Chapter 6: Seismology and the Earth

Student Worksheet

Objective:

Understand the basics of seismological activity and how it contributes to the understanding of the layers of Earth.

Engage:

Have you ever experienced an earthquake? If so, what surprised you? If not, what do you imagine this might be like? Which famous earthquakes inform this picture?

Introduction:

In this activity, you will use a seismometer on your smart phone or iPod Touch to explore the strength of earthquakes. You will simulate earthquakes of varying strengths.

Chapter 6 in your textbook explains how scientists can learn about the internal structure of our planet by studying the P and S waves measured at various distances from an earthquake's epicenter. It is not easy to study the interior of our planet. Your book tells you if you liken the Earth to an apple, the deepest humans have ever drilled (about 12km) would not even penetrate the apple's skin. Scientists rely on inferring information about the interior of the Earth from seismic activity and other methods to paint a picture of the Earth's internal structure. This is true not only for Earth, but also for stars.

Procedure:

1. Your instructor will guide you through downloading, installing and interpreting your new seismometer app.

2. Answer the following questions using the software iSeismometer.

a. Describe what happens to the graphs when you tilt the phone vertically, horizontally, and diagonally, and flip it like a pancake?

b. What determines the readings on the graph?

c. What directional force is acting on the phone to cause a reading of +1 or -1?

d. Shake the phone. Notice that you get a reading of negative g's. Does this mean gravity has gone away?

3. Shake your phone so you reach about a force of + or – 1 g. Describe how hard it is shaking. What would this feel like if it were the Earth shaking?

4. If your house were shaking like this, would it be enough to cause damage?

5. What is the maximum g level you can shake your phone?

6. Study Table 1 below. The Roman numerals indicate the Modified Mercalli Intensity scale, which quantifies observable effects of an earthquake. The intensity values are listed side by side with the acceleration values.
Your instructor will set a table that you and your classmates may shake to try to match the accelerations listed on Table 1.

Table 1

Modified Mercalli Intensity	Acceleration (g)	Description of Intensity Level
I	<0.0017	Not felt except by a very few under especially favorable circumstances.
II	0.0017	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	0.014	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	0.014 – 0.039	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	0.039 – 0.092	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	0.092 – 0.18	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	0.18 – 0.34	Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	0.34 – 0.65	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	0.65 – 1.24	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	> 1.24	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	> 1.24	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	> 1.24	Damage total. Lines of sight and level distorted. Objects thrown into the air.

Credit: U.S. Geological Survey

7. Figure 1 below shows an intensity map of the 1994 Northridge earthquake in the Los Angeles area. Study the map and answer the questions that follow.

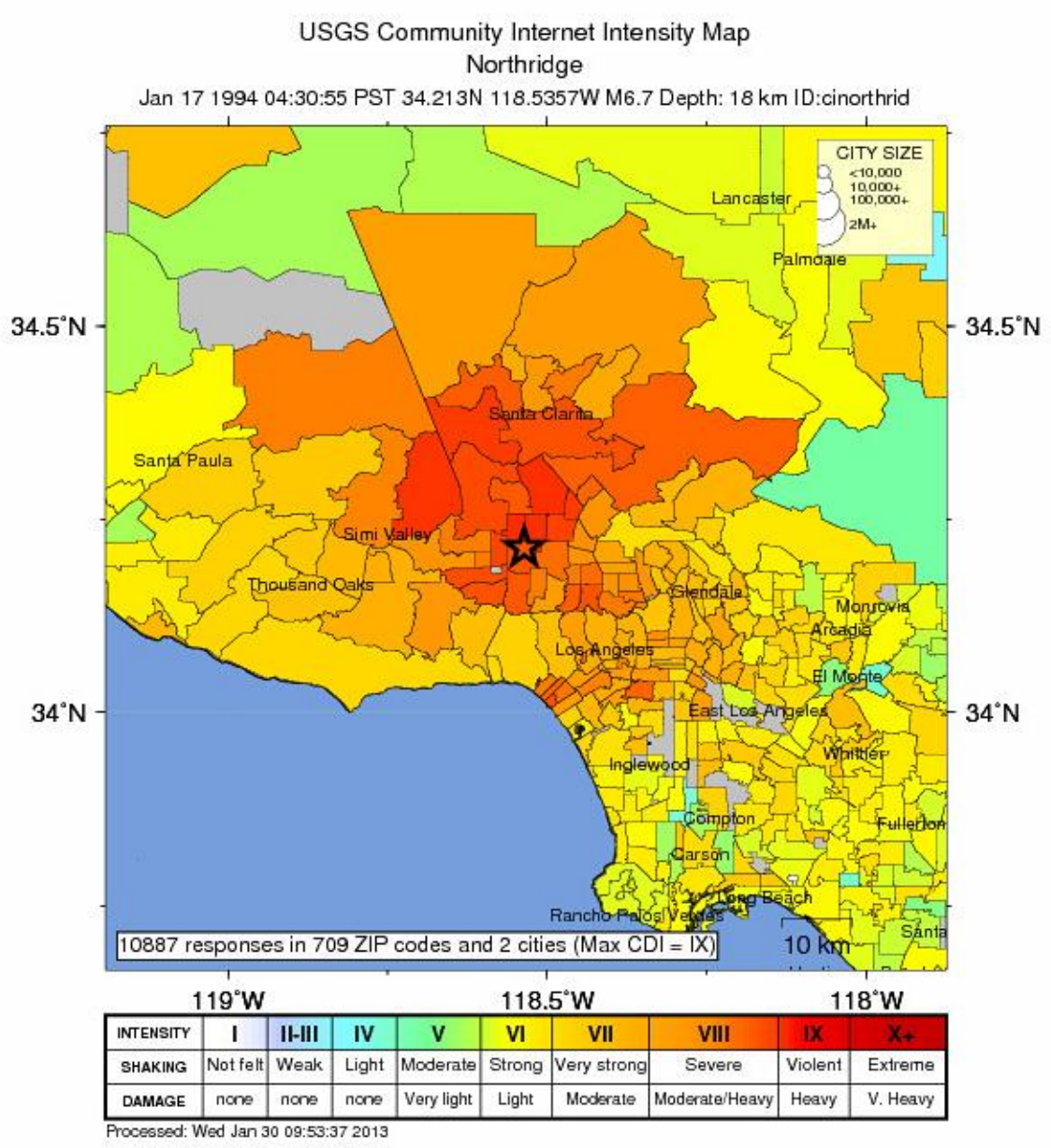

Figure 1 U.S. Geological Survey

a. What is the highest probable range of accelerations felt?

b. How do these accelerations compare to the shaking you created in your demonstration?

c. How could the iSeismometer app be used as a tool in measuring earthquakes? What are the limitations? What are the benefits?

Extend:

- Study some of the biggest earthquakes of our planet's history: San Francisco, 1906; Chile, 1960; Japan, 2011. What were some of the intensities felt? Describe some of the damage done.

- Describe how earthquakes and density give us an understanding of the interior of our planet.