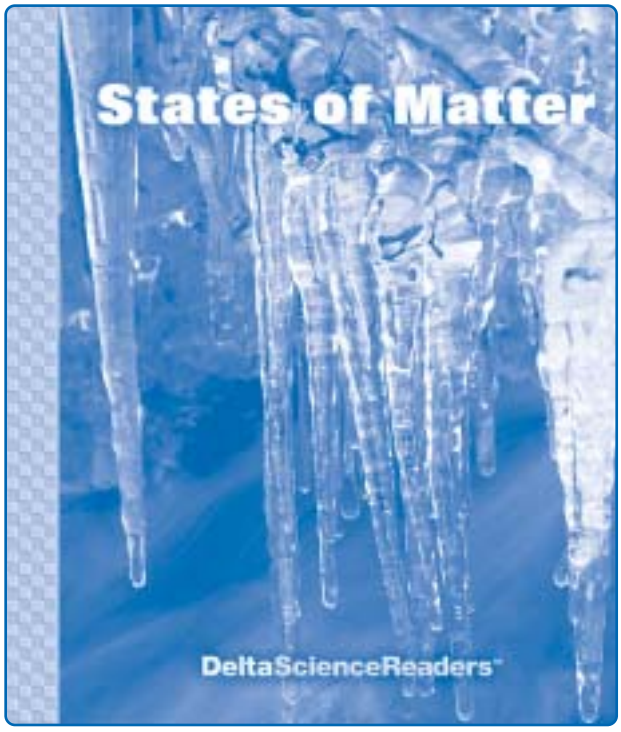
DELTA SCIENCE READER

States of Matter



Delta Science Readers *are nonfiction student books that provide science background and support the experiences of hands-on activities. Every* ***Delta Science Reader*** *has three main sections: Think About . . . , People in Science, and Did You Know?*

Be sure to preview the reader Overview Chart on page 4, the reader itself, and the teaching suggestions on the following pages. This information will help you determine how to plan your schedule for reader selections and activity sessions.

Reading for information is a key literacy skill. Use the following ideas as appropriate for your teaching style and the needs of your students. The After Reading section includes an assessment and writing links.

Overview

The Delta Science Reader *States of Matter* introduces students to matter and its physical properties. Students learn about three states of matter: solid, liquid, and gas. They read about changing from one state to another by melting, freezing, evaporation, and condensation. Students meet two scientists who work with matter in different states—one at a crayon factory and another in Antarctica. Finally, they discover how heating gases keeps a hot air balloon afloat.

Students will

- read about matter
- identify the properties of solids, liquids, and gases
- discuss physical changes in matter
- discuss chemical changes in matter
- discuss the function of a table of contents, headings, captions, and a glossary
- make inferences from photographs
- complete a concept web

READING IN THE CONTENT AREA SKILLS

- Compare and classify matter
- Predict outcomes
- Identify cause and effect relationships
- State the main idea of a passage
- Draw conclusions based on information read
- Demonstrate critical thinking
- Summarize information

NONFICTION TEXT ELEMENTS

States of Matter includes a table of contents, headings, photographs and illustrations, captions, boldfaced terms, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *atom, balance, chemical change, condensation, evaporation, gas, liquid, mass, matter, mixture, physical change, physical property, solid, solution, state of matter, temperature, volume, water vapor.*

BEFORE READING

Build Background

Access students' prior knowledge of states of matter by displaying the cover, reading the title aloud, and inviting students to share what they know about the topic from personal experiences and hands-on science explorations. Ask, *Have you ever seen something melt?* If necessary, give students examples in addition to the icicles on the cover, such as butter or ice cream or snow melting. Explore their ideas about changing states of matter by asking questions: *What shape was the butter in before it melted? What shape was it in after it melted? Was it still butter? How do you know?*

To stimulate further discussion of states of matter, ask questions such as these: *Let's say you have a fort made of snow and a fort made of bricks. Which fort might melt on a hot, sunny day? Have you ever seen anything else change when it's heated or cooled?* (Accept reasonable suggestions.)

Begin a class KWL chart by recording facts students know about states of matter in the K column. You may wish to copy the KWL chart and ask students to maintain their own charts as they read.

K What I Know	W What I Want to Know	L What I Learned	+ What I Want to Explore Further

Preview the Book

Take a few minutes to have students look through the book. Remind them of the steps involved in previewing nonfiction: read and think about the title; think of what they already know about the topic; read the table of contents, headings, and boldfaced words; and examine the photographs, diagrams, and illustrations.

Call attention to the various nonfiction text elements and explain how they can help students understand and organize what they read. Point out that the table of contents lists all the main headings in the book and their page numbers. Ask: *How do you think the headings help you know what you will learn about?* Point to some of the illustrations and ask questions such as: *What does this picture show you? How do you think it will help you understand the text?* Explain that the words in dark type, called **boldface** type, are important words related to states of matter. Point out that they are listed with their meanings in the glossary. Have students find the glossary in the table of

contents. *What page is the glossary on?* (page 16) Choose one word and have students find its meaning in the glossary.

Preview the Vocabulary

You may wish to preview some of the vocabulary words before reading, rather than waiting to introduce them in the context of the book. Possibilities include creating a word wall, vocabulary cards, sentence strips, or a concept web.

Set a Purpose

Discuss what students might expect to find out from the book, based on their preview. List students' predictions on the board. Use the list and the questions in the KWL chart to set an overall purpose for reading.

GUIDE THE READING

Preview the book yourself to determine the amount of guidance you will need to give for each section. Depending on your schedule and the needs of your class, you may wish to consider the following options:

- **Whole Group Reading** Read the books aloud with a group or the whole class. Encourage students to ask questions and make comments. Pause as necessary to clarify and assess understanding.
- **Shared Reading** Have students form pairs or small groups and read the book together. Ask students to pause after each text section. Clarify the text as needed. Discuss any questions that arise or have been answered.
- **Independent Reading** Some students may be ready to read independently. Have them rejoin the class for discussion of the book. Check understanding by asking students to explain in their own words what they read.

Tips for Reading

- If you spread out the reading over several days, begin each session by reviewing the previous day's reading and previewing what will be read in the upcoming session.
- Begin each text section by reading or having a volunteer read aloud the heading. Discuss what students expect to learn, based on the heading. Have students examine any illustrations or graphics and read accompanying captions and labels.
- Help students locate context clues to the meanings of words in boldface type. Remind them that these words are defined in the glossary. Provide help with words that may be difficult to pronounce.
- As appropriate, model reading strategies students may find helpful for nonfiction: adjust reading rate, ask questions, paraphrase, reread, visualize.

Think About . . . (pages 2–12)

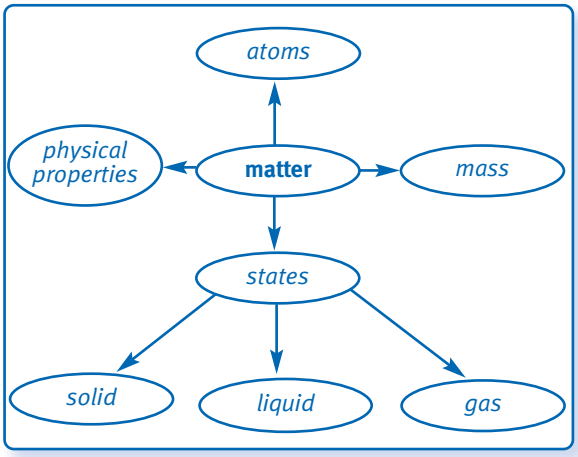
Pages 2, 3 *What Is Matter?*

- Read aloud the heading and the first paragraph on page 2. Confirm students' understanding by asking questions such as, *Is this desk made of matter? Is rain made of matter? Is the air you breathe made of matter?* (Yes, everything is made of matter.)
- Read the second paragraph. Have students look at the pictures on page 3 and ask, *What are the physical properties of this rock?* (Students may say that it is large or hard or rough.) *What are the physical properties of ocean water?* (Students may suggest that it feels wet or tastes salty.)
- Read the third paragraph. Then direct students' attention to the photograph of the balance. Ask, *Have any of you ever seen or used something like this before?* Read aloud the caption and ask, *Which object in the picture has more mass? How do you know?* Hold up a heavy and a light object, for example, a large book and a paper clip. Ask, *Which of these objects do you think has more mass?* (the book) *How might you find out for sure?* (use a balance) *If you were to put this book in*

one pan and the paper clip in the other pan, which pan would sink lower? (the one with the book in it)

- Read the text and discuss the photographs and captions on page 3. Point to the windmill and ask, *Why do you think there is a picture of a windmill to show a gas? What makes a windmill turn?* (the wind, or air blowing) Point out that air is a gas. Ask, *Can you see air?* (no) *How do you know it is there?* (because it turns the windmill)

- Begin a concept web by writing *matter* in a circle on the board. Ask, *What have you found out about matter so far?* Record students' responses in connecting circles, as shown.



▲ *A concept web for* ***matter.***

- Point out the words printed in boldface type on pages 2 and 3. Ask, *What does that tell us about each of these words?* (that it is listed in the glossary) Have students turn to the glossary, locate the word *matter,* and read its meaning.

Page 4 *What Are Solids, Liquids, and Gases?*

Solids

- Read aloud the question at the top of the page. Then have students read the text on page 4 to find out about solids.

- Direct students' attention to the photographs on page 4. Ask, *What solids do you see pictured?* (log, blocks, bowling ball) *What are some other solids you can see right now?* (Accept all reasonable answers. Students may mention desks, chairs, books, pencils, and other solid classroom objects.)

- Invite students to describe the shapes of some of the objects they name. Then ask how they might find out the sizes of these objects. (Students could measure them with rulers, meter sticks, or measuring tapes. They could use nonstandard units of measurement such as string, paper clip chains, or handspans.) Reinforce that a solid has a shape and a size of its own.

- Discuss the diagram on page 4. Ask what the diagram shows. If necessary, explain that it shows what the particles in a solid look like. Elicit that the particles in a solid are packed very close together. This is why the solid keep its shape.

- Point to the circle labeled *solid* on the concept web. Ask, *What have you found out about solids?* Record students' suggestions on the concept web.

Page 5 *Liquids*

- Have students look at the pictures on page 5. Ask, *What state of matter do you think you will read about next?* (liquid) Read page 5 with students to find out if their predictions are correct.

- Look at the photographs on page 5. Ask, *What liquid is pictured here?* (honey) *What is different about the two pictures of honey?* (The honey is in different containers. The honey has different shapes in each picture.) *What do you notice about the shape of the honey?* (It is the same shape as the container it is in.) Ask students to name

other liquids that they know about. (Possible answers are milk, water, syrup, juice, soft drinks, and tea.) Invite students to describe the shapes they have seen some of these liquids take. (Accept all reasonable answers, such as the shape of a cup, a milk carton, or a pitcher.)

- Check students' understanding of liquids by asking how the shapes of solids and liquids are different. (A solid has its own shape, but a liquid takes the shape of its container).

- Point to the word *volume,* and ask students what they think this word means. If necessary, provide help with the pronunciation (VOL-yuhm), and have a volunteer look up the definition in the glossary. Reinforce that the volume of a liquid is how much space it takes up. *Does the volume of a liquid change when you pour it from one container to another?* (no)

  Ask, *How do you think you could measure the volume of a solid?* (Accept students' ideas. As appropriate, suggest that you could place a solid in a container of water and measure how much the water level goes up. That amount of water is the same as the volume of the solid. That is how much space the solid takes up.)

  If your students have studied multiplication in math, you may explain that the volume of a solid with a regular shape can be found by measuring its length, width, and height and then multiplying the three dimensions.

- Then have students compare the diagrams showing the particles in a solid and in a liquid. Ask, *How are the particles in a liquid different from the particles in a solid?* (They are arranged more loosely. There is more space between them.)

- Encourage students to compare and contrast the properties of liquids and solids. Ask, *If you put a marble into a measuring cup like the one on page 5, would the shape of the marble change?* (no) *Would the size of the marble change?* (no) *If you poured honey from the bear container into the measuring cup, would the shape of the honey change?* (yes) *Would the volume of the honey change?* (no)

- Point to the circle labeled *liquid* on the concept web. Ask, *What have you found out about liquids?* Record students' suggestions on the concept web.

Page 6 *Gases*

- Direct students' attention to the photograph on page 6 and read aloud the heading. Ask, *What do you think balloons have to do with gases?*

- Read the text and the caption on page 6. Ask students to answer the question in the caption. (The gas inside the balloon is in the shape of the balloon. It is in the shape of a whale.) Let students tell about other balloon shapes they have seen. Each time, ask what the shape of the gas inside the balloon was.

- Have students compare the diagram showing particles in a gas with the diagrams on pages 4 and 5. Ask, *How are the particles in a gas different from those in a solid? How are they like those in a liquid? How are they different?* (Accept answers based on information in the text.)

- Point to the circle labeled gas on the concept web. Ask, *What have you found out about gases?* Record students' suggestions on the concept web.

Page 7 *What Are Physical Changes?*

- Remind students that they have been learning about solids, liquids, and gases. Tell them that now they are going to learn about how solids, liquids, and gases can change. Read aloud the heading and the text on page 7.

- Have students identify the first picture on page 7. Ask, *How is the butter on this ear of corn changing?* (It is melting.) Read aloud the caption to confirm students' responses. Ask, *What would happen if you put this butter into the refrigerator and cooled it?* (It would become solid again.)

- Have students identify the second picture. Ask, *Have you ever made a juice pop? What did you start with?* (juice) *Was that a solid, a liquid, or a gas?* (liquid) *What did you do to make it into a juice pop?* (froze it) Read aloud the caption.

- Ask, *What is in the bowl in the third picture?* (cereal and milk) Read aloud the caption. Then ask, *Have you ever mixed two foods together? What did you mix?*

- Tell students that they will learn more about all these changes as they read on.

Page 8 *Liquid to Solid*

- If you have a thermometer handy, hold it up and ask, *What is this?* (a thermometer) *What do you use it for?* (to find out how hot or cold it is)

- Have students look at the picture on page 8. Ask, *Do you think the weather is hot or cold? What makes you think so?* (cold, because the children are skating, wearing mittens, hats, and jackets, and so on)

- Have students read page 8. Point to the word *temperature* and help students pronounce the word (TEM-pur-uh-chur). Ask, *What does temperature tell?* (how hot or cold something is) *How do we measure temperature?* (with a thermometer) *What happens when a liquid reaches its freezing point?* (It turns into a solid.)

- On the board, write *0° Celsius* and *32° Fahrenheit*. Point to each part of the terms as you read them in words *(zero degrees Celsius, thirty-two degrees Fahrenheit)*. Provide help with the pronunciation of *Celsius* (SEL-see-uhs), and *Fahrenheit* (FA-ren-hite). Explain that temperature is measured in *degrees,* which is represented by the symbol °. Point out that Celsius and Fahrenheit are the names of different scales on a thermometer for measuring temperature.

- Ask students if they have ever made ice cubes at home. Briefly discuss the procedure for making ice. Point out the word *freezing point* in the text. Remind students that the temperature at which a liquid changes to a solid is called its freezing point. Ask, *What temperature do you think the water had to reach before it changed to ice?* (0° C or 32° F). *When something freezes, was heat added or taken away?* (Heat was taken away.)

Page 9 *Solid to Liquid* and *Liquid to Gas*

- Have students look at the picture at the top of page 9. Ask, *Imagine it is a warm day. What do you think will happen to this ice cube?* (It will melt.) *Why?* (The ice will warm up to its melting point.)

- Have students read the top of page 9. Ask, *What happens when something melts?* (It changes from a solid to a liquid.)

- Have students turn back to page 7 and look at the picture of the melting butter. Ask, *What do you think is making this butter melt?* (the heat from the corn) Point out that different solids have different melting points—that is, the temperature at which butter melts is different from the temperature at which ice melts.

- Discuss with students other things they have seen change from a solid to a liquid, for example, ice cream,

a chocolate bar, or plastic melting. Ask, *When something melts, was heat added or taken away?* (Heat was added.)

- Read aloud the text at the bottom of the page. Point to the word *evaporates*. If necessary, provide help with the pronunciation of *evaporate* (i-VAP-uh-rate). Ask, *What does the word* evaporate *mean?* Reread the context in which the word is explained. Remind students that sometimes they can use context clues to figure out the meanings of new words. Ask, *When water evaporates, what happens to it?* (It changes to water vapor.) Point out the word *vapor* in *evaporate,* as a hint. Ask, *When something boils and evaporates, was heat added or taken away?* (Heat was added.)

- On the board, write *100° Celsius* and *212° Fahrenheit* and ask a volunteer to read the terms aloud. Ask, *What happens to water when it is heated to 100° Celsius?* (It boils. It changes into a gas, or water vapor.)

- Point out that students have been reading about water. Other substances have different boiling points, freezing points, and melting points.

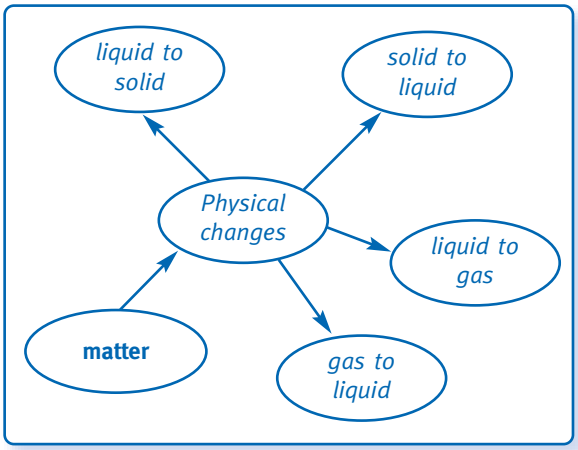
Page 10 *Gas to Liquid*

- Read aloud the first paragraph on page 10 and discuss students' responses to the question.

- Ask students, *When water vapor comes out of a kettle, where does it go?* (into the air) *What do you think might happen to the temperature of that water vapor if it hits something cool like a cold kitchen window?* (It becomes cooler.) *What might happen to that gas when it is cooled?* (It changes back to a liquid.)

- Have students read the rest of the page to confirm their ideas.

- On the concept web on the board, add a new circle connected to the circle labeled *matter.* Label the circle *physical changes.* Ask, *What are some ways in which matter can change states?* Record students' responses as shown.



Page 11 *Mixtures and Solutions*

- Ask students, *Have you ever helped make a salad? What did you put in your salad?* Point out that a salad is a mixture of different foods. Tell students that they will be learning more about mixtures as they read the next page.

- Have students read page 11. Ask, *Have you ever seen or splashed in a mud puddle? What happens to a mud puddle on a hot, sunny day?* (It dries up.) *What happens to the water?* (It evaporates.) *What is left behind?* (dirt) Point out that a mud puddle is a solution. Ask, *What two kinds of matter mix together to make a mud puddle?* (dirt and water)

- Ask, *What other mixtures can you think of?* (spaghetti and sauce, salad, cereal and milk) *Can you think of other examples of solutions?* (laundry detergent mixed with water, cocoa powder mixed with milk)

- Add circles labeled *mixtures* and *solutions* to the web on the board and attach them to the circle labeled *physical changes.*

Page 12 *What Are Chemical Changes?*

- Ask, *Have you ever baked cookies? What ingredients did you use to make your cookies?* List the ingredients on the board. Ask, *What did you do with the ingredients?* (mixed them together into dough) *What did you do with the dough?* (put it in the oven to bake) *Did the dough look the same after it was baked?* (no) Tell students that the cookie dough is matter, and that baking it causes a change. Tell them that they will find out more about this special kind of change as they read the next page.
- Have students read page 12. Ask, *What kind of change happens when you bake pizza dough or burn wood?* (a chemical change) *Think about the cookies we were just talking about. After you bake your cookies, can you "undo" them? Can you separate them into flour, sugar, butter, and other ingredients again?* (no)
- Point out that the term *chemical changes* is printed in boldface type. If necessary, provide help with the pronunciation of *chemical* (KEM-uh-kuhl). Have a volunteer read aloud the glossary definition.
- Add chemical changes to the concept web and attach it directly to the central circle labeled *matter.*

People in Science (pages 13–14)

Page 13 *Crayon Maker*

- Direct students' attention to the heading, *People in Science*. Tell them that next they will be reading about a man who worked with different states of matter every day.
- Ask, *How many of you have used crayons? Have you ever seen a melted crayon? What did it look like? What made it melt?* Briefly discuss students' experiences. Then read together page 13.
- Ask a volunteer to retell the steps by pointing to each picture.
- Review the steps for making crayons and relate them to other information in the book by asking questions such as, *In what state is the wax when the crayon maker begins to work?* (a solid) *What temperature does the solid wax have to reach before it changes to a liquid?* (its melting point) *What do you get when you add the dry powder to the liquid wax?* (a mixture) *How do you change the liquid wax back into a solid?* (take away heat; cool it)

Page 14 *Coastal Geologist*

- Ask students to name some of the coldest places in the world. If you have a globe available, point out Antarctica. Explain that Antarctica is the coldest place on Earth, with temperature extremes ranging from highs of 15°C (59°F) to lows of -89°C (-129°F). Remind students that the freezing point of water is 0°C (32°F). Ask, *Do you think the water in Antarctica is mostly solid, liquid, or gas?* (solid, or ice) Tell students that about 90 percent of all the world's ice is located in Antarctica. Almost 98 percent of Antarctica is covered with ice.
- Tell students that next they will be reading about a scientist who works in Antarctica. Have students read the text and caption on page 14.
- Ask students to speculate about which parts of this coastal geologist's job they would like and dislike.

Further Facts

Chris Malzone

- Chris Malzone works from a research station that is about a 3-hour plane ride from the South Pole.
- Chris's special *dry suit* keeps his body completely dry because any direct contact with the cold water could cause a fatal loss of body heat.
- Chris's team uses a Remotely Operated Vehicle to find out where the trash is located and determine whether it is hazardous to the marine environment.
- Many years ago, people didn't realize that any life could survive under 10 feet of ice. Vehicles and containers of trash were dumped into the ocean near the station.
- Over the years, some of the trash has become a habitat for all kinds of sea life. Removing all of it might upset the new ecosystem. Dumping trash in the ocean is now illegal.

Did You Know? (page 15)

How a Hot Air Balloon Works

- Ask students to identify the object in the photo on page 15. Ask, *What do you know about hot air balloons?* Discuss students' previous knowledge. Then tell them that this page will give them information about how a hot air balloon works.
- Have students read the body text and caption on page 15. Ask, *What do you already know about gases?* If necessary, direct students' attention to the concept web on the board and read aloud the properties listed for gases.
- Remind students that they have already learned that a gas takes up more space when it is heated. You may wish to point out that the air inside the balloon is heated by burning a fuel called propane—the same fuel that many people use in their outdoor grills. The pilot can turn a lever like a knob on a stove to produce a larger flame and more heat. When the pilot wants the balloon to descend, he or she can pull open a parachute valve in the balloon to let some of the hot air escape.

Further Facts

- The first untethered hot air balloon with passengers flew over Paris in September 1783. It was launched by two French brothers, Joseph and Étienne Montgolfier. They thought it was smoke that lifted the balloons. The passengers were a rooster, a caged duck, and a sheep. The balloon traveled about 3 kilometers (2 miles) in eight minutes.
- The first hot air balloon flight with human passengers took place two months later, in November 1783 in Paris. The flight lasted 22 minutes, and the balloon traveled about 9.5 kilometers (6 miles).
- In August 1783 the first gas-filled balloon was launched. The balloon was filled with a newly discovered gas, hydrogen, and it flew 24 kilometers (15 miles) at an altitude of 915 meters (3,000 feet).
- The first non-stop, around-the-world balloon flight took place in March 1999.

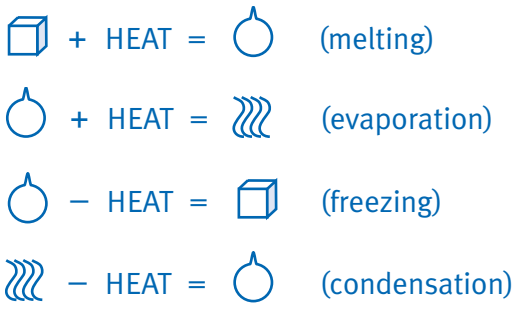
AFTER READING

Summarize

To help students summarize what they've learned about states of matter, draw an ice cube, a raindrop, and several wavy lines representing water vapor on the board as shown. Ask, *What three states of matter have you learned about in this book?* Label each drawing. (solid, liquid, gas)

Use the drawings to create rebus equations showing how matter changes states. Ask

questions, such as *What do you get when you add heat to a solid?* (a liquid) *What is that process called?* (melting) *What do you get when you take heat away from a liquid?* (a solid) *What is that process called?* (freezing) Include the following changes:



Ask, *Does water remain the same substance no matter what state it is in?* (Yes. It is still water.)

Review/Assess

Use the questions that follow as the basis for a discussion of the book or for an oral assessment.

1. Is this (hold up a small object) a solid, liquid, or gas? (solid) What will happen to the shape of this object if you move it from this desk to this table? (The shape will stay the same.)

2. Is ketchup a solid, a liquid, or a gas? (liquid) What will happen to the shape of ketchup if you pour it onto the table? (The shape would change.) Would the volume of the ketchup change? (no)

3. Is the air inside a balloon solid, liquid, or gas? (gas) If you pressed on one side of a balloon, would the shape of the air inside it change or stay the same? (It would change.) If you let the air out of the balloon, would its volume change or stay the same? (It would change.)

4. How does water change from one state of matter to another?

   Students may suggest any of the following:

   - Water changes from liquid to gas when it is heated to its boiling point.
   - Water changes from liquid to solid when it is cooled to its freezing point.
   - Water changes from solid to liquid when it is heated to its melting point.
   - Water changes from gas to liquid when it is cooled to its condensation point.

Writing Links/Critical Thinking

Present the following as writing assignments.

1. Ask students to imagine that they lived in ice houses. What might be the advantages or disadvantages? What would they have to do to make sure their houses didn't melt? How would they keep warm inside their ice houses?

2. Have students write a recipe for a favorite dish. Have them explain whether the ingredients in the recipe undergo a physical or chemical change.

Science Journals: You may wish to have students keep the writing activities related to the reader in their science journals.

References and Resources

For trade book suggestions and Internet sites, see the References and Resources section of this teacher's guide.