Funky Fractals

The Big Idea:

We're going to use small items to make wild repeating patterns called **fractals**! Clouds and snowflakes form fractal patterns – so do broccoli and cauliflower and mountains and rivers!

You Will Need:

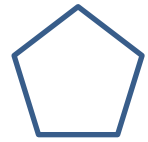
- ★ At least 27 small items, such as crayons, toothpicks, popsicle sticks, markers or pencils. All items should be similar in length. The more items you have, the larger your pattern will be!

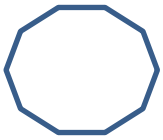
The Math Behind the Scenes:

Scientists use **fractal geometry** to visually model much of what is seen in nature, like coastlines, mountains and soil erosion and to analyze seismic patterns. Our game is a great way to visualize the patterns behind all that fractal geometry and in nature!

Play with Shapes

1. Use 10 of your items to explore any geometric shape you like. You can make squares, triangles or even a 6-sided shape called a hexagon!
2. A **polygon** is a closed shape made up of straight lines. So a circle isn't a polygon, because it's curved but a rectangle is. Can you use 10 sticks to make a polygon with all equal sides? Yes! You can make pentagons with 5 equal sides (two sticks per side) and decagons with 10 sides. Try it!





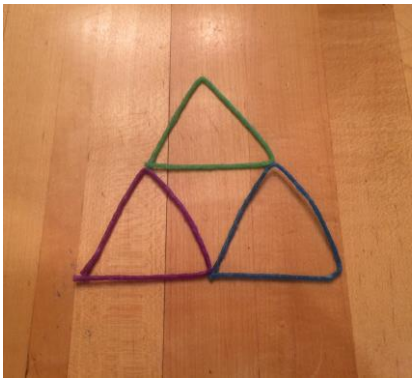
3. What are all the says you could make a perfect square with your 10 sticks? You can make a square with 4 items or use 8 items to make a square with 2 items per side. Will that work with 6 items? How about all 10?

Let's Fractal!

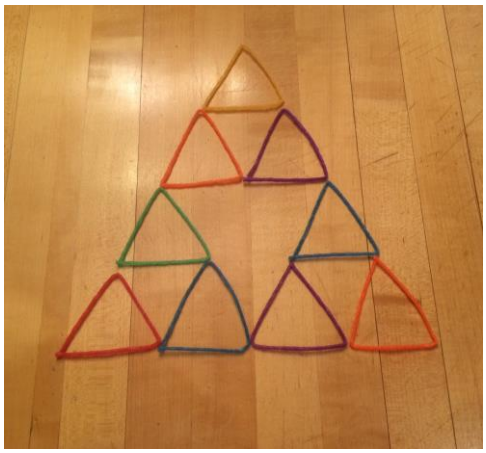
Fractals are never-ending patterns. The patterns can be different sizes and directions, but the same small pattern is used over and over to create an ongoing larger pattern. There are lots of fractals in nature, including snowflakes. Let's make some of our own fractals!

Level I

★ Start by making a triangle pattern made of 9 sticks. What do you notice about the shape? It's a big triangle made from 3 smaller triangles. Did you also notice the 3 smaller triangles create an interior upside-down triangle?

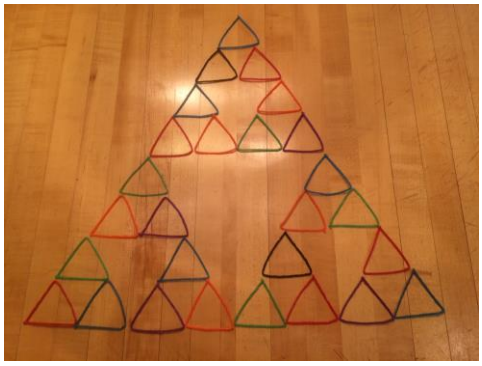


Level 2



- ★ Let's take our first pattern to the next level. Make 2 more of the first pattern and connect them as shown in this photo.
- ★ Notice how this new larger pattern mimics the first – see the same upside-down triangle in the center?
- ★ If there were 9 sticks in our first pattern, how many wax sticks should this next level use? We can multiply 9 by 3 to get 27 sticks.

Level 3 and beyond...



- ★ If you have lots more items at home, or want to recreate your fractal pattern on paper, you can branch out as many times as you like. This Level 3 pattern uses 3 Level 2 patterns and 9 Level 1 patterns!
- ★ The math behind fractals is more obvious as the pattern grows larger. For example,

Level 4 would include:

3 Level 3 patterns
9 Level 2 patterns
27 Level 1 patterns

Level 5 would include:

3 Level 4 patterns
9 Level 3 patterns
27 Level 2 patterns
81 Level 1 patterns

Fractal patterns aren't limited to triangles. You can use any shape and design you like to make your first pattern then repeat that same pattern as you grow on and on!

Math Teasers

Try as many questions as you can! Answers upside-down below.

Kindergarteners: How many different shapes can you name?

1st-graders: Which shapes have four sides?

2nd-graders: Can you name a shape with 4 equal sides?

3rd-graders: If your first fractal pattern has 3 shapes each made with 4 sticks, how many total sticks will you need to make the first pattern?

4th-graders: If your first fractal pattern has 3 squares made with a total of 12 sticks, how many sticks were used for each square?

5th-graders: If your first fractal pattern has 3 squares made with a total of 12 sticks, how many sticks will you need to make the second level pattern?

Answers:

K: Kids can say any shapes, like circle, square, triangle, rectangle and so on…

1st: Some examples of 4-sided shapes include: squares, rectangles, rhombus…

2nd: The square and rhombus have 4 equal sides.

3rd: 12 sticks. 3 x 4 = 12

4th: 4 sticks. 12 divided by 3 = 4

5th: If the first pattern has 3 shapes, then the second level will have 3 patterns of 3 shapes each. If each of those 3 patterns uses 12 sticks, then 3 x 12 = 36 sticks.