Word Problem Types

Students often complain that word problems are the most difficult part of algebra. But there are ways to make them easier to figure out. I see them as four main groups with some overlap: Translations, Structures, Assumed Knowledge, and Formulas. Within each are several types. One way of making word problems much easier is to identify which type they are. Then you can have an idea of where you are headed as you develop the right equation.

- **Literal Translation / Math Language / Numbers** – These problems use math language to indicate what is going to happen with numbers. In short forms, they are like translating a foreign language. In the longer forms, situations will involve numbers of things (years, sales, people) that will usually form a sum (total), but may form a difference, product or quotient.
  - ✓ *Comparisons* - In many word problems, there are one or more "comparison phrases" that involve literal translations. These can seem to be about a variety of daily things: number of Democrats and Republicans, lengths of pieces of wood, number of viewers of a television show. *If you're not sure of the type of problem, start by looking for a comparison sentence.*

- **Structure – Chart/Drawing/Formulas** – Although these problems use formulas, these formulas are often used twice or with two things. Because of that, these problems are often structured by putting the information into charts or drawings.
  - ✓ *Distance Rate Time(DRT)* – Traveling is usually going on in these problems, with phrases involving distance, time, and rate/speed/mph. There are 4 main types:
    - Two vehicles going opposite directions (usually added)
    - Two vehicles going the same direction at different speeds (usually subtracted)
    - Two vehicles going at right angles (e.g. north and east), which form a right triangle. The Pythagorean formula is involved.
    - Two trips involving the same vehicle with different rates affected by the environment (e.g. with/against the wind, up/down stream, with/against the current). These have two rates: the vehicle's, which is increased or decreased by the environment. There is usually a same distance or same time to establish how the equation is set up.

  - ✓ *Mixture* – Mixing liquids (% solutions) to a goal middle rate is most common, but these problems can also involve mixing things that have different prices (nuts, candy, flowers, etc) to a goal middle price (rate).
  - ✓ *Financial mixtures* – Similar to the above; however, these interest rates or forms of money have a final value rather than a middle rate.
  - ✓ *Work* – Work problems always have two people/things that can do a task together or separately (pipes filling a pool, photocopiers, painting, mowing, etc). Take each one's time divided by rate and add them together to get 1.
  - ✓ *Proportions* - These may be the most difficult to recognize. The words "per" or "for each" may be present to suggest ratios, but otherwise you need to recognize that two equal ratios are being set up. The proportion set up is used for these rather than a chart.

- **Assumed Knowledge** – Key to solving these problems is a number, structure, or concept (vocabulary) that you are expected to already know. Make sure you memorize them!

  ✓ _Consecutives_ – consecutive integers are x, $x + 1$, $x + 2$, … Consecutive odd or even integers are x, $x + 2$, $x + 4$, …

  ✓ _Angles_ – Complementary angles add up to 90 degrees, supplementary angles add up to 180 degrees, and opposite or vertical angles are equal to each other. In addition, the three angles of a triangle add up to 180 degrees, a circle is 360 degrees, and the angles of a parallelogram add up to 360 degrees.

  ✓ _Outside Frames_ – These problems include actual picture frames, borders or paths around yards/gardens/pools, or even the outer border of a computer screen. Be sure to consider the border on each side (i.e. twice) for the length and width of the outer as well as inner regions.

  ✓ _Pythagorean_ – Watch for a situation that sets up a right triangle: trees with shadows, ladders against walls, poles with strings. Then shift the information into the Pythagorean formula

  ✓ _Average_ – The word "average" will show up in the question for these problems, and means to add up the items related to the average in question, and divide by the number of them.

- **Formula** – There are two kinds of formula problems: those with formulas you are expected to know – like the assumed knowledge type – but may be given, and those where an unfamiliar formula is presented for you to work with.

  ✓ _Known (Memorized)_ – These word problems make use of a formula that you should know, but it may be given.
    - Geometry: perimeter, area of: parallelogram, triangle, trapezoid, circle; circumference, volume of a cube
    - DRT of single vehicles
    - Profit/Loss/Net
    - Percents, which may include increases/decreases in the cost of something

  ✓ _Given_ – These word problems may seem daunting, but are actually some of the easiest. A formula is given. Simply read the word problem for what each variable stands for and which ones are given. Plug them into the formula and solve for the remaining unknown variable.
    - Simple/Compound interest (sometimes expected to be memorized)
    - Quadratic equations
    - Exponential equations

Once you have determined what _type_ of word problem you have, then you can begin to think about how to set it up in terms of translating, developing a chart or drawing, or remembering a formula. These set ups can guide you to what information or numbers to look for in the word problem, and where to place them to build your equation.

For many of you, once you have the equation, the rest is easy!