Coordinate Pairs and Graphing

Activity Set 3

Trainer Guide
Algebra Walk

In this activity, selected participants will physically move around a large coordinate grid to model the plotting of coordinate pairs. Observers will graph the results on a coordinate plane.

**MATERIALS**
- Transparency/Page: Living Line Practice Graph
- Transparencies/Pages: Graphs 1–6
- Transparencies/Pages: Graphs 1–6
  Answer Keys
- Transparency/Page: Algebra Walk Summary
  Answer Key
- blank transparency
- masking tape
- heavy string or rope
- 2 overhead counters (2 separate colors)
- chart paper

**VOCABULARY**
- coordinate pair
- coordinate plane

**TIME**: 30–40 minutes
TEACHING TIP: For this activity, the following must be prepared prior to the beginning of the workshop.

- A large four-quadrant coordinate plane made with masking tape on the floor. It must have 11 horizontal lines with the x-axis placed on line 6. It must have 19 vertical lines with the y-axis on line 10.
- 4 card tents, each labeled with 1 quadrant name (e.g., Quadrant I)
- 1 card tent labeled (0,0)
- 2 card tents, 1 labeled x-axis and 1 labeled y-axis

INTRODUCE

- Explain to participants that volunteers, using the graph on the floor, are going to plot lines by moving according to instructions from an equation.
- Display Transparency: Living Line Practice Graph. (Use this graph to model what participants are going to do.)
- Put a counter on the point (2,0) on the x-axis.
- Explain that the counter is positioned on the input point—the x-value (2) of an ordered pair. The counter needs to move to the output point—the y-value of the ordered pair.
- Indicate that the rule that the counter must follow is “Multiply x by 2.”
- Ask participants what the output, or y-value, will be. (4)
- Announce that because the y-value is positive, the counter will move four units in the positive direction.
- Move the counter to the new point and announce the ordered pair that marks the spot: (2,4), input 2 and output 4.
• Position a second counter at (–2,0).
• Point out that the \(x\)-value, or input, is –2.
• Ask participants what the \(y\)-value, or output, should be if the rule remains “Multiply by 2.” (–4)
• Announce that because the \(y\)-value is negative, the counter must move backward (the opposite of positive) 4 units in the negative direction.
• Announce the ordered pair, when you have moved the counter to the new point, that marks the spot: (–2,–4), input –2 and output –4.
• Position a third counter at (0,0).
• Ask participants what the input and output, or \(x\)-value and \(y\)-value, should be. (0 and 0)
• Lay string or rope across the three points on the graph to create a line.
• Tell participants that they will now take the place of the counters and create a living line graph.

DISCUSS AND DO

• Move the group into position to view the coordinate plane that you have created on the floor.
• Pass out the seven card tents that you have created and ask volunteer participants to place them on the graph. Clarify any misconceptions.
• Move five volunteers to one side.

**TEACHING TIP:** If the group would benefit from peer support, use 10 volunteers instead of 5. There will still be 5 individuals to move to the points, but each individual will have a partner with whom to consult.
• Have the rest of the participants form groups of 3 or 4 and locate their Pages: Graphs 1–6.

• Walk to the graph.

• Select a point in each quadrant. Stand on each point in turn.

• Ask participants to name the ordered pair that identifies the selected point in each quadrant on the graph.

• Ask the volunteers to stand at various points along the x-axis, facing in the positive direction of the y-axis—toward QI and QII. (They should be distributed across both negative values and positive values, with no value greater than +4 and no value less than −4.)

• Have each participant identify the ordered pair for his or her location (n,0).

**TEACHING TIP:** If participants understand the concept of using the x-value to find the y-value, proceed with the instructions as written. If there is any hesitancy, have one “positive” volunteer and then one “negative” volunteer give a y-value for their x-values by using the rule “Add 4 to x.”

• Ask the volunteers to apply the rule, “Multiply x by 2” to their x-coordinate and move to the spot for the correct y-coordinate. Those with negative x-values should move backward to their points. (Move in the opposite of the positive direction.)

**TEACHING TIP:** Suggest to members of the living line that they compute the y-value, or output value, before they move to reduce the chance of confusion. Also, remind them that when calling out their ordered pairs, x is first and y is second.
COORDINATE PAIRS AND GRAPHING
ACTIVITY SET 3

- Have each participant name the ordered pair for the spot on which he or she is standing.
- Have the observers verify the accuracy of the location.
- Have the observers record the points on their copy of *Graph 1* as each person names his or her ordered pair. Have observers include the ordered pair.
- Use a string or rope to connect each member of the living line when all points are recorded.
- Have observers connect the dots on their graphs.
- Have observers write the rule below the graph.
- Have the graph members trade places with five observers.
- Have the members of the living line repeat the same steps for each of the remaining five graphs:
  - Line up along the x-axis.
  - Call out the ordered pair. \((n,0)\)
  - Apply the rule.
  - Move to the new points.
  - Call out the new points.
  - Use rope to create the line.
- Have observers:
  - verify the points when they are called
  - graph the points on *Graphs 1–6*
  - draw the line
  - write the rule below the graph
- Use five new participants for each line.
- Repeat this activity until there are six lines and graphs.
The rules for the six lines and graphs are:

- Graph 1—Multiply $x$ by $+2$.
- Graph 2—Multiply $x$ by $-2$.
- Graph 3—Multiply $x$ by $+2$; then add $+1$.
- Graph 4—Multiply $x$ by $+2$; then subtract $+1$.
- Graph 5—Multiply $x$ by $+1$; then add $+1$.
- Graph 6—Multiply $x$ by $-1$; then add $+1$.

**CONCLUDE**

- Bring the group together to discuss the activity.
- Display, in order, *Transparencies: Graphs 1–6 Answer Keys*, permitting participants to verify work.
- Display *Transparency: Algebra Walk Summary Answer Key*.
- Ask participants how the lines are affected by the rules. Sample responses include:
  - Multiplying by a negative number causes the line to slope downward from left to right.
  - Multiplying by a positive number causes the line to slope upward from left to right.
  - Adding a number causes the line to cross the $y$-axis at that number. (When nothing is added to or subtracted from $x$, the line crosses at the origin.)
  - The greater the multiplier, the steeper the line.
- Record participants’ responses on chart paper.
COORDINATE PAIRS AND GRAPHING
ACTIVITY SET 3

KEY QUESTION

How does an activity such as this augment similar instruction that uses paper and pencil? (helps students get a physical sense of dimensionality; addresses the kinesthetic learner)

End of Algebra Walk
Living Line
Practice Graph
Graph 1
Graph 4
Graph 6

II
(-,+)

I
(,+)

(0,0)

y

x

III
(-,-)

IV
(,+,-)
Multiply $x$ by $+2$. 
Graph 2

Answer Key

Multiply \( x \) by \(-2\).
Graph 3
Answer Key

Multiply $x$ by $+2$; then add $+1$. 

Multiply $x$ by $+2$; then add $+1$. 
Multiply $x$ by $+2$; then subtract $+1$. 
Multiply $x$ by $+1$; then add $+1$. 
Graph 6
Answer Key

Multiply $x$ by $-1$; then add $+1$. 
Algebra Walk
Summary Answer Key

**Rule 1:** Multiply $x$ by $+2$.  

**Rule 2:** Multiply $x$ by $-2$.  

**Rule 3:** Multiply $x$ by $+2$; then add $+1$.  

**Rule 4:** Multiply $x$ by $+2$; then subtract $+1$.  

**Rule 5:** Multiply $x$ by $+1$; then add $+1$.  

**Rule 6:** Multiply $x$ by $-1$; then add $+1$.  

Glossary
Coordinate Pairs and Graphing

cordinate pair  An ordered pair of numbers that indicates the coordinates of a point on a plane.

cordinate plane  The plane containing the x- and a y-axes.

domain  The set of all the first elements in the ordered pairs of a relation.

equation  A number sentence that says that two expressions are equal in value.

exponential function  A function in which the y value, or output, is the x value, or input, raised to a power.

function  A relationship between two quantities in which one quantity is dependent upon the other quantity; a relation in which each element of the domain is paired with exactly one element of the range.

input  The number (x) to which a rule or a function is applied.

linear equation  An equation in the form Ax + By = C the graph of which is a straight line.

negative number  A number that is less than zero.

nonlinear equation  An equation in which at least one variable is raised to a power other than 1 (e.g., x² + 3x + 1 = 5 or y₁₂ = 5).
ordered pair  A pair of numbers in which one number is specified as occurring first and the other number is specified as occurring second.

origin  The place on a coordinate plane where the $x$-axis and the $y$-axis intersect; the point (0,0) on the coordinate plane.

output  The outcome ($y$) of applying a rule or a function to a number.

parabola  A curved line that represents one type of non-linear equation.

class  A simple, closed plane shape composed of a minimum of three straight line segments.

positive number  A number that is greater than zero.

quadrant  One of the four regions into which the two perpendicular number lines of the coordinate plane separate the plane.

range  The set of all the second elements in the ordered pairs of a relation; (statistics) the difference between the greatest value and the least value of a set of data.

reflection  The transformation in which a figure is flipped over a line of symmetry.

rise-over-run  The ratio of the change in $y$ value over the change in $x$ value for two points on a line.

tangent  The rise-over-run ratio between any two points on a line.
Glossary (continued)

**transformation**  A movement of a geometric figure.

**translation**  The transformation in which a geometric figure is slid horizontally, vertically, or both.

**vertex (vertices, pl.)**  The intersection point shared by two sides of a polygon or the two sides (rays) of an angle. Also, the intersection point shared by three or more edges of a polyhedron.

**x-axis**  The horizontal number line in a coordinate plane.

**y-axis**  The vertical number line in a coordinate plane.

**y-intercept**  The intersection point of a graph of a linear equation with the y-axis of the coordinate plane.