Grade Level	**Content Area**	**Course Title** *(9-12 Only)*	**Unit Title**
8	Mathematics	N/A	Functions
Length of Unit	**Time of Year Taught**	**Expected Prior Knowledge**	
1 week	Quarter 4 (April)	Students should be proficient with dividing integers, graphing in the coordinate plane, and graphing equations with two variables.	
Unit Description			
In this unit, students will build on their knowledge of locating points and identifying coordinates and of writing and solving one-step and two-step equations to plot points in the coordinate plane and to graph and solve linear equations. Students will investigate sequences and both linear and nonlinear functions. They also write function rules and then draw graphs for those rules.			

Strand(s), Concept(s), and PO(s) *List and define the required Strand(s), Concept(s), and PO(s) for each lesson included in this sample.*	Common Core Domain: Functions (8.F) • CC Cluster: Use functions to model relationships between quantities. ○ CC Standard 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.
Summative Assessment *Describe a cumulative and comprehensive activity that allows students to demonstrate mastery of stated POs. A copy of the summative assessment must be included in the application package.*	Students will demonstrate mastery of objectives on the following assessments: • Checkpoint Quiz ○ A 10-question assessment that measures level of mastery for CC Standard 8.F.4 • Please refer to "Appendix A" for a copy of the summative assessments and answer keys
Assessment Scoring *Explain how each assessment is scored, to include points per question, total points possible, criteria, and grading scale. Describe rubric, if applicable, to include components being evaluated and the scoring criteria for each. A copy of the answer key and/or scoring rubric must be included in the application package.*	Assessment Scoring: • The checkpoint quiz features 10 questions scored at 1 point each. • Please refer to "Appendix A" for a copy of the summative assessments and answer keys Criteria for Mastery: • All assessments will be converted to a percentage score and assigned a grade based on the following scale: 90-100=A; 80-89=B; 70-79=C; 60-69=D; 59 and below=F • The minimum score for student mastery is 80% (8/10 correct items). Students who do not achieve mastery will receive additional instruction, then re-assessed to determine if the material has been mastered.

Materials/Resources Needed *(Include all items for the entire unit.)*	Overhead projector, train speed graph transparency, aquarium transparency, skateboard ramp transparency, white board, markers, pencils, paper, index cards, mathematics textbook, skills puzzles, and activity labs.

Lesson Activities				
Lesson 1	**Lesson 2**	**Lesson 3**	**Lesson 4**	**Lesson 5**
Objective: To identify rules of sequences as a basis for understanding and modeling functions (8.F.4) Anticipatory Set: • Review solving linear equations (x+5=12; solve for x). Input: • Introduce a mathematical sequence as a set of numbers that follow a pattern stated in a rule (sequences are a type of function with input numbers consisting of the natural numbers, and the output numbers being the terms) • Explain arithmetic sequences have a common difference; geometric sequences have a common ratio.	Objective: To interpret and sketch graphs that represent real world situations (8.F.4) Anticipatory Set: • Review arithmetic sequences, geometric sequences, algebraic expressions, and word problems. Input: • Explain that graphs can show relationships between variables. • Point out many graphs use time on the x-axis because the other variable depends on time. • Explain that it is possible to sketch a graph without actual data to show the general nature of a relationship.	Objective: To represent functions with equations, tables, and function notation (8.F.4) Anticipatory Set: • Review graphical reasoning, interpreting graphs, sketching graphs, and solving word problems. • Explain a sequence can be thought of as a function, with the input numbers consisting of the natural numbers, and the output numbers being the terms. Input: • Define a function as a relationship between two or more quantities. • Explain the value of the function (output) depends on the value of	Objective: To find the slope of a line from a graph or table (8.F.4) Anticipatory Set: • Review interpreting function tables, using function rules, writing input-output pairs, and solving word problems. Input: • Introduce the concept of slope as a rate of change. • Explain the slope of a non-vertical line is calculated by finding the ratio of the change in y-values (or the difference between values of the function at two inputs) to the change in x-values (or the difference between the two inputs).	Objective: To use tables and equations to graph linear functions (8.F.4) Anticipatory Set: • Review graphing coordinate points, graphing table data, finding the slopes of lines, and solving word problems. Input: • Explain discrete data often result from counting and are connected with a dashed line. • Explain continuous data often result from measuring and can have values between the graphed points joined with a solid line. • Introduce the slope-intercept form of a

Model: • On the board, model the use of inductive reasoning to find the next three terms in a sequence, then show how the pattern is written as an algebraic expression. • Example: For the sequence "2,6,10" the next 3 terms are "14, 18,22" and the algebraic expression of this sequence is "n+4." Check for Understanding: • Write a sequence on the board, then have each student write the next term in the sequence on an index card and hold it up when asked to do so. • With student input, describe the sequence as an algebraic expression. • Do further examples as necessary. Guided Practice: • Divide students into pairs	Model: • Put a graph that shows the speed of a train on its morning commute on the overhead. • Show how the graph can be used to answer questions: how long did the trip take? (30 minutes); when did speed increase most? (7:49 to 7:51). Check for Understanding: • Ask follow-up questions about the model graph (What was the fastest speed? What was the slowest speed?) • Follow up with additional examples if necessary Guided Practice: • Divide students into small groups and have them complete the Activity Lab while monitoring and assisting • Review the AL answers upon completion	the input. • Point out functions can be represented numerically, graphically, symbolically, or verbally. • Explain the set of ordered pairs that satisfies a function has exactly one output value for a given input value. Model: • Put a graphic of fish in an aquarium on the overhead. These fish cost $2 each. • Show how to use function notation to show the relationship between total cost and number of fish bought. • *f*(n)=the total cost • *f*(n)=2n Check for Understanding: • For the aquarium example, ask students what *f(6)* represents and how to solve it (*f*(6)=12) Guided Practice: • Divide students into	• Point out the slope of a line is the same (or constant) between any two points on the line. Model: • Put a graphic of a skateboard ramp on the overhead. • Show that "run" corresponds the length of the ramp and "rise" to the height. • Overlay a coordinate plane to illustrate how points on the coordinate plane define the slope. Check for Understanding: • Have students take turns at the white board graphing the slope of lines when given coordinate points. • Multiple students and/or pairs of students can work at the same time. Guided Practice: • Divide students into small groups and have	linear equation (y=mx + b describes a line with slope "m" and y-intercept "b"). Model: • Put a table of discrete data (e.g., total cost of a gallon of milk and number of gallons) and demonstrate how to put the information into a graph. • Put a graph of continuous data (e.g., number of calories burned walking and amount of time) and demonstrate how to put the information into a graph. Check for Understanding: • Checkpoint Quiz 2 (see Appendix A quiz and key) Guided Practice: • Divide students into pairs and have them complete the Adapted Practice activity while

and have them complete the Skills Puzzle while monitoring and assisting. • Review puzzle answers upon completion. Closure: Discuss the following: • What is an arithmetic sequence? • What is a geometric sequence? • How do you use an algebraic expression to write a sequence? Independent Practice: • Assign "Homework Exercises" 1-40	Closure: Discuss the following: • Explain how to interpret and to sketch the graph of a mail truck making deliveries. Independent Practice: • Assign "Homework Exercises" 1-20	pairs and have them complete the Skills Puzzle while monitoring and assisting. • Review puzzle answers upon completion. Closure: Discuss the following: • What is a function? • How can you use function notation to write a function rule? Independent Practice: • Assign "Homework Exercises" 1-21	them complete the Activity Lab while monitoring and assisting • Review the Activity Lab answers upon completion. Closure: Discuss the following: • What is slope? • How does the rate of slope relate to the coordinate pairs that define the points in a line? Independent Practice: • Assign "Homework Exercises" 1-21	monitoring and assisting • Review answers upon completion. Closure: Discuss the following: • Explain how to use a table to graph a function. • How do you decide whether to make a solid or dashed line? • Explain how to graph an equation when you know only the slope and the y-intercept. Independent Practice: • Assign "Homework Exercises" 1-28

Student Activities				
Lesson 1	**Lesson 2**	**Lesson 3**	**Lesson 4**	**Lesson 5**
During this lesson, students will do the following activities to master Common Core Standard 8.F.4: • Review and discuss the concept of solving linear equations with teacher guidance and class input.	During this lesson, students will do the following activities to master Common Core Standard 8.F.4: • Review and discuss arithmetic sequences, geometric sequences, algebraic expressions,	During this lesson, students will do the following activities to master Common Core Standard 8.F.4: • Review and discuss graphical reasoning, interpreting graphs, sketching graphs, and	During this lesson, students will do the following activities to master Common Core Standard 8.F.4: • Review and discuss interpreting function tables, using function rules, writing input-	During this lesson, students will do the following activities to master Common Core Standard 8.F.4: • Review and discuss graphing coordinate points, graphing table data, finding the slopes

• Learn about arithmetic and geometric sequences through direct teacher instruction and modeling. • Apply knowledge by solving a classroom-based sequence problem with whole class and teacher input. • Participate in a cooperative learning puzzle activity that reinforces understanding of arithmetic and geometric sequences. • Complete homework to practice the following concepts independently: arithmetic sequences, geometric sequences, algebraic expressions, and word problems.	and solving word problems with teacher guidance and class input. • Through direct and explicit instruction and modeling, learn using graphs to show relationships among variables. • Participate in a large group discussion about graphing variable relationships. • Participate in a cooperative learning activity lab to practice relating graphs to events. • Complete homework to practice the following concepts independently: graphical reasoning, interpreting graphs, sketching graphs, and solving word problems.	solving word problems. • Through direct instruction and modeling, learn about functions, values of functions, and representations of functions. • Demonstrate understanding by answering follow-up questions for a sample problem. • Participate in a cooperative learning puzzle activity that reinforces understanding of using tables to create ordered input-output pairs of functions that follow function rules. • Complete homework to practice the following concepts independently: interpreting function tables, using function rules, writing input-output pairs, and solving word problems.	output pairs, and solving word problems. • Learn about slope and its relation to function input values through explicit instruction and modeling. • Demonstrate graphing slope when given a coordinate points. • Participate in a cooperative learning activity lab to practice using coordinate points to determine slope. • Complete homework to practice the following concepts independently: graphing coordinate points, graphing table data, finding the slopes of lines, and solving word problems.	of lines, and solving word problems. • Through direct and explicit instruction and modeling, learn about discrete data, continuous data, and the slope-intercept form of a linear equation. • Demonstrate understand on a formative assessment by taking a checkpoint quiz that directly measures knowledge of listed objectives. • Participate in a cooperative learning practice activity that reinforces identifying discrete and continuous data and graphing the functions of that data. • Complete homework to practice the following concepts independently: finding slope and y-intercept, using discrete and continuous data to create tables and graphs, and graphing linear functions.

Appendix A

Checkpoint Quiz

The following quiz measures the student's ability to perform operations described in CC Standard 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."

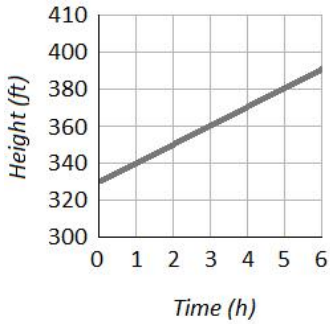
Use the function rule f(x) = -3x+2. Find each output.

1. *f* (-1)
2. *f* (5)

For each function, find the slope (rate of change) and the y-intercept.

3. y = 4x-1
4. y = x+4

The graph displays the elevation of two students as they hike on a mountain. Use the following figure to answer questions 6-9.



5. Determine the initial height at the start of their hike.
6. Determine the height after hiking for 3 hours.
7. Use two points on the line to identify the slope (rate of change) of the line.
8. Construct a height function, H(t), of the line as a function of time, t.

For the following problems, construct a function and model a linear relationship.

9. Suppose potatoes cost $1.00 plus an additional $0.75 per pound. Construct a cost function, C(p), to model the relationship as a function of the pounds, p, purchased.
10. Model the relationship by creating a table and graphing the function.

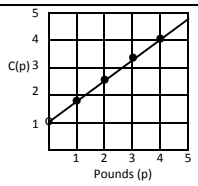
Checkpoint Quiz 2 Answers:

1. 6 2. -13 3. 4;-1 4. 1;4 5. 330 ft. 6. 360 ft. 7. 10 (ft/h) 8. H(t)=10t+330

9. C(p)=0.75p+1

10.

p	1	2	3	4
C(p)	1.75	2.50	3.25	4



Grading Scale:

- This assessment will be converted to a percentage score and assigned a grade based on the following scale: 90-100=A; 80-89=B; 70-79=C; 60-69=D; 59 and below=F

Criteria for Mastery:

- The minimum score for student mastery is 80% (8/10 correct items).
- Students who do not achieve mastery will receive additional instruction for the objectives measured, then re-assessed to determine if the material has been mastered.