CHAPTER

1 Problem Solving

In grades 3–5, students should investigate numerical and geometric patterns and express them mathematically in words or symbols. They should analyze the structure of the pattern and how it grows or changes, organize this information systemically, and use their analysis to develop generalizations about the mathematical relationships in the pattern.[1]

Activity Set 1.1 SEEING AND EXTENDING PATTERNS WITH PATTERN BLOCKS

PURPOSE

To recognize, describe, construct, and extend geometric patterns.

MATERIALS

Pattern blocks and color tiles from the Manipulative Kit or from the Virtual Manipulatives.

INTRODUCTION

In this first activity set colored geometric shapes called pattern blocks will be used to recognize, study, and extend geometric patterns. The set of pattern blocks consists of six different polygons: a green triangle, an orange square, a red trapezoid, a blue rhombus, a tan rhombus, and a yellow hexagon.

Human beings are pattern-seeking creatures. Babies begin life's journey listening for verbal patterns and looking for visual patterns. Scientists in search of extraterrestrial intelligence send patterned signals into the universe and listen for incoming patterns on radio telescopes. Mathematics is also concerned with patterns. Many mathematicians and educators involved in reforming mathematics teaching and learning at the elementary and middle school levels are suggesting that the notion of mathematics as the study of number and shape needs to be expanded. Some suggest that "mathematics is an exploratory science that seeks to understand every kind of pattern."[2]

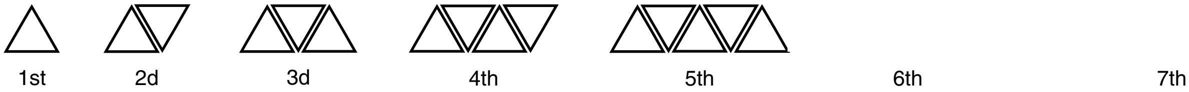
In this set we will look at a variety of sequences. A *sequence* is an ordered set of mathematical objects. There are many possibilities for sequences. A few examples of sequences

[1]*Principles and Standards for School Mathematics* (Reston, VA: National Council of Teachers of Mathematics, 2000): 159.

[2]Lynn A. Steen, *On the Shoulders of Giants: New Approaches to Numeracy* (Washington, DC: National Academy Press, 1990): 1–8.

are a sequence of pattern block figures, a sequence of tile figures, a sequence of letter groupings, a sequence of whole numbers, and a sequence of fractions.

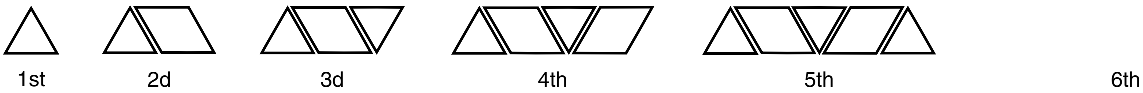
1. The pattern block figures shown here form the first five figures of a sequence. Use your green triangles to construct the sixth and seventh figures that you think extend the given pattern and sketch these figures.



***a.** Describe in writing at least three ways that the seventh figure in your sequence differs from the sixth figure.

***b.** Describe in writing what the 15th figure in this sequence would look like so that someone reading your description, who had not seen this sequence, could build the same figure.

2. Use your pattern blocks to construct the sixth figure of the sequence below and sketch that figure.



a. Describe in writing how new figures are created as this sequence is extended.

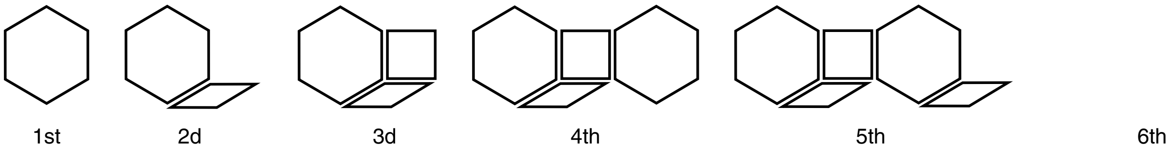
b. Will the 10th figure in an extended sequence have a green triangle or a blue rhombus on the right end? Explain your reasoning.

c. How many triangles and how many rhombuses are in the 25th figure of the extended sequence? Explain how you arrived at your answer.

d. Complete the following statement that will enable readers to determine the number of triangles and rhombuses in any figure they choose.

In the *n*th figure, where n is an even number, there will be $n \div 2$ triangles and $n \div 2$ rhombuses. If n is an odd number, the *n*th figure will contain ________ triangles and ________ rhombuses.

3. The pattern block sequence started below uses three different types of pattern blocks. Use your pattern blocks to build and sketch the next figure in the extended sequence.



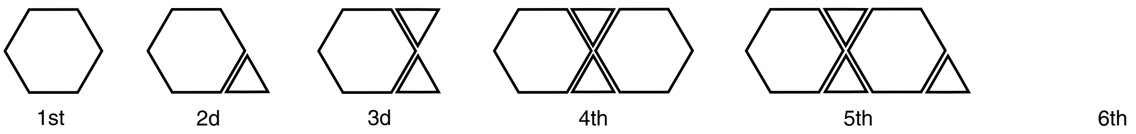
***a.** Describe in writing how new figures are created as this sequence is extended.

***b.** What pattern block will be attached to the right end of the 16th figure to obtain the 17th figure in this sequence?

***c.** Determine the number of hexagons, squares, and rhombuses in the 20th figure of the sequence. Explain how you thought about it.

***d.** Repeat part c for the 57th figure in the sequence.

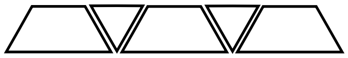
4. Use your pattern blocks to build and sketch the sixth figure of the sequence here.



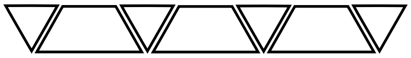
a. Determine the number of triangles and hexagons in the 10th figure of the extended sequence. Do the same for the 15th figure.

b. Any figure number that is a multiple of 3 has 1/3 that number of hexagons and 2/3 that number of triangles. Explain how you can determine the number of hexagons and triangles if the figure number is 1 more than a multiple of 3. One less than a multiple of 3.

5. The third and fourth figures of a pattern block sequence are given below. Use your pattern blocks to construct and sketch the first, second, and fifth figures in this sequence.



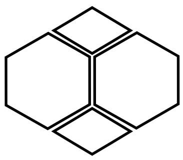
1st 2d 3d

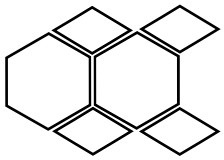


4th 5th

a. Describe how the odd-numbered figures differ from the even-numbered figures.

b. Sketch the missing figures for the next sequence. Explain how you can determine the number of hexagons in any even-numbered figure of the sequence, then explain it for any odd-numbered figure.



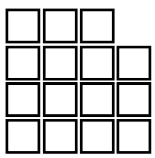


1st 2d 3d 4th 5th 6th

Explanation:

***6.** The third term of a color tile sequence is shown below. Use your color tiles to create more than one sequence for which the given figure is the third figure. Sketch diagrams of the first, second, and fourth figures. Write a rule for extending each pattern you create so that the reader is able to build the next few figures in the sequence.

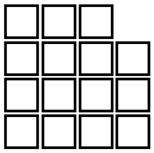
Sequence I



1st 2d 3d 4th

Rule:

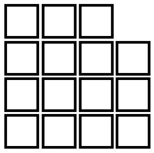
Sequence II



1st 2d 3d 4th

Rule:

Sequence III

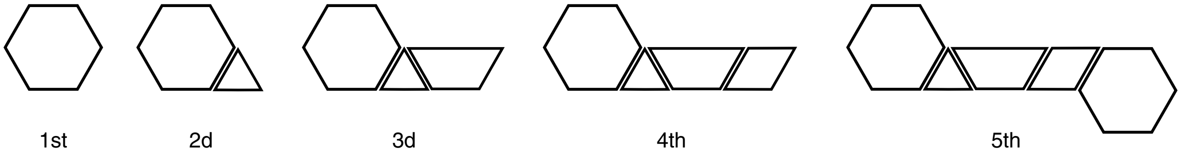


1st 2d 3d 4th

Rule:

7. Pattern block sequences I and II begin repeating in the fifth figure and pattern block sequence III begins repeating in the sixth figure. Build and sketch the next figure in each sequence with your pattern blocks. For the 38th figure in each sequence determine which pattern block is at its right end and how many of each type of pattern block the 38th figure contains. Describe how you reached your conclusion in each case.

Sequence I

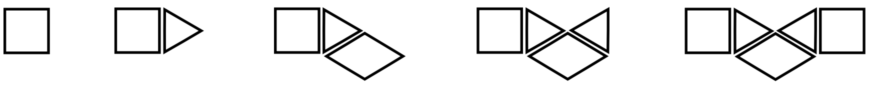


1st 2d 3d 4th 5th

Explanation

6th

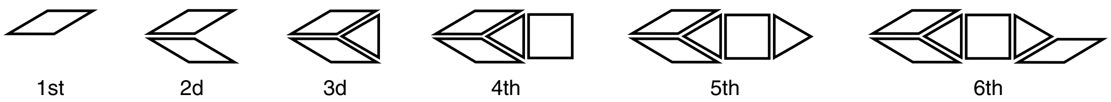
***Sequence II**



1st 2d 3d 4th 5th 6th

Explanation:

Sequence III



Explanation:

7th

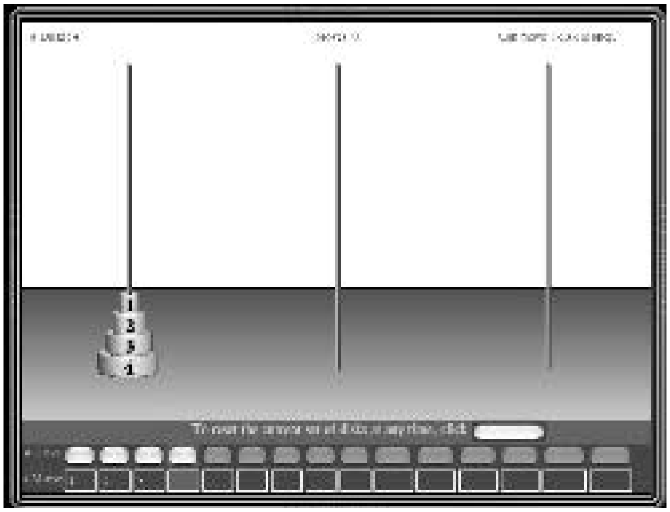
8. Devise your own sequence of figures with pattern blocks. Pose at least three questions about your sequence. Ask another person to build your sequence and answer your questions. Sketch at least the first four figures from your sequence and record your questions.

JUST FOR FUN

TOWER PUZZLE

This ancient puzzle is sometimes referred to as the "Tower of Brahma." The story says that at creation, the priests were given three golden spindles. One golden spindle has 64 golden disks with the largest disk at the bottom of the spindle and each successive disk getting smaller up to the top smallest disk. Day and night the priests were to transfer disks from one spindle to another, moving the disks one at a time but never placing a larger disk on a smaller one until all the disks are transferred to another spindle—in the original order. When the priests finished transferring the spindle of 64 disks, the world was to come to an end.

Use a model, or the interactive applet from the Online Learning Center, and the problem-solving strategies of simplifying, making a table, and looking for a pattern as you try to form a conjecture about the minimum number of moves to transfer all 64 disks from one spindle to another spindle. By experimenting with special cases, such as 2 disks, 3 disks, etc., data can be gathered that lead to conjectures for predicting the number of moves for transferring 64 disks.



Tower Puzzle Applet, Chapter 1
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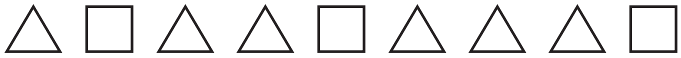
Connections 1.1 SEEING AND EXTENDING PATTERNS WITH PATTERN BLOCKS

1. *School Classroom:* A second-grade teacher started the following pattern block sequence and asked her students to continue the pattern by adding five more pattern blocks.



a. One student looked at the sequence and said he did not know what to do. Describe what you would say or do as the teacher.

b. Another student continued the pattern block sequence as follows. Describe what you believe this student was thinking. What questions can you ask to encourage the student to reveal how she perceived and extended the pattern?

2. *School Classroom:* Design a pattern block sequence that you believe is appropriate for an elementary school student and write a few questions that you can ask about your sequence. Try this activity on an elementary school age child of your choice. Record your sequence, your questions, and the student's responses.

3. *Math Concepts:* Make up two secret pattern block or color tile sequences that have the same first four figures but different figures after that. Show the first four figures to a partner and challenge them to find both of your secret sequences. Illustrate your sequences and explain the results of your challenge.

4. *NCTM Standards:* The National Council of Teachers of Mathematics (NCTM) is a professional organization whose goal is to improve the teaching and learning of mathematics. Go to the NCTM website, www.nctm.org, to locate information on their publication, *The Principles and Standards for School Mathematics.* Write a short description of the purpose of this publication and give the specific URL where you found this information.

5. *NCTM Standards:* Go to the **Pre-K–2 Standards** in the back pages of this book and find the *Expectation* where studying patterns is recommended. State the *Expectation* and the *Content Standard* the *Expectation* is under and explain why you think the study of patterns is under this particular *Standard*.

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Activity Set 1.2 GEOMETRIC NUMBER PATTERNS WITH COLOR TILE

PURPOSE

To use geometric patterns to represent number patterns and provide visual support for extending number sequences.

MATERIALS

Color tiles from the Manipulative Kit or from the Virtual Manipulatives.

INTRODUCTION

How long would it take you to find the sum of the counting numbers from 1 to 100?

$$1 + 2 + 3 + 4 + \cdots + 49 + 50 + 51 + \cdots + 97 + 98 + 99 + 100$$

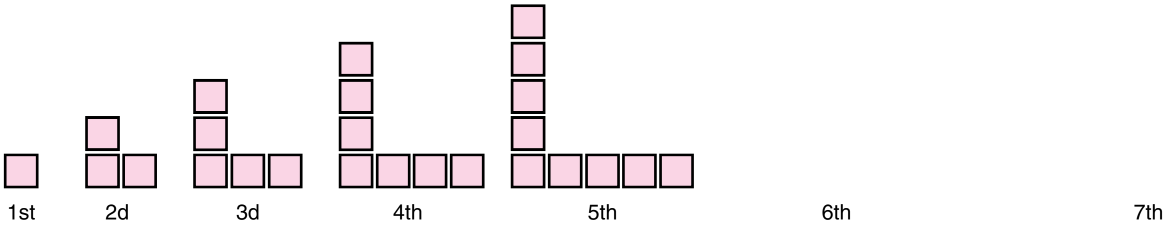
Karl Friedrich Gauss

Karl Friedrich Gauss (1777–1855), one of the greatest mathematicians of all time, was asked to compute such a sum when he was 10 years old. As was the custom, the first student to get the answer was to put his or her slate on the teacher's desk. The schoolmaster had barely stated the problem when Gauss placed his slate on the table and said, "There it lies."

No one knows for sure how the young Gauss obtained the sum so quickly. It is possible, however, that he, like many other creative thinkers, made a mental calculation by thinking of this number problem in a pictorial or visual way. Can you think of a picture or diagram that represents Gauss' sum?

Often in mathematics, visual information can give valuable insights into numerical questions. Visual images can also help us remember mathematical ideas and concepts. In the following activities, geometric patterns will be used to generate number sequences. The visual information in the patterns will aid you in making numerical generalizations.

1. Find a pattern in the following sequence of tile figures and use your tiles to construct and then sketch the sixth and seventh figures.



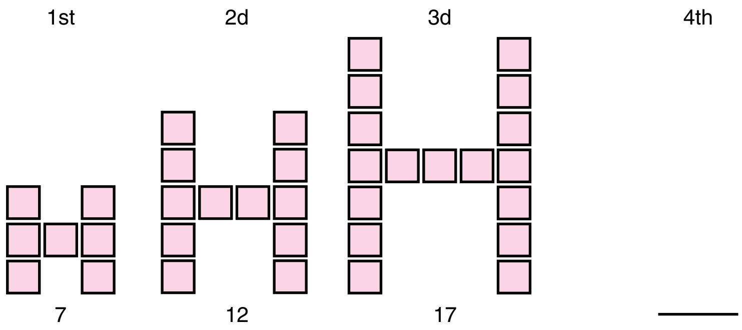
***a.** By counting the number of tiles in each figure, we can see that the first seven figures represent the sequence of odd numbers 1, 3, 5, 7, 9, 11, and 13. Use your tiles to build the 10th figure for this sequence. Determine the 10th odd number by counting the tiles in the 10th figure.

***b.** Write a sentence or two describing precisely how you would build the 20th figure. How many tiles would be needed? What is the 20th odd number?

***c.** Write a sentence or two describing what the 50th figure would look like and how many tiles it would contain.

***d.** Write a statement that will enable readers to determine the number of tiles for any figure number, *n*.

2. The first three terms of the number sequence represented by the tile figures here are 7, 12, and 17. Build and sketch the fourth figure and record the number of tiles needed to build it.



a. Write directions for constructing the eighth figure so that someone who has not seen any of the figures could build the figure by following your directions.

b. How many tiles are in the eighth figure?

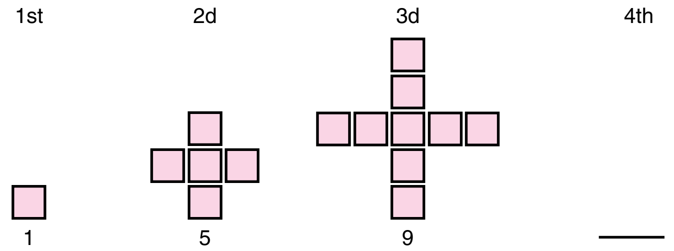
c. Determine the number of tiles in the 15th figure. (Imagine how you would construct that figure.)

d. Describe in words what the 50th figure would look like and how many tiles it would contain.

e. Write a procedure using words or an algebraic expression to determine the number of tiles for any figure, *n*.

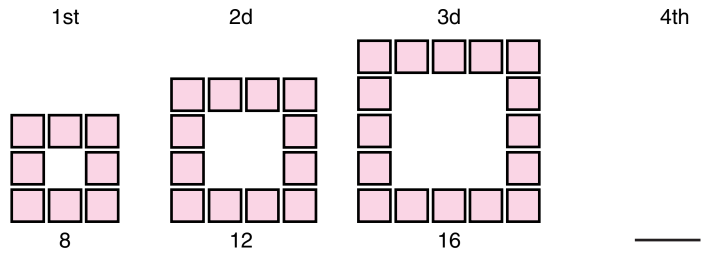
3. Here are three sets of tile figures and the number sequences they represent. Build the fourth figure and record the fourth number in each number sequence. Determine the 10th number in each number sequence by imagining how you would construct the 10th figure in each tile sequence. Write a procedure using words or an algebraic expression that would enable the reader to determine the number of tiles in any figure, given the figure number, *n*.

a.



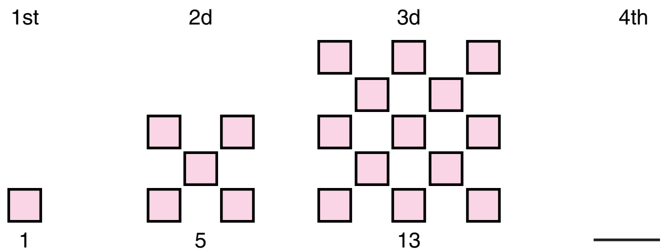
Procedure:

***b.**



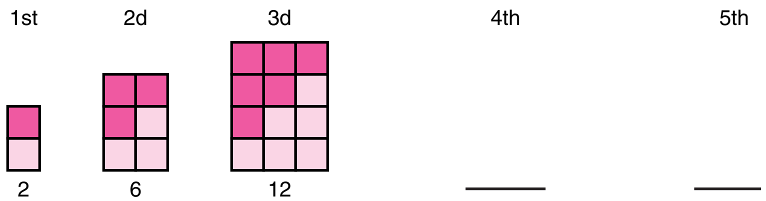
Procedure:

c.



Procedure:

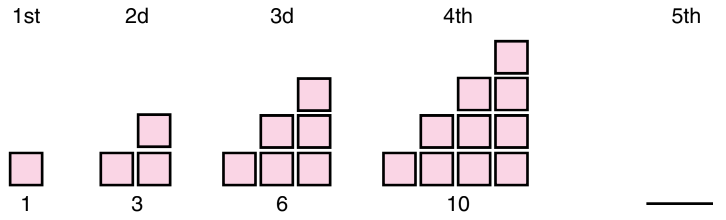
4. Using red and blue tiles, construct and then sketch the fourth and fifth figures in this sequence of rectangles and determine the fourth and fifth terms of the corresponding number sequence.



a. Describe the 10th rectangle in the sequence, including height, width, total number of tiles, number of red tiles and number of blue tiles.

b. Explain how you can determine the number of red tiles and the number of blue tiles in the 50th rectangle.

5. The following figures resemble a stairstep pattern. Use your tiles to construct and then sketch the fifth figure (fifth stairstep).



***a.** What number does the fifth stairstep represent? The 10th stairstep?

***b.** Explain how the results from activity 4b above can help to determine the number of tiles in the 50th stairstep.

***c.** Which stairstep corresponds to Gauss' sum $1 + 2 + 3 + 4 + \cdots + 99 + 100$?

***d.** Explain how stairsteps and activity 4 can be used to determine Gauss' sum in part c.

***e.** Write a paragraph explaining how the sum of consecutive whole numbers from 1 to any given number, *n,* can be obtained by using stairsteps.

6. Suppose young Gauss had been asked to compute the sum

$$2 + 4 + 6 + 8 + 10 + 12 + 14 + \cdots + 78 + 80$$

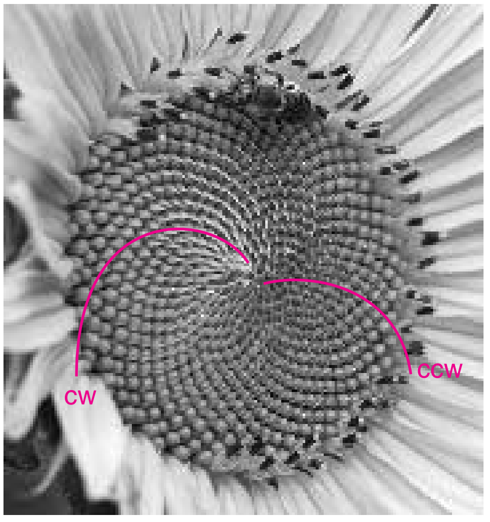
How might he have computed this sum quickly? Devise a method of your own to compute the sum. (*Hint:* One way is to build a stairstep sequence similar to that in activity 5, except for the height of the steps.) Record your method and any diagrams or sketches you use.

JUST FOR FUN

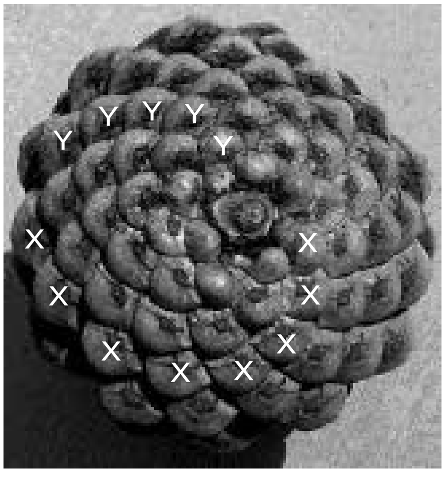
FIBONACCI NUMBERS IN NATURE

The Fibonacci numbers 1, 1, 2, 3, 5, 8, 13, . . . occur in nature in a variety of unexpected ways. Following the first two numbers of this sequence, each number is obtained by adding the previous two numbers. What are the next five numbers in this sequence?

***1. Daisies:** Field daisies often have 21, 34, 55, or 89 petals. If you are playing the game "loves me, loves me not" with a daisy, which numbers of petals will result in a yes answer? The centers of daisies have clockwise and counterclockwise spirals. The numbers of these spirals are also Fibonacci numbers.



2. Sunflowers: The seeds of the sunflower form two spiral patterns, one proceeding in a clockwise direction and one in a counterclockwise direction. The numbers of spirals in the two directions are consecutive Fibonacci numbers. In the drawing, there are 34 counterclockwise and 55 clockwise spirals. In larger sunflowers, there are spirals of 89 and 144. Find a sunflower and count its spirals.

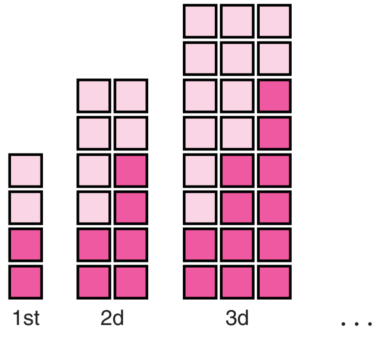


3. Cones: Pine, hemlock, and spruce cones have spirals of scalelike structures called bracts. The numbers of these spirals are almost always Fibonacci numbers. In the pinecone photograph, a clockwise spiral is identified by Xs and a counterclockwise spiral with Ys. See if you can find the 8 clockwise and 13 counterclockwise spirals.

4. Pineapples: The sections of a pineapple are also arranged in spirals that represent Fibonacci number patterns. Find a pineapple and count its spirals from upper left to lower right and from lower left to upper right.

Connections 1.2 GEOMETRIC NUMBER PATTERNS WITH COLOR TILE

1. *School Classroom:* Suppose you were teaching a middle school class and helping students understand how to use tile patterns to quickly compute sums such as $2 + 4 + 6 + \cdots + 20$. If one of your students simply chose to count the individual color tiles, explain how you would help him understand how to use this pattern to find the sum of the first 10 consecutive even numbers without just counting the individual tiles or without just adding $2 + 4 + 6 + \cdots + 20$.



2. *School Classroom:* One *Expectation* in the **Pre-K–2 Algebra Standard** in the back pages of this book says that students should be able to transfer from one representation of a pattern to another.

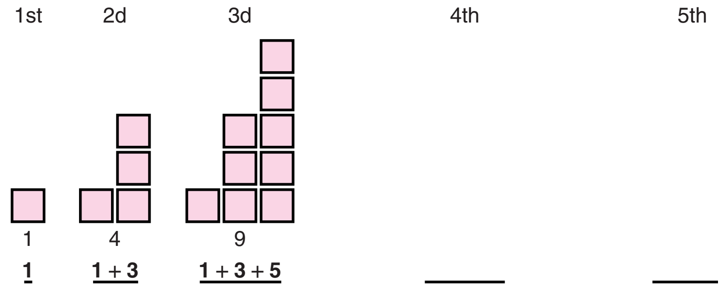
a. Create a pattern with color tiles that you believe children at the Pre-K–2 level can "transfer" from a tile pattern to a number pattern. Record your tile pattern and the corresponding number pattern.

b. Create a number pattern that you believe children at the Pre-K–2 level can transfer from a number pattern to a color tile pattern. Record your number pattern and the corresponding tile pattern.

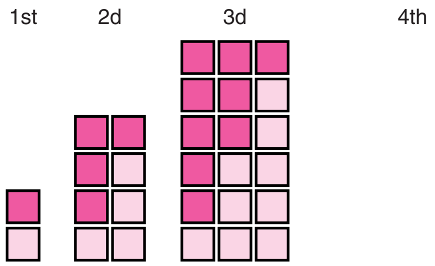
c. If you were to try the patterns you created with children at the Pre-K–2 level, what difficulties might you expect them to encounter and how would you prepare them to overcome those difficulties?

3. *Math Concepts:*

a. Use color tiles to build and then sketch the next two figures of this tile sequence. Record the number of tiles in each tile figure and the sum each figure represents to continue the number sequence.



b. By duplicating each of the figures in part a and inverting the duplicate copy, rectangles are formed. Build and sketch the 4th figure in the sequence of rectangles. Explain how you can use the 4th rectangular array in the tile sequence to find the sum of the odd numbers 1 + 3 + 5 + 7 without just adding.



c. Explain how you can use rectangular arrays to obtain the sum of the odd numbers from 1 to 191 without just adding $1 + 3 + 5 + 7 + 9 + \cdots + 191$.

4. *Math Concepts:* Design and sketch the first three figures of a color tile sequence that grows in an interesting pattern such as the tile sequences in activities 2 and 3.

a. Write a procedure in words that enables you to determine the number of tiles in the 10th figure of your tile sequence without actually constructing the 10th figure. How many tiles are in the 10th figure of your tile sequence?

b. Write a procedure using words or an algebraic expression to determine the number of tiles for any figure, *n*, in your tile sequence. Explain your thinking.

5. *Math Concepts:* Open the **Math Investigation 1.2: Read Me—Triangular Numbers Instructions** from the Online Learning Center and investigate the units digit patterns as described in questions 1 and 2 of the *Starting Points for Investigations 1.2.* State a few of your patterns or conclusions and explain your thinking.

6. *NCTM Standards:* Go to the **Algebra Standards** in the back pages of this book and for each grade level, Pre-K–2, 3–5, and 6–8; find "Understand patterns, relations and functions." Using the tile sequence in question 3a above, describe how a child at each level is expected to work with this tile sequence.

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Activity Set 1.3 SOLVING STORY PROBLEMS WITH ALGEBRA PIECES

PURPOSE

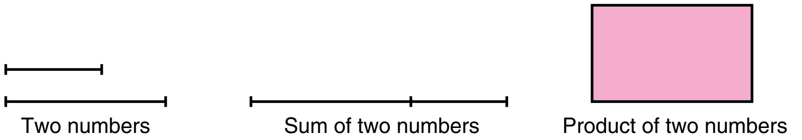
To use algebra pieces as a visual model for representing and solving algebra story problems.

MATERIALS

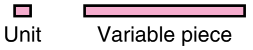
Algebra pieces on Material Card 13 and scissors to cut them out.

INTRODUCTION

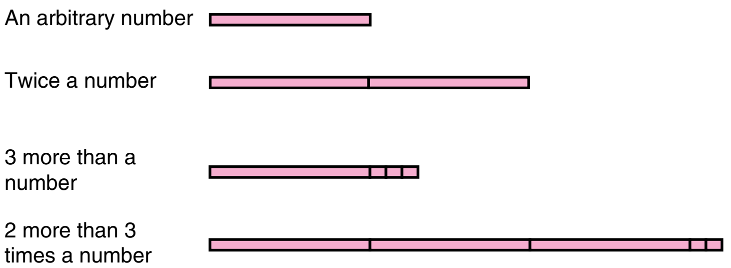
The Greek algebra of the Pythagoreans (ca. 540 B.C.E.) and Euclid (ca. 300 B.C.E.) was not symbolic with letters for variables, as we think of algebra, but geometric. An arbitrary number was expressed as a line segment. To express the sum of two arbitrary numbers, the Greeks joined the two segments end to end. The product of two numbers was represented as the area of a rectangle with the two segments as sides.



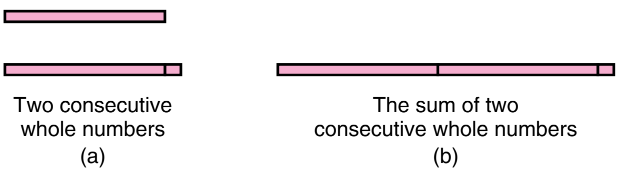
In this activity set, we will represent and solve algebra story problems using a geometric model similar to that of the Greeks. Our model will consist of two types of pieces: a variable piece and a unit piece. The variable piece will be used to represent an arbitrary line segment or an arbitrary number. Each unit piece will represent a length of 1 unit.



The algebra pieces can be placed together to form different expressions.



1. If a variable piece represents a whole number, then two consecutive whole numbers are represented by the algebra pieces in figure a. Figure b illustrates the sum of the two consecutive whole numbers.



a. Represent four consecutive whole numbers with your algebra pieces. Sketch them here.

b. Using your model and mental arithmetic, determine four consecutive whole numbers, which have a sum of 58. Explain your thinking.

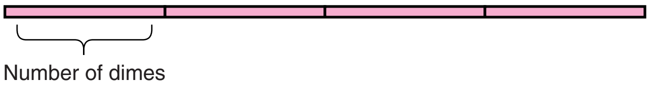
2. Use your algebra pieces to represent the sides of the triangle described as follows:

The second side of the triangle is twice the length of the first side. The third side of the triangle is 6 units longer than the second side.

***a.** Draw a sketch of your algebra-piece model of the triangle.

***b.** Using your model and mental arithmetic, determine the length of each side of the triangle if the perimeter of the triangle is 66 units. Explain your thinking.

3. A box contains $2.25 in nickels and dimes. There are three times as many nickels as dimes. If one variable piece represents the *number of dimes* in the box, explain why the variable pieces shown here represent the total number of nickels and dimes.



a. Suppose each dime is replaced by two nickels so that there are only nickels in the box. Explain why the total number of coins is now represented by the following pieces.

b. The total amount of money in the box is $2.25. Explain how the model in part a can be used to determine the total value of nickels represented by each variable piece.

c. Explain how you can use the information in part b to determine the original number of dimes and nickels in the box.

Activities 4–9: Use your algebra pieces to represent the information in each story problem. Sketch an algebra-piece model for each problem. Explain how each solution can be arrived at using the algebra pieces and mental arithmetic.

***4.** Two pieces of rope differ in length by 7 meters. End to end, their total length is 75 meters. How long is each piece? (*Hint:* Let one variable piece represent the length of the shorter rope, and let the unit piece be 1 meter.)

5. There are 3 boys on the school playground for every girl on the playground. Altogether there are 76 children. How many are boys? (*Hint:* Let one variable piece represent the number of girls on the playground.)

***6.** Andrea has a collection of nickels, and Greg has a collection of dimes. The number of nickels Andrea has is four times the number of dimes that Greg has. Andrea has 80 cents more than Greg. How much money does Greg have? (*Hint:* Let one variable piece represent the number of dimes Greg has.)

7. The length of a rectangle is 5 feet more than three times its width. Determine the length and the width if the perimeter is 130 feet.

***8.** Three-fifths of the students in a class are women. If the number of men in the class were doubled and the number of women were increased by 9, there would be an equal number of men and women. How many students are there? (*Hint:* Represent the number of women by three variable pieces and the number of men by two variable pieces.)

9. The sum of three numbers is 43. The first number is 5 more than the second number and the third number is 8 less than twice the first number. What are the three numbers? (*Hint:* Let one variable piece represent the second number, construct the first and third numbers, and add.)

JUST FOR FUN

ALGEBRAIC EXPRESSIONS GAME[3] (2 TEAMS)

In this game, players match algebraic expressions to word descriptions. Copies of algebraic expression cards appear on Material Card 14. There are two decks of 12 cards, one for each team of 12 students. Each student has an expression card similar to the samples shown here.

Play: Team A plays through its 12 cards and the amount of time required is recorded. Then team B plays through its 12 cards and records its time. On team A, the player who has the $n + 1$ card begins by saying, "I have $n + 1$. Who has two less than a number?" Then the player on team A, who has the card with $n - 2$, says, "I have $n - 2$. Who has one more than two times a number?" The game continues in this manner.

On team B, the first player is the player with the $n + 2$ card, and the next player is the player with an algebraic expression matching the word description on the first player's card.

Each deck of 12 cards is circular. That is, the last card in the deck calls the first card. Therefore, all the cards in the deck should be used. If there are fewer than 12 students on a team, some students can use more than one card. If there are more than 12 students on a team, two students can share a card, or more cards can be made.

Objective: The two teams compete against each other to complete the cycle of cards in the shortest amount of time.

Variation: The game can be changed so that word descriptions are matched to algebraic expressions. Two sample cards are shown here. In this case, player 1 says, "I have two more than three times a number. Who has $4x - 1$?" Player 2 says, "I have one less than four times a number. Who has $3x + 5$?" Make a deck of these cards and play this version of the game.

First Player

I have

$n + 1$

Who has

two less than
a number

Next Player

I have

$n - 2$

Who has

one more than
two times a number

I have

two more than three
times a number

Who has

$4x - 1$

I have

one less than four
times a number

Who has

$3x + 5$

[3] T. Giambrone, "I HAVE . . . WHO HAS . . .?" *The Mathematics Teacher* 73 (October 1980): 504–506.

Connections 1.3 SOLVING STORY PROBLEMS WITH ALGEBRA PIECES

1. *School Classroom:* Suppose you were working with a student who was struggling with the idea of using a variable and could not understand that the variable was not a fixed value. Explain how you could use algebra pieces to help the student understand how the variable is just a placeholder. Give an example question that you would use to help the student.

2. *School Classroom:* Devise a problem that you believe is appropriate for an upper elementary school student to solve using algebra pieces and mental arithmetic. Write out the problem and anticipate "getting started" help you may have to give by asking the student appropriate questions. Try this activity on an upper elementary school age child of your choice. Record your problem, questions or hints you posed, and the student's responses.

3. *Math Concepts:* Use algebra pieces and mental arithmetic to determine four consecutive odd numbers whose sum is 64. Sketch and label your algebra piece model and explain how you solved the problem.

4. *Math Concepts:* Use your algebra pieces to construct a rectangle whose length is twice its width. Draw a sketch of this rectangle. Using algebra pieces and mental arithmetic, explain how you can determine the length and width of this rectangle if you know the perimeter of the rectangle is 54 units.

5. *NCTM Standards:* Go to http://illuminations.nctm.org/ and under "Lessons" select grade levels K–2, 3–5, and 6–8 and all of the **Content Standards.** Search for the keyword "pattern." Choose a lesson that involves extending and analyzing patterns.

a. State the title of the lesson and briefly summarize the lesson.

b. Referring to the **Standards Summary** in the back pages of this book as necessary, list the *Problem-Solving Standard Expectations* that the lesson addresses and explain how the lesson addresses these *Expectations.*

6. *NCTM Standards:* One of the **Grades 3–5 Algebra Expectations** in the back of this book states "Model problem situations with objects and use representations such as graphs, tables and equations to draw conclusions." Explain why you think using algebra pieces and mental arithmetic as a problem-solving tool addresses this *Expectation.*

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Elementary School Activity

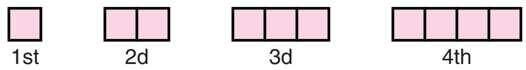
EXPLORING PATTERNS WITH COLOR TILES

Purpose: To introduce elementary school students to recognizing, describing, and extending geometric patterns.

Connections: Ask the class what the word "patterns" means. They may suggest several meanings, such as a pattern in cloth, a pattern used to make a piece of clothing, etc. Discuss a few meanings of this word and tell them that "We will look at some mathematical patterns!"

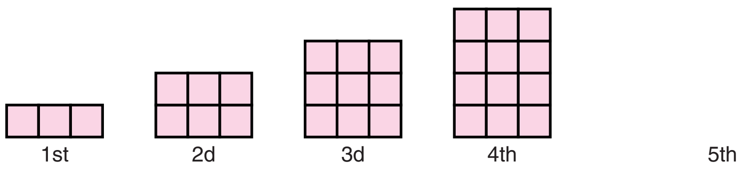
Materials: Sets of color tiles can be created by copying 2-centimeter grid paper on four different colors of cardstock or by downloading the color tile images from the Online Learning Center. Color tile transparencies can also be made with the color tile images. Sets of 20 of each of four colors can be placed in plastic sealable bags. Each group of two to four students will need one set of color tiles.

1. Pass out sets of tiles to each group. Form the following sequence of four tile figures at the overhead and ask each group to form these four figures with their own tiles.
   - Ask the class what they think the pattern is, what the 5th figure might look like, and to explain their reasoning. You may wish to have volunteers go to the overhead to demonstrate as they explain.
   - Once the class agrees on a pattern, such as 5 tiles in a row for the 5th figure, ask each group to build the next two figures.
   - Ask the class to describe what the 10th and the 50th tile figures in the sequence look like.

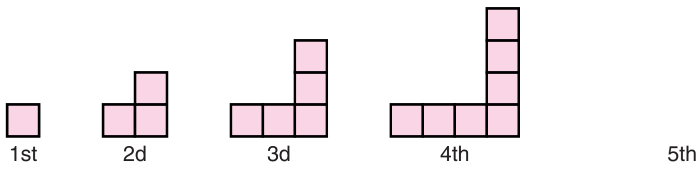


2. Repeat activity 1 for the following tile sequences, or depending on your students, create more challenging sequences.

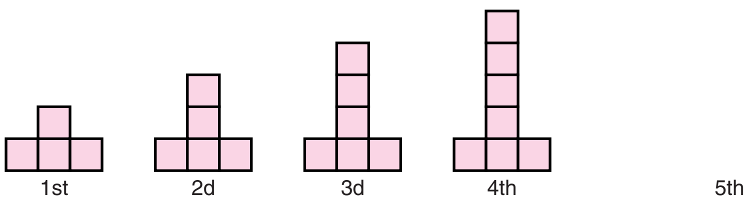
a.



b.



c.



3. Ask each group to build a tile sequence of four figures so there is a pattern in how the figures change. Select a few examples to be shown at the overhead and have the children describe their patterns.