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Exploring Quadratic Functions through Angry Birds [8th grade]

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UNDERSTANDING BY DESIGN

Unit Cover Page

Unit Title: Exploring Parabolas and Quadratic Functions through Angry Birds

Grade Level: 8th Grade

Subject/Topic Area(s): Algebra 1/Quadratic Functions

Designed By: Amber Sanchez

Time Frame: 4 – 5 weeks

School District: KIPP San Antonio

School: KIPP Camino

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San Antonio, Texas 78207

Brief Summary of Unit (Including curricular context and unit goals):

This unit is designed to help students understand the role of parabolas in Algebra and the world around us. Students will be able to create quadratic functions, solve quadratic equations and change quadratic functions to be to go through certain coordinate points.

The performance assessment is designed so that students can demonstrate their understanding of quadratic functions. They will be able to use their understandings to create parabolas.

Prerequisite Skills – Solving linear equations and understanding how a linear function behave

UbD Template 2.0

Stage 1 – Desired Results

-TEKS

Readiness Standards

A.6(A) determine the domain and range of quadratic functions A.7(A) graph quadratic functions on the coordinate plane and identify key attributes, if possible, including *x*-intercept, y-intercept, zeros, maximum and minimum values, vertex, and axis of symmetry A.7(C) determine the effects on the graph of the parent function $f(x) = x^2$ when $f(x)$ is replaced by $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values o f a, b, c, and A.8(A) solve quadratic equations having real solutions by factoring, taking square roots, completing the square, and applying the quadratic formula

Supporting Standards

A.6(B) write equations of quadratic functions in vertex form ($f(x) = a(x - h)^2 + k$), and rewrite the equation from vertex form to standard form ($f(x) = ax^2 + bx + c$) A.7(B) describe the relationship between the linear factors of quadratic expressions and the zeros of their associated quadratic functions A.8(B) write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems

Transfer

Students will independently use their learning to…

Create different levels of the Angry Birds game using parabolas to hit specified targets.

*Project Inspired by Miss Rudolph's blog at http://secondarymissrudolph.blogspot.com/2013/06/angry-birds.html

Meaning

Understandings

Students will understand that…

- Algebra can be used to solve real world problems
- Quadratic functions and equations have real life meanings
- The key features of a quadratic function can be shown in a variety of ways and has significance to the context of the situation.

Essential Questions

- Where are quadratics seen in real life? How can they be used to solve problems?
- How can you make a function follow the path that you want it to follow?

Acquisition

Knowledge

Students will know…

- The key parts of a parabola
- Meaning of roots/zeros/solutions to a quadratic function
- The quadratic formula
- The effects of changing values in the quadratic function
- A quadratic function has a parabolic shape
- Quadratic equations can be solved in a variety of ways
- There are relationships between each of the features of a quadratic function including the zeros, y-intercepts, vertex and axis of symmetry

Skills

Students will be able to…

- Use a variety of methods to solve a problem
- Compare and contrast the effects of changing values in a quadratic function
- Transfer real world problems to a quadratic functions
- Determine the effects of changing parts of the parabola
- Create quadratic functions that meet certain criteria
- To solve quadratic functions using factoring, completing the square and the quadratic formula
- How to write quadratic functions in vertex form and standard form

<table>
<tr><th colspan="3">Stage 2 – Evidence</th></tr>
<tr><td>CODE
(M or T)</td><td>Evaluative Criteria
(for rubric)</td><td></td></tr>
<tr><td>T

M

T</td><td>Rubric attached with performance assessment</td><td>Performance Task(s)
Students will demonstrate meaning-making and transfer by…
Creating quadratic functions that meet criteria for specific x and y intercepts, zeros, and goes through specific (x, y) values, writing quadratic functions in vertex and standard form based on specific criteria about the quadratic, changing values of a quadratic function to create parabolas that hit different targets. This will be done by creating an Angry Birds diorama that demonstrates three parabolas that hit targets and meets specific criteria for three different levels. Performance task is attached.

Other Evidence (e.g., formative)
● Quizzes – Identifying parts of a parabola, solving quadratic functions using a variety of methods, writing quadratic functions in standard and vertex form
● Exit Tickets – Daily check ins to measure students' understandings/misconceptions
● Student self-assessment and reflection – self assess performance task, reflect on work through project
● Peer Reflection
● Quadratic Unit Exam</td></tr>
<tr><th colspan="3">Stage 3 – Learning Plan</th></tr>
<tr><td>CODE
(A, M, T)</td><td colspan="2">Pre-Assessment
How will you check students' prior knowledge, skill levels, and potential misconceptions?</td></tr>
<tr><td>M</td><td>Learning Activities
EQ: Where are quadratics seen in real life? How can their shapes be used to solve problems?
Day 1 – Fireworks Dilemma
Warm Up – Word problem match to certain graphs. Students read word problem about an object being shot into the air and falling. Match with graph they think matches situation.
Introduction – Read fireworks dilemma. Students highlight and pick out important parts of text.
Partner Work -Through partner work, students work through problem using a sketch, rewriting questions, problem solving through information provided. (Students should create a parabola to demonstrate firework's path). Provide chart paper for students to work on.
Independent Work/Exit Ticket – Reflection on Fireworks</td><td></td></tr>
</table>

M	problem (from IMP) **Day 2 –** Corral Variation/Rat Problem **Warm Up –** Display sketch/work of fireworks problem. Students respond to question: Does our work from yesterday create a linear relationship? Why or why not? How can you tell? **Introduction –** Students read through corral variation problem. **Partner Work –** With a partner, students problem solve through corral variation problem. Students explore how we can change the dimensions to get the same area. This allows students to begin to work with quadratic functions and see how they can change the values of x. **Independent Work –** Rat Problem. Students work through problem solving with the rat population dilemma. **Exit Ticket** – Reflection **Homework –** Complete Rat Population problem (from IMP)	
A M	**Day 3** – Introduction to a Parabola **Warm Up** – YouTube video showing various types of quadratics in real life. Students answer questions – What shape do you see? What are some characteristics of the shape? Are these linear relationships? **Introduction/Guided Notes –** Students put handouts in interactive notebook showing a parabola and its key features (vertex, x-intercepts/zeros/solutions, maximum/minimum, y-intercept, axis of symmetry) **Independent Work** – Complete quadratics in action. Students identify parts of a parabola in real life situations. Complete football or diving sketch with key parts labeled. **Exit Ticket –** Diving or football problem signed off by teacher/expert at end of class. **Homework –** A Closer Look – Quadratics in Action	
A M	**Day 4** - Domain and Range for Situations **Warm Up -** Review of parts of parabola, identifying domain and range of images **Introduction** - Students graph and label coordinate graph of parabola given data from a winning 3 pointer shot **Partner Work** - Students determine reasonable domains and ranges for real life problem - Think/Pair/Share **Independent Work**- Students complete Soccer Problem where they find domain and range of data and graph parabola. Students answer follow up questions about meaning of parts of parabola in problem. **Exit Ticket** - Signed off soccer problem	

	EQ: **How can you make a function follow the path that you want it to follow?**	
A	**Day 5 – 7** – Determine effects of changing a and c on y = ax^2 + c **Warm Up/Mini Quiz** – Label parts of a parabola. **Introduction –** Review of standard form of a quadratic function. **Partner Practice** – Students work through various activities exploring the effects of changing a and c on a quadratic function. Day 5 – Students attempt to change parabolas based on certain criteria by plugging in different equations into a graphing calculator and recording how it changed the shape. Day 6/7 – students work through determining effects of a and c. **Homework –** 3-2-1 Blastoff Problem. Students find reasonable domain and range for rocket problem. **Quiz -** Effects of changing parts of the parabola	
A	**Day 8** - Students determine solutions of quadratics given different information and graphing calculator **Introduction** - Students highlight key information and notes. Determine what each section is giving them and asking for. **Partner Practice -** Finding your roots Notes and Packet **Independent work/Exit Ticket** – What do I need to solve? 2 problems – Word problems and students determine what they are trying to find (ex: roots, vertex, etc.) **Homework** Complete What do I need to solve for?	
A	**Day 9 - 10** - Multiplying Polynomials Introduction and Practice **Warm Up** - Distribution Practice **Guided Notes** - Students are introduced to box method of multiplying polynomials and FOIL method. **Practice** - Activity 1: Students complete scavenger hunt around classroom practicing multiplying polynomials. Activity 2: Partner multiplying polynomials activity. Each student creates one binomial, finds partner and multiplies together to create new polynomial. **Exit Ticket** - Multiplying Polynomials practice - problems **Homework** - Multiplying Polynomials Practice (KUTA)	
A	**Day 11** - Standard and Vertex Forms of Quadratic Functions **Warm Up** - Multiply Polynomials **Introduction/Guided Practice** - Standard form vs. Vertex Form. Students write different types in notebook. Play short game to remember the different forms. Whiteboard game - starts with two teams, display function on board, eliminate players who are wrong, audience plays and records answers on separate sheet of paper. For standard form - students identify a, b and c . For vertex form - students determine h and k. **Independent Practice/Exit Ticket** - Students identify vertex given vertex form of equations.	

	Homework - Identify forms of quadratics and identify vertex from vertex form. **Day 12 - 13** Standard Form/Vertex Form	
A	**Warm Up** - Two problems standard form vs. vertex form. **Introduction** - With partner, answer: How can you tell the difference between standard form and vertex form. Why vertex form could be useful? **Guided Practice** - Notes on how to transform standard form to vertex form for notebook. **Partner Practice** - Practice transforming vertex form to standard form and identifying key features of parabola based on vertex form. **Independent Practice** - Mini Quiz Day 13: Transforming vertex form to standard form. **Homework** - Transforming vertex form to standard form and identifying vertex.	
A	**Day 14 - 16** Solving Quadratics using factoring and the quadratic formula. **Warm Up -** Write all the factors of 24 and 36 that you can come up with. **Introduction** - With partner, come up with a list of factors for -12 and - 6. Answer questions using partner talk protocol: What are some strategies you use to find factors of negative numbers? What do you have to consider when the numbers are not positive? **Guided Practice/Notes** - Introduction to cross products and factoring. Students take notes in notebook. Examples using cross products to solve. Day 15 - Introduction to quadratic formula and how to use it. **Partner Practice and Independent Practice** - Practice solving quadratics using various methods. Day 14 - Practice cards and cross product practice. Day 15 - quadratic formula practice. Day 16 - using both methods to solve quadratic formulas. **Homework** - KUTA Worksheets - solving quadratics using quadratic formula.	
M	**Day 17** - Review Day **Partner Practice** - X Game to review materials : Students are in groups of 3-4. Answer questions and erase teammates x's based on whether answer is correct or not. **EQ**: **How can you make a function follow the path that you want it to follow?**	
T & M	**Day 18 - 20** - Performance Assessment Intro and Work Time. Half class assessment over quadratic unit.	

Angry Birds Quadratics Assessment

You have been given the job of designing your own Angry Bird level. Your Angry Bird level will need to show the birds, pigs, and any obstacles that are in the path. The flight path of the birds should model a parabola. The equations for each flight path must be written in both **VERTEX** and **STANDARD** form. You will need to find a reasonable domain and range and be sure to label your x and y axis. You may work alone or in a group of 2 or 3. Follow the checklist below and the attached rubric to make sure your project meets the criteria.

Groups:

- 1 person – 2 flight paths
- 2 people – 3 flight paths
- 3 people – 2 dioramas, 3 flight paths each

Checklist (get signed off as completed):

_____ **Step 1**: Determine the three points that each bird/flight path will need to go through. You will be selecting coordinate points of the pigs to help you with this step. For each bird you will determine the following (completed on sheets attached):

- The maximum height
- The axis of symmetry
- Distance traveled
- Reasonable domain and range

_____ **Step 2**: Write equations for each bird/path that represents the parabola in both VERTEX and STANDARD form. All work must be done neatly and with steps clearly shown.

_____ **Step 3**: Create a graph representing each flight path and clearly identify three points along the path. Each graph should be drawn on the same sheet of graph paper. This will be the background for your final diorama.

_____ **Step 4**: Put your diorama together. Physical representations of the birds, pigs, and obstacles should be present. Use color and creativity when designing your Angry Birds level.

_____ **Step 5**: An explanation about how the structures will fall when hit along the flight path. Explanation should be clear, accurate and include details.

Your final product is due on _____. This project will be a summative grade for this unit. Parent Signature _____

Angry Birds Assessment Problems and Questions

Flight Path #1:

1. Where is your slingshot located? Answer should be given as a coordinate pair.

2. What three coordinate points does your Angry Bird need to hit?

3. Create a quadratic equation that can represent this function.
    a. Vertex Form:

    b. Standard Form:

4. What is the maximum height that the bird travels? How do you know?

5. What is the axis of symmetry of the flight path? How do you know?

6. How much distance did your Angry Bird travel in total?

7. Write a reasonable domain and range for your Angry Bird. Be sure to write it in correct format and with inequalities.

8. How will your angry bird hit the pig and knock over any obstacles? Answer in complete sentences with detail and reasoning.

Flight Path #2:

1. Where is your slingshot located? Answer should be given as a coordinate pair.

2. What three coordinate points does your Angry Bird need to hit?

3. Create a quadratic equation that can represent this function.
    a. Vertex Form:

    b. Standard Form:

4. What is the maximum height that the bird travels? How do you know?

5. What is the axis of symmetry of the flight path? How do you know?

6. How much distance did your Angry Bird travel in total?

7. Write a reasonable domain and range for your Angry Bird. Be sure to write it in correct format and with inequalities.

8. How will your angry bird hit the pig and knock over any obstacles? Answer in complete sentences with detail and reasoning.

Flight Path #3 (if necessary):

1. Where is your slingshot located? Answer should be given as a coordinate pair.

2. What three coordinate points does your Angry Bird need to hit?

3. Create a quadratic equation that can represent this function.
    a. Vertex Form:

    b. Standard Form:

4. What is the maximum height that the bird travels? How do you know?

5. What is the axis of symmetry of the flight path? How do you know?

6. How much distance did your Angry Bird travel in total?

7. Write a reasonable domain and range for your Angry Bird. Be sure to write it in correct format and with inequalities.

8. How will your angry bird hit the pig and knock over any obstacles? Answer in complete sentences with detail and reasoning.

Angry Birds Quadratics Project Rubric

	Exemplar	Accomplished	Developing	Beginner
Quadratic Functions and Equations **(30%)**	I have written a quadratic equation for each flight path. My quadratic functions are written correctly in both standard and vertex form. I clearly showed all of my work without any errors.	I have written a quadratic equation for each flight path. My quadratic functions are either not correct or were not written in both standard form or vertex form (might be just one). I showed all of my work but have some math errors.	I have written a quadratic equation for each flight path. My quadratic functions are not written in either standard form or vertex form. I might have shown my work or I made more than 6 math mistakes.	I did not write a quadratic equation for each flight path.
Graphs of Parabolas for each Flight Path **(30%)**	I accurately graphed a parabola for each flight path. My parabola starts from the sling shot and correctly hits my target. Three points are clearly marked for each parabola. My graph is correctly labeled and there is a key for each parabola.	I graphed my parabola for each flight path. My parabola starts from the slingshot and hits my targets. I did not clearly mark each point or my graph is incorrectly labeled/missing a key for my parabolas.	I did not graph my parabola for each flight path (might be missing one or two). My parabola does not start at the slingshot or does not hit my targets. I did not clearly mark each point on my graph or am missing labels/key for parabolas.	I did not graph any parabolas for my flight path.
Calculations and Attached Questions/Work **(20%)**	All of my math is neatly shown and is accurate. I answered each question with detail and correctly. I attached all work.	I might have made 1-2 mathematical errors. I did answer each question but might have been missing some details. I attached all of my work.	I might have made 3 or more mathematical mistakes. OR I did not answer each question correctly or with detail. OR I turned in some work but am missing the rest.	I did not attach my work nor complete the work in the project packet.
Presentation and Explanation **(10%)**	I created a diorama that is unique to me and used colors and physical representations to display my Angry Birds level. I explained in at least 4 sentences about how my obstacles would collapse once hit.	I created a diorama that is unique to me but might not have used physical representations to display my level. OR I explained in less than 4 sentences about how the obstacles collapse.	My diorama is missing uniqueness and/or colors and physical representations of the Angry Birds level. OR I did not provide an explanation.	My diorama is missing key parts. I did not complete the explanation.