Number Line Tightrope

Brief Description:
This number line provides opportunities to explore families of numbers, positive and negative integers, patterns, and much more. Activities at this exhibit include demonstrating integer arithmetic, creating new number families, identifying additional values for the represented number families, and deriving the formulas that will yield the different number patterns displayed on the Number Line Tightrope.

Objectives:
These activities aim to expose students to various number families and their properties by observing patterns.

Links to Websites:
http://mathmidway.org/Training/numberline.php

http://mathmidway.org/Training/pdf/numberlineTourGuide.pdf

http://mathmidway.org/math-midway-puzzles-century1.php

http://en.wikipedia.org/wiki/Triangular_number

Vocabulary:
Cake Numbers
Constructible Polygon Numbers
Counting Numbers
Cubes
Factor
Factorials
Fibonacci Numbers
Highly Composite Numbers
Integers
Pentagonal Numbers
Perfect Numbers
Pizza Numbers
Powers of Two
Primes
Squares
Tetrahedral Numbers
Triangular Numbers
Whole numbers
Zero

Before:
- (*Level 1,2*) Begin by demonstrating that individuals share some human properties and some are unique to individuals. Ask all students with brown hair to stand in one area and all students with blue eyes to stand in another. Those students with both brown hair and blue eyes must share common space. Illustrate the outcome with a Venn diagram.

  Relate the idea of shared and unique properties to the number families, for example comparing the prime numbers to the even numbers.

  Define level-appropriate number families from the number line with the symbols.

  Create groups of students and ask them to come up with the properties that each group of numbers shares.

- (*Level 2, 3*) Learn about Triangular Numbers

Look at how bowling pins are arranged—in a triangle.

Provide dot paper for students to draw equilateral triangles and discover a geometric explanation of triangular numbers. http://en.wikipedia.org/wiki/Triangular_number

Make a chart of the triangular numbers according to the definition. (A number you get by adding up 1, then 1+2, then 1+2+3, then 1+2+3+4, etc.) Can you discover a pattern to find a large triangular number without having to do many additions? As triangular numbers can be displayed in a geometric display, how can square numbers be displayed geometrically?

- (Level 3) Derive a formula for the triangular numbers by studying the chart or by looking at the sum of two consecutive triangular numbers. [$T_n = \frac{n(n+1)}{2}$]

- (Level 1, 2, 3) Learn about Fibonacci Numbers in Nature: http://britton.disted.camosun.bc.ca/fibslide/jbfibslide.htm

- (Levels 2, 3) Activities for discovering many number families can be found on http://en.wikipedia.org/wiki/Main_Page using the search words: triangular numbers, factorials, perfect numbers, Lazy Caterer's Sequence (for pizza numbers) and highly composite numbers.

- (Level 3) Compass work to build 5-sided regular polygon (pentagonal numbers): http://www.kjmaclean.com/Geometry/PentConstruct.html

- Teachers should decide whether to show the training videos on the website http://mathmidway.org/Training/pdf/numberlineTourGuide.pdf before or after visiting the museum.

During:

- Investigations: (*Level 1, 2*) Gathered around the number line tightrope:
  Can you guess why different symbols are used for the same number or for different numbers?
  Which number families do you recognize?
  Of the number families tagged, which family has the greatest number of tags? Least?
  What familiar numbers do not appear on this model of the number line?

  Divide class into groups, with each group getting a number family to investigate. Worksheets should require defining the type of number, making a list of the numbers up to 100, and any interesting facts that the group finds.
  What symbol does the family of numbers have?

  After the investigation, groups can share their findings.
  Why do some numbers have more than one tag?
  What properties are shared? Unique?
  Can the students illustrate the shared and unique properties with a Venn diagram?

- (*Level 2, 3*) Find the numbers that are not integers. This provides an introduction to irrational numbers and infinity. Teacher should see brochure http://mathmidway.org/Training/pdf/numberlineTourGuide.pdf.

- (*Level 2*) Choose any tag on the number line. Good choices are the Fibonacci numbers, primes, squares, cubes, triangular numbers, or pizza numbers. Find all of the numbers that have that tag and make a chart. If the number line kept going, what would be the next three numbers to have that tag?

- (*Level 3*) Figure out the ratio of the two periods of the motors using a stopwatch to time the periods and note different intervals.

After:

- (*Level 1*) Explore the Sieve of Eratosthenes for finding prime numbers by downloading a worksheet from the following website:
  http://www.worksheetworks.com/math/numbers/sieve-of-eratosthenes.html

- (*Level 1*) There were no fractions on the number line. Choose some you consider appropriate, perhaps $\frac{1}{2}, \frac{5}{8}, \frac{4}{3}, \frac{15}{6}$, etc., and ask students to make a number line and place these fractions on it.

- (*Level 2, 3*) Create a new family of numbers for the number line.
  Ask students to think about what numbers would be included and what formula could be used to define them.
  Have students design a tag that defines the family of numbers.
  Make a number line for your classroom with the families you created. Make it go past 100. (For example: Even or odd, multiples of 7, powers of 3)

- (*Level 2*) Pick three categories for Venn Diagrams (ex. prime, triangular, fibonnacci), restricting the scale, and have students construct the diagrams.

- (*Level 2, 3*) To discover the triangular numbers in a physical context, try this handshake activity suggested by Elena Weinstein (NYC Lab School) and Aaron Orzech (The Urban Academy of Government and Law). The plan is referenced on momath.org, from a lesson plan written for Math For America, titled "Math Midway Field Trip Number Theory (advanced level).

Resources:

What's Next? A Pattern Discovery Approach to Problem Solving by Wilbert and Elaine Reimer (published by AIMS Educational Foundation, 1996) Contains life-related problems which address concepts from every area of mathematics and blackline masters to download.