Shaker

**Purpose**
To demonstrate why some buildings are more damaged by earthquakes than others.

**Materials**
- Scissors
- Ruler
- Transparent Tape
- Sheet of copy paper
- 4- by-8-inch (5-by-20-cm) piece of corrugated cardboard

**Procedure**
1. Cut two 1-inch (2.5-cm) strips from the paper. One strip should be 10 inches (25 cm) long, and the other 8 inches (20 cm) long.
2. Tape the ends of each strip together to form two rings.
3. Tape the rings to the center of the piece of cardboard so that they are about 1 inch (2.5 cm) apart and stand side by side like the wheels of a car. The openings of the two rings should face the short ends of the cardboard.
4. Shake the cardboard from side to side, starting with a slow back-and-forth movement and gradually increasing the speed of the movements.

**Results**
The large ring moves when the cardboard is shaken slowly, and the small ring moves when the cardboard is shaken quickly.
Shaker

Why? Every object has its own natural frequency, or rate of vibrations. The larger ring's natural frequency is lower than the smaller ring's, so it vibrates at a lower frequency (has a slower back-and-forth motion) than the smaller ring. This is because it is less stiff and more massive. When an outside force of the same frequency causes an object to vibrate, this action is called resonance or sympathetic vibration. So when the cardboard is shaken at the frequency of the large ring, it vibrates or resonates, but the small ring does not. The opposite is true if the cardboard is shaken at the frequency of the small ring. During an earthquake (violent shaking of the Earth caused by sudden movement of rock beneath its surface), buildings of different sizes respond differently to the shaking of the Earth. One reason is their natural frequencies. If the earthquake’s frequency matches a building's natural frequency, the building resonates, meaning it shakes more violently.