Lesson Title: Quadratic Functions in Vertex Form   Date:_____

Subject: Algebra I or Algebra II	**Topic:** Quadratic Functions in Vertex Form
Grade: 8, 9, or 10	**Designer:** Jessica Ulcickas

Stage 1 – Desired Results

Lesson Overview: This activity teaches students how to graph parabolas when the equation is given in vertex form. The activity is intended for Algebra I students who are learning to graph parabolas for the first time, or Algebra II students who are reviewing how to graph parabolas or who need extra help with the subject. After completing the activity, students will be able to graph a parabola using from an equation given in vertex form, identify the vertex of a parabola from a quadratic function given in vertex form, and to use a chart in order to help them graph a parabola.

Standards Addressed:

- CCSS.Math.Content.HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★

- CCSS.Math.Content.HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★

    o CCSS.Math.Content.HSF-IF.C.7a Graph linear and quadratic functions and show intercepts, maxima, and minima

- CCSS.Math.Content.HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

    o CCSS.Math.Content.HSF-IF.C.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

★ *Modeling is best interpreted not as a collection of isolated topics but in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol.*

Enduring Understanding:	**Essential Questions**:
Graphing a parabola can be done in many different ways. The most important point necessary to graph a parabola is the vertex, which will either be the maximum or the minimum of your parabola. The equation for a	How does the equation of a function affect its graphical representation? How can we translate a quadratic function into a parabolic graph?

parabola is called a quadratic equation. Every quadratic function when graphed will take on the shape of a parabola. In order to accurately graph a parabola, it is necessary to have at least 3 ordered pairs to help graph as a parabola takes on a u-shape.	
Students will need to know: Students will need to know what a vertex is. They will also have to have knowledge of graphing parabolas when the equation is given in standard form. Students will also have to have knowledge of how to graph ordered pairs on the x-y axes.	**Students will be able to**: • Graph a parabola given a quadratic function of the form $y = a(x - h)^2 + k$. • Identify the vertex of a quadratic function of the form $y = a(x - h)^2 + k$. • Use a chart in order to graph a quadratic function given in vertex form.

Stage 2 – Assessment Evidence

Performance Tasks:	Other Evidence:
Performance Tasks: In this activity: • Asking students to identify the x- and y-values of the vertex of a parabola. • Asking students to solve multiple ordered pairs on a given parabola. • Asking students to identify ordered pairs on the x-y axes. • Asking students to graph a parabola given the vertex and four other ordered pairs.	**Other Evidence**: • To be decided by the teacher.

Stage 3 – Learning Plan

Lesson Procedure:	Required Materials:
<u>Many Days Before</u>: Students will be introduced to the topic of quadratics. Up to this point students will have learned how to factor and solve quadratic equations as well as how to use the quadratic formula. It is also possible that students will have learned how to complete the square. <u>Day Of</u>: Students will go to the computer lab in order to complete this activity. For the duration of the activity, the teacher will monitor student progress to ensure that students complete the activity properly and do not simply click to complete. The activity will not take all class period, so the remainder of the class period will be at the discretion of the classroom teacher.	• Computers for each student.

Possible Discussion Questions for Students:	**Sample Answers to Discussion Questions**:
• How could we change a quadratic function from vertex form to standard form? How could we change a quadratic function standard form to vertex form?	• A quadratic function can be changed from vertex form to standard form by multiplying (using the FOIL method) and combining like terms. A quadratic function can be changed from standard form to vertex form by completing the square.
• What part of the equation of a parabola will dictate whether the parabola opens upwards or downwards?	• The coefficient a dictates whether or not the parabola opens upwards or downwards. If a is negative, the parabola opens down, while if a is positive, the parabola opens up.
• Do you notice any patterns created when you graph a parabola?	• The vertical distance from a point on the parabola to the vertex is ab^2 where a is the leading coefficient of the parabola and b is the horizontal distance from the vertex.