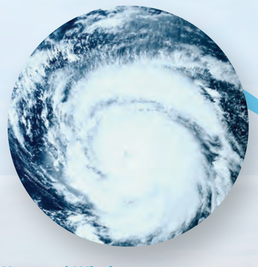
THE ULTIMATE WAVE TAHITI
A GIANT SCREEN EXPERIENCE

WHAT IS A WAVE? WHERE DO WAVES COME FROM? WHERE DO THEY GO?

Solar Source
Stars like our sun are sources of energy in wave form. In the sun, chemical energy is transformed into radiant energy (electromagnetic waves), some of which reaches the molecules of Earth's atmosphere and ocean.

Solar Radiation and Heat
The radiant energy of the sun causes increased vibration among the molecules of the Earth's atmosphere, oceans and landforms; in this way, radiant energy is transformed into thermal (heat) energy.



Heat and Wind
Uneven heating causes areas of high and low pressure. Atmospheric gases move from high pressure areas to low pressure areas, and rise when they are heated, resulting in winds (mechanical energy) and wind storms (hurricanes, typhoons).

Wind and Waves
Wind blowing across the ocean's surface transfers some of its energy to the water, producing the mechanical energy of ocean waves.

Breaking Waves
When ocean waves encounter an obstruction, like a shoreline or shallow water, they break, transferring much of their energy as heat to rocks, reef or sandy bottom. Energy is again transformed.

Energy Transformed
The total amount of energy in an isolated system remains constant over time (Law of Conservation of Energy). This means that energy can neither be created nor destroyed, it can only be transformed from one state to another.

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All waves have three features in common:

1
Waves are energy transport phenomena: they transport energy, but do not transfer matter.

2
The energy of waves moves in specific patterns.

3
Waves have characteristics that include wavelength, amplitude, velocity, and sometimes frequency.

There are two basic kinds of waves:

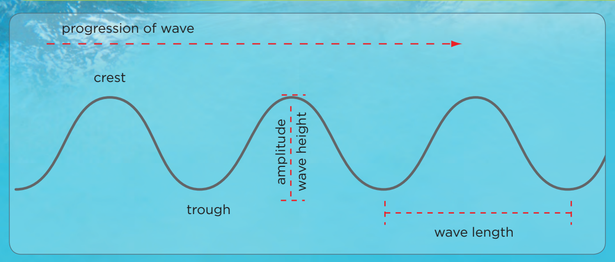
Electromagnetic Waves
are produced by the movement of elementary particles called photons, and include visible light, ultraviolet and infrared light, radio waves and microwaves. Energy is transferred by an electric field and a magnetic field oscillating together.

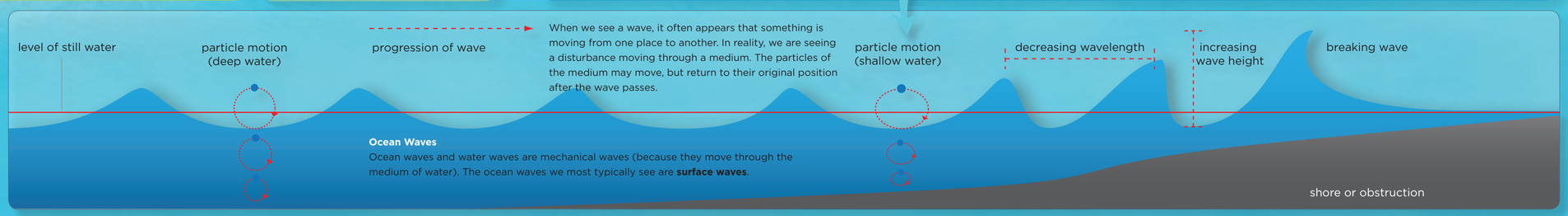
Mechanical Waves
are produced by movement of particles in a medium such as air or water. This movement causes transfer of kinetic energy from one particle to another. Mechanical waves include: sound waves, water waves, seismic (earthquake waves), and shock waves (explosions).

In a **surface** or **circular wave**, the particles of the medium move in a circular or elliptical pattern.

In a **transverse wave,** the particles of the medium move in a direction that is perpendicular to the direction in which the wave energy moves.

In a **Longitudinal or compression wave** the particles of the medium move in a direction that is parallel to the direction in which the wave energy moves.



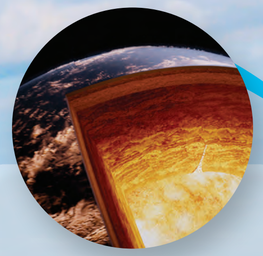


When we see a wave, it often appears that something is moving from one place to another. In reality, we are seeing a disturbance moving through a medium. The particles of the medium may move, but return to their original position after the wave passes.

Ocean Waves
Ocean waves and water waves are mechanical waves (because they move through the medium of water). The ocean waves we most typically see are **surface waves**.

WAVES ARE EVERYWHERE. HOW MANY DIFFERENT KINDS OF WAVES CAN YOU THINK OF? SOUND WAVES, LIGHT WAVES, MICROWAVES, OCEAN WAVES, EARTHQUAKE WAVES... BUT HOW CAN I SEE ONE? WHAT IS A WAVE? WHERE DO THEY COME FROM? WHERE DO THEY GO? WHAT MAKES SOME WAVES DIFFERENT THAN OTHERS? WHAT DO WAVES MEAN TO ME? MY BRAIN WORKS ON WAVES. CAN YOU CATCH A WAVE? WAVES CARRY ENERGY ACROSS THE COSMOS. **OCEAN WAVES** ARE SURFACE WAVES VISIBLE ON A GRAND SCALE: CARRYING ENERGY AROUND THE PLANET, SHAPING COASTS AND TRANSFORMING OUR ENVIRONMENT. WAVES ARE SIGNIFICANT IN ALMOST EVERY BRANCH OF SCIENCE. SCIENTISTS STUDY LIGHT WAVES, ELECTROMAGNETIC WAVES, GRAVITY WAVES, WATER WAVES AND MANY MORE SPECIFIC KINDS OF WAVES. CAN YOU HARNESS A WAVE? WHAT WOULD YOU DO WITH IT IF YOU COULD? WHAT IS YOUR ULTIMATE WAVE?

WHAT IS AN ISLAND? WHAT IS A CORAL REEF? WHERE DO THEY COME FROM?



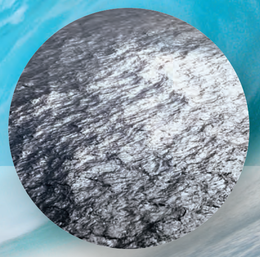
Island Origin
Volcanic islands begin as molten rock deep beneath the surface of the Earth. The Pacific island of Tahiti and those nearby were born out of the deep.

The Process
Upwelling of a hot mantle plume from Earth's interior promotes melting of rock under the oceanic crust, and the migration of magma toward the surface. Thin areas of the oceanic crust where this occurs are referred to as *hot spots.*

From Seamount to Island
Depositing blankets of lava and debris on the ocean floor, volcanoes must rise some 10,000 feet from the seabed to break the ocean surface in order to become an island.

An Island Chain
Over several million years, as the Pacific plate drifts over an underlying hot spot, a chain of volcanoes is formed. Young volcanic islands typically have a rounded or dome-shaped appearance.

Mountainous Landscape
Over millions of years, the exposed rock of a dormant volcanic island is eroded by water and wind into steeper and more mountainous structures. In tropical regions, coral organisms colonize the shallows around the island and coral reefs form.



Disappearing Act
Over time, through a combination of erosion and subsidence, volcanic islands eventually sink back below the surface of the ocean. An island that has sunk, leaving a lagoon and a surrounding coral reef, is known as an *atoll.* An island that has disappeared entirely beneath the ocean surface is known as a *guyot.*

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Life on a Reef
Waves breaking on reefs dissolve gasses and help support a diverse ecosystem and dense concentration of life. The reef environment is characterized by constant turbulence as seawater is pumped back and forth through the coral structures by waves, currents and tides. Coral reefs provide food and habitat. Fish and other organisms living around the reef are well adapted to harvesting nutrients in this turbulent garden.

Corals are Animals
Coral reefs are colonies of many individual coral animals called polyps ("PAHL-ips"). Each polyp makes its own cup-shaped skeleton called a calyx ("KAY-lix") from limestone (calcium carbonate). Most corals are carnivorous and feed on small floating animals or even fish. Many corals also feed by collecting small bits of floating material on strings of mucous, which they pull into their mouths. Reef-building corals have very small polyps (about 1-3 mm in size) and most also contain algae called Zooxanthellae ("zoh-zan-THELL-ee"). The corals and algae have a relationship that is called "mutualistic": the coral provides a protected environment and chemicals the algae needs to make food; the algae provides food and oxygen and helps remove wastes from the coral.

Living Rocks
Most reef-forming coral species thrive in tropical regions where mean temperatures are not less than 20°C (68°F). They develop in shallower waters where there is sufficient access to sunlight—occurring along coasts, along the edge of continental shelves and around islands like the volcanic island of Tahiti (below). A living shallow water coral reef is a self-renewing structure that absorbs wave energy and reduces coastal erosion. Some coral species are better adapted to cold water conditions and to deep water where there is little or no sunlight.

AT THE INTERFACE BETWEEN AN ISLAND AND THE OPEN OCEAN, IS A MAGIC ZONE WHERE THE ENERGY OF WAVES BREAKING IN SHALLOW WATER HELPS SUPPORT A RICH DIVERSITY OF LIFE. CORAL REEFS ARE STRUCTURES BUILT BY LIVING ORGANISMS—A SYNERGY OF PLANT AND ANIMAL LIFE. HOW IS MY COMMUNITY LIKE A CORAL REEF? HOW MIGHT MY COMMUNITY IMPACT CORAL REEFS AND OTHER MARINE ECOSYSTEMS?

This classroom poster was produced by The Ultimate Wave Tahiti Education Team: Mel Goodwin, PhD, Marine Biologist and Science Writer; Paula Keener, Director, Education Programs, NOAA Ocean Exploration and Research Program; poster design & illustration by Alexander Low. Images from The Ultimate Wave Tahiti, produced by The Stephen Low Company in association with K2 Communications.

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