



# CALIFORNIA STATE SCIENCE FAIR 2002 PROJECT SUMMARY

<b>Name(s)</b> <b>Bowen W. Dunnahoo-Kirsch</b>	<b>Project Number</b> <b>J1510</b>
<b>Project Title</b> <b>How Big Around Is the Earth? The Eratosthenes Method</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The objective of this project is to estimate the circumference of the Earth by using Eratosthenes method, a procedure that uses the angle of the Sun at solar noon in two distant geographic locations and the north-south distance between those locations to determine the circumference.</p> <p><b>Methods/Materials</b> On January 20, 2002, the angle of the Sun's rays was measured at solar noon by me in Menlo Park, CA and by my uncle's family in Carlsbad, CA. Solar noon is when the Sun is at its highest point in the sky. We found solar noon at both sites from the U.S. Naval Observatory website. Vertical sticks were set up using a carpenter's level and plum-bob, and butcher paper was spread under it to mark the length of the Sun's shadow. Beginning a few minutes before solar noon, the shadow length was marked every minute, until the shortest shadow was reached (solar noon). The stick height and shadow lengths were drawn to scale on graph paper, so that the angle of the Sun's rays in each site could be determined. Using geometry, the two Sun angle's are used to determine the central angle, or pizza slice, of a circle (the Earth). Using a World Atlas and mileage key, the north-south distance between our two cities was measured with a ruler. Finally, the number of pizza slices that fit in the circle (360 divided by the central angle) was multiplied by the north-south distance between the two cities. The result is an estimate of the Earth's circumference.</p> <p><b>Results</b> The Sun angle measured at solar noon in Menlo Park was 56 degrees, and 52 degrees in Carlsbad, which is 302 miles away on a north-south line. The difference in the Sun angles, 4 degrees, is our central angle and "pizza slice". 90 "slices fit in a circle. 90 multiplied by 302 miles equal 27,180 miles around the Earth. The true distance as found in our World Atlas is 25,120 miles. I was about 8% off the real distance.</p> <p><b>Conclusions/Discussion</b> I thought the result was pretty good. I think I could have gotten closer to the real distance by doing the measurements on June 21, when the Sun is at its highest point of the year and the shadow of the stick would cast a sharper image on the paper, making it easier to measure. Also on June 21, I would know that the angle of the Sun's ray is zero at the Tropic of Cancer, and be able to make a very good measurement of that distance on an Atlas.</p>	
<b>Summary Statement</b> My project is about estimating the circumference of the Earth by measuring Sun angle's and knowing the north-south distance at two locations on the Earth.	
<b>Help Received</b> My dad helped me set up the measurement of the Sun angle, and helped me prepare the project. My aunt and uncle performed the Sun angle measurements in their town.	