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The Eratosthenes experiment: calculating the Earth's circumference

Extension activities

Extension activity 1: Calculate the radius of the Earth

Calculating the circumference of the Earth is a good chance to refresh knowledge of circle mathematics and, more specifically, how we calculate the radius of a circle when we know its perimeter. Thus, students can calculate the Earth's radius and compare it with the one we know today.

- Remind your students of the equation that connects radius and perimeter.
- Ask them what π is.

At this point, you can start a discussion on the basics of a circle (diameter, radius, surface, etc.), depending on your students' ages.

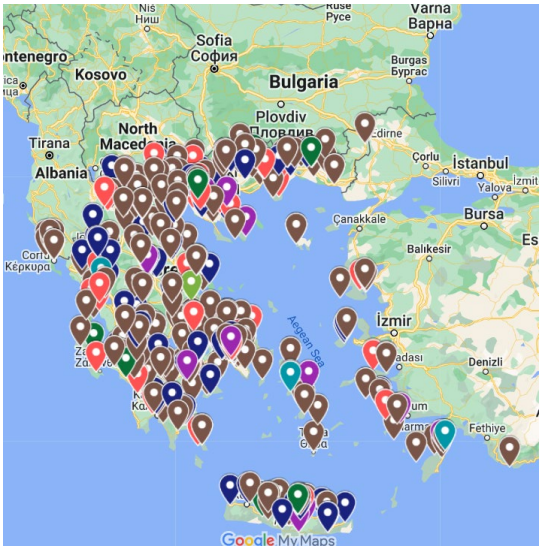
1. Calculate the Earth's radius (r) based on the value of the perimeter found in Activity 3.
2. Write down the value of r on the worksheet.
3. Compare it with the mean value we use today.

What is the Earth's exact geometrical shape? (We now know that it is not perfectly spherical.)

Ask your students which radius value they calculated and why.

Extension activity 2: Collaborate with another school

The activity can be done with two partner schools on the same meridian. But, for this activity, a database of schools is necessary. For example, in Greece, in the last few years, the Panhellenic Union of Heads of Laboratory Centers of Natural Sciences (PANEKFE)[1] has guided all science teachers in Greece on how to carry out the experiment. Firstly, by providing worksheets and instructions for the teachers to carry out the experiment to measure the distance from the equator on the equinoxes. Secondly, by making a database of all the Greek schools, if the experiment is to be done with two schools, a teacher interested in collaborating with another school can find a partner through this database, exchange e-mails to make the calculations, and obtain a result for the Earth's circumference.



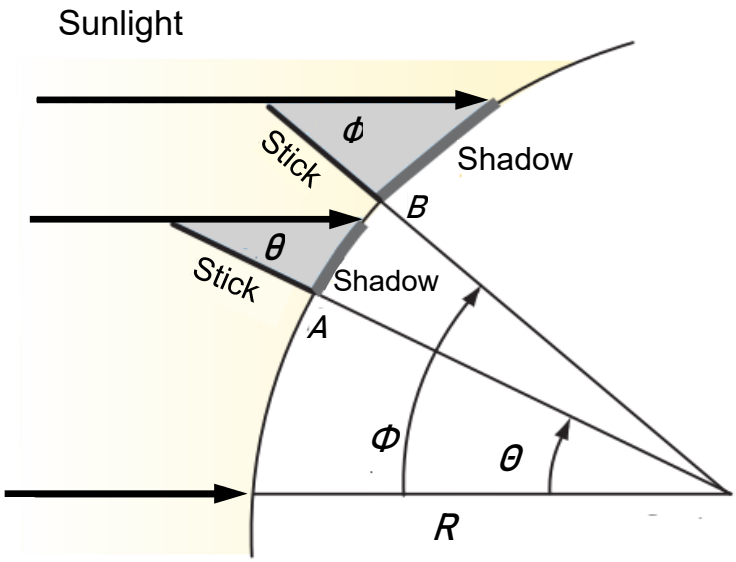
Schools in Greece taking part in the March 2023 Eratosthenes Experiment organized by PANEKFE, Greece

Made with "Google My Maps" application

The geometry and calculations are quite different from those needed for one school, but the logic is the same. If you are going to be school A:

1. Find the angle θ.
2. Ask your partner school to do the same to find angle φ and send you its value.
3. Subtract the two angles.
4. Measure the distance between school A and school B using Google Maps or Google Earth.

To measure angles ϕ and θ, you do the same as in the main activities: measure the length of a stick and its shadow at local noon, calculate the tangent, and then find the angle. The corresponding angle to the arc *AB* is the difference of $\phi - \theta$.



Geometry for measuring the circumference of Earth using data from two collaborating schools on the same meridian

Adapted from Teacher's guide: the Eratosthenes project

You can then calculate the circumference (C) of the Earth by using the following equation:

$$\frac{AB}{\phi - \theta} = \frac{C}{360}$$

Even if this activity seems to be more difficult, it is worthwhile because students get in touch with other schools and other countries, exchange angles, and work as a team to measure the circumference of the Earth.

The experiment will have better results if the distance *AB* between the two schools is as large as possible. You can ask your students to explain why.