Snapology Origami

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San Diego MTC

Joint Mathematics Meetings
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San Diego Math Teachers' Circle

Co-located at UC San Diego and San Diego State Univ

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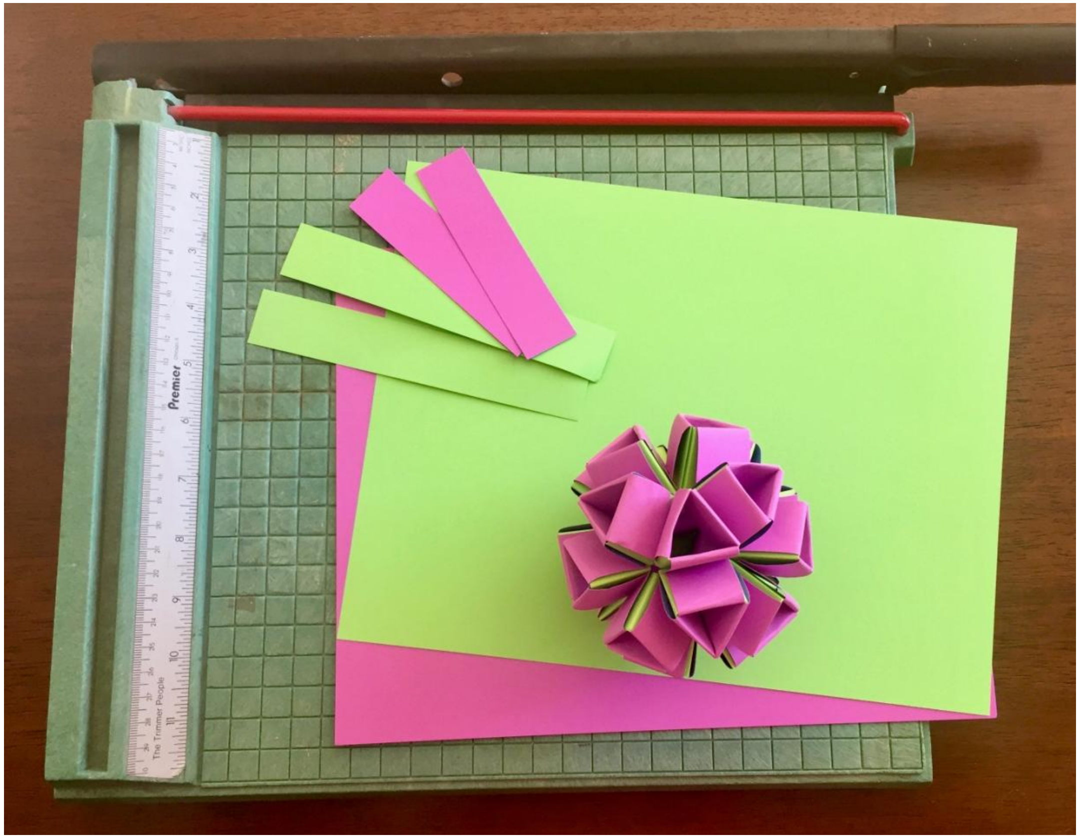
HOW THESE BECAME A MATH TEACHERS' CIRCLE SESSION

What is snapology origami?

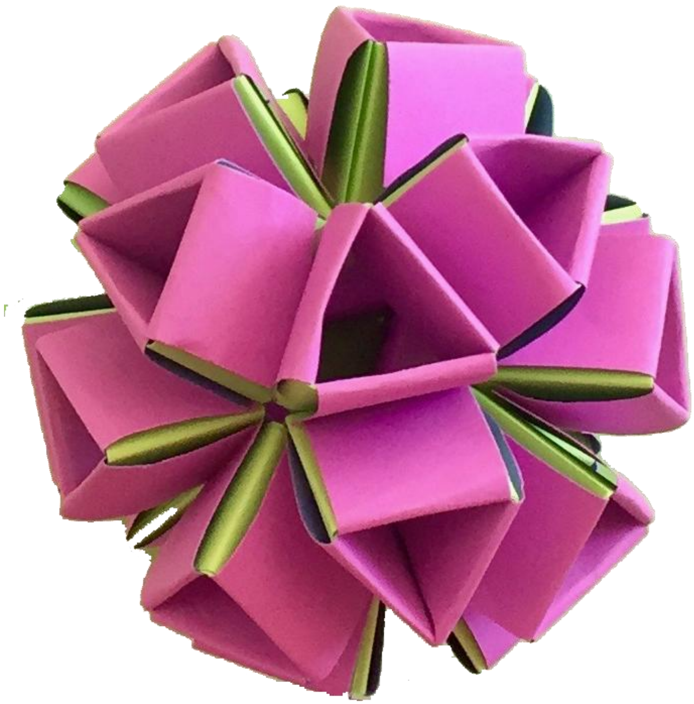


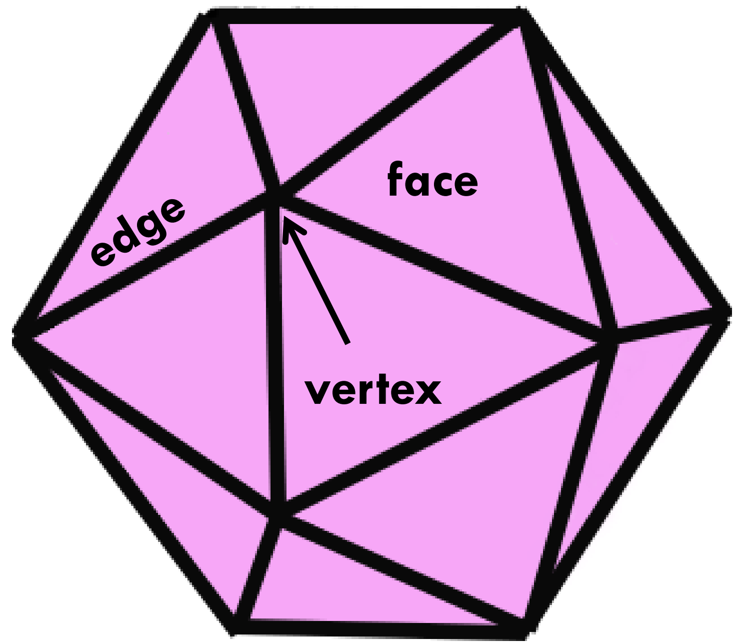
Created by Heinz Strobl, snapology origami uses only strips of paper to create shapes.

Partial list of teachers' questions

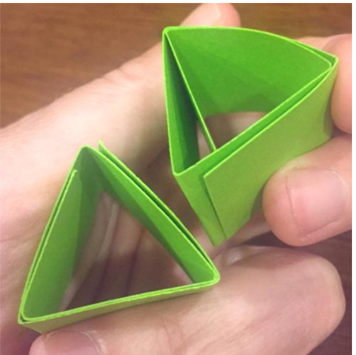
1. How many pieces of paper to build?
2. What's the area of the paper?
3. How does outer surface area compare to inner?
4. Can we swap out some shapes with others? What happens?
5. Are 12 pentagons (or multiple) needed to make these shapes?
6. Area of flat paper and surface area of shape relationship?
7. What gives shapes affective appeal?
8. Is the stress on the material uniform throughout shape?
9. Spherical = triangles and pentagons, ellipsoid needed different. Correla tion between sphericity and shapes used?
10. The objects are unexpectedly heavy. What is the significance of their weight and its relationship to the shape?

Snapology origami and polyhedra

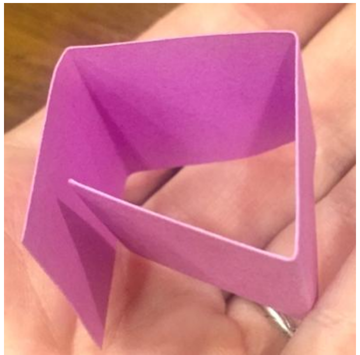


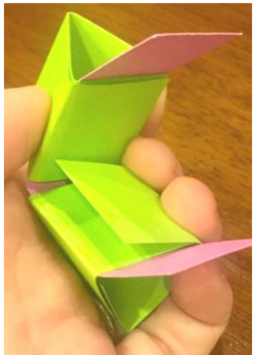


“faces”



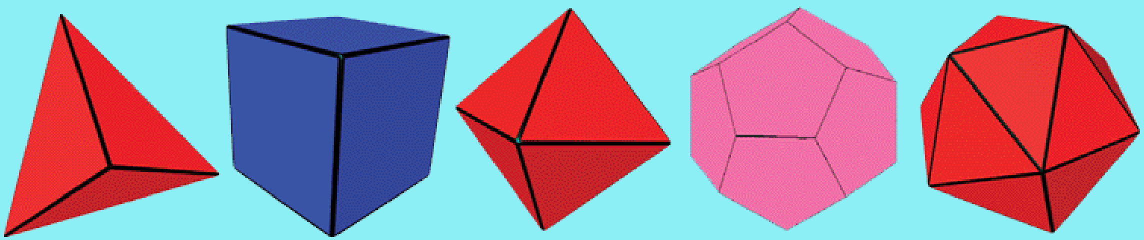
“edges”





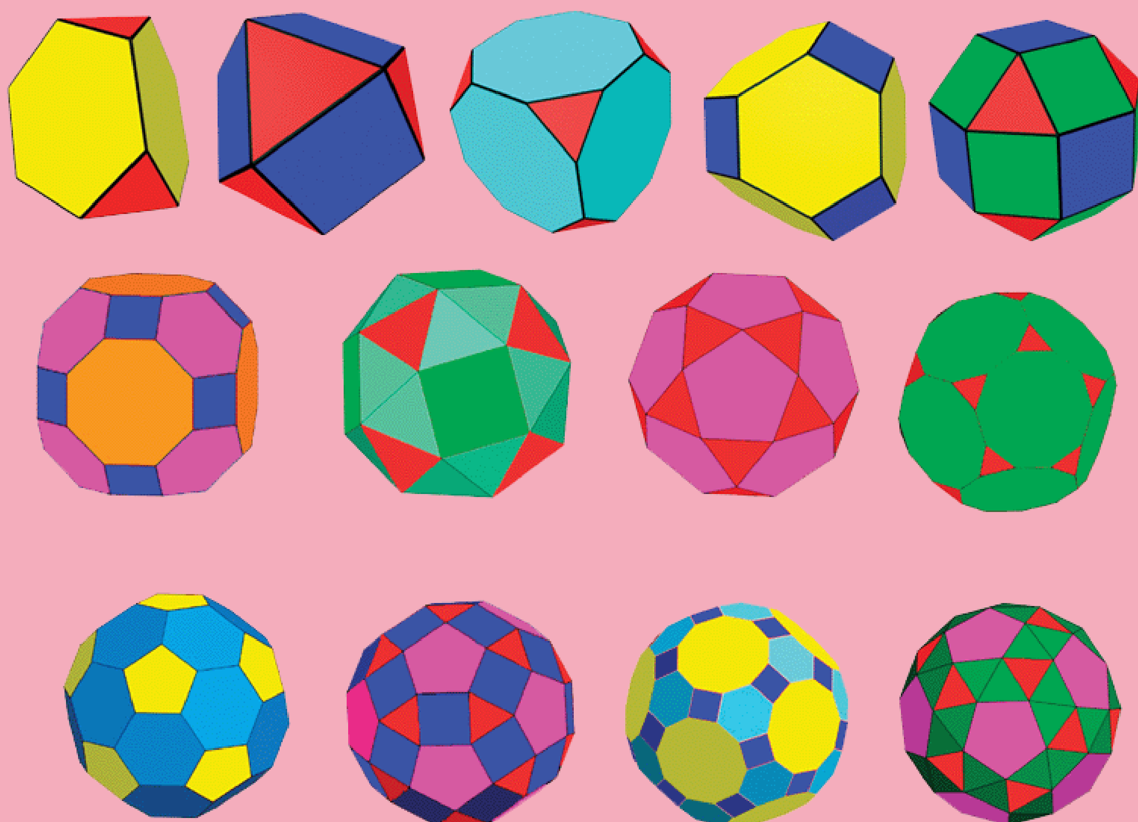
Two “faces” connected by an “edge”

Natural starting point: Platonic and Archimedean Solids



Platonic

Made of **identical** regular polygons; each vertex is symmetry equivalent to every other vertex



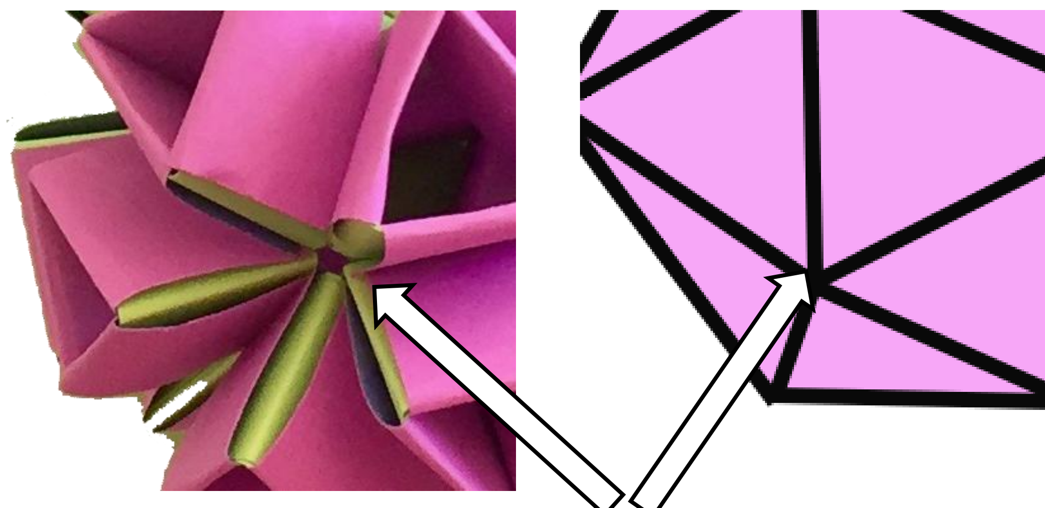
Archimedean

Made of **non-identical** regular polygons, all having sides of the same length; each vertex is symmetry equivalent to every other vertex.

Why are Platonic/Archimedean solids so well suited to snapology origami models?

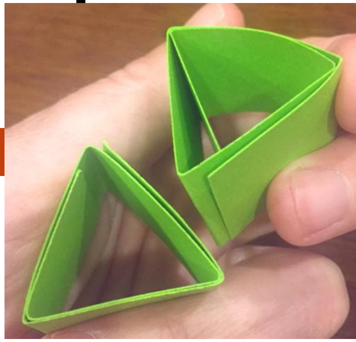
1. Made of regular n-gons, so "faces" are 2n-unit long strips

2. Each vertex is symmetry equivalent to every other vertex; so there's just one simple formula for making them! For example:



5 triangles at every vertex

Now look at how many strips of paper we need



Example: Icosahedron

20 triangular faces , so 20 of 3*2 units long strips

Calculate number of edges:

Each face is surrounded by 3 edges, and each edge is shared by two faces.

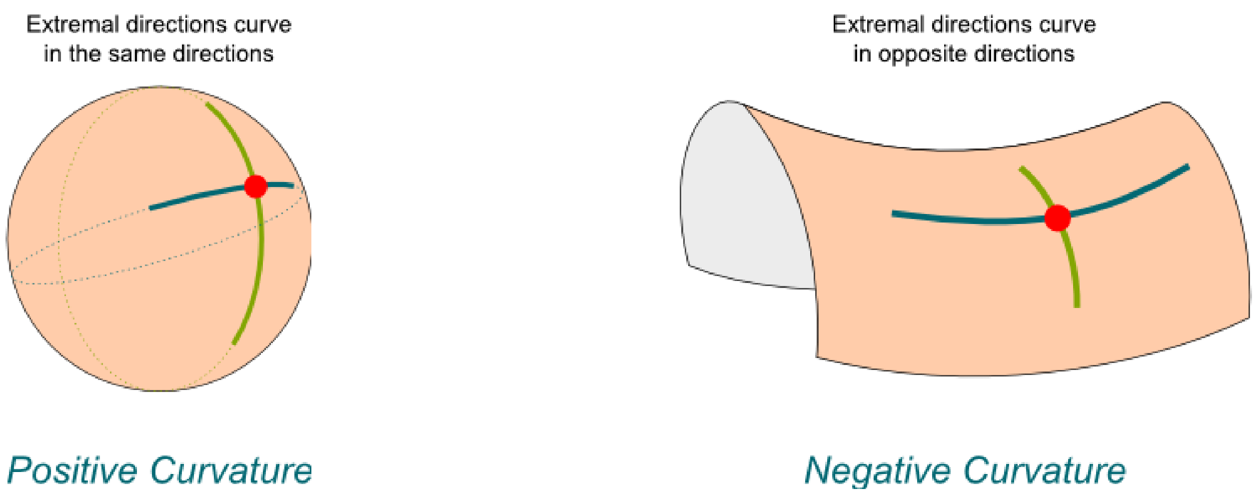
So the number of edges is $\frac{20\times 3}{2} = 30.$

We will need 30 of the 4 unit long strips.

Natural extensions:

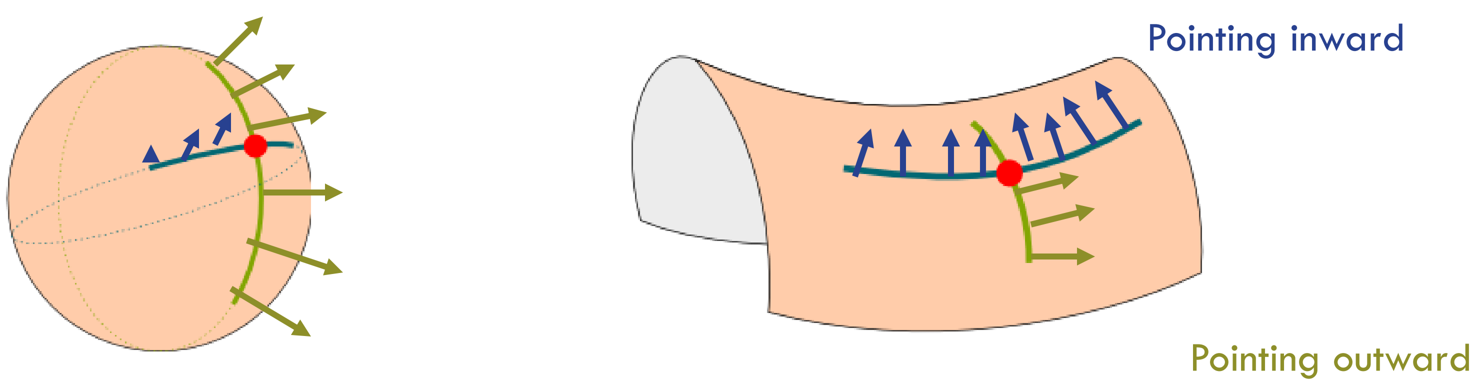
1. How many pieces of notebook paper?
2. What is the cost of the paper?
3. What is the weight of your finished solid (paper has known density.)?

What about tori? Need to create saddle points.

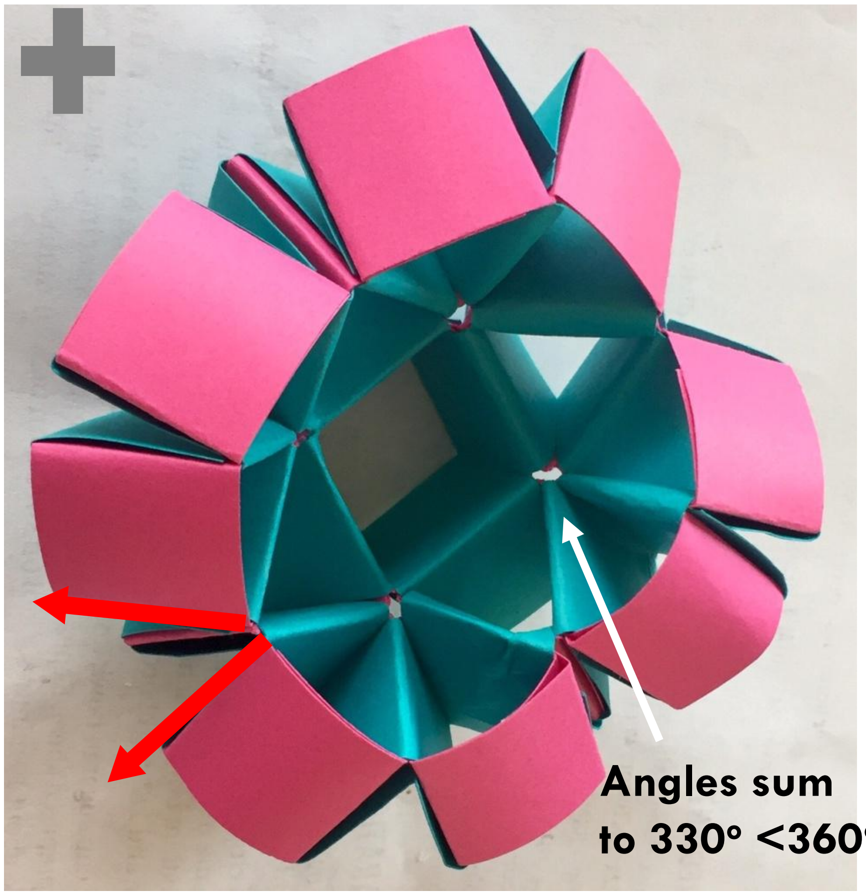


Pictures from science4all.org

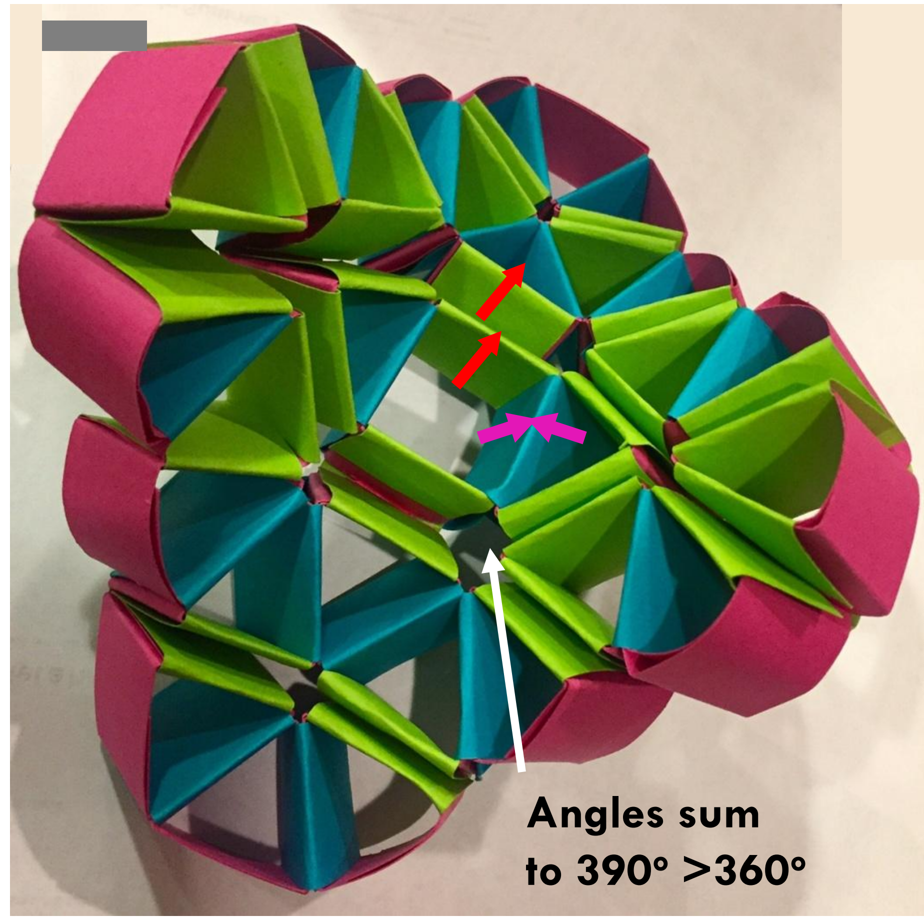
Note the differences in the positions of the normal vectors along the paths



Positive and negative curvature implemented in snapology origami



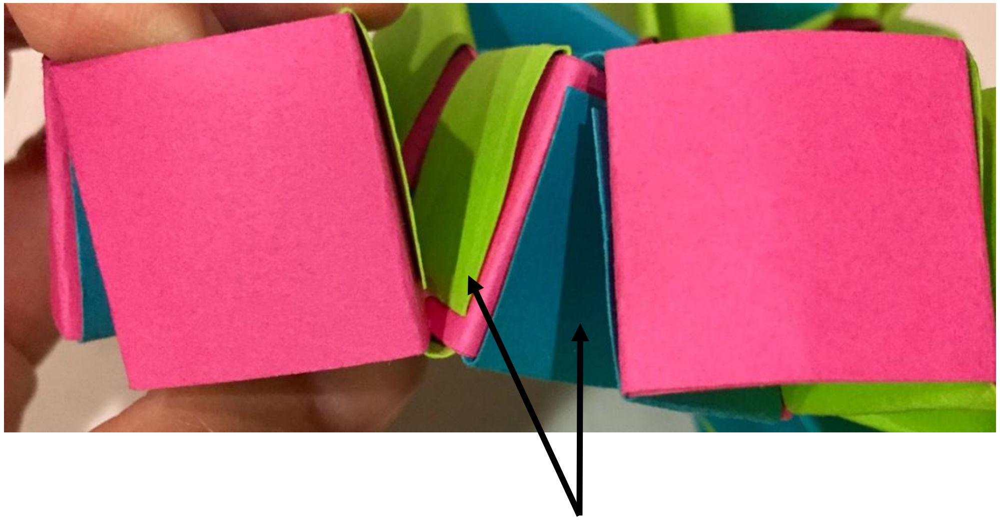
Normals point
"away from each other".



Normals point
"away from each other"
along one direction

Normals point
"toward each other"
along other direction

Parting words about saddle shapes



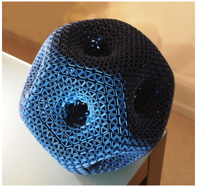
Saddles are necessary for making tori with any number of holes, Klein bottles, and any surfaces that contain areas of negative curvature.

Learn How!

Dave Honda has made a series of instructional videos teaching how to make an icosahedron:

http://tinyurl.com/snaporigami

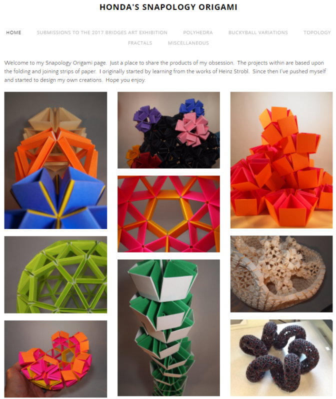
Also, please go see Dave's dodecahedral 11-hole torus as part of the Mathematical Art Exhibition in the exhibit hall!



Update (1/15/18): Dave's entry won **first place** for "best textile, sculpture, or other medium" at the exhibition!

Resources

Visit Dave Honda’s website: snaporigami.weebly.com



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