

NATIONAL GEOGRAPHIC *Explorer!*

Teacher's Guide Pathfinder Edition March 2010

Dear Educator:

The arrival of spring signals the return of color to many wintry landscapes. This issue of EXPLORER celebrates the season by taking readers on three color-filled adventures.


In “Fantastic Frogs,” students come face-to-face with frogs and a dazzling array of colors, patterns, and behaviors. Readers will learn about frogs’ physical characteristics, amazing life cycle, and remarkable survival techniques. They also will learn about the role frogs play as sentinel species, acting as warning signs of an unhealthy environment. Students can complete the Vocabulary Survey on p. T7 to rate their knowledge of academic vocabulary before and after they read the story. The KWL chart on p. T8 will help them plan and monitor their reading.

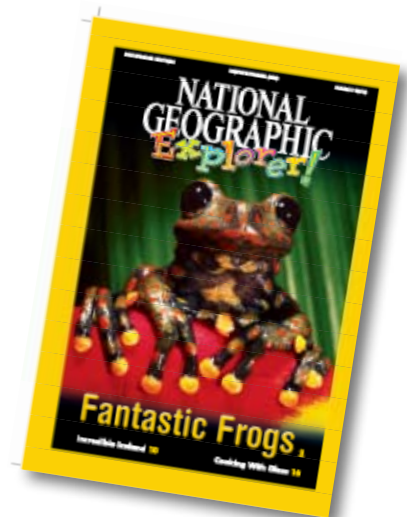
“Iceland: Land of Fire and Ice” takes students on a journey across Iceland’s ever-changing landscape. They’ll travel from fiery volcanic eruptions to milky blue lagoons. They’ll trek across rainbow-hued mountains to black sand beaches dotted with icebergs. Along the way, readers will learn how moving tectonic plates continue to change Iceland above and below Earth’s surface, and how the elements of fire and ice bring both benefits and challenges. You can use the graphic organizer on p. T16 to support students in using the visualize strategy as they read.

Our third color-filled adventure is “Cooking with Glass,” a terrific introduction to states of matter and the physics behind the versatility and beauty of glass. As readers step into the studio of celebrated artist Dale Chihuly, they’ll explore the unique properties that allow glass to be malleable yet strong, and often transparent. As students read this article, they will learn that glass is not only beautiful—it also has countless uses in science, industry, communications, and daily life. As they read, students can use the Observation Log on p. T26 to track the steps in the process of making glass.

We hope this issue inspires young readers through the beauty of the natural world and the inventiveness of the human spirit.

Sincerely,


Jacalyn Mahler
Editor in Chief



Fantastic Frogs

Teacher's Guide

March 2010

Curriculum Connections

- Language Arts
- Life Science

Standards Correlations

- Language Arts: Use Strategies to Access Word Meaning
- Life Science: Interdependence of Organisms; Human Impact on the Environment

Literacy Skills

- Vocabulary: Word-Learning Strategies
- Reading Strategies: Plan and Monitor; Summarize
- Writing: Research Report; Poetry; Persuasive Writing

Activity Masters

Vocabulary Survey, T7

KWL Chart, T8

Comprehension Check, T9

Comprehension Check, Answer Key, T10

Fantastic Frogs

About the Story

When someone says *frog*, what do students think of? Words like *green*, *slimy*, *hopping*, or even *ribbit* may come to mind. In this story, students will learn that there is much more to frogs than they may think. They will learn about frogs' physical characteristics, amazing life cycle, physical diversity, and remarkable survival techniques. They also will learn about the role frogs play as sentinel species, acting as warning signs of an unhealthy environment.

Fast Facts

- Frogs have adapted to many different habitats—from fresh water to deserts. They can be found on all continents except Antarctica.
- Frogs' bulging eyes come in many colors. Their pupils can be horizontal, round, triangular, and even star- or heart-shaped. For an example, see pp. 2 and 8 of the September 2009 issue of NATIONAL GEOGRAPHIC EXPLORER.
- Although frogs swallow their food whole, they have teeth on their upper jaw and the roof of their mouth. The teeth aren't used to chew, but to hold their prey in place before swallowing.
- Toads technically are considered frogs. The distinction is that toads generally have dry, warty skin and short hind legs used for walking, instead of jumping. Usually frogs have smooth, moist skin and long, strong hind legs with webbed feet for swimming.

Vocabulary

Access New Words Point out that when students read nonfiction texts, they often come across new words. When they do, they can use different strategies to help them figure out the meanings. As you introduce the strategies, display these steps:

- When you come across a new word, write it down or put a self-stick note next to it.
- Say the word out loud to see if it sounds familiar.
- Look closely at the word to see if it looks like another word you know. Their meanings may be connected in some way.
- Look for familiar word parts such as prefixes or base words.
- Look for clues to the word's meaning in surrounding words and sentences. Think about what meaning would make sense.
- If you are still stuck, look up the new word in a dictionary or glossary, or ask someone.

Model using the first three steps to figure out the meaning of *terribilis* on p. 4 of the story. You may want to keep the steps displayed for students to refer to as they read.

Next, tell students that in “Fantastic Frogs,” they will come across some words that may be new to them. Distribute the survey on p. T7. Review the directions, explaining that they will have a chance to rate how well they understand the words before and after reading the story. They can also use the survey to note the strategies they use to figure out new words' meanings.

Fantastic Frogs

(continued)

Preview

Activate Prior Knowledge Remind students that good readers preview nonfiction texts to identify the topic and think about what they already know about that topic. Invite them to begin to preview the story by turning to the opener on pp. 2-3. Call on volunteers to predict what the story will be about, based on the photographs, headline, and deck. Say: *This story is about frogs. Think about what you know about frogs. You may know a lot, or just a little bit. Either way, you'll learn more when you read the story.*

You can use the KWL chart on p. T8 to help students **plan and monitor** their reading. Have each student turn to a partner and talk for one minute, sharing what he or she knows about frogs. As students are brainstorming, have them select five facts to list in the first column. Next, say: *With your partner, preview the rest of the story. Page through reading the headings, photo captions, and bold words. Then, on your own, decide what you want to learn about frogs from this story. For example, how big is the biggest frog? Write your questions under the W portion of the chart.*

Access Science Content

English Language Learners You may want to pair English language learners with more fluent readers and have them pause at the end of each section to orally sum up the main ideas.

Have all students who are able to do so read the story independently. To further explore the key science concepts, set up four Jigsaw cooperative learning groups. A student from each group goes to a designated area to discuss a set of questions. If necessary, groups can reread the appropriate section of the story.

Metamorphosis What stages does a frog go through in its life cycle? What are these changes called? (“Amazing Makeover,” p. 4)

Survival Techniques How do some frog parents help their tadpoles survive? What sign of intelligence do some mother frogs show? (“Piggyback Parents,” p. 5)

Adaptation Where do frogs live? How do their legs and eyes help them survive? (“Got Water” and “Big Peepers,” p. 6)

Traits What are some difference in the size and color of frogs? What are some ways frogs attract mates? (“It’s All About Looks” and “Calling All Frogs,” p. 6)

Ask students to take notes in their discussion groups and report back to their original Jigsaw group on their assigned questions. Then as a whole class, revisit the questions, allowing students to expand their thoughts and ideas. Finally, lead students in discussing these big ideas:

Interdependence of Organisms How do people and frogs depend on each other? What do scientists mean when they say frogs are a **sentinel species**?

Fantastic Frogs

(continued)

Sum Up

After students have finished reading the story, have them go back and complete the appropriate sections of their vocabulary surveys and KWL charts. As they review their surveys, invite students to share the strategies they used to figure out the meanings of new words. As they review their KWL charts, ask them what new information they learned and listed in the *L* portion of their charts.

To encourage further investigation, say, *What questions did you have about frogs that the story didn't answer? Turn your paper over and list those questions. Now think about where you might find the answers.* Work with students to brainstorm how they might go about finding the answers to their questions.

Assess and Reteach

Materials: Comprehension Check, pp. T9 and T10; “Fantastic Frogs” story

Assign the Comprehension Check for “Fantastic Frogs” on p. T9. Use the Answer Key to score the assessment. Based on the results, you may want to reteach key science concepts. For example, students still may be unclear about the stages in a frog’s **metamorphosis** or why frogs are especially **vulnerable to changes in the environment**.

Ask students to think about three stages in a frog’s life cycle. Then invite a volunteer to read aloud the “Amazing Makeover” section on p. 4. Prompt students to name the three stages and record their responses as a chain of connected events. (Egg --> Tadpole --> Adult Frog) Ask students to give you more details about what occurs during each phase, and record the information. Make sure students understand that during the tadpole stage, frogs have gills that allow them to breathe in water. Then point out that during the huge metamorphosis that takes place over a few weeks, the tadpole changes dramatically: it loses its tail, develops legs and arms, and replaces its gills with lungs that breathe air.

To review frog’s unique traits, have students skim pp. 5-8 looking for information about frogs’ special body parts and behaviors. Students can jot down key words or phrases or use self-stick notes. Next, work with students to develop a concept web of Frog Traits. Have them share the special traits they read about. Encourage them to elaborate as you add details to the web. (Possible answers: parent frogs carry tadpoles to safe places, some females have great memories, sticky substance keeps tadpoles on parents’ backs, can live everywhere but Antarctica, soak up water through their skin, long legs help them jump, bulging eyes help them see in many directions and swallow, different sizes, different colors, make sounds or dance to attract mates)

Finally, ask students to reflect on why the author might have written the story. Allow them time to prepare and show thumbs-up when they are ready. Ask: *What did we learn about frogs that can be important to our lives? How can we use this new information?* Lead students to recognize that frogs are warning us that we have many unhealthy ecosystems. We also depend on frogs to keep the number of insect pests down. So we must think of ways to decrease pollution and keep the environment healthy.

Fantastic Frogs

(continued)

Extend the Learning

Review Fact and Opinion Remind students that all authors have a purpose for writing. When good readers read a story, they try to get inside the writer's head by asking: *Did the author write this mainly to give me information, to entertain me, or to persuade me to think a certain way?* To meet their purpose, writers often include their opinions, or personal beliefs, as well as facts. Invite students to go back into the text of "Fantastic Frogs" and find examples of facts and opinions. Before they begin, you may want to review the difference between a fact and opinion using a few examples. Read aloud the following statements. Have students raise their hands if they think it is a fact. Say: *Some frogs can jump 20 times the length of their bodies. (Fact) Frogs use their eyes to swallow. (Fact) Frogs are cute. (Opinion)*

Research Frogs in Your Area Invite students to research the types of frogs that live in your state. Using print or online resources, they should find names, descriptions, habitats, predators, and any environmental challenges these particular frogs face. Written reports can be shared in small groups or with the class.

Poetry Students may enjoy writing a poem about frogs that gives information and entertains the reader. You may want to have each student contribute a line to a single class poem. Suggest they include details from the story about how frogs look, move, and sound. Students can illustrate their poems when finished and post them on a bulletin board or school website for other classes to enjoy.

Peer Teaching Invite students to make a Frog Fact Book for younger students. First, have them agree upon nine important facts they want to include. Then give each student five pieces of plain paper. Have students fold the paper in half hamburger style, nest all pieces together and staple at the top. Students should design a cover and title page, then on the remaining pages, write one important fact combined with a drawing to go along with the fact. When completed students can take their books to a class of younger students in the school and read the book aloud to one or more reading pals.

PSA or Game Board Tell students there are many plants and animals that are considered sentinel species. Have students research other species that fall into this category. Their research should include important facts about the species, including the environmental issues that are adversely affecting the species. When finished researching this topic, challenge students to write a PSA about a specific sentinel species and how changes in the environment are affecting it. Other students may prefer to make a board game with question and answer cards. Players can leapfrog from the start to end by correctly answering questions about sentinel species.

Fantastic Frogs

Complete this survey twice: once before you read the story, and once after you read it.
Compare your answers.

	Can you say the word?	Rate how well you know the word. 1 = I don't know what it means. 2 = I have an idea what it means. 3 = I know it really well.	What can help you figure out the meaning of the word?
amphibian			
camouflage			
dissolves			
ecosystem			
metamorphosis			
mutate			

Fantastic Frogs

Answer the question before
you read the story.

Answer the question after
you preview the story.

Answer the question after
you read the story.



	K What do you know about frogs?	W What do you want to learn about frogs?	L What did you learn about frogs?
1.			
2.			
3.			
4.			
5.			

COMPREHENSION CHECK

Answer these questions about “Fantastic Frogs.” For items 1–4, fill in the circle by the correct answer. Write your answer to item 5.

1. Which statement is true for all frogs?
 - (A) They can live in water and on land.
 - (B) They spend their entire lives in water.
 - (C) They blend into their surroundings.
 - (D) They use their vocal sacs to attract mates.

2. Why does the author compare the Brazilian gold frog with the goliath frog?
 - (A) To show that frogs come in different colors.
 - (B) To show that frogs vary greatly in size.
 - (C) To explain that frogs make a variety of sounds.
 - (D) To explain that frogs eat different kinds of insects.

3. What do a frog’s bulging eyes help it to do?
 - (A) find insects
 - (B) swallow food
 - (C) see danger
 - (D) all of the above

4. Why are frogs called a “sentinel species”?
 - (A) They guard Earth’s fragile wetlands.
 - (B) They are the only creature harmed by fungus.
 - (C) They are sensitive to environmental changes.
 - (D) They are found on all continents except Antarctica.

5. Describe the dangers tadpoles face when they are born. Explain how some adult frogs try to help their offspring survive.

COMPREHENSION CHECK

Answer these questions about "Fantastic Frogs." For items 1–4, fill in the circle by the correct answer. Write your answer to item 5.

1. Which statement is true for all frogs?
☒ (A) They can live both in water and on land.
☐ (B) They spend their entire lives in water.
☐ (C) They blend into their surroundings.
☐ (D) They use their vocal sacs to attract mates.
2. What point does the author make by comparing the Brazilian gold frog with the goliath frog?
☐ (A) Frogs come in different colors.
☒ (B) Frogs vary greatly in size.
☐ (C) Frogs make a variety of sounds.
☐ (D) Frogs eat different kinds of insects.
3. What do a frog's bulging eyes help it to do?
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5. Describe the dangers tadpoles face when they are born. Explain how some adult frogs try to help their offspring survive.

Sample top-scoring response: Snakes and other dangerous predators live all around the small

tadpoles. To keep her tadpoles safe, the female strawberry dart frog carries each tadpole up into the

trees and puts it in a pool of water between a plant's leaves. She lays a special egg in the pool so the

tadpole can eat. To keep his offspring safe, the male green poison dart frog lets the tadpoles climb

onto his back. Then he carries them to a safe stream and lets them go.

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Teacher's Guide

March 2010

Curriculum Connections

- Language Arts
- Earth Science
- Geography

Standards Correlations

- Language Arts: Use of Background Knowledge
- Earth Science: Processes that Change Earth and Landforms
- Geography: Physical Processes that Shape the Pattern of Earth's Surface; Interpret Maps

Literacy Skills

- Reading Strategy: Visualize
- Vocabulary: Figurative Language
- Writing: Science Inquiry

Activity Masters

- Access Science Content, T16
- Access Science Content, Answer Key, T17
- Comprehension Review, T18
- Comprehension Review, Answer Key, T19

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About the Story

This story takes readers on a journey across Iceland, a country of extremes. Students will explore icy glaciers, sizzling volcanoes, massive icecaps, and bubbling geysers. They will learn how moving tectonic plates continue to change Iceland above and below Earth's surface and how the ever-changing elements of fire and ice bring benefits and challenges to residents and visitors alike.

Fast Facts

- Iceland is located in the Northern Atlantic Ocean between Greenland, Norway, Ireland, and Scotland. Its area is similar to that of Ohio: 40,000 square miles. It slowly grows bigger, thanks to continuing volcanic eruptions.
- Iceland's population is just over 300,000 people, about the number of residents in Pittsburgh, Pennsylvania. The main industry is fishing.
- Over 70 percent of Iceland's energy comes from geothermal and hydroelectric sources.

Vocabulary

Similes Display this sentence: *My house was as cold as the North Pole.* Discuss the meaning, asking students if your house really could be as cold as the North Pole. Explain that you compared your house to the North Pole to get across the idea that your house was very cold. Circle or highlight the phrase *as cold as*. Explain that a comparison that uses the word *like* or *as* is called a simile.

Ask students to listen for a simile as you read aloud the third paragraph on p. 11. After volunteers identify the sentence with the simile, display it: *This created a landmass that acted like scar tissue covering a wound in Earth's crust.* Use the following discussion points to lead students in further examining the sentence:

- *Let's look at this sentence closely. What does This refer to at the beginning of the sentence?* (tons of lava and rock)
- *What does a sore or wound look like?* (an opening in the skin) *What happens when it heals and gets better?* (a scar forms over the opening so the skin below can heal) *What I think this means is that over millions of years, the lava and rock that erupted from volcanoes kept building up, creating the island of Iceland*
- *The author helps me visualize what occurs by suggesting that the eruption along the rift created an open wound and by comparing the landmass to scar tissue that covered that wound.*

Have students silently read the third paragraph on p. 12 under "Sizzling Sites." Ask them to show thumbs-up when they have found another simile. Invite a volunteer to read the simile aloud (*Minerals and white mud in the water make your skin as soft as a newborn baby's skin.*) Ask students to identify the two things the author is comparing and to explain the meaning. (the skin of someone who soaks in Blue Lagoon and a baby's skin; the minerals and mud make your skin very soft.)

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Preview/Tap Into Prior Knowledge

Often without even being aware of it, students will summon up what they know about a topic when they initially preview a text. Invite students to preview the story by reading the opener on pp. 10-11. Then help them recall what they learned about Earth's layers and tectonic plates from reading "Active Earth" in the January/February issue of NATIONAL GEOGRAPHIC EXPLORER. You may want to use the following true/false questions to quickly assess students' recall of the main ideas. Discuss the responses as a group. Encourage students to keep this key information in mind as they read "Iceland: Land of Fire and Ice."

1. Earth has two layers: the mantle and crust. (F)
2. Earth's crust is broken into huge pieces called tectonic plates. (T)
3. These plates have stayed in the same place for millions of years. (F)
4. Heat from Earth's core makes rock in the mantle rise up and sink. (T)
5. Moving tectonic plates create earthquakes, mountain ranges, and hot springs. (T)
6. Volcanoes form where two plates move apart and molten rock oozes into the gap. (T)
7. Pangaea is the name of a famous hot spring. (F)

Next, direct students' attention to the subtitle, "Land of Fire and Ice." Ask them why they think the author chose this subtitle. Lead them to understand that both fire and ice played a part in creating the unusual landscape of Iceland.

Access Science Content

After students read the story to themselves, work through the story together. Read each page aloud, pausing to discuss the key science concepts, as noted below.

Page 11: Iceland is made up of more than ice. It has volcanoes, hot springs, and geysers. The heat comes from an underwater split in Earth's crust called the Mid-Atlantic Ridge. Iceland sits atop two tectonic plates that are pulling apart very slowly. As the plates move, the land stretches out, covering more area.

pp. 12-13: Some changes to Iceland's landscape happen suddenly. In 1973, a volcano erupted on the small island of Heimaey. Molten rock burned hundreds of buildings; others were buried in ash. The residents stopped the surging lava by spraying cold seawater on it. In just five months, the island grew one-fifth bigger.

Over millions of years, volcanoes and flowing lava have formed Iceland's landscape. Iceland has many steam vents and hot springs. The steam comes from heated rock and water below Earth's surface. Icelanders take advantage to the natural hot water by soaking in it and using it to generate electricity to heat their homes and to grow vegetables in greenhouses.

pp. 14-15: Glaciers cover one-tenth of the country. As the glaciers move toward the sea, they carve valleys deeper. The largest glaciers are called icecaps. Iceland's biggest icecap is larger than all the glaciers in mainland Europe combined. Iceland is one of the few places where active volcanoes lie below icecaps. They can cause destructive floods. The floods carry ash and sand, which form large black plains called sandurs. In some places, the water from melted glaciers fills the exploded tops of volcanoes.

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Sum Up

Distribute the activity master on p. T16. Pairs can work together to complete the graphic organizer. Suggest that they reread the descriptions of the different geological features and use the **visualize** strategy to create a mental picture of each one. Partners then can list each feature in the appropriate column: fire or ice. After students share their responses, revisit the question you posed earlier, asking if they think “Land of Fire and Ice” is a good choice for the story’s subtitle. Students may enjoy thinking of other possible subtitles based on the story content.

Assess and Reteach

Materials: Comprehension Check, pp. T18 and T19; “Iceland” story, “Incredible Iceland” poster in the Teachers’s Edition

Assign the Comprehension Review for “Iceland” on p. T18. Use the Answer Key to score the assessment. Based on the results, you may want to reteach key science concepts. For example, students may be unclear about the **movement of the North American and Eurasian plates** and how **volcanic eruptions and glaciers** have shaped and continue to change Iceland’s topography.

Remind students that Earth’s crust is like a jigsaw puzzle, broken into huge plates. Also remind them that these plates move. Explain that the North American plate and the Eurasian plate are slowly pulling apart. Iceland sits on top of an underwater split where these plates are pulling apart. This split is called the Mid-Atlantic Ridge. Display the poster and point to the photograph below the headline. Explain that in this location people can see where the two plates have pulled apart and created a big rift.

Then say: *It may seem unusual for one place to have icecaps and glaciers as well as sizzling volcanoes and steaming hot springs.* Clarify that it is the underground geology of tectonic plates pulling apart that provides the perfect scenario for fiery volcanoes to form and erupt. Point to the photograph of the erupting volcano on the poster. Ask students to draw on what they know and describe what lies below Earth’s crust. (Answers may include: mantle and core, hot rocks, molten rock, steam, etc.) Explain that millions of years ago, volcanoes started forming along the Mid-Atlantic Ridge. Ask: *What happens when a volcano erupts and hot lava flows out over an area?* Lead students to understand that the lava kept building up, creating the landmass we know today as Iceland.

Then say: *We also learned in the story that other natural features give Iceland its unique landscape. What are some of those features?* (Answers may include: ice, snow, glaciers, icecaps, geysers, hot springs, mud pots, etc.) As students name the features, invite them to come up and point to those shown on the poster. (Not all are shown.) Continue to help students link what occurs below Iceland with the features that exist on the surface. Ask: *What creates hot springs and geysers? What happens when a volcano erupts beneath a glacier? How do glacial floods change the landscape of Iceland?* Have students scan pp. 11 and 14 to find the answers. (Sample responses: Heated rocks and hot water below Earth’s surface create hot springs and geysers. A volcanic eruption can melt glacier ice and create a flood. Glacial floods can carry ash and sand, forming plains called sandurs. Glacial water also can form new lakes by flowing into the exploded tops of ancient volcanoes.)

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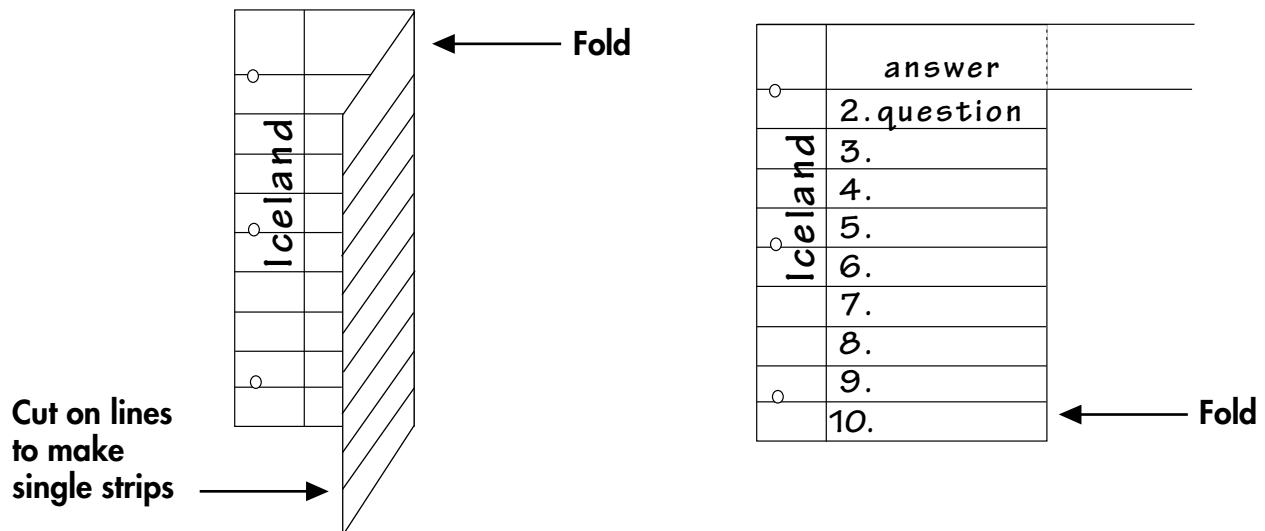
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Extend the Learning

Research Local Topography Students can work in small groups to research the natural features of your town, state, or region. With the class, take a few minutes to brainstorm some of the natural features of your area. Guide students to consider landforms and bodies of water such as mountains, lakes, rivers, canyons, caves, valleys, and sand dunes. Then have small groups select a particular geographical feature and prepare an oral presentation. Encourage them to gather photographs as well as information about how the feature formed and the ways in which it may still be changing. Students also should be prepared to explain how the geographical feature impacts people's lives in terms of both benefits and challenges.

Big Ideas in Nonfiction Point out that when good readers read nonfiction texts, they are able to sift through small details and focus on the author's big ideas. Tell students to skim the "Iceland" story, placing a self-stick note next to important information. Explain that they should look for big ideas and important facts, not small details. Then have them write a question connected to each idea. Tell them they will be creating a Fact-Check to exchange with other students. To create the Fact-Checks, students should follow these steps:

- Fold a sheet of notebook paper in half lengthwise, placing the paper's edge along the left-hand margin line. Crease the fold.
- With the 3 holes at the top, write the topic of the story: Iceland. Next, along the edge facing the title, cut every third line to the fold. This will provide a strip that can be flipped back leaving paper underneath it for the answer to the question. (See first diagram below.)
- Number and write your questions on the top of the cut strip. Then fold back each strip and write the answer on the paper below. (See second diagram below.)



When the Fact-Checks are finished, students can exchange them with a classmate.

Write Captions with Similes Remind students that they learned about similes, a special type of comparison that uses the word *like* or *as*. Challenge them to come up with new captions for the photos in the "Iceland" story, using their own similes. For example, "Melting icebergs sparkle like diamonds in the sea," or "In some places, Iceland is as colorful as a rainbow."

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After you read the story, think about the different natural features the writer describes. Use the writer's words to make a mental picture. Then decide if each type of feature belongs under the heading "Fire" or "Ice." An example has been done for you.

FIRE**ICE**

volcano

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After you read the story, think about the different natural features the writer describes. Use the writer's words to make a mental picture. Then decide if each type of feature belongs under the heading "Fire" or "Ice." An example has been done for you.

FIRE

volcano
geyser
lava flow
hot spring
hot ash
steam vent
hot rock
bubbling mud pot
steam

ICE

frozen ash
iceberg
icecap
glacier
ice
snow
glacial flood
cold seawater
lake

COMPREHENSION CHECK

Answer these questions about "Iceland: Land of Fire and Ice." For items 1–4, fill in the circle by the correct answer. Write your answer to item 5.

1. Which phrase best describes the part of Earth where Iceland is located?
 - ☐ (A) One large volcano erupts there.
 - ☐ (B) Two huge plates split apart there.
 - ☐ (C) Massive glaciers melt there.
 - ☐ (D) Hot lava collects there.

2. What caused the island of Heimaey to grow in size?
 - ☐ (A) Heat caused the land to expand.
 - ☐ (B) Glaciers carved out new valleys.
 - ☐ (C) Two plates crashed together, forming mountains.
 - ☐ (D) Streams of lava formed new land.

3. What causes the steam in Iceland's steam vents?
 - ☐ (A) lava from volcanoes
 - ☐ (B) minerals and white mud
 - ☐ (C) heated rocks and water
 - ☐ (D) hot springs like Blue Lagoon

4. Which event happens first in a glacial flood?
 - ☐ (A) Water melts and forms a lake.
 - ☐ (B) A volcano erupts under an icecap.
 - ☐ (C) Water bursts out of an icecap.
 - ☐ (D) Melted water runs out of room.

5. Explain why the landscape in Iceland is white, black, blue, and yellow. Write one sentence that explains each land color.

COMPREHENSION CHECK

Answer these questions about "Iceland: Land of Fire and Ice." For items 1–4, fill in the circle by the correct answer. Write your answer to item 5.

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☐ (C) Water bursts out of an icecap.
☐ (D) Melted water runs out of room.
5. Explain why the landscape in Iceland is white, black, blue, and yellow. Write one sentence that explains each land color.

Sample top-scoring response: Much of Iceland is white because of the many glaciers

and icecaps that cover the land. The blue in Iceland's landscape is caused by hot springs

such as the milky Blue Lagoon and by glacial water flows. The black color is caused by

ash from volcanoes that has settled on the ground. Minerals in the rock cause yellow

streaks in the mountains.

Cooking with Glass

Teacher's Guide

March 2010

Curriculum Connections

- Language Arts
- Physical Science
- Fine Arts

Standards Correlations

- Language Arts: Use Text Structure
- Physical Science: Changes in Matter

Literacy Skills

- Reading Strategy: Plan and Monitor
- Vocabulary: Develop Academic Vocabulary
- Writing: Critical Thinking

Activity Masters

- Observation Log, T26
- Observation Log, Answer Key T27
- Comprehension Check, T28
- Comprehension Check, Answer Key, T29

Cooking with Glass

About the Story

Clear or multi-colored, flat or cylindrical, glass is EVERYWHERE! In this story, students will learn how glassblowers transform a few basic materials into fantastic glass shapes. As readers step into the studio of celebrated artist Dale Chihuly, they'll explore the unique properties of glass that allow it to be malleable yet strong, and often transparent. Students will learn about the many ways people have used glass over the centuries as well as its use in some cutting-edge technology.

Fast Facts

- Dale Chihuly is a world renowned glass artist. He is famous for his beautiful, enormous glass creations that often are inspired by forms in nature, especially flowers and sea life.
- Over 75 percent of waste glass ends up in landfills yet 100 percent of glass is recyclable. Most cities provide glass recycling at the curb or in designated sites. In some parts of the country, waste glass is being made into a new product called "glassphalt." Used glass is being crushed and combined with asphalt for roads and highways.
- Obsidian, a natural glass of volcanic origin, once was used to make cutting tools.

Vocabulary

Teach Key Concept Vocabulary Display these key words from the story: *furnace*, *solid*, *liquid*, *scattered*, *ingredient*, and *sculpture*. Use the following steps to teach the word *furnace*:

1. **Pronounce** Tell students when they read "Cooking with Glass," they are going to learn how people make and shape glass using a furnace. Ask students to say the word *furnace* aloud with you. Then have students pronounce it again, by syllable: *fur-nace*.
2. **Explain** Tell students that a *furnace* is a type of oven. Say: *To make glass, artists mix different materials and heat them up in a furnace.*
3. **Engage** Ask students to help you complete this sentence: *To heat the glass, the artist put it in the _____. (furnace)*
4. **Involve** Say: *Listen to this sentence and tell me if I'm using the word furnace correctly. I went to a furnace to buy a glass bottle.* Ask students for a thumbs-up or thumbs-down. Explain that those who voted "no" are correct because *furnace* refers to a type of oven used in a factory or artist's workshop, not a place where you go to buy things.
5. **Elaborate** Ask: *In what types of texts would you expect to find the word furnace?* Accept responses from students. Reinforce logical answers such as science textbooks, descriptions of how products are made in factories, etc.

Repeat the process to introduce the other key concept vocabulary.

Cooking with Glass

(continued)

Preview Text Structure

Steps in a Process Lead students in previewing the story, directing their attention to the headline and deck on pp. 16-17. Based on the text and photograph, ask them what they think the story will be about. Then ask why they think the writers chose to compare the process of making glass to cooking. Suggest that students draw on their own experiences with cooking food, including any experiences they have had with following recipes. Invite volunteers to explain what they made and what steps they took. Then ask: *What would have happened if you left out one of the ingredients or skipped a step?* Explain that making glass is like following a recipe, so the writers chose words and phrases related to cooking for the subheads: *a pinch, a sprinkle, season, and bake.*

Continue to lead students in previewing the remaining pages of the story by having them scan the photographs and read the subheads. Ask what they notice about the way the writers organized the information. Lead students to understand that the story will take them step-by-step through the process of making glass. Much like a how-to manual, it presents steps in a procedure in time order sequence.

Access Science Content

Read pp. 18-19 with students, pausing at the end of each page to discuss the key concepts. You may want to use the following prompts to guide discussion.

p. 18: *What happens to glass when glassblowers heat it in a furnace?* (It glows and oozes like honey. Then artists can shape it.) *What happens when glass cools?* (It hardens.) *Why do the writers say that it's hard to imagine everyday life without glass?* (Glass is used to make so many things—from windows to lights and computers. It even is used in telescopes, microscopes, and in fibers that carry phone, TV, and Internet signals.)

pp. 19: *How do the writers describe glass?* (They say it's versatile because it can be shattered or it can be stronger than steel. It can feel hard or ooze into shapes.) *How does Chihuly describe glass?* (He thinks it's mysterious and magical.)

Before moving on, you may want to reinforce the key concept of **states of matter**. Say: *Have you ever thought about how glass can be made into so many different shapes? It has to do with the changing properties of matter.* Remind students that matter is everywhere; it is all the “stuff” in our world. Everything that takes up space in your classroom is matter: books, pencils, desks, backpacks, even a pet snake. Scientists describe three states of matter: solid, liquid, and gas. Often, physical changes occur in matter when it is heated. Ask students: *What happens to an ice cube you drop in a glass of water?* When students respond that it melts, explain that that occurs because the water is warmer than the ice cube. When the ice cube comes in contact with warmer water, it melts and turns into liquid. When liquid water is further heated, it becomes water vapor, which is a gas.

Explain that glass also changes depending on its temperature. When the right ingredients are mixed together and then heated, the glass becomes a thick goo (liquid). That's when glass artists and manufacturers can shape glass into different forms. When it cools, you have a hard glass object (solid), maybe a drinking glass, light bulb, a car windshield, or a beautiful sculpture.

Cooking with Glass

(continued)

Access Science Content, continued

English Language Learners You may want to use photographs and/or realia to help students better grasp the concept of states of matter. First, display the word *matter*. Explain that everything in our world is made up of matter. Its form and behavior can change. Matter can be liquid, solid, or gas. Draw three spokes connecting the word *matter* to the words *liquid*, *solid*, and *gas*. For each state of matter, discuss what it is like. Then display a photograph with an example. Finally, ask students to name some additional examples. For instance, point to liquid and say, *When something is in its liquid state, it can move and flow. Drinking water is a liquid. Name some other things that can be in a liquid state.* As you work through each state of matter, you may want to display photographs of a glass of water, ice cubes, and a steaming tea kettle.

To reinforce the connection between **atoms** and **transparency**, direct students' attention to the question at the bottom of the first column on p. 19: "How does glass let light shine through?" Remind them that all matter is made up of atoms. Atoms are so small, they cannot be seen with the eye or even a microscope. They tend to follow certain rules. In solids, the atoms are packed together. To illustrate this, you may want to draw a solid wall made up of rows of bricks that are neatly stacked on top of each other.

Explain that in a liquid, the atoms are still in a contained place, but they are scattered with space between them. When glass melts, the atoms start to spread apart. When it cools, the atoms start to get back in a regular pattern, but the glass hardens too fast. As a result, space is left between the atoms. To illustrate this, you may want to draw an array of bricks that cover the same area as the solid wall, but shown at different angles and with space between them. Point to the illustration and explain that this arrangement of atoms is what lets light shine through glass.

Before students read pp. 20-21, distribute the Observation Log on p. T26. Review the directions. Then have them work together with a partner to read the rest of the story and complete the log.

Sum Up

Invite volunteers to share the steps listed in their Observation Log. As a class, determine if there were any important steps left out and create a group log. Pairs then can make corrections to their activity master, if necessary.

Next, discuss with students how previewing the story before reading and using the Observation Log helped them **Plan and Monitor** their reading. Help them to understand that good readers always preview a text to get an idea of what it will be about and how the information is organized. In this way, students know what to look for as they read and how to track what the writers say.

Challenge Based on their completed Observation Logs, ask students to think about the type of training and skills someone would need to become a glass artist. Students can write a paragraph on the back of their logs that explains what glass artists need to know and why.

Cooking with Glass

(continued)

Assess and Reteach

Materials: Comprehension Check, pp. T28 and T29; “Cooking with Glass” story

Assign the Comprehension Check for “Cooking with Glass” on p. T28. Use the Answer Key to score the assessment. Based on the results, you may want to reteach key science concepts. For example, students may be unclear about why glass is like a liquid and a solid.

Display the word *glass* in the center oval of a concept web. Tell students that you are going to revisit the story to review what glass is like. Draw three spokes from the center oval connected to these three traits: *useful*, *liquid*, *solid*. Have students reread the section “Counting on Glass” on p. 18. Tell them to show thumbs-up when they are prepared to explain how glass is useful. Students should name some of the many ways that we depend on glass in our everyday lives.

Repeat the process, asking students to reread the sections “A Pinch of Physics” and “Running Hot and Cold” on p. 19. Tell them to show thumbs-up when they are prepared to explain how glass is like a liquid and a solid. Students should mention that when glass is heated, it flows and changes shape. When it cools, it feels hard like a rock and its shape doesn’t change. Help students connect the changing arrangement of atoms to the fact that light can pass through glass. You may want to repeat the two illustrations of bricks described on p. T23.

To help clarify the sequence of steps used for making glass, ask students to review their responses and any corrections to their Observation Log. Invite them to reread pp. 20-21 of the story, checking off each step they listed. If they find they missed a step, have them add it in the correct spot. Discuss students’ responses.

Cooking with Glass

(continued)

Extend the Learning

Critical Thinking Have students brainstorm 20 things made of glass, individually or as a class. Then ask each student to select the five things that have had the greatest impact on our lives. Invite students to write a paragraph about one of the items they selected. Encourage them to explain how people have benefited from its use and how life would be different without it.

Compound Words Display the following words from the story: *bubblegum*, *glassblowers*, *skywalk*. Ask students: *What do you notice about each of these words?* As students respond, lead them to notice that each word is made up of two base words. When the words are combined, they make a new word with a new meaning. Tell students these are called compound words. Say: *If you know what a bubble and what gum is, how would you describe bubblegum?* Repeat the process with the words *glassblower* and *skywalk*.

Have students go back through the story and list other compound words. They can compare their list to a partner's list and put a check mark by any compound word they listed that their partner did not. Students then can add up the check marks to see who found the most compound words in the story. Partners can challenge a word listed as a compound word and should check with the teacher or a dictionary for clarification.

Art Students can design their own three-dimensional sculpture. First, remind them that Chihuly based his work upon forms found in nature such as flowers, sea creatures, seaweed, etc. After students have thought of a form in nature they would like to have their sculpture represent, distribute wire, pipe cleaners, foil, or other materials that can be formed into desired shapes. Then have students adhere colored tissue paper or plastic wrap to the open areas of the sculpture allowing light to shine through. Invite students to share their sculptures, explaining what natural form they were using as their inspiration.

Challenge Invite students to examine Dale Chihuly's work in print or online. Have students note the unique style, size, and subject matter of his work. Also ask students to learn more about the life of Chihuly and follow his development as a glass artist. Then students can write a short biography of Chihuly, including their impressions of his work. Note: Students may choose to use a timeline format to track the milestones in Chihuly's life and career.

Cooking with Glass

Observation Log

Imagine you are a scientist visiting Dale Chihuly's hot shop. As you read the story, list the steps you need to follow to make glass art. Be sure to include all the steps in a glass artist's "recipe."

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

Cooking with Glass

Observation Log

Imagine you are a scientist visiting Dale Chihuly's hot shop. As you read the story, list the steps you need to follow to make glass art. Be sure to include all the steps in a glass artist's "recipe."

1. **Start with silica, a type of sand.**

2. **Add soda powder to help silica melt at a lower temperature.**

3. **Add lime powder for strength and water resistance.**

4. **For color, add metals like gold, iron, or cobalt.**

5. **Add boron for extra strength.**

6. **Mix and then bake for up to 24 hours.**

7. **Blow and twirl the molten glass into shapes.**

8. **If the glass becomes thick, reheat it to continue shaping.**

9. **Put the glass in an oven at about 480° C (900° F). Cool down slowly
to room temperature.**

COMPREHENSION CHECK

Answer these questions about "Cooking with Glass." For items 1–4, fill in the circle by the correct answer. Write your answer to item 5.

1. What is unique about glass?
☐ (A) Light can pass through it.
☐ (B) It has many uses.
☐ (C) The Romans invented it.
☐ (D) It is made up of atoms.
2. When Dale Chihuly makes a glass sculpture, which step does he do last?
☐ (A) Heat the mixture.
☐ (B) Mix up the ingredients.
☐ (C) Cool the glass very slowly.
☐ (D) Twirl the glass into a shape.
3. Why do the authors compare glass to sports fans at a stadium?
☐ (A) to explain what happens when glass cools
☐ (B) to show how atoms behave in glass
☐ (C) to explain why light shines through glass
☐ (D) all of the above
4. Which ingredient makes glass stronger?
☐ (A) boron
☐ (B) gold
☐ (C) cobalt
☐ (D) soda
5. Write a paragraph that explains why glass is so useful. Tell how it is used in communication, scientific study, art and entertainment, and daily life.

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5. Write a paragraph that explains why glass is so useful. Tell how it is used in communication, scientific study, art and entertainment, and daily life.

Sample top-scoring response: Glass is useful in many ways. Thin glass fibers carry data for phones, computers, and TVs. Glass lenses are used in telescopes and microscopes, helping scientists study the world. Artists create beautiful sculptures from glass. A glass sidewalk called the Skywalk at the Grand Canyon lets tourists step out over the Grand Canyon and look straight down. At Boston's Mapparium, a huge glass globe lets people explore Earth in a new and different way. We use glass in daily life, too. Windows let light in, and glass containers have been used since ancient times.