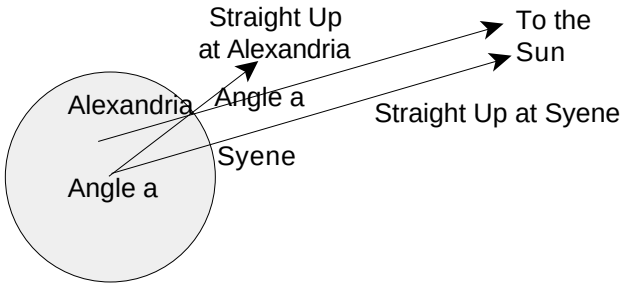
Two centuries before the birth of Christ (-200 CE) a Greek librarian and mathematician living in Alexandria, Egypt devised a way to determine the size of the Earth. Fortunately, his travels had also taken him to the city of Syene, far to the south along the great Nile River. Quite remarkable that someone would calculate the dimensions of planet Earth over a thousand years (!) before most people realized that the Earth is, in fact, a sphere and that Earth is, in fact, a planet. Perhaps more remarkably, based on the work that Eratosthenes had done, one of his students (Aristarchus) actually calculated both the size of the moon, as well as its distance from the Earth to the moon!!!

Date _____ Per. _____

But Eratosthenes (era TASS then ease) was a well educated and remarkable man.

Materials: A plastic hemisphere An external protractor
A strip of masking tape 10-15 cm long

Eratosthenes based his calculation on observations of the sun at the summer solstice in Alexandria and at Syene. On this date, the sun was straight overhead at noon in Syene, but it was not quite overhead at Alexandria



A. Make two very small dots near the center of the tape exactly 1.25 centimeters (12.5 mm) apart. Label one dot "Alexandria" and the other dot "Syene." Alexandria • • Syene

B. Carefully place the tape straight along a plastic hemisphere so there are no folds in the tape.

C. Use an external protractor to measure the angle from Alexandria to Syene. **a =** _____

D. Place your strip of tape along the bottom of this page.

E. Use the following proportion to calculate the circumference of the plastic sphere. (Show your work below.)

$$\frac{a}{360^\circ} = \frac{\text{Distance d}}{\text{Circumference}}$$

a = the difference in angle from Syene to Alexandria
Distance d = the distance from Syene to Alexandria

1. What is "angle a" other than the difference in the position of the noon sun in the sky from Syene to Alexandria? (Hint: See the diagram above to find the other angle angle that **a** represents.)

_____

2. Why did most people (and perhaps even Eratosthenes) actually think the Earth is flat? (Not a sphere)

_____

Place your marked tape here. ↘

(Continue to page 2)

3. Why was "Librarian" a title of more respect in the days of Eratosthenes than it is today? (Please give several reasons.)

_____

_____

4. How could you repeat the experiment that Eratosthenes did with the real Earth? Please list the steps of your procedure 1, 2, 3...

_____

_____

_____

_____

_____

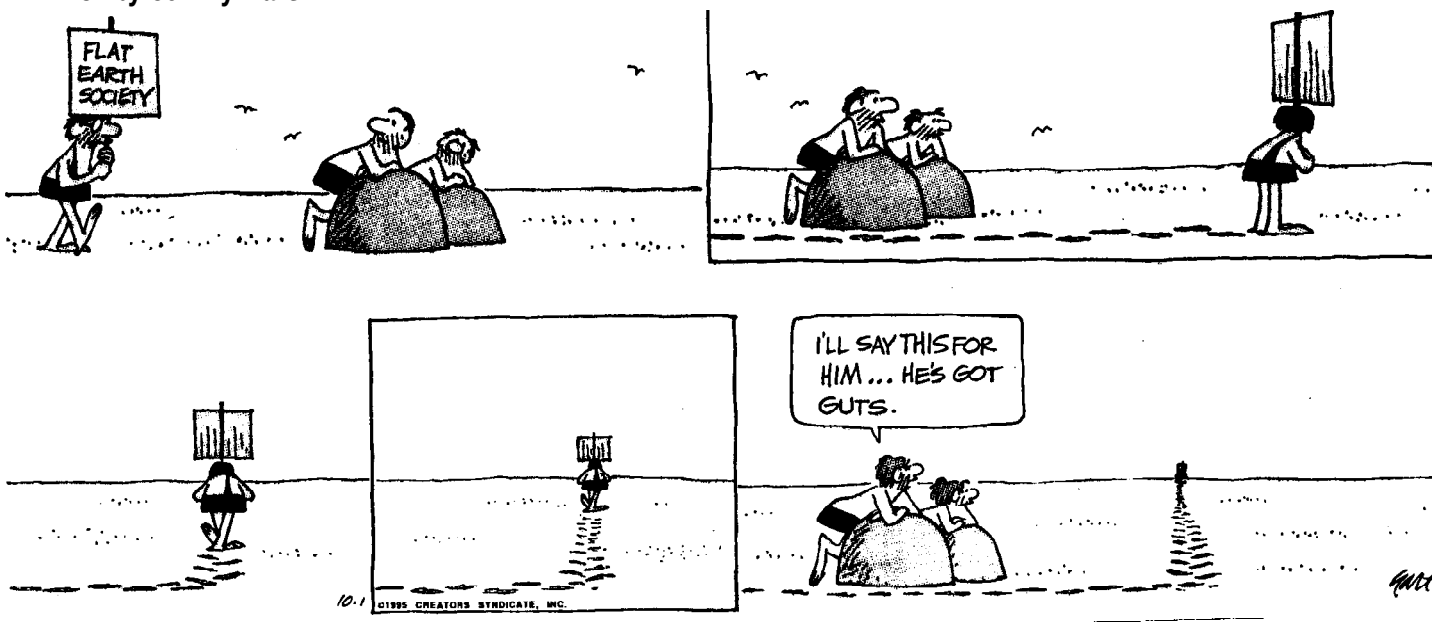
Extension 1: (Historical)

A. Why was the Nile so important to the people of Egypt?
B. What relatively recent construction project has upset the ecology of the Nile Valley?
C. What benefits and what problems did the modern construction project cause?

Extension #2: (Mathematical)

Use a photograph of the the moon during an eclipse or a diagram supplied by your teacher to find the size of the moon as well as it's distance from Earth.

B.C. by Johnny Hart



Greek Geometer Key

Globe Circumference: About 64 cm. (Allow ± 10%: 57-71 cm)

1. Angle “a” is also the angle from Alexandria and Syene with a vertex at the center of the Earth.

2. As we look around us, the Earth seems flat.

3. Because most people could not read and because “books” (scrolls) were very rare and slowly made by hand, recorded knowledge took on special meaning.

4. 1. Select two distant locations on the Earth where the sun is visible at the same time. (If they are located on a North-South line, it is easier to do.)
   2. Measure the angle of the sun above the horizon at both places at the same time.
   3. Set up the proportion below:

$$\frac{a}{360^\circ} = \frac{\text{Distance d}}{\text{Circumference}}$$

a = the difference in angle from Syene to Alexandria
Distance d = the distance from Syene to Alexandria

4. Solve the proportion for the circumference of the Earth.

The Greek Geometer Tips

Difficulty: Not Terribly Difficult

Content: Important

Preparations: Set out materials

Materials: As listed in the lab.

Time: ~ 40 minutes

Suggestions for the Teacher:

1. This lab is written for ESCP plastic globes or hemispheres about 64 cm in circumference.
2. Try the procedure yourself before you use it in class.
3. Stress understanding of the method in preference to to just getting a good answer.
4. Although students can cheat by measuring the circumference with a string, the author's experience is that this is very rear.

Student Intro: Explain to students how Eratosthenes measures the size of the Earth.

Post-Lab: None

Extensions: As listed on the lab.