

**Dear Educator:**

Get ready for some amazing adventures. The October issue of EXTREME EXPLORER takes you and your students to some of the most extreme places on Earth.

In “Cool Corals,” you’ll dive deep into some of world’s coldest oceans. See how ongoing scientific discovery is changing what we know about corals. In “Extreme Cuisine,” you’ll travel around the world with National Geographic Explorer-in-Residence Wade Davis to get a taste of some pretty wild foods. Students will learn why such delicacies as wriggling insects are on the menu in many places. It’s a great opportunity for them to take a new look at the foods they eat—and why. In “Kaboom!,” you’ll travel to the foot of an active volcano in Iceland. Find out what’s going on deep inside Earth to cause the eruption, and how it impacts families living nearby, as well as those far away.

After reading the issue, use the **Comprehension Check** on p. T20 to help your students review their understanding of the stories. In addition, don’t forget to check out our Whiteboard Content and new Digital Edition. We’d also love to hear from you about this issue—and what you’d like to see in future issues. By joining our Teacher’s Panel, you can provide valuable feedback and receive a 20% discount to the National Geographic online store. Links to all three are posted under the Teacher Resources column. Just click the For Teacher’s tab on EXTREME’s website.

We can’t wait to hear from you!



Macon Morehouse
Editor, EXTREME EXPLORER

Cool Corals, pp. 2-9**Curriculum: Standards**

- Life Science: Interdependence of organisms; ecosystems; observation; use of science to inform decisions
- Language Arts: Pre-reading strategies; ask questions to deepend understanding; similes

Literacy Skills

- Comprehension Strategy: Ask questions
- Content Literacy: Compare and contrast
- Vocabulary: Develop academic vocabulary; context clues
- Extend the Learning: Critical thinking

Extreme Cuisine, pp. 10-15**Curriculum: Standards**

- Social Studies: Cultural diversity; natural resources; distribution of people, places, and environments
- Health: Nutrition
- Language Arts: Make connections to self and the world; creative writing

Literacy Skills

- Comprehension Strategy: Make connections
- Vocabulary: Develop academic vocabulary; suffixes
- Writing: Journaling

Kaboom!, pp. 16-23**Curriculum: Standards**

- Earth Science: Earth’s structures; geological characteristics; plate tectonics; natural disasters
- Language Arts: Synthesize text and form generalizations; vivid verbs

Literacy Skills

- Comprehension Strategy: Form generalizations
- Vocabulary: Develop academic vocabulary
- Content Literacy: Read a diagram
- Writing: Dialogue
- Engage students: Map active volcanoes



COOL CORALS

About the Story

In "Cool Corals," students will discover how scientific observation can change what we know about our world. Marine scientists once thought that most corals needed warm, shallow, sunny water to survive. So imagine their surprise when they dove into some of the deepest, darkest, coldest seas and found corals and coral habitats so abundant and colorful they rival better-known tropical reefs.

The story takes students into the icy, cold fjords of Chile and deep into the Gulf of Alaska to see some of these vibrant coral communities. Students will learn about tiny animals called coral polyps that build corals. They will compare and contrast the corals that grow in warm waters versus cold waters. And they will see how scientists are using the discovery of cold-water corals to protect parts of our oceans.

Before Reading

Preview-Predict-Question Direct students to preview the story looking for pieces of information that will help prepare them for reading. Explain that pictures, captions and headings provide clues about the story's content. Use the Before Reading activity, p. T14, to guide their preview. (Answers will vary.)

When finished, allow time to have volunteers share responses. Display the questions students want answered in the story. Later, check back to find out if they were answered. If not, guide students to other resources where their answers can be found, such as:

- <http://na.oceana.org/en/our-work/protect-marine-wildlife/corals/overview>
- http://www.unep.org/cold_water_reefs/comparison.htm
- <http://assets.panda.org/downloads/cwcbrochure.pdf>
- <http://coris.noaa.gov/about/deep/>

Comprehension Strategy

Ask Questions Tell students that thinking about the text, clarifying understandings, developing questions, and predicting answers are all part of critical reading. Before reading, write the following four directives, each on a separate slip of paper: **SIMPLIFY**, **QUESTION**, **SUM UP**, **GUESS**. Fold the slips and place them in a container. As students read in pairs or small groups, have them stop at the end of each section and take turns pulling out a slip and following the directive on it. Explain what they should do with each slip.

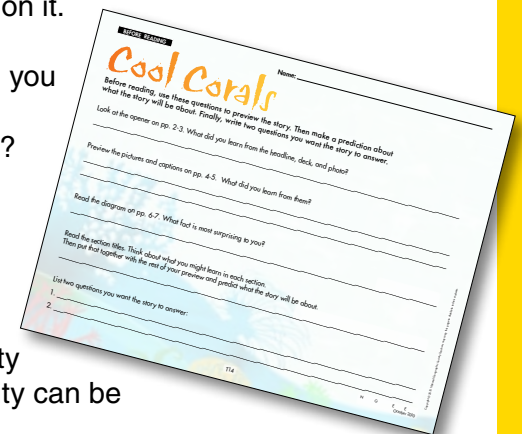
SIMPLIFY: Are any ideas confusing? What do you think the author meant?

QUESTION: What new questions do you have?

SUM UP: What are the the important facts? What is the main idea?

GUESS: Read the title of the next section. Guess what it will be about.

When finished, ask students how this activity helped them understand the text. This activity can be repeated for other stories, if desired.



Splash! Eduardo Sorensen leaps from the boat. He and three other divers slide under the icy waters off the coast of Chile.

Cold seeps through his dive suit. Yet he goes deeper. At 35 meters (115 feet) below the surface, his flashlight barely lights up the murky water. Does anything live here?

Suddenly, he spots a flash of color. He swims closer. He can't believe his eyes! Bright red corals sprout from rock walls. Tiny animals called coral polyps wave their rosy tentacles. Feathery yellow sea pen corals sway gently.

Everyone should see this, Sorensen thinks. Snap! He takes a photo. Snap, snap! He takes another, and another.

Thousands of kilometers north, Jon Warrenchuk is in a boat far out in the Gulf of Alaska. He climbs into a small submarine. It dives for an hour until it reaches an underwater mountain. This seamount is 2,000 meters (6,500 feet) deep.

The marine scientist looks out the sub's window. He's stunned. He sees a forest of red bubblegum tree corals. It stretches on and on. Then he spots live bamboo corals for the first time. Dead ones look like white skeleton hands. These don't. They're orange. Tentacles ring the base like a hula skirt!

Sunny and Warm

Why are these finds in Chile and Alaska so surprising? Scientists once thought corals mostly grew in warm, shallow water.

The Great Barrier Reef in Australia is a perfect example. There, sun lights up endless hills of pink, purple, and yellow corals. A wrinkly one looks just like a giant human brain! Colorful fish swim by.

Diving Deep

Now imagine the deep, dark ocean. What do you see? If you're like many people, you may think, "Not much!"

Well, think again. Divers and submarines are exploring the oceans' deepest, darkest, and coldest spots. In many places, they're finding colorful corals.

These discoveries keep changing what we know about corals. It turns out some corals can grow in waters as chilly as -1° Celsius (30° Fahrenheit). They can survive in the dark and the deep. From pole to pole, they live in every ocean on Earth. It turns out that more corals may grow in cold, dark seas than in warm, tropical waters.

4. NATIONAL GEOGRAPHIC EXTREME EXPLORER



Cold-water coral habitats exist in all the seas. Dead ones' feathery tentacles and stony structures form a forest in this one in Norway.

It's cold above water, too, for the team looking for corals in Chile.

Academic Vocabulary

Display these academic vocabulary words: **coral reef**, **coral polyp**, and **symbiotic relationship**. Tell students it is helpful to have an idea what new words mean before reading them in the story. Invite volunteers to read aloud the definitions listed in Wordwise, p. 8. Then have students add these words to their **Academic Vocabulary Log**.

Context Clues Explain that when students come across a difficult word, one way they can figure out its meaning is to look for clues in the nearby text. One option is to look for a restatement clue, or when the author says the same thing but in a different way. Direct students to the first paragraph on p. 6 and challenge them to find the context clues for the word *invertebrate*. ("They have no backbone. They have no bones in them at all.") An author also may signal a restatement with such words as *or*, *called*, or *are*. Repeat the process for *algae*, *plankton* (p. 7), and *trawling* (p. 8).

Explore Science

Use a world map to help students understand the diverse locations where corals are found. Invite a student to locate Chile on the map. (Note: The dives took place near Tortel, in the fjords toward the southern end of Chile.) Point out that the water is cold in this area. Then have a student find the Gulf of Alaska. Ask: *How were these two areas explored by marine scientists?* (Divers explored in Chile; in Alaska, a small submarine was used.)

Then have a student find the Great Barrier Reef off of Australia. Note that this coral reef is located in warm, shallow water.

Finally, have a student find the Equator. Ask them to compare these three locations' proximity to the Equator. Ask how that might affect water temperature. (It is hotter near the Equator than farther away, so the shallow parts of the oceans are warmer near the Equator.)

Ask: *Why do you think scientists have just started finding out so much about cold-water corals?* (These places are hard to explore.)

Ask students to describe what Sorensen and Warrenchuk saw in their cool water explorations. What did the corals look like? (Possible answers: bright red corals, coral polyps with rosy tentacles, feathery yellow sea pen corals, red bubblegum tree corals, bamboo corals, etc.) Ask: *Why do you think some corals are given names like red bubblegum tree or bamboo corals?* (Students may infer that the corals look like these more familiar objects.)

Comprehension Quick Check

What parts of the world are cool corals found? (in every ocean on Earth; in the deep, dark, and cold parts of the oceans)

How are these areas explored by marine scientists? (by diving or the use of small submarines)

Master Builders
No matter where they grow, all corals start with polyps. These soft animals are invertebrates. They have no backbone. They have no bones inside them at all. Polyps are a lot like jellyfish. They have clear bodies and tentacles. Unlike jellyfish, though, they don't float from place to place. Polyps find something to stick to. Rocks are good. So are shipwrecks. Thousands of polyps often cluster. They form colonies. Some polyp species build a hard outer skeleton around themselves. When one dies, another young polyp builds on top of it. Layer by layer, they can build coral reefs. A reef can be as small as a schoolyard—or as big as a city. Other kinds of polyps grow soft outsiders. These colonies might look like feathers or fans. They sway in the current. cluster group

Home Sweet Home
What makes cold-water corals different? Start with the shapes they build. Only a few build reefs. Most do not. They build habitats that look more like forests or underwater gardens. They grow in different places, too. Warm-water coral polyps can die if water temperatures dip below 20°C (68°F). So you need to head toward the Equator to find them. Most cold-water corals live in waters from 4°C to 13°C (39°F to 55°F). Some grow in cold parts of the world. Others grow in the cold, deep parts of all the oceans. Even in the warm tropics, the deeper you dive, the colder it gets. So if you're looking for these corals, bundle up. In Chile, divers swim through melted water from a glacier. The water is only 7°C (44°F). In Alaska, Warrenchuk wears fuzzy slippers to stay warm in the sub.

What's For Dinner?
Where a polyp lives affects what it eats. In warm, sunny seas, many polyps have personal chefs. They're algae, or tiny plants. First, a polyp gobbles the algae. It doesn't digest the plants, though. The algae move into the polyp's tentacles. In their new home, the algae turn sunlight into food and oxygen. The algae feed the polyp. This **symbiotic relationship** helps both organisms survive. Cold-water polyps don't have this handy helper. Most live in the dark. There's no sunlight. So there are no algae. These polyps must catch everything they eat. That means they need to grow near a strong current. The fast flowing water is full of tiny animals called plankton. In Alaska, Warrenchuk sees a polyp pop out of its home. It stretches out its tentacles and snags passing plankton. As he watches, the polyp sweeps the meal into its mouth.

A Coral Polyp
tentacles
mouth
stomach
skeleton

Compare the polyp parts in the diagram to the photo of coral polyps. What parts do you see?

Coral in Chile
Great Barrier Reef, Australia

Cool Corals	Warm Corals
<ul style="list-style-type: none"> Live in cold water from 4°-13° Celsius Grow 40 to 1,000+ meters below the surface of the ocean Grow very slowly, 4 to 25 millimeters per year Found in all oceans 	<ul style="list-style-type: none"> Live in warm water from 20°-29° Celsius Grow 0 to 100 meters below the surface of the ocean Can grow quickly, up to 150 millimeters per year Found only in tropical and subtropical oceans

Explore Science

Pair students. Have them read “Master Builders” on p. 6 to themselves, then turn to their partner and take turns explaining how a coral reef forms.

Distribute the Venn Diagram activity on p. T15. Ask students to use the information in the text and the chart on pp. 6-7 to fill in the ovals. Explain they are looking for characteristics that are unique to cold-water and warm-water corals, as well as ones they share.

Point to the boldface words on p. 7. Remind them of the Wordwise definition of **symbiotic relationship**. Then ask volunteers how coral polyps and algae each benefit from their relationship. (Polyps get food; algae get a home.) This kind of a symbiotic relationship is called **mutualism**. Challenge students to think of other symbiotic relationships. (Examples: plant and pollinator such as a bee; oxpecker and zebra; some bacteria and humans.)

Engage Students

Research: Interested students may want to continue researching cold-water corals. Alone or in pairs, ask students to come up with one question they want to answer, such as: Do any cold-water corals grow near where I live? What is the deepest coral ever found? Encourage students to use such resources as the Internet sources cited on p. T2 or their local aquarium to find answers.

Deep Sea Diorama: Have students create a diorama that depicts the features one would find in a cold-water coral habitat. Use various materials to create the contents. Allow students to present their underwater world and describe it to the class.

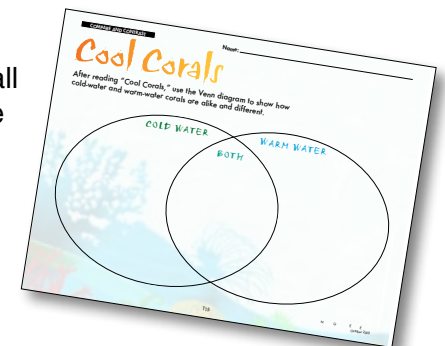
Fast Facts

- The world's largest known cold-water coral complex was discovered in May 2002 off Norway, inside the Arctic Circle. It is about 40 kilometers (25 miles) long and 3 kilometers (1.9 miles) wide.
- Some cold-water corals recently discovered near Hawaii have living polyps that are more than 4,000 years old.

Comprehension Quick Check

What are coral polyps? (Coral polyps are small sea animals. They are invertebrates—they have no bones—but they can form hard or soft outer skeletons.)

Why are coral polyps important to a reef? (They build the reef. Polyps with hard outsides build on top of each other, creating a reef.)



Full of Life

There's plenty of other action among the cold-water corals, too. In Alaska, the sun's light shines on a pink bubblegum tree coral. Hundreds of eyes stare back. They belong to baby shrimps! The shrimps have found a great place to hide from predators. In Chile, a basket star curls its arms around corals. It sucks polyps right out of their skeletons! A baby king crab crawls by. Tiny chirps and clicks of fish and shrimps break the deep-water silence. "Wherever you look, it's full of life," Sorensen says.

Danger Zone

Not all cold-water corals are so lucky. Just west of the Gulf of Alaska, a sub descends to the Pacific Ocean floor. Its video camera captures a sad scene. Broken coral skeletons litter the seafloor. Few still stand.

What's to blame? It's a kind of deep-sea fishing called trawling. Fishermen use giant nets. The nets can weigh as much as 2,700 kilograms (5,000 pounds). They sink deep into the water. Then the fishing boats drag the nets across the seafloor. The nets crush everything in their path.

In Chile, fish farming puts corals at risk. Farmers raise fish in holding pens built in the water. Fish food and waste pollutes the water. This pollution can kill corals.

The corals in the Gulf of Mexico face a different danger. Earlier this year, millions of gallons of oil spilled out of a broken oil rig there. Oil hurts birds, fish, and other sea life in the Gulf.

spilled: poured

Slow Growers

Did the oil smother corals in the Gulf of Mexico? Did it poison them? No one knows. Scientists do know that damaged corals take a long time to grow back. All corals are slow growers. Cold-water corals grow less than an inch a year on average.

So scientists are trying to protect the corals and other animals that live in these habitats. What? Warrenchuk takes a video of that forest of bubblegum tree corals in Alaska. Snap! Sorensen gets a photo of a silvery anemone in Chile. It has long, flowing tentacles.

Photo after amazing photo documents these undersea worlds. Will they help save them? Maybe. In 2006, the United States government banned trawling in some places near Alaska. In Chile, a group called Oceana is using Sorensen's photos. They hope to stop new fish farms.

It's a start. Yet there's more work left. The oceans have barely been explored. Scientists expect to find cold-water corals growing in many more places around the world. So there will be new, amazing sights to see. There will be new places to protect.

Learn how you can protect the oceans at ocean.nationalgeographic.com.

Wordwise

coral reef: rock-like structure built by tiny sea animals called coral polyps.

coral polyp: sea animal that builds corals.

symbiotic relationship: when two different organisms depend on each other to survive.



Snap! A basket star spreads its many arms around sea whip corals in Chile.

Snap! This pink anemone grows near cool corals in Chile.

Snap! A photographer spots giant sea anemones on a dive near Chile.

Extend the Learning

Interview Scientists: Tell students that they have been invited to attend a National Geographic Symposium on deep-water habitats. A panel of marine biologists will be there to answer questions about the history and future of ocean life. Each student must prepare three to five questions they want answered. Allow students to read their questions aloud. As an added challenge, have students find answers to the questions. Then reconvene the symposium and ask some volunteers to role-play the scientists and provide the answers. Encourage them to respond as if they had been on an expedition to see these habitats. To encourage descriptive responses, remind students of the experiences of photographer Eduardo Sorensen and marine scientist Jon Warrenchuk as described in "Cool Corals."

Similes: Tell students that vivid language helps make stories interesting. In this story the author uses similes to compare two things. The comparisons help readers visualize what is being described. Often, the words *like* or *as* signal the comparison. Display the example: "Tentacles ring the base like a hula skirt." Ask students what they "see" when they read that sentence. Then have students look back through the story to find several other similes. (Answers may include: "Dead ones look like skeleton hands." "A wrinkly one looks just like a giant human brain!" "They build habitats that look more like forests or underwater gardens.")

Photojournalism: Explain to students that photojournalism is a way that reporters tell a story using pictures. Point to the example of Sorensen's photos. Have students think about what they learned in this story and decide what photos would re-tell the story best. As a class have students decide how they can present a photo story with pictures they draw, design, or find in magazines or on Internet sites. Each student can be responsible for one or two "photos." Use them to create a chronological sequence that works best. Find a place to display for others to view.

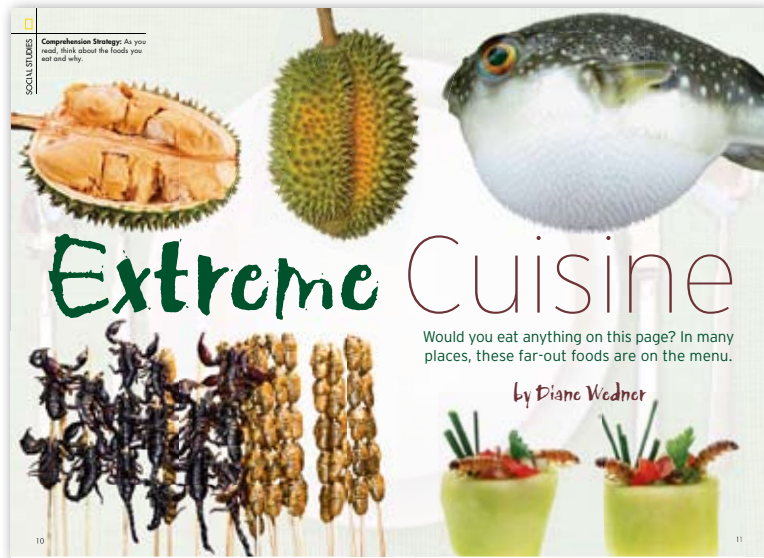
National Geographic Connections

Learn more about our oceans and efforts to protect them and the organisms that live in them at <http://ocean.nationalgeographic.com>.

Explore Science

Have students consider the threats to corals as explained in the story. Ask: *What does trawling do to corals?* (Heavy fishing nets drag across the seafloor, crushing everything in their path.) *How might fish farming affect coral habitats?* (Fish food and waste can pollute the water where corals live. The water becomes too toxic for corals to survive.)

Then remind students of the recent oil spill in the Gulf of Mexico. Ask: *How could the oil harm corals?* (The oil may sink to the seafloor and smother or poison corals. Scientists are studying the Gulf to find answers.) Use the Layers of Life poster that accompanies this teacher's edition, plus the Teacher's Guide for the poster on p. T13, to explore these ideas more deeply.



Extreme Cuisine

About the Story

Would you eat wriggling insects? How about fruit that smells like garbage or a fish so poisonous, just a pinch could kill 30 adults? In “Extreme Cuisine,” your students will learn why these and other wild foods are on the menu in many places.

With National Geographic Explorer-in-Residence Wade Davis as their guide, they’ll travel around the world to discover what people eat. They’ll see how nutrition, availability of natural resources, and cultural traditions impact people’s decisions when it comes to what they eat. They’ll also discover why Davis, an anthropologist, thinks it’s important to keep an open mind when it comes to trying new foods. Finally, students will make connections with their own lives as they think about what they eat, and why.

Before Reading

Preview—Skimming As students look at the title page of this story, read aloud the deck. Ask students to look at each photo and give a thumbs up or thumbs down if they would try eating it. Then have student pairs skim “Extreme Cuisine” to further familiarize themselves with what they will be reading about. Point out that students should look at pictures, captions, and titles of each section. As students skim the story, ask them to write down three things they are interested in learning more about. Take students responses and display a few of the topics students found interesting.

Comprehension Strategy

Make Connections Tell students that what they read can remind them of something else they read, saw, or experienced in their own lives. Tell them that when they make those kinds of connections, it helps them understand and remember what the text is saying. Further explain that when they bring their own experiences to their reading, they are linking their lives with the author’s story.

Tell students that “Extreme Cuisine” is about different foods people around the world eat. Ask them if they have eaten any of the foods described in the story. Then ask: *Think of two foods you have eaten that others may think are extreme to eat.* Invite students to share their responses, including why others might think the food is extreme.

Distribute the Make Connections activity on p. T16. After reading, ask students to write in the first column five interesting things they learned in the story. In the second column, ask them to write down how each item connects to their own experiences. For instance, if a student writes about the smell of the durian fruit, he or she might connect that experience to a time he or she tried a food that they thought smelled bad.

Wade Davis will eat just about anything. That gung'ho approach to life really comes in handy for this National Geographic explorer. Take one time he went to Colombia. He hiked deep into the rain forest. The local people welcomed him into their village. They offered him a treat. It was insects from a fresh termite mound. Yum? Why not? Davis joined a group of running and laughing children. Together, they chased the crawling insect snacks. Davis grabbed a fingertip-size bug. He popped it in his mouth. It squirmed on his tongue.

"Please don't crawl down my throat!" he thought. He bit down quickly. Juice squirted out. Gulp! Davis swallowed the crunchy critter. It tasted like a mix of lemon and bacon. "I didn't feel it for a second!" he says.

For Davis, the termite was more than a tasty treat. He's an **anthropologist**. That's a scientist who studies people and cultures. Sharing food helps him make friends with strangers. It helps him learn about different people and how they live.

Sweet Snack
You may think insects are gross. Yet people all over the world eat them. Why? Like those lemony termites, they taste good to many people.

The sweetest may be honey ants. These ants eat nectar and other insects. They turn their food into a juice called honeydew. The ants store the sugary juice in their abdomens. They swell like grapes. The stored food feeds the ant colony. The Aboriginal people in Australia like them, too. They catch the ants. Then they bite off the "honey pot" and sip the juice. Sweet!

How many licks does it take to get to the cricket in this lollipop?

In China, shoppers can buy bug snacks like these brown silkworm pupa on a stick.

Insects are more than a sweet treat, though. They're also **nutritious**. Many are high in protein. That helps build muscles. People also need vitamins and minerals. Insects are a great source of those, too. Take those juicy termites Davis ate. They're high in magnesium. That's a mineral that helps muscles, nerves, hearts, and bones work.

The back-end of this honey ant is full of a sweet juice.

Bug Bounty
Bugs have another advantage. There are lots of them. For each human on Earth, there are hundreds of millions of insects! They live just about everywhere. If you're hungry, you can probably find an insect nearby.

Many insects live in big groups. In rain forests, eight million leaf-cutter ants can live in a single nest. Finding a nest is like going to a grocery store to shop for insects.

Today, insects are part of **traditional diets** throughout much of the world. You don't even have to go to remote places like a rain forest to find bugs on the menu. In Mexico, you can buy grasshoppers by the bag. Just roast and wrap in a tortilla.

Go to the movies in South America. The snack bar might serve roasted ants instead of popcorn. Wander through a market in Thailand. You'll find bins of deep-fried silkworms and water bugs. A handful makes a perfect snack.

Even if you haven't been to these places, you may have eaten bugs, too. You may not have done it on purpose, though. Bug bits end up in such processed foods as chocolate and peanut butter. In the United States, an average person eats about half a kilogram (a pound) of insects a year. Don't worry. They can be good for you!

Davis has tried many creepy-crawly critters besides termites. He admits he isn't **crazy** about all of them. "I tried to eat slugs," he says. "They tasted terrible!"

crazy: excited

Explore Social Studies

Start a discussion about the role food and meals play in our lives (family time, celebrations, bringing communities together). Ask: *How do we use food and meals for special occasions?* (Answers may include: weddings, funerals, birthday parties, church pot-luck dinners, holidays such as Thanksgiving, etc.) Explain that food is a tradition common to all cultures. However, from culture to culture, traditional foods can vary.

Tell students that anthropologists who study people may share meals as a way to get to know people and their cultures better. Ask students why they think meal times are a good way to get to know other people. Say: *If an anthropologist wanted to understand the culture of middle-school students, what could he/she learn by eating lunch with you?* (Answers may include: the foods students eat, things they like to talk about, clothes they wear, hairstyles, unique language or slang that is used, etc.)

Point out that in order to stay healthy, whatever foods people eat must be nutritious. Diets should be balanced with foods from all food groups. As a quick review, ask students to list the basic food groups. (dairy, eggs and meat, fruits and vegetables, nuts and beans, grains) Ask students: *What food group do insects belong to?* (eggs and meat) *Why are insects nutritious?* (answers may include: They are high in protein which builds muscle; some like termites are high in magnesium, which is good for muscles, nerves, hearts, and bones.)

Finally, ask a volunteer to read aloud the first paragraph under the section "Bug Bounty" on p. 13. Explain that, in this case, insects are a natural resource. A natural resource is something that occurs in nature and is useful to people. Ask students to brainstorm other natural resources we use, and how we use them. Examples: wood (to build houses), water (to drink), or oil (to run our cars). Explain that different cultures use different natural resources.

Comprehension Quick Check

Why do people eat insects?

(They are plentiful. Many people think they taste good. They are nutritious, with proteins, vitamins, and minerals we need to stay healthy.)

Academic Vocabulary

Display **anthropologist**, **culture**, **nutritious**, and **traditional diet**. Ask: *Do you have ideas about what these words mean?* Accept student responses, then clarify by inviting a volunteer to read the definitions on p. 15. Have students add these words to their **Academic Vocabulary Log**.

Suffixes Circle *-ist* in the word *anthropologist*. Explain that some words have endings, or suffixes, that can help readers figure out what they mean. For example, *-ist* means a kind of person. So *anthropologist* means someone involved in anthropology. Other examples include *florist* (someone who works with flowers) and *dentist* (someone who works with teeth.)

Then circle *-ous* in nutritious. Explain that the suffix *-ous* means "full of." So nutritious means "full of nutrition." Other examples: *hazardous*, *famous*.



Explore Science

Ask: *How do smells affect what we decide to eat?* Explain that our sense of smell is part of our sense of taste. In fact, up to 75% percent of what we perceive as taste actually comes from a food's odor. Our taste buds just detect sweet, sour, salty, and bitter flavors. To test this theory, bring in a variety of finger foods. Ask students to close their eyes and hold their nose while trying the foods. Ask if they can identify what they are eating.

Ask how that knowledge might affect their willingness to try durian, a fruit famous for its stink. **Ask:** *What other foods can you think of that smell really bad or really good?* Create a T-chart with student responses. Remind students that people have different senses of smell, so something that smells bad to one person might smell good to another.

Extend the Learning

Email: Have students write an email to a friend about the story. Tell them to think about what stood out and the important ideas they want to share. Also ask them to include any thoughts they had about their own diets as they read the story. Students can draft their email or letter on paper and send it later.

Food and Culture: Explain to students that many types of foods are associated with different cultures, ethnic groups, traditions, and celebrations. Food becomes part of a family's history. Distribute the family food activity on p. T17. Tell students that the questions will help them learn about their own family food traditions. When finished, ask volunteers to share a special food that their family eats. Note: Students may need to gather some information from family members to complete this page.

Traveler's Food Diary: Tell students to pick a country and research foods associated with it. Then ask them to imagine they are traveling through that country, trying all sorts of foods. Ask them to create a traveler's food diary. Entries may include names of cities visited, descriptions of sights the traveler may see, as well as any food adventures. Diaries should cover a five-day trip.

Fast Facts

- Kimchee is a cultural staple in Korea. It is a spicy fermented cabbage dish that smells like garbage to many people.
- Yup'ik natives of Alaska's Bering Sea coast enjoy "stinkheads," or salmon heads that have spent the summer buried in the ground.

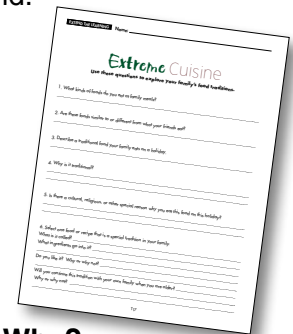
National Geographic Connections

Anthropologist Wade Davis is a National Geographic Explorer-in-Residence. Go to National Geographic's website to learn more about him and his work:
<http://www.nationalgeographic.com/field/explorers/wade-davis.html>

Comprehension Quick Check

Which food would you try: durian, manioc, or fugu? Why?

Answers will vary; tell students to use details from the story to explain why.





Kaboom!

About the Story

Iceland's now famous volcano Eyjafjallajökull, startled Iceland residents and people around the world when it awakened explosively in April 2010. In this story, readers will get a glimpse of what it was like for one family that lives just eight kilometers (five miles) from this erupting volcano. From the middle-of-the-night "Get out!" call to efforts to recover, students will learn first-hand about the fears, challenges, and effects of a natural disaster. They'll also see how a natural disaster in one place can affect people across the planet. In addition, "Kaboom!" takes students deep into Earth to learn why Eyja erupted and why it—or something even more explosive—could happen again.

Before Reading

Build Background Knowledge Display the word *volcano*. Explain to students that thinking about a topic before they read will increase their understanding as they move through the text. Have students do a two-minute quick write, jotting down all the words they can think of that have something to do with a volcano. If needed, display photos of volcanoes for the students. After two minutes is up, have students work with a partner and compare their lists.

Have each pair create a Venn Diagram. Have each student label one of the ovals with their name. Then ask them to place the words they came up with in their own oval. Words that both of them came up with should be in the overlapping section of the ovals. Invite student volunteers to read their shared words. Display these words and tell students to watch for them as they read. Have students circle words on the list that show up in the story.

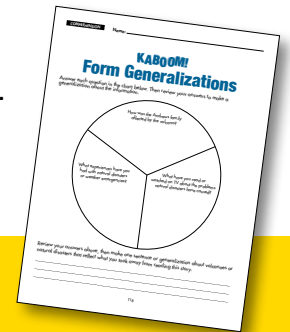
Comprehension Strategy

Synthesize and Form Generalizations Explain to students that when we read, it is important to "put it all together." When a reader combines ideas from the story with their own personal knowledge, they create new understandings. This process can be applied to many situations. We call these generalizations.

Before reading "Kaboom!" ask: *What do people usually think when the phone rings in the middle of the night?* Lead students to use what they know or have experienced to make a generalization that a phone call late at night could mean something is wrong. Then tell students to use the steps below to help them pull the information together and make generalizations as they read:

1. Ask yourself: How does the volcano affect the Andrews family?
2. How do the events and ideas fit together? Use your own experiences with natural disasters or knowledge to imagine what it was like to be near the erupting volcano.
3. Put it all together to come up with one statement, a generalization, about the impact of natural disasters.

Use the Form Generalizations activity on p. T18 to further help students synthesize the information.



The night was quiet. In Iceland, Hanna Lara Andrews and her family slept soundly inside their farmhouse. Suddenly, the phone rang. It was 2 a.m. "Get out!" a government official yelled. The nearby volcano was erupting. Andrews grabbed her baby son. She and her family raced to the car.

Active Earth
A fountain of fire gushed from the volcano's top. Ribbons of lava oozed down its steep sides. Gritty ash shot into the sky. All of this action came from deep inside Earth. What caused it? To understand, start with the top layer of Earth, the **crust**. That's the ground. It feels solid. Yet compared to the rest of Earth, it's really thin like an eggshell. The crust is always **shifting**, too. That's because it's broken into giant pieces called **tectonic plates**.

Deep Heat
The **mantle** lies under the crust. This layer is really hot. The heat melts rock. This **magma** flows like molasses inside Earth. The tectonic plates float on this hot rock. In some places, they bump into each other. In other places, they scrape against each other. Iceland sits on two plates. Here, they pull away from each other. This plate action causes earthquakes. It builds mountains—and volcanoes. A volcano can look like a mountain. As pressure in the mantle grows, magma boils up. It rises through a vent, or channel, inside the volcano. When it gets to the top, the volcano erupts. Lava flows. It can destroy everything in its path.

Lava and Floods
Andrews wasn't worried about the lava, though. She feared flooding. That may sound strange, but here's why. The Icelandic name of this volcano is "Eyjafjallajökull," or Eyja, for short. Its name can be broken down into three parts. In English, they mean "island," "mountain," and "glacier." That describes Eyja perfectly! A thick glacier covers this volcano. In places, the ice is 200 meters (650 feet) thick. That's where the eruption started. The heat from the magma quickly melted the ice. Would it turn into a raging river racing toward Andrews' nearby farm?

Thin-skinned
If Earth were the size of an apple, its crust would be about as thick as the apple's skin.

Crust At its thickest, the crust is only 70 kilometers (43 miles) thick.

Mantle Magma rises from the mantle. This part of Earth is 2,900 kilometers (1,800 miles) deep.

Core Liquid metal in the outer core reaches 3704° C (6,700° F). The inner core is solid metal.

shifting; moving

18 NATIONAL GEOGRAPHIC EXTREME EXPLORER

Academic Vocabulary

Create and display a semantic map using the academic vocabulary words from Wordwise on p. 23. First, display the word *volcano* in the center. Then add the seven Wordwise words on spokes around it: **crust**, **dormant**, **lava**, **magma**, **mantle**, **tectonic plate**, and **vent**.

Use guided discussion to help students brainstorm related words or phrases that are associated with each word and add to the map. Example: *crust*: Earth, mountains, deserts, oceans, surface, etc.

Next, ask students why they might expect to see these words in a story about volcanoes.

Finally, have students add these words to their **Academic Vocabulary Log** and complete the appropriate columns. If you have a **Word Wall**, add these words for students to use in future activities.

Explore Science

Direct students to study the photo and diagram on p. 19. Tell students to think of the Earth as being a hard-boiled egg. As you read aloud the information for each layer, suggest students think of the core as the yolk, the mantle as the white part of the egg, and the crust as the shell. Further point out that the Earth's crust is broken into big pieces called tectonic plates. The plates float on the mantle and, when they shift or move, we can experience earthquakes and volcanic eruptions.

Use two paper plates or like items to demonstrate how plates can move. Explain that volcanoes occur along boundaries of two plates. Using the paper plates, explain that where the two plates touch each other is a boundary. Tell students that there are different kinds of boundaries. In some places, the plates crash against each other. That action can push up mountains. In other places, they grind against each other. That can cause earthquakes. In Iceland, the plates are pulling apart. This is what scientists call a divergent boundary. The action creates a way for magma to rise to the crust, or surface.

Fast Facts

- Volcano comes from the name of Vulcan, a god of fire in Roman mythology.
- Ninety percent of Earth's volcanoes are in the Ring of Fire along the edges of the Pacific Ocean.
- In the September issue of EXTREME EXPLORER, we learned the tallest volcano in the solar system is on Mars. On Earth, the two tallest volcanoes are in Hawaii.
- Volcanoes can provide valuable mineral deposits, fertile soil, and geothermal energy.

Comprehension Strategy

How can a volcanic eruption cause a flood?

In some places, volcanoes lie under glaciers. The heat from the magma melts the glacier's ice, causing floods.



A Sleeping Giant Wakes

Andrews had raised cows and crops on her farm for years. She hadn't worried about the volcano, although it was only eight kilometers (five miles) away. Eyja wasn't active. It had never caused trouble before. Eyja wasn't extinct, either, though. Extinct volcanoes are ones that erupted long ago. Then they stopped. They will never erupt again.

People thought Eyja was dormant, or sleeping. It last erupted in 1821. Yet, as Andrews quickly learned, it can be hard to predict what volcanoes will do.

The eruption turned her life upside down. She had to leave everything behind at the farm. She worried about her 60 dairy cows. The 1821 eruption lasted more than a year. Would this one? The cows could not wait that long to be milked.

In the Thick of It

All Andrews and her neighbors could do was wait in a safe place. Even from there, they felt and saw the power of Eyja.

The volcano rumbled. Gritty particles of rock, glass, and sand inside the ash cloud smashed into each other. The friction caused charges of static electricity to build, like in a storm cloud. Lightning flashed!

An unpleasant smell filled the air. Was it rotting seaweed? Rotten eggs? The stench burned their noses. Then they saw the plume of ash. They understood.

The eruption sent ash and foul-smelling gases such as sulfur dioxide into the air. Within a day, the plume rose 11 kilometers (seven miles) high. Air currents carried it over parts of Iceland and beyond. Andrews had a second worry now. Breathing in ash could sicken people and animals.

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Explore Science

Point out to students that although scientists are learning ways to better predict when a volcano may erupt, there can be surprises. Say: *The volcano in this story last erupted in 1821. How many years ago was that?* (189 years)

Next, ask students if they ever saw a spark or felt a shock after shuffling their feet across a carpet. Explain that this is an example of static electricity. So is volcano lightning—but on a much bigger scale. As particles blast out of the volcano, they crash into each other. These collisions result in a massive dose of static electricity. We see lightning.

Finally, ask students: *What made the erupting volcano smell so bad?* Explain that it was a gas called sulfur interacting with steam and other elements. Sulfur is an element found in nature. It's used in matches, fertilizers, and insecticides. You can also smell it near hot springs, like those around Yellowstone National Park.

Engage Students

Mapping: Have students use this weblink:

www.esri.com/hazards/makemap.html to make their own map of current volcano hazards around the world. Create a volcanologist group that monitors this website weekly to note new hazards or changes to the map and report back to the class. This could be tracked on a world map and provide many opportunities for quick geography lessons throughout the year.

Television News Producer: Tell students they are a television news producer. This is the third day of the volcanic eruption on Iceland. They have been receiving hundreds of photos of the eruption taken from cell phones and cameras. However, only six photos can be used for the upcoming newscast. Which ones tell the story best? Ask students to fold three pieces of paper in half to create six boxes. Then draw the six pictures they have chosen as the best representation of what is occurring in Iceland for their TV audience. Challenge: Have students write three sentences for each picture to describe what is happening for viewers.

ELL—Retell the Story: Have students think about what was the most important information they learned in the story. Suggest they use the five W's: Who, What, When, Why, and Where to guide their thinking. Then tell them they are a news reporter. They need to explain the story to their television-watching audience. Encourage students to role play as they retell the story. Possible roles include journalists and people being interviewed (i.e. eyewitnesses or such experts as scientists or emergency response officials). Students can make notes or write down key words to guide their retelling.

WebConnect

Invite students to go to <http://volcanoes.usgs.gov> and click on webcams of volcanoes in the United States. Students will be able to see what's happening at various volcanoes across the country.

Comprehension Quick Check

Describe the physical characteristics of Eyja's eruption.
rumbling, lightning, ash clouds, sulfur stench, lava

Sheep take shelter from the ash cloud. Ash coats their fur.

Homeward Bound
The floods came the next morning. Rivers of melted ice spilled down the volcano's sides. Roads washed out. Homes flooded. Was Andrews' farm destroyed?
While she stayed in a safe place with her baby, other family members headed home. They saw the ash plume sweep across the land. It blocked the sun. Ash fell dark and thick. They could barely see ahead of them. They finally made it. The farm was fine! Still, they had a lot of work to do, including milking the cows. As they worked, they wore masks. That way, they wouldn't breathe in ash. They kept the cows in the barn to protect them, too.
Now they had a new problem. Floods washed out a lot of roads. How could they get milk to their customers? They weren't the only people who were stuck. The volcano made it hard for many to travel.

Volcanic ash covers cars and roads in Iceland.

Life Interrupted
Air currents carried the ash far from Iceland. The ash cloud spread. It traveled thousands of miles east, as far as Russia. Experts worried fine, hard particles of ash could jam jet engines. So airports across Europe shut down for days. No planes flew over the northern Atlantic Ocean. That's a major route between Europe and North America for people and goods.
The closings stranded thousands of passengers. It stopped food shipments, too. Stores in Europe ran low on fresh fruit and vegetables. Bags of animal feed went nowhere. Bands couldn't get to America to perform. Eyja caused problems all across the planet.

This satellite image shows the ash plume streaming over the Atlantic Ocean.

Looking Ahead
Now months have passed since Eyja's fiery eruption. Once again, jets crisscross the Atlantic Ocean every day. They carry people, mail, and goods. Life is mostly back to normal for Andrews and her neighbors, too.
Eyja appears to be sleeping. Scientists say it has entered a "june" phase. Only steam and small amounts of ash rise from it these days.
Still, the people of Iceland remain on edge. No one knows how long the pause will last. Plus, Eyja is not Iceland's only volcano. There are 29 other volcanoes on the island. One of the most powerful, Katla, is near Eyja.
The last three times Eyja erupted, so did Katla. Will that happen again? If so, it could be even bigger and more damaging. For now, there's only one thing scientists and people like Andrews can do. They wait—and watch.

WORDWISE
crust: top layer of Earth
dormant: not active, sleeping
lava: hot, melted rock on the surface of Earth
magma: hot, melted rock inside Earth
mantle: layer of Earth made up of hot, partly melted rock
tectonic plate: giant piece of Earth's crust
vent: opening in a volcano through which lava, steam, and gases pass

Explore Science

Ask: Which hazard do you think posed the greatest danger to Hanna's family: flooding, lava, or ash? Ask students to turn to a neighbor and explain their choice. Call on several students to share their ideas and supporting reasons.

Explain to students that the volcano caused airports all over Europe to close because ash could damage jet engines. Have students brainstorm ways people would be impacted if airports closed for a week. Display responses. Have the class vote on the three problems they feel would be the most disruptive to peoples' lives.

Remind students that preparedness is critical in saving lives. Say: *Think of three things you could do that would help you survive a volcanic eruption.* Ask them to jot their ideas down and then share with a partner. Call on student pairs to share their top two most useful ideas.

Extend the Learning

Vivid Verbs: Display the poster that accompanies this story, "Inside a Volcano." Invite a student volunteer to read the deck aloud. Display a T-chart and have students find the noun in each of the first six sentences in the deck. List those on the left. Then have students call out the vivid verb that was used with each noun. Point out how the vivid verbs create a picture of what is happening. Then distribute the Vivid Verb student activity on p. T19. Review directions with students and have them complete the activity.

Write Dialogue: Tell students that when natural disasters occur, communication and information is critical to individuals as well as to officials providing help to communities. Ask them to write a cell phone conversation between Hanna and the emergency headquarters for Iceland's volcano response team. Say: *Consider what information an emergency team needs to know and what questions they would ask. What does Hanna see that officials need know about?* When finished, have student pairs read their dialogues aloud. What makes the phone conversations sound real or not?

Make Connections: Ask students to brainstorm the kinds of natural disasters that could occur near where they live. Ask them to create a list of how the disaster could affect life. Then ask them to create their own preparedness plan for their families and pets.

Comprehension Quick Check

What affect did the ash have people in Iceland?

The ash made it difficult to see. People had to wear masks to protect their lungs. Thick ash covered roads, houses, cars, everything.

What affect did the ash clouds have on people in other countries?

In other countries, ash clouds shut down air traffic due to danger to jet engines.

LANGUAGE ARTS

NAME: _____

KABOOM!

Vivid Verbs

Combine vivid verbs and nouns from the story to make up your own sentences.

NOUN BANK

ground, lightning, lava, glacier, magma, clouds, Earth, rock, Iceland, volcano, ash

Add your own nouns:

VERB BANK

rumble, ooze, gush, flow, boil, smash, erupt, flood

Add your own verbs:

Example:

Lava oozes from the erupting volcano.

1. _____

2. _____

3. _____

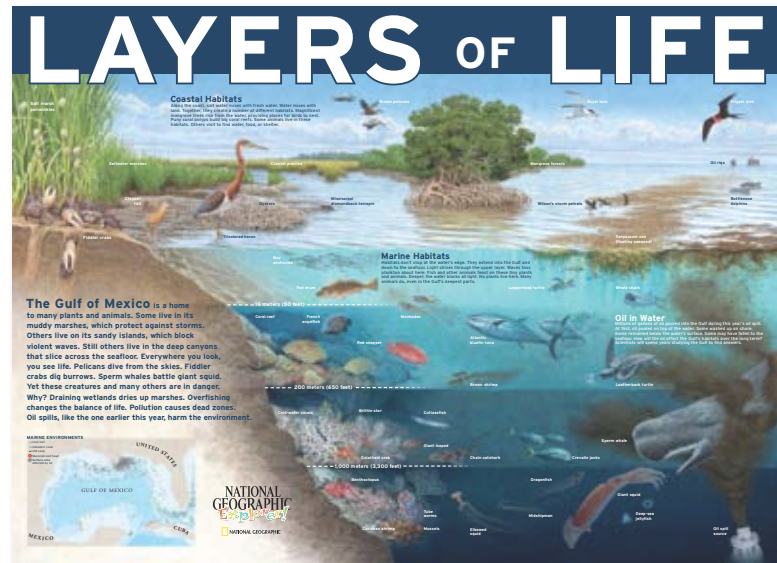
4. _____

5. _____

T19

Illustration: © iStockphoto.com/Robert K. O'Neil

October 2010



WebConnect

Watch a New York Times news clip about the threats to Louisiana's coastal ecosystem and the impact of the oil spill. (Please preview to make sure it is appropriate for your class.) Go to: <http://video.nytimes.com/video/2010/05/01/us/1247467754098/oil-spill-threatens-wetlands-ecosystem.html>

Engage Students

Show/Don't Tell: Use the poster to discuss how plant and animal habitats are interconnected. For instance, fiddler crabs burrow in the marsh mud. That helps marsh grasses grow. Marsh grasses help prevent erosion. Ask: *What can happen if oil disrupts the natural environment of these organisms?* Then have students create a picture, mural, or diorama depicting a "Before" and "After" scenario from an oil spill. [Note: For more information, check out a more detailed version of this poster in the October 2010 issue of NATIONAL GEOGRAPHIC MAGAZINE.]

Explore Science

Display the words *ecosystem*, *habitat*, and *community*. Tell students it is important to understand the difference between these three words and how each is an integral part of our world.

Draw three concentric circles. Write *ecosystem* around the largest one. Explain that the ecosystem includes all living and non-living things in an environment. Label the next circle *community*. Explain that a community is a made up of all the living organisms in an ecosystem. In the smallest circle, write the word *habitat*. Tell students that a habitat is an environment where a population of similar living organisms lives and gets food, water, air, and other life needs met.

Using the Layers of Life poster, point out that the habitat for the oysters is different from that of the bluefin tuna and the giant squid. They each have food needs that can only be met in certain areas. Yet these living organisms are all interconnected and need one another. Explain that events can have an impact on all three. The impact can be direct, such as pollution killing an organism, or indirect, such as pollution killing an animal's food source. Remind students of the 2010 oil spill in the Gulf of Mexico. Ask: *How might oil in the water affect the habitats, communities, and ecosystems along the Gulf Coast?*

Extend the Learning

Make Connections: Ask students to brainstorm disasters that have occurred in or near their communities, such as fires, floods, severe thunderstorms, etc. Ask: *How did the disaster affect our habitats? How did it affect people?*

Critical Thinking: Let students choose an animal featured on the poster. Ask them to research how it lives, including what it eats and its role in its ecosystem. Then ask them to think of what might happen if the organism disappeared from the ecosystem. Questions to think about include: *How would that affect the food chain? How would that affect the habitat?* Students can create cause-and-effect diagrams, including illustrations and captions, and share them with the class.

Cool Corals

Before reading, use these questions to preview the story. Then make a prediction about what the story will be about. Finally, write two questions you want the story to answer.

Look at the opener on pp. 2-3. What did you learn from the headline, deck, and photo?

Preview the pictures and captions on pp. 4-5. What did you learn from them?

Read the diagram on pp. 6-7. What fact is most surprising to you?

Read the section titles. Think about what you might learn in each section. Then put that together with the rest of your preview and predict what the story will be about.

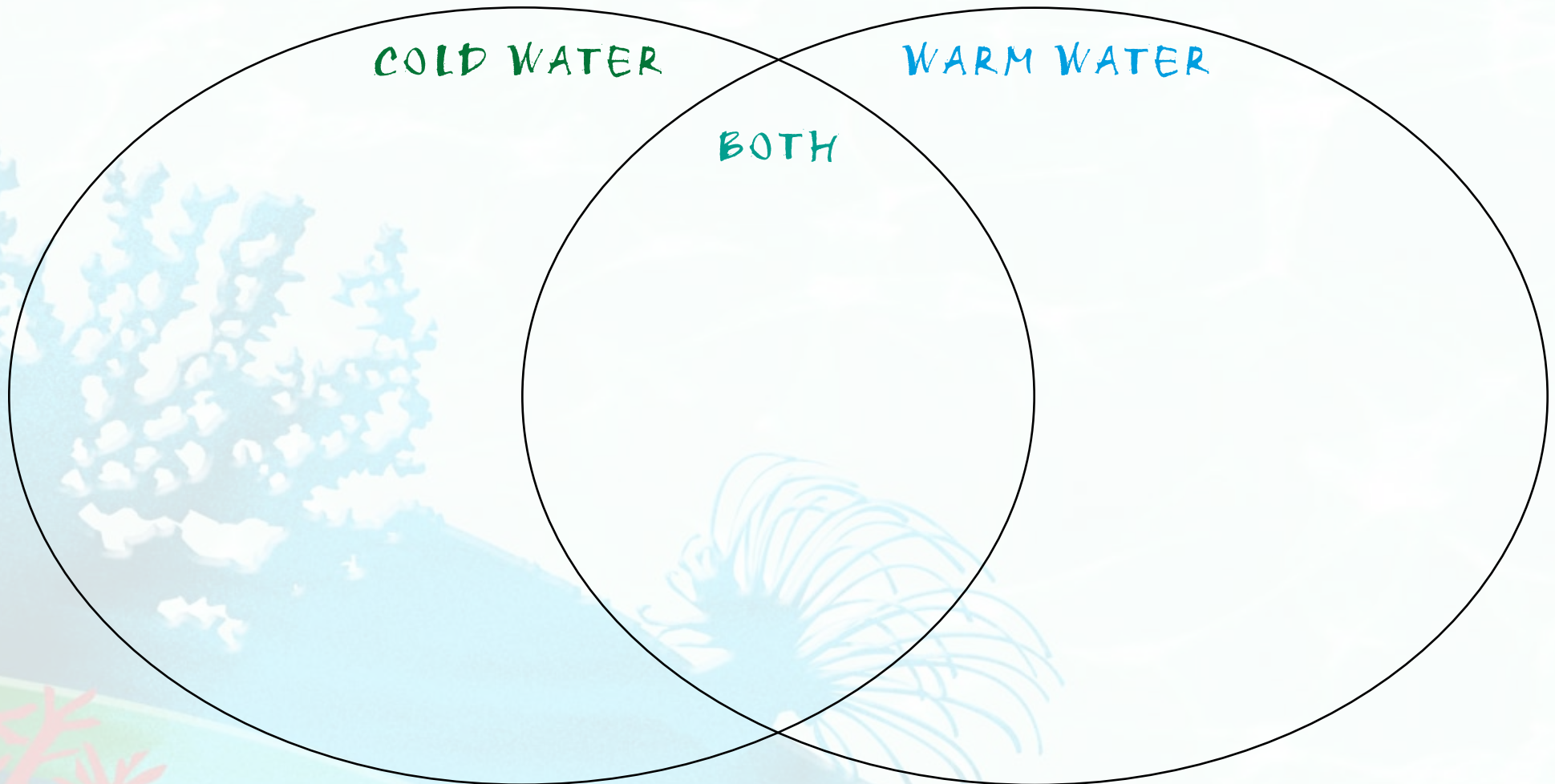
List two questions you want the story to answer:

1. _____

2. _____

Cool Corals

After reading "Cool Corals," use the Venn diagram to show how cold-water and warm-water corals are alike and different.



Extreme Cuisine

In the first column, write five things you learned about extreme foods from reading the story. In the second column, compare each item to your own experiences.

What I Learned

My Experiences

--	--

Extreme Cuisine

Use these questions to explore your family's food traditions.

1. What kinds of foods do you eat at family meals?

2. Are these foods similar to or different from what your friends eat?

3. Describe a traditional food your family eats on a holiday.

4. Why is it traditional?

5. Is there a cultural, religious, or other special reason why you eat this food on this holiday?

6. Select one food or recipe that is a special tradition in your family.

What is it called? _____

What ingredients go into it? _____

Do you like it? Why or why not? _____

Will you continue this tradition with your own family when you are older? _____

Why or why not? _____

KABOOM!

Form Generalizations

Answer each question in the chart below. Then review your answers to make a generalization about the information.

How was the Andrews family affected by the volcano?

What experiences have you had with natural disasters or weather emergencies?

What have you read or watched on TV about the problems natural disasters have caused?

Review your answers above, then make one sentence or generalization about volcanoes or natural disasters that reflect what you took away from reading this story.

KABOOM! Vivid Verbs

Combine vivid verbs and nouns from the story to make up your own sentences.

NOUN BANK

ground, lightning, lava,
glacier, magma, clouds, Earth, rock,
Iceland, volcano, ash

Add your own nouns:

VERB BANK

rumble, ooze, gush,
flow, boil, smash,
scrape, flood

Add your own verbs:

Example:

Lava oozes from the erupting volcano.

1. _____
2. _____
3. _____
4. _____
5. _____

Comprehension Check

Write the correct letter of the word that matches each definition next to numbers 1-6.

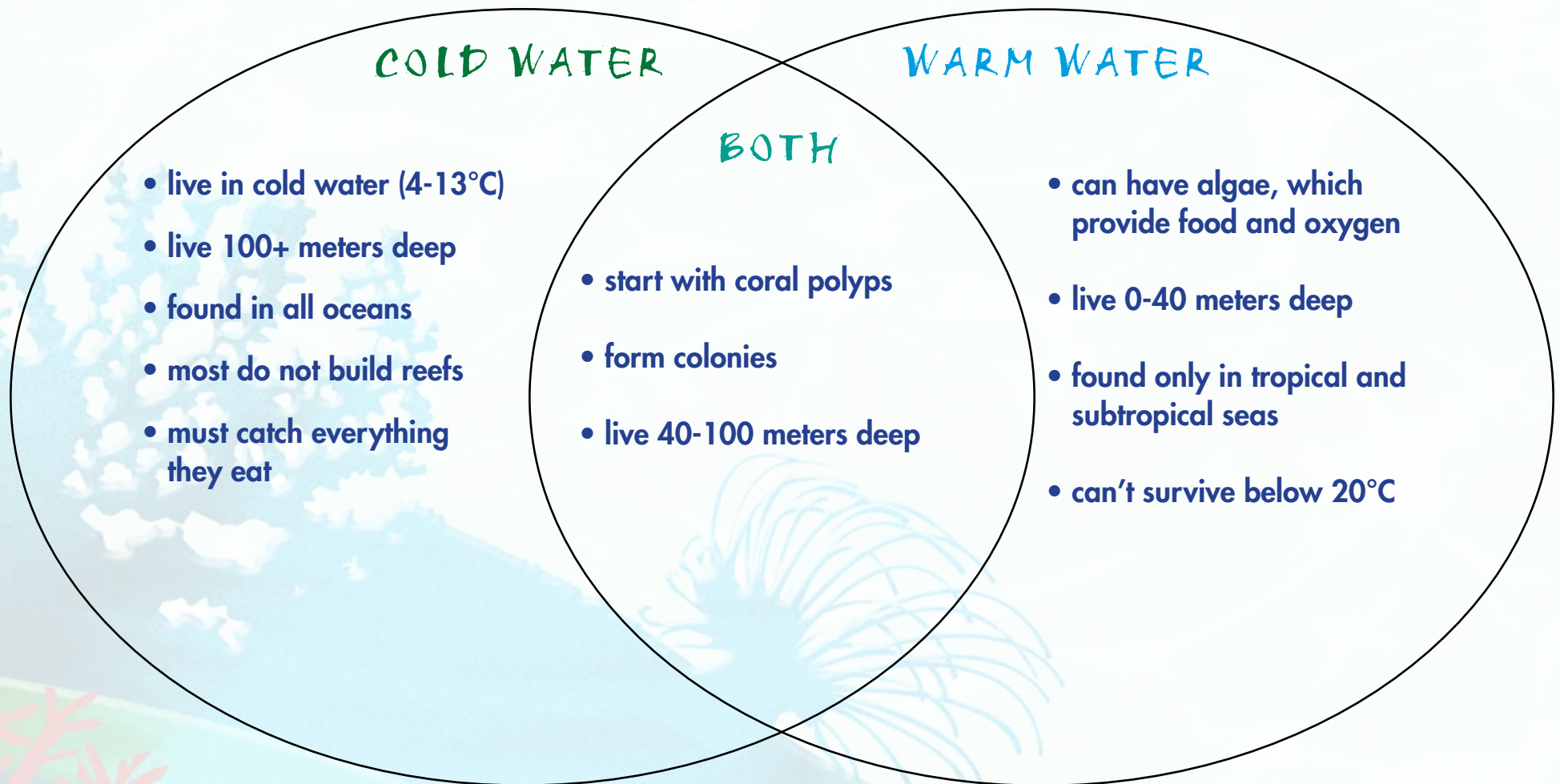
- | | |
|--|----------------|
| ___ 1. sea animal that builds corals | a. culture |
| ___ 2. rock-like structure built by coral polyps | b. coral polyp |
| ___ 3. healthy for you | c. dormant |
| ___ 4. way of life for a group of people | d. magma |
| ___ 5. not active, sleeping | e. nutritious |
| ___ 6. hot, melted rock inside Earth | f. coral reef |

Read questions 7-9. Circle the correct answer.

7. Which does **not** describe cold-water corals:
- A. grow 4 to 25 millimeters per year C. can grow in water -1° Celsius (30° Fahrenheit)
- B. found only in the Pacific Ocean D. most do not grow reefs
8. In many cultures, insects are part of traditional diets because they are—
- A. nutritious and plentiful C. easy to cook
- B. tasty and fun to catch D. part of traditional holiday meals
9. The eruption of Iceland's volcano Eyja taught us—
- A. dormant volcanoes can erupt C. a volcanic eruption under a glacier causes floods
- B. volcanoes can spew smoke, ash, and smelly gases D. all of the above
10. Describe the impact that the eruption of Eyja had on people in Iceland and other parts of the world.

Cool Corals

After reading "Cool Corals," use the Venn diagram to show how cold-water and warm-water corals are alike and different.



Comprehension Check

Write the correct letter of the word that matches each definition next to numbers 1-6.

- | | |
|--|----------------|
| _____ 1. sea animal that builds corals | a. culture |
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- B. volcanoes can spew smoke, ash, and smelly gases D. **all of the above**
10. Describe the impact that the eruption of Eyja had on people in Iceland and other parts of the world.

Answers should include the fact that many people had to flee their homes, floods destroyed roads, and ash coated everything, including cars and farm animals. In addition, airports closed and planes stopped flying because ash could harm jet engines. This impacted thousands of people traveling for work or vacation. It also affected people's everyday lives because it interrupted international transportation of mail, goods, and other things sent around the globe by plane.