

# Earth Science Regents

## The Circumference of Earth

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Name \_\_\_\_\_

Period \_\_\_\_\_

Around 200 B.C., a mathematician living in Egypt named Eratosthenes used a clever method involving observation of the sun in two nearby locations to determine the actual circumference of the earth. In this lab, you will use some modern technology to collect data that you will use to determine the size of the earth without leaving the campus!

### Materials:

2 wooden stakes or other suitable location markers

50m tape measure

GPSr (a GPS receiver)

Field notebook or data sheet attached to this lab

(NOTE: If you know how to set placemarks (waypoints) and go tos with your GPSr, you don't need the stakes or tape measure)

### Procedure: (if you **don't** know how to set placemarks and go tos)

1. Set your GPSr to report your position in decimal degrees (DD.DDDD) and to report distances in meters and kilometers.
2. Locate yourself in an open area, say near the center of one of the playing fields, and plant one of the stakes in the ground there.
3. Holding the GPSr directly over the stake, read and record the EXACT latitude and longitude of your location.
4. Walk in such a way that your latitude changes, but your longitude remains constant .....(In what direction(s) can you walk to accomplish this? \_\_\_\_\_). 30 or 40 long paces should be far enough.
5. Check that your new location has exactly the same longitude as your original location, and plant the second stake in the ground at your new location. Record the EXACT latitude and longitude of your new location.
6. Determine the angular distance between the two stakes by finding the difference between the latitudes of the two stakes. Record that angular distance.
7. Using the tape measure, determine the distance between the two stakes, and record that distance.

Skip to "Answer/Do the following"

### Procedure: (if you **do** know how to set placemarks and go tos)

1. Set your GPSr to report your position in decimal degrees (DD.DDDD) and to report distances in meters and kilometers.
2. Locate yourself in an open area, say near the center of one of the playing fields, and set a waypoint. You can call it what you want - I suggest "point 1"
3. Walk in such a way that your latitude changes, but your longitude remains constant .....(In what direction(s) can you walk to accomplish this? \_\_\_\_\_). 30 or 40 long paces should be far enough.
4. Check that your new location has exactly the same longitude as your original location, and set a second waypoint.
5. Determine the angular distance between the two waypoints by finding the difference between the latitudes of the two waypoints. Record that angular distance.
6. Set a 'go to' from your second waypoint back to the first, and read and record the distance between them.

**Answer/Do the following:**

1. What is the angular distance (in degrees) from your position north to the north pole, then south to the south pole, and then back to your position? You can use a globe if you're having a hard time imagining it.

\_\_\_\_\_

2. What fraction of those 360 degrees is between the two stakes? \_\_\_\_\_

3. We are trying to determine the circumference of the earth (we'll call that  $C_e$ ). What fraction of  $C_e$  (in meters) is between the 2 stakes?

\_\_\_\_\_

4. How do the 2 fractions you determined in steps 2 and 3 above compare with each other? Write an equation showing that relationship:

5. Solve for  $C_e$ , and check for the accepted value by performing a web search for "polar circumference of the Earth" Record your calculated value for  $C_e$ , and the accepted value for  $C_e$  below (make sure both are in the same units!):

Calculated (or observed)  $C_e$  = \_\_\_\_\_

Accepted Value of  $C_e$  = \_\_\_\_\_ (Source? \_\_\_\_\_)

5a. How many meters (or kilometers) did you miss by? \_\_\_\_\_

6. Refer to the ESRT, and write the equation for determining percent deviation (percent error) below:

7. Calculate the percent of error in your calculation of the Earth's circumference (show your work, even if you use a calculator).

8. Assuming your measurement is not exactly the accepted value, list and EXPLAIN where the error may have come from. (Do not include "human error" – I assume you were both thoughtful and careful as you made your measurements).

## FIELD and CALCULATED DATA:

First Observation Point

Latitude \_\_\_\_\_

Longitude \_\_\_\_\_

Second Observation Point

Latitude \_\_\_\_\_

Longitude \_\_\_\_\_

Angular distance (difference in latitude) between Observation Points

\_\_\_\_\_

Linear distance between Observation Points \_\_\_\_\_m \_\_\_\_\_ km