Fibonacci's Perfect Spiral

This lesson was created to combine math history, math, critical thinking, and art. Students will learn about Fibonacci, the code he created, and how the Fibonacci sequence relates to real life and the perfect spiral. Students will practice drawing perfect spirals and learn how patterns are a mathematical concept that surrounds us in real life.

This lesson is designed to take 3 to 4 class periods of 45 minutes each, depending on the students’ focus and depth of detail in the assignments.

Common Core Standards:

**CCSS.MATH.CONTENT.HSF.IF.A.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by \( f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) \) for \( n \geq 1 \).*

**CCSS.MATH.CONTENT.7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

**CCSS.MATH.CONTENT.7.G.A.1** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
CCSS.MATH.CONTENT.7.G.A.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.

CCSS.MATH.CONTENT.8.G.A.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

CCSS.MATH.CONTENT.8.G.A.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Objectives: Students will
- review the Fibonacci sequence
- learn how to draw a perfect spiral
- use art to learn about math and how it relates to real life
- have fun learning math

Materials: Samples pictures of perfect spirals in nature
Sample of a perfect spiral on paper (included in lesson)
Grid Paper (about 0.75” squares)
Color pencils (blue, orange, red, green and yellow)

Background Knowledge: Knowledge of Fibonacci, good but not required
How to solve one face of a Rubik’s Cube (edges and corners)
Procedure: **Before class:**
- Ensure all materials are available.
- Make copies of handouts for students.

**With students:**
1) Introduce or review Fibonacci sequence.
   \((0,1,1,2,3,5,8,13,21,43\ldots)\)

2) Explain that this sequence is a part of everyday life in the form of what is known as the “perfect spiral.”

3) Show examples of real life perfect spirals, pointing out the sequence in each.

4) Explain the steps for drawing a perfect spiral by demonstrating on the dry erase board
   1. In the center of the graph paper outline a single square. See purple square on perfect spiral example sheet (included)
   2. Go to the square to the right of the 1. Outline that little square to represent the next number in the pattern, another 1! (outlined in light blue)
   3. Use the line above the two 1 squares to outline a square that is 2 little squares long and 2 little squares high. This represents the next number in the sequence – 2. (Outlined in brown)
   4. Now move to the right of the 1 and 2 squares. Use the right side of the 2 square and the right side of the second 1 square to draw a square that is 3 little squares high and 3 little squares long. 3 is the next number in Fibonacci’s pattern. (Outlined in light purple)
   5. Use the bottom of both 1 squares and the bottom
of the 3 square to make the next number in the pattern – a big square that is 5 little squares long and five little squares high. (outlined in orange)

6. Move to the left of the 2 square, the 1 square, and the 5 square. Use their left edges to make the 8 square. (Outlined in green)

7. Continue this way until you run out of room or have enough spirals to work with.

5) The next step is to draw Fibonacci’s spiral. All you have to do is connect one corner of each square with the opposite corner of that square with a sweeping curve. You may need to practice a few times to get it right. Examples on the Perfect Spiral example sheet. This is the biggest that is really needed for art project.

6) Once the spiral is drawn then boxes could be erased or used to create an abstract piece of art.

7) Show examples of what can be drawn out of the perfect spiral and have students create a picture with their spiral that can be pixelated using the colors of the Rubik’s Cube.

8) Once the picture is complete have the students create their masterpiece using Rubik’s Cubes.

**Technology Connection:** Information about perfect spirals and spirals in nature can be found at [https://www.goldennumber.net/spirals/](https://www.goldennumber.net/spirals/)

**Notes to Teacher:** The more examples you have, the better idea it gives the students.
For students that need a challenge, have them draw a double spiral or create a pattern using multiple spirals (have examples available).

Drawing a large example on the board is helpful and compasses make drawing the spiral easier.

3x3 Rubik’s Cubes are available to borrow from the You CAN Do the Rubik’s Cube Lending Library at no cost other than return shipping. [www.youcandothecube.com/lending-library](http://www.youcandothecube.com/lending-library)

This lesson was written by Kim Hyde.

Use this as an example to follow.
Example of a double spiral abstract
Perfect Spiral Example page:
Examples of Rubik’s Cube mosaics of perfect spirals: