Power From Waves

How ocean motion can become electricity

P.8.6.2 "Investigate research-based mechanisms for capturing and converting wave energy (frequency, amplitude, wavelength, and speed) into electrical energy."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that turn wave motion into electricity. Circle each wave measurement and number the two devices described in the passage.

Electricity at the Water's Edge

1. At a windy coast, a passing ocean wave lifts and lowers the water. Its amplitude is the greatest height of the water above its resting level; a larger amplitude usually carries more wave energy. Frequency tells how many wave crests pass one point each second. Wavelength is the distance between crests, and wave speed tells how far a crest travels each second. For a steady train of waves, speed equals frequency times wavelength. These measurements help engineers choose where to place devices and how to design them.

2. One device, called a point absorber, is a floating buoy tied to equipment below it. As waves lift and lower the buoy, its motion drives a generator, which converts motion into electricity. Engineers can tune the buoy's motion to waves with a certain frequency so it responds strongly. If the incoming waves have a very different frequency, it may move less and capture less energy. Higher-amplitude waves can move the buoy farther, but its parts must withstand strong waves. Electric cables carry the power to shore.

3. Another design, called an oscillating water column, has a chamber open to the sea below. Waves raise and lower the water inside, pushing air out and drawing it back in. A turbine designed to spin as air flows in either direction drives a generator. Engineers check wavelength and speed when choosing a site: together they indicate how often crests will arrive, since frequency equals speed divided by wavelength. That helps them match the turbine system to the wave pattern. Both devices turn wave motion into electrical energy, but they use different moving parts.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does a point absorber turn wave motion into electricity, and how can amplitude affect its motion?

2. Why might a buoy tuned to one wave frequency capture less energy when the frequency changes?

3. Trace the motion from an incoming wave to the generator in an oscillating water column.

4. Two sites have the same wave speed, but Site A has shorter wavelengths. Which site has a higher wave frequency, and why would an engineer need to know?

3 YOUR TURN

Your own words

A harbor has waves with large amplitude, short wavelength, and a fairly steady speed. In four sentences, choose one device from the passage, trace how it makes electricity, explain how two of the harbor's wave measurements would guide its design, and name one engineering concern.

Power From Waves

PART 1 · READ AND MARK

Underline the steps that turn wave motion into electricity. Circle each wave measurement and number the two devices described in the passage. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does a point absorber turn wave motion into electricity, and how can amplitude affect its motion?	**Waves lift and lower its buoy, which drives a generator. Higher-amplitude waves can move the buoy farther.**
2	Why might a buoy tuned to one wave frequency capture less energy when the frequency changes?	**A very different wave frequency may make the buoy move less, so it captures less energy.**
3	Trace the motion from an incoming wave to the generator in an oscillating water column.	**The wave raises and lowers water in the chamber. The water pushes air out and draws it back in, and the moving air spins a turbine that drives a generator.**
4	Two sites have the same wave speed, but Site A has shorter wavelengths. Which site has a higher wave frequency, and why would an engineer need to know?	**Site A has a higher frequency because frequency equals speed divided by wavelength. An engineer needs the frequency to match a device to the wave pattern.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would use a point absorber at this harbor. Its buoy rises and falls with the waves, driving a generator that makes electricity. I would calculate wave frequency from the steady speed and short wavelength, then tune the buoy to that frequency. The large amplitude may move the buoy farther, so its parts must be strong enough to withstand the motion.

Accept either device if the response correctly traces its energy-conversion steps and uses two stated wave measurements to guide design. Engineering concerns may include strong wave motion or matching the device to the wave pattern.