

WAMC Lab Template

Math Concept(s): Creating Quadratic Equations and Identifying Key Features

Source / Text:

Developed by: Algebra and Beyond (adapted by Chelsi Boswell)

E-Mail: cboswell@chewelak12.us

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Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

Students will take a selfie with a parabola they find and use that image to create a poster with the equations and features for the associated quadratic function. This lab should be towards the end of the unit when students are familiar with the vocabulary and formulas needed.

Lab Plan

Lab Title: Parabola Selfie

Prerequisite skills:

- Domain and Range
- Minima/Maxima
- Intervals of Increase and Decrease
- Vertex
- A point and a reflection point
- Axis of Symmetry
- Zeros
- Y-Intercept
- Writing equations in vertex and standard form

Lab objective: Students will identify a quadratic function in the real world and use an image of it to create the equations and identify key features.

Standards: (Note SPECIFIC relationship to Science, Technology, and/or Engineering)

Mathematics K–12 Learning Standards:

- A-CED-1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- A-REI-4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .
- F-IF-7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

Standards for Mathematical Practice:

- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Use appropriate tools strategically.
- Look for and make use of structure.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Technology

- 6a Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- 5c Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

Leadership/21st Century Skills:

<u>21st Century Interdisciplinary themes</u> (Check those that apply to the above activity.)			
<input type="checkbox"/> Global Awareness	<input type="checkbox"/> Financial/Economic/Business/Entrepreneurial Literacy	<input type="checkbox"/> Civic Literacy	
<input type="checkbox"/> Health/Safety Literacy	<input type="checkbox"/> Environmental Literacy		
<u>21st Century Skills</u> (Check those that students will demonstrate in the above activity.)			
LEARNING AND INNOVATION	INFORMATION, MEDIA & TECHNOLOGY SKILLS	LIFE & CAREER SKILLS	Productivity and Accountability
<u>Creativity and Innovation</u>	<u>Information Literacy</u>	<u>Flexibility and Adaptability</u>	<input type="checkbox"/> Manage Projects
<input checked="" type="checkbox"/> Think Creatively	<input type="checkbox"/> Access and Evaluate Information	<input type="checkbox"/> Adapt to Change	<input checked="" type="checkbox"/> Produce Results
<input type="checkbox"/> Work Creatively with Others	<input type="checkbox"/> Use and manage Information	<input type="checkbox"/> Be Flexible	Leadership and Responsibility
<input checked="" type="checkbox"/> Implement Innovations	<u>Media Literacy</u>	<u>Initiative and Self-Direction</u>	<input type="checkbox"/> Guide and Lead Others
<u>Critical Thinking and Problem Solving</u>	<input type="checkbox"/> Analyze Media	<input checked="" type="checkbox"/> Manage Goals and Time	<input type="checkbox"/> Be Responsible to Others
<input type="checkbox"/> Reason Effectively	<input type="checkbox"/> Create Media Products	<input checked="" type="checkbox"/> Work Independently	
<input type="checkbox"/> Use Systems Thinking	<u>Information, Communications and Technology (ICT Literacy)</u>	<input type="checkbox"/> Be Self-Directed Learners	
<input checked="" type="checkbox"/> Make Judgments and Decisions	<input type="checkbox"/> Apply Technology Effectively	<u>Social and Cross-Cultural</u>	
<input checked="" type="checkbox"/> Solve Problems		<input type="checkbox"/> Interact Effectively with Others	
<u>Communication and Collaboration</u>		<input type="checkbox"/> Work Effectively in Diverse Teams	
<input type="checkbox"/> Communicate Clearly			
<input type="checkbox"/> Collaborate with Others			

Council

<https://wa-appliedmath.org/>

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials:

- Camera/smartphone (used to upload pictures)
- Tape measure
- Computer with access to Desmos
- Printer
- Posterboard
- Copies of student packet

Set-Up Required:

- Print copies of student packet
- Create sample poster (having worked through this first will be helpful as the creation of the image in Desmos can be tricky)

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students are creating a poster or PowerPoint to be presented.

Cooperative Learning:

- NA

Expectations:

- Students will use the photograph they take to write the equations for the parabola in vertex and standard form and identify the following items:
 - Domain and Range
 - Minima/Maxima
 - Intervals of Increase and Decrease
 - Vertex
 - A point and a reflection point
 - Axis of Symmetry
 - Zeros
 - Y-Intercept

Timeline:

- 2 50 minute class periods

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- Where do you find parabolas in the real world?

Career Applications

- Architecture
- Sports

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Parabola Selfie

Vertex Form

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

$$1 = a(4 - 2.1)^2 + 2.5$$

$$1 = a(1.9)^2 + 2.5$$

$$1 = a(3.61) + 2.5$$

$$-1.5 = a(3.61)$$

$$-0.416 = a$$

$$y = -0.416(x - 2.1)^2 + 2.5$$

Standard Form

$$y = -0.416(x - 2.1)^2 + 2.5$$

$$y = -0.416(x - 2.1)(x - 2.1) + 2.5$$

$$y = -0.416(x^2 - 2.1x - 2.1x + 4.41) + 2.5$$

$$y = -0.416(x^2 - 4.2x + 4.41) + 2.5$$

$$y = -0.416x^2 + 1.747x - 1.835 + 2.5$$

$$y = -0.416x^2 + 1.747x + 0.665$$



Axis of Symmetry	$x = 2.1$	Domain	$(-\infty, \infty)$
Vertex	$(2.1, 2.5)$	Range	$y \leq 2.5$
Zeros	$(-0.351, 0)$ and $(4.551, 0)$	Interval of Increase	$(-\infty, 2.1)$
Y-intercept	$(0, 0.665)$	Interval of decrease	$(2.1, \infty)$
Point and Reflection Point	$(1, 2)$ and $(3.2, 2)$	Min/Max	Maximum

PARABOLA SELFIE

OBJECTIVE: You will analyze a parabola in the real world by demonstrating your knowledge and understanding of the following skills:

- Find a parabola in the real world and identify its dimensions
- Graph the parabola and determine the following characteristics of the function:
 - Domain and Range
 - Minima/Maxima
 - Intervals of Increase and Decrease
 - Vertex
 - A point and a reflection point
 - Axis of Symmetry
 - Zeros
 - Y-Intercept
- Write an equation (vertex form and standard form) that represents the parabola

PART A: Parabola Selfie

Find a real life parabola and do the following:

- Take a selfie with it!
- Take another picture of the parabola, so it can be used on a coordinate plane.
- Find the dimensions of your parabola (may need to use Google, ex: McDonald's arch).
- Explain what your parabola is and where you found it.



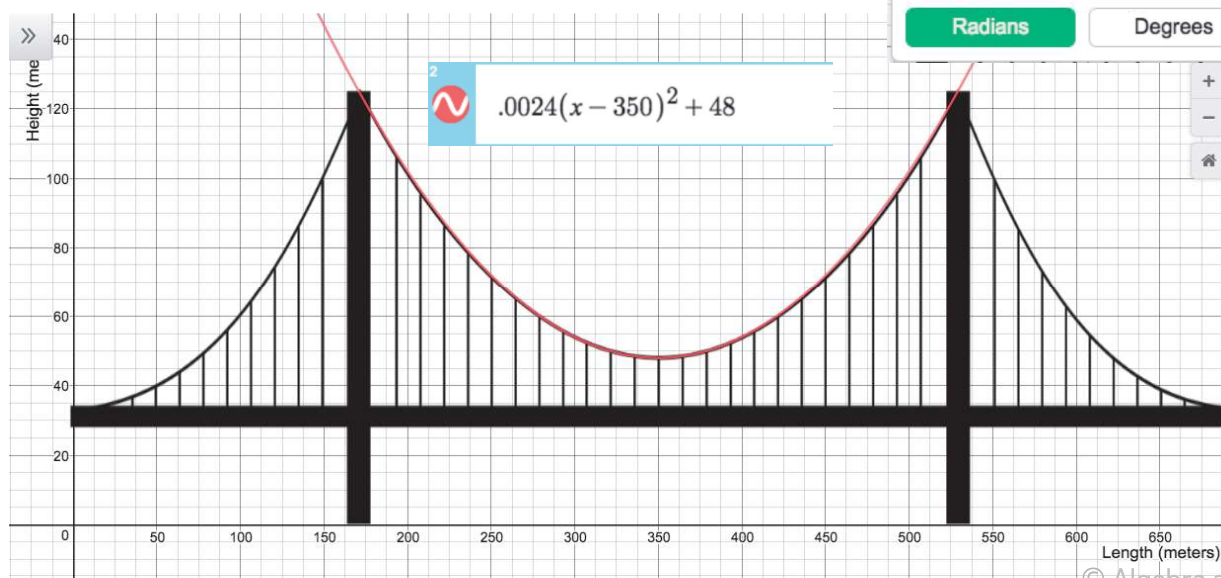
PART B: Graph Your Parabola

Use Desmos (online graphing calculator) to graph your parabola:

- Insert your parabola into a Desmos graph. Move the parabola so it is in the first quadrant.
- Change the settings to the appropriate dimensions for your parabola and adjust the size of your parabola, if necessary.
- After you do Part D, graph your equation and two points to ensure it matches your parabola picture.

Projector Mode

- Grid
- Axis Numbers
- Minor Gridlines
- Arrows
- Zoom Square
- X-Axis
- Length (meters)
- $-20 \leq x \leq 717$ Step: 50
- Y-Axis
- Height (meters)
- $-20 \leq y \leq 156$ Step: 20
- Radians
- Degrees



Name/Group: _____

PART C: Characteristics of My Parabola

Fill in the table with the information from your parabola selfie.

Axis of Symmetry		Domain	
Vertex		Range	
Zero(s)		Interval of Increase	
Y-Intercept		Interval of Decrease	
Point and Reflection Point		Minima/Maxima	

PART D: Quadratic Equation

Write the quadratic equation for your parabola in standard form and vertex form. Show how you found your “a” in vertex form and show your work for converting from vertex form to standard form.

Part E: Put it all together.

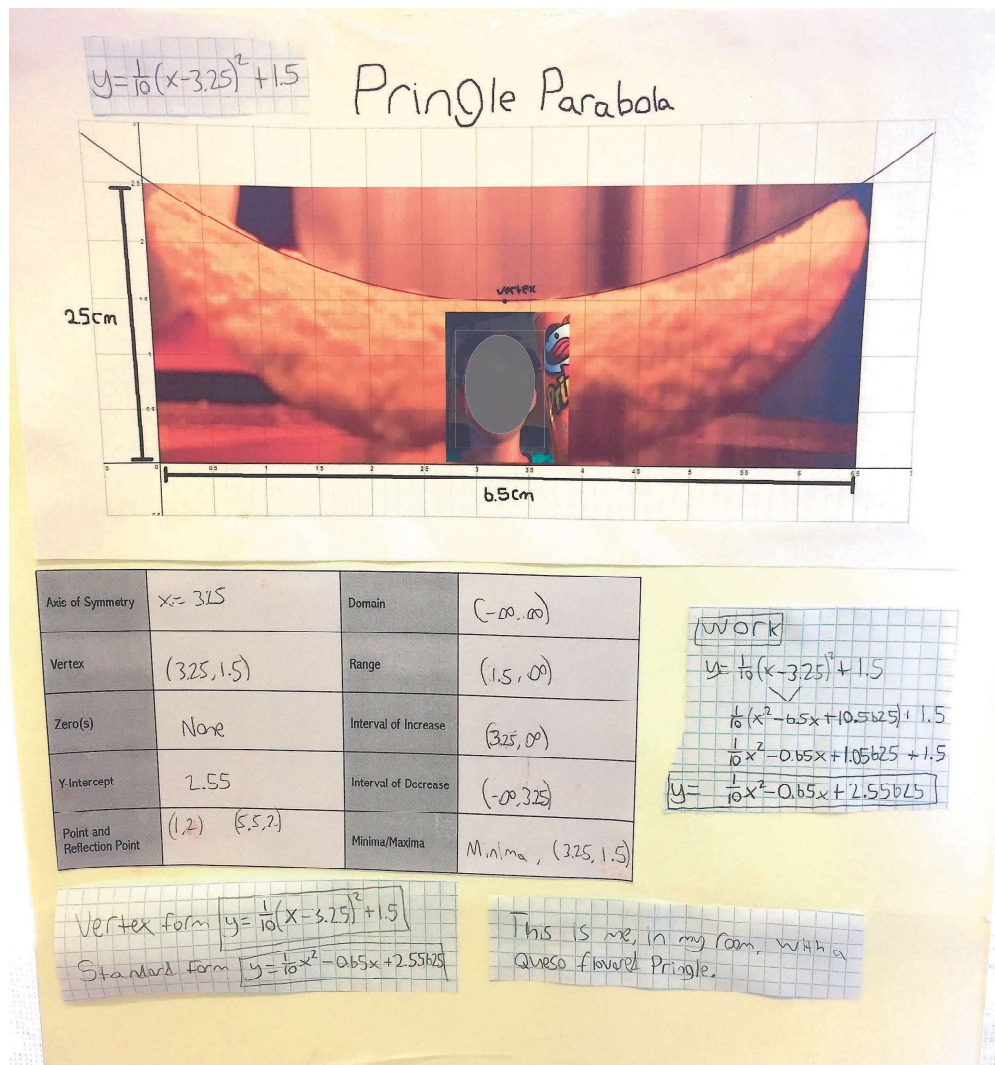
Create a poster board that includes:

- information from Part A: dimensions, what your parabola is, and where you found it.
- the graph of your parabola from Desmos
- the table from Part C
- Part D equations and your work

Turn in separately:

- Parabola Swap
- Rubric

EXAMPLE



Your Name/Group: _____ Parabola Name/Group: _____

PARABOLA SWAP	Axis of Symmetry		Domain	
	Vertex		Range	
	Zeros		Interval of Increase	
	Y-Intercept		Interval of Decrease	
	Point and Reflection Point		Minima/Maxima	

Your Name/Group: _____ Parabola Name/Group: _____

PARABOLA SWAP	Axis of Symmetry		Domain	
	Vertex		Range	
	Zeros		Interval of Increase	
	Y-Intercept		Interval of Decrease	
	Point and Reflection Point		Minima/Maxima	

PARABOLA SELFIE- RUBRIC

Category	Weight	3	2	1	Total
Neatness/ Organization	x 2	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in an organization fashion or easy to read, but not both.	The work appears sloppy and unorganized. It is hard to know what information goes together.	
Parabola Selfie (Part A)	x 2	Picture of you with a parabola on your graph, state what it is, and location.	One item is missing: parabola, you, what it is, or location.	Two items are missing: parabola, you, what it is, or location.	
Graph (Part B)	x 4	The graph is clear, labeled properly (axis and scale), includes graphed equation, and greatly adds to the audiences understanding.	One item is missing: clarity, includes graphed equation, proper labeling (axis and scale), or adds to the audiences understanding.	Two items are missing: clarity, includes graphed equation, proper labeling (axis and scale), or adds to the audiences understanding.	
Characteristics (Part C)	x 5	90-100% of solutions are correct.	Almost all (70% - 89%) of the solutions are correct.	Most (50% - 69%) of the solutions are correct.	
Quadratic Equation (Part D)	x 3	Both equations are stated, accurate, and work is shown.	One item is missing: an equation, accuracy, or work.	Two items are missing: an equation, accuracy, or work.	
LEVEL 2		GRADE:			/48

Comments: