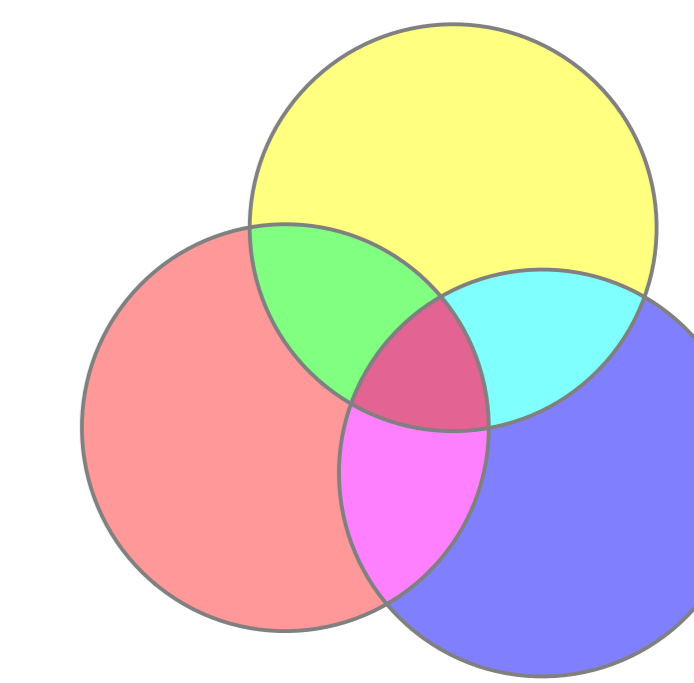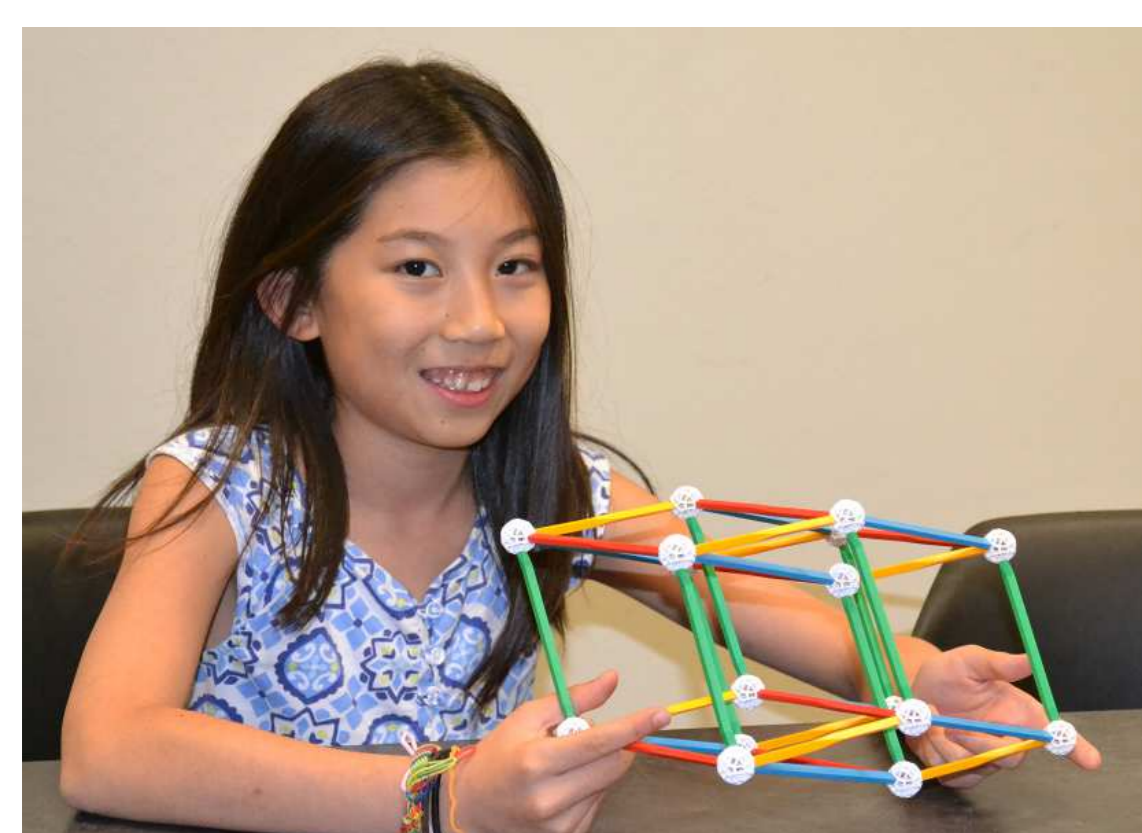# Texas A&M Math Circle
Hyperbolic Soccer Ball

Frank Sottile   January 11, 2013

Our Circle

The Texas A&M Math circle is for students in grades 5–8 from local schools with an interest in mathematics. Its weekly meetings begin with 30 minutes of unstructured activities (games, puzzles, problems, zomes),

followed by a 90-minute directed activity, such as *Hyperbolic Soccer Balls*.

When: Saturdays, 3–5 PM

Where: Blocker Hall, TAMU Campus

Organizers: Alex Sprintson, FS, Phil Yasskin

History: Following Yasskin's 2011 SEE-Math summer program for middle school children, a parent (Sprintson) asked Yasskin if he would consider running a math circle at a local school (Oakwood Intermediate). Sottile joined, and after one semester as an after school club, it moved to Texas A&M, opened to students from all local schools, and became the TAMU Math circle.
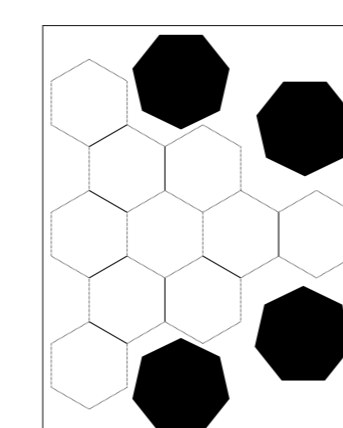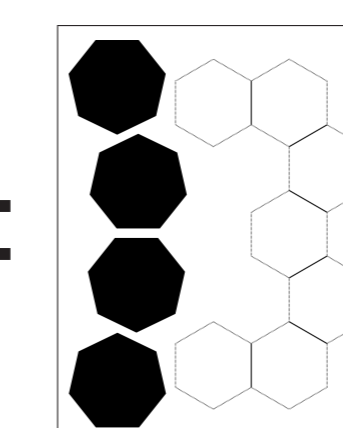

Hyperbolic Soccerball

Goal: Create a beautiful model of the discrete hyperbolic plane patterned after the world's favorite game, and use it to investigate non-Euclidean geometry.

Materials:

● Printed templates. One: One or Two:

● Scissors and Tape

Directions: Carefully cut out polygons along the dotted lines. Save the central hexagon in the first template, cutting a path to it. Tape a black heptagon edge-to-edge to the six hexagons in the hole. (Tape on the unprinted side.) When taping a second edge at a vertex, the model must be opened a bit, and it will not lie flat. Tape the central hexagon into the gap which is left.
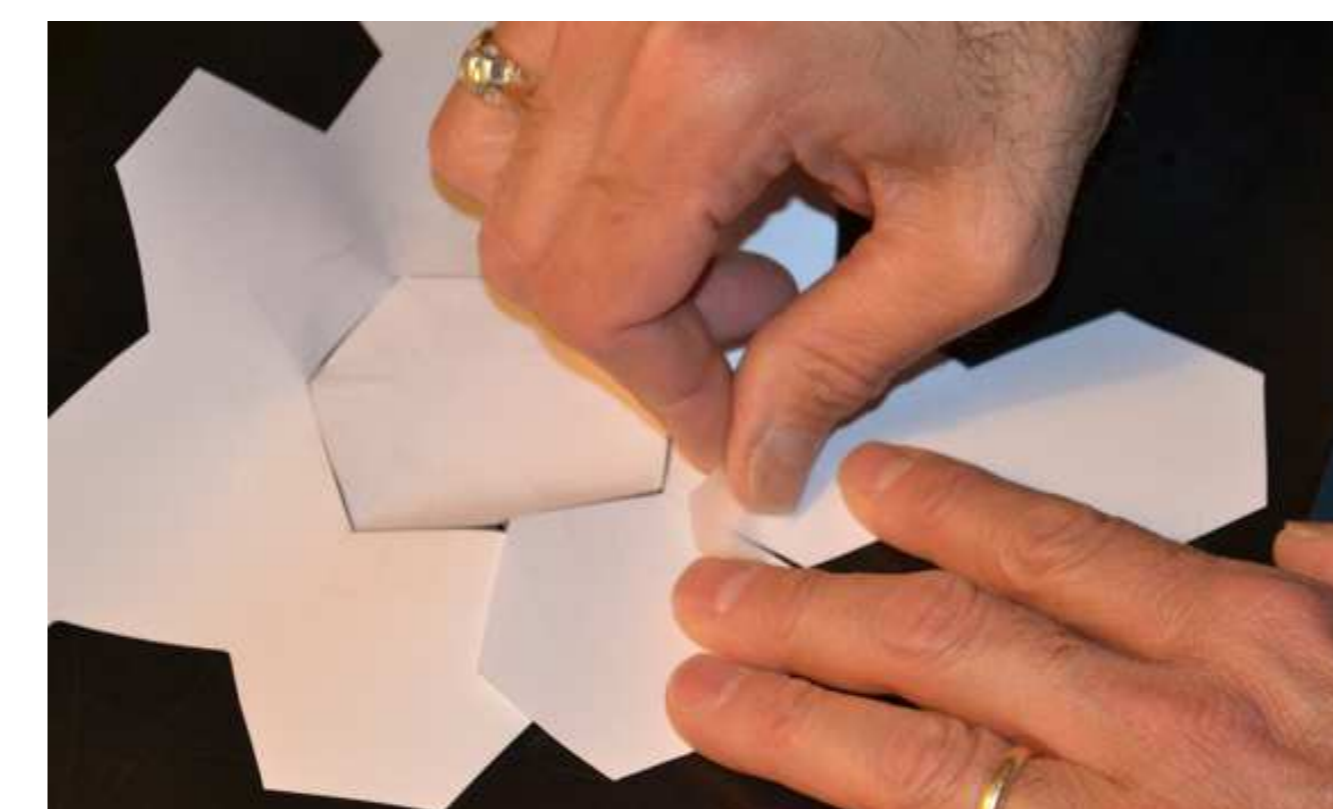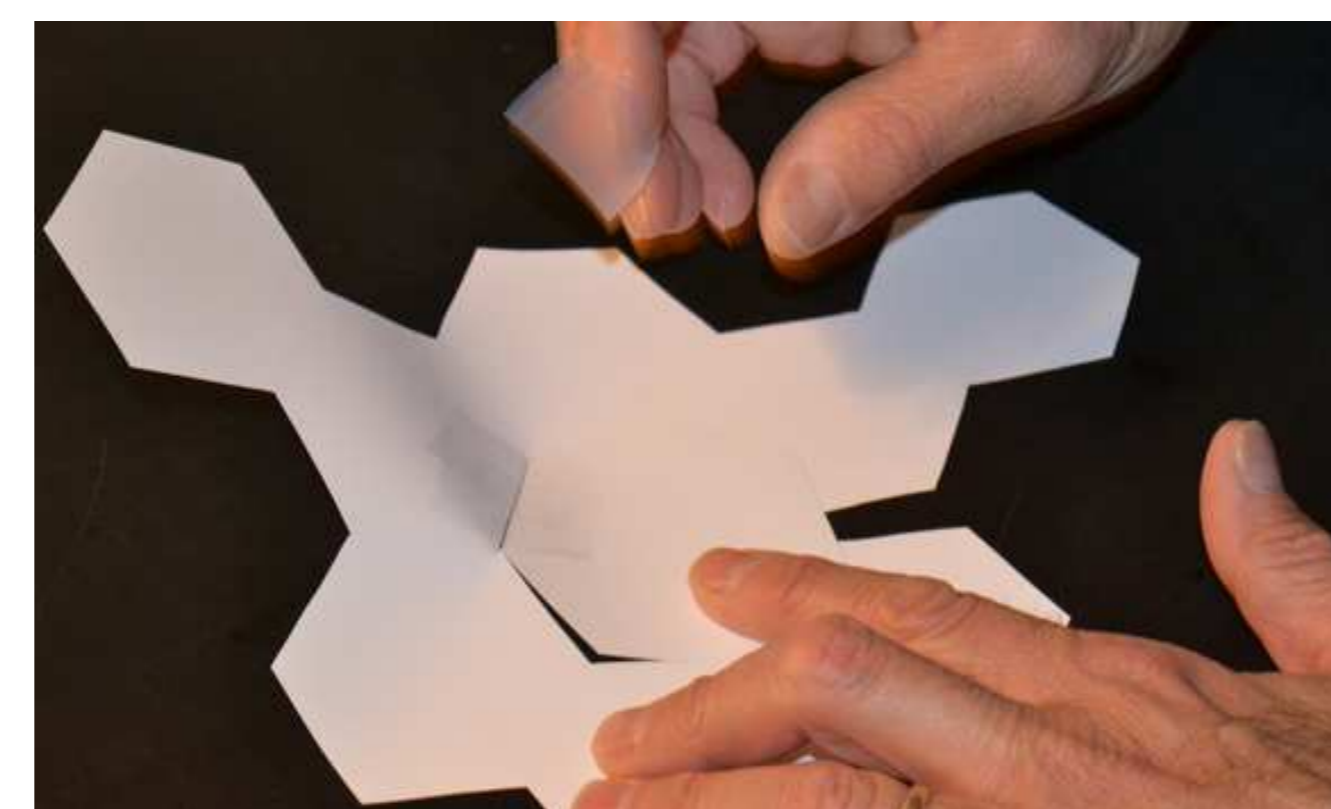
Tape two heptagons into the indentations along a side and then the W-shaped strip of hexagons from the second template to them.

This gives three heptagons surrounding a central hexagon, surrounded by 15 hexagons with one more breaking the symmetry. Tape the remaining five heptagons to complete this model.
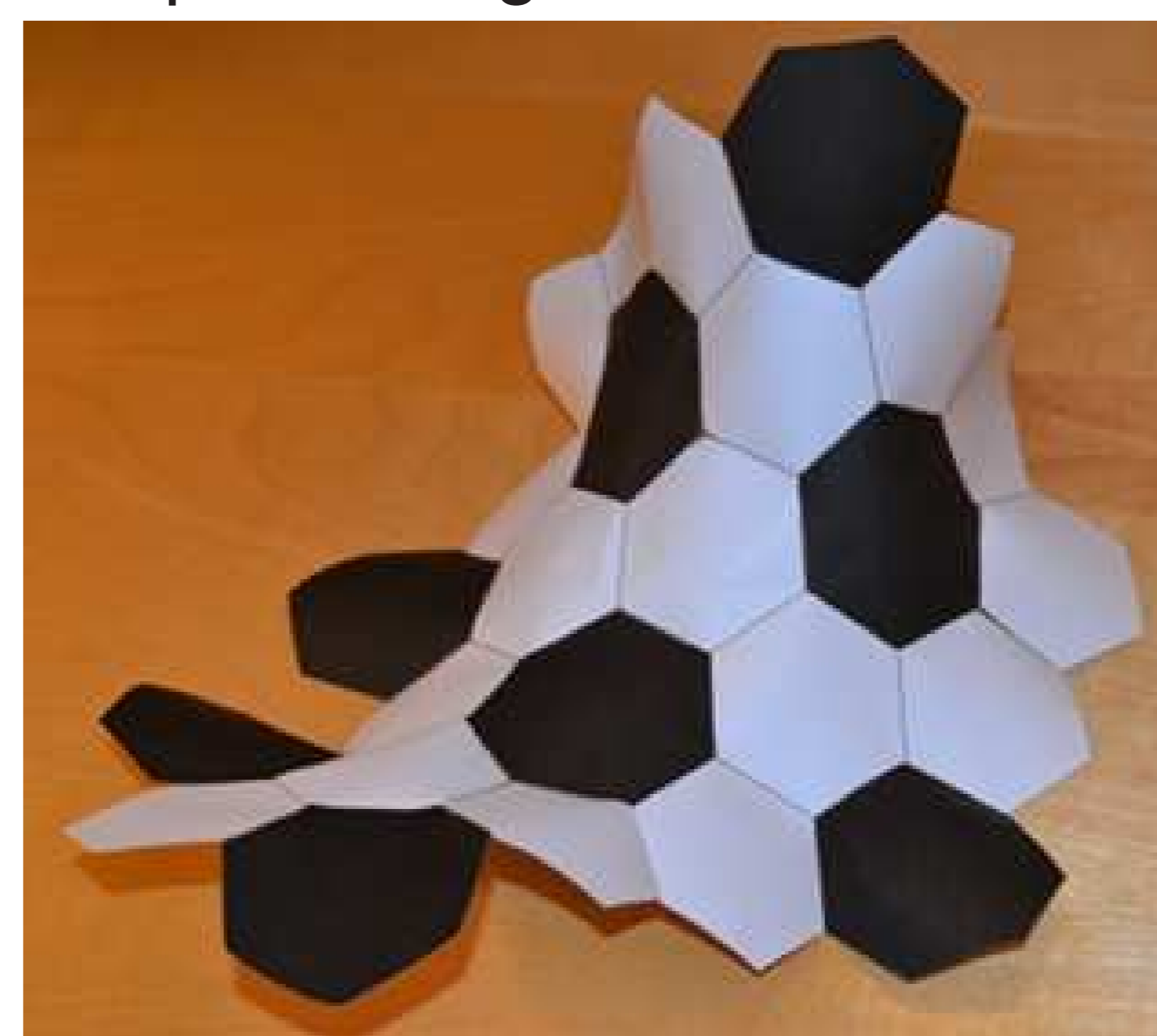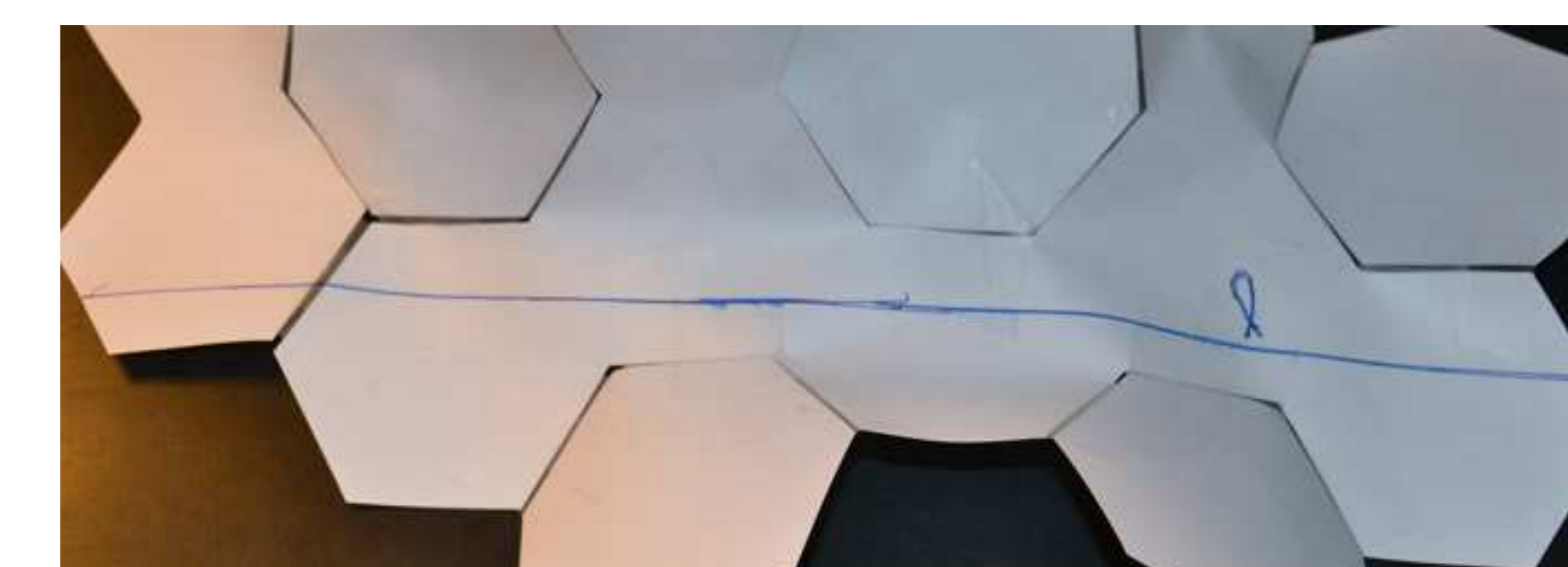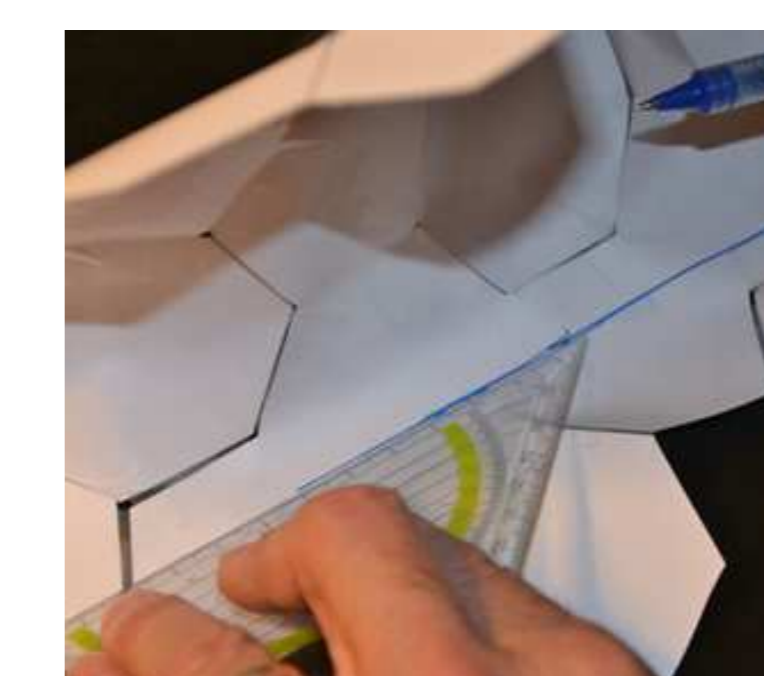

Non-Euclidean Geometry

Materials:

● Pencil and a short (≤ 15 cm) straightedge.

Draw a Line: With unprinted side up, flatten two adjacent polygons and draw a line segment. Extend this segment across model with straightedge to a line ℓ.

Diverging parallels: Draw a segment m perpendicular to ℓ, and then a line ℓ' perpendicular to m. The lines ℓ and ℓ' are parallel. Notice how they diverge.

Triangle: Draw a large triangle on your model. What are its angles? Try to measure them or measure their sum. Compare your angle-sum to that of others.