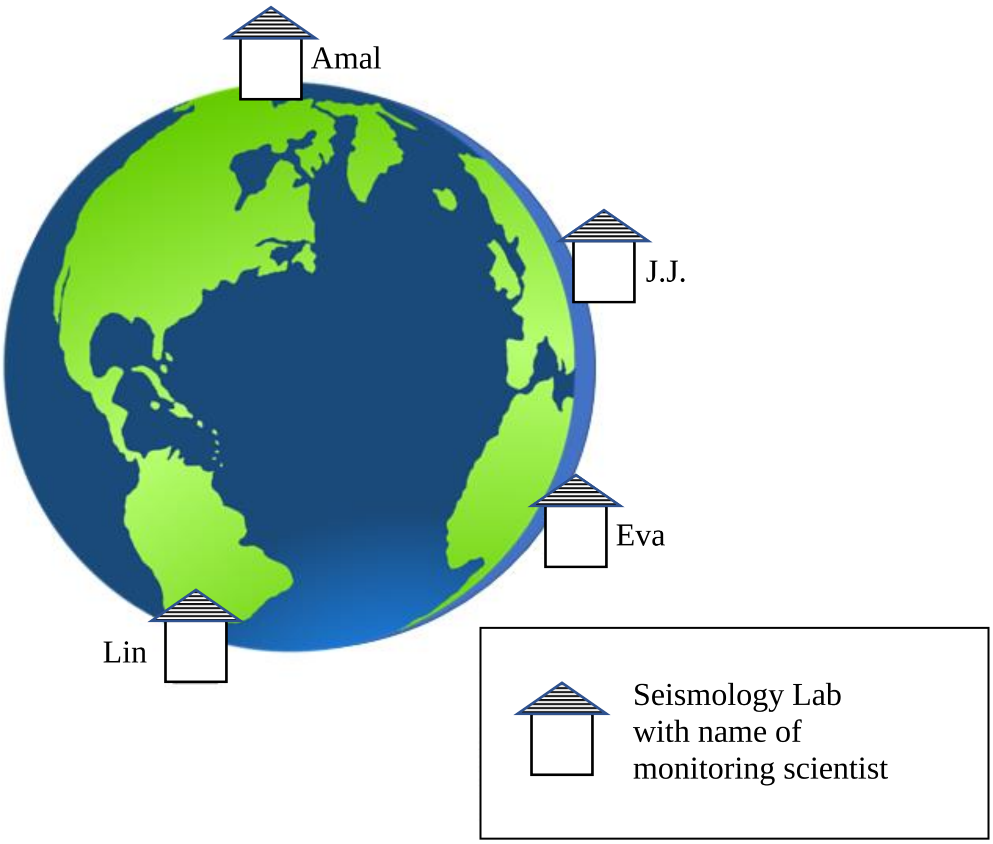
Anchoring Phenomenon:
The puzzle of the missing earthquake: Where and why can we detect earthquakes at different locations on the Earth's surface?



Conversation among the scientists:

Lin "Hey, guys! Did you just feel an earthquake? Did you record data on your lab equipment?"

Amal "Yeah! It was a big one! It hit so hard that I was tossed up in the air. I'm okay, and I'm sure glad my equipment was bolted to the floor! My lab equipment recorded one long period of shaking."

Eva "No, I didn't feel anything. Hang on a minute while I check my equipment. It doesn't show any shaking at all for the past few hours."

J.J. "That's weird. At first it felt like someone was punching my feet from below. Then a few minutes later it felt like I was bobbing up and down in a boat. My equipment recorded a few seconds of shaking. Then after a little while it recorded another few seconds of shaking."

Lin "That IS weird. At my lab it felt like a series of small, sharp punches and then it stopped. My equipment recorded about 20 seconds of shaking."

POGIL® Activities that support the anchoring phenomenon:

PSActivity 13 – Exploring Predictable, Repeating Patterns of Data
Describing waves in terms of amplitude and wavelength

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PSActivity 14 – More Properties of Waves
Wavelength and frequency are inversely related

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PSActivity 15 – How Does the Amplitude of a Wave Relate to the Wave's Energy?
Waves with greater amplitudes contain more energy; more energy causes more damage

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ESSActivity 2 – Earth's Layered Structure
The Earth is made of different layers, some solid and some liquid

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ESSActivity 3 – Movements Inside the Earth (Plate Tectonics)
The movement of magma inside the Earth causes movement of crust on the surface of the Earth

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ESSActivity 4 – To Shake or Not to Shake? Exploring How Earthquakes Behave
Earthquakes are caused by two types of mechanical waves traveling through the Earth. The waves travel differently through different materials

POGIL® Activity	NGSS Performance Expectation	Learning Outcomes
PSActivity 13	**MS-PS4-1** 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.	**Exploring Predictable, Repeating Patterns of Data** 1. I can describe the characteristics of a wave based on a time vs. height (distance) graph. 2. I can measure the height, amplitude, and wavelength of a wave from a time vs. height graph.
PSActivity 14	**MS-PS4-1** 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.	**More Properties of Waves** 1. I can estimate the wavelength of a wave from a time vs. height graph. 2. I can calculate the frequency of a wave from a distance vs. height graph. 3. I can describe the relationship between wavelength and frequency.
PSActivity 15	**MS-PS4-1** 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.	**How Does the Amplitude of a Water Wave Relate to the Wave's Energy?** 1. I can describe how the amount of energy in a wave changes as the amplitude of the wave changes. 2. I can predict damage to boats tied to a dock based on the amplitude of water waves.
ESSActivity 2	**MS-ESS1-3** Analyze and interpret data to determine scale properties of objects in the solar system.	**Earth's Layered Structure** 1. I can draw and label an accurate diagram that shows the three main layers of the Earth, including each layer's two parts. [includes the terms continental crust, oceanic crust, upper mantle, lower mantle, outer core, and inner core]

		2. I can describe how the density of different substances affects each substance's floating and sinking behavior. [using descriptions of relative densities - not numerical density values] 3. I can describe how the density of Earth's materials changes as you travel from the surface of the Earth to the center of the Earth. [finding patterns in numerical density values of Earth's layers; relating those patterns to position relative to the Earths' surface and center] The concepts developed in this activity (density/sinking/floating/structure of the Earth) are the foundational for students to develop the concepts of plate tectonics, mantle rock convection, boundary collisions, subduction, uplift, etc.
ESSActivity 3	**MS-ESS2-2** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	**Movement Inside the Earth (Plate Tectonics)** 1. Using a cross-section drawing of the layers of the Earth that includes magma flow patterns, I can predict where these features are likely to occur: mid-ocean ridges, ocean trenches, and uplift mountain ranges. 2. I can describe the differences and similarities between convergent and divergent plate boundaries. 3. I can write an accurate definition of the term plate tectonics
ESSActivity 4	**MS-ESS3-2** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of	**To Shake or Not to Shake? Exploring How Earthquakes Behave** 1. I can describe the differences in motion and travel speed between two types of mechanical waves.

	technologies to mitigate their effects. **MS-PS4-2** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	2. I can describe how the two types of mechanical waves travel through the Earth's layers during an earthquake.