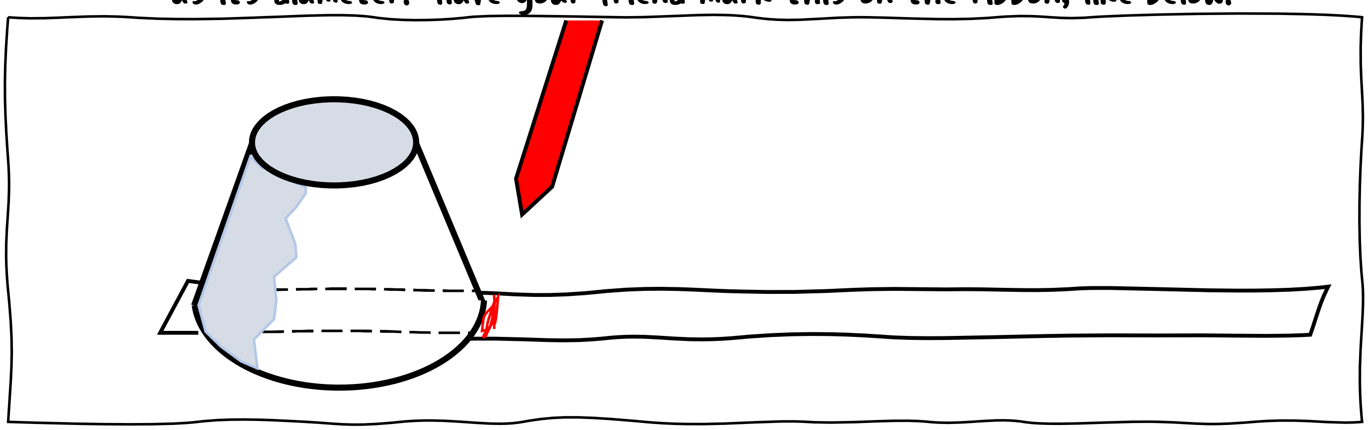
EGYPTIAN PI: MEASURE LIKE AN EGYPTIAN

This is an activity you can do to approximate pi like an Egyptian. You will need:

- A circle shapes: like a cans, a cups, or a paper tube
- Some ribbon to wrap around the shape
- Scissors to cut the ribbon
- Markers to color the ribbon
- A friend to help you

To measure pi in the Egyptian style:

1. Take one of your circle shapes & wrap the ribbon around circle shape once.
2. Have your friend cut the ribbon so that it wraps around the shape exactly one time.
3. Now lay your ribbon out flat and hold it tight.
4. Have your put the circle shape at one end of the ribbon, with the ribbon as its diameter. Have your friend mark this on the ribbon, like below.



5. Line the circle shape up against the new mark, and repeat step 4. Keep doing this until you run out of ribbon.
6. Color the ribbon a different color in between each mark. How many colors did you use?

You will probably get three full sections of color, with a little bit extra at either end. That means that a circle's circumference measures about the same as *three* diameters!

GREEK PI: EXHAUSTED ARCHIMEDES

This is an activity you can do to approximate pi like Archimedes. You will need:

- A scientific calculator

Archimedes used a process called "exhaustion" to find approximations of the value pi. He started with a circle of diameter one and inscribed a 6-sided shape in it, each with sides of length ½ and used that to compute the perimeter of the polygon. He then doubled the number of sides of the polygon, and used

$$s_{doubled} = \sqrt{0.5 - 0.5\sqrt{1 - s^2}}$$

to find the length of each of its sides and repeated this process over *and over.* (No wonder this was called "the method of exhaustion"!)

You can try it yourself, using your calculator to help you with the math. Fill in each row of the table. What do you notice above the numbers in the right-hand column?

Number of sides of the polygon		Length of a side (use the formula)		Polygon perimeter (multiply them)
6	x	0.5	=	3
12	x	0.2588190453	=	
24	x		=	
48	x		=	
96	x		=	

Archimedes stopped at a 96-sided polygon because he didn't have a calculator to help him. What happens if you continue his work?

192	x		=	
	x		=	
	x		=	

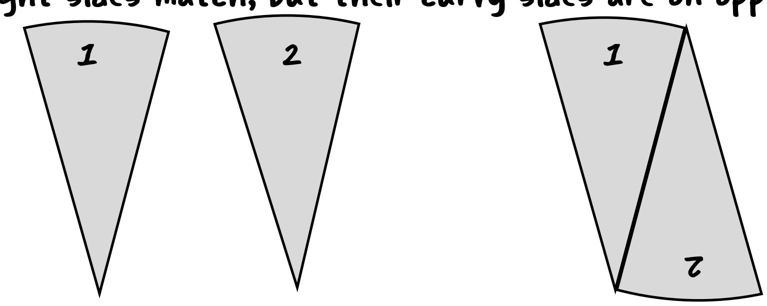
CHINESE PI: PI ARE SQUARED (OR RECTANGULAR?)

This is an activity you can do to approximate pi like Liu Hui. You will need:

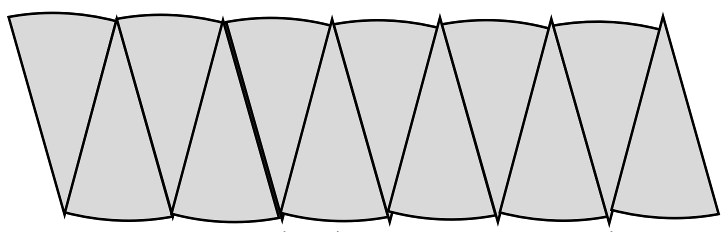
- Scissors, to cut the paper
- Tape, to reassemble it
- Colors, to make it beautiful

Liu Hui showed that the area of a circle was the same as the area of a certain rectangle… let's see how he did that. We start with a circle divided into 12 sections (like a clock!) on the other page.

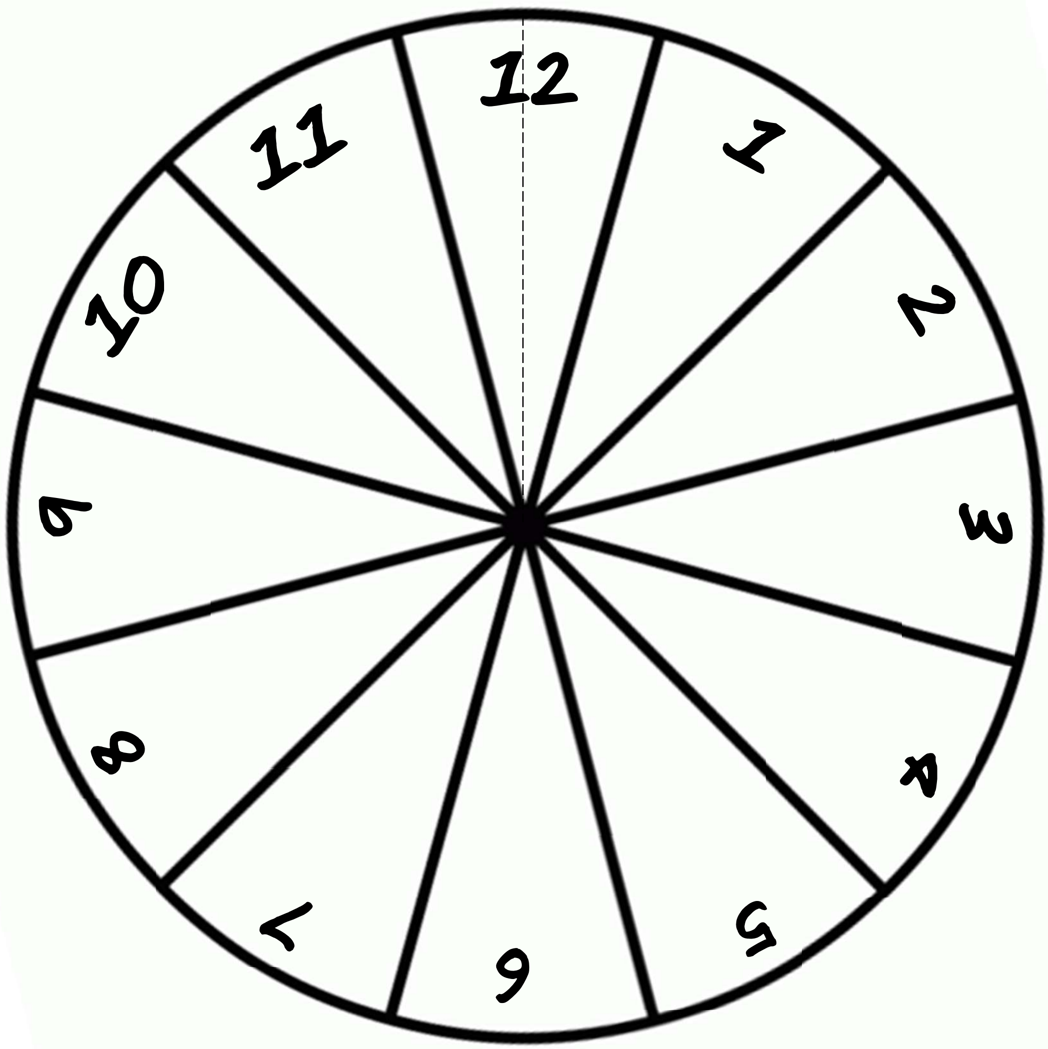
1. Color a pretty picture on your circle.
2. Cut out the 12 sections of the circle, along the solid lines.
3. Take the "1" and "2" pieces, and rotate one of them around, so that their straight sides match, but their curvy sides are on opposite ends.



4. Repeat this for the remaining five remaining pairs. You should no have six pairs of taped-together wedges.
5. Take the "1-2" piece, and tape it to the "3-4" piece so that they interlock like dinosaur teeth… and then repeat.



6. Now you should have a shape that looks like a slanting rectangle. Cut off that extra bit from the "12" piece along the *dotted* lines, and tape it to the "1" piece. You have a rectangle!
7. *Bonus!* If you have a ruler & a calculator, you can test the area of your rectangle (length x height) to the area of the original circle (pi x radius^2). Use 3.14 for pi.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