Solving Problems with Patterns That Grow

A Lesson for Grades 3–5

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Lesson Objective

Students will solve problems by building, extending, describing, and representing patterns that grow.

References

- *Lessons for Algebraic Thinking, Grades K–2,* by Leyani von Rotz and Marilyn Burns (Math Solutions, 2002)
- *Lessons for Algebraic Thinking, Grades 3–5,* by Maryann Wickett, Katharine Kharas, and Marilyn Burns (Math Solutions, 2002)

Materials

- 1 bag of pattern blocks per pair of students, each containing 9 squares, 9 trapezoids, 5 triangles, 5 hexagons
- *Pattern Block Trees* recording sheet, 1 copy per student
- *Pattern Block Fish* recording sheet, 1 copy per student
- Chart paper
- Markers
- Paper and pencil for each student
- Demonstration pattern blocks
- Demonstration charts of student recording sheets

Reviewed Vocabulary

hexagon, pattern, square, trapezoid, triangle

New Vocabulary

constant, represent, sketch, three-column chart, variable

Overview of Lesson

Students use pattern blocks as a tool to explore patterns that grow and solve problems. Using the contexts of trees and fish that grow in consistent and predictable ways, students build, extend, describe, and represent patterns. They record and analyze numerical data, link the data to the patterns generated with the pattern blocks, and make and verify predictions about how the trees and fish grow. Representations used in this lesson to show and analyze growth include pattern blocks, numerical data recorded in a three-column chart, and sketches.

Lesson Outline

Focus or Warm-Up

1. In partners, students briefly explore the pattern blocks for these two purposes:
    - *Review the names of the pattern blocks.*
    - *Practice several quick sketches of each of the blocks.*
2. Introduce the task and model the idea of quick sketches. Allow five to seven minutes for students to name and sketch.
3. As a whole group, confirm the names of the shapes and record on the board. Let students know they will be sketching the pattern blocks during the lesson, making recognizable but quick sketches to record their work.
4. As a whole class, briefly discuss patterns and a few examples students find in the room. Likely, these will be repeating patterns. Ask the following questions:

    Q. What is a pattern?

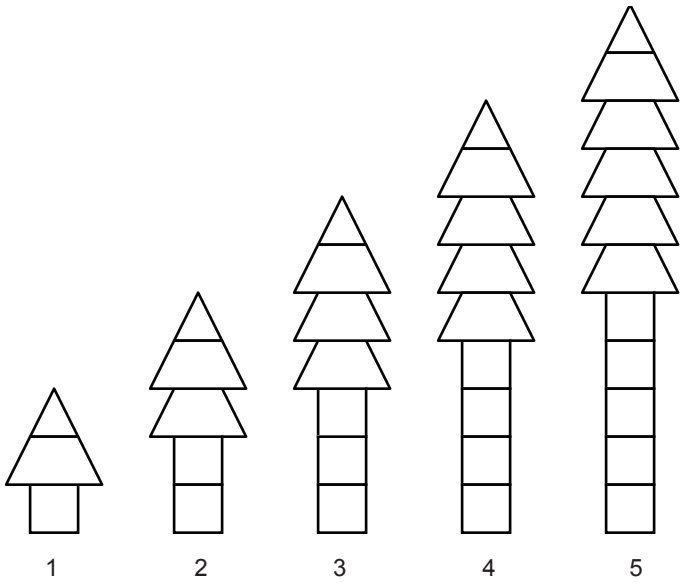
    Q. Where do you see patterns?

    Q. How do you use patterns in your everyday life?

    Q. How do you use patterns in math?

Introduction

Here are the first five birthdays of a pattern block tree.

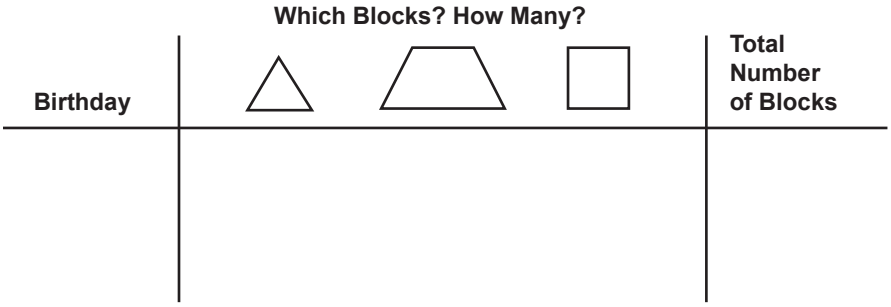


Introduce the task *Pattern Block Trees* to students. Model only what the tree looks like on its first, second, and third birthdays while students observe.

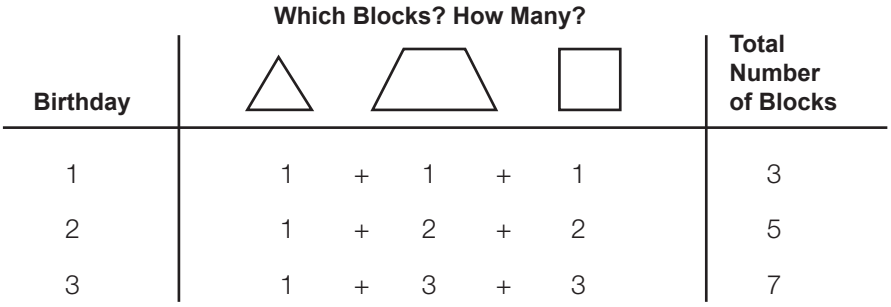
1. Ask students to build the tree on its fourth birthday and on its fifth birthday and check with their partners to see if they agree.

2. Volunteers build the tree at age 4 and at age 5 for the class to confirm how the tree grows.

3. Distribute the recording sheet *Pattern Block Trees.* (See Blackline Master at the end of the lesson.) Introduce the three-column chart to record how the tree is growing using numbers.



4. Model how to record the tree growth in the chart for birthdays 1, 2, and 3.



5. In partners, students fill in their own charts for birthdays 1, 2, and 3. In addition, they complete the chart for birthdays 4 and 5.

6. Ask students as a class to help complete the class chart as a check. In partners and as a whole class, discuss the following questions:

   Q. What patterns do you notice in the numbers?

   Q. What patterns do you notice when you look across each row?

   Q. What stays the same? What changes?

7. Pose this problem: "Let's think about this tree when it's ten years old. You and your partner don't have enough blocks to actually build the tree on its tenth birthday. But I do think you have enough information to figure out how many of each block you would need to build the tree on its tenth birthday.

   "Do two things with your partner:

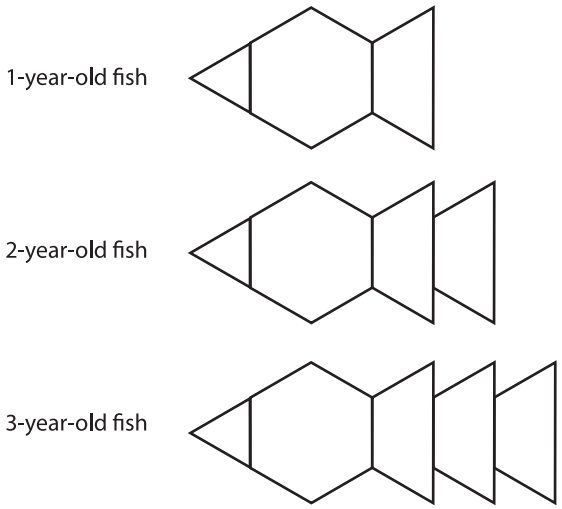
   - Decide how many of each block would be needed for the tree on its tenth birthday.
   - Sketch the tree on your recording sheet."

8. Have partners confirm sketches and numbers of blocks with another pair.

Exploration

Introduce the independent task.

1. Introduce *Pattern Block Fish.* Model the fish on its first, second, and third birthdays.



2. Distribute the *Pattern Block Fish* recording sheet. (See Blackline Master at the end of the lesson.) Students work in partners to complete the task, but each completes her own recording sheet:
   - Build and sketch the fourth and fifth birthdays.
   - Complete the table for birthdays 1, 2, 3, 4, and 5.

Possible questions to focus and extend students' learning during their independent work:

Q. What stays the same? What is the constant?

Q. What changes? What is the variable?

Q. What patterns do you see?

Q. How many blocks would it take to build the fish on its eighth birthday? Tenth birthday?

Q. What would it look like?

Q. What if it took fourteen blocks to build the fish? How old would the fish be and what would it look like?

Summary

1. With student help, complete the class chart for the pattern block fish from 1 to 10. Use questions to probe and focus student thinking.

2. Pose one or more of these questions for students to discuss with their partners and with the class:

   Q. What would we put in the chart for the fifteenth birthday? The nineteenth? The hundredth?

   Depending on student responses, you may want to provide the following sentence frame for partner conversations:

   To build any pattern block fish, no matter how old, we would . . .

3. Review the lesson objective: Today you solved problems by building, extending, describing, and representing patterns that grow. Then give the following discussion task:

   Talk with your partner about when in the lesson you

   - solved problems;
   - built and extended patterns that grow; and
   - described and represented patterns that grow.

4. Ask students to complete this journal prompt:

   What did you learn today about solving problems using patterns that grow?

Lesson Notes for the Teacher

Content

Students often see patterns vertically in the expanded chart. Throughout the lesson, listen to their observations and acknowledge the importance of those patterns. The push here is to help students also look across the rows to see how the numbers in the chart relate to birthday number/stage number.

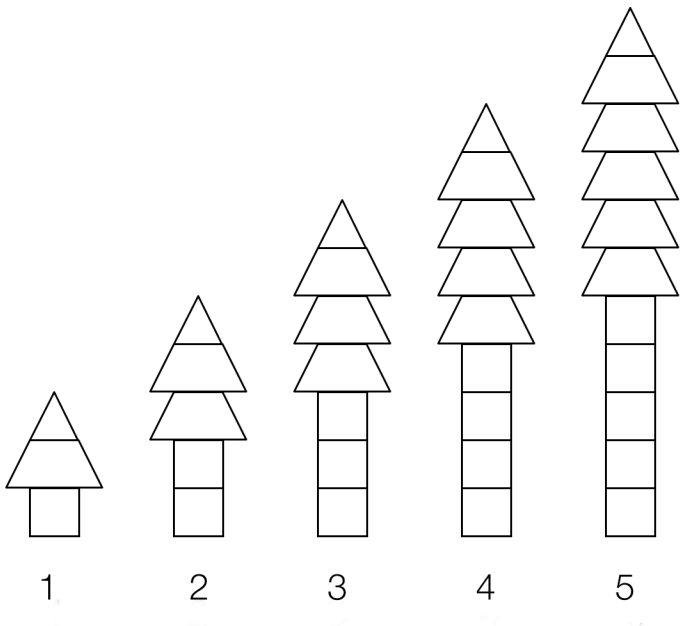
If students don't see any relationships or patterns, the teacher's role is to contribute an observation or two as examples for students. This usually prompts their observations. Some examples from the tree growth chart:

- "I notice that regardless of the birthday number, there is always one triangle."
- "I notice that the number of trapezoids is the same as the birthday number."
- "The number of squares is the same as the birthday number."
- "The sum of the numbers in a row from the middle column equals the total column."

Vocabulary

It is appropriate during this lesson to begin to use the term *constant* for the part of the pattern that stays the same and *variable* for the part of the pattern that changes.

Pattern Block Trees

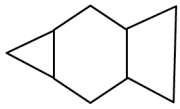


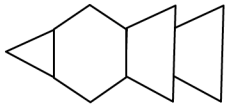
How many of each block would you need to build the tree on its 10th birthday?

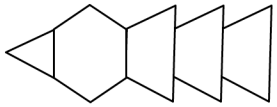
Sketch what the tree will look like on its 10th birthday?

Birthday	Which blocks? How many? 	Total Number of Blocks

Pattern Block Fish

1 

2 

3 

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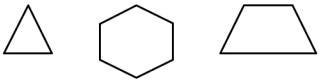
How many of each block would you need to build the fish on its 10th birthday?

Sketch what the fish will look like on its 10th birthday?

Birthday	**Which blocks? How many?** 	**Total Number of Blocks**