Title of Lesson: Reversibility of Linear Equations – Multiple Representations
UFTeach Students' Names: Heather McNeill

Teaching Date and Time: 11/15/2012

Length of Lesson: 50 minutes

Grade / Topic: 8th grade Algebra I Honors

Source of the Lesson: TI – Education – Math Inspired: Multiple Representations

http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5022&t=5030&id=11347

Appropriateness for Middle School Students:

This lesson is appropriate for middle school students because it teaches math that is set in a real-world context through technology. Students can relate to the given situation about a student earning money through both an allowance and a part-time job. Students are about to manipulate the equation, the values in the table and the points on the graph, this allows for students to explore the concept and make connections about the three different representations. Exposing students to three different representations appeals to multiple types of learners. Students are provided the opportunity to work individually as well as in small group settings.

Concepts:

Many times teachers incorporate multiple representations into their lessons when teaching topics such as linear equations. Providing students with the symbolic representation, or equation, and asking students to them make a table that follows the equation and from table to graph the points to see the graph of the equation. Thus students understand that these three ideas are connected, but it has shown that most students think that the relationship is one way; we start with the equation, then make the table then make the graph. When really, it is crucial that students see that you can begin with any of the three and come up with the other two. There is no particular order to follow. Teaching through multiple representations, it is important to not always begin with the same form of a question, similarly, don't always asses the same form. Students should understand that they can be asked to work with any of the taught forms, they are all equally weighted.

Rider, R. Shifting from Traditional to Nontraditional Teaching Practices Using Multiple Representations,

Mathematics Teacher. March 2007 p.494-500.

Florida State Standards (NGSSS):

- MA.912.A.3.9: Determine the slope, ~~x-intercept~~, and y-intercept of a line, given its graph, ~~equation~~ or two points on the line. Basic application of Skills and Concepts

Performance Objectives

- Students will be able to identify the y-intercept in a table, and as an ordered pair on a graph.
- Students will be able to recognize the slope of a line using a table or a graph.
- Students will be able to compare aspects of a function when viewed symbolically, in a table, or as a graph.

Materials List and Student Handouts

- 27 student exploration sheets
- 27 student evaluation sheets
- 27 TI-Nspire calculators
- 27 sheets of graph paper
- SmartBoard

Advance Preparations

- Prepare and open SmartBoard presentation
- Copy student forms
- Be prepared to send "Multiple Representations" file to student calculators
- Instruct students to pick-up calculators as they enter the room

Safety

- There are no significant safety concerns.

5E Lesson Templates

ENGAGEMENT		**Time: 3 minutes**
What the Teacher Will Do	**Teacher Directions and Probing Questions**	**Student Responses and Potential Misconceptions**
Students are presented with an analogy to the multiple representations lesson. Ask the EQ.	What do you see in this slide? What do all of these things have in common? What do these pictures help us to do? What are multiple ways we can work with and view linear equations?	[an apple, applesauce, apple pie, and a caramel apple] [They all have apples in them.] [They help us think about the different ways we can eat apples/use apples/ see apples.] [equation, table, graph]
EXPLORATION		**Time: 25 minutes**
What the Teacher Will Do	**Teacher Directions and Probing Questions**	**Student Responses and Potential Misconceptions**
The teacher will assist the group leader in passing out the student exploration sheet. Each student should have a TI-Nspire and an exploration sheet. Ms. McNeill will request Mrs. Olsen's help with sending out the file "Multiple Representations" to the student calculators. The teacher will ask for a student volunteer to read the **Problem Situation** at the beginning of the student WS. The teacher will ask other students to clarify the situation we are working with.	 Please, will somebody read the **Problem Situation** at the top of the student sheet? Thank you. Who will now explain in their own words what is going on here?	 [Tricia gets paid an allowance each week and also works at her job. The amount of money she is paid will depend on the amount of hours she works at her job.]
The teacher will instruct students to	Look around at the calculator page	

look at page 1.1 on their calculator. A student will read page 1.1 to the class and the teacher will instruct students to move to page 1.2 The teacher will instruct students to work individually on problems 1 – 4 The teacher will circulate throughout the room asking HOT questions.	1.2; notice that you can change values and points on the graph. You will now work individually on the first 4 problems. If you finish early you may go on to the next problems, but you should really focus on explaining numbers 1-4. You have 5 minutes. What do you know about the y-intercept? What does it look like in an equation/graph/table? What does the y-intercept represent in our situation? What do the h and i(h) mean on the graph? How does this relate to our table? How do you figure out how much she earns when working a specific number of hours?	[It is where the x-value is 0.] [In an equation it is = b, graph is where the line crosses the y-axis, table is where x = 0.] [It shows how much money she gets when she works 0 hours.] [h = hours, it is the independent variable, it lies on the x-axis on the graph and is in the left column on our graph, i(h) = the amount of money Tricia gets in relation to the number of hours she works, it is the dependent variable and lies on the y-axis and in the right hand column.] [Find that value on the horizontal axis and go up to the line, plug that time into the equation, find that time in the table.]
The teacher will now have students stop working and find their partner. Persons 1 and 2 are a pair; persons 3 and 4 are a pair. (Student desks are numbered 1-4) The teacher will circulate throughout the room asking HOT questions.	Now you need to partner up, persons 1 and 2 are together, persons 3 and 4 are together. Talk through 1-4 with your partner. You have 2 minutes. The same questions asked above will continue to be asked to different students.	
The teacher will instruct students to work individually on problems 5 - 8	You will next work individually on numbers 5-8. You have 5 minutes. What did you find for the rate? What would the units be for that? Explain? How many hours would she have to work to make $100? How do you know that?	[$6.50/hr, dollars per hour] [14 hours, I plug it into my equation, I look at my graph, I look at my table.]

	What is the most she can make in a week? Could there be a week where she makes only $5? Explain.	[$140, she makes $10 allowance and the most she can make from work in a 20 hour week is $130, so $140 is the most.] [No, she will always make the $10 from her allowance.]
The teacher will now have students stop working and find their partner. Persons 1 and 3 are a pair; persons 2 and 4 are a pair. The teacher will circulate throughout the room asking HOT questions.	Now you need to partner up, persons 1 and 3 are together, persons 2 and 4 are together. Talk through 1-4 with your partner. You have 2 minutes. The same questions asked above will continue to be asked to different students.	
The teacher will instruct students to work individually on problems 9 - 12	Now you are back to working individually, finish out the sheet with 9-12. You have 5 minutes. What would the x-intercept be in our situation? Explain. How does an increase in her allowance change our representations? How does a change in her hourly wage change our representations? Which representations were easiest? When? Why?	 [It doesn't exist. We can't have a negative time value.] [The constant is changed from 10 to 15, the y-intercept is changed and the ordered pair is now (0, 15).] [The slope, rate of change and coefficient in front of the h is changed.] [It depends on what information we are looking for.]
The teacher will now have students stop working and find their partner. Persons 1 and 4 are a pair; persons 2 and 3 are a pair. The teacher will circulate throughout the room asking HOT questions.	Now you need to partner up, persons 1 and 4 are together, persons 2 and 3 are together. Talk through 1-4 with your partner. You have 2 minutes. The same questions asked above will continue to be asked to different students.	
The teacher will bring the class together to have a whole class discussion.	Let's next come together as a class to discuss our findings.	
EXPLANATION		**Time: 10 minutes**
What the Teacher Will Do	**Teacher Directions and Probing Questions**	**Student Responses and Potential Misconceptions**
The teacher will begin a	Who would like to begin our	

conversation about the activity. The teacher allows for students to discuss their findings. To ensure specific ideas are hit on, the teacher will go through the questions on the student sheet to be sure they were discussed.	discussion about what you discovered during this activity? What surprised you? What did you learn? What was hard? What was easy? (Explain each answer) (Teacher asks questions from student sheet not already mentioned – these are the same questions that were asked as probing questions during the exploration.) Why did we do this activity?	[Student answers will vary.]
ELABORATION		**Time: 7 minutes**
What the Teacher Will Do	**Teacher Directions and Probing Questions**	**Student Responses and Potential Misconceptions**
The teacher will instruct students to now create their own example of a linear equation that they will share with their group members who will come up with the other ways to represent their equation. Students will then end back up with their original paper and identify the similarities in the representations.	Now it's time for you to be creative. I am passing out graph paper, I need you to make up your own linear equation, graph it on the graph paper and then when I say you will pass the paper to your right. (2 minutes) You may now pass. Next, you should have received your group member's graph. It is your job to write **either** a table, or a linear equation to represent the graph. Then stop. (1 minute) You may now pass to your right. Everyone should have a paper that they have not yet had. You will see a graph and either an equation or a table of values. It is your job to create the third representation, the one that is not there. Once you add the third piece you should see a table, a graph and an equation. Then stop. (1 minute) Please pass to your right. You should now have your original piece of paper. You are to now mark in each representation the part	

	that tells you the y-intercept, you should circle this part. Then you will underline the part that tells you the rate of change, or slope. (2 minutes)	
EVALUATION		**Time: 5 minutes**
What the Teacher Will Do	**Teacher Directions and Probing Questions**	**Student Responses and Potential Misconceptions**
The teacher asks students to clear their desks and to work individually.	Please clear you desk and work quietly and individually for the remainder of the period. When you finish please put your calculator away. Thank you.	

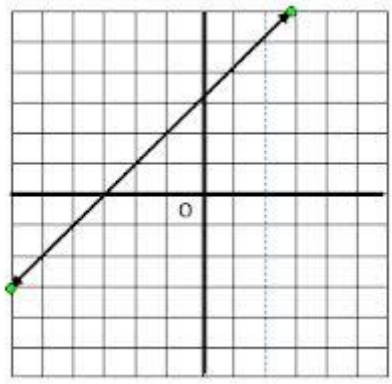
Name: _____

Evaluation

x	y
-4	-4
-2	0
-1	2
0	4
1	6
3	10
6	16

1.) What is the y-intercept?
[(0, 4)]

2.) What is the rate of change?
[2]



3.) What is the y-intercept?
[(0, 3)]

4.) What is the rate of change?
[1]

5.) Explain the relationship between a symbolic, tabular and graphical representation of a linear equation.

[Where the x-value = 0 on the graph is the y-intercept, the ordered pair (0, ?) in the table also represents the y-intercept, as does the 'b' part of an equation in slope-intercept form. Similarily, the slope/rate of change is the same in all 3 representations, the coefficient in front of the independent variable in the equation, the rate of change in the values in the table, and the slope of the graph.]