Dear 8X Math Families,

Last week, the students began a new unit of study entitled *Frogs, Fleas and Painted Cubes*. They have already explored a variety of relationships that can be represented with tables, graphs, and equations. This unit focuses on quadratic relationships.

Quadratic relationships are encountered in such fields as business, sports, engineering and economics. We are dealing with quadratic relationships, for example, when we study how the height of a ball – or a jumping flea – changes over time. A quadratic graph, called a parabola, is shaped like either a **U** or an **upside-down U**.

Students will learn to recognize quadratic patterns of change in tables and graphs, and they will learn to write equations to represent those patterns. They will compare and contrast quadratic patterns of change with those of linear and exponential patterns of change, which they have already studied in depth. Students will continue using graphing calculators (there is also a link on my blog for an online graphing calculator). Being able to quickly make a graph of a situation will help students to better understand many of the problems they will encounter.

Here are some strategies for helping your child during this unit:

- Talk with your child about the situations that are presented in the unit.
- Search with your child for other situations that might be modeled by a quadratic equation or graph.
- Review your child's notebook, and ask for explanations of the work.
- Encourage your child's best efforts in completing all homework assignments.

Also see the attached sheet that provides other details about the important concepts of the unit.

As always, if you have any questions or concerns about this unit or your child's progress in the class, please feel free to call me at (212) 477-5316 ext. 397, or email mboehm@lrei.org.

Best regards,
Michelle Boehm

Important Concepts	Examples

Representing Quadratic Patterns of Change With Tables

In linear relationships, the *first differences* of successive values are constant, indicating a constant rate of change. In quadratic relationships, first differences are not constant, but *second differences* are. The first difference is the rate at which y is changing with respect to x. The second difference indicates the rate at which *that rate* is changing. If the second differences are all the same, then the relationship is quadratic.

Example: $y = 6(x - 2)^2$

x	y
0	24
1	6
2	0
3	6
4	24
5	54

First Differences	Second Differences
$6 - 24 = {}^-18$	$^-6 - (^-18) = 12$
$0 - 6 = {}^-6$	$0 - (^-6) = 12$
$6 - 0 = 6$	$18 - 6 = 12$
$24 - 6 = 18$	$30 - 18 = 12$
$54 - 24 = 30$	

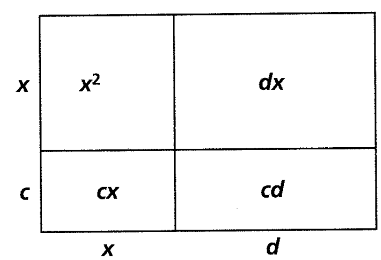
The second differences are all 12, which indicates that the table represents a quadratic relationship.

Representing Quadratic Functions With Equations

Traditionally, quadratic relationships are defined as relationships that have equations fitting the form $y = ax^2 + bx + c$, in which a, b, and c are constants, and $a \neq 0$. This form of the equation is called the *expanded form*. The emphasis is on observing that the equations contain an independent variable raised to the second power. It is also important to understand the *factored form* of such equations.

Many quadratic equations can also be defined as functions whose y-value is equal to the product of two linear factors—the form $y = (ax + c)(bx + d)$, where $a \neq 0$ and $b \neq 0$. The power of this form is that it relates quadratic polynomials as products of linear factors.

Example: The area of the rectangle below can be thought of as the product of two linear expressions, as the result of multiplying the width by the length, or as the sum of the area of the subparts of the rectangle.



$A = (x + c)(x + d)$ factored form

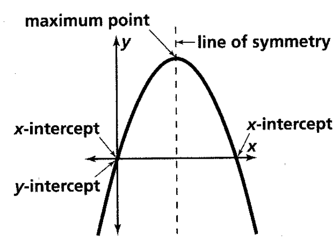
$A = x^2 + cx + dx + d$ expanded form

Representing Quadratic Patterns of Change With Graphs

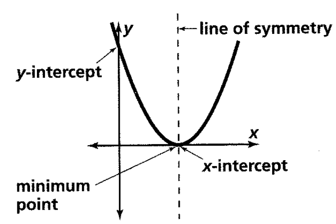
The values in the equation affect the shape, orientation, and location of the quadratic graph, a parabolic curve.

If the coefficient of the x^2 term is positive, the curve opens upward and has a minimum point. If negative, the curve opens downward and has a maximum point.

The maximum or minimum point of a quadratic graph **(parabola)** is called the **vertex**. The vertex lies on the vertical *line of symmetry* that separates the parabola into halves that are mirror images. The vertex is located halfway between the **x-intercepts**, if the x-intercepts exist. The x-intercepts are mirror images of each other. The **y-intercept** is where the parabola crosses the y-axis.



$y = -2x^2 + 8x$



$y = x^2 - 8x + 16$

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**