Name Date Time

LESSON 3•1

General Patterns and Special Cases

SRB 103, 253

1. You are describing a general number pattern for a special case when you write a rule for a "What's My Rule?" table.

Write a rule for each table shown below.

in	out
8	13
11	16
20	25
105	110

Rule: ______________________

in	out
12	4
21	7
60	20
300	100

Rule: ______________________

2. You are writing special cases for a general number pattern when you complete a "What's My Rule?" table.

Complete.

Rule: Add the opposite of the number. ($x + -x = 0$)

in	out
3	0
25	
−7	
−53	

Rule: Divide by the number. ($y \div y = 1$)

in	out
8	1
9	
$\frac{1}{4}$	
100	

Use the values from the table above to write special cases for the following general number patterns:

$x + -x = 0$.

Special cases

Example: $3 + -3 = 0$

____

____

____

$y \div y = 1$.

Special cases

Example: $8 \div 8 = 1$

____

____

____

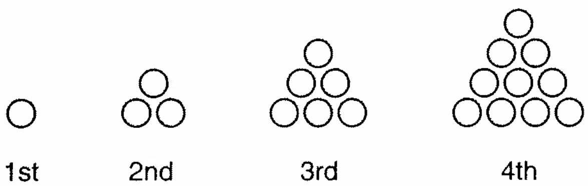
Name Date Time

LESSON 3•1

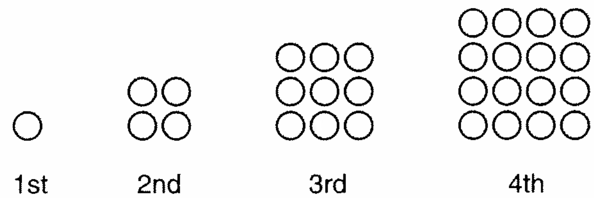
Number Patterns

Triangular, square, and rectangular numbers are examples of number patterns that can be shown by geometric arrangements of dots. Study the number patterns shown below.

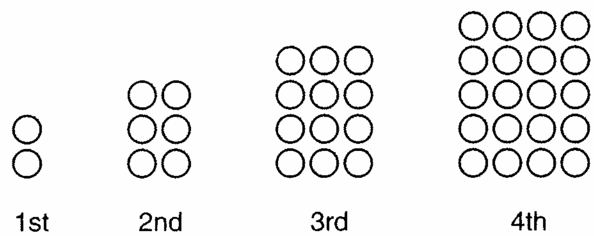
Triangular Numbers



Square Numbers



Rectangular Numbers



1. Use the number patterns to complete the table.

Number of Dots in Arrangement

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Triangular Number	1	3	6	10						
Square Number	1	4	9	16						
Rectangular Number	2	6	12	20						

2. What is the 11th triangular number? ________

How does the 11th triangular number compare to the 10th triangular number?

____

Name Date Time

LESSON 3•1

Number Patterns *continued*

3. Describe what you notice about the sum of 2 triangular numbers that are next to each other in the table.

____

____

4. Add the second square number and the second rectangular number; the third square number and the third rectangular number. What do you notice about the sum of a square number and its corresponding rectangular number?

____

____

5. Describe any other patterns you notice.

____

____

6. You can write triangular numbers as the sum of 4 triangular numbers when repetitions are allowed. For example: 6 = 1 + 1 + 1 + 3

Find 3 other triangular numbers that can be written as sums of *exactly* 4 triangular numbers.

____ = ____ + ____ + ____ + ____

____ = ____ + ____ + ____ + ____

____ = ____ + ____ + ____ + ____

Name Date Time

STUDY LINK 3•1

Variables in Number Patterns

SRB 103

1. Following are 3 special cases representing a general pattern.

$17 + 0 = 17$ $-43 + 0 = -43$ $\frac{7}{8} + 0 = \frac{7}{8}$

a. Describe the general pattern in words.

____

____

b. Give 2 other special cases for the pattern.

______________ ______________

For each general pattern, give 2 special cases.

2. $(2 * m) + m = 3 * m$

______________ ______________

3. $s + 0.25 = 0.25 + s$

______________ ______________

For each set of special cases, write a general pattern.

4. $3^2 * 3^3 = 3^5$

$5^2 * 5^3 = 5^5$

$13^2 * 13^3 = 13^5$

____

5. $7 * 0.1 = \frac{7}{10}$

$3 * 0.1 = \frac{3}{10}$

$4 * 0.1 = \frac{4}{10}$

____

6. $2^0 = 1$

$146^0 = 1$

$(\frac{1}{2})^0 = 1$

____

Practice

Complete.

7. $\frac{1}{10} = \frac{\square}{100} = 0.10$

8. $\frac{1}{4} = \frac{25}{\square} = 0.\square$

9. $\frac{1}{5} = \frac{\square}{100} = 0.20$

10. $\frac{3}{4} = \frac{\square}{\square} = 0.75$

11. $\frac{4}{5} = \frac{\square}{100} = 0.\square$

12. $\frac{7}{10} = \frac{\square}{100} = 0.\square$

Name Date Time

STUDY LINK 3·2

General Patterns with Two Variables

SRB 103

For each general pattern, write 2 special cases.

1. $(6 * b) * c = 6 * (b * c)$ ______________ ______________

2. $a \div \frac{b}{2} = (2 * a) \div b$ ______________ ______________

3. $\frac{x}{y} = x * \frac{1}{y}$ ______________
   (y is not 0) ______________

For each set of special cases, write a number sentence with 2 variables to describe the general pattern.

4. $7 - 5 = 7 + (-5)$

   $12 - 8 = 12 + (-8)$

   $9 - 1 = 9 + (-1)$

   General pattern:

   ____

5. $\frac{4}{6} = \frac{4 * 3}{6 * 3}$

   $\frac{1}{2} = \frac{1 * 3}{2 * 3}$

   $\frac{2}{5} = \frac{2 * 3}{5 * 3}$

   General pattern:

   ____

6. $\frac{6}{10} = \frac{6 \div 2}{10 \div 2}$

   $\frac{4}{12} = \frac{4 \div 2}{12 \div 2}$

   $\frac{2}{4} = \frac{2 \div 2}{4 \div 2}$

   General pattern:

   ____

7. $\frac{1}{5} * \frac{1}{2} = \frac{1 * 1}{5 * 2}$

   $\frac{2}{3} * \frac{1}{2} = \frac{2 * 1}{3 * 2}$

   $\frac{3}{4} * \frac{1}{2} = \frac{3 * 1}{4 * 2}$

   General pattern:

   ____

Practice

Write each fraction as a decimal.

8. $\frac{250}{100} =$ ________

9. $\frac{106}{100} =$ ________

10. $\frac{100}{100} =$ ________

Name Date Time

LESSON 3•2

True and Not True Special Cases

For each of the following, write one special case for which the sentence is true. Then write one special case for which the sentence is not true.

1. $m * n = m + n$

True ____________________

Not true ____________________

2. $\frac{a}{2} + b = a + b$

True ____________________

Not true ____________________

For each of the following, write at least 2 special cases for which the sentence is true. Circle each sentence that you think expresses a general pattern that is always true.

3. $a^2 = 2 * a$

____

____

4. If a is not 0, then $\frac{a^m}{a^n} = a^{m-n}$

____

____

5. $(a + b) * (a - b) = a^2 - b^2$

____

____

Name _______________ Date _______________ Time _______________

STUDY LINK 3•3

General Patterns with Two Variables

Write an algebraic expression for each situation. Use the suggested variable.

SRB 240

1. Kayla has x CDs in her music collection. If Miriam has 7 fewer CDs than Kayla, how many CDs does Miriam have? _______________ CDs

2. Chaz ran 2.5 miles more than Nigel. If Nigel ran d miles, how far did Chaz run? _______________ miles

3. If a car dealer sells c automobiles each year, what is the average number of automobiles sold each month?

   _______________ automobiles

First translate each situation from words into an algebraic expression. Then solve the problem that follows.

4. The base of a rectangle is twice the length of the height. If the height of the rectangle is h inches, what is the length of the base?

   _______________ inches

   If the height of the rectangle is 4 inches, what is the length of the base?

   _______ inches

Try This

5. Monica has 8 more than 3 times the number of marbles Regina has. If Regina has r marbles, how many marbles does Monica have?

   _______________ marbles

   If Regina has 12 marbles, how many does Monica have? _______ marbles

Practice

6. 2.75 m = _______ cm
7. 3.5 cm = _______ mm
8. 500 m = _______ km

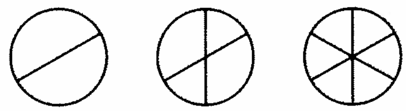
Name Date Time

LESSON 3•3

"What's My Rule?" for Geometric Patterns

1. When you cut a circular pizza, each cut goes through the center.

Cuts	Pieces
1	2
2	4
3	
4	
	12
	16



1 cut 2 cuts 3 cuts

Fill in the missing numbers in the table. Then write an algebraic expression that describes how many pieces you have when you make *c* cuts.

________________ pieces

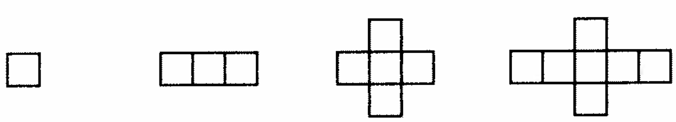
2. Fold a sheet of paper in half. Now fold it in half again. And again. And again, until you can't make another fold.

After each fold, count the number of rectangles into which the paper has been divided. Fill in the missing numbers in the table. Write an algebraic expression to name the number of rectangles you have after you have folded the paper *k* times.

____________ rectangles

Folds	Rectangles
0	1
1	2
2	
3	
4	
5	
6	

3. Below are the first 4 designs in a pattern made with square blocks. Draw Design 5 in this pattern.



Design 1 Design 2 Design 3 Design 4 Design 5

4. How many square blocks will there be in

a. Design 10? ____________________________

b. Design *n*? ____________________________

Name _______________ Date _______________ Time _______________

LESSON 3·3

More Algebraic Expressions

Write each word phrase as an algebraic expression.

1. t increased by 5 ____________

2. the product of w and 3 ____________

3. 7 less than g ____________

4. m halved ____________

5. k shared equally by 8 people ____________

6. 24 less than x tripled ____________

7. b decreased by 12 ____________

Evaluate each expression when $y = 9.05$.

8. $y + 4.98$ ________ 9. $y - 8.9$ ________ 10. $y * 10^2$ ________

Write an algebraic expression for each situation. Then solve the problem that follows.

11. Talia earns d dollars per week.

    How much does Talia earn in 10 weeks? ____________ dollars

    If Talia earns $625.75 per week,
    how much does she earn in 10 weeks? ____________ dollars

12. Michelle is 5 years younger than Ruby, who is r years old. Kyle is twice as old as Michelle.

    a. Using Ruby's age, r, write an expression for:

       Michelle's age ________ years old

       Kyle's age ________ years old

    b. Suppose Ruby is 12 years old. Find:

       Michelle's age ________ years old

       Kyle's age ________ years old

Name ______________________ Date ______________ Time ______________

STUDY LINK 3•4

"What's My Rule?" Part 1

SRB 253

1. a. State in words the rule for the "What's My Rule?" table at the right.

____

b. Which formula describes the rule? Fill in the circle next to the best answer.

Ⓐ $n = m - 0.22$ Ⓑ $m + n = 0.22$ Ⓒ $m = n - 0.22$

m	*n*
4.56	4.34
10	9.78
0.01	−0.21
$\frac{24}{100}$	0.02
7.80	7.58

2. a. State in words the rule for the "What's My Rule?" table at the right.

____

b. Which formula describes the rule? Fill in the circle next to the best answer.

Ⓐ $r - 0.25 = t$ Ⓑ $t + 0.12 = r$ Ⓒ $r * 0.5 = t$

r	*t*
20	10
15	7.5
1	0.5
1.5	0.75
3.4	1.7

3. Which formula describes the rule for the "What's My Rule?" table at the right? Fill in the circle next to the best answer.

Ⓐ $q - 13 = p$ Ⓑ $q = (2 * p) - 2$ Ⓒ $q = 2 * (p - 2)$

p	*q*
7	12
10	18
1	0
15	28
30	58

Practice

4. 180 in. = ______________ feet

5. $3\frac{1}{2}$ minutes = ______________ seconds

6. 5,280 ft = ______________ yards

7. $5\frac{1}{2}$ miles = ______________ feet

Name Date Time

LESSON 3·4

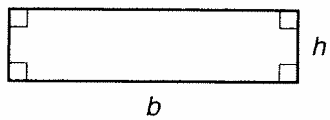
Special Cases for Formulas

A formula is an example of a general pattern. When you substitute values for the variables in a formula, you are writing a special case for the formula.

Area Formulas

Example:

To find the area of a rectangle, use the formula $A = b * h$.



Write a special case for the formula using b = 12 cm and h = 3 cm.

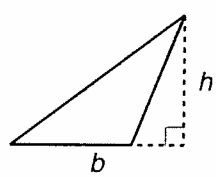
First substitute only the value of b. A = **12 cm** $* h$

Next substitute the value of h. A = 12 cm * **3 cm**

Now find the value of A and write the special case.

36 cm² = 12 cm * 3 cm

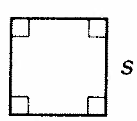
1. To find the area of a triangle, use the formula $A = \frac{1}{2} * (b * h)$.



Find the value of A and write a special case for the formula using b = 4.5 cm and h = 4.8 cm.

______ $cm^2 = \frac{1}{2} *$ (______ cm * ______ cm)

2. To find the area of a square, use the formula $A = s^2$.



Find the value of A and write a special case for the formula using b = 2.5 ft and h = 2.5 ft.

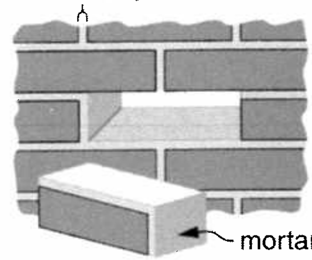
______ ft^2 = ______ ft^2

Name ______________________ Date ______________ Time ______________

LESSON 3·4

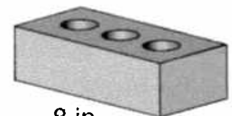
Formula for a Brick Wall

Suppose you were going to build a brick wall. It would be useful to estimate the number of bricks you would need. You could do this if you had a formula for estimating the number of bricks for any size wall.



Study the following information. Then follow the instructions for measuring an actual brick wall. Try to devise a formula for estimating the number of bricks needed to build any size wall.

- A brick wall is built by putting layers of bricks on top of one another. The space between the bricks is filled with a material called *mortar,* which hardens and holds the bricks in place. The mortar between the bricks forms the *mortar joint.*
- A standard building brick is $2\frac{1}{4}$ inches by 8 inches by $3\frac{3}{4}$ inches. The face that is $2\frac{1}{4}$ inches by 8 inches is the part of the brick that is visible in a wall.



Equivalents: 1 ft = 12 in. $\quad$ 1 ft^2 = 12 in. ∗ 12 in. = 144 $in.^2$

1. Find a brick wall in your school, home, or neighborhood. Using a ruler or tape measure, measure the length and height of the wall or part of the wall. Count the bricks in the area you measured.

a. Length ______ (unit) **b.** Height ______ (unit) **c.** Number of bricks ______

d. Measure the width of the mortar joint in several places. Decide on a typical value for this measurement.

The mortar joints are each about ______ inch(es) wide.

2. Devise a formula for calculating the number of bricks needed to build a wall. Let *l* stand for the length of the wall in feet. Let *h* stand for the height of the wall in feet. Let *N* stand for the estimated number of bricks needed to build the wall.

a. The area of this wall (the side you see) is ______ square feet.

b. My formula for the estimated number of bricks: *N* = ______

3. Test your formula. Use the length and width you measured in Problem 1. Does the formula predict the number of bricks you counted?

____

Name Date Time

STUDY LINK 3•5

"What's My Rule?" Part 2

SRB 253

1. *Rule:* Subtract the *in* number from $11\frac{1}{2}$.

in	out
n	$11\frac{1}{2} - n$
1	
2	
$8\frac{1}{2}$	
	5
12	

2. *Formula:* $r = 4 * s$

in	out
s	r
12	
	24
0.3	
	1
$\frac{1}{2}$	

3. *Rule:* Triple the *in* number and add −6.

in	out
x	$(3x) + (-6)$
1	−3
2	
	15
8	
	−6

4. For the table below, write the rule in words and as a formula.

Rule: ______________________________

____

Formula: ______________________________

in	out
b	d
1.5	0.5
$6\frac{3}{4}$	$2\frac{1}{4}$
24	8
81	27
9.75	3.25

5. Make up your own.

Rule: ______________________________

____

Formula: ______________________________

in	out
x	y

Practice

6. $3 + -6 =$ ____________

7. $-17 + 5 =$ ____________

8. $8 + (-2) + (-9) =$ ____________

9. $5 + 3 + (-5) + 7 =$ ____________

Name Date Time

LESSON 3·5

Rates

Solve the rate problems. You can use tables similar to "What's My Rule?" tables to help you find the answers, if needed.

1. Renee reads 30 pages per hour.

a. At this rate, how many pages can she read in 3 hours? ______ (unit)

b. Would she be able to read a 220-page book in 7 hours? ______

Hours	Pages
1	30
2	
3	

2. Wilson was paid $105 to cut 7 lawns. At this rate, how much was he paid per lawn? ______

Lawns	Dollars
7	105
6	
5	

3. Gabriel blinks 80 times in 5 minutes.

a. At this rate, how many times does he blink in 2 minutes? ______ (unit)

b. In 4 minutes? ______ (unit)

Minutes	Blinks
5	80
4	
3	

4. Michael can bake 9 batches of cookies in 3 hours.

At this rate, how many batches can he bake in 2 hours? ______ (unit)

Hours	Batches
3	9
2	
1	

5. Elizabeth can run 5 miles in $\frac{2}{3}$ of an hour.

At this rate, how long does it take her to run 1 mile?

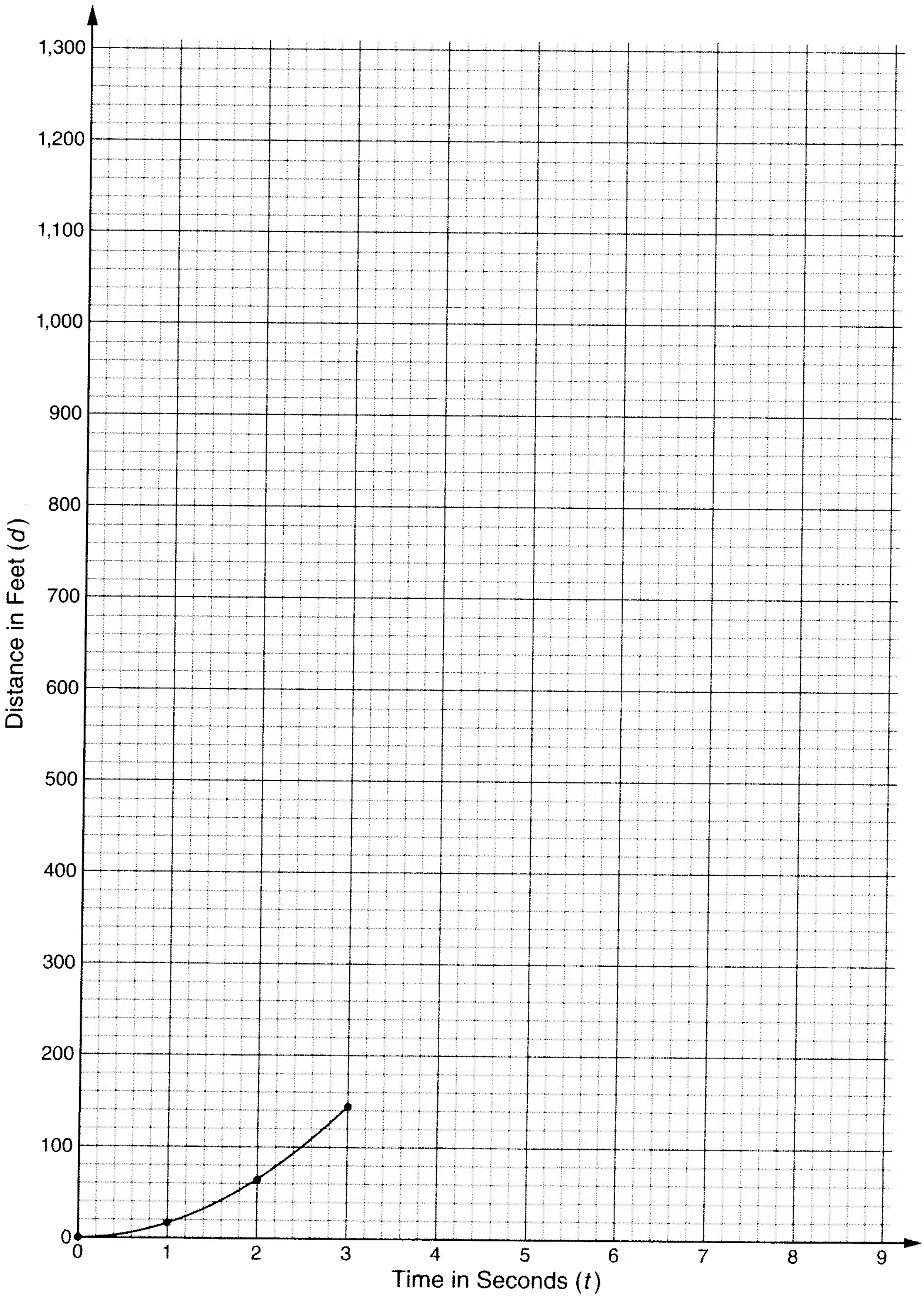
______ (unit)

Hours	Miles
$\frac{2}{3}$	5
$\frac{1}{3}$	
1	

Name Date Time

LESSON 3•6

When an Object Is Dropped



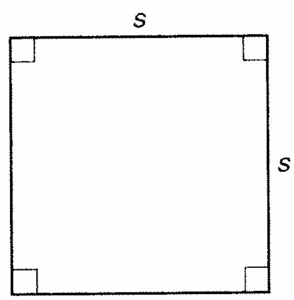
Name Date Time

STUDY LINK 3•6

Area and Perimeter

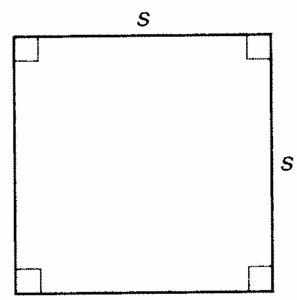
SRB 212, 214, 215

Perimeter



$P = 4 * s$

Area



$A = s^2$

1. Use the perimeter and area formulas for squares to complete the table.

Length of side (in.)	Perimeter (in.)	Area (in.^{2})
1		
2		
3		
4		
5		

Use the table above to complete the graphs on *Math Masters*, page 87.