

Perceiving Patterns

Summary

Students will learn to recognize, create, and predict patterns on a more advanced level than before.

Main Core Tie

Mathematics Grade 6

[Strand: EXPRESSIONS AND EQUATIONS \(6.EE\) Standard 6.EE.9](#)

Materials

Invitation to Learn

- [What's Next in the Pattern?](#) (pdf)

Herculean Task

Centimeter cubes, beans, beads, marbles, candy, copies of Boulders black line master, or any other manipulative for each student to represent the boulders in the activity

Egg cartons

- [Boulder Task](#) (pdf)

Bold Boulder Patterns

- [Bold Boulder Patterns](#) (pdf)

Additional Resources

Book

Navigating Through Algebra in Grades 3-5, by Gilbert J. Cuevas and Karol Yeatts; ISBN 0- 87353-500-6

Background for Teachers

Patterns are all around us: In nature, technology, financial trends, and especially in math. The ability to see patterns and predict what will come next in patterns will help students in all aspects of their life. Students have been creating, understanding, and discovering patterns throughout their schooling. The toddler separates yellow and green blocks; the act of separating is a pattern. The third grader learns their multiplication facts, which is a series of patterns (repeated addition).

Likewise, the sixth grader needs to be able to recognize, create, and predict patterns. These patterns should be seen with manipulatives, pictures, graphs, tables, and numbers. Patterns can be simple one-step rules (add 1) or multiple-step operations (times 2 minus 1). Pattern recognition is one of the first steps in algebraic thinking.

Once a pattern is identified, students need to be able to communicate a rule associated with the pattern. For example, if the numerical pattern is 3, 5, 7, 9 . . . , the rule is to add 2. If the pattern is 3, 11, 43, 171 . . . , the rule is to multiply by 4 and subtract 1. This skill needs practice and exposure to different pattern representations to be mastered. To assist students with correct identification of the pattern, they can create a T-chart or table. The left side is the order the number is in, while the right side is the actual number. Keep in mind that this is not a function table, so the left column doesn't necessarily help with the pattern prediction. If the pattern is 2, 5, 14, 41 . . . , the table would look like this:

Number Order	Number in Pattern
1	2
2	5
3	14
4	41
5	?

The students use trial and error to find the rule, which will help them find what is next in the pattern. The following activities will help students become proficient pattern predictors!

Instructional Procedures

Invitation to Learn

Hand out the *What's Next in the Pattern?* worksheet to each student. You may have them work alone, in partners, or in small groups.

Students will see the pattern and draw the appropriate amount of items for each situation. This starter will be a good gauge to see how well students are able to see patterns. The first problem is a simple single-step problem; they will get progressively harder. As students are working, monitor for understanding and help them as needed. If you wish, you may allow students to write the number rather than draw the items.

You may choose for students to write down the pattern rule (e.g., add 4).

You may extend this activity by asking students what the eighth, tenth, twelfth number in the pattern would be.

The last two is for the students to create their own patterns with their own ideas.

You may have students share their examples to the rest of the group to see if they can stump their classmates.

Instructional Procedures

Herculean Task

Read or paraphrase the following story (or make your own up!):

Ah, Heracles (known as Hercules in Roman mythology) is in for it again! One of the lesser-known tasks that he had to endure was the strength-sapping Boulder Task. Each day, Heracles must lift an increasing amount of boulders from the base of Mt. Olympus to the river Styx. As he began transporting the massive rocks, Heracles calculated that the most he could carry was exactly 27 boulders in one day. Unaware of how many days he had to do this task, he became concerned that his time would run out!

Summarize to students what the objective is: To figure out how many days Heracles can carry the boulders before he reaches or exceeds 27 boulders.

Hand out student materials. Go over the *Boulder Task* worksheet. Tell students that on the first day, Heracles had to carry 3 boulders. Students will put 3 "boulders" in the first box or egg carton holder. On the second day, he carried 5 boulders; 5 boulders will go in the day 2 box, and so on. Write the following on the board:

Day	Boulders
1	3
2	5
3	7
4	9
5	11
6	13
7	15
8	17
9	19
10	21

As students put the boulders in the boxes, they may figure out the pattern (add 2).

How many days will pass before Heracles has to carry 27 or more boulders to the river Styx? (13 days). Fortunately for our muscular friend, he only had to carry the boulders for 12 days!

Next, introduce a couple more patterns that go with the same story. Here are some examples:

Day	Boulders	Day	Boulders
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1	2	1	1
2	5	2	5
3	8	3	9
4	11	4	13
5	14	5	17
6	17	6	21
7	20	7	25
8	23	8	29
9	26	9	33
10	29	10	37

Bold Boulder Patterns

Read or paraphrase the following story (or make your own up!): While Heracles was forced to move boulders from Mt. Olympus, he placed them in the shape of a diamond (Okay, so he was bored!). When he had moved 25 boulders, this is what it looked like (draw this on the board): Heracles was really proud of himself, and marveled at all of the different patterns he saw in this boulder diamond.

At this point, have students share any patterns they see right off. Write them on the board. Ask questions to guide the students' thinking:

What numerical pattern can you describe from the array of boulders? (An obvious pattern is $1 + 3 + 5 + 7 + 5 + 3 + 1$.)

What other patterns do you see? (Point out the 3×3 square in the middle.)

What numerical pattern can you see now? [$9 + 4 + 4 + 4 + 4$ or $9 + (4 \times 4)$]

Hand out the *Bold Boulder Patterns* worksheet. Tell the students that their job is to find as many ways as they can to partition the boulders into different patterns. Listen to their discussions and observe the different patterns they come up with. Emphasize the translation of the visual patterns into numerical patterns. It's amazing to see how many different patterns they can come up with!

Extensions

To extend the Herculean Task activity, you can craft patterns in which numbers go below 1 or get very large, including exponents.

As an extension of the Bold Boulder Patterns activity, use an array of forty-one and/or sixty-one (see the other pages of the worksheet).

To adapt the Herculean Task activity, start with one-step patterns until students have a solid grasp on the concept.

For integration of the Herculean Task activity, you may have students come up with other stories from Egyptian, Greek, or Roman mythology similar to the story presented.

Tessellations are patterns of shapes that cover a plane without overlapping or gaps. Explore with students what shapes can be used to create tessellations. Start with one and work into multiple shapes.

Family Connections

Have students create patterns and take them home in an attempt to stump other family members. Students will look for patterns in their everyday life. They may observe bowling pins, measuring cups and spoons, etc.

Students will watch television for 30 minutes, recording how long the program segments are and how long the commercial breaks are. When they bring back their results, have them compare with the rest of the class. This would be a great time to create a graph to show the class results. What patterns do you see?

Assessment Plan

The *What's Next in the Pattern?* starter is an excellent preassessment to gauge student ability of seeing patterns.

For an assessment of the Herculean Task activity, students will come up with their own patterns in an attempt to stump their neighbors. They may continue to use the manipulatives or start using a chart and numbers, which ever they prefer. This may be drawn and handed in, or performed in front of the teacher.

Bibliography

Furner, J. M., Yahya, N., & Duffy, M. L. (2005). 20 ways to teach mathematics: Strategies to reach all students. *Intervention in School and Clinic*, 41(1), 16-23.

Many excellent mathematical teaching strategies are presented in this article. The use of manipulatives, interdisciplinary connections, student drawings, heterogeneous grouping, and the consideration of multiple intelligences are some of the strategies that will be used in these activities. Le, V., Stecher, B.M., Lockwood, J.R., Hamilton, L.S., Robyn, A., Williams, V.L., Ryan, G., Kerr, K.A., Martinez, J.F., & Klein, S.P. (2006). Improving mathematics and science education: A longitudinal investigation of the relationship between reform-oriented instruction and student achievement. Rand Source (MG-480-NSF). Retrieved January 2007 from rand.org

This three-year study explored the connection between student achievement and the use of manipulatives (reform-oriented instruction) in math and science. Students who had more hands-on lessons performed better on standardized tests than those who did not. Problem-solving skills were especially improved by use of manipulatives.

Authors

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