WAMC Lab Template

Math Concept(s): Quadratic transformations
Source / Text: Big Ideas Algebra Two textbook
Developed by: Trevor Roberts E-Mail: troberts@cpps.org Date: 6/21/2022

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):

Lab Plan

Lab Title: Quadratic transformations of a basketball shot

Prerequisite skills: Understanding of the components of a quadratic equation

- Vertical stretch/shrink
- Horizontal stretch shrink
- Horizontal/vertical shift

Lab objective: At the end of the lab students should be able to recognize and understand the different kinds of transformations of a quadratic equation and their impact on the graph of the quadratic

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

Mathematics K–12 Learning Standards:

- CCSS.MATH.CONTENT.HSF.IF.C.7.C
  Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- CCSS.MATH.CONTENT.HSF.BF.B.3
  Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Standards for Mathematical Practice:

- CCSS.MATH.PRACTICE.MP4 Model with mathematics.

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

- CCSS.ELA-LITERACY.SL.11-12.4
  Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance,

and style are appropriate to purpose, audience, and a range of formal and informal tasks.

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
- ☐ Think Creatively
- ☒ Work Creatively with Others
- ☐ Implement Innovations

Critical Thinking and Problem Solving
- ☒ Reason Effectively
- ☒ Use Systems Thinking
- ☐ 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)
- ☐ Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability
- ☐ Adapt to Change
- ☐ Be Flexible

Initiative and Self-Direction
- ☐ Manage Goals and Time
- ☐ Work Independently
- ☐ Be Self-Directed Learners

Social and Cross-Cultural
- ☒ Interact Effectively with Others
- ☐ Work Effectively in Diverse Teams

Productivity and Accountability
- ☐ Manage Projects
- ☐ Produce Results

Leadership and Responsibility
- ☐ Guide and Lead Others
- ☒ Be Responsible to Others

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

Materials

- Basketball, Video Camera, Data Collection Sheet, Tape Measure, Pencil, Calculator

Set-Up Required:

- Handout Data Collection Sheet, Put down basketball hoops in gym

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students will show leadership through directing each other and working together to complete the lab in a timely and organized manner

Cooperative Learning:

- Students will do the lab in groups of three where one shoots the basketball, one records the video of the shot, and one measures where the ball lands and the distance between the shooter and the landing point. The students will do each role once per spot shots are taken from

Expectations:

- The students are expected to be mindful of their surroundings and to make sure the path is clear when they shoot the basketball

Timeline:

- The lab is expected to take 60 minutes for the students to take the shots and to record and analyze the data points from each shot spot. 15 minutes per spot.
-

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- In this lab the students will learn to collect data and compare and contrast the results from their data

Career Applications

- Data collection, sports science

Optional or Extension Activities

- This lab can be adapted to use launch angles and velocity to create a quadratic equation rather than looking at transformations

Basketball Transformation lab data sheet			
Use nail below the basketball hoop to act as the point (0,0) Measure in terms of feet and make sure to be in-line with the nails on the court to ensure a flat plane for your x-axis			
Basketball Shot Spot	Student 1 Student 1 Height: _____	Student 2 Student 2 Height: _____	Student 3 Student 3 Height: _____
Shot Spot #1 Free Throw Line 15ft	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
Shot Spot #2 Three Point Line 19.9 ft	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:

	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
Shot Spot #3 Half-Court Shot 42 feet	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	High Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:

Shot Spot #4 Full Court Shot 84ft	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Low Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:	Medium Arc Shot Data Axis of Sym: _____ Time: _____ Estimated Height of Vertex:_____ Landing Point of Ball: _____ Drawing of Shot Arc:
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RUBRIC				
Criteria:	1	2	3	4
Accurate Data:	Data is not collected	Data is recorded but inaccurate/outside range of error	Data is recorded but is sometimes inaccurate/outside range of believable error	Data is recorded but is inside range of error
Number of Shots completed	0 completed	1-2 completed	3 completed	4 completed

Lab Instructions:

1. Get into groups of four
2. Make sure to bring a pencil, data collection packet, video camera or phone, basketball, timer
3. In the gym, select one of the hoops to use and establish the rotation of the roles. Who shoots first, who times first, who videos first, and who tracks the balls landing point first
4. At each of the shot stations, each student will shoot three times in a row. First a low arc shot, then a medium, then a high arching shot. Record the time, distance, and video for each shot. Rotate once a student has shot all three shots
5. Once all four students have finished at a spot, move onto the next spot and repeat
6. Compare and contrast the shots for each person at each spot
7. Compare and contrast the shots between the group at each spot

Lesson Plan

Name(s): Trevor Roberts
Email Address: troberts@cpps.org
Lesson Title: Quadratic Transformations
Date: 6/21/2022
Text: Big Ideas Algebra 2 STEM Correlation:
Lesson Length: 30 Minutes

Big Idea (Cluster): Quadratic Functions (Transformations of Quadratic Functions)	
Mathematics K–12 Learning Standards: • CCSS.MATH.CONTENT.HSF.IF.C.7.C • CCSS.MATH.CONTENT.HSF.BF.B.3	
Mathematical Practice(s): CCSS.MATH.PRACTICE.MP4 Model with mathematics.	
Content Objectives: Students will be able to describe transformations of quadratic functions	Language Objectives (ELL): Students will be able to explain the difference between the transformations of a quadratic functions
Vocabulary: • Horizontal translation • Vertical translation • Reflection • Horizontal stretch/shrink • Vertical stretch/shrink	Connections to Prior Learning Students will connect the lesson to prior learning using quadratic equations and knowledge of linear transformations and compare the differences between linear and quadratic transformations
Questions to Develop Mathematical Thinking: • What are the real life factors that are manipulating the equation of the quadratic equations found at each drinking fountain? How does each one effect the equation? (Vertical/Horizontal Stretch/shrink)	Common Misconceptions: • Misuse of vocabulary. • Difference of a stretch and shrink • Difference between a horizontal reflection and vertical reflection within the equation

Assessment (Formative and Summative):

- Summative: Turn in homework of Quadratic Modeling that is made via Big Ideas Algebra 2 Textbook
    - The Summative will contain 12 questions from the Algebra 2 Big Ideas Textbook from section 2.1: Transformations of Quadratic Function
- Formative: Entry Task discussion, Exit Ticket Reflection

Materials:

- Pencil, Paper, graphing calculator, graphing paper, Lesson Worksheet, and Exit Ticket

Instruction Plan:

Introduction:
When students enter the classroom, have up 6 quadratic graphs and their 6 corresponding equations. Have the students attempt to match up the graph with the equation. After five

minutes have students give their answers and justify their reasoning. Go over the correct answers and have the students think about what in the equation may help them identify which graph goes with what equation.

Explore:
The class will go over the different kinds of transformations for quadratic equations and discuss the impact that they have within the equation of the quadratic. Students will work together to help match graphs to equations, and also create equations for provided graphs and also create graphs based on the provided quadratic equation.

When I observe students: When I observe students, the students should be able to analyze the model given and apply the correct formula to create the quadratic equation associated with the model.
When I observe students, the students should be able to explain and identify the different kinds of transformations with their peers, and to the entire class. The students should be able to create graphs based on their equations, match graphs to their equations and create equations based on their graphs

Questions to Develop Mathematical Thinking as you observe:

- What do you notice in the quadratic equation when the graph is moved up/down or left and right?
- In what ways does this connect to what you know about linear transformations?
- What patterns do you find in the transformations of the graphs and/or equations?

Answers:

- There is a number in the equation at (multiple answers) place
- Answers may vary. Should be like saying they both have stretches and shrinks and reflections
- Answers may vary. Each transformation should have correlation to numbers appearing in specific spots in the equations

Summarize: In summary, this lesson should help the students be able to recognize and create transformations in quadratic functions.

Career Application(s):

- Analyzing data and graphs
- Comparing different trends in graphs

Leadership/21st Century Skills:

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

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