Math in Nature: Activity 1

DISCOVERY WORLD @HOME

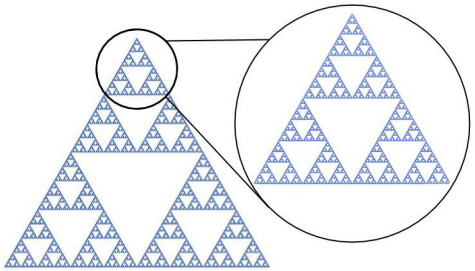
Introduction

Nature creates according to the laws of math. Exploring the ways that we see math in the natural world is as easy as taking a walk around the neighborhood!

Activity No. 1: FRACTALS

Age recommendation: 9+

A fractal is a pattern that repeats at different scales - a tiny piece has the same pattern as a larger piece, which has the same pattern as the whole. This repeating pattern is called **self-symmetry**.



In mathematics, we can find perfect fractals, like this **Sierpiński triangle**. Each triangle has perfect self-symmetry with the whole and the pattern could continue to infinity.

In nature, there are many imperfect fractals. A tasty example is Romanesco Broccoli - if you cut one spiral off, it would look like a miniature version of the whole head of broccoli. The branch patterns of many trees are also imperfect fractals.

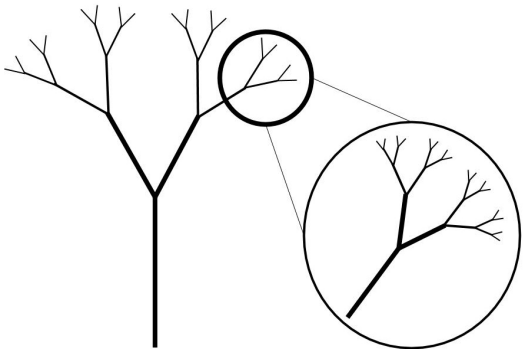
Create your own fractal tree with sticks!

Materials:

- ☐ A piece of paper
- ☐ A writing utensil
- ☐ Sticks (various sizes)
- ☐ A bag or anything to carry sticks in

Directions

1. Draw a fractal tree on a piece of paper. This will be the template for the fractal tree you will build with sticks.
   - **a** Choose a number to base your fractal tree off of. We recommend either 2 or 3 to start with.
   - **b.** Draw a large trunk for the tree.
   - **c.** Add branches, depending on the number you chose. If you chose 2, add two, and so forth.
   - **d.** Then, draw 2 (or your chosen number) more branches on each of the branches.
   - **e.** Repeat the above step several times, until the tree is the desired size.



2. Count how many lines (branches) there are at each level. Write this down so that you can reference it later.
3. Gather as many sticks as you need for each level. (Remember that you can break sticks to get smaller pieces!)
4. Find a large space such as a sidewalk to create your fractal tree. Using your drawn tree as a template, recreate the tree
5. Experiment with different fractal branching patterns by using a different number to base the fractal tree on.

Learn more about fractals and try other fun "Fractivities" from the Fractal Foundation at https://fractalfoundation.org/resources/fractivities/

Math in Nature: Activity 2

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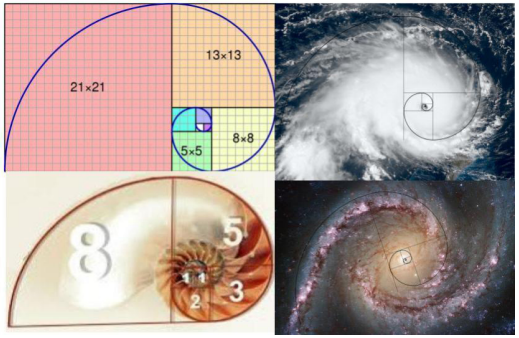
Activity No. 2: FINDING FIBONACCI

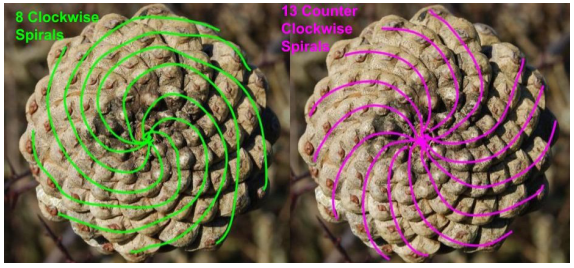
Age recommendation: 10+

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144... What connects these numbers? Each number is the sum of the two previous ones (0+1=1, 1+1=2, 1+2=3, 2+3=5...). This sequence of numbers is called the **Fibonacci Series**. Make a series of squares with side lengths that match the Fibonacci numbers and you get a Fibonacci spiral. Both the individual Fibonacci numbers and the Fibonacci spiral are commonly seen in nature.



Some examples are the spiral patterns of seashells, hurricanes, and galaxies; the family trees of honeybees, the number of petals and number of seed spirals in flowers, the number of branches in a tree, and many more.

One of the easiest places to find Fibonacci numbers is in a pinecone! Pinecones tend to have two Fibonacci numbers of spirals going in opposite directions. The pinecone below has 8 clockwise spirals and 13 counter clockwise spirals. Look for pinecones in your neighborhood and see what Fibonacci spirals you can find!



Materials

- ☐ A sheet of paper
- ☐ 2-3 colored markers
- ☐ As many pinecones as you can find

Directions

1. Go outside and collect pinecones. If you can, gather different kinds and sizes.
2. Look at the widest part of the pinecone and try to see how the seeds form spirals. Use a colored marker to mark all of the spirals going in one direction. Count the spirals. Use a different color marker to mark spirals going in the opposite direction. Count them.
3. Write out the Fibonacci number sequence on a sheet of paper. (You can find it in the first paragraphs to the left!)
4. Check the number of spirals you counted. Are they Fibonacci numbers?
   a. The example has 8 clockwise spirals and 13 counter clockwise spirals. 8 and 13 are both numbers in the Fibonacci sequence!
5. Repeat with other pine cones!

To learn more about the Fibonacci series in nature, check out this video and background reading from PBS LearningMedia! **https://www.pbslearningmedia.org/resource/math_nature/fibonacci-sequence/support-materials/**

Math in Nature: Activity 3

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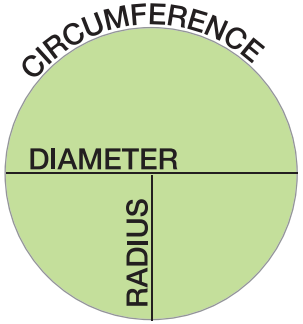
Activity No. 3: PI SCAVENGER HUNT

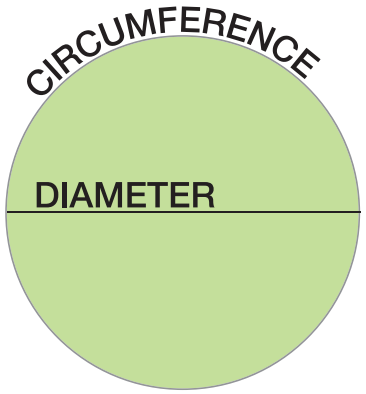
Age recommendation: 12+



What is pi? Pi is the ratio, or comparison, between a circle's diameter (the distance across the center) and its circumference (the distance around the edge). Pi equals 3.141592653589... It is an irrational number, which means its decimals continue to infinity and it cannot be represented by a fraction. The first calculation of pi was made over 2000 years ago!

Pi is represented by the symbol π and is used to calculate the many parts of a circle. Multiplying the diameter of a circle by pi will always equal the circumference. The diameter of a circle is easy to measure because it is a straight line. Pi is used to calculate the circumference from the diameter.

Circumference: C= dπ **Diameter: d=C/π**



Find and measure circles in nature. Use the circumference and diameter equations to test pi!

Materials

- ☐ Piece of paper
- ☐ Writing utensils in two different colors
- ☐ Measuring tape
  - If you don't have one, using a long string and ruler will also work
- ☐ A calculator or calculator app on a phone

Directions

1. On a piece of paper, make a table with three (3) columns. Label the columns "Natural Circle", "Diameter", and "Circumference".
2. Go outdoors with the table, a writing utensil, and measurement tool. Look around to find natural circles - things in nature that are round.
3. When you find a natural circle, write it down in the "Natural Circle" column. Measure and write down the diameter and circumference, if possible.
   - **a.** Sometimes, it may be difficult to measure both. For example, if measuring a tree trunk, it is easy to get the circumference by wrapping the measuring tape around the trunk but impossible to measure the diameter without cutting down the tree! Measure what you can.

Natural Circle	Diameter (d = C/π)	Circumference (2πr or dπ)
Tree		25 inches
Flower	3 inches	9.5 inches

4 Use pi and your measurements to calculate the diameter and circumference. Write your measurements and calculated values in different colors so that you can compare them. How close are your measurements to what pi says they should be?

Natural Circle	Diameter (d) (d = C/π)	Circumference (C) (C= d x π)
Tree	7.96 inches	25 inches
Flower	3 inches 3.02 inches	9.5 inches 9.42 inches

Where did you find math in nature? Let us know at

AtHome@discoveryworld.org