

The Eratosthenes Project



Silvina Ponce Dawson

Departamento de Física, FCEN-UBA

Supported by:



www.df.uba.ar

www.fisica.org.ar

What is it?

It is a project for high and/or middle school students to measure in a collaborative way the radius of the Earth.

In this talk

Basics of the measuring process



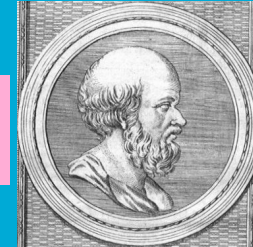
How participation was organized



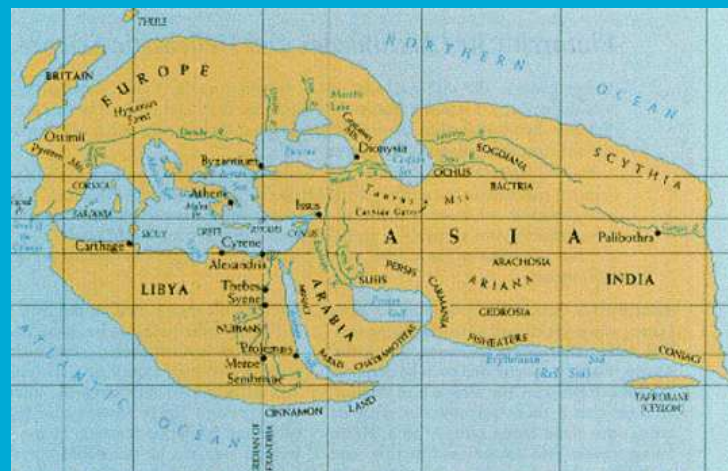
The method

The method was "designed" by Eratosthenes in III BC.

Who was Eratosthenes?



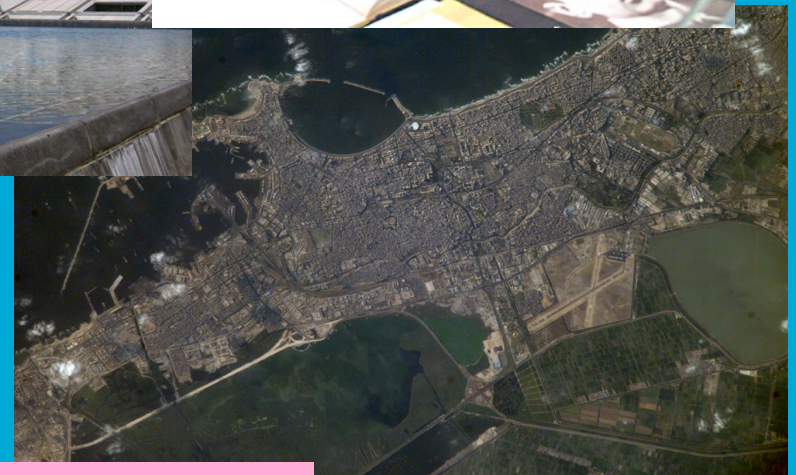
He was a Greek mathematician, geographer and astronomer that was born in what is currently Libia. For many years he worked at the library of Alexandria. It was while working there that he devised a way to measure the radius of the Earth.



Alexandria was one of the most famous cities of the ancient world. Founded by Alexander the great in IV BC it was the capital of Egypt for many years.

It was very well known for its library that was destroyed by a fire.

In 2003 a new library was opened nearby where the ancient one was.



Alexandria and its library nowadays

What did Eratosthenes realize?

He saw that, at noon, the Sun's rays formed a different angle with respect to the vertical depending on the point on the Earth.

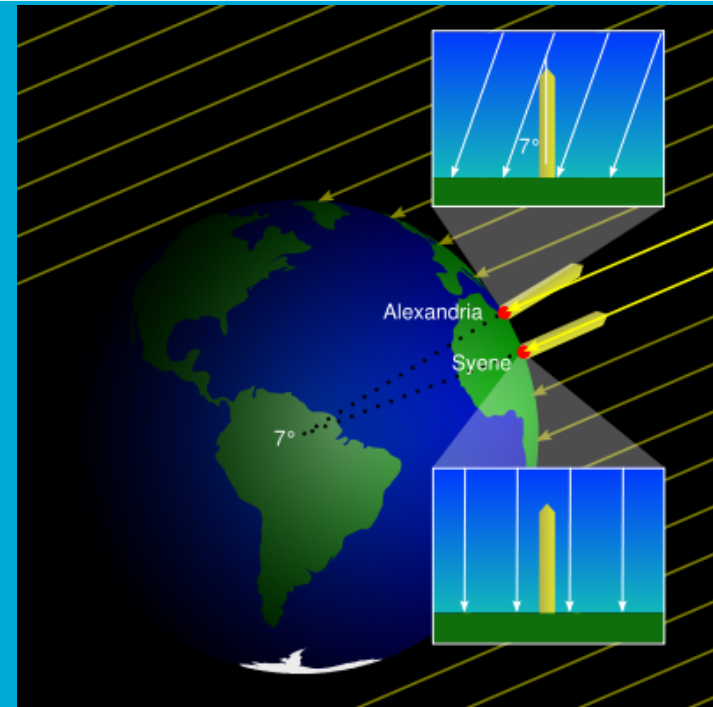


He compared what happened in Alexandria and Syene (today's Aswan)

[Animation in French webpage](http://lamap.inrp.fr) (la main a la pate, lamap.inrp.fr)

The angle that a vertical line forms with respect to the rays was different in Syene and Alexandria because the Earth is round.

For this reason the size of the shadows of two objects of the same size at noon (when the shadow is shortest) is different in Syene and Alexandria.



By measuring the size of the shadow of a vertical object and comparing it to the size of the object it is possible to determine the inclination of the rays at a particular site.

Calculating as Eratosthenes

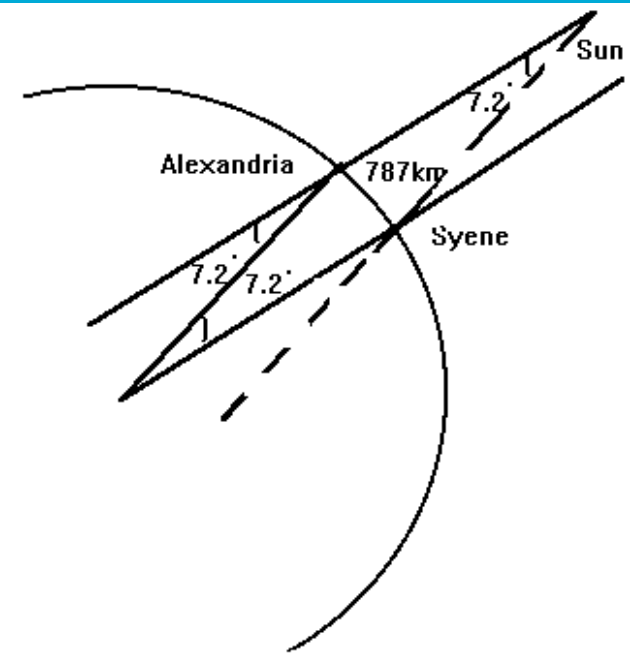
At noon on June 21st, the rays are completely perpendicular in Aswan, but form a 7.2 degree angle in Alexandria.

Knowing the distance between Aswan and Alexandria, 787 km, (and knowing that they are roughly on the same meridian) we can compute the Earth's diameter, X.

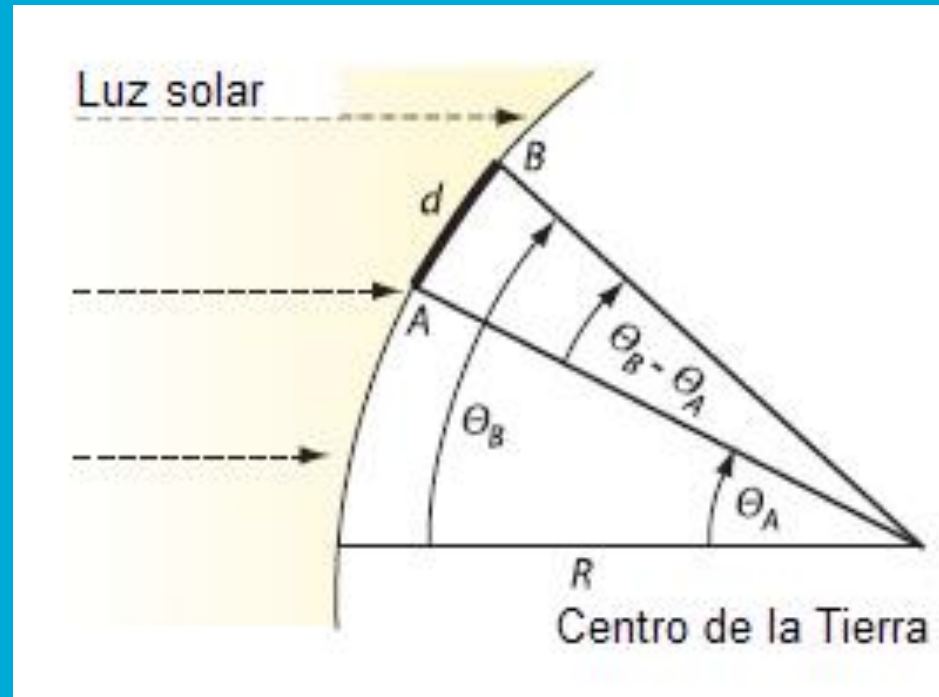
$$7.2 / 360 = 787 / X$$

We then deduce: $X = 39350$ km.

Since R and X are related by: $2\pi R = X$, we get R. Eratosthenes got: $R = 6263$ km (R is currently considered to be 6371 km)



Actually, you can do the calculation comparing the measurements performed at noon on any 2 points along the same meridian.



Given the angles along the meridian of the 2 points (θ_A y θ_B) and knowing the distance, d , between both, we equate: $d/X = (\theta_B - \theta_A) / 360$, from which we can obtain the perimeter, X .

If 2 groups agree to measure the size of the shadow of a vertical object at noon on the same day, sharing their measurements and knowing the location of the two sites it is possible to deduce the size of the Earth's radius.

This is what the Eratosthenes project is about. Students from groups of "partner schools" need to agree on when to measure and share the necessary information to obtain the Earth's radius.

Us, as organizers of the activity, pair up the participating schools (define "partners") and mediate their collaboration. We also provide any necessary support and collect all measurements to compute the Earth's radius ourselves.

To this end we set up a [web page](#) where schools can register. A guide for the teachers is also provided in that page.

We also created a [Facebook group](#) where any participant can share experiences and photos.

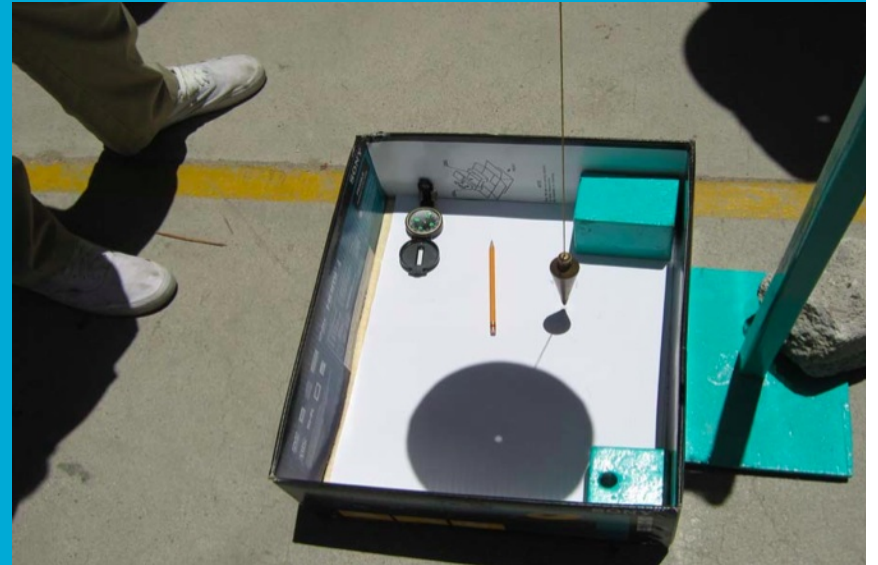
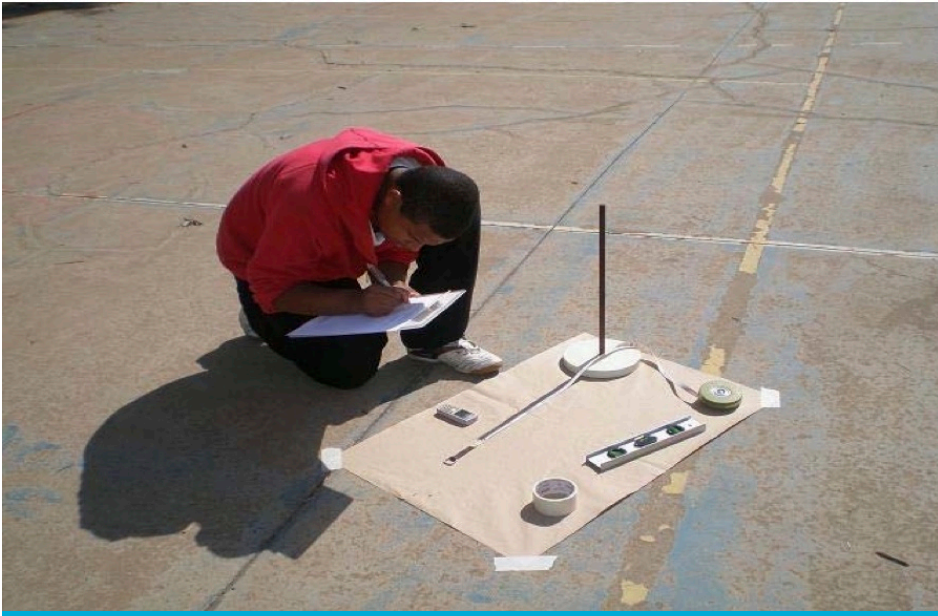
2010 was very special because many schools from places other than Argentina participated ([list of schools](#)).

In 2010, 226 schools participated and the students involved were more than 15000. Measuring dates ranged between June 18th and 24th. The number of schools that effectively collaborated with the final calculation were 174.

The values that the pairs of schools obtained varied between 6000 and 8000km. We built a histogram based on those values that was fitted by a Gaussian. We obtained the mean:

$$R = (6375 \pm 25) \text{ Km.}$$





This year we are planning to make the measurements around September 21st.

If you would like schools that you know to participate of this project, please ask them to visit our web page at:
<http://eratostenes.df.uba.ar/> or www.df.uba.ar

Or come and join our Facebook group Proyecto Eratostenes