






Finding Fibonacci

OVERVIEW

- Students will be able to identify, explain, and continue a sequence.
- Students will be able to solve multi-digit addition problems.
- Students will be able to create, find, and place numbers on a number line.
- Students will be able to graph arrays and represent arrays with multiplication equations.
- Students will be able to identify the main idea of a text.
- Students will be able to write a summary.

<p>AUTHOR Kathleen Janes</p>	<p>GRADE LEVEL 2nd Grade</p>	<p>CONTENT AREA Science Social Studies Math Literacy</p>
		
<p>ESSENTIAL QUESTIONS</p> <p>How do we see math in the world around us?</p> <p>What is a sequence?</p> <p>How can we represent math?</p>	<p>TIME NEEDED</p> <p>Read Aloud and Discussion 20 minutes</p> <p>Number Line - 20 minutes</p> <p>Array Art - 40 minutes</p>	<p>STANDARDS</p> <ul style="list-style-type: none"> ● CCSS.MATH.CONTENT.2.OA.B.2 ● CCSS.MATH.CONTENT.2.OA.C.4 ● CCSS.MATH.CONTENT.2.NBT.B.5 ● CCSS.MATH.CONTENT.2.NBT.B.6 ● CCSS.MATH.CONTENT.2.NBT.B.7 ● CCSS.ELA-LITERACY.RI.2.1 ● CCSS.ELA-LITERACY.RI.2.2 ● CCSS.ELA-LITERACY.RI.2.10

Making Connections

The intent of this lesson is for students to learn the Fibonacci sequence, along with how it is calculated and where to find it in the world around them. Students will need to know what a pattern is and how to continue a pattern. Students will also need to know how to add, use a number line, and use a calculator.

Background

In this lesson, students will identify math in the natural world, build a number line, and create their own artwork using mathematical properties of the Fibonacci sequence.

Students will read various texts to discover the sequence and examples in the world. They will then use their own work and calculators to extend the sequence on a number line. This work can be scaffolded for students' readiness levels.

Students will then create the Golden Spiral on graph paper using arrays. They will make

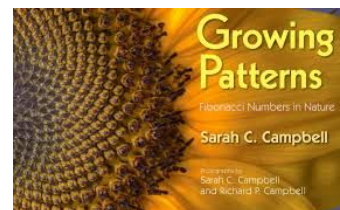
“stained glass” art pieces by graphing the arrays for the sequence and coloring over with Sharpie and Press N’ Seal wrap.

Students will write a paragraph to summarize their creations and understanding.

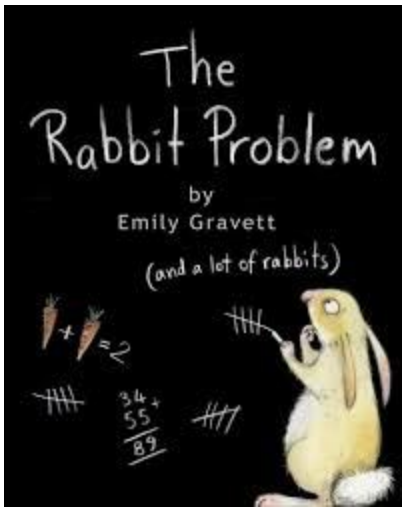
In order to access this lesson, students will need to know how to count using a number line, how to add two- (and three-) digit numbers, and how to create arrays.

Materials

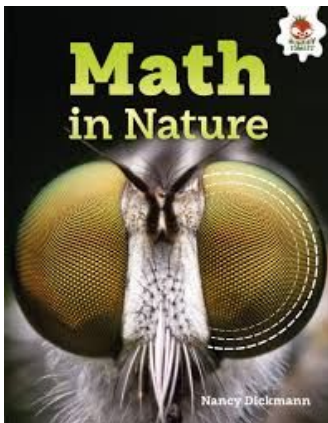
- Books:
 - Growing Patterns: Fibonacci Numbers in Nature by Sarah C. Campbell



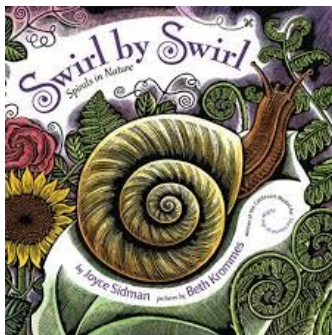
- The Rabbit Problem by Emily Gravett



- Math in Nature by Nancy Dickmann



- Swirl by Swirl by Joyce Sidman



- Adding Tape

- Calculators
- Graph Paper
- Sharpie Permanent Markers
- Press N' Seal Wrap
- Lined paper

Teacher Tips

Number Line: Students may need support in spacing out their number line. Try scaffolding by labeling 0 and 100. Then folding the adding tape in half to find 50. Have students continue to fold to place 25 and 75 and identify multiples of 10 from there.

Graphing: Make sure students place their arrays in the correct orientation so they can draw the spiral through the arrays correctly.

The Activity

Part 1: Building Knowledge

- Show students 4 -5 examples of the following images or items: pinecone, lily, tree with branches, sunflowers with concentric circles, Nautilus shell, or artists' renditions of the joints of the human body.

- Conduct [See, Think, Wonder](#) with the images.
- Line up students in groups with 0, 1, 1, 2, 3, 5, 8. Have students state the numbers of the group and write the numbers on the board. Have students turn and talk to a partner about what they think the pattern is.
- Read from *Growing Patterns* or *Math in Nature* (listed above). Throughout the text, ask students if they see how the numbers on the board are connected.

Part 2: Using Math Tools to Extend the Sequence

- Put three addition-based equations on the board, varying for readiness levels in your classroom. Ask students to pick an equation and solve it using a number line.
- Discuss what a number line, how it is used, and examples of objects we see it printed on (i.e. ruler).
- Tell students they are going to build a number line today to show the Fibonacci sequence. Students will plot numbers from 0 - 200 and circle the Fibonacci numbers on the line.
- Model how to use a calculator for more advanced sums.

Part 3: Discussing Observations

- List the Fibonacci numbers out on the board using post it notes.
- With a blank piece of adding tape, plot the numbers 0, 50, 100, and 200. Have students place the sticky notes on the adding tape and explain why they placed the notes as they did.

Part 4: Arrays

- Introduce the concept of arrays throughout the week, using magnetic tiles to represent the date. Note the type of arrays that can be made with even and odd numbers. Represent these arrays using the term “groups of”. For example, students can build an array of 4 tiles by 5. State this as 4 groups of 5 equals 20 in all or $4 \times 5 = 20$.
- Read *The Rabbit Problem* and identify the arrays present in the text.
- Tell students that the property of this problem is the Fibonacci sequence and it’s present in other parts of our world.
- Show pictures of artwork, architecture, storms, and faces that features of the Golden Spiral.

- Tell students they are going to make their own art work (stained glass) to represent the Fibonacci sequence and Golden Spiral.
 - Give students a piece of graph paper and share out observations. Tell students they can represent arrays on the graph paper.
 - Model how to box in the amount to create the array. Guide students to add the next array on the side that would make sense.
 - Students will graph their arrays on the paper. Then they will lay Press N' Seal wrap over the array, outline, and color in Sharpie.
- place under their artwork. The paragraph should include the following:
- Topic sentence stating what the Fibonacci sequence is
 - A sentence explaining how the sequence is calculated
 - Examples of the sequence in the world (either natural, engineering, or artistic)
 - A concluding sentence connecting the sequence to their artwork
- Conduct a gallery walk for students to view and read each other's work.

WRAP UP AND ACTION

- Review the purpose and procedure for writing a summary.
- Ask students to write a paragraph to explain their Golden Spiral artwork to

Extensions

Calculating the Sequence

- Students can multiply the sequence numbers and find the pattern.
- Students can work with 4 digit numbers to extend the sequence.

Artwork

- Students can combine their arrays to make a collaborative picture.
- Students can identify the Golden Ratio in other works of art or natural images.

Resources

[National Geographic](#)

[Funza Academy Video](#)

[15 Uncanny Examples of the Golden Ratio in Nature](#)

[Fibonacci Sequence and the Golden Ratio](#)

About the Author

Kathleen Janes is a 2019 - 2020 Kenan Fellow. She is an elementary teacher in Durham, North Carolina.

About the Fellowship

Kelly Witter is the Director of Community Engagement and STEM Education at the Environmental Protection Agency at Research Triangle Park. In my three week internship with Kelly at the EPA, I conducted over 30 interviews with various researchers and engineers throughout the EPA to learn about their work as well as the talent pipeline applying to open positions at the EPA. Additionally, I assisted 4 summer student camps and attended 3 workshops at the EPA. Through those discussions and events, I discovered that most people who engaged in environmental science work shared this idea of their wonder and appreciation for nature and their community as an inspiration for their studies. I wanted to instill that same sense of fascination in my students so I designed this lesson to help them connect this incredible design pattern to the everyday natural world.

Appendix

Number Line		
1	2	3
Student identifies the sequence to 8.	Student identifies the sequence to 21.	Student identifies the sequence past 34.
Student places numbers on the line with incorrect spacing.	Students places numbers on line with inconsistent spacing.	Student places numbers on line with appropriate spacing.

Golden Spiral Stained Glass		
1	2	3
Student creates 1 - 2 arrays.	Student creates 3 - 4 arrays.	Student creates 5 - 6 arrays.
Students' arrays are not connected.	Students' arrays are connected inconsistently so the spiral does not extend correctly.	Students' arrays are connected appropriately so the spiral extends through the design.

Reflection Template		
1	2	3
Student states the Fibonacci sequence but does not explain it or provide examples.	Student somewhat explains the Fibonacci sequence and provides at least one example.	Student fully explains the Fibonacci sequence and provides at least 2 examples.
Student does not use grade level writing conventions.	Student consistently uses grade level writing conventions.	Student consistently uses grade level writing conventions.