PCMI Japanese Lesson Study
July 12 – July 31, 2004
Lesson: Version 2

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: ***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 $^1/_2$)
- 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)	*Seating of students:* 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.			- Color index cards on tables - Folded color index cards for students
Welcome (3 min.)	*Introduction:* 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.			- Teacher's name on board - Class guidelines on board
Launch (5 min.)	*Personal Change:* Teacher posts the following: *What are things in your life that change?* Teacher revolves around the room and reads student responses as they write. Students are asked to share 1-2 ideas each while the teacher records on a chart paper. *Ex: money, growth, skin color, weight, friends, teachers, grades, classes, weather*	*List things in your life that change.* *What are things that change?* *What things around you are changing?* *Write about a situation where something is changing.* *What is different because it's summer?* Transition: *We will come back to this list later.* OR *When I made* my *list I thought about a balloon…*	*What do you mean? Can we talk?*	- Launch task on chart paper - Chart paper for brainstorm - Marker(s)

Activity 1.a (7 min.)	*Balloon Observation:* 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. Teacher blows up a second balloon, slowly, then quickly, releasing some air, etc… Students write down what is changing from the observation. When the teacher has finished the demonstration, he/she walks around the room to make observations about the range of answers. Teacher can take mental note ("drive-by assessment") of on-task behavior, range of answers, etc. Teacher calls on volunteers. Responses will be recorded on the board/ flip-chart. Ex: size, shape, air, surface area, volume, color, length, words, sound, time, etc.	"*I want you to write about changes in the balloon as I blow it up."* *"What was changing about the balloon?"* *What is different about the balloon?* *What do you know changed that you can't SEE?*		- balloons!

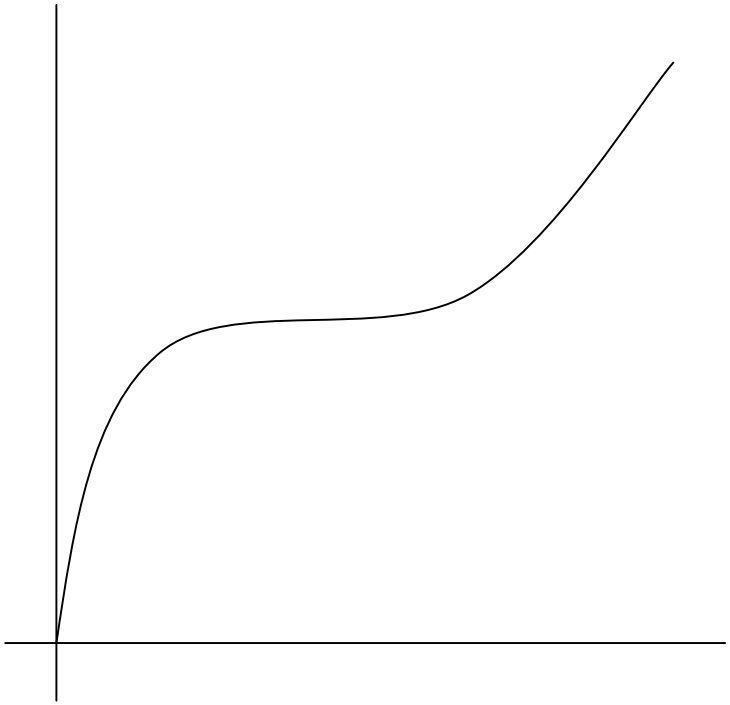
Activity 1.b (5 min.)	*Graph to Story – Part I:* Pairs of students are given the first graph and asked to explain what is happening to the balloon. Each student must write down the story the pair comes up with. Teacher will circulate as the students discuss and write to make sure everyone is on-task. During this time the teacher will also "choose" two or three student pairs to share their description. Teacher can look for different ways students described "size," for example.	What *is changing?* *What causes this change?* *Why were you able to come up with different ideas?*	-- Time and Size - Time and Inflation - Time and "Stretch" - Speed of Inflation - Picture on balloon - Axes labeled or not - Units labeled or not *What labels should I put?*	- Worksheets for each student - Worksheet "blown-up" on a poster and hung up

Activity 1.c (15 min.)	*Sharing of Ideas:* 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. 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. Teacher can draw a vertical shift and ask students if the graph is now different or not and how. Teacher can make sure vocabulary students use in the discussion is correct. *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. Key ideas that should emerge are rate of change and the idea that the graph shows a relationship between two things.	*Can someone other than [authors of the story] explain how you think this story describes the graph well or not?* *What is the same about these two points? What is different? What happened between them?* *How did you know this was happening here?* *What was the difference between ___'s story and ___'s story.* *Bill, what do you think is changing in ___'s story?* *How is it changing?* *What do you think is* causing *the change?* *How do I show this on my graph? How does this show up on the graph?*		
Activity 2.a (10 min.)	*Graph to Story – Part II:* 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 *not* expected or encouraged to use a balloon in their new story.	*Think of a new story for the same graph that has nothing to do with a balloon.* *What from the list can be used as a story for the*	*Can we use a balloon anyway?* *Do we need to label our graphs?* *I can't think of anything.* *Do I have to use this*	

	Again, teacher will circulate around the room checking for understanding.	*same graph?*	*[axis] that you gave me?*	
Activity 2.b (10 min.)	*Sharing of Ideas:* 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. 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.	*What is changing?* *What is causing that change?* *Megan, do you think Claudia's story describes this graph?*		
Activity 3 (if time)	*Story to Graph:* Students are given two situations and are asked to create graphs to represent them.			
Wrap-up (5 min.)	Teacher will wrap-up the lesson by asking students to answer the question: *What is something you learned today that you didn't already know?* Students will leave all materials from the lesson in the classroom for later review by teacher and observers. Students clean up and are dismissed.			

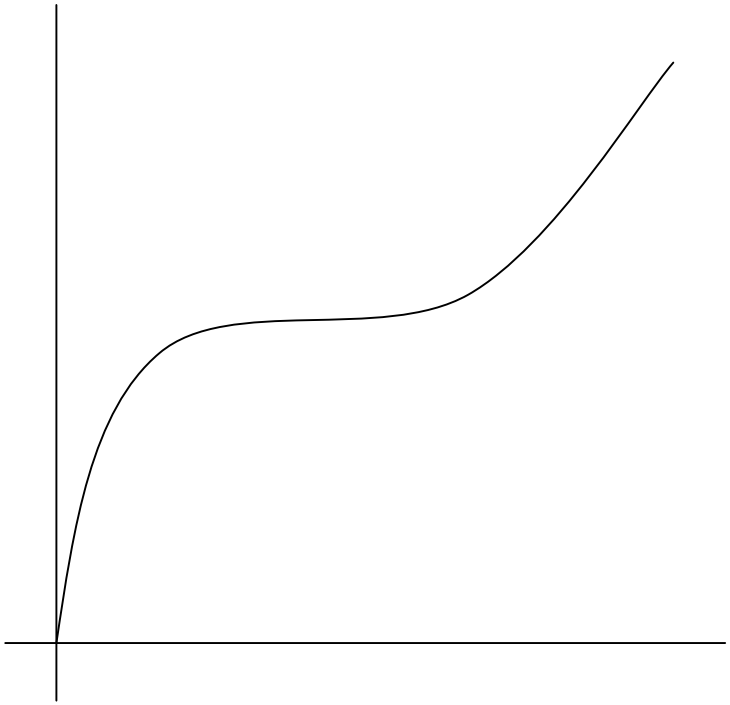
Graph to Situation – Part I

DIRECTIONS: Create a story about a balloon for the graph below.



Graph to Situation – Part II

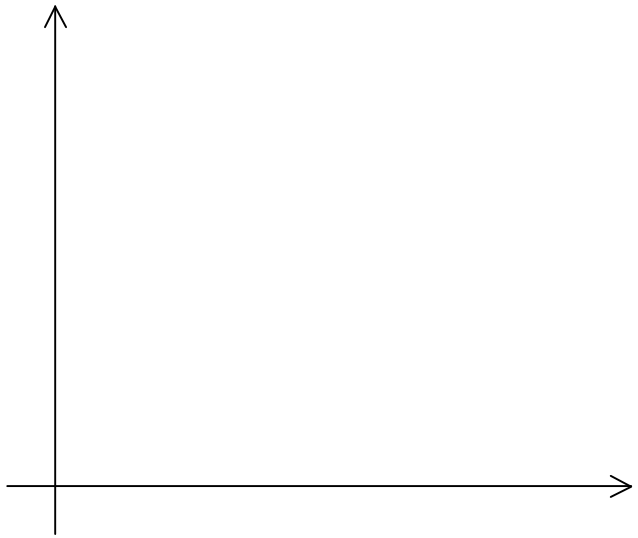
DIRECTIONS: Create another story for the same graph.



STORY to GRAPH

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

1. Jamie rode her skateboard up Mt. Timpanogas, ate lunch, then rode back down again.



2. Tom spent part of his allowance on a movie, part on some candy and the rest on the bus.