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Activity Cards

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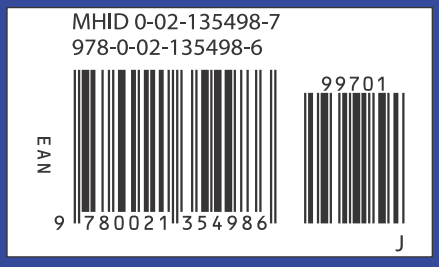

Mc Graw Hill Education

Level J

ACTIVITY 3U

Maura's Murals

Objective

Students can graph and interpret functions of the form $y = x^2$.

Materials

Program Materials

Graph Activity Sheet 1, 1 per student

Alternative Groupings

Pair: Have pairs work together to complete the table and graph, checking one another's work.

Introduce the Activity

- Create a two-column table. Label the first column *Tiles on One Side* (*x*) and the second column *Total Tiles* (*y*). Draw three murals where all the students can see. The first mural should be a single square or tile. The second mural should be two tiles wide and two tiles high. The third mural should be three tiles wide and three tiles high. Record the size and total number of tiles in the table. Explain that these are Maura's Murals and that she only makes murals in the shape of a square.
- Ask students to describe in words a rule for determining the total number of tiles needed for any size mural that Maura creates. square the amount of tiles on one side
- Ask students to use the rule to write an equation. $y = x^2$

Begin the Activity

- Give each student a copy of the Graph Activity Sheet 1.
- Have students plot the ordered pairs from the table and then connect the points including the origin.
- Discuss the graph, specifically about how the points are connected. Point out that the students can't connect them with one straight line.

Conclude the Activity

- Students should notice that like other graphs they have worked with in this unit, as one quantity increases the other quantity increases too. In the graphs of linear functions, the change in rise for every run was the same, but in this graph, for every one unit of run, the rise gets bigger and bigger.
- Make sure students understand that the relationship between two quantities increases at a constant rate, the graph of that relationship forms a line. These are called linear functions. The graph of the equation $y = x^2$ forms a curve not a straight line; therefore, it is referred to as a *nonlinear function*.

Questions to Ask

- **Your graph represents a relationship between two quantities. What are those quantities?**
- **As the first quantity increases, what happens to the second quantity?**
- **What do you notice about the points on your graph?**
- **How is it like the other graphs we have worked with in this unit? How is it different?**
- **What is the run between points (1,1) and (2,4)? What is the rise?**
  Repeat these questions for (2,4) and (3,9).

ACTIVITY 3V

The Other Half

Objective

Students can graph and interpret functions of the form $y = x^2$ in the four quadrants of the coordinate plane.

Materials

Program Materials

Coordinate Grid (I–IV), 1 per student

Alternative Groupings

Pair: Have pairs work together to complete the tables and graphs, checking each other's work.

Prepare Ahead

Prepare Coordinate Grid (I–IV) for display to the class.

Introduce the Activity

- Have students recall that in the last lesson, $y = x^2$ was an equation for determining the total number of tiles for any size mural that Maura wanted to create. When students created a table of values for x and y, they looked only at positive values for x. In that scenario, it did not make sense to use negative values for x because Maura could not build a negative size mural. However, we can further explore the graph of the equation $y = x^2$ by using negative values for x.

Begin the Activity

- Draw a two-column table where all the students can see. Label the first column x and the second column y. Fill the x column with whole number values from -3 to 3. Have students copy the table onto a piece of paper and use $y = x^2$ to find the y values.
- Give each student a copy of the Coordinate Grid (I–IV). Have them plot the ordered pairs from the table onto the grid and connect them.

Conclude the Activity

- When students have completed their table and created their graph, complete the displayed table and create the graph on the display of the Coordinate Grid (I–IV). Have students compare their table and graph to yours to make sure theirs are correct.
- Have students look for patterns in their graph and share observations about the graph.

Questions to Ask

- **How did adding negative x values change the shape of the graph?**
- **If you could name the shape of your graph, what name would you give it?** Tell students that the math term for this shape is *parabola*.

Challenge

Explore what happens to the graph of $y = x^2$ when you add a coefficient to x. Use equations such as $y = 2x^2$ or $y = 3x^2$.

ACTIVITY

3W Cube Factory

Objective

Students can graph and interpret functions of the form $y = x^3$.

Materials

Program Materials

Graph Activity Sheet 2, 1 per student

Alternative Groupings

Pair: Have pairs work together to complete the table and graph, checking each other's work.

Prepare Ahead

Prepare Graph Activity Sheet 2 for display to the class.

Introduce the Activity

- Create a two-column table where students can see. Label the first column *Width of Cube* (x) and the second column *Total Cubes* (y). In the first column, list numbers from 0 to 3.
- Tell the students that the table shows the number of smaller cubes it takes to create a larger cube. Having a larger cube with a width of 0 cubes would be a total of 0 cubes. Having a larger cube with a width of 1 cube would be 1 total cube, and having a larger cube with a width of 2 cubes would take 8 total cubes. Insert these quantities to the table for y.
- Challenge students to fill in the table for the total number of cubes when x is 3. Record the y value in the table.
- Ask students to determine an equation for y when you know x. $y = x^3$

Begin the Activity

- Give each student a copy of the Graph Activity Sheet 2 and display the prepared version to the class.
- Have students title the graph *Large Cubes*, the x-axis *Width of Cube*, and the y-axis *Total Cubes*. Have students label the x-axis from 0 to 10, and the y-axis from 0 to 30.
- Have students plot the ordered pairs from the table and then connect the points.
- Create the same graph on the displayed version.

Conclude the Activity

- Have students compare the graph of $y = x^3$ with the graph of $y = x^2$ that they created in the warm-up.
- Students should notice that the graphs appear to be similar in shape but the graph of $y = x^3$ is steeper/narrower than the graph of $y = x^2$.
- Remind students that in the graphs of *linear functions*, the change in rise for every run was the same; but in this graph (like the graph of $y = x^2$) for every one unit of run, the rise gets bigger and bigger. Both $y = x^2$ and $y = x^3$ are *nonlinear functions*.

Questions to Ask

- **Your graph represents a relationship between two quantities. What are those quantities?**
- **As the first quantity increases, what happens to the second quantity?**
- **What do you notice about the points on your graph?**
- **How is it like the other graphs we have worked with this week? How is it different?**
- **How large would the y-axis have to be to fit the graph for $y = x^3$ when $x = 5$? How did you determine your answer?**

ACTIVITY

3X Curve Ball

Objective

Students can graph and interpret functions of the form $y = x^3$ in the four quadrants of the coordinate plane.

Materials

Program Materials

Coordinate Grid (I–IV), 1 per student

Alternative Groupings

Pair: Have pairs work together to complete the tables and graphs, checking each other's work.

Prepare Ahead

Prepare Coordinate Grid (I–IV) for display to the class.

Introduce the Activity

- Review with students about how squaring a negative number results in a positive number.
- ► **If you cube a negative number, will the answer be a positive or a negative number?** negative
- Give the example of $(-2)^3$. When you multiply the first two -2*s* together you get 4. When you multiply 4 by -2 you get -8. Have students cube a few more negative numbers.

Begin the Activity

- Draw a two-column table where all the students can see. Label the first column *x* and the second column *y*. List the numbers -3 through 3 in the *x* column.
- Have students copy the table and use the equation $y = x^3$ to find the missing values for *y*.
- Give each student a copy of the Coordinate Grid (I–IV) and display the prepared version to the class.
- Have them plot the ordered pairs from the table onto the grid and connect them. Inform them that they won't be able to plot for the *x* values of -3 and 3.
- When students have completed their own graphs, create the graph on the displayed version for the students to check to make sure they graphed correctly.

Conclude the Activity

- Make sure everyone created the same graph.
- Have students look for patterns in their graph and share observations about the graph.
- Inform students that this graphed shape is called either a cubic curve or an S-curve.

Questions to Ask

- ► **Are you surprised by the shape of the graph? Is it what you predicted?**
- ► **What patterns do you notice in your graph?**
- ► **How did adding negative *x*-values change the shape of the graph?**
- ► **Use your graph to estimate the value of x^3 when *x* is 2.5.**
- ► **Use arithmetic to find the exact value of x^3 when *x* is 2.5.**

Challenge

Explore what happens to the graph of $y = x^3$ when you add a coefficient to x. Use equations such as $y = 2x^3$ or $y = 3x^3$.