TITLE: Quadratic Equations and Parabolas

Lesson Plan

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Goal: To recognize the graph of a quadratic equation and to realize that you can find the equation of a parabola given three points lying on the curve.

Grade and Course: 9^{th} – 12^{th} grade algebra courses

KY Standards: MA-HS-3.3.1 (Coordinate Geometry)
MA-HS-4.1.3 (Data Representation)
MA-HS-4.2.3 (Characteristics of Data Sets)
MA-HS-5.2.1 (Variables, Expressions, and Operations)
MA-HS-5.2.2 (Variables, Expressions, and Operations)

Objectives: Complete the parabola construction as described in the worksheet, attach the graph paper to put the parabola on a coordinate plane, identify three points on the parabola, and then compute the equation of the quadratic equation that fits the parabola previously constructed.

Resources/materials needed: Wax paper, permanent markers, rulers, Popsicle sticks, and graph paper.

Description of Plan: Students will work in groups of 3. First they will each construct the parabola on the wax paper, and then they will work together to complete the rest of the worksheet.

Lesson Source: Adapted from a website that I can no longer find.

Instructional Mode: Guided group work.

Date Given: 3/1/07 **Estimated Time**: 50 minutes

Date Submitted to Algebra^3: 2/28/07

Form 8-18-06

Quadratic Equations and Parabolas

For this activity, you will need a piece of wax paper, a ruler, a piece of graph paper, a permanent marker, and a Popsicle stick.

Step #1: Draw a line segment across the wax paper that is 2 inches from the bottom of the paper. Then draw a dot in the center of the paper that is 2 inches above the line. When you are finished, your paper should look like

Step #2: Take the left side of the paper and fold it until the leftmost point of the segment is touching the dot. Crease this fold using the Popsicle stick being careful not to rip the wax paper.

Step #3: Now, slide the dot $\frac{1}{4}$ inch down the marker line. Crease the wax paper as before.

Step #4: Repeat Step 3 by sliding the dot another $\frac{1}{4}$ inch down the line segment and then creasing the wax paper. Continue this process. It will take a little while, but as you continue to slide the wax paper in $\frac{1}{4}$ inch increments, your wax paper will begin to "turn". You are finished when you reach the rightmost point of the line segment.


Step #5: Open up your wax paper. The curve you see is called a parabola. Each of the creases that you made are lines that touch the parabola at one point, these lines are called tangent lines to the parabola. We want to find an equation for this parabola. To do this, place the sheet of graph paper behind the wax paper (line up the line segment with a horizontal line on the graph paper). Staple them together. Draw a line segment on the wax paper that goes through the dot and is perpendicular to the line segment. The marker lines will serve as your coordinate axes.

Step #6: Write down the coordinates of 3 points that lie on the parabola (try to pick points that have nice coordinates, for example we would rather have a point like (3,4) than a point like (3.542, 4.6728)).

Point #1: _____ Point #2: _____ Point #3: _____

Step #7: Equations of parabolas look like $y = ax^2 + bx + c$. For each of your 3 points that you wrote down above, substitute the coordinates of each point for x and y in the equation $y = ax^2 + bx + c$. Write down the three equations you get.

Equation #1:

Equation #2:

Equation #3:

Step #8: Form a coordinate matrix (3x3 matrix), a variable matrix (3x1 matrix), and a constant matrix (3x1 matrix) using the equations you wrote above.

Step #9: Write down your matrix equation. Then solve this equation by finding the inverse of the coordinate matrix.

Step #10: Substitute the values of a , b , and c that you found above into the equation $y = ax^2 + bx + c$. This is the equation of your parabola. You can check it by graphing the equation you found in your graphing calculator.