Mathematics and Visual Art

Fibonacci Solar System

Fifth/Sixth Grade

Lesson by Julia Harker Hall

Objectives

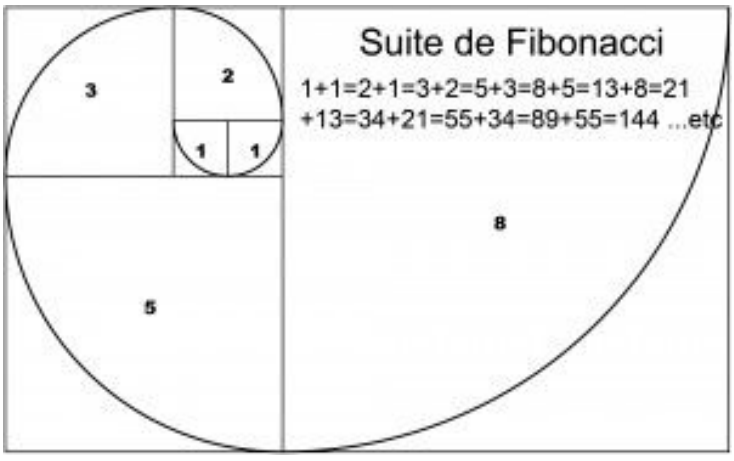
- Students will learn to generate the Fibonacci sequence.
- Students will be able to identify examples of the sequence in nature and art.
- Students will then apply their learning by creating art depicting the solar system using the Fibonacci sequence.

Activity

(This lesson will take 2 or 3 class periods)

1. Have a box on a table filled with items from nature like pinecones, pineapples, cauliflowers or succulents (any item that illustrates the Fibonacci sequence). A variety of items is best. Tell the students that you are going to pull items out of the box and want them to think of what the items have to do with math. Have students pull items out of the box one at a time and then try to guess what it has to do with math.

2. After letting the students guess, leave the items on the table and let them know that you are going to do some math that will help you discover the connection. Start with zero and have the students help you add the numbers to generate the Fibonacci sequence. Example: 0+1=1, 1+1=2, 1+2=3, 2+3=5, etc… The sequence will go as follows 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, etc… You are adding the previous number to the new sum in the sequence. Have students try to guess the next numbers in the sequence. Explain that this sequence was discovered by a man named Fibonacci and is called the Fibonacci sequence. He used it initially to try to guess how many rabbits could be born if you started with two rabbits. But he soon discovered that the numbers could be found not just in rabbit populations, but also throughout nature.



Materials

- Pinecones, Pineapples, Cauliflowers or Succulents (Pictures may work)
- Compass
- Pencil
- Large Black Construction Paper
- Multicolored Construction Paper
- Glue Sticks
- Scissors
- Chalk
- Cardboard box

Images from the Museum

- Wulf Erich Barsch, *In the Valley of the Sun and the Moon*

Utah Core Standards

Mathematicsv5
Strand: Mathematical Practices
Standard 5.MP.2
Reason abstractly and quantitatively. Make sense of quantities and their relationships in problem situations. Contextualize quantities and operations by using images or stories. Decontextualize a given situation and represent it symbolically. Interpret symbols as having meaning, not just as directions to carry out a procedure. Know and flexibly use different properties of operations, numbers, and geometric objects.

Strand: Operations and Algebraic Thinking (5.OA)
Write and interpret numerical expressions (Standards 5.OA.1–2), and analyze patterns and relationships (Standard 5.OA.3).

Strand: Number and Operations - Fractions (5.NF) Use equivalent fractions as a strategy to add and subtract fractions (Standards 5.NF.1–2). Apply and extend previous understandings of multiplication and division to multiply and divide fractions (Standards 5.NF.3–7).

Visual Arts 5
Strand: Create (5.V.CR.)
Students will generate artistic work by conceptualizing, organizing, and completing their artistic ideas. They will refine original work through persistence, reflection and evaluation (Standards 5.V.C.1–3).

Standard 5.V.C.1:
Combine ideas to generate an innovative idea for art-making

Science 6
Standard 3
Students will understand the relationship and attributes of objects in the solar system.

Objective 1
Describe and compare the components of the solar system.

Activity continued

3. Ask students if they can guess how the numbers on the board relate to the items you pulled out of the box. Show students the similar spirals found when looking at the bottom of the pinecones, pineapples, or at the top of cauliflower or succulents. Demonstrate to students how you can count the spirals. Divide the students into groups and give each group one of the items from nature. Have the students use markers to mark and count the spirals and record their findings. Ask students to report their findings. If students have counted correctly they will find that the number of spirals will match the numbers found in the Fibonacci sequence. Explain that this sequence is found throughout nature in seed heads, seashells, human bodies, and solar systems. Artists have understood this connection too and use this sequence to make artwork that is beautiful and balanced.

4. Show students Wulf Barsch's In the Valley of the Sun and Moon. Ask students what they notice about the artwork? Allow them to share their observations. Help students understand that this artwork demonstrates balance and harmony because the artist used the ratios we've been talking about to create it. Now we are going to make artwork using the same ratios.

5. Students will now apply what they have learned about the Fibonacci sequence to create a solar system artwork. Students will use a compass and colored construction paper to make circles that reflect the ratios of the Fibonacci sequence. Students can use the numbers on the compass to make the circles, or you can use a ruler to measure the compass distance. For example, they would set their compass at 1, then 3, then 5, then 8. If the compass doesn't have measurements have students create a ruler guide. They could use fractions instead of whole numbers such as ¼ inch, ½ inch, ¾ inch, 1¼ inch, etc… Have students mark the back of each circle with its measurement. Students can create seven circles to represent our solar system, or they could create their own imaginary solar system.

6. Once students have drawn their circles, they should cut them out and add decorations to make them planets.

7. Next students can work on the background of their artwork on black paper. Using chalk they can add stars, constellations, or swirls to their black paper. Finally, they will glue their circles to the black paper to complete their solar system.

Extensions

As a science extension you could spend additional time discussing how technology can be used to understand the Fibonacci sequence in space. You can add a literary extension to this lesson by having students create a poem about their artwork that uses the Fibonacci sequence. Students would make a poem in which the words in each line increase. So the first line would have one word, the second line would have two words, then three, then five etc…

Assessment

Student's understanding of the Fibonacci sequence can be assessed by having students write the sequence starting from the beginning, or by giving them a set of numbers and asking them to continue the sequence. A visual inspection of the artwork will help teachers assess the student's understanding of the Fibonacci sequence. Circles can also be measured for accuracy before they are glued to the paper.

Wulf Barsch, *In the Valley of the Sun and Moon*, 2000

Wulf Barsch, *In the Valley of the Sun and Moon,* 2000