Science Learning Packet

Grade 4 Reader:
Waves, Energy, and Information:
Warning: Tsunami!

Suggested science learning activities for SPS students during the COVID-19 school closure.

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WARNING: TSUNAMI!

by Tessaly Jen
illustrated by Lanny Markasky
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Materials to be used solely for remote learning due to COVID-19

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Amplify Science Elementary is based on the Seeds of Science/Roots of Reading® approach, which is a collaboration between a science team led by Jacqueline Barber and a literacy team led by P. David Pearson.

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Grade 4
Warning: Tsunami!
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Tsunami Warning

Sirens wail and a warning comes over the radio. It’s time to flee the coast and move to safety on higher ground. A tsunami (sue-NAH-mee) is coming!

Tsunamis are powerful and dangerous ocean waves. These waves can travel thousands of miles across the ocean. They may cause floods and terrible destruction when they hit land.
What Causes a Tsunami?

Underwater earthquakes are the source of most tsunamis. Most tsunamis happen after an earthquake jolts the seafloor up and down suddenly. When the seafloor suddenly moves, it disturbs the water above it, moving the water upward and letting it fall back down. That up-and-down movement of the water is the beginning of a tsunami wave. The tsunami wave travels out in all directions from its source.
3. Up-and-down movement of water becomes a tsunami wave.

4. Tsunami wave travels outward in all directions.

Not all earthquakes cause tsunamis. To cause a tsunami, an earthquake must happen under the ocean. It also needs to move the seafloor with enough energy to disturb a lot of water. Most tsunamis happen in the Pacific Ocean, because earthquakes are common there.
How Tsunami Waves Are Different

People often think of tsunamis as extremely high waves. However, a tsunami wave is not always very high. Tsunamis are often just a few centimeters (a couple of inches) high as they travel across the ocean. Out in the open ocean, a person in a boat might not even notice a tsunami wave traveling by. The passing up-and-down movement of water does not harm ocean animals.
In fact, tsunami waves are different from ordinary ocean waves not because they are higher, but because they are longer. Tsunamis have extremely long **wavelengths**. A wavelength is the distance between two peaks of a wave. For a tsunami wave, this distance can be greater than 100 kilometers (about 60 miles)!

This diagram shows what “wavelength” means. Wavelength is the distance from one peak of a wave to the next peak. Tsunamis have very long wavelengths.
Speed is another important difference between ordinary ocean waves and tsunami waves. Tsunami waves travel faster than ordinary ocean waves—much faster. Tsunami waves can travel as fast as 800 kilometers per hour (about 500 miles per hour) across huge distances. In less than a day, a tsunami can travel from one side of the Pacific to the other. That’s a journey that would take a ship about ten days!

Another Kind of Wave

Tsunami waves and regular ocean waves are not the only two kinds of waves in the ocean. Sound waves can also travel through ocean water! However, sound waves are different from tsunamis and ocean waves. Tsunamis and ocean waves happen at a large scale—we can see them. Sound waves, on the other hand, happen as invisible movements of particles that are too small for us to see. All three kinds of waves are patterns of motion, but the patterns of motion are different in a sound wave than they are in an ocean wave—even when that sound wave is traveling through water.

Sound waves happen as invisible movements of particles that are too small for us to see. The particles move back and forth as the sound travels.
On this map, you can see how fast a tsunami travels across the ocean. The map shows the path of a tsunami that started with an earthquake in Alaska. The lines show how far the tsunami traveled each hour after the earthquake. It took less than a day to reach the southern tip of South America!
High speed and extremely long wavelengths become a deadly combination when a tsunami reaches land. The ocean water is shallower near the shore. When a tsunami wave enters shallow water, the wave builds in height, piling up the water near the shore. The water flows over the land, flooding areas that usually remain dry. The fast-moving water can destroy trees, homes, and everything else in its path.

When a tsunami reaches land, the wave crashes into the shallow seafloor. The water is forced to pile up, flowing over the land.
People ran from the tsunami that hit Hawaii in 1946. It was caused by an earthquake that happened near Alaska.

What Moves in a Tsunami?

An earthquake near Alaska can cause a tsunami that devastates Hawaii, about 4,600 kilometers (almost 3,000 miles) away. However, that doesn’t mean that water from Alaska travels all the way to Hawaii. The water itself is hardly even moving in a tsunami. If it was, imagine all of the ocean animals living in the water near Alaska that would get swept across the ocean and land on the beach in Hawaii!
It’s not the water that travels across the ocean in a tsunami: all that travels is the energy of the wave. When the earthquake in Alaska makes the seafloor move, the moving seafloor disturbs the water on top of it. Then that water disturbs the water close to it, the water close to it disturbs water a little farther along, and so on for thousands of miles. The up-and-down movement travels like a relay race across the ocean. All ocean waves behave like this: it’s the energy of the wave that travels, not the water.
How to Detect Tsunamis

There’s no way to stop a tsunami. However, tsunamis are only dangerous to people on the coast in the path of the wave. With enough warning time, people can get to safety before a tsunami hits. Scientists have figured out how to detect tsunamis while the waves are still out in the open ocean, before they reach shore and become dangerous.

To detect tsunamis out in the ocean, scientists have placed sensors on the ocean floor in areas all over the world. These sensors are called tsunameters (sue-NAH-muh-ters), and they detect changes in the level of the water above them.
This is a tsunameter. It senses when a tsunami has disturbed the water, even just a little bit. A buoy gets data from the tsunameter and sends a message to scientists at a tsunami warning center.
How does a tsunameter work? As a tsunami passes, it disturbs the water, raising the water level. Remember that in the open ocean, a tsunami wave might only raise the water level a small amount, so tsunameters are very good at detecting small changes in water level. The tsunameter sends the water level data to a buoy (BOO-wee) floating on the surface, which passes the data on to scientists at a tsunami warning center.

At the tsunami warning center, scientists study the water level data. They watch for waves with extremely long wavelengths traveling at high speed. When they find a wave like this, they know they have detected a tsunami. They use computer models to figure out where and when the tsunami is likely to hit land. They look for cities and towns in the path of the tsunami and send alerts to warn the people there.
Tsunami Safety

Scientists use computer models to look at different areas of coastline and predict how a tsunami would affect them so people can be better prepared. Many areas on the coast have signs marking tsunami danger zones, as well as plans for helping people escape. Some places even have tsunami drills, similar to fire drills, when people have a chance to practice what they would do in case of a real tsunami.
These people are participating in a tsunami drill. They are practicing how they would get to safety during a tsunami.

Thanks to scientists who study tsunamis, we are learning how to avoid the dangers of these powerful waves. The more we learn, the more lives we can save. By sharing what you know about tsunamis, you can help others learn more.
Glossary

data: observations or measurements recorded in an investigation

detect: to discover or identify that something exists

energy: the ability to make things move or change

model: something scientists make to answer questions about the real world

pattern: something we observe to be similar over and over again

source: the place where something comes from

tsunami: a long ocean wave caused by movement on the seafloor that disturbs the water above

wave: a pattern of motion that travels away from a source

wavelength: the length of a wave from one peak to the next
Books for *Waves, Energy, and Information*:
Sound on the Move
Warning: Tsunami!
The Scientist Who Cracked the Dolphin Code
Seeing Sound
Patterns in Communication

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What really happens when a tsunami wave moves across the ocean?

Find out the truth about tsunamis—what causes them, how they move, and how big they really are. Learn what tsunamis have in common with other kinds of waves and what makes them different. Then find out how scientists are working to keep people safe from tsunamis.