The Earth Lesson Plan

Time: 50 minutes

Goals: To gain an understanding of the size of the Earth and the methods used to calculate distance.

Objectives: Students will:

- Watch the "Earth" segment of the "How far away is it" video book
- Use a tape measure and protractor to measure distance in the classroom – checking the measurement errors introduced
- Take a short quiz

Materials:

- Protractor
- Tape measure capable of reaching the ceiling
- Calculator for computing Tangent of an angle
- Internet connection with a computer for viewing "The Earth" segment on YouTube

Directions:

1. Introduce the video book as a tool for learning the size of the Earth, the Solar System, our galaxy, and the Universe. Point out that we'll be building a distance ladder that starts in a backyard and ends at the edges of the known visible Universe.
2. Introduce the Earth segment as our starting point on this journey. Point out that we'll be constructing the first rungs of our distance ladder.
3. Show the video.
4. Review what they saw:

    - How we use direct measurement and triangulation for objects you can see such as the top of a mountain.
    - How we use going there for objects you can reach such as a pillar or the top of the atmosphere.
    - How we use geometry for the largest objects such as the Earth itself.
    - How we use knowledge of physical processes to calculate distances such as how far away a lightning strike is.

5. Enforce how important measurements are and how errors introduced in the measurements translate into uncertainty about the distances.

Assessment options: Here are two assessment options based on prerequisites:

1. Without Trigonometry: Take a simple quiz. Print and distribute the quiz on page 3. Here are the answers:

    - In what layer of the atmosphere does the Space Station orbit?
      Answer: b) The Thermosphere
    - Remembering that sound travels through air at around .2 miles per second, how far away is a lightning strike that is seen four and a half seconds before it is heard?
      Answer: c) d = (.2 miles/sec) x 4.5 sec = 0.9 miles
    - What did Eratosthenes calculate in 200 B.C.?
      Answer: d) The circumference of the Earth

2. With Trigonometry: Using a protractor and tape measure, triangulate the height of your classroom ceiling. Exercise instructions in handout form are on page 4.

    - Pick a corner. Measure a baseline along the floor. Use the protractor to measure the angle from the end of the baseline to the ceiling corner.
    - Calculate the height.
    - Then measure the height directly with the tape measure.
    - Note the difference in the two methods.
    - Ask the class why the triangulation was as off as it was:
        - Errors measuring distance due to the granularity of the tape measure
        - Error measuring angel due to the granularity of the protractor
        - Error making the baseline parallel with the floor

The Earth quiz

- In what layer of the atmosphere does the Space Station orbit?

  a) The Stratosphere
  b) The Thermosphere
  c) The Mesosphere
  d) The Troposphere

- Remembering that sound travels through air at around .2 miles per second, how far away is a lightning strike that is seen four and a half seconds before it is heard?

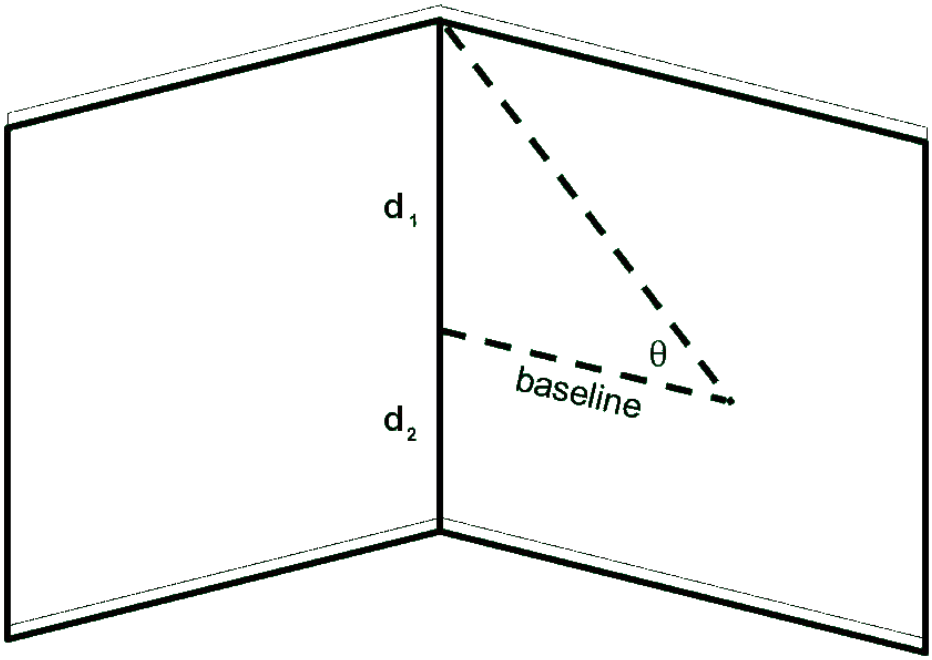
  a) .5 miles
  b) .7 miles
  c) .9 miles
  d) 1.1 miles

- What did Eratosthenes calculate in 200 B.C.?

  a) Pythagorean's theorem
  b) Distance to the Sun
  c) The length of one day
  d) The circumference of the Earth

The Earth Exercise

- Pick a ceiling corner.



- Measure a baseline parallel to the floor.
- Note the baseline's distance from the floor = d_2
- Use the protractor to measure the angle from the end of the baseline to the ceiling corner = θ
- Calculate d_1 = baseline x tan(θ)
- Calculate the ceiling height = $d_1 + d_2$
- Then measure the height directly with the tape measure.
- Note the difference in the two methods.
- Ask the class why the triangulation was as off as it was.