Magnitude & Log Scale: A Visual Demonstration

***Putting Down Roots*, pp. 14-15**

Idaho State Standards:

8/9th Earth Science 1.2
8th Mathematics 1.1.1
9th Mathematics 1.1

Objectives:

Students will learn the earthquake magnitude scale by breaking different amounts of spaghetti. The visual scale of the pasta emphasizes the relative differences between magnitudes each whole step in magnitude.

RATIONALE

This is a teacher demonstration that visually explains the idea of the magnitude logarithmic scale for earthquakes.

FOCUS QUESTION(S):

- What is the difference between the energy released in a magnitude 5 and a magnitude 6 or 7 earthquake?

TEACHING CLUES AND CUES

The severity of an earthquake can be expressed in terms of both intensity and magnitude. However, the two terms are quite different and they are often confused.

Intensity is based on the *observed* (qualitative) effects of ground shaking on people, buildings, and natural features. It varies from place to place within the disturbed region, depending on the location of the observer with respect to the earthquake's epicenter.

Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake and is based on the amplitude of the earthquake waves recorded on instruments with a common calibration. Thus, the magnitude of an earthquake is represented by a single, *instrumentally determined value* (quantitative).

The magnitude scales for earthquakes are logarithmic scales. In particular, each increase of 1 unit on the Richter scale --say from 6 to 7--represented an increase of one order of magnitude, i.e. times 10, in the amount of motion recorded on a particular type of seismograph.

The now-common **Moment Magnitude** (Mw) scale was defined because the Richter scale does not adequately differentiate between the largest earthquakes. The new "moment magnitude" scale is a new technique for using the Richter scale. In the moment magnitude scale, a magnitude increase of one unit corresponds to a factor of 30 increase in the energy released by the breaking of the fault in an earthquake. That is why we increase the number of spaghetti noodles from 1 to 30 to 900.

MATERIALS:

- 1-lb. package of thin spaghetti
  or
- 2-lb. package of regular spaghetti

PROCEDURE:

Teacher Preparation

Bundle the spaghetti prior to the class.

A. Introduction

Hold up a piece of spaghetti. Inform students that you will be using the spaghetti to demonstrate and develop a magnitude scale similar to the Richter scale or Moment Magnitude scale for earthquakes. The scale is based on the amount of energy needed or generated during earthquakes.

B. Lesson Development

1. Hold up a piece of spaghetti. Bend the piece between your hands until it breaks. Notice the work it takes to break the spaghetti. Call this a 5 on the "Pasta Magnitude" (Mp) scale.

2. Hold up a bundle of 30 pieces of spaghetti. Bend the bundle until it breaks. Notice the work it takes to break the bundle. If the pasta scale were like the earthquake magnitude scale this would be a Pasta Magnitude 6 break.

3. Hold up the remainder of the package, about 900 pieces of pasta. Bend the bundle until it breaks. Notice the work it takes to break the bundle. This is a Pasta Magnitude 7 break (*Haiti, 01/12/10*).

C. Conclusion

To release the same amount of energy released by one **M7** earthquake would require the equivalent of 30 **M6** or 900 **M5** quakes. Did you see/hear all the little "quakes" before and after the big-quake break?