Positive Impact on Student Learning Project

Teaching Linear Relationships to 6th and 7th Grade Math Students

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Section 1: Contextual Factors

Community, District, and School Characteristics

The middle school at which this study was conducted is located in Lakewood, WA, just south of Tacoma. It serves a diverse population of 630 sixth through eighth grade students from many racial backgrounds, including White (31%), Black (26%), Hispanic (24%), and Asian/Pacific Islander (15%). The school is close to Fort Lewis and McChord Air Force Base, and serves a number of students from military families. This is an important, though not the sole contributing factor to the school's high turnover rate (about two-thirds of the students who began the year at this middle school will finish elsewhere). Seventy-three percent of the students at this school qualify for free and reduced lunch. Academically, the school has failed to meet overall AYP requirements and is in Improvement Step 3, which has included the introduction of new administrative staff to coach current faculty, Failure on state tests has also led to the introduction of a remedial math program in which all students were enrolled at the beginning of the school year. This class is taken in addition to students' regular math classes.

Classroom Characteristics

The math class in which this study took place is for sixth and seventh grade students in the Advanced Study Program (ASP). On a regular day, math took place during a seventy minute period. Physical space was limited by the presence of sinks and lab stations around the perimeter of the room. Students were seated in groups of three or four, based on their academic readiness as determined by the pre-assessment for this unit. The primary form of technology in this math classroom was graphing calculators. Each student was provided access to a graphing calculator during class time. Parents were not significantly involved in the daily classroom routine, nor were any para-educators provided as aides to the

students in this classroom. Classroom routines generally included a ten to fifteen minute entry task and debrief, which prepared the students for their investigation for the day. Most activities were inquiry-based, with mini-lesson and inquiry debriefs included strategically to help students bring together a clear understanding of the important mathematical content of the unit. Often, an individual exit task was provided at the end of a class period to assess each student's understanding of the important content for the day.

Student Characteristics and Instructional Implications

In order to accommodate the age range and developmental stages of students between 11 and 14, I designed instruction in this unit to introduce linear relationships through primarily context-based investigations. Though this was a class of generally high achieving students, about half of the students in this classroom had taken this course the previous year, and therefore had more prior knowledge of the topic than those students in sixth grade who were new to the class. Therefore, from the beginning, some tasks were differentiated based on students' readiness to accommodate for both students whose understanding was strong, and those whose understanding was still emergent.

All students in this class were proficient in reading, writing, and understanding English, though some spoke another language as their primary or home language. Additionally, no students in this classroom had been identified as having a disability that interfered with their learning or required accommodations or specially designed instruction.

I constructed the unit to be responsive to students' cultural backgrounds, in particular SES. In order to do this, I designed learning experiences where students could access a mathematical understanding of linear relationships through the lens of investigating the minimum and living wages in the city of Lakewood, where most of them live. In order to ensure respect for the backgrounds of the

students and their families, extreme care was taken to present the service-sector jobs that the students were examining as honorable and important positions so that the focus of students' skepticism would be on the wages and not the jobs themselves.

Case Study Student Profiles

Ty, (all student names have been changed to protect privacy) a Caucasian female, is the first student whose case study is presented in this project. She comes from a low SES background and her parents seem to take little or no interest in her schooling. She is in seventh grade and took this class before as a sixth grader. She is 13 years old, and though she struggled significantly in the program last year, she has experienced a great deal of mathematical success this school year. Ty has strong discussion skills and a willingness to engage other students in mathematical conversations without always going through the teacher. She is also generally a willing participant in classroom discussions. Ty needs very clear instructions about what is expected of her and has some trouble working with students that she is good friends with. She is aware of this and generally requests to be partnered with or seated by those students who are not her close friends.

The second student followed in this case study is Marcela, a 12 year old, Hispanic female. She is an average student, but has struggled with her mathematical understanding of the concepts covered this year, and will most likely be asked to repeat the class next year as a seventh grader. Marcela comes from a middle class family that is interested in her success in education, and her older sister who is an eighth grader in the algebra class I teach, provides Marcela with significant support and assistance in math. Marcela is a quiet student, and does not have a lot of confidence in herself mathematically. It is only when she feels like she really understands something that is she willing to contribute to class discussions. Her behavior is usually on task, though she has a hard time asking for clarification or help when she needs it.

Iliana is the final student whose case study is presented in this project. She is a female, 12 year old sixth grader, of Asian and Pacific Islander descent. Iliana is quiet and engages in classroom discussion even less often than Marcela. She struggles more than any other student in this class to keep up with the concepts being taught. She will either be asked to repeat this class next year, or will be removed from they ASP track and put into a regular seventh grade math class. Iliana and her sister (who is also a student in this class) come from a military family with eight children. With their father deployed, they are consistently kept home from school or pulled out in the middle of the day to take care of their younger siblings. These absences have affected their ability to keep up with classroom instruction. However, because Iliana's sister is a year older and has gone through this class before, she has been more successful than Iliana in math this year.

1A: Introductory Letters to Parents

March 23, 2009

Dear Parents or Guardians,

My name is Lorri DeFoor, and I'm currently a student in the Master in Teaching program at The Evergreen State College. For the next ten weeks I will be a student teacher in Mrs. Newton's classroom. Beginning immediately after spring break, I will take on the full teaching responsibilities for you son or daughter's math and science classes, and will continue in my role as the teacher through June 5, 2009.

As part of my student teaching assignment I am required to videotape some of the lessons that I teach for review by my colleagues and faculty. The purpose of these videos is not to analyze the students, but to analyze my teaching. However, I want these lessons to be interactive and student-centered, which means they will likely involve some footage of students. Your prompt completion and return of the permission slip on the bottom of this page will allow me to complete this assignment successfully.

I'm looking forward to getting to know your son or daughter and to helping them prepare for whatever the next school year has in store. I encourage you to get in touch with me if you have any questions, and I look forward to getting to know some of you in my time at Lochburn Middle School.

Sincerely,

Lorri DeFoor
deflor16@evergreen.edu

Please return this permission slip **BEFORE** SPRING BREAK!

I give permission for Lorri DeFoor to record my son/daughter, _____
(student's first name)
_____, on video or audio tape between April 6, 2009 and June 5,
(student's last name)
2009. These recordings will only be shared with Ms. DeFoor's faculty and colleagues at the Evergreen State College.

_____ _____
parent/guardian signature date

Dear Family,

The next unit in your child's course of study in mathematics class this year is *Moving Straight Ahead*. In this unit, students are developing skills in areas that are traditionally known as algebra. This unit introduces them to situations that can be modeled with linear functions and graphed with straight lines.

We have structured this unit so that students are exposed to linear and nonlinear situations in a variety of forms: tables, graphs, and algebraic equations. Students are encouraged to move freely from one form to another and to use the different forms in various situations. They are introduced to several other important algebraic terms and concepts—like x- and y-intercepts and the slope of a line—that will be built on in later units. Students encounter these and other ideas in real-world situations that help them understand the concepts in ways that make sense to them.

Here are some strategies for helping your child work with the ideas in this unit:

- Ask your child to describe some real-world situations in which linear functions are used and to explain how the situation can be described using a table, a graph, and an equation. Here are some examples:
  - Phone charges that increase at a constant rate based on the length of the call
  - The distance traveled in a vehicle moving at a constant speed
  - The amount of water in a sink that is draining at a constant rate
- Look at your child's mathematics notebook. You may want to read some of the explanations that have been written and, if they aren't clear, talk with your child about why you think they may need more explanation.
- Encourage your child's efforts in completing homework assignments, and help make sure your child understands the work that has been done.

As always, if you have any questions or concerns about this unit or your child's progress in the class, please feel free to call. We are interested in your child's success in mathematics.

Sincerely,

Lorri DeFoor

1B: Classroom and Student Characteristics

State Pedagogy Instrument

CLASSROOM AND STUDENT CHARACTERISTICS

Teacher Candidate: Lorri DeFoor Date: April 25, 2009
Cooperating Teacher: Stacia Newton School/District: Lochburn Middle School
Grade: 6/7 Supervisor: Terry Ford
Lesson Title: Unit - Linear Relationships

1. Classroom rules and routines that affect the lesson: Routines - Entry Task, Launch Activity, Do Activity, Debrief Activity, Exit Task

2. Physical arrangement and grouping patterns that affect the lesson: Students grouped heterogeneously based on readiness as determined by pre-assessment data

3. Total number of students: 26 4. Females: 13 Males: 13 5. Age range: 11-14

6. Describe the range of abilities in the classroom: AEP students - Highly Capable/gifted track.

7. Describe the range of socio-economic backgrounds of the students: Lower to Middle Class

8. Describe the racial/ethnic composition of the classroom, and what is done to make the teaching and learning culturally responsive: Many students w/ Biracial backgrounds, But the rough breakdown is African American - 4 Asian/Pacific Islander - 6 White - 10 Hispanic/Latino - 6

9. How many students are limited English proficient? none

10. Describe the range of native languages and what, if any, modifications are made for LEP students: ~4 students speak Spanish as a first language, but none are LEP

11. How many special education and gifted/talented students are in the class and what accommodations, if any, are made for them? Ø

Special Education Category	Number of Students	Accommodations/Pertinent IEP Objectives

12. How many 504 students are there? Ø What accommodations are made for these students?

13. Are there additional considerations about the classroom/students for which you need to adapt your teaching (e.g., religious beliefs, family situations, sexual orientation)?
Some students are homeless or have very unreliable home situations.

Section 2: Learning Goals

Unit Guiding Question

Can you make a living wage working at McDonalds?

Learning Outcomes

Given an inquiry based unit on linear relationships the SWBT:

1. Recognize that linearity is associated with a constant rate of change between two numbers
2. Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms.
3. Write and interpret linear equations in the forms $y = mx + b$.
4. Find the slope of a line as it relates to the unit rate in a context
5. Interpret the slope of a line as the ratio of vertical change to horizontal change.
6. Identify y intercept from a table, graph, or an equation and interpret its meaning.

WA State Performance Expectations—Grade 7

7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations.

- Addressed by Learning Outcomes 2, 3, 5 and 6

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

- Addressed by Leaning Outcome 4

7.2.H Determine whether or not a relationship is proportional and explain your reasoning.

- Addressed by Learning Outcome 1

Alignment and Appropriateness of Outcomes and Guiding Questions

Learning Outcomes 1-6 all address the comprehension/understanding level of Bloom's Taxonomy because they call on students to interpret and move between representations of models of linear relationships. However, some parts of Learning Outcomes 3 and 6 also fall into the knowledge level because they can be partially fulfilled through memorization of information, and also in the case of Learning Outcome 3, require that a student be able to remember the slope-intercept form for linear equations. Learning Outcome 4 also closely relates to the analysis level of Bloom's Taxonomy because it requires that students analyze situations and create representations based on that analysis. In particular, it requires a deeper conceptual understanding that allows students to examine a context and not only create models, but analyze how those models would change if the situation changed. The guiding question for the unit asks that students be able to use all of the skills covered in the learning outcome to evaluate a statement made by a student on the first day of the unit, "You can't live working at McDonalds" and support their argument using mathematical evidence that includes models of linear relationships. However, because this was an introductory unit to linear relationships, the evaluative nature of the essential question was not included in the learning outcomes for all students, and was attempted as a partner task near the end of the unit.

Section 3: Assessment Plan

Overview of Assessment Plan

Date	Assessment	Performance Expectation	Format	Adaptations
03/25/09	Pre: Linear Relationships	7.2 E, 7.2 H	Individual	
04/06/09	Pre: Exit Task—Relating Unit Rate to Slope	7.2 G	Individual	
04/09/09	Formative: Identifying/Defining Linear Relationships	7.2 H	Class Discussion and Brainstorm	
04/13/09	Formative: Class Work and Exit Task, Determining Slope from Graphs and Tables	7.2 E	Individual and Partner	
04/20/09	Formative: Quiz A	7.2 E, 7.2 G, 7.2 H	Individual	
04/20/09	Metacognitive: Self Assessment 1		Individual	
04/27/09	Formative: Exit Task—Moving Between Models	7.2 E	Individual	Differentiated Content Based on Readiness
05/01/09	Formative: Calculating the Living Wage	7.2 E, 7.2 G	Partner Project	
05/06/09	Summative: Unit Test	7.2 E, 7.2 G, 7.2 H	Individual	
05/06/09	Metacognitive: Self Assessment 2		Individual	

Pre Assessment

The major formal pre assessment for this unit was given the week before the unit started, so that the results could be used to design the learning goals and activities for the unit. The pre assessment was evaluated using a checklist of key skills, the results of which were then transferred to the criteria for the unit rubric (see p. 31-32). In fact, all assessments throughout the unit were evaluated using the criteria from the Unit Rubric. The second pre assessment data were collected during first day of the unit, after I

realized that the data collected from the context-based problem better fit performance expectation 7.2 G, and that this would be a key performance expectation on which to evaluate student progress during the unit.

Formative Assessments

My plan for formative assessment in this unit was to be sure that after every major lesson or piece of instruction on a given learning outcome/performance expectation, the students would be formatively assessed to determine how much of the learning they internalized and what key points were not clearly understood. This plan resulted in a formative assessment of student learning on one or more of the performance expectations roughly every 2-3 class periods, as shown in the overview (with a one week gap during which the students were completing the WASL test). Formative assessments took several forms, including class discussions and brainstorms, short individual exit tasks, a mid-unit quiz, and an investigative project completed in pairs and designed to assess the students' abilities to problem solve and evaluate a real-life situation using linear algebra. The decision to use the exit task format for many of the formal, formative assessments was to determine how well students' were individually understanding the key concepts from the problems they completed in pairs or small groups during the class period.

Summative Assessment

The final summative assessment was designed as a way to evaluate the students' understanding of the core concepts of the unit. Unlike projects or investigations that were completed along the way, the final summative assessment was stripped of complications or distractors, in order to determine clearly whether students understood the big ideas in the unit. Like all assessments in the unit, it was evaluated

using the Unit Rubric, and the tasks were similar to but more complex than those on the pre-assessment, as the students had added a great deal to their knowledge and understanding of linear relationships.

Positive Impact on Student Learning

Although the assessments were not uniform from start to finish, using a standard rubric for the whole unit allowed me to clearly track students' progress toward the learning goals and performance expectations, and to determine my impact on student learning. Additionally, metacognitive conversations and two written, formal self-assessments (one at mid-unit, and one at the final) were designed to document students' thinking about their own thinking and learning processes in the unit.

3A: Unit Assessments

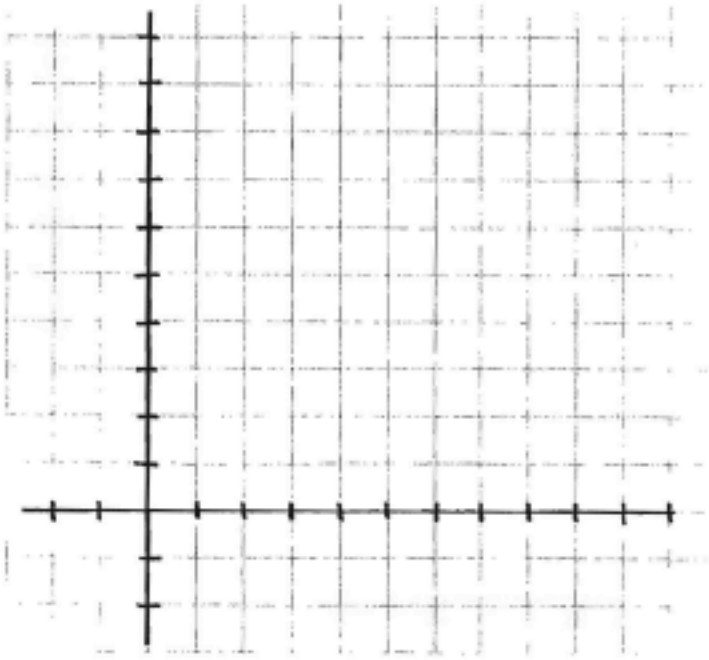
Pre Assessment 7.2.E/7.2.H (3/25/09)

Pre-Assessment
Linear Relationships

Work by yourself to complete the following to the best of your ability. I will use the results to help me plan the next unit for math, but they will not be entered as a grade in the grade book.

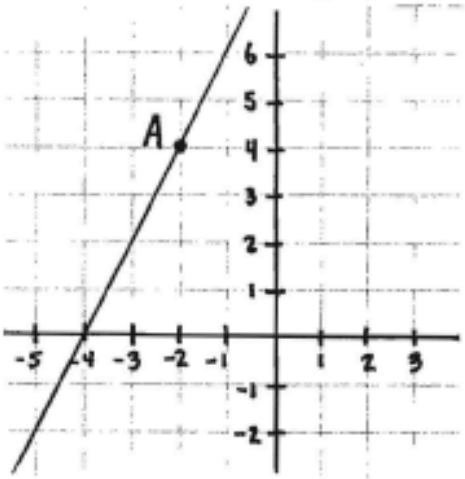
1. Graph the following data points on the coordinate graph below. Clearly label the x and y axes and connect the data points with a line.

X	Y
0	0
2	1
4	4
6	9



2. The graph in problem 1 shows the relationship between 2 variables (x and y). Is this a linear relationship? How do you know?

3. Use the coordinate graph below to complete parts a-d.



a. Write the coordinates of the point labeled "A." _____

b. Find the point with the coordinates (-4, 0) on the graph, and label it "B."

c. What is the slope of the line shown above? _____

d. What is the y-intercept of the line shown above? _____

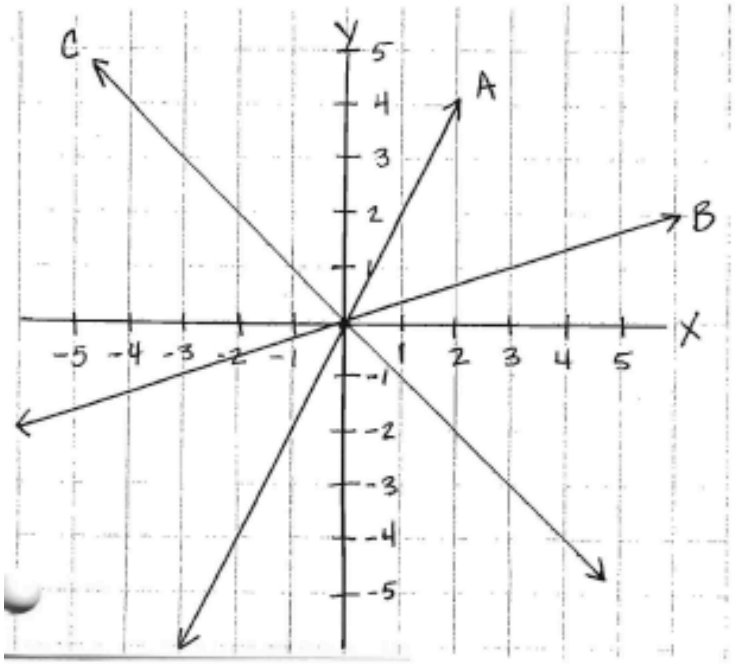
4. The graph in problem 3 shows the relationship between 2 variables (x and y). Is this a linear relationship? How do you know?

5. Write an equation for the line shown in problem 3.

Formative Assessment 7.2.E (4/13/09)

Name:_____

Identify the slope and write an equation for the following lines on the coordinate grid below.



Line A

Slope_____

Equation_____

Line B

Slope_____

Equation_____

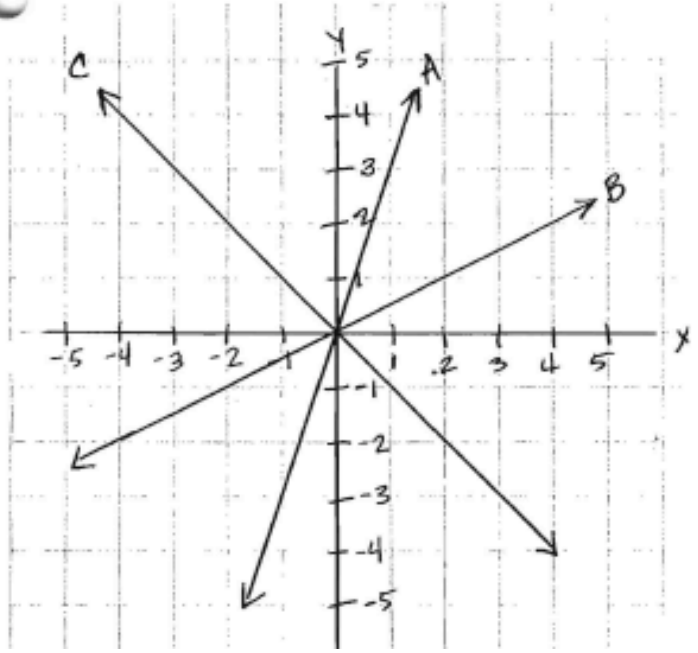
Line C

Slope_____

Equation_____

Name:_____

Identify the slope and write an equation for the following lines on the coordinate grid below.



Line A

Slope_____

Equation_____

Line B

Slope_____

Equation_____

Line C

Slope_____

Equation_____

Formative Assessment 7.2.E/7.2.G/7.2.H (4/20/09)

Quiz A

1. a. Which table or tables show the patterns of a linear relationship?

Table A

x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

Table B

x	y
-3	-7
-2	-5
-1	-3
0	-1
1	1
2	3
3	5

Table C

x	y
-3	1
-2	$1\frac{2}{3}$
-1	$2\frac{1}{3}$
0	3
1	$3\frac{2}{3}$
2	$4\frac{1}{3}$
3	5

b. Describe how you decided whether the relationship between the variables in each table was linear.

2. The graph to the right shows gallons of gas consumed by Jake's car compared to distance traveled.

a. What would it mean in this situation if the line were steeper than shown and the scales on the graph stayed the same?

b. Put a sensible scale on the axes, and write a question that can be answered from your graph. Show where the answer can be found on your graph.

Quiz A

In 3–6, use this information: Matthias has a summer job as a lifeguard earning $6.00 an hour. Jill has a summer job as a carpenter's helper earning $5.50 an hour.

3. How many hours does each student have to work to make $200.00? Show all the work you do to find your solution.

4. If they both work 25 hours, how much more money will Matthias earn than Jill? Show your work.

5. It takes Jill 23 hours to earn $126.50. How long will it take Matthias to earn that much? Show your work.

6. For each student's salary, write an equation [redacted] that shows how that student's pay is related to the number of hours he or she works.

7. These three equations were offered as possible walkathon pledge plans.

   $y = 1.5x$ $y = 15 + 0.25x$ $y = 0.50x + 2$

   a. Choose the equation you think is most reasonable for a pledge plan. Explain why you chose that equation and how the numbers in the equation affect the payment for the walkathon.

   b. Make a table that shows how much money a sponsor would pay, using your chosen rule, for a participant walking up to 10 miles.

   c. Make a graph of the rule you chose. Be sure to label the scales of your axes.

Quiz A

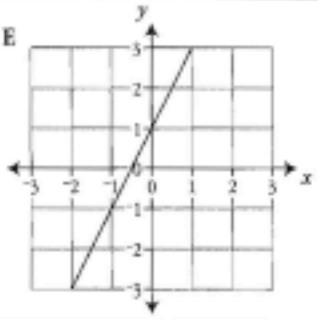
8. Match each table with a graph and an equation. On the lines below, write the letters that make up your matches.

_____ _____ _____ _____

A

x	y
−2	−5
−1	−3
0	−1
1	1
2	3

E



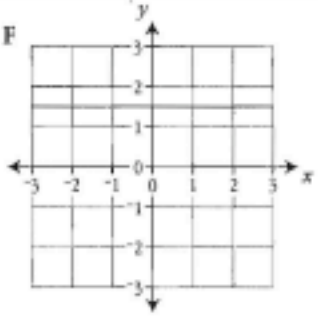
I

$y = -x + 1$

B

x	y
−2	3
−1	2
0	1
1	0
2	−1

F



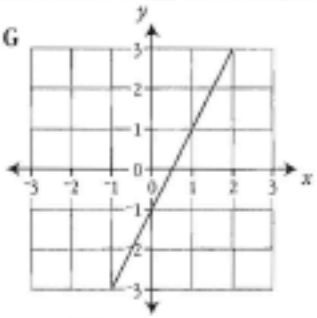
J

$y = 2x + 1$

C

x	y
−2	1.5
−1	1.5
0	1.5
1	1.5
2	1.5

G



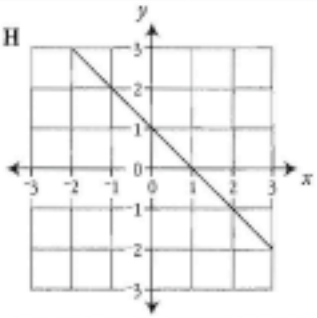
K

$y = 1.5$

D

x	y
−2	−3
−1	−1
0	1
1	3
2	5

H



L

$y = 2x - 1$

Formative Assessment 7.2.E (4/27/09)

EXIT TASK

E1. Caroline makes $88 in an 8 hour day. How much money does she make per hour. Demonstrate your answer with a table, a graph, an equation, and a clear verbal description.

EXIT TASK

E2. This morning, on his walk to his job as a cashier at the local grocery store, Tony found a $20 bill on the street. If Tony makes $10 an hour, how much will he have made by the end of an 8 hour day if he includes the $20 he found in his income for the day? Demonstrate how to find your answer using a table, a graph, an equation, and a clear verbal description.

EXIT TASK

E3. This morning, before leaving for her job at the dentists' office, Jana received a bill from the car repair man for $100, so she starts the day $100 in debt. If Jana makes $20 an hour, how many hours will it take her to earn the money she owes for car repairs? Demonstrate how to find your answer using a table, a graph, an equation, and and a clear verbal description.

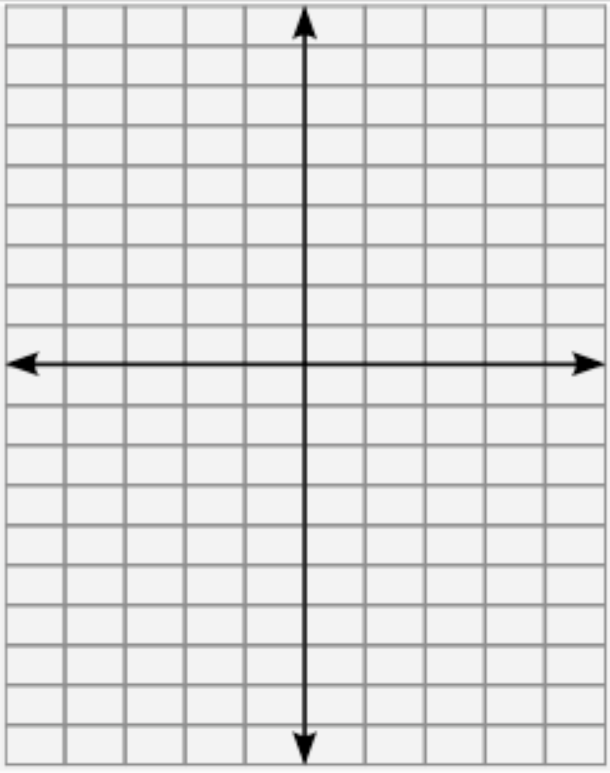
Exit Task: Problem Number:

Verbal Description	Equation
_____ _____ _____ _____ _____ _____ _____	

Table of Values

x	y

Graph



1. Is the slope of the graph you drew negative or positive? _____

2. Circle the parts of your equation AND verbal description which indicate that the graph should have a positive or negative slope.

Formative Assessment 7.2.E/7.2.G (5/1/09)

CALCULATING THE LIVING WAGE

The data below was collected from the website, *The Living Wage Calculator*, which was able to calculate the specific amount needed to live (no extras included) in Lakewood, WA. Using the data in the chart below, calculate the monthly, annual (yearly), and hourly income needed to "get by" in Lakewood.

	HOUSEHOLD SIZE				
Monthly Expenses	One Adult	One Adult, One Child	Two Adults	Two Adults, One Child	Two Adults, Two Children
Food	$237	$386	$458	$607	$756
Child Care	$0	$624	$0	$624	$1,104
Medical	$94	$186	$188	$280	$372
Housing	$678	$845	$678	$845	$845
Transportation	$278	$479	$556	$757	$958
Other	$200	$393	$400	$595	$786
Monthly Taxes	$18	$26	$31	$41	$44
Total					

	One Adult	One Adult, One Child	Two Adults	Two Adults, One Child	Two Adults, Two Children
Monthly Income Needed					
Annual Income Needed					
Hourly Wage*					

*Assume a full time position at 8 hours per day, 5 days per week, and 52 weeks per year

1. If x represents hours worked and y represents pay, write a series of equations (in y=mx form) that demonstrate the following hourly wages:

a) The WA State minimum wage ($8.55 per hour):

b) The living wage for a single adult:

c) The living wage for one adult and one child:

d) The living wage for two adults:

e) The living wage for two adults and one child:

f) The living wage for two adults and two children:

2. Is the minimum wage equal to or more than a living wage for any household size in the state of Washington? For which households is it enough, and for which does it fall short?

3. On your graphing calculator, graph and compare the following pairs of equations from problem 1:

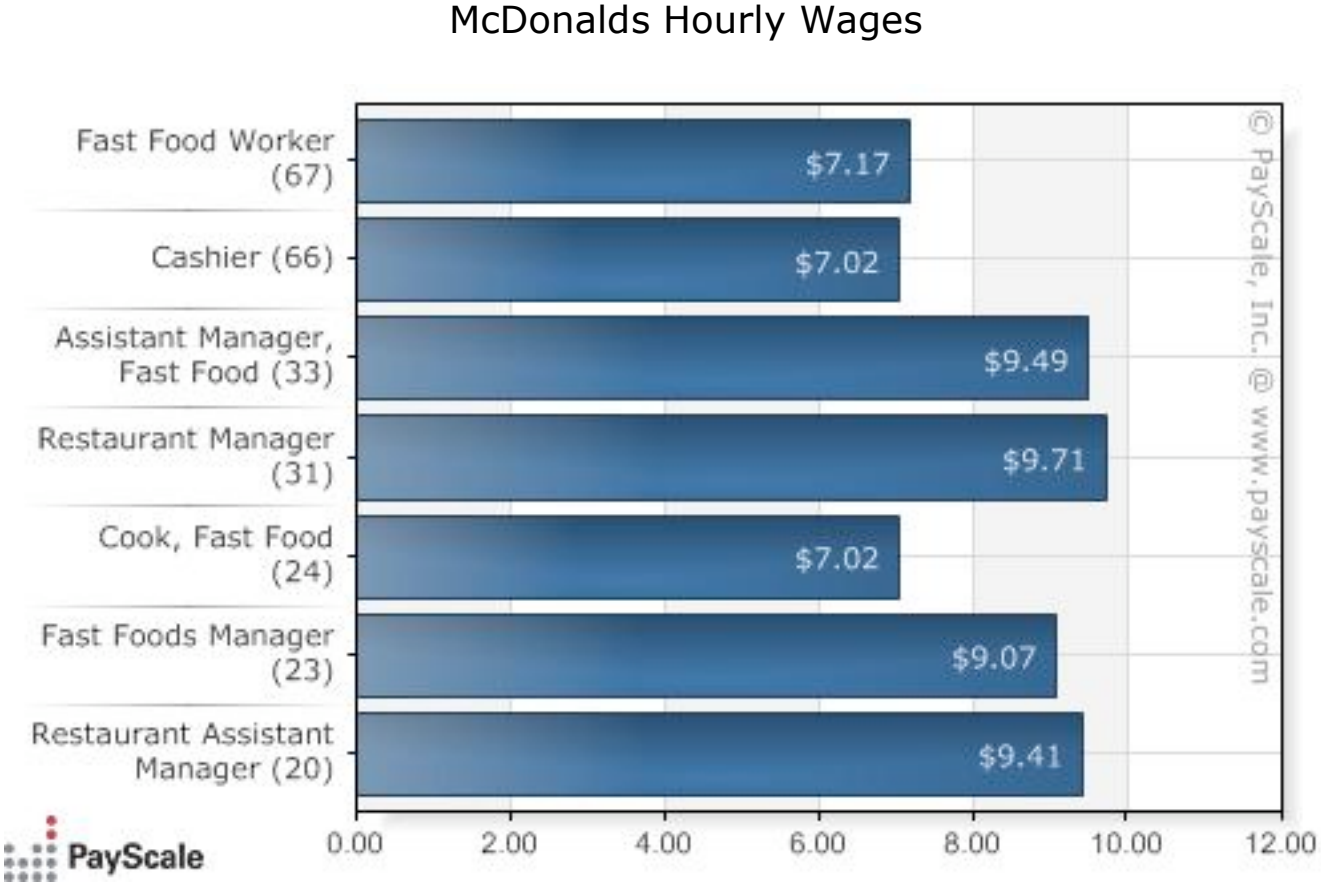
a & b **a & c** **a & d** **a & e** **a & f**

a) In which pairs is the line for the minimum wage steeper than the line for the living wage?

b) In which pairs is the line for the living wage steeper than the line for the minimum wage?

c) How does the steepness of the lines in comparison to the minimum wage relate to your answer in problem 2?

PayScale.com is a website that allows future employees to investigate the rate of pay for a job they are applying for. The following graph shows the hourly wages for different positions at McDonalds. Keep in mind that some of these are below the Washington State minimum wage because the federal minimum wage is lower than our state's. Use the graph below to answer the following question:



4. If we define "living" as making enough money to get by, can you live working at McDonald's.

In order to receive credit for this problem, you must support your answer using a linear graph (on a separate sheet of graph paper) combining information from the *The Living Wage Calculator* and *payscale.com* and provide a written explanation of how the graph supports your answer.

Summative Assessment 7.2.E/7.2.G/7.2.H (5/6/09)

Table A

x	y
0	0
2	2
4	4
6	6
8	8

Table B

x	y
0	0
1	1
2	4
3	9
4	16

Table C

x	y
0	0
3	-1
6	-2
9	-3
12	-4

Table D

x	y
0	0
4	.5
8	1
12	1.5
16	2

Table E

x	y
0	0
2	2
4	4
6	4
8	4

1. List all of the tables on the left that show the patterns of a linear relationship?

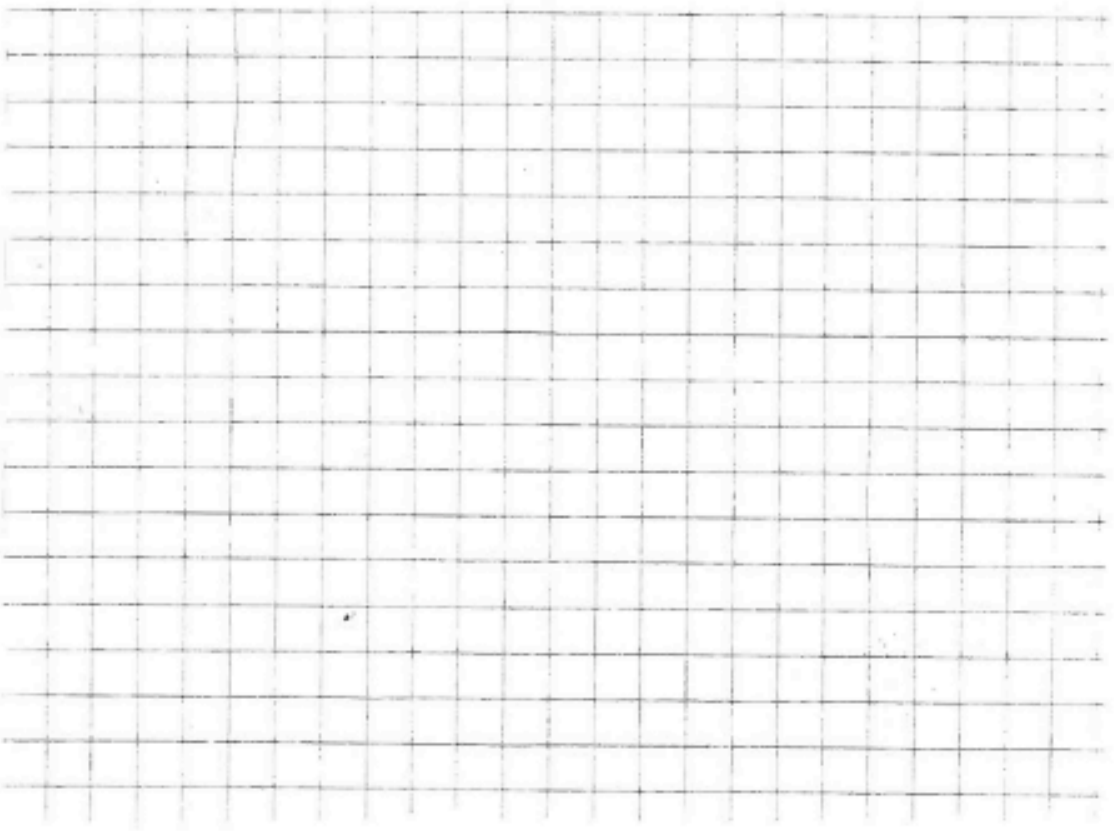
2. Describe how you decided whether the relationship between the variables in each table was linear.

For his summer job, Ken was hired as a waiter at a local restaurant. His wage is $10 an hour. For her summer job, Natalie decided to mow lawns around the neighborhood and charge $9 per hour for her work.

3a. Write an equation that shows the relationship between how many hours Ken works and how much money he earns.

3b. Write an equation that shows the relationship between how many hours Natalie works and how much money she earns.

3c. Draw a graph on the grid below that shows Ken's and Natalie's wages for their first 10 hours of work. Be sure to label your axes (with both the unit name, and the interval).



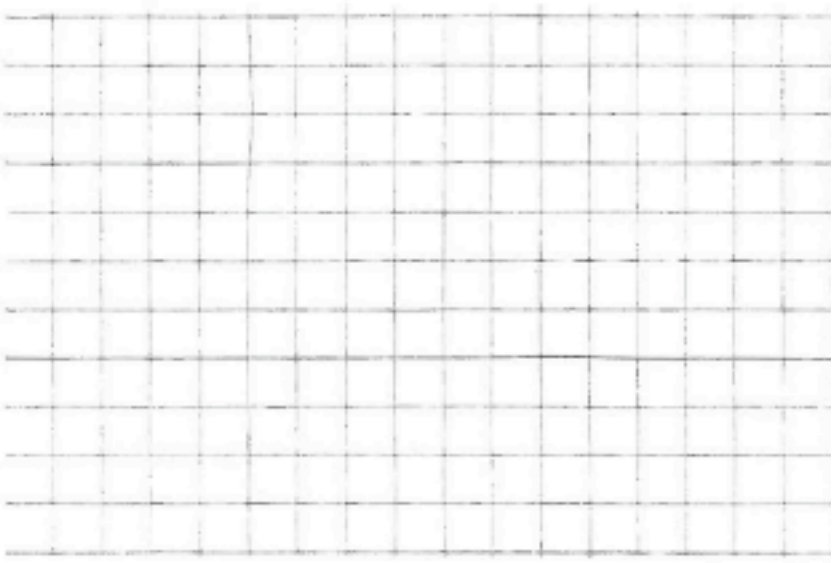
4. Ken is going on a family vacation to the beach after working for 2 weeks. If he works 20 hours per week and saves all of the money he's earned, how much money will he have earned before his vacation? SHOW YOUR WORK and BOX YOUR ANSWER!

5. Natalie is saving up to buy a new mountain bike. The bike is on sale at the local bike shop for $324 dollars. How many hours will Natalie have to work to earn enough to purchase the bike? SHOW YOUR WORK and BOX YOUR ANSWER!

6. How much more money will Ken have than Natalie after they've both worked for 100 hours? SHOW YOUR WORK and BOX YOUR ANSWER!

Jamie is also spending his summer mowing lawns for $9 per hour. However, he had to pay his parents a one time, upfront payment of $100 in order to borrow the lawn mower for the summer.

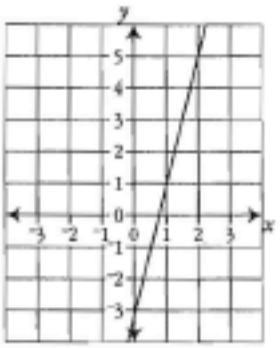
7a. Draw a linear graph that shows Jamie's earnings if he starts the summer $100 in debt to his parents. Be sure to label your axes (with both the unit name, and the interval).



7b. Write an equation that shows the relationship between how many hours Jamie works and how much money he earns that takes into account Jamie's debt to his parents at the beginning of the summer.

7c. How many hours will Jamie have to work to pay off his debt? SHOW YOUR WORK and BOX YOUR ANSWER.

8. Given one of the representations below, find the other two.

Table	Graph	Equation
$\begin{array}{\|c\|c\|}\hline x & y \\ \hline -2 & 14 \\ 0 & 8 \\ 1 & 5 \\ 2 & 2 \\ 3 & -1 \\ \hline \end{array}$		
		
		$y = \frac{1}{3}x + 1$

a. Find the y-intercept for each representation above.

b. Find the slope for each representation above.

Pre Assessment Check List

	Table to Graph	Linear relationship	Identifying coordinates	Label pt. B	Slope	y-intercept	Linear relationship	Equation

Unit Rubric

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations		7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.	7.2.H Determine whether or not a relationship is proportional and explain your reasoning.
	In Context	Abstract Representations		
Beginning	The student accurately identifies familiar proportional relationships but does not represent these relationships using graphs, tables, or equations.	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student does not accurately identify linear and nonlinear relationships from graphs or tables.
Emerging	The student accurately represents familiar proportional relationships using graphs, tables, or equations.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables some of the time but does not say why the relationship is linear or nonlinear.
Developing	The student accurately represents familiar, simple proportional relationships using graphs, tables and equations ($y = mx$).	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately identifies linear and nonlinear relationships most of the time from graphs, and/or tables but provides only an explanation of the process for identification that is only partially complete.
Meeting	The student accurately represents familiar, but more complex proportional relationships using graphs, tables and equations ($y = mx + b$).	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables and provides a clear explanation of their decision making that demonstrates an understanding of the constant rate of change.

Student Rubric For Unit Test

CRITERIA FOR EVALUATION ON THIS TEST:

An "A" on your test will demonstrate that you:

- Consistently and accurately model rates of change using tables, graphs, and equations, and move from one model to another accurately.
- Determine the unit rate in familiar, real-world situations, and relate the unit rate to the graph and equation of a situation.
- Use the unit rate to solve problems relating to changes in variable values.
- Correctly identify linear relationships and support your identification with a clear and accurate reason.

A "B" on your test will demonstrate that you:

- Accurately demonstrate rates of change using at least two of the three models we've learned about (tables, graphs, or equations).
- Determine the unit rate in familiar, real-world situations.
- Use the unit rate to solve problems relating to changes in variable values most of the time.
- Correctly identify linear relationships most of the time, with a rationale that doesn't account for the rate of change, OR demonstrate an understanding of why a relationship is linear, but be unable to apply that understanding to identify linear relationships.

A "C" on your test will demonstrate that you:

- Accurately demonstrate rates of change using at least two of the three models we've learned about (tables, graphs, or equations), some of the time.
- Use the unit rate to solve problems relating to changes in variable values some of the time.
- Correctly identify linear relationships some of the time, without providing an accurate rationale.

A "D" on your test will demonstrate that you:

- Do not accurately demonstrate rates of change using the models we have learned about (tables, graphs, and equations)
- Attempt to use the unit rate to solve problems, but with inaccurate results.
- Do not yet accurately identify linear relationships.
- HAVE ATTEMPTED ALL PROBLEMS ON THE TEST!*

*NO STUDENT WILL BE GIVEN A GRADE BELOW A "D" IF THEY ATTEMPT ALL OF THE PROBLEMS ON THE TEST. IF YOU DO NOT ATTEMPT ALL OF THE PROBLEMS ON THE TEST, YOU MAY BE ELIGIBLE TO RECEIVE LESS THAN A 60%

Section 4: Design For Instruction

Pre Assessment Results

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations			
	Beginning	Emerging	Developing	Meeting
	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.
Ty		X		
Marcela	X			
Iliana	X			
Class	5	21	0	0

	7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.			
	Beginning	Emerging	Developing	Meeting
	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.
Ty		X		
Marcela		X		
Iliana		X		
Class	2	20	0	0

	7.2.H Determine whether or not a relationship is proportional and explain your reasoning.			
	Beginning	Emerging	Developing	Meeting
	The student does not accurately identify linear and nonlinear relationships from graphs or tables.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables some of the time but does not say why the relationship is linear or nonlinear.	The student accurately identifies linear and nonlinear relationships most of the time from graphs, and/or tables but provides only an explanation of the process for identification that is only partially complete.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables and provides a clear explanation of their decision making that demonstrates an understanding of the constant rate of change.
Ty			X	
Marcela	X			
Iliana	X			
Class	13	5	7	0

Unit Overview

Lesson Title	Unit Learning Outcomes Addressed	Performance Expectation
Introducing Procedures and the Linear Relationships Unit	• N/A	N/A
Graphing Wages and Writing Simple Linear Equations	• Write and interpret linear equations in the forms y = mx + b. • Find the slope of a line as it relates to the unit rate in a context	7.2.E 7.2.G
Defining and Identifying Linear Relationships	• Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms. • Recognize that linearity is associated with a constant rate of change between two numbers.	7.2.H
Introducing Constant Rates of Change	• Recognize that linearity is associated with a constant rate of change between two numbers.	7.2.E 7.2.G 7.2.H
Introducing Slope	• Find the slope of a line as it relates to the unit rate in a context • Interpret the slope of a line as the ratio of vertical change to horizontal change.	7.2.E 7.2.G
Identifying Slope and Writing Equations to Fit a Given Context	• Interpret the slope of a line as the ratio of vertical change to horizontal change.	7.2.E
Introducing Negative y-Intercept through Upfront Costs	• Identify y intercept from a table, graph, or an equation and interpret its meaning. • Find the slope of a line as it relates to the unit rate in a context • Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms.	7.2.E 7.2.G
Investigating y-Intercept	• Identify y intercept from a table, graph, or an equation and interpret its meaning. • Find the slope of a line as it relates to the unit rate in a context • Write and interpret linear equations in the	7.2.E 7.2.G

	forms y = mx + b.	
Constructing Accurate Graphs, Data Tables, and Equations from New Contexts	• Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms. • Find the slope of a line as it relates to the unit rate in a context • Identify y intercept from a table, graph, or an equation and interpret its meaning. • Write and interpret linear equations in the forms y = mx + b.	7.2.E 7.2.G
Moving Between Models	• Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms. • Write and interpret linear equations in the forms y = mx + b. • Interpret the slope of a line as the ratio of vertical change to horizontal change. • Identify y intercept from a table, graph, or an equation and interpret its meaning.	7.2.E 7.2.G
Exploring Living Wage and Minimum Wage With Graphing Calculators	• Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms. • Write and interpret linear equations in the forms y = mx + b. • Find the slope of a line as it relates to the unit rate in a context	7.2.E 7.2.G
Reviewing Key Concepts for the Unit Test	• Recognize that linearity is associated with a constant rate of change between two numbers. • Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms. • Write and interpret linear equations in the forms y = mx + b. • Find the slope of a line as it relates to the unit rate in a context • Interpret the slope of a line as the ratio of vertical change to horizontal change. • Identify y intercept from a table, graph, or an equation and interpret its meaning.	7.2.E 7.2.G 7.2.H

Learning Activities

All lesson plans are included in 4A, with teacher talk and questioning. However, below is a more detailed description of the rationale behind three specific learning activities undertaken by the students in this unit, as well as a description of exactly how they meet the demographic and learning characteristics of the students in this classroom.

The first major mathematical activity in the unit was "Graphing Wages and Writing Simple Linear Equations" (p. 53-59). In this lesson, students received job description cards, detailing a service sector job and worked in groups to compare their wages with one another using a linear graph. I based this activity on both the demographics of my students, as discussed more thoroughly in Sections 1 and 5, and the pre assessment data which demonstrated that nearly all of the students felt comfortable with graphing data on coordinate grids, but none were yet familiar with writing linear equations. By asking the students to complete an activity which started with graphing and ended with writing equations, this activity gave all of the students an entry point that they felt comfortable with. By keeping their data and equations in context, most of them were able to write a linear equation using variables to describe the process they had gone through to find how much money they would have made after any number of hours.

Materials and technology needed for the activity were graph paper, colored pencils or markers, job description cards, rulers, and a document camera for showing an example of how one could graph wages on a coordinate grid. Differentiation of the task of writing equations included the option to either write a written description of how students calculated the amount of money made after a given amount of hours (most concrete), a written description of how they could calculate the amount of money made after working any amount of hours, a formula using D (dollars) and H (hours) as variables that could be used to calculate the amount of money made after any amount of hours, and a formula using X and Y as variables that could be used to calculate the amount of money made after any amount of hours (most abstract).

Students were individually assessed on their final journal entry for the day, in which they interpreted how steepness of slope related to hourly wage and described the process in either words or an equation for finding the amount of money made after working a certain number of hours at their given wage.

The introduction of negative y-intercept through upfront costs (Lesson 7, p. 84-88) again related to students' demographic backgrounds in the ways discussed in Sections 1 and 5. However, it went a step farther and allowed students to investigate CraigsList and Classified Ads in the local paper to find a place to live and determine how much they would have to pay for this home upfront, before they started working. This was an investigation/exploration based task, which was used as an informal pre-assessment for me to determine how students were making sense of graphing an hourly wage when they had to take upfront costs into account. As a result, it created grounds for a strong classroom discussion about which methods most accurately depicted both a steadily increasing amount of money based on an hourly wage and showed that the employee started his/her job in debt.

Materials needed for this activity were graph paper, rulers, copies of classified and Craigslist rental advertisements, and uniform description/cost cards. Additionally, a projector and computer were needed to stream a video from the PBS website. Student learning was informally assessed using the students' individual graphs of their own upfront costs graphed along with their hourly wage. Additional assessment was done the following day at the beginning of class to determine whether students could take their understanding of graphing upfront costs and apply it to graphing an upfront signing bonus for a job.

I wrote the Living Wage and McDonalds problems (p. 22-25; 103-106) in direct response to the teacher and student-generated guiding questions for the unit. As in the first problem described above, this problem provided all students with a way to access the math by starting with something they already knew—calculating rates and converting rates into different units. While evaluative-level thinking tasks on Bloom's taxonomy were not part of the specific learning outcomes for the unit, and therefore unnecessary

to assess individually, I wanted to push the students to tie their work with linear relationships in this unit into a real life problem that they all had strong, but unsupported opinions about.

Information for the activity was collected from PayScale.com and The Living Wage Calculator online. Graphing calculators were also introduced in this lesson as a way to help students compare a number of different sets of lines without taking the time to graph them all by hand. In order to meet the needs of the students who may have struggled more with this task, students were paired heterogenously so a supportive, more capable peer could provide scaffolding. While the task engaged students' evaluative thinking levels, students were assessed on how their arguments reflected their understanding of the learning outcomes, according to the rubric for the unit.

Technology

In this unit, technology was used in a number of ways. In planning and instruction, I utilized a video streamed from PBS titled, "Waging a Living" to set the tone for investigating expenses in the lesson where the students begin to explore how to model a negative y-intercept in graphs and equations. Additionally, for this activity, the students also used ads from Craigslist to investigate the cost of housing and choose a housing situation to factor into their expenses. Unfortunately, due to restrictions in what students and teachers can access from school computers, this had to be done ahead of time from my home computer, and the students used a hard copy of the ads prepared prior to the lesson.

Students utilized technology through the introduction of graphing calculators toward the end of the unit. The rationale for introducing graphing calculators was two-fold. First, I wanted to give them a less time-consuming way to compare equations and the graphs of their lines as they were comparing living and minimum wages. Second, for most of the students this was the first time they had used a graphing calculator specifically for a graphing function, a skill which I wanted to familiarize them with before they

were expected to use them more frequently and for more complicated purposes when they started algebra the following year.

Other Instructional Resources

Curricular Resources

- Lappan, G., Fey, J. T., Fitzgerald, W. M. Friel, S. N., & Phillips, E. D. (1998). *Connected Mathematics* (Algebra Strand): *Moving Straight Ahead—Linear Relationships*. Menlo Park, CA: Dale Seymour Publications
- Dean, J. (2007) Living Algebra, Living Wage. *Rethinking Schools.*

Video Resources

- PBS. (2006). *Waging a Living* on http://www.pbs.org/pov/pov2006/wagingaliving/for.html. Author.

4A: WA State IP Rationale

Learning Targets

a. Although the class this project was conducted with is comprised of 6th and 7th grade students, the learning targets in this unit align with the performance expectations for 7th grade, Standard 2: Proportionality and Similarity. The following Learning Outcomes for the unit relate to the specific performance expectations listed below:

Learning Outcomes

Given an inquiry based unit on linear relationships the student will be able to:

1. Recognize that linearity is associated with a constant rate of change between two numbers.
2. Identify, represent, and interpret linear relationships in tabular, graphic, and symbolic forms.
3. Write and interpret linear equations in the forms $y = mx + b$.
4. Find the slope of a line as it relates to the unit rate in a context
5. Interpret the slope of a line as the ratio of vertical change to horizontal change.
6. Identify y intercept from a table, graph, or an equation and interpret its meaning.

WA State Performance Expectations—Grade 7

7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

7.2.H Determine whether or not a relationship is proportional and explain your reasoning.

b. Prior to beginning this unit, the students had just completed a unit on positive and negative integers, which provided a key piece of prior knowledge necessary to understanding how to calculate slope and y-intercept in proportional relationships, as well as for determining constant rates of change. For many of these students who will test into the algebra class offered by the middle school next year, this unit on linear relationships provides a key piece of foundational understanding that they will take into exploring both linear and nonlinear functions that are more sophisticated in nature.

c. The learning targets in this unit address a key component of instruction that is focused on social justice and multicultural education, namely preparing students from diverse racial and socioeconomic backgrounds to begin Algebra in 7^{th} or 8^{th} grade, thereby giving them access to the mathematics required for entry into higher education. Further, though the mathematical goals do not reflect adjustment based on multicultural priorities, the lens through which this unit is taught—examining discrepancies between the living and minimum wages in the state of Washington—creates a relevant and familiar context to many of these students who come from low SES backgrounds.

d. The class on which this study was conducted is one of two Advanced Study Program (ASP) classes in the middle school, meaning that they have shown above average abilities in both language arts and mathematics. Therefore modifications of the learning targets were not made for individual students.

Assessment Strategies

a. Assessments were designed to incorporate a combination of concrete and abstract examples of linear relationships to accommodate for the fact that the age range of the students is between 11 and 14, likely placing some of these students at a developmental stage where access to abstract representations (such as graphs, equations, or tables out of context) was more difficult than for others. Additionally, after the mid-unit assessment some tasks were differentiated based on difficulty of contexts to accommodate

for both those students whose understanding was exceptionally strong, and those whose understanding was still emergent.

b. Though some of the students in this class speak a language besides English as their first language, all are proficient in reading, writing, and understanding English. Some of the assessments, including the final partner task in which students compare a McDonalds' wage to a living wage ask that the students consider complicated contextual scenarios. Research has demonstrated that these types of contextual problems can create significant distractions for students from historically marginalized backgrounds, including female and low SES students (Lubienksi, 2000). Therefore, as suggested by Boaler (2002), and Fosnot and Dolk (2002), when including these problems in the lesson and assessment plans, room has either been made for students inclusion of interpretations and responses to contextual factors that may influence their answers, or clear parameters have been set to focus the students on the mathematical thinking expected.

Learning Experiences

a. In addition to taking into consideration the potential for contextual distractors, as mentioned in the previous section, the unit takes students' cultural backgrounds, in particular SES, into consideration by teaching linear relationships through the lens of examining the minimum and living wages in the city of Lakewood, where most of these students live. In order to ensure respect for the backgrounds of these students and their families, and because the goal was for students to think critically about and evaluate wage rather than employee, extreme care was taken to present the service-sector jobs that students were examining as honorable and important positions.

b. No students in this class have an IEP or are covered under section 504.

c. The primary way I incorporated multicultural perspectives into this unit was by introducing many of the ideas around costs of living through the PBS documentary, "Waging a Living." In this way I was able to include the perspectives and voice of an individual who is barely able to sustain himself on a full time job because of the high costs of living, an experience that I cannot bring to the classroom based on my own experiences in life. For many of the students, this documentary seemed to ground the unit in something familiar, as they were able to discuss similar experiences from their own lives after watching the video.

d. This unit was designed to be inquiry-based, calling on resources from *Connected Mathematics Project* (Lappan, Fey, Fitzgerald, & Phillips, 1998) and Dean's (2007) "Living Algebra, Living Wage" project. Activities called on students to construct the relationships between unit rates, fixed values, and how those could be included in equations so that the output would be accurate. Basing linear relationships in familiar contexts from the start (such as miles or dollars per hour) allowed the students to call on their prior knowledge to solve problems, and then deduce the equation they used from how they solved the problems. Similarly, when students were asked to model scenarios like one-time costs or pay along with a constant rate of change, their prior understanding allowed them to calculate a solution to a problem and then deduce their procedure and therefore an equation and graph from that prior knowledge. Because the students, for the most part, brought a strong understanding of rate problems into this unit, they were able to problem-solve around graphs and equations with only a little scaffolding.

e. One of the ways a safe and supportive learning environment was established was to begin the unit with a lesson and discussion in which the students identified the ways in which they could participate in group work and discussions that would allow others to feel safe. In the first lesson, in particular, no mathematical goals were identified, but instead the students focused on generating a list of effective group-work and discussion habits that included giving all students an opportunity to share and supporting

one's arguments with reasoning. One of the most important things that came out of this lesson was a discussion amongst the students about what it meant to “really listen” to someone instead of just pretending to listen.

The second strategy I used to create a safe and supportive learning environment was to allow students a chance to bring in their real-life experiences around money and financial stability or instability. Giving even the students who were weaker in mathematics frequent opportunities to be part of discussions by calling on their expertise as people, existing in the real world, I think a lot of students became more comfortable acting as authorities with important opinions to be listened to. And, by evaluating something much more experiential where there truly were no right answers, all students had a chance to share their opinions and support them with their lived experiences, the gravity of which seemed to promote more respect than mathematics discussions alone might have.

f. In *Principles and Standards of School Mathematics*, The National Council for Teachers of Mathematics (NCTM, 2000) compiled and presented recommendations based on the most seminal pieces of research in mathematics education. In this document, the NCTM focused on inquiry and construction of understanding and connections as important processes in students' mathematical development. The document's focus on creating learning experiences to foster student understanding and teaching in response to one's understanding of students' learning styles and assessment data drove the development of this unit. Extensive evidence of this is provided in Sections 5 and 6 of this document.

Family Interactions

Evidence of collaboration with families through an introductory letter to parents from me, as well as the 'Family Letter' from the school's math curriculum is provided in the Contextual Factors section of this document. Though I did not teach exclusively from the *Connected Mathematics Project* curriculum, I

felt that the letter provided in the curriculum effectively addressed the main points and general structure of the unit that I followed when teaching linear relationships to the students. I also sought to incorporate family into this unit plan by having students do informal interviews with adults from their families, or other adults in the community, about their opinions on whether or not the minimum wage was high enough in the state of Washington.

References

Boaler, J. (2002). Learning from teaching: exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education, 33*(4), 239-258.

Dean, J. (2007) Living Algebra, Living Wage. *Rethinking Schools. 21*(4).

Fosnot, C. T. & Dolk, M. (2002) Y*oung mathematicians at work: Constructing fractions, decimals, and percents*. Portsmouth, NH: Heinemann.

Lappan, G., Fey, J. T., Fitzgerald, W. M. Friel, S. N., & Phillips, E. D. (1998). *Connected Mathematics (Algebra Strand): Moving Straight Ahead—Linear Relationships*. Menlo Park, CA: Dale Seymour Publications

Lubienski, S. T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education, 31*(4), 454-482.

National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author.

4B: Unit Lesson Plans

LESSON 1: Creating Group/Class Agreements & Introducing Procedures and the Linear Relationships Unit
Math 7 - 3rd Period
Monday April 6, 2009

Learning Outcomes:
Given an individual reflection activity on prior group-work experiences, and a small group and whole class discussion on what students need to be successful in a group, and what responsibilities they have to other members in their small groups and the classroom, SWBT generate a class agreement with guidelines to make the classroom a successful learning environment for all students.

Communication GLEs:
2.2.2. Applies skills and strategies to contribute responsibly in a group setting.

Assessments:
-Group Work Self Reflection Sheet
-Teacher will assess students' group process skills during the group work time as a pre-assessment of students' skills and strategies for contributing responsibly in a group setting.

Rationale for Student Grouping:
Students have been arranged in heterogenous working groups for the unit, based on prior knowledge and understanding of the unit's focus: linear relationships, as determined by pre-assessment data.

Skills for the Teacher to Develop During the Lesson:
-Anecdotal, qualitative record-keeping of individual student's group participation
-Facilitating group-process, community building, and class discussion

Materials	Copying
Math Notebooks Newsprint/Butcher Paper Markers Statements For Unit Introduction Typed out for Doc. Camera	Student Self-Reflection on Group Work (28)

Time	Procedures	Comments/Reflection
11:08-11:18	Find New Seats **Entry Task** Student Self-Reflection on Group Work	
11:18-11:30	**Group Guidelines** Group members share self-reflection, groups work to generate agreement about working cooperatively to maximize everyone's learning experience.	

11:30-11:50	**Class Meeting**
	
	• Groups share out their strategies for working cooperatively
	• Teacher shares observations about what she noticed during group process
	• Safe and Successful Learning Environment
	  • expectations for students in the classroom
	  • signal for getting students' attention
	  • issues about language and respect within the classroom community
	• Generate a Class Agreement	

11:50-12:00	**Introduce the Unit** • Guiding Question: What is a Living Wage? • Objectives in Student Friendly Language • How students will be evaluated?	
12:00-12:05	**Establish Guidelines for Discussion of Mathematical and Contextual Topics** • Issues about right/wrong answers, opinions, and process • Arguing using mathematical sense-making • Realizing that learning experiences come from making mistakes • Respecting people and different opinions	

	• "I agree/disagree because..."	
12:05-12:13	**Launch the Unit** Put the following statements up on the document camera and read them out loud: 1. Those who work should be paid. 2. No one who works full time should live in poverty. 3. Wages should be high enough to support a family on one income. 4. The legal minimum wage should be high enough to 'get by.' Have students discuss with a partner whether they agree or disagree with each of these statements. Why or why not? Give pairs the opportunity to share out ideas with the whole class about whether or not they agree or disagree with the statements. Give space for the students to guide the discussion with their questions and disagreements. Take notes about their ideas.	
12:13-12:22	**Math Notebooks** Why do we have them, how should we format them (date, topic, etc.) How will they be evaluated? What type of writing is expected in them? When students return for 5th period their entry task will be to write their first entry in their math notebook about a prompt on the document camera.	

NAME_____

Student Self-Reflection on Group Work Experiences

Complete the following individually. You do <u>not</u> need to use complete sentences. Lists or phrases are fine.

Think about a time when you worked in a group and had a really successful learning experience. What went well? What did you, other members of the group, and/or the teacher do to make this a successful group work experience.

Think about a time when you worked in a group and had a really terrible learning experience. What went wrong? What could you, other members of your group, or the teacher have done differently to make that experience more successful?

What do you need from other group members in order to have a successful LEARNING experience while working in a group?

What do you think you should do while working in a group so that everyone has the opportunity to have a successful LEARNING experience?

LESSON 2: Graphing Wages and Writing Simple Linear Equations
Math 7 - 5th Period
Monday April 6, 2009

Learning Outcomes:
Given a cooperative activity in which students graph rates of pay for common service sector jobs, SWBT work in groups to generate equations that represent their data set and individually record their observations about and apply their understanding of how rate of pay affects the slope of a line.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
-Math Notebooks: Internalization Check

Rationale for Student Grouping:
Students have been arranged in heterogenous working groups for the unit, based on prior knowledge and understanding of the unit's focus: linear relationships, as determined by pre-assessment data.

Skills for the Teacher to Develop During the Lesson:
-Responsive questioning during small group work to scaffold student construction of the concept without giving away the answer
-Facilitating class discussion to scaffold student construction of the concept without giving away the answer
-Anecdotal, qualitative record-keeping of individual student's group participation

Materials	Copying
11”x17” graph paper Colored Markers or Pencils Math Notebooks Sample Graph	Job Cards (7 sets) Task Sheet (7)

Time	Procedures	Comments/Reflection
1:45-1:50	**Entry Task** In your math notebooks, write about what you know about the terms "minimum wage" and "living wage." Are these terms familiar to you? If so, what do you know about them? If not, what do you think they might mean?	
1:50-2:00	**Introduce the Activity** • Students will be working in their groups of four to graph and write equations for four common jobs people have in this area. • Go over the group task sheet. • Have each student take a minute to read his/her job card, which gives a job description as well as the hourly rate of pay for an employee in that position. • Show the example of a graph that compares several rates of pay (different from those on their role-play cards) as a model for what you'd like the students to be doing. • Have the students remind you of the components of a graph that make it accurate and easy to read (title, labeled x and y axes, use a ruler to draw straight lines, label lines on the graph or use a key so we know which lines belong to which jobs).	
2:00-2:05	**Review Group-work Procedures** • Everyone participates in designing and creating the product • Give space for everyone's ideas and opinions to be heard • Introduce the first role card for group work: timekeeper, students will have 30 minutes to complete the task.	
2:05-2:35	**Activity** Students work in groups of 4 people to graph one day's (8 hour's) wages on an 11"x17" paper for each of the 4 jobs. Teacher takes notes on group processes observed-both general and individual, makes observations to bring up to the class at the end of the period.	

2:35-2:45	**Brief Discussion** • In a whole group discussion, have student relate their graphs to their understanding of x/y variables to the data sets they've graphed. • Have students write, in their math notebooks, an equation to describe the graph of the job description and hourly wage they were given. If they're stumped on an equation, have them write in words, what they need to do to figure out how much a person has made after working that job for any number of hours. *Collect as a Pre-assessment*	
2:45-2:50	**Debrief** • Share Observations about Group Process • Discuss how improvements could be made to group process the next time the students meet.	
2:50-3:00	**Math Notebooks** *Collect as a Formative Assessment* How does the rate of pay affect the shape and steepness of the lines on your coordinate grid? Describe the shape and steepness of a graph for the wage of a job at $20 per hour. Describe the shape and steepness of a graph for the wage of $7.25 per hour (the federal minimum wage).	

Group Task—Graphing Wages

April 6, 2009

To Be Finished: _____

Amount of Time Given to Complete the Task: _____

Name of Group's Timekeeper: _____

5. Each person in your group has been given a job card for a job they've just been hired for. Take a few minutes to read your job cards aloud to one another, including how much you are making per hour.
6. On the piece of graph paper provided by the teacher, your job as a group is to construct one graph to demonstrate the wages of all 3 or 4 people in your group for one day of work (8 hours). If you're confused about how this will look, check out the example at the front of the room. Remember to include titles, keys, labels, and to clearly show what the scale of the x/y axes are.

7. If you finish early discuss the following questions with your group, and record the ideas you come up with below.

   a) Which, if any, of these jobs probably pays enough for a single person to live on? Does everyone in your group agree on this? If there are differences of opinion, what are they?

   b) Do you think any of these jobs pay enough for a family to live on? Does everyone in your group agree on this? If there are differences of opinion, what are they?

   c) What information would you need to know to make an informed mathematical argument about whether any of these wages was enough to live off of?

Job Cards

NURSING AID

You have always enjoyed helping and taking care of people. You attribute you ability to help elderly people feel at ease to the fact that your grandmother raised you and you began taking care of her when you were sixteen. You nursed her until she passed about a year ago. Even though you have no nursing home experience, you talk about your grandmother in the interview and you get the job. Your duties include staffing the dining room and changing sheets for bed-ridden patients.

Your Wage
$11.00 per hour

SECURITY GUARD

You've always been trustworthy, and your record is clean. You work hard and you show up on time. Even though you have no experience in the security industry, you think a job at the front desk of a large building downtown might be the first step to getting into the police academy and on into the state patrol. Besides, the hours work well for your family. You won't see your wife much, but with her working days and you working nights, you'll save on child care. You stress how dependable you are during your interview and you're hired. Your duties include patrolling the parking lot once an hour and monitoring the electronic card lock print-outs to see who's in the building at all times.

Your Wage
$10.00 per hour

RETAIL CLERK—WALMART

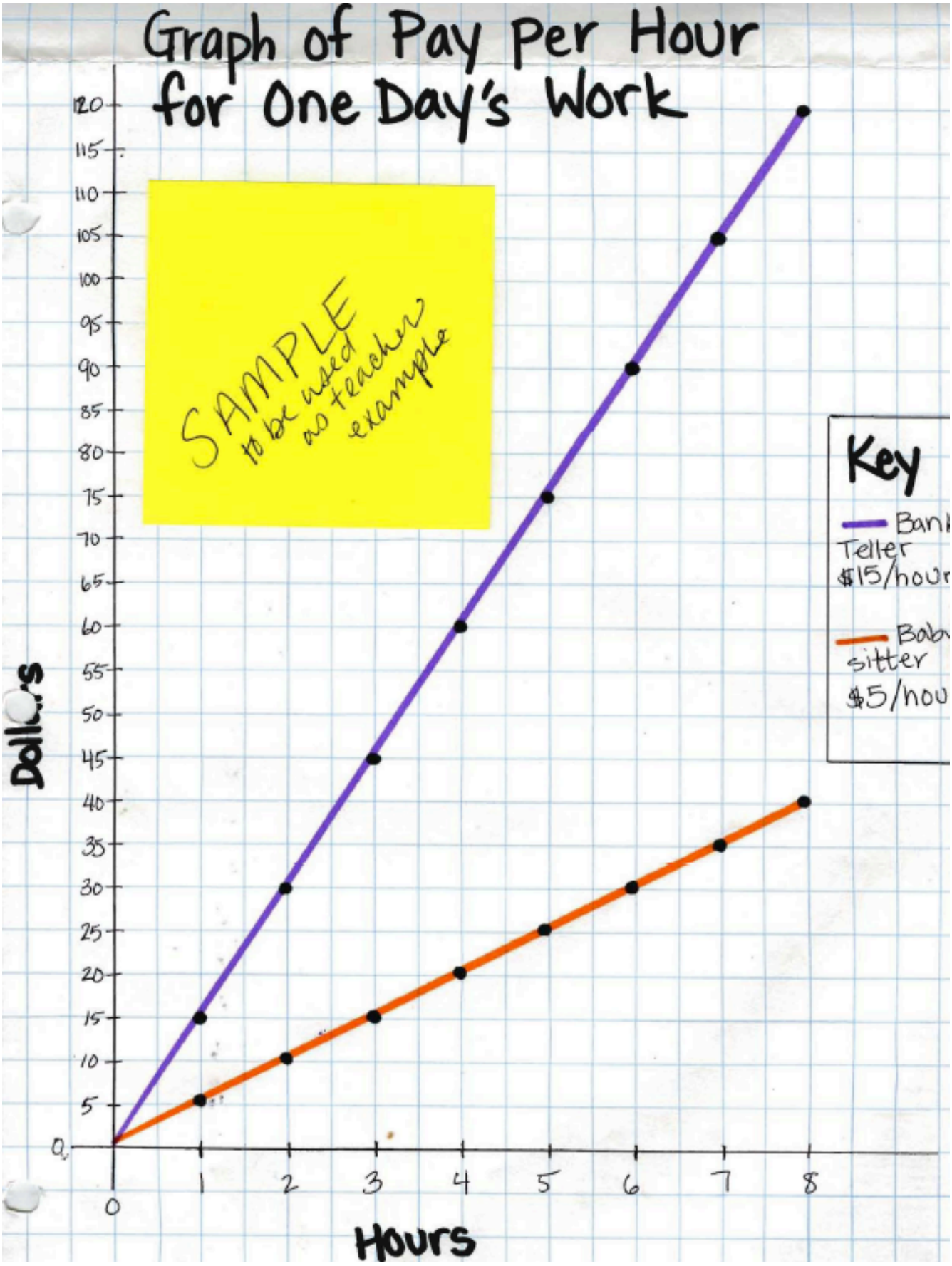
You're friendly and you love to find a bargain. You really know how to get along with people and meet their needs even though they might be cranky and tired after a long day's work. You've also always been good at math. You never minded getting math homework and usually got at least a B on your tests, so keeping an accurate cash register till probably won't cause you any grief. In the interview, you tell about how you're so honest that once when you found a wallet with $100 in it, you looked the person up in the phone book and called them to return it. You're not sure, but you think that story might have gotten you the job. Your duties include sorting and restocking items in apparel and two shifts a week at the cash register.

Your Wage
$9.00 per hour

RETAIL CLERK—COSTCO

In high school, you went out for basketball. You've always been really strong and light on your feet. Teachers always asked you to run errands because they knew you'd do the job quickly and well. In the interview, you talk about how you've always wanted to make a living by working as part of a team. It worked. You were hired. Your duties take you all over the store, nearly at a run. You check prices for customers at the register, you return unwanted items, you break down boxes and you restock with the pallet truck.

Your Wage
$14.00 per hour


Graph of Pay per Hour for One Day's Work
SAMPLE to be used as teacher example
Key
Bank Teller $15/hour
Baby sitter $5/hour
Dollars
Hours
0
5
10
15
20
25
30
35
40
45
50
55
60
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70
75
80
85
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100
105
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115
120
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LESSON 3: Defining and Identifying Linear Relationships
Math 7 - 3rd Period
Wednesday April 8, 2009

Learning Outcomes:
Given an cooperative inquiry activity in which students investigate examples and non-examples of linear relationships, SWBT work as a group, and then as a whole class, to develop a set of criteria for linear relationships that will allow them to identify linear relationships from story problems and tables, in addition to the straight lines on graphs.

Math Performance Expectations:

7.2.H Determine whether or not a relationship is proportional and explain your reasoning.

Assessments:
-Class assessment – discussion about identifying linear relationships
-Group assessment – observation sheet

Rationale for Student Grouping:
Students have been arranged in heterogeneous working groups for the unit, based on prior knowledge and understanding of the unit's focus: linear relationships, as determined by pre-assessment data.

Skills for the Teacher to Develop During the Lesson:
-Anecdotal, qualitative record-keeping of students' understanding of core concepts of the lesson.

Materials	Copying
Math Notebooks Example/Nonexample sets A-E (7)	Task Sheet (7) Observation Sheet (7)

Time	Procedures	Comments/Reflection
10:45-11:05	**Entry Task** Have one student from each group work on graphing information from one of the cards for A. If a student finishes early, have him/her work on the next one until all the graphs from set A have been completed by at least one person in the group (some of these will be linear, some	

	nonlinear, all those that are linear should have positive slopes and a y intercept of 0) When the graphs are complete, have students compare their lines. Which ones are similar, which are different? Which one is the most similar to the lines created in the previous day's graphs? Why? Record students' ideas about the above question on the board.	
11:05-11:12	**Introduce the concept of Linear Relationships** • Are any students who know what we call graphs that create straight lines? (There should be a few students who know this is a linear relationship, based on pre-assessment data). • Besides looking at a graph that shows a straight line, how else could we tell, by looking at a table or a contextualized problem, that something represents a linear relationship? • Record students' ideas on this topic, but don't correct them or clue them into your own at this point in the lesson.	
11:12-11:22	**Introduce the Activity** Students will be given several sets of examples of linear and nonlinear relationships in story problems and tables. As a group, they need to split up the tasks of drawing the graphs so that for each set they can compare graphs and the table or story problem. The students use the graphs to sort the story problems and tables into linear and nonlinear categories. After examining the first set of problems/tables each group needs to develop a set of rules to help them determine, without graphing a table or a story problem, that it represents a linear relationship. With each subsequent set, the group should alter or modify their set of rules so that it pertains to all problems and tables which result in the creation of a straight line on the graph. Remind them that the only thing we know for sure right now is that linear relationships are represented by straight lines on graphs, so as they do their initial sorting, they'll want to use that as a guide. Set types are listed in the Activity section below, in the order they will be received by groups	

11:22-11:25	**Review Group-work Procedures** • Everyone participates in designing and creating the product • Give space for everyone's ideas and opinions to be heard • Introduce the second role card for group work: recorder, students will have 30 minutes to complete the task.	
11:25-11:55	**Activity** (11:48-12:18) All groups start with set B and exchange for sets in order as they go. They should use the observation sheet to record observations as they go. The sets contain examples of the following types of linear relationships in story problems and/or tables, as well as non-examples to contrast the linear relationships with: 1. (A-entry task) Start with linear relationships with an equivalent rate of positive change and a y intercept of 0 (e.g. $y = x$) 2. (B) Add linear relationships with a nonequivalent rate of positive change and a y intercept of 0 (e.g. $y = 4x$) 3. (C) Add linear relationships with equivalent and nonequivalent rates of negative change and a y intercept of 0 (e.g. $y = -x$ and $y = -2x$) 4. (D) Add linear relationships with positive y intercepts (e.g. $y = 2x + 6$) 5. (E) Add linear relationships with negative y intercepts (e.g. $y = 2x – 6$)	
11:55-11:58	**Wrap Up** Depending on where groups are in the process, this can either be a time for questions and/or observations about group process, or it can be a preview of the next activity where groups will share out and discuss to see if we can come up with a common understanding of how to recognize linear relationships in tables and story problems without creating a graph.	

SET 1

Angel is participating in a fund raiser at his school that was designed by the leadership class to increase student activity and raise money for the end of the year dance. People from his community have pledged to donate a certain amount of money to the school for every mile he runs or walks on the track. So far, Angel received enough sponsorship to earn a dollar toward the school dance for every one mile he runs or walks. Sketch a graph showing how much Angel will earn if he walks or runs two miles every day of the school week for 2 weeks. Is this a linear graph? A1

Kevin and Muriel are doing a science experiment. They are trying to figure out how much water is wasted every day because of the classroom's dripping faucet. So, they set up a tub underneath the leaking faucet to catch the drips. After six hours they return to the tub and measure the contents. They realize that in 6 hours, six liters of water have dripped out of the faucet. Sketch a graph of their data to show the school how much water is being wasted per hour by not fixing the leaky faucet. Is this a linear graph? A2

SET 2

A student preparing for Friday's cultural potluck has decided to make a red curry. She knows that for every can of coconut milk she uses, she has to add 2 tablespoons of curry paste. Sketch a graph to figure out how much curry paste she needs for any amount of coconut milk she decides to use. Is this a linear graph? B1

Noelani decided to do an experiment to figure out how much time it took her to read her science book each night, so that she could better estimate how much time she needed to spend on her homework. She figured out that in 3 minutes, she can read a page from the science text book. Sketch a graph that would allow her to quickly see how much time it would take her to complete a 12 page reading assignment from her text book. Is this a linear graph? B2

SET 3

In order to generate customers for their lawn mowing business, Justin and Ryan spend a week driving around town putting up fliers and going door to door, talking to potential customers. Though they haven't made any money yet, they spend 5 dollars a day for the gas it takes them to drive around. They started with no money, and have to borrow from Justin's mom for the expenses. Sketch a graph detailing how much money they lost in the first week. Is this a linear graph? C1

SET 4

At the local taekwondo studio, 40 people have signed up for the summer classes. However, every week the owner notices that 2 people drop out. He's wondering if this is a trend that will continue, and if it does, how long will it be until he has no customers left. Sketch a graph that would help him figure out when he'll run out of customers. Is this a linear graph? D1

Jessica just bought her first cell phone. She pays $20 a month just to have the cell phone, and an additional $0.25 a minute every time she uses it. Sketch a graph to figure out how many minutes she can afford to use, if she has only budgeted $45 a month to spend on her cell phone. Is this a linear graph? D3

SET 5

Terrin turned on the television one morning to hear that it was -5 degrees Celsius outside. Then, he heard the weatherman say that throughout the daylight hours, it would warm up 2 degrees every hour. Sketch a graph that shows the temperature increase for the next 5 hours. Is this a linear graph? E1

A3

x	y
0	0
2	2
4	4
6	6
8	8
10	10

A4

x	y
0	0
100	100
200	200
300	300
400	400
500	500

B3

x	y
0	0
1	6
2	12
3	18
4	24
5	30

B4

x	y
0	0
3	1
6	2
9	3
12	4
15	5

C2

x	y
0	0
1	-2
2	-4
3	-6
4	-8
5	-10

C4

x	y
0	0
-5	25
-10	50
-15	75
-20	100
-25	125

D4

x	y
0	4
1	5
2	6
3	7
4	8
5	9

D5

x	y
0	7
2	4
4	1
6	-2
8	-5
10	-8

E3

x	y
0	-7
1	0
2	7
3	14
4	21
5	28

E4

x	y
0	-3
2	-4
4	-5
6	-6
8	-7
9	-8

A5

x	y
0	2
1	4
2	8
3	16
4	32
5	64

C3

x	y
0	-2
2	2
4	4
6	2
8	-2

E2

x	y
0	0
1	1
2	2
3	3
4	3
5	3

NON Examples

D2 When I took the temperature reading from the thermometer this morning, the temperature outside was 40 degrees Fahrenheit, 2 hours later the temperature outside was 45 degrees Fahrenheit, 2 hours after that the temperature was 50 degrees Fahrenheit, and after 2 more hours the temperature was 60 degrees Fahrenheit. Sketch a line graph to represent this data. Is this a linear graph?

B5 Taylor was training to run a marathon. After an hour he had run 6 miles, after 2 hours he had run a total of 12 miles, after 4 hours he had run a total of 22 miles, and finally, after 5 hours he had run all 26 miles. Sketch a line graph to represent this data. Is this a linear graph?

TASK SHEET – IDENTIFYING LINEAR RELATIONSHIPS

Names of Group Members: _____

Time Keeper: _____

Recorder: _____

Directions

In your group, work through sets B-E of the examples and nonexamples of linear relationships. Not everyone needs to sketch every graph, divide up the work so that everyone is sketching one or two graphs for each set. However, by the end of the activity, every student in your group needs to have had the opportunity to sketch at least 2 graphs from tables, and at least 2 from word problems in their notebooks. Be sure that for whichever graphs you end up sketching, you label them with the letter and number on the table or word problem.

After completing each set, write down what you notice about the word problems and tables that represent linear relationships. How are they different from those that do not represent linear relationships?

Observations

How are the problems and tables of linear relationships in this set different from the previous sets? How are they different from the problems or tables representing non-linear relationships?

SET A

SET B

SET C

SET D

SET E

LESSON 4: Introducing Constant Rates of Change and Slope
Math 7 - 3rd Period
Thursday April 9, 2009

Learning Outcomes:
Given a class discussion about the properties of linear relationships and mini-lessons introducing the concepts: constant rate of change and slope, the SWBT individually identify slopes and write equations for lines with positive and negative integer and fractions as their slope, and y intercepts of zero as demonstrated by their work on an exit slip.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

7.2.H Determine whether or not a relationship is proportional and explain your reasoning.

Assessments:
Partner Task – Problem 4
Exit Slip

Rationale for Student Grouping:
Students are working in partners because there is not enough to do if they work in small groups, but I think some of them still need scaffolding from a more capable peer on this task. Pairs were selected to match students with a stronger understanding of the concepts of linear relationships to students with a less developed understanding.

Skills for the Teacher to Develop During the Lesson:
-Facilitating student construction of mathematical concepts through a mini-lesson
-Trying to rescue a lesson that went not so well.

Materials	Copying
Math Notebooks CMP Books	

Time	Procedures	Comments/Reflection
11:08-11:22	**Entry Task** How can you determine whether a situation is linear by examining a table of data without making a graph? Revisit the Linear Relationships Concept Map on the board---is there anything that the students want to add or change?	
11:22-11:27	**Introduce the concept of Constant Rate of Change** "Constant Rate of Change" and match it with the ideas written in the guidelines by the students. In particular, discuss how the straight line that we associate with a linear relationship, is actually a representation of a data set changing at a constant rate. (Copy down the guidelines and make a poster for the classroom about identifying linear functions.)	
11:27-11:55	**Equations for Linear Functions with y intercepts of 0** Use student work from Monday to review how to write an equation to represent a linear relationship with a y intercept of 0. Students can work in pairs on the problem on page 10 in Moving Straight Ahead, #4, a-f, on letter c, students should try to write their rule in the form of an equation, but they do not have to.	
11:55-12:15	**Introduce the concept of Slope** Introduce the term "slope" to give the students a way to identify the constant rate of change that they're noticing in the problems. So far, they've worked with problems that have slopes that are positive integers. Ask the students what they think a graph would look like that had a slope that was a fraction. What about a slope that was a negative integer? Have them work in pairs to design examples of these slopes. What are some contexts that would create a negative slope, or a slope that is a fraction? Have students share their examples, then, as a class have them help you to construct the equation for finding slope (change in y/change in x).	

12:15-12:22	**Exit Slip/Internalization Check** *Collect as an informal assessment* Have students identify the slopes and write equations for lines with a positive integer as the slope, a negative integer as the slope, a positive fraction as the slope, and a negative fraction as the slope.	

LESSON 5: Introducing Slope
Math 7 - 3rd Period
Friday April 10, 2009

Learning Outcomes:
Given a class discussion about the properties of linear relationships and mini-lessons introducing the concepts: constant rate of change and slope, the SWBT individually identify slopes and write equations for lines with positive and negative integer and fractions as their slope, and y intercepts of zero as demonstrated by their work on an exit slip.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
Exit Slip

Rationale for Student Grouping:
Students are working in partners because there is not enough to do if they work in small groups, but I think some of them still need scaffolding from a more capable peer on this task. Pairs were selected to match students with a stronger understanding of the concepts of linear relationships to students with a less developed understanding.

Skills for the Teacher to Develop During the Lesson:
-Facilitating student construction of mathematical concepts through a mini-lesson
-Facilitating student discussion of mathematical concepts

Materials	Copying
Math Notebooks CMP Books	Exit Slips (30)

Time	Procedures	Comments/Reflection
11:08-11:22	**Entry Task**	

	7. Moving Straight Ahead, Problem 2.1 A-C (page 17) 8. Debrief/Go Over Entry Task, make sure students are all on the same page for the activity	
11:22-11:42	**Activity** Moving Straight Ahead, Problem 2.2 A-C and Follow-Up Questions	
11:42-12:55	**Debrief the Activity.** Students share answers, and as a class discuss and determine which ones accurately represent the data. Work on having the students discuss amongst each other, rather than through the teacher.	
11:55-12:22	**Introduce the concept of Slope** Introduce the term "slope" to give the students a way to identify the constant rate of change that they're noticing in the problems. So far, they've worked with problems that have slopes that are positive integers. Ask the students what they think a graph would look like that had a slope that was a fraction. What about a slope that was a negative integer? Have them work in pairs to design examples of these slopes. What are some contexts that would create a negative slope, or a slope that is a fraction? Have students share their examples, then, as a class have them help you to construct the equation for finding slope (change in y/change in x).	

LESSON 6: Practicing Identifying Slope and Writing Equations to Fit a Given Context
Math 7 - 3rd Period
Monday, April 13, 2009

Learning Outcomes:
Given several situations in which students work in pairs to write equations and/or make graphs to determine the slope of equations, SWBT individually identify slopes and write equations for lines with positive and negative integer and fractions as their slope, and y intercepts of zero as demonstrated by their work on an exit slip.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

Assessments:
Exit Slip

Rationale for Student Grouping:
Students are working in partners because there is not enough to do if they work in small groups, but I think some of them still need scaffolding from a more capable peer on this task. Pairs were selected to match students with a stronger understanding of the concepts of linear relationships to students with a less developed understanding.

Skills for the Teacher to Develop During the Lesson:
-Facilitating student construction of mathematical concepts through a mini-lesson
-Facilitating student discussion of mathematical concepts

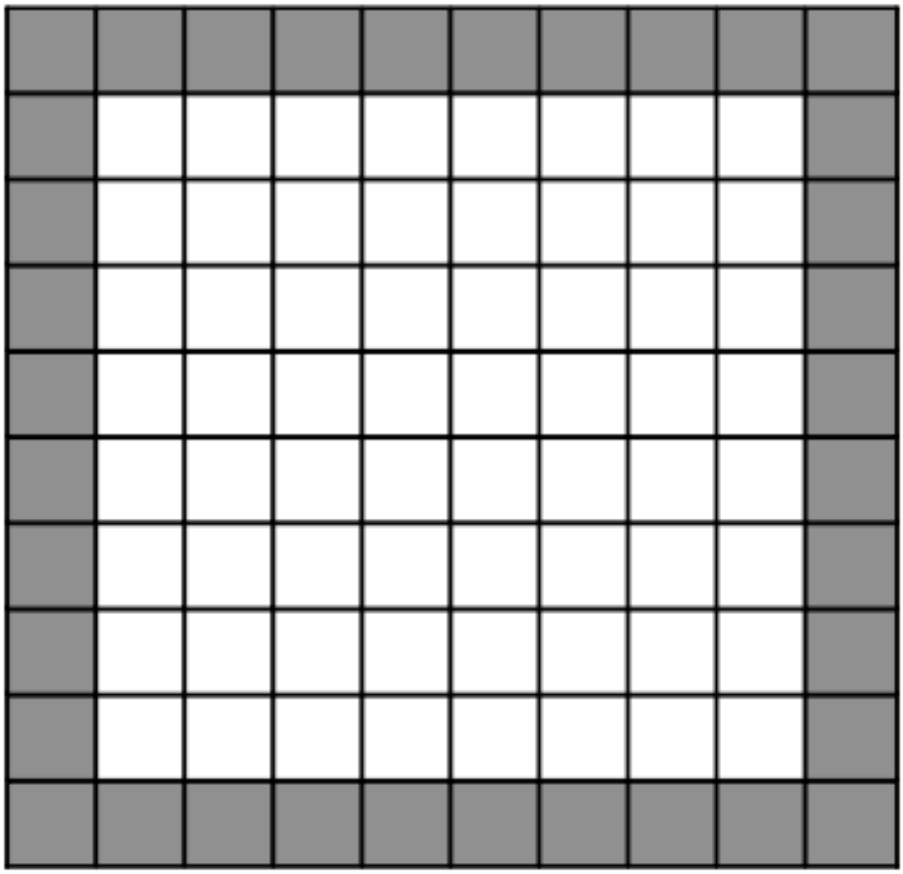
Materials	Copying
Math Notebooks Shaded squares Graph of Data for Activity 1	Data sets and graphs for Activity 2 (15) Exit Slips (30)

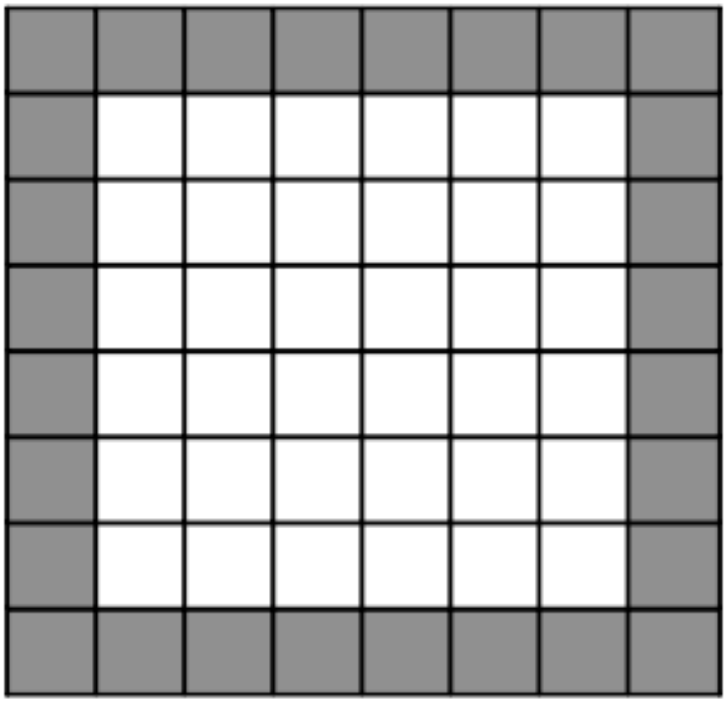
Time	Procedures	Comments/Reflection
11:08-11:25	**Entry Task** • Put the 10x10 square on the board with the shaded outer perimeter. How many square	

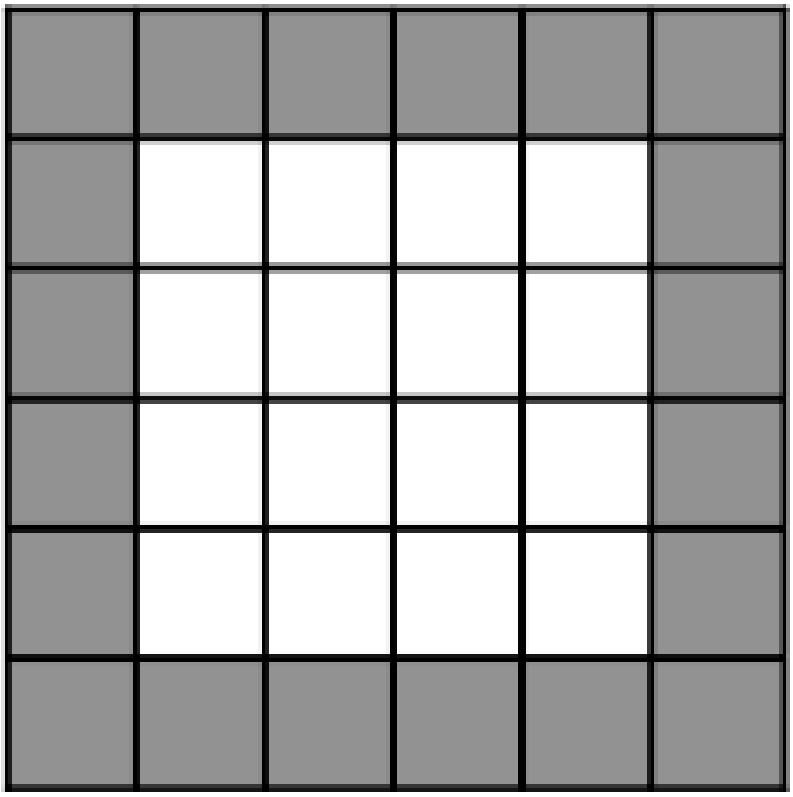
	units of this figure are shaded. • Debrief/Go Over Entry Task: • What did students get for their answers? (36 is the correct answer) • What strategies did they use? • Did any students get another answer first, and then realize it was incorrect? What was that answer? (most likely 40) • On the board, create a table like the one below and have students copy it in their math notebooks: Side length | Square Units Shaded 10 | 36 8 | 28 6 | 20 4 | 12 25 | 96 n | 4(n-1)	
11:25-11:45	**Activity 1:** Put up the 8x8 square, have students take 2 minutes of quiet think time to individually figure out how many square units are shaded and write it in the table in their math notebook, then share with their elbow partners. If there is a disagreement, have the students discuss it between themselves and convince their elbow partner of why their answer makes mathematical sense. Put up the 6x6 and the 4x4 square, have students take 2 minutes of quiet think time to individually figure out how many square units are shaded and write it in the table in their math notebook, then share with their elbow partners. If there is a disagreement, have the students discuss it between themselves and convince their elbow partner of why their answer makes mathematical sense. Have students help you fill in the table for the 8x8, 6x6, and 4x4 squares. Review the strategies that they've used to come up with their answers. Then, put the 25x25	

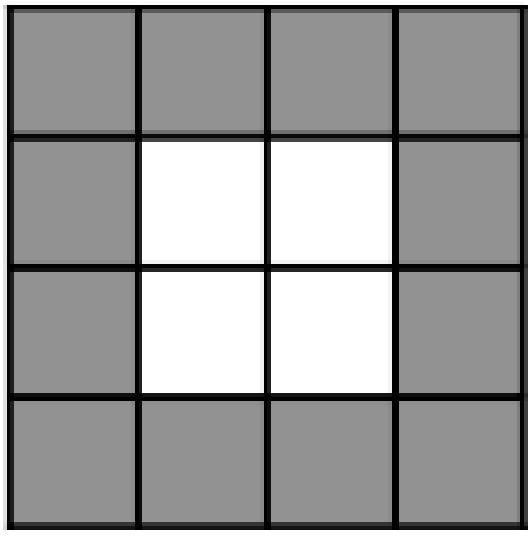
11:25-11:45	**Activity 1:** Put up the 8x8 square, have students take 2 minutes of quiet think time to individually figure out how many square units are shaded and write it in the table in their math notebook, then share with their elbow partners. If there is a disagreement, have the students discuss it between themselves and convince their elbow partner of why their answer makes mathematical sense. Put up the 6x6 and the 4x4 square, have students take 2 minutes of quiet think time to individually figure out how many square units are shaded and write it in the table in their math notebook, then share with their elbow partners. If there is a disagreement, have the students discuss it between themselves and convince their elbow partner of why their answer makes mathematical sense. Have students help you fill in the table for the 8x8, 6x6, and 4x4 squares. Review the strategies that they've used to come up with their answers. Then, put the 25x25 square on the board. Have students take 2 minutes of quiet think time to figure out the number of squares shaded. What were their answers? Now, have the students work together to write a formula to determine how many shaded squares there would be for a square with a side length of x. What are their responses. Have the students discuss and test the responses until they are certain of one formula that works. Now, show them your graph. In terms of this graph, we are using the variable x to describe the side length of the square. So, what variable are we using to describe the number of shaded units? Is this data linear? How do you know? Which part of our equation represents the slope of the graph? How do you know? Review how to find the slope of a graph, and show how on the graph at the front of the room how students can find the slope using a rise/run triangle.	
11:45-11:50	**Introduce Activity 2:**	

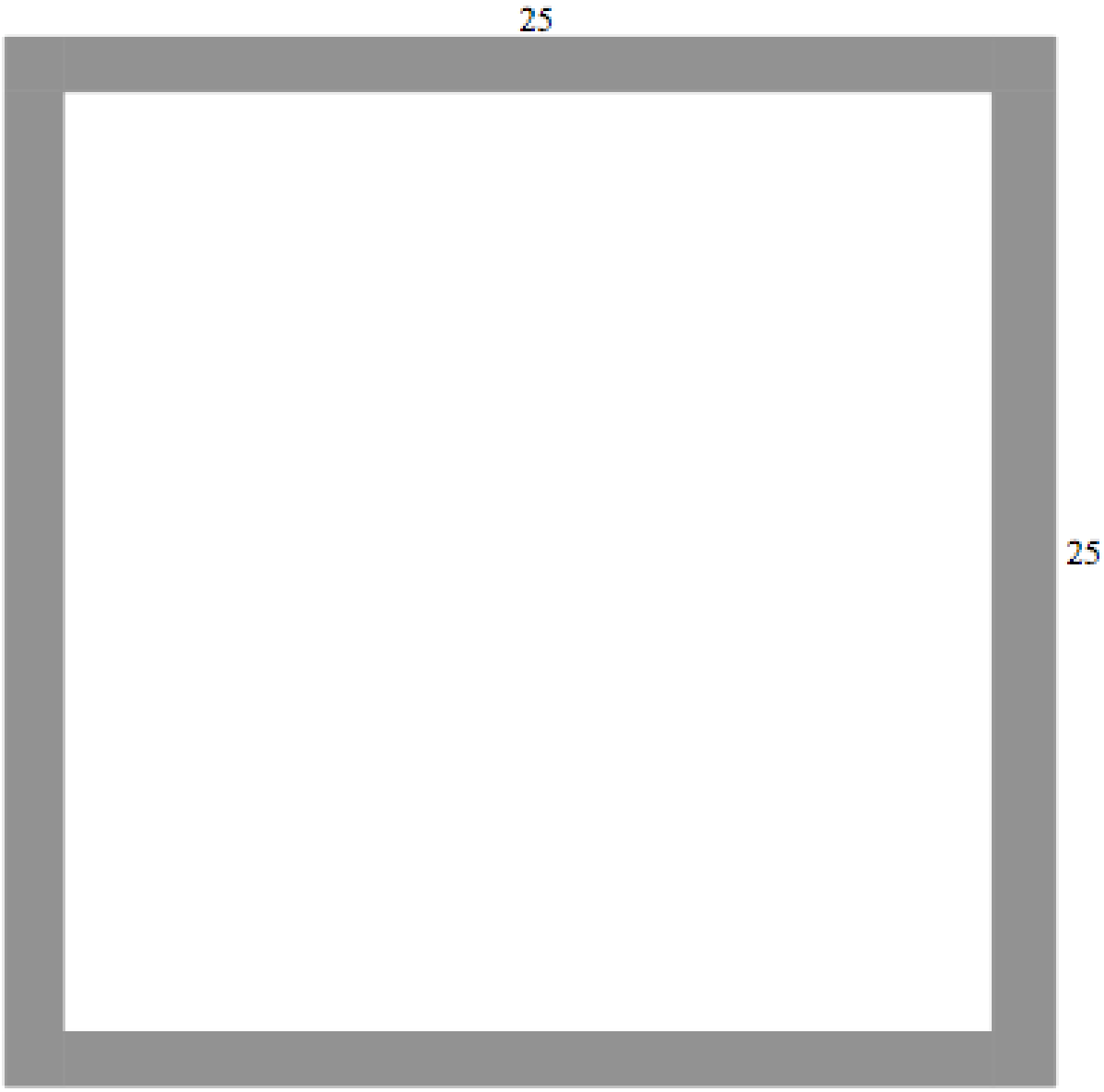
	In partners, students will be working with a series of data sets and graphs to write equations that accurately represent the linear relationships they see. For each of these equations, the students should circle the slope in their equation, and demonstrate how that slope from their equation matches the graph by drawing a rise over run triangle. Do the first one as an example, and leave it up for students to refer to as they do their work in partners.	
11:50-12:00	**Activity 2**	
12:00-12:10	**Debrief the Activity:** Have students write their equations with circled slopes on the board, and have them discuss any disagreements. Review Positive vs. Negative Slopes, and fraction vs. integer slopes.	
12:10-12:22	**Exit Slip** *Collect as a Formative Assessment* Have students identify the slopes and write equations for lines with a positive integer as the slope, a negative integer as the slope, a positive fraction as the slope, and a negative fraction as the slope.	







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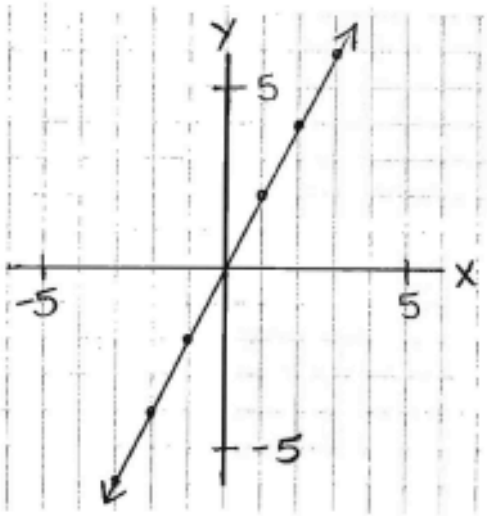
Using Tables and Graphs to Generate Slopes and Equations

In each of the following problems, you are given a graph which represents a set of data given in the table next to it. For each graph and table, find the slope of the line, then write a **y = mx** equation to represent the line. Draw a rise over run triangle on the graph to show that your slope and equation match the line on the graph.

1.

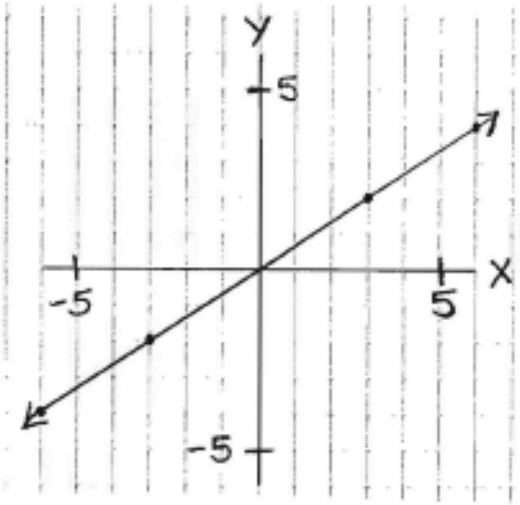
x	y
-2	-4
-1	-2
0	0
1	2
2	4



Slope: _____ **Equation:** _____

2.

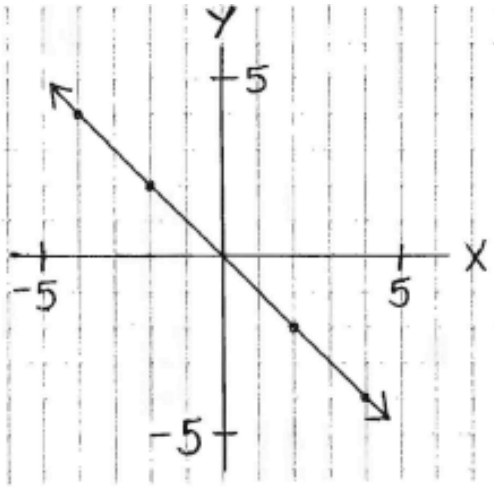
x	y
-6	-4
-3	-2
0	0
3	2
6	4



Slope: _____ **Equation:** _____

3.

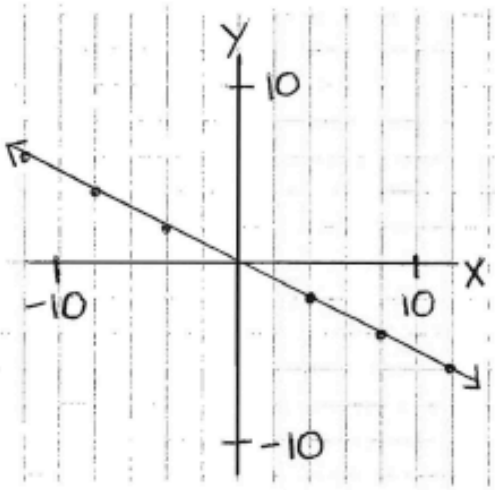
x	y
-4	4
-2	2
0	0
2	-2
4	-4



Slope: _____ **Equation:** _____

4.

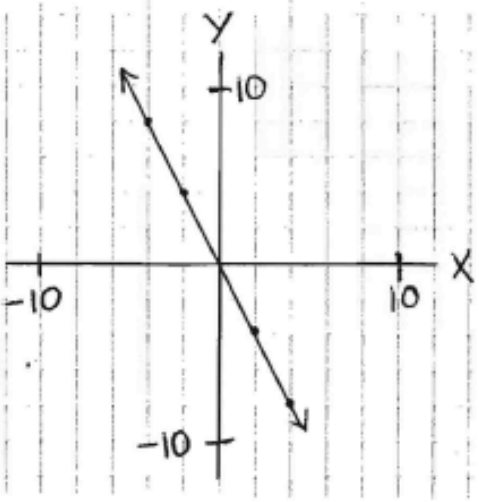
x	y
-8	4
-4	2
0	0
4	-2
8	-4



Slope: _____ **Equation:** _____

5.

x	y
-4	8
-2	4
0	0
2	-4
4	-8



Slope: _____ **Equation:** _____

LESSON 7: Introducing Negative Y-Intercept through Upfront Costs
Tuesday, April 14, 2009

Learning Outcomes:
Given a short video, a class brainstorm on expenses, and an activity in which students determine upfront expenses for uniform costs of their job and housing, the SWBT create a linear graph on a coordinate grid that reflect upfront expenses paid prior to earning a consistent wage.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
Graphs

Materials	Copying
Math Notebooks Documentary: Waging a Living	Uniform Cards (15) Classified Ads (15) Craigslist Ads (15)

Time	Procedures	Comments/Reflection
11:08-11:13	**Video:** **Show the second half of the first part of the documentary: Waging a Living (**http://www.pbs.org/pov/pov2006/wagingaliving/for.html**)**	
11:13-11:23	**Discuss Video/Brainstorm Upfront Expenses** 9. What expenses did Jerry have as a result of his job? (uniform, nice clothes) 10. How did he find an economical way to meet these expenses? (shopping at Goodwill sales). 11. What are other "costs of living?" (record student ideas on the board).	

11:23-11:30	**Activity 1** Hand out a job card to each pair of students (See Lesson 2). Then, have each pair of students take a uniform card A and B for their job. Each student should calculate the upfront expense of clothing for work .	
11:30-11:35	**Video:** **Show the first half of the first part of the documentary: Waging a Living (**http://www.pbs.org/pov/pov2006/wagingaliving/for.html**)**	
11:35-11:45	**Discuss Video/Brainstorm Expenses Associated with Housing** 12. How much did Jerry pay for his room in the hotel? ($540) 13. What do you think he means by, "because of the cost of living, $12 an hour in San Francisco is like $6.50 anywhere else."? 14. Why was it important that Jerry live in the city, instead of farther out where he could get a cheaper place to live? (transportation and getting to work on time) 15. What do you think it costs per month to rent a house or apartment in Lakewood?	
11:45-12:05	**Activity 2** Have students work in pairs going through classified ads from the newspaper, and ads you've taken from Craigslist, to find housing that they can afford with the job they've been given. Remind them that if they have pets, they need to find a place that's pet friendly, and if they have a uniform card which says they have a washer and dryer, they need to find a place with a washer and dryer in their unit. At the end of the activity, students need to have calculated the cost per month for housing that they have to pay, and the upfront costs (first month's rent, security deposit, application fee). As students begin to investigate the ads and come up with questions about costs (deposits, applications fees, etc.), as well as symbols in the ads (eg. w/d, dw) pause their work and go over the different costs and symbols that have come up. If they are sharing housing, remind them that while they can split the cost of the deposit and the monthly costs for rent, application fees must be paid in full by each individual.	

	By the end of the activity, students need to have found a place to live, calculated individual (some students will probably choose to share houses, but they need to calculate their individual costs for rent and deposit) costs, and determined upfront vs. monthly expenses.	
12:05-12:22	**Graphing Upfront Expenses** *Use as a whole group formative assessment* Students are asked to devise a graph in their math notebooks that demonstrates upfront costs and their earnings for their first 10 hours of work. If they are uncertain, encourage them to try several strategies to make it clear that they start their job in debt.	

WALMART EMPLOYEE – UNIFORM CARD A

Starting at Walmart the company has provided you with two polo-style shirts and a pair of Khaki pants, but they'll take the money these things cost ($5 for each shirt, and $15 for the pants) out of your first pay check. You know that 2 shirts won't be enough to last you through a 5 day week, but because there is a washer and dryer in your home, you'll be able to do wash mid week. So, you decide to purchase only one extra shirt and one extra pair of pants (at the same price as above) before you start your job.

WALMART EMPLOYEE – UNIFORM CARD B

Starting at Walmart the company has provided you with two polo-style shirts and a pair of Khaki pants, but they'll take the money these things cost ($5 for each shirt, and $15 for the pants) out of your first pay check. You know this won't be enough to get through the whole week, and because you don't have a washer and dryer in your home, you have to wait until the weekend to get to the Laundromat, so you'll have to buy 3 extra shirts at $5 apiece, and 2 extra pairs of pants at $15 each.

NURSING AID – UNIFORM CARD A

Nursing Aids at your new job are expected to wear scrubs, and lucky for you your sister just left a job at a hospital, so she's got a few extra pairs to spare. However, four pairs won't quite be enough, as this is a job where you'll get dirty and you'll need a clean pair each day. So you invest in 2 additional pairs, just in case you're asked to work overtime Each shirt costs $12, and each pair of pants costs you $15. You also have to have a pair of completely white tennis shoes, which you were able to find at Walmart for $20.

NURSING AID – UNIFORM CARD B

Nursing Aids at your new job are expected to wear scrubs and because this is a job where your clothes get dirty, you'll need a clean pair each day. You invest in 5 shirts and 5 pairs of pants before you even start your job. Each shirt costs $12, and each pair of pants costs you $15. You also have to have a pair of completely white tennis shoes, and because you'll be on your feet all day, you decide to invest in a good pair of shoes for $55.

SECURITY GUARD – UNIFORM CARD A

The company wants you in uniform. Even though you already have nice clothes, they issue you the following, and take the cost of the items out of your first pay check: hat $15, belt $20, pants $36, and three shirts — $25 each.

SECURITY GUARD – UNIFORM CARD B

You're expected to look nice. Luckily you're an average size and you can make it to Goodwill before your first day on the job. You pick up two jackets for $12 each, slacks for $7 and three dress shirts for $5 each. Shoes you have to buy new. You have foot trouble, so you decide you'd better get good ones. They cost you $70.

COSTCO EMPLOYEE – UNIFORM CARD A

Costco has a casual dress code, which means you can wear your jeans to work. However, with all the moving around and lifting you'll be doing, you've decided to invest in a good pair of shoes to keep yourself from getting hurt. These cost $70. Costco also charges their employees $1 for name badges which display the company logo on the top portion of the name badge. It's fairly easy for a name badge to come unclipped from your shirt while packing orders at the register due to lifting products up against our chest. Usually they just fall on the floor but sometimes it might fall somewhere into the boxes you are packing customers products into and then they are gone for good. So, you're required to purchase 3 of these in advance, so you're not waiting for another one to arrive if you lose yours.

COSTCO EMPLOYEE – UNIFORM CARD B

Costco has a casual dress code, which means you can wear your jeans to work. Costco charges their employees $1 for name badges which display the company logo on the top portion of the name badge. It's fairly easy for a name badge to come unclipped from your shirt while packing orders at the register due to lifting products up against our chest. Usually they just fall on the floor but sometimes it might fall somewhere into the boxes you are packing customers products into and then they are gone for good. So, you're required to purchase 3 of these in advance, so you're not waiting for another one to arrive if you lose yours. Also, although you have a good pair of shoes already, because this is a job where you lift a lot of weight and you suffered an injury playing sports in high school, and have to invest in a back brace to keep from getting hurt again. This will cost you $50 before you even start the job, but it's worth it to keep you safe.

LESSON 8: Investigating y-Intercept
Wednesday, April 15, 2009

Learning Outcomes:
Given an entry task and lesson in which students discuss the strategies for graphing upfront costs or pay, the SWBT individually construct a graph that demonstrates upfront costs and the break even point in their earnings (where they actually begin to make money).

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
Graph

Skills for the Teacher to Develop During the Lesson:
-Responsive questioning to lead students to form conclusions about the graph that makes the most mathematical sense.
-Organizing student ideas and responses on the white board in a way that is clear and makes sense.

Materials	Copying
Math Notebooks Graph Paper	

Time	Procedures	Comments/Reflection
11:08-11:18	**Entry Task (In Math Notebooks):** Rowlanda was recently hired as a teller at a local bank for a wage of $12 per hour. She was also given a signing bonus of $100 just for signing an agreement saying she would work for the bank for at least 6 months. Sketch a graph that shows Rowlanda's pay for her first 8 hours of work and takes into account the $100 she received upfront from the company. While students are completing the entry task, walk around the classroom and take notes about	

	which strategies students are using. During the debrief, call one student up to demonstrate each strategy so that a range of strategies are offered.	
11:18-11:48	**Debrief Entry Task/Class Discussion** • Students practice explaining strategies to their elbow partner. • Call forward the students you've chosen to demonstrate each strategy employed to graph the data. (as the students show their more detailed graphs on the overhead and explain them to the class, record simpler versions, specifically paying attention to y intercept and rate of pay on the white board so that by the end of the student share out the range of possible solutions will be displayed). • Once the have been displayed, have the students discuss what each graph really shows. Use the following questions to direct them: • What is the rate of pay per hour in the first hour (or several hours depending on scale and strategy) for each of these graphs? • What about the rate of pay for later hours? • Does that match the scenario we're given? • Do the different graphs affect the total you calculate Rowlanda to have earned after her first 8 hours of work? Why or Why Not? • What happens if we extend the line from some of these straight back to the y-axis, where does it cross? • How many hours did Rowlanda have to work in order to receive her signing bonus? • Which of these graphs best reflects that she received the bonus before she worked any hours? • Which of these graphs best reflects hat for all of her hours at work, she made the same wage ($12/hour)?	
11:48-12:00	**Mini-Lesson: Y-intercept in graphs and equations** Make clear what the accurate graph is by erasing the others from the board. Introduce y-intercept (where the line crosses the y-axis) as a way to show upfront costs or pay. Ask: • How would this graph change if Rowlanda's signing bonus had been $300 dollars?	

	• What about if Rowlanda had started her job in debt because she had to go shopping for work clothes before her first day of work and spent $60? • When we calculate how much Rowlanda has made after 8 hours of work, on our original graph, what process do we use to get an accurate answer. • So how could we write our process into an equation?	
12:00-12:22	**Graph Assignment:** *Collect as a Formative Assessment* Introduce the concept of a break-even point – where upfront expenses have been paid for and the employee begins to make money. For their own upfront costs, students need to use the graphing strategy of changing the y-intercept of their line to fit their data, and to demonstrate how many hours they'll have to work before they break even and begin to make money. Graphs should be on a separate sheet of paper, and need to have clear title, labels, etc. as they will be turned in for assessment.	

LESSON 9: Constructing Accurate Graphs, Data Tables, and Equations from New Contexts
Friday, April 17, 2009

Learning Outcomes:
Given an introduction to the contexts of a walk-at-thon, students will work individually, and then in pairs, to construct data tables, graphs, and equations to model a walk-a-thon problem situation.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
Problem 2.3 (informal)

Materials	Copying
Math Notebooks Moving Straight Ahead Text Books Graph Paper	

Time	Procedures	Comments/Reflection
12:26-12:36	**Entry Task (In Math Notebooks):** Moving Straight Ahead—Page 76, ai, and aii. As students begin to work the problems, address questions that come up about (where do I go up and over to/from when I'm finding slope). Then, have the students go back and check or retry the problems. Focus on student's understanding that they should pick 2 points on a line that cross at an even number in order to get an accurate slope.	

12:36-12:46	**Introduce the Activity and Context of the Problem** • Have students read the set up for problem 2.3 in their math texts on page 19. • What is a walk-a-thon? • Have students ever heard of or done anything similar before as a way to raise money? • Students will have until 1:05 to work on Problem 2.3 and Follow-Up Question 2-A. At 1:08, any questions remaining about the content in 2.3 or about anything for the quiz on Monday will be addressed.	
12:46-1:05	**Problem 2.3** Teacher should make note of misconceptions observed in students' work and bring these forward during the last few minutes of class set aside for review. Focus on checking in with kids who have been struggling with the concepts the students have worked with thus far in the unit.	
1:05-1:14	**Review** Address student questions and observed misconceptions. Go over the different types of problems that will be on the quiz on Monday. Students will need to be able to: • Identify the rate of change in problems involving raising money for charity and through employment and express these as graphs and equations. • Calculate money earned after a given number of hours worked or miles walked. • Match Graphs to Equations and Tables. • Identify Linear Relationships and write about what makes them linear.	

LESSON 10: Moving Between Models
Math 7 - 3rd Period
Monday April 27, 2009

Learning Outcomes Today:

Given a mini-lesson to review connections between verbal descriptions, tables, graphs, and equations and to introduce the new template for recording these connections, the SWBT work in pairs to accurately describe the many models with which they can represent problems with a constant rate of change, and individually complete an exit task with the same format and objective.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:
Entrance/Exit Slip

Differentiation:

Activity Problems
Formative Assessment (Exit Slip) Problems

Skills for the Teacher to Develop During this Lesson:
In class assessment of students verbal understandings of the concepts.

Materials	Copying
	Entrance/Exit Slip (32) Double Sided Problem Worksheets (32) Task Sheets (17)

Time	Procedures	Comments/Reflection
11:08-11:24	**Entry Task** After being hired for his first job, Darrell opened a bank account. To help him save money, he made a plan to deposit $10 a month into the account. On the entry task template provided, describe in words, an equation, a table, and a graph the rate of change for Darrell's bank account. Then, use an arrow to indicate on the graph and in the table the place that shows how much money he will have saved after working for 8 months. Debrief the entry task. -Have students come to the board and demonstrate the different ways in which they modeled the problem. -Do their answers correspond to one another. If not, how can we determine which ones are accurate? -Is the slope of the graph positive or negative? How do they know? -Where in the equation and verbal description does it show that the slope should be positive?	
11:24-11:30	**Introduce the Activity** Have students take a few minutes to read the task sheet silently with their partner. -What are the students jobs for the day? -What must be done before they can receive credit for the assignments? -Any Clarifying Questions? Students will have 30 minutes to complete the activity before the end of class. The last 15 minutes of class will be spent working on their exit slip—a problem similar in format to the ones they'll be working on during class. There will be a few minutes for review and questions before the exit activity.	
11:30-12:00	**Activity** Students work on tasks to complete the templates for the problems they are provided.	

	During this time, the teacher should be walking around, checking in with groups, and assessing their mathematical understanding through their conversations with their partners using the attached rubric.	
12:00-12:07	**Debrief the Activity** What types of things did students find in their written descriptions of the problem's solution that indicated whether the line of the graph would have a positive or negative slope. Have a couple of students share their verbal descriptions to analyze for clarity. What are the strengths, what could be improved? Were there any other questions students had about the assignment before they complete the exit task?	
12:07-12:22	**Exit Slip** *Collect as a Formative Assessment*	

Partner Task for 4/27/09

DO NOT USE A GRAPHING CALCULATOR FOR THIS ACTIVITY!

Directions: For each problem you're given:

- write the problem number down on the top right hand corner of one of the sheets provided
- Work with your partner to fill in the spaces in each box. Your verbal description should contain the rate of change with respect to the context given in the problem.

When each sheet is done, the verbal description, equation, table, and graph should all match the data in the problem.

Check your work for the following (If you haven't checked and corrected your work to make sure it makes mathematical sense, I'll return the assignment and wait to give you credit until you have completed this step!)

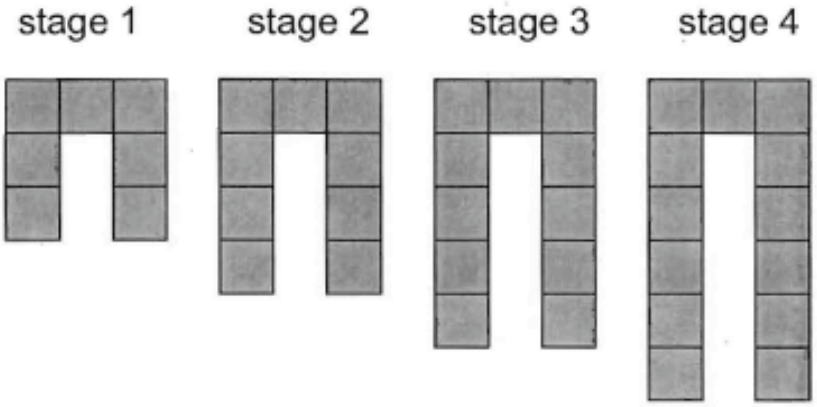
1. The axes on your graphs are clearly labeled (with both the units are AND the intervals the units increase or decrease by).
2. The points on your graph match up with the points in your table. If they don't, find your mistake and correct it so they match.
3. When you enter an x coordinate from your table into the equation, it produces the y coordinate that it corresponds to on the table. If it doesn't, find where you've made an error and correct it.
4. Read each verbal description out loud to your partner to make sure your language is clear and that you're saying what you meant to say.

Finally, In a colored pencil or pen (not a marker!) star the graphs that have a positive slope, then, circle the parts of the equation AND verbal description of that problem which indicate that the graph should have a positive slope.

PROBLEM SET 1

1A. It took Summer 90 minutes to drive to her grandmother's house, which was 105 miles away. Assuming she drove at a constant rate, how fast did she travel to get to her grandmother's. Demonstrate how to find your answer using a table a graph, and an equation, and a clear verbal description.

1B. Find a rule that would allow you to calculate the total number of squares in any stage of the pattern below. Express your rule in words, as an equation, a table, and a graph.



1C. During the holiday season, UPS provides its seasonal workers with a $100 signing bonus if they agree to work on Christmas and New Year's Day. If John works 8 hours per day for UPS, at a wage of $10 per hour, and receives the $100 signing bonus upfront, how much money will he have made (including his $100 bonus) after working for 3 days? Demonstrate how to find your answer using a table, a graph, and an equation, and a clear verbal description.

1D. Jameylee has $25 and no groceries in her apartment. If she won't get paid for another 10 days, how much money per day can she spend on food in order to get her through until her paycheck arrives? Demonstrate how to find your answer using a table, a graph, and an equation, and a clear verbal description.

PROBLEM SET 2

2A. It took Angelina 40 minutes to drive to her grandmother's house, which was 20 miles away. Assuming she drove at a constant rate. Make a table of how far she had gone after 10, 20, 30, and 40 minutes. Graph the data on the coordinate grid provided. Describe her rate of change in words, and write an equation that would allow you to calculate the number of miles she had traveled after any amount of minutes.

2B. Find a rule that would allow you to calculate the total number of triangles in any stage of the pattern below. Express your rule in words, as an equation, a table, and a graph.

stage 1 stage 2 stage 3 stage 4

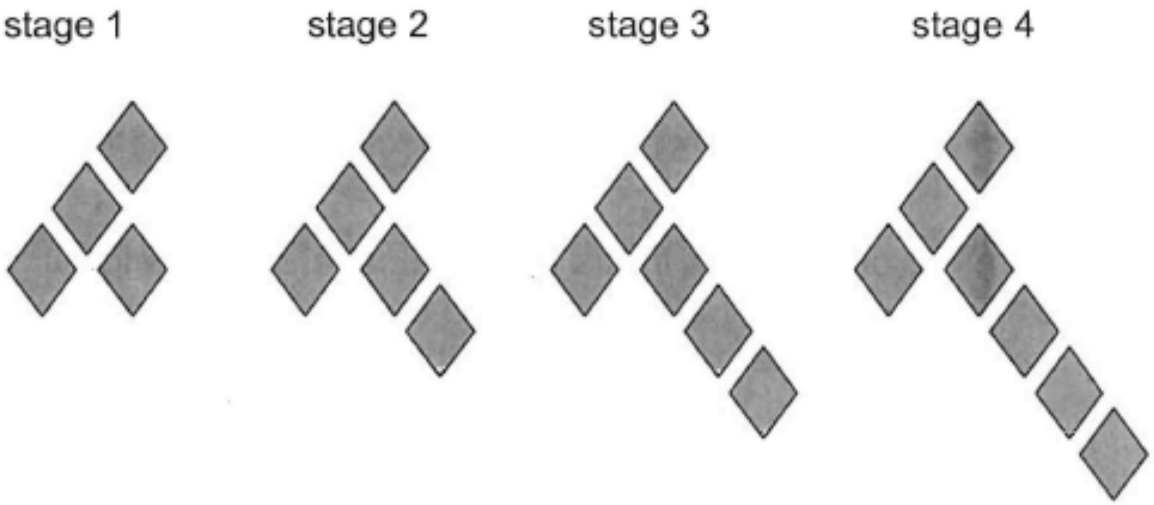
2C. Teba begins a new job sewing clothing at a factory. After 6 days of work, she has earned $9. How much money does she make per day? Demonstrate how to find your answer using a table, a graph, an equation, describe her rate of pay in words.

2D. On the first day of spring, there were 45 inches of snow in the mountains. After 7 days of warm spring weather, only 10 inches of snow remained. Assuming a constant rate of change, how many inches of snow melted each day? Demonstrate how to find your answer using a table, a graph, an equation, a clear verbal description.

PROBLEM SET 3

3A. It took Summer 90 minutes to drive to her grandmother's house, which was 105 miles away. Assuming she drove at a constant rate, how fast did she travel to get to her grandmother's. Demonstrate how to find your answer using a table, a graph, an equation, and a clear verbal description.

3B. Find a rule that would allow you to calculate the total number of parallelograms in any stage of the pattern below. Express your rule in words, as an equation, a table, and a graph.



3C. Before starting her job as a barista at a local coffee shop, Cassandra purchased 3 pairs of khaki pants from Walmart for $12 a pair, to meet the company's dress code. If Cassandra makes $9 an hour, how long will it take before she pays off her clothing costs and begins to make money? Demonstrate how to find your answer using a table, a graph, an equation, and a clear verbal description.

3D. Marcus coaches a four week long basketball camp during the summer. Each year he starts with 32 middle school basketball players at the camp, but by the end of four weeks usually only 24 remain. Assuming a constant rate of change, how many basketball players drop out of the camp per week? Demonstrate how to find your answer using a table, a graph, an equation, and a clear verbal description.

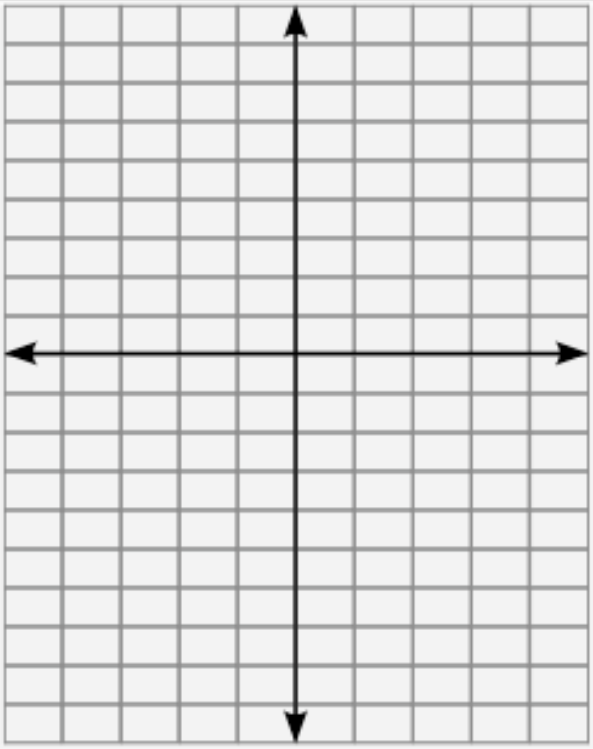
Entry Task:

Verbal Description	Equation

Table of Values

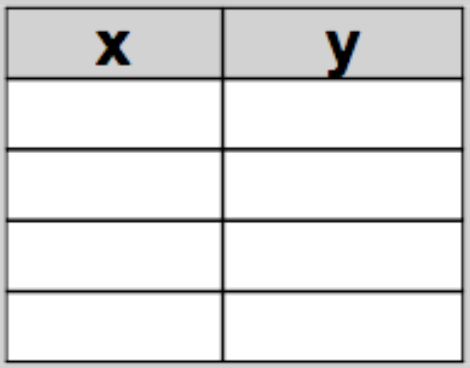
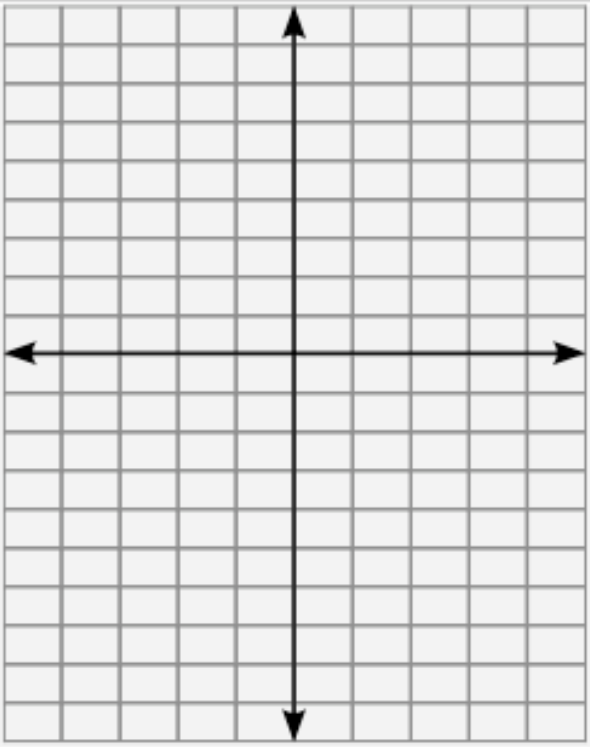
x	y

Graph



Names: **Problem Number:**

Verbal Description	Equation
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____	

Table of Values	Graph
	

LESSON 11: Exploring Living Wage and Minimum Wage With Graphing Calculators
Math 7 - 3rd Period
Friday, May 1/Monday, May 4, 2009

Learning Outcomes Today:

Given a task in which students work with partners to determine the living wage for different size households in Lakewood, WA and compare that to the minimum wage in the state of Washington, the SWBT make a clear mathematical argument about in response to the unit's guiding question: "Can you make enough to live working at McDonalds," and support his/her argument by representing the given data in linear graph and a written explanation.

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

Assessments:

McDonalds Problem
Exit Slip

Materials	Copying
Moving Straight Ahead Books Graphing Calculators Graph Paper Rulers	Calculating the Living Wage (20) Extension Questions (20)

Time	Procedures	Comments/Reflection
	FRIDAY	
11:08-11:28	**Entry Task**	

	Moving Straight Ahead, Page 37 (Graphing Calculator Exploration) . Debrief and Model: -What happened when you changed the values to match the vales in Window 1? -What happened when you changed the values to match the vales in Window 2? -How does changing the XMIN/MAX and YMIN/MAX values change the graph you see on the screen? -What does SCL represent and how does it change the graph you see on the screen? -When might you need to change the MIN/MAX values for a graph? -When might you need to change the scale for a graph? Have students return to the standard window and enter the equation, y = 2x and graph it. -What do they notice? How could they change the scale or min/max values to see more of the graph? Have students graph the equation y = 200x -What do they notice? How could they change the scale or min/max values to see more of the graph? Will they need to change the scale? Have students graph y=20x+4 -Have students graph the equation y = 200x -What do they notice? -How could they change the scale or min/max values to see more of the graph? Will they need to change the scale? Have students return to standard window and graph two lines y = 2x and y = x. How can they tell which line is which. Introduce the TRACE function on the graph and have students identify where on the screen it tells them which function they're looking at.	
11:28-11:33	**Introduce the Activity** Students can work in pairs of their choice to complete the activity. Take a tally from the	

	students. How many think that McDonalds wage is a living wage? How many do not? Tell them that the ultimate goal of their exploration will be to argue for or against the statement, "You can live working at McDonalds" using mathematical evidence and a clear graph and written explanation to support their answer. Students are encouraged to use graphing calculators.	
11:33-12:22	**Activity**	
MONDAY		
11:08-11:23	**Review the Assignment from Friday** Hand out criteria for evaluation on the final question. -Were there questions about Problems 1-3? Strategies to Share? -Do students have any questions about what the expectations are? -Do students have any questions about what the task is? -Extension Questions for Students who finish are at the front of the classroom.	
11:23-12:08	**Activity**	
12:08-12:12	**Debrief** -What did students decide about whether or not a McDonalds wage was a living wage? -What about the minimum wage in Washington State?	
12:12-12:22	**Exit Slip** *Collect as a Formative/Metacognitive Assessment* -What did you learn from this activity ("nothing" is not an acceptable answer!) -How have your ideas about the cost of living and the minimum wage changed over the course of this unit? -Think back to the interview you did with a family member or another adult about the minimum wage in Washington state?	

	-Did that person think the minimum wage was high enough? -Do you agree? -How could you use a linear model to support your argument?	

LESSON 12: Reviewing Key Concepts for the Unit Test
Math 7 - 3rd Period
Tuesday May 5, 2009

Learning Outcomes Today:

Given a review session, the SWBT meet or exceed standard on the unit test the following day

Math Performance Expectations:

7.2.E Represent proportional relationships using graphs, tables, and equations, and make connections among the representations.

7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.

7.2.H Determine whether or not a relationship is proportional and explain your reasoning

Assessments:
Student Self-Assessment of Understanding
Unit Test - Summative

Materials	Copying
Moving Straight Ahead Books Graphing Calculators White Boards/White Board Markers Graph Paper Rulers	

Time	Procedures	Comments/Reflection
11:08-11:20	**Entry Task** -Read The Rubric -Discuss the scoring of the final exam using the rubric	

11:20-11:55	**Review the Key Concepts for the Exam** Have students complete examples of the following problems (see attached) on whiteboards, a given amount of time, have students hold up their answers, then go over questions. -Determining Whether A Relationship is Linear from Tables and Graphs Graphing Determining a Constant Rate of Change -Determining Slope and y-intercept from graphs, equations, and tables -Moving Between Models Graphs, Tables, and Equations -Finding Unit Rates and y-intercept from Contexts and Relating them to the Slopes of Lines -Using Unit Rates from Contexts to solve problems -Using Graphing Calculators	
11:55-12:15	**Answer Student Questions about Test or Concepts they're still wondering about.**	
12:15-12:22	**Student Self-Assessment on the Rubric**	

Section 5: Instructional Decision-Making

As referenced briefly in Section 4, one of the first major instructional decisions I made after beginning this unit was to both add a performance expectation (7.2 G) and split performance expectation 7.2 E into two different categories on the rubric—context-based and abstract representations. I made this decision after observing, through formal and informal assessments during Lesson 2 of the unit, that although the students had very little prior understanding of linear relationships as an abstract concept, or knowledge of the vocabulary used to describe linear relationships, they did possess some understanding of and ability to apply constant rates of change to real-world situations. Throughout the unit, this insight also led me to tie abstract representations back to concrete situations when, at any point, the students were having trouble making sense of linear relationships. Another key observation that came from this lesson was that a few groups of students were still grappling with accurately graphing a line that started (or should have started) at the origin on a coordinate grid. This meant that throughout the beginning part of the unit, informal focus was also placed on drawing a line that accurately represented a rate of change (and analyzing lines that were drawn to determine whether they actually represented the situation) in context, in order to prepare the students for investigating y-intercept using this same approach.

After introducing slope as corresponding to rise over run on a graph, the students' exit slips, assessed on April 13th after Lesson 6, uncovered a key question or misunderstanding that many of the students brought to the task. This had been their first real attempt at moving between models in the abstract, without a context to tie them to, and though most of them successfully made the connection between rise over run on their partner task, their exit task revealed that individually they were struggling to determine slope using this strategy, and that many of them were still not connecting the slope in the abstract to linear equations, even though they could connect a rate of change in context to its equation. The exit task also revealed a key piece of information about the students' understanding that was later

confirmed by discussing the task with them. As demonstrated by both Marcela and Iliana's work on the "Using Slopes to Generate Equations" sheet and the exit task that followed, most students successfully grasped the concept of rise over run as a way to find slope when coordinate points had been labeled along the lines. I realized as I was assessing the students' work that I had inadvertently not labeled points on the lines for the exit task. Therefore, though many looked for a rise over run on their exit task, without the coordinate points there to help them see where to start and end their right angle in relationship to the line, only four of the students in the class were able to accurately identify starting and ending points and find the correct slope during the exit task. When we discussed it the next day, comments such as, "I get the rise over run part, but I don't know where to draw the lines from," which were echoed by nodding heads allowed me to see that for most students this was creating a barrier to their ability to find slope from the abstract representation of a graph. This informed my decision to start the next lesson with an entry task similar to the exit task, only this time we discussed, and the students generated the most effective strategies to find and label coordinate points on a line that would serve as starting and stopping points for determining rise over run. The students weighed the advantages or disadvantages of different locations for points (for example, we discussed whether it would it make more sense to use a point that landed on 2 integers, as opposed to an integer and a fraction or two fractions).

Though I did not formally assess at the end of Lesson 7, I recognized while checking in with students that while about a third of the students had developed both accurate and inaccurate strategies for graphing their upfront costs and their wages using the same line, most of the students were struggling with where to start on this task. Knowing that the students were generally more comfortable with positive integers than they were with negative integers, I made the decision to begin the next day with an entry task and activities introducing upfront signing bonuses, anticipating that this would provide the necessary scaffolding for them to at least begin to think about strategies for graphing upfront costs. For many of the

students, the entry task for Lesson 8 provided an easier access point to attempting to graph a line with a positive or negative y-intercept. Most students quickly developed a clear strategy for beginning the task, and started by calculating how much money would have been made after an hour, two hours, all the way up to eight hours, and then plotting these points.

A few students, including Ty, could not seem to put anything on paper now that this new component of upfront money had been added to the mix. After they struggled for a bit with it, I wanted to give them an access point that would keep them from getting too frustrated before the lesson really began, so I advised only those students to first develop a graph that showed only the hourly wage and earnings without accounting for the upfront bonus. At a later point in the lesson, after the students had discussed and determined which line from the student examples actually accurately represented the situation, I then used the graphs created by this group of struggling students to help demonstrate the relationship between the two lines (that they were parallel and the one with the upfront bonus was always exactly 100 more than the one without) so that the students could begin to make a conjecture about how they could write an equation to show the upfront bonus they had just graphed. The graphs collected at the end of the period which demonstrated the students' upfront costs and break even point for their wages they had been assigned the previous day generally demonstrated that students had clearly made the connection between the work with positive y-intercepts and the assessment task with negative y-intercepts. A couple of students, similarly to what Marcela revealed when I asked her about her work, misinterpreted the task and instead of graphing their own upfront costs, graphed the uniform costs we had considered in the class discussion during Lesson 8, or like Ty didn't quite get their lines to demonstrate a constant rate of change. However, because the goal of the task had more to do with graphing y-intercept, I considered the scaffolding lesson successful in helping the students move toward Learning Outcome 6.

After the students took their quiz on April 20, I had about a week to design lessons to fill in the gaps that the students demonstrated on the quiz while we took a break for WASL testing. One of the clearest gaps in student understanding was in the students ability to move between abstract representations (Performance Expectations 7.2 E). So, I decided to focus one of the last lessons of the unit on helping the students move between abstract representations that were centered around context-based problems. My decision to embed Lesson 10 in context and to maintain a strong focus on abstract models stemmed from the fact that in their quiz the students continued to show a stronger grasp on linear relationships in context than in their abstract representations, which was predictable based on age and developmental level. I also differentiated the tasks for students based on their performance on Quiz A, so that those students who were having trouble with y intercepts or negative y intercepts could focus more clearly on how the models (in particular the slope) were related without getting hung up on the y-intercept piece. Students' performance on the April 27 exit task for Lesson 10, clearly demonstrated that with differentiated content (problems representing $y = mx$, $y = mx + b$, and $y = mx – b$) set in contexts, most of the students performed in the developing or meeting categories of the rubric on Performance Expectation (7.2 E). However, this was only moderately successful in bringing them to a place where they could move between abstract representations of linear relationships on the unit test, and it was clear after examining the summative assessment data that for these students a familiar context is still a key piece of the puzzle that allows them to connect the various representations of linear relationships to one another.

Section 6: Analysis of Student Learning

Summary of Whole Class Results

As discussed in Section 5, I decided after beginning the unit to split student performance on Performance Expectation 7.2 E into two categories, one addressing representations in context, and the other addressing students' abilities to move between abstract representations of linear relationships. As a result, no formal pre-assessment data was collected on student performance on 7.2 E in context, and the first official data collected on students was through Quiz A on April 20. However, it is still apparent when looking at the data presented in Figure 6.1 that the students made significant progress between the quiz on April 20 and the unit test on May 6. while most students performed at the emerging and developing levels on the two formative assessments, on the unit test almost half of the students had met the standard, clearly demonstrating an ability to connect context-based problems with positive and negative y-intercepts to linear graphs, tables, and equations.

The students' ability to apply their understanding of linear relationships to moving between purely abstract models did not progress nearly as significantly in this unit. However, it should be noted that the progression is more difficult to accurately assess from Figure 6.2, because the summative assessment was more difficult than the formative assessments on April 20 (requiring students to create, rather than match abstract representations), and unlike the assessment on April 27 it had no contextual grounding, nor was it differentiated. As mentioned in Section 5, even when moving between abstract models the students seem to ground their understanding and ability to create multiple representations in an underlying context, and perform better when they have that to refer back to.

Figure 6.3 clearly demonstrates the students' progress on Performance Expectation 7.2 G, showing that most students made steady progress throughout the unit from emerging to developing or meeting

standard. On the unit test, over half of the students met standard, 35 percent performed at the developing level, and only 13 percent (or 3 students) remained in the emerging category.

Finally, Figure 6.4 shows a significant change between students' understanding of and ability to identify linear relationships on mid-unit quiz and the summative assessment at the end of the unit. While less than 15 percent of students met standard on this part of the formative assessment, over 80 percent met standard on the summative assessment. While no formal lessons were taught on this concept between the two assessments, during almost every lesson between April 20 and May 6, we discussed and reviewed linear relationships and the idea of constant rate of change. I also worked to help the students clear up misconceptions between the quiz and the unit test. However, part of this progress, I hypothesize, can also be attributed to the fact that I intentionally removed certain distractions, such as fractions, from the final exam, in order to determine the students' ability to meet standard on this learning goal.

Summary of Sub Group Results

The subgroup analysis that I chose to pursue in this study was grade level. My rationale for this decision was informed by several factors. This is a seventh grade unit and the performance expectations that the students were held to were from the grade seven standards. Because I was working with sixth and seventh grade students. I operated with many questions throughout the unit about the developmental appropriateness of some of the more abstract concepts and representations in this unit, and therefore I was curious to see whether or not the difference between sixth and seventh grade significantly affected performance. However, this is not a factor that could be isolated, as the seventh graders not only were an older group of students, but most of them had also had exposure to this topic prior to this unit because they were repeating the class. So, I was curious to see whether either or both of those factors were at play in students' performance in this unit.

My second reason for choosing grade level as a sub group to examine is that I've done some informal tracking of student progress based on race and sex and have seen very few patterns emerge as far as academic performance goes. In part, this may be the result of this being an ASP tracked class. Therefore, a lot of the systemic discrimination based on race has already occurred in the initial sorting process. White students are significantly over-represented in this class when compared to the school population, whereas black students are under-represented. The percentages of both Latino and Asian/Pacific Islander students in this class more closely resemble the racial composition of the school. Finally, the last major reason for choosing these two subgroups was that in this class, there is a nearly even split between sixth and seventh grade students, so comparisons are not significantly affected by different sized groups.

Results from this subgroup analysis (see Figure 6.5), however, demonstrate that seventh grade students in this classroom did not significantly outperform the sixth grade students. In fact, in the case of abstract representations, the area that all students had the most difficult time navigating, roughly thirty percent of the sixth graders were in the developing or exceeding categories of the rubric on the final assessment, as compared to only fifteen percent of the seventh grade students. One possible explanation for this unexpected discrepancy is that the students in the sixth grade have not yet been sorted into two tracks within the ASP classes, whereas the stronger ASP seventh graders have already been moved into an algebra class.

Summary of Case Study Results

Students selected for case study at the beginning of this unit showed results that were in some cases representative of the class as a whole. However, as Figures 6.6 through 6.9 demonstrate, these

specific students showed more irregularity in performance than most of the students in the class, often moving up and down between the levels of the rubric rather than showing a consistent pattern of growth.

Figure 6.6 shows that while both Ty and Marcela increased or maintained their performance steadily on contextually-based representations of linear relationships, Iliana began and ended the unit in the same spot. While the Formative Assessment on May 1 showed Iliana as improving significantly, it should be noted that this was a project completed in pairs, and therefore is not a reliable indicator of whether Iliana understood and/or was able to apply an understanding of context-based models for linear relationships.

On the Abstract Representations component of Performance Expectation 7.2.E (see Figure 6.7), Ty and Iliana showed a pattern in the last formative and summative assessment that was discussed in the whole group analysis. That is, due to the more difficult nature of the final task, while both students performed at a level higher than they had originally started the unit on the April 27 formative assessment, their performance returned to their original levels on the summative assessment. However, Marcela, who has struggled throughout the year in this class, showed marked improvement in this category as the unit progressed.

Similarly to most of the students in the class, all three of the case study students demonstrated growth on Performance Expectations 7.2.G and 7.2.H (see Figures 6.8 and 6.9). Ty's significant drop in performance on 7.2.H during the formative assessment on April 20 (see Figure 6.9) was not at all representative of the class data, and her explanation of her thought process following the mid unit quiz revealed that both fractions and negative integers had significantly interfered with her ability to successfully complete the problems on the quiz related to this performance expectation.

Summary of Students' Metacognitive Performance

Students responses on their first self-assessment, given during Quiz A on April 20, indicated that their metacognitive processes in this unit had not been significantly activated. Although we had been working with linear relationships in context up to that point, few students were able to make connections between linear relationships and the real world, and most felt that no information had been communicated to them about how they were being evaluated. Still, at this stage, many of the students could clearly identify what they were learning about, and the areas in which they needed more scaffolding or had questions about linear relationships.

As a result of this information, prior to the summative assessment, during which students also completed afinal self-assessment, we often discussed at the end of class periods the ways in which their learning in this unit connected to the real world and other learning, and we took time to go over the rubric which I used to evaluate students' performance. The results of this discussion were evident in the second self-assessment, as most students were able to communicate clear responses to the metacognitive questions which demonstrated that they were more aware of their own learning, the ways in which they were being evaluated, the strategies that were available to them when working with linear relationships, and the ways in which linear relationships connected to the real world and their prior learning. Examples of student responses to these questions are provided in Attachment 6D. Though some represent lingering misconceptions, they clearly demonstrate that the students' became increasingly comfortable writing about their mathematical understandings and their own thinking.

6A: Classroom Data

Figure 6.1 Student Achievement on Performance Expectation 7.2.E

Represent proportional relationships using graphs, tables, and equations and make connections among the representations (in context)

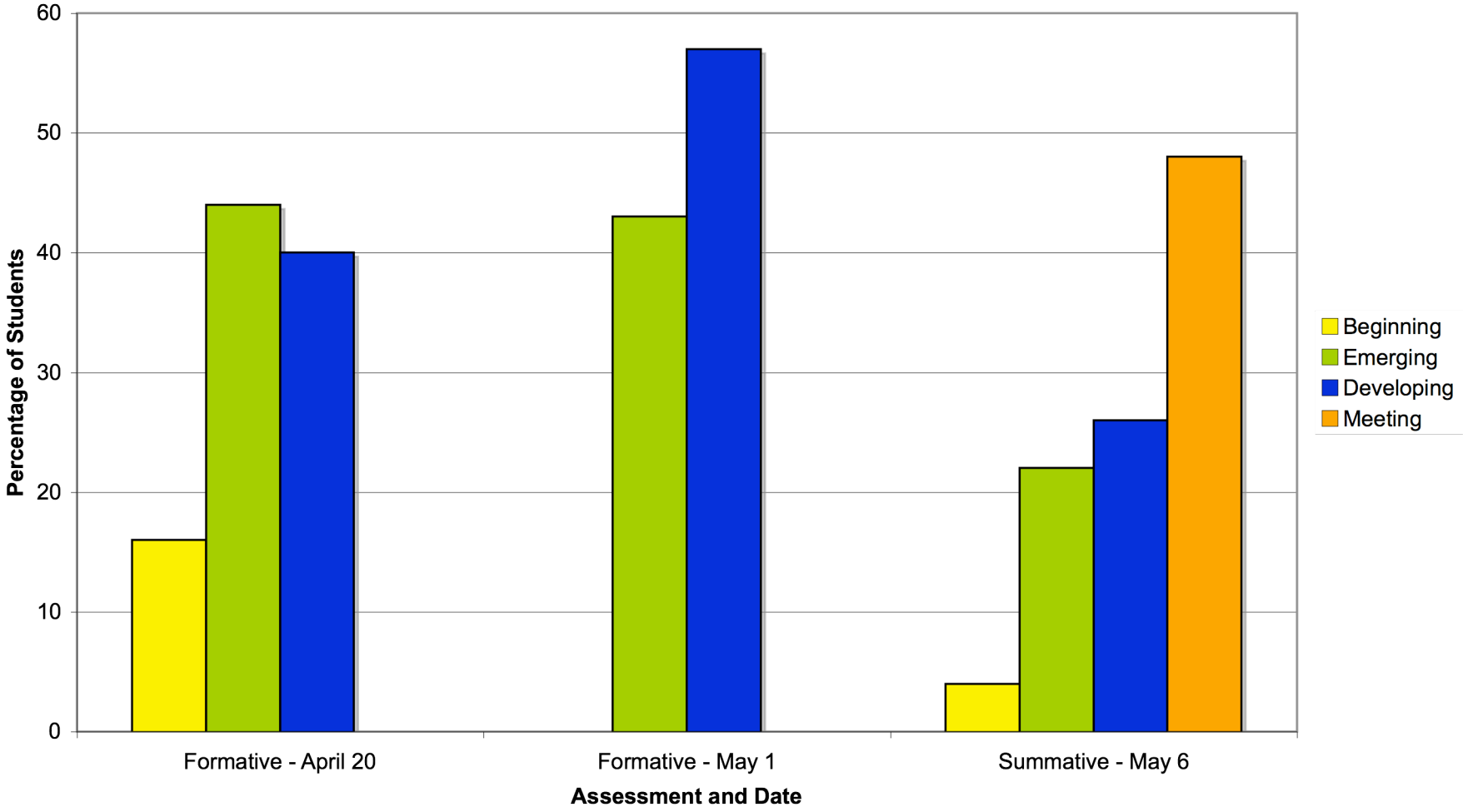


Figure 6.2 Student Achievement on Performance Expectation 7.2.E
Represent proportional relationships using graphs, tables, and equations and make connections among the representations (abstract representations)

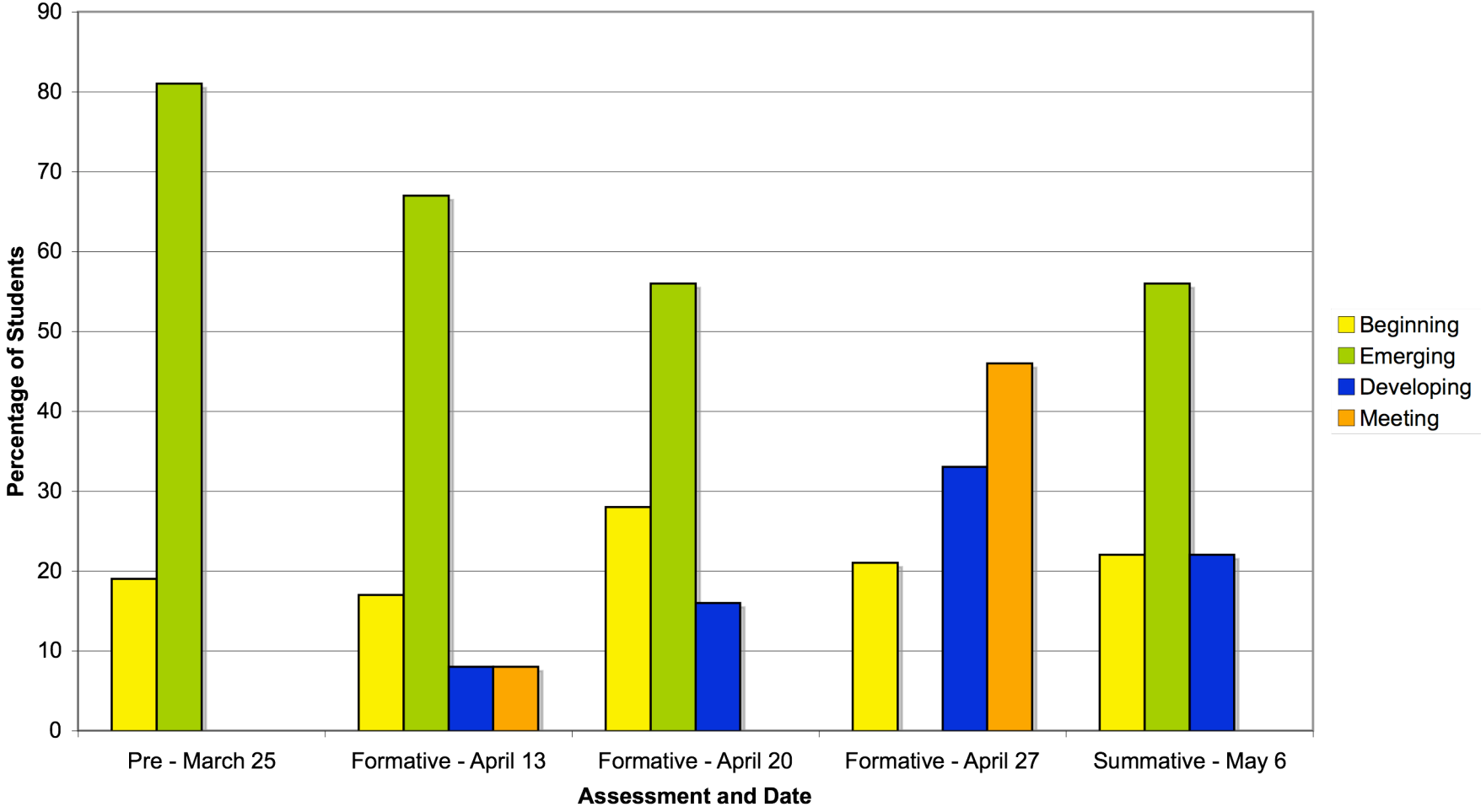


Figure 6.3 Student Achievement on Performance Expectation 7.2.G

Determine the unit rate in a proportional relationship and relate it to the slope of the associated line

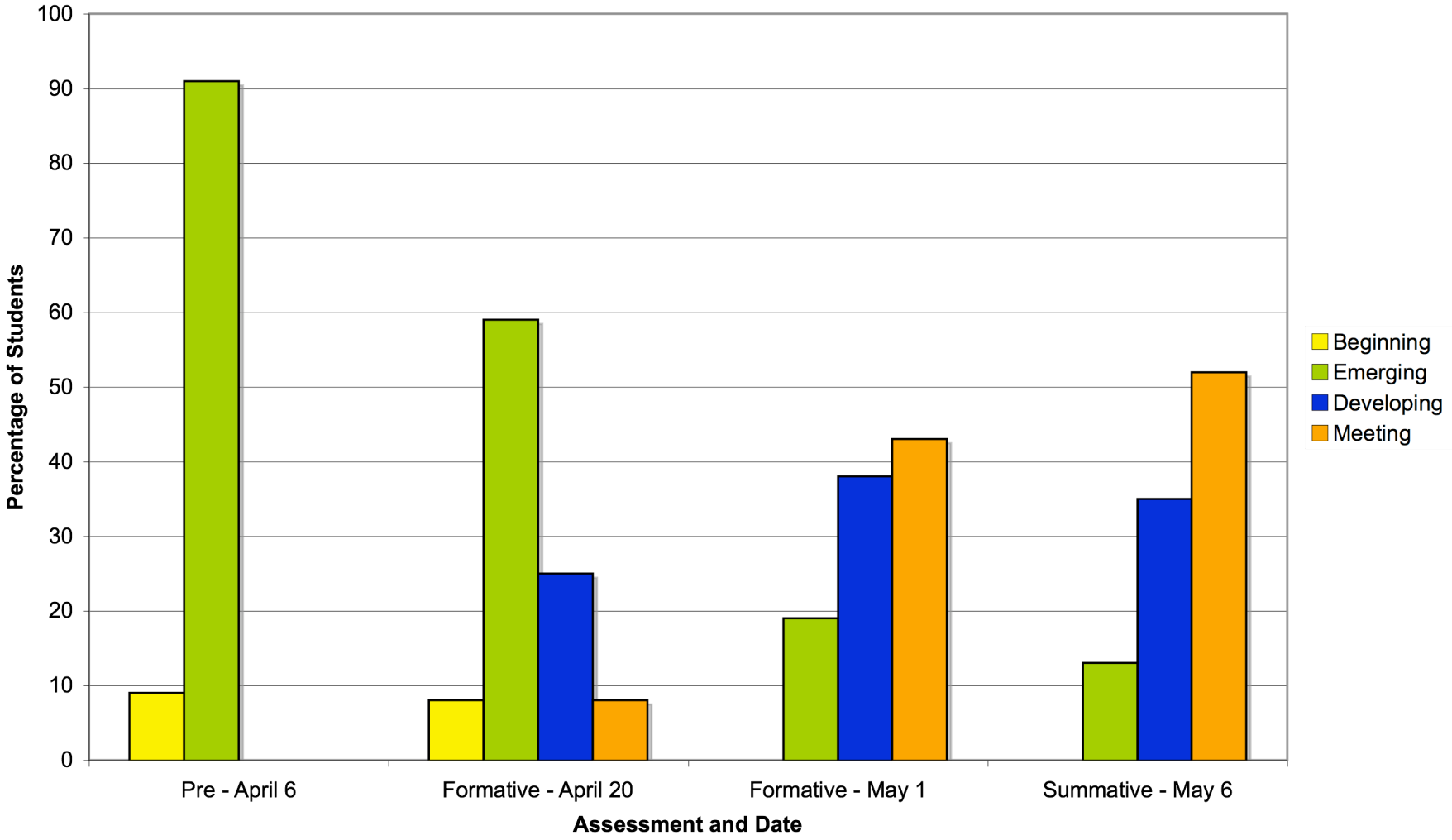
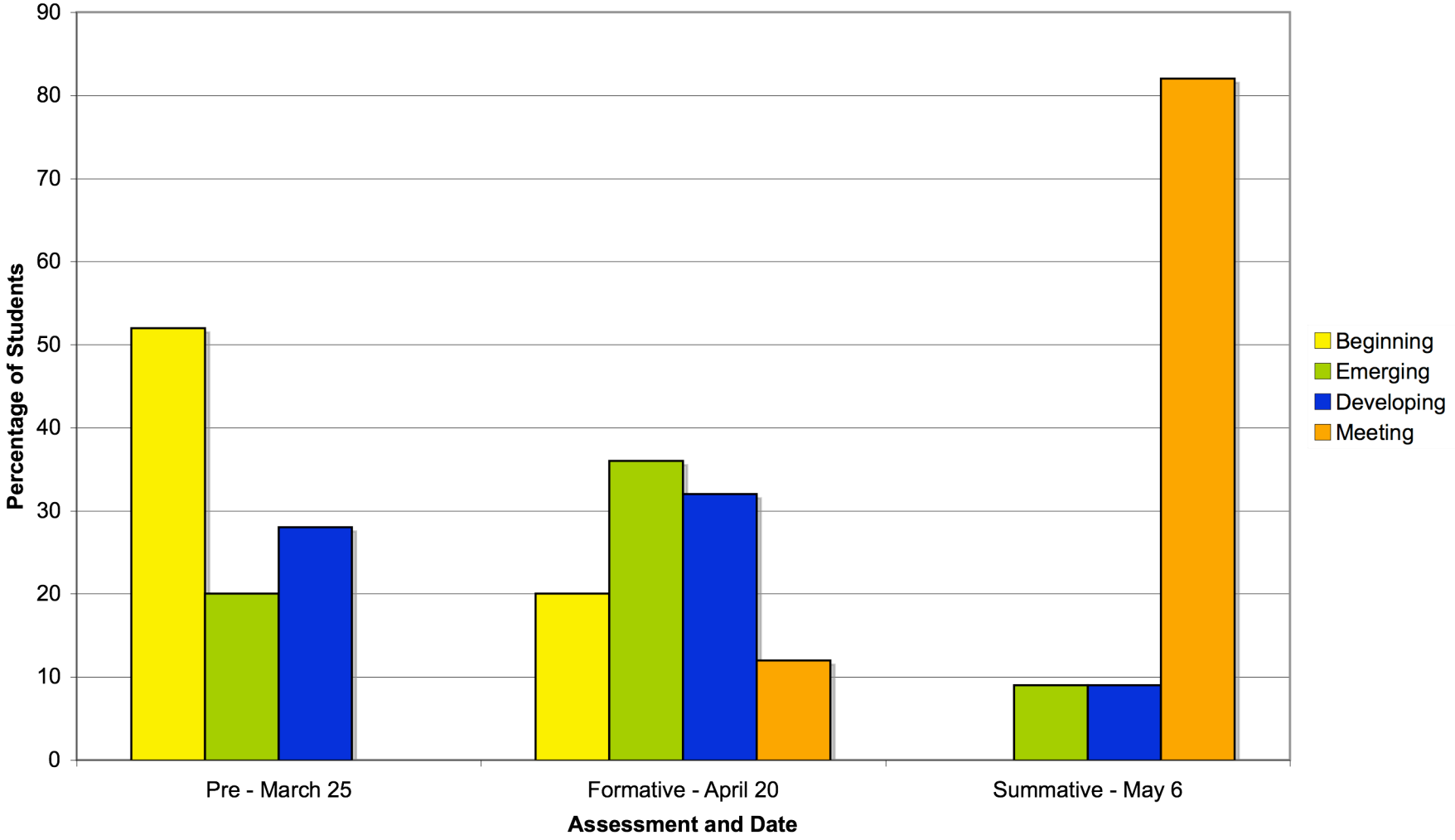


Figure 6.4 Student Achievement on Performance Expectation 7.2.H

Determine whether or not a relationship is proportional and explain your reasoning

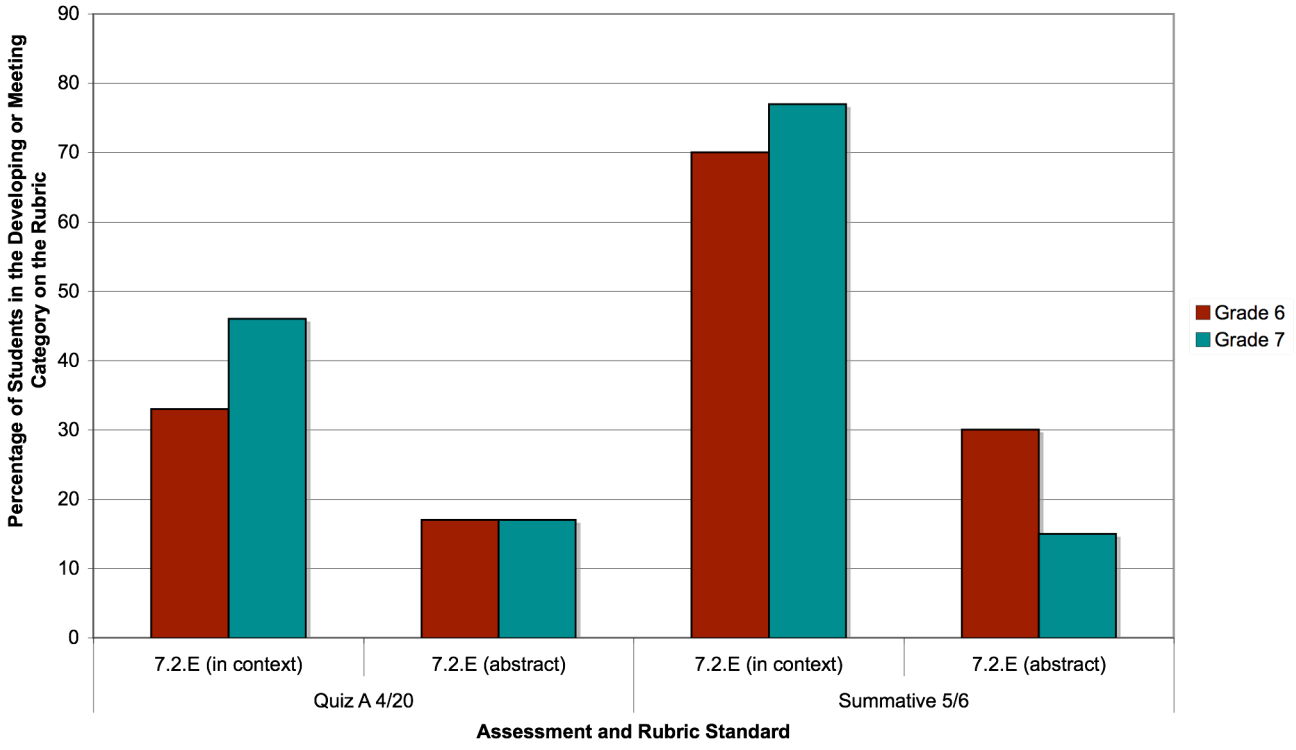


6B: Sub Group Data

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (IN CONTEXT)											
	QUIZ A				Calculating The Living Wage				Unit Test			
	B	E	D	M	B	E	D	M	B	E	D	M
Grade 6	3	5	4	0	0	4	6	0	1	2	3	4
Grade 7	1	6	6	0	0	5	6	0	0	3	3	7

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (ABSTRACT REPRESENTATIONS)															
	Pre-Assessment				Quiz A				Moving Between Models				Unit Test			
	B	E	D	M	B	E	D	M	B	E	D	M	B	E	D	M
Grade 6	4	8	0	0	2	8	2	0	4	0	3	6	2	5	3	0
Grade 7	1	12	0	0	5	5	2	0	1	0	6	5	3	8	2	0

Figure 6.5 Comparison of Student Performance by Grade Level on Performance Expectation 7.2.E



6C: Case Study Data

Pre Assessment Results

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations			
	Beginning	Emerging	Developing	Meeting
	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.
Ty		X		
Marcela	X			
Iliana	X			
Class	5	21	0	0

	7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.			
	Beginning	Emerging	Developing	Meeting
	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.
Ty		X		
Marcela		X		
Iliana		X		
Class	2	20	0	0

	7.2.H Determine whether or not a relationship is proportional and explain your reasoning.			
	Beginning	Emerging	Developing	Meeting
	The student does not accurately identify linear and nonlinear relationships from graphs or tables.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables some of the time but does not say why the relationship is linear or nonlinear.	The student accurately identifies linear and nonlinear relationships most of the time from graphs, and/or tables but provides only an explanation of the process for identification that is only partially complete.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables and provides a clear explanation of their decision making that demonstrates an understanding of the constant rate of change.
Ty			X	
Marcela	X			
Iliana	X			
Class	13	5	7	0

Formative Assessment Results

4/13/09 Exit Slip – Identifying Slope and Writing Equations

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations			
	Beginning	Emerging	Emerging	Developing
	The student does not accurately determine the slopes of lines from a graphic representation.	The student accurately determines the slopes of some lines from graphic representations.	The student consistently and accurately determines the slopes of lines from graphic representations.	The student accurately determines the slopes of lines from graphed representations and uses these slopes to write accurate equations in the y = mx form.
Ty		X		
Marcela	X			
Iliana	X			
Class	4	16	2	2

4/20/09 QUIZ A

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (IN CONTEXT)			
	Beginning	Emerging	Developing	Meeting
	The student accurately identifies familiar proportional relationships but does not represent these relationships using graphs, tables, or equations.	The student accurately represents familiar proportional relationships using graphs, tables, or equations.	The student accurately represents familiar, simple proportional relationships using graphs, tables and equations (y = mx).	The student accurately represents familiar, but more complex proportional relationships using graphs, tables and equations (y = mx + b).
Ty			X	
Marcela		X		
Iliana	X			
Class	4	11	10	0

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (ABSTRACT REPRESENTATIONS)			
	Beginning	Emerging	Developing	Meeting
	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.
Ty		X		
Marcela			X	
Iliana		X		
Class	7	14	4	0

	7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.			
	Beginning	Emerging	Developing	Meeting
	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.
Ty			X	
Marcela		X		
Iliana	X			
Class	2	14	6	2

	7.2.H Determine whether or not a relationship is proportional and explain your reasoning.			
	Beginning	Emerging	Developing	Meeting
	The student does not accurately identify linear and nonlinear relationships from graphs or tables.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables some of the time but does not say why the relationship is linear or nonlinear.	The student accurately identifies linear and nonlinear relationships most of the time from graphs, and/or tables but provides only an explanation of the process for identification that is only partially complete.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables and provides a clear explanation of their decision making that demonstrates an understanding of the constant rate of change.
Ty	X			
Marcela		X		
Iliana			X	
Class	5	9	8	3

4/27/09 Exit Slip – Moving Between Models

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (ABSTRACT REPRESENTATIONS)			
	Beginning	Emerging	Developing	Meeting
	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.
Ty			X (y = mx + b)	
Marcela		X (y = mx + b)		
Iliana		X		X (y = mx)
Class	3 (y = mx) 2 (y = mx + b)	0	1 (y = mx) 7 (y = mx + b)	5 (y = mx) 6 (y=mx)

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (IN CONTEXT)			
	Beginning	Emerging	Developing	Meeting
	The student accurately identifies familiar proportional relationships but does not represent these relationships using graphs, tables, or equations.	The student accurately represents familiar proportional relationships using graphs, tables, or equations.	The student accurately represents familiar, simple proportional relationships using graphs, tables and equations (y = mx).	The student accurately represents familiar, but more complex proportional relationships using graphs, tables and equations (y = mx + b).
Ty			X	
Marcela			X	
Iliana			X	
Class	0	9	12	0

	7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.			
	Beginning	Emerging	Developing	Meeting
	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.
Ty				X
Marcela				X
Iliana		X		
Class	0	4	8	9

Summative Assessment Results

5/6/09 Unit Test

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (IN CONTEXT)			
	Beginning	Emerging	Developing	Meeting
	The student accurately identifies familiar proportional relationships but does not represent these relationships using graphs, tables, or equations.	The student accurately represents familiar proportional relationships using graphs, tables, or equations.	The student accurately represents familiar, simple proportional relationships using graphs, tables and equations (y = mx).	The student accurately represents familiar, but more complex proportional relationships using graphs, tables and equations (y = mx + b).
Ty				X
Marcela			X	
Iliana	X			
Class	1	5	6	11

	7.2.E Represent proportional relationships using graphs, tables, and equations and make connections among the representations (ABSTRACT REPRESENTATIONS)			
	Beginning	Emerging	Developing	Meeting
	The student does not yet demonstrate and understanding of the connection between abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables and graphs as abstract representations of proportional relationships.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and can creates graphs and tables to match equations, but does not write equations that match graphs and tables.	The student demonstrates an understanding of the connection between tables , graphs, and equations as abstract representations of proportional relationships, and moves easily between these representations.
Ty		X		
Marcela			X	
Iliana	X			
Class	5	13	5	0

	7.2.G Determine the unit rate in a proportional relationship and relate it to the slope of the associated line.			
	Beginning	Emerging	Developing	Meeting
	The student inaccurately determines the unit rate in context-based problems or never applies the unit rate to solve problems.	The student accurately determines the unit rate of proportional relationships but does not yet associate this with the slope of a line represented by graphs or equations. The student uses the unit rate to accurately solve problems some of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by either a graph or an equation, but not both. The student uses the unit rate to accurately solve problems most of the time.	The student accurately determines the unit rate of proportional relationships and associate this with the slope of a line represented by graphs and equations. The student uses the unit rate to accurately solve problems all of the time.
Ty				X
Marcela				X
Iliana			X	
Class	0	3	8	12

	7.2.H Determine whether or not a relationship is proportional and explain your reasoning.			
	Beginning	Emerging	Developing	Meeting
	The student does not accurately identify linear and nonlinear relationships from graphs or tables.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables some of the time but does not say why the relationship is linear or nonlinear.	The student accurately identifies linear and nonlinear relationships most of the time from graphs, and/or tables but provides only an explanation of the process for identification that is only partially complete.	The student accurately identifies linear and nonlinear relationships from graphs, and/or tables and provides a clear explanation of their decision making that demonstrates an understanding of the constant rate of change.
Ty				X
Marcela			X	
Iliana				X
Class	0	2	2	19

Figure 6.6 Case Study Student Progress on Performance Expectation 7.2.E (in context)

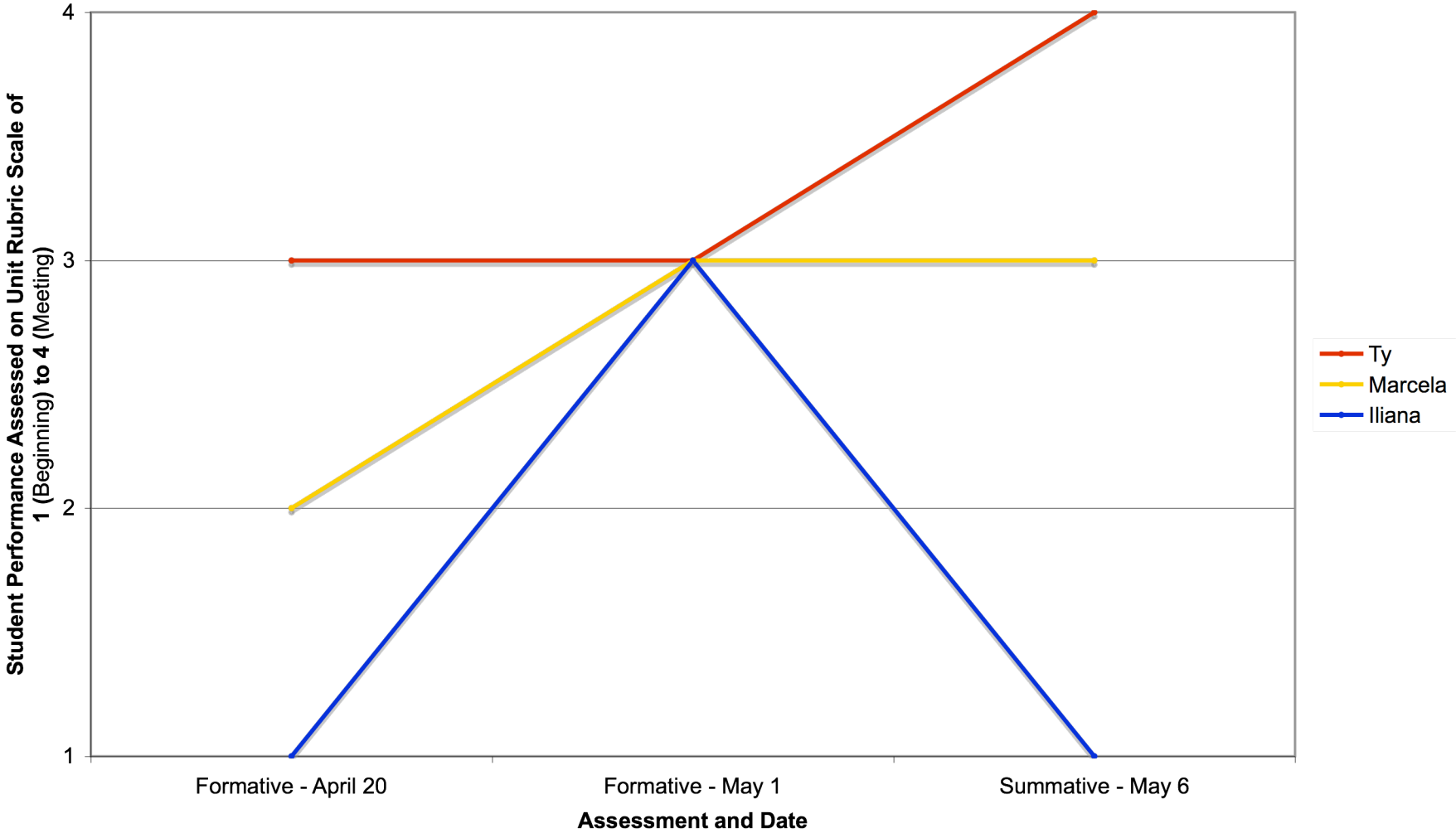


Figure 6.7 Case Study Student Progress on Performance Expectation 7.2.E
(abstract representations)

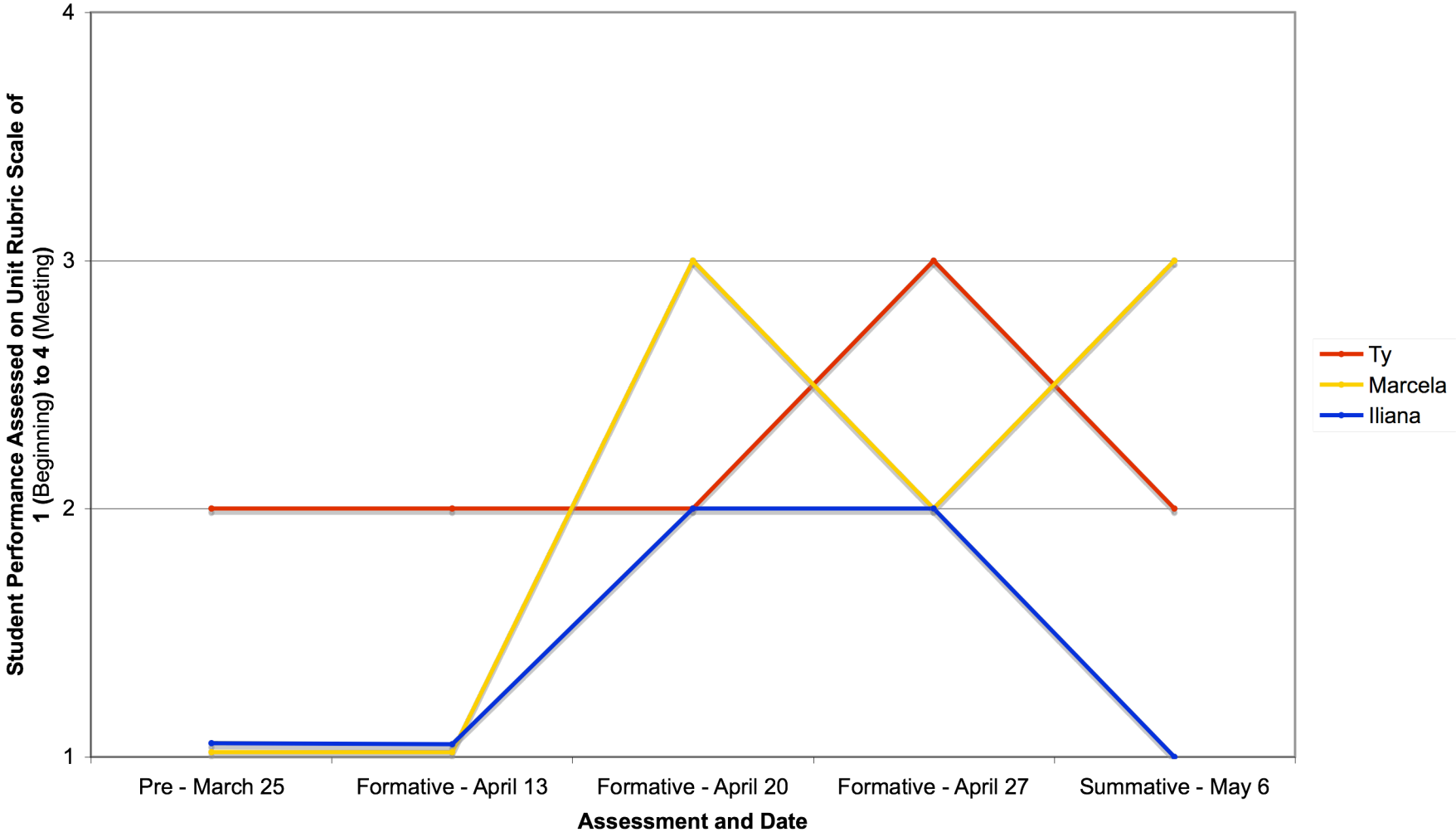


Figure 6.8 Case Study Student Progress on Performance Expectation 7.2.G

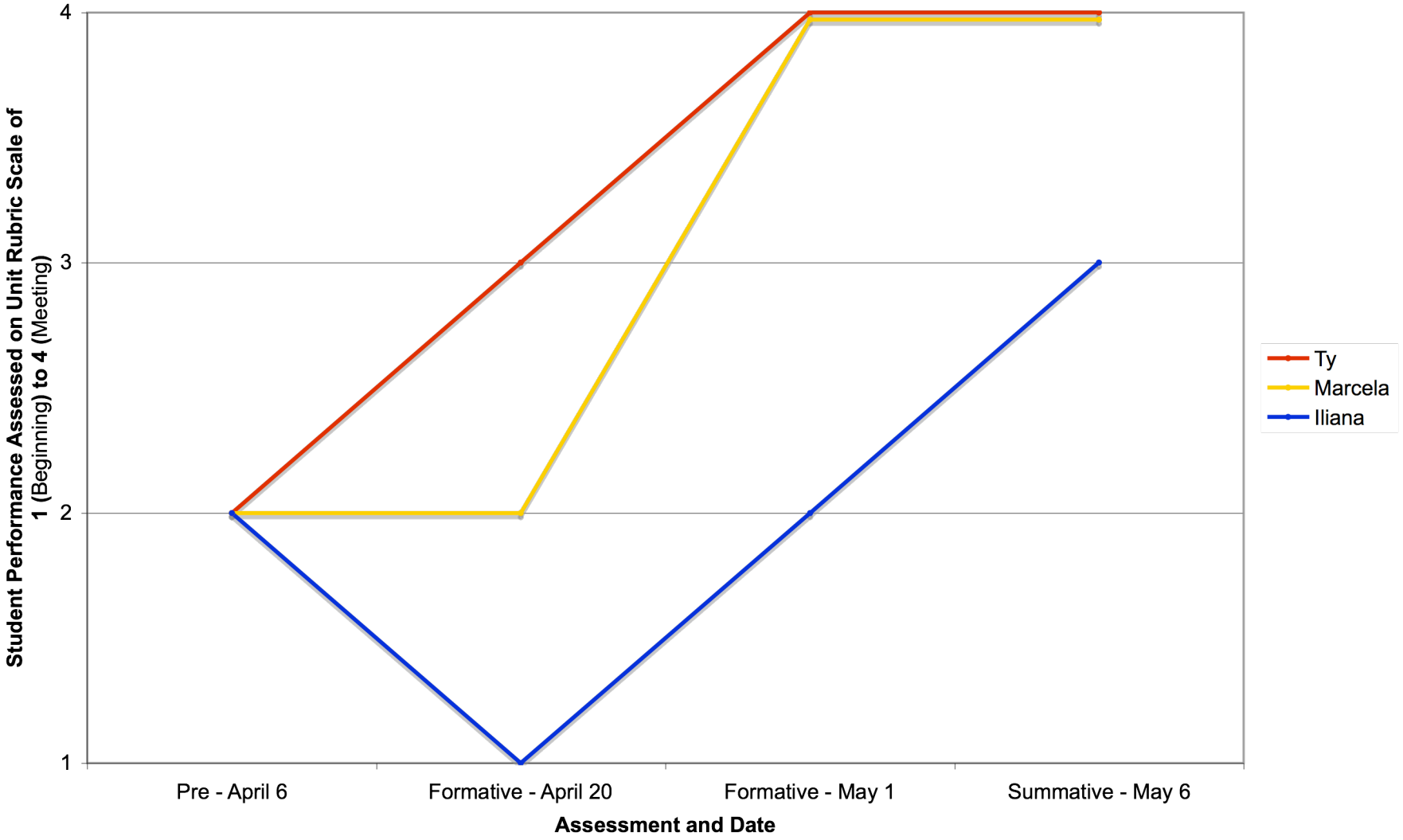
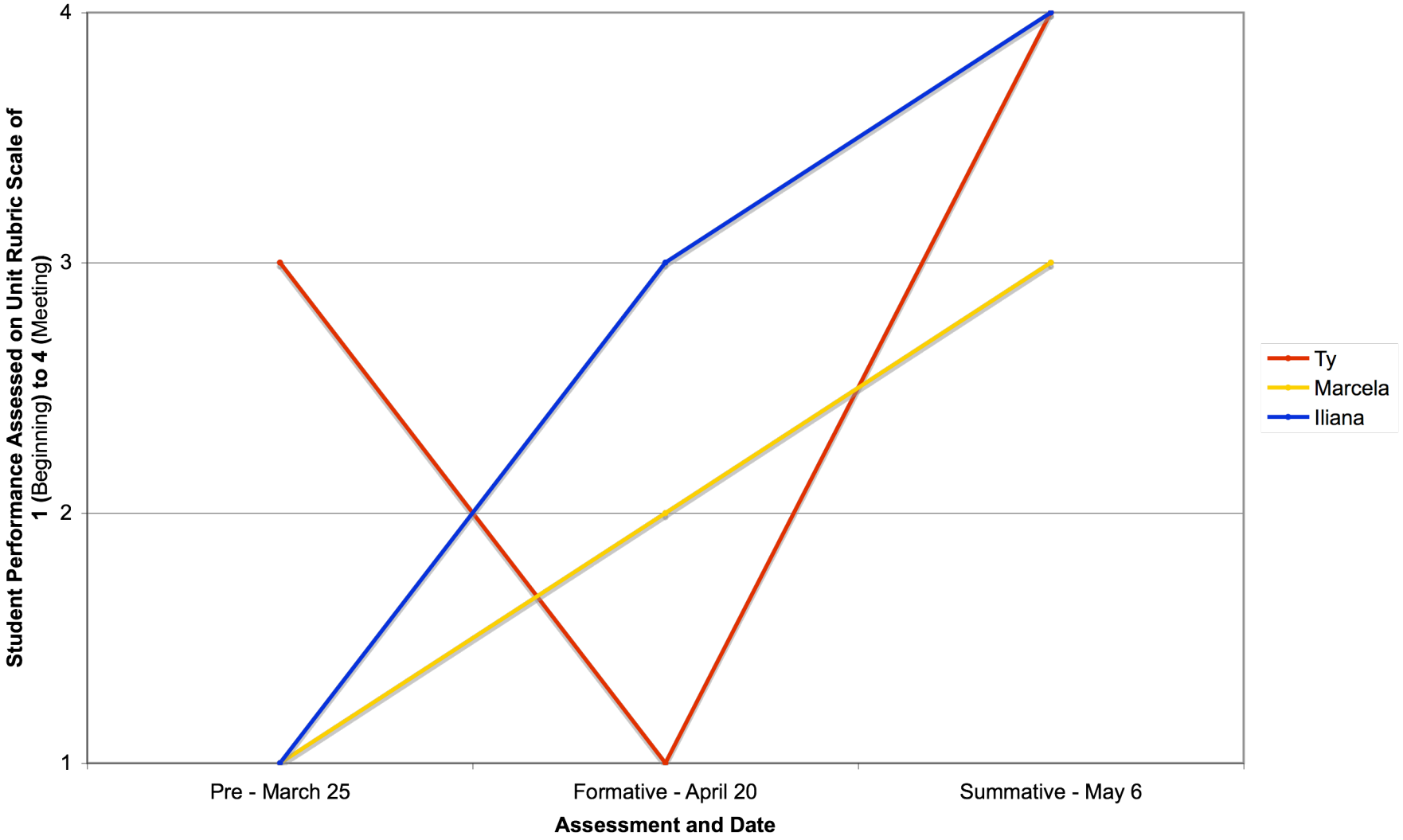


Figure 6.9 Case Study Student Progress on Performance Expectation 7.2.H



6D: Examples of Student Metacognition

(a) What have you learned about the relationship between slope and rate of change in this unit?

- *"I learned that the rate of change affects the slope."*
- *"If the rate of change is constent then it is linear"*
- *"I find slope to be rather easy now that I understand it. Slope is rise over run and y equals the slope(x) + b. Rate of change is the rate at which something chang. Rate of change and slope are basically the same."*
- *"If your slope is negative then your rate of change will be negative as well."*

(b) What have you learned about y-intercept in this unit? How is it different from slope?

- *"y-intercept is where the line crosses the y axis. Slope is the steepness of the line."*
- *"y-intercept is where the line passes the y-axis."*
- *"It's different because it's at which point des the y reach x's 0 and the slope is each time x goes 1 how many times y goes over.*
- *"I learned that the y-intercept is where the linear line crossed the y line of 0. Its different from slope because it tells where it goes into the positive and negative."*
- *"I learn that it is the breakpoint from the negative 'chamber' to the positive 'chamber.' It is different from slope because slope is the steepness of the line."*

c) What strategies are available to you if you're asked to represent a linear equation as a graph and aren't quite sure where to start?

- *"You can see if there are patterns that will show up on a graph."*
- *"You can create a table fist or an equation but it depends on the person because maybe they can come up with a different strategy that works better for them."*
- *"I would start with a table so after your done with that you know actzactly what to graph."*
- *"I could make a table and go from there."*
- *"You start by finding the first pair (x,y), then plotting the points."*

d) How do linear relationships relate to real world situations?

- *"They relate to real world situation like if a company wants to make a graph about whatever it is they would need to know about linear relationships."*
- *"They relate to real world to calculate population, money, sales, etc. to a graph to an equation."*
- *"Linear relationships relate to real world situations because if I were to graph some salary or hw much they make an hour, the relationship would be linear.*
- *"I think if you get a job you need to know how much you're getting paid."*
- *"A linear relationship could represent a paycheck or a bill, just some regular expense."*

e) How did our unit on linear relationships relate to learning you've done before in math?

- *"We did a lot of things that had to do with money which we did at JA [Junior Achievement] finance."*
- *"The linear relationship unit related to multiplication and division."*
- *"It related to fractions and alot of algebra."*
- *"They relate because in class we have done quite a lot of graphs before."*
- *"We've done patterns and equations earlier in the year."*

f) How are you being evaluated on your understanding of concepts in this unit?

- *"I'm being evaluated by on my understandings by showing that I know how to make linear, slope, equasions, and tables on a graph."*
- *"By being asked verbal questions, written questions, self assessments, and tests."*
- *"By the rubric."*
- *"I'm being evaluated based on the criteria paper."*
- *"I am being evaluated by my understanding of slope, linear equation/relationships, by my ability to answer all questions, and my attentiveness toward the unit."*

6E: Case Study Student Work

Section 7: Teacher Reflection and Self-Evaluation

Although my students showed success on several of the learning goals in the unit, the learning goal on which my students made the most significant and consistent progress was identifying linear relationships (Performance Expectation 7.2.H). I have several hypotheses about why almost all of the students showed progress on this learning outcome. First, although fewer lessons in this unit were concentrated on this learning outcome than on other learning outcomes, this was a key concept that we returned to and addressed in almost every lesson, whether it be during the entry task, investigation, or debrief. Additionally, I had an easier time identifying and targeting student misconceptions on this learning outcome, whereas on some of the others I either struggled to figure out what was standing in the way of students' understanding or their making mistakes, or my attempts to target their misunderstandings or misconceptions were not as effective. Additionally, as mentioned in Section 6, I intentionally removed many of the distractors from the problems on unit test. However, this was true of problems on all of the standards, so I do not think this would have had as significant an effect on this standard alone.

My students were least successful on the learning goal that targeted moving between abstract representations of linear relationships. As mentioned before, I think that developmentally, this level of abstraction is difficult for students in sixth and seventh grade, and that many of them struggle with these concepts because they are edge of developmental appropriateness. In discussing the results of this unit with my mentor teacher, she revealed that her students from previous years had shown similar levels of performance in this unit. However, I also think that two components of my instruction could have been improved to help the students better connect and move between abstract representations. First, I could have done a better job setting up investigations, debriefing and providing mini lessons to really help students see how these models connect. Second, I don't think I gave the students enough

opportunity to practice and see the connections between these models. Particularly because the task on the summative assessment asked them to draw missing representations, whereas a lot of previous tasks had only asked them to match representations.

Several professional development goals emerged for me when reflecting on my teaching during this unit. The first one is to work on improving my ability to identify student minsconceptions using formal and informal methods of assessment. In particular, I plan to focus on having students do more writing about their mathematical procedures and thinking to go along with their work on assessments, so I can get a better picture of their thinking about the concepts. Additionally, I plan to develop a better record-keeping system (comprised of rubrics and checklists) for keeping track of student answers on questions posed and responded to verbally). The second major professional development goal I set for myself is to work on clarity in teacher talk, direction giving, and intentionality in debriefing discussions. I plan to do this through better planning and rehearsal, as well as maintaining more focus on my goals for each days' lesson, with the goal of helping students obtain a clearer and more sophisticated understanding of the mathematical concepts in this and other units.