

Measure Your World



A Collaborative Science Education Activity for students in the United States, Chile and Mexico

Eratosthenes Method to determine the Circumference of the Earth

Materials Needed

1. A large sheet of paper (11" x 17" will work) or the Shortest Shadow Circle (SSC) downloadable at www.educared.cl
2. Compass
3. Level
4. Plummet or plumb bob (optional)
5. Gnomon (Note: a gnomon is the 'pointer' on a sundial.) Your gnomon can be a straight stick or an empty tube. Your gnomon must be able to stand independently and should be set such that it stands vertically. A longer gnomon will result in a more accurate measurement.
6. Pencil or Pen

Procedure

Register your team

1. You will need to form a team and register this team online at www.measureyourworld.org/register.php. A team should consist of one adult sponsor (teacher, parent or adult community member), one bilingual speaker (someone that is bilingual in English and Spanish), and at least one student. Registration is open from August 13th – September 14th.
2. After registration, your team will be partnered with two other teams to form a MYW Partnership. The MYW Partnership will consist of three teams, one each from the U.S., Chile, and Mexico. Partnership information will be mailed to you on September 21st.
3. Meet your partners through online communication between September 21st and 29th. You are encouraged to learn

about the geography and culture of your partner teams (see partnership checklist at www.measureyourworld.org/part_checklist.html) and share this online at www.measureyourworld.org/part_share.php

Preparation – Determining solar noon and identifying your location

1. Choose the day(s) that you will most likely take your measurement. You can take as many as one measurement per day between September 29th and October 7th.
2. Determine solar noon for your location on the day(s) you plan to take a measurement. (for help visit www.measureyourworld.org/meas_solarnoon.html)
3. Gather your materials. If you are using the SSC, download and print.
4. Identify an appropriate place outside where you can take your measurement(s). There are two important steps in identifying a location:
 - a. Identify a place that is away from trees and buildings to eliminate extra shadows.
 - b. Your chosen surface must be level. You can use a level surface on the ground (such as a concrete walkway) or a flat table. Use a level to make sure your surface is horizontal.

Set up and measure

Plan on doing a practice set up at least a day or two in advance of the day you plan to take your measurement(s).

1. About 20 minutes before solar noon on your measurement day, take all of your materials and go to your chosen location.

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- Place your paper or SSC on a level surface.



- Place your gnomon near one edge and mark the location with a pencil, or if using the SSC, in the center. Be sure the gnomon is set such that it stands vertically. The plummet or plumb bob may help you with this.



- If using a sheet of paper, use the compass to mark North.
 - If using the SSC, use the compass so that the arrow (with the letter N) in the SSC points to the North.
- At solar noon, using a pencil, mark the top of the shadow on your SSC or paper.



Note: It is likely that the top of your shadow will be 'fuzzy.' Please measure in the middle.

- Measure the length of the shortest shadow cast by the gnomon.



Report, Calculate and Report!

- Complete the Shadow Measurement Report Form (Page 3) and report online at www.measureyourworld.org/rep_shadow.php
- Share your measurements with your Partnership. A data lookup is available to review all your Partnership's shadow measurements at www.measureyourworld.org/calc_datalookup.php
- Calculate the Earth's circumference following the steps on Page 4. For complete information, visit www.measureyourworld.org/calculate.html
- Complete the Earth's Circumference Report Form (Page 4) and report online at www.measureyourworld.org/rep_earthcirc.php

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Shadow Measurement Report Form

(* = required fields)

Please fill out this form for each measurement you make. You can make up to one shadow measurement per day between September 29th and October 7th. After completing this form, report your data online at www.measureyourworld.org/rep_shadow.php

***Measure Your World ID:** _____

(For help, visit www.measureyourworld.org/reg_id_reminder.php)

***Local Time:** _____

(This time must be close to local solar noon.)

Date

***Month:** _____

***Day:** _____

Location (For help, visit www.measureyourworld.org/meas_latlon.html)

***Latitude:** _____ North | South

***Longitude:** _____ West

Elevation: _____ meters

***Height of gnomon:** _____ cm

***Length of shortest shadow:** _____ cm

Report your data online at www.measureyourworld.org/rep_shadow.php



Calculate the Earth's Circumference (and radius)

There are 6 main steps involved in calculating the circumference (and radius) of the Earth. For complete information on each of the steps, please visit www.measureyourworld.org/calculate.html

1. Measure the length of the shadow cast by a gnomon at local solar noon. For MYW, this will be done with your Partnership in each of three locations; United States of America, Chile, and Mexico. Report this online at www.measureyourworld.org/rep_shadow.php
2. Determine the angle of the shadow in each location, called the gnomon-sunbeam angle.
3. Determine the vertical angle by combining (either adding or subtracting depending on the latitude) the angles at pairs of locations from your MYW Partnership.
4. Determine the separation distance between measurement locations projected over the zenithal circle. This can be found using the online distance calculator at www.measureyourworld.org/calc_calculator.html
5. Calculate the Earth's circumference (and radius) using the vertical angle (step 3) and separation distance (step 4) between locations for each pair of locations.
6. Average the Earth's circumference (and radius) values for each pair of locations you calculated to get a final value for the Earth's circumference and radius! Report this online at www.measureyourworld.org/rep_earthcirc.php

Earth's Circumference Report Form

(* = required fields)

Each team in your MYW Partnership can report their calculation of the Earth's circumference. After completing this form, report your data online at www.measureyourworld.org/rep_earthcirc.php

***Measure Your World ID:** _____

(For help, visit www.measureyourworld.org/reg_id_reminder.php)

***Earth's circumference:** _____ km

***Earth's radius:** _____ km

Additional Information:

Report this calculation online at www.measureyourworld.org/rep_earthcirc.php