GRADE 5 • MODULE 6

Problem Solving with the Coordinate Plane

New or Recently Introduced Terms

- Axis (fixed reference line for the measurement of coordinates)
- Coordinate (number that identifies a point on a plane)
- Coordinate pair (two numbers that are used to identify a point on a plane; written (,) where represents a distance from 0 on the -axis and represents a distance from 0 on the -axis)
- Coordinate plane (plane spanned by the -axis and -axis in which the coordinates of a point are distances from the two perpendicular axes)
- Ordered pair (two quantities written in a given fixed order, usually written as (,))
- Origin (fixed point from which coordinates are measured; the point at which the -axis and -axis intersect, labeled (0, 0) on the coordinate plane)
- Quadrant (any of the four equal areas created by dividing a plane by an -axis and -axis)

In this 40-day module, students develop a coordinate system for the first quadrant of the coordinate plane and use it to solve problems. Students use the familiar number line as an introduction to the idea of a coordinate and construct two perpendicular number lines to create a coordinate system on the plane. They see that just as points on the line can be located by their distance from 0, the plane's coordinate system can be used to locate and plot points using two coordinates. They then use the coordinate system to explore relationships between points, ordered pairs, patterns, lines and, more abstractly, the rules that generate them. This study culminates in an exploration of the coordinate plane in real world applications.

Topic A: Coordinate Systems

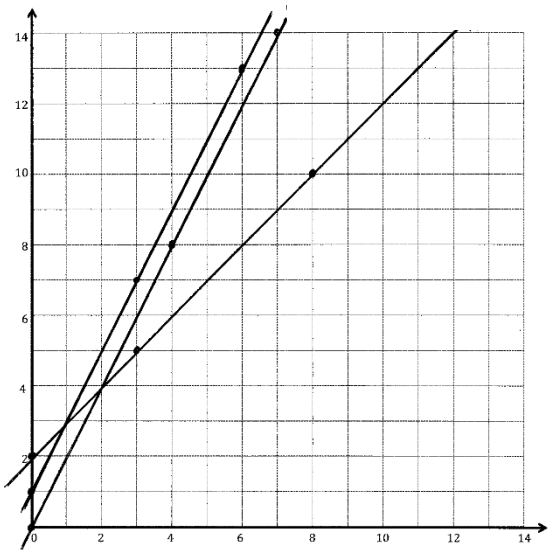
In Topic A, students revisit a Grade 3 activity in which lined paper is used to subdivide a length into *n* equal parts. In Grade 5, this activity is extended as students explore that *any* line, regardless of orientation, can be made into a number line by first locating zero, choosing a unit length, and partitioning the length-unit into fractional lengths. Students are introduced to the concept of a coordinate as describing the distance of a point on the line from zero.

As they construct these number lines in various orientations on a plane, students explore ways to describe the position of points *not* located on the lines. This discussion leads to the discovery that a second number line, perpendicular to the first, creates an efficient, precise way to describe the location of these points. Thus, points can be located using coordinate pairs, , by travelling a distance of units from the origin along the -axis, and units along a line parallel to the -axis.

Students describe given points using coordinate pairs, and then use given coordinate pairs to plot points. The topic concludes with an investigation of the patterns in coordinate pairs along vertical or horizontal lines, which leads to the discovery that these lines consist of the set of points whose distance from the - or -axis is constant.

Topic B: Patterns in the Coordinate Plane and Graphing Number Patterns from Rules

In Topic B, students plot points and use them to draw lines in the plane. Students begin by investigating patterns relating the - and -coordinates of the points on the line and reasoning about the patterns in the ordered pairs, which lays important groundwork for Grade 6 work with proportional reasoning.



Line A: y is 2 more than x		
x	y	(x, y)
0	2	(0,2)
3	5	(3,5)
8	10	(8,10)

Line B: y is 2 times of x		
x	y	(x, y)
0	0	(0,0)
4	8	(4,8)
7	14	(7,14)

Line C: y is 1 more than double of x		
x	y	(x, y)
0	1	(0,1)
3	7	(3,7)
6	13	(6,13)

Topic B continues as students use given rules (e.g., multiply by 2, then add 3) to generate coordinate pairs, plot points, and investigate relationships. Patterns in the resultant coordinate pairs are analyzed to discover that such rules produce collinear sets of points, or lines. Students next generate two number patterns from two given rules, plot the points, and analyze the relationships within the sequences of the ordered pairs and the graphs. Patterns continue to be the focus as students analyze the effect on the steepness of the line when the second coordinate is produced through an addition rule as opposed to a multiplication rule. They also create rules to generate number patterns, plot the points, connect those points with lines, and look for intersections.

Topic C: Drawing Figures in the Coordinate Plane

Topic C finds students drawing figures in the coordinate plane by plotting points to create parallel, perpendicular, and intersecting lines. They reason about what points are needed to produce such lines and angles, and then investigate the resultant points and their relationships.

Topic D: Problem Solving in the Coordinate Plane

Students also reason about the relationships among coordinate pairs that are symmetric about a line Problem solving in the coordinate plane is the focus of Topic D. Students draw symmetric figures using both angle size and distance from a given line of symmetry. Line graphs are also used to explore patterns and make predictions based on those patterns. To round out the topic, students use coordinate planes to solve real world problems.

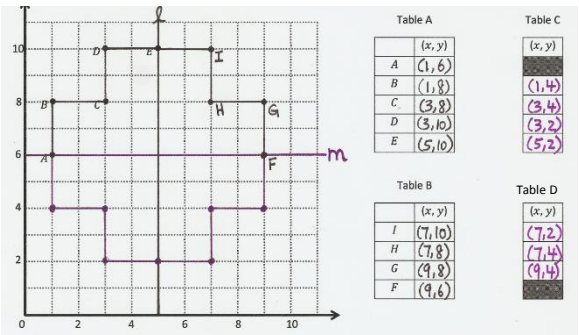


Table A

	(x, y)
A	(1, 6)
B	(1, 8)
C	(3, 8)
D	(3, 10)
E	(5, 10)

Table B

	(x, y)
I	(7, 10)
H	(7, 8)
G	(9, 8)
F	(9, 6)

Table C

(x, y)
(1, 4)
(3, 4)
(3, 2)
(5, 2)

Table D

(x, y)
(7, 2)
(7, 4)
(9, 4)

Topic E: Multi-Step Word Problems

Topic E provides an opportunity for students to encounter complex, multi-step problems requiring the application of concepts and skills mastered throughout the Grade 5 curriculum. They use all four operations with both whole numbers and fractions in varied contexts. The problems in Topic E are designed to be non-routine, requiring students to persevere in order to solve them. While wrestling with complexity is an important part of Topic E, the true strength of this topic is derived from the time allocated for students to construct arguments and critique the reasoning of their classmates. After students have been given adequate time to ponder and solve the problems, two lessons are devoted to sharing approaches and solutions. Students will partner to justify their conclusions, communicate them to others, and respond to the arguments of their peers.