WAMC Lab Pamela Perez#1
Math Concept(s): Function Art (Parabola String Art)
Source / Text:
Developed by: Pamela Perez E-Mail: pperez@toppenish.wednet.edu Date: June 25, 2024

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):

- To be done with the Quadratic lessons on Graphing transformations of Quadratic functions.

Lab Plan
Lab Title: Function Art

Prerequisite skills: Students should know how to write the equation for a line (in point slope and/or slope intercept form, Quadratic functions in vertex form, and a quick reference to Absolute values functions if they hadn't seen yet (as they relate to Quadratics). May also use and work with other functions such as Exponential, Circles, etc.…

Lab objective: Write equations for a piece of student created art that incorporates at least three different function types. When writing equations, write the domain restrictions as well.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards:

- HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- HSF-BF.A.1 Write a function that describes a relationship between two quantities.★
- HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables
- HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.
- HSF-IF.C.7ab Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★

Standards for Mathematical Practice:

- 5 Use appropriate tools strategically.
- 6 Attend to precision.
- 7 Look for and make use of structure.

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

K-12 Science Standards

- Design a test of a model to ascertain its reliability. Science SEP 2

Technology

- 4.a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- 4.b. Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks
- 6.d. Students publish or present content that customizes the message and medium for their intended audiences

Engineering

-

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
x☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving
☐ Reason Effectively
☐ Use Systems Thinking
x☐ Make Judgments and Decisions
☐ Solve Problems
Communication and Collaboration
☐ Communicate Clearly
☐ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☐ Access and Evaluate Information
☐ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
x☐ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☐ Manage Goals and Time
x☐ Work Independently
x☐ Be Self-Directed Learners
Social and Cross-Cultural
☐ Interact Effectively with Others
☐ Work Effectively in Diverse Teams

Productivity and Accountability
x☐ Manage Projects
☐ Produce Results
Leadership and Responsibility
x☐ Guide and Lead Others
☐ Be Responsible to Others

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

Materials

- Graph paper, poster size graph paper, rulers, markers/color pencils, desmos calculator, google slides, youtube.

Set-Up Required:

- Powerpoint with appropriate links.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Guide and Lead Others

Cooperative Learning:

- Work cooperatively when starting the lesson, rough drafts, and the initial practice of finding equation of the parabola that was created.

Expectations:

- Produce a final product unique in nature that connects art and math in the form of equations of functions and it's domain restrictions.

Timeline:

- Approximately 2 days.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- How to use this concept to enhance it and make it marketable.

Career Applications

- Entrepreneurships

Optional or Extension Activities

- Another form of the projects beyond paper/pencil or computer.

Rubric: Parabola and Other Functions Art

Targets:

I. Create artwork using the string art applications.

II. Write equations for a piece of student created art that incorporates at least three different function types but has to include the Parabola equations.

III. Also, write the domain restrictions.

Note: These scoring categories do not have to be equivalent in value. For example you can make the Equations worth twice as much as the other 2.

	Level 1	Level 2	Level 3	Level 4
I. Visual	Artwork is attempted.	Artwork is solid with little to no color or shading	Artwork is pleasing to the eye with some color or shading dimension.	Unique and/or exceptional visual piece of artwork with color and dimension.
II. Equations	Write either a linear equation or one parabola equation for artwork.	Write all the equations for artwork using only the Parabola equations but utilizing more than one parabola.	Write all the equations for artwork using two function types (one function has to be Parabola and used at least twice)	Write all the equations for artwork using at least three different function types (one has to be Parabola and used at least twice)
III. Domain	Write a few domain restrictions for the picture.	Write the domain restrictions for only one set of equations.	Write the domain restrictions for all the Parabola equations.	Write the domain restrictions for every equation written.

Slides

Powerpoint (google slides) as a Teacher Guide

Function Art

Parabola String Art

Learning Targets:

Create Art in Math

Create Art by utilizing writing equations for Linear, Absolute Value and Quadratic Functions.

Focus for the day: Write the Vertex form of a Parabola in Vertex form with a focus on the "a" value for today.

Note: Found the inspiration from google and youtube under string art making parabolas but I am adjusting the point to connect so that the parabolas are facing up and down perfectly and can be switched to sideways as the $x = y^2$ formulas.

Day 1 - Write Equations for Parabolas

Step 1: Graph (0,6)(1,5)((2,4)(3,3)(4,2)(5,1)(6,0)(7,1)(8,2)(9,3)(10,4)(11,5)(12,6)

What do you notice/wonder?

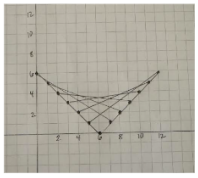
Step 2: Connect (0,6) to (7,1)

Step 3: Connect (1,5) to (8,2)

Continue (2,4) to (9,3) etc……

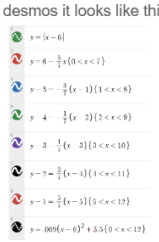
Notice the Parabola took form

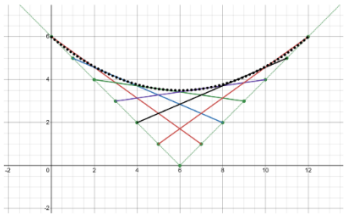
Next step is to write the equation for that parabola



3

In desmos it looks like this





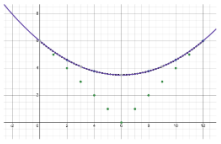
Students can do the drawing on paper, just giving you the desmos here so you can illustrate what it looks like and when the students get to the lab they can write up the equations as illustrated.

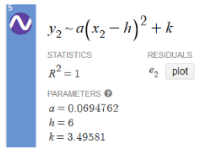
The main objective if for the students to play around with finding the "a" value for themselves. Please allow them to investigate and guess and check this in order to reason and communicate

4

Find equation for parabola in vertex form $y = a(x-h)^2 + k$

x_2	y_2
0	6
2	4.6
4	3.776
6	3.5
8	3.776
10	4.6
12	6





Alternate option or extension, write desmos to give you the quadratic regression equation for you. This can be used to check equations students came up with as well.

You can use systems of equations to find the vertex if you find the solutions to the system of the two equations that cross to create the

5

Next Step

Once we go over everyone has the same "a" value and verex form then have students move onto the other quadrants.

Quadrant II: Graph the absolute value $y = |x + 6|$

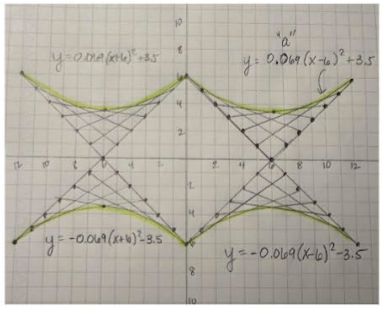
Then Start by connecting points (-12,6) to (-6,0)

Then (-11,5) to (-5,1) etc.

See the parabola, write the equation for this parabola.

Continue for each Quadrant. Let them struggle a little bit with Quadrants III and IV.

6



7

Check for understanding of Vertex form:

May do a Quick Exit Task Matching drag and drop

$y = 0.069(x-6)^2 + 3.5$

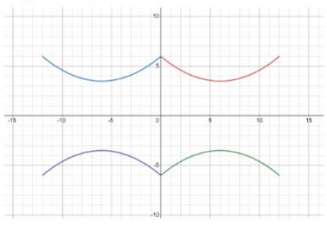
$y = -0.069(x-6)^2 - 3.5$

$y = -0.069(x-6)^2 - 3.5$

$y = 0.069(x+6)^2 + 3.5$

$\{0 < x < 12\}$

$\{-12 < x < 0\}$



8

Ask students to think on what they created and saw.

Do you have any additional Notice and Wonders on our work?

9

Next Steps -

The Lab -

Lab objective: Write equations for a piece of student created art that incorporates at least three different function types. When writing equations, write the domain restrictions as well.

10

Rubric: Parabola and Other Functions Art

Targets:

I. Create artwork using the string art applications.

II. Write equations for a piece of student created art that incorporates at least three different function types but has to include the Parabola equations.

III. Also, write the domain restrictions.

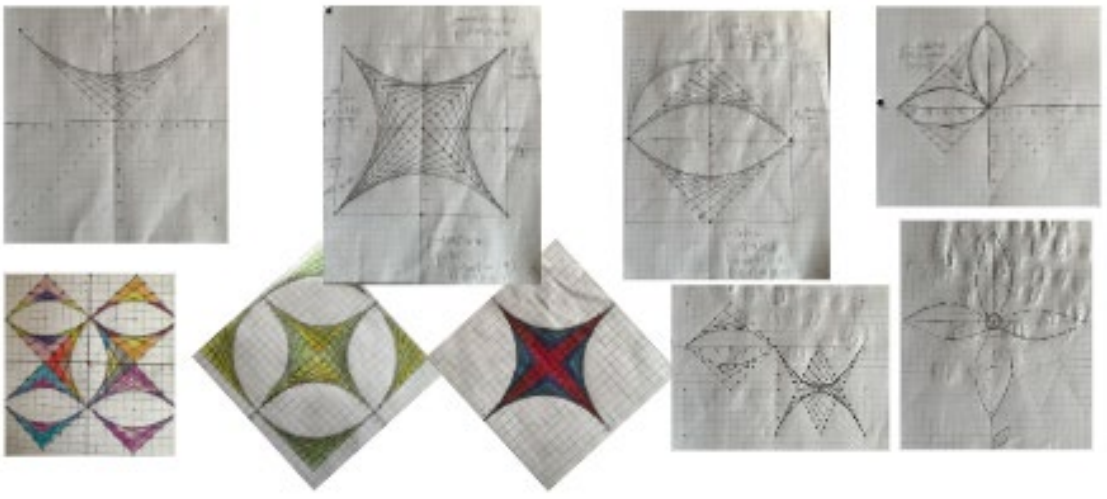
Note: These scoring categories do not have to be equivalent in value. For example you can make the Equations worth twice as much as the other 2.

11

Rubric

	Level 1	Level 2	Level 3	Level 4
I. Visual	Artwork is attempted.	Artwork is solid with little to no color or shading	Artwork is pleasing to the eye with some color or shading dimension.	Unique and/or exceptional visual piece of artwork with color and dimension.
II. Equations	Write either a linear equation or one parabola equation for artwork.	Write all the equations for artwork using only the Parabola equations but utilizing more than one parabola.	Write all the equations for artwork using two function types (one function has to be Parabola and used at least twice)	Write all the equations for artwork using at least three different function types (one has to be Parabola and used at least twice)
III. Domain	Write a few domain restrictions for the picture.	Write the domain restrictions for only one set of equations.	Write the domain restrictions for all the Parabola equations.	Write the domain restrictions for every equation written.

Inspirational Pics



13

Washington Applied Math Council

https://wa-appliedmath.org/