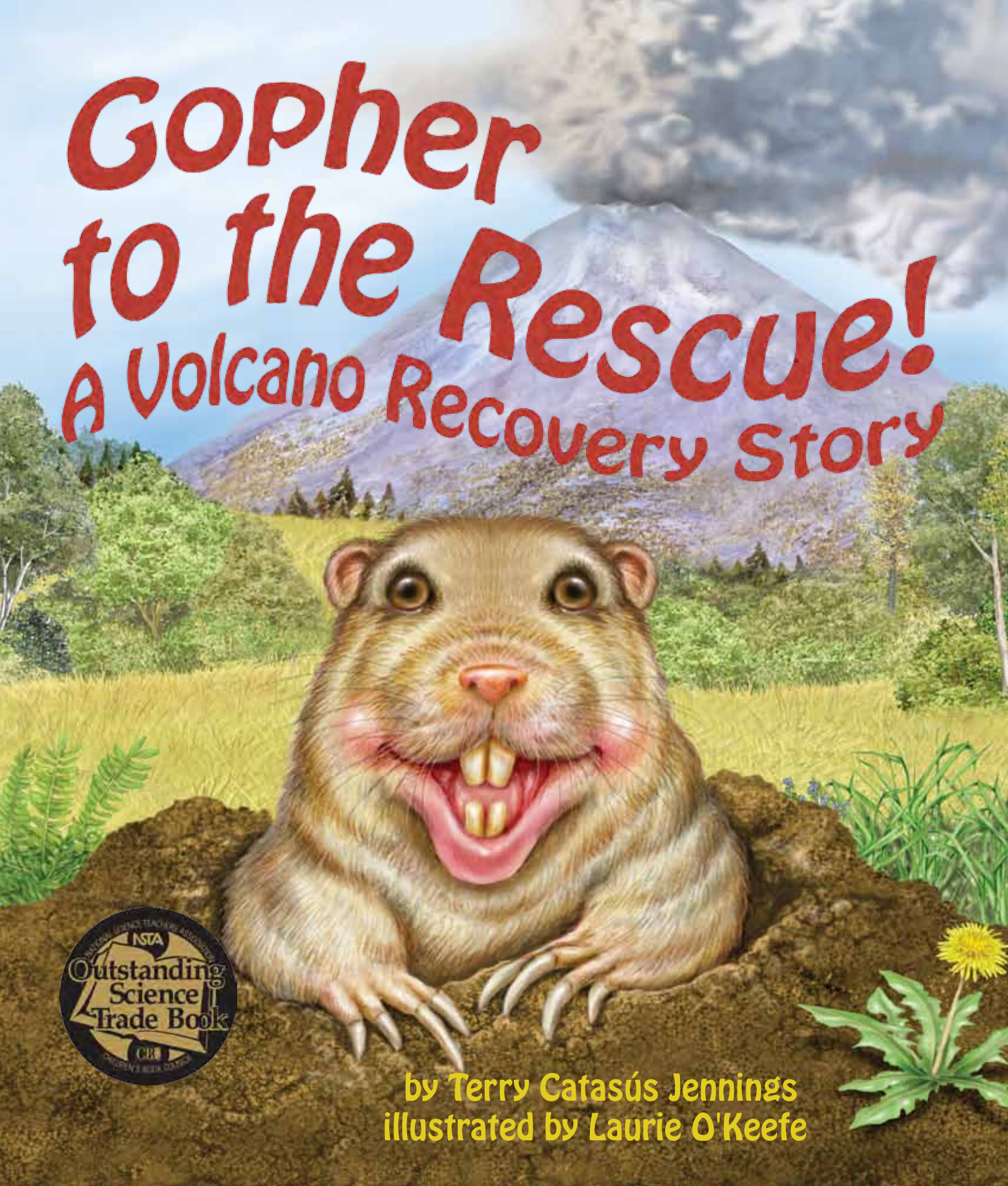
Gopher to the Rescue!

A Volcano Recovery Story



by Terry Catasús Jennings
illustrated by Laurie O'Keefe

Gopher to the Rescue! A Volcano Recovery Story

The forest animals are surprised when a volcano suddenly explodes, covering the land in gritty, warm ash and rocks that make it unlivable for many plants and animals. Gopher survives in his underground burrow with food to eat. How does Gopher help bring life back to the mountain? Scientists spent years observing life returning to the mountain following the eruption of Mount St. Helens on May 18, 1980. This fictionalized story is based on their surprising observations of how life returns to an area that has been totally changed or destroyed.

It's so much more than a picture book . . . this book is specifically designed to be both a fun-to-read story and a launch pad for discussions and learning. Whether read at home or in a classroom, we encourage adults to do the activities with the young children in their lives. Free online resources and support at www.ArbordalePublishing.com include:

- For Creative Minds as seen in the book (in English & Spanish):
  - What and Where Are Volcanoes?
  - Tectonic Plates (with map)
  - Natural Disasters and Habitat Changes
  - Hands On: Pressure and Melting
- Teaching Activities (to do at home or school):
  - Reading Questions
  - Language Arts
  - Science
  - Math
  - Geography
  - Coloring Pages
- Interactive Quizzes: Reading Comprehension, For Creative Minds, and Math Word Problems
- English and Spanish Audiobooks
- Related Websites
- Aligned to State and Core Standards
- Accelerated Reader and Reading Counts! Quizzes
- Lexile and Fountas & Pinnell Reading Levels

eBooks with Auto-Flip, Auto-Read, and selectable English and Spanish text and audio available for purchase online.

Thanks to Peter Frenzen, Mount St. Helens Monument Scientist, US Forest Service; Frederick J. Swanson, Research Geologist with the USDA Forest Service, Pacific Northwest Research Station and co-editor of *In the Blast Zone: Catastrophe and Renewal on Mount St. Helens* and *Ecological Responses to the 1980 Eruption of Mount St. Helens*; and Liz Westby, Outreach Assistant and Carolyn Driedger, Hydrologist/ Outreach Coordinator at the USGS Cascades Volcano Observatory, for reviewing this book for accuracy.

Terry Catasús Jennings (pronounced cat ah soos) has been heavily involved in the arts for the past 20 years, serving as a Cultural Arts Chair in her children's schools. She is a contributor to the National Science Resource Center's (NSRC) Science and Technology for Children and Science and Technology Concepts for Middle Grades series. Her articles have appeared in The *Washington Post*, *Long Island News Day*, *Ranger Rick*, and she wrote a family humor column for her local newspaper, *The Reston Connection*, for four years. ***Gopher to the Rescue! A Volcano Recovery Story*** is her first picture book. Terry is a member of SCBWI. She and her husband live in Northern Virginia.

Laurie O'Keefe's undergraduate degree in zoology and her graduate degree in human anatomy have helped with her scientific illustrations in the medical and scientific fields. Her client list reads like a "Who's Who" in scientific illustrations from text books and magazines to zoos and museums. This is her first picture book.

Terry Catasús Jennings

Laurie O'Keefe

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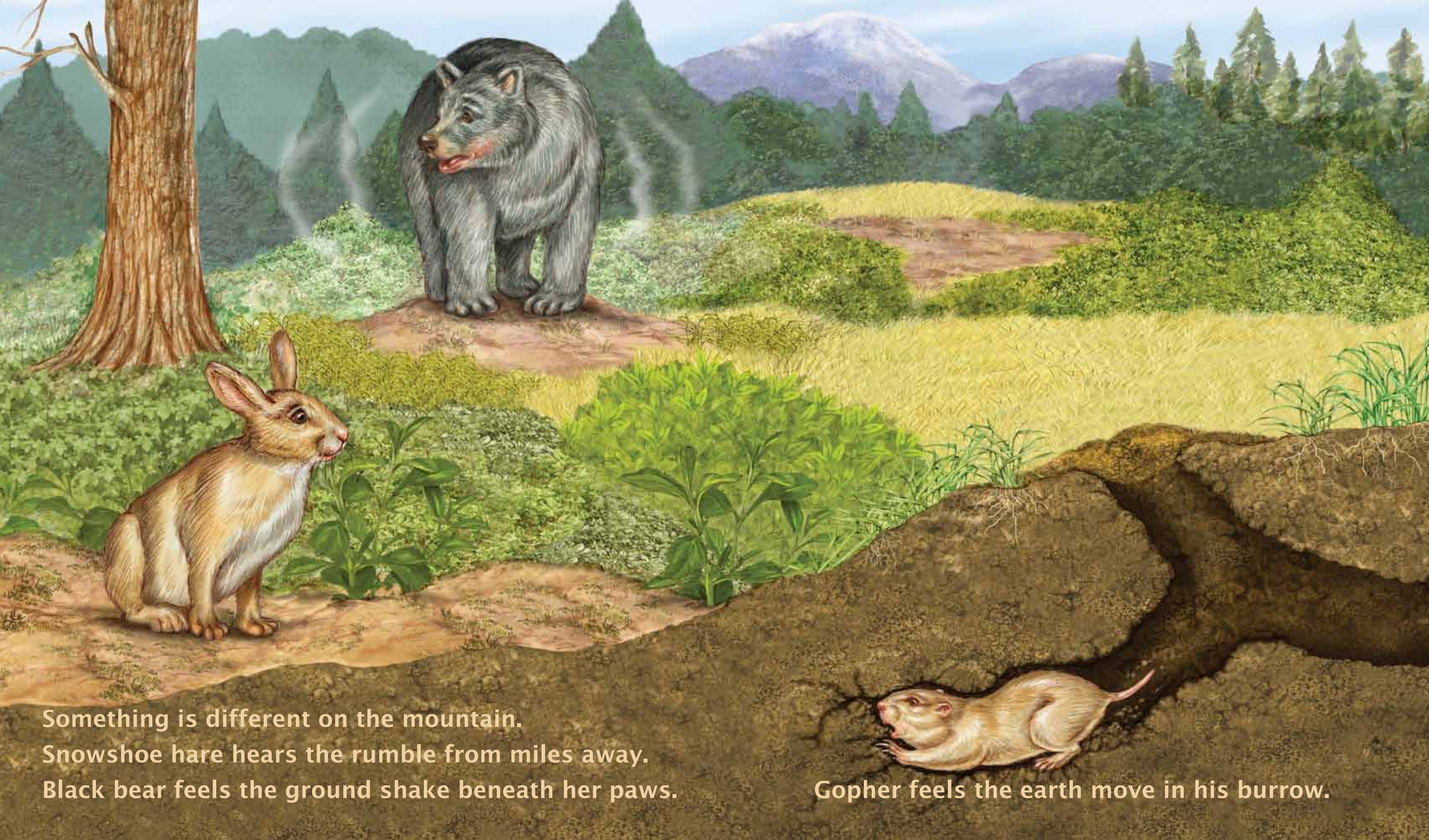


Something is different on the mountain.
Snowshoe hare hears the rumble from miles away.
Black bear feels the ground shake beneath her paws.

Gopher feels the earth move in his burrow.

Steam and ash burst from the top of the mountain. It looks like smoke.

Elk has never seen this before.

Squirrel sees black smudges on the snowy mountain.

The rumblings go on for days. The mountain is changing. A volcano is waking up.

But gopher just digs and digs in his burrow.

Early one morning, the animals feel rumbling and trembling and shaking more terrible than they've ever felt before. They hear a terrible sound.

The top of the mountain slides away. Snow and rock slide down the mountain and into the valley. Then, the mountain explodes!

The blast from the explosion blows down all the trees. The top of the mountain disappears in a cloud of ash and rock. The volcano is erupting!

The animals try to run away.

For Creative Minds

What and Where Are Volcanoes?

A volcano is a vent in the Earth's surface where magma, gases, and ash erupt. It also refers to the landform constructed by erupted material. Erupting lava builds new land but volcanic explosions can destroy the area around them.

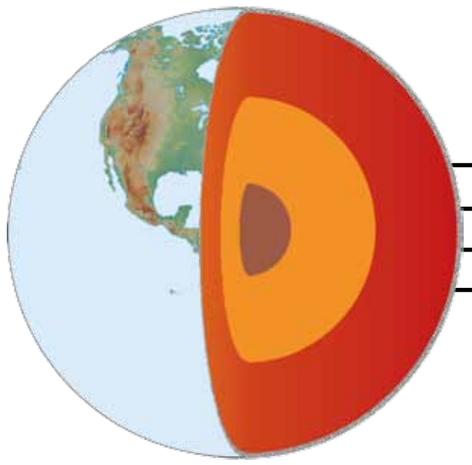
Volcanoes are active (erupting or expected to erupt in the near future), dormant (like sleeping), or extinct (not expected to erupt again).

To understand volcanoes, we have to understand a little bit about the Earth. The Earth is made up of four layers. It might help to imagine the Earth as a kiwi fruit.

The outer layer is the Earth's ***crust*** (represented by the kiwi's skin). It is very thin compared to everything else. If you could dig very deep, you could dig through the crust. But nobody can dig that deep—not even oil drillers or miners.

The next layer is the Earth's ***mantle*** (represented by the kiwi's green flesh). It is a dense, hot layer of semi-solid rock.

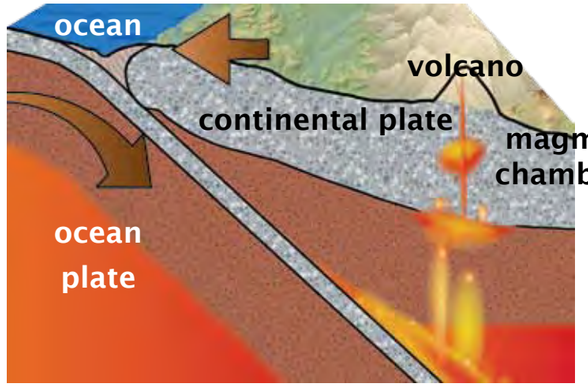
The Earth's two inner layers (called the ***core***) are mostly iron and nickel. The ***inner core*** (represented by the white center of the fruit) is solid. The ***outer core*** (represented by the black seeds) is in between liquid and solid—more like an oatmeal mush (molten).



- The crust is only 5 to 25 miles (8 to 40 km) thick.
- The mantle is about 1800 miles (2900 km) thick.
- The inner core is 770 miles (1250 km) thick.
- The outer core is 1400 miles (2200 km) thick.

TECTONIC PLATES

The Earth's crust and the top part of the mantle are broken into puzzle-like pieces called ***tectonic plates***. These plates glide past, pull away from, or move toward each other.



- Earth's crust
- top (uppermost) part of mantle
- mantle
- water melting rocks/magma

As the cooler and denser ocean plate sinks into the warmer mantle of the continental plate above, temperatures are hot enough to drive water out of the plate.

The water causes part of the mantle to melt—making ***magma***. Since magma is less dense than the rock around it, it moves up—just as a balloon floats up into the air.

As it moves up, it melts the solid rock in the Earth's crust along the way.

The magma pools as a ***magma chamber***. Gases in the magma can cause it to erupt, sometimes explosively!

The red lines show where the plates meet. What do you notice about the location of most volcanoes (shown in circles) and the location o the plates?

There are some areas that are not along plate boundaries where magma erupts at the Earth' surface. These places are called ***hotspots***. As the plate moves over the hotspot, a chain of v not Hawaiian Islands.

Volcanoes also form where two plates pull apa mountain ranges and are called rift volcanoes.

Once magma reaches the Earth's surface, it's called ***lava.***

Most of the world's volcanoes are along plate boundaries, like the boundary around the Pacific Ocean. This area is known as the Ring of Fire.

Natural Disasters and Habitat Changes

Living things rely on the living and non-living things in their habitat to meet their basic needs. Changes in their habitat can affect how their needs are met. Volcanoes, hurricanes, earthquakes, tsunamis, floods, tornadoes, and wildfires are just some of the natural disasters that can change a habitat in a very short time.

Scientists can sometimes warn humans that a natural disaster is coming, but wild animals have to rely on their own senses. Some living things may survive, but not all. How does life return to an area that has been destroyed?

Mount St. Helens in Washington State erupted on May 18, 1980, destroying habitat. Based on past volcanic eruptions, scientists knew that the area around the volcano would eventually recover. They spent years observing and documenting how the area recovered. This information helps us to understand how life returns to any area that has been totally changed or destroyed.

Which came first? Can you put the events in order of how they happened to unscramble the word?

D Once there were enough plants for food and shelter, animals moved in. Eventually meat-eating animals (predators) came back to eat the plant-eating animals (prey).

B The volcano erupted. The force of the explosion blew down trees. Rock and ash covered the land, making it hard for plants to grow.

L Seeds start new plants. Wind carried in seeds from surrounding areas. Visiting animals dropped seeds that were stuck in their fur or deposited when they went to the bathroom. The seeds that fell to the ground either grew into plants or became food for other animals.

I Plants provide food and shelter for animals, but they need water and nutrients to grow. As gopher dug, he softened the ground and mixed the buried soil from his tunnels with the ash, making it easier for plants to grow. Animals visited looking for food to eat. As these animals walked around, they helped break up the ash to uncover the soil.

U A few living things survived the blast. Some young trees and bushes survived buried under snow. Some animals survived in underground burrows—as long as they had food to eat. Some rodents and insects survived in rotten logs. Hibernating frogs, toads, and salamanders survived under the lake's ice.

Answer: build

Hands On: Pressure and Melting

Imagine the weight or pressure of a million rocks sitting on top of you! The deeper into the Earth, the more rocks there are so the more pressure there is. Pressure deep in the magma makes gases (like water vapor and carbon dioxide) dissolve. As the magma rises and pressure decreases, the gasses make bubbles—like those in a can of soda.

What happens when you shake a can or bottle of soda and then open it? *Do this outside and point the soda away from you or other people when you open it.*

When the soda is being made, carbon dioxide (a type of gas) is added with the soda flavor. This gas is what makes the bubbles in the soda you drink. As the can sits, the gas tries to escape from the soda and a small amount usually rises to the top of the can. That's what makes the small popping sound when you open a can. Shaking the can adds energy. That energy separates the gas from the soda water—making tiny bubbles in the liquid. The bubbles increase the pressure inside the can and will explode out of the high-pressure environment into the lower pressure atmosphere as soon as you open the can.

Bubbles of water vapor and other gases in the magma react almost the same way as the soda bubbles. As the gas bubbles push the magma towards the surface, they can expand up to thousands of times their original volume—the eruption!

How can a solid melt into a liquid? Heat. The amount of heat needed and the length of time depends on the solid to be melted.

Place some ice cubes in a microwave-safe bowl. Heat the bowl of ice for 15 seconds. Open the door and look for evidence of melting. If you do not see evidence of melting, heat it for another 15 seconds. Repeat until you see evidence of melting, then stop. Record the time required to show some melting. Now, follow the same procedure with 2 oz. (1/4 cup) of chocolate chips. Did both substances have equal melting times?

Water boils at 212˚F (100˚C). The temperature needed to melt rock depends on the type of rock but ranges from 1300˚F to 2400˚F (700˚C to 1300˚C). Do you think that your microwave could heat a rock until it melts? Why or why not?

Go to the book's homepage at www.ArbordalePublishing.com for more free activities including time-elapsed sequencing using actual photos of the Mount St. Helen's recovery, changing environments, information on how scientists monitor volcanoes, how volcanoes behave, and different types of volcanoes.

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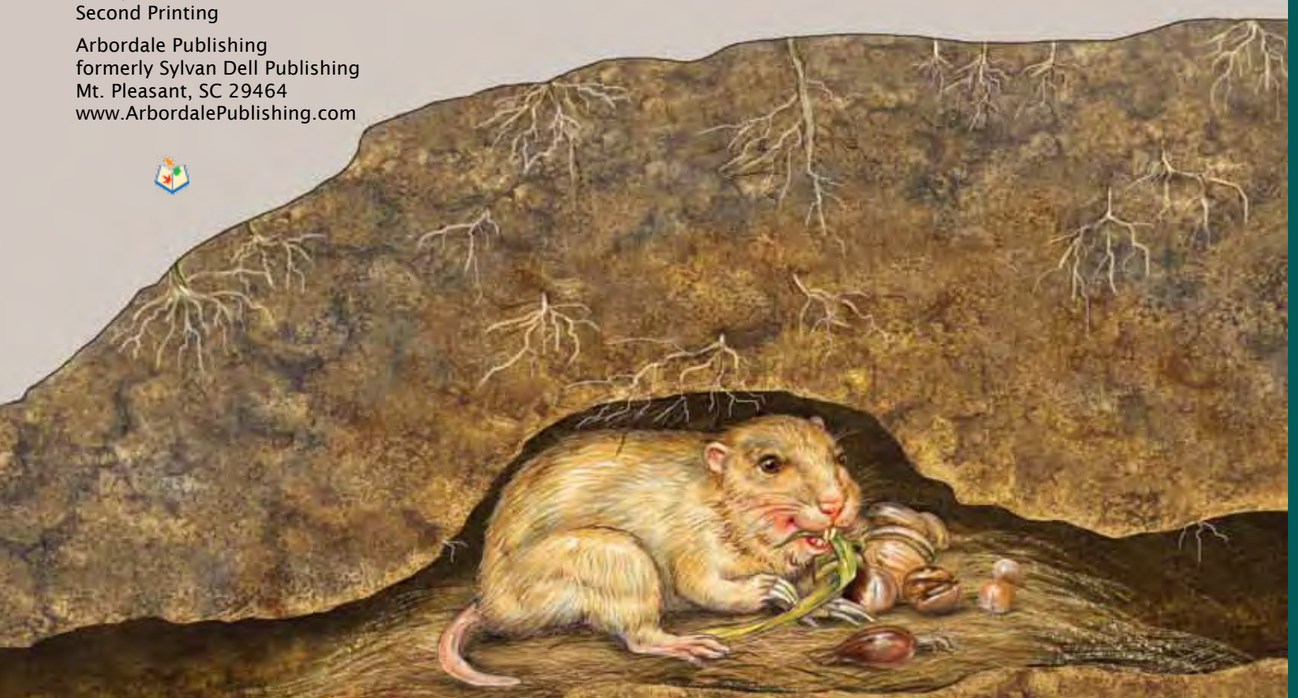

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The gopher's role in providing microhabitats and maintaining soil becomes clear in this personalized story that never misses the science. — *NSTA Recommends*

Full of interesting facts, this picture book introduces youngsters to the eruption on Mount St. Helens. Through the point of view of a gopher that lives on the mountain, readers are told of the effects of the disaster on the habitat of living and nonliving things. — *School Library Journal*

Includes 4 pages of learning activities.

Look for more free activities online at

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