Ripples in Motion

Trace causes and effects in four wave interactions

PS.2.b "Develop models to illustrate reflection, refraction, interference, and diffraction."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each feature that changes a wave, circle what the wave does next, and number the four interactions in the order described. Use your marks to plan wave models.

A Wave's Route Through a Tray

1. In a school lab, a motor gently shakes one edge of a water tray, sending straight, evenly spaced crests across its surface. A crest is a line of high water, and the distance between neighboring crests is the wavelength. Sketches of these waves work best when they show direction with arrows and successive crests with lines. When the ripples strike a rigid wall at an angle, they turn back into the water. The outgoing direction mirrors the incoming direction across a line perpendicular to the wall. If the depth stays constant, the wavelength stays constant too.

2. A clear plastic shelf under part of the tray makes that region shallower. When ripples cross the shelf's edge at an angle, one side of each crest enters the shallow water first and slows first. The crest pivots, so the waves change direction. In the shallow region, they travel more slowly and their crests lie closer together, but the motor still sets the same frequency. A useful model keeps the crest lines connected across the boundary, bends their direction toward the perpendicular as they enter shallow water, and packs the shallow-water lines more closely.

3. Next, students set a barrier with two narrow gaps in the tray. Ripples passing through either gap spread outward as curved crests instead of continuing only straight ahead. This spreading is diffraction, and it is easiest to see when a gap is about as wide as a wavelength. Beyond the barrier, curved ripples from the two gaps overlap. Where crest meets crest, the surface moves more strongly; where crest meets trough, the motions partly cancel. A model of this interference can mark stronger regions and weaker regions, rather than drawing the waves as if they pass without combined effects.

2 ANSWER WITH EVIDENCE

Use the passage

1. Ripples strike a straight wall at an angle. Describe the outgoing arrows and crest spacing you would draw if the water depth stays the same.

2. Ripples cross from deep water into shallow water at an angle. Describe how your model should show their direction, crest spacing, and frequency.

3. Straight crests reach one narrow gap in a barrier. What shape should you draw for the crests beyond the gap, and what causes that shape?

4. Ripples from two gaps overlap. How would you mark a place where two crests meet and a place where a crest meets a trough?

3 YOUR TURN

Your own words

Design a wave-tank route that sends ripples around a corner and then creates both strong and weak regions. In the box, sketch a source, a slanted wall, a shallow patch, and a barrier with two narrow gaps; use wavefronts, arrows, and short labels to show how one set of ripples undergoes reflection, refraction, diffraction, and interference.

ANSWER KEY

Ripples in Motion

PART 1 · READ AND MARK

Underline each feature that changes a wave, circle what the wave does next, and number the four interactions in the order described. Use your marks to plan wave models. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Ripples strike a straight wall at an angle. Describe the outgoing arrows and crest spacing you would draw if the water depth stays the same.	**Draw arrows turning away from the wall at the same angle to its perpendicular as the incoming arrows. Keep the crest spacing unchanged.**
2	Ripples cross from deep water into shallow water at an angle. Describe how your model should show their direction, crest spacing, and frequency.	**Keep the crests connected at the boundary. Bend their direction toward the perpendicular and draw the shallow-water crests closer together. The frequency stays the same.**
3	Straight crests reach one narrow gap in a barrier. What shape should you draw for the crests beyond the gap, and what causes that shape?	**Draw curved crests spreading outward from the gap. The narrow opening causes diffraction.**
4	Ripples from two gaps overlap. How would you mark a place where two crests meet and a place where a crest meets a trough?	**Mark crest with crest as a stronger region and crest with trough as a weaker region because their motions partly cancel.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Sketch a source sending evenly spaced straight crests toward a slanted wall. Draw the reflected crests leaving at the same angle to the wall's perpendicular and traveling toward the shallow patch. At the patch boundary, keep the crests connected, bend their direction toward the perpendicular, and space them closer together. Direct them to two narrow gaps, then draw curved crests spreading from each gap. Mark a crest-crest overlap as strong and a crest-trough overlap as weak.

Accept any workable layout in which the wave path reaches the wall, shallow patch, and gaps in that order. Models should show the direction and spacing changes accurately and distinguish stronger from weaker overlap regions.