Dear Family,

The next unit in your child's mathematics class this year is ***Growing, Growing, Growing: Exponential Relationships***. This unit focuses on exponential relationships, in which a quantity grows larger or smaller at an increasing rate rather than at a constant rate.

UNIT GOALS

Your child has previously studied linear growth, in which a fixed amount is repeatedly added to a beginning quantity to produce a sequence of values. Exponential growth involves patterns that are based on multiplication rather than addition. For example, in the sequence 3, 9, 27, 81, 243, ..., each term is 3 times the previous term.

The basic goal in *Growing, Growing, Growing* is for students to learn to recognize situations, data patterns, and graphs that are modeled by exponential expressions, and to use tables, graphs, and equations to answer questions about exponential patterns.

HELPING WITH HOMEWORK

You can help with your child's homework and encourage sound mathematical habits as your child studies this unit by asking questions such as:

- Is the relationship between variables an example of exponential growth or decay? Why?
- How can this relationship be detected in a table, graph, or equation? What is the growth factor?
- What table, graph, or equation would model the data or the pattern in a graph relating the variables?
- How could I answer questions about an exponential situation by studying a table, a graph, or an equation of the exponential relationship?
- How does this exponential relationship compare to other relationships between variables I have studied?

In your child's notebook, you can find worked-out examples from problems done in class, notes on the mathematics of the unit, and descriptions of the vocabulary words.

HAVING CONVERSATIONS ABOUT THE MATHEMATICS IN *GROWING, GROWING, GROWING*

You can help your child with his or her work for this unit in several ways:

- Talk with your child about the applications that are presented in the unit and similar applications that you encounter in your daily activities.
- Have your child pick a question that was interesting to him or her and explain it to you.
- Look over your child's homework and make sure that all questions are answered and that explanations are clear.

A few important mathematical ideas that your child will learn in *Growing, Growing, Growing* are given on the back. As always, if you have any questions or concerns about this unit or your child's progress in class, please feel free to call.

Sincerely,

Important Concepts

Exponential Growth

An exponential pattern of change involves patterns that are based on multiplication and can often be recognized in a verbal description of a situation or in the pattern of change in a table of (*x, y*) values.

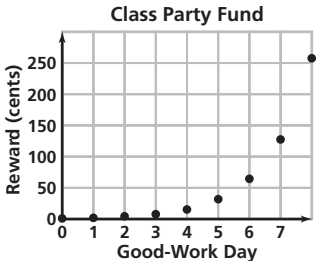
The increasing rate of growth is reflected in the upward curve of the plotted points.

Examples

Suppose a reward is offered. At the start, 1¢ is put in a fund. On the first day, 2¢ is added; on the second day, 4¢ is added; and on each succeeding day, the reward is doubled. How much money is added on the eighth day?

Class Party Fund

Good-Work Day	Reward (cents)
0 (start)	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	?



Growth Factor

A constant factor can be obtained by dividing each successive *y*-value by the previous *y*-value. This ratio is called the *growth factor* of the pattern.

In the example above, you multiply the previous award by 2 to get the new reward. This constant factor can also be obtained by dividing successive *y*-values: $\frac{2}{1} = 2$, $\frac{4}{2} = 2$, etc.

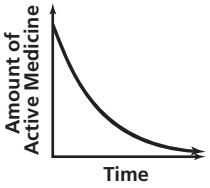
Exponential Equations

EXPONENTIAL GROWTH An exponential growth pattern, $y = a(b)^x$, increases slowly at first but grows at an increasing rate because its growth is multiplicative. The growth factor is *b*.

Day	Calculation	Reward (cents)
0	1	1
1	1×2, or 2^1	2
2	$1 \times 2 \times 2$, or 2^2	4
3	$1 \times 2 \times 2 \times 2$, or 2^3	8
⋮	⋮	⋮
6	$1 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$, or 2^6	256
⋮	⋮	⋮
n	$1 \times 2 \times 2 \times \cdots \times 2$, or 2^n	2^n

On the *n*th day, the reward, R, will be $R = 1 \times 2^n$. Because the independent variable in this pattern appears as an exponent, the growth pattern is called exponential. The growth factor is the *base*, 2. The *exponent*, *n*, tells the number of times the 2 is a factor.

EXPONENTIAL DECAY Exponential models describe patterns in which the value decreases. Decay factors result in decreasing relationships because they are less than 1.



$y = 50(\frac{1}{2})^n$

Rules of Exponents

The multiplicative structure of bases leads to:

$(b^m)^n = b^{mn}$ — $(2^3)^2 = (2 \times 2 \times 2)^2 = (2 \times 2 \times 2) \times (2 \times 2 \times 2) = 2^6$

$(b^m)(b^n) = b^{m+n}$ — $3^2 \times 3^3 = (3 \times 3) \times (3 \times 3 \times 3) = 3^5 = 243$

$(a^m b^m) = (ab)^m$ — $(2 \times 5)^2 = (2 \times 5) \times (2 \times 5) = (2 \times 2) \times (5 \times 5) = 2^2 \times 5^2$

$a^m/a^n = a^{m-n}$ — $5^3/5^2 = (5 \times 5 \times 5)/(5 \times 5) = 5^{3-2} = 5^1 = 5$

On the **CMP Parent Web Site,** you can learn more about the mathematical goals of each unit, see an illustrated vocabulary list, and examine solutions of selected ACE problems. **http://PHSchool.com/cmp2parents**