Fold and Cut.

We have a piece of paper. How many straight line cuts do you need to cut a square out in the middle of a piece of paper? 5 cuts? 4 cuts? 2 cuts? Who can do it in the fewest cuts?

How we can do it in 2 cuts? Maybe if we fold it along the diagonal?

Can we do it in even fewer cuts? If a square has 4 sides, how can we cut all of them out in a single cut? Maybe we should join them together somehow.

Let us fold the paper along the diagonal to join 2 sides of a square into 1. This will give us 2 lines to cut. But we can repeat this and join the remaining 2 sides in a single side, which will require only a single straight line cut. So it is after all possible to cut a square in the middle of a paper with a single cut.

Is this feature only true for the square, or can it be done for some other shapes as well? What kind of shapes?
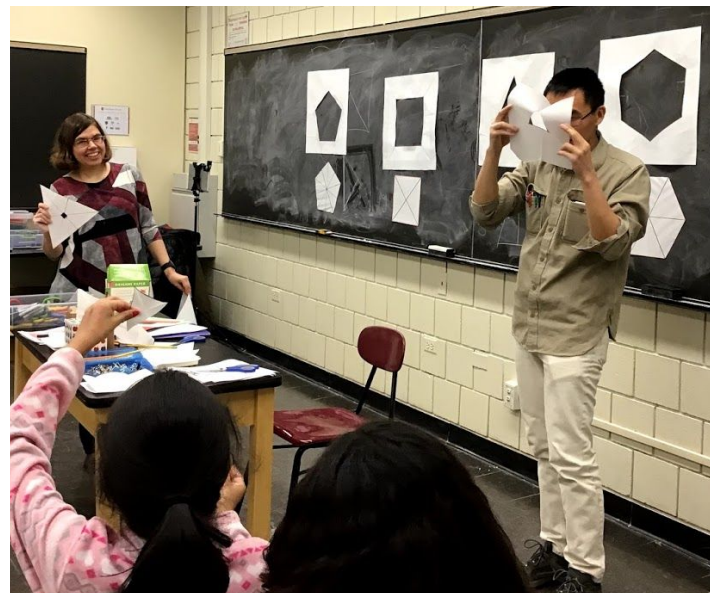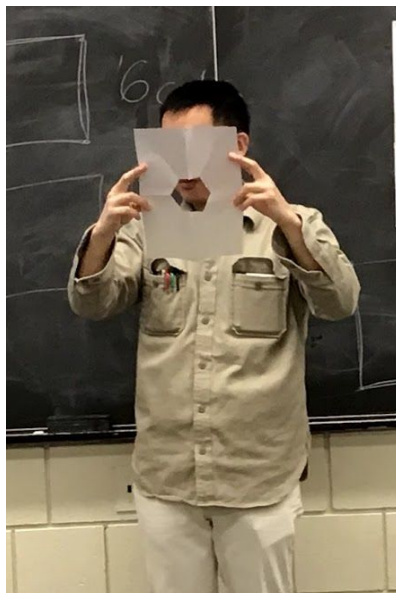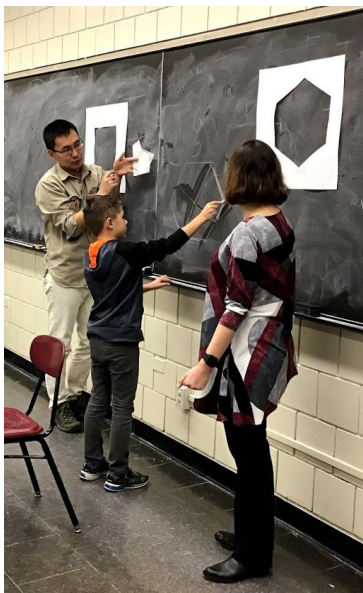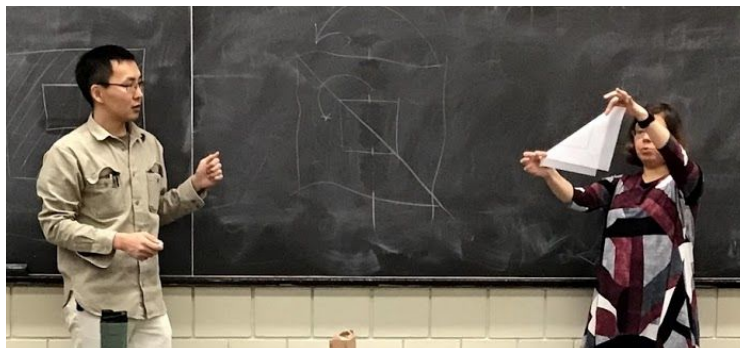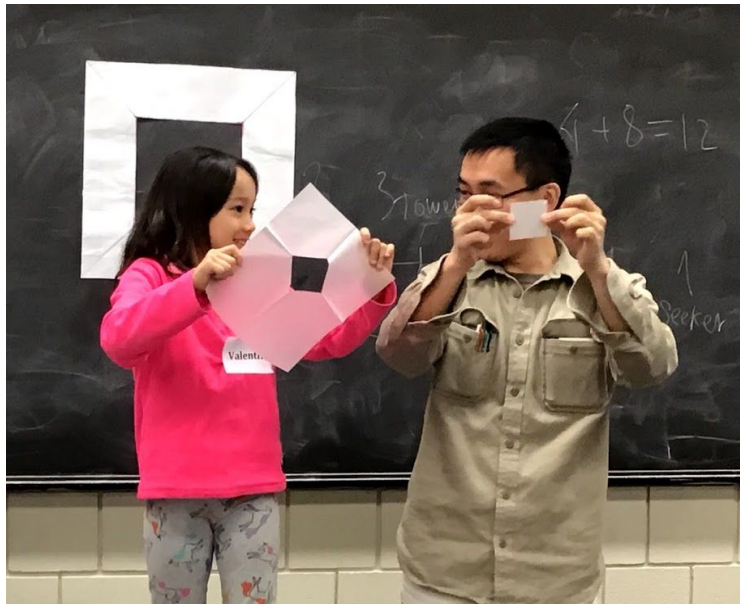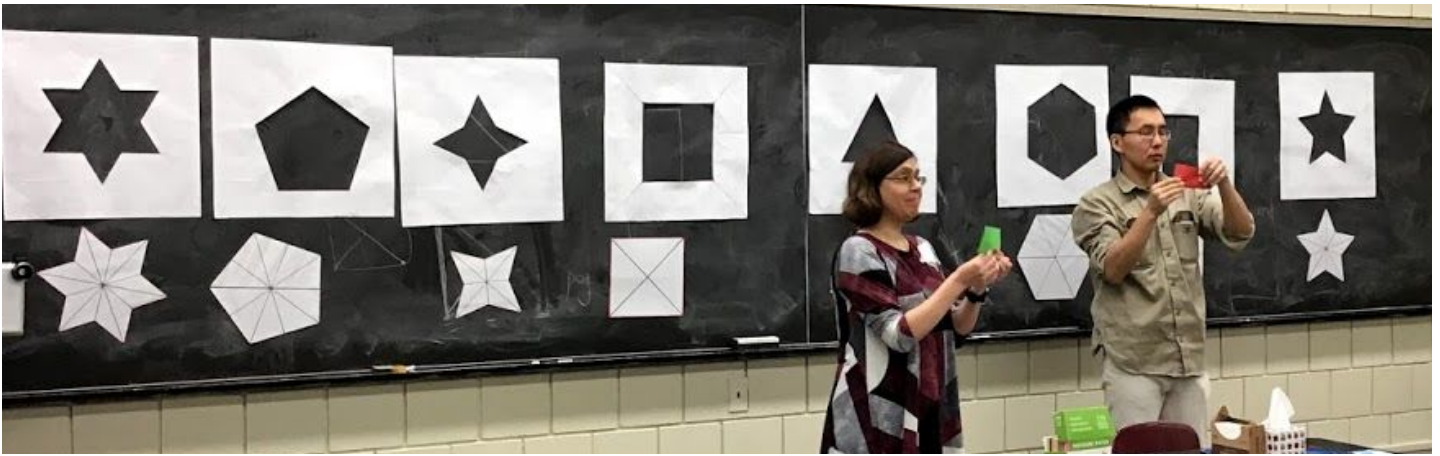
We will do only one type of activity today - fold up a piece of paper, make one straight cut, then unfold the paper. **Recently, mathematicians have shown that any shape made of straight lines can be cut from a sheet of paper by folding it beforehand and making a single straight line cut.**All we have to do is to figure out which lines we will use to fold the paper! Let us start!


Let us start with some simpler shapes. We will trace the shape on a patty paper, which is transparent and start folding. Make sure you try to align the sides of the shape as much as possible when you fold it.
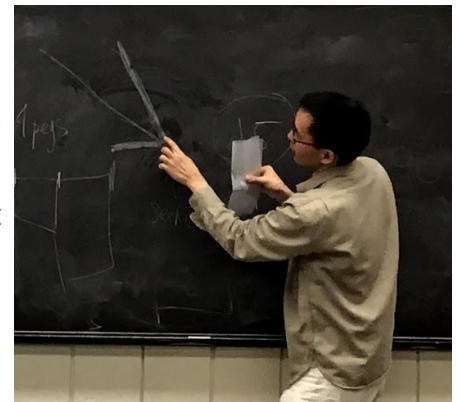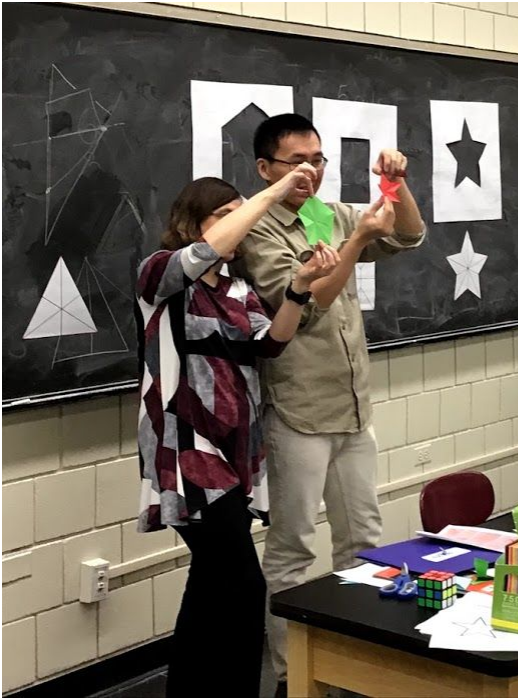
How do we fold and cut the paper to get a triangle? Is it even possible? Let us take a triangle with all sides equal and fold it in half, right down the midline. We now have 2 straight lines left instead of 3.

How do we combine them? We can simply fold the paper along a straight line going right through the middle of those lines. This is called the bisector of an angle and we will be using it a lot from now on!
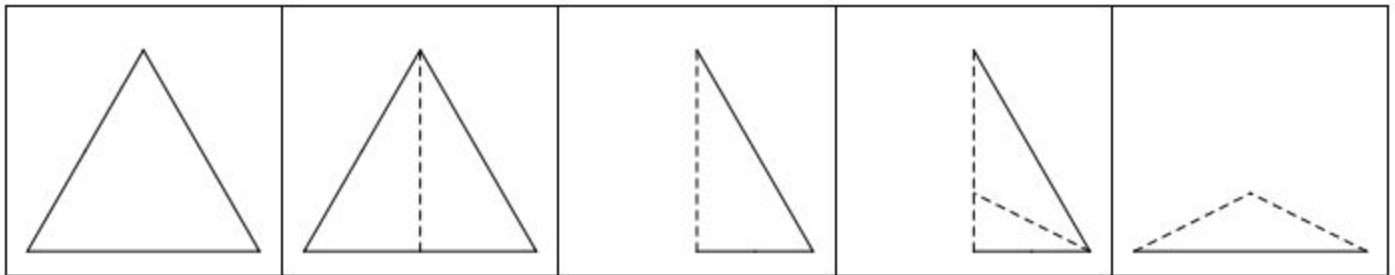
In the row of pictures with triangles, the bisectors are shown in dashed line and they are in fact dividing the angle into two equal parts.
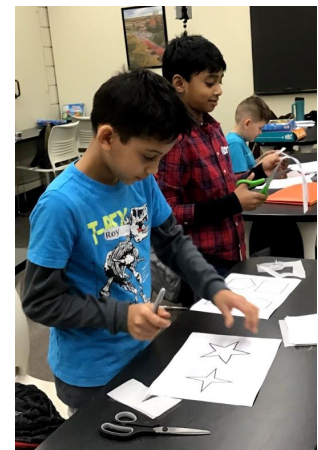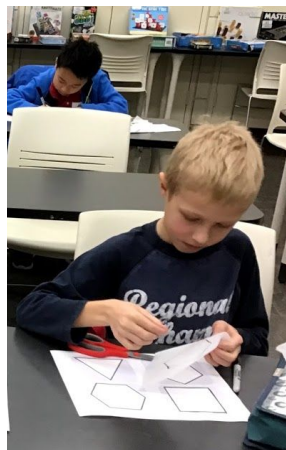
How about some more complicated shapes? Is there a general rule on how to fold the shape so that we cut make a single cut? Unfortunately there is no easy to follow secret recipe known like that just now. But we can always start by doing what we did with the triangle: look for angles that can be divided in half. In simpler shapes we can always look for a line of symmetry, along which we can fold the shape and divide it in half. This will already reduce the outlines of the shape half way and get us closer to the single straight line.

Now we will attempt the real trick: we will make a 5-point star by folding the paper and making a single cut without drawing the star trace beforehand.

The legend goes that more than two centuries ago, Betsy Ross suggested a 5-point star for the original US flag partially because she knew how to fold a cloth and make a single cut to make a 5-point star shape.

See you next week!