Fibonacci Numbers and the Golden Ratio

Area of Study

Mathematics

Teacher

Michael K. Wilson

Grade Level

6th

Duration of Instruction

2 class periods

Objective

Students will

- learn Fibonacci numbers and the golden ratio
- learn measuring with a meter stick.
- learn number patterns
- learn ratios
- write ratios in decimal form
- learn about mathematical connections to nature.

Standards

- **Standard 3**: Mathematics as reasoning
- **Standard 4**: Mathematics as connections
- **Standard 8**: Patterns and functions

Materials

- Meter sticks and Rulers
- Pictures of other occurrence of Fibonacci numbers in nature
- Lemon
- Apple
- calculators
- Golden ratio worksheet

Procedures

- Arrange students to works in groups of 2 or 3.
- Ask if students have heard of the Fibonacci numbers or Leonardo of Pisa. Give a brief history of Leonardo de Fibonacci
- Pose the question: "If you begin with one pair of rabbits on the first day of the year, how many pairs of rabbits will you have on the first day of the next year?" It is assumed that each pair of rabbits produces a new pair every month and each new pair begins to produce two months after birth.
- Draw or show picture via PowerPoint to depict the idea.
- Ask students if they see any pattern or relationship.
- Use the pattern to point out the Fibonacci sequence.
- Ask students if they see a pattern in the Fibonacci sequence.
- Explain and derive the recursive function of the Fibonacci numbers.
- Ask students extend the sequence. (part I of worksheet)
- Ask students to explain how they will attain a number that is not a Fibonacci number. That is by combining numbers in the Fibonacci sequence. For example, how could the number 4 be obtained from the sequence? How about 11? 56? Ask students to think of a number not in the sequence and try to figure out what numbers to combine to get it.
- Show the occurrence of Fibonacci numbers in nature by having students cut open an apple and count the number of seeds, slice a lemon and count the number of sections.
- Through pictures (and materials available in class) show other occurrences of the Fibonacci numbers in nature.
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  Look at your hands. You have...
  2 hands, each of which has...
  5 fingers, each of which has...
  2 or 3 parts, separated by...
  1 or 2 knuckles.

Remember: adding & subtracting the Fibonacci numbers we can obtain other numbers that do not appear in the sequence.

- Ask students what they think will happen if we divided each Fibonacci number in the sequence by the previous one. We work on this together. (part II on worksheet)

- Phi, the golden ratio, the golden section, the golden mean, the divine proportion. It's known as many things, but the ratio they all refer to is the same, **1: 1.61803399...**

- Measure the distance from the floor to one's waist (navel), and then measure from the floor to the top of the head. What is the ratio of these measurements? (part III of worksheet)

  OTHER examples

- Similarly, find the ratio of the distance from the neck to the top of the head to the distance from the neck to the navel; then, find the ratio of the distance from the knee to the floor to the distance from the navel to the knee. How are these ratios related? In an adult, these ratios are approximately equal to the Golden Ratio (as discussed below). For students in varying stages of growth, they may not hold true. Students can work in pairs to help measure each other and record the measurements on a piece of paper
- Measure rectangles in the classroom and check to see if they follow the golden ratio.

Assessment

The students will be evaluated according to their ability in:

1. class participation