Using Quadratic Functions in Vertex Form to Describe Projectile Motion

1) Warm Up: Open the Phet Simulation Projectile Motion
Create several different launches. Use the crosshairs tool and move it around a projectile's path. What does the crosshair tool tell you about points on the graph?

Notice the vertex points. Discuss what the Vertex Form equations for these launches will look like. How might the "a" coefficient in each equation change depending on what the launch looks like?

2) Choose a set of initial conditions and perform a launch. Your launch does not need to hit the target. Record the following information. (Don't forget units!)

Initial Height		Initial Speed	
Launch Angle		Object	

Look at the path of your projectile. Your goal is to write a quadratic equation in Vertex Form that models the projectile's path. *Your equation will relate the object's horizontal distance (called the range) to its vertical height*.

3) Find the vertex point of the projectile:

Horizontal Distance	meters	Height	meters

Write your vertex as a coordinate (horizontal distance, height):   (,   )

4) Next record the total distance that your projectile traveled and its height at that distance:

Horizontal Distance	meters	Height	meters

Write this point as a coordinate (horizontal distance, height):   (,   )

5) From the sim, draw a sketch of the launch. Be sure to label your axes and any key points.

6) Recall the Vertex Form of a quadratic equation: $f(x) = a(x - h)^2 + k$
   Use words to describe what the following variables represent in this context:

x?		h?	
y?		k?	

7) Use the vertex and one other point to find the "a" coefficient for your equation. Round to the hundredths place, if needed.

$$f(x) = a(x - h)^2 + k$$

Now that you have an "a" coefficient, write the Vertex Form equation:

 = Stop and talk

8) What do you notice about the "a" coefficient in your equation? Does this "a" value make sense to you? Explain.

9) Change your Vertex Form equation into Standard Form: $f(x) = ax^2 + bx + c$

10) What are some things that the Standard Form equation tells you about the projectile launch? Explain any connections that you observe.

11) Decide on a way to confirm that your equation(either Vertex Form or Standard Form) correctly models the projectile's path. Then use your method to verify that the equation is accurate.