

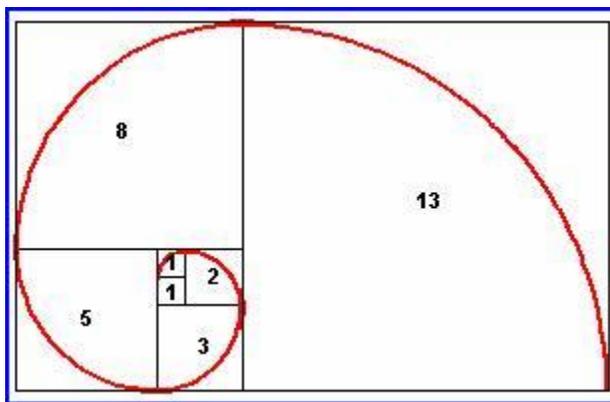
Connection Activity: Fibonacci Sequence

Estimated time: 90 minutes

Materials: Graph paper, markers, rulers, measure tape, natural objects (pineapple, grapefruit, daisy, pinecone), man-made objects (index cards, ID cards, books).

Procedure:

1. Ask students if they can figure out the next number in this sequence: 0, 1, 1, 2, 3, 5, 8, ...
How can you determine the next number in the sequence?
2. Using graph paper ask students to draw something like this:



Where can we find spirals like this one? (Encourage them to think about natural objects like shells, hurricanes, fingerprints, flowers and so on.)

3. Watch the "[Doodling in Math Spirals Fibonacci and Being a Plant](#)" video about the Fibonacci sequence and discuss student's observations afterwards.
4. *Divide the class into three different groups:
 - a) The first group will measure natural objects and record their results on a worksheet (provided below). For example: Count the number of sides of an unpeeled banana, is this number in the Fibonacci sequence? On a pineapple, students can count the number of squares in two adjacent spirals, are they adjacent numbers in the Fibonacci sequence? Count the segments of a halved grapefruit, is the grapefruit Golden? Examine a pinecone for the number of spirals that go to the right and compare that number to the number of spirals that go to the left. Look at a daisy, compare the number of petals that grow in a clockwise direction to the number that grow in a counter-clockwise direction, is this daisy Golden? Check any other natural objects that students brought to class.

- b) The second group uses body measurements that approximate the Golden ratio. Write the ratio of finger segments in one finger to the number of fingers on one hand, is the hand Golden? Measure each student's height and record the results on a worksheet, then measure each student from the top of the head to the top of the middle finger of the outstretched arm and record the results. What is the ratio of the height to the measure of the length from the top of the head to the end of the outstretched arm? Does it approximate to the Golden ratio?
Measure the height of each student and then from an elbow to floor height, write the result as a ratio of body height to an elbow to floor height. Is the result close to the Golden ratio?
Measure each student's arm length and fingertip to the elbow, write the result as a ratio, is it Golden?
- c) Group three measures manmade objects. Verify the Fibonacci numbers by measuring the length and width of an index card, an ID card or any other object in the classroom or brought to class. Record results on a worksheet. Find out if any of these objects are Golden.
- d) Rotate groups in order to give all students the opportunity to work with the three different kinds of objects.
5. When all groups finish with their explorations, they can summarize their findings and report to the rest of the class.
6. The students will describe in four sentences the activity they just completed.
- Was everything you examined Golden?
 - How do you determine if an object is Golden?
 - Do you think there is another special ratio like the Golden ratio that exists in nature? Why?

*NASA Connect activity- Retrieved from: <https://www.youtube.com/watch?v=TBfsrJXNPWU>

