# Algebra Connections

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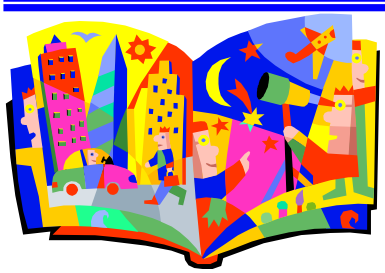

# Problem Solving With Story Problems!

George Polya was a Hungarian who immigrated to the United States in 1940. His major contribution is his work in problem solving. He was frustrated with the practice of having to memorize information.

He was a talented mathematician and an excellent problem solver. He created a 4-step problem-solving model that is used in a variety of academic and practical situations all over the world.

**Step 1: Understand the problem.**

Sometimes the problem lies in understanding the problem. If you are unclear as to what needs to be solved, then you are probably going to get the wrong results. In order to show an understanding of the problem, you, of course, need to read the problem carefully.

Sounds simple enough, but some people jump the gun and try to start solving the problem before they have read the whole problem. Once the problem is read, you need to list all the components and data that are involved. This is where you will be assigning your variable.

**Step 2: Devise a plan (translate).**

When you devise a plan (translate), you come up with a way to solve the problem. Setting up an equation, drawing a diagram, and making a chart are all ways that you can go about solving your problem.

**Step 3: Carry out the plan (solve).**

The next step, carry out the plan (solve), is big. This is where you solve the equation you came up with in your 'devise a plan' step. The following two properties of real numbers are important tools that help simplify and solve equations and inequalities.

- **Addition Property of Equality.** If a = b, then a + c = b + c
- **Multiplication Property of Equality.** If a = b, then a(c) = b(c)

**Step 4: Look back (check and interpret).**

You may be familiar with the expression 'don't look back'. In problem solving it is good to look back (check and interpret). Basically, check to see if you used all your information and that the answer makes sense.

Always ask yourself, "Did I actually answer the question?" If your answer does check out, make sure that you write your final answer with the correct labeling or units.

**Source:** www.wtamu.edu

## Strategies for Solving Linear Equations

You may ask, "Why are we back to solving linear equations?" The answer is because that is what this unit on problem solving is really all about! Think of story problems as equations (mathematical statements that algebraic expressions are equal) or inequalities (mathematical statements that algebraic expressions are **NOT** equal).

Our challenge is to translate the "story" from a word problem into a mathematical statement. Then we can apply algebraic procedures to determine a solution. In class we presented a 6-step process to solve linear equations. Here, it is presented as a 4-step process. Notice how Step 1, simplify each side, is actually steps 1-3 as presented in class. Some people may find a 4-step procedure more useful, others, a 6-step process.

**Step 1:** Simplify each side, if needed.

- Remove fractions (multiply **BOTH SIDES** by the lowest common denominator).
- Remove parenthesis or groupings (apply the distributive property).
- Combine like terms.

**Step 2:** Get all terms with variables (variable terms) to one side of the equation (addition property -- add the opposite to **BOTH SIDES**). Move all numbers on the other side (addition properties -- add the opposite to **BOTH SIDES**).

**Step 3:** Remove any values (coefficients) that are in front of the variable (multiplication property – multiply BOTH SIDES by the reciprocal of the coefficient(s).

**Step 4:** Check your answer by substituting the "proposed" solution back into the original problem. **THIS IS AN IMPORTANT STEP**, especially in a "Beginning Algebra" class. Please take advantage of the opportunity to review algebraic procedures, practice math skills, and verify that the solution is correct. If you think about it, doesn't it just make sense? Please maximize your practice and learn these procedures and skills by performing **ALL CHECKS!**

# Translating Word Expression into Algebraic Expressions

- "What is the sum of 8 and y?" ( 8 + y)
- "4 less than y" (y – 4)
- "y multiplied by 13" (13y)
- "The quotient of y and 3" (y / 3)
- "The difference of 5 and y" (5 – y)
- "The ratio of 9 more than y to y" [(y + 9) / y]
- "Nine less than the total of a number (y) and two" [(y + 2) – 9] or (y – 7)
- "The length of a football field is 30 yards more than its width. Express the length of the field in terms of its width" (y * y + 30) or ($y^2$+30)
- "Twenty gallons of crude oil were poured into two containers of different size. Express the amount of crude oil poured into the smaller container in terms of the amount y poured into the larger container." The expression they're looking for is found by this reasoning: There are twenty gallons total, and we've already poured y gallons of it. That means that there are X gallons left." (20 – y)
- "Twice as much as the unknown" (2 * x)
- "Two less than the unknown" (2 – x)
- "Five more than the unknown" (5 + x)
- "Three more than twice the unknown" (3 + 2x) or (2x+3)
- "A number decreased by 7" (x – 7)
- "Ten decreased by the unknown" (10 – x)
- "Sum of a number and 20" (x + 20)
- "Product of a number and 3" (x * 3)
- "Quotient of a number and 8" (x / 8)
- "Four times as much" (4 * x)
- "Three is four more than a number" (3 = 4 + x)
- "Sheri's age (x) 4 years from now" (x + 4)
- "Dan's age (x) 10 years ago" (x – 10)
- "Number of cents in x quarters" [x (.25)]
- "Number of cents in 2x dimes" [2x(.10)]
- "Number of cents in x+5 nickels" [(x + 5)(.05)]
- "Separate 17 into two parts" (x and 17 – x)
- "$20,000 separated into two investments" (x and 20,000 – x)
- "Distance traveled in x hours at 50 mph" (x * 0)
- "Distance traveled in 3 hours at x mph" (3 * x)
- "Distance traveled in 40 minutes at x mph" (2x / 3) Note: (40 Minutes = 2/3 hours)
- "Interest on x dollars for 1 year at 5%" (0.05x)
- "Two consecutive integers" (x and x + 1)
- "Two consecutive even integers" (x and x + 2)
- "Two consecutive odd integers" (x and x + 2)

**NOTE**: No unit labels such as feet, degrees, and dollars are used in equations. In this book we have left these labels off the answers as well. Just refer to the "Let x =" statement to find the unit label for the answer.

## Addition

- increased by
- more than
- combined together
- total of
- sum
- added to

## Subtraction

- decreased by
- minus, less
- difference between/of
- less than, fewer than72
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## Multiplication

- of
- times, multiplied by
- product of
- increased/decreased by a factor of (this one is both addition or subtraction AND multiplication)

## Division

- per, a
- out of
- ratio of, quotient of
- percent (divide by 100)

## Equals

- is, are, was, were, will be
- gives, yields
- sold for

## Vocabulary

**"Per" Means "Divided By" as** "I drove 90 miles on three gallons of gas, so I got 30 miles per gallon" Also 30 miles/gallon

**"A" Sometimes Means "Divided By" as** in "When I tanked up, I paid $3.90 for three gallons, so the gas was 1.30 a gallon, or $1.30/gallon

**"Less Than" If** you need to translate "1.5 less than x", the temptation is to write "1.5 - x". DON'T! Put a "real world" situation in, and you'll see how this is wrong: "He makes $1.50 an hour less than me." You do NOT figure his wage by subtracting your wage from $1.50. Instead, you subtract $1.50 from your wage

**"Quotient/Ratio Of" Constructions** If a problems says "the ratio of x and y", it means "x divided by y" or x/y or x÷y

**"Difference Between/Of" Constructions** If the problem says "the difference of x and y", it means "x - y"

**Want to see more?** Check out **purplemath's** *Translating Word Problems* at this URL: http://www.purplemath.com/modules/translat.htm