

## Learning Objectives

### Students will:

- determine the main idea and key details of the book.
- write and revise a paragraph about a state of matter.
- identify the distinct physical properties of the different states of matter.

## Standards

- **Reading:** Determine the main idea of a text; recount the key details, and explain how they support the main idea.
- **Writing:** With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.
- **Content:** Know that matter has different states and that each state has distinct physical properties; some common materials such as water can be changed from one state to another by heating or cooling.
- **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 95)

#### Summary of Student Learning Activities

Observe different states of matter.

### Day 2

#### Task

**Before Reading** (page 96)

#### Summary of Student Learning Activities

Make predictions about the book.

### Day 3

#### Task

**During Reading** (page 97)

#### Summary of Student Learning Activities

Identify the main idea and key details in the book, and write and revise a paragraph about a state of matter.

### Day 4

#### Task

**After Reading** (page 98)

#### Summary of Student Learning Activities

Identify key details that support the book's main idea.

### Day 5

#### Task

**Activity from the Book** (page 98) and **Assessments** (pages 103–104)

#### Summary of Student Learning Activities

Mix cornstarch and water to make gloop, and take the assessments.

## Materials

- copies of the *States of Matter* activity sheet (page 99)
- strong perfume or air freshener
- antacid tablet, such as Alka-Seltzer®
- balloons
- plastic bottles
- water

### Day 1

Observe different states of matter.

## Introductory Activity

### Engage

1. Before students enter the room, spray some strong perfume or air freshener. Have students enter the room as usual, and allow time for them to comment on the scent. **Note:** You may need to check for allergies before doing this activity.
2. Ask students which senses they are using to describe the change in the room. Discuss how even though the perfume or air freshener is invisible, they know it is there. Tell students that they will use their senses to describe other kinds of matter.

## Lab Activity

### Explore & Explain

1. Place students in small groups. Distribute an antacid tablet, a balloon, a plastic bottle, and water to each group. Have students fill the bottle halfway with water. **Note:** You may wish to complete this step before distributing the bottles. You may also wish to stretch out the balloons before distributing them to ensure that they will properly inflate.
2. Have students break the antacid tablet into pieces and drop them into the water. Have them immediately place a balloon over the neck of the bottle and observe what happens.
3. Distribute copies of the *States of Matter* activity sheet (page 99) to students. Have them write and draw their observations on the activity sheet.
4. Ask questions to guide students to the idea that the antacid tablet combined with the water to create the gas that inflated the balloon.
  - *What do you notice about the water and the balloon?*
  - *What is the balloon filled with?*
  - *How do you think the balloon became inflated?*
  - *Why do you think that happened?*
  - *What would the reaction look like without the balloon?*
5. Bring the class together for instruction. Clarify misconceptions by having students explain their understandings using logic and evidence to support their ideas.

## Materials

- *Changing Matter* books
- copies of the *Predictions Matter* activity sheet (page 100)

**Day 2**

Make predictions about the book.

## Vocabulary Word Bank

- atoms
- chemical change
- evaporates
- physical change
- properties
- volume

## Before Reading

## Elaborate

1. Write the vocabulary words on the board and explain their meanings. Divide the class into six groups, and assign each group a vocabulary word. On a sheet of paper, have students write the word and draw pictures that relate to the word. Have groups share their work. As a class, create student-friendly definitions of the words. Use the *Changing Matter* book, as needed. Display these definitions in the room, and refer to them throughout the lesson to support comprehension.
2. Display the *Changing Matter* book for students. Explain that determining the main idea of the book is a strategy that helps readers determine what is important about the text and what information the author is trying to convey. Explain that each section of the text has a main idea that is supported by details. The sections of the text are also details that support the main idea of the whole book.
3. Have students preview some of the text features and photographs in the book. Have them discuss what they think the main idea of the book will be, based on their observations.
4. Distribute copies of the *Predictions Matter* activity sheet (page 100) to students. Have students justify their predictions with evidence from the book.
  - Provide **below-level learners** and **English language learners** with a Word Bank to reference while writing their predictions.
5. Bring students together for instruction. Ask them to share their predictions from the activity sheet. Tell students that they will read the book to find the main idea and key details.

## Materials

- *Changing Matter* books
- copies of the *Paragraph Edit* activity sheet (page 101)

### Day 3

Identify the main idea and key details in the book, and write and revise a paragraph about a state of matter.

## During Reading

## Elaborate

1. Distribute *Changing Matter* books to students. For the first reading of the book, read aloud as students follow along. After each section, pause and model how to find the main idea and key details. For example, after reading page 4, explain that the main idea on that page is that everything is matter. Explain that each paragraph and section has its own main idea and that those support the overall main idea of the entire book.
  - You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
2. For the second reading, have students read the book in small groups. Have students pause and discuss the main idea and the key details after reading each section.
  - You may wish to have students digitally annotate the PDF of the text.
  - 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 recording will help struggling readers practice fluency and aid in comprehension.
3. Distribute copies of the *Paragraph Edit* activity sheet (page 101) to students. Have students write a paragraph about one state of matter. Remind students that their paragraphs should have a main idea and supporting details. Encourage students to use information from the book in their paragraphs.
4. Once students have finished writing, have them trade papers with a partner. Tell students that their partners will edit their paragraphs. Tell them to focus on looking for a strong main idea with supporting details. Have the student editors write their notes on the right column of the sheet. Then, have students revise their paragraphs and write a final draft on a separate sheet of paper. **Note:** You may wish to provide students with a writing rubric to help them edit their partners' work.

### Materials

- *Changing Matter* books
- Copies of *Main Idea and Supporting Details, Changing Matter Quiz* and *Melting Points* activity sheets (pages 102–104)
- cornstarch
- water
- bowl

**Days 4&5**

Identify key details that support the book's main idea. Mix cornstarch and water to make gloop, and take the assessments.

### After Reading

### Elaborate & Evaluate

1. Write the vocabulary words on the board and review their definitions. Have groups of students write meaningful sentences for each word. Use the following sentence stems or create your own.

- *Atoms* are particles that \_\_\_\_\_.
- A *chemical change* happens when \_\_\_\_\_.
- *Water evaporates* because \_\_\_\_\_.
- You can see a *physical change* when \_\_\_\_\_.
- *Volume* is \_\_\_\_\_.

2. Review the idea that a text can have a main idea for each section, and that those support the main idea of the whole book. Ask students what the main idea of the book is (*states of matter have unique properties and can go through many types of changes*). Then, have students identify key details that support the main idea.

3. Distribute the *Changing Matter* books and copies of the *Main Idea and Supporting Details* activity sheet (page 102) to students. Model for students how to cite the text using page numbers to identify where key details support the main idea.

- Have **above-level learners** draw a chart that shows how the main ideas of the sections support the main idea of the book as a whole.

### Activity from the Book

Read the Your Turn! prompt aloud from page 32 of the *Changing Matter* book. Have students mix cornstarch and water together in a bowl and observe it.

1. A short posttest, *Changing Matter Quiz* (page 103), is provided to assess student learning from the book.
2. A data analysis activity, *Melting Points* (page 104), is provided to assess students' understanding of how to analyze scientific data. Explain to students that the graph compares the melting points of four kinds of food. **STEM**
3. The Interactiv-eBook activities may be used as a form of assessment (optional).

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## States of Matter

**Directions:** Use the bottle below to draw what you observed. Label the states of matter in your drawing. Then, answer the questions.

- 1 What happened when you dropped the tablet into the water?

---



---



---



---



---



---

- 2 What states of matter did you observe?  
How do you know they are there?

---



---



---



---



---



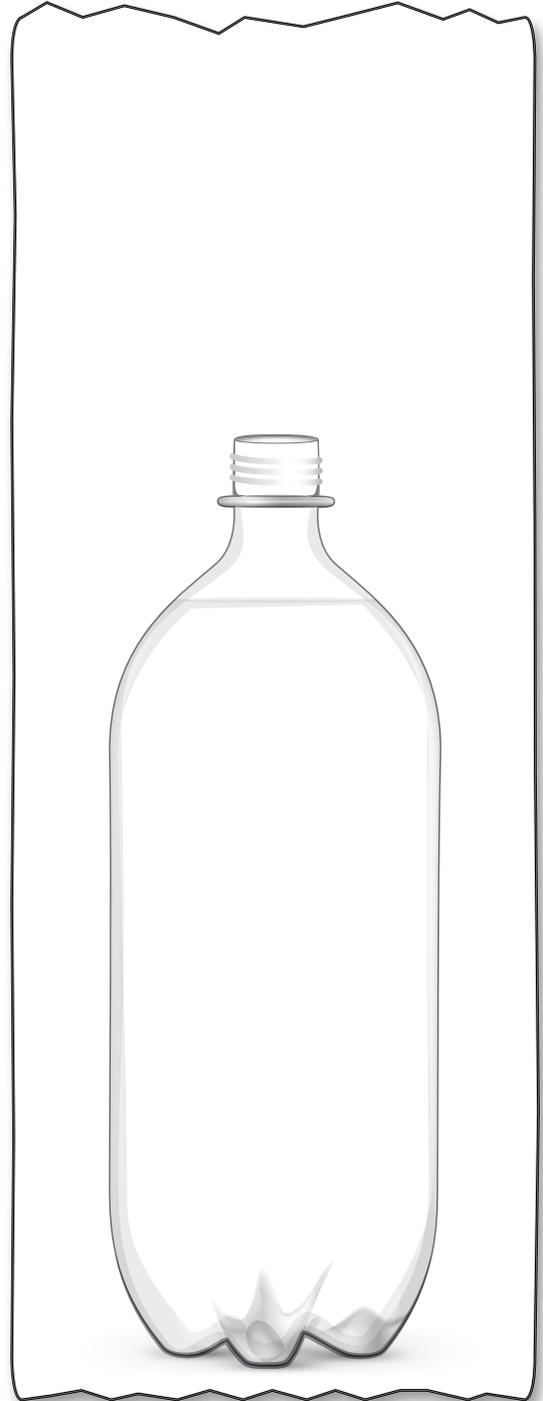
---



---



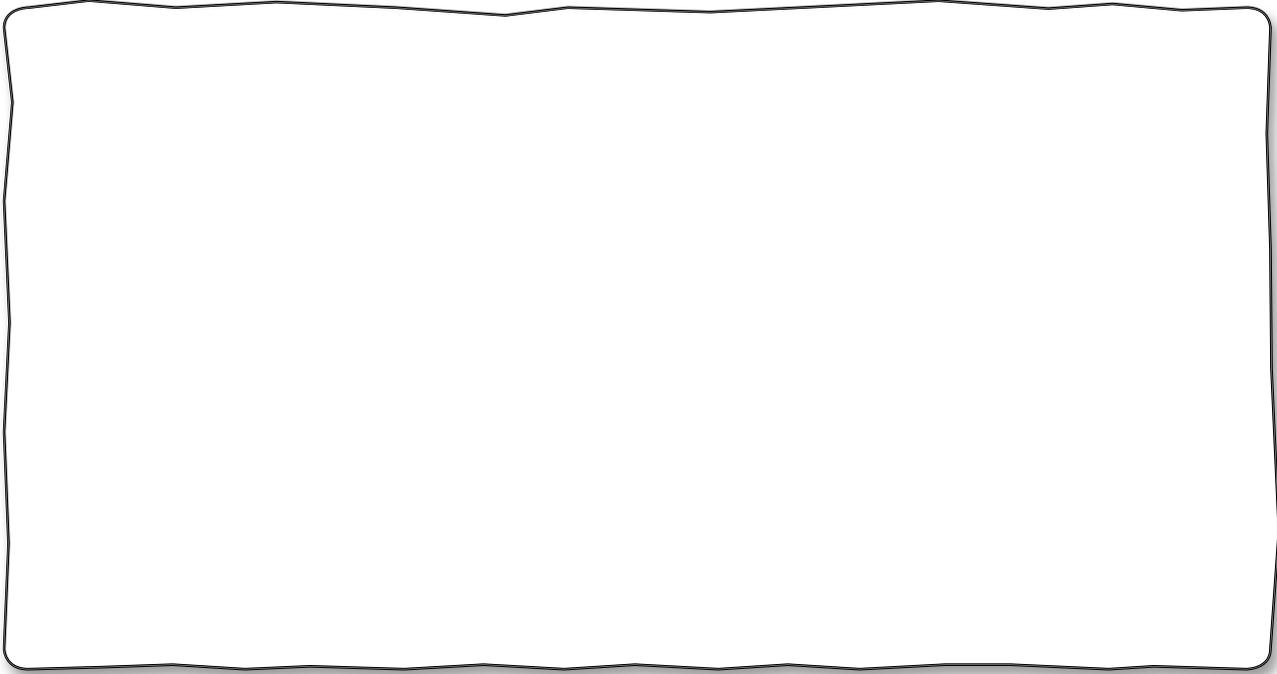
---



Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Predictions Matter

**Directions:** Draw a picture to show what you think the book will be about. Then, write about your prediction.



---

---

---

---

---

---

---

---

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Paragraph Edit

**Directions:** Write a paragraph about one of the states of matter in the left column. Then, have a partner edit your work and add their comments in the right column.

Paragraph	Editor Notes
<hr/>	<p><b>Editor Name:</b></p> <hr/>

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Main Idea and Supporting Details

**Directions:** Write the main idea and supporting details of the whole book. Write the page numbers where you found the details.

Main Idea	
Supporting Details	
1.	Page _____
2.	Page _____
3.	Page _____
4.	Page _____
5.	Page _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Changing Matter Quiz

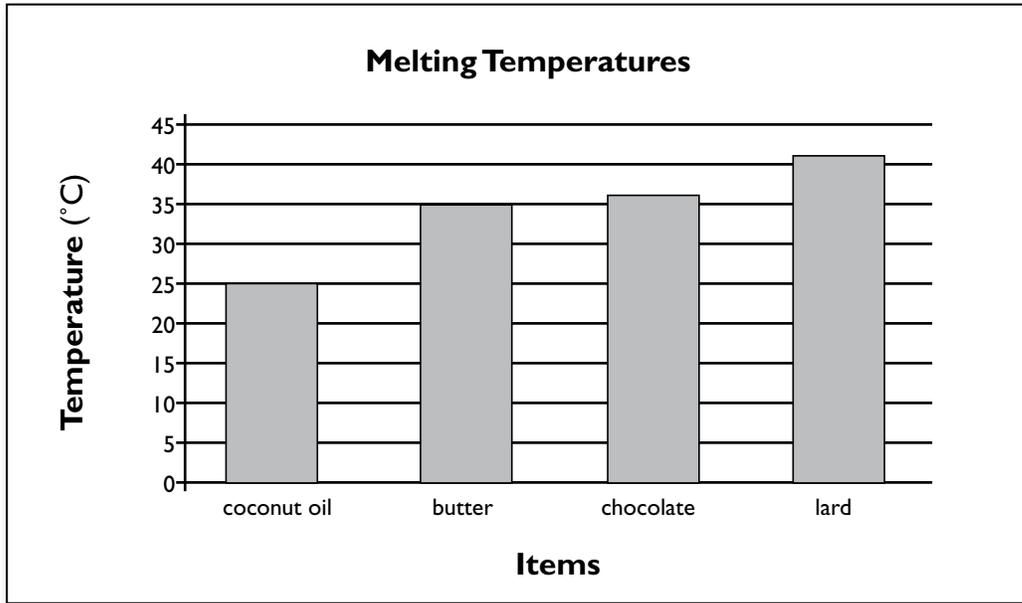
**Directions:** Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

- 1** Which sentence best describes the main idea of the book?
- (A) Gases spread out through the air.
  - (B) Water freezes to become ice and evaporates.
  - (C) States of matter have unique properties and can change in many ways.
  - (D) Pressure can change matter.
- 2** Which sentence supports the main idea of the book?
- (A) Heating matter is one way to change it.
  - (B) Volume is the amount of space that is filled by something.
  - (C) Mass is not the same as weight.
  - (D) Gas molecules cannot move.
- 3** Which example is a physical change?
- (A) rusting nail
  - (B) butter melting
  - (C) burning wood
  - (D) weighing mass
- 4** Which example is a chemical change?
- (A) slicing bread
  - (B) freezing water
  - (C) melting ice
  - (D) burning paper
- 5** Which detail supports the idea that water can be turned into a gas?
- (A) Boiled water becomes steam.
  - (B) Gases are often invisible.
  - (C) Gases flow easily.
  - (D) A can of soda can be compressed.
- 6** \_\_\_\_\_ occurs when a gas changes into a liquid.
- (A) Evaporation
  - (B) Condensation
  - (C) A chemical change
  - (D) Pressure

Name: \_\_\_\_\_ Date: \_\_\_\_\_

# Melting Points STEM

**Directions:** Julie recorded the melting points of some food. Use her data to answer the questions below.



- 1 Which two items melted at nearly the same temperature? Around what temperature did they melt?  
\_\_\_\_\_
- 2 What is the difference between the melting points of coconut oil and butter?  
\_\_\_\_\_
- 3 If 30° Celsius is considered a hot day, which food(s) would you expect to melt on a hot day? Why?  
\_\_\_\_\_  
\_\_\_\_\_

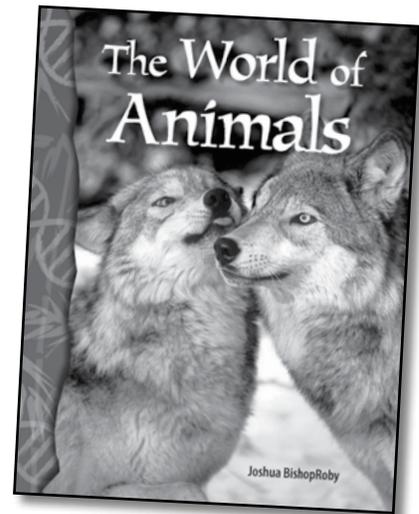
# The World of Animals Reader

## Learning Objectives

Students will implement strategies for monitoring comprehension. (Nonfiction Reading Objective)

Students will use descriptive language in writing. (Writing Objective)

Students will explore concepts related to the study of animals. (Science Content Objective)



## Materials

- chalkboard/white board
- chalk/wipe-off markers
- paper and pencils
- *Whimsical Clades* activity sheet and transparency (page 144)
- *Pet Project* activity sheet (page 145)
- *A Honey of a Bee* activity sheet (page 146)
- materials for Lab (see page 140)
- *Reader Quiz* (page 147)

## Before Reading

- 1 Complete the Introductory Activity (page 136) with the whole class. Then divide the students into ability-based reading groups. The students who read this book should be reading on or above level.
- 2 Discuss with the students the reading and writing objectives for this lesson. Tell them that they will first employ strategies for monitoring their own comprehension. Then they will write about the topic of the reader using descriptive language.
- 3 Remind students that monitoring comprehension is a strategy that good readers use to ensure understanding of the text. Explain that they have had experience connecting what they know to new information, but it is also important to identify what they *don't* know. Give the following examples:

*Thinking about what you know and what you don't know is called metacognition. It helps a reader think critically about the text. For example, I may know a lot about cats, but there are things I don't know about them as well. I don't know why cats get hairballs and I don't know how they can jump so high (dogs can't). When reading new information about a topic, a reader can first identify what he or she does not know about a topic and this may help to set a purpose for reading.*

## Before Reading *(cont.)*

- 4 Read aloud pages 4 and 5 of *The World of Animals*. Then ask the following questions:
  - Brainstorm as many different animals as you can think of.
  - What are some examples of animals we see every day? What are some that we may never see?
  - The text states that animals differ in many ways (appearance, brain functions, habitats). What is it that you don't know about differences between animals?
  - The platypus is a very strange animal; what other strange animals have you heard of?
  - What other things don't you know about animals that you might learn after reading the text?
- 5 List student responses on the board and save for later reference.

## During Reading

- 6 Have students read the text independently or in pairs.
- 7 Begin a discussion of the need to classify. Have students list as many sports as possible. Then they work in pairs to classify them. They may choose to classify them as team or individual, with balls or without balls, or team with balls, team without balls; individual with balls, individual without balls, etc.
- 8 As a class, have pairs share their classifications, then work to combine classifications. What happens if two pairs disagree? Explain that this happens in the science world, too. Read on until page 12 and the discussion of the mollusk clade. Then display the transparency.
- 9 Have students work with their partner to classify the whimsical animals in the transparency. After sharing, discuss whether all the pairs came up with the same classifications, and why this did or did not happen.
- 10 Ask students what they know about DNA and genes. Explain, if the students do not, that DNA is a part of all organisms' cells that tell the organism how to grow and develop. DNA is inherited from parents and ancestors, and is a good way of finding how organisms are related.
- 11 Distribute *Whimsical Clades* (page 144). Read the introductory paragraph together with the class. Have all students complete the first question and touch their nose when they have an answer. Wait until the entire class has a pair and ask for a few examples. Complete the rest of the activity sheet in pairs.
- 12 On page 24, students will encounter the Latin word *Primates*. Explain that the word is spelled the same in English and in Latin. The pronunciation in Latin is described in the book. Ask students to share the pronunciation in English.

## After Reading

- 13 Ask students the following questions:
  - What new information did you learn about the study of animals?
  - Was any of your prior knowledge confirmed by reading the text? Explain.
  - Before reading, you identified things you did not know. Did you learn anything that added to your knowledge in these areas? Explain.
  - What questions do you still have about animals or the study of animals?
- 14 Discuss with students the importance of using descriptive language in writing in order to add interest and detail. For example, have students open the reader to page 6. Note the use of descriptive words—*natural settings*, *hot desert climates*, *arctic cold*. Explain to students that they will select a subtopic from the reader about which to write. As they write about the topic, they should purposefully include words that add greater detail and visual imagery for the reader.
- 15 What types of pets do the students have (or wish they had)? Define your students' environment: rural, suburban, urban. Define each of these terms. If the students lived in a different environment, how do they think their pet list would change?
- 16 Distribute *Pet Project* (page 145) to students and allow them time to complete the activity sheet. Conduct your own local survey of pets. Compare how the data reflects the data in the chart.
- 17 Poll the class to see who enjoyed honey or a piece of fresh fruit so far today. Explain that students who met either of these criteria probably ate a plant that was once pollinated by an insect. Reread pages 14–15 about arthropods.
- 18 Distribute *A Honey of a Bee* (page 146) to students. Allow time for students to complete the activity sheet independently. Compare picnic baskets when students are finished. Which common picnic foods did they have to cross out due to lack of pollination?
- 19 Use the *Reader Quiz* (page 147) to assess your students' understanding of the reader.
- 20 Finally, gather the students back together in a whole group to have them complete the lab activity (pages 139–140) and the Concluding Activity (page 137).

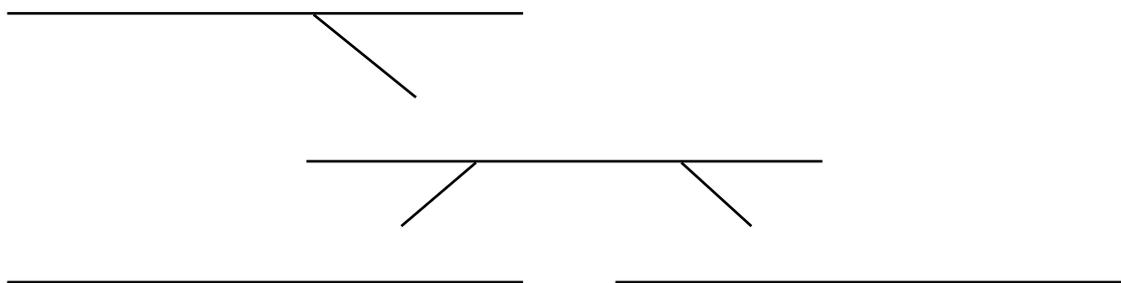
## Whimsical Clades

Below are fifteen fictional animals and a segment of their DNA. DNA is the instructions for making organisms. There are only four “letters” in the DNA alphabet: A, T, C, and G. Every species has a different sequence of these letters. Differences in the sequences create different organisms. Organisms that are related have similar DNA sequences because they share a common ancestor.

Grim Reaper AAACGG	Gryphon AATGGC	Fell Beast TAACGG	Rhinogradentia ATTGCC	Dufflepud ATTCCG
Sasquatch TTACCC	Babel Fish AAACCC	Jackalope TTACCG	Kraken AAACGC	Bunyip ATTCCG
Bandersnatch ATACCC	Phoenix TAAGGC	Pushmi-pullyu TTAGCC	Jabberwock AAAGGC	Jubjub Bird AATCGG

**Directions:** In this activity, each animal has only had one letter different from its ancestor. Zoologists know that these fifteen animals are related, but they are not sure how. It is your job to find the relationships between the animals and their DNA. As you do so, you will discover how all these animals are related to each other.

1. Find two animals on the chart whose DNA has only one letter changed between them. Write their names and DNA segments here: \_\_\_\_\_ and \_\_\_\_\_
2. Find another animal that is related to one of the animals you listed under #1. It will have just one letter changed. It may or may not be the same letter. Write all three of the animals and their DNA segments here: \_\_\_\_\_ , \_\_\_\_\_ , and \_\_\_\_\_
3. Now find another animal that is related to the animal you wrote into the middle line in #2. Write their names and DNA into the diagram below:



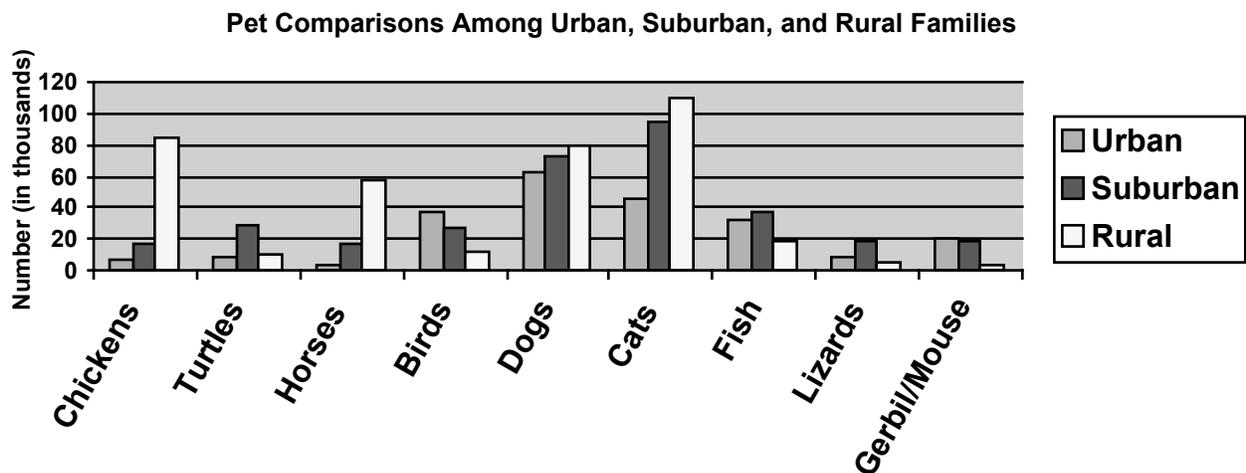
*Hint:* If you cannot find another related animal for the animal in the middle, you have found the ancestor of all the other animals. Skip to step 4.

4. Keep finding relationships between the animals until you have fit all fifteen animals into one diagram that connects all the animals with similar DNA. Draw your diagram on the back of this page. Be sure to label both the animal names and their DNA segments.

*Hint:* The easiest way to do this is to use fifteen scraps of paper with one DNA sequence on each scrap. Then shuffle the pieces around to find similar sequences.

## Pet Project

Mr. Schmidt's science class participated in an electronic data project. They wanted to find out if a person's home affected the types of pets he or she kept. The data collection program organized the data into three home categories: rural, suburban, urban. Students from across the United States participated. They shared the type of home in which they lived, and the animals they kept. The findings are in the chart.



**Directions:** Use the information and what you read in *The World of Animals* to answer the questions.

1. According to the data, what is the most popular urban pet? Suburban pet? Rural pet?
2. According to the data, which types of pet did more urban students keep than rural?
3. According to the data, which types of pet did more rural students keep than urban?
4. According to the data, about how many more urban and suburban students kept cats versus rural students?
5. According to the data, about how many more rural students kept horses than urban and suburban students together?
6. What does the data tell you about the kinds of pets people keep?
7. Why do people keep pets?
8. What other pets are not listed in the chart?
9. Why do dogs and cats top the pet list for people?

## A Honey of a Bee

Bees make honey. But they also are responsible for creating many fruits and vegetables which you may eat all the time. One third of a person's diet comes from insect-pollinated plants. Eighty percent (80%) of insect-pollinated produce is done by honeybees. So bees really do make more than just honey!

**Directions:** Look at the illustration of a honeybee. Use the descriptions to label its parts. Use the bold words. Use what you read in *The World of Animals* to answer the questions.

A honeybee has three body parts. Label the **head**, **thorax** (middle), and **abdomen** (end).

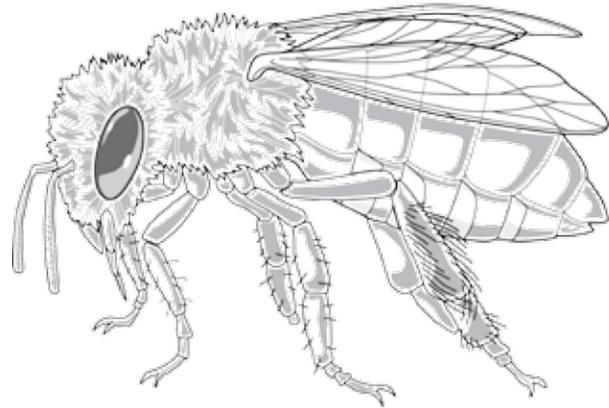
A honeybee has **forked body hairs** on its hind legs to help it pick up pollen and transport it to other locations.

The **corbiculae** are also called pollen baskets. They are on the hind legs of worker bees.

A bee's **antennae** help it communicate with other bees. They are on the top of its head.

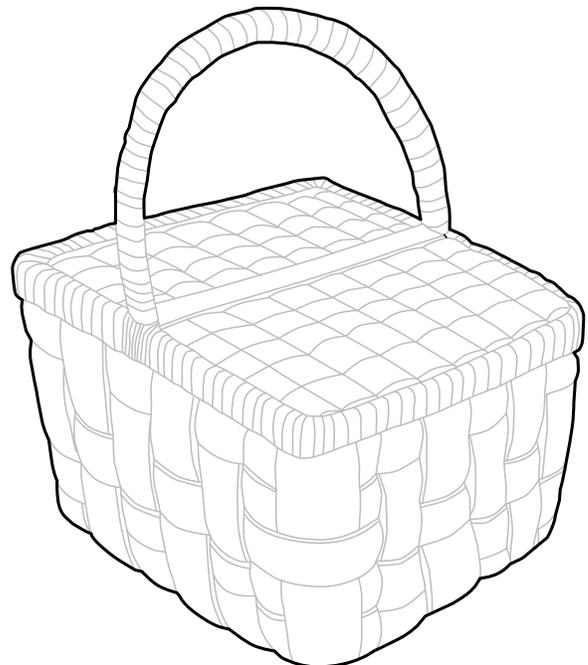
Honeybees also have **antennae cleaners** in the form of U-shapes on their front legs.

A tube-like tongue, called a **proboscis**, helps the honeybee pull nectar from flowers.



Write the names of some of your favorite picnic foods in the basket. Be sure to include condiments, such as ketchup and mustard. Then think about all the foods you would not be able to put in your basket if pollinating insects like honeybees didn't do their job. Put an X over each food item that would not be part of your picnic. (Anything with vanilla, chocolate, or sugar should be crossed out, too! All these foods are processed from flowering plants.)

1. A honeybee is an insect. Would it be part of the same class as humans? Why or why not?
2. What would happen if honeybees were not around to pollinate plants?
3. A friend sees a bee and insists on killing it. How would you convince your friend that this is NOT a good idea?



## Reader Quiz

**Directions:** Use what you learned from reading *The World of Animals* to choose the best answer for each question.

- Which of these lists the taxons of living things from broadest to narrowest?
  - phyla, class, order, kingdom, family, genus, species
  - kingdom, phyla, order, genus, species, class, family
  - kingdom, phyla, class, order, family, genus, species
  - species, genus, family, order, class, phyla, kingdom
- Which of the following animals are NOT members of the family *Felidae*?
  - tiger
  - house cat
  - dog
  - lion
- What makes a mollusk a mollusk?
  - All mollusks have tentacles.
  - All mollusks share a common ancestor.
  - All mollusks share a common descendent.
  - Mollusks have no skeleton.
- Grouping living things by the way they look is using...
  - morphological groups.
  - clades.
  - zoology.
  - good judgment.
- At some point in their lives, all the members of the phylum *Chordata* have a...
  - backbone
  - segmented exoskeleton
  - radial symmetry
  - notocord
- Which of these traits do you share with members of the phylum *Annelida*?
  - bilateral symmetry
  - a notocord
  - a tube for digesting food
  - tentacles
- Compare and contrast morphological groups and clades. Which one is easier? Which one is most useful? If you were a zoologist, which one would you use?

## The World of Animals Answer Key

### Whimsical Clades

1. – 3. Answers will vary.
- 4.

Babel Fish AAACCC							
Bandersnatch ATACCC				Kraken AAACGC			
Sasquatch TTACCC		Bunyip ATTCCC		Grim Reaper AAACGG		Jabberwock AAAGGC	
Pushmi-pullyu TTAGCC	Jackalope TTACCG	Dufflepud ATTCCG	Rhinogradentia ATTGCC	Fell Beast TAACGG	Jubjub Bird AATCGG	Phoenix TAAGGC	Gryphon AATGGC

### Pet Project

1. Urban: dog; Suburban: cat; Rural: dog
2. turtles were about equal; birds, fish, lizards, and gerbils
3. chickens; turtles were about equal; horses, dogs, cats
4. about 25,000 students
5. about 40,000 students
6. People in rural areas keep more farm-like animals than urban and suburban combined. (or similar comparison)
7. for companionship
8. rabbits, pigs
9. People have developed bonds with dogs, trained them to work for them, and trained them for special tasks. Dogs come in a variety of species, which allows families to choose the best dog for their living. People like cats because of their loving nature, cleanliness, and intelligence.

### A Honey of a Bee

Check students' papers. They should have labeled the head, thorax, abdomen, forked body hairs, corbiculae, antennae, antennae cleaners, and proboscis.

Check students' baskets. They should have crossed out any fruits or vegetables, and foods made of produce, vanilla, chocolate, and sugar.

1. No. Insects are invertebrates. Humans are mammalian and have backbones.
2. Plants that use pollination to reproduce would die.
3. Answers will vary.

### Reader Quiz

1. c
2. c
3. b
4. a
5. d
6. c
7. Answers will vary.

# Jane Goodall: Animal Scientist and Friend

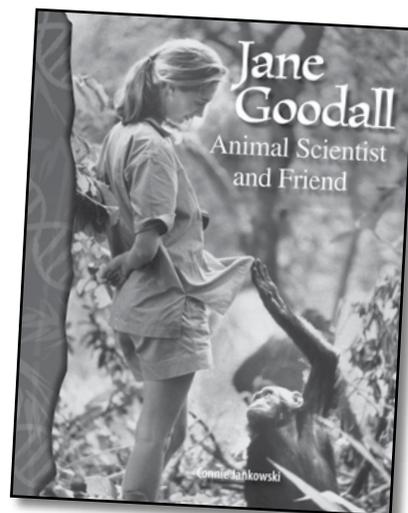
## Reader

### Learning Objectives

Students will implement strategies for monitoring comprehension. (Nonfiction Reading Objective)

Students will use descriptive language in writing. (Writing Objective)

Students will explore concepts related to the study of animals. (Science Content Objective)



### Materials

- whiteboard/chalkboard
- wipe-off markers/chalk
- paper and pencils
- *A Chance to Live* activity sheet and transparency (page 152)
- *Primarily Primates* activity sheet (page 153)
- *How Close Are We?* activity sheet (page 154)
- materials for Lab (see page 140)
- *Reader Quiz* (page 155)

### Before Reading

- 1 Complete the Introductory Activity (page 136) with the whole class. Then divide the students into ability-based reading groups. The students who read this book should be reading below level.
- 2 Begin the lesson by reading aloud pages 4 and 5 of *Jane Goodall: Animal Scientist and Friend*. Ask the students why they think this woman was so devoted to the study of chimps? What did she give up in order to study them?
- 3 Take time to review words that represent important themes and concepts in the reader, such as:
  - ethology—the study of animal behavior
  - primatologist—a person who studies primates
  - anthropologist—a person who studies human behavior and culture
  - veterinarian—animal doctor
  - extinction—no longer in existence
- 4 Ask them what these terms all have in common and how they might relate to the content of the reader for this lesson.

## Before Reading *(cont.)*

- 5 Tell students that before they read, they will take time to think about the things they know and the things they don't know about this topic. First, ask them to think about what they *know* about the study of animals and animal behavior. List their responses on chart paper.
- 6 Then ask the students to think about what they don't know. For example, they may know that chimps live in the jungle, but they may not know where these jungles are. They may know that Jane Goodall lived in the jungle with chimps, but they may not know how she actually survived.
- 7 Ask students to consider what they don't know and record their responses on the board. Tell students that when a reader thinks about what is *not* known about a topic, it helps to direct his or her thoughts while reading. It provides a purpose for reading.

## During Reading

- 8 Divide students into pairs to read the text. You may choose to have students read sections of the book or have them read the entire text. If having pairs of students read only portions of the book, be sure to allow time after reading for all pairs of students to share what they read in order to inform the others in the group.
- 9 Ask the students to consider the difference between endangered, vulnerable, and critically endangered species. Why would organizations wish to include so many classifications of threatened species? Display the transparency *A Chance to Live* showing several threatened species around the world. Which of the animals shown are mammals?
- 10 Have the students consider why these animals may be at risk of extinction. Reread pages 18–19 about different species of primates, and threatened and endangered animals.
- 11 Distribute *A Chance to Live* (page 152) to students. Read the information and review the table together. Explain that the table includes data on two different kinds of mollusks. The class bivalves includes animals such as scallops, clams, oysters, and muscles. The class gastropods includes animals such as snails, slugs, and conch. Allow time for students to answer the questions. Do students think primates would have been added to the threatened species list if Jane Goodall had not done so much research on them? Why or why not?

## After Reading

- 12 Ask students to think about the information they gained from reading. Did they learn anything new? Did any of the information answer questions they had about the topic before reading?

**After Reading** (cont.)

- 13** Assign each student a portion of the text to describe in writing. Tell students that they will not only write about the assigned topic, but they will try to use descriptive language in order to provide interest and detail for readers.
- 14** Draw students' attention to the descriptive language used on page 4:
  - leading* authority
  - comfortable* home
  - fascinating* creaturesHave students write about their topics and then encourage them to go back and add words that provide greater detail and description.
- 15** Ask students to state whether Goodall studied monkeys or apes, and how they know. Reread pages 18–21 comparing monkeys, and lesser and great apes.
- 16** Distribute *Primarily Primates* (page 153) to students. Read the information together. Discuss the kind of chart students could create for question #5. Allow time for students to answer the questions. (Students may need a calculator; they will also need to know how to find the mean.)
- 17** Ask students to think about a distant relative not living with them. Since they are related, do they have the same kinds of behaviors?
- 18** Reread the statement on page 18 about how closely related by genetics (DNA) that chimpanzees are to humans. Since chimps and humans are genetically alike, are their behaviors also alike?
- 19** Distribute *How Close Are We?* (page 154) to students. Have students scan the book for information related to chimpanzee behavior that they can use to complete the left column in the table. Then allow students time to complete the right column. Would the students say chimps and people behave more alike or more differently? Students may use available text and electronic resources to complete question #3.
- 20** Use the *Reader Quiz* (page 155) to assess your students' understanding of the reader.
- 21** Finally, gather the students back together in a whole group to have them complete the lab activity (pages 139–140) and the Concluding Activity (page 137).

## A Chance to Live

Animals all over the world are threatened. Some are being hunted too much. Others are losing their homes. Governments and organizations do what they can to protect these animals. To figure out which animals need the most help, an organization called the IUCN makes a list of the most threatened animals. It is called the IUCN Red List.

Endangered animals are classified in three categories: vulnerable, endangered, and critically endangered. Many laws now protect threatened species around the world. The following table shows classes of animals on the threatened species list.

Threatened Animals Around the World						
Class	Critically Endangered	Endangered	Vulnerable	Subtotal	Least Concern	Total
Mammals	162	348	583	1,093	3771	4,864
Birds	181		674	1,206		9,934
Amphibians		738	631	1,811		5,981
Fish	232	212		1,058		2,351
Insects	68	129	426		569	
Bivalves		28	15	95		212
Gastropods	213	194		880		1,951

\*Data from IUCN Red List of Threatened Species

### Endangered Species Terms

**Least Concern**—animal species whose numbers are high enough to not need help right now

**Vulnerable**—animal species that are at risk because of declining numbers or small range

**Endangered**—animal species whose numbers have declined so much that they are at risk of becoming extinct

**Critically Endangered**—animal species that are at risk of becoming extinct in the near future.

**Directions:** Use the information from the chart and what you read in *Jane Goodall: Animal Scientist and Friend* to answer the questions.

1. Complete the table. The first three columns of numbers should equal the "Subtotal." The "Subtotal" plus the "Other" column should equal the "Total." (See Mammals for an example.)
2. Which class of animal listed on the threatened species list has the greatest total?
3. Which class of animal listed on the threatened species list has the greatest subtotal?
4. Why do you think the two classes of animals in questions 2 and 3 are different?
5. Which class of animal has the greatest number of species at risk of becoming extinct?
6. What might happen to the status of a species should its numbers increase?
7. To which class do primates belong? How did the work of Jane Goodall help primates?

**Challenge:** Use the information to create a four-column stacked bar chart comparing classes of animals on the threatened species list.

## Primarily Primates

All monkeys and apes are classified as:

Kingdom Animalia, Phylum Chordata, Class Mammalia, Order Primates

Then they fall into one of three categories: new world monkeys, old world monkeys, and apes. There are two families of apes: lesser apes and greater apes. Humans are part of the great ape family!

The table compares three apes and three monkeys. All lengths and weights are approximate.

Species	Adult Male Weight	Adult Male Length	Adult Female Weight	Adult Female Length	Life Span	Interesting Fact
Golden Lion Tamarin Family: Cebidae Genus: Leontopithecus	700 g	34 cm	550 g	25 cm	15 years	Live in the canopy of the Rain Forest of Brazil
Mandrill Family: Cercopithecidae Genus: Mandrillus	25 kg	81 cm	11.5 kg	56 cm	40 years	Live in groups of 800 or more
Rhesus Macaque Family: Cercopithecidae Genus: Macaca	7.7 kg	53 cm	5.3 kg	47 cm	25 years	Good swimmers; tail can be 23 cm long
Lar Gibbon (Lesser Ape) Family: Hylobatidae Genus: Hylobates	6 kg	.50 m	5 kg	.42–.58 m	25 years	Can be heard up to 1 km away
Chimpanzee (Great Ape) Family: Hominidae Genus: Pan	35–70 kg	.9–1.2 m	26–50 kg	.66–1 m	60 years	Stone tools date back 4,300 years
Mountain Gorilla (Great Ape) Family: Hominidae Genus: Gorilla	220 kg	1.5–1.8 m	100 kg	1.4 m	50 years	Have finger prints

**Directions:** Use the information in the table and what you read in *Jane Goodall: Animal Scientist and Friend* to answer the questions.

1. If the mandrill weighs about 3 times as much as a lar gibbon, why is a lar gibbon classified as an ape, and not a monkey?
2. According to the data, which of these six primates is the smallest? Which is the largest?
3. How do females compare to males in each species?
4. Calculate the mean life span of the three monkeys and three apes.
5. Use the data about monkeys and apes to create a double bar chart on the back side of this paper.

## How Close Are We?

Mary Claire King showed in 1973 that chimpanzees and humans share 99% of their genes. Scientists since then have revised this figure. Today their closeness ranges from 94% to 98% of genes. Gorillas share 97% to 98% of genes with humans. Gorillas and the two chimpanzee species are the closest relatives to humans.

People and chimpanzees may share genetic material, but what about physical and behavioral features?

**Directions:** Use the information from *Jane Goodall: Animal Scientist and Friend* and what you know about humans to complete the comparison chart. Some information is filled in. Add information to these boxes. Answer the questions.

	Chimpanzees	Humans
How and what they eat		
How they interact with one another		
Tools they use		Early tools were stone; also use metal; use simple and compound machines; electronic and motorized tools; use tools to eat, play, and work
Where and how they live	Jungles of western and central Africa; build nests in trees at night	
Wars between populations		People battle over religion and territory

1. In which category do you think chimpanzees and humans are the most similar? The most different?
2. If you added gorillas to the chart, do you think they would be more like chimpanzees or humans? Why do you think so?
3. On the back side of this page, add one other category comparing chimpanzees to humans.

## Reader Quiz

**Directions:** Use what you learned from reading *Jane Goodall: Animal Scientist and Friend* to choose the best answer for each question.

- When did Goodall begin her career studying apes?
  - on a trip
  - after she met Louis Leaky
  - after college
  - when her dad bought her a toy chimp
- How did Goodall know she was welcomed to the chimp family?
  - The chimps welcomed her right away.
  - The chimps let her come near them.
  - Goodall stayed quiet and didn't make sudden movements.
  - Goodall brought the chimps food and tools to use.
- What did Goodall record in her journal?
  - chimp tool making
  - chimp wars
  - chimp diets
  - all of these

- Look at the pictures. One is an ape. The other is a monkey. How can you tell the difference?
  - The monkey is much darker in color.
  - The monkey is much bigger than the ape.
  - The monkey has long arms.
  - The monkey has a long tail.



- What dangers did Goodall face to study apes?
  - accidents
  - man-eating animals
  - threats by other people
  - all of these
- What was the most challenging task for Jane Goodall as she studied the chimps? Use details and examples from the book to explain your answer.
- Would you be able to do research like Goodall? Use details from the book to support your answer.

## Jane Goodall Answer Key

### A Chance to Live

1.

Threatened Animals Around the World						
Class	Critically Endangered	Endangered	Vulnerable	Subtotal	Least Concern	Total
Mammals	162	348	583	1,093	3771	4,864
Birds	181	351	674	1,206	8728	9,934
Amphibians	442	738	631	1,811	4170	5,981
Fish	232	212	614	1,058	1293	2,351
Insects	68	129	426	623	569	1192
Bivalves	52	28	15	95	117	212
Gastropods	213	194	473	880	1071	1,951

2. birds

3. amphibians

4. Answers will vary.

5. amphibians

6. Its status would improve.

7. mammals.

**Challenge:** Check students' charts for accuracy.

### Primarily Primates

1. The lar gibbon does not have a tail.
2. Smallest: golden lion tamarin; largest: mountain gorilla
3. Females are smaller and weigh less than males.
4. Average life span for monkeys = 26.6 years; apes = 45 years
5. Check students' graphs. They could have compared height or weight of males and females for each of the three species listed (monkeys or apes).

### How Close Are We?

Check students' charts.

1. Answers will vary.
2. Accept all reasonable, justified responses.
3. Check the back of students' pages. They may have included life span, work, or play activities, life cycle, or other comparable categories.

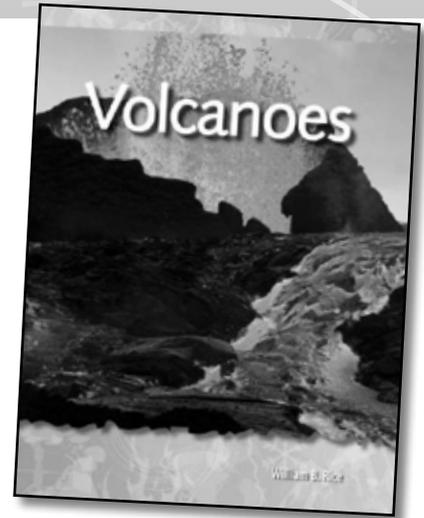
### Reader Quiz

1. b
2. b
3. d
4. d
5. d
6. Answers will vary. Example: Goodall did not realize chimps went to war. She watched a gruesome war between two groups of chimpanzees rage for four years.
7. Answers will vary. Example: I could not conduct research like Jane Goodall. Sitting for too long is boring. I cannot stay quiet for long, either. The jungle is no place for me.

# Volcanoes Reader

## Learning Objectives

- Students use headings, graphics, and typeface features to locate information in a text. (Nonfiction Reading Objective)
- Students write in response to literature. (Writing Objective)
- Students know how landforms are created through constructive forces. (Science Content Objective)
- Students know how features on the Earth’s surface are constantly changed by a combination of slow and rapid processes. (Science Content Objective)



## Materials

- *Volcanoes* Reader (volcanoes.pdf; volcanoes.ppt)
- chocolate chip cookies for the Introductory Activity (page 22)
- chart and drawing paper
- markers or sticky notes
- *Blast and Ooze* activity sheet (page 39; page39.pdf)
- *An Explosive Event* activity sheet (pages 40–41; page40.pdf)
- *A Long Line of Activity* PDF file (line.pdf)
- *A Long Line of Activity* activity sheet (page 42; page42.pdf)
- *Reader Quiz* (page 43; page43.pdf)
- materials for lab activity (page 26)

## Before Reading

- 1 Complete the Introductory Activity (page 22) with the whole class. Then, divide the students into reading groups. Below-grade-level students should read this book.
- 2 Next, introduce vocabulary words students will encounter in the text. Write on the board, the six boldface words below. Take time to discuss each word. Have students share what they think the words mean and have them try to use the words in sentences. Use the glossary in the back of the reader, and go over the rest of the vocabulary as needed.

### Vocabulary

<b>pressure</b>	<b>plate</b>	volcanologist
plate tectonics	<b>magma</b>	<b>crust</b>
<b>mantle</b>	continental ridge	boundary
hot spot	spreading center volcanism	ocean ridge
<b>erupt</b>	subduction zone volcanism	trench

## During Reading

- 3 Brainstorm with students how they think volcanoes form. Record their ideas on a group chart. Explain key vocabulary terms if the students do not use them. For example, if a student mentions that volcanoes “blow up,” explain the word *erupt*. Explain to students that as they read, they will learn that not all volcanic eruptions happen the same way, or in the same places. But, they all have similar causes and varied effects.
- 4 Read pages 4–5 in the reader about pressure and how it causes volcanic eruptions. Distribute copies of the *Blast and Ooze* activity sheet (page 39). Read the information and review the data chart. Then, allow students time to answer the questions.
- 5 Have students open their readers and page through them until they find pages that particularly interest them. Some students can share the reasons they chose the pages they did. Show students how to use the table of contents at the beginning of the reader to find the headings for these sections. Students can tell whether these pages are explaining pressure, what makes a volcano, where volcanoes happen, what happens during a volcanic eruption, or the fact that volcanoes are everywhere. Have each student preview the table of contents and share one interesting fact from the information.
- 6 Explain that students should think about what causes volcanoes to erupt and the effects volcanoes have on the land and people.
- 7 Read pages 6–7 in the reader. Discuss how volcanoes are alike and different. Explain that students will encounter more similarities and differences among volcanoes as they read on.
- 8 Have students read pages 9–19 in the reader silently or with a partner. Following a full read, divide these pages among pairs of students. When the pairs find information about how volcanoes form, they should raise their hands. Include the information the students share on the chart from step 3 in the Before Reading activities. Summarize as a group the different places and ways volcanoes form.
- 9 Next, read pages 20–25 in the reader. Review the events that happen when volcanoes erupt, as discussed on page 21 in the reader. Compare this information to what students read on pages 4–5 in the reader from step 4 in this section. Have students fold sheets of drawing paper twice to make four rows. They should describe the chronological events that lead to a volcanic eruption, one event in each row. Have them use these words to label their illustrations: *pressure, plate, mantle, erupt or eruption, magma, and crust*.
- 10 Information on page 25 of the reader explains how volcanic eruptions are rated using a Volcanic Explosivity Index (VEI). Distribute copies of the activity sheet *An Explosive Event* (pages 40–41) to further investigate how volcanic eruptions are rated. Read the information together. Then, give students time to complete the activity.

## After Reading

- 11 Before reading, students were asked to think about the causes of an eruption and the effects this has on the land. Create one group chart to post on the chalkboard or wall. Write *The Effects of Plate Tectonics* at the top of the chart, and *Volcanoes* in a volcano outline at the bottom of the chart. Each student should add one or two ideas from the reader with a marker or sticky notes. Examples include all of the following: Pressure causes an eruption. Moving plates make magma. Steam causes an exploding volcano. Hot spots form islands. Magma forms igneous rock. Lava kills living things.
- 12 Display the PDF file *A Long Line of Activity* (line.pdf), found on the Teacher Resource CD. Discuss the information presented, and talk about the similarities and differences in the forming of the volcanoes in the Aleutian Arc and the Hawaiian Islands. Distribute the activity sheet *A Long Line of Activity* (page 42) to the students. Read the information together, and then allow the students to complete the activity.
- 13 Use the *Reader Quiz* (page 43) to further assess student learning.
- 14 Gather students together to complete the lab activity (pages 25–26).
- 15 As a class, complete the Concluding Activity (page 23).

## Extension Idea

Have students read “Scientists Then and Now” on the back cover of the reader. Ask students if they were to assist one scientist, would they rather study volcanoes then or now? Have them write summaries explaining their opinions.

**Note:** Additional extension ideas may be found in the Differentiation Strategies section (page 24) of this unit.

Name \_\_\_\_\_

## Blast and Ooze

Some volcanoes erupt in a big blast. Other volcanoes ooze slowly. Some volcanoes erupt somewhere in between a blast and a slow ooze. One thing they all have in common is that they erupt because of pressure that builds up beneath Earth's surface. This pressure pushes magma from deep inside Earth to the surface. Once magma reaches the surface of Earth, it is called lava.

Penny knew that magma is like clay or thick glue. She wanted to experiment with different levels of pressure on a thick substance. The closest thing she had were tubes of toothpaste. Penny applied different amounts of pressure to the toothpaste tube to see if she could make it ooze and blast. She applied the pressure and then measured how far the toothpaste landed from the tube. Penny used a new tube of toothpaste for each trial. Her findings are in the table below.

**Toothpaste Experiment**

	Pressure	Result	Distance Toothpaste Jumped
Trial 1	Gentle hand squeeze	Toothpaste slowly oozed down the sides of the tube.	1 cm (the thickness of the toothpaste)
Trial 2	Set the tube along a wall. Slowly, press a heavy dictionary against it.	Toothpaste oozed out of the top of the tube, but it jumped out first.	3 cm
Trial 3	Set the tube along a wall. Slowly, step on it.	Toothpaste squirted, then fell along the edges of the tube.	4 cm
Trial 4	Set the tube along a wall. Step on it, fast and hard.	Toothpaste squirted and landed all over.	10 cm

**Directions:** Use the information from the table and pages 4–5 of the *Volcanoes* reader to answer the questions.

- Which trial used the least amount of pressure? \_\_\_\_\_
- Which trial used the most amount of pressure? \_\_\_\_\_
- How did Penny measure the effects of the pressure on the “magma”?  
\_\_\_\_\_
- Will Penny ever be able to get the toothpaste to erupt like a can of soda? Explain your answer on the back of this sheet of paper.
- How are the toothpaste eruption, the soda eruption, and the volcanic eruption all alike?  
\_\_\_\_\_
- What caused the lava to erupt so high in the picture on pages 4–5 of the *Volcanoes* reader?  
\_\_\_\_\_

Name \_\_\_\_\_

## An Explosive Event

A volcano's power is measured by many factors.

- How much material it releases, measured in cubic kilometers (km<sup>3</sup>)
- How high the dust cloud rises, measured in kilometers (km)
- The number of eruptions and how often they happen again (frequency)
- How long the volcano has been actively erupting (duration)

Each eruption is assigned a Volcanic Explosivity Index (VEI) number, depending on the explosiveness of the eruption. Some volcanoes continuously erupt with little effect. These are called Strombolian eruptions. They are given a rating of 1 or 2. The more powerful the volcanic eruption is, the greater the VEI number. The highest rating is 8. Some volcanoes erupt, then are quiet for a while, and then erupt again. They are still considered active, even when they are quiet. This list shows information on several volcanoes.

Volcano: Location and Description	Amount of Released Material (km <sup>3</sup> )	Height of Cloud (km)	Frequency	Duration	VEI
Mt. St. Helens (Washington, USA, 1980) Eruption triggered by earthquake May 18, 1980	1.2 (km <sup>3</sup> )	18 km	2 eruptions	1 day	5
Paricutin (Mexico, 1943) Erupted in a farmer's field	<1 (km <sup>3</sup> )	10–25 km	Continuous eruptions	9 years	4
Stromboli (Greece) Continuously erupts; emitted lava flow in 2002	<0.1 (km <sup>3</sup> )	3–15 km	Continuous eruptions	2,000 years	3
Tambora (Indonesia, 1815) Became active in 1812	10–100 (km <sup>3</sup> )	25 km	4 eruptions	3 years	7
Vesuvius (Italy, A.D. 79) Frequent earthquakes occurred before this eruption	10–100 (km <sup>3</sup> )	25 km	39 eruptions	1 day	6

## An Explosive Event *(cont.)*

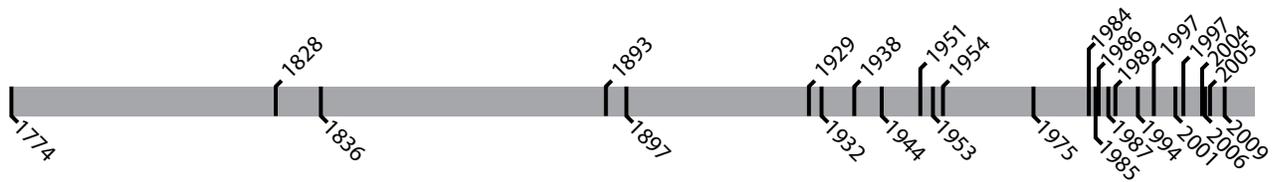
**Directions:** Use the information from the table on the previous page and from the *Volcanoes* reader to answer the questions.

1. How long was Mount Tambora active before it erupted in 1815? \_\_\_\_\_  
\_\_\_\_\_
2. Of the volcanoes listed, which one had the most powerful eruption?  
\_\_\_\_\_  
\_\_\_\_\_
3. Why does Mt. Kilauea's eruptions have a VEI of 1?  
\_\_\_\_\_  
\_\_\_\_\_
4. Most volcanic eruptions with a VEI of 5 or higher erupt to heights over 25 kilometers. Why do you think Mt. St. Helens' eruptions are rated a 5?  
\_\_\_\_\_  
\_\_\_\_\_
5. The least explosive volcanic eruptions are rated with which numbers? \_\_\_\_\_  
\_\_\_\_\_
6. Volcanic eruptions rated 5, 6, 7, or 8 are considered "very large." Which volcanic eruptions listed on the table were very large?  
\_\_\_\_\_  
\_\_\_\_\_
7. A volcano erupts with a cloud that is 12 kilometers high. It releases less than 1 km<sup>3</sup> of material. What VEI rating do you think the eruption would get?  
\_\_\_\_\_  
\_\_\_\_\_

Name \_\_\_\_\_

## A Long Line of Activity

A chain of islands stretches out from the tip of Alaska along what is called the Aleutian Arc. This island chain is home to at least 75 volcanoes. These volcanoes erupt where the Pacific plate meets the North American plate. Ash from volcanic activity poses many hazards. Air travel is sometimes disrupted. The seafood industry and oil production are also affected. Residents must sometimes deal with mud flows and ash. Since the recording of volcanic activity began, 40 of the 75 volcanoes have erupted a total of 265 times. This timeline shows the frequency of activity since 1774 of Mt. Cleveland in Alaska. There have been 27 reported events of possible volcanic activity from this one volcano.



**Directions:** Use the information above, the map provided by your teacher showing active volcanic activity in Alaska, and *Volcanoes* to answer the questions.

- Look at the map provided by your teacher showing the line of volcanoes spreading out from Alaska. This arc, or curve, happens because of subduction zone volcanism. This means that...
  - the Pacific plate and the North American plate are spreading apart.
  - the Pacific plate and the North American plate are colliding.
  - the Pacific plate and the North American plate are sliding past each other.
  - these volcanoes are the result of hot spots from one plate.
- Using the map scale, how many miles long is it from Mt. Spurr to Mt. Kiska? \_\_\_\_\_
- Look at the recorded activity from Mt. Cleveland in the timeline above. Is this volcano becoming more or less active? \_\_\_\_\_
- Find Mt. Cleveland on the map provided by your teacher. Is it toward the west, center, or east side of the island chain? \_\_\_\_\_
- Which kind of plate meeting usually does not result in volcanic activity?
  - spreading apart
  - colliding
  - crumbling
  - sliding
- Would you want to live near Mt. Cleveland? Explain why or why not on the back of this sheet.

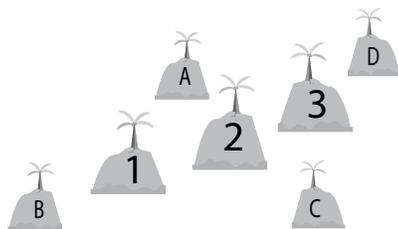
Background and timeline source: [http://woodshole.er.usgs.gov/operations/obs/rmobs\\_pub/html/alaska.html](http://woodshole.er.usgs.gov/operations/obs/rmobs_pub/html/alaska.html)

Name \_\_\_\_\_

## Reader Quiz

**Directions:** Circle the best answer.

- What is true of magma?
  - It is hot, liquid rock made from the mantle.
  - It comes up to the Earth's surface.
  - It is caused by the movement of the Earth's plates.
  - all of these
- Look at the islands. They are a result of hot spots. They are numbered in the order in which they appeared. If the plate continues to move in a similar direction, where will the next island form?



- Island A
  - Island B
  - Island C
  - Island D
- In the example above, which island is the oldest?
    - Island A
    - Island B
    - Island C
    - Island D
  - What is true of all volcanic eruptions?
    - They are all caused by hot spots.
    - They are all caused by pressure built up under the Earth.
    - They are all caused by a subduction zone.
    - They all erupt the same way.
  - What do you know about a volcanic eruption with a Volcanic Explosivity Index (VEI) of 6 compared to one with a VEI of 2?
    - The level 6 eruption is smaller than the level 2 eruption.
    - The level 6 eruption lasted longer than the level 2 eruption.
    - The level 6 eruption is a result of greater pressure than the level 2 eruption.
    - The level 6 eruption killed many living things.

**Directions:** On another sheet of paper, write three or more sentences to answer the question. Use the words *pressure*, *plate*, *mantle*, *erupt* or *eruption*, *magma*, and *crust* in your explanation.

- What causes volcanoes to erupt?

## Volcanoes Answer Key

### Blast and Ooze

1. trial 1
2. trial 4
3. by how high it jumped out of the tube (in cm)
4. Answers will vary. Example: No, Penny cannot create the pressure found in a soda can because the eruption of a soda can is stronger and caused by a change in gas. The soda is also thinner and lighter than the toothpaste, so it gushes rather than oozes.
5. They are all caused by pressure.
6. a lot of pressure from inside Earth

### An Explosive Event

1. 3 years
2. Tambora
3. It erupts continuously with little effect.
4. It released a large amount of material.
5. 0, 1, 2
6. Mt. St. Helens, Tambora, Vesuvius
7. 4

### A Long Line of Activity

1. b
2. about 2,400 km (1491 mi.)
3. more
4. west or center
5. c
6. Answers will vary.

### Reader Quiz

1. d
2. d
3. b
4. b
5. c
6. Answers will vary. Example: Eruptions start in the mantle, where magma forms. Pressure and heat push magma into a chamber. The magma rises above Earth's crust along with gas, rock, ash, and steam. It escapes through a hole in the crust. The volcano erupts.