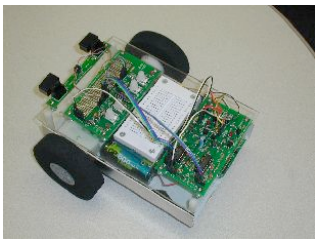

The SPIRIT Project

Educational Robotics

Lesson Building Block

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Directions: Definition of a Lesson Building Block: This is a "Lesson Building Block" from the SPIRIT educational robotics institute. A 'lesson building block' is in essence an educational activity that might be later turned into a more formal classroom lesson by a creative teacher. The SPIRIT Institute is striving to put a variety of "lesson building blocks" up on the web for the potential use of teachers as they try to prepare more formal educational lessons using the TekBot robotics platform.

I. Concepts: Graphing a Linear Equation/ Slope of a Line

II. Standards:

Alg 1-2 – Standard 5 – Graph a linear equation using a table of values.
Alg 1-2 – Standard 6 – Write the equation of a line in intercept form.
Pre-Alg – Standard 4 – Graph ordered pairs.

III. Learning Activity Context:

Context: Moving Tekbot

Abstract: Put students into groups of 3-4. They will construct ramps with different slopes using their books (1 book, then 2, 3, 4). They will use the book as their independent variable. They will measure the time it takes the Tekbot to go up the ramp. Time will be their dependent variable. Once they have collected their data and made a table of values, they will graph their function. If it is not completely linear they will use a "line of best fit". Once they have their line graphed they will be given a handout with several questions asking them to identify the dependent and independent variables, determine the slope of the line, write an equation in slope-intercept form of the function, identify the x and y-intercepts and determine whether there is a positive or negative correlation to their function. Materials would include: stopwatches, books, student worksheets, graph paper, boards for ramp, and Tekbots.

IV. Teacher and Student Suggestions/Tips:

Make sure that all students bring their books to class that day so that you will have enough books. You may want to talk about how to construct a graph (give it a title, label axes, independent variable should be on the x-axis, dependent variable on the y-axis, etc.) before the activity or go over it with the whole class at that time. Make sure each student is given a part in the assignment (one student can run the Tekbot, one student can keep the time (stopwatch), one student can stack the books under the ramp each time, and the last student can record the data).

V. Teacher Questions:

1. Given your data, how long would it take the Tekbot to go up a ramp with 6 books?
2. As the slope gets steeper, what happens to the time it takes the Tekbot to go up the ramp?
3. At what height (in terms of books) would the Tekbot not be able to go up the ramp?

VI. Assessment Ideas:

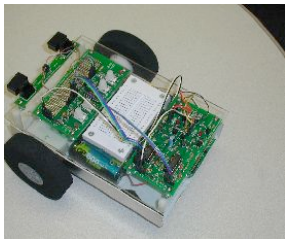
Students would be assessed through observation as the teacher walks around to each group and observes and asks questions. They would also be assessed on the questions that they will answer individually for homework after the activity.

VII. Other Information

Extensions:

1. Have students determine the slope for each ramp.
2. Students could graph a line for data on the time it takes the Tekbot to go down the ramp instead of up (negative correlation and slope).
3. Students could use a spreadsheet to analyze data and graphed lines.
4. Ask students "As an engineer, how would you create a better ramp and improve the Tekbots time and ability to travel up the ramp." Students could then be given sandpaper, rubber bands, and other surface materials to experiment with on their ramp to find the answer).
5. Could get into direct variation and discuss the constant of variation.

VIII. list of materials



Name _____ Hour _____

TekBot Lab Student Worksheet

List Group Members here (each group member should fill out their own lab worksheet).

_____
_____
_____
_____

1. **Objectives: Data Collection, Measurement, Problem Solving, Linear Equations, Graphing, Cooperative Learning.**

2. **Instructions:**
   a. **Gather all materials needed.**
   b. **Start with one book. Set the book against the wall. Place one end of the ramp on top of the book. Make sure the ramp is against the wall so that it will not move. Measure the height of the book (in inches) and record the data.**
   c. **Place the Tekbot at the bottom of the ramp. Make sure to turn the stopwatch on when you turn on the Tekbot.**
   d. **Turn the Tekbot on and measure the time it takes the Tekbot to travel up to the top of the ramp. Record the data.**
   e. **Perform each experiment twice. Repeat the experiment. Record the data.**
   f. **Repeat the experiment for 2, 3, and 4 books.**

3. **What materials did you use?**

4. **The independent variable is the _____, measured in: _____.**

5. **The dependent variable is the _____, measured in: _____.**

6. **Instructions:**

   a. **Once you have gathered all the data, determine the points to be graphed. Use the shortest amount of time in each trial for the dependent value.**

   b. **On the graph paper, make a rectangular coordinate system and graph the points. Be sure to label the axes with an appropriate scale and title the graph.**

Height of Book(s)	Time Traveled Trial 1	Time Traveled Trial 2	Ordered Pairs to be Graphed
1.			
2.			
3.			
4.			

c. If your function is not completely linear, draw the line of best fit. It should be a straight line.

D. Answer the following lab questions for homework.

1. Find the slope of the line you graphed? m =
2. Find the y-intercept of the line. y =
3. Given the slope and y-intercept write the equation for the line you graphed in

   b. slope-intercept form: $y = mx + b$

   c. standard form: $Ax + By = C$

4. Each time you add a book what happens to the slope of the ramp?

5. As the slope gets steeper, what happens to the time it takes the Tekbot to travel up the ramp?

6. **Given your current data, how long would it take the Tekbot to travel up a ramp with a height of 7 books? Could it travel up a ramp that steep?**