

# Worksheet on Earth and Universe Measurements and Shape

Dr. Sarah's MAT 3610: Introduction to Geometry

**Goals:** • Geometric Perspectives

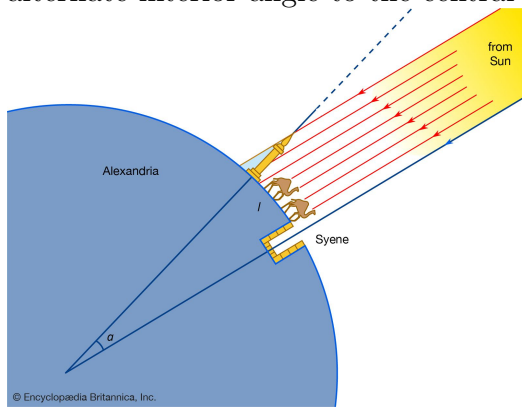
I can compare and contrast multiple geometric perspectives.

**Welcoming Environment:** Actively listen to others and encourage everyone to participate and try to help each other! Keep an open mind as you engage in our class activities, explore consensus and employ collective thinking across barriers. Maintain a professional tone, show respect and courtesy, and make your contributions matter.

Discuss and ask me questions during group work time as well as when I bring us back together:

1. **Building Community:** What are the preferred first names of those sitting near you? If you weren't able to be there write N/A or give reference to anyone you had help from.
2. Discuss with your group and respond: what does “geo” in geometry mean?
3. Discuss with your group and respond: what does “metry” in geometry mean?
4. If we are expecting the earth to be perfectly round, that isn't correct, as on a local scale we have mountains and more. Even on a global scale, there are some variations from a perfect sphere. Search the web for the smallest radius of the earth. List the number and the units (*km* or *mile*).
5. Search the web for the largest radius of the earth in the same units as the last question and list.
6. What is the difference between the two in the same units?
7. Compute the ratio of your last two responses  $\frac{\#6}{\#5}$  and **convert to an approximation as a percentage**, which provides a quantification of the approximate % error of a spherical earth.
8. Next multiply the reciprocals of your responses in #4 and #5 together:  $\frac{1}{\#4} \frac{1}{\#5}$ . This gives a rough estimate of the earth's curvature per miles<sup>2</sup> or km<sup>2</sup> (depending on which measurement you worked in) via  $\frac{1}{r^2}$ . Recall that scientific notation of  $10^{-8}$  means that the decimal moves to the left 8 additional places. Write your response (scientific notation is fine) and notice how small this is—not curvy at all!
9. How could we know that the earth is basically a sphere on the global scale—not a flat Euclidean plane—without using technology from the 20th or 21st centuries? Discuss and write down as many ideas as your group can come up with.
10. When you are finished coming up with ideas, add to  
[https://docs.google.com/document/d/1-wtrqvY0gOmGS6sCfUWgxb5cdOL3zz\\_10e0a5owqBkw](https://docs.google.com/document/d/1-wtrqvY0gOmGS6sCfUWgxb5cdOL3zz_10e0a5owqBkw)

11. Long ago, Eratosthenes computed the circumference of the earth using local data about shadows and camel caravans. At midsummer's day at noon, light came in directly at Syene, Egypt, but made a shadow at Alexandria. He then abstracted to the global circumference of the earth by first applying the congruence of alternate interior angles. Assuming that the light rays were parallel—identify the alternate interior angle to the central angle  $\alpha$  below. You might re-sketch to clarify.



12. Eratosthenes knew the distance between the cities as 5000 stadia, and the alternate interior angles as  $7.2^\circ$ , and then set up a fraction using proportional reasoning to extend to all the way around:  

$$\frac{7.2^\circ}{360^\circ} = \frac{5000 \text{ stadia}}{\text{circumference}}$$
 Amazingly, working with what he had at the time, Eratosthenes was only off by 2% to 15% depending on the definition of stadia. Put another way, he was 85—98% correct! Solve for that circumference of the earth.
13. Today we are engaged in an intellectual debate to understand the shape of space—search for shape of the universe Euclidean  
 discuss with your group and write down one item you found interesting
14. search for  
 shape of the universe sphere  
 discuss with your group and write down one item you found interesting
15. search for  
 shape of the universe dodecahedron  
 discuss with your group and write down one item you found interesting
16. Prepare to share from your groups discussions of #13–#15 when we come back together.
17. **Help each other and PDF responses to ASULearn:** If you are finished with the worksheet before I bring us back together, first ensure that your entire group is finished too, and if not, help each other. Then submit this, continue reviewing and solidifying or discuss upcoming class work. Collate your handwritten responses, preferably on this handout, into one full size multipage PDF for submission in the ASULearn assignment. I recommend you turn it in sometime today, but you have until the next class.