

Model Seismograph-Classroom Demonstration

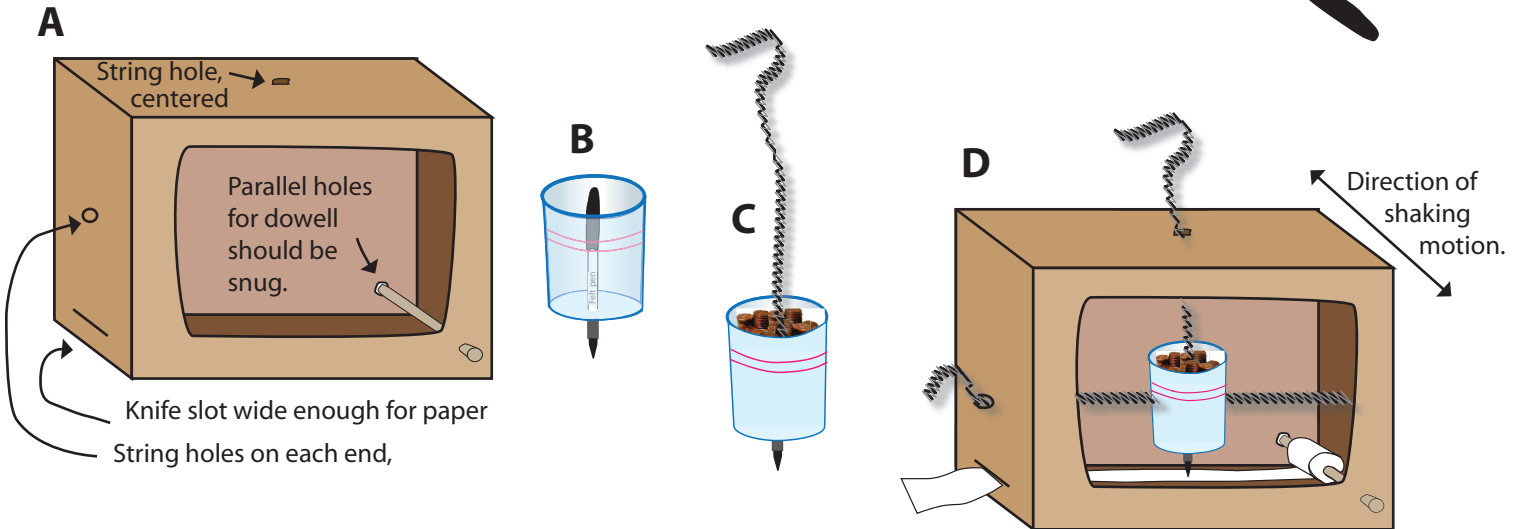
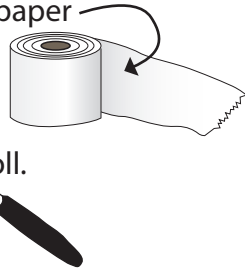
By Jenda Johnson*, based on [John Lahr's](#) earthquake website, and modified from a design developed by the California Science Center.. This is the simplest classroom seismograph I have found using common materials. For background information go to: [IRIS](#) website and select "[Seismograph](#)"

Concepts

A seismograph detects, amplifies, and records earthquakes as well as other ground motion. Seismographs operate on the principle of inertia—stationary objects, such as this cup of pennies hanging on a string, remain stationary following sudden movement of the surrounding frame and drum. Although this model detects and records movement, it won't amplify the signal as a sophisticated instrument does.

Materials

- Rigid cardboard box, ~14"
- Can or cup, 12 oz.
- String, three ~18-inch pieces
- Roll of adding machine paper
- Pennies, cup full
- Felt-tip pen
- Tape
- Dowell, must fit paper roll.



Construction Instructions

- Cut a cardboard box with the front opening, 4 holes and a paper slot. Slide dowell into snug hole.
- Make a snug pen-diameter hole in the bottom of a cup or can. Insert pen from inside until it is good and stuck. This may require taping it inside and out.
- Tie a string tight around the pen, or duct tape it. (You might want to do this before putting the pen in the can.) Fill the can with pennies.
- Hang the cup inside the box so that the pen just touches the bottom lightly (with the cap off; replace cap when not in use!). You may need to reinforce the box top so it doesn't sag. Attach string to the sides of the can with tape to restrict lengthwise motion. Here we are trying to just get the back-and-forth movement (see arrow), not set off a circular pendulum motion. Put paper roll on dowell in box; feed paper end out the slot. Make sure that the uncapped pen is touching the paper.

Demonstration

Set the box on a table. Block the ends to limit right-left motion. Pull the paper slowly through the slot to record a straight line. (No earthquakes)

Begin discussion on what might happen. Make hypotheses. There will be different responses depending on how abrupt the shaking occurs.

One person pulls paper at a steady rate and another jiggles the table side-to-side. You need to make sure that the "earthquake" motion is **quick and short** (1/2 inch to an inch back and forth) so you don't overcome the inertia of the mass that is on a short string. The squiggle on the paper is the "seismogram."

Why didn't the pen move with the box?



Right: Photographs of an actual Model Seismograph taken at an NSTA meeting in 2002. The upper is viewed from the back, keeping the mystery of the internal workings.

Left: A modified Model Seismograph made by John Lahr. The tin can is suspended from a loop of wire that only allows it to move in one direction. A marking pen is pushed through a hole in the bottom of a can, which is then filled half way with small pebbles.



Design Your Own Seismograph

modified from [Alan Kafka's](#) activity, *Buld Your Own Seismograph for AS-1 users*

Objective:

Students will gain a greater appreciation of how a seismograph works, and a better understanding of recordings of ground motion that they see on seismograms.

Activity:

In small groups of 3-4 students, students are asked to design and construct a seismograph using common household and craft materials provided. Students will demonstrate to the class how their seismographs record motion.

Procedure:

Ask the students to think of a creative way to measure seismic waves generated by an earthquake using some of the materials provided. Ask them to draw a clear diagram of their seismograph, and label all the parts. For homework, ask them describe how their seismograph works.

A good design would be:

- capable of determining the relative size of each disturbance it measures;
- capable of measuring vibrations continuously for at least several sec;
- capable of measuring vibrations from three different sources: a bang on or shaking of the table holding the seismograph; a person jumping up and down on the floor next to the table on which the seismograph is located; and a ball bounced off of a wall or floor nearby.
- After the designing and building of the seismographs have been completed, each team should present to the class how their seismograph works. After each group presents their design, the teacher will give a brief description of how seismographs (including the AS1) record ground motion.

Reflection:

How can your seismograph design be improved?

What elements of your seismograph are similar to seismographs used by seismologists? What elements are different?

What were some of the challenges you encountered in designing and building your seismograph? How did you try to solve those problems? Did you succeed in solving those problems?

What are the physical principle underlying the mechanism of how your seismograph measures ground motion?

Can you think of any other reflection questions that would be appropriate for this exercise? If yes, what is your question, and how would you answer it?

Suggested list of materials for this exercise:

- masking tape and/or duct tape
- weights or sinkers
- empty paper towel rolls or toilet paper rolls
- coil springs
- straws
- paper
- paper plates
- paper cups
- pipe cleaners
- marbles
- pens and pencils
- bouncy ball for demos
- string or wire
- scissors
- miscellaneous items brought to class by the students.