3.0 Row Boat Lab (Linear Equations)

Once students have a strong understanding of ratios, proportional relationships, and how to read and create their graphical representations, it is much easier to help students build an understanding of linear relationships in general. By representing real data, they can apply their experience with proportional relationships to other data that is not necessarily proportional. Students will have a more intrinsic sense of what the data is representing as well as a greater real world connection and understanding of graphical representations of data.

Instructional Goals:

- **6th Grade:** Use variables to represent two quantities that change in relationship to one another to solve mathematical problems and problems in real-world context. Write an equation to express one quantity (the dependent variable) in terms of the other quantity (the independent variable). Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation
- **7th Grade**: Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.
- **8th Grade**: Given a description of a situation, generate 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 a graph. Track how the values of the two quantities change together. Interpret the rate of change and initial value of a linear function in terms of the situation it models, its graph, or its table of values.

Section 3.0: Row Boats (Linear Equations)

Suggested Lesson Breakdown

Row Boat Lab	**Wrap Up**
3.1 Row Boat Lab: Collect Data and Make Whiteboards	**Suggested Assignment:** Help with Functions
3.2 Row Boat Lab: Discuss Your Models	**Suggested Assignment:** Slope-Intercept Form Assignment
3.3 Row Boat Lab: Whiteboard Meeting	**Post Test**
3.4 Row Boat Lab: Takeaways	3.0 Full Packet of Student Assignments

Row Boat Lab

Lesson	**Text**	**Teacher Directions**	**Digital Elements**
Row Boat Lab 3.1	**3.1 Row Boat Lab: Collect Data and Make Whiteboards** In the Buggy Lab we collected data which showed that the buggy's constant speed was a proportional relationship. Now, we will begin experimenting with changing one parameter at a time to see how it changes the graphs and the equations. We will also need to agree if our new relationships are proportional.	**Discussion Questions as students run the experiment:** • How does the slope change when the boat goes faster/slower? • Does the boat start at 0? What does that do to the line? • Can we Break the model? If it doesn't fit with what we know, there is something new going on. We are no longer working with a	3.0_Boat lab instruction slides 3.0_Teacher Link to Boat Lab 3.0_Student Link to Graphing Eileen's Motion Lab (Boat Lab) 3.0_Boat Lab Assignment

	You will run the experiment two times. The first time, just push start and collect your data without making any changes. The second time, you may click on the "Paddles" button and, as a group, choose one variable to change. Then collect your data a second time with the new parameter. How do you think this will change your graph? On your whiteboard, include: ● Table ● Graph ● An equation for each line ● How did changing the variable change the speed? ● How can you tell just by looking at the graph? At your equation? At your table? **Is every equation dealing with constant speed proportional? Whose boat is going the fastest?**	proportional relationship. Now we need to think more broadly about all linear relationships. ● Are **all** lines describing constant speed proportional? ● Who's boat is going fastest? (discuss absolute value) **Main takeaways:** ● When, why, how do we get a y-intercept other than 0 ● The more steep the line, the greater the slope. The greater the slope, the faster the boat. **In-person:** Have students conduct the experiment on classroom devices (either one per student or per group). **Digital:** Have students conduct the experiment on their personal devices	Digital graphing tool for linear equations Whiteboard option 1 - Jamboard Whiteboard option 2 - https://www.whiteboard.chat/ Whiteboard option 3 - Miro's Web White Board
Row Boat Lab 3.2	**3.2 Row Boat Lab: Gallery Walk**	Move around with the students to observe the boards and see where they are so far. Are there any groups	

	Look at other student's solutions and use a sticky note to leave a comment on each picture. Use talk moves to ask a question, give a compliment, or explain what you are thinking. Be specific. (Do you understand / agree with their solutions?) Once you have commented individually, move back to your group for a quick discussion. With your group members, discuss what you saw on other boards and see if there are any changes you want to make to your group's board before our board meeting.	that need a little direction or pointed questions about their representations or understanding at this point?	
Row Boat Lab 3.3	**3.3 Row Boat Lab: Whiteboard Meeting** Is every equation dealing with constant speed proportional? Whose boat is going the fastest? How do you know? What do we need to graph this boat's motion? Do we need more than a ratio to write an equation?	**Address common misconceptions:** ● *input vs output: "Let's discuss input and output. Point to an input on your board. How do you know that's an input? So how about an output? What does it mean when someone says there is only one output for every input? ● What does f(x) mean Often students think it means "f times x" when in reality, it means "f of x" ● How would you describe	

		what a function is to someone who hasn't heard of the word before? ● Graphs that are not linear can still be functions. Lines on a graph look different because relationships are different. ● Graphing the function helps us understand the "story" of the equation. Give us a way to visualize the relationship. **Definition of a function** 1. one input = one output 2. It has three parts ● an input (x) ● a relationship ● and an output (y) 3. A function ***relates*** an input to an output. 4. Sometimes a function has a name - f(x) 5. Sometimes it has no name - y=x^2 Every straight line is a graph of a linear equation.	

3.4 Row Boat Lab: Takaways	**3.4 Row Boat Lab: Takaways** We have worked with two types of functions: Proportional functions and linear functions. We need to summarize what we know about functions. Let's add to our Model-So-Far page as a class: ● When is an equation a function? When is it not a function? ● When is a function proportional? ● Where is the ratio in the function? ● Why do we need b? Why do we need more information than the relationship between the two variables (ratio)?	**Wrapping Up** When the whiteboard meeting ends, have students summarize the model individually in words. Then discuss. Add to the Model-So-Far vocabulary as you discuss. The goal is for students to have a complete understanding of y=mx+b as an equation, how changing the equation affects the graph, and how to move from equation to data to graph in any order. You can use the provided linear equation graphic organizer to structure your discussion.	Model-So-Far page 3.0_Linear equation graphic organizer - to help organize student thinking on linear equations

Wrap Up

Lesson	Text	Teacher Directions	Digital Elements

Suggested Assignment	**Helping with Functions** You have one more opportunity to help the computerized Student Cobi with a new assignment. Read through the problems and explain to Cobi how you would solve them	**Suggested help-giving activity:** if you are active on Khan Academy/have accounts, have your students comment on the Khan Academy video to either ask a question or answer somebody else's question.	3.0_Help with Functions Assignment 3.0_Teacher Answers for help with Functions Assignment
Suggested Assignment	**Slope-Intercept Form Assignment** We now understand that we can understand a problem better by easily switching between data in a table, an equation and a graph using Slope-Intercept Form. Complete Slope-Intercept Form Assignment using Khan academy to help you think about making equations.	**Suggested help-giving activity:** if you are active on Khan Academy/have accounts, have your students comment on the Khan Academy video to either ask a question or answer somebody else's question.	3.0_Khan Academy - Intro to slope-intercept form (y=mx+b) | Algebra 3.0_Intro to Slope Intercept Form Assignment
Post-test		You can use either of the tests linked here as a pretest and use the other test as a post-test.	Test Option 1 Test Option 2

Additional Khan Academy Videos

- Khan Academy - Intro to slope | Algebra (supplement, not used in curriculum)
- Khan Academy - Linear Equations Graphs: word problems (supplement, not used in curriculum)
- Khan Academy - Modeling with Linear Equations: snow (supplement, not used in curriculum)