Article from SIRS Discoverer Database; (ProQuest) Lexile: 820L

Waves

National Geographic Explorer!
(Vol. 8, No. 3)
Nov/Dec 2008, pp. 14+

Waves

Motion in the Ocean

By Toby Garfield

*• Day after day, minute by minute, **waves** crash onto Earth's shores. They can be fun or big trouble. It's your turn to dive into the science of surf.*

Each winter, the word goes out. Emails and text messages reach surfers around the world. It's the news they've been waiting for: Huge **waves** are breaking off the coast of northern California. That means it's time for the Mavericks Surf Contest.

Surfers have 24 hours to make their way to the San Mateo Coast, about 40 kilometers (25 miles) south of San Francisco. They come from all over the United States and from all over the globe.

Surfers come to brave 12-meter (40-foot) **waves**, strong currents, jagged rocks, and freezing water. They come for the chance to surf some of the largest **waves** in the United States. The wonder **waves** at Mavericks can be taller than a four-story building! It takes skill and courage to ride them.

What Is a Wave?

You won't catch me competing at Mavericks. I'm an **oceanographer**, not a daredevil. That means I study the ocean. I explore how ocean water moves.

Still, I think the contest is cool. It gets people interested in **waves**, and it raises some important questions: Just **what** is a wave? How do **waves** form? **What** makes the ones at Mavericks so big? How are they different from the **waves** called **tsunamis**?

Let's start with the first question: **What** is a wave? You may think you know the answer. It's water moving toward the beach, right? Wrong. A wave is actually energy that is moving through the water.

This may be easier to understand if you think of dominoes. Picture them standing neatly in a line. Now imagine that someone knocks over the first domino. It falls. It hits the second domino, which falls, too. This continues all down the line.

What happened? That push was a bit of energy. It made its way through the line of dominoes. Along the way, it affected the dominoes, yet it didn't move them very far.

(See picture, "**Waves** Smashing onto Coastline, Tasmania, Australia.")

Waves Smashing onto Coastline, Tasmania, Australia

(Credit: Jason Edwards/National Geographic/Getty Images) Photo Selected by ProQuest Staff

Waves in the Water

A wave moves through the water in a similar way. For most **waves**, the energy comes from wind blowing over the ocean. The wind transfers, or moves, energy to the ocean. Then it starts moving through the water.

If you drew a wave passing through the water, it would look like a line of hills and valleys. The top of the hill is the wave's **crest**. As the wave heads toward the crest, it pulls water upward. That's **what** makes the tall **waves** we see at the beach. The distance between two crests is called the **wavelength**.

Then the wave slopes back down. It reaches a low point called the **trough**. The distance between the crest and the trough is the wave height. The wave pulls the water down with it. That's why **waves** always topple over, or break.

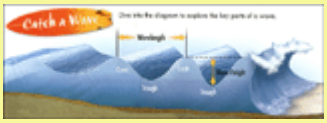

Diagram: Wave

(Credit: Precision Graphics)

(See picture, "Diagram: Wave.")

Like the dominoes, the water is affected by the energy moving through it. Pulled up and down, the water molecules move in a circle. They don't, though, move any closer to the shore. You can see this for yourself. Next time you're at the beach, let a toy float in the **waves**. They'll move the toy up and down. Yet they probably won't carry it onto the beach.

The Monsters at Mavericks

So now you know **what** a wave is, how it forms, and how it moves. You're probably still curious, though, about how the **waves** at Mavericks get so huge.

The first part of the answer has to do with time. Remember that the Mavericks Surf Contest takes place in winter. That's no accident. It's the time of year when big storms brew over the Pacific Ocean. Those storms have powerful winds. That means they make **waves** packed with energy. The **waves** travel thousands of kilometers to the California coast.

The second part of the answer has to do with the seafloor. Below Mavericks lie rocky ledges, or step-like layers of stone. These ledges play a key role. To understand how, picture yourself holding a magnifying glass in the sun. The lens focuses the light to a point. Well, the rocks at Mavericks focus wave energy in a similar way.

As a result, the **waves** climb to higher crests than before. Then they plunge to lower troughs. That creates the massive **waves** that make Mavericks a surfers' paradise.

Walls of Water

Awesome though they are, the **waves** at Mavericks are small compared to some others. Take **rogue waves**, for instance. They are huge **waves** that appear out of nowhere.

Rogue **waves** can be more than 20 meters (66 feet)! Sailors who have survived them talked about seeing huge walls of water. For a long time, people thought the sailors were telling tall tales.

Opinions have changed recently. Modern satellites took images of rogue **waves** in action. Sailors even

snapped pictures of a few.

Now there's no doubt: Rogue **waves** are real. We just don't know exactly **what causes** them. They may form when two or more **waves** get stacked on top of one another.

I have never seen a rogue wave, and that's just fine with me. On a sailing trip once, we were pounded by two-story **waves**. That experience was enough to renew my respect for the power of **waves**! Of course, we still have not talked about the most terrifying **waves** of all.

Killer Waves

For raw power, no **waves** can beat tsunamis. A tsunami is an incredibly powerful wave. It differs from a regular wave in two ways.

First, a tsunami isn't formed by wind. It results from a major underwater event. That could be an earthquake or volcanic eruption. So a tsunami has a huge amount of energy.

Second, ordinary **waves** travel near the surface. They don't affect the water underneath them. Not tsunamis. They affect all the water from the seafloor to the surface. That makes them far more powerful than everyday **waves**.

Tsunamis can be huge. The wavelength can be many kilometers. Tsunamis are fast, too. They can zip through the water at 800 kilometers (500 miles) an hour. That's as fast as a modern passenger jet!

Add all that power and speed together, then imagine it slamming onto a shore. The result can be large **waves** that cause huge damage.

Over the ages, tsunamis have killed countless people. In fact, a group of powerful tsunamis caused one of the worst disasters in modern times.

On December 26, 2004, a strong earthquake shook Indonesia. The quake triggered a series of tsunamis. Killer **waves** plowed into the shores of 14 countries. The **waves** killed more than 200,000 people.

(See picture, "Tsunami Damage in Thailand.")

Killer **waves** in Southeast Asia are a far cry from a surfing contest in California. Yet both fascinate me. Each shows, in very different ways, the amazing power of **waves**.

Tsunami Damage in Thailand

In December 2004, a powerful tsunami destroyed this hotel in Thailand. (Credit: AP Photo/Suzanne Plunkett)

Wordwise

crest: highest point of a wave

oceanographer: scientist who studies the ocean

rogue wave: huge wave that suddenly appears

trough: lowest point of a wave

tsunami: powerful wave caused by an underwater earthquake or volcano

wavelength: distance between two crests

About the Story

This story uses the annual Mavericks Surf Contest in California to help students dive into the science of **waves**. Readers learn that **waves** are a form of energy that moves through water and that most **waves** form when wind blows over water, transferring energy to it. Students also learn about rogue **waves** and tsunamis, the massive and sometimes deadly **waves** caused by earthquakes and volcanic eruptions.

Fast Facts

• The West Coast generally has better surfing **waves** than the East Coast. On the East Coast, prevailing winds blow against **waves**, weakening them. On the West Coast, prevailing winds blow with **waves**, strengthening them.

• In 2004, an earthquake caused tsunamis in the Indian Ocean. They killed some 200,000 people, destroyed thousands of miles of coastline, and left millions of people homeless.

Vocabulary

Dictionary Skills: Direct attention to the word *focus* (in the article above). Ask: *How could you learn **what** this word means if you didn't know?* (Look it up in a dictionary.) Explain that sometimes the dictionary will offer more than one definition for a word. Tell students that, in that case, they need to select the definition that makes the most sense in **what** they are reading.

Model looking up *focus: I see that focus can be a noun or a verb. It's used as a verb in the story, so I'll look at the verb definitions. It can mean "to adjust in order to make a clear picture." No, that makes no sense in the story. It can also mean "to bring to a point." That makes more sense. The story talks about using a magnifying glass to focus light to a point. Then it says that the rocks at Mavericks focus wave energy the same way. That must mean that they bring the energy to a point.*

Before Reading

Build Background: To demonstrate kinetic energy, bring a set of dominoes to the classroom. Write *energy* on the board. Invite students to share **what** the word brings to mind. Point out that we cannot see energy, but we can see the changes it **causes**. Arrange the dominoes in a line standing fairly close to one another. Push the domino at one end of the line so that it sets off a chain reaction. Have students describe **what** they saw as the energy passed through the dominoes. Tell them to keep this example in mind as they read about wave energy.

Reading Strategy 1

As you read this story, use the words and photos to picture how **waves** are formed.

Reading Strategy 2

Visualize: Discuss with students how picturing **what** they are reading can help them get more out of the text. Read aloud the third paragraph in the introduction to the story (in the article above) and model using the strategy: *The first sentence describes how tall the **waves** are and how cold the water is. It also mentions jagged rocks. In my mind, I can picture **what** the scene must be like. It seems pretty exciting and dangerous.*

Help students see that by picturing the setting, they can appreciate the courage and skill of the surfers in the Mavericks Surf Contest. As students read the rest of the story, have them note other descriptive words and phrases that help them visualize **what** the author is describing.

After Reading

• **Content Literacy:** Have students complete the blackline master (below) and work with a partner to summarize **what** they learned about **waves**.

• **Creative Writing:** Invite students to write a poem or haiku about **waves**. It might be based on their observation of **waves** at the beach, or it could capture the fear a ship's crew might feel while facing a rogue wave.

• **Geography:** Encourage students to create multimedia reports about the Indian Ocean tsunamis of 2004.

Content Literacy

Read "**Waves**" above. Then complete the items below.

1. Explain how a row of dominoes can be like a wave.

2. Why does the Mavericks Surf Contest take place in winter?

3. Why are tsunamis such powerful **waves**?

4. List three of the most interesting facts you learned from the story.

Review

Answer each question. Circle the correct answer.

1. Why does it take courage to enter the Mavericks Surf Contest?

a. The water is very cold.
b. The **waves** are huge.
c. There are jagged rocks nearby.
d. all of the above

2. What is a wavelength?

a. distance between the trough and the crest
b. distance between two crests
c. time it takes a wave to reach the shore
d. an underwater volcano

3. Which sentence best explains why **waves** break?

a. Wind pushes the water down.
b. The wave runs out of energy.
c. The wave energy pulls water down.

d. none of the above

4. Which sentence is ***not*** true?

a. Tsunamis are caused by blowing wind.
b. A tsunami's wavelength can be many miles long.
c. Tsunamis can move as fast as a jet.
d. Tsunamis can do huge damage.

Answer Key

Content Literacy

1. Energy moves dominoes as it passes through them. In the same way, energy moves water while passing through it.
2. Big winter storms make bigger **waves**.
3. Tsunamis are caused by major events, so they have a lot of energy. They affect all the water from the seafloor to the surface.
4. Answers will vary.

Review

1. d, **2.** b, **3.** c, **4.** a