## Big Idea/ Topic
- Analyze, graph, and solve linear equations and inequalities to interpret solutions.
- Interpret linear models.

## Standard(s) Alignment

**MGSE9-12.A.REI.3** Solve linear equations and inequalities in one variable including equations with coefficients represented by letters. For example, given $ax + 3 = 7$, solve for $x$.

**MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear functions.

**MGSE9-12.S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

## Diagnostic Assessment

**Diagnostic Review of Linear Equations**

Students will begin with the problems in column C. Once they complete column C, answers will be checked. Incorrect cells will be highlighted, and the problem will be corrected in column A. The problems form column A will be similarly checked, and corresponding problems from column B will be used for corrections. Finally, all problems from column D will be completed.
Instructional Design

Desmos Activity: **Linear Power Drive !!!**

*Note: In this Desmos, each activity question is introduced by a gif. The gifs are not included in this teacher’s guide.*

Engage

1. **Welcome**
   - **Teacher Moves**
     - It is recommended that PACING be set to screens 1-14 at the onset of this activity. The first half involves writing equations based on a model. The second half involves writing equations AND adjusting the model.
   - **Sample Responses**
     - Answers will vary (randomized questions).

2. **Jars of Hearts**
   - **Teacher Moves**
     - Help students make the connection between where you begin (jar height) and how that height changes (heart height).
   - **Sample Responses**
     - Answers will vary (random questions).

- **Synchronous**: Complete during a classroom discussion while pausing the activity to highlight student responses.
- **Asynchronous**: Introduce the problem to students in a virtual platform; this can be done via e-document or video. Allow students to share responses within the Desmos platform and provide feedback via the teacher dashboard. Additionally, students could use an audio/video to share. Provide feedback to individual student responses and highlight multiple strategies used by students.
- **Unplugged/Offline**: Provide the opening image for students to engage in the task. Have students share ideas through email/text/phone. Provide feedback to students and share other students’ ideas before engaging in the remaining sections.

Explore

4. **Enter the Equation for**
   - **Teacher Moves**
     - Students are encouraged to find the beginning point (y-intercept) and the change (slope). Students will receive feedback on the graph once they press submit.
   - **Sample Responses**
     - Answers vary (random linear equations).
6 New Direction: Enter …

**Teacher Moves**

Have students discuss and discover how to express a decreasing linear change. Have students keep in mind that they will see checkmarks once a correct response is submitted.

**Sample Responses**

Responses will vary.
Random linear equation with a negative slope.

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8 Level Up! Enter the E…

**Teacher Moves**

Even though the numbers involved are higher, the equation is still created by locating the y-intercept and calculating the slope. Students having trouble can be encouraged to write the y-intercept first, and then the slope, such as \( y = 13 + 10x \).

**Sample Responses**

Responses vary.

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10 Sky High! Enter the …

**Teacher Moves**

The numbers involved are even higher, and the equation is still created by locating the y-intercept and calculating the slope.

**Sample Responses**

Answers will vary (randomized questions).

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12 Negative to Positive…

**Teacher Moves**

Encourage students to use the visual feedback when they submit an equation. Have them check to see if the slope looks correct or if the y-intercept looks correct.

**Sample Responses**

A random line with a positive slope and a negative y-intercept.
Teacher Moves

It is recommended that PACING be set to screens 1-14 at the onset of this activity. This is the final screen in which students simply write an equation.

For the second half of the activity, students are to write function rule \( z(x) \), and adjust the model to match the verbal scenario.

Sample Responses

Random negative intercept and negative slope.

- **Synchronous**: Complete the Desmos activity during synchronous learning, either face-to-face, virtual, or blended.
- **Asynchronous**: Using the teacher dashboard, unrestrict screens one-14. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit responses.
- **Unplugged/ Offline**: Provide printed materials for students to write equations from linear models. Have students share ideas through email/text/phone. Provide feedback to students and share other students’ ideas before engaging in the remaining sections.

Apply

**Teacher Moves**

You can tell students that they are free to use \( f(x) \) or other function names normally. However, in the construction of this activity, \( f(x) \) is already defined in the graph.

If students accidentally erase an expression line in the graph, they can RESET by pressing the gear icon at the top of the expression list and clicking the RESET button.

**Teacher Moves**

Remind students for this section that BOTH the function rule AND the model need to be correct. They will use the draggable points on the graph to create a model that reflects the verbal scenario.

**Sample Responses**

Answers will vary (randomized questions).
Teacher Moves

**Synchronous** Complete Desmos activity during synchronous learning, either face-to-face, virtual, or blended.

**Asynchronous** Using the teacher dashboard, unrestrict screens 14 through 21. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit responses as needed.

**Unplugged/ Offline** Provide students with access to graph paper and allow students to engage in the questions presented on screens 14-21. Ask students to complete the questions and have them submit responses via email/text/phone. Provide feedback, share these responses with other students, and share other students' responses with them.

Sample Responses

Answers will vary (randomized questions).
Students will engage in a discussion about how linear equations and linear models can help answer many different questions about a given scenario. Students will be encouraged to demonstrate how to use both representations to arrive at answers.

- **Synchronous: Think-pair-share.** First, students work independently to solve slides 23 and 25, which ask a specific question about a scenario. Slide 27 asks a multi-part question that may require reflection and discussion about how to calculate profit. Students can then work together to discuss strategies used to solve these problems.

- **Asynchronous: Virtual Think-Pair-Share.** First, students work independently to solve slides 23 and 25, which ask a specific question about a scenario. Slide 27 asks a multi-part question that may require reflection and discussion about how to calculate profit. If possible, students can then work together to discuss strategies used to solve these problems.

- **Unplugged/Offline:** Students work independently to solve slides 23 and 25, which ask a specific question about a scenario. Slide 27 asks a multi-part question that may require reflection about how to calculate profit. Students can share feedback via email/phone/text.

### Evidence of Student Success

**Formative Assessment Questions:**

- How can you create a linear model to explain a real-life scenario?
- Describe the mathematics of the model you created. (What does the y-intercept and slope mean in the context of the problem?)
- Can you use your model to answer questions about a scenario?
- What are real-life scenarios that can be modeled by a linear equation?
- Can you make predictions about a scenario based on analyzing the model and/or equation?
**Establish mathematics goals to focus learning.**
- Make instructions and expectations clear for the activities.
- Make explicit connections between current and prior lessons or units.

**Facilitate meaningful mathematical discourse.**
- Explicitly model and teach good “discussion board” etiquette.

**Pose purposeful questions.**
- Predetermine when you will call on the student or use the pause feature within the activities.
- Break class into small discussion groups to work collaboratively and then have groups report back to the whole group.

**Support productive struggle in learning mathematics.**
- Offer outlines and other scaffolding tools and share tips that might help students learn.
- Provide feedback using the feedback feature within activities and offer corrective opportunities.
- Consider the pacing of the lesson.

**Elicit and use evidence of student thinking.**
- Anticipate any misconceptions or questions students might have about the task, materials or technology. Proactively address them with readily available and accessible resources such as this introduction from [Math is Fun](https://www.mathsisfun.com/linear-function.html) to give students and families an introduction to linear functions.

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**Engaging Families**

- Families can have fun with the [Human Graphs](https://www.transum.org/software/?id=Human%20Graphs) activity from transum.org. Families will be given a graph to mimic with their bodies. When they press the see reflection button, they will see the correct physical modeling.

- Limitless practice activity: As a family or independently, students can [practice writing linear equations](https://www.transum.org/software/?id=Linear%20Equations) given randomized models.

- Limitless practice activity part two: As a family or independently, students will [practice modeling equations](https://www.transum.org/software/?id=Linear%20Equations) (generated by the students themselves or their parents).