Polynomial Functions and Scatter Plots

The interactive white board Teacher Tool for this lesson is available on our website under Resources www.dreambox.com/teachertools. In this DreamBox Lesson, students create linear, quadratic, or cubic functions to direct a robot along a path that collect objects arranged in a narrow scatter plot. Students construct the function by choosing and arranging tiles that represent coefficients in standard form or constants in factored form. To successfully create these functions, students must look for and make use of the structures and relationships between their symbolic and graphical representations. Students learn to use and understand rates of change, y-intercepts, translations of parent functions, and solutions or zeros of linear, quadratic, and cubic functions.

Linear Function in Standard Form: Sample Lesson

Objective: Students use the graph of a narrow linear scatterplot to determine the equation of the line of best fit that will direct the robot to collect all of the objects.

Background: Students should be familiar with linear relationships, linear equations, and coordinate locations.

Instruction:

1. Launch the DreamBox interactive white board lesson. At the Menu screen, select the Linear, Standard Form option. Once the problem has loaded, present the task to the students: "We need to direct the robot collect all these objects. We can only program the robot by creating a single function that tells the robot what path to follow." To build a function, drag number tiles from the area on the right to the empty space just below the f(x) = at the top.

2. Begin by exploring the tool with students. This digital tool supports mathematical processes, practices, and dialogue because students can easily compose and manipulate functions while exploring relationships. Ask students questions about the interactive tool such as, "How does the number of tiles determine the type of function we are creating?" or "Why might the zero be off to the side; is it a special value for creating functions?" or "How can we create negative numbers?"

3. Once students understand how to create functions using the tiles, ask, "How many tiles do you think we'll need for a function that will collect all items?"

Possible responses:

- "One. The slope looks like it's about 2, so just use a 2 tile."
- "Two. One tile is needed for the x term, and the other for the y-intercept."
- "Two. The first is the coefficient for x, and the second is the y-intercept."
- "The first tile you place will be the y-intercept, but when you put a second tile there, your initial tile might change to be the slope of the line because it's on the left."
- "The tile on the right isn't a coefficient in the equation. It's a constant."
- "The first tile is the constant rate of change for the function. That's the slope."

4. After building the first equation, activate the robot by selecting the green checkmark.

Sample 1

Sample 2

5. Discuss the function and its graph. If the robot did not collect all the objects, ask students to discuss in pairs why it didn't work. After students have discussed their reasoning with each other, ask them to share their explanations and ideas for correcting the function.

   Possible responses for Sample 1:

   - "The slope was going in the right direction but intersected at the wrong place. It should be closer to 0." *If this is the response, prompt the student to use correct vocabulary: "The slope was positive, but crossed the y-axis in the wrong location. Then prompt the student to change the equation. Note that the graph will immediately reflect the new function.*
   - "The coefficient is positive, but it's probably too steep." *If this is the response, prompt the student to change the equation. Note that the graph immediately reflects the new line.*

   Possible responses for Sample 2:

   - "This function is not linear. The objects are basically in a straight line. We should try using only two tiles." *If this is the response, prompt the student to change the equation. Note that the graph immediately reflects the new line.*

6. Once the "hint" line is visible on the graph, ask, "Do you think the robot will be able to collect all the objects if traveling on this function? Discuss it with your partner and prepare to defend your answer."

Possible responses:

- "The line is not in the middle of all the objects. The robot might not be able to collect the items on the right side. We may need to change the y-intercept again."
- "The slope is still not quite right. We may need to change the coefficient."
- "The line looks about right. I think we should try it."

7. After discussing the possibilities, select the green check mark to see what the robot can collect. If the robot does not collect all the objects, continue the discussion until the robot is successful. Once successful, discuss with students why that function worked and how the correct function differed from the initial equations the class tried.

As you discuss the functions students create to match the narrow scatterplots, keep the points below in mind:

- **Linear or Not?** When it comes up, discuss the difference between linear and non-linear functions.
- **Correct Values?** Once students recognize *f(x) = ax + b* as the standard form of a linear function, discuss how the graph gives clues about the correct values of ***a*** and ***b***. What strategies do students use to analyze the graph? Do they identify ***a*** as the rate of change and ***b*** as the y-intercept? Do students substitute values for ***x*** to calculate ***f(x)***?
- **Trial and Error.** There is no limit to the tries that your students might make. Encourage them to commit to functions that might be incorrect because they can learn by observing the robot's path. Are students mistaking positives and negatives?
- **Bread Crumbs.** After an incorrect answer, the robot will leave a "hint" trail on the graph showing the previous function. This can help students rethink their answer. As a teacher, you have control over this visual help in a way that students wouldn't have during a lesson. Select this button to turn this assistance on or off at any time.

You may want to allow students to use it consistently in early exploration, but switch it off as their understanding improves.