Fibonacci Sequence in Nature:

Age group: Middle School
Total Time: ~90 minutes total

Big Idea: Exploring how math can be found in nature through the Fibonacci Sequence.

Guiding Questions:

1. What is the Fibonacci Sequence?
2. Where do we find the Fibonacci Sequence in nature?
3. Can I find the Fibonacci Sequence in the place I live?
4. How can we use math to find sequences in the natural world?
5. What can I create with Fibonacci sequences?

Background Information for teachers and parents:
In this lesson, students will be able to connect math with nature. The Fibonacci Sequence was discovered/invented by Leonardo Fibonacci. It is one of the most famous formulas in Mathematics. Being able to connect math with the outside world will allow students to draw connections between numbers and shapes. If students have difficulties with math or are struggling to connect the two, have them focus more on finding, creating, or drawing things in nature that match the swirl (shape) of the Fibonacci Sequence.

Materials needed- colored pencils, graph paper, ruler, handouts from packet, internet capable device

Step 1: ~5 minutes
Invitation
Journal Prompt: Write or draw a few examples of mathematics or numerical patterns you have observed in nature. Try for 1-2 examples.

Step 2: ~3 minutes
Today you are going to learn about the Fibonacci Sequence. Check out this short video to find out more!

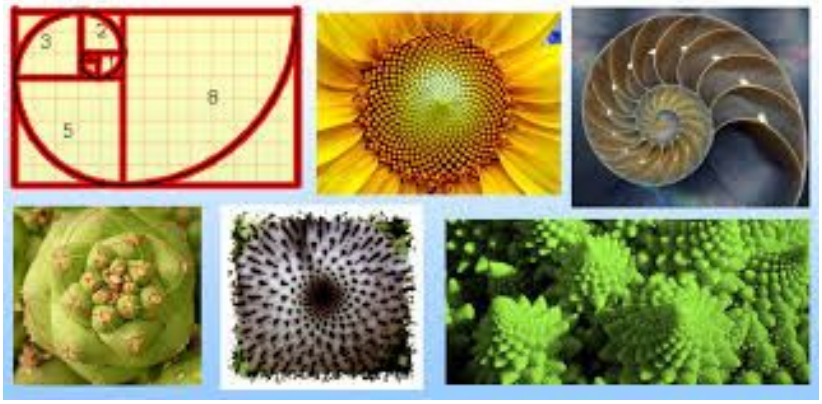
Step 3: ~20 minutes
Exploration
Let's explore the Fibonacci Sequence by drawing it out! For this activity you will need: colored pencils, a pencil, and a blank piece of graph paper. If you do not have graph paper you can use the example piece which we have added to this packet.

-Using the blank graph paper, replicate the example piece of Fibonacci's sequence by coloring each number set a different color. You will first start out with a 1x1 square and you will add

another 1x1 square below that. Next add a 2x2 square next to the first squares and so on and so forth. Remember that the sequence is found by adding the previous number to the current number. Example: 1+1 = 2; 2+1 = 3; 3+2 = 5; and so on.

You can reference the example in the packet to see how your paper should look when you have finished this activity.

-Now that you have created the Fibonacci Sequence on your graph paper, let's connect all of the squares within the sequence. This is where the Fibonacci spiral comes in. This spiral can be seen throughout the natural world! The first example below is what your graph page may resemble.



Step 4: ~15 minutes

Concept Invention

The Golden Ratio:

Another part of the Fibonacci Sequence is the Golden Ratio. This is the idea that with this sequence of numbers:

You can divide each number by the previous number and get the Golden Ratio (Phi). For example:

The Golden Ratio, Phi

3/2 = 1.5
5/3 = 1.6667
8/5 = 1.6
13/8 = 1.625
21/13 = 1.6154
32/21 = 1.6191

55/34 = 1.6176
89/55 = 1.6182
144/89 = 1.618

The Golden Ratio is Phi, 1.618.

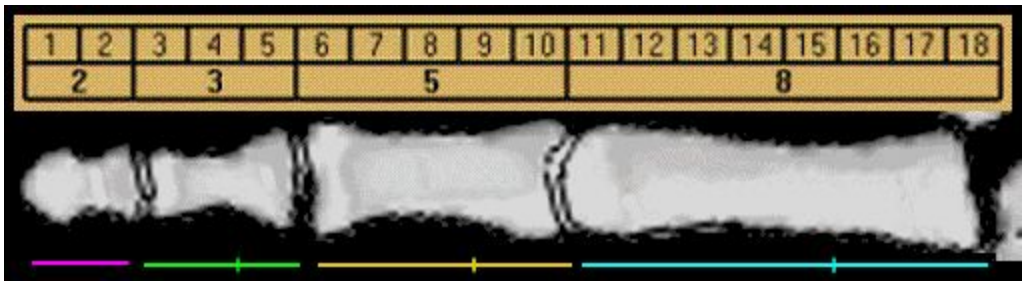
The Hand shows Phi and the Fibonacci Sequence:

Let's dive in deeper to the Fibonacci Sequence by starting with something simple. For this activity, you will need a ruler and your index finger (pointer finger).

-The unit of measurement for this activity will be your index fingernail! If you want to make a model of your fingernail out of something you can, or you can just measure the length.

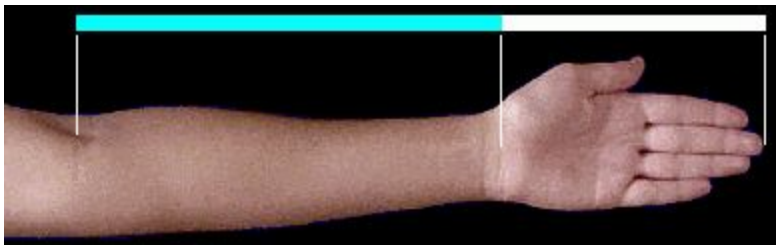
-Each section of your index finger, from the tip to the base of the wrist, is larger than the preceding one by about 1.618 which is the same number as the Golden Ratio, also fitting the Fibonacci numbers 2, 3, 5 and 8. By this scale, your fingernail is 1 unit in length.

-Take your fingernail and see if it matches the Fibonacci sequence as shown in the picture below.



The ratio of the forearm to the hand is also Phi!

Your hand creates a golden section in relation to your arm, as the ratio of your forearm to your hand is also 1.618, the Divine Proportion.



Step 5: ~30 minutes
Application
Fibonacci Nature Art

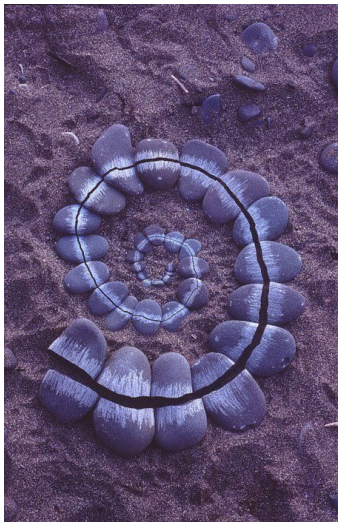
The fibonacci sequence and fibonacci numbers can be artistically represented in a variety of ways.
Using objects that you find in nature make your own representation of the Fibonacci sequence.

If you need some inspiration, here are examples!

Ex1: MOSS Instructor, Eric has used pine needles in a rather simple representation. Each pine needle has a Fibonacci numbered length in cm: 1cm, 1 cm, 2cm, 3cm……..all the way to a string of pine needles that is 144 cm long. This can be done with lengths of sticks or other objects found in nature as well.

Ex 2: MOSS Instructor Eric, places pine cone scales in a semi-circular formation,while using fibonacci numbers for each row of scales.

Ex 3: Nature Artist, Andy Goldworthy makes a fibonacci spiral using sliced and scratched stones.



These are just examples! Create in any way that you see fit!

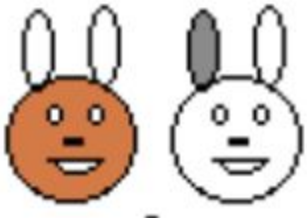
This can also be done with household items if you are quarantining inside.

We would love to see your artwork! Please send a photograph and a short explanation to mossgrad@gmail.com!

Step 6: ~10-15 minutes
Reflection
Fibonacci's Rabbit Problem

Today we've learned that Fibonacci numbers and sequences can be found everywhere in nature, and that there is endless potential for creation and design using them. In closing, a math problem has been devised to help you apply the concept, just one more time, with greater understanding.

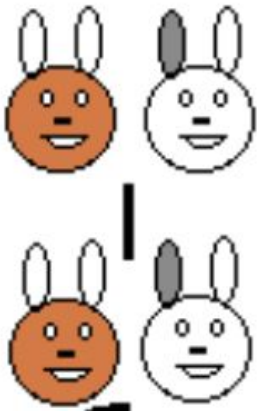
One day you decide that you want to be a rabbit parent. You go to the rabbit breeder and select a male and a female.



Number of pairs

1

To your surprise, at the beginning of your second month with them, they decide to become parents as well.

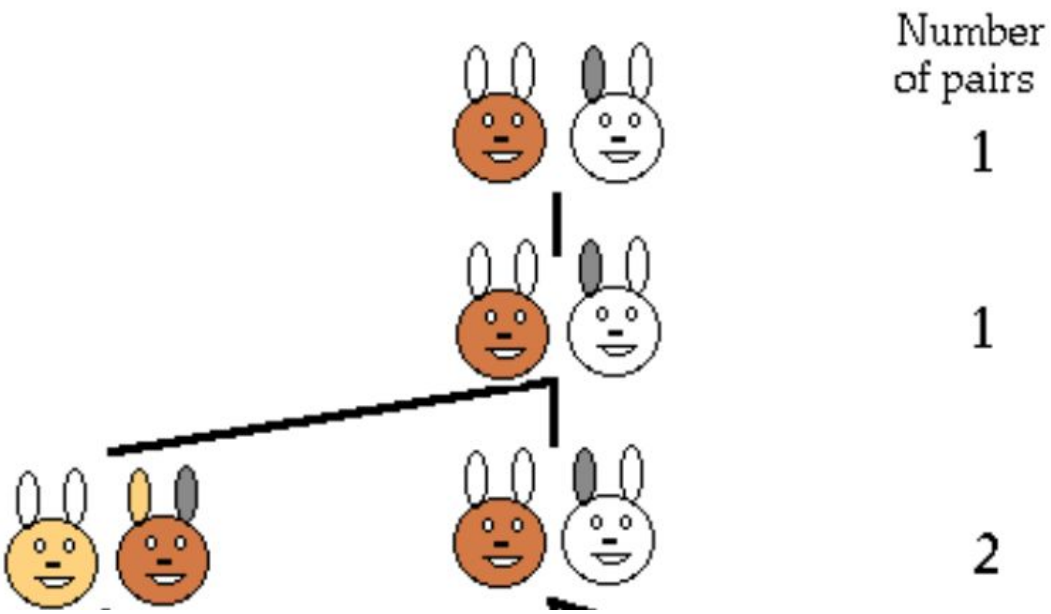


Number of pairs

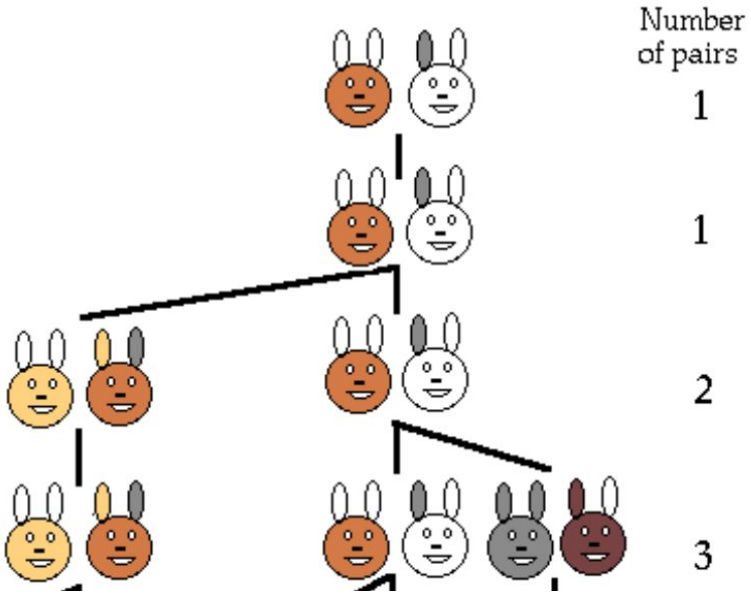
1

1

At the beginning of the third month they produce two baby rabbits. One is male and one is female.



After each set of male and female rabbits is a month old, they too begin to produce babies, always one male and one female.



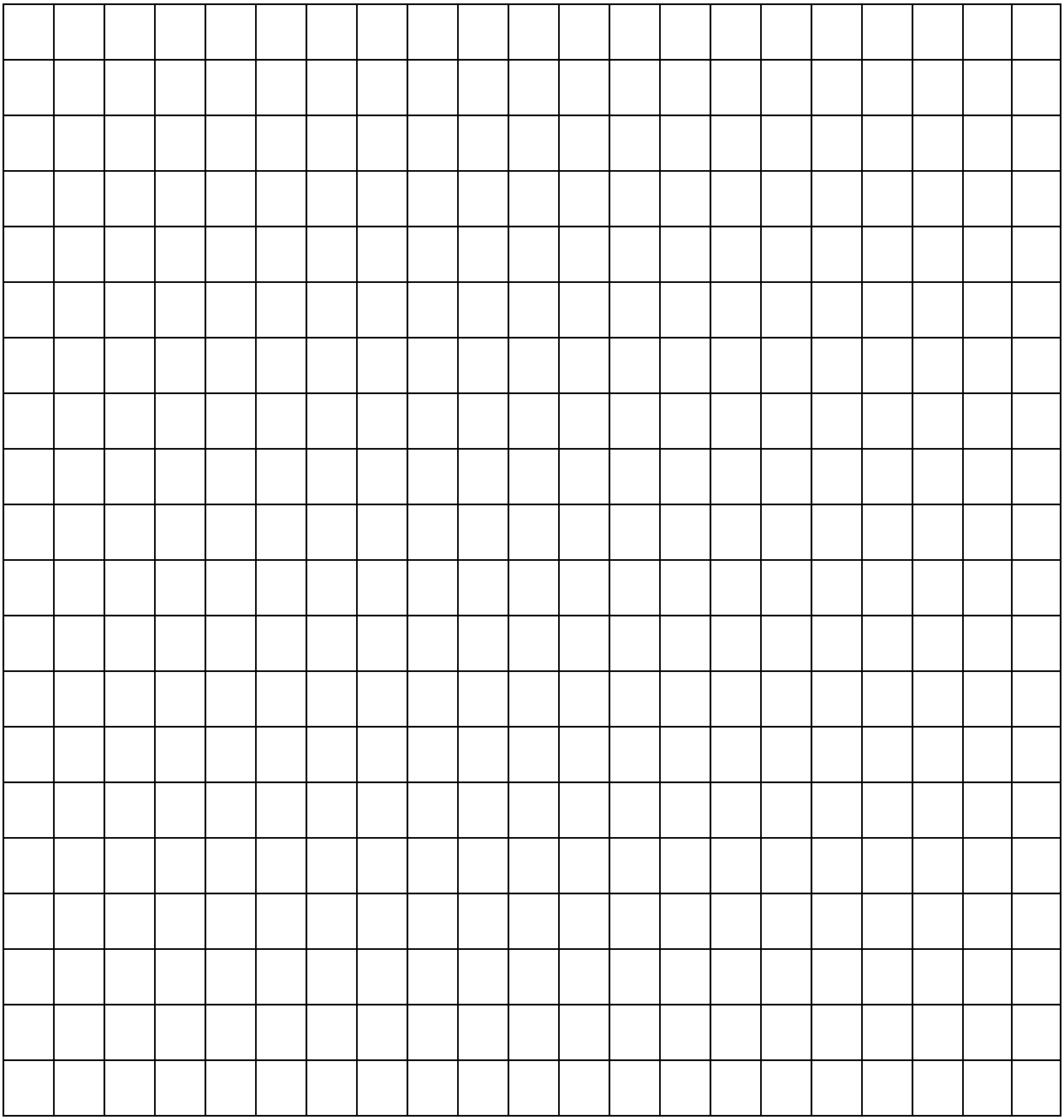
At the end of every month, all the rabbit pairs who are one month old or older produce offspring. As you can see, at the end of the fourth month there are three pairs of rabbits.

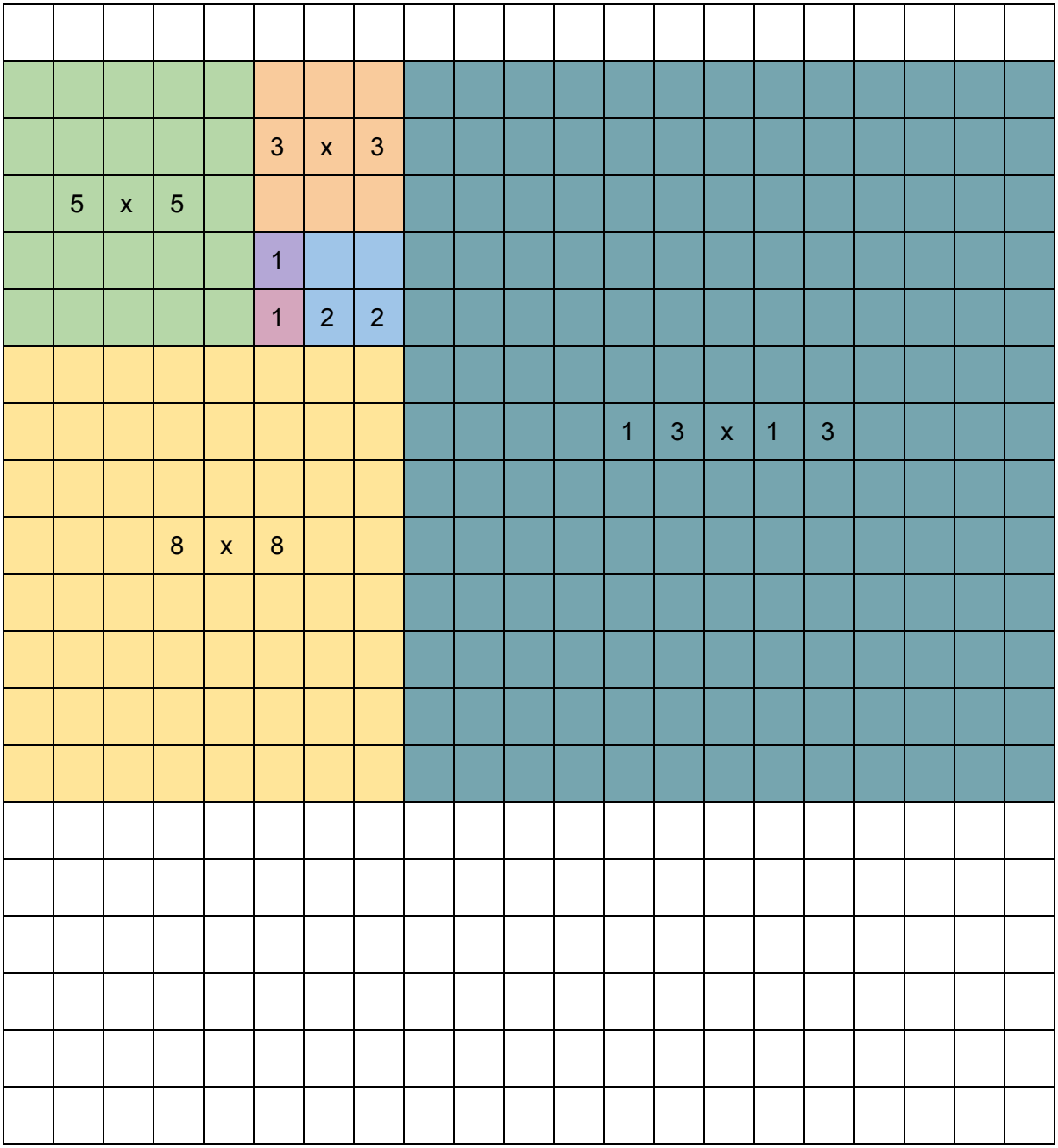
Questions:

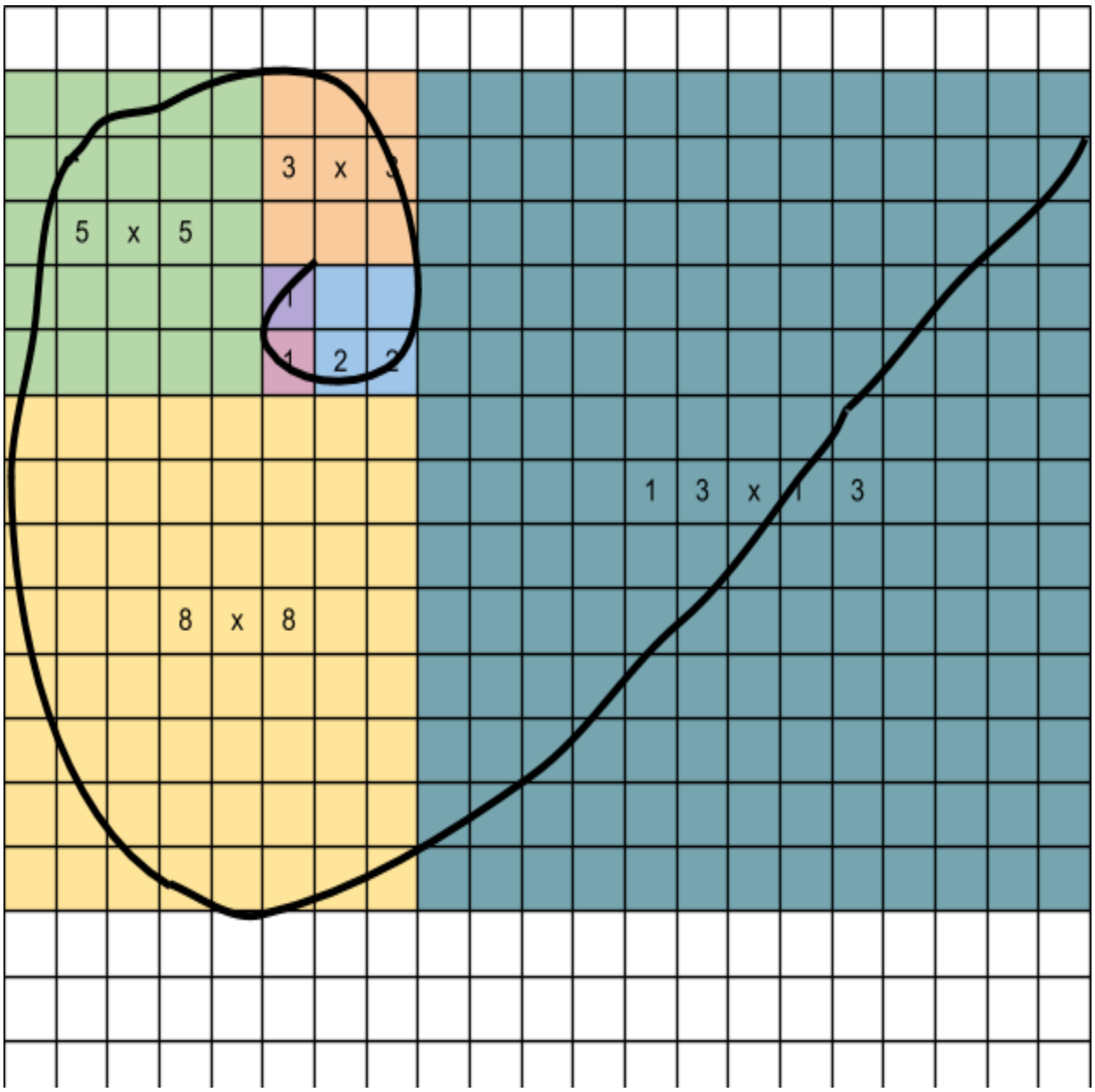
1. If this trend continues, how many pairs of rabbits will you have after one year as a rabbit parent? You may use arithmetic or draw a diagram to solve this problem!

2. Once you solve the problem briefly describe in what way it represents a fibonacci sequence.

Additional Resources:




3 x 3
5 x 5
1
1 2 2
1 3 x 1 3
8 x 8


3 x 3
5 x 5
1
1 2 2
1 3 x 1 3
8 x 8