THE STANDARD

Waves & Energy

Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

ANCHORING PHENOMENON

The Tsunami That Hid in the Open Ocean

On December 26, 2004, a massive earthquake near Sumatra sent a tsunami across the Indian Ocean. In the deep open ocean, ships barely felt it. The wave was less than a meter tall and stretched for hundreds of kilometers. By the time it reached shore, the waves were up to 30 meters tall in some places, killing hundreds of thousands of people. Same wave. Same energy. The amplitude exploded as the water got shallow.

> **DRIVING QUESTION**
>
> *"How can a wave look harmless in deep water and devastating in shallow water if the energy didn't change?"*

INVESTIGATIVE 1

The Tuning Fork and the Water Cup

A tuning fork tapped softly and dipped into a cup of water makes small ripples and a quiet hum. Tapped harder and dipped in again, it splashes water out of the cup and the hum is much louder. Same fork. Same water. Two different amplitudes. Use this one to sharpen the amplitude-and-energy lens the anchor is pushing on: when a wave carries more energy, the amplitude is bigger.

> **DRIVING QUESTION**
>
> *"What changed about the wave when you hit the fork harder, and why did the sound get louder at the same time?"*

INVESTIGATIVE 2

The Slinky on the Floor

A slinky stretched across the floor between two students. One end gets a single up-and-down flick. A wave pulse travels down the slinky, hits the other end, and reflects back. Students can change the flick height and the flick speed independently. Big flick, small flick. Slow flick, fast flick. Same slinky, four different waves. The pattern they see is the same shape every time. Just different numbers.

> **DRIVING QUESTION**
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> *"Can you change the amplitude without changing the frequency, or are they tied together?"*