

Topics: Number Sense, Addition, Binary Numbers, Place Value

Materials List

- ✓ Paper, cardstock or gold matte board
- ✓ Pencil
- ✓ Scissors
- ✓ Ruler

This activity can be used to teach:

Common Core Math Standards:

- Factors
(Grade 4, Operations and Algebraic Thinking, 4)
- Place Value
(Grade 4, Number and Operations in Base Ten, 1; Grade 5, Number and Operations in Base Ten, 1 & 2)
- Exponents (Grade 6, Expressions and Equations, 1)
- Problem Solving and Reasoning
(Mathematical Practices Grades 4-8)

The Gold Bar Puzzle

This math brain teaser is worth its weight in gold!



This puzzle is frequently given to applicants for software developer positions. With some guidance many students will successfully find a solution to the puzzle. The concepts behind the puzzle have interesting connections to place value, binary numbers and “making change”.

To Do and Notice

Read the following puzzle and use the materials to solve the puzzle.

“Imagine that a rich Renaissance merchant captain wanted to hire a navigator away from a rival captain. He offers the navigator a special bonus - for each of the next seven voyages- the navigator will have a chance to earn an extra piece of gold. The captain has a gold bar to pay the navigator. The bar is molded in such a way that there are seven connected segments. Any of the segments can easily be broken off. The navigator earns one segment of gold as a bonus for each successful voyage. The captain must pay the navigator at the end of each voyage. The captain may only make two breaks in the gold bar. How can the captain pay the navigator? (Hint: Assume that the navigator will have all the previous voyages’ pay in his sea chest and that the navigator would be willing to make change with the captain.)”

1. Cut a strip of paper, ~14 cm x 2 cm (or 7” x 1”) will work well. Draw six evenly spaced vertical lines on the paper to represent the perforations on the gold bar. Optional: If available, use a die cut machine to create six perforations along the strip of paper/cardstock.
2. Let the gold bar in the puzzle be represented by the strip of paper/cardstock. By only tearing the piece of paper/card stock along two of the lines or perforations, devise a way that the captain could pay the navigator.

The Content Behind the Activity

It is possible to pay the navigator the equivalent of 1 segment each voyage by tearing the “bar” so that there are pieces with the segment lengths of four, two and one. Using different combinations of the sums of the integer values of these pieces, it is possible to make all the integer values from one to seven. It is not a coincidence that the values “one”, “two” and “four” are the first three place values in the binary number system.. This puzzle is a great way of introducing the concept of counting in binary (for additional information on the binary number system see the *Binary Birthday Bracelets* and *Binary Dots* idea sheets).

Taking it Further

How would you solve the problem if the bar was 15 segments of gold and could be divided into four pieces and the navigator needed to work for 15 voyages?

Image adapted from:

<http://www.mainlesson.com/display.php?author=tappan&book=middle&story=petrarch&PHPSESSID=b69b730b2bb84d597c7276bd8e5170b3>

Web Resources (Visit www.raft.net/raft-idea?isid=85 for more resources!)