Investigating Chemical Change

**Get ready to start investigating the Big Question: Does the amount of matter change during a chemical change?** In this activity, you will carry out investigations and record your observations of a chemical change.

**SAFETY NOTE:** Put your safety goggles on before beginning this activity. You should only smell materials when specifically instructed to do so and should then use your hands to lightly wave the odor from above the materials to your nose.

**STEP 1:** Weigh the following empty items on the scale, and record their weights in the table at the bottom of this page.

- plastic bag
- bottle cap
- paper cup and thermometer

**STEP 2:** Pour the baking soda into the bottle cap. Weigh the bottle cap on the scale, and record the weight in the table.

Describe the properties of the baking soda. What does the baking soda look and smell like?

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**STEP 3:** Pour 2 tablespoons of vinegar into the small paper cup. Weigh the paper cup on the scale, and record the weight in the table.

Describe the properties of the vinegar. What does the vinegar look and smell like?

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**Touch the outside of the cup of vinegar.** How does the temperature feel?

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Object	Weight (g)
Plastic bag (empty)	
Bottle cap (empty)	
Paper cup and thermometer (empty)	
Bottle cap with baking soda	
Paper cup with thermometer and vinegar	
Starting weight: bag with all contents	
Ending weight: bag with all contents	

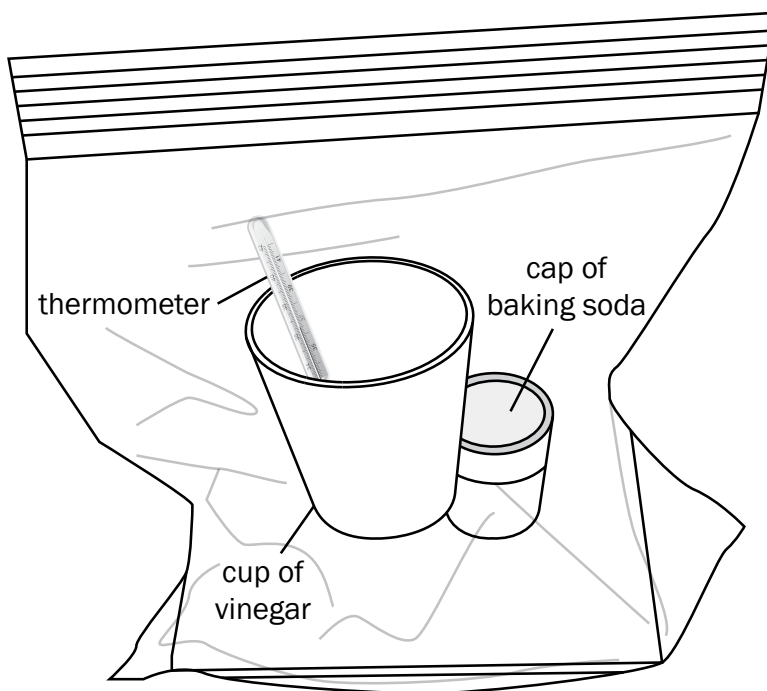
**STEP 4:** Place the piece of cardboard at the bottom of the plastic bag.

**STEP 5:** Carefully set the bottle cap of baking soda upright on the cardboard.

**STEP 6:** Carefully set the cup of vinegar upright on the cardboard with the thermometer in the cup.

**STEP 7:** Squeeze as much air out of the bag as you can without spilling the contents of the cap or cup. Seal the bag shut, and record the temperature on the thermometer.

**STEP 8:** Carefully place the bag—with all its contents—onto the scale, and record the weight in the table on the previous page.



**Identify** what makes this a closed system.

**STEP 9:** Set the bag back down on the table, and without opening the plastic bag, pour the baking soda into the cup of vinegar. You will need to maneuver it through the plastic bag.

**Describe** what happens when the baking soda is added to the vinegar. What did you see happen?

**STEP 10:** Predict whether you think the mass will be conserved or if it will change when the baking soda is added to the vinegar.

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**STEP 11:** Without opening the plastic bag, set it on top of the scale again, and record the weight in the table. What happened to the weight of the plastic bag?

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**STEP 12:** Do not open the bag, but place your nose next to the bag to smell it. What happened to the odor of the vinegar?

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**STEP 13:** Record the temperature of the thermometer through the plastic bag. What happened to the temperature of the cup?

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**STEP 14:** Look at the plastic bag. Was a new type of matter formed in this closed system? Support your answer with evidence from the investigation.

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**STEP 15:** Look at the results of the investigation that you recorded in the table, and review your answers to the questions in the Activity Pages.

**ESSAY QUESTION:**

Compare the results of the investigation to your initial prediction. Did the reaction confirm or contradict your prediction about conservation of matter? Write a summary that describes the phenomenon being investigated and provides evidence as to whether or not this chemical change caused a change in the amount of matter within the system.

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Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 11.1

Use with Lesson 11.

**What Is Matter Made Of?**

Everything is made up of atoms. Some matter is made up of the same kind of atoms. Other matter is made up of different kinds of atoms.

As you go through the Student Reader, write down any examples of atoms you come across. If there are any molecules or elements related to that atom, write those down as well. You also may write down any examples your teacher gives you or any you can think of. Use the table to organize your information.

If you don't have enough examples for every row, you may leave them blank.

Atoms	Elements	Molecules

**Write one question that you have about each term.**

1. atoms: \_\_\_\_\_  
\_\_\_\_\_

2. molecules: \_\_\_\_\_  
\_\_\_\_\_

3. elements: \_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_

Date \_\_\_\_\_

## Activity Page 12.1 (Page 1 of 2)

Use with Lesson 12.

## Comparing Molecules

**Get ready to start comparing molecules!** In this activity, you will make models of ammonia and methane molecules to compare and contrast them.

The following is the key you will use for making your molecule models.

Atom	Shape of atom	Color of atom	Size of atom
Carbon	Round	Yellow	Medium
Hydrogen	Round	Blue	Small
Nitrogen	Round	Red	Medium

### Part 1: Make an Ammonia Molecule

Ammonia molecules contain the following atoms:

- 1 nitrogen, which has 3 bonds to share with other atoms
- 3 hydrogens, each of which has 1 bond to share with another atom

**Make an ammonia molecule out of clay using the key. Use toothpicks to get the balls of clay to stick together.**

In the space below, draw a picture of the ammonia molecule you made. Label the drawing to show the names of the atoms.

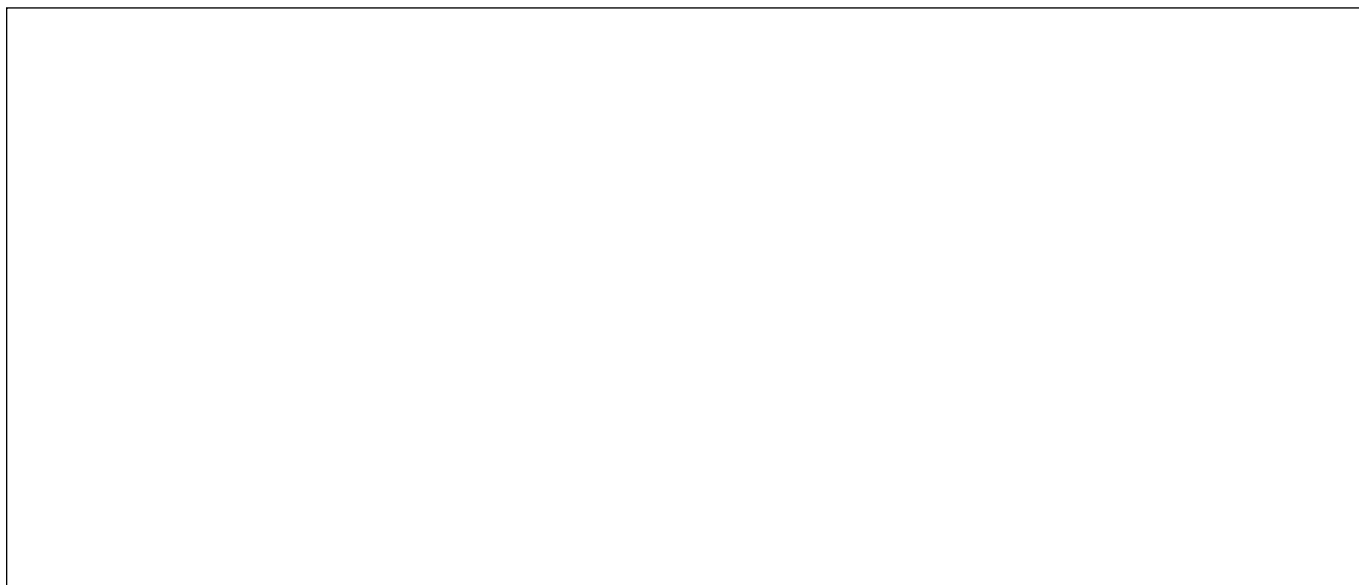
**Part 2:** Make a Methane Molecule

Methane contains the following atoms:

- 1 carbon, which has 4 bonds to share with other atoms
- 4 hydrogens, each of which has 1 bond to share with another atom

**Using the key, make a methane molecule out of clay. Use toothpicks to get the balls of clay to stick together.**

In the space below, draw a picture of the methane molecule you made. Label the drawing to show the names of the atoms.



How are the ammonia and methane molecules similar?

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How are the ammonia and methane molecules different?

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Think about this statement: *Different types of matter are made of different molecules.* Does this activity support that statement? Why or why not? Use evidence to support your answer.

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Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page UR.1

Use with Unit Review.

## Matter Review Game

### Game Rules

In this game, you will work with your team to answer the most questions and score the most points.

- Teams get thirty seconds to answer the question.
- The team that answers the question correctly gets to pick the next question.
- If a team gets the answer wrong, another team can try to answer the question and win the point.
- The first team to raise a hand answers the question first.
- Do not shout out the correct answer. Wait to be called on by the teacher.
- Teammates can discuss the answers with each other before raising their hands.
- Teams can use their Core Vocabulary cards to search for the answers.

**Use the space below to jot notes to your teammates and keep track of your score.**

Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page UR.2 (Page 1 of 2)

Use with Unit Review.

**Matter Vocabulary Crossword Puzzle**

**Use the words in the word bank to complete the crossword puzzle. Review the cards in your Core Vocabulary deck before you begin.**

liquid	matter	mass	weight	volume	properties	measure
particle	expand	evaporate	physical change*	states of matter*		
gas	solid	conserve	dissolve			

\*Spaces that appear between words in terms above do not appear in this puzzle.

**Across**

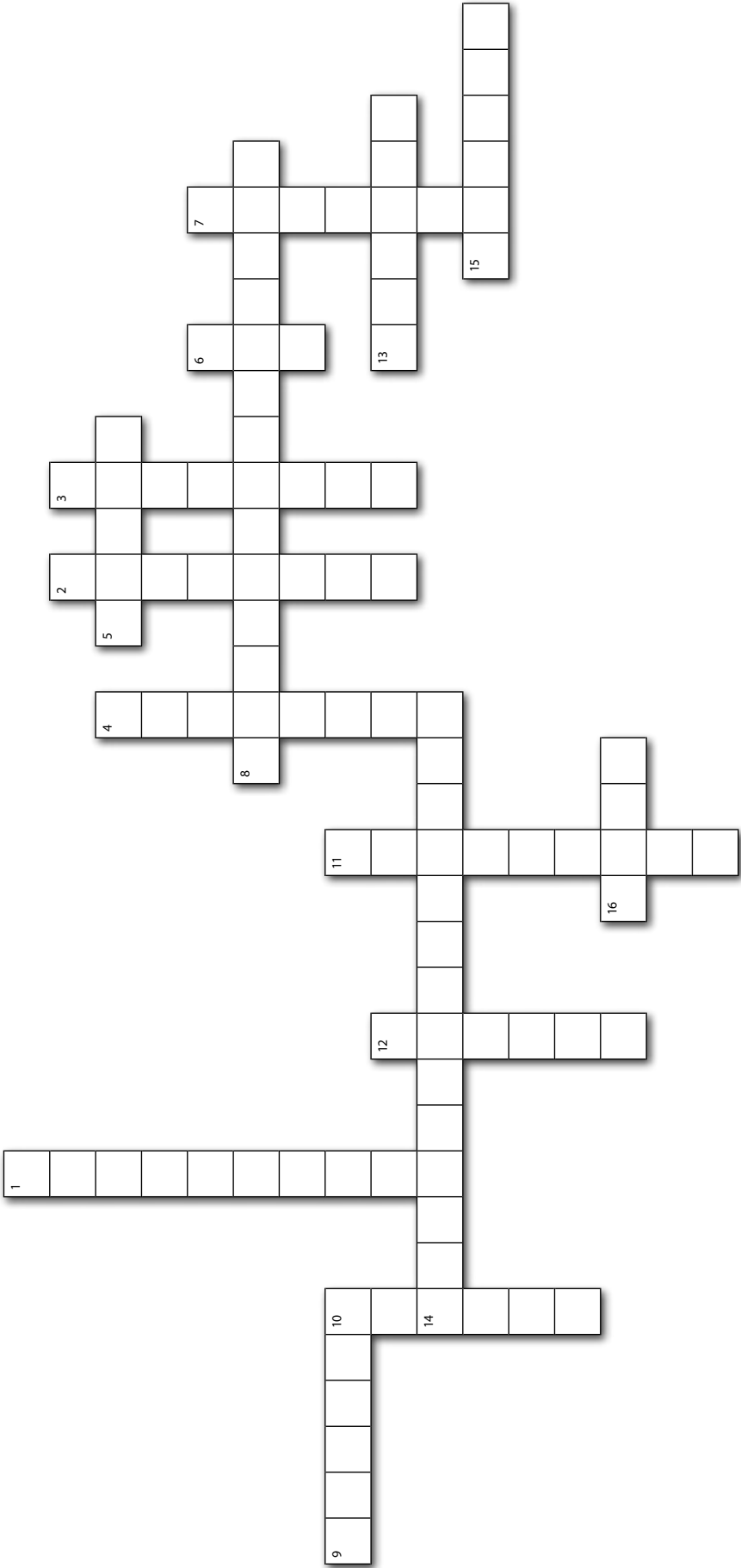
- 5. a form of matter that retains its shape
- 8. Solid, liquid, and gas are examples of this.
- 9. a measure of the amount of space an object takes up
- 13. a form of matter that can flow and takes the shape of its container
- 14. a change that affects the shape of matter but not its chemistry
- 15. a measure of the effect of gravity on an object's mass
- 16. a measure of the amount of matter in an object

**Down**

- 1. things used to identify types of matter, such as color and hardness
- 2. to stay the same
- 3. to distribute evenly into a solution
- 4. a tiny bit of matter
- 6. another word for vapor
- 7. to determine the size, weight, or amount of something
- 10. to become larger
- 11. to turn from liquid into gas
- 12. anything that has mass and takes up space



Matter Vocabulary Crossword Puzzle



Name \_\_\_\_\_

Date \_\_\_\_\_

Activity Page UR.3

Use with Unit Review.

### Matter Vocabulary Review

**Complete each sentence with the correct Core Vocabulary term or phrase. Not every word in the word bank will be used. Review the cards in your Core Vocabulary deck before you begin.**

physical change	chemical change	element	mass	weight	volume		
properties	measure	particle	evaporates	chemical change	conserved		
changed	chemical	atoms	break	bond	molecules	solid	liquid
gas	dissolve	matter					

1. When substances undergo a \_\_\_\_\_, a new substance is formed; however, no matter is gained or lost, and the total weight of matter is \_\_\_\_\_.
2. A(n) \_\_\_\_\_ is a form of matter made up of only one kind of atom.
3. Matter is made up of particles too small to be seen, called \_\_\_\_\_.
4. Atoms can join, or \_\_\_\_\_, with other atoms to form \_\_\_\_\_.
5. The states of matter include \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
6. Sugar will \_\_\_\_\_ in water, but the sugar molecules are still there, even if they are not visible.
7. When water turns from liquid into a gas, it \_\_\_\_\_.
8. The measure of the effect of gravity on an object's mass is known as \_\_\_\_\_.
9. Color, hardness, reflectivity, and magnetism are examples of \_\_\_\_\_.
10. A type of matter can go through a \_\_\_\_\_ while remaining the same type of matter.

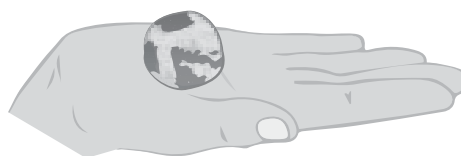
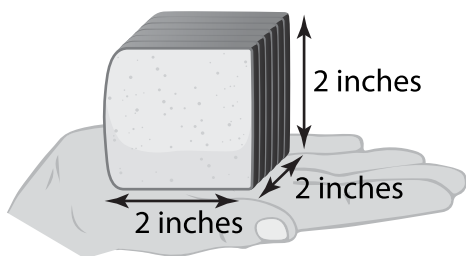
Name \_\_\_\_\_

Date \_\_\_\_\_

## Unit Assessment (Page 1 of 7)

### Unit Assessment: What Have I Learned About Matter?

Answer the following items to show what you have learned.



1. Which of the following can you observe to have changed by just looking at this picture? Circle all the correct answers.
- a) solubility
  - b) density
  - c) state of matter
  - d) weight
  - e) reflectivity
  - f) odor
  - g) volume
  - h) hardness
  - i) conductivity
  - j) magnetism

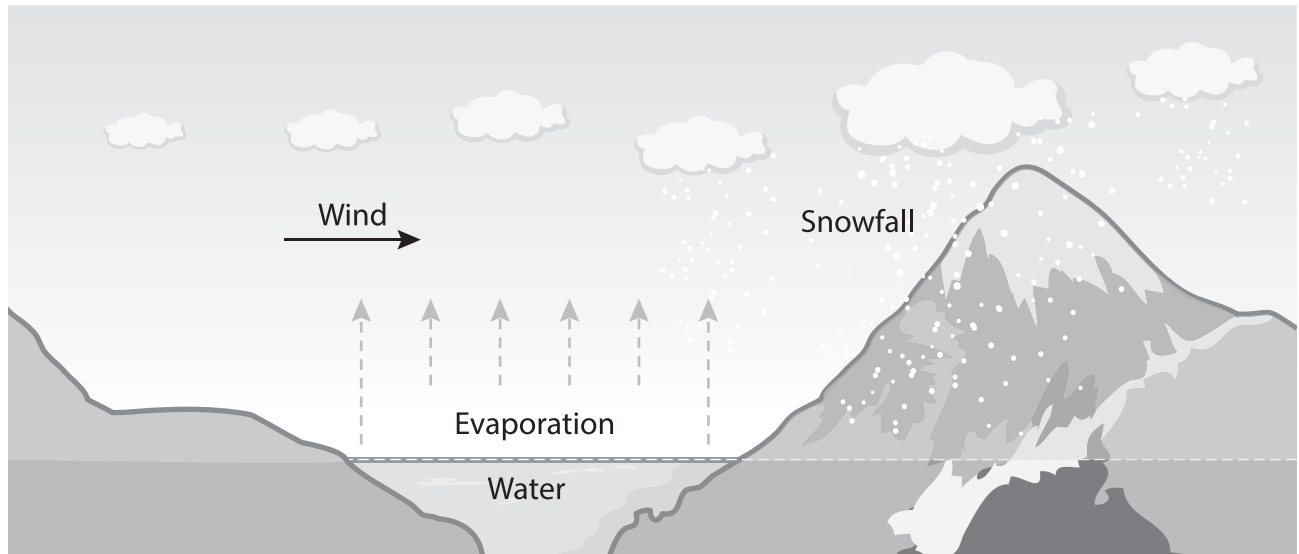
## Unit Assessment (Page 2 of 7)

2. Which of the following can be used to identify the type of matter that an unknown rock sample is made of? Circle all the correct answers.
- a) hardness
  - b) reflectivity
  - c) shape
  - d) electrical conductivity
  - e) thermal (heat) conductivity
  - f) size
  - g) density
  - h) color
3. Draw, label, and describe what happens when a sugar cube is added to warm water.



## Unit Assessment (Page 3 of 7)

4. Explain how this picture is a model that represents the following idea:  
Matter is made up of particles too small to be seen.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

## Unit Assessment (Page 4 of 7)

5. The recipe on a gelatin dessert tells you to mix the 3 ounces of flavored gelatin powder in the packet with 2 cups of water and 1 cup of sugar. The water you add weighs 20 ounces, and the sugar that you add weighs 7 ounces.

You stir the mixture until the sugar and the colored gelatin powder dissolve.

- a) How much does the solution weigh?

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Then, you place the liquid gelatin solution in the refrigerator.

When the mixture cools, it turns into a jiggly dessert that keeps the shape of the bowl when you turn the bowl upside down and dump the gelatin onto a platter.

- b) How much does the dessert weigh?

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- c) Does the weight of the dessert change? Why or why not?

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It is a warm day, though. And before you can eat any of the gelatin, it begins to melt into a puddle on the platter. It looks like about half of the gelatin has melted. You weigh the part that is still a jiggly lump and find that it weighs 16 ounces.

- d) What is the weight of the liquid left on the platter?

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- e) How do you know?

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If you left the dessert to melt the rest of the way on the platter and then waited a few days for the water to evaporate, you would be left with a platter of flavored, sugary, gelatin crust.

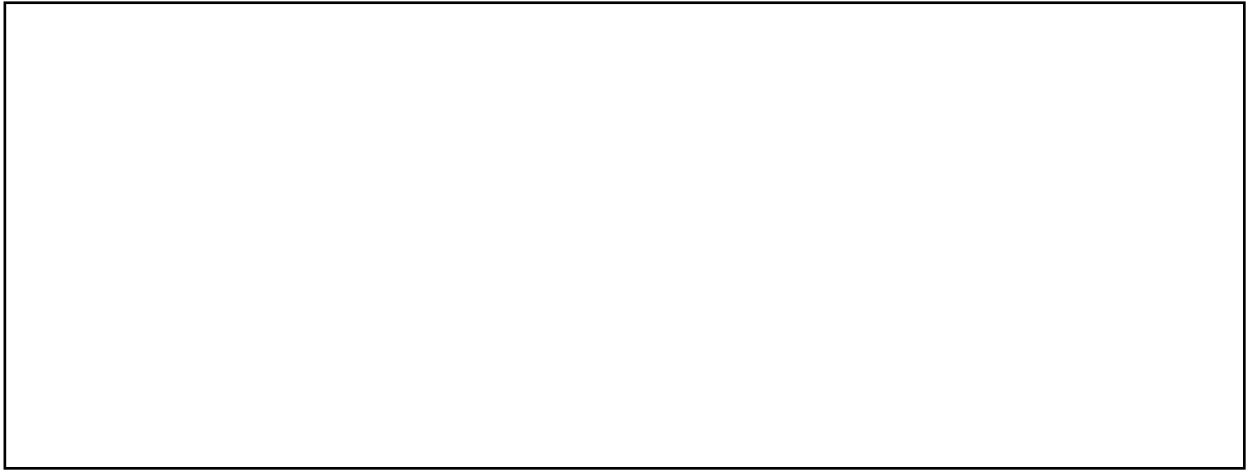
- f) How much would you expect the remaining material to weigh? Why?

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## Unit Assessment (Page 5 of 7)

- 6.** Draw and label circle graphs to show the weight of matter from the gelatin example at these three points:
- a)** when all the matter is mixed and dissolved in the bowl



- b)** when part of the dessert is melted and part is still solid



- c)** when the water is evaporated and the remaining crust is collected from the platter



## Unit Assessment (Page 6 of 7)

7. Which of the following are examples of physical changes? Circle all the correct answers.
- a) grass being cut
  - b) baking soda plus vinegar releasing a gas
  - c) bread baking in the oven
  - d) paper being torn
  - e) plastic melting
8. Chemical change occurs when a substance changes into one or more new substances with different properties. This can happen when certain substances are combined or when energy is applied to a substance. Which are examples of chemical change? Circle all the correct answers.
- a) a tree being cut down
  - b) a tree burning down
  - c) metal rusting
  - d) paper being wadded up
  - e) milk becoming sour
9. Describe an example of matter changing into a different type of matter with different properties.
- 
- 
- 
- 
- 
- 
10. Which of the following correctly describes an element?
- a) An element is matter that is made up of different kinds of atoms.
  - b) An element is matter that is made up of the same kind of atoms.
  - c) An element is matter that is made up of different kinds of molecules.
  - d) An element is matter that does not contain atoms.



## Unit Assessment (Page 7 of 7)

**11.** Write two to three sentences describing the difference between an atom and a molecule.

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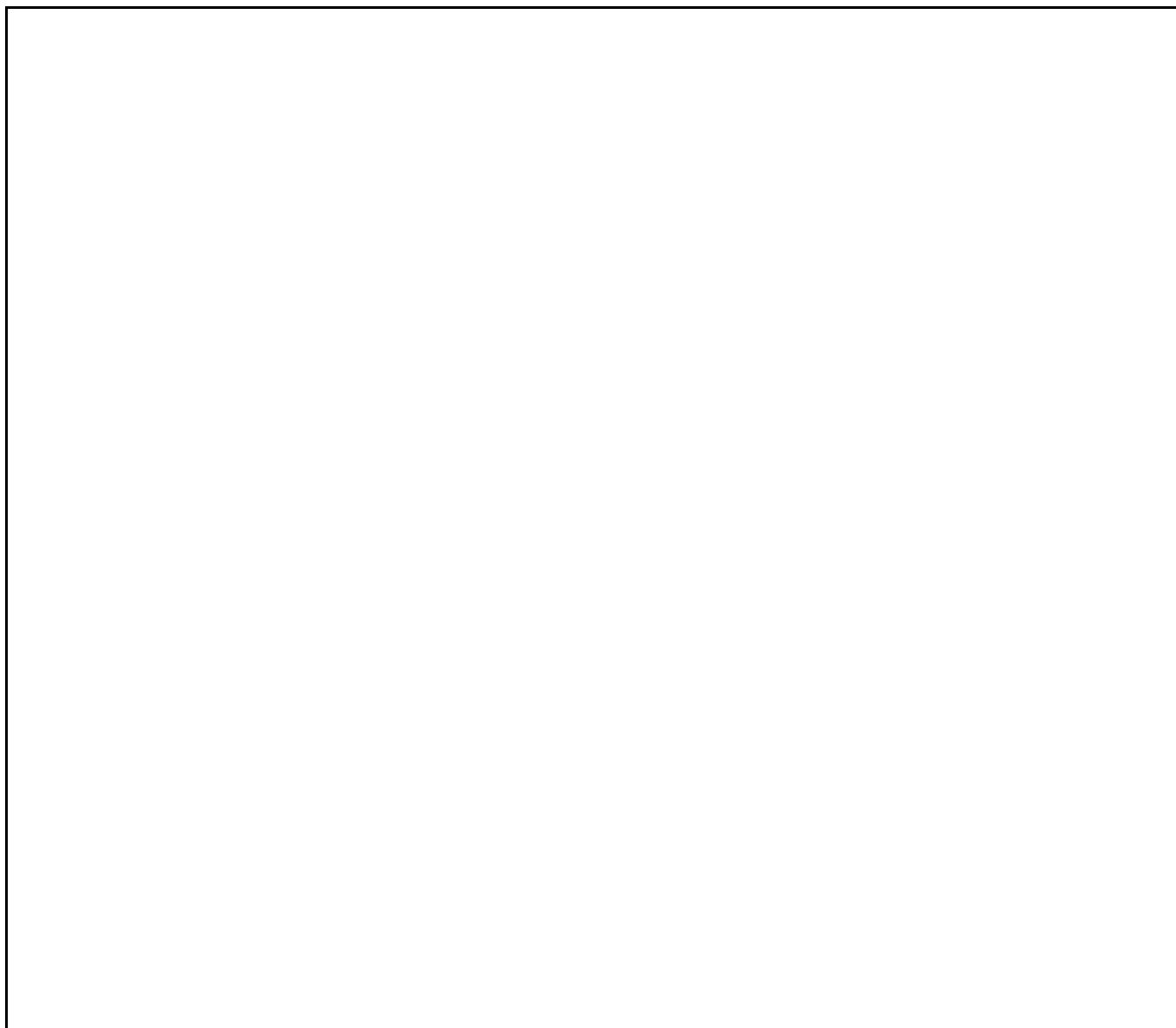
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**12.** Draw simple models of an atom and a molecule to support your descriptions above.



## Activity Pages Answer Key: Investigating Matter

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This answer key offers guidance to help you assess your students' learning progress. Here, you will find descriptions of the expectations and correct answers for each of the Activity Pages of this unit.

### AP 1.1 Observing Matter (page 111)

Accept any reasonable observations and scientific questions based on student observations students submit.

- **Station 1:** Students should note the sugar cube dissolves but the rock does not. They should also note that the volume in the beaker increases notably when the rock is added but not when the sugar cube dissolves.
- **Station 2:** Students should note the deflated balloon has less air in it than the partially inflated balloon.
- **Station 3:** Students should observe condensation forming on the outside of the metal cup.
- **Station 4:** Students should observe that the chalk is softer than the rock.
- **Station 5:** Students should observe that the aluminum foil reflects more light than the paper and the paper absorbs more light than the aluminum foil.
- **Station 6:** Students should observe that the magnet attracts the metal hardware but not the plastic hardware.

### AP 2.1 What's the Matter? (page 112)

- Student descriptions should include observations based on the properties of the samples of matter such as weight, temperature, odor, shape, and buoyancy.
- Accept all reasonable student questions.

### AP 3.1 Identifying Matter: Investigation Guide (Days 1 and 2) (pages 113–115)

- Students should identify the design problem you presented to them.
- Students should list the properties of matter they are familiar with.
- Students should identify properties of matter that will help them solve the design problem.

### AP 3.1, continued

- For the individual investigations, accept plausible observations of materials.
- **Demonstration:** Students should observe that the different materials leave different color streaks and, depending on the tile, different depths to each scratch.
- **Station 1:** The magnet attracts the metal paper clips but not the aluminum wire.
- **Station 2:** The salt water will be more conductive than the water with sugar.
- **Station 3:** The flour and water will mix but not react.
- **Station 4:** The salt and water will mix but not react.
- **Station 5:** The sugar and water will mix but not react.
- **Station 6:** The plaster and water will mix but not visibly react. The reaction of plaster and water will create some heat.
- **Station 7:** The baking soda and water will mix but not react.
- **Station 8:** The flour and vinegar do not mix or barely mix.
- **Station 9:** The salt and vinegar will mix but not react.
- **Station 10:** The vinegar will form beads on top of the sugar.
- **Station 11:** The vinegar and plaster will not mix and will separate.
- **Station 12:** The baking soda and vinegar will fizz and bubble when added together.

### AP 3.2 Identifying Matter: Conclusions from Evidence (Day 2) (pages 116–117)

- Students should identify the powders and liquids as follows based on their evidence: Powder 1—flour; Powder 2—salt; Powder 3—sugar; Powder 4—plaster; Powder 5—baking soda; Liquid 1—water; and Liquid 2—vinegar.

### **AP 3.3 Identifying Matter: Investigation**

#### **Wrap-Up—Solving a Problem (Day 3)**

(page 118)

Students should identify their solution and the needs of their materials for the design problem posed earlier in the lesson. They should also make an argument for the type of material to use to solve the design problem using evidence from their investigation.

### **AP 4.1 Observation Sheet**

(page 119)

Student observations should include the properties of the sugar cube and the crushed sugar. Students should also include an observation of what happened to the sugar and to the ice cubes in Beaker #1 and Beaker #2.

### **AP 4.2 Lesson 4 Check**

(page 120)

1. particle
2. False
3. b, c
4. Student drawings should include labels, arrows, and captions to explain their drawing.

### **AP 5.1 Balloon Model**

(page 121)

- Each balloon model should show more particles in each balloon and more tightly spaced as the balloon gains size.
- Students should note that air has filled up the balloon because the balloon gets firmer as it gets larger.
- The opened balloon should set the pinwheel to moving as the air inside the balloon pushes the blades of the pinwheel.
- Students should note that the movement of the pinwheel indicates matter is pushing on the blades.
- Students should note that heating air in the balloon would make the balloon bigger as the matter moves more and pushes against the inside of the balloon.

### **AP 6.1 Ice and Water Investigation (Day 1)**

(pages 122–123)

#### **Physical Change**

1. Accept all plausible student predictions.
2. Students should use their prediction for Question 1.

### **AP 6.1, continued**

3. The water should have the same weight as the ice. There may be a minor loss of weight due to evaporation.
4. Accept all plausible student predictions.
5. Student drawings of the system should include all components of the system, show the movement of matter and energy in the system, and identify the system as an open system.

### **AP 6.2 Ice and Water Investigation (Day 2)**

(pages 124–126)

#### **Physical Change**

1. Students should note the weight did not change because changing states of matter is a physical change and matter is conserved.
2. Bar graphs should show that the weights of the water did not change regardless of state.
3. The weight of the water remained the same, as the graph shows.

#### **Chemical Change**

1. Accept all plausible student predictions.
2. Students should note the materials in the beaker started foaming.
3. After the chemical change, the weight of materials should be 0.2 grams lighter due to the gas that forms and is released during the reaction.
4. The system is an open system, as the gas can escape out of the beaker.
5. Student drawings of the system should include all components of the system and show the movement of matter and energy in the system.

### **AP 7.1 Matter Conservation**

(pages 127–128)

1.  $144 \text{ nickels} \times 5 \text{ grams/nickel} = 720 \text{ grams}$   
 $1309 \text{ grams} - 720 \text{ grams} = 589 \text{ grams of scrap}$   
Pennies = 820 grams starting weight  
Nickels = 589 grams of scrap  
Dimes = 655 grams of dimes
2. Students should note that the pennies would have the same weight regardless of state of matter.
3. Students should note that the ice cubes would have the same weight regardless of state of matter.

### AP 7.1, continued

- Students should note that in an open system, the ice cubes would have the same weight as the water vapor because the water would undergo a physical change and matter would be conserved.

### AP 8.1 Chemical Changes Observation Sheet (pages 129–130)

**Candle**—Light and heat are evidence of a change occurring. The heat from the flame caused the changes. The new matter is the melted wax, which is a liquid until it cools.

**Glow stick**—Light is evidence there is a chemical change. Breaking the stick caused the change. The new matter gives off light until the chemical change stops.

**Slime**—The different properties of the slime are evidence of a change due to the chemicals combining. The new matter is slimy.

**Bleach**—The change in color is evidence that a change occurred. The bleach mixing with the solution caused the change. The new matter has a different color.

**Bubbling acid tablet**—The bubbling is evidence of a change. Putting the tablet in the solution caused the change. The new matter is part gas.

- The candle and glow stick both gave off light. Chemical changes in both released energy in the form of light.
- Except for the light, each reaction was different, but all of them were the result of chemical changes.
- Most chemical changes are easily observable, such as color changing, heat being given off, or light being emitted. Other chemical changes are harder to see, such as gas being made.

### AP 9.1 What Kind of Change Will Happen? (page 131)

- The two pieces of steel wool are gray and about the same size and shape. Both look very rough in texture.
- Accept all plausible predictions.
- The steel wool that was in the acetic acid is starting to rust and turn orange.
- The steel wool that was dipped in the acetic acid underwent a chemical change. The vinegar interacted with the steel wool and washed the oil off the steel wool. Then, as the steel wool dried, it interacted with the air and started rusting.

### AP 9.2 Chemical Changes Finder (page 132)

Accept all plausible changes and descriptions.

### AP 9.3 Lesson 9 Check (page 133)

- a, b, d, e
- conserved; new; cannot easily be separated
- Baking cookies: color, odor, temperature; Glow sticks: color, light emission; Slime: precipitate; Lighting a match: color, odor, gas, light emission, temperature
- The salt and water cause the metal in cars to change by making the metal rust faster.

### AP 10.1 Investigating Chemical Change (pages 134–136)

**Step 2:** The baking soda is white and smells fresh.

**Step 3:**

- The vinegar is a slightly yellow liquid and smells like an acid.
- The vinegar is room temperature.
- The total mass of the materials in the bag should be the same as the sum of the total of the materials in the bag.

**Step 7:** The temperature in the bag should be room temperature.

**Step 8:** This is a closed system because matter cannot get out of the sealed bag.

**Step 9:** The powder and liquid started foaming. The bag started inflating.

**Step 10:** Students should predict that matter will be conserved.

**Step 11:** The weight in the sealed bag after the reaction should be identical to the weight before the reaction.

**Step 12:** The vinegar smell should be gone.

**Step 13:** The temperature in the cup should have gone down a few degrees.

**Step 14:** The cup will have precipitate at the bottom. This is different matter than the baking soda due to the chemical change.

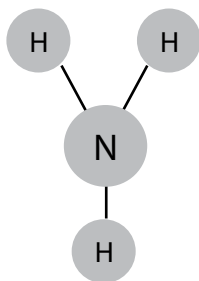
**Essay:** Students should note whether the reaction confirmed or refuted their prediction. They should note that the evidence from the investigation shows that matter is conserved in a closed system.

## AP 11.1 What Is Matter Made Of? (page 137)

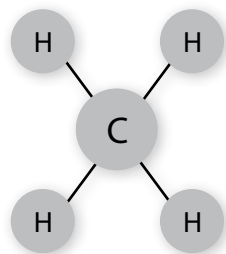
Accept all reasonable examples of atoms, molecules, and elements as well as the related questions they have about each term.

## AP 12.1 Comparing Molecules (pages 138–139)

**Part 1** Student models should look like an ammonia ( $\text{NH}_3$ ) molecule:



**Part 2** Student models should look like a methane ( $\text{CH}_4$ ) molecule:



- Both molecules have hydrogen as the outer molecules.
- There are more hydrogen atoms in the methane molecule than the ammonia molecule.
- The models prove the statement that different types of matter are made of different molecules. There are different kinds of atoms in each molecule.

## AP UR.2 Matter Vocabulary Crossword Puzzle (pages 141–142)

### ACROSS:

- 5. solid
- 8. states of matter
- 9. volume
- 13. liquid
- 14. physical change
- 15. weight
- 16. mass

### DOWN:

- 1. properties
- 2. conserve
- 3. dissolve
- 4. particle
- 6. gas
- 7. measure
- 10. expand
- 11. evaporate
- 12. matter

## AP UR.3 Matter Vocabulary Review (page 143)

- 1. chemical change, conserved
- 2. element
- 3. atoms
- 4. bond, molecules
- 5. solid, liquid, gas
- 6. dissolve
- 7. evaporates
- 8. weight
- 9. properties
- 10. physical change

## Unit Assessment: Teacher Evaluation Guide

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**Teacher Directions:** The Unit Assessment is designed as a fifty-point test. Through this assessment, students demonstrate their overall learning of the unit's Learning Objectives. CKSci Unit Assessments typically range from ten to fifteen questions in the upper elementary grades, which can be answered in a longer, single classroom session or administered in two sittings.

Items with simpler answers that assess knowledge but not the deeper understandings of the content, such as multiple choice or short answers, are weighted differently and are worth fewer points. Assessment items that require more complex thinking and a deeper understanding of the content, such as writing explanations or identifying multiple relationships, are worth more points. Items that require synthesis of content and other student knowledge, are weighted with more points as well. Some test items encourage students to use their Core Vocabulary decks as a reference source for terminology and concepts related to the test item.

### Expected Answers and Model Responses

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1. g (2 points)
2. a, b, d, g, h (5 points)
3. Drawings should depict the apparent disappearance of the solid matter composing the sugar. (5 points)
4. Student response should indicate that water evaporates into the air. It seems to disappear, but the matter's small particles are still present in the air and carried to a new place on the wind. Water vapor condenses into liquid water again. (4 points)
5. a) 30 ounces (10 points)  
b) 30 ounces  
c) No, it contains the same amount of matter, even though it is no longer a liquid.  
d) 14 ounces  
e) I know because the liquid that is left is the original 30 ounces minus the remaining solid part that weighs 16 ounces. 30 ounces minus 16 ounces equals 14 ounces.  
f) 10 ounces; the amount of water used was 20 ounces. If all of that has evaporated, the remaining sugar and gelatin powder is what is left. That matter equaled 10 ounces.
6. Student drawings do not need to be precise but should reflect the following proportions:
  - a) The whole circle represents the combined amount of matter. (5 points)
  - b) Slightly more than half of the circle (16/30) represents the solid gelatin; slightly less than half of the circle (14/30) represents the liquid portion.
  - c) Two-thirds of the circle represents the evaporated water; one-third of the circle represents the residual sugar and dried gelatin.

- 7.** a, d, e (3 points)
- 8.** b, c, e (3 points)
- 9.** Responses will vary. Students should indicate the change in properties that permit identification of the new type of matter. For example, vinegar and baking soda, a liquid and powdered solid, give off a new type of matter that is a gas. (5 points)
- 10.** b (1 point)
- 11.** An atom is a small part of a single type of matter. A molecule is a combination of atoms joined together. (2 points)
- 12.** Drawings should show simple particle models representing a single type of atom and a molecule of two or more atoms joined by representation of a bond or bonds. (5 points)

## Glossary

**Purple words and phrases** are Core Vocabulary terms for the unit. **Bold-faced words and phrases** are additional vocabulary terms related to the unit that you should model for students during instruction and that are often used within the Student Reader, and these latter terms do not have specific page numbers listed. Vocabulary words are not intended for use in isolated drill or memorization.

### A

**atom, n.** a small particle of chemical matter (33)

### B

**bond, n.** a connection that holds atoms together (36)

### C

**change, v.** to become different

**chemical, n.** a specific type of matter made of particles of the same type (28)

**chemical change, n.** the result when two or more types of matter interact to form a new type of matter (28)

**chemical reaction, n.** the process of chemical change

**chemistry, n.** the science of what matter is made of and how matter changes (33)

**condense, v.** to change state from gas to liquid (23)

**conserve, v.** to maintain a constant quantity (24)

### D

**data, n.** recordable details or measurements

**design process n.** a plan that is used to find and develop solutions to a problem (7)

**dissolve, v.** to separate and spread out particles of matter into another substance (15)

### E

**element, n.** a substance made of a single type of atom (35)

**evaporate, v.** to change form from liquid to gas (18, 23)

**evidence, n.** information that helps answer a question, support a claim, or solve a problem (11)

**expand, v.** to grow bigger (13)

### G

**gas, n.** matter with indefinite volume and shape, in which the particles move around freely and expand to fill any container (21)

### I

**interact, v.** to act upon and affect one another

**investigate, v.** to examine something in order to learn more about it

### L

**liquid, n.** matter with definite volume but indefinite shape, in which the particles move around each other freely but do not expand to fill any container (21)

### M

**mass, n.** the amount of matter in an object

**matter, n.** anything that has mass and takes up space (1)

**measure, v.** to compare an amount of something to a known quantity

**mixture, n.** a combination of different types of matter that can usually be separated back into its original parts (27)

**models, n.** pictures, symbols, or physical examples that help explain something that we cannot directly observe (12)

**molecule, n.** a substance made of one or more kinds of atoms joined together by chemical bonds (36)

### O

**observe, v.** to inspect or notice something

### P

**particles, n.** tiny pieces of matter that are too small to be seen (12)

**phase, n.** the state of matter

**physical change, n.** a change that occurs when matter changes form (shape, size) but no new type of matter is formed (19)

**precipitate, n.** a solid formed from a chemical change (31)

**property, n.** a quality, trait, or detail used to describe something (3)



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## S

**solid, n.** matter with definite shape and volume, in which the particles are rigidly arranged in place (21)

**solution, n.** a way to solve a problem (7)

**states of matter, n.** the different physical forms of matter (20)

**substance, n.** a type of matter that is the same throughout

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## V

**volume, n.** the amount of space an object occupies

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## W

**weight, n.** the pull of gravity on an object's mass

### Classroom Safety for Activities and Demonstrations

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In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- Report and treat any injuries immediately.
- Check equipment prior to usage, and make sure everything is clean and ready for use.
- Clean up spills or broken equipment immediately using the appropriate tools.
- Monitor student behavior to ensure they are following proper classroom and activity procedures.
- Do not touch your eyes, ears, face, or mouth while engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances, such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page, for students to read and agree to prior to the start of the first unit so students are aware of the expectations when engaged in science activities.

#### Online Resources



For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

# Student Safety Contract

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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 daughter or son and sign this contract. If you have any questions, please feel free to contact me.

\_\_\_\_\_ / \_\_\_\_ / \_\_\_\_ /

Parent or guardian signature and date

## Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles, but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned, and will last for more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

### Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

[www.coreknowledge.org/cksci-online-resources](http://www.coreknowledge.org/cksci-online-resources)

## Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

### Consider some of the following as methods for acquiring the science materials:

- **School Supply Drive**—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- **Open Houses**—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- **Parent Teacher Organizations**—Reach out to the local PTO for assistance with acquiring materials.
- **Science Fair Drive**—Consider adding a table to your science fair as part of a science materials drive for future units.
- **College or University Service Project**—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- **Local Businesses**—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or for examples of how their sponsorship will benefit students.

Remember: if your school is public it will be tax exempt, so make sure to have a Tax Identification Number (TIN) when purchasing materials. If your school is private, you may need proof of 501(c)(3) status to gain tax exemption. Check with your school for any required documentation.

## Advance Preparation for Activities and Demonstrations

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Being properly prepared for classroom activities and demonstrations is the first step to having a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

### **Before doing demonstrations and activities with the class:**

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

### **While engaged in the activity or demonstration:**

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

### **After the activity or demonstration:**

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices, such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

## What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and X-rays are just some of the discoveries made when people were practicing science and something did NOT go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity doesn't work.

**When going over an activity with an unexpected result, consider these points in discussion with your students:**

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence, or they missed a step when performing the activity. Review and provide feedback on students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson's Big Question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly, a measurement was made in error, such as a wrong unit of measure or quantity, or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but guiding them through the problem and figuring out *why* something happened will help them to develop a better sense of how to do science.



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Core Knowledge **SCIENCE™**

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# Core Knowledge Curriculum Series™

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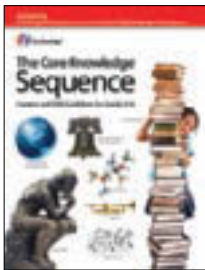
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## CKSci™

Core Knowledge SCIENCE™

### Investigating Matter

Core Knowledge Science 5



#### What is the Core Knowledge Sequence?

The *Core Knowledge Sequence* is a detailed guide to specific content and skills to be taught in Grades K–8 in language arts, history, geography, mathematics, science, and the fine arts. In the domains of science, including earth and space, physical, and the life sciences, the Core Knowledge Sequence outlines topics that build systematically grade by grade to support student learning progressions coherently and comprehensively over time.



#### For which grade levels is this book intended?

In general, the content and presentation are appropriate for readers from the middle to upper elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 5 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the  
**Core Knowledge SCIENCE** series,  
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