

Snapology Origami

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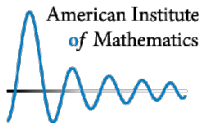
San Diego MTC



Joint Mathematics Meetings
January 11, 2018

San Diego Math Teachers' Circle

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



Founded in 2011.

Monthly meetings of (mostly) middle-school teachers.



Math Teachers' Circle Network

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Professional communities centered on mathematics

We connect teachers and professors through shared mathematical discovery.

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Image provided by San Diego MTC.



MTCs empower teachers' voices and experiences

MTCs are highlighted as a "bright spot" in teacher professional development in a 2017 [white paper](#) published by 100Kin10.



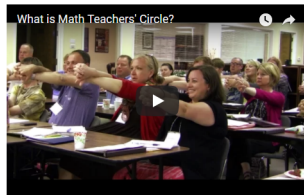
MTCircular Magazine

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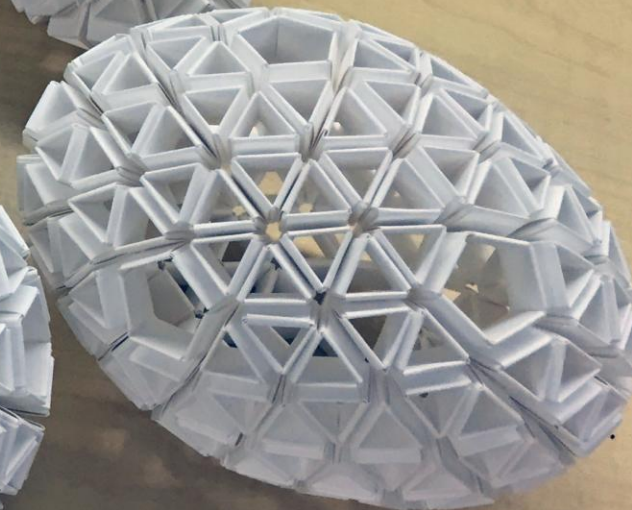
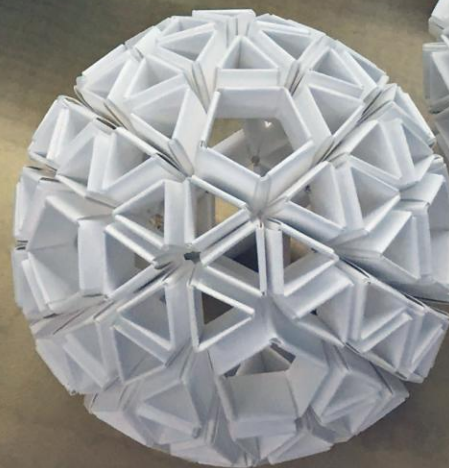
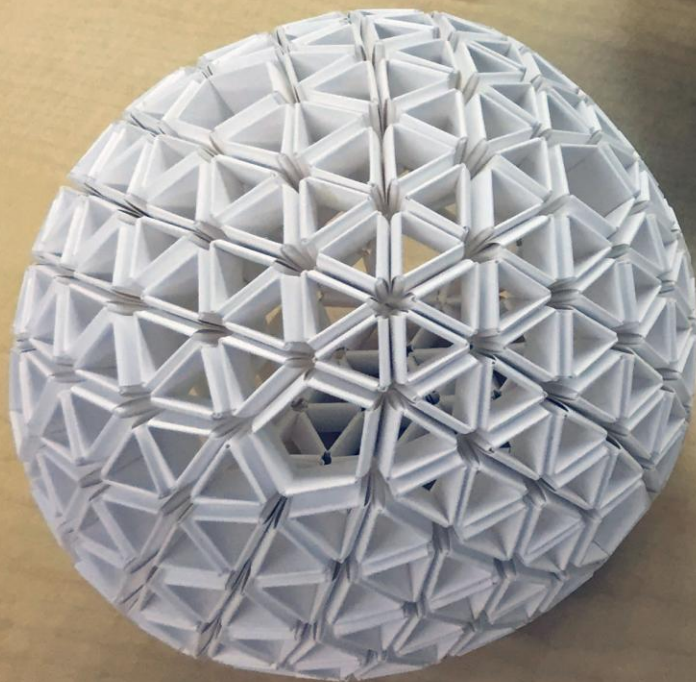
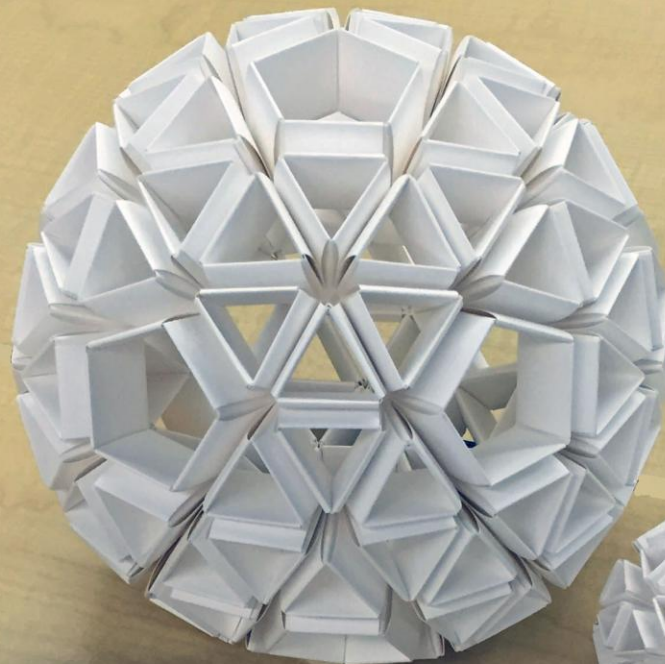
Start a Circle

Our [Organizer Toolkit](#) contains a wealth of materials to help you start a successful, self-sustaining MTC. Our [seed grant program](#) provides start-up funding to selected Circles.

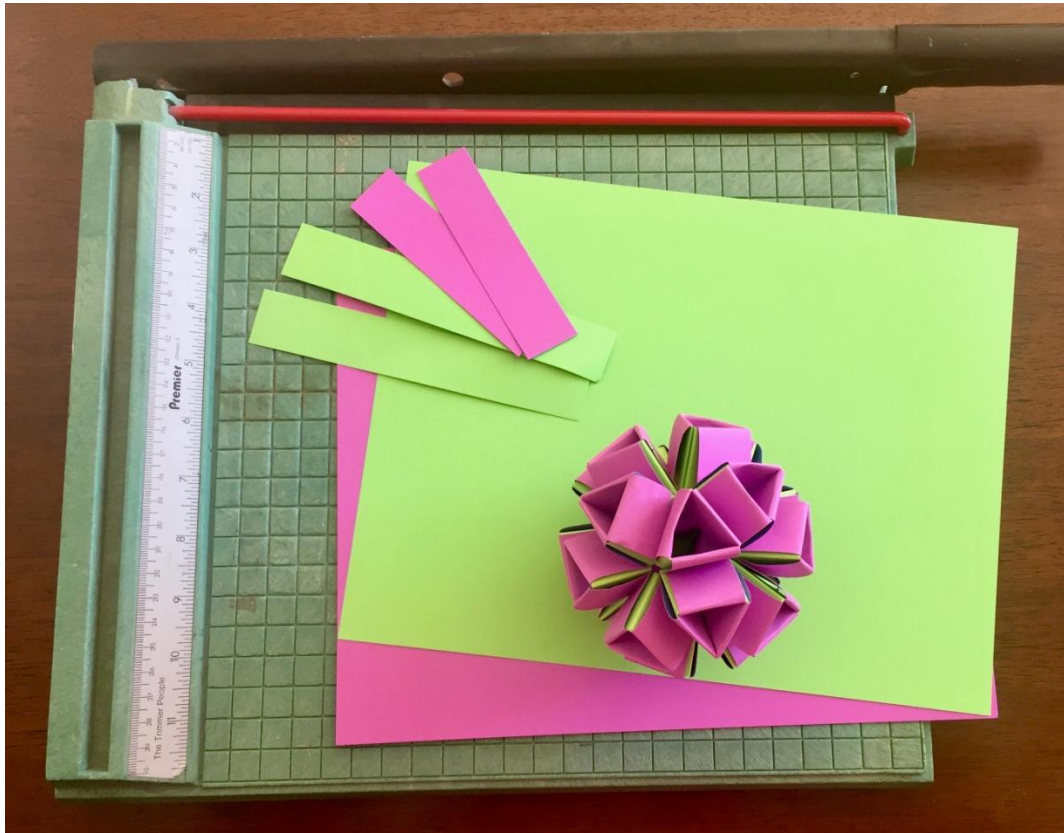


"Unparalleled professional development in

**HOW THESE
BECAME A MATH
TEACHERS' CIRCLE
SESSION**



What is snapology origami?

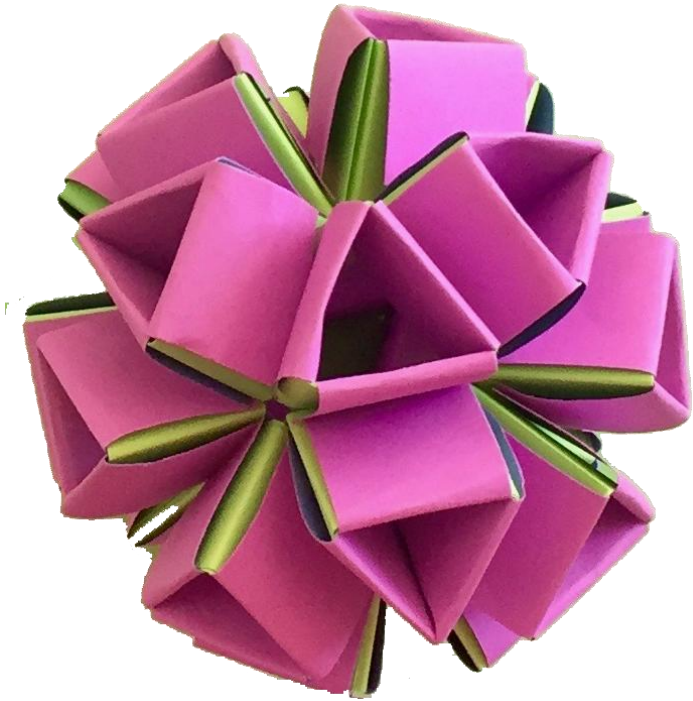


Created by Heinz Strobl, snapology origami uses only strips of paper to create shapes.

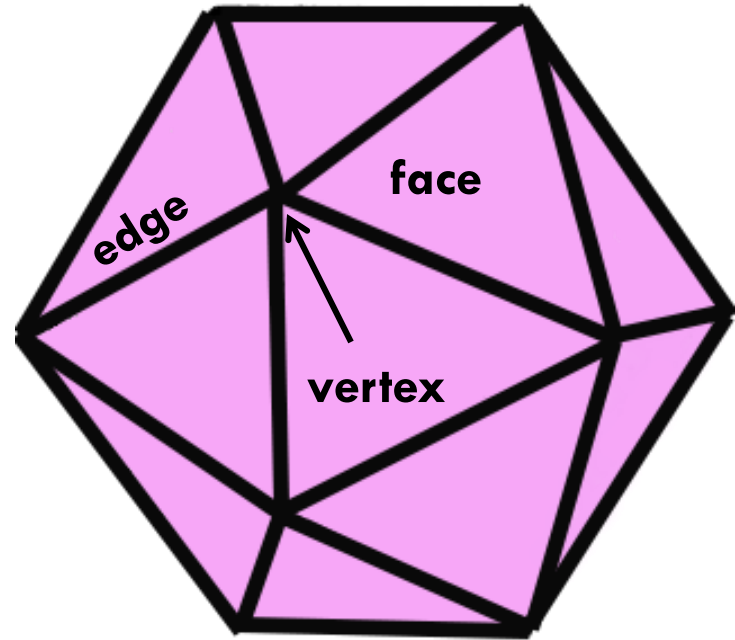
Partial list of teachers' questions

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. Correlation between sphericity and shapes used?
10. The objects are unexpectedly heavy. What is the significance of their weight and its relationship to the shape?

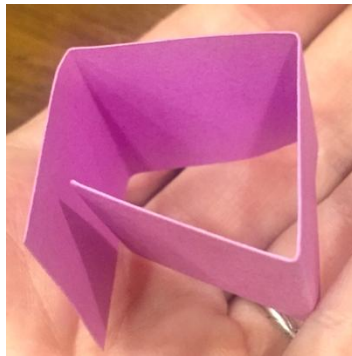
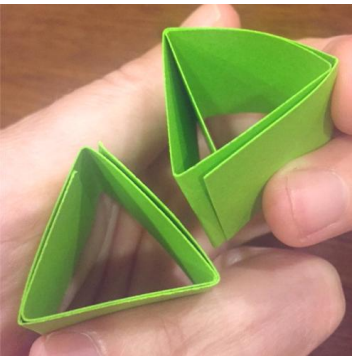
Snapology origami and polyhedra



“faces”



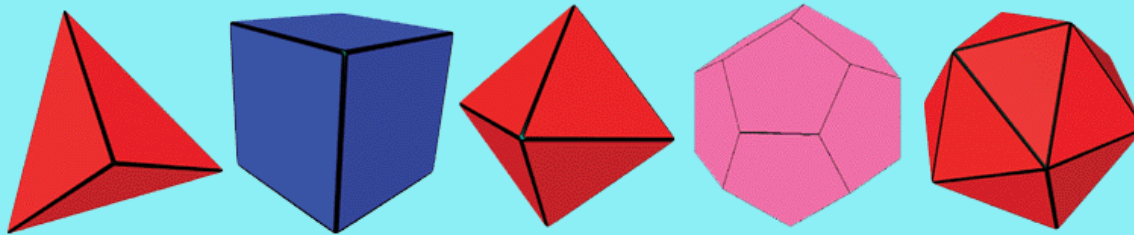
“edges”



Two “faces”
connected
by an
“edge”

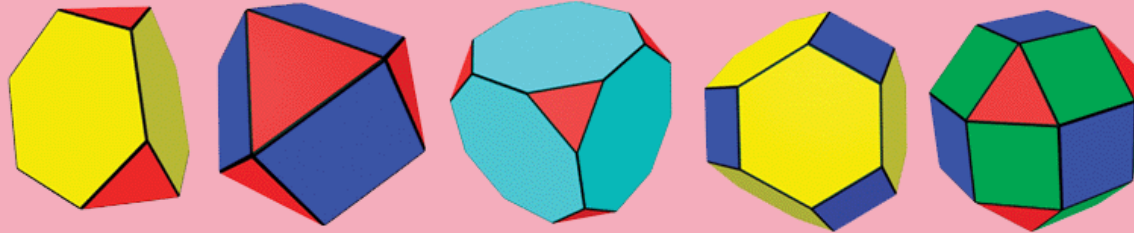


Natural starting point: Platonic and Archimedean Solids



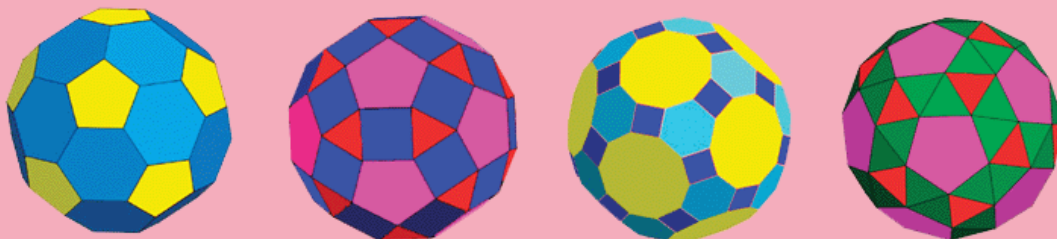
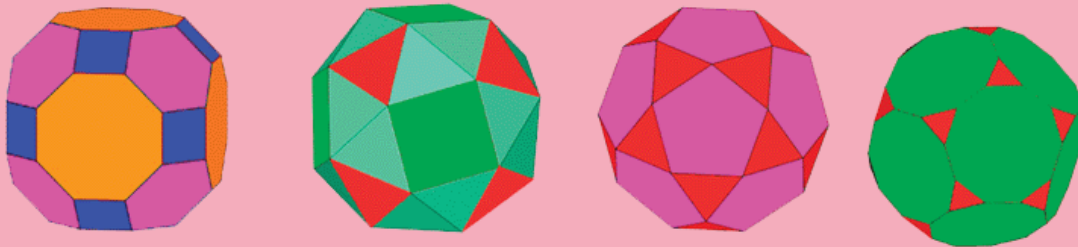
Platonic

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.

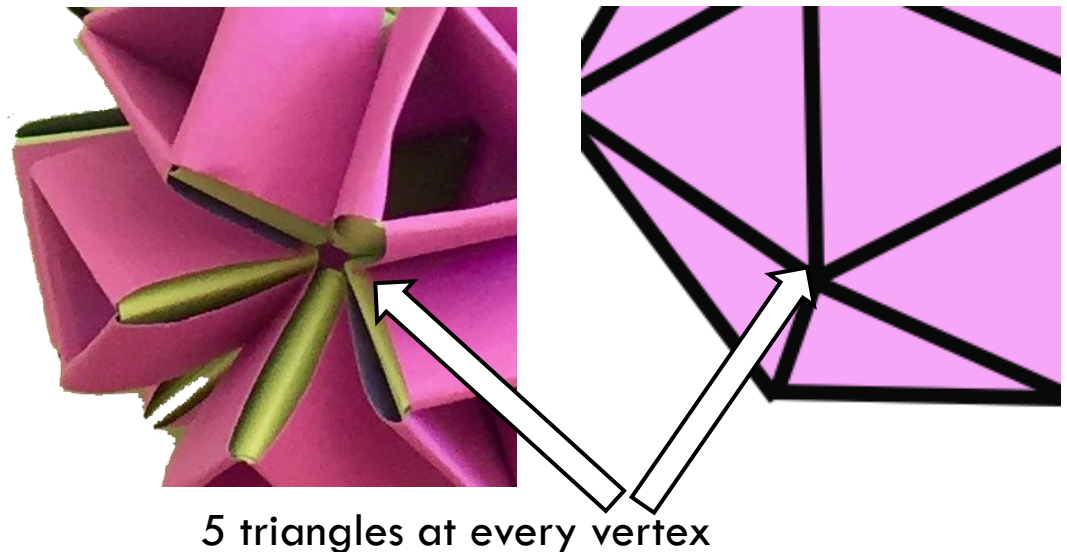


Why are Platonic/Archimedean solids so well suited to snapology origami models?

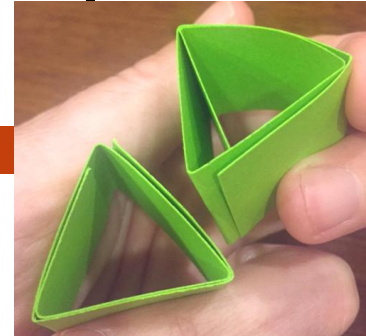
1. Made of regular n -gons, so “faces” are $2n$ -unit long strips



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



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 $\frac{20 \times 3}{2} = 30$.

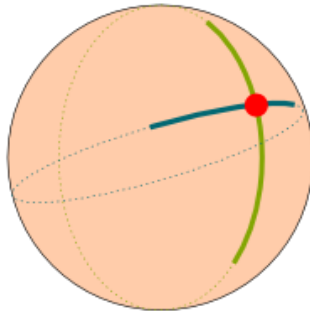
We will need 30 of the 4 unit long strips.

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.)?

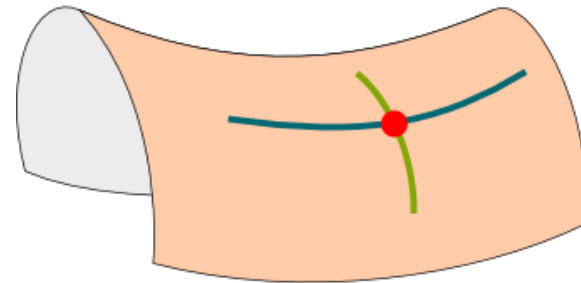
What about tori? Need to create saddle points.

Extremal directions curve
in the same directions



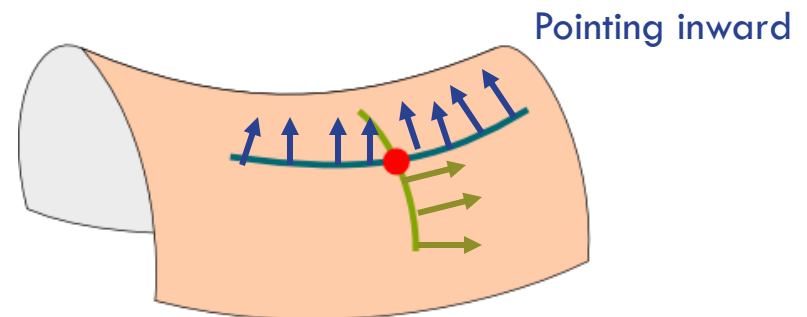
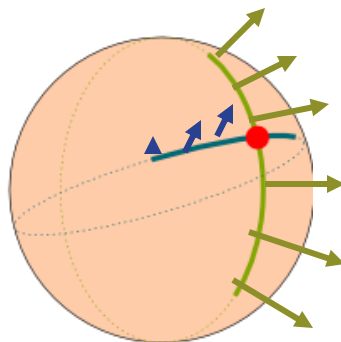
Positive Curvature

Extremal directions curve
in opposite directions



Negative Curvature

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

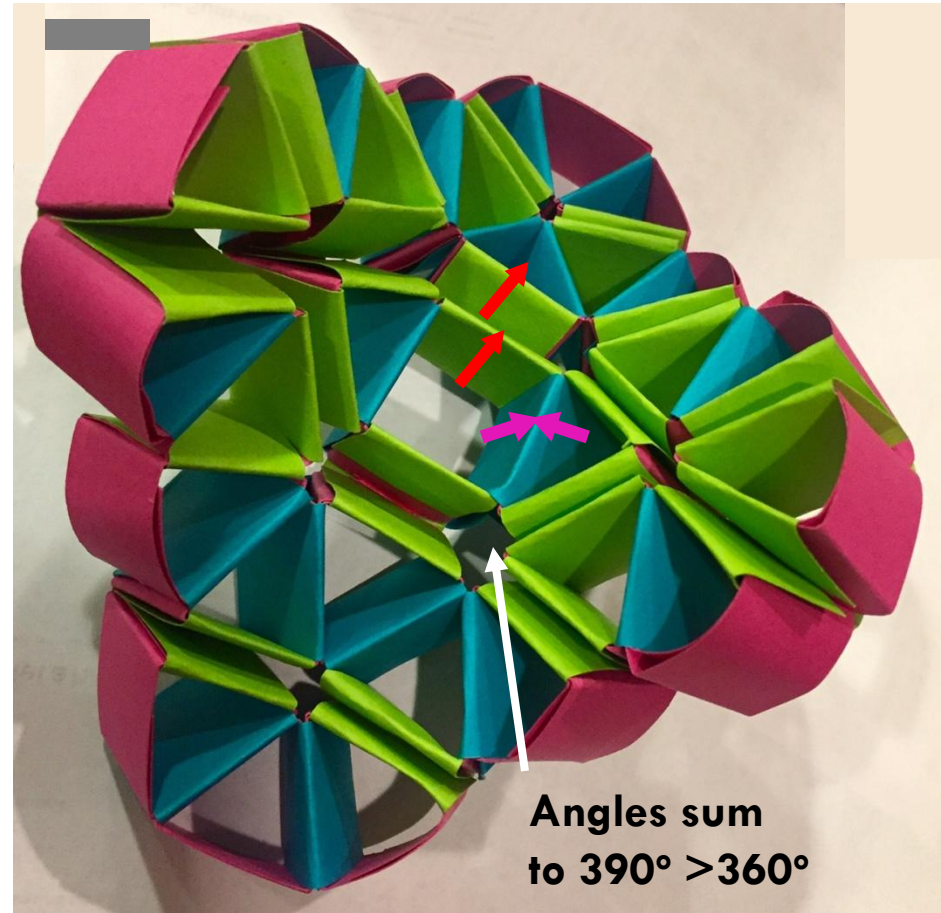


Pointing outward

Positive and negative curvature implemented in snapology origami



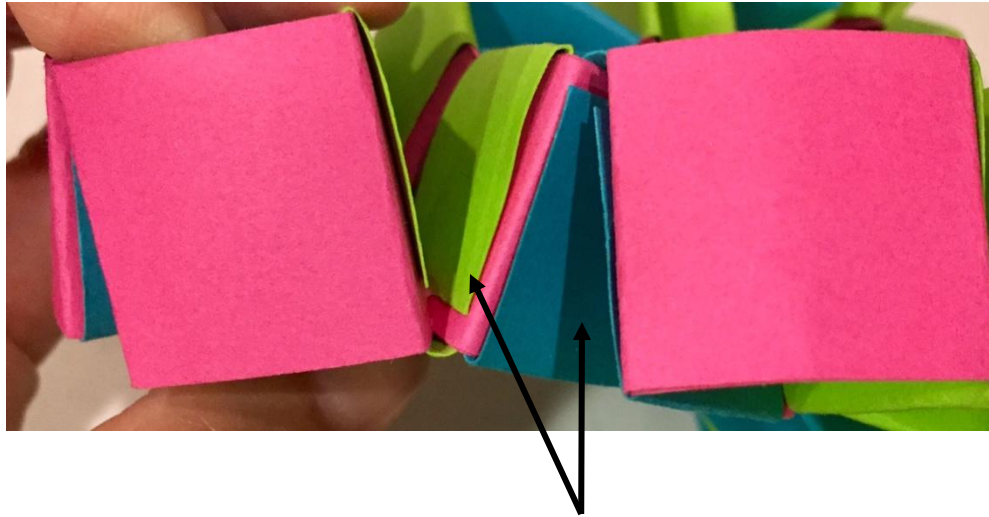
Normals point
“away from each other”.



Normals point
“away from each other”
along one direction

Normals point
“toward each other”
along other direction

Parting words about saddle shapes



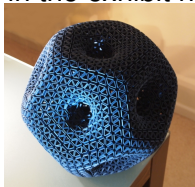
Saddles are necessary for making tori with any number of holes, Klein bottles, and any surfaces that contain areas of negative curvature.

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!

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

HONDA'S SNAPOLOGY ORIGAMI

HOMEPAGE | SUBMISSIONS TO THE 2017 BRIDGES ART EXHIBITION | POLYHEDRA | BUCKYBALL VARIATIONS | TOPOLOGY | FRACTALS | MISCELLANEOUS

Welcome to my Snapology Origami page. Just a place to share the products of my obsession. The projects within are based upon the folding and joining strips of paper. I originally started by learning from the works of Heiko Strobl. Since then I've pushed myself and started to design my own creations. Hope you enjoy.



A screenshot of the San Diego Math Teachers' Circle website. The header features a logo with a compass rose and the text "SAN DIEGO MATH TEACHERS' CIRCLE" over a background image of a coastline. Below the header, there is a navigation menu with links for Home, About Us, Our Staff, Assessments, Calendar, Frequently Asked Questions, Links, and Contact Us. The main content area includes a welcome message, a description of the circle's mission, and information about upcoming events and the organization's logo. The footer contains navigation icons and the text "San Diego MTC", "Snapology Origami", "1/11/18", and "7 / 7".

San Diego Math Teachers' Circle: sdmathteacherscircle.org