

Red Edition
Grade 3–4
reading level

Purple Edition
Grade 4–5
reading level

Objectives

- Explore some physical and chemical properties of matter.
- Describe physical changes in matter.
- Explain how matter changes state.
- Compare types of mixtures.
- Describe chemical changes in matter.
- Explain how to recognize chemical changes.
- Understand what happens to the mass of matter during chemical or physical changes.

Reading Comprehension Skills

Preview the Book ♦ How to Read Diagrams
Main Idea and Details

Skillbuilders are available for this title.

Supporting English Learners

Teach Academic English Make school language comprehensible to English Learners. Carefully select words that have to do with academic tasks, such as *preview*, *paragraph*, and *diagram*, and teach them in meaningful contexts. Provide daily, explicit instruction to teach both science words and school language in depth.

Summary

Everything around us—including us—is made of matter. In the Delta Science Content Reader *Changes in Matter*, students learn about various properties of matter and how these properties can change. They learn that properties such as size and state (solid, liquid, or gas) are physical properties, while properties such as the ability to burn (combustibility) and the ability to rust are chemical properties. Students explore the differences between physical and chemical changes and learn how to recognize each.

Science Background

Matter is anything that has mass and takes up space. We can differentiate objects from one another based on the objects' properties. Matter has physical properties and chemical properties. Physical properties can be observed by the senses. An object's state of matter is one physical property. Chemical properties are those that describe how a substance may react with other substances to form new substances.

Matter can undergo both physical and chemical changes. In a physical change, a substance's chemical makeup is not affected. Changes of state, such as melting and freezing, are examples of physical changes. Being combined in a mixture is another example of a physical change.

A chemical change occurs when a substance reacts with another substance and a new product or products are formed. A common example is the oxidation reaction that occurs when iron is exposed to oxygen and water. This produces iron oxide, or rust. The production of heat and light, such as when fireworks are burned, is also a familiar sign that a chemical change has occurred.

During physical and chemical reactions, matter is not created or destroyed, but rather changes form. This is the law of conservation of mass.



How Do We Describe Matter? (pages 2–7)

Before Reading

Discuss the Cover

Cover Image Discuss the photograph on the cover of *Changes in Matter*. Use the information on the inside front cover to support the discussion.

Science Statement Discuss the science statement. Ask: *Do you think an ice cube melting is a physical change or a chemical change? Why?* (Possible answer: physical change, because ice cube's shape changes)

Build Reading Skills (page 2)

Preview the Book Use Build Reading Skills on page 2 to review how to preview the book. Discuss the steps. Then model previewing bold words.

Think Aloud *Why are some words in the book in bold type? I see on page 4 the bold words matter and physical property. The sentences that contain these words explain what they mean. I also see physical properties repeated a couple more times further down the page. So these words must be important. I will keep an eye out for bold words as I read.*

Guide students as they finish previewing *Changes in Matter*. Focus on nonfiction text features.

- Prompt them to look at the headings, photographs, captions, and diagrams. Ask questions such as *Why do you think that feature is there? How will it help you understand what you read?*
- Prompt them to look at the bold Vocabulary words. Guide the class in looking up a Vocabulary word in the Glossary.

Students can apply the skill in the Reflect on Reading activity on page 7.

K-W-L Chart Have students begin a K-W-L chart. They should add to it after each section.

What I Know	What I Want to Learn	What I Learned
Water can freeze. Ice can melt.	How else can matter change?	

Make a Connection (page 3)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about matter. (Possible answer: An apple can be red or green. It is hard, crunchy, and juicy.) Point out that we use our five senses to learn about matter around us.

Find Out About Read the statement to help students set a reading purpose. Explain that this is the important topic that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a T-chart for examples of *physical properties* and *chemical properties* of matter. Have students suggest examples as they read.

During Reading

Physical Properties (page 4)

- Discuss that matter is anything that takes up space and has mass—even substances we can't see, such as air. Explain that energy, including heat, light, and sound, is *not* matter.
- Ask: *What are atoms?* (tiny particles that make up matter) *What do atoms have to do with the properties of matter?* (The way matter looks or acts depends on the kinds of atoms it is made of and the way the atoms are joined.)
- **Addressing Misconceptions.** Many students confuse mass, volume, and weight. Mass is the amount of matter in an object. Volume is the amount of space the object takes up. Weight is a measure of the force of gravity on the object. If astronauts land on the Moon, they have the same mass as on Earth. But they weigh less because of the Moon's lesser gravitational pull.
- Note these metric units:
 - mass*—grams (g) and kilograms (kg)
 - volume*—cubic centimeters (cm³) for solids
milliliters (ml) for liquids
 - density*—g/cm³
- Ask: *Imagine a rock and an apple of the same volume. The apple has less mass than the rock. Which object has a greater density?* (the rock)
- Ask: *What does it mean if an object has the property of being magnetic?* (It can be attracted by a magnet or can become a magnet.)
- Ask: *Which metals are magnetic?* (iron, cobalt, nickel, and usually steel)

- *State* and *matter* are multiple-meaning words. Make sure students understand the differences between the words' science meanings and the way they are generally used in everyday speech.

✔ **Checkpoint** (This book is paperback and rectangular. It is a solid. It has many colorful pictures. The pages are smooth, but the edges are sharp.)

Chemical Properties (page 7)

- Ask: *What do chemical properties tell us?* (how one kind of matter reacts with other kinds of matter)
- Help students understand that *combustibility* means being *able to burn*, not the act of burning.

✔ **Checkpoint** (The book has the chemical property of combustibility. It can burn.)

After Reading

Reflect on Reading (page 7) Remind students to think back to their experience previewing the book. Ask: *Which features most helped you understand what you were about to read? Are these the same features that helped most when you were reading?* (Answers will vary.)

Apply Science Concepts (page 7) This activity applies a concept from Find Out About on page 3. Help students list the physical properties and chemical properties of a new candle. (Physical: size, shape, color; Chemical: combustibility) Then guide them through thinking about the candle's properties after it has burned. (Its size and shape change. Its color stays the same. The candle is still combustible even after being partially burned.)

What Are Physical Changes? (pages 8–17)

Before Reading

Build Reading Skills (page 8)

How to Read Diagrams Use Build Reading Skills on page 8 to review how to read diagrams. Discuss the tips. Then model how to read the diagram on page 13.

Think Aloud *First I read the title. I learn that the diagram is about how water changes state. Then I look at the first photograph on the left. It shows ice and is labeled "Solid," so ice must be the solid state of water. I follow the first arrow across the top. It is*

labeled "melting" and points to the photograph of the glass of water. Between the two photographs is written a temperature, 0°C (32°F). I think this must be the temperature when solid ice changes state to become a liquid: water.

Guide students to look at the rest of the diagram. Have them follow the arrows. Have volunteers explain what change of state each arrow shows. Students can apply the skill in the Reflect on Reading activity on page 17.

Make a Connection (page 9)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about physical changes in matter. (Possible answers: Sand is often dry and loose. When you build a sand castle, you add water so that the sand will be wet and stick together. The sand also changes color when you add water. You can change its shape when it is wet. These changes usually last until the castle comes down.)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a word web on the board with *Physical Changes* in the center. Have students add to the web as they read.

During Reading

Changes of Shape or Size (page 10)

- Ask: *Can you think of an example of causing a physical change by squeezing?* (Possible answers: tube of toothpaste, ball of clay)
- Ask: *What are some other ways of causing physical changes?* (tearing, folding, bending, breaking, cutting)

✔ **Checkpoint** (The way it looks changes, but it does not change into another kind of matter.)

Changes of State (page 11)

- Ask: *How does adding or taking away thermal energy change the way particles in a substance act?* (Adding thermal energy causes the particles to move faster. Taking away thermal energy causes the particles to slow down.)

- *Addressing Misconceptions.* Some students may think that only water changes state. Have students think of some other familiar substances that they have seen change state, such as wax, chocolate, and butter. Explain that all matter will change state if enough energy is added or removed.
 - Explain that the temperature at which changes of state occur varies a lot among substances. Ice melts at 0°C (32°F), while iron melts at 1,535°C (2,795°F). Water boils at 100°C (212°F), but iron must be heated to 2,750°C (4,982°F) to turn to gas.
 - Ask: *How does liquid water become solid ice in the freezer?* (Thermal energy from the water moves to the cold air in the freezer. When the water molecules lose enough thermal energy, they slow down so much that they change to solid ice.)
 - Discuss the photograph of the pot of boiling water on page 12. Ask: *How can you tell that liquid water is changing to water vapor in this picture?* (You can see gas bubbles forming.)
 - Discuss the photograph of the drinking glass on page 12. Ask: *How do water droplets form on a cold glass?* (The cold glass cools water vapor in the air around it. Some water vapor molecules slow down so much that the gas changes to a liquid.)
 - Ask: *What are two ways matter can change from a liquid to a gas?* (It can change from a liquid to a gas when enough thermal energy is added so that it reaches its boiling point. It can also change when it is below its boiling point by evaporating.)
 - Emphasize that evaporation happens when molecules on the surface of a liquid have enough thermal energy so that they are moving fast enough to break free of the surface and turn to gas. This is different from when a liquid reaches its boiling point, when gas not only escapes from the surface but also forms throughout the liquid as bubbles.
- ✓ **Checkpoint** (Matter can change state when it is heated [thermal energy is added] or cooled [thermal energy is taken away].)

Mixtures (page 14)

- Note that the concentration of a solution is how much solute is dissolved in the solvent. There is a limit to how much solute can be dissolved in a solvent at any given temperature and pressure.

When the solution has reached that limit, it is said to be saturated. During the process of reaching this limit, the solution becomes more and more concentrated.

- Point out that solubility—the ability to dissolve—can be affected by temperature. In many cases, more solute can dissolve in a solvent at higher temperatures than at lower temperatures.
 - Note that temperature also affects how quickly the solute dissolves. Generally, the higher the temperature, the faster the solute dissolves. Stirring also makes a solute dissolve faster by helping to mix the particles of the solvent and the solute together. Additionally, smaller particles of solute tend to dissolve faster than larger particles.
 - Ask: *How is a colloid a little like a solution and a little like a suspension?* (The particles in a colloid do not dissolve, yet they tend to stay mixed.)
 - Ask: *When would you use a strainer, filter, or screen to separate a mixture?* (when the mixture has ingredients of different sizes)
 - Discuss the photograph of the recycling plant on page 17. Ask: *How does a recycling plant use the physical properties of metals to help separate them?* (The plant can use a magnet to separate magnetic metals from other metals and materials that are not magnetic.)
- ✓ **Checkpoint** (The substances that are mixed do not change into different substances.)

After Reading

Reflect on Reading (page 17) If students are having trouble, have them refer back to the diagram of how water changes state on page 13. Once they have completed their diagrams, have them exchange drawings with a partner. Can they follow the path of thermal energy through each other's diagrams?

Apply Science Concepts (page 17) This activity applies a concept from Find Out About on page 9. Guide students by asking them to list one property of ice cream at a time. (Possible answers: Ice cream tastes sweet. It is cold. It has a smooth texture.) Then have them explain whether that property changes when the ice cream melts. (Possible answers: Its taste stays sweet. Its temperature becomes less cold. Its texture changes, becoming more and more liquid.)

What Are Chemical Changes? (pages 18–23)

Before Reading

Build Reading Skills (page 18)

Main Idea and Details Use Build Reading Skills on page 18 to review how to identify main idea and details. Read and discuss the tips. Then read aloud the first paragraph on page 22 and model identifying the main idea and details in a paragraph.

Think Aloud *I know the first sentence often tells the main idea of a paragraph. The first sentence of this paragraph tells me about signs that can show that a chemical change is happening. This seems like the main idea. As I read on, I learn that a change in color is one sign. I also read that bread dough baking and an apple turning brown are two examples of chemical changes that you can see by a change in color. These facts and examples are details that support the main idea.*

Then read aloud the second paragraph on page 22 and guide students to identify main idea and details. Point out that the main idea of one paragraph sometimes can help support the main idea of another paragraph. Students can apply the skill in the Reflect on Reading activity on page 23.

Make a Connection (page 19)

Make a Connection Discuss the Make a Connection questions. Use this discussion to build background and activate prior knowledge about chemical changes. (Possible answers: Before it is baked, the dough is soft and sticky. The cheese is not melted. As it bakes, the dough hardens and the cheese melts. This happens from the heat of the oven.) Ask: *Can the pizza ever go back to the way it was before it was baked? Why or why not?*

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary word aloud. Explain to students that they will see this word in bold in this section. Start a list on the board with *Chemical Changes* as the heading. Have students list examples of chemical changes as they read.

During Reading

Recognizing Chemical Changes (page 20)

- Ask: *How is a chemical change different from a physical change?* (A chemical change forms new substances that have different properties from the original substances.)
 - Ask: *What is the name for new substances formed during a chemical reaction?* (products) *What is the name for the original substances?* (reactants)
 - Ask: *What are some signs of a chemical reaction?* (a change in color, a new substance forming, a new smell, bubbles, light, sound, or heat)
- ✓ **Checkpoint** (Rusting and burning are two examples of chemical changes. During a chemical change, substances react and form new substances.)

Matter, Mass, and Change (page 23)

- Remind students that mass is the amount of matter in an object.
 - Discuss the photographs on page 23 of the campfire before and after it burned. Say: *It seems as if there is less matter after the campfire has burned, but there is not. What happened to the matter?* (It changed to ashes, smoke, and gases.)
- ✓ **Checkpoint** (The mass stays the same.)

After Reading

Reflect on Reading (page 23) To support students, ask questions such as *What is this section mostly about? What are all the examples in this section about?* (Possible answers: Main idea: In a chemical change, two or more substances react and form new substances. Details: Examples include a nail rusting, a log burning, and bread baking. A smell, a change in color, or a new substance that forms can all be signs of a chemical change.)

Apply Science Concepts (page 23) This activity applies a concept from Find Out About on page 19. Suggest that students look for signs of chemical changes in a kitchen or on metal objects. Have students share their completed lists with a partner. (Possible answers: I saw a rusty iron fence. I smelled bread baking. I burned a piece of toast.)

➔ **Continued on last page**

Name: _____

Date: _____

Test: Changes in Matter

Part A: Vocabulary

change of state	chemical change	chemical property	matter
mixture	physical change	physical property	states of matter

Choose the correct vocabulary word for each definition. Write the word on the line.

1. All _____ is made of tiny particles called atoms.
2. Size is an example of a _____.
3. The three main _____ are solid, liquid, and gas.
4. One _____ of an iron nail is the ability to rust.
5. Bending is an example of a _____.
6. When water is heated until bubbles show up, a _____ has happened.
7. The _____ of salt and sand was not easy to separate.
8. A _____ happens when two or more substances react and form new substances.

Part B: Science Concepts

Mark the best answer to each question.

9. A liquid _____ when it changes to a gas below its boiling point.
Ⓐ melts
Ⓑ freezes
Ⓒ condenses
Ⓓ evaporates
10. What property describes how easily one substance dissolves in another substance?
Ⓐ density
Ⓑ conductivity
Ⓒ solubility
Ⓓ combustibility

Test: Changes in Matter (continued)

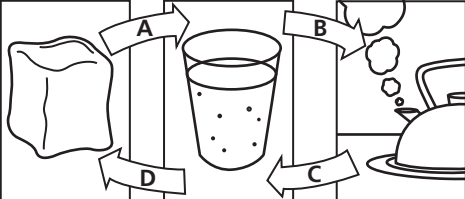
- 11.** What can a new color, a new substance, or a new smell be signs of?
- (A) a chemical change (C) a state change
(B) a physical change (D) a temperature change
- 12.** In both physical and chemical changes, what happens to the total mass of matter?
- (A) It increases. (C) It stays the same.
(B) It decreases. (D) It disappears.

Write the answer.

- 13.** Look at the diagram. What does each arrow show? Label each arrow with the correct word from the word box.

boiling	condensing	freezing	melting
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A: _____
D: _____



B: _____
C: _____

Now write a sentence explaining what the diagram shows.

- 14.** Imagine you have a mixture of rocks and sand. What could you do to separate the rocks from the sand? Why is it possible to separate a mixture?

- 15.** Imagine you left a toy truck made of plastic and metal outside for a long time. When you find it later, the metal has rusted and the plastic has cracked. What kinds of changes happened to the toy truck? Explain.

Let's Review

(inside back cover)

Have students complete their K-W-L charts before answering these questions. Possible answers are shown.

- Cover Connection** (Matter can go through physical changes, such as tearing, bending, breaking, cutting, or a change of state. Matter can also go through chemical changes, for example, a nail rusting, an apple turning brown, or bread baking.)
- (Physical properties: silver, smooth, sharp; Chemical property: ability to rust)
- (Thermal energy from the warm air moves to the cold ice cream. The ice cream's molecules move faster, and it gets warmer. Soon, the solid ice cream reaches its melting point and starts to become liquid.)
- (The leaves may change color. A new substance may appear when the leaves break down and get slimy. The leaves may begin to smell moldy.)
- Main Idea and Details** (Main idea: Mix two or more kinds of matter together and you have a mixture. Details: 1. Solutions: One substance is mixed evenly with another substance. Example: salt and water. 2. Suspensions: Substances do not mix evenly together. Particles of one substance float in another substance. Suspensions do not stay mixed for long. Example: oil and vinegar salad dressing. 3. Colloids: Particles do not dissolve, but tend to stay mixed. Examples: milk, toothpaste, paint.)

- Write** (Descriptions should include physical properties, such as size, shape, color, taste, smell, texture, hardness, mass, weight, volume, density, and state of matter; and chemical properties, such as the ability to burn or rust.)

Try It! Guide students to understand that temperature affects solubility, which is why the sugar dissolves more easily in the warm water than it does in the cold water.

Science at Home Remind students to look out for various changes of state, including melting, freezing, condensing, boiling, and evaporating. Remind them to explain that changes of state happen due to changes in thermal energy, which affect the speed at which the particles in a substance move.

Answers to Test

(Teacher's Guide pages 6–7)

1. matter 2. physical property 3. states of matter 4. chemical property 5. physical change 6. change of state 7. mixture 8. chemical change 9. D 10. C 11. A 12. C 13. A: melting; B: boiling; C: condensing; D: freezing; the diagram shows how water changes state. 14. You could use a strainer that has holes big enough for the sand to go through but too small for the rocks to go through. You can separate a mixture because it is a physical change, so the substances that are mixed do not change into different substances. 15. The rust forming is a chemical change. The ability to rust is a chemical property, and a new substance is a sign of a chemical change. The cracks in the plastic are a physical change, because this did not change the plastic into another kind of matter.

ADDITIONAL ASSESSMENT OPPORTUNITIES Use the Checkpoints, Reflect on Reading, and Apply Science Concepts features and Let's Review questions as additional assessment opportunities.

Delta Science Content Readers are 24-page nonfiction student books with informative, engaging text and full-color photos and illustrations. The readers present key science content and vocabulary found on state tests, present key reading skills and strategies useful for reading informational text, support and extend the experiences and content of hands-on activities, promote scientific inquiry, and serve as a home-school link. They are available in two editions: Red Edition for Grades 3–4 and Purple Edition for Grades 4–5.

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