Lesson Plan # 3

Name: Don R. Douglas  Date: April 8, 2003

Content Area: Algebra 1A  Unit Topic: Quadratic Expressions and Functions

Today’s Lesson: Graphing Quadratic Functions  Grade Levels: 9, 10, and 11
(seven of the twelve students in this class are students with IEP’s, some are repeaters).

NYS Mathematics, Science, and Technology Learning Standards Addressed

Standard 1: Students will use mathematics analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers and develop solutions.

Standard 3: Students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying mathematics in real-world settings, and by solving problems through integrated study of number systems, geometry, algebra, data analysis, probability and trigonometry.

Standard 6: Students will understand the relationship and common themes that connect mathematics, science, and technology and apply the theme to these and other areas of learning.

Standard 7: Students will apply the knowledge and thinking skills of mathematics, science, and technology to address real-life problems and make informed decisions.

Objectives: In this lesson the students will be able to (1) identify the vertex of a quadratic function (analysis), (2) complete the construction of the table of values – using x-values, on the task sheets that the teacher will give them (application), (3) sketch the graph of at least three quadratic functions, and (4) discover the relationship between the coefficient of the $x^2$ and the shape of the graph i.e. they will be able to compare the coefficients of different quadratic functions and conclude whether the graph opens up or opens down (evaluation).

Materials:

- Graphing calculators for students and one fitted with the overhead for the teacher, Texas Instrument 83 plus Graphing will be provided by the teacher for those who do not own one of their own.
- One package of task sheets. Included in this package will be: a) Three to be completed table of values, one for each for each graph, b) Three grids to sketch the graphs, c) One table in which the students will be required to summarize what they have learned in the lesson.
Anticipatory Set:

“Take a look at the following this function.”

a. \( y = x^2 - 2x + 1 \)

“Do you remember what they should look like?” [Wait for a few answers.] “In today’s class, we will be graphing functions like these and we will be learning some interesting things about them.”

Lesson Body:

With the class organized as a single large group, the teacher will say,

1. “Working in groups of two’s or individually by those who are acquainted with graphing, using this process on your calculators.”
2. “On your calculators, type the equation, ‘ \( y = x^2 - 2x + 1 \)’, in the [Y=] screen.”
3. “Press the second function key that is the key looking like this [2nd], then press the [GRAPH] key.”
4. “You should be seeing a table with ‘X’ and ‘Y_1’. On that table do you should notice that the values of ‘Y_1’ goes down and then up or up and then down.”
5. “What is the value of \( x \) at which the ordering of the numbers change?”
6. “Write that number in the space marked with ‘**’ on your task sheet in the first table.” “Write the next two smaller and the next two larger \( x \)-values in the space of the first column of the first table.”
7. “Substitute these values of \( x \) in the corresponding second column to find the corresponding \( y \)-values.” “Fill in the \( y \)-values in the third column.”
8. “Those of you that are having difficulties, follow me on the overhead.”
9. “Now that you have completed the table, press the [GRAPH] key.”
10. “You should be seeing the graph of the equation that you typed in your [Y=] window.”
11. “If you are not seeing you graph, you will need to go into your [WINDOW] screen and change the values you see there.”
12. “Press the [TRACE] key, you should see a flashing dot on your calculators. Use the ‘<’ or the ‘>’ keys to see where the ‘Y=’ values begin to change form going up to going down or from going down to going up.”
13. “Do you notice anything about this value and the value corresponding with of your \( x \)-coordinate that you already have written in the table?”
14. “Plot the points of the graph using the values of \( x \) and \( y \) then join the points.”
15. “Follow this example and complete the other two tables.”
16. “Make certain you complete the table at the back of your task sheet by filling in the appropriate answers.”
Closure
“You were able to identify the vertex of a quadratic function, complete the construction of the table of values – using $x$-values, sketch the graph of the other two quadratic functions.” “You were also able to see the relationship between the coefficient of the $x^2$ and the shape of the graph.” “You were able to compare the coefficients of different quadratic functions and conclude whether the graph opens up or opens down.” “This was a really great achievement by you.”

Homework/Assignment
“The homework sheet that you got from the aides must be completed tonight. There are only four problems each resembling those we have just done” “You may begin your homework, especially those of you without calculators of your own.”

Extensions
“Tomorrow, we will be revising the homework and what you have learned today. Remember to try and commit to memory the definitions in the Note box.”

“Have a good day and see you tomorrow”
Guided Discovery

Sketching quadratic functions

1. On your calculators, type \( x^2 - 2x + 1 \) in the \([Y=]\) window.
2. Use the \([2^{nd}]\) function key then the \([GRAPH]\) key. Find the \(x\)-coordinate when the values of \([Y_1]\) changes its direction from going down to going up or from going up to going down.
3. Complete the table of values below, using \(x\)-values smaller and larger than the \(x\)-coordinate at the turning. Write the value of \(x\) at the turning point in the place in the table with **.

<table>
<thead>
<tr>
<th>(x)</th>
<th>(x^2 - 2x + 1)</th>
<th>(y)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plot the points of the graph of the function on the grid below, using the \(x\) and \(y\) values from the table above. Then join the points.
Graph # 2

1. On your calculators, type the graph of $y = x^2 - 2x - 3$.
2. Use the [2nd] function key then the [GRAPH] key. Find the x-coordinate when the values of $[Y_1]$ changes its direction from going down to going up or from going up to going down.
3. Complete the table of values below, using x-values smaller and larger than the x-coordinate at the turning. Write the value of $x$ at the turning point in the place in the table with **.

<table>
<thead>
<tr>
<th>x</th>
<th>$x^2 - 2x - 3$</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plot the points of the graph of the function on the grid below, using the $x$ and $y$ values from the table above. Then join the points.
Graph # 3

4. On your calculators, type the graph of \( y = -x^2 + 2x - 3 \).

5. Use the [2nd] function key then the [GRAPH] key. Find the \( x \)-coordinate when the values of \([Y_1]\) changes its direction form going down to going up or from going up to going down.

6. Complete the table of values below, using \( x \)-values smaller and larger than the \( x \)-coordinate at the turning. Write the value of \( x \) at the turning point in the place in the table with **.

<table>
<thead>
<tr>
<th>( x )</th>
<th>(- x^2 + 2x - 3)</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>**</td>
<td>( )</td>
<td>( )</td>
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<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
</tbody>
</table>

Plot the points of the graph of the function on the grid below, using the \( x \) and \( y \) values from the table above. Then join the points.
Conclusions:

“What do you notice about each of the graph?”

<table>
<thead>
<tr>
<th></th>
<th>Graph # 1</th>
<th>Graph # 2</th>
<th>Graph # 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation of the line of symmetry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinates of the Vertex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation of the parabola</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graph opens upwards/downwards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( x = -\frac{b}{2a} )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOCABULARY

A quadratic function is a function that can be written in the standard form as: \( y = ax^2 + bx + c \), where \( a \), \( b \) and \( c \) are constants and \( a \neq 0 \).

Every quadratic function has a “kind of” U-shaped graph called a parabola.

The vertex of a parabola is the lowest point of that parabola if the graph opens upward and the highest point of that parabola if the graph opens downward.

The vertex of the graph has an \( x \)-coordinate of \( -\frac{b}{2a} \).

The axis of symmetry of a parabola is the vertical line passing through the vertex.

The axis of symmetry in the vertical line \( x = -\frac{b}{2a} \).