GRADES: 8–9
(students in Pre-Algebra or Algebra 1)

Algebra...Your Second Language

OVERVIEWS:

This lesson incorporates animation sequences, video presentation, and activities to engage students in developing the skills needed to translate from words into algebraic expressions; it offers a series of problem-solving strategies for use with algebra problems; and it provides students with opportunities to use these skills and strategies.

ITV SERIES:

The Power of Algebra: Program #10: Words Into Symbols

LEARNING OBJECTIVES:

In this lesson, students will:

- ❖ translate some words/phrases directly into operation symbols
- ❖ use algebraic expressions/sentences with 1 or 2 variables to model English expressions/ sentences
- ❖ evaluate algebraic expressions using given replacement sets
- ❖ use linear equations to solve word problems involving number relations
- ❖ ist several problem-solving strategies
- ❖ use varied problem-solving strategies appropriately
- ❖ translate real-world situations into algebraic expressions

MATERIALS

Student Materials:

- 1 scientific calculator for each group of 2-4
- 1 set of 2-color algebra tiles for each group of 2-4 (optional)
- pencil
- activity sheets for each student

Teacher Materials:

- set of 2-color algebra tiles for the overhead projector (optional)
- overhead marking pens
- transparencies of activity sheets
- a few blank transparencies

VOCABULARY:

sum	difference
product	quotient
perimeter	area

PRE-VIEWING ACTIVITIES:

Tell students that people have been interested in applying mathematics to situations described in words since the beginning of written history. If possible, show them examples of such problems found in ancient sources like papyrus or translations of such problems.

Many words or phrases may be directly translated into algebraic symbols. Form students into groups of 2-4. For Activity 1, ask the class to "brainstorm" a list of words or phrases that translate into the "+" symbol. (Be sure they include "sum" in their lists.) Then, ask the groups to make lists for the other symbols and phrases

on the chart. (Before they start, have them correctly place the next three words from the vocabulary list.) After groups have shared their lists with each other and done any needed editing, tell them they will be using this chart in this lesson and will be adding to their lists.

Review the formulas for the perimeter (P=2L + 2W) and area (A= L W) of rectangles. Then ask the groups to complete the chart for Activity 2. Again, results should be shared and discussed with the entire class. Students should be told that this activity helps prepare them for viewing one of the video segments. (This gives students practice in a concrete problem situation; also, they realize that a variable can represent numbers chosen from a given set and that variables are useful to describe generalizations.)

FOCUS FOR VIEWING:

Give the students a specific responsibility for their viewing by telling them that they will see Holmes and Watson faced with the problem of solving a riddle to save their lives. They are to listen carefully to the riddle, and to the following segment, to identify any expressions that are listed (or could be added to) the Activity 1 chart. They will also be asked to state the riddle.

VIEWING ACTIVITIES:

Start the video after the title, with Holmes and Watson walking towards the pyramid. Stop after Holmes says, "I've already solved it." Ask what expressions they noticed related to Activity 1 and make needed additions to that chart. What does the riddle say? (It should be written in their notes. (You may want to rewind the tape to where Watson begins to read the riddle to make sure they've written it correctly.) How could they solve the riddle?

Fast forward to the male narrator saying, "In this program we're going to look at ... "Play until he says "Formulas are another good example of how good algebra is at simplifying things." Pause to discuss any additions to be made to the Activity 1 chart based on this segment.

Tell the students that the next viewing segment will focus on four questions that can help them solve word problems. They will be asked to list these questions. Continue the tape until the narrator has explained the questions. Pause at "Let's start with a simple problem and have the students list the questions." (Or pause after each question for students to list and discuss them one at a time.)

The next viewing segment will apply the problem-solving questions to a specific word problem; tell the students that they should refer to Activity 2 in conjunction with this viewing. Play to "That was an easy problem" and stop. Discuss the problem's solution: Were the questions helpful in solving the problem? Had they used any of the questions in their work on Activity 2? Ask what algebra properties were used to solve the equation. (distributive; subtraction and division properties of equality.)

In this final segment, focus on using skills to solve the beginning riddle. Fast forward to "What has algebra got to do with solving riddles."

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Play until the written riddle appears, after "What are the unknown variables." Pause while the students answer that question. Resume playing the tape and pause after "... our second question, What do we already know?" while the students answer that question, resume, and pause after "Our word problem is already in the form of an equation." Ask the students to solve the equation and answer the riddle. Resume playing until the end of the "Sphinx" sequence; verify that the groups have correctly solved the riddle and examine any errors.

POST-VIEWING ACTIVITIES:

Using their textbooks as a resource, groups should find more expressions for algebra symbols to be added to Activity 1.

Groups should complete Activity 3 and analyze any errors they make. (This activity is designed to help students avoid translation difficulties.)

The teacher plays "Pick a Number." (see directions) The class discusses what happened and determines the "trick" by using translation skills to develop the algebra of the game.

Pick a Number

Directions	Algebra
1. Choose any number	n
2. Multiply it by 5	5n
3. Add the number of wheels on a car.	5n+4
4. Double the result	10n+8
5. Add the number of eggs in a dozen	10n+20
6. Add 110	10n+130
7. Divide by 10	n+13
8. "Tell me you final result, and I'll tell you the original number you picked."	(Subtract 13 from the result.)

Complete the Student Worksheet problems.

Using their own ages and the age(s) of some family member(s), students should create a word problem which requires solving for these ages and write it on a 4 x 6 index card; on one side will be the problem, and on the other side they'll write the solution and the answer. Students will trade cards, solve the problems, and check their solutions.

Students will select a "number trick" problem from a cited source or write an original one. They will write the problem, following the directions using a sample number, and write the algebra analysis for how the "trick" works. These may be presented to the entire class by each student.

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The 2-color chips or algebra tiles may be used to concretely model the number relations in word problems or algebraic expressions in activities 2 and 3, or in the viewing and post-viewing activities. The appropriateness of this activity would depend on individual learning styles and levels of understanding.

ACTION PLAN:

Have a guest speaker who uses these translation skills in his/her occupation speak to the class on this topic; for example, a pharmacist must create medicinal solutions and determine the proper IV-line size to yield a desired drip-rate.

Have each student (or pair of students) interview a community member who uses these skills in his/her work, asking questions like what is their job title and description? What educational background and math courses are required? What are specific situations in their work which require these skills? A written report and oral presentation should be prepared.

EXTENSIONS:

FOREIGN LANGUAGE: Translation skills are inherent in the study of any language. Students could ask foreign language students or teachers for specific techniques for translating into their particular language. Also, they may present a word problem to the class in a foreign language and relate it to the Activity 1 Chart.

SOCIAL STUDIES: Textbooks and documents often include number relations (ex."four score and seven years ago," age requirements to run for office, salary levels). Students could make a report on several of these instances or could use them as the basis for writing original word problems.

ART: Students find a piece of art (watercolor, printing, sculpture, etc.) that they like or find interesting. Use it as the basis for a word problem which can be presented in math class while showing the artwork. Or relate the problem-solving techniques to the planning and execution of an art piece.

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ACTIVITY 1

Complete this chart by listing expressions in words that translate to be the equivalent algebra symbols given and by giving the symbols that are equivalent to the given phrases.

+	
-	
X	
÷	
=	
	Twice
	Half
	The Quantity

Derived from ***The Power of Algebra*** lesson guide

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ACTIVITY 2

For some rectangles, the length of the rectangle is one foot more than the width. Use this information and the formulas for the perimeter and area of a rectangle to complete this table.

Width	Length	Perimeter	Area
1	_____	_____	_____
5	_____	_____	_____
8.4	_____	_____	_____
_____	15	_____	_____
w	_____	_____	_____
_____	_____	14	_____

Work Space

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ACTIVITY 3

Directions: Translate these sentences into ML (mathematical language). Use letters as variables which are related to the words, and use a "let" statement to define your variables. (for example: let F= Fred's salary, or let h= number of hours.) For sentences involving 2 unknown values, use 2 different variables.

1. The combined salaries of James and Scott equals $970.

2. Lisa worked 25 hours at $4 an hour, plus 10 more hours at $4.50 an hour to earn a total of $145.

3. Larry is four times as old as his son Curly.

4. Ten pounds less than sixty-seven pounds is fifty-seven pounds.

5. Four more than five times a number equals one less than six times the same number.

6. A woman worked a certain number of hours at $3 an hour and the same number of hours plus twenty more hours at $4 an hour, earning $150 all together.

7. Calculate the number of feet in a measurement if you know the number of yards.

Modeled from *The Ideas of Algebra K-12,* "From Words to Algebra: Mending Misconceptions"

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Student Worksheet

Name: _____

I. Translate these phrases into their Algebraic equivalents:

A. a added to c

B. q less than 7

C. 7 divided by n

D. x less 2

E. twice b

F. 6 times the quantity c minus t

G. 6 more than half of w

H. twice the sum of 8 and y

I. the sum of m and n, divided by negative 3

J. the product of m and x, decreased by 7

II. Solve these:

A. Find a number such that twice the number increased by seven is the same as four times the number decreased by three.

B. Find three consecutive integers whose sum is 69.

C. The length of a rectangle is 6 less than three times the width. The perimeter of the rectangle is 52cm. Find its length and width.

D. The first side of a triangle is three times the second side. The third side is 5 inches longer than the first. The perimeter is 19 inches. Find the lengths of the sides.

Questions selected from *The Power of Algebra* lesson guide.