Comparing Functions Formative Assessments

Comparing Functions Formative Assessment 1: Comparing Rates of Change

Cluster & Content Standards	Mathematical Practice Standards
Functional Reasoning/System Unit. **NC.8.F.2** Compare properties of two linear functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	3. Construct viable arguments and critique the reasoning of others 7. Look for and make use of structure

Learning Targets
- Compare properties of linear functions (rates of change and intercepts) and use this information to solve problems.
- Identify and interpret key features of a graph that models a relationship between two quantities.
- Compare inputs and outputs of functions that are represented in different ways.

Timing
This assessment can be used after Task 1, the Desmos task *Card Sort: Linear Functions.* *Card Sort: Linear Functions*

Correct Solutions:
In this problem, the equation, $y = 2 + 3.5x$, has the greatest rate of change (slope). The equation has a slope of 3.5 and a y-intercept of (0, 2). The table has a slope of 3 and a y-intercept of (0, 5). The graph has a slope of 2 and a y-intercept of (0, 3). Remember, when an equation is in slope-intercept form, the slope is the coefficient of the variable x. Remember that the y-intercept is the point where the line crosses the y-axis, where x = 0.

- Look for students who will think the slope of the equation is 2 instead of 3.5. Encourage them to use the commutative property of addition and change the equation to $y = 3.5x+2$ if this helps them from making that mistake. As students are often used to seeing the equation in the form $y = mx + b$, with the slope "coming first," some could have the misconception that the slope is determined by its location in the equation rather than its relationship to the independent variable x.
- Especially as they are learning the concept of rate of change, students could still confuse the x and y coordinates in determining rates of change. Remind them that since y depends on x, the rate of change is determined by how much y changes based on how x changes.
- Students may think that the rate of change in the table is non-linear because they are not considering the change in x coordinate.
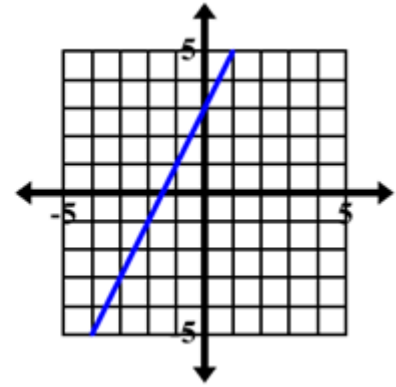
Comparing Functions Formative Assessment 1

Comparing rates of change

1. Determine which representation has the greatest rate of change. Justify your answer.

$y = 2 + 3.5x$

x	y
1	8
5	20
7	26

2. Using a representation of your choice above, create a new representation of a relationship that has a rate of change greater than the one in problem 1. Explain your choice and state the rate of change.

Comparing Functions Formative Assessment 2: Limousine Service

Cluster & Content Standards *Functional Reasoning/System Unit* **NC.8.F.2** Compare properties of two linear functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	**Mathematical Practice Standards** 1. Make Sense of Problems and Persevere in Solving Them 2. Reason Abstractly and Quantitatively 4. Model With Mathematics

Learning Targets
- Compare properties of linear functions (rates of change and intercepts) and use this information to solve problems.
- Write an equation that displays key features of a function that has been described verbally.
- Compare inputs and outputs of functions that are represented in different ways.

Timing
This assessment can be used after Task 4, the [Battery Charging Task (illustrative mathematics website)](#).

Correct answers
- **Part 1** - Answers will vary based on students' justification. Students may use various methods to compare. Lenny's service (y=30x+50) is cheaper if they rent for less than 5 hours (x), Carrie's service (y=25x+75) is cheaper if they rent for over 5 hours, and either service if they rent for exactly 5 hours because the price would be the same.
- **Part 2** - If Khalil's dad pays the one-time fee ('b' which is the 50 or 75) then Carrie's service would be cheaper no matter how long they rent if for.
- **Part 3** - Answers could vary depending on students reasoning. One possible solution is Carrie's service for 6 hours...using the equation y=25x +75 where x is the number of hours, 25(6) + 75=$225, 10% of $225=$22.5, $225+$22.5=$247.5, which is under their budget. If they used Lenny's service (y=30x+50) for 6 hours they would be over budget by $3.

- Students may want to pick Carrie's service at first for 7 hours since it's $250 for 7 hours but caution them they need to include the tip with their budget and not just the service.
- Some students may argue they do not need limousine service for the Prom that long. Listen to all arguments and allow them if they are mathematically correct.
- Some students might think that the one-time fee for Carrie's company is $100, as that is the first price in the table. Remind them that the $100 includes the one-time fee and 1 hour of driving, and ask them to reconsider.

Comparing Functions Formative Assessment 2
Limousine Service

Dacia and Khalil want to rent a limousine for their senior prom at the best rate possible. They found two possible choices.

- Lenny's Limousine Company charges a one-time fee of $50 plus an additional charge of $30 per hour.
- The table below shows the cost to rent a limousine from Carrie's Limousine Company for different lengths of time but also charges a one-time fee.

Time (hours)	1	2	3	4	5
Total Cost	$100	$125	$150	$175	$200

Part 1
Your task is to help Dacia and Khalil decide which Limousine Company they need to choose if they want to save on their overall total cost. Justify your reasoning.

Part 2
Khalil's dad said he would pay for the one-time fee. Does this change your recommendation from Part 1?

Part 3
Dacia and Khalil decide they want to tip the driver 10% of the total limo rental cost. Their budget for the rental as well as the tip is $250. Which company should they choose if they want to rent the limo for the longest possible time? Justify your reasoning.

Comparing Functions Formative Assessment 3: Domino's Pizza

Cluster & Content Standards	**Mathematical Practice Standards**
Functional Reasoning/System Unit	2. Reason Abstractly and Quantitatively
NC.8.F.2 Compare properties of two linear functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).	4. Model With Mathematics
	7. Look for and make use of structure.

Learning Targets
- Compare properties of linear functions (rates of change and intercepts) and use this information to solve problems.
- Identify and interpret key features of a graph that models a relationship between two quantities.
- Write an equation of a function that displays key features of a function that has been described verbally.
- Use tables, graphs, and/or verbal descriptions to compare linear functions.

Timing
This assessment can be used at the beginning of the unit as a pre-assessment, the end of the unit to check for understanding, or mid-unit after Task 3, the *Summer Vacation* task.

Correct Answers
   a) A pizza with no toppings is $8. Students may guess and check, use a table, or draw pictures.
   b) A pizza with 7 toppings would cost $22. Students could use a variety of methods including a table to show a common difference or write an equation using (2, 12) and (5, 18) as ordered pairs.
   c) Using slope-intercept form would be y=2x+8 where y, total cost of pizza and x, the number of toppings. Students' answers will vary for the price of their favorite pizza depending on the number of toppings they choose.
   d) The price of the pizza does not double when you double the toppings due to the 'b' remaining the same.

Conceptions
- Allow students to use any method for answering these questions while using mathematical arguments.
- Watch for students who will divide $12 by 2 toppings and think a 1 topping pizza is $6. You may ask them how much would a 5 topping pizza will be based on their price and if that fits the given information.
- Many examples that students have worked with for slope/rate of change and y-intercept involve some form of time as the independent variable. They could be confused in this example that the x represents pizza toppings and the rate of change is the amount per topping.

Domino's Pizza

How much?

You and your friends are going to buy pizza from Domino's. From previous orders you know that a medium pizza with two toppings costs $12 and a medium pizza with five toppings costs $18. All toppings cost the same amount.

a) **How much is a cheese pizza with no toppings?**

b) **Assuming every topping costs the same amount, how much would you pay for a pizza with 7 toppings? Justify your answer.**

c) **Write a general rule you could use to determine the price of any medium Domino's pizza. Describe your favorite medium pizza. How much would you expect to spend?**

d) **If you double the number of toppings that you order, do you pay twice as much for the pizza? Why or why not?**