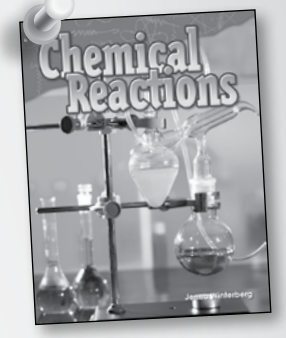
Chemical Reactions



Learning Objectives

Students will:

- identify the main ideas of sections of the text.
- use information from the text to write a paragraph about chemical reactions in their everyday lives.
- observe chemical changes and chemical properties.

Standards

- **Reading:** Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
- **Writing:** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- **Content:** Know that substances can be classified by their physical and chemical properties.
- **Language:** Communicate information, ideas, and concepts necessary for academic success in the content area of Science.

Lesson Timeline

Day 1

Task

Introductory and **Lab Activities** (page 139)

Summary of Student Learning Activities

Observe and record the results of a chemical reaction.

Day 2

Task

Before Reading (page 140)

Summary of Student Learning Activities

Predict the main idea of the book.

Day 3

Task

During Reading (page 141)

Summary of Student Learning Activities

Identify the main ideas of sections of the text, and write a paragraph about chemical reactions.

Day 4

Task

After Reading (page 142)

Summary of Student Learning Activities

Refer to notes to summarize the text.

Day 5

Task

Activity from the Book (page 142) and **Assessments** (pages 147–148)

Summary of Student Learning Activities

Observe chemical changes in food, and take the assessments.

Materials

- copies of the *Cabbage Observations* activity sheet (page 143)
- 3 clear cups
- hot water
- powdered laundry detergent
- purple cabbage
- sealable bags
- spoon
- vinegar

Day 1

Observe and record the results of a chemical reaction.

Introductory Activity — Engage

1. Ask students whether they have ever helped bake cookies. Ask students about the changes the ingredients, or reactants, underwent to become a cookie.
2. Tell students that the ingredients had to undergo chemical changes to make a new substance. Tell students that they will learn more about chemical reactions.

Lab Activity — Explore & Explain

1. Place students in small groups. Distribute a set of materials and copies of the *Cabbage Observations* activity sheet (page 143) to each group.
2. Have students place 5–10 purple cabbage leaves into a sealable bag and fill the bag halfway with hot water. Have them zip the bag tightly and squish the ingredients together until they have purple cabbage juice. **Note:** Cabbage juice may stain clothing and surfaces.
3. Have students fill each cup about halfway with the cabbage juice, making sure not to pour large chunks of cabbage into the cups. Have students record their observations on the activity sheet.
4. Have students add a spoonful of vinegar to the first cup, a spoonful of powdered laundry detergent to the second cup, and a spoonful of water to the third cup. Have students record the results on the activity sheet. **Note:** Be sure to have students rinse their spoons each time to avoid contamination.
5. Ask questions to guide students to the idea that color change often indicates a chemical reaction.
   - ➢ *What happened when you added different ingredients to the juice?*
   - ➢ *What do you think caused these changes?*
   - ➢ *What kind of change resulted from each ingredient? How do you know?*
6. Bring the class together for instruction. Clarify misconceptions by having students explain their understandings using logic and evidence to support their ideas.

Chemical Reactions *(cont.)*

Materials

- *Chemical Reactions* books
- copies of the *Main Idea Prediction* activity sheet (page 144)
- drawing paper
- coloring supplies

Day 2

Predict the main idea of the book.

Vocabulary Word Bank

- byproduct
- catalyst
- inhibitor
- product
- reactants

Before Reading — Elaborate

1. Distribute drawing paper and coloring supplies to students. Lead students in drawing and labeling a diagram of a reaction as an introduction to the vocabulary words. Have students follow along while you narrate each part.
   - ➢ *Reactants are substances that are added to create a reaction.* (Draw two beakers and label them *reactants*.)
   - ➢ *The result of a reaction is a product.* (Draw a beaker and label it *product*. Draw an arrow from the reactants to the product.)
   - ➢ *A catalyst can speed up a chemical reaction.* (Draw a beaker above the reactants with a rabbit on it and label it *catalyst*.)
   - ➢ *An inhibitor can slow down a chemical reaction.* (Draw a beaker below the reactants with a tortoise on it and label it *inhibitor*.)
   - ➢ *A byproduct is a secondary product that is made during a chemical reaction.* (Draw a little beaker next to the product and label it *byproduct*.)
   - ➢ Support **below-level learners** and **English language learners** by analyzing and comparing word parts. For example, *reactants* contains the word *react*. *Byproduct* also contains the word *product*.
2. Distribute the *Chemical Reactions* books to students. Have students flip through the book, asking them to notice the various text features, such as headings, sidebars, captions, and images. Explain to students that authors include many details in the body text and in the text features to support the main ideas.
3. Distribute copies of the *Main Idea Prediction* activity sheet (page 144) to students. Have students use the text features they observed to complete the activity sheet.
4. Discuss student predictions as a class. Explain to students that the main idea of sections or chapters may also be key details that support the main idea of the text as a whole.

Materials

- *Chemical Reactions* books
- copies of the *Taking Notes* activity sheet (page 145)

Day 3

Identify the main ideas of sections of the text, and write a paragraph about chemical reactions.

During Reading — Elaborate

1. Distribute the *Chemical Reactions* books to students. For the first reading, read the book aloud as students follow along. Pause periodically to paraphrase the main ideas of sections or pages of text. Explain that paraphrasing means putting the author's ideas into your own words. Discuss key details in the text that support the main ideas.
   - ➢ You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
2. Distribute copies of the *Taking Notes* activity sheet (page 145) to students. For the second reading of the book, have students read in small groups. Have them use their activity sheets to record the main idea of each chapter. Encourage students to find at least three details that support the main ideas that they write. **Note:** Save students' activity sheets for later use.
   - ➢ You may wish to have students digitally annotate the PDF of the text by highlighting key details.
   - ➢ For **below-level learners** and **English language learners**, you may choose to play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station. The recordings will help struggling readers practice fluency and aid in comprehension.
3. Discuss types of chemical reactions that students observe in their everyday lives, such as cookies baking or iron rusting. Discuss examples from the text, and ask students to discuss examples that may not have been included in the text. Record student responses on the board.
4. Have students write a paragraph explaining how chemical reactions affect their everyday lives. Ask them to include specific examples from the text. Have them include a main idea with at least three supporting details in their paragraphs.
   - ➢ Challenge **above-level learners** to include a strong introduction and conclusion to support their main idea.

Chemical Reactions *(cont.)*

Materials

- *Chemical Reactions* books
- copies of the *Chemical Reactions Summary*, *Chemical Reactions Quiz*, and *pH Scale* activity sheets (pages 146–148)
- students' copies of the *Taking Notes* activity sheet (page 145)

Days 4&5

Refer to notes to summarize the text. Observe chemical changes in food, and take the assessments.

After Reading — Elaborate & Evaluate

1. Write the vocabulary words on the board, and review their definitions as a class. Place students in small groups, and assign each group a vocabulary word. Have students write an acrostic poem for their assigned word. Explain to students that their acrostic poem should include words that are related to the vocabulary word or explain its meaning. Once students are finished, have them share their poems with the class.

2. As a class, review the main ideas students wrote on the *Taking Notes* activity sheet (page 145) from the During Reading activity. Explain to students that each section can have its own main idea but they all support the main idea of the entire text. As a class, brainstorm the main idea of the whole text. Record student responses on the board.

3. Distribute copies of the *Chemical Reactions Summary* activity sheet (page 146) to students. Model for students how to refer to their notes of the text to write a summary of the whole text. Then, have students complete the activity sheet. Once students are finished, have them share their summaries with the class.

Activity from the Book

Read the Your Turn! prompt aloud from page 32 of the *Chemical Reactions* book. Have students observe chemical changes in foods as they cook.

1. A short posttest, *Chemical Reactions Quiz* (page 147), is provided to assess student learning from the book.

2. A data analysis activity, *pH Scale* (page 148), is provided to assess students' understanding of how to analyze scientific data. Explain to students that the pH scale shows how acidic or basic common items are. STEM

3. The Interactiv-eBook activities may be used as a form of assessment (optional).

Name: _____ **Date:** _____

Cabbage Observations

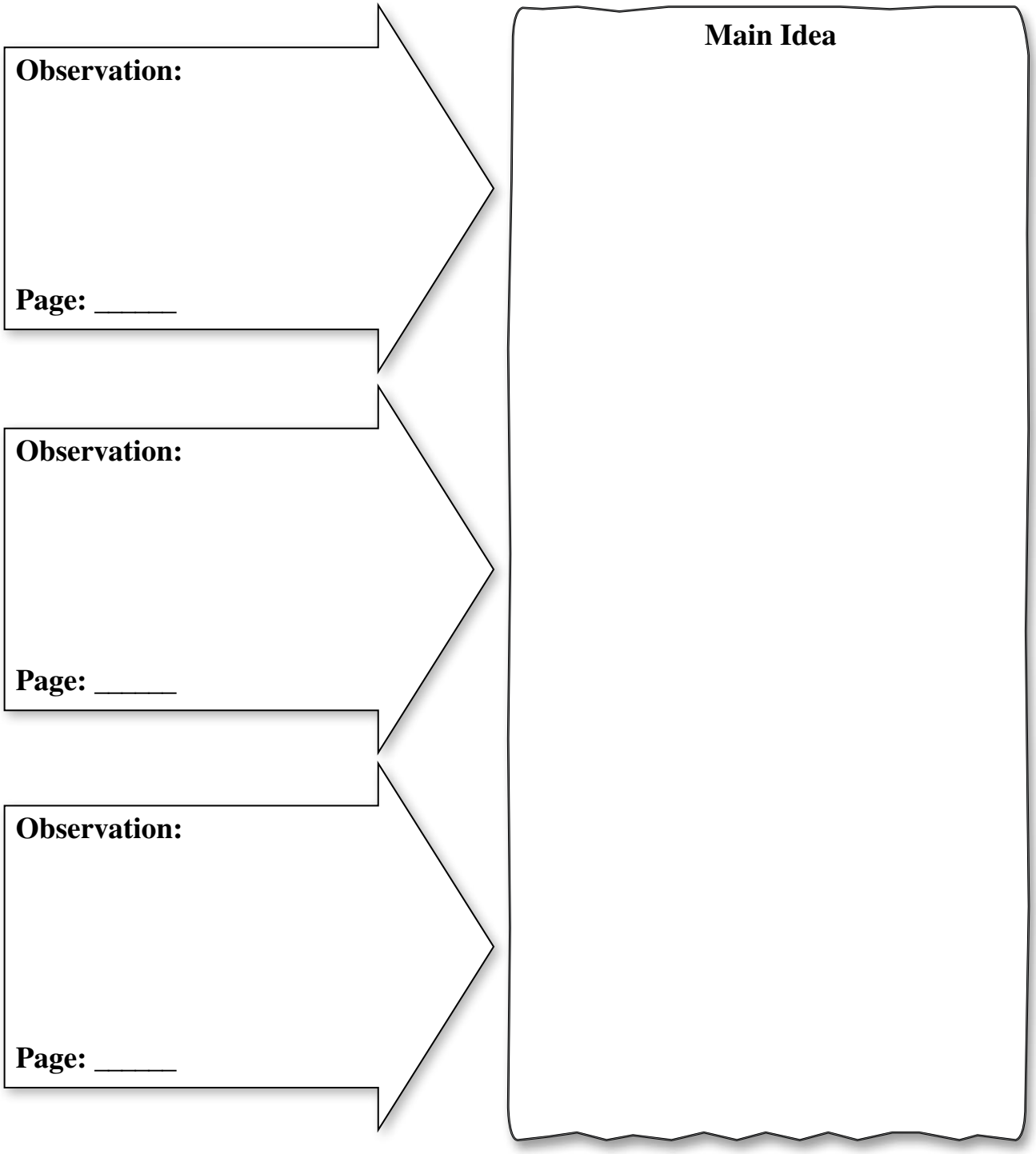
Directions: Pour cabbage juice into cups and record your observations. Then, record your observations when you add each of the reactants listed below.

Reactants	Observations
cabbage juice	
cabbage juice and vinegar	
cabbage juice and laundry detergent	
cabbage juice and water	

Name: _____ **Date:** _____

Main Idea Prediction

Directions: Predict the main idea of the text. Write what you observed in the book that led you to that prediction.



Name: _____ **Date:** _____

Taking Notes

Directions: Paraphrase the main idea of each chapter of the text.

Chapter Title	Main Idea
Combining Substances	
Examining Properties	
Creating a Product	
Categorizing Reactions	

Name: _____ **Date:** _____

Chemical Reactions Summary

Directions: Use your notes to write a summary of the text. Include the main idea of the whole text. Then, explain how key details in the text support it.

Name: _____ **Date:** _____

Chemical Reactions Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

1 Which of the following is NOT a physical property?

- (A) weight
- (B) color
- (C) how much you like something
- (D) magnetism

2 Which sentence best describes one of the main ideas of the book?

- (A) A fire in a fireplace is a chemical reaction.
- (B) Physical properties tell about a substance.
- (C) Acids can be weak.
- (D) Chemical reactions happen all around us.

3 What is NOT a key detail that supports the main idea you chose above?

- (A) Combustion is a chemical reaction that can send a rocket to the moon.
- (B) Airbags use chemical reactions to expand.
- (C) Preparing food is a fun way to see chemical reactions.
- (D) Chemical reactions only occur in labs.

4 Which of the following is NOT a type of reaction?

- (A) synthesis
- (B) destruction
- (C) single displacement
- (D) double displacement

5 What term means to put the author's ideas in your own words?

- (A) main idea
- (B) details
- (C) paraphrase
- (D) quote

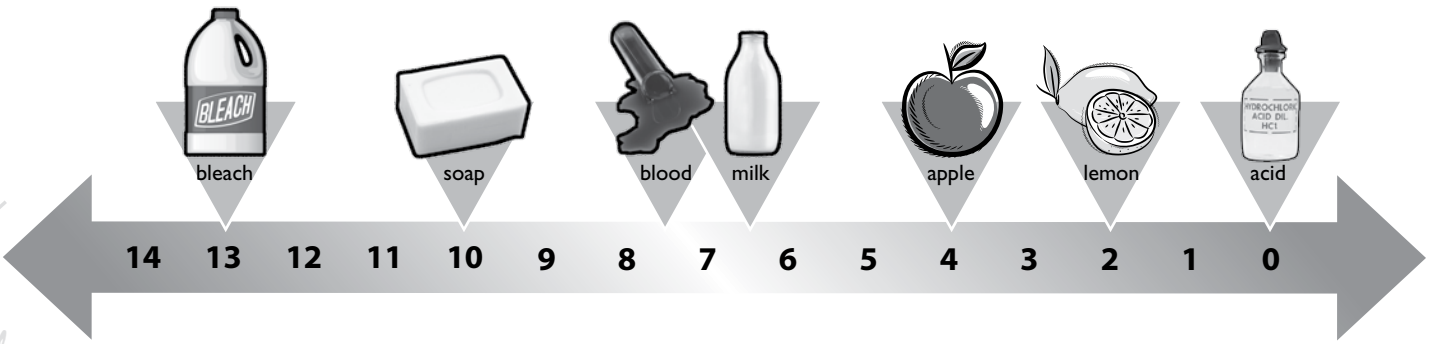
6 Chemical _____ are the characteristics of matter that can be observed during a chemical change.

- (A) catalysts
- (B) changes
- (C) properties
- (D) combustions

Name: _____ **Date:** _____

pH Scale STEM

Directions: The pH scale below shows how acidic or basic common items are. Use the scale to answer the questions below.



1. What item has the highest pH?

_____

2. What has a pH of 4?

_____

3. Which item is more acidic, a lemon or an apple? How do you know?

_____

_____

4. Describe the trend in the data above.

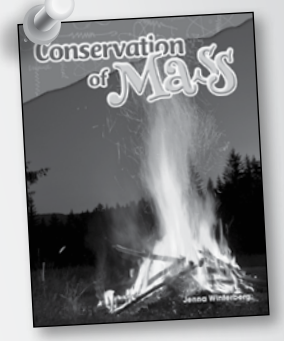
_____

_____

_____

_____

Conservation of Mass



Learning Objectives

Students will:

- identify descriptive and cause-and-effect text structures in the text.
- use details and examples from the text to write a letter explaining the conservation of mass.
- observe how a substance's weight does not change during a chemical reaction.

Standards

- **Reading:** Compare and contrast the overall structure of events, ideas, concepts, or information in two or more texts.
- **Writing:** Draw evidence from literary or informational texts to support analysis, reflection, and research.
- **Content:** 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.
- **Language:** Communicate information, ideas, and concepts necessary for academic success in the content area of Science.

Lesson Timeline

Day 1

Task

Introductory and **Lab Activities** (page 117)

Summary of Student Learning Activities

Observe a chemical reaction.

Day 2

Task

Before Reading (page 118)

Summary of Student Learning Activities

Identify descriptive and cause-and-effect text structures.

Day 3

Task

During Reading (page 119)

Summary of Student Learning Activities

Identify examples of text structures, and use details from the text to explain the conservation of mass.

Day 4

Task

After Reading (page 120)

Summary of Student Learning Activities

Reflect on how and why authors use different text structures.

Day 5

Task

Activity from the Book (page 120) and **Assessments** (pages 125–126)

Summary of Student Learning Activities

Observe the conservation of mass while cooking, and take the assessments.

Materials

- copies of the *Watch the Mass* activity sheet (page 121)
- clay
- kitchen scales
- baking soda
- balloons
- funnels
- measuring cups
- measuring spoons
- vinegar
- water bottles

Day 1

Observe a chemical reaction.

Introductory Activity — Engage

1. Place a lump of clay on a scale, and record its mass on the board. Then, break the clay into two pieces. Ask students how much they think both pieces will weigh when weighed together. Continue breaking the clay into more and more pieces and weighing them together.
2. Ask students why they think the clay always weighs the same amount. Explain that even though the clay changes, none of it is removed. In other words, the amount of clay is conserved.

Lab Activity — Explore & Explain

1. Place students in small groups. Distribute baking soda, a balloon, a funnel, a kitchen scale, a measuring cup, measuring spoons, vinegar, a water bottle, and copies of the *Watch the Mass* activity sheet (page 121) to each group. STEM
2. Have students use the funnel to pour two teaspoons of baking soda into the balloon. Have them rinse the funnel and use it to pour $\frac{1}{4}$ cup of vinegar into the water bottle.
3. Have students put the balloon around the mouth of the water bottle without pouring the baking soda into the vinegar. Have students place the water bottle on the scale and record its mass on the activity sheet.
4. Have students hold the balloon upright so that the baking soda falls into the bottle. Have students weight the bottle again, and record the results on the activity sheet.
5. Ask questions to guide students to the idea that mass is conserved in a chemical reaction.
   - ➢ *What changes did you observe? What did the reaction produce?*
   - ➢ *Did the mass change? Why not?*
   - ➢ *What do you think would have happened if you removed the balloon?*
6. Bring the class together for instruction. Clarify misconceptions by having students explain their understandings using logic and evidence to support their ideas.

Conservation of Mass *(cont.)*

Materials

- *Conservation of Mass* books
- copies of the *Text Structures* activity sheet (page 122)
- drawing paper
- coloring supplies

Day 2

Identify descriptive and cause-and-effect text structures.

Vocabulary Word Bank

- mass
- product
- reactant
- system
- volume

Before Reading — Elaborate

1. Distribute drawing paper and coloring supplies to students. Lead students in drawing and labeling a diagram of a chemical reaction as an introduction to the vocabulary words. Have students complete individual drawings while you narrate each part.
   - ➢ *Reactants, or the ingredients in a reaction, are what you start with.* (Draw two beakers of liquid and label them *reactants*.)
   - ➢ *After a reaction has taken place, you are left with the products.* (Draw two beakers of liquid being poured into a larger beaker with smoke coming out of it. Label the larger beaker *products*. Draw an arrow from the reactants to the products.)
   - ➢ *Mass is the amount of matter, or how much "stuff," that a substance contains.* (Draw dots close together in the liquid of one of the beakers. Label them *mass*.)
   - ➢ *Volume is the amount of space that is filled by something.* (Shade the liquid in a different beaker and label it *volume*.)
   - ➢ *A system is a group of related parts.* (Draw a bubble or a dome over the reaction and label it *system*.)
2. Tell students that text structure is the way an author organizes sentences and paragraphs in a text. Explain that in a cause-and-effect text structure, the author explains how one event causes another event to happen. Tell students that in a descriptive text structure, the author uses details to describe something in depth.
3. Read the first paragraph on page 4 of the *Conservation of Mass* book aloud. Tell students that this is a cause-and-effect text structure. Then, read the first paragraph on page 6 aloud. Tell students that this is a descriptive text structure.
4. Distribute copies of the *Text Structures* activity sheet (page 122) to students. Allow time for students to independently complete the activity sheet.

Materials

- *Conservation of Mass* books
- copies of the *Conservation Letter* activity sheet (page 123)

Day 3

Identify examples of text structures, and use details from the text to explain the conservation of mass.

During Reading — Elaborate

1. Distribute the *Conservation of Mass* books to students. Read the book aloud as students follow along for the first reading. After each paragraph or section, pause and point out a few examples of cause-and-effect and descriptive text structures. For example, after reading page 6, point out the descriptive text structure the author uses in the first paragraph and the cause-and-effect text structure used in the second paragraph. You can also find cause-and-effect text structures on pages 8, 10, and 11, and descriptive text structures on pages 7, 16, and 17.
   - ➢ You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
2. Have students read in pairs for the second reading of the book. Ask students to take turns reading sections aloud with their partners. Ask them to identify sections of text with cause-and-effect or descriptive text structures.
   - ➢ You may wish to have students digitally annotate the PDF of the text by highlighting cause-and-effect and descriptive signal words.
   - ➢ For **below-level learners** and **English language learners**, you may choose to play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station. The recordings will help struggling readers practice fluency and aid in comprehension.
3. Distribute copies of the *Conservation Letter* activity sheet (page 123) to students. Help students brainstorm ideas for their letters. Remind students to use the book to find details and examples.
   - ➢ Have **below-level learners** and **English language learners** outline their letters before writing.
   - ➢ Challenge **above-level learners** to use a cause-and-effect or a descriptive text structure in their letters.

Conservation of Mass *(cont.)*

Materials

- *Conservation of Mass* books
- copies of the *Text Structure Reflection, Conservation of Mass Quiz,* and *Testing the Law* activity sheets (pages 124–126)
- ingredients for cookie dough

Days 4&5

Reflect on how and why authors use different text structures. Observe the conservation of mass while cooking, and take the assessments.

After Reading — Elaborate & Evaluate

1. Write the vocabulary words on the board. Review the definitions as a class. Place students in small groups, and assign each group a vocabulary word. Have students write an acrostic poem for their assigned word. Explain to students that their acrostic poem should include words that are related to the vocabulary word or explain its meaning. Once students are finished, have them share their poems with the class.
2. Review the purposes and distinguishing features of the cause-and-effect and the descriptive text structures. Discuss how text structures connect ideas, paragraphs, and sentences within a text.
3. Distribute copies of the *Text Structure Reflection* activity sheet (page 124) to students. Allow time for students to complete the activity. Discuss student responses as a class.

Activity from the Book

Read the Your Turn! prompt aloud from page 32 of the *Conservation of Mass* book. Have students weigh and measure ingredients, and compare those with dough after the ingredients are combined.

1. A short posttest, *Conservation of Mass Quiz* (page 125), is provided to assess student learning from the book.
2. A data analysis activity, *Testing the Law* (page 126), is provided to assess students' understanding of how to analyze scientific data. Explain to students how the test was done. Then, have them complete the activity sheet. STEM
3. The Interactiv-eBook activities may be used as a form of assessment (optional).

Name: _____ **Date:** _____

Watch the Mass

STEM

Directions: Write the total mass of your materials before the reaction. Record your observations of the reaction. Write the total mass of your materials after the reaction. Then, answer the questions.

Mass Before Reaction	
Observations	
Mass After Reaction	

1. What happened during the reaction?

_____

_____

2. Why do you think this happened?

_____

_____

_____

Name: _____ **Date:** _____

Text Structures

Directions: Write *CE* if a phrase below describes a cause-and-effect text structure. Write *D* if a phrase describes a descriptive text structure.

1 explains why	
2 uses a lot of adjectives	
3 gives the results of something	
4 explains the effect of an event	
5 uses details to describe	
6 tells why something happens	
7 gives details about a topic	
8 explains characteristics	

Name: _____ **Date:** _____

Conservation Letter

Directions: Write a letter to a friend explaining the law of conservation of mass. Use details and examples from the text to support your explanation.

_____
(date)

Dear _____,
(name)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____
(closing)

_____
(signature)

Name: _____ **Date:** _____

Text Structure Reflection

Directions: Answer the questions about text structure below.

1. How does identifying text structure help a reader better understand a text?

_____

_____

2. Why would an author use a cause-and-effect text structure?

_____

_____

_____

3. Why would an author use a descriptive text structure?

_____

_____

_____

4. How are cause-and-effect and descriptive text structures similar?

_____

_____

_____

Name: _____ **Date:** _____

Conservation of Mass Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

1 What supports the idea that chemical changes can create new substances?

- (A) A chemical change affects the very makeup of something.
- (B) Weight and volume may not be the same after a chemical change.
- (C) Matter cannot be created or destroyed.
- (D) Atoms are tiny bits of matter.

2 In what text structure might the following sentence appear? *A physical change affects the way something looks—such as its size, shape, or color.*

- (A) description
- (B) compare-and-contrast
- (C) cause-and-effect
- (D) question

3 What is the law of conservation of mass?

- (A) Chemicals are everywhere.
- (B) Matter is made out of atoms.
- (C) Matter can sometimes be destroyed.
- (D) Matter cannot be created or destroyed.

4 What word has about the same meaning as *properties?*

- (A) matter
- (B) characteristics
- (C) volume
- (D) idea

5 In what text structure might the following sentence appear? *If you let it sit for long enough, it will even grow mold.*

- (A) description
- (B) hypothesis
- (C) cause-and-effect
- (D) sequence

6 The amount of space that is filled by something is its _____.

- (A) matter
- (B) mass
- (C) weight
- (D) volume

Name: _____ **Date:** _____

Testing the Law STEM

Directions: Denise tested the same reaction twice. In the first test, she placed the items in a bowl, weighed it, started the reaction, and weighed it again after the reaction. In the second test, she placed the items in a bowl, covered it with a lid, weighed it, started the reaction, and weighed it again after the reaction. The reaction created a fizzing sound and steam both times. Use her chart to answer the questions.

Test	Beginning Weight	Ending Weight
1	100 grams	98 grams
2	120 grams	120 grams

1. What happened to the weight of the items in each test?

_____

_____

2. If the same reaction is being studied, why do you think the weight changed in one reaction and not the other?

_____

_____

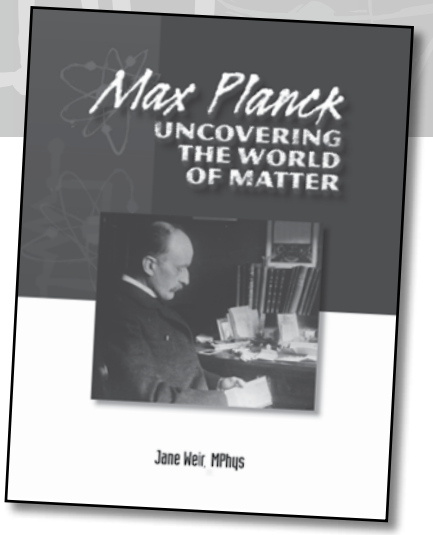
_____

3. Does Test 1 disprove the law of conservation of mass? Why or why not?

_____

_____

Max Planck: Uncovering the World of Matter Reader



Learning Objectives

Students establish and adjust purposes for reading (Nonfiction Reading Objective).

Students summarize and paraphrase information in texts (Nonfiction Reading Objective).

Students know that matter is made up of tiny particles called atoms, and different arrangements of atoms into groups compose all substances (Science Content Objective).

Students know that atoms often combine to form a molecule, the smallest particle of a substance that retains its properties (Science Content Objective).

Materials

- notebook paper
- note cards
- chalkboard or whiteboard
- chalk or wipe-off markers
- Crystal Clear transparency and activity sheet (page 42)
- Heat Me Up! activity sheet (page 43)
- Back to Normal activity sheet (page 44)
- materials for Lab (see page 30)
- *Reader Quiz* (page 45)

Before Reading

1. Complete the Introductory Activity (page 26) with the whole class. Then divide the students into reading groups. The students who read this book should be reading below grade level.

2. Explain to students that expository writing provides facts to the reader. Their job during this unit will be to use the information they gather from the text to summarize the facts they learn. Before reading, have students skim through the reader, jotting down their initial ideas about the content to be presented in the book. Collect these lists for use with Step 12.

3. Introduce the scientist, Max Planck, to students. Distribute the readers and ask the students to brainstorm what they might learn about Planck and how the work of this man might relate to the concept of matter presented in the Introductory Activity. Ask the students to consider the following questions:

   - What is matter?
   - What kind of scientist studies matter?
   - What would interest a scientist in the study of matter?
   - How do you think the study of matter contributes to advancements in our society?
   - Is matter something you would want to study? Why or why not?

   Encourage students to think of questions of their own about Max Planck and his work as a scientist. Have students share one question they hope to have answered when they read. Each student should write their question on a note card. Collect them to redistribute after the reading (Step 13). Ask students to share their ideas about the purpose of reading this book.

Before Reading *(cont.)*

4 Max Planck was interested in an area of science called physics. Help students understand the general areas of science and how each specialty works together to paint a full picture of the world. On the board write a heading, "Areas of Science." Underneath this heading list the general areas of science: Life Science, Physical Science, Earth and Space Science.

5 Brainstorm together topics of study that fall under each heading. For instance, the study of light, heat, chemical reactions, atoms, and nuclear energy would all be considered physical science. The study of rocks, planets, and global warming would fall under earth and space science. Life cycles, the human body, cells, and plants are studied by those interested in life science.

During Reading

6 Review the Table of Contents with the students. Explain that they will be assigned a portion of the book to read. Keep in mind the reading abilities of the students as you determine which students will read which parts of the reader and the number of total pages they will be required to read.

7 Allow students time to read. If necessary, pair struggling readers or second language learners during this time.

8 After students have the chance to read their assigned sections for the first time, ask them to recall the information they read. Ask them about the author's purpose for writing and the big ideas the author attempts to share. Explain that the big ideas are main ideas or central messages in the book. Write the students' main ideas on the board.

9 Encourage the students to read their sections again. This time, ask them to read aloud, quietly, focusing on the accuracy and fluency of their reading. Invite all students to then share with the group the information they gathered from their portions of text.

10 As the students look out their classroom or bus window, or their window from home, have them consider what is happening to the heat energy as it approaches, then collides with the window. Reread pages 10 through 13 with the class. Display the transparency. Review the effects of heat energy for each of the different types of windows. Distribute *Crystal Clear* (page 42) to students. Read through the questions and answers together. Have several students share their ideas for question #8, then allow the students time to write their responses.

11 Reread pages 12 and 13 with the class. Have students consider additional examples of conduction, convection, and radiation. Distribute *Heat Me Up!* (page 43) to students. Discuss the image of the beach, and discuss how these three related concepts occur there. Allow time for students to answer the questions independently.

After Reading

12 Review with the students what they read. If necessary, allow students to reread their assigned portion of the book. Distribute students' lists from Step 2. Remind them that this was the list they created of what they thought they would encounter in the text. Have students review their lists. Then have them add new ideas or make corrections about the actual content of the reader.

13 Return the students' note cards with the question they posed prior to reading in Step 3. Have them reread a part of the reader that addresses their questions and write the answer. Help students as needed find the appropriate place in the reader by using the Table of Contents or the Index. If the student's question was not answered, have him or her write "not answered in the book" and consider an alternative place to look for a response (experimentation, internet, scientist at a nearby university, company or organization related to the topic such as a power company or medical facility, etc.). Have students share their question and answer with the class.

14 Lead a class discussion. The author claims that "Quantum theory was Planck's greatest success" (page 18). Discuss why the author made this statement. What do the students consider to be Planck's greatest achievement? Are their ideas different from the author's?

15 Demonstrate how to use the Index to find the pages related to specific topics. Pose the following questions to students. Have pairs of students reread and answer the questions with their partner. Share two or three pairs' responses to each question with the class.

- What is entropy? How does entropy relate to a messy bedroom?
- What is equilibrium and what are equilibrium reactions?
- What does it mean if something is radioactive?

16 Discuss how students keep things hot or cold. Reread pages 10 and 11, especially the side bar which discusses Zeroth Law. Distribute *Back to Normal* (page 44) to students. Read the information related to thermal energy and Zeroth Law. Then read the experiment summary. Review the data in the chart. Allow time for the students to answer the questions independently. Lead a discussion as to what outside influences affect the storage of heat energy. Would the surface area of the liquid play a role?

17 Remind students of the discussion related to expository writing before they read (Step 2). Explain again that this kind of writing presents factual information. Have students think about the factual information the author presented in the reader. What were the most important ideas the author communicated? List these main ideas on the board. Then instruct each student to use the ideas on the board to summarize the reader. Encourage students to limit their summaries to five to seven sentences.

18 Use the *Reader Quiz* (page 45) to further assess student learning. For ELL students, you may need to read the test questions aloud to them to assess their comprehension.

19 Gather students together as a whole group to complete the Lab (pages 29–30).

20 Gather the students together as a whole group and have them complete the Concluding Activity (page 27).

Crystal Clear

Directions: Look at the transparency showing several types of windows. Use what you read about thermal heat energy to answer these questions.

1. How is heat energy getting to the outside of the windows?
   a. from the heating and cooling system in the building
   b. from the building itself
   c. from the ground
   d. from the sun

2. This is an example of what kind of energy transfer?
   a. conduction b. convection c. radiation d. can't tell

3. If a single-pane window is directly facing the sun, what happens when the heat hits the window?
   a. The heat transfers through the glass to the room.
   b. The heat changes to light energy.
   c. The heat reflects off the glass.
   d. The window glows brightly.

4. This is an example of what kind of energy transfer?
   a. conduction b. convection c. radiation d. can't tell

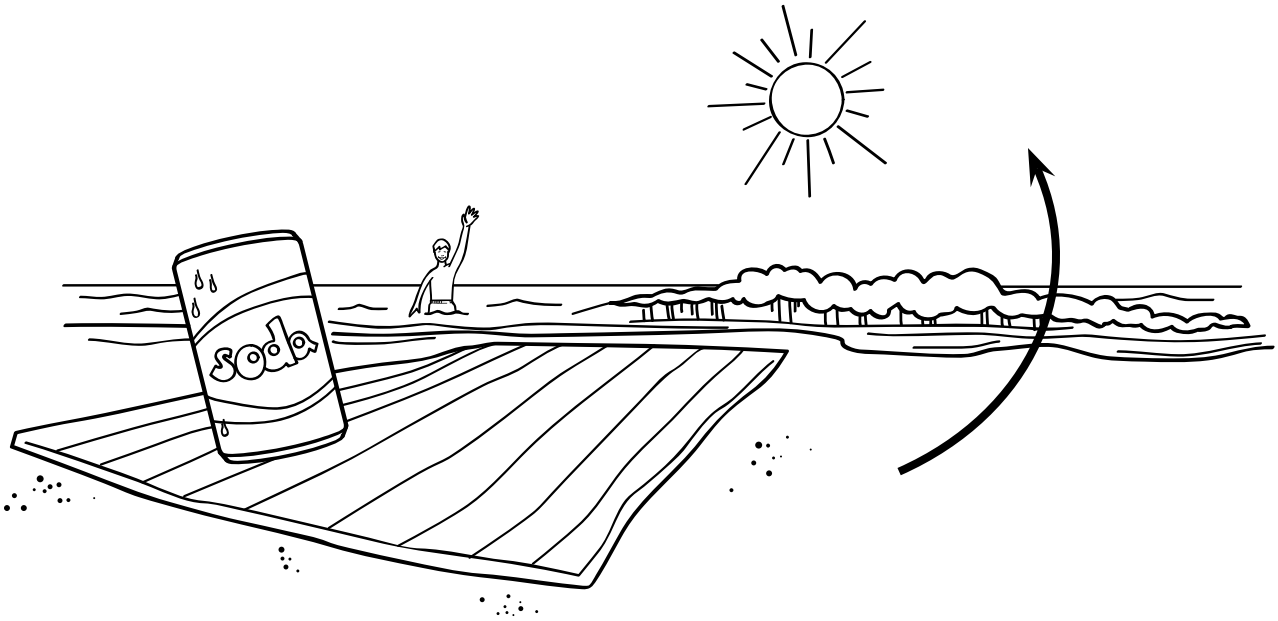
5. If you were the builder of a large office building that faced the sun, which type of windows would you want on your building?
   a. plain b. mirrored c. tinted d. double pane

6. Use information about energy transfer to explain your answer to number 5.

7. If you were an herb grower and needed to keep your plants warm, which window would you choose for your greenhouse?
   a. plain b. mirrored c. tinted d. double pane

8. Use information about energy transfer to explain your answer to number 7.

Heat Me Up!



Directions: Look at the illustration. Use these words to complete the sentences.

conduction convection radiation

1. The sun heats the water through _____.

2. The person gives off heat in the water through _____.

3. The water current heats the water through _____.

4. Food left in the sun is heating through _____.

5. When a pot of water boils, the water heats through _____.

6. Boiling spaghetti in a pot of water, the spaghetti heats through _____.

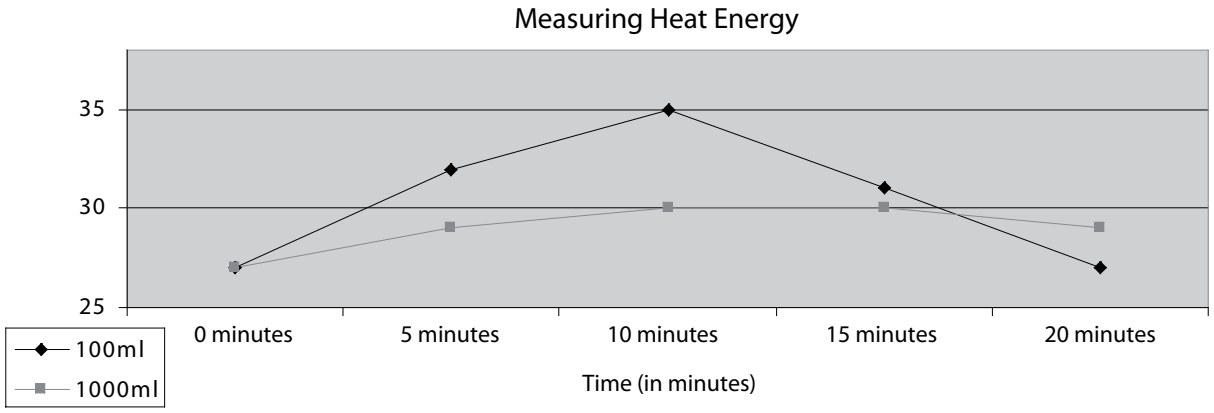
Back to Normal

Thermal energy is the amount of heat energy in a substance. The more particles a substance has, the greater its thermal energy.

The Zeroth Law states that heat moves from hotter objects to cooler ones until they are both the same temperature. For example, if you leave a cooler full of ice open all day, the temperature of the room and the cooler will eventually become the same.

This chart shows data collected during an experiment to measure thermal energy. Sam wanted to find out which held its thermal energy longer: a tea cup, or a swimming pool?

He measured 100ml of water in a small container, and 1000ml in a larger container. He placed a thermometer in both, and set them in a solar oven at the same time. He measured each container's temperature every five minutes for ten minutes. Then he brought the two containers inside to measure how fast they cooled down. Sam observed that the smaller container heated up more quickly, but it also lost all its heat energy quickly. The large container heated up slowly, but lost heat energy more slowly after it was brought inside.



Directions: Look at the chart. Answer the questions.

1. Which container had a greater temperature after heating for 10 minutes? _____
2. Which container had a greater temperature after cooling for 10 minutes? _____
3. Which container held its thermal energy longer? _____
4. Which container had the most thermal energy? _____
5. Can thermal energy be measured by temperature? _____
6. According to the Zeroth Law, what will happen after the two containers sit in the room for a long time? _____
7. To answer Sam's question, which would hold its thermal energy longer, a tea cup or a swimming pool? Why? _____

_____

Reader Quiz

Directions: Circle the best answer.

1. The three methods of heat transfer are...
   a. conduction, convection, and radiation.
   b. fire, sun, and electricity.
   c. molecules, atoms, and elements.
   d. thermal energy, temperature, and equalization.

2. An example of a high entropy system is...
   a. a new stack of playing cards.
   b. a newly cleaned hotel room.
   c. an orderly library.
   d. a town after a tornado has hit it.

3. Read these sentences from the book.

   For years, the laws of physics were clear. They explained what people wanted to know. But they didn't explain the movement inside of atoms. Quantum theory did.

   How was Quantum theory different from physics of that time?
   a. Quantum theory explains events on an atomic level.
   b. Physics is only part of quantum theory.
   c. Physics is the study of matter and energy.
   d. Quantum theory explains how energy affects matter.

4. Quantum theory led to what important discovery?
   a. prisms b. lasers c. space travel d. light waves

5. Why did the author write this book?
   a. to tell about molecules
   b. to compare states of matter
   c. to show how one scientist's work can affect many areas of science
   d. to persuade people to give money to scientific research

Directions: Write two to three sentences to answer this question. Use details and examples from the book to explain your answer.

6. How did Max Planck's study of thermodynamics benefit future scientists?

Max Planck Answer Key

Crystal Clear

1. d 2. c 3. a 4. a
5. Any answer is correct, as long as students can justify their response.
6. Accept responses that justify the student's answer to number 5. For example, if a student chose **b. tinted**, he or she might write that some of the heat energy from the sun would be reflected away from the building. This would keep the cooling costs down.
7. c is the best choice
8. Accept responses that justify the student's answer to number 7. For example, if a student chose **c. tinted**, he or she might write that the energy would be trapped inside the room, which would keep it warm.

Heat Me Up!

1. radiation 2. conduction 3. convection
4. radiation 5. convection 6. conduction

Back to Normal

1. the small container
2. the large container
3. the large container
4. the large container
5. no
6. Both containers and the room will all become the same temperature.
7. swimming pool

Reader Quiz

1. a 2. d 3. a 4. b 5. c
6. Answers will vary. Students may include information related to the work of Marie Curie, Stephen Hawking, Sally Ride, or Frances Hellman.

Unit 2: *Investigating the Chemistry of Atoms* and *Marie Curie: Pioneering Physicist*

Time Line for the Unit

	Investigating the Chemistry of Atoms	*Marie Curie: Pioneering Physicist*
Day 1	Complete the **Introductory Activity** (page 48) as a class.	
	Before Reading (pages 53–54) in reading groups.	**Before Reading** (page 61) in reading groups.
Day 2	**During Reading** (page 54) in reading groups. Use: *Inside an Atom* activity sheet (page 56) *Inside an Atom* transparency	**During Reading** (page 62) in reading groups. Use: *What Does That Atom Weigh?* (page 64) *What Does That Atom Weigh?* transparency
Day 3	**After Reading** (page 55) in reading groups. Use: *What's My Number* activity sheet (page 57) *Radioactive Day* activity sheet (page 58) *Reader Quiz* (page 59)	**After Reading** (pages 62–63) in reading groups. Use *The Power of Nuclear Energy* (page 65) *Nobel Prize Time line* activity sheet (page 66) *Reader Quiz* (page 67)
Day 4	Complete the **Lab** activity (pages 51–52) as a class.	
Day 5	Complete the **Concluding Activity** (page 49) as a class.	

Unit Learning Objectives

- Students will use strategies to monitor comprehension. (Nonfiction Reading Objective)
- Students will organize and present information in a logical manner, including an introduction and conclusion. (Expository Writing Objective)
- Students will explore different aspects of atomic theory. (Science Content Objective)