

PCMI Japanese Lesson Study
July 12 – July 31, 2004
Lesson: Version 4

Overall Theme: *Translation between Math and Real Life*

Overall Goals:

- Lesson will emphasize the meaning of graphs.
- Lesson will convey some necessity, importance, beauty of Math.
- Lesson will focus on conceptual versus procedural understanding.

Content Theme: *Modeling Change*

The Essential Question(s): *How can change be represented graphically?*

Content Goal(s):

Students should understand how change can be represented graphically. “Understanding” means students can explain how graphs represent change and can tell “stories” with graphs. Students can create a real-life scenario for a given graph and conversely can sketch a graph using a description of a situation (“a story”). Students should be able to label graphs and choose quadrants effectively and understand that one graph can describe more than one situation. Finally, students should see graphs as showing relationships between two or more variables.

Materials:

- balloons
- post-it chart paper
- double-sided tape
- markers
- blank paper, pens/pencils at each desk
- graph/grid paper
- large, color cards for tables, students (student cards folded in $\frac{1}{2}$)
- worksheets for Activity #1 and #2
- various questions pre-written on poster paper
- 8 graphs from Part I enlarged on poster paper

Planning Team:

Teachers: Claudia Gutierrez, Megan Taylor

Activity (Time)	Description	Questions	Student Responses	Materials/ Preparation
Pre-Class Organization (n/a)	<p><i>Observation Foci:</i></p> <ul style="list-style-type: none"> - Student Responses (JoAnn) - Student Actions/ Discussions (Luis) - What teacher does that students could do (Bill) - Questions (Student) (Remy) - Questions (Teacher) (Cheryl) - Time (Megan / Claudia) <p><i>Seating of students:</i> Each student is handed a color index card that tells him/her where to sit. Each card is folded in half when given to the student to act as name-plates. Students will sit in randomized pairings.</p>			<ul style="list-style-type: none"> - Color index cards on tables - Folded color index cards for students
Welcome (3 min.)	<p><i>Introduction:</i> Teacher will introduce herself/himself and the observers (briefly). Teacher will relay to the students that the observers are there to learn how to improve their teaching. Teacher will help students feel comfortable in the class before launching into the lesson.</p>			<ul style="list-style-type: none"> - Teacher's name on board - Class guidelines on board

<p>Launch (7 min.)</p>	<p><i>Balloon Observation:</i> Students observe the teacher blowing up a balloon. When he/she finishes, the students are asked to make observations about what is changing as the balloon is inflated and deflated a second time.</p> <p>Teacher blows up a second balloon, slowly, then quickly, releasing some air, etc... Students think about what is changing from the observation. When the teacher has finished the demonstration, teacher calls on volunteers. Responses will be recorded on the board/ flip-chart. <i>Ex: size, shape, air, surface area, volume, color, length, words, sound, time, etc.</i></p> <p>Teacher uses list to begin short discussion about what changed and HOW. Students are asked to “analyze” list in terms of different kinds of change.</p>	<p><i>“I want you to think about changes in the balloon as I blow it up.”</i></p> <p><i>“What was changing about the balloon?”</i> <i>What is different about the balloon?</i> <i>What do you know changed that you can’t SEE?</i></p>		<ul style="list-style-type: none"> - balloons! - poster of graph should be up
<p>Activity 1.a (5 min.)</p>	<p><i>Graph to Story – Part I:</i> Pairs of students are given the first graph and asked to explain what is happening to the balloon. Each student must write down the story the pair comes up with. Teacher will emphasize that stories do not have to do with the way the teacher blew up the balloon, just how a balloon can change.</p> <p>Teacher will circulate as the students discuss and write to make sure everyone is on-task. During this time the teacher will also “choose” two or three student pairs to share their description. Teacher can look</p>	<p><i>This graph represents change in a balloon. Write a situation for this graph that describes how the balloon is changing.</i></p> <p><i>What is changing?</i> <i>What causes this change?</i> <i>What does the change depend on?</i> <i>Is anything changing at the same time? Do these things affect each other?</i></p>	<ul style="list-style-type: none"> - Time and Size - Time and Inflation - Time and “Stretch” - Speed of Inflation - Picture on balloon - Axes labeled or not - Units labeled or not <p><i>What labels should I put?</i></p>	<ul style="list-style-type: none"> - Worksheets for each student - Worksheet “blown-up” on a poster and hung up

	for different ways students described “size,” for example.	<i>Why were you able to come up with different ideas?</i>		
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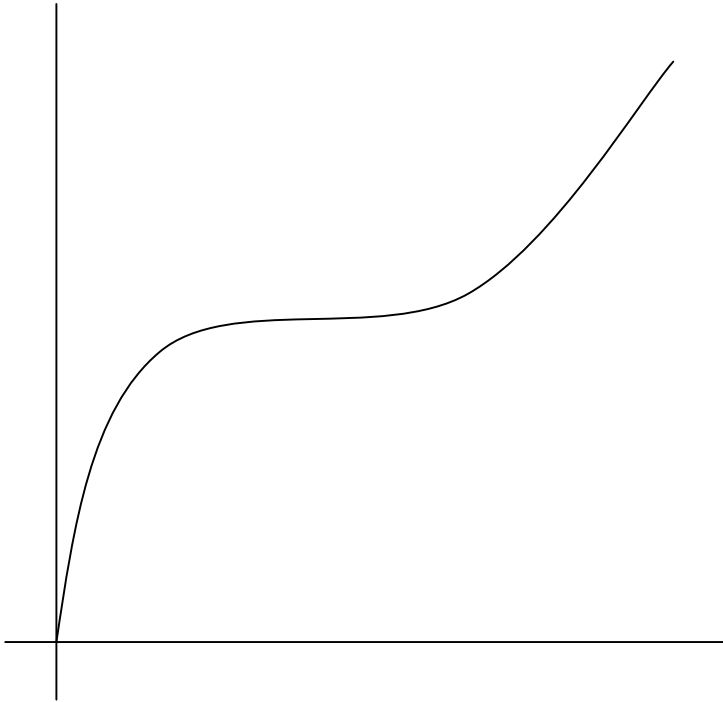
<p>Activity 1.b (15 min.)</p>	<p><i>Sharing of Ideas:</i> Situation #1: Chosen pairs will be asked to describe what is happening in the graph. Teacher will call on students and facilitate a short discussion about each graph. - OR - Situation #2: Student pairs will switch graphs and will be asked to analyze the graph given to them. Does the story the other pair wrote match the graph? Why or why not?</p> <p>Teacher can pick a point on the graph and ask students what is happening in their story at this point. Teacher can pick another point, for example with the same y-coordinate, and ask students what happened between the two.</p> <p>Teacher can draw a vertical shift and ask students if the graph is now different or not and how.</p> <p>Teacher can make sure vocabulary students use in the discussion is correct.</p> <p>** Closure: Teacher can ask a student or two to summarize how the graph shows change. The idea that our graph shows a big change, no change, then a smaller change is key.</p> <p>Key ideas that should emerge are rate of change and the idea that the graph shows a relationship between two things. Students should also understand that “the flat part” of the graph represents something not changing.</p>	<p><i>Can someone other than [authors of the story] explain how you think this story describes the graph well or not?</i></p> <p><i>What is the same about these two points? What is different? What happened between them? How did you know this was happening here?</i></p> <p><i>What was the difference between ___'s story and ___'s story.</i></p> <p><i>Bill, what do you think is changing in ___'s story? How is it changing? What do you think is causing the change?</i></p> <p><i>How do I show this on my graph? How does this show up on the graph?</i></p> <p><i>What if I used a helium tank to blow up the balloon? What if I change this part of the graph to look like this? Where is the deflated balloon represented on the graph? What if this part of the graph was less steep?</i></p>		
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<p>Activity 2.a (10 min.)</p>	<p><i>Graph to Story – Part II:</i> Pairs of students are given the same graph again and asked to use it to write a new story. Each student must write down the story the pair comes up with. Students are <i>not</i> expected or encouraged to use a balloon in their new story.</p> <p>Again, teacher will circulate around the room checking for understanding. Students will be given graph on large paper to provide labels, title, etc.</p>	<p><i>Think of a new story for the same graph that has nothing to do with a balloon.</i></p> <p><i>What from the list can be used as a story for the same graph?</i></p> <p><i>Which of the things from your list will be easy to make a graph from and which will be harder to use?</i></p>	<p><i>Can we use a balloon anyway?</i> <i>Do we need to label our graphs?</i> <i>I can't think of anything.</i> <i>Do I have to use this [axis] that you gave me?</i></p>	
<p>Activity 2.b (10 min.)</p>	<p><i>Sharing of Ideas:</i> Each pair will share out the description of the story while teacher notes key ideas on chart paper. Other students are given the opportunity to ask questions about the story. The sharing should be quick and should emphasize how many different ways there are to interpret a graph. Students from the audience can be asked to describe the story just using the graph.</p> <p>At the end of the activity we want students to see how one graph can represent many different situations. Also, we want students to see how a graph can represent change. Students should understand the idea of independent and dependent variables and should understand the concept of slope as rate of change. This vocabulary may or may not be used.</p>	<p><i>What is changing?</i> <i>How is it changing?</i> <i>What is causing that change?</i></p> <p><i>Megan, do you think Claudia's story describes this graph?</i></p> <p><i>Which things from your original list would be hard to graph?</i></p>		
<p>Activity 3</p>	<p><i>Story to Graph:</i></p>	<p><i>How can change be</i></p>	<p><i>Why is it flatter here</i></p>	

<p>(if time)</p>	<p>Students are given two situations and are asked to sketch a graph to represent them (on a single axis).</p> <p>Depending on time, students will draw graphs with partners or “as a class.” Discussion will involve the entire group.</p>	<p><i>represented graphically? What is changing? How is it changing?</i></p> <p><i>When should the slope be different? How is this like the graphs from the balloon?</i></p> <p><i>How can your graph be more accurate? What does this graph tell us?</i></p>	<p><i>and steeper there?</i></p>	
<p>Wrap-up (5 min.)</p>	<p>Teacher will build from visible work to make concluding points about the lesson. <i>What was the goal?</i> The important ideas that should surface at this time are rate of change (+/-, slopes, steepness, going through the origin, etc.), labeling, independent and dependent variables, and the idea that a story can be represented with a graph and vice-versa.</p> <p>Students will leave all materials from the lesson in the classroom for later review by teacher and observers.</p> <p>Students clean up and are dismissed.</p>	<p><i>Today we talked about change. In this graph, we looked at a graph that represented the change in a balloon...</i></p> <p><i>What was this lesson about? What can you tell me about change?</i></p> <p><i>What is change?</i></p>		

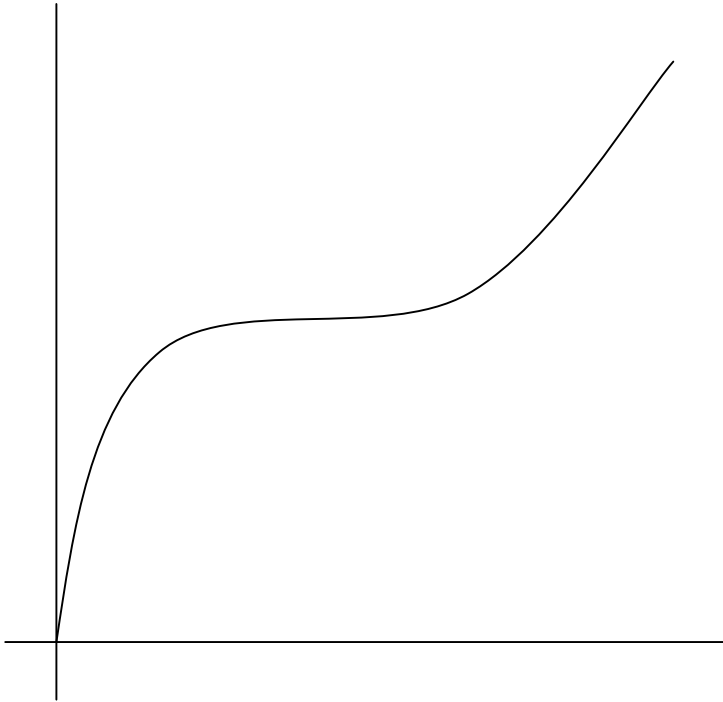
Graph to Situation – Part I

DIRECTIONS: Create a story about a balloon for the graph below in one or two sentences.



Graph to Situation – Part II

DIRECTIONS: Create another story for the same graph in one or two sentences.



Story to Graph – Part III

DIRECTIONS: *Sketch a graph for the situations below.*

1. (a.) Lance Armstrong rode up and over a mountain pass in the Alps. Draw a graph to represent his ride.

(b.) Lance overtook his rival, Ivan Basso, during the ascent.

