CI 402 Unit Plan
CME Project Algebra 1:
Introduction to Functions

Scenario A:
Your classroom has 24 students 40% are low socioeconomic status
2 are English Language Learners who sometimes struggle to keep up.
Many of the students do not have a great deal of motivation to get high grades

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Unit Rationale

In this unit, students will be exploring functions. They will first be asked to think about real life examples of functions using their prior knowledge of input and output. They will develop an understanding of the properties of functions of being one-to-one, having a domain and range, and having an input and output. Students will also be able to see the relationship between a table and a function as well as a graph and a function. They will know how to create a function from a table and graph. In addition, they will learn about recursive functions and how to determine a recursive rule for a function. Students will also understand how to use functions to solve real-world problems. The main goal of this unit is that the students will be able to understand different types of functions and how to use them in many situations.

Students will be expected to know a number of things before starting this unit. They should have prior knowledge in variables and understand the difference between independent and dependent variables. These are important to know because they are used to determine the input and output of a function and the domain and range. Students should also know how to graph linear equations. They will need to be able to graph their functions, especially linear functions, so being able to graph from an equation is a necessary skill. In addition, students will need to have prior knowledge in using linear graphs to solve problems. They should know how to calculate slope both from an equation and graph, find points on a linear graph from an equation, find a linear equation from a graph, and use linear graphs and linear equations to solve problems. This knowledge is essential because the students will be expected to solve problems using functions, finding functions from graphs, and creating a graph from a function, so this new knowledge will build off their previous knowledge. They will also be looking at constant differences, which relates to slope. The students should already know how to identify and generalize patterns with equations and rules, as well. This prior knowledge is needed because it is part of creating a function from a situation and also finding the recursive function from a set of data.

To meet the needs of students, several strategies will be implemented. The two English Language learners will be seated at tables that have proficient English speaking students with them. If these two students are having trouble understanding something that was said in class, they can use a dictionary that's in the room or ask their classmates to explain. Also, there will be no words or situations in class work that could be foreign to the students. The two English Language Learners should be familiar with the examples that are being used in class. However, if they are not, they will be encouraged to ask the teacher or their classmates' questions. One of the norms of the classroom will be that students should be comfortable asking any questions they have, so every student needs to be respectful. To accommodate the 40% of students that are of low socioeconomic status, no homework will be assigned that requires more than the provided textbook, work that had been handed out in class, calculator, paper, and pencil. Extra materials will be provided in class if there are lessons that require students to use supplemental materials. There are also extra calculators in the classroom that the students can check out for a night if they need to. Just like for the English Language Learners, the situations and examples that are used in class should not be unfamiliar to the students that are of low socioeconomic status. The examples that are used will not be tailored toward one way of living so that all students can feel included and feel comfortable in the classroom. To accommodate the students who do not have a lot of motivation to get high grades, the lessons will frequently be interactive so that the students have fun and are playing a role in their learning. The lessons will not be in the same structure every day, so the students should not get bored of how they are being taught.

Date	Brief Description of Content and Lesson	?Technology, Special Activities, Manipulatives, Problem-Based, Instructional Strategies?
Day 1 5/5	Unit Hook - Sections 5.1-5.3: (Exploring Functions: Looking at inputs and outputs): Students will be introduced to functions by examining inputs and outputs through function machines. To get students to start thinking about inputs and outputs, they will be asked to brainstorm properties about three machines. Then as a class, students will explore different function problems, identifying the rules, inputs and outputs, and come up with their own situations of functions. This discussion will spark interest from students for the unit because it will be interactive and incorporating real life examples.	Implementation of Technology: Students will present their ideas and work on the Smartboard to explore function machines in a more interactive way through animations. The Smartboard will allow students to explain and justify their ideas, and also provide a more visual perception of functions.
Day 2 5/6	Section 5.4 (Naming Functions: Exploring Function notation): After being introduced to functions, this lesson will allow students to write functions using function notation. The class will discuss and distinguish the differences between a function and equation. Students will identify and use function notation to evaluate inputs and outputs.	Students will work in groups of 2-3 on in-class application problems that will allow them to explore and use function notation in evaluating inputs and outputs.
Day 3 5/7	Section 5.5 (Function Inputs and Outputs: Domain and Range): Today students will develop a more in-depth understanding of domain and range by considering constraints of particular functions. In this problem-based lesson, students will be asked to first consider a real life example of a function and to express it using function notation. Then they will be given the challenge to create a non-linear function using their prior knowledge; and as a class, students will discuss about domain and range.	Problem-Based Instruction: In the launch, students will work in groups of no more than three students to come up with a real life function using function notation. For the explore, students will work in groups to come up with a non-linear function and come up with their own constraints and provide an explanation. In the conclusion, the class will present their functions and will discuss about the meaning of domain and range.
Day 4	Functions: Input, Output, Domain, and Range Review Activity:	Students will be assigned one definition in each group to create an example to explain the definition. They are

5/8	In preparation for the quiz, students will review the definitions of input, output, domain, and range of functions.	allotted 5 minutes to present their example and justify their ideas.
Day 5 Half Day 5/9	Quiz: Students will be taking the Mid-Unit Quiz.	Half day, students will take quiz.
Day 6 5/12	5.6 (Graphing functions): Today students will explore the similarities and differences of graphing equations vs. functions. In addition, students will discover what benefits graphing can offer when analyzing functions (for example, the vertical line test). Next, students will be working with a partner while going over examples and will be showing their work on mini white boards for assessment purposes.	Students will work with a partner and will use mini white boards so the teacher can gather assessment information from each student throughout the lesson.
Day 7 5/13	Section 5.7 (Getting Started on Linear Functions): This day will be about matching tables of inputs and outputs to linear functions. Students will work through example problems where they must determine if the table is describing a linear function and predict the next data points. They will also go through some real-world examples with the same tasks, but also they will have to say what kinds of factors would affect their predictions.	Students will work in groups. Students will go over the problems on the board as a class after finishing their work with the group.
Day 8 5/14	Section 5.8 (Constant Differences): Students will work this day on finding and using constant differences. They will learn what a constant difference is and find it from a data table. They will then learn how to use the constant difference in functions and in graphs with slope.	Students will work in groups. Students will go over the problems on the board as a class after finishing their work with the group.
Day 9 5/15	Section 5.11 (From Situations to Equations): Today, students will work on creating functions that correspond to certain situations. They will be given word problems and will build function machines to help them create the function. They will also use their functions to look deeper	Students will work in groups. They will use mini-white boards to show their answers to the class when the group has finished.

	into the situation and answer questions about the situation.	
Day 10 5/16	Section 5.11 (From Situations to Equations - Day 2): This day is a continuation of Day 9. Students will review what they had done the day before and then start creating a situation for a given function. They will use the problems from the day before as a guide.	Students will work in groups. They will use the strategy “writing to learn”.
Day 11 5/20	Section 5.9 (Recursive Rules): Today students will be learning a new concept, recursive rules. By using their prior knowledge of constant differences in order to identify a recursive rule specific to a table of information. Students will then work in groups in order to identify appropriate recursive rules.	Students will work in groups and present their findings/ideas to the rest of the class.
Day 12 5/21	Section 5.12 (From Situations to Recursive Rules) In this lesson, students will be going deeper into the understanding of recursive rules by looking at word problems and real life situations. They will start by working through some examples as a class and then work in groups in order to create their own situation given a recursive rule.	Students will work in groups to create a word problem, given a recursive rule, and then exchange their problems with one another to have their peers solve them.
Day 13 5/22	Review: Today students will be playing a Jeopardy-style review game in order to prepare for their test tomorrow.	Students will be divided into groups and will work together in order to solve problems that will be similar to those on the test.
Day 14 5/23	Test: Today students will be taking their chapter test.	Testing.

C&I 402: Group Unit Plan Project

Day 1 Lesson Plan
Jennifer Dao
Date: 5/10/12
Grade Level: 9th Grade
Course: Algebra I
Time Allotted: 50 minutes
Number of Students: 24

Lesson 1: Exploring Functions: Looking at inputs and outputs

Goal(s):

To develop the ability to identify the properties of functions as well as begin analyzing functions through generalizing patterns and understanding relations through input and output (NCTM Algebra Standard: "Understand patterns, relations, and functions" (NCTM, 2000).

Objective(s):

- Students will define a function through recognizing the relation between input and output.
- Given a scenario representing a function, students will identify the set of inputs and set of outputs.
- Students will determine the rule of a function.
- Students will apply their working definition of function to create functions in real life situations.

Materials and Resources

- Smartboard to present slides and allow students to display work and explain ideas.
- Students expected to bring a pencil & daily journal for taking notes (24).

Motivation: (5-10 min)

1. Ask students to "List all the properties you know about the three given pictures on the Smartboard: camera, soda machine, and car. Can you think of some generalization that relates these three things?" Allow students wait time to brainstorm and jot down their thoughts in their daily journal around 2-3 minutes.
2. After students brainstorm, have a discussion about the relationship between students' observations and functions in mathematics.
    a. Allow students to share their observations to the class and list them on the board. Some possible student observations include:
        i. Camera- input: film, batteries, image; output: photo
        ii. Soda machine- input: money coins, dollar bills; output: can of soda
        iii. Car- input: gas; output: distance
3. Ask students, "how may this relate to math?" Students may see that all machines require an input and output. Tell students that similar to functions in the real world, in

mathematics, functions represent a relationship between a set of inputs and outputs. To better understand functions, we will explore them using function machines.

4. Then ask students what other real life situations can they think of that requires an input and an output. Have students brainstorm list their contributions on the board.
    i. Some possible ideas from students include: computers, calculating cost, population, etc.
    ii. Let students know that, "we will be discussing in detail about input and output and how that relates to functions in class. Be prepared to think about these examples when you work with a partner at the end of class to come up with a real life example of a function (this will be the exit ticket for students to submit before they leave class).

Transition: Explain to students, "as we are beginning to think about what it means to have an input and output, throughout the upcoming weeks, we will be investigating the characteristics of functions; today we will deduct a working definition of function through focusing on inputs and outputs by working with function machines"

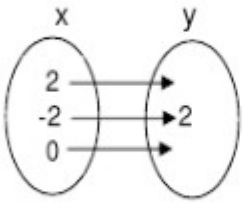
Lesson Procedure: (45-50 min)

1. (5 minutes) Tie the motivation into the lesson by explaining; "through examining real life examples of inputs and outputs from the beginning of class, we can define a function in mathematics as a rule that relates inputs to outputs." Show students that functions can be presented in multiple ways. "The following shows examples of multiple representations of functions through tables, graphs, and mappings. Ask students to think about what do they see in common among all three representations of functions. Allow them wait time to brainstorm for a few minutes then discuss as a class. Students may recognize that all three examples have a set of x values and a set of y values. Once they recognize the set of x values and y values, explain to students the set of x values represent the inputs and the set of y values represent the outputs.

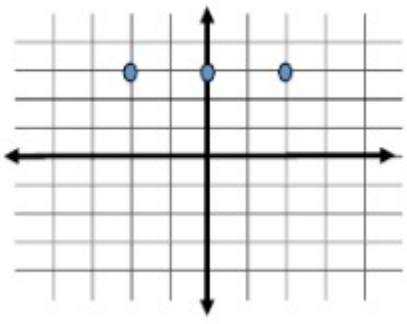
Table

x	y
2	2
-2	3
0	-1

Mapping

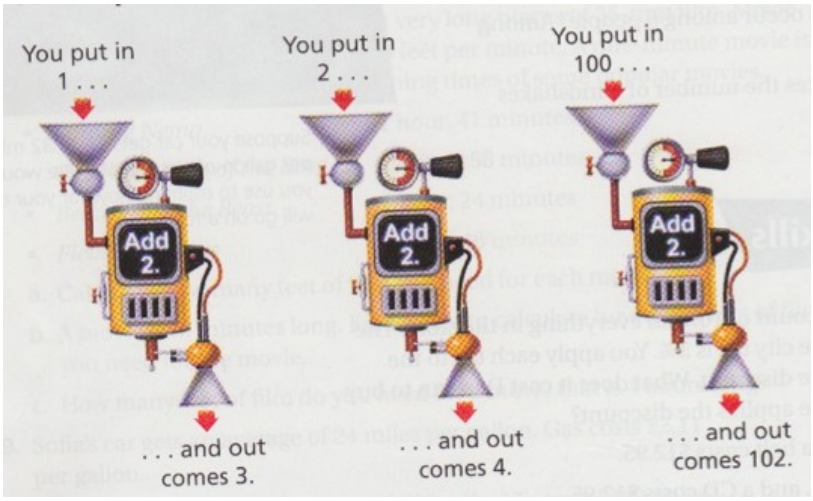


Graph



2. (5 minutes) Continue discussing multiple representations by introducing to students that one simple way to think about a function is to refer to a function machine—you put something into the machine and then it sends something out." Present students a picture of a function machine, referring to page 420 in the CME textbook. On the smartboard, have the function machines work with animations (function machine game) and allow

students to come up to the board and place inputs into the machine, receiving outputs. Students will then determine the rule of the function as a class.

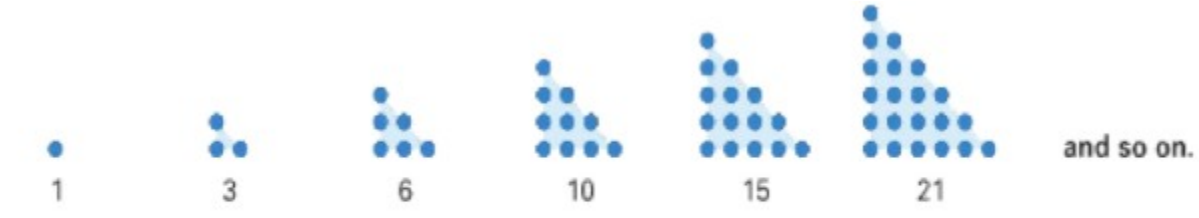


3. Ask students what do they notice about inputs and outputs of a function. Students may respond, "for whatever input you place in the machine, you get a different output." Conclude with the students that a function is a rule that assigns every element from the set of inputs to exactly one element from the set of outputs.
4. (10-15 min) Show students examples of functions using function machines. Explain to students that functions map inputs to exactly one output. Ask students are functions machines the only way to represent functions? Give them a few minutes of wait time to brainstorm. Some students may have an idea, creating a table or chart of the numbers. Tell students that as mentioned earlier functions can be presented through descriptions, function machines, tables, mappings, and graphs. Present students different problems to work as a class in determining whether the given rule is a function:
    a. Example 1: Present students a "rule" in the function machine that is not a function: Add 2 or 3 to the input.
        i. Ask students, "Does this rule represent a function? Why or why not? Take a few minutes to jot down your predictions in your notebook and discuss with the person next to you"
        ii. Give students a few minutes of wait time to think about the question to determine whether or not the rule is a function.
        iii. Students should recognize that there are two possible outputs for one input, which does not satisfy the definition of a function.
        iv. To incorporate multiple representations, ask students to explain their reasoning and allow students to write their explanation on the Smartboard if they created a table or chart. For instance, students may show that if you put in 3 as the input, the output is either 5 or 6 and a function does not have two outputs for one input.
    b. Example 2: Given the rule: "Add 4 to the input and square the result" determine whether or not it defines a function. Explain why or why not.
        i. Ask students, "Does this rule represent a function? Why or why not? Take a few minutes to jot down your predictions in your notebook."

ii. Allow students wait time to work on this problem. Students should recognize that for every input there is exactly one output.
iii. To incorporate multiple representations, ask students to explain their reasoning and allow students to write their explanation on the smartboard if they created a graph, table or chart.

Transition: Now that students have been accustomed to the notion of input and output in functions, present students the definition of domain and range in preparation for future lessons; the set of inputs is called the domain and the set out outputs that a function produces is the range.

1. (10 min) The following statements are functions. These scenarios will help students think about the domain and range as the set of inputs and outputs respectively. The teacher should ask students to explain their reasoning behind which is the domain and which is the range. A misconception that students may have is mixing up the domain and range. Students should think of "function of" as the result of an input; they should think of a function as requiring an input to produce an output. So for instance, salary is an outcome of skill level therefore it is an output. Have students discuss with a partner and identify the domain and range in the following scenarios (CME pg 431):
    a. The salary of a worker is a function of his or her skill level
    b. The price of an advertisement during a television show is a function of the number of viewers
    c. The magnitude of a sonic boom is a function of an airplane's weight and fuselage length.
    d. The call number is a function of the library book
2. (10 min) The following problem is a problem that can be continually referred to when exploring functions. For the purposes of this lesson, students will become acquainted with the domain and range of this problem by examining the set of inputs and outputs
    a. The diagram shows the first six triangular numbers that have a pattern. Ask students to work with a partner in creating an input output table that describes the pattern.
    b. As students work with their partner, walk around the class to observe students work, as students work on creating a table of inputs and outputs.
    c. Then ask does the table represent a function, why or why not? Ask students to describe the domain and range.



Closure: "We started class, getting in the mindset of thinking about inputs and outputs. Today, we have discovered that functions have exactly one output for every input."

i. As an exit ticket for students to submit before they leave class, they will be asked to come up with a real life example of a function, giving the set of inputs and outputs and justifying why the example is a function.
ii. Assign students homework problems from page 423 numbers 1-6
iii. Explain to students that developing a solid definition of functions and identifying its characteristics will help in understanding its properties. Through exploring the properties of functions, they will be able to use functions to interpret various relations such as population growth, baseball statistics, and metric conversions.

Extension: Have students work in groups to come up with 3 examples of functions (real life example, ordered list of numbers, graph, table, etc), generating their own list of inputs and outputs and have them justify why their description fits the definition of a function. Students may work in groups of no more than three students. This activity will allow students to summarize what they have learned in class today, applying definitions of input, output, and functions

Assessment:
Students will be assessed through formative assessment. Students are required to brainstorm throughout the lesson as the teacher asks them to think about various situations and ideas—to determine whether or not the given rule is a function, to justify their answers, and presenting and explaining their ideas to classmates on the Smartboard. Moreover, the exit ticket and homework assignment are additional ways to assess students' understanding of the definition of functions, inputs, and outputs.

Standards:
8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.1
8.F.2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F-IF.1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

These standards listed are incorporated into the lesson as students identified whether or not the given relation was a function; they applied the definition of functions by recognizing that they were relations that had an input assigned to exactly one output. Students were shown a preview of how functions can be presented in multiple ways through graphs, tables, and descriptions—representations that they will explore deeper in future lessons.

Day # 2:	Section 5.4 Exploring Function Notation
Goal:	To develop the ability to identify function notation and distinguish the differences between functions and equations.
Objectives:	Students will determine the differences between a function and an equation. Students will identify the two forms of function notation expressed as f(x) or arrow notation. Students will interpret function notation to evaluate inputs in the domain of a function.
Lesson Summary (one paragraph maximum)	Review homework solutions from the previous class and answer any questions. Then start off the class explaining to students that representing functions algebraically is the shortest and easiest to use, giving information that other descriptions (graphs and tables) do not always show. For instance, if you want to find out what happens to a particular quantity in the long run, i.e. population of an animal increasing or decreasing. The teacher will present examples of equations (y=2x+5, y=x^2+9, etc.) on half of the board. Then remind students that they have worked with equations before. On the other side of the board, the teacher will present examples of functions (f(x)=2x+5, f(x)=x^2+9, etc.) Ask students to think about what differences do they see between the notation of an equation and a function. A possible misconception could be that some students may perceive f(x) as "f times x" as opposed to "f of x." Functions and linear equations look similar since they have x and y coordinates, however they have differences in limitations, appearance, and purpose. Functions give you the value of x or y, but linear equations ask to solve for both x and y. Present students the two ways functions can be expressed using f(x) notation and arrow (transformation) notation. Allow students to work in groups of 2-3 on in-class application problems using function notation on page 427 of CME textbook; these problems will allow students to develop a mindset of interpreting function notation.
HW:	pg. 428-430: 1,3,5,6, 10, 12

Day # 3:	Section 5.5 Domain and Range (Problem-Based)
Goal:	To develop the ability to identify domain and range in a function.
Objectives:	Given a scenario representing a function, students will identify the domain and range. Given a function, students will interpret and determine its domain.
Lesson Summary (one paragraph maximum)	Begin class reviewing homework problems and answering any questions from the previous class. For the launch of the problem based lesson, the teacher will ask students to come up with a real life example of a function and ask students to write the function using function notation. Students may work in groups of no more than three students. Allow students to present their examples and recall the definition of domain and range from Day 1. For the explore, students will be given the challenge of creating a non-linear function. Students will come up with their own constraints and provide an explanation using their prior knowledge. Students may consider examples of functions that have restrictions in the domain such as x--> 1/(x-7); domain contains all real numbers. For the conclusion, the class will come together to discuss what they have done and what actually makes a domain and range.
HW:	Pg 433:1,2,4,6,7,9

Day #: 4	Functions: Input, Output, Domain, and Range Review Activity
Goal:	To review and apply the concepts of functions in relation to input, output, domain, and range.
Objectives:	• Given a scenario representing a function, students will identify the set of inputs and set of outputs. • Given a scenario representing a function, students will identify the domain and range. • Given a function, students will interpret and determine its domain. • Given a function in function notation, students will evaluate inputs in the domain of a function.
Lesson Summary (one paragraph maximum)	Students will be each assigned a characteristic of functions (definition of domain, range, input, and output) to present them in class in groups of 3-4 students. They are required to create their own example to explain the definition. Students will be allotted 15-20 minutes in class to work and 5 minutes to present their definition and example. This review activity aims to give students time to review the topics discussed over the past few days and for students to create their own example in justifying their ideas. These objectives to review will be the ones they will be tested on in the quiz for the following class.
HW:	Study for Quiz on Monday

Day #: 5 -	Lesson Title: Mid-Unit Quiz
Goal: - -	To demonstrate an understanding of the properties of functions.
Objectives: - - -	• Given a scenario representing a function, students will identify the set of inputs and set of outputs. • Given a scenario representing a function, students will identify the domain and range. • Given a function, students will interpret and determine its domain. • Given a function in function notation, students will evaluate inputs in the domain of a function.
Lesson Summary (one paragraph maximum) - -	Today, students will be taking a quiz. It is just a half day, so they will get a half-period to finish the quiz. The quiz will be distributed at the beginning of class and students are expected to work on the quiz for the entire period. If students finish the quiz early, they can work on homework from another class or read silently, but must be sure not to disrupt the other students who are taking the quiz.
HW - -	None

Name: Kelsey Drea

Date: Day 6

Subject: Algebra I

Prerequisite Knowledge:

Graphing linear equations
Properties of functions

Time: 50 minutes

Number of Students: 24

Goal:

To understand the similarities and differences of graphing functions and graphing equations.
To use prior knowledge of graphing equations to graph functions.

Student Objectives:

Students will be able to describe how graphing equations are related to graphing functions.
Students will be able to graph a function given the function equation.
Students will be able to determine if a graph is the graph of a function.

Content Standards:

F-IF.7. Graph functions expressed symbolically and show key features of the graph.

- Students will be given functions in both function notation as well as tables of information and will graph these. They will also be comparing the features of equations and functions.

Process Standards:

Make sense of problems and persevere in solving them.

- Students will be analyzing the relationship between graphing equations (which they already have experience with) and graphing functions. They will also be using their prior knowledge of properties of functions and seeing how they are present in the graphs of functions.

Materials

Pencil & paper
Individual dry erase boards and markers for each student
Ruler for graphing
Projector

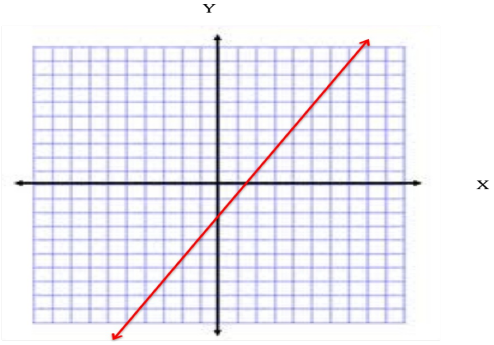
Time

<table>
<tr><td></td><td>Motivation:

1. We've seen multiple ways to represent functions over the past few days- function machines, equations, and tables. Today we're going to look at another method, graphing. Graphing a function can help us to see the functions' rule a bit quicker too!</td></tr>
<tr><td>15 minutes</td><td>Procedure

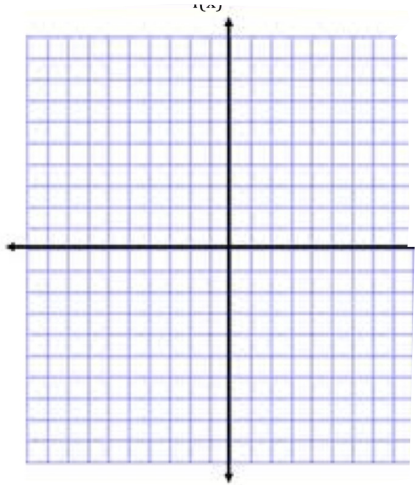
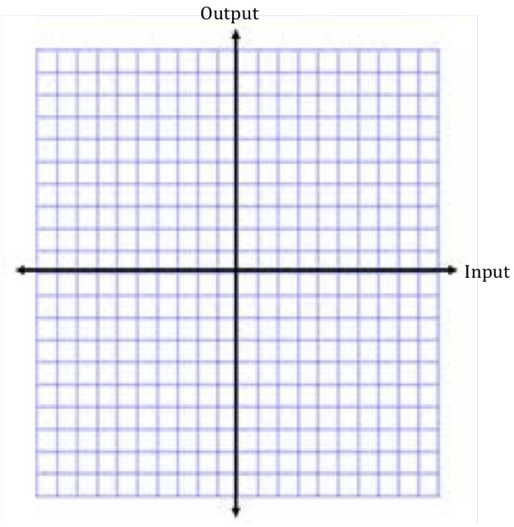
2. If you remember earlier in the year when we learned how to graph equations, this process will be very similar. Display the following example on the board:
Graph the following equation: $y = 2x - 3$
o Give students a few minutes to work on this individually. While they are working circulate throughout the room and observe student work. Look for different approaches such as table of values or finding the slope and y-intercept.
o Based on what you observe invite students with different approaches to come to the board and share their ideas with the class.
o Be sure to have the table method displayed on the board. If no students solve the problem this way ask them "do you think it would be possible to graph this equation by using a table?" Then have a volunteer share their thoughts on the board with the rest of the class.

<table>
<tr><td>x</td><td>$y = 2x - 3$</td></tr>
<tr><td>-2</td><td>2(-2) – 3 = -7</td></tr>
<tr><td>-1</td><td>2(-1) – 3 = -5</td></tr>
<tr><td>0</td><td>2(0) – 3 = -3</td></tr>
<tr><td>1</td><td>2(1) – 3 = -1</td></tr>
<tr><td>2</td><td>2(2) – 3 = 1</td></tr>
</table>
▪ Do not erase this table when moving onto the next problem.
o Answer:</td></tr>
</table>

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>10 minutes</td><td>Transition: Now that we've had a little refresher on graphing equations let's take a look at some functions.

3. Display the following problem on the board. What is the rule for this function? Write your rule in function notation.

<table>
<tr><td>Input</td><td>Output</td></tr>
<tr><td>-2</td><td>-7</td></tr>
<tr><td>-1</td><td>-5</td></tr>
<tr><td>0</td><td>-3</td></tr>
<tr><td>1</td><td>-1</td></tr>
<tr><td>2</td><td>1</td></tr>
</table>
"Try to find the rule/function on your own. When you think you've found it, compare with a neighbor.
o Answer: $f(x) = 2x - 3$
Students should be comfortable with this type of problem, but if some students struggle with it, go over the problem as an entire class on the board.
4. Compare this table with the table some of you used in our first example. What do you notice?
Anticipated student responses include: They have the same numbers but the labels for the columns are different (x and y vs. input and output).
"So when graphing functions, we have a similar approach as when we graphed equations, but now our axis we will label our axis a little differently. For example, based on the input/output table you were given our axis will be the following</td></tr>
</table>

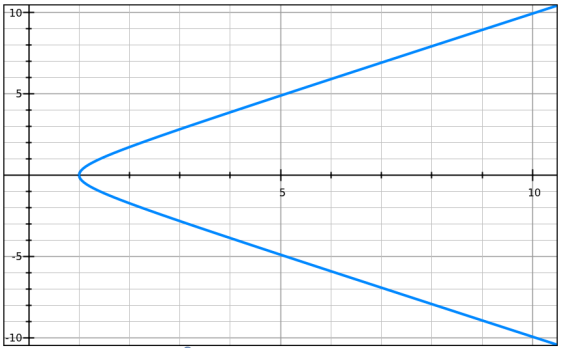
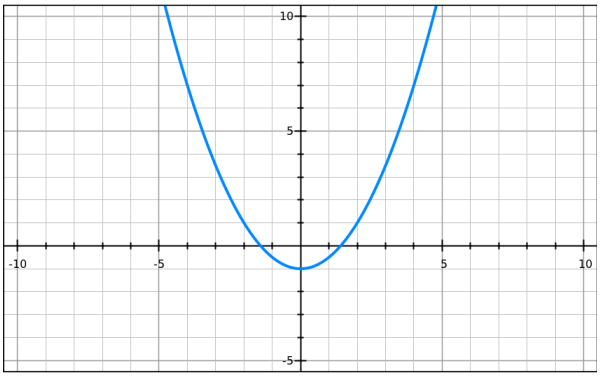
	  5. "Now with your neighbor try graphing the function from earlier, f(x) = 2x – 3 Circulate throughout the room while students are working. Look to see that students are labeling their axis correctly (x and f(x) rather than x and y).
10 minutes	6. "With your dry erase boards try to graph the following functions. When your graph is complete hold it up facing forward so I can check it. Remember to label your axis" (note: only display one problem at a time. Display the next problem once all of the students are finished. 1. $f(x) = x + 1$ 2. $f(x) = \frac{x^2}{3}$ If a student produces an incorrect graph then you can give them a small hint how to improve their answer (double check your computations, check your axis labeling,

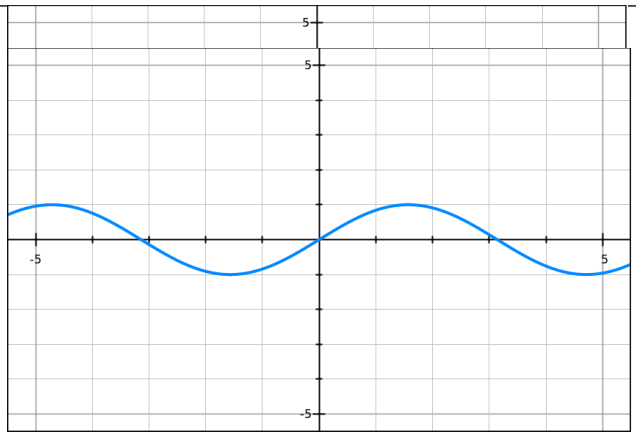
<table>
<tr><td></td><td>etc). If after a hint there are still students who cannot produce the correct graph invite a student with a correct graph to come to the board to display and explain their answer. Repeat this process for both examples.</td></tr>
<tr><td>5 minutes</td><td>Transition: Graphing also helps us to more easily determine whether or not a graph is a function.

7. “One special requirement of functions is that they can only have one output given an input. We saw this when looking at tables because we never saw anything like this

<table><tr><td>x</td><td>$f(x)$</td></tr><tr><td>2</td><td>4</td></tr><tr><td>3</td><td>2 or 6</td></tr><tr><td>4</td><td>4</td></tr></table>
This is NOT a function because there are two different outputs (2 and 6) for the input 3.”

8. “We can visualize this concept by using the <u>vertical line test.</u> That is, if you can draw any vertical line that intersects the graph in two places then it is not a function. For instance, in the previous example if we drew a vertical line at $x = 3$ then it would intersect the graph at $f(x) = 2$ and $f(x) = 6$.” (write the text in italics on the board).</td></tr>
</table>

5 minutes	9. Display the following graphs onto the board: "Determine whether or not these graphs represent functions by writing **yes** or **no** on your white boards. When you've answered all four problems please hold your board up facing me so I can check them. 1.  2.  3.

	4.  Answer: no, yes, no, yes. For each question have a student explain his or her reasoning behind their answer. If multiple answers are present have both students explain their thought process and let the rest of the class determine who is correct.
5 minutes	**Closing** Give students their homework assignment for tomorrow: p. 438-443 #1-3, 8, 14, 16 In your journals please answer the following questions: 1. In your own words, what are the similarities and differences of graphing equations and functions? 2. Sketch an example of a graph that is a function. Explain why this is a function. 3. Sketch an example of a graph that is NOT a function. Explain why it is not a function.
	Extension If time permits display the following problem on the board for students to work on: Kevin gave Sarah the following table of values for her to determine what function represents those values. Sarah asks Kevin if it is $f(x) = 3x + 2$ and Kevin says no, the function he chose was $f(x) = 3(x - 1) + 5$. Sarah believes that both functions are equivalent. Who is right? Check this by graphing both functions.
	Student Assessment The objective, "students will be able to graph a function given the function equation" is assessed by the teacher when going through the examples in step 6.

	Here, the teacher will be able to collect information from each student and better gauge his or her understanding of the material and then adjust the pace of the lesson. The objective “students will be able to determine if a graph is the graph of a function” is assessed by the teacher when going through the examples in step 9. Similarly with the previous assessment, the teacher will be able to gather information from each student about their understanding of which types of graphs are and are not functions. Since both of these types of assessment are done during the lesson the teacher will be able to have a better idea of the students’ learning process. Lastly, the objective “students will be able to determine if a graph is the graph of a function” is assessed by the teacher through the journal entry prompt “In your own words, what are the similarities and differences of graphing equations and functions?” By asking the students to describe this in their own words rather than just repeating a definition, the teacher will be able to better determine each student’s understanding.

Day #: 7 -	Lesson Title: Getting Started on Linear Functions
Goal: -	To develop the concept of a linear function.
Objectives: - - -	Given a table of data with an input and output column, students will plot the points to determine whether the table describes a linear function. Given a table of data with an input and output column, students will predict later outputs and inputs. Students will determine the factors that could affect predictions of linear data. Students will apply linear functions to a real-world situation.
Lesson Summary (one paragraph maximum) - - - - - - -	First, we will go over any questions on the homework problems from the day before. Then, I will show students a table with inputs and outputs to a function and ask the class to graph the data while I graph it on the board. We will notice that the points are all linear and I will say that this means the function is linear. The class will go over some more tables of functions and determine whether they are linear or not. Next, we will go back to our first example and, as a class, see how to predict the next data point. The class will then work in groups to find the next two points for the other examples they had gone through. After going through the answers as a class, the class will go through a real-world example with determining if it is a linear function and predicting the next data point, but also answering what factors would change the predictions. If time allows, the students will work in groups to go through the same process with other real-world examples.
HW	Pg. 449-450 #11-17

Day #: 8 -	Lesson Title: Constant Differences
Goal: -	To develop the concept of constant differences.
Objectives: - - -	Given a table of linear data, students will find the constant difference. Given linear data, students will use their knowledge of constant differences to find a function that represents the data. Given a set of points on a line, students will find the slope of the line. Given a set of points on a line, students will use their knowledge of slope to find an equation for the line.
Lesson Summary (one paragraph maximum) - - - - - - -	First, we will go over any questions on the homework problems from the day before. Then, I will give the students a table and show the students how to find the constant difference. They will make a third column on their table to write the constant difference. I will then guide the students to using the constant difference to find the function to represent the data as a class. After going through some problems in groups pertaining to finding the constant difference and function from the table, I will move onto graphs. I will give a set of linear points and have someone from the class graph it on the board. After connecting the points and seeing they form a line, I will introduce slope and show the students how to find it. I will relate slope to constant differences and the students will use the slope to make an equation for the line. The students will then work on group work that has them find the slope and equation of the line.
HW - -	Page 454-457 #1-6

Day 9 Lesson Plan: From Situations to Equations

Name: Marissa Walczak
Date: 5/15/12
Grade Level: 9
Course: 9th Grade Algebra
Time Allotted: 50 minutes
Number of Students: 24

I) Goal:

To develop a function network to write equations and solve problems.

II) Objectives:

By using prior knowledge of finding equations from data, students will write the equation corresponding to given situations.
Given a real-world situation, students will draw a function machine to represent what is happening.
Given a real-world situation, students will identify the variables for a function.
The students will use their functions to explore the function's situation further.

III) Materials and Resources:

Notebook, worksheet, calculator, and pencil, one mini-white board per table

IV) Motivation:

(5 minutes) Bring in several different cutout ads for discounts and special sales at different stores. Say to the class, "Do you guys ever go to the store and see these ads, but realize that the ads never tell you how much you're actually going to be paying? Well, every time you figure out for yourself how much you'll be paying, you are using a function." Give each table a cutout of a sales event. "From the sales ad I gave you, work with your table to find how much an original $25 purchase would cost after the discount."

V) Lesson Procedure:

1) Transition: "Let's look at a situation just like the sales events you see in these ads."
2) (20 minutes): Show the following problem on the projector and work on solving it as a class: At a music store website, CDs cost 28% off original price. After that discount, you add a 5% sales tax and $2 shipping charge. Build a function machine using the original price of a CD as the input. The output is the cost on the music store website.

i) Ask students what the variables are and write them under the problem. [The input is the original CD price and the output is the final cost of the CD.] Possible misconception: Students may mix up the variables.

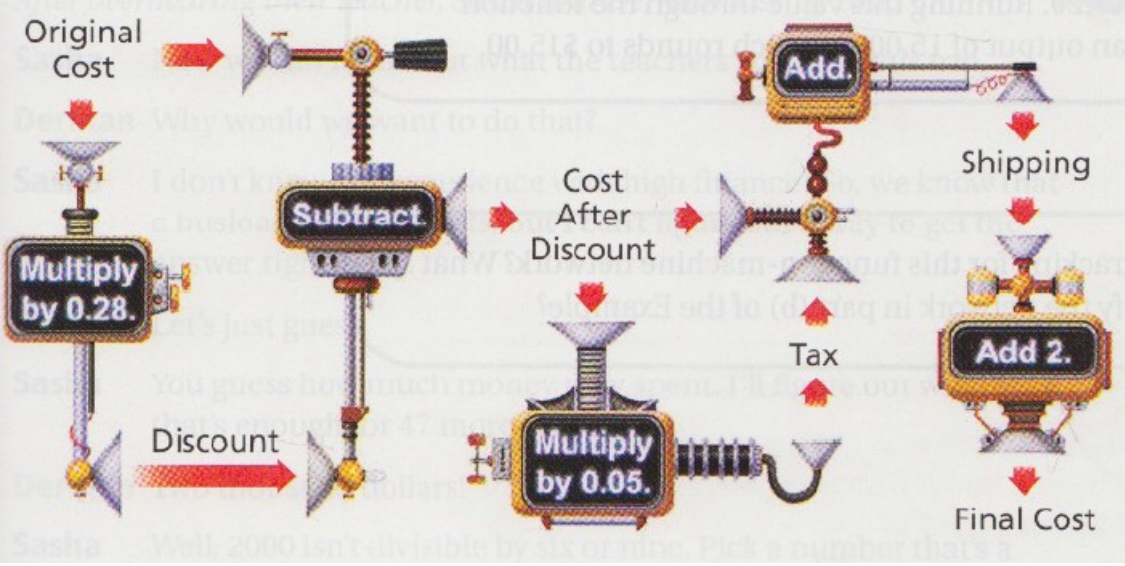
ii) Ask class to find the cost of the discount when the price is $20. [$5.50] When each table has come up with the answer, they should write it on their white boards. If all tables have the same answer, then go on. If there is a discrepancy, such as a group has made a calculation error or did not do the calculations in the correct order, have someone in another table explain how to get the answer.

iii) Ask the class to find the cost of the CD after applying the discount. [$14.40] When each table has come up with the answer, they should write it on their white boards. If all tables have the same answer, then go on. If there is a discrepancy, such as the students made a calculation error or did the calculations in an incorrect order, have someone in another table explain how to get the answer.

iv) Ask the class to calculate the tax on the new price of the CD. [$.72] Use the previous technique for the class answering the question.

v) Ask the students to find the final cost of the CD after adding tax and shipping charges. [$17.12] Use the previous technique for the class answering the question.

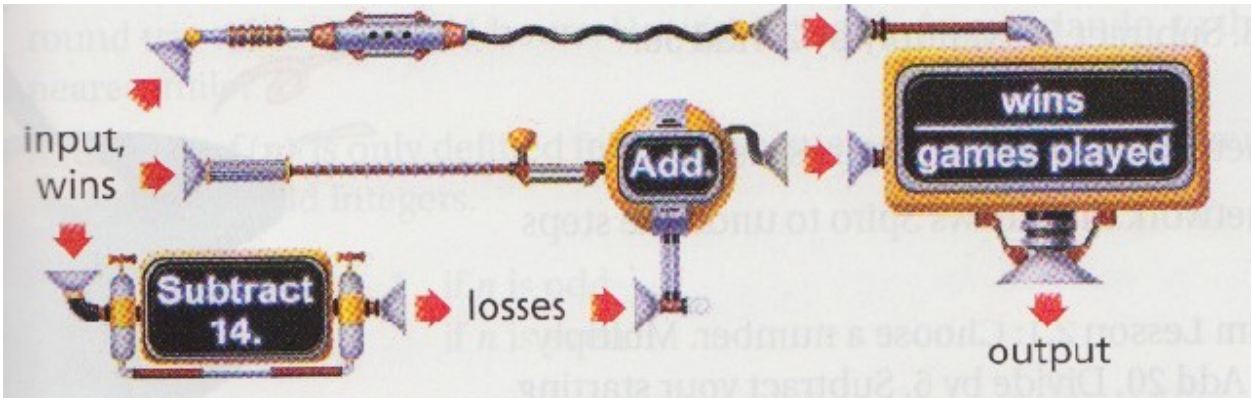
vi) Draw a function machine as a class on the board that corresponds to this situation. Ex: (from page 473 of the CME Algebra textbook)



vii) Ask class what would have happened if the tax was applied before the discount? Would the final cost of the CD be affected if the shipping cost was added first? Anticipate students saying yes, and have them explain why. If they do not think the final cost would be affected, have students calculate it with the tax being applied before the discount.

3) (5 minutes) Ask class to find the original cost of the CD if the final cost is $15. [$17.20]. When the groups are finished, they should write their answer on the mini-white boards and discuss as a class at the end how the class came to their answer. (Could talk about turning function machine into an equation or working backwards in the function machine.)
4) (15 minutes) Display the following problem on the projector and have students work through it in their table groups: The manager of the Texarkana Tube Sox notes that his team has achieved its goal for the year. He says, "Well, right now we're 14 games over .500 (which means we have won 14 more games than we have lost). We've won 55 percent of our games." What is the Tube Sox's win-loss record right now?
Example of how a student could work through it:

Guess 22 wins → 22-14=8 losses → 22/(22+8)=73.3% win
Guess 50 wins → 50-14=36 losses→ 50/(50+36)=58.1% win
Draw a function machine like: (from page 477 of the CME Algebra textbook)



Let input be the number of wins (w), and the output be the percentage of wins. From the function machine, make the function f(w) = w/[w+(w-14)] = w/(2w-14). By setting f(w) = 55/100 = 0.55, you find w = 77, so the team wins 77 games and loses 63.

VI) **Closure:** (5 minutes)

1) "We have now gone through two examples of real-life situations that involve functions. We solved the problems associated to the situations by finding our variables, making function machines, and clearly writing our steps. You will continue to use these techniques in the future for solving problems."
2) Give the students their homework problems (Page 478-481 #1-6).
3) Ask if there are any final questions.
4) Give exit slip to students before they can leave. (Write down two strategies for solving real-world problems with functions.)

VII) Extension:

1) If time allows, have students look at another example: You hear your teacher say at your field trip, "They were going to charge $9 per student, but we talked them down to $6. With the extra money, we were able to bring another busload of 47 students on the trip." Find how much money was in the budget for the field trip.
   i) Have students identify the input and output.
   ii) Have students draw a function machine.

VIII) Assessment:

When students are working on the first problem, check that each group has a correct answer on their mini-white board for each step.

When students are working in groups, check that each group has worked through the correct answer before telling the answers to the class and address the common misconceptions in the full class.

Collect the exit slips before students leave class to make sure they have a correct answer.

Collect homework the next day and check answers to make sure that each student understands.

IX) Standards

8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Make sense of problems and persevere in solving them: The students will need to analyze the relationships and constraints in the given situations to be able to turn them into functions. They use the aid of a concrete object (the function machine) to conceptualize the problem. They will need to check that their answers are reasonable for the given situation.

Model with Mathematics: The students will apply the mathematics they know concerning functions to solve real-life problems. They will analyze the given information to find how to represent the situation with a function. They will make sure that their answers make sense with the situation and revise their model if necessary.

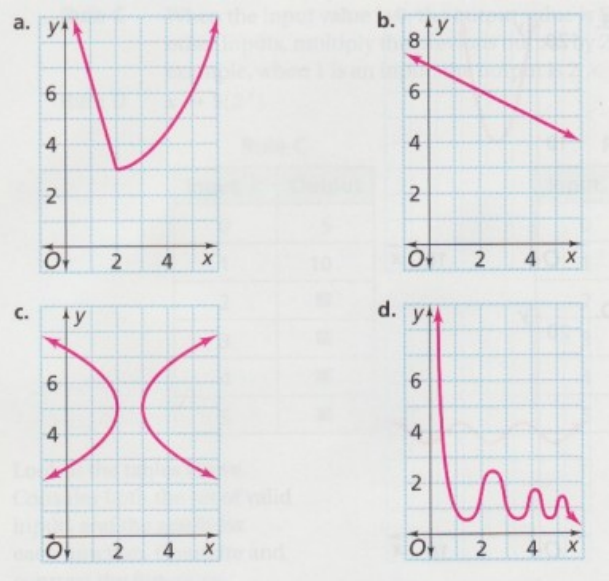
Day #: 10 -	Lesson Title: From Functions to Situations Day 2
Goal: -	To develop a function network to write equations and solve problems.
Objectives: - - -	By using prior knowledge of finding equations from data, students will write the equation corresponding to given situations. Given a real-world situation, students will draw a function machine to represent what is happening. Given a real-world situation, students will identify the variables for a function. The students will use their functions to explore the function's situation further. By using prior knowledge of writing functions for situations, students will create their own problems that involve functions.
Lesson Summary (one paragraph maximum) - - - - - - -	The students will use a writing to learn strategy where they write their own word problems that involve functions. First, we will go over any questions on the homework problems from the day before. Then, we will review writing functions for equations with another example that we had not done the day before. Students will work through this example in groups and we will go over it as a class. For the remainder of the class, students will be assigned to create their own situation that fits their group's given function. Each group will be given a function, and the groups will have to make up a situation that would fit the function as well as questions that could follow the problem. They will use the previous day's problems, homework problems, and today's example as a guide. They will also need to provide an answer key that shows that their situation fits the function. If the students do not finish this during class, they will need to finish it for homework by the next class.
HW - -	Pg. 479 #7-13 and any work they did not finish on their situation that they were making in class.

Day #: 11 -	Lesson Title: Recursive Rules
Goal: - -	To use prior knowledge of constant change in order to determine the recursive rule of a function.
Objectives: - - -	Students will determine the recursive rule of a function given a table of values. Students will solve real world problems using recursive rules Students will describe the meaning of a recursive rule and base case in their own words
Lesson Summary (one paragraph maximum) - - - - - - -	We will begin the lesson by going over homework from the previous lesson and addressing any misconceptions students had. Next, we will begin the lesson by using the lesson on constant differences as a motivator. We will revisit an example that the students are familiar with and examine the constant differences. I will ask students, "how could you describe the change in the output? I will then inform students that this trend is called a recursive rule. Next, I will ask them what value we started with based on the table we were given. I will then tell them that this is the base case. From here I will ask students to work in groups in order to try to express this information in function notation. Then after all groups are done, volunteers can share their ideas. We will continue with these types of examples and then move onto more real life situations in the form of word problems. Lastly, as an exit slip students will be asked to write a journal entry in which they describe the terms recursive rule and base case in their own words.
HW - -	p. 463-464 #2, 4-7

Day #: 12 -	Lesson Title: From Situations to Recursive Rules
Goal: -	To apply the concept of recursive rules to word problems and real life situations.
Objectives: - - -	Students will construct recursive functions given a real world situation in the form of a word problem. Students will create their own word problems given a recursive function.
Lesson Summary (one paragraph maximum) - - - - - - -	We will begin this lesson by going over the homework from day 11 and address any misconceptions students may have. It is important that all students have a good understanding of recursive functions because we will be adding another layer to the process- word problems. After this, I will present an example to students that we will discuss as an entire class. Next, I will divide students into eight groups of three students. In these groups students will be given a recursive function and asked to write their own word problem based on the function they were given. As groups begin to finish their problems, proofread each before moving on. Lastly, have groups exchange problems with their peers and try to solve each others' problems. If we run out of time students will finish these problems as homework.
HW -	Finish solving the other groups' word problems.

Day #: 13	Lesson Title: Chapter Test Review
Goal:	To review and apply the concepts of functions in relation to properties of functions, recursive rules, linear functions, and representing functions.
Objectives:	● Identify a recursive rule, given a real life situation. ● Students will be able to determine if a graph is the graph of a function. ● Students will create a function (recursive or not) from a given situation. ● Given a function, students will create a graph, table, situation, or other representation of the function. ● Students will identify a linear function and its constant difference. ● Students will define the different properties of a function.
Lesson Summary (one paragraph maximum)	Today we will be doing a Jeopardy review game in order to help prepare students for their chapter test tomorrow. Divide the class into six groups of four groups. For this review, there will be six categories: Graphing Functions, Situations to Equations, Recursive Rules, Is it a function?, Properties of functions, Linear Functions. For each category there will be 5 questions of varying difficulty that students can choose from. If the choosing group cannot give a correct answer the other groups have the opportunity to steal the points by answering the question correctly. The winning group will be awarded 5 extra credit points counting towards their test. Encourage students to take notes on the questions that appear during the review because they will be similar to those on the test.
HW	Study for the test!

Day #: 14 -	Lesson Title: Unit Test
Goal: - -	To demonstrate an understanding of all aspects of functions and their applications to real life.
Objectives: - - -	● Identify a recursive rule, given a real life situation. ● Students will be able to determine if a graph is the graph of a function. ● Students will create a function (recursive or not) from a given situation. ● Given a function, students will create a graph, table, situation, or other representation of the function. ● Students will identify a linear function and its constant difference. ● Students will define the different properties of a function.
Lesson Summary (one paragraph maximum) - -	Today, the students will be taking a test. They will get the full period to work on the test and are expected to use the entire period. The test will be distributed at the start of class. If students finish the test early, they should work on homework from another class or read silently. The students should be sure to not disturb other students if they happen to finish the test early.
HW -	None

#	Learning Objective	Assessment Item
1	Identify a recursive rule, given a real life situation.	Dana's parents start saving money for her college education. They deposit $5000 in a fund that earns 10% interest at the end of each year. Write a recursive rule that describes how the amount of money increases over time. How much money will Dana's parents have after 3 years?
2	Students will be able to determine if a graph is the graph of a function.	Which of the following graphs is a function? If it is not a function, explain why.  From textbook p. 442
3	Students will create a function from a given situation.	A round trip flight from Seattle, Washington, to Orlando, Florida, is one of the longest flights in the continental United States. Due to the jet stream that blows from west to east, a plane flying nonstop from Seattle to Orlando flies at an average speed of 523 miles per hour. The same plane flying from Orlando to Seattle travels at an average speed of 415 miles per hour. The full round trip takes exactly 11 hours. How far is Seattle from Orlando, to the nearest mile.
4	Given a function, students will create a graph, table, situation, or other representation of	Graph each function: a. x a $4x + 9$ b. x a $\frac{x^2}{5}$

<table>
<tr><td></td><td>the function.</td><td>c. x a $\frac{x}{2}+4$

d. x a $x+1$</td></tr>
<tr><td>5</td><td>Students will identify a linear function and its constant difference.</td><td>In the table the variable a represents an arbitrary number.

<table><tr><th>Input</th><th>Output</th><th>Change</th></tr><tr><td>0</td><td>3</td><td>a</td></tr><tr><td>1</td><td>_____</td><td>a</td></tr><tr><td>2</td><td>_____</td><td>a</td></tr><tr><td>3</td><td>_____</td><td>a</td></tr><tr><td>4</td><td>_____</td><td>a</td></tr><tr><td>5</td><td>_____</td><td>a</td></tr></table>
a) Complete the table by finding the missing outputs in terms of a.

b) Find a linear function that matches the table.</td></tr>
</table>