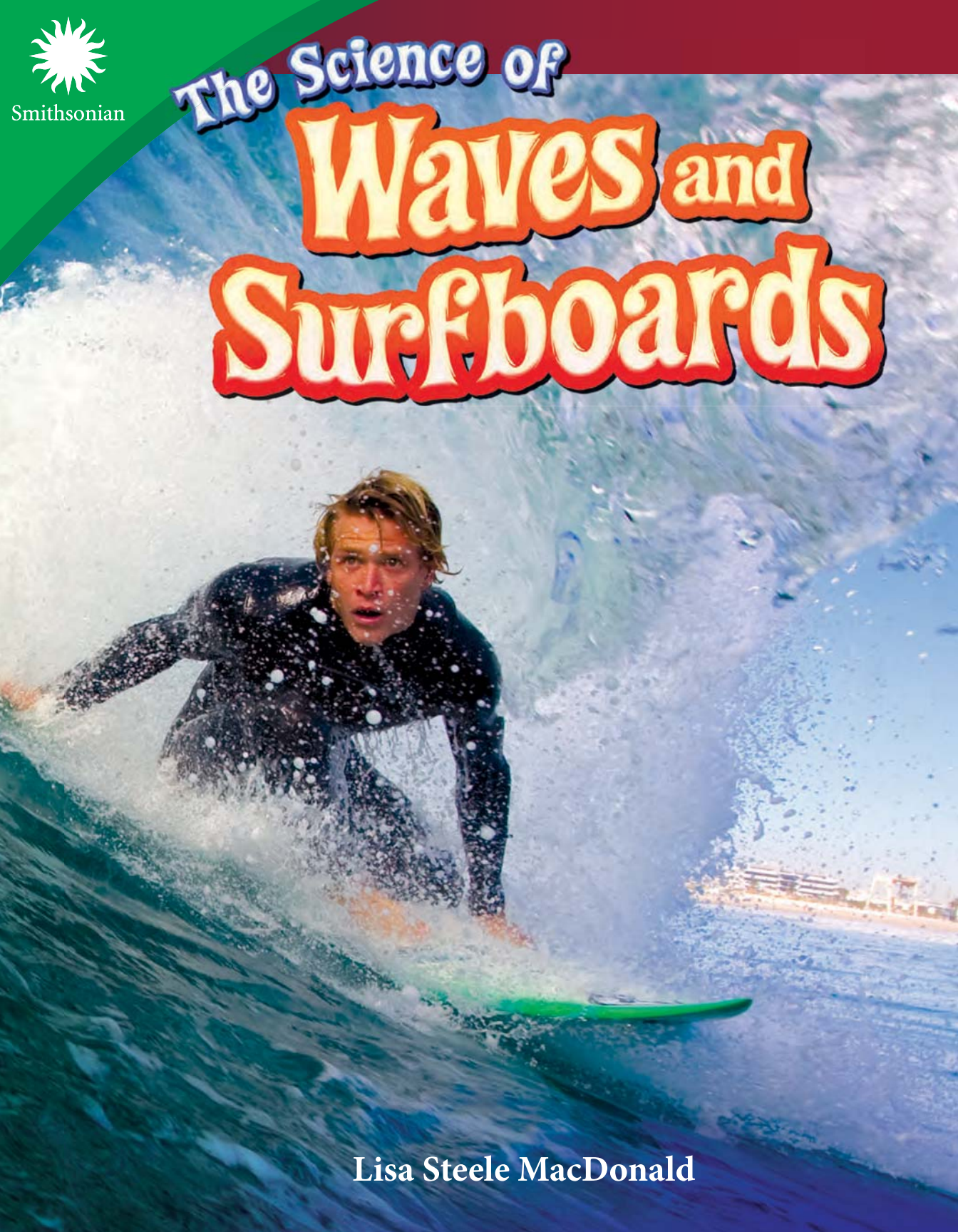
Smithsonian

The Science of Waves and Surfboards



Lisa Steele MacDonald

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Catching a Wave

From the shore or on television, surfing might seem like magic. Skilled surfers make it look like riding even the biggest waves takes no effort at all.

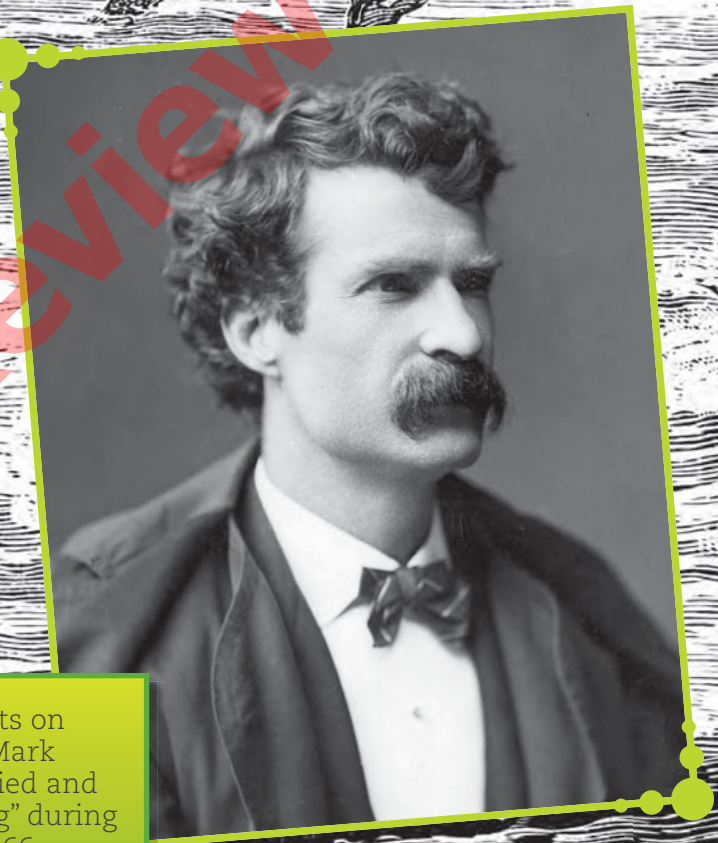
But surfing requires a lot of athleticism and knowledge. In fact, the sport relies on science. Without **buoyancy**, surfers would sink. Without acceleration, they would not be able to travel the length of a wave.

Science also plays a role in how surfboards are made. Early surfers used planks of wood as boards. They learned by trial and error which materials and shapes worked best. They could only use materials that were native to their homes. Today's surfboards are the results of years of research, engineering, and applied science.

The history of surfing is a lesson of the progress in science. So, dive in and find out more!

Duke Kahanamoku was a popular surfer from Hawai'i in the early 1900s.

1882 engraving of surfers in Polynesia



One of the first reports on surfing comes from Mark Twain. The author tried and failed at "surf-bathing" during a trip to Hawai'i in 1866.

The Science of Surfing

Imagine you are holding a water balloon. If you squeeze it, the balloon bulges out on one side or another. As your hand squeezes, the water pushes out on the balloon. This creates pressure in different places. In a similar way, opposing forces act on water in a wave. One force pushes down, and one pushes up. The energy creates pressure. This pressure is what pushes a surfer through a wave.

Three factors combine to create a successful ride. First, surfers need the motion provided by waves. Second, they need an item to give them buoyancy—a surfboard. Third, they need balance and control to help them stay in the right place on the board and feel comfortable moving the board in the water. These three things act together to create a thrilling ride.

The world record for longest time and distance surfed on open water is 3 hours and 55 minutes! Gary Saavedra surfed a man-made wave created by a boat.

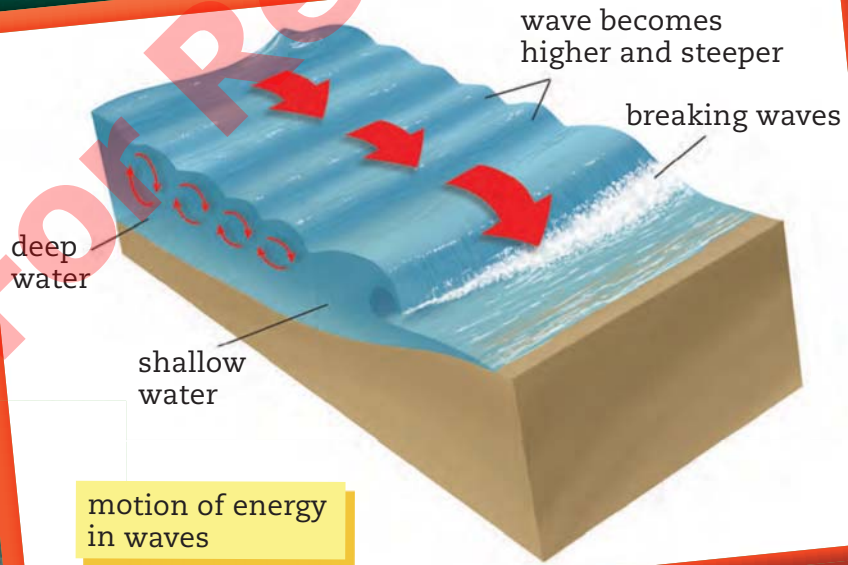
The Motion of the Ocean

Water in the ocean is always moving. This movement can form waves and currents. Ocean waves are energy that travels on the surface of water toward shore. Ocean currents are moving water far beneath the surface of the water. Meanwhile, air is moving water above the surface of the water.

At first, wind travels across the water freely. The **ripples** pick up speed and get larger and more powerful. By the time the water nears land, it is moving quickly and with great force.

As a wave gets closer to shore, water becomes more shallow. The ocean's bottom current slows when it hits the sloping sea floor. The ocean's top current continues to move at the original speed. When the top moves faster than the bottom, a wave begins to form.

As the top current rushes on, the bottom moves up to meet it. This upward movement of water becomes the **face** of the wave. This is where surfers ride.



motion of energy in waves

Surfers spend most of their time paddling out and waiting for waves. For every hour they spend in the water, only about five minutes is spent actually riding waves.

STEAM CHALLENGE

Define the Problem

You and your friends like to surf, but it is tough to get all your boards to the beach. You saw a foldable kayak and are wondering whether you can create a foldable surfboard that would be easier to transport and still hold up after use.

Constraints: Your surfboard should not bend or buckle when placed in the water.

Criteria: Your foldable surfboard must reduce its length or width by at least one half and should be bouyant in water.

1 Research and Brainstorm

How will folding a surfboard affect buoyancy? What folded shape will be easiest to transport? What materials will work best? Are any extra supports needed at your folds? Search the Internet for ideas that might inspire you.

2 Design and Build

First, make a paper model of your surfboard to decide how your board will fold. Then, sketch your design. List materials you are using in your model and materials that could be used in an actual foldable surfboard. Then, build your model.

3 Test and Improve

Create waves in a container of water to test how your surfboard holds up. How did your board perform? Can you decrease the size of the folded surfboard even more? Modify your design and try again.

4 Reflect and Share

How might a foldable surfboard compare to a regular surfboard? Consider the pros and cons of each. Which would you prefer?