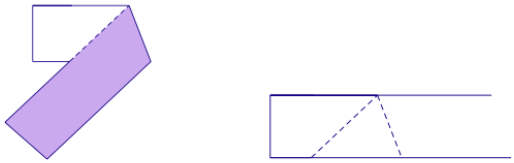
Hexaflexagons[1]

1 Equilateral Triangles

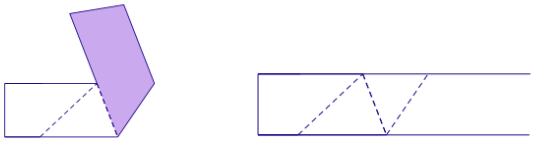
1. Last time, we made strips of equilateral triangles like this. They don't start out equilateral, but they end up that way.

   (a) Take a long, thin strip of paper and begin by folding up to form any angle you like, then unfolding it to see the angle formed by the crease line and the bottom edge of the paper.

   (b) Now fold down so that the top edge of the paper falls along the crease line you just made, and unfold to see the new crease line.



   (c) Next fold up along the newest crease line, then unfold.



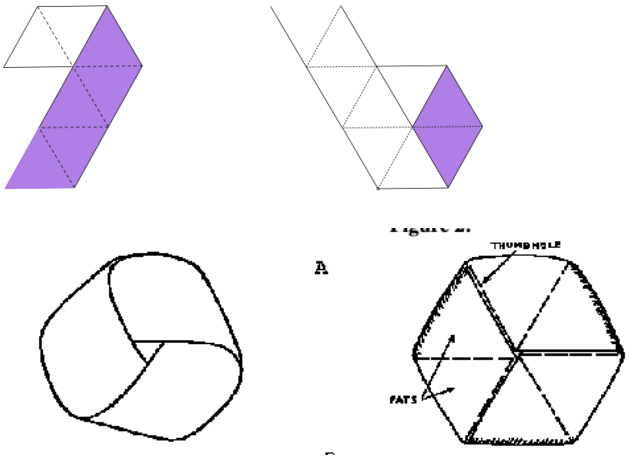
   (d) Keep alternating up folds and down folds.

[1] See Vi Hart videos to learn how to make these

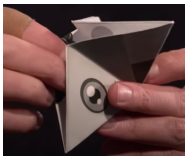
2 Tri-hexaflexagons

2. Use the strip of triangles to fold a hexagon. Throw away the first few triangles on your strip of paper, then fold the paper along crease lines to form a hexagon, as illustrated below. You will need 9 triangles and some tape.

   You can think of the hexagon as being made from three strips of 3 triangles each. Make sure that each strip of three triangles lies over its neighbor on one side and under its neighbor on the other side.



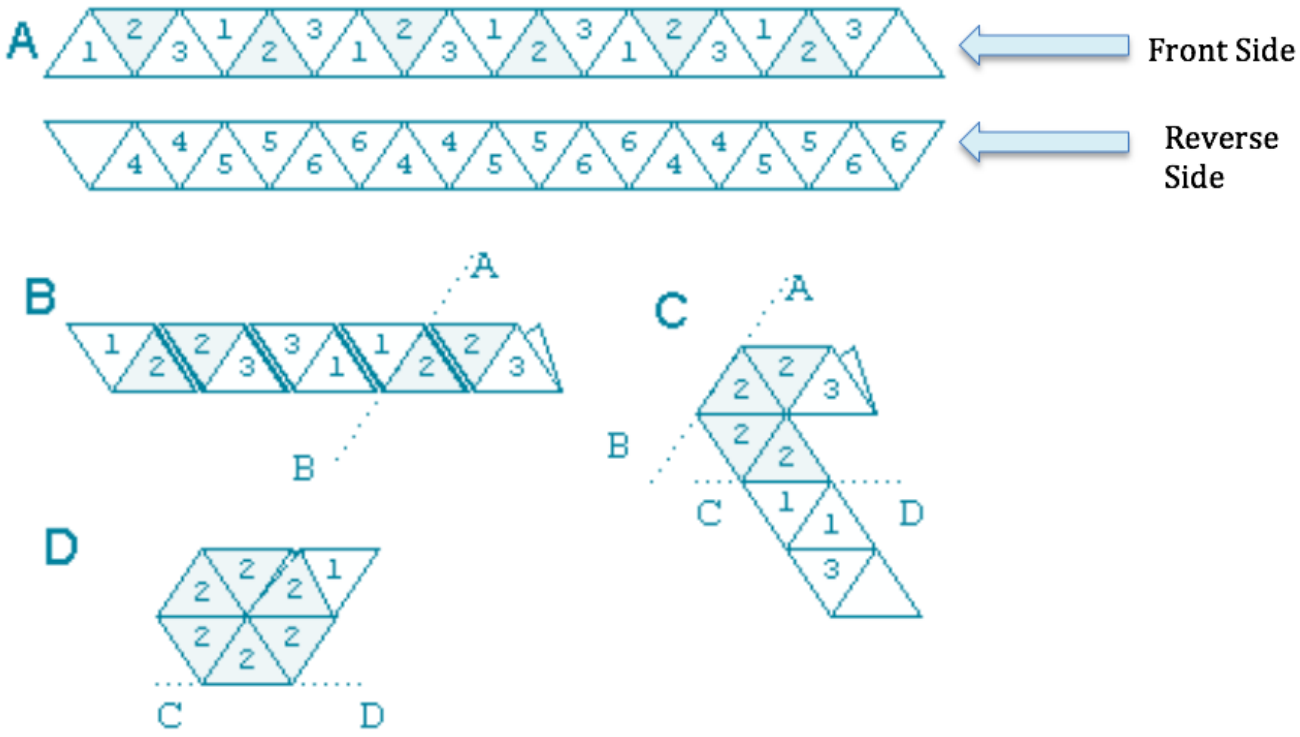
3. Color each of the two sides of the hexagon that you have made. Then pinch and unfold it to reveal ... a third side!



3 Hexa-hexaflexagons

4. Hexa-hexaflexagons are made from a longer strip of triangles, by first wrapping the triangles to make a double strip of 9 triangles, and then folding a tri-hexaflexagon out of the 9 triangles.

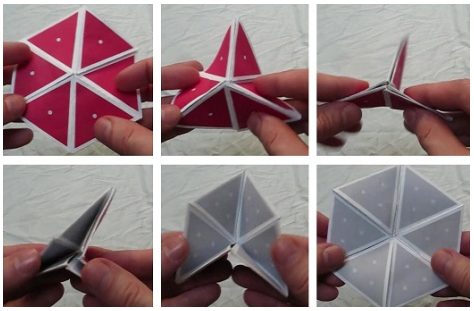
   If you'd like, you can make your own hexa-hexaflexagon, using the instructions below. Or, you can grab one of the pre-made ones, and skip to the next page.



4 Coloring hexa-hexaflexagons

5. Pick two different colors and color each side of your hexaflexagon a different color.

6. Flex the hexaflexagon by pinching it and gently pulling the center out, to uncover a third, uncolored side. Color it with a new color.



7. Continue flexing the hexaflexagon. Can you uncover any additional sides? How many sides, total, can you find? Color each new side with a color you haven't used yet.

8. Once you have colored all the sides you can find, pair up with a neighbor and compare results. Do the rest of these instructions together, working on one hexaflexagon.

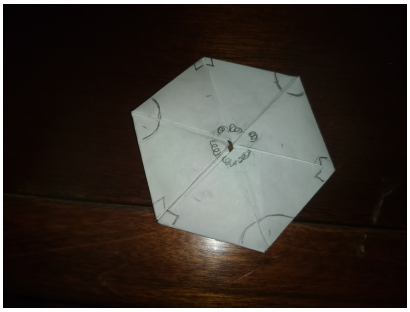
9. Make a chart of which colors go together front and back. It might help to put numbers on the sides. For example, side 1 might sometimes be on the back of side 2, and other times on the back of side 3. Which colors / numbers seem to come up most frequently? Which are hard to find?

Side number	Which other sides appear on the back of this side?
1	
2	
3	
4	
5	
6	

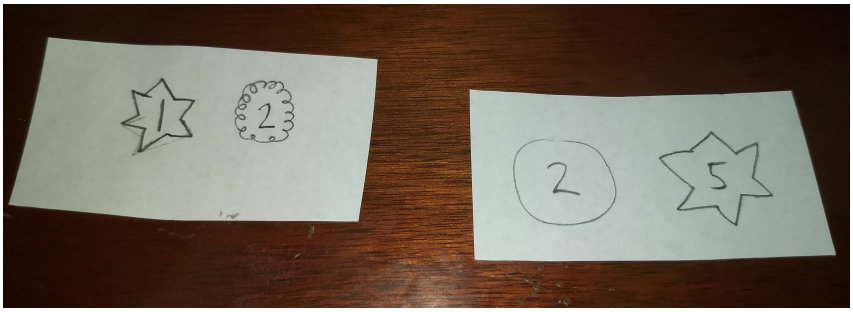
10. Some sides can be flexed in two different ways, depending on how you rotate your fingers before flexing. Which sides can be flexed in two ways and which in just one?

11. Draw a star in the center of one of the sides that comes up frequently. As you flex, can you get to a position where the star is now on the outside, not the inside? If so, draw another shape on the inside, like a circle, or a squiggly line.

12. Every time you have find center that is not decorated with a star, circle, or curly line, draw one. Make sure you use different decorations for different "centers" on the same side – if you are drawing on the yellow side and you already drew a circle in the center that migrated to the outside, next time use a star, and next time use a squiggly line for the center of that side.



13. Let's try to figure out how all the sides fit together. Write down pairs of sides with both numbers and decorated centers that go front and back from each other. For example, 1 with a star might go front-to-back with 2 with a squiggly line, and 2 with a circle line might go front to back with 5 with a star. Draw the symbols on paper rectangles to make dominoes.



14. Now fit together the dominoes so that 5 goes next to 5, 4 goes next to 4, etc. It's ok if some of the numbers are upside down. Try to fit them around in triples. This gives you a map of how to get to all the sides of the hexaflexagon!

15. Use your map to get to the hard-to-find sides efficiciently!

5 How many triangles?

16. Hexaflexagons are made out of strips of paper folded into lots of triangles. How many triangles would you need on a strip to make one like this? Remember that a regular sheet of paper already has two sides. This one is called a hexa-hexaflexagon, because it has 6 sides and each side looks like a hexagon.

17. A tri-hexaflexagon has 3 sides, and each side looks like a hexagon. How many triangles would you need to make a tri-hexaflexagon?