Demonstration Lesson: "Slopes with Starburst"

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Technology Lesson: Yes
Date of Lesson: 9/21/2010
Length of Lesson: 45 minutes
Source of the Lesson: http://education.ti.com
Grade Level: 8th Grade
Honors or Regular: Honors Algebra 1

Developmental Appropriateness for Middle School Students: Students will be able to work in groups and help one another, should a technological difficulty occur. Also, students will be using graphing instruments (TI Inspire) and will become familiar with instruments that they will be using for the remainder of the time that they will be in school. Students will be making predictions about the shapes of graphs and the effects of certain variables.

Performance Objectives

Students will be able to…

- solve problems involving distance and time.
- predict and draw graphical representations of motion.
- interpret graphs of position versus for motion in a single direction.

Sunshine State Standards Addressed

Mathematics

Grade 8

BIG IDEA 1: *Analyze and represent linear functions and solve linear equations and systems of linear equations.*

MA.8.A.1.1	Create and interpret tables, graphs, and models to represent, analyze, and solve problems related to linear equations, including analysis of domain, range and the difference between discrete and continuous data.
MA.8.A.1.2	Interpret the slope and the x- and y-intercepts when graphing a linear equation for a real-world problem.
MA.8.A.1.3	Use tables, graphs, and models to represent, analyze, and solve real-world problems related to systems of linear equations.
MA.8.A.1.5	Translate among verbal, tabular, graphical and algebraic representations of linear functions.
MA.8.A.1.6	Compare the graphs of linear and non-linear functions for real-world situations.

Materials List

- Measuring tape 10 meters long
- 1 cart
- 1 roll of masking tape
- Starbursts (at least 30)
- 1 stop watch
- 27 TI-Nspires
- 52 copies of Pre/Post Test

- 27 Exploration Data Worksheets
- 27 Worksheets with TI instructions
- Smart board
- Software for smart board (including pre-made chart for use during activity)
- Software for TI-Nspires (already loaded onto calculator)

Advance Preparations

Software must be loaded and tested on Calculators, as well as the smart board. Copies of all worksheets must be made and any necessary smart board worksheets will be emailed to the mentor teacher. The mentor teacher must choose 3 to 4 of her most well behaved students to participate in the time trial (3 will be used in the time trial, the fourth will be for back up as well as set up of the activity). A suitable area for the time trial must be found which should be at least 10 meters long and covered. While one UFTeach volunteer begins the Engagement, the other will take the 4 students out to the area where they will be completing the trial and set up the area. The other teacher will bring the rest of the class when Engagement is over and everything is ready.

Safety

Students will be pushing others on moving carts with wheels, so it should be stressed to them that they be very careful to not push others too hard to one side or too fast. Students riding on the carts should keep their hands away from the wheels and be careful not to lean to one side too much.

5Es of Lesson

ENGAGEMENT		**Time: 5 minutes**
What the Teacher Will Do	**Probing Questions**	**[Correct answers] & Potential Misconceptions**
Mentor teachers will ask the 4 students to help them outside, the other will lead the remainder of the engagement.		
Find out what students know about the relationship of distance to time.	"How do we measure how fast cars are going on the roads?" "So we all know that speeds in America are measured in units of miles per hour?"	[Divide the distance traveled by the time][Miles per hour] time divided by distance
Guide students into understanding that units can be replaced with different scalars.	"So if I were to see how fast we are going to go in the hallway, would it be appropriate to measure our speeds in miles per hour?"	[No] yes
	"What would be better units of measurement?"	[meters per second, centimeters per second, meters per minute, centimeters per minute] miles per second, meters per hour
Guide students into knowing how to complete and average speed calculation.	"So what would it mean to say 'centimeters per second?' What are we actually saying?"	[dividing distance by time]
Present the idea of completing distance time charts in order to visualize the data.	"If we have charts, we can see the distance that a person is at for a certain time. Could we use	[yes]no

ENGAGEMENT		Time: 5 minutes
What the Teacher Will Do	**Probing Questions**	**[Correct answers] & Potential Misconceptions**
Present the idea of graphing calculators. Move on to exploration, by now the activity should be set up in the hallway.	this data to find out more about the speed of a person moving on a cart in the hallway?" "Has anyone ever used a graphing calculator before?"	Yes or no

EXPLORATION		Time: 25 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
The teacher who led the engagement will pass out one activity sheet to each student.		
One student will be assigned to a certain time. They will be instructed to record the distance for their own particular time.		
The 3 of the 4 students who were selected will be a part of the task. One will be a "pusher" one will be a "rider" and one will be a "timer." The pusher will push the rider on a cart down the wall. The rider will have 27 or so starbursts, and will drop one every 2 seconds, while being pushed at a constant rate of speed. The other students will record the distance for the time they have been assigned.		
After the activity is complete, all students will go back into the classroom and each student will be instructed to write his or her assigned data point on the chart located on the smart board.		
The teachers will hand out the calculator instructions for the calculator activity. The teacher should instruct the	"Using your instructions, enter the data into the calculators." "Now find the line of best fit.	Some students may have issues with the calculators. [an equation to find the distance

EXPLORATION		Time: 25 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
students to find the line of best fit.	What would this represent?"	or time for any given variable]

EXPLANATION		Time: 10 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
After the students have finished creating a graph of their data on the TI-Nspires, begin class discussion of the questions on the worksheets. (Students will follow along and fill in answers).	1) What was the average speed the cart moved (in cm/s)? How do you know? 2) What did the graph of your data look like? 3) Why do you think it looked like this? 4) What would the graph of the data look like if you stopped for 10 seconds after pushing the cart, then turned around and returned to the starting line at the same average pace? 5) How would we sketch that graph?	Answers to worksheet: 1. Answers will depend on student data, but the students should mention that they calculated the speed by dividing the distance travelled by the time it took to travel. 2. Straight line: some points above and below the line. As the time increases, so does the speed. 3. Answers will vary. 4. The graph would have a positive slope at first, then it would level off for 10 seconds, and then it would have a negative slope. 5. See Number 4.

ELABORATION		Time: 5 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
Help students understand what the slope and y-intercept of their graph represents by eliciting responses to the questions in the next column.	1) Now we've looked at a graph of the motion of a cart in the hallway. How did we determine how fast the cart was moving? 2) If you only had a graph of the data to look at, how would you determine the speed of the car? 3) What does a flat line represent? 4) How many changes in velocity does each graph have? How can	1) We divided distance travelled by time it took to travel. 2) Slope – if students do not readily know this, help students to see that slope is equal to distance traveled over a given time on a distance-time graph. 3) A flat line represents a speed of 0, meaning the cart has stopped. 4) Various responses. Any time

ELABORATION		Time: 5 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
	you identify these points from the graph? 5) How can you tell where the cart is moving fastest? 6) What does the y-intercept represent? 7) Why does our graph not have a y-intercept equal to 0?	there is a change in the slope there will be a change in velocity 5) Where the slope is steepest. 6) Where the car starts relative t the starting line. 7) Our graph gives the average speed so we may not have been pushing the cart at a constant speed which would mean there is some error. However, the y-intercept is close to 0. .

EVALUATION		Time: 5 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
Gives the post-assessment		

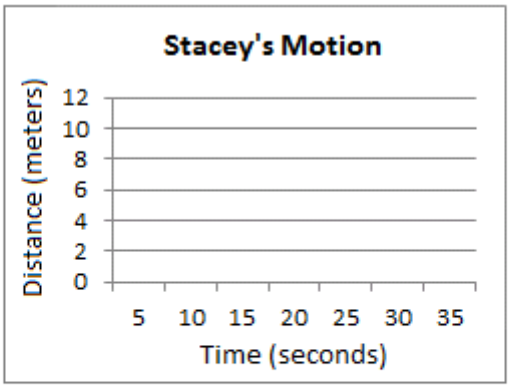
Assessment

Name _____ Date _____

1. What two things do you need to know in order to create a graph of your motion?

2. Sketch a graph of time versus distance for Stacey's motion:

   Stacey walked 4 meters in 10 seconds, stopped for 5 seconds, then walked another 4 meters in 20 seconds.



3. When looking at a graph of an object's motion, how do you know how fast the object is moving?

Worksheet

Name _____ Date _____

Time the cart has travelled from the start: _____ (seconds)

Distance from start: _____ (centimeters)

Line of best fit for data (y=mx+b): _____

1. What was the average speed the cart moved (in cm/s)? How do you know?

2. What did the graph of your data look like?

3. Why do you think it looked like this?

4. What would the graph of the data look like if you stopped for 10 seconds after pushing the cart, then turned around and returned to the starting line at the same average pace?

Sketch a graph of that motion below:

Instructions for TI-Nspires

1. Turn the calculator ON.
2. Press the HOME KEY.
3. Navigate to 3: LISTS AND SPR… and press ENTER
4. You should now see a screen with a blank chart.
5. Navigate UP and highlight the box labeled A.
6. Type “time” using the GREEN BUTTONS.
7. Navigate RIGHT and highlight the box labeled B
8. Type “distance” using the GREEN BUTTONS.
9. Navigate back to BOX A1.
10. Type the TIME (the X-VALUE) from the chart on the smart board.
11. Press ENTER.
12. Repeat this process until you’ve entered all the TIMES.
13. Navigate back to BOX B1.
14. Type the DISTANCE (the Y-VALUE) from the chart on the smart board.
15. Repeat this process until you’ve entered all the DISTANCES.
16. Press HOME.
17. Navigate to 5: DATA & STAT… and press ENTER.
18. You might see a random assortment of points. This is okay. Continue on with the instructions anyway.
19. Move the pointer to the bottom of the screen and click where it says “Click to add variable”.
20. Select TIME and press ENTER.
21. Now move the pointer to the left side of the screen until a BOX is highlighted. Click and choose DISTANCE.
22. You should now see a scatter plot with two axes.
23. To insert the LINE OF BEST FIT, press MENU.
24. Press 4: Analyze.
25. Press 6: Regression.
26. Press 1: Show Linear (mx+b)
27. Your LINE OF BEST FIT, as well as its equation should appear.
28. Write the equation in the space provided on your worksheet.

Chart for Smartboard:

DROP	TIME (seconds)	DISTANCE FROM START (cm)	Rate (cm/s)
