

Science of Big Waves

Watch it online <http://www.kqed.org/quest/television/view/249>

TV story length 11:40 minutes

QUEST SUBJECTS

Life Science
Biology
Health
Environment

Earth Science
Geology
Weather
Astronomy

Physical Science
Physics
Chemistry
Engineering

CA SCIENCE STANDARDS

Grade 6

Plate Tectonics and Earth's Structure

1. Plate tectonics accounts for important features of Earth's surface and major geologic events. (a)

Grade 8

Motion

1. The velocity of an object is the rate of change of its position. (b, c)

Forces

2. Unbalanced forces cause changes in velocity. (e)

Grades 9-12

Physics

1. Newton's law predicts the motion of most objects. (a,g)

4. Waves have characteristic properties that do not depend on the type of wave. (a,c,f)

Investigation and Experimentation

1. Scientific progress is made by asking meaningful questions and conducting careful investigations. (l,m)

PROGRAM NOTES



In this segment you'll find out...

- ⦿ what a maverick wave is and how it forms.
- ⦿ how scientists use technology to study and predict when and where these waves form.
- ⦿ why and how surfers surf big waves.

TOPIC BACKGROUND

Where do ocean waves come from? How are they generated and how do they gain speed? What makes one wave bigger than the next and how do different waves move? When wind blows over large areas of the ocean, waves are created. How big the waves get are determined by three things: the speed of the wind, the amount of time the wind travels across the ocean and the distance that the wind travels. Surfers have given the name "maverick" to the biggest waves in the oceans. These waves get their energy from powerful storms formed in the deep ocean. Surfers must understand the science behind these massive waves in order to surf and survive them.

An ocean wave can be described as a disturbance in the water that travels from one location to another. The water is the medium that the wave travels through. Other kinds of waves like sound, radio, visible light, earthquake and stadium travel through other mediums other than water. As a wave moves through water, energy is transferred between the water molecules causing them to move in a circular motion. The peak of the wave is the water at the surface that moves up and forward. As the water moves down and back the ditch of the wave becomes visible. This kind of circular motion is not that visible in the deeper parts of the ocean. As the depth of the water decreases the waves become bigger. When waves traveling a long distance from the far ocean reach the shoreline they usually become much taller and slow down. How far they have traveled and how fast their speed will determine the size of the wave.

The energy that is created by big storms out in the deep sea is transported through the water as a wave. As this energy moves through the water the wave develops a crest and a trough. As each crest of the wave comes one after another it is separated by a trough and this creates the alternating pattern that we can see when looking out into the ocean. As you watch the ocean wave moving through the water you can observe the crests moving along through a given span of time. In order to observe the distance of a wave you must watch the crest. The speed of the wave can then be calculated by dividing the distance traveled by a part of the wave like the crest by given amount of time using the formula $speed = distance/time$.

For the generation of "maverick" waves, scientists study the underwater topography of the ocean floor. They also use bathymetry, which is the measurement of the depths of oceans and other large bodies of water. They use these data along with satellite technology to monitor and predict when and where these massive waves will hit. Finally, surfers use their knowledge of the physics of these big waves to learn how to catch the ultimate ride.

Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

PRE-VIEWING

- List all the words that come into your mind when you hear the word "wave."
- Where do ocean waves come from? What gets them started?
- Toss a penny into a bucket of water then describe how the waves move through the water.
- What do you think a surfer should know about waves before they try and ride a wave while surfing?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- Record any facts you find interesting while you watch.
- Observe all the waves that you see and describe how they form and break. Use as many words found in the segment for your descriptions.
- Describe how waves are formed, how they originate, and how they are measured?
- What is a maverick wave and what is special about the way it is formed?
- How is energy stored and transferred during wave?
- List any kind of advice given by the surfers about how to survive these "big waves."

POST-VIEWING – Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Viewing Focus Questions.
- **Explore** wave formation by using a slinky. Stretch it out and vibrate the first coil and observe how a wave travels back and forth.
- **Debate** the challenges that surfers face when they attempt to ride these big waves. Think about what they need to understand about the physics of big waves to survive.
- **Design** a poster board presentation of Maverick waves from different parts of the world. Be sure to describe the geography and the topography of the ocean floor in these areas.
- **Create** a hallway presentation at your school on the science of surfing. What do surfers need to know about the science of waves to be able to catch the perfect wave? Be sure to describe how surfers use their knowledge of gravity, momentum, and balance to ride their surf boards.

Look for the



indicating resources from QUEST partner organizations

For half a mile from the shore it was one mass of white breakers, which, with the wind, made such a din that we could hardly hear ourselves speak... This was the stormiest sea that we witnessed.

— Henry David Thoreau

LESSON PLANS / ACTIVITIES



Hanging Ten: Surfing the Web, then surfing the waves, The Exploratorium

<http://www.exploratorium.edu/theworld/surfing/index.html>

- Listen to a radio report and find informative articles about everything from the buoyancy of a surfboard to predicting storms.

Wave That Shook the World, NOVA

http://www.pbs.org/wgbh/nova/teachers/activities/3208_tsunami.html

- An activity designed to be used in conjunction with the NOVA episode of the same name to calculate approximate speeds and travel times for sample tsunamis (video not required for activity).

Introduction to Waves, National Geographic Xpeditions

<http://www.nationalgeographic.com/xpeditions/lessons/07/gk2/wavesintro.html>

- A lesson for younger students teaching the components of a wave, wave height and wavelength and using a demonstration about how to make waves, and an activity that allows students to experiment with creating waves of varying sizes.

COAMPS, Coupled Ocean/Atmospheric prediction center

<http://www.nrlmry.navy.mil/coamps-web/web/home>

- Have students research real time graphic 3D models of wave and atmospheric predictions using this site. Click on real time forecasts to observe data collected on waves and weather from research stations around the world.

ARTICLES / READING



California Academy of Sciences, Wild California

<http://www.calacademy.org/calwild/1999spring/stories/tsunamis.html>

- Read about Tsunamis and how they impact our lives through the online version of the magazine called Wild California. Check out the back issues for other informative articles on what you are presenting in the classroom.

CDIP, The Coastal Data Information Program

<http://cdip.ucsd.edu/>

- This site analyses data and conducts measurements on coastal environments. Educate yourself further about the science of waves by clicking on “documents” and read about wave generation and the dynamics of wave behavior.

QUEST QUAD

FIELD NOTES



Go outside and ...

- 🔍 Observe big waves
 - Estimate wave height, wave period, and determine wind direction.
 - Record differences during different times of the day and during different types of weather

FIELD TRIP



Visit ...

- 🔍 **Bay area Discovery Museum, Sausalito**
Wave Tank in Toddler Beach exhibit
www.baykidsmuseum.org
Bay Area Discovery Museum, Fort Baker
557 McReynolds Road, Sausalito, CA 94965
 - Observe wind pushing water into swells and how objects behave while in a water wave.

FIELD RESEARCH



Find out more about...

- 🔍 Tides
 - What causes high tides and low tides?
 - Why are high tides different at different times?
- 🔍 Big waves around the world
 - Identify where these “big waves” occur in other countries and create a worldwide map.
 - How does the geography and topography of these areas contribute to the formation of big waves?

FIELD TEST



Experiment with...

- 🔍 How energy is transferred during a wave.
 - Find a friend and a jump rope. Stretch the rope between you until it almost touches the ground. Jerk the rope and observe how the snap traveled through rope.
 - Mark a spot on the rope with tape and watch how those spots move when the wave is moving back and forth along the rope.
- 🔍 Creating your own wave pool.
 - Fill a long pan with water. Tap the water surface with a pencil to observe what happens. Describe what you notice about the direction of the waves.
 - After the water is still put a straw in the center of the water. Disturb the water with a pencil and observe what happens to the straw.
 - Drop some food coloring in the water and blow through the straw on the water surface. What happens to the colored water?

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www.oaklandzoo.org

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www.techmuseum.org

UC Berkeley Natural
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<http://bnhm.berkeley.edu/>

OTHER WAYS TO PARTICIPATE IN QUEST



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WATCH

**KQED Channel 9
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