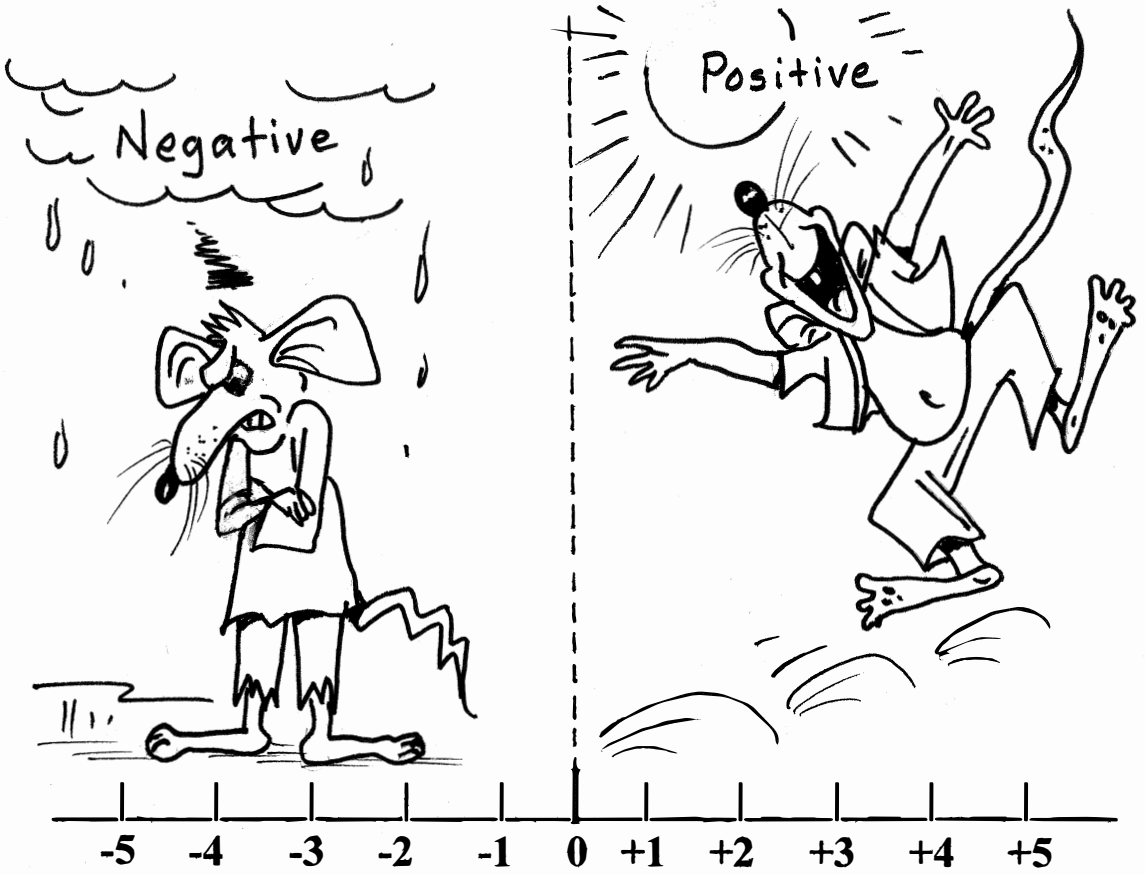
SECTION 10



ALGEBRA

INTRODUCTION TO ALGEBRA

You may recall that the word "arithmetic" means "the art of counting." The word "**algebra**" comes from an Arabic word, *al-jabr*, meaning "the reduction." Webster's dictionary defines algebra as "arithmetic in which letters representing numbers are combined according to the rules of arithmetic."

In arithmetic, all the facts necessary to solve a problem are given, like this:

3 + 3 = (of course, the answer is 6)

In algebra, you work with unknown facts. As stated in the definition, these unknown facts are represented by **letters of the alphabet** instead of **numbers**, like this:

3 + n = 6 (you can see that "n" represents 3)

You may be surprised to realize that you have already been using formulas of algebra in your head, if you've been working with the 13 to 19 times tables. You are simply applying algebraic formulas to missing numbers, and then reducing equations to get your answer!

Some students ask--WHY do I need to know algebra? How does it apply to my life? Algebra is used by scientists, engineers, physicists, chemists, businessmen, computer experts, and nearly every other form of industry. It even involves homemaking! (See if you can figure out how to prepare a full meal for eight people with half a pound of hamburger!) You can apply algebra to your bank account, or in figuring the costs of things you buy. Everyone uses algebra at one time or another, sometimes without even realizing it.

Algebra can be useful in your schooling as well. In your science curriculum you have learned that certain chemistry formulas work together to create various minerals, solutions and gases. These formations of matter combined with the principles of algebra can help us understand how God created the universe and everything in it.

So in a way, understanding algebra helps us understand to a greater depth the Creator and His patterns of organizing, disorganizing and re-organizing all things.

In this section, we will learn the principles of algebra one step at a time, explaining the necessary information as we progress. Once you understand the basics, doing arithmetic with *equations, formulas* and *unknown factors* will be a positive, stimulating exercise for you!

Now, let's get started!

Algebra Vocabulary Words You Need to Know

Absolute Value--is the value of a number which has no sign attached to it, shown like this: | 5 |

Aggregation Signs--Three aggregation signs are used to *enclose expressions*. They are:

(1) Parentheses ( )
(2) Braces { }
(3) Brackets [ ]

Binomial-- In algebra, this expression means that two terms have been connected by the symbols + or – like this: 5 + 9 or 25 – x. (Remember that "bi" means two, as in bi-cycle. Also, "nom" is French for "name.")

Coefficient--When a variable or a number is written, the coefficient usually appears next to the variable and becomes its multiplier, like this: 4n (Isn't that an "efficient" way to "co-operate"?)

Constant--is a number which always has the same value. Variables which are used in a given formula are also called constants, because the variables must always have the same value. An example of a "constant variable" is: 5 x 4 = 2 x 10

Equation--This word is used in algebra to show two expressions which are equal.

Exponent--This is a small number placed at the upper right of a number or variable to show how many times it is to be used as a factor. For example, 5^2 is the same as 5 x 5 .

Expression--This is a written number or variable (or numbers and variables) which combine with addition, subtraction, multiplication, or division. For example, 2 x + 97 ÷ y =

Factors--are two or more expressions whose product is given. Example: 7 x 7 (factors) = 49

Monomial--a product of numbers and variables. (mono means "one") Example: 6n x 4 x u = monomial

Negative Numbers--Numbers less than zero. Example: – 3

Polynomial--an expression of two or more terms (poly means "many") Example: 5 – 2 + 9

Positive Numbers--Numbers greater than zero. Example: +9 or 9

Quadratic--refers to a variable that has been squared. (quad means "four") Example: n^2

Signed Numbers--The positive and negative numbers together. Example: 21 – (–10) + 45

Solution--The answer to a given equation. Example 21 x 4 + 9 - 5 = solution (88)

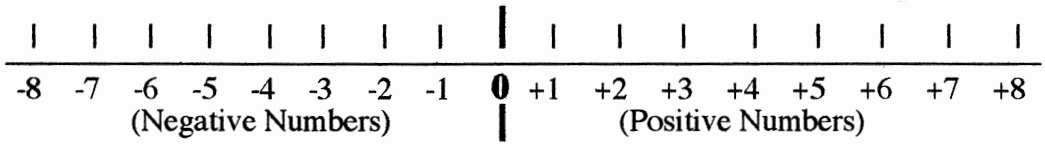
Term--is part of an expression connected to other terms by + or – [Example: 59 (term)+ 1 (term) – 6 (term)]

Variable--a letter of the alphabet which takes the place of an unknown number. Example: 5n= 10 is the same as 5 x 2 = 10.

Variable Expression--This is an expression which contains one or more variables. Example: a + x + 3 = 10.

Introduction to "Signed Numbers"

In algebra, numbers are given assignments. They can be assigned to be positive (+) or negative (–). Numbers with assignments are called "signed numbers." They can be illustrated on a NUMBER LINE, like this:



Notice on the number line that there are numbers LESS THAN zero. In the previous chapters of this math book, we have only dealt with numbers which have a greater value than zero. Now we will get acquainted with numbers which are less than zero.

Have you looked closely at a thermometer? Temperature marks are shown "below zero" as well as "above zero." During winter, a weatherman might show the temperature like this: -7° F. He would say the temperature is "seven degrees below zero, Fahrenheit." On a hot summer day, he might say it is 101° F, or one hundred one degrees above zero, Fahrenheit. The number 101 is positive (or 101 degrees above zero), and the number 7 is negative (7 degrees below zero).

Positive and Negative is also shown in a bank account. If you have money in your checking account, the bank says there is a "positive" balance. If you write too many checks, however, and do not deposit any money to cover them, the bank will show that there is a "negative" balance.

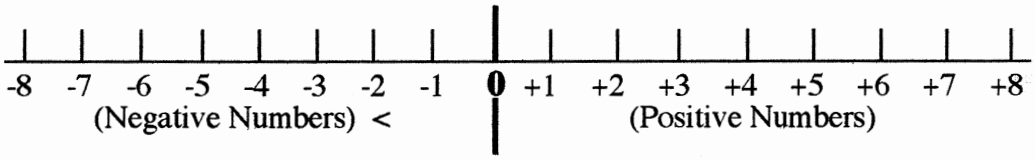
It seems there are positives and negatives in nearly everything! They are also in batteries, magnets, electricity, compasses, and even people's attitudes! Do you know someone who has a negative attitude? They are generally unhappy with the world and think that there is not much good to look forward to. They usually don't like themselves. But do you know people who have a positive attitude? They seem cheerful and have a good outlook on life. People are always attracted--like a magnet--to a "positive" person.

Now let's continue with algebra. We're POSITIVE you will understand it when you complete this section!

PRINCIPLE #1

A NUMBER THAT APPEARS TO THE LEFT OF A GIVEN NUMBER ON THE NUMBER LINE IS ALWAYS LESS THAN THE GIVEN NUMBER (<).

The Number Line



EXAMPLES OF "LESS THAN"

Example #1--With positive numbers: +4 is to the left of +8 on the number line, so that means +4 < +8

Example #2--With negative numbers: -5 is to the left of 0 on the number line, so that means -5 < 0

(Remember that the jaws of the "alligator" will always "eat" the larger number!)

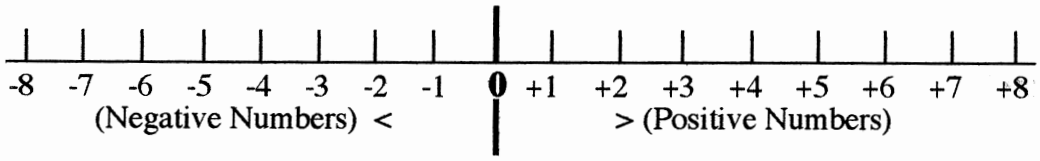
Learning Exercise

Create five comparisons of positive numbers showing "less than."
Create five comparisons of negative numbers showing "less than."

PRINCIPLE #2

A NUMBER THAT APPEARS TO THE RIGHT OF A GIVEN NUMBER ON THE NUMBER LINE IS ALWAYS MORE THAN THE GIVEN NUMBER (>).

The Number Line



EXAMPLES OF "MORE THAN"

Example #1--With positive numbers: +6 is to the right of +3 on the number line, so that means +6 > +3

Example #2--With negative numbers: –2 is to the right of -8 on the number line, so that means –2 > – 8

Learning Exercise

Create five comparisons of positive numbers showing "more than."
Create five comparisons of negative numbers showing "more than."

PRINCIPLE #3

A NUMBER WITHOUT ITS SIGN IS CALLED A NUMBER OF "ABSOLUTE VALUE." THIS IS THE SYMBOL FOR AN ABSOLUTE NUMBER: |3|

(TWO VERTICAL LINES ON EACH SIDE OF THE NUMBER)

EXAMPLES OF "ABSOLUTE VALUE" NUMBERS

The absolute value of +3 is three--or |3|
The absolute value of -3 is also three--or |3|

The + and - signs merely indicate which side of the zero the number appears on the number line. In this example, both threes are "three digit positions" away from zero.
Either way, this makes them both "absolutely" three!

Learning Exercise

Write 15 numbers with signs, and then show their absolute values.

PRINCIPLE #4

TO ADD SIGNED NUMBERS THAT HAVE THE *SAME SIGNS*, ADD THE ABSOLUTE VALUES, AND THEN ATTACH THAT SIGN TO THE ANSWER.

EXAMPLES OF ADDING SIGNED NUMBERS WHICH HAVE THE SAME SIGNS

Example #1--Add 7 and 8. (Since both signs are + the answer will be +15.)
$|7| + |8| = 15$

Example #2--Add -7 and -8. (Since both signs are - the answer will be -15.)

The absolute numbers are still $|7| + |8|$, even though they are negative. $-7 + (-8) = -15$

(Parentheses have been placed around the (-8) to eliminate confusion between the + and - signs.)

Learning Exercise

Create five problems, adding signed numbers which have the same signs.

PRINCIPLE #5

TO ADD SIGNED NUMBERS THAT HAVE *DIFFERENT SIGNS*, SUBTRACT THE ABSOLUTE VALUES, AND THEN ATTACH THE SIGN OF THE HIGHEST ABSOLUTE NUMBER TO THE ANSWER.

EXAMPLES OF ADDING SIGNED NUMBERS WHICH HAVE DIFFERENT SIGNS

Example #1--Add 3 and –4.
$|4| - |3| = -1$

Example #2--Add 10 and –7.
$|10| - |7| = 3$

(It will help you to try and visualize where each of these numbers appear on the number line.)

Learning Exercise

Create and solve ten addition problems with signed numbers which have different signs.

PRINCIPLE #6

TO ADD *MORE THAN TWO* SIGNED NUMBERS, START FROM THE LEFT AND ADD THE FIRST TWO NUMBERS. THEN ADD THE SUM TO THE 3rd NUMBER --CONTINUING UNTIL ALL NUMBERS HAVE BEEN ADDED.

EXAMPLES OF ADDING MORE THAN TWO SIGNED NUMBERS

Example #1--ADD: 8 + 2 + (-3)

Add the first two numbers: 8 + 2 = 10
Add the sum to the third number: 10 + (-3) = 7

ANSWER: 7

Example #2--ADD: -6 + 2 + (-9) + 3

Add the first two numbers: -6 + 2 = -4
Add the sum to the third number: -4 + (-9) = -13
Continue adding, left to right: -13 + 3 = -10

ANSWER: -10

Learning Exercise

Create and solve five problems adding more than two signed numbers which have the same signs.
Create and solve five problems adding more than two signed numbers which have different signs.