

► Grade 4 Topic 14: Algebra: Generate and Analyze Patterns

Big Conceptual Idea: [Operations and Algebraic Thinking](#) (pp. 46-48)

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. 729A-729F), the *Topic Planner* (pp. 7297I-729J), all 4 lessons, and the *Topic Assessments* (pp. 763-763A).

Topic 14
Algebra:
Generate and Analyze Patterns

Number of lessons: **4**

A/D/E: **3** days

NVACS Focus:
O.A.C

Total Days: ~7

<p>Mathematical Background: Read Cluster Overview- (TE, pp. 729A-729F)</p>	<p>Topic Essential Questions: How can you use a rule to continue a pattern? How can you use a table to extend a pattern? How can you use a repeating pattern to predict a shape?</p> <p style="font-size: small;"><i>Reference TE (p. 729) and Answering the Topic Essential Questions (TE, pp. 761-762) for key elements of answers to the Essential Questions.</i></p>
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[4th grade Curriculum Pacing Framework:](#)
[Balanced Calendar](#)

The lesson map for this topic is as follows:

14-1	14-2	14-3	14-4	Assessment
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3 A/D/E days used strategically throughout the topic.

Instructional note:

This topic focuses on generating and analyzing patterns. Focus for standard 4.OA.C.5, “generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself” (Nevada Academic Content Standards (NVACS), 2010). Van de Walle, Karen Karp and Jennifer Bay-Williams (2010) state, “patterns are found in all areas of mathematics. Learning to look for patterns and how to describe, translate and extend them is part of thinking algebraically” (p. 267).

There are different types of patterns: repeated, growing and functional thinking. The focus for this topic will be on repeated and growth patterns. **Repeated patterns** identify the core of the pattern (**Core** is the string of elements that repeats). Students use knowledge of the core to extend the pattern and lays the foundation for the idea that two very different situations can have the same mathematical features. Prediction is an important part of algebraic thinking. (Van de Walle, et al., 2010). **Growing patterns** is a known sequence. In growing patterns, students look for generalizations or algebraic relationships. Students try to determine how each step in the pattern differs from the preceding step. Growing patterns also have a numeric component-the number of objects in each step. This patterning demonstrates the concept of function and can be used as an entry point for this mathematical idea. (Van de Walle, et al., 2010).

“Students are surrounded by patterns in the world around them. Keep a look out for patterns that can be analyzed and used to make predictions. Encourage students to do the same” (Van de Walle, et al., 2014, p. 304).

Focus Math Practice 7: Look for and use structure

Consider focusing on opportunities for students to develop *Mathematical Practice 7* behaviors, as this is the focus of the Math Practices and Problem Solving, lesson 14-4. Reference the *Teacher’s Edition* (pp. F27-F27A) and the NVACS (2010, p. 8).

Essential Academic Vocabulary Use these words consistently during instruction.	
<p>New Academic Vocabulary: <small>(First time explicitly taught)</small></p> <p>rule repeating pattern</p>	<p>Review Academic Vocabulary: <small>(Vocabulary explicitly taught in prior grades or topics)</small></p> <p><i>growing patterns</i></p>

Additional terminology that students may need support with: multiples

***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 question: "Are students able to determine the pattern based on a rule?"

Lesson	Evidence	Look for
14-2	<i>Quick Check</i> (digital platform)	Focus CTC around the big idea: <ul style="list-style-type: none"> students determine or use the rule to find patterns Printable version available under "Teacher Resources".
14-4	<i>Solve & Share</i> (student work samples)	Focus CTC around the big idea: <ul style="list-style-type: none"> students determine the nth term by applying the rule and looking for patterns.

Learning Cycle Assessments (summative)	Topic Assessments SE pp. 761-764	Use <i>Scoring Guide</i> TE pp. 761-764A
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Standards listed in **bold** indicate a focus of the lesson.

NVACS (Content and Math Practices)	Mathematical Development of the Big Idea	Instructional Clarifications & Considerations
Lesson 14-1: Number Sequences		
4.OA.C.5 MP.1 MP.2 MP.4 MP.5 MP.7 MP.8	Access Prior Learning: In Topic 7, students found patterns in multiples and factors, and generalized a rule for determining when all the factors of a number had been listed. Developing the Big Idea: In this lesson, students use a given rule to extend a number sequence and then find features of the pattern in the sequence that are not given in the rule.	Solve & Share: Considering giving students the opportunity to use tools or representations to support them in the <i>Solve & Share</i> . Look Back: Consider having students complete the <i>Look Back!</i> , as they create a rule and find patterns to fit those rules. Visual Learning: In the <i>Visual Learning</i> , students learn to use a number line to help find patterns. The problem is an increasing pattern. Read the <i>Prevent Misconception</i> before teaching the lesson (TE, p. 734). Another Example: In the <i>Another Example!</i> , students understand and clarify any misconceptions that patterns only increase, as students find decreasing patterns in this problem.
Lesson 14-2: Patterns: Number Rules		
4.OA.C.5 MP.2 MP.7	Access Prior Learning: In the previous lesson, students found patterns from a given rule. Students then found features of the pattern that were not given in the rule. Developing the Big Idea: In this lesson, students generate a table of ordered pairs from a given rule and look for features of the pattern in the table.	Solve & Share: Consider removing the rule or the table, and "Use the rule to complete the table" from the <i>Solve & Share</i> to elicit more student strategies and increase the cognitive demand. Look Back: Consider having students work on the <i>Look Back!</i> as partners or small groups. Consider using a Gallery Walk (ELL Toolkit p. 22), to enable students to critique the reasoning of others and use mathematical language when explaining their reasoning. Independent Practice/Math Practices and Problem Solving: Consider taking some of the tables in the <i>Independent Practice</i> and turning them into problems where students determine the rule and the relationships between the features in the problem. For example, change item 5 from finding the rule and relationship between the numbers of books and weight of the books in ounces to, "The FedEx driver has to carry a box full of books. One book weighs 16 ounces. Two books weigh 32 ounces. How much would the FedEx driver's box weigh if the driver has to carry 10 books? 25 books?" Students determine how to organize the information and find the pattern. *CTC: <i>Quick Check</i> (digital platform)
Lesson 14-3: Patterns- Repeating Shapes		
4.OA.C.5 MP.2 MP.3	Access Prior Learning: In previous grades, students identified and reasoned with shapes and their attributes. In Lesson 14-1, students learned to	Solve & Share: Consider giving students an opportunity to use tools or representations to support them when completing the <i>Solve & Share</i> . Child-watch for students who do every single repeated pattern to the 37 th shape or have a strategy to find the 37 th shape. <p style="text-align: right;"><i>-continues on next page-</i></p>

<p>MP.6 MP.7</p>	<p>extend number patterns, following a given rule.</p> <p>Developing the Big Idea: In this lesson, students extend shape patterns following a given repeating pattern by interpreting remainders.</p>	<p>As an extension for early finishers, have students predict what the 60th shape would be using the rule.</p> <p>Visual Learning: Prior to students watching the animation, have students work on the problem. Encourage the use of pattern blocks or reasoning strategies. Pause the <i>Visual Learning Animation</i> prior to part C “Use the Repeating Pattern to Solve” or discuss strategies if students did not come up with dividing by 3.</p> <p>In dividing by 3, students solve a measurement division problem with interpreting the remainder of what shapes are included and what are not. The quotient can be interpreted as 16 groups and 1 more shape. Ask students, “Can we use division to solve this problem?” Connect the use of pattern blocks with the statement on Part C (TE, p. 746f).</p> <p>Convince Me: Consider having students work on the <i>Convince Me!</i> with partners to solve the problem. Have students use pattern blocks and division.</p> <p>Another Example: In the <i>Another Example!</i>, students figure out the 100th number in the pattern by using division. Again, this is a measurement division problem with no remainder. Consider asking students to find the 115th term, where they will have to interpret a remainder.</p> <p>Independent Practice/Math Practice and Problem Solving: Consider having students work on items 8 and 9, as students can use tools or strategies to solve the problems. Facilitate a discussion around these items and students’ responses.</p> <p>Homework & Practice: Consider using item 9 in the <i>Homework & Practice</i> as an extension to solving for patterns. Considering having students work with partners or use as a Gallery Walk.</p>
<p>Lesson 14-4: Math Practices and Problem Solving- Look For and Use Structure</p>		
<p>4.OA.C.5</p> <p>MP.7 MP.1 MP.2</p>	<p>Access Prior Learning: In previous topics, students had the opportunity to look for and use structure.</p> <p>Developing the Big Idea: In this lesson, students continue look for and use structure to find growth patterns.</p>	<p>Solve & Share: Consider modifying the <i>Solve & Share</i> to “Evan’s baby brother is stacking blocks. How many blocks are in the 6th stack? How many blocks are in the 19th stack?” By modifying the problem, this may elicit more student strategies or models.</p> <p>Consider having tools and representations available for students to use when solving the growing pattern, such as connecting cubes or graph paper.</p> <p>Look Back: Consider facilitating a discussion around the <i>Look Back!</i> as students use the rule found in the <i>Solve & Share</i> to figure out the 10th stack of blocks.</p> <p>Guided Practice: Consider taking the triangle pattern from the <i>Guided Practice</i>, put it on the board and have students solve the growing pattern. Do not include the table, as you use this opportunity to child-watch students to see how they organize the information. Consider facilitating a discussion around what the students determined about the growing pattern.</p> <p>Independent Practice/Math Practices and Problem Solving: Consider choosing items 4-6 or 7-10 to have students solve for growing patterns. Consider also having students come up with their own growing pattern to give their peers to figure out the rule and pattern.</p> <p>Assess and Differentiate/Intervention Activity: Consider using the <i>Intervention Activity</i> with all students to reinforce area. By doing this problem, this will support students with <i>Homework Practice</i> items 4-7.</p> <p>*CTC: <i>Solve & Share</i> (student work samples)</p>

References

Common Core Standards Writing Team. (2011, May 29). *Progressions for the Common Core State Standards in Mathematics (draft). K, Counting and Cardinality; Grades K-5, Operations and Algebraic Thinking*. Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

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.

Van de Wall, J., Karp, K., & Bay-Williams, J. (2010). *Elementary and middle school mathematics: Teaching developmentally*. Boston, MA: Pearson

Van de Walle, J. A., Bay-Williams, J. M., Lovin, L. H., & Karp, K. S. (2014). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades 3-5* (2nd ed.). New York, NY: Pearson.