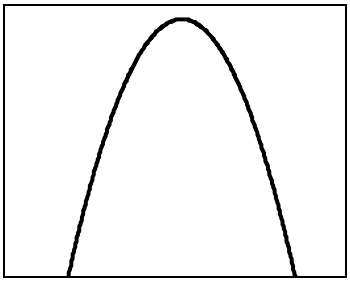
Sketch a Graph

Student Probe

Sketch a graph for this situation:
The height of a baseball in terms of time from when it is thrown straight up to the time it hits the ground.

Answer:



Lesson Description

The focus of this lesson is on using a graph to express the relationships involved in a function. It is designed for students who cannot create a graph to reflect the features of a function that has been described verbally.

Rationale

Graphs are one of the most powerful representation tools in mathematics. The ability to deeply understand functional relationships is dependent upon both interpreting a graph to describe a function and creating a graph to describe a function. Generalizing about change can help students understand the situations that the functions represent.

Preparation

Prepare graph paper with clearly labeled x-and y-axes for each student.

At a Glance

What: Students will sketch a graph that exhibits the qualitative features of a function that has been described verbally.
Common Core State Standard: CC.8.F.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
Mathematical Practices:
Reason abstractly and quantitatively.
Model with mathematics.
Look for and make use of structure.
Who: Students who cannot describe the features of a function on a graph when has been verbally described.
Grade Level: 8
Prerequisite Vocabulary: x-and y-axis, increasing, decreasing, horizontal, vertical, positive, negative
Prerequisite Skills: plotting points, recognizing positive and negative slope, recognizing quadrants
Delivery Format: small group, whole group
Lesson Length: 15 to 30 minutes
Materials, Resources, Technology: graph paper
Student Worksheets: None

Lesson

The teacher says or does…	Expect students to say or do…	If students do not, then the teacher says or does…
1. We are going to sketch a graph for the following situation: The level of water in a bathtub from the time you begin to fill it to the time it is completely empty after your bath. When you think about the entire process of having the water fill the tub, taking a bath, and emptying the tub, how many times can you think of that the water level changes?	Answers may vary.	
2. First, let's make a list of all the events, or times, that the water level would change or stay the same during this process. (See Teacher Notes.)	Answers may vary, but listen for and record: 1. Water fills the tub. 2. Water sits for a short time before you get in. 3. Water level rises as you get in. 4. Water level stays the same as you sit in the tub. 5. Water level decreases as you get out. 6. Water level stays the same as you dry off. 7. You pull the plug and the water drains until the tub is empty.	Prompt students as they discuss the process. Model as described in Teacher Notes 2.
3. What could we label each axis?	Time and water level	What are the important pieces of information to know in this problem that will have numerical data?
4. Which axis would be best to label with the time?	x-axis	Remind students that time should go on the horizontal or x-axis.

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5. Which unit of time would be appropriate to use on the x axis?	minutes	What do you know about how long it takes to fill a bathtub and take a bath? Would it be best to measure in hours, minutes, or seconds?
6. So the x-axis should be labeled “minutes”.		
7. How should we measure the level of the water in the bathtub?	inches	What is the depth of a bathtub? Should we measure that depth in yards, feet, or inches?
8. So the y-axis would be labeled “inches of water”.		
9. For each event we have listed, there will be a line segment to represent it on the graph.		
10. Where would be the best place to start the graph? Why?	0,0 When we start to fill the tub, no time has passed, and there is no water in the tub.	Remind students that if no time has passed, and no water is in the tub, zero represents both measurements.
11. Let’s start placing the line segments on our graph. What does the first line segment need to do?	Show the water level increasing as the tub is filling.	
12. How could we represent this on our graph?	With a line segment that shows an increase from 0,0 upward for a few minutes.	
13. What should the second line segment look like that represents the time between the tub filling and getting in the water?	A horizontal line segment.	If the water level doesn’t increase, as time passes there will be no increase or decrease in the slope of the line.

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14. Next we need to have a line segment that represents the water level as we would sit down in the tub. How would it look?	The water level would go up slightly for a very short period of time.	Prompt students, if necessary.
15. Now, we need to represent the water level in the tub as we bathe. We should use a line segment that represents a constant water level as time passes. Should this line segment be longer than the second one that we used (to represent the water level during the time between filling the tub and stepping into the tub)?	Longer. Students draw a horizontal line segment that is longer than the segment used to represent the level between filling and getting in.	Make sure students draw a horizontal segment with an appropriate length as compared to the segment used between filling and getting into the water.
16. What was the event after bathing in our list?	Stepping out to dry.	Refer students back to the list created in Step 2.
17. What happens to the water level as time passes in this event?	The level quickly goes down.	Prompt students as necessary to get the correct response.
18. How would we represent this on our graph?	With a short line segment that goes down.	What is happening to the water level as time passes?
19. Let's place this line segment on our graph.	Draw a short line segment with a decreasing slope.	Remind students that the line segment should be short and sharply decreasing.
20. While drying, we should have a line segment representing the water level before pulling the plug to drain the water. What should this line segment look like?	A horizontal line segment.	Remind students what it looked like after the tub was filled, before we got into the water.
21. Add this line segment to your graph.		
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		teacher says or does…
22. After drying, we pull the plug and let the water drain from the tub. How could we represent this?	With a line segment that is decreasing	Remind students that draining the tub would be the opposite of filling the tub, so the line segment should do the opposite of the first line segment.
23. Now, place the line segment on the graph.		
24. Notice on your graph that every event listed in Step 2 has a line segment to represent the change on our graph.		Point out each segment and review the event it represents.

Teacher Notes

1. After giving students the scenario, have them discuss the events that lead to water level changes in pairs or small groups, making a list. Then let the whole group discuss and create a list from the small group discussions.
2. Model the water level changes using a clear, or semi-transparent, plastic tub to represent the bathtub and a brick or other object to represent a person. Mark the water levels on the outside of the tub as you (1) pour water into the tub, (2) insert the brick, (3) remove the brick, (4) pour out the water.
3. The final graph should have 7 line segments (2 increasing, 2 decreasing, and 3 constant rates).
4. Students frequently say a segment is “straight” when they mean it is horizontal. Be sure to model the correct terminology.

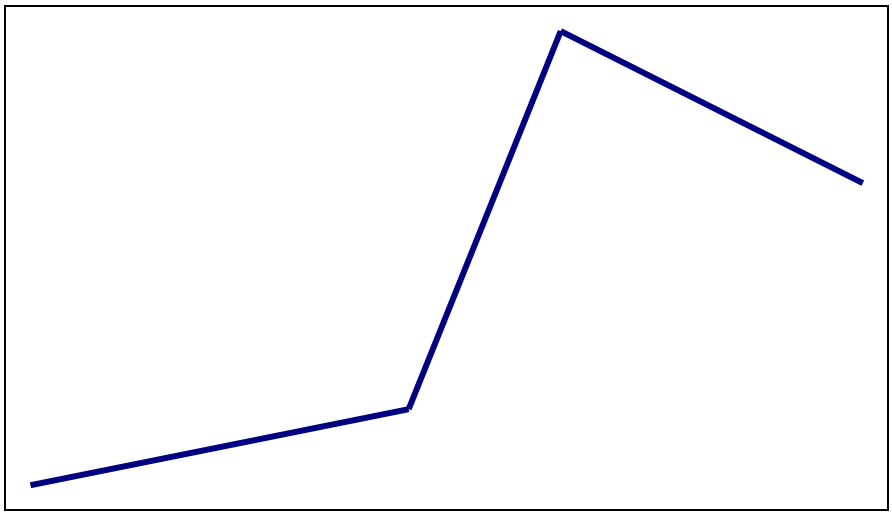
Variations

It might be necessary to have direct instruction on sketching a graph before students work through this lesson. A suggested scenario could be filling a mug with hot cocoa, drinking some, and refilling before drinking it all. Be sure to point out that since it is hot, you wouldn’t just turn it up and drink it all at once, there would need to be sipping and cooling. This could show the increasing and decreasing of levels at varying rates.

Formative Assessment

Sketch a graph for the following situation:
The temperature of a frozen dinner from 30 minutes before it is removed from the freezer until it is removed from the microwave and placed on the table. (Consider time 0 to be the moment the dinner is removed from the freezer.)

Answer:



References

Paulsen, K., & the IRIS Center. (n.d.). *Algebra (part 2): Applying learning strategies to intermediate algebra*. Retrieved on May 13, 2011.

Van de Walle, J. A., & Lovin, L. H. (2006). *Teaching Student-Centered Mathematics Grades 5-8 Volume 3.* Boston, MA: Pearson Education, Inc.