CHAPTER 4

Family Letter

Section A

What We Are Learning

Exponents

Vocabulary

These are the math words we are learning:

base a number that is used as a factor in a power

exponent a number that represents how many times the base will be used as a factor in a power

exponential form a number written as a base and an exponent

monomial a number or a product of numbers and variables with exponents that are whole numbers

power a number produced by raising a base to an exponent

scientific notation a shorthand way of writing very large or very small numbers using powers of 10

Dear Family,

The student will be learning about exponents and the properties associated with them. An **exponent** is a part of a **power.** The exponent is a number that represents how many times the **base** is to be multiplied by itself.

Using exponents will allow the student to write repeated multiplication in a more efficient way. This is how the student will write and evaluate exponents.

Write using exponents.

$2 \cdot 2 \cdot 2 \cdot 2$

$2 \cdot 2 \cdot 2 \cdot 2 = 2^4$ Identify how many times 2 is a factor.

Evaluate 4^3.

$4^3 = 4 \cdot 4 \cdot 4$ Find the product of three 4's.

$= 64$

When evaluating expressions with exponents, remind the student to follow the order of operations.

As the student becomes familiar with writing and expressing exponents, he or she will learn how to apply exponent properties. There are important relationships that exist between exponents and the operations of multiplication and division. The student will learn how to multiply and divide powers with the same base by using some of these basic properties of exponents.

Multiplying

When multiplying powers with the *same* base, keep the base constant and add the exponents.

Multiply. Write the product as one power.

$5^6 \cdot 5^2$

5^{6+2} Add the exponents.

5^8

Dividing

When dividing powers with the *same* base, keep the base constant and subtract the exponents.

Divide. Write the quotient as one power.

$$\frac{12^{14}}{12^9}$$

12^{14-9} Subtract the exponents.

12^5

When multiplying or dividing powers with the same base it is important to remember **not** to multiply or divide the bases. This property only applies when bases are the same. Powers with unlike bases cannot be combined using the two properties shown in the examples.

A special case occurs when the bases are the same and the difference in the exponents is zero. The zero power of any number, except zero, will always equal 1. For example, $5^0 = 1$.

Since it is possible to have a sum or difference that is a negative number, the student will learn how to evaluate expressions with negative exponents. A number raised to a negative exponent equals 1 divided by that number raised to the opposite of the exponent. This is how the student will learn to evaluate expressions with negative exponents.

The rules for multiplying and dividing powers can be extended to **monomials.** To multiply two monomials, multiply the coefficients and add the exponents that have the same base. To divide two monomials, divide the coefficients and subtract the exponents in the denominator from the exponents in the numerator that have the same base.

Evaluate.

$\frac{5^4}{5^6}$

5^{-2} The bases are the same so subtract the exponents.

$\frac{1}{5^2}$ Write the reciprocal and change the sign of the exponent.

$\frac{1}{25}$ Simplify.

Scientific notation is a shorthand way to write very small or very large numbers. Numbers in scientific notation are written as the product of a decimal and ten with an exponent. To change numbers from scientific notation to standard form, move the decimal point the number of places indicated by the exponent, to the right for a positive exponent and to the left for a negative exponent. Similarly, to convert numbers from standard form to scientific notation, move the decimal point and multiply by ten to the power of the number of places the decimal point moves. Multiplying and dividing numbers in scientific notation works the same way as multiplying and dividing numbers with other exponents.

Have the student explain the purpose of exponents and the many ways they are used in mathematics. Allowing the student to verbalize this information is a way to help the student understand this material.

Sincerely,

CHAPTER 4

Family Letter

Section B

What We Are Learning

Roots

Vocabulary

These are the math words we are learning:

density property a property that states that between any two real numbers there is another real number. This property is also true for rational numbers, but not for whole numbers and integers.

hypotenuse the side on a right triangle across from the right angle

irrational number number written as a decimal that is not terminating or repeating

leg one of the two sides that make up the right angle in a right triangle

perfect square a number that has integers as its square root

Pythagorean Theorem in any right triangle, the sum of the squares of the legs is equal to the square of the length of the hypotenuse

real numbers the set of numbers that consists of the set of rational numbers and the set of irrational numbers

square root one of the two equal factors of a number

Dear Family,

In this section the student will learn about squares and square roots. Although every positive number has two square roots, most of the time you only write the non-negative square root, better known as the principal square root.

The student will also learn to recognize a **perfect square** and use this knowledge to evaluate expressions and estimate the square roots of numbers that are not perfect squares.

Find the two square roots of 81.

$\sqrt{81} = 9$	9 is a solution, since $9 \cdot 9 = 81$.
$-\sqrt{81} = -9$	-9 is also a solution since $-9 \cdot -9 = 81$.

The student will need to remember to follow the order of operations when evaluating expressions with exponents.

Evaluate the expression, $4\sqrt{64} + 9$.

$4\sqrt{64} + 9$	
$4(8) + 9$	Evaluate the square root.
$32 + 9$	Multiply.
41	Add.

Square roots are also used with algbraic expressions. Since $\sqrt{\ }$ represents the nonnegative square root, use absolute value to express your answer. For example, $\sqrt{x^2} = |x|$, since x can be positive or negative.

The square root of 55 is between two integers. Name the integers.

$\sqrt{55}$	Think: What perfect squares are close to 55?
$7^2 = 49$	$49 < 55$
$8^2 = 64$	$64 > 55$
$7 < \sqrt{55} < 8$	

$\sqrt{55}$ is between 7 and 8.

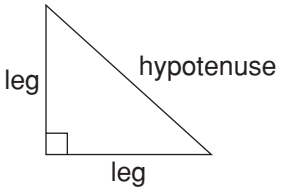
The study of square roots leads to the question of what to call the square roots of numbers that are not perfect squares. These numbers are called **irrational numbers** and are written as decimals that are non-repeating and non-terminating.

There is one last set of numbers that encompasses all the sets of numbers the student has studied. The set of **real numbers** includes the sets of whole numbers, integers, rational numbers, and irrational numbers. However, there are some numbers that are not real numbers.

The square root of a negative number or a number divided by zero is NOT considered to be a real number. The student will learn to identify the set or sets of numbers to which a given number belongs.

The student will also study a special kind of triangle called a **right triangle**. Right triangles have one right, or 90°, angle. The side opposite the right angle, called the **hypotenuse**, is the longest side. The shorter sides, that form the right angle, are called **legs**.

The student will learn an important formula called the Pythagorean Theorem. This theorem relates the length of the legs of a right triangle to the length of the hypotenuse.



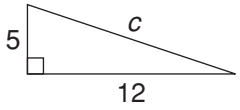
The **Pythagorean Theorem** states that the sum of the squares of the lengths of the two legs is equal to the square of the length of the hypotenuse. Sometimes, the formula is a little easier to understand.

$$a^2 + b^2 = c^2$$

legs legs hypotenuse

Find the length of the hypotenuse.

$a^2 + b^2 = c^2$ Pythagorean Theorem
$5^2 + 12^2 = c^2$ Substitute values.
$25 + 144 = c^2$ Simplify powers.
$169 = c^2$
$\sqrt{169} = \sqrt{c^2}$ Solve for c: $c = \sqrt{c^2}$
$13 = c$



Powers and roots, real numbers, and the Pythagorean Theorem are all ideas at the foundation of the student's math education. Understanding them is essential to his or her progress.

Sincerely,