Math: Grade 8, Lesson 7, Interpreting a Linear Function

Lesson Focus: Interpreting a Linear Function
Practice Focus: Students will focus on practicing strategies for interpreting the slope/rate of change and y-intercept/initial value from a function's graph or equation in terms of the context.
Objective: Students will use tables, graphs, and equations to recognize slope/rate of change and y-intercept/initial value with a focus on interpreting these in contextual situations.
Key Vocabulary:

- Slope/Rate of Change – the change over an interval in the height of a linear function on a graph or the change over an interval of any value. Slope can be visualized as rise over run or calculated from two points on the line (found in a table or on a graph) by this formula:
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
- Y-intercept/Initial Value - the point where the graph of the linear function crosses the y-axis or the value when *x* is zero.

TN Standards: 8.F.B.4
Teacher Materials:

- Whiteboard and Markers, Graph Paper if available
- Student Practice Packet

Student Materials:

- Paper and a pencil, and a surface to write on
- Calculator not required but may be used to check calculations.
- Optional but helpful: Graph Paper

Note: There are several graphs and tables in lessons this week. They will need to be prepared in a way to show to students.

Teacher Do	Student Do
<u>Opening:</u> (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 8th graders out there, though all children are welcome to tune in. This lesson is the seventh in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!** **If you didn't see our previous lesson, you can find it on the TN Department of Education's website at www.tn.gov/education. If you don't already have the student packet for this lesson, you can find it online at www.tn.gov/education. You can still tune in to today's lesson if you haven't see any of our others. But, it might be more fun if you first go back and watch our other lessons since we'll be talking about things we learned previously.**	Students get materials ready for the lesson.

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Today we will be learning about Interpreting Linear Functions in mathematics! Before we get started, to participate fully in our lesson today, you will need:

- **Paper and a pencil, and a surface to write on**
- **A calculator not required but may be used to check calculations.**
- **This is optional but helpful: Graph Paper**

Ok, let's begin!

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<u>Intro</u> (3 min)
Today, we are going to develop strategies for interpreting the slope or rate of change and y-intercept or initial value from a function's graph or equation based on the context. We started a little bit of this in the previous lesson.

But first, let's review by doing a quick inquiry – which one doesn't belong? [show each of the following]

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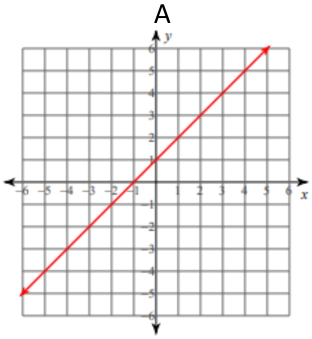
<td>A

</td>
<td>B
2y = 1 + 2x</td>
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<tr>
<td>C
Y = x + 2</td>
<td>D
x – y = -2</td>
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Let's think about how these could be grouped and identified.
[Pause]

Did you see any of these? Let's think aloud together.
[point to each box as you describe the variance]

- **Box A is the only graph.**
- **Box C is the only equation in slope-intercept or y=mx+b form.**
- **Box D is the only equation with x and y on the same side of the equal sign.**

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<td>Students are thinking about the ways the equations and graph are similar and different and recalling things they know about linear functions and the slope-intercept form of a linear function.</td>
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- **Box B is the only model that is not equivalent to the function y = x + 2 if you transform it to slope-intercept form.**

Great! Let's keep in mind today that graphs and equations can represent the same linear function.

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<u>Teacher Model</u> (11 minutes)
[give plenty of time to pause for students to work]

<u>Objective 1: Reviewing Prior Learning/Explicit Instruction & Example/Guided Practice</u>
Let's look at a situation described in words and a graph, and just so you know a little bit about the context, rappelling is an activity where a person uses a special rope to work their way down the rock face or other nearly vertical surface.
[show the words and graph and read the words aloud]

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Aretha is rappelling down the side of a cliff. The graph shows her height above the ground in feet as a function of time in seconds as she descends.

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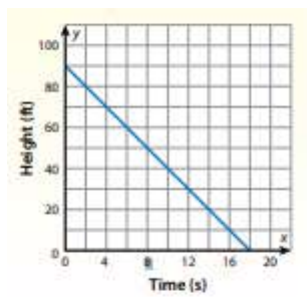

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Now, let's think about a couple questions together.

First, what is Aretha's height above the ground when she begins rappelling down? Let's look at where Aretha is when the time equals zero. [point to the location (0, 0) and then raise up to (0, 90)] **The graph shows us that Aretha is at 90 feet above the ground. So, the initial value or y-intercept of this graph is 90.**

Now, let's look at her rate of descent. How can we use the graph to find that rate of change? Let's think about what we probably already know about slope from a line.

We need to look for two points on the graph that we can easily read or make a table of values from. We already know one point – the y-intercept at (0, 90). Can you see another point? [pause]

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Students will identify specific information from the graph given the context such as Aretha's height when the descent began, and what the graph can show us about the rate of change.

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I saw several different points I could use, but I think will use the one at (6, 60). [point to (6, 60)] **Since slope or rate of change of a line can be defined as rise over run, we can see that as we move from 90 to the next point, the line decreases by 30** [move finger down to 60 from 90] **and over to 6** [move to the right to 6]. **So, we can calculate the slope as -30 divided by 6 or -5.** **So, we would say that the rate of change in this context is that Aretha is descending at a rate of 5 feet per second.** **Now, let's think about how we could model this situation as a linear equation. We need to find the slope and y-intercept of the graph.** **Let's remember that we can also calculate slope using the change in the y coordinates divided by the change in the x coordinates or rise over run like we talked about before. This is what that looks like** [write or show the slope formula] $$m = \frac{y_2 - y_1}{x_2 - x_1}$$ **In this case, we used the points (0, 90) and (6, 60).** **The slope would look like this.** [write or show the solution path] **Slope** $= \frac{60-90}{6-0} = \frac{-30}{6} = -5$ **This is the same value we discovered by looking at the graph – as it should be.** **Now, what is the y-intercept?** [pause] **Right! It was 90. We saw that on the graph.** [point to the location (0,90)] **and we understood that in context as the starting point or initial value for Aretha's trip down the side of the cliff.** <u>Objective 2: Example/Guided Practice</u> **So, now using the slope-intercept form of a linear equation or y = mx + b where "m" is the slope or rate of change and "b" is the initial value or y-intercept, we can write our equation model this way:** [write or show the following] **y = -5x + 90** **This model of the situation tells us the same information as the graph. We see that the rate of change or slope is -5 or a**	Students will review the ways to identify rates of change on a graph and to calculate slope from two points. Students will use the identified rate of change and initial value to model the linear function as an equation.

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descent of 5 feet per second, and Aretha's initial height or the y-intercept of the equation is 90 feet.

How are you feeling about your understanding of that situation? Are you ready to try another one? [pause]

<u>Objective 3: Example/Guided Practice</u>
Let's think about this scenario without a graph.
Jay collects gaming cards. He has 50 cards collected now, and he plans to collect 15 more a week.

I'm going to ask you some questions about this scenario, and you try to answer. You write down your thoughts on this while we go.

How can you use the terminology is a function of to describe the relationship? [pause]

Okay – another question. What is the initial value? How do you know? [pause]

And another question. What is the rate of change? How do you know? [pause]

Okay – now, let's think about your responses. Did you come up with these?

The number of cards Jay collects is a function of the number of weeks collecting.
The initial value is 50 because it is the number of cards already collected.
The rate of change is 15 because it is the number of cards collected each week.

How did you do?
[pause]

Awesome!
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Students will build off their ability to identify rate of change and initial values from a graph to only using a descriptive scenario of a linear function.
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<u>Guided Practice </u>(10 minutes)
[You will probably use the additional problem here. Just be sure to give plenty of time for students to try their work]
Let's try this with a table instead. [write or show the table and description]

<table>
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<td>Rain falls early in the morning and stop. Then at noon, it begins to rain again and accumulate as constant rate. The table shows</td>
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<tr><td>Hours after noon</td><td>Inches of Rain</td></tr>
<tr><td>0</td><td>1.5</td></tr>
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Students will work through a sample using a table and will be given additional time at various points to explore the responses independently. They are continuing to identify or calculate rate of change and initial value in context along with writing an equation to model the linear function.
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the number of inches of rain in a rain gauge as a function of the time in the afternoon.	**1**	**3**
	2	**4.5**

Let's see what we can learn from the table.

What is the initial value or y-intercept of this value?
[pause]

Right! It's 1.5 because that's how much rain had been measured before it started raining again. [point to the 1.5 and 0]

What is the rate of change or slope? We can't see it on a graph, so how can we calculate it?
[pause]

Right! We can use the slope calculation to work it out. The change in the inches of rain compared to the change in time. Why don't you try calculating that part for a minute?
[pause]

Here's what I got. You might have used different points from the table, but we should still all come up with the same rate of change.

Slope/Rate of Change = $\frac{3-1.5}{1-0} = \frac{1.5}{1} = 1.5$ **inches of rain per hour.**

So, now what would the equation model look like for this problem? I'll give you a second to try it out. [pause]

This is my model. [write or show]
Y = 1.5x + 1.5

I think we might be ready to give this a try on your own!

<u>Additional Problems (if Needed):</u>
Let's consider this situation:

> **A bakery has 300 muffins. It then sells 50 muffins every hour after it opens.**

Using the phrase *is a function of*, how could we describe this situation? [pause]
Did you say it this way? The number of muffins a bakery has left is a function of how many muffins it sells each hour.

Guided Practice Additional Problems:
Students will work through a sample using another description of a linear function in context and will be given additional time at various points to explore the responses independently. They are continuing to identify or calculate rate of change and initial value in context along with writing an equation to model the linear function.

What would be considered the initial value or y-intercept in this case? [pause] **Right! The initial value is the number of muffins the bakery had to start with. 300 in this case.** **What about the rate of change?** [pause] **Right! It's 50 muffins every hour, but let's think about this mathematically. Are they gaining 50 muffins every hour or losing 50 muffins every hour?** [pause] **If you said, they were losing 50 muffins, you are correct because they are selling the muffins.** **Now, how would we represent losing 50 muffins symbolically in mathematics?** [pause] **If you said to use a negative sign, you're correct! The rate of change is a decrease of 50 muffins or -50 every hour.** **Last thing – how would we represent this linear function in an equation? Take a minute and write down what you think is correct.** [pause] **This is what I put together. Since the rate of change is -50 and the initial value is 300, the linear function can be written as $y = -50x + 300$ in slope-intercept form.** **How did you do on that one? Do you feel ready for that independent practice? I think you are ready! Let's go!**	
<u>Independent Practice</u> (1 min) **Terrific work today, students! Today, we explored strategies for Interpreting a Linear Function in mathematics. After this lesson, you will have a few problems to practice on your own using graphs, tables, and descriptions of linear functions in context. I will show you the independent practice problems now, or you can find them in the student practice for this lesson posted on our website, <u>www.tn.gov/education</u>.** [Teacher shows student practice page under document camera or camera zooms in on student practice page.] **Good luck and do your best!**	
<u>Closing</u> (1 min)	

I enjoyed reviewing the interpretation of linear functions in mathematics with you! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series! Bye!	