

Biggest Output

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Summary	Students will decide on what linear and quadratic functions will result in the greatest output, starting from an algebraic expression, and using tables and graphs to help them make these decisions.
Goals	<ol style="list-style-type: none">1. Use algebraic notation, tables, and graphs for both linear and quadratic functions.2. Use representations to compare functions, strategize about the most efficient way to solve a problem, and demonstrate that your choices are correct.3. Address functions of the following formats:<ol style="list-style-type: none">a. $y = ax$b. $y = ax + c$c. $y = ax^2$d. $y = ax^2 + c$e. $y = ax^2 + bx + c$4. Have fun!
Materials	Handouts, Small Whiteboards, Whiteboard Markers
Duration	30 minutes
Keywords	Full Class Discussion Linear Functions Math Game Production of Graphs Quadratic Functions Small Group Work

Activity Plan:

Compare quadratic and linear functions, as part of planning and playing a game, to determine which will give the greater value, and over which ranges.

An important part of the activity is the strategize phase. This is when the teams will be trying to represent each function, comparing them, and determining general rules for which function they should choose to generate the highest output, given an input.

The sequence of activities is as follows:

1. Introduce the game. Share and discuss the rules of the game. Handout (below) is available to give to students. Run a few examples of game trials. Tell class the winners will get a treat.
2. Assign teams and do a trial run of the game.
3. Discuss the trial run and how teams can strategize.
4. Play the game for real!
5. Discuss how the game went this time, and how different strategies helped or didn't help.

After the trial run, there will be a full class discussion about the game and the trials. Discuss:

1. What kinds of discussions did you have in your group when you were deciding which function to use?
2. Did you feel like you wanted more time to make decisions?
3. What strategies were you using to make your decisions?
4. Do you think that picking one function is better than the other? Is it always better?
5. We're next going to have some time to strategize in our groups before we play the game again. What kinds of things could we do so that when we play the game, we'll have the right answer in 10 seconds? Is there a way to prepare so that you'll always get the highest answer?

After the game, there will be a full class discussion about the game and the strategies. Discuss:

1. What kinds of discussions did you have in your group this time when you were deciding which function to use? Were they different than in the trial run?
2. Did you still feel like you wanted more time to make decisions?
3. What strategies were you using this time to make your decisions?
4. How did the strategies and the plans you made with your group help you in the game? Did they change the way you played the game this time from the way you played it during the trial run?
5. Do you think that picking one function is better than the other? Is it always better?

Round 1

- $y = x - 3$
- $y = -x + 7$

Round 2

- $y = 3x + 2$
- $y = -4x + 30$

Round 3

- $y = 2x$
- $y = -3x - 15$

Round 4

- $y = x + 5$
- $y = x - 5$
- $y = 9$

Round 5

- $y = -x$
- $y = x - 18$
- $y = \frac{1}{2}x - 9$

Round 6

- $y = x$
- $y = x^2$

Round 7

- $y = x^2 + 1$
- $y = 2x$

Round 8

- $y = -x^2 + 4$
- $y = 2x + 5$

Round 9

- $y = x^2 - 16$
- $y = -x^2 + 16$

Round 10

- $y = 3x$
- $y = x + 13$
- $y = x^2 - 10x - 4$

Handout: Rules for Math Game

Name: _____ Date: _____

The rules of the game are as follows:

1. The instructor will share two/three functions with the class. These will be written on the board through the whole round.
2. Each team will copy the two/three functions, each one in a separate 5x7 file card.
3. For each round, the instructor will draw a whole number from 0 to 20 (inclusive) out of a hat. So the input values are $\{0, 1, 2, \dots, 20\}$.
4. As soon as the instructor draws the number, he/she will read the number out loud and write it on the board. He/she will also start the timer for 10 seconds!
5. Each team has these 10 seconds to choose the file card with the function they believe will give the highest value of y for the value of x that was drawn from the bag. When the timer goes off, each team has to hold up one of the functions.
6. Each team choosing the correct function will then have to prove that the function they have chosen is in fact the one that gives the highest output.
7. The order for the teams' presentation of proofs will be randomly determined by the teacher. After one team presents a proof, the next team needs to come up with a new proof.
8. Each team will win one point for correct choices and two extra points for presenting an accepted proof.
9. If a team detects that two functions give the same value, the team will hold up both functions and will get 2 points for the choice and 2 points for the proof. If a team detects that three functions give the same value, the team will show the three functions and get 3 points for the choice and 3 points for the proof.
10. The points will be tallied for each team and cumulative over different rounds. Each round starts again from Step 3.