# Battering Waves

**Would you want to battle stormy ocean waves in a small sailboat?**

Have you ever seen "The Wave" in a sports stadium? The fans in one area stand up and raise their hands in the air. As they begin to lower their arms and sit back down, the people beside them stand up and raise their arms. Then they sit and lower their arms, and so on. Fans on the other side of the stadium see a "wave" moving across the stadium. The crowd is the medium, or substance, through which this "wave" passes.

Water waves are mechanical waves. This means that, like "The Wave," they can only travel through matter. In this case the matter is water. Mechanical waves, including water waves, carry energy from one place to another.

## Before You Read

**WATER WAVES** Think about times when you have seen waves. You might have seen them in an ocean, lake, pond, or pool. Perhaps you've seen a movie or television show where a boat was being knocked about by the waves. Or, maybe you've even had such an experience of your own.

▸ ***What experiences have you had with waves? Describe one experience.***

## Read

**In the novel *The Voyage of the Frog*, a 14-year-old boy named David sails alone into the Pacific Ocean aboard the *Frog*, a small sailboat. During a storm, the waves threaten his boat and his life.**

### The Voyage of the Frog

The wind had increased in strength. He climbed onto the cabin and reefed the main [sail] down to half size but left the jib full. Then he went back to the helm, brought her around, and the sails filled and the *Frog* started taking the swells.

There were waves coming in now as well, on top of the swells, growing in chop and intensity each moment. The *Frog* was slamming, making noise, but he held her angled up into the wind and took it. Spray came over the bow and covered him, soaking him, but he...would not...let the sea have her....

The wind became worse. The waves grew until they were larger than the swells they rode on, towering over him, burying the bow. More than once he was knocked off his feet by a wall of water coming back over the side of the cabin but he never let go of the helm, rose and took it again and again, held her through wave after wave when they rose over him, walls of water, mountains of water moving down on him, down on the *Frog*.

**reefed:** reduced the size of the sail by rolling it and tying it down
**jib:** a triangular sail in front of the main sail
**helm:** the steering wheel of a boat
**swells:** long waves that move continuously without breaking
**chop:** short, slapping motion
**intensity:** strength
**bow:** front section of a boat

NOTEZONE

What do you think was the source of energy carried by the waves?

Underline three clues to the amount of energy in the waves.

FIND OUT MORE

SCIENCESAURUS
Characteristics of a Wave 306
Kinds of Waves 307

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## Explore

**WIND AND WAVES** Sailors—like David in *The Voyage of the Frog*—depend on energy from the wind to power their boats. Moving air particles push against the sails and move the boat forward.

Winds blowing over the ocean also transfer their energy to the water, creating ocean waves. The size of the waves created by wind and the amount of energy they contain is determined by several factors. Three of these factors are shown in the chart. Each one affects the amount of energy that is transferred from the wind to the water. The greater the amount of energy that is transferred, the larger the waves are.

| Factors Affecting the Size of Water Waves | | |
|---|---|---|
| **Wind Velocity** | **Wind Duration** | **Fetch** |
| the speed at which the wind blows in a certain direction | the length of time the wind blows | the area the wind blows over |

► *What can you infer about the velocity of the wind in the reading from* The Voyage of the Frog*? What clues help you make this inference?*

► *What can you infer about the duration of the wind in the reading? What clues help you make this inference?*

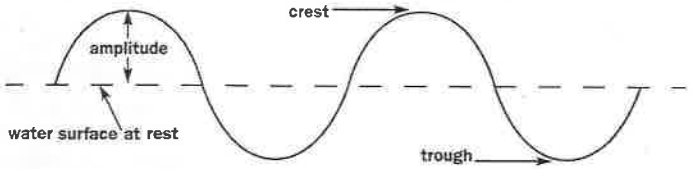
► *What can you infer about the fetch of the wind? What clues help you make this inference?*

► *What do the clues about wind velocity, wind duration, and fetch tell you about the amount of energy in the waves that struck the* Frog*?*



## Propose Explanations

**HOW STRONG ARE THE WAVES?** All water waves have the same basic shape. The dashed line in the diagram represents the water surface at rest. A wave moving along the water surface has a crest and a trough. The crest is the highest point of the wave and the trough is the lowest. Amplitude is the distance from the resting point to the crest of the wave. The greater the amplitude, the greater the amount of energy the wave carries.




► *What can you infer about the amplitude of the waves that struck the* Frog*? What evidence do you have?*

► *What does this tell you about the amount of energy in the waves in the story?*

► *The wind transferred some of its energy to the water, making waves. What did the waves transfer some of their energy to? What evidence do you have?*

## Take Action

**THAT'S DISTURBING!** In *The Voyage of the Frog*, the wind's motion is the "disturbing force" that creates the ocean waves. Every mechanical wave has a disturbing force that creates it. For each kind of wave below, write what might be the disturbing force. If necessary, do some research to get ideas.

| Mechanical Wave | Disturbing Force |
|---|---|
| A flag waving at the top of a flagpole | |
| Ripples in a pond | |
| Vibrations of a guitar string | |