

# Origami for Mathematics and Engineering

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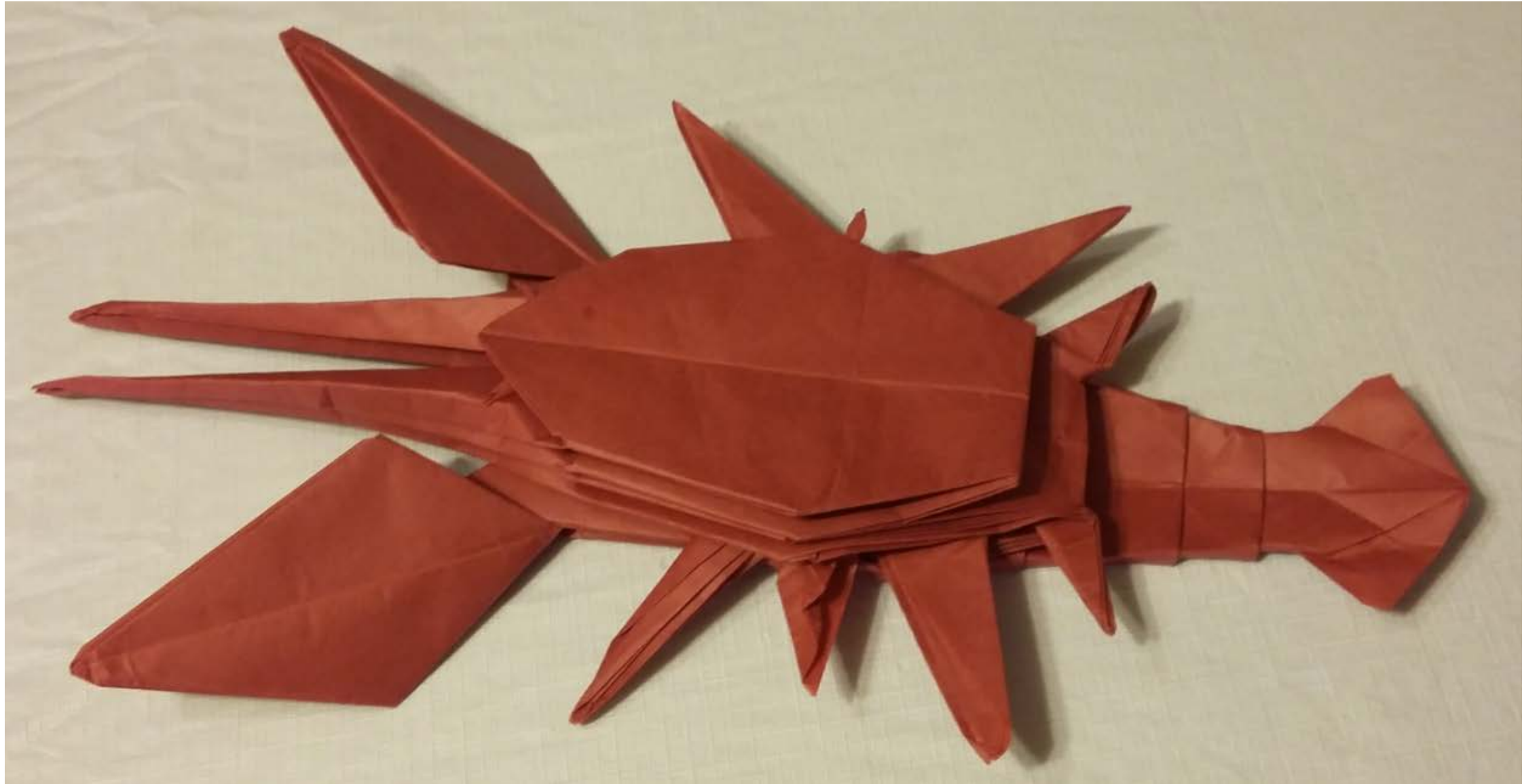
**Department of Mathematics**

**University of Wisconsin – River Falls**

**Math Forward**

**Victor Valley Community  
College District**

**April 21, 2018**



The background features a series of concentric circles in light gray, some solid and some dashed, creating a ripple effect. A prominent red callout box is centered on the page, containing the title text. The box has a rectangular top and a pointed bottom, resembling a speech bubble or a callout.

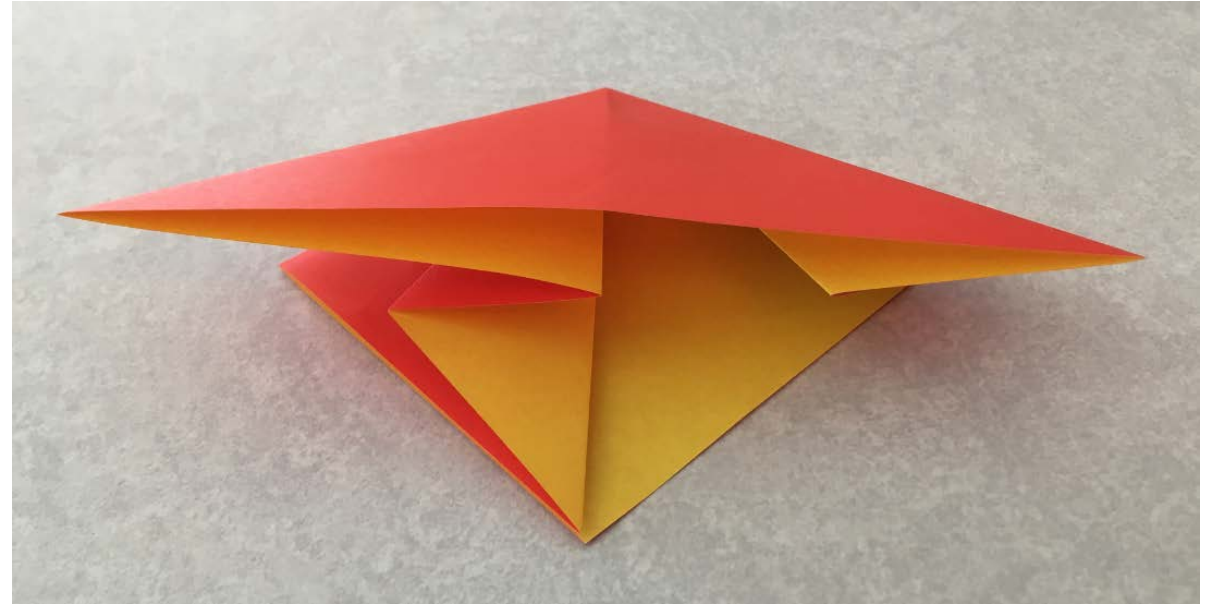
# Axioms of Origami

- O1:** We can fold a line connecting any two points  $P$  and  $Q$ .
- O2:** We can fold any two points onto each other.
- O3:** We can fold any two lines onto each other.
- O4:** Given a point  $P$  and a line  $L$ , we can make a fold perpendicular to  $L$  passing through  $P$ .
- O5:** Given two points  $P$  and  $Q$  and a line  $L$ , we can make a fold that passes through  $P$  and places  $Q$  onto  $L$ .
- O6:** Given two points  $P$  and  $Q$  and two lines  $K$  and  $L$ , we can make a fold that places  $P$  onto line  $K$  and places  $Q$  onto line  $L$ .
- O7:** Given a point  $P$  and two lines  $K$  and  $L$ , we can fold a line perpendicular to  $K$  placing  $P$  onto  $L$ .

The background features several concentric circles of varying radii, some solid and some dashed, creating a ripple effect. A prominent red callout box is centered on the page, containing the text 'Kawasaki-Justin-Husimi Theorem'.

# Kawasaki-Justin-Husimi Theorem

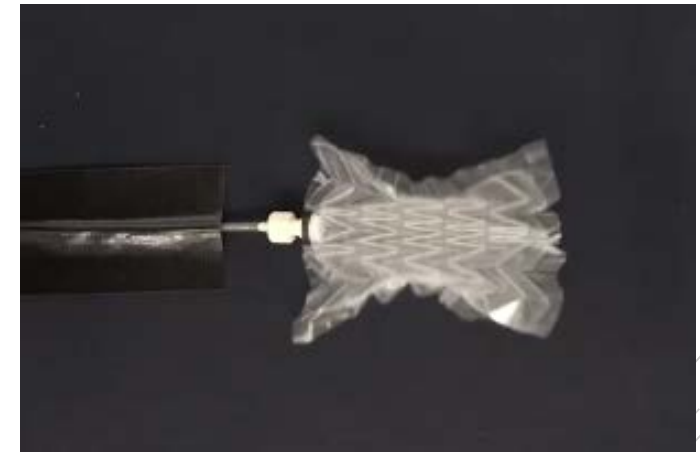
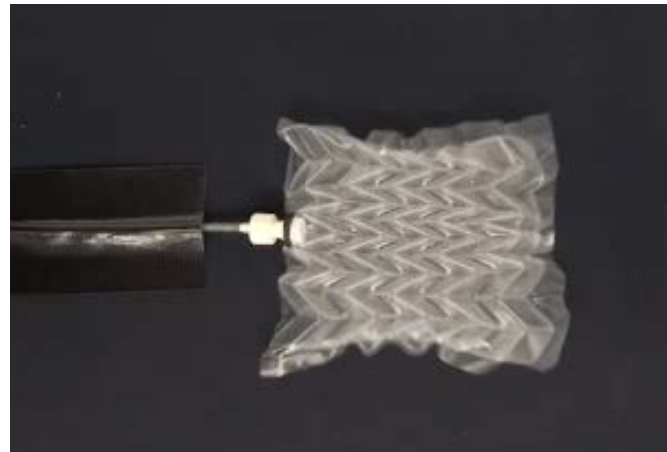
A crease pattern is flat-foldable if and only if the alternating sum about a vertex is zero.



$$90^\circ - 45^\circ + 22.5^\circ - 22.5^\circ + 45^\circ - 90^\circ + 22.5^\circ - 22.5^\circ = 0^\circ$$

Source: Kawasaki (1989); [https://en.wikipedia.org/wiki/Kawasaki%27s\\_theorem](https://en.wikipedia.org/wiki/Kawasaki%27s_theorem)

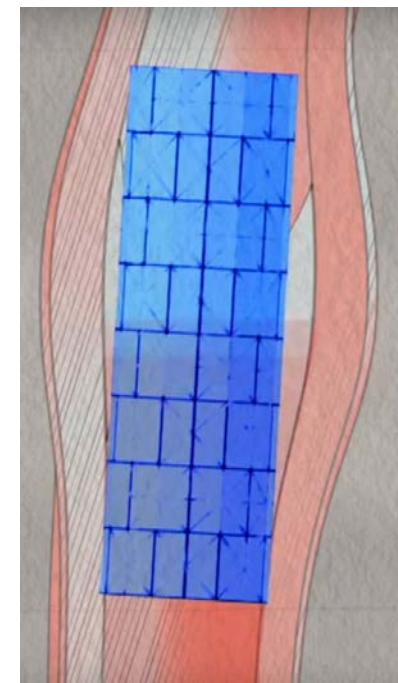
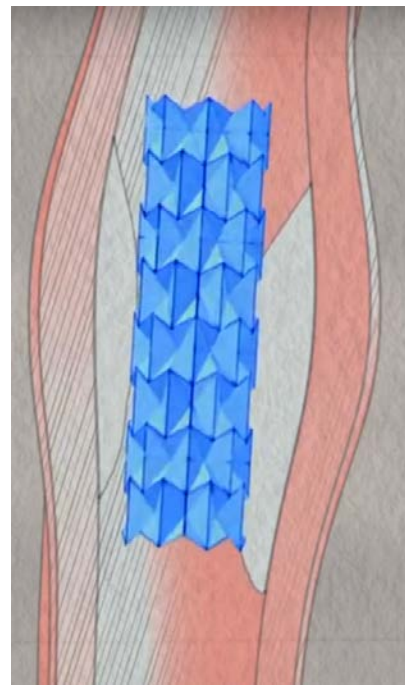
Functionality  
Collapsibility  
Strength



Source: Wyss Institute at Harvard University



# Functionality Expandability



Source: "The Origami Revolution," *Nova* PBS,  
Season 44, Episode 5, Aired February 15, 2017.

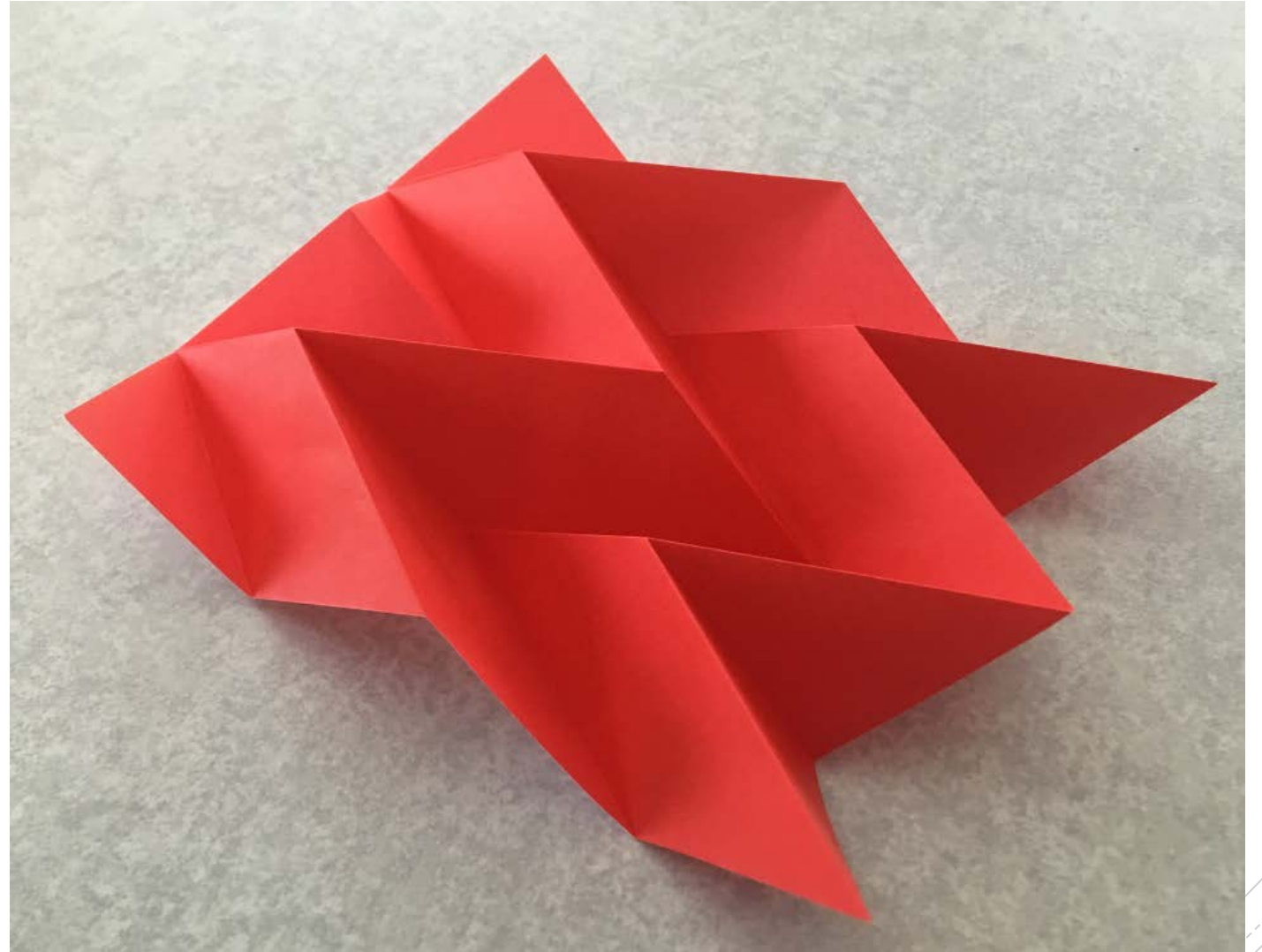


Functionality  
Expandability  
Strength

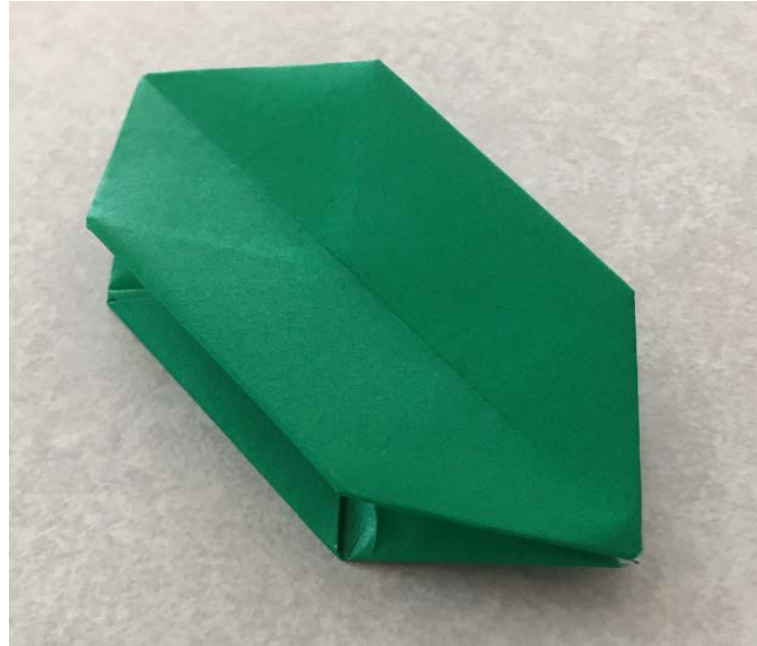


Source: Brigham Young University

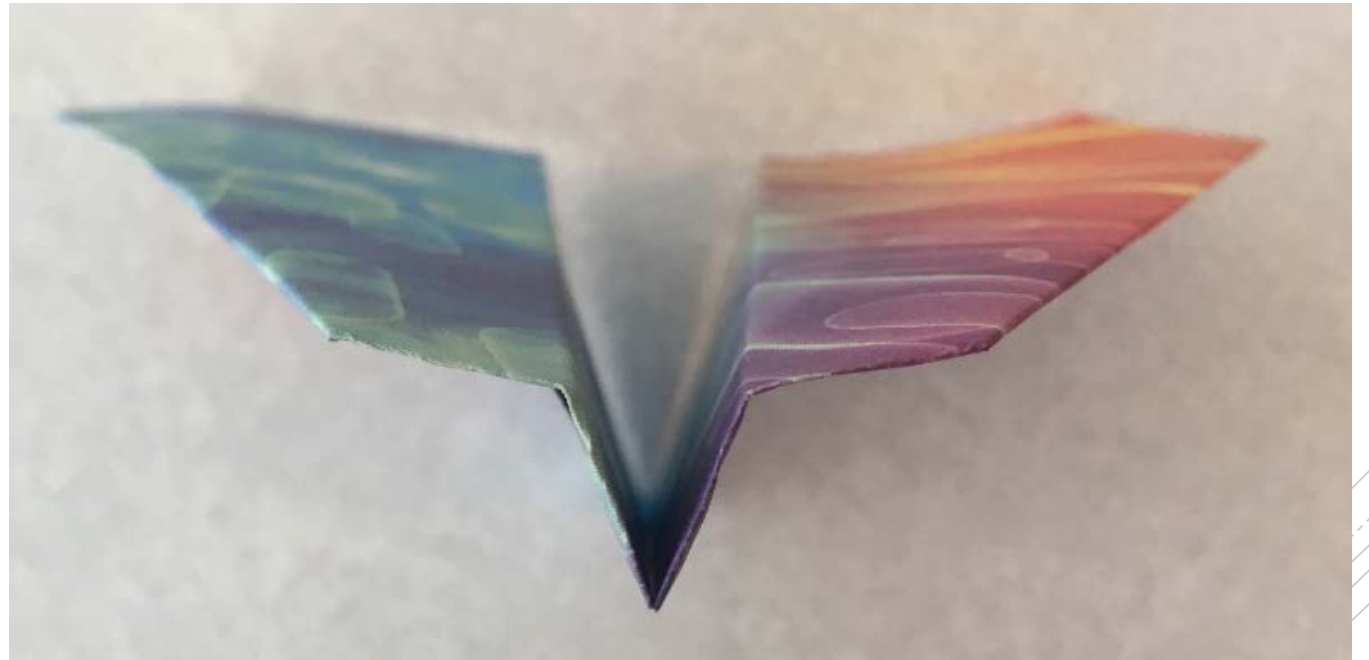
Miura Ori



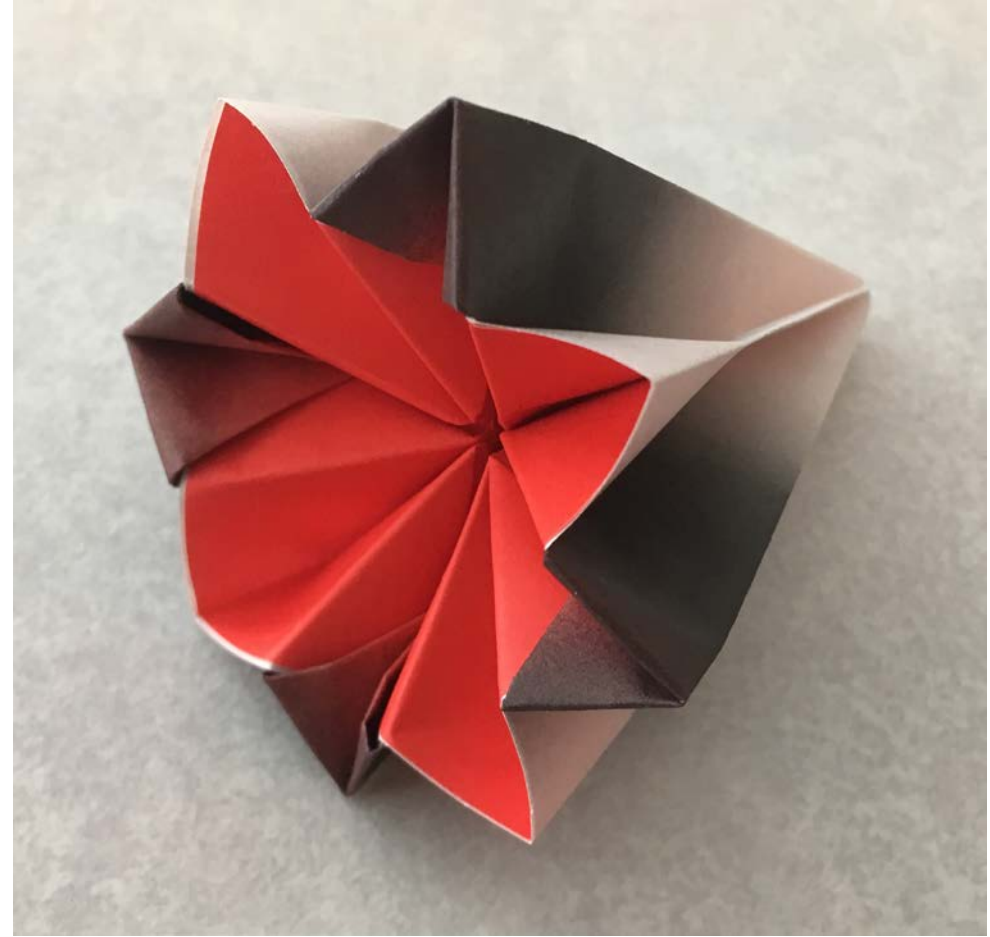
# Water Bomb



Nakamura  
Lock



Cone





Comments?



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