Robogals Science Challenge

Minor Challenge Set #3
STEM Field: Civil Engineering
Level: Senior
Challenge Name: Build Your Own Seismograph
Project Cost: 0-20 USD
Materials Required:

- Cardboard box
- Paper or plastic cup
- String
- Marker
- Scissors
- Paper, or the blank side of a long printed receipt
- Tape
- Small, heavy objects to use as weights, such as coins, marbles
- An extra person to help (optional, but highly recommended)

Safety:

- Be careful when handling scissors.

Duration:

- The challenge takes approximately 1 hour to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules.

Introduction:

A seismometer or seismograph is an instrument that measures motions of the ground, for example, motions created by earthquakes, explosions or other sources. Seismographs are used to find and measure the size

of those motions. They are installed in the ground throughout the world, so that when the earth shakes, the recording device on seismographs record the motion. They are very sensitive and can detect earthquakes that occur very far away, which can be hard for humans to feel.

In this project, we will build our own seismograph and observe how the motion recorded by the seismograph tells us about the shaking pattern.

Instructions:

1) Fold a piece of paper in half along the longer side, then fold in half again. Cut the paper along the folds to form four equal-sized strips, and tape them together end-to-end, to form one long strip. Alternatively, use a long printed receipt, and skip this step.

2) Cut the lid off the cardboard box. Stand the box up on one of the smaller sides.

3) On the bottom edge of the cardboard box, cut two slits on opposite ends. Ensure that the slits are as close as possible to the bottom edge. The slits should be wide enough for the paper or receipt to fit.

4) Poke two holes opposite each other near the rim of the cup. Be careful when poking the holes.

5) Cut a piece of string slightly longer than the length of the box. Tie the string to each hole on the cup.

6) Push the two pieces of string through the holes and tie or tape them together at the top of the box, so that the cup hangs down inside the box. See the figure below for reference. The bottom of the cup should not touch the bottom of the box.

7) Poke a hole in the centre of the bottom of the cup. Remove the cap from the marker and push the marker through the hole, so that its tip barely touches the bottom of the box.

8) Fill the cup with coins or small weights, ensure the marker is vertical.

9) Place the paper such that the marker is centred on the paper strip.

10) You are ready to use your seismograph! Ask your helper to stabilise the box with their hands as you slowly start to pull the paper strip through the box from one side to another. Remember to always pull the paper at a constant speed.

11) The helper now shakes the box back and forth, as you pull the paper strip slowly through. Observe how the line on the paper strip changes.

12) Pause the shaking for a few seconds while continuing to pull the paper strip. Then try shaking the box harder.

13) Vary the shaking pattern until the paper strip has been pulled all the way out of the box.

Extension

Does your seismograph work if you shake the box side-to-side or up and down? Can you design a seismograph that can record motion in multiple directions?

You can observe the data from real-time seismograph displays on this website. Each plot represents 24 hours of data from one station. Read the seismograph from left to right, and top to bottom. When an earthquake occurs, the seismograph will show ground motions, including different wave types.
https://earthquake.usgs.gov/monitoring/seismograms

Reflection Questions:

- Are there any improvements you would make to this challenge?

- Can you tell how hard the box was shaking based on the line? What do you notice about the pattern of the shaking and the line drawn?
- Do your own research and explain in your own words, how does a seismograph work in real life? If seismographs record all ground motions (from ones caused by a car passing by, to a real earthquake), how can we tell which signal is caused by an earthquake?
- What is the name of the scale used to measure earthquakes' strengths?

Submission Guidelines:

- Submit a photo of the experiment setup. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- Learn more about how seismographs work - https://www.britannica.com/science/seismograph
- Learn more about applications of the seismograph - https://www.britannica.com/science/seismograph/Applications-of-the-seismograph

Bibliography:

- *Make your own seismograph: Stem activity* (no date) *Science Buddies*. Available at: https://www.sciencebuddies.org/stem-activities/make-a-seismograph (Accessed: May 8, 2023).
- *Seismometers, seismographs, seismograms - what's the difference? how do they work?* (no date) *Seismometers, seismographs, seismograms - what's the difference? How do they work? | U.S. Geological Survey*. Available at: https://www.usgs.gov/faqs/seismometers-seismographs-seismograms-whats-difference-how-do-they-work (Accessed: May 8, 2023).