The learner will recognize, determine, and represent patterns and simple mathematical relationships.

5

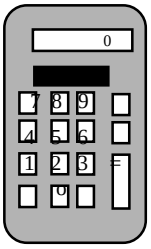
5.01 Describe and extend numeric and geometric patterns.

Notes and textbook references

A. Give each student a calculator. Key in **1** + = , and continue pressing = . Discuss pattern. **Clear**. Have student key in **2** + = . Discuss pattern. Predict what will happen if you key in **3** + = . Allow students to discover and share other patterns on the calculator. How can you make your calculator count backwards? Extension: Have students key in any number such as 39. Then make the calculator skip-count by 2's. Ask what would you punch into the calculator?

Relationshapes™, pattern blocks, or attribute blocks lend themselves to many investigations related to classification.

B. Show students how to skip-count and multiply with their calculators. To count by 2's press **Clear** + **2** . As the student presses the = , the calculator will skip-count by twos. If the student presses = six times, the calculator will show **12**. Have students count by 5's. **Clear + 5 = = = .**
Continue with other sequences, keeping count of the number of times the = is pushed. Ask children to explain how the calculator is showing a form of multiplication and write the multiplication sentences. Start with **Clear 2 + 5 = = = = .** What is the pattern now?



C. Have students work in pairs and use a calculator to add all numbers in a horizontal row on a hundred board, beginning with the top row. (The answers are 55, 155, 255...955). After adding four rows, look at patterns of answers. Ask students to suggest why these sequences appear and what they think the sums of the remaining rows will be. Next add vertical columns (460, 470, 480...550). After students add four columns, have them predict the sums of the remaining ones. Why does this pattern appear?

Notes and textbook references

D. A palindrome is any number or sentence that is the same forward or backward. Some examples are 44, 131, 2002, TOOT, Madam, I'm Adam. Many numbers can be made into palindromes by adding the number with its digits reversed. For example, 31 + 13 = 44. Other numbers may require two steps to make a palindrome. 75 + 57 = 132 and 132 + 231 = 363. Other numbers may require 3, 4, 5, 6 or more steps to become a palindrome. The goal of this group activity is to find how many steps it takes to turn each number on a hundred board into a palindrome. Let students work with partners to encourage discussion of the patterns and to check each other for accuracy. Have students color-code their answers for 1-, 2-, 3-, 4-, 5- and 6-step palindromes. Ask them to discover all numbers on the hundred board that will become a palindrome in six or fewer steps. (Watch out for 89 and 98!) As they work, ask students if they see any patterns that emerge as they investigate the numbers. (Note that this activity could be completed on a 0 to 99 board instead of a 1 to 100 board.)

E. Use snap and clap patterns to practice rote skip-counting. Clap regular counting sequence and snap when multiples of five, for example, are named. "One (clap), two (clap), three (clap), four (clap), five (snap), six (clap),...." When children know the patterns well, play "**Buzz**", count by ones; but when a multiple of the sequence appears, the child says "**Buzz**" instead of the number.

F. Give students a copy of the hundred chart and markers. On the overhead, write an incomplete number pattern. For example: 1, 3, __, 7, 9, 11, __, __, 17, ... Have students cover given numbers in a pattern and discover the missing parts. Continue giving students pattern sequences ranging from easy to difficult.

G. Using pattern blocks, have students design a pattern. Let each student draw and color the pattern onto paper leaving space for another student to continue the pattern. Students exchange papers, explain and complete the patterns. This is a good homework assignment with discussion to follow-up. (Note: While this is an activity that can be used with first and second grade children, it is also appropriate for third graders who have not had many experiences with patterns.)

Notes and textbook references

H. Students will need hundred boards and counters. Present guidelines and have them cover the answers and look for patterns. For example, cover all the numbers with a 4 or cover all numbers whose digits add up to 8. Cover all numbers where the digit in the ones place is 1 less than the digit in the tens place. Have children make up other directions. Extension: Have children work in pairs or alone with a direction sheet and color their answers on a hundred chart. See Blackline Master I - 2.

I. Using small sheets of wallpaper glued in the center of plain drawing paper, have students describe the pattern and extend it by coloring the entire sheet. Challenge them to create a similar pattern changing one or more of the properties.

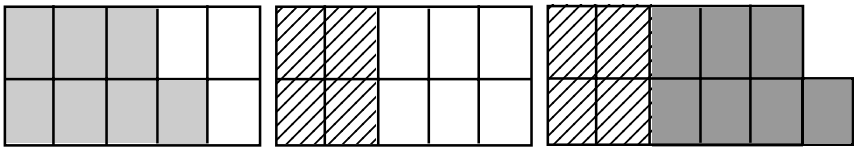
J. Have students explore "constant" functions on their calculators. This can be accomplished by keying as follows: **1 + =**, and continuing to press the = button. Discuss the resulting pattern. Be sure to have students clear before beginning any new explorations. What pattern results when keying **+ 2**? Have students figure out how to get their calculators to skip-count by 5.

K. Using pattern blocks, have students create a pattern. Have each student color this pattern on a strip of adding-machine tape using about three repeats of the pattern. These patterns then become "task cards" for other students who are required to continue the pattern using pattern blocks. Students could then be asked to write about these patterns and find another form for representing the pattern. For example, a pattern of square, square, triangle could be represented as clap, clap, snap or A,A,B. Using a collection of rubber stamps would also offer an engaging opportunity for creating patterns. The MECC computer program, called "Patterns," would also provide extended practice with identifying and creating patterns.

L. Use an understanding of patterns to review addition and subtraction facts. Review the doubles of addition with your students. Example: 4 + 4 = 8 and 5 + 5 = 10. Then look at a double plus one rule. Example: 4 + 4 + 1 = 9 and 5 + 5 + 1 = 11.

Notes and textbook references

M. Investigate the sums of odd and even numbers while reviewing number facts. Each student needs grid paper, crayons, and digit cards with 0 to 9. Students should first cut out strips that are two squares wide by the length of the grid paper. For each number, 1 through 9, have them try to color a rectangle that has a dimension of two squares on one side and area. *Talk with the students about modeling numbers as odd or even with rectangles of two squares on one side. Even numbers will make these rectangles, but odd numbers will not. Cut these figures out.* Next choose a number, for example, 7, and find the model. Then pick up a second number and find that model. Let each student complete the task ten times. With a partner, have students examine their charts and write conclusions about adding odd and even numbers.



7 is odd 4 is even 4 + 7 is odd

Have students try to form one longer rectangle (note that addends may be reversed). Record the results on a chart.

numbers drawn	odd / even	sum	odd or even
7 + 4	odd + even	11	odd

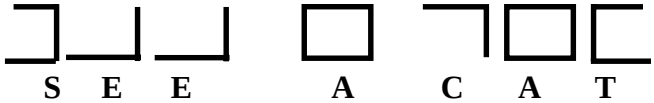
Let each student complete the task ten times. With a partner, have students examine their charts and write conclusions about adding odd and even numbers.

N. Make a pattern of colored cubes or blocks. Have students name the pattern (ex. RRBBBRRBBB.) Have students decide what will come next in the pattern. Ask students to predict what color the 20th (or any number) block will be. Have them discuss why they think so.

Notes and textbook references

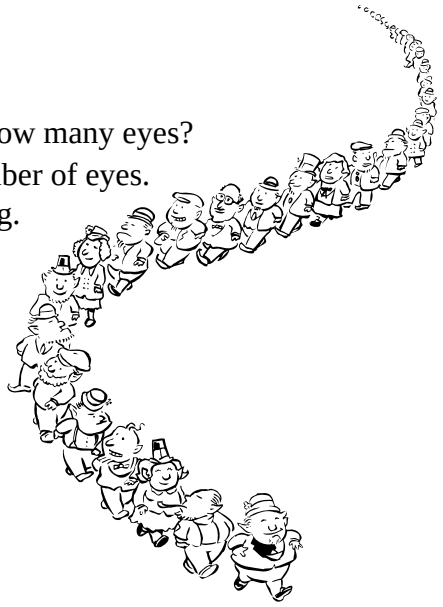
O. Draw a tic-tac-toe grid. Put one letter inside each grid space. Each letter will have its own pattern. Draw the pattern to make words. After decoding the patterns, students may like to create their own grid puzzles. Note that the letters inside the grid could be changed.

E	**B**	**R**
S	**A**	**T**
C	**D**	**M**

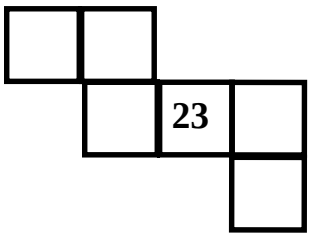


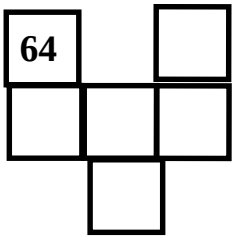
P. Play strategy games such as checkers or chess and try the name games on the Friday-the-13th Blackline Masters V - 1 and V - 2. Can you find winning patterns? There is also a collection of Friday-the - 13th activities .

Q. Have a child stand. How many eyes? Add a second child and note the number of eyes. Continue until 8 children are standing. How many people would we need to have 24 eyes? 30 eyes? Show students how to make a table to help organize their data.



R. Cut out shapes from a hundred board (Blackline Master I - 2) made up of five to seven squares each and resembling puzzle pieces. Fill in each piece with one or two numbers. Have students solve for the remaining empty spots and explain how they arrived at their solutions.





Notes and textbook references

5.02 Extend and find missing terms of repeating and growing patterns..

A. **Growing Squares.** Divide the class into small groups. Give each group 100 color tiles or squares of construction paper. Have each group use one tile to make a square. Next use four tiles to build a square. Have students continue the pattern by making each square bigger than the previous square. Have students make a table; have them record the number of tiles used on each side and the total number in each square. Challenge students to predict how many tiles or squares of paper would be used if a large square were 12 units across the bottom. Each group should write about patterns its members find.

B. **Growing Triangles.** Use counters to build triangular shapes. Have students use three counters in the first example. Notice that in the top row there is one counter. In the second row there are two counters. When you build the next figure, notice that row one has one counter, row two has two counters, and row three has three counters. To build the next larger size triangle, how many counters are in the fourth row? Continue to build triangles in this manner and talk about the patterns children see (For example, note the sides of the figures). Ask students to describe how they might figure out the number of counters needed to build a triangle whose bottom row has eight counters.

C. Have students use hundred boards (Blackline Master I - 2) to cover skip-counting patterns. Have them record these patterns by coloring in the numbered squares that follow a certain pattern such as counting by threes, fives, nines, etc. Students might be asked to find a way to describe these resulting patterns and then write about them. Display the hundred boards' colored patterns and read a student's description of one of the patterns. Note which students readily identify patterns. This will be valuable background for learning multiplication.

Notes and textbook references

D. Use charts to solve problems such as the following:

- How many calories are in a dozen doughnuts if each doughnut has 95 calories?
- How many half dollars are in $12.00?

Donuts	Calories
1	95
2	190
3	

- You owe your mother $16.50. You agree to pay $1.50 each week until the debt is paid. How many weeks will it take to pay the debt?

E. Direct students, in pairs, to measure their arm spans and their heights. Record the class data and lead students to discover a relationship between the two measurements. Height and arm span measurements should be almost equal. The activity can be extended to show relationships between other body dimensions such as knees and necks.

F. Give students a square of graph paper that is 4 x 4. Have them color a pattern that has an area of 8 square units. How many different patterns can be created? (This is also an opportunity to talk about what fractional part or percent has been colored.) This could be extended by changing the number of units to be colored and the size of the original square. Students could also be asked to group the designs according to some criteria they choose. This sorting activity could be repeated many times using different criteria.

Notes and textbook references

G. How Many Rectangles Do You See?: Some children will reply that there are three rectangles; others will say that there are more than three. Help them to see and count the total number of rectangles. Refer to the drawing as a 3-rectangle because it is made from three small rectangles (three 1-rectangles). Draw a 4-rectangle and give the class some time to count the total number of different-sized rectangles in a 4-rectangle. How many 1-rectangles are there in a 4-rectangle? How many 2-rectangles? How many 3-rectangles? Can you explain your answer? What about a 5-rectangle and a 6-rectangle? Is there any pattern that you can see in these investigations? Help the class in organizing their information for each rectangle into a table.

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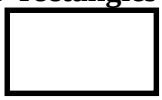
3-rectangle

A 3-rectangle has

three rectangles this size:



two rectangles this size:

one rectangle this size:

Third-grade is not too early to ask students to look for patterns in tables horizontally as well as vertically. As they try to find the relationship of the total number of rectangles in consecutive terms, they might discover a relationship between the type of rectangle and its total. (in a 4-rectangle there are 10 rectangles 1 + 2 + 3 + 4 = 10).

Discuss the idea that being organized and systematic is helpful in seeing patterns and becoming confident in solving these types of problems.

Type of large rectangle	Total number of different-sized rectangles
1-rectangle	1
2-rectangle	3
3-rectangle	6
4-rectangle	10
5-rectangle	15
6-rectangle	21

After students have explored the rectangle problems, with the class make a table that records the total number of different-sized rectangles in each large rectangle. Enter the data for a 4-rectangle and a 3-rectangle. Ask the children to fill in the total number of rectangles for the remainder of the table and to look for patterns.

What patterns can you find in the table? For example, the total number of rectangles for a 4-rectangle drawing is 4 more rectangles than for a 3-rectangle drawing. The total number of rectangles for a 5-rectangle is five more than for a 4-rectangle, and so on.

- How many rectangles will there be in a 7-rectangle? (21 + 7, or 28).
- If there are 210 rectangles in a 20-rectangle, how many will be in a 19-rectangle? (210 - 20, or 190). In an 18-rectangle? (171).
- If there are 66 rectangles altogether, what kind of rectangle (i.e., *n*-rectangle) do we have? (11)

Notes and textbook references

This Rectangle Activity is adapted from the National Council of Teachers of Mathematics series called the Addenda Project. The activity is found on pages 5 and 6 of the Grade 4 Addenda.

H. Using geoboards, give students the following directions:

- Place one rubberband as a line segment that goes across the entire geoboard. Record total number of sections the board is divided into (2).
- Place a second rubberband on geoboard <u>perpendicular</u> to the first. Record the total number of different sections (4).
- Add a third rubberband as a line segment which intersects other line segments on the geoboard.

Have each pair of students or each student create a table. Extend the table until they have placed five rubber bands on their boards:

Rubberbands	Section
1	2
2	4
3	
4	
5	

Discuss with the class why their charts might be different. If they had drawn line segments on a piece of paper with the directions being to make as many sections as possible, would their charts be more alike? Try this!

Notes and textbook references

I. Begin tables such as these and have students extend the patterns.

CARS

Cars	Tires
1	4
2	8
3	___
___	16
6	___

DICE

Dots on side one	Dots on opposite
3	4
1	___
2	___

FOWL

Chickens	Legs
1	2
2	4
3	___
4	___

5.03 Use symbols to represent unknown quantities in number sentences.

Notes and textbook references

A. Lay a foundation for symbols representing an unknown in a number sentence by giving students number sentences that contain a blank for the missing number in the expression. Example: 2 + 3 = ____ + 4. It is important to convey the idea to your students that the equal sign means a balance between the quantity that comes before it and the quantity that comes after it.

B. Have students explore situations in their environment that have natural variables. Have students gather and represent the data using questions like the following:

How does the length of a student's foot vary with their height?
How does school attendance vary with the day of the week?
How does the number of hours of daylight vary with the time of the year?
How does student age vary with grade level?
How does student attendance at school vary with weather or month of the school year?
How does the number of students in the school cafeteria vary with the time of day?
How does the number of students buying lunch vary with the lunch menu?
How does the speed of a swinging pendulum vary with its length?

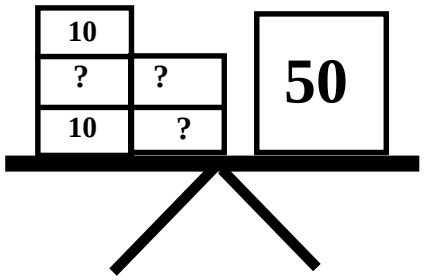
*A **variable** is a symbol that can stand for numbers or objects. For example, "n" may represent the number of people who can ride in my car. The cost of supporting workshop participants could be figured as "n" people at $75 per person. Some variables represent a specific unknown such as x + 5 = 9. Other times they are used in formulas such as A = bh. Variables are also used to generalize patterns.*

Encourage students to come up with their own questions in order to add to this list. During this entire process, emphasize the search for any patterns that might emerge and encourage students to make "predictions" based on these patterns. For example, the average age of students graduating from high school would be 18 based on the pattern found when answering the question "How does student age vary with grade level?"

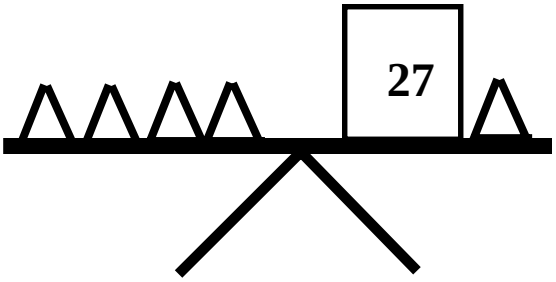
Notes and textbook references

5.04 Find the value of the unknown in a number sentence.

A. Generate a series of problems like the example below:



How does the above picture and the equation help you think about this problem?



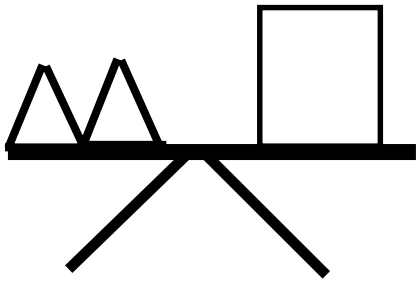
B. Take your students through a series of number sentences with unknowns where the solution is based on the solution in the previous number sentence.

Example: 3 + 5 = 2 + ____
30 + 50 = 20 + ____
300 + 500 = 200 + ____

or 12 + 13 = 10 + _____
12 + 13 = 8 + _____
12 + 13 = 6 + _____
12 + 13 = 4 + _____

Notes and textbook references

C. Show students a diagram like this:



What do you think it means? Have students decide the values

of the △ or the □ when you give them information such as:

If a △ is 3, the □ is ___.

If the □ is 8, each △ is ___.

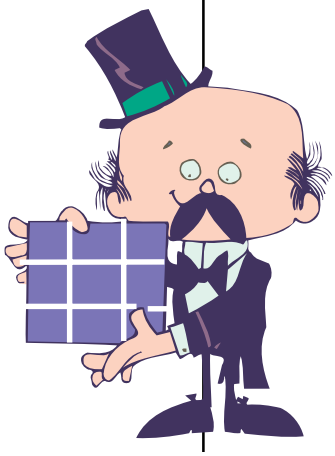
If the △ is 10, the □ is ___.

D. Make a literature connection! Read Frank Murphy's book Ben Franklin and the Magic Squares to your students and then show them how to solve a magic square. (Blackline Master V - 3) A magic square is a three by three square where the sum of the rows, columns and diagonals is the same number.

The **Magic Square 15** is a guide to creating other magic squares.

Any sequence of nine consecutive numbers can be used to create a new magic square if the numbers are placed in corresponding positions to the numbers 1 - 9 in the **Magic Square 15**.

6	1	8
7	5	3
2	9	4



Notes and textbook references

E. Using the ideas from Activity 1.02c) - A, fill in one side of the equation with number of students that you want in one group and use a variable in the other. Have students arrange themselves and find the missing addend.