TIMSS

NAEP

Standard Indicator
4.3.2

The Magic Formula

Purpose

Students will use and interpret formulas to answer questions about quantities and their relationships.

Materials

For each student: copy of Black Line Master (BLM) *The Magic Formula*

Activity

A. Introduction

1. Tell students that you want to change some dollar bills into quarters to use in a vending machine. Ask how many quarters they would give you for $1, $2, $5, etc. Record their answers in a table.
2. Ask students if they can tell you a rule for the number of quarters they would give you for any number of dollar bills. Use answers like "multiply by 4" to work toward an equation of the form $Q = 4 \times D$, making sure to write careful definitions of Q (the number of quarters) and D (the number of dollars) and emphasizing that these definitions are a necessary part of writing what we call a formula.
3. If students are ready for an additional step, tell them that mathematicians usually leave out the multiplication sign and write $Q = 4D$.

B. Group Activity

1. Divide students into groups of three or four.
2. Give the groups a list of other unit conversions (e.g., 12 inches in a foot, three feet in a yard, 100 centimeters in a meter, 60 seconds in a minute, 60 minutes in an hour, seven days in a week, eight pints in a gallon).
3. Have students write formulas for these situations, always including three parts: the definition of the first variable, the definition of the second variable, and the equation.
4. Reassure students who are comparing their formulas with those of others that they can choose different letters for their variables, as long as they define them clearly.

(continued)

MEETING INDIVIDUAL NEEDS

Help students who are having difficulties by writing numerical equations in a pattern that will lead them to the rule for a given situation.

EXTENDING THE ACTIVITY

Have students produce formulas involving division by considering unit conversions, such as how to change dimes to dollars, inches to feet, pints to gallons, and minutes to hours.

Standards Links
4.3.1, 4.3.4, 4.4.3, 4.5.3

Activity (continued)

C. Follow-Up Activity

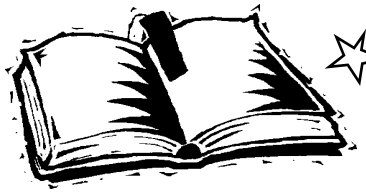
1. Hand out the BLM *The Magic Formula.* (Note that formulas relating to rectangles and squares are not included here, so that students can develop these formulas as described in Standard 5.)
2. Ask students to use each group of pictures to find a rule and then write a formula for the perimeter of that kind of shape. Remind students to include definitions of the variables as well as the equation for the rule.

Questions for Review

Basic Concepts and Processes

During the activity, discuss the following questions with students to gauge their understanding of the indicator:

- What is the rule for this situation?
- What are the variables and what letters are you going to use for them?
- What is the equation for this situation?
- How can you check that your formula works?

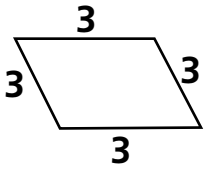


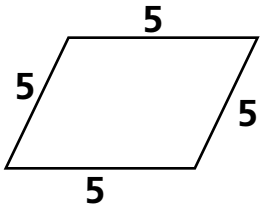
Name: _____

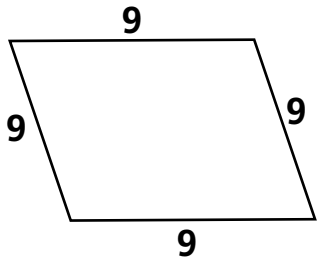
The Magic Formula

Use each group of pictures to find a rule for the perimeter of that kind of shape and then write a formula. Remember to include definitions of the variables as well as the equation for the rule.

1.





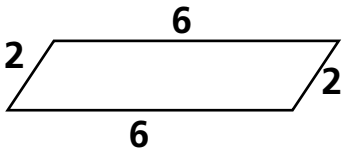


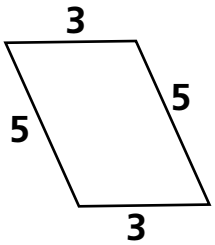
Rule: _____

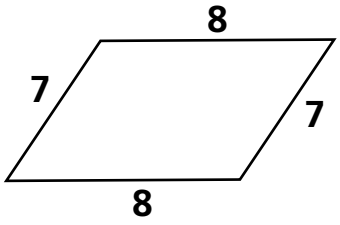
Formula: _____

_____

2.





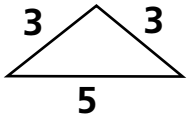


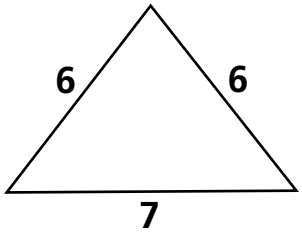
Rule: _____

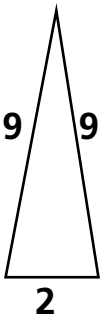
Formula: _____

_____

3.







Rule: _____

Formula: _____

_____

The Magic Formula

Teacher Directions

Have students use each group of pictures to find a rule for the perimeter of that kind of shape. Have them write a formula for the perimeter.

Remind students to include definitions of the variables as well as the equation for the rule.

Answer Key

Note that students may give other, equivalent answers.

1. Rule: 4 times the side length
   Formula: let P be the perimeter, let l be the side length, $P = 4 \times l$ or $P = 4l$

2. Rule: twice one of the side lengths add twice the different side length
   Formula: let P be the perimeter, let a be the horizontal side length, let b be the other side length, $P = 2 \times a + 2 \times b$ or $P = 2a + 2b$

3. Rule: base length add twice the other side length
   Formula: let P be the perimeter, let b be the base length, let l be the other side length, $P = b + 2 \times l$ or $P = b + 2l$