

Big Idea

Coordinate geometry can be used to represent and verify geometric and algebraic relationships.

Vocabulary

coordinate plane, origin, x -axis, y -axis, plot, coordinates, ordered pair, horizontal, vertical, scale, axis, pattern, sequence, scale, term, numerical patterns, rules, coordinate system, first quadrant, points, lines, axis/axes, intersection of lines, x -coordinate, y -coordinate

Prior Learning

In Grade 4, students have had experience graphing points on a number line and identifying and extending patterns.

Essential Questions

- How does graphing points on the coordinate system help solve mathematical problems?
- How are coordinates used to determine location on two-dimensional surfaces?
- What is the coordinate plane?
- How do we use coordinates to identify and find points?
- How do we graph points using coordinates?
- How can geometric/algebraic relationships be represented and verified?
- How do we interpret coordinate values of point in contextual situations?
- Explain how to generate numerical patterns with two rules.

Competencies

- Students will graph ordered pairs in the first quadrant of the coordinate plane (x and y values are positive)
- Students will identify the x -axis, y -axis and origin on the coordinate plane
- Students will identify a point on the coordinate plane using an ordered pair
- Students will graph points on the coordinate plane understanding that the first coordinate is the x value and the second coordinate is the second value.
- Students will use the coordinate grid to visualize algebraic relationships.

Misconceptions

- Students may reverse the points when plotting them on a coordinate plane. They count up first on the y -axis and then count over on the x -axis. The location of every point in the plane has a specific place. Have students plot points where the numbers are reversed such as (4, 5) and (5, 4). Begin with students providing a verbal description of how to plot each point. Then, have them follow the verbal description and plot each point.
- Students may have difficulty with two rule numerical patterns.
- Students may have difficulty seeing the relationship between two sets of patterns.

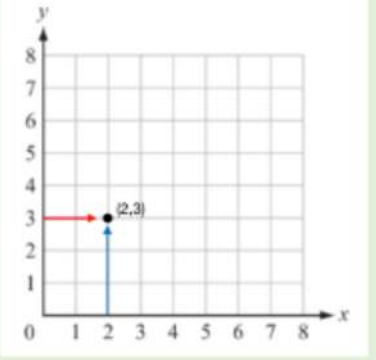
**Resources from The Key Elements to Mathematics Success - KEMS Grade 5
for Building the Conceptual Understanding of this Module**

LESSON 28 - COORDINATE PLANE AND PLOTTING POINTS

Additional Activities: Quiz – T843-T845, Coordinate Plane and Plotting Points- Scavenger Hunt – T1033-T1036

LESSON 15 - PATTERNS AND RELATIONSHIPS

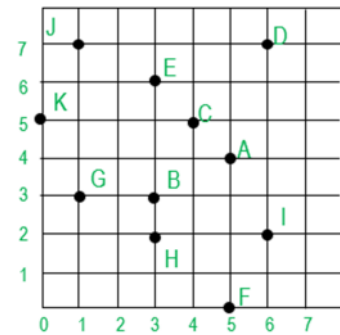
Additional Activities: Quiz – T435-T438; Patterns and Relationships– Scavenger Hunt– T1009-T1012

Mathematics Content Standard	Examples
<p>5.G.1</p> <p>Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., <i>x</i>-axis and <i>x</i>-coordinate, <i>y</i>-axis and <i>y</i>-coordinate).</p>	<p>Students should understand that the coordinate plane is formed by a horizontal number line, called the <i>x</i>-axis, and a vertical number line, called the <i>y</i>-axis. The two axes intersect at a point called the origin (0,0). Students need to understand coordinates define a distance from the <i>y</i>-axis and a distance from the <i>x</i>-axis.</p> <div data-bbox="560 478 1218 871" style="border: 1px solid gray; padding: 5px;"> <p>Students should distinguish between two different ways of viewing the point (2, 3). First, they should view the coordinates as instructions: "right 2, up 3". They should also understand the coordinates as the point defined by being a distance 2 from the <i>y</i>-axis and a distance 3 from the <i>x</i>-axis.</p>  </div>

Questions for 5.G.1

1. Name the ordered pair for the following points:

- D: _____
 B: _____
 H: _____



Answer Key for Questions for 5.G.1

1. D: (6, 7) B: (3, 3) H: (3, 2)

Tasks for 5.G.1

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Battle Ship Using Grid Paper

<https://tasks.illustrativemathematics.org/content-standards/5/G/A/1/tasks/489>

Extra Questions for Warm-ups and Homework for 5.G.1

1. Explain how to plot the point (4, 7) on the coordinate grid.

Mathematics Content Standard

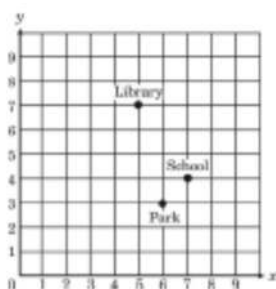
5.G.2

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Examples

This standard addresses real-world and mathematical problems, including the traveling from one point to another and identifying the coordinates of missing points in geometric figures, such as squares, rectangles, and parallelograms. (Quadrant 1 only)

Example 1:



Using the coordinate grid, which ordered pair represents the location of the school?
Explain a possible path from the school to the library.

Example 2:

Use the graph below to determine how much money Jack makes after working exactly 9 hours.



Example 3:

This standards deal with only the first quadrant (positive numbers) in the coordinate plane.

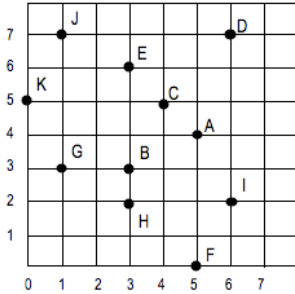
Plot these points on a coordinate grid. Point A: (2,6); Point B: (4,6); Point C: (6,3); Point D: (2,3) Connect the points in order. Make sure to connect Point D back to Point A.

1. What geometric figure is formed? What attributes did you use to identify it?
2. What line segments in this figure are parallel?
3. What line segments in this figure are perpendicular?

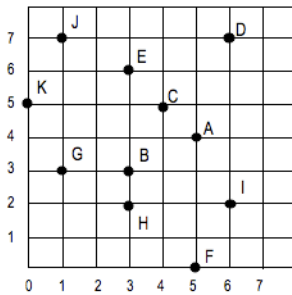
Questions for 5.G.2

1. What are the coordinates of the following points?

A _____ C _____ E _____



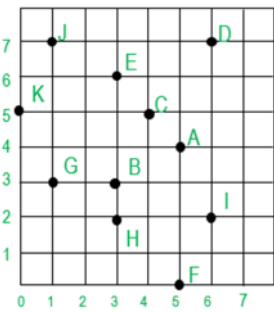
2. Points *G*, *B*, and *H* form three vertices of a rectangle. What are the coordinates of the fourth vertex?



3. The grid to the right shows the location of the houses of several of Frank’s friends. Frank’s house is represented by Point *F*. Frank walks to his friend Andrew’s house. (Point *A*).

How far did he walk to Andrew’s house? _____

If Frank and Andrew want to walk to Jack’s house (Point *J*), what is the shortest route from Andrew’s house?



Answer Key for Questions for 5.G.2

1. A (5, 4) C (4, 5) E (3, 6)

2. (1, 2)

3. It is 4 blocks from Frank’s house to Andrew’s house. 4 blocks west, 3 blocks north

Tasks for 5.G.2

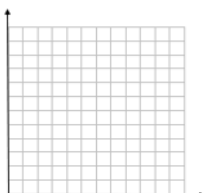
*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Meerkat Coordinate Plane Task

<https://tasks.illustrativemathematics.org/content-standards/5/G/A/2/tasks/1516>

Extra Questions for Warm-ups and Homework for 5.G.2

1. Identify the axes, write in the scale and plot the following points: (3,4) (5,6) (0,2)



Mathematics Content Standard

5.OA.3

Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. For example, given the rule “Add 3” and the starting number 0, and given the rule “Add 6” and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.

Examples

This standard extends the work from Fourth Grade, where students generate numerical patterns when they are given one rule. In Fifth Grade, students are given two rules and generate two numerical patterns. The graphs that are created should be line graphs to represent the pattern. This is a linear function which is why we get the straight lines. The Days are the independent variable, Fish are the dependent variables, and the constant rate is what the rule identifies in the table.

Example 1:

Make a chart (table) to represent the number of fish that Sam and Terri catch.

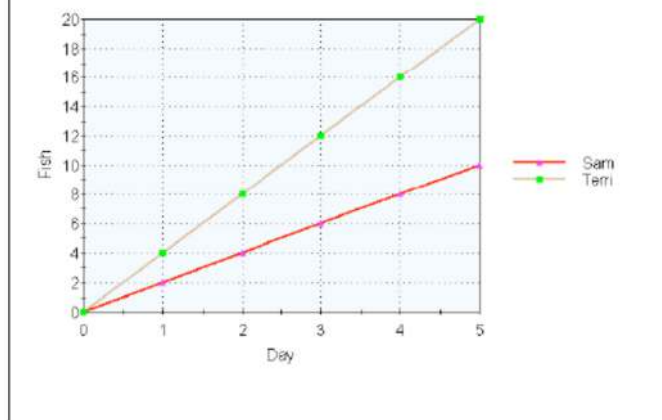
Days	Sam's Total Number of Fish	Terri's Total Number of Fish
0	0	0
1	2	4
2	4	8
3	6	12
4	8	16
5	10	20

Example 2:

Describe the pattern:
 Since Terri catches 4 fish each day, and Sam catches 2 fish, the amount of Terri's fish is always greater. Terri's fish is also always twice as much as Sam's fish. Today, both Sam and Terri have no fish. They both go fishing each day. Sam catches 2 fish each day. Terri catches 4 fish each day. How many fish do they have after each of the five days? Make a graph of the number of fish.

Plot the points on a coordinate plane and make a line graph, and then interpret the graph.
 Student:
 My graph shows that Terri always has more fish than Sam. Terri's fish increases at a higher rate since she catches 4 fish every day. Sam only catches 2 fish every day, so his number of fish increases at a smaller rate than Terri.
 Important to note as well that the lines become increasingly further apart. Identify apparent relationships between corresponding terms. Additional relationships: The two lines will never intersect; there will not be a day in which boys have the same total of fish, explain the relationship between the number of days that has passed and the number of fish a boy has ($2n$ or $4n$, n being the number of days).

Catching Fish



Example 3 :

Use the rule “add 3” to write a sequence of numbers. Starting with a 0, students write 0, 3, 6, 9, 12, . . .

Use the rule “add 6” to write a sequence of numbers. Starting with 0, students write 0, 6, 12, 18, 24, . . .

After comparing these two sequences, the students notice that each term in the second sequence is twice the corresponding terms of the first sequence. One way they justify this is by describing the patterns of the terms.

Their justification may include some mathematical notation (See example below). A student may explain that both sequences start with zero and to generate each term of the second sequence he/she added 6, which is twice as much as was added to produce the terms in the first sequence. Students may also use the distributive property to describe the relationship between the two numerical patterns by reasoning that $6 + 6 + 6 = 2(3 + 3 + 3)$.

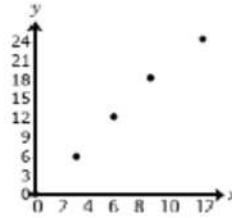
$$0, +^3 3, +^3 6, +^3 9, +^3 12, \dots$$

$$0, +^6 6, +^6 12, +^6 18, +^6 24, \dots$$

Once students can describe that the second sequence of numbers is twice the corresponding terms of the first sequence, the terms can be written in ordered pairs and then graphed on a coordinate grid. They should recognize that each point on the graph represents two quantities in which the second quantity is twice the first quantity.

Ordered pairs

- (0, 0)
- (3, 6)
- (6, 12)
- (9, 18)



Questions for 5.OA.3

1. Dan is saving money to buy a bicycle. The bicycle costs \$165. Dan earns \$15 in allowance each week. If he saves his entire allowance, how many weeks will pass before Dan has enough money for his bicycle? Create a table to show how long it will take and how much money Dan will have saved each week.

2.

Given the rule add 6 and starting at 0 complete the table below.

Given the rule add 12 and starting at 0 complete the table below.

Look at both of the tables once they are complete and explain the relationship between the two tables using the rules to help you.

0	0
1	
2	
3	

0	0
1	
2	
3	

3. Farmer Brown has 12 animals in his barn. Some of them are cows, and the rest are chickens. Altogether, his animals have 40 legs. How many of them are cows, and how many are chickens?

Use a table to explore the different possibilities.

Answer Key for Questions for 5.OA.3

1. It will take Dan 11 weeks to save enough money.

Week	1	2	3	4	5	6	7	8	9	10	11
Amount Saved	15	30	45	60	75	90	105	120	135	150	165

2. 8 cows and 4 chickens

Cows	Legs	Chickens	Legs
1	4	1	2
2	8	2	4
3	12	3	6
4	16	4	8
5	20	5	10
6	24	6	12
7	28	7	14
8	32	8	16
9	36	9	18
10	40	10	20
11	44	11	22
12	48	12	24

3.

0	6
1	7
2	8
3	9

0	12
1	13
2	14
3	15

Tasks for 5.OA.3

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Sidewalk Patterns

<https://tasks.illustrativemathematics.org/content-standards/5/OA/B/3/tasks/1895>

Extra Questions for Warm-ups and Homework for 5.OA.3

1. Complete the following patterns in the table below. Describe any pattern you observe between Pattern A and B.

Pattern A Add 1	Pattern B Add 4
0	0
1	4

Works Referenced in the Development of the Module

Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	