

Geometry on a Sphere

Chaos and Fractals

College of the Atlantic.

This lab is only indirectly related to chaos. It's designed to give you a small taste of non-Euclidean geometry. Geometry is the study of the shapes and sizes of things—lengths and angles and such. I haven't done this lab before, so I'm not sure how it will go. I suspect that many of the questions/instructions below will be unclear.

1. Make a sphere

- (a) Blow up a balloon. Do not inflate it too much. It should give a little.
- (b) We will pretend that the balloon is a sphere.
- (c) Draw an “equator” on the “sphere.”

2. Straight Lines

- (a) Draw two dots on the sphere at the same Northness. Maybe one where Bar Harbor would be and the other where Budapest would be.
- (b) Draw a straight line between the two dots.
- (c) Wait. What does that even mean? The surface is curved. No lines are straight. Muse on this for a moment.
- (d) What might be a reasonable way to define straightness on a curved surface? Why?
- (e) If needed, try drawing a straight line again.

3. More Lines

- (a) Quito and Macapá are two cities that are both almost exactly on the equator and are about 1000 miles apart. Draw dots for those two cities.
- (b) Draw a straight line due North from each city. The lines are going in the same direction—due North—so they presumably are parallel, right?
- (c) What happens to the two lines as you keep drawing extending them Northward?

4. Triangles

- (a) Somewhere in the pacific ocean, draw a small triangle.
- (b) Macapá and Mbandaka are two cities on the equator that are separated by about a quarter of the circumference of the earth. Draw two dots for those cities.
- (c) From each city, draw lines due South to the South Pole. Together with the equator, you have just made a triangle.
- (d) Compare your two triangles. What is the sum of the interior angles of the large triangle? How about for the small triangle. Discuss.