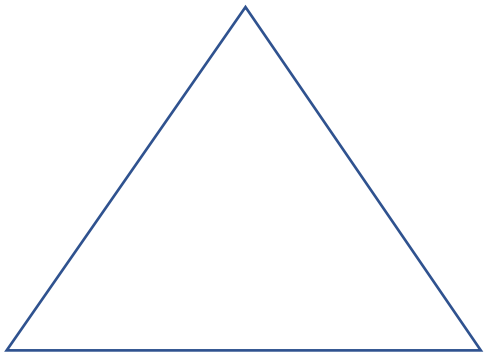
Fractals

Definition:

Fractal examples in nature:

Sketch a Fractal Tree

Sketch a Sierpinski Triangle



Sketch the curve from the video

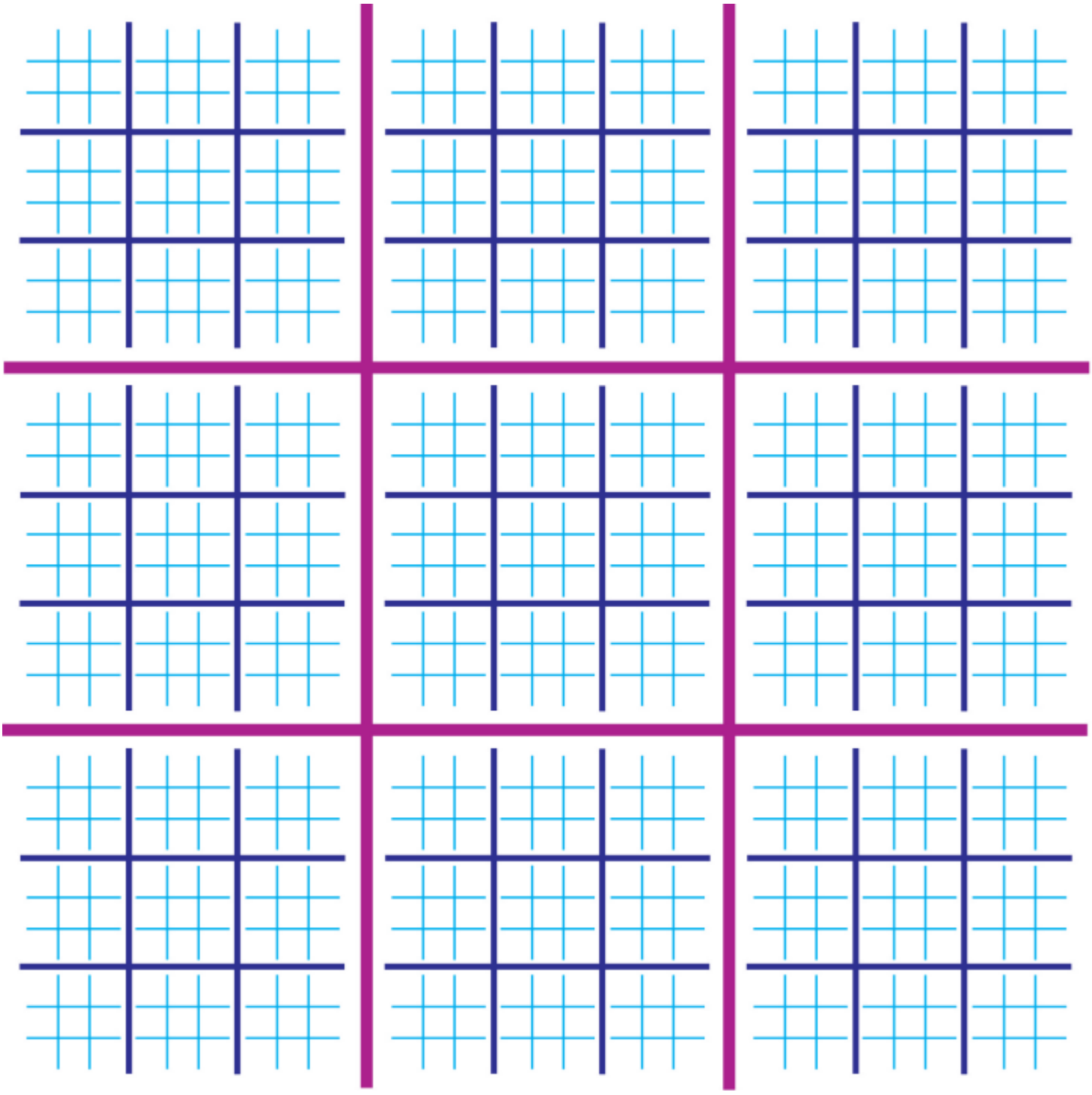
Sketch one more fractal idea from the Fractal Generator link

Tic Frac Toe

Play Fractal Tic Tac Toe! This fractal variation turns a simple game into a wonderfully complex game of deep strategy. The giant game board (purple) is really 9 games of Tic Frac Toe (navy). Choose one navy blue board to begin. Then you play a set of 9 games in the small turquoise grids.

The trick is this: After player X makes their move in a space in the turquoise grid, that sends player Y to the turquoise grid in the corresponding position in the navy board. (If that turquoise grid is full, the space is “wild” and the player gets to choose where else to play in the navy board.) Think carefully about each move, as it determines where your opponent will be able to play!

When a player wins three turquoise grids in a row, they win that entire navy board. The position of the winning turquoise board determines which navy board is played next. The player who loses a game gets to go first in the next. Three navy boards in a row wins!



Tesselations

Definition:

Basic shapes that can be used in a tesselatation:

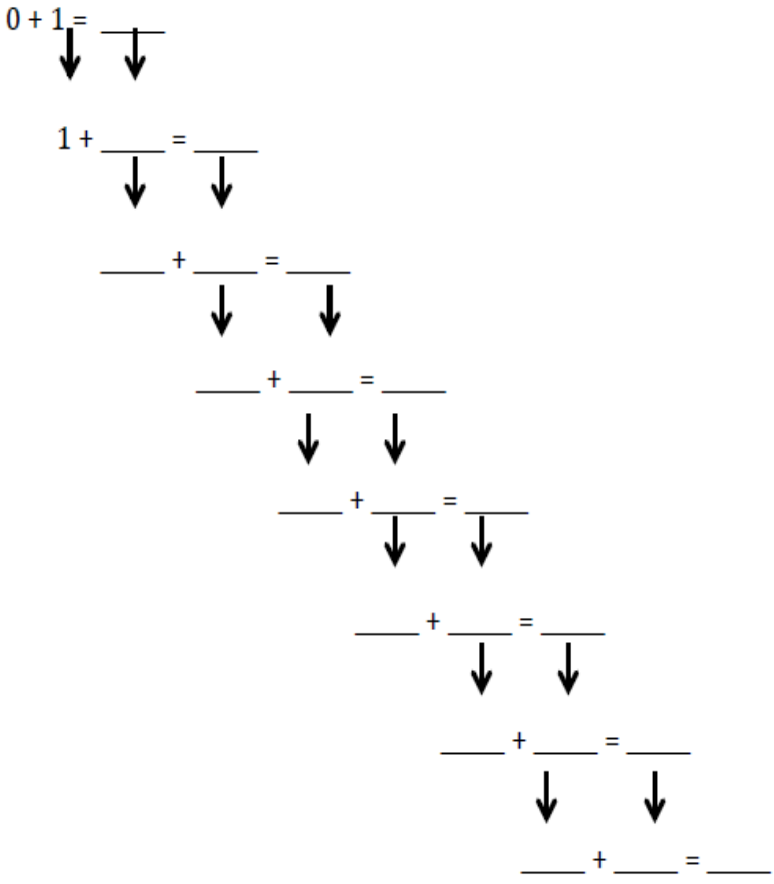
Translation Tesselation

Reflection Tesselation

Rotation Tesselation

Fibonacci Sequence and Fractal Spirals

1. First, we're going to figure out the Fibonacci sequence. Fill out the blanks below:



2. List each number after the equal sign: 1 2 ____ ____ ____ ____ ____ ____

3. Let's do some graphing to see more about how this pattern makes a spiral!

On the graph paper at the end of this handout, there is square that is 1 x 1.

a. What's the first number of the Fibonacci sequence? _____
Right **above** the square that is drawn, draw another 1 x 1 square.

b. What's the second number in the Fibonacci sequence? _____
Directly to the **left** of the two existing squares, draw in a 2 x 2 square.

c. What's the next number in the Fibonacci sequence? _____
Right **below** your existing squares, draw a 3 x 3 square.

d. What's the next number in the Fibonacci sequence? _____
To the **right** of all that you've drawn, draw a 5 x 5 square.

e. What's the next number in the Fibonacci sequence? _____
Above all that you've drawn, draw an 8 x 8 square.

f. What's the next number? _____
To the **left** of all that you've drawn, draw a 13 x 13 square.

g. What's the next number? _____
Below all that you've drawn, draw a 21 x 21 square.

... To the right of that would be the next square, but we've run out of room.

4. Now let's see how we can make a pattern out of these squares.

In the original square, draw a line from the bottom left to the top right.
On the next 1 x 1 square, continue that line across your square, from the bottom right to the top left.
Cross the 2 x 2 square from the top right to bottom left. Cross the 3 x 3 square from the top left to bottom right. Cross the 5 x 5 square from bottom left to top right. Cross the 8 x 8 square from bottom right to top left. Continue the line across the 13 x 13 square and the 21 x 21 square, wrapping up with a line that would go through the 34 x 34 square.

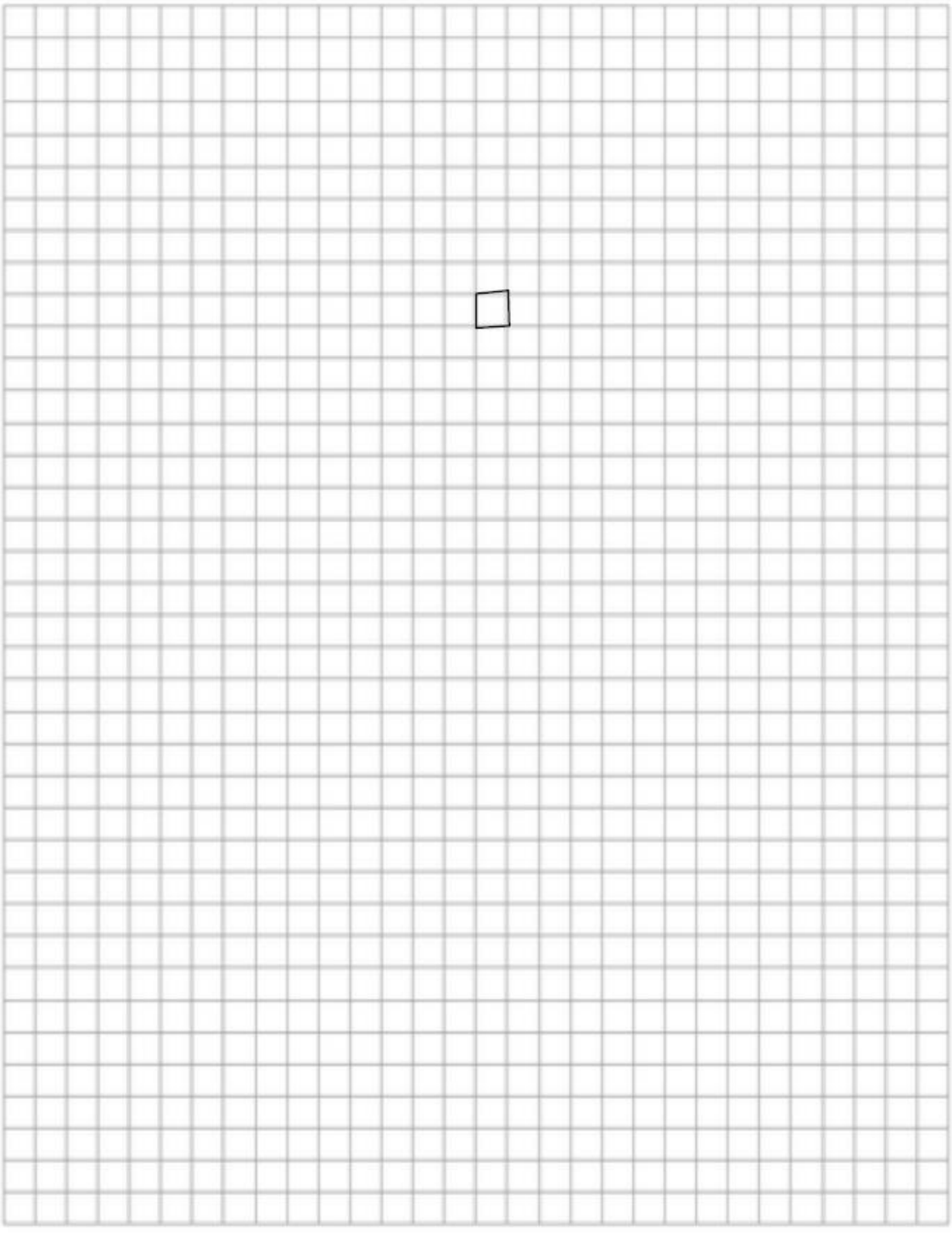
5. What pattern do you get?

6. Where do we find spirals naturally?

7. Count the number of things that make up a spiral on a pineapple or a pine cone or the number of petals on a flower or number of spirals on a froccoli or seeds of a sunflower.

They all occur in Fibonacci numbers! Nature is full of mathematical patterns! Amazing, huh? See what other cool patterns you can figure out in nature.

Fibonacci Sequence and Fractal Spirals



The Golden Ratio

Fibonacci Sequence 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, ……

Divide each Fibonacci number by the previous number and put the results below:

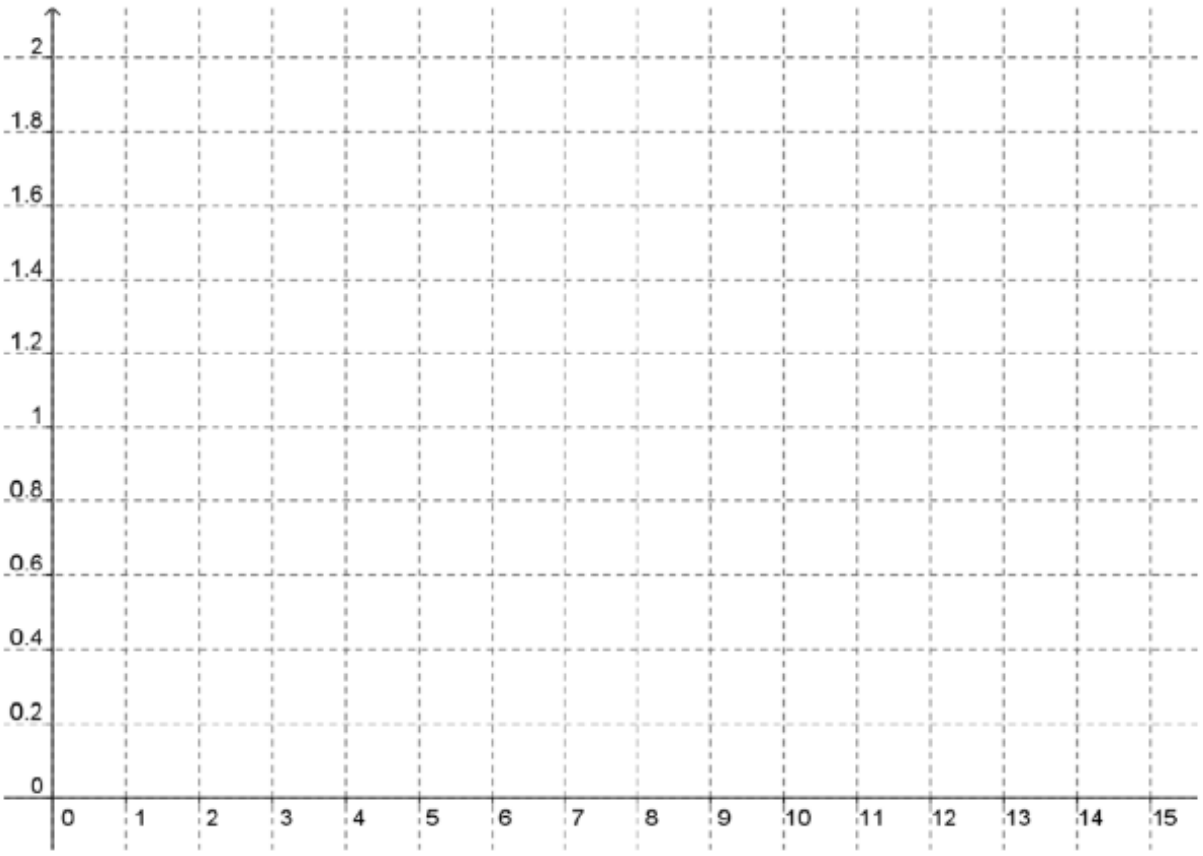
1) $\frac{1}{1} = 1$ 2) $\frac{2}{1} = 2$ 3) $\frac{3}{2} =$ 4) $\frac{5}{3} =$

5) $\frac{\square}{\square} =$ 6) $\frac{\square}{\square} =$ 7) $\frac{\square}{\square} =$ 8) $\frac{\square}{\square} =$

9) $\frac{\square}{\square} =$ 10) $\frac{\square}{\square} =$ 11) $\frac{\square}{\square} =$ 12) $\frac{\square}{\square} =$

What do you notice about the results of each quotient?

Now graph your results below:



The Golden Ratio and the Human Body

Fill in the measurements below, being consistent with using either inches or cm.
Then divide to see if it matches the Golden Ratio!

1) $\frac{\text{Floor to belly button}}{\text{Belly button to top of head}}$ = ___ =

2) $\frac{\text{Finger tips to elbow}}{\text{Elbow to shoulder}}$ = ___ =

3) $\frac{\text{Elbow to wrist}}{\text{Wrist to finger tips}}$ = ___ =

Golden Rectangle:

4) $\frac{\text{Top of head to chin}}{\text{Width of head at ear level}}$ = ___ =

Draw a picture with placement of objects featuring the golden rectangle:

Project Description

Create artwork / drawing / music / clothing design / interior design / landscape design, etc.

Must feature:

- Fibonacci numbers: 1 through 13*
- Golden ratio **or** Golden spiral **or** Golden rectangle
- Fractal **or** Tessellation

Minimum of 8.5 X 11 but can be poster size.

If you want to do something different than a drawing you must get teacher approval first.

*The numbers should not be obvious. For example, your drawing can include 13 different colors or a tree branch can have 5 branches and then 8 branches after that etc.