Linear Equations

A hands-on method for teaching the connections among equations, tables, and graphs.

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Video Notes

Video Notes Directions

- This guide supports the video presentation and provides you a copy of the PowerPoint slides used in the program. There are multiple segment breaks in the video that are included to allow time for you to process the information you have seen and heard.
- The slides that are associated with the segment breaks have reflection questions to consider during the interim period.
- It is advisable to print out all of the supplemental files for this program as resources to utilize during and after viewing.
- The follow-up activities should be completed and submitted to your professional development director for possible credit

Why "Hands-On" Experiences

- Middle school students have difficulty understanding linear equations as they have traditionally been taught
- Using "hands-on" activities puts abstract concepts into relevant, concrete activities that provide understanding for all levels of students

Hands-On Research

The North Central Regional Educational Laboratory Research

- **Hands-on:** involve students in doing math
- **Minds-on:** focus on essential concepts and critical thinking
- **Authentic:** allow students to explore, discover, and discuss math concepts using real-world situations

Why Hands-On Experiences Work

Children need to:

- be active, reflective thinkers
- work and form relationships
- make connections among mathematics and real world situations

Keys to Effective Teaching

1. Use models, manipulatives, drawings, and calculators
2. Encourage interaction and discussion
3. Use cooperative learning groups
4. Require self-validation
5. Create a problem-solving environment
6. Listen actively

Van de Wall, J.A. 1995. *Elementary school mathematics: Teaching developmentally*. White Plains, NY: Longman.

What Is a Linear Equation?

- It is a constant rate of change between two variables
- It can be represented by a straight line on a coordinate grid
- It is used to show real-life situations such as:
  a) distance traveled over time
  b) total cost based on the number of items purchased

What Makes a Linear Equation?

- It is an equation written as a relationship between two variables, x and y
- x is the independent variable graphed on the (horizontal) x-axis
- y is the dependent variable graphed on the (vertical) y-axis
- It follows the format of y=mx + b, which is the slope intercept form

Why Look at Hopping Frogs?

Students will:

1. Make their own frog and review geometry skills
2. Collect data and review measures of central tendency
3. See that variables affect the distance of frog jumps
4. Develop a table, equations, and a graph to display data
5. See that graphing equations on the same graph develops a pattern

Hop To It Directions

- Use a yardstick to measure the distance of five different frog hops
- Record the five hop lengths in inches
  - What was your shortest hop length?
  - What was your longest hop length?
  - What was your average hop length?
- Use these hop lengths to create a table that shows 1 to 10 hops at each distance

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Hop To It Graph

- Label the x-axis for the number of consecutive hops, 1-10. This is the independent variable
- Multiply the length of the longest hop by 10 to determine the maximum value for the y-axis
- Establish an appropriate scale, probably 2, 5 or 10 inches, for the y-axis. This is the dependent variable that shows the total inches hopped for 10 consecutive hops
- Using the tables, plot each ordered pair on the graph
- Connect the points to make a line that intersects the y-axis

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How Are the Table and Graph Related?

- Which line has a steeper slope? The one with the longest jump
- Which table has the longest jump? The table with the most number of inches
- What are the coordinates where lines of all jumps intersect? (0, 0)
- What does this ordered pair mean? All jumps started at zero inches
- How can you write an equation using the graphs or tables using the y=mx + b format?

  (Hint: b can be 0.) Let the length of one jump equal m, and let x equal the number of jumps. Then y equals the total inches jumped

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Segment 1 is now finished– Frogs

Please proceed with the activity.

Explain the difference between continuous and discrete data. Identify events or situations that would produce continuous data, and then events or situations that would produce discrete data.

Continue to the next segment at the conclusion of the activity.

Flights of the Wright Brothers?

1. The distance of their flights is a linear equation that closely follows the flight of the balloon activity
2. Students can discuss variable changes in the simulated flights that lead to increased time in each
3. There are variables that will affect the distance the balloon will travel
4. Students can develop a table, equation, and a graph from the data they collect

To look at the video, go to:

http://media.dsc.discovery.com/convergence/wright/wright.html

Time and Distance of the First Flights

- Flight 1 Time=12 sec, Distance=120 ft
- Flight 2 Time=12 sec, Distance=175 ft
- Flight 3 Time=15 sec, Distance=200 ft
- Flight 4 Time=59 sec, Distance=852 ft

From Video to Math

Determine the **rate of speed** of each of the **four flights** of the Wright Brothers expressed in **feet per second** using the basic equation $d = r\ t$

Rate of the Wright Brothers Flights

- Flight 1 120 = r * 12
  120 ÷ 12=10 ft/sec
- Flight 2 175 = r * 12
  175 ÷ 12 = 14.5 ft/sec
- Flight 3 200 = r * 15
  200 ÷ 15 = 13.3 ft/sec
- Flight 4 852 = r * 59
  852 ÷ 59 = 14.4 ft/sec

On To Algebra

1. Write an equation for each flight using the y=mx + b format.

   Flight 1 y=10x
   Flight 2 y=14.6x
   Flight 3 y=13.3x
   Flight 4 y=14.4x

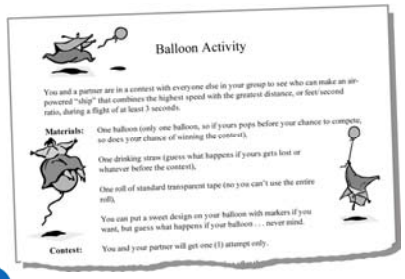
2. How does the "r" (rate) affect the equation written for each flight?

   It changes the number multiplied by x

Simulated Flights

Do the flight simulation following the directions on the "Balloon" handout

Balloon Activity


Balloon Activity

You and a partner are in a contest with everyone else in your group to see who can make an air-powered "ship" that combines the highest speed with the greatest distance, or feet/second ratio, during a flight of at least 3 seconds.

Materials: One balloon (only one balloon, so if yours pops before your chance to compete, so does your chance of winning the contest),

One drinking straw (guess what happens if yours gets lost or whatever before the contest),

One roll of standard transparent tape (no you can't use the entire roll),

You can put a sweet design on your balloon with markers if you want, but guess what happens if your balloon . . . never mind.

Contest: You and your partner will get one (1) attempt only.

Review the Activities

What are the variables in each situation?

- The simulated flight variables
- The frog hopping variables

What are the equations for each activity?

- The simulated flight equation
- The frog hopping equations

Are these examples of linear equations?

Segment 2 is now finished– Balloons, Part One

Please proceed with the activity.

Why is it critical that students understand and can apply the term coefficient?
How does the coefficient affect the shape of the graph?
Which variable represents the coefficient in y=mx+b?

Continue to the next segment at the conclusion of the activity.

Assessment

Create a poster for the data collected that includes:

- A table
- An equation or equations
- A coordinate graph

And This Leads To . . .

- Understanding of the relationship among tables, equations, and graphs
- Use of the graphing calculator to display the collected data
- Development of the equation for slope