

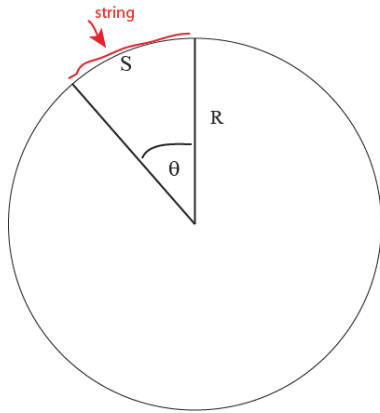
PHY 1033C - Lab 1

Credit: (Modified after P. Hirschfeld 2016)

How Eratosthenes Measured the Circumference of the Earth

In today's lab we will use the method of Eratosthenes, a Greek mathematician, that he used to estimate the circumference of the Earth using a sundial and some information about shadows in a 'nearby' city.

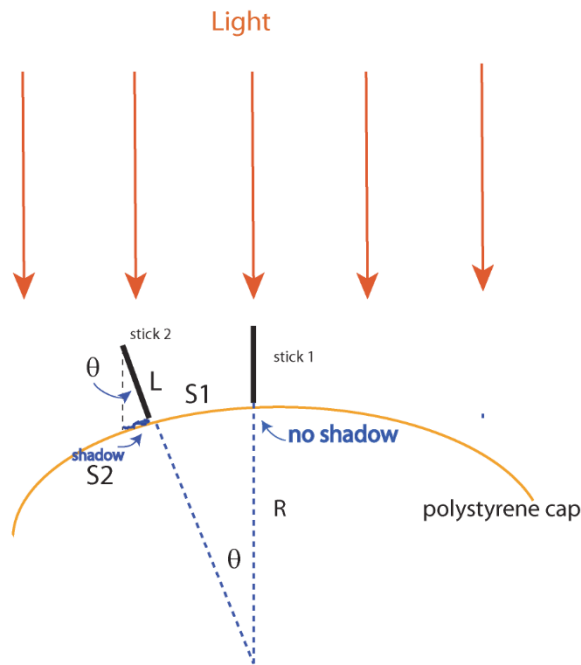
First some **geometry** (curved surfaces)



The length of the curved surface $S = R\theta$
PROVIDED that θ is in radians (NOT degrees)
 $360^\circ = 2\pi$ radians. To measure S place string (red) on curved surface. Pick string up by its ends and lay in flat surface against a ruler.

Lab Experiment

1. To start, place a toothpick at the peak of the 'sphere' (hemisphere) leaving about 3 cm exposed, being careful to make sure the toothpick is perpendicular to the surface.
2. Place another toothpick in the sphere around 3 to 7 cm away from the first, again leaving about 3cm exposed and making sure it is perpendicular to the surface.



S2 is very small and can be approximated as if it were a straight line.

Geometry $\theta = S1/R = S2/L$
Hence, $R = L * S1/S2$. Just measure L, S2 and S1 to determine radius of hemisphere.

3. Align your ‘Sun’ (using a small handheld) lamp so that toothpick1 leaves no shadow.
4. Measure and record the length of the second toothpick’s shadow S2.
5. Measure and record how much of that toothpick is exposed = L.
6. Use length of string to measure S1.
7. Redraw figure above in your lab book, showing the two angles are the same by drawing on the figure..
8. Use L and S2 to measure θ .
9. Use θ to determine R and thus the diameter d from $R=L*S2/S1$.
10. Estimate the percent error in your measurement by directly measuring the diameter of your sphere, d_m , with a ruler.

$$\% \text{ Error} = \frac{d - d_m}{d_m} * 100$$

LAB BOOK WRITE UP (about 2 pages)

Title

Date

Goal

Experimental Methods

Measurement Results

Calculations

Conclusion