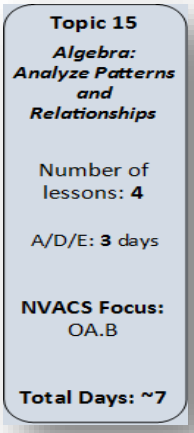
Grade 5 Topic 15: Algebra: Analyze Patterns and Relationships



5th grade Curriculum Pacing Framework: Balanced Calendar

Big Conceptual Idea: K-5 Operations and Algebraic Thinking, (pp. 32-35)

Prior to instruction, view the Topic 15 Professional Development Video located in Pearson Realize online. Read the Teacher's Edition (TE): Cluster Overview/Math Background (pp. 809A-809F), the Topic Planner (pp. 583I-583J), all 4 lessons, and the Topic Assessments (pp. 843-844A).

Mathematical Background: Read Topics 15 Cluster Overview/Math Background (TE, pp. 809A-809F)	Topic Essential Question: How can number patterns be analyzed and graphed? How can number patterns and graphs be used to solve problems? *Reference Answering the Topic Essential Questions (TE, pp. 841-842) for key elements of answers to the Essential Question.*

The lesson map for this topic is as follows:

15-1	15-2	15-3	15-4	Assessment

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

Instructional Note:

This topic focuses on the Nevada Academic Content Standards (NVACS) cluster 5.OA.B: Analyze patterns and relationships and includes one standard:

- 5.OA.B.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" (2010).

In 4th grade, students used a rule to generate and continue number patterns. In Topic 15, they will extend this knowledge to using rules to generate two separate number patterns. In addition, they will graph lines representing the patterns. The graph will help students identify relationships between terms, make comparisons, and analyze number patterns. Through this process students learn that identifying and representing the relationships between corresponding terms can be used to solve mathematical problems. "This work prepares students for studying proportional relationships and functions in middle school" (Common Core Standards Writing Team (CCSWT), 2011, p. 32).

As students analyze terms, they will discover that relationships can be additive or multiplicative. Students may also observe that some patterns have consistent rates of change starting from different values. Other patterns may start with the same value and change at different rates. Both of these scenarios will be examined through the use of tables and graphing on the coordinate plane.

Although lessons *15-1* and *15-2* will not ask students to graph the ordered pairs found in tables, consider adding this instructional component to help students visually represent the patterns being analyzed. Graphing is an important part of standard 5.OA.B.3 that can aid students' ability to see relationships in data. "The graph allows one to observe at a glance the relationship between (terms). The context gives meaning to the graph, and the graph adds understanding to the context," (Van de Walle, Karp, Lovin, & Bay-Williams, 2014, p. 254). The visual representation allows observations such as "the lines will never intersect" (excluding the point of origin) or "that line is going up faster" (informal observations of slope). These observations can be difficult to make using only the frequency table.

Math Practice 1: Make sense of problems and persevere in solving them

Focus on opportunities for students to develop *Mathematical Practice 1* behaviors as this is the focus of the Math Practices and Problem Solving, lesson 15-4. Reference the Teacher's Edition (TE, pp. F21-F21A) 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)
corresponding terms number sequence	*variable*

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 generate a numerical rule from a given mathematical situation?"
"Are students able to analyze the information in a graph to discover patterns and solve a real world problem?"

Lesson	Evidence	Look for
15-4	*Solve and Share* (student work samples)	Focus CTC around the big idea: • recognize ordered pairs as data that can be used to solve a problem. • generate numerical patterns based on given rules. • use a data table and/or graph as tools to analyze relationships between terms and use the information to help solve a problem.
15-4	*Quick Check* (digital platform) Items 1 and 2	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 15-1: Numerical Patterns		
5.OA.B.3 MP.2 MP.3 MP.4 MP.5 MP.7	Access Prior Learning: In 4th grade, students worked with number patterns that followed a given rule (4.OA.C). Developing the Big Idea: Students will build conceptual understanding analyzing number patterns and using discovered relationships to solve a problem.	Solve and Share: Students use the context of the problem to find a rule and complete the tables. While students are likely to focus on the rule of "add 10", they may also observe patterns between the two tables. Why does Emma always have more money than Jorge? Can this relationship also be expressed as a rule? Consider asking students to graph a line for each table on a single coordinate grid. Can seeing the data as two separate line graphs help students discover relationships? Visual Learning: A similar problem type is modeled using two tables. The vocabulary words *corresponding terms* and *number sequences* are introduced. Consider revisiting the *Topic 15 Essential Question*. How did the tables help to solve these problems? The *Convince Me!* adds the idea that patterns can be extended. Will the Rosemary plant always be taller?
Lesson 15-2: More Numerical Patterns		
5.OA.B.3 MP.2 MP.3 MP.4 MP.7 MP.8	Access Prior Learning: In 4th grade, students worked with number patterns that followed a given rule (4.OA.C). Student used a rule to extend number patterns in the previous lesson. Developing the Big Idea: Students build conceptual understanding analyzing number patterns and using discovered relationships to solve a problem.	Solve and Share: Students can build on observations from the previous lesson to help analyze the two tables. A multiplicative relationship is shown here while the previous lesson used an additive pattern. A different starting point is also given for each pattern. What relationships can be discovered between the two tables? Questioning can help students move from observing differences to noticing relationships between quantities. Visual Learning: The *Visual Learning Bridge* in lesson 15-2 moves from representing two patterns in two separate tables to using the same table to show both patterns. The constant (weeks) is only shown once. Students may need clarification on how to read this table or benefit from seeing the same problem represented in two separate tables.
Lesson 15-3: Analyze and Graph Relationships		
5.OA.B.3 MP.1 MP.3 MP.4 MP.7	Access Prior Learning: Students learned to use a ratio table to represent data and graph points on a coordinate plane during Topic 14. Developing the Big Idea: Students work to build conceptual understanding and procedural skill by extending two patterns, finding relationships, and graphing the points on a coordinate grid.	Solve and Share: Students are asked to graph the ordered pairs after using a rule to complete a table. The table uses muffins for the x- and y-coordinates. Alternatively, students may decide to create two separate graphs using boxes as the independent variable (x-axis) and muffins as the dependent variable (y-axis). Both graph lines could be drawn onto the same coordinate grid. Either graphing strategy will allow students to analyze the relationships in the number sequences. How does the visual representation of the graph help to discover relationships between the terms of two sequences? *-continues on next page-*

		Visual Learning The problem used in this *Visual Learning Bridge* is very similar to the *Solve and Share.* Using mathematical reasoning to analyze a graph is demonstrated. This context can also be modeled using two separate tables and two separate graphs. Consider revisiting the *Topic 15 Essential Question*. How do tables and graphs help to analyze number patterns and solve problems?
Lesson 15-4: Math Practices and Problem Solving- Make Sense and Persevere		
5.OA.B.3 MP.1 MP.2 MP.5 MP.6	Access Prior Learning: Students have practiced the thinking habits of MP.1 in previous grades and topics. Students analyzed patterns and graphed points on the coordinate plane to solve a problem in previous lessons. Securing the Big Idea: Students apply knowledge to solve a problem and practice the thinking habits of MP.1.	Solve and Share: Students create two separate number sequences and graph each to determine the best location for a birthday party. This problem uses a different starting point and a different change for each table. Students will need to make sense of the problem and create a plan. How did the graphs help to solve this problem? Students may observe that the graphed lines intersect. What does this mean for the given context? What happens to the two lines after the intersection? What does this represent? Visual Learning: A similar problem is modeled. Can students connect the thinking and problem solving skills demonstrated to strategies and thinking habits they used to complete the *Solve and Share* problem? Assess and Differentiate: The *Reteach* page focuses on using rules to complete a number sequence and does not ask students to graph. The *Homework and Practice* page has more opportunities for students to practice graphing and analyzing two number sequences. Can students reason why time units are usually placed on the x-axis? *CTC: ***Solve and Share*** (student work samples) *CTC: ***Quick Check*** (digital platform) Items 1 and 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. (2015, March 6). *Progressions for the Common Core State Standards in Mathematics (draft). K-5, Numbers in Operations Base Ten.* 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.

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