

Unit 5 Quadratic Functions and Modeling  
Quadratic Functions in Angry Birds  
**Project**

**Unit 5 Quadratic Functions and Modeling**

In preparation for work with quadratic relationships students explore distinctions between rational and irrational numbers. They consider quadratic function, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students learn that when quadratic equations do not have real solutions the number system must be extended so that a solution exists, analogous to the way in which extending the whole numbers to the negative numbers allows  $x+1=0$  to have a solution. Formal work with complex numbers comes in Algebra II. Students expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise defined. The eight lessons (5.1-5.8) provide the instruction and practice that supports the culminating activity in the final unit project. The lessons in this unit focus on working with quadratic relationships.

**Unit 5 Project: Quadratic Functions in Angry Birds**

In this project students will graph quadratic functions based on the popular game, Angry Birds, by using equations and a Web-based graphing tool. Students will work in groups to apply the same principles to create their own game that uses quadratic functions. Students will exchange games with other groups, play the game and assess that game using a set student rating scale.

**Common Core State Standards by Cluster**

Grade Level	Cluster	CCS Standard
9	Interpret functions that arise in applications in terms of a context	F.IF.4, F.1F.6
9	Analyze functions using different representations	F.IF.7a, F.IF.8a, F.IF.9

**Project Preparation Materials and Resources for Teachers:**

Geogebra (located at [www.geogebra.org/](http://www.geogebra.org/)) Load this application on classroom computers prior to activity.

TE\_Unit 5 Project Rubric

YouTube video that illustrates how the parabola factors into the Angry Bird game.

<http://www.YouTube.com/watch?v=bsYLPXI7VQ>

YouTube video that explains the Angry Birds problem

<http://www.YouTube.com/watch?v=FEhw1MgGOnU&feature=related>

Maximum and Minimum Values Graphing Calculator Activity

[http://www.curriki.org/xwiki/bin/view/Coll\\_hkeith/MaximumandMinimumValuesGraphingCalculatorActivity](http://www.curriki.org/xwiki/bin/view/Coll_hkeith/MaximumandMinimumValuesGraphingCalculatorActivity)

Graphing Quadratics Investigation

[http://www.curriki.org/xwiki/bin/view/Coll\\_IsaacNewton/GraphingQuadraticsInvestigation](http://www.curriki.org/xwiki/bin/view/Coll_IsaacNewton/GraphingQuadraticsInvestigation)

Investigating the Parabola in Vertex Form (Activity # 5)

[http://www.curriki.org/xwiki/bin/view/Coll\\_Group\\_GAMath/Activity5-InvestigatingtheParabolainVertexForm](http://www.curriki.org/xwiki/bin/view/Coll_Group_GAMath/Activity5-InvestigatingtheParabolainVertexForm)

### **Project Materials for Students:**

SE\_Project 5 Angry Birds Worksheet

SE\_Unit 5 Project Student Rating Chart

Geogebra (located at [www.geogebra.org/](http://www.geogebra.org/))

### **Project Objectives:**

Students will

- Graph quadratic functions using equations and graphing
- Create a game that uses a quadratic function
- Play and assess a game created by a classmate

**Time:** Two 50-minute sessions

### **DAY ONE**

#### **1. Warm up Activity:**

Show on the projector this YouTube video that illustrates how the parabola factors into the Angry Bird game.

<http://www.YouTube.com/watch?v=bsYLPiXI7VQ>

#### **2. Whole Group Activity:**

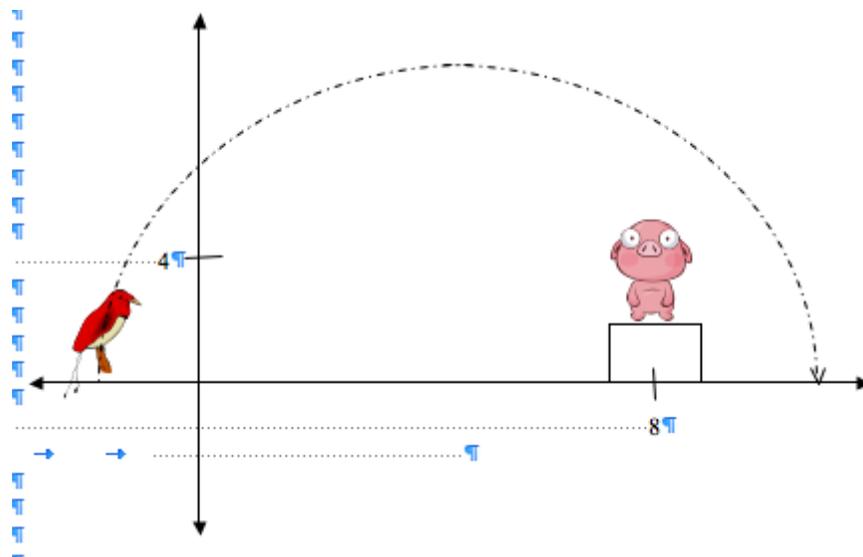
Show the YouTube film that explains the Angry Birds problem

<http://www.YouTube.com/watch?v=FEhw1MgGOnU&feature=related>

Give each student a copy of the SE\_Project 5 Angry Birds Worksheet.

Explain that they will use the worksheet to apply what they know about quadratic equations and graphing.

[This worksheet comes from the material developed by Kathy Belden at the San Diego Community Colleges Developmental Math Exchange in California, published on Curriki.](#)



The game Angry Birds requires that you shoot a bird from a slingshot in a parabolic curve and try to knock down a variety of objects.

Suppose you have a red bird (object) and you are trying to knock over a pig (target) standing on top of a platform.

The slingshot is attached to the y-axis and you pull the red bird in the negative direction to the x-axis and then let it go. The pig you are trying to hit is located at the point (8, 4). (See diagram)

### 3. Small Group Activity:

Provide each student with a copy of [the Angry Birds Quadratic Graphing Worksheet](#). In small groups of two or three, students will use the worksheet to graph the point (8, 4) and each of the functions to determine which if any will successfully knock the pig off the platform.

Once students have graphed the equations and determined which function passes through (8, 4) instruct students to check their work using [Geogebra](#). (Note: Prior to using the program, you should download it on the computers students will use. Simple directions are located on the site.) Students will enter each of the three equations in the “Input” box at the bottom of the page and then hit enter. (Note: superscripts cannot be entered in the Input, so  $-x^2$ , would be entered as  $-x^2$ ). This powerful tool creates a graph automatically for equations typed into the “input” box. When students hit enter, the graph of the parabola will appear and they can check their work.

## DAY TWO

### 4. Individual Activity: This activity is the basis for the assessment for this unit project.

Students use [Geogebra](#), graphing calculators, or other graphing program to create their own video game. Students may choose to create a basketball game, archery game, golf game, and pumpkin throwing contest, or other activity where an object will travel along a parabolic path. They should determine the creative characters and the setting for the game.

Students create a minimum of three screens showing the starting point of the object (i.e. the bird) and the target (i.e. the pig) as shown in the Angry Bird example. Students use their knowledge of the transformation of equations to change the position or distance of the target in each of the screens. Then, for each screen, students provide three possible equations for parabolas of which one will lead to the object hitting the target (meaning, the target is on a point that the parabola passes through). The screens and equations should be manually created using graph paper.

As a self assessment/quality control check, students enter their equations in Geogebra, a graphing calculator or other graphing program to verify their solutions. Students make any necessary adjustments to finalize their game before exchanging it with another group.

Next, students exchange games with another group. Each group then plays the game created by their exchange group. Group members play by selecting the correct equation from those given (similar to the Angry Birds activity done on day 1).

### 5. Assessment

(Both students and teacher participate in the assessment. )

Give each student a copy of the [Unit 5 Project Student Rating System sheet](#). After playing, students assess the game using the following rating system:

I could easily identify the moving object	1	2	3	4	5
I could easily identify the target	1	2	3	4	5
The parabolic equations given were believable	1	2	3	4	5
I could identify the correct answer	1	2	3	4	5
The game was fun to play	1	2	3	4	5

A rubric for assessment is provided. The teacher may use the [Unit 5 Project Rubric](#) to assess the project for the following elements:

- Game/screens created by each group
- Parabolic equations provided

- Accuracy of the solution

### Unit 5 Project Rubric

	4	3	2	1
Graphics Setting/Characters	Context/setting is clearly stated; object and target are shown.	Context/setting is given; object and target is given, but not related to context/setting.	Context/setting is unclear; object and target is shown.	No context/setting is given; object and target are unclear.
Parabolic Equations	3-4 parabolas are given; only 1 hits target; distracters are believable	3 parabolas are given; at least one hits the target; some distracters are believable	3 parabolas are given; more than 1 hits the target or no distracters are believable	less than 3 parabolas are given; none hit the target; no distracters are believable
Graphing	All parabolas are correctly plotted; graph is neat and clearly labeled	Most parabolas are correctly plotted; graphs are readable and labeled	Some parabolas are correctly plotted; graphs are readable	No parabolas are correctly plotted; graphs are illegible and unlabelled

### 6. Extension Activities

Maximum and Minimum Values Graphing Calculator Activity

[http://www.curriki.org/xwiki/bin/view/Coll\\_hkeith/MaximumandMinimumValuesGraphingCalculatorActivity](http://www.curriki.org/xwiki/bin/view/Coll_hkeith/MaximumandMinimumValuesGraphingCalculatorActivity)

This activity uses parabolas to calculate the height of a golf ball after it is hit.

Graphing Quadratics Investigation

[http://www.curriki.org/xwiki/bin/view/Coll\\_IsaacNewton/GraphingQuadraticsInvestigation](http://www.curriki.org/xwiki/bin/view/Coll_IsaacNewton/GraphingQuadraticsInvestigation)

This activity has students look at quadratic equations and creating new equations from existing ones. This may be assigned as an extension activity or as homework.

Investigating the Parabola in Vertex Form (Activity # 5)

[http://www.curriki.org/xwiki/bin/view/Coll\\_Group\\_GAMath/Activity5-InvestigatingtheParabolainVertexForm](http://www.curriki.org/xwiki/bin/view/Coll_Group_GAMath/Activity5-InvestigatingtheParabolainVertexForm)

This activity investigates the parabola in vertex form. This investigation involves activities that require a graphing calculator. The activities can be done in class or assigned as homework.