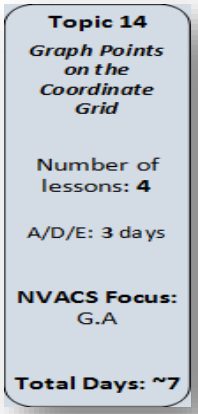
Grade 5 Topic 14: Graph Points on the Coordinate Plane



5th grade Curriculum Pacing Framework: Balanced Calendar

Big Conceptual Idea: K-6 Geometry, (pp. 17-18)

Prior to instruction, view the Topic 14 Professional Development Video located in Pearson Realize online. Read the Teacher's Edition (TE): Cluster Overview/Math Background (pp. 773A-773F), the Topic Planner (pp. 773I-773J), all 4 lessons, and the Topic Assessments (pp. 807-808A).

Mathematical Background: Read Topics 14 Cluster Overview/Math Background (TE, pp. 773A-773F)	Topic Essential Question: How are points plotted? How are relationships shown on a graph? *Reference Answering the Topic Essential Questions (TE, pp. 805-806) for key elements of answers to the Essential Questions.*

The lesson map for this topic is as follows:

14-1	14-2	14-3	14-4	Assessment

3 A/D/E days used strategically throughout the topic

Instructional Note:

This topic focuses instruction on Nevada Academic Content Standards (NVACS) cluster 5.G.A; "Graph points on the coordinate plane to solve real-world and mathematical problems" (2010). Two standards make up this cluster:

- 5.G.A.1; 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., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).

- 5.G.A.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.

Fifth grade is the first time students will have formal instruction on graphing points in the coordinate plane. Many students have prior experiences with this content because it is commonly integrated into other content areas such as science or used to play popular games. These experiences may have familiarized students with the basics of using coordinate grids. However, students might still lack an understanding of conventions such as beginning at the origin, knowing that an ordered pair always contains an X-coordinate and a Y-coordinate, and that an ordered pair indicates a location on a two-dimensional plane.

A common misconception for fifth graders using the coordinate plane is confusing the x and y values. Students mistakenly try to move a point up on the y-axis before moving over on the x-axis. An analogy to help students remember the convention correctly could be to think about trying to reach a window on the second story of a house. The ladder always starts from where it is stored (the origin). Then the ladder must be moved underneath the window (along the x axis) before it is climbed (moving up the y axis). Notice that this analogy connects formal mathematical language to a real world situation.

Students might wonder about the purpose of the coordinate plane and the conventions needed for its use. Sharing real world examples of using coordinates to describe locations and represent data can help students to understand its uses and its importance as a mathematical tool. Students may be surprised to learn that computer graphics are created using the same ideas they will be studying during Topic 14! Students will use this knowledge extensively in middle school mathematics and beyond (Van de Walle, Karp, Lovin, & Bay-Williams, 2014).

In fifth grade, students use only the first quadrant which contains positive numbers on both the x and y axis. In sixth grade, students will use all four quadrants and work with negative numbers.

Although Topic 14 will not ask students to use fractional ordered pairs, the idea may be raised by students thinking about how to represent real world contexts. The Progression Documents for the Common Core Math Standards (2013) also mention fractions and state, "students extend their knowledge of the coordinate plane, understanding the continuous nature of two-dimensional space and the role of fractions in specifying locations in that space" (p. 17). In lesson 14-2, the growth of a plant is shown to always occur in whole numbers. Yet, in real life, measurements often contain fractional pieces of units. How would this data be represented on a coordinate plane? Fifth graders have had lots of practice with fractions and using number lines. Have students extend this understanding to observe that the x and y axis are essentially two number lines placed perpendicularly and used to describe a location in two-dimensional space. From this understanding, have students decide how a fractional ordered pair can be placed.

Students will discover that real world relationships can be represented as a table of ordered pairs and as points on the coordinate grid. These representations are used to analyze information and relationships in order to solve problems. Students will practice the 3 ways to use these representations to solve problems. Students can:

- continue to generate ordered pairs and create a ratio table,
- find the relationship between the x and y coordinates for y given any value of x, or
- extend the line on the coordinate plane to find a solution for any given value of x or y.

Do students realize that when they create ordered pairs and use them to graph a line, every single ordered pair on that line may represent a solution? These strategies are different ways of representing and analyzing information which can be used to quantify and solve real world problems.

Math Practice 2: Reason abstractly and quantitatively

Focus on opportunities for students to develop *Mathematical Practice 2* behaviors as this is the focus of the Math Practices and Problem Solving, lesson 14-4. Reference the Teacher's Edition (TE, pp. F22-F22A) and the NVACS (2010, p. 6).

Essential Academic Vocabulary Use these words consistently during instruction.	
New Academic Vocabulary: (First time explicitly taught)	Review Academic Vocabulary: (Vocabulary explicitly taught in prior grades or topics)
coordinate grid ordered pair x-axis y-axis origin x-coordinate y-coordinate	

Additional terminology that students may need support with:

Collaborative Team Conversations (CTC)

Consider using ***one*** of the following as part of the formative assessment process at the lesson level to **collect student work** to analyze for evidence of mathematical understanding:

Guiding questions: "Are students able to accurately place ordered pairs on a coordinate grid?"
"Are students using the information represented in a graph to solve real world problems?"

Lesson	Evidence	Look for
14-2	*Math Practices and Problem Solving* (student work samples) Item 19	Focus CTC around the big idea: • explanation of conventions for graphing a point on a coordinate plane. • inclusion of "origin" as a starting point for placing a point on a coordinate plane.
14-2	*Quick Check* (digital platform) Items 1, 3 and 4	Focus CTC around data analysis and collection of student workspace (scratch paper). Printable version available under "Teacher Resources".
14-3	*Math Practices and Problem Solving* (student work samples) Items 7 and 8	Focus CTC around the big idea: • correct placement of points on the coordinate plane. • understanding that coordinates represent information for a given situation which can be used to solve problems.
14-3	*Quick Check* (digital platform)	Focus CTC around data analysis and collection of student workspace (scratch paper). Printable version available under "Teacher Resources".

Learning Cycle Assessments (summative)	*Topic Performance Assessments* SE pp. 805-808	Use *Scoring Guide* TE pp. 805-808A

Standards listed in **bold** indicate a focus of the lesson.

NVACS (Content and Practices)	Mathematical Development of the Big Idea	Instructional Clarifications & Considerations
Lesson 14-1: The Coordinate System		
5.G.A.1 MP.2 MP.3 MP.4 MP.5 MP.6	Access Prior Learning: Students have experience finding points on number lines and representing data using line plots from previous grades and lessons. Developing the Big Idea: Students learn procedures for graphing in the first quadrant of a Cartesian coordinate plane.	Solve and Share: Students are asked to plot points on a coordinate grid and then describe where the points are located to a partner. Look for partner pairs having difficulty describing locations successfully. How can we use the coordinate grid more accurately? Students are discovering the need for conventions such as x-coordinates and y-coordinates, starting from the origin, and moving over on the x-axis before moving up the y-axis. The *Look Back*! can be used to facilitate a discussion about graphing conventions. Visual Learning: A coordinate grid is modeled for finding locations. What other real world contexts could a coordinate grid be used for? *Math Practices and Problem Solving*: Items 20-24 ask students to find missing coordinates needed to complete a picture of a house. As a challenge, consider asking students to change the coordinates by a consistent amount and re-graph the pairs. For example, add 3 to all x values or to both the x and y values. What happens to the picture of the house? Why? Teaching Tool 20 (coordinate grids) could help students complete this task.
Lesson 14-2: Graph Data Using Ordered Pairs		
5.G.A.1 MP.1 MP.2 MP.3 MP.5 MP.6 MP.8	Access Prior Learning: Students graphed points on the coordinate grid in the previous lesson. Developing the Big Idea: Students practice graphing on the coordinate plane to build procedural skill.	Solve and Share: Look for students using the conventions of graphing. What would happen to their results if they did not follow the conventions? Have students describe the shape they graphed using geometric attributes? Challenge: What happens to the picture of the square if we change all the coordinates by the same amount. Students could begin by multiplying all the coordinates by 2. What happens to the picture of the square? Why? Visual Learning: Students see how data can be recorded in a table and then used to create a graph. Why is the visual representation of data on a graph helpful? Can students use the graph to make predictions about future growth of the plant? Assess and Differentiate: *Another Look!* ask students graph a parallelogram. Consider using this shape for the challenge task noted in the Solve and Share. *CTC: *Math Practices and Problem Solving* (student work samples) Item 19 *CTC: *Quick Check* (digital platform) Items 1, 3 and 4
Lesson 14-3: Solve Problems Using Ordered Pairs		
5.G.A.2 5.G.A.1 MP.4 MP.6 MP.7	Access Prior Learning: Students graphed points on the coordinate plane in the previous two lessons. Developing the Big Idea: Students increase procedural skill and apply knowledge of graphing on the coordinate plane to solve problems.	Solve and Share: Students graph the points in the data table and use the line formed to answer a question. Students often notice that it is possible to use the table to answer the question. How does graphing data as ordered pairs help us to look for patterns and solve problems? Consider asking students where the line will intersect the x-axis. Will they use the data table or the coordinate graph to find this point? Visual Learning: The earnings of Ann and Bill are shown as ordered pairs in a data table and graphed. Can students determine what the coordinates represent using the context of the problem? What relationship between the amounts can be found using the graph? *Guided and Independent Practice*: The problems use ordered pairs in the hundreds and thousands. These items can be used to facilitate a discussion about matching scale of the x-axis and y-axis to the context of problems. *CTC: *Math Practices and Problem Solving* (student work samples) Items 7 and 8 *CTC: *Quick Check* (digital platform)

Lesson 14-4: Math Practices and Problem Solving- Reasoning		
5.G.A.2 5.G.A.1 MP.1 MP.2 MP.4 MP.5 MP.7	Access Prior Learning: Students have used the thinking habits of MP.2 in previous lessons. Students have analyzed and represented data to answer questions in previous grades and lessons. Securing the Big Idea: Students practice using data represented in a table on a coordinate graph to solve a problem.	Solve and Share: Students graph ordered pairs to analyze the data and solve a problem. What is represented by the x-coordinates and y-coordinates? How does the coordinate graph help to solve this problem? Visual Learning: Using a coordinate graph to solve a problem is modeled. Watch for students who create a data table using the given patterns. Orchestrate a whole class discussion around "How does each coordinate represent the context of the problem? If that a point in the data chanced what might that mean? *Independent Practice* items 4-6 require students to extend the pattern beyond what can be displayed on the coordinate grid provided. What generalizations can be made about extending patterns and the graphed line on the coordinate grid? Consider assigning a small sample of items from the *Guided Practice, Independent Practice*, and *Math Practices and Problem Solving* page and asking students to justify their solutions with mathematical reasoning MP.2.

References

Council of Chief State School Officers. (2010). The Nevada Academic Content Standards. Retrieved from http://www.doe.nv.gov/uploadedFiles/nde.doe.nv.gov/content/Standards_Instructional_Support/Nevada_Academic_Standards/Math_Documents/mathstandards.pdf.

Common Core State Standards Writing Team. (2013). *Progressions for the Common Core State Standards in Mathematics (draft). Geometry, K-6.* Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

Van de Walle, J., Karp, K., Lovin, L., & Bay-Williams, J. (2014). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades 6-8*. (2nd ed.). New York, NY: Pearson.