Building and Testing Earthquake Resistant Structures

Grade Level:

- 4
- 5
- 6
- 7
- 8

Lesson Time:

55 minutes

Objective:

Students will be able to discuss how different magnitudes of earthquakes affect structures uniquley by simulating how buildings become damaged in an earthquake.

Preparation

Before going to the classroom, you will need to:

1. Contact the teacher to find out the length of the class period, as well as how many copies of handouts and sets of materials you need to bring.
2. Alert the teacher that this investigation is set up for groups of two.
3. Collect all the materials in the materials list and organize them into one Tool Bag for each group of four students (zip-closing baggie with index cards, roll of plastic tape, cardboard base, paper clips, and stopwatch)
4. Make photocopies of the handouts.
5. Collect any giveaways for the students, such as plate tectonic posters.
6. Run through the investigation yourself and record the data, just to see how long it takes. Adjust the timing to the class period, remembering that you will need time to introduce the investigation, clean up afterwards and re-set up for the next class.

Materials:

Provide students, in groups of two, with the following:

- 16 4” x 6” (10 X 15 cm) index cards

- Roll of clear plastic tape
- 12” square (30.5 cm) piece of cardboard for a base
- Box of metal paper clips
- Paper and pen to record observations
- Watch with a second hand or stopwatch
- Observation Sheet

For instructional purpose:

- Overhead or PowerPoint of *Photos of Earthquakes*

Purpose

Earthquakes are a sudden motion that results from a release of built up energy within the Earth. Seismologists can record the energy (seismic waves) from earthquakes by using an instrument called a seismometer. The greater the amount of energy, the more the needle on the seismometer jumps to make “pulse-like” patterns. When we think of earthquakes, we often think of the damage that occurs as a result of the quake. With many earthquakes, damage to buildings and structures can be devastating.

In this investigation, students will learn how different magnitudes of earthquakes affect structures differently. Depending upon how a structure is built, the damage done to the structure can vary.

Safety

Participants should put on safety goggles before starting this investigation. Please review it for the specific setting, materials, students, and conventional safety precautions.

Investigation Question

How do earthquakes destroy buildings?

What to do

1. **(5 minutes)** Introduce participants to the destruction earthquakes cause by sharing *Photos of Earthquakes* and discussing how the damage to the building happened. Be sure to accept as many explanations as you can. Some questions you might want to ask are:
    - What happened in this picture? How do you know?
    - What caused the damage to the buildings?
2. **(5-10 minutes)**. Have the classroom teacher help break students up into pairs. Instruct each pair of students to build structures. Participants will:
    - Roll 12 index cards into equal-size tubes and secure them with tape.
    - On the cardboard base, build a model of a four-story building by using the tubes as pillars and using the remaining index cards as floors and the roof. Do not tape the tubes or cards together, but you should tape the floor of your structure to the cardboard base!
3. **(5-10 minutes)** After all the participants have finished building their structures, instruct participants to shake the base gently for five seconds. Participants should record their

observations. Then shake for 10 seconds, 15 seconds, and 20 seconds. Record what you observe after each interval of shaking. This shaking demonstrates a small-scale earthquake and its effect on structures that are not properly reinforced.

4. **(5-10 minutes)** Instruct participants to rebuild the structure as before. Now, repeat your test and shake the base faster and harder than before. Participants should record their observations on their observation sheet. This demonstrates a much larger earthquake and the extensive damage to structures that are not properly reinforced. Discuss results. Be sure to accept as many explanations as you can. Some questions you might want to ask are:
    - Was your building more or less resistant than it was for the first shaking tests? Why was that?
    - How do you think you could make your structure stronger and more stable?
5. **(10-20 minutes)** Rebuild the structure you tested, but this time, use the tape and paper clips to reinforce the structure so that it will not collapse easily. Once you have built your reinforced structure, repeat the tests as before, by first shaking the base gently and then harder and faster. If necessary, add more reinforcing material to make your structure as stable as you can and repeat the shaking tests. Participants should record their observations on the observation sheet. Discuss the results of the simulation. Be sure to accept as many explanations as you can. Some questions you might want to ask are:
    - What did you have to do to your structure to keep it from falling down? What was the most important reinforcement you made and why?
    - What differences did you see in testing the reinforced structure compared to the non-reinforced structure?
    - How can your models resemble and demonstrate what happens to real buildings during an earthquake?
    - If you had to design a building to withstand an earthquake, what would you do to make sure it was strong enough, and why?
6. **(2 minutes)** Thank students for their time and attention. You can leave giveaways behind for the classroom teacher to distribute.

ObservationSheet-eqstructures.pdf