Questions and ideas to ponder about

- What does **locally minimizing distance** mean? Hint: Recall what are the geodesics on sphere. Also, recall the geodesic in the surface made of bubble solution joining two rings.

- What are the geodesics on the torus with the pac-person metric?

- What are the horocycles in the upper half plane model?

- -Find 2 really different surface words that label the same surface.

- Think about what happens with a closed curve on a surface when you unroll the surface. The surface can be a cylinder, a torus, or whatever your mind can unroll.

- Consider a hyperbolic pair of pants whose boundary components are geodesics. Prove the shortest segment joining two boundary components in the pair of pants intersects boundary components at a right angle.

- Compute the Gaussian curvature at a point in the sphere of radius R. If you feel brave, compute also the curvature at a point in the hyperbolic plane (using one of the models).

$$K(p) := 3 \left(\lim_{r \to 0^+} \frac{2\pi r - C(r, p)}{\pi r^3} \right)$$

- Compute the Gaussian curvature of a point in the hyperbolic plane. The Poincare disc model is a good one to do this, and since all points are made equal, you can choose the center of the disc to simplify calculations.

- Make your own hyperbolic paper as we did in our first discussion, but with more than two rings. Find the horocycles in your hyperbolic paper.

- A spider is sitting in the middle of one of the smallest walls in a room and a fly is resting by the side of the window on the opposite wall, 1.5m above the ground and 0.5m from the adjacent wall.. The room is 5m long, 4m wide and 2.5m high. What is the shortest distance the spider would have to crawl to catch the fly?

glue.