Raspberry Shake

Lesson #1:

What is Raspberry Shake?

Goal:

Understand and be able to describe what the Raspberry Shake is — Understand what seismology and seismographs are, how the geophone works, how the data is processed, and how it can be used.

Key Terms:

- Seismic: Related to ground movement
- Seismograph: A device that measures and records seismic movement
- Geologic Fault: A fracture, or break, in the earth's crust
- Seismic Wave: Acoustic energy that moves through the earth's layers
- Geophone: A sensor that detects vibrations in the ground

Reading for understanding:

To understand what the Raspberry Shake seismograph is and how it works, we must start by gaining an understanding of what seismology and seismic waves are. We will start with the question:

What is seismology?

Seismology is the study of seismic waves, waves of acoustic energy that travel through the earth. Like sound waves, seismic waves can be measured. Just like we can measure sound waves with microphones, we can measure seismic waves with seismographs.

Natural seismicity is caused by events such as earthquakes, volcanic activity, harmonic tremors, and extreme weather events, among other causes. Man-made seismicity can be caused by events like construction work, explosions, and fracking.

What are seismographs and how are they used?

A seismograph is any device that detects and records seismic wave energy, meaning basically any ground vibrations. The sensor, called the seismometer, is usually a suspended mass that stays in the same place while the earth around it

moves. As the mass moves, it sends analog data to a “digitizer”, which converts the data into frequency and amplitude. This data is then recorded digitally into the squiggly-line graph format that is commonly seen called a seismogram.

Seismographs can “feel” everything from earthquakes to a car driving by. Any movement that travels through the ground is picked up by these sensitive devices. For this reason, it is not common to see seismographs in areas with major traffic and other anthropogenic disturbances.

Around the world, seismographs are used for different industries and areas of study, all pertaining to the movement of the earth. Seismologists use them to locate the epicenter (starting point) of earthquakes and un, volcanologists use them to detect underground magma movement, and petroleum geologists use them to discover oil underground.

What about our shake? What is a geophone?

Our Raspberry Shake has two main components: The sensor that actually measures the movement, and the analog-to-digital converter on the Shake board.

The main sensor is a geophone. We can think of a geophone as a low-frequency “ground microphone”. A geophone works by generating electric signals that represent ground motion (and earthquakes!). These signals are “+” and “-” and, since they are measured through voltage, we commonly refer to them as “analog” signals. When you pass a magnet through a coil, an electrical current is generated in the coil. This is exactly what happens inside a geophone - a coil suspended on a spring surrounds a magnet. As the Earth moves and shakes, the inertial mass rises and falls, passing up and down around the magnet creating a small electrical current. The Raspberry Shake board, the device that digitizes the data, then converts the signal to a digital signal that you can see on your computer screen.

How can we use our shake?

The Shake can be used to measure anything that causes ground vibrations, and it can process that data in a variety of ways. The raw seismic data that the Shake records can be seen on the waveform-viewer application SWARM. SWARM also gives access to all Raspberry Shake seismographs forwarding data to the

network, so you can see the data from the more than 800 Shakes connected to the network.

Raspberry Shake is unique in that is the only affordable seismograph that offers

The Shake can also do much more than measure earthquakes. Any ground vibrations are detected by the Shake's sensitive geophone, meaning that the Shake can also "hear" traffic, fireworks, busy streets, strong bass speakers... anything that can cause the ground to vibrate!

The University of Michigan created a "cheer-meter", to measure which team had the biggest applause during sports games. They created Cheer Magnitude equations and everything! Just imagine the possibilities of use in our classroom, outside of earthquake monitor.

Practice

Time: 10-15 Minutes — Get to know Raspberry Shake

Use laptops to explore the Raspberry Shake website — especially the Station View and EQ View web apps. Explain how each of the stations play a part in the EQ View earthquake map, and how your Raspberry Shake is a part (or will be a part) of that network.

Closing - Writing and Sharing

Time: 5-10 minutes — Planning for the Future

Option 1: Get into groups of two or three and brainstorm five (5) uses for the Raspberry Shake seismograph *other* than detecting earthquakes. Then, volunteers will share with the class.

Option 2: Your Raspberry Shake will soon become part of an important global seismic network, that detects, identifies, and measures earthquakes! Come up with ideas of the best place in the school to deploy the Shake as part of the seismic network. Keep in mind noise, power connection, ethernet connection, etc