Catapults and Quadratic Regression – A Co-Teaching Lesson Plan

Co-Teaching Approaches

A "(Y)" in front of the following list items indicates the approach is outlined in the lesson. An "(N)" in front of the following list items indicates the approach is not outlined in the lesson.

- (Y) Parallel Teaching
- (Y) Team Teaching
- (Y) Station Teaching
- (N) One Teach/One Observe
- (N) Alternative Teaching
- (Y) One Teach/One Assist

Subject

Algebra, Functions, and Data Analysis (AFDA)

Strand

Algebra and Functions

Topic

Finding and modeling quadratic curve of best fit

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AFDA.3 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems using models of linear, quadratic, and exponential functions.

Outcomes

Students will use a graphing calculator to find a quadratic curve of best fit. Using a catapult of their own design, students will model a parabolic relationship, collect data, and draw conclusions from data and the quadratic curve of best fit.

Materials

- Computer hooked to a projector (for intro videos)
- Catapult building materials
    - Plastic spoons, rubber bands, clothes pins, tape
- Overhead projector
- Student or teacher phones (for slow-motion recording feature)

- Orange ping pong balls
- Quadratic Regressions (Curve of Best Fit) worksheet (attached)
- Flying Quadratics worksheet (attached)

Vocabulary

curve of best fit, domain, quadratic, range, regression, vertex, x-intercept, y-intercept

Co-Teacher Actions

Lesson Component	Co-Teaching Approach(es)	General Educator (GE)	Special Educator (SE)
Anticipatory Set	Team teaching/ Parallel teaching	GE activates prior knowledge by discussing linear relationships and regression/line of best fit. GE divides class in half randomly. Leads discussion on "Quadratic Regression" notes with group 1.	Prompts students to verbalize new concept of quadratic regression. SE leads discussion on "Quadratic Regression" notes with group 2.
Lesson Activities/ Procedures	Team Teach	GE explains to students the task of building a catapult. Each student creates a catapult using the provided materials. Students then choose one person to represent the group. That person launches a ping pong ball against the projected quadrant 1 grid while another student in the group films the trajectory in slow motion. GE assists students with catapult construction. GE leads students to the hallway and conducts the launchings with each group.	SE shows students a pre-built catapult model and launches a ping pong ball to ensure understanding. SE assists students with catapult construction. SE leads students to the hallway and conducts the launchings with each group.
Guided/	Team Teaching	GE assists students in gathering data from	SE assists students in gathering data from

Lesson Component	Co-Teaching Approach(es)	General Educator (GE)	Special Educator (SE)
Independent Practice		the slow-motion video and completing the questions on the Flying Quadratics sheets.	the slow-motion video and completing the questions on the Flying Quadratics sheets.
Closure	One teach/One assist	GE circulates and assists students with closure activity.	SE instructs students to write on the index card a real-life situation in which a quadratic curve of best fit would be appropriate. SE collects for discussion tomorrow.
Formative Assessment Strategies	Team Teaching	GE checks for understanding during practice. GE collects and grades the Flying Quadratics worksheet. GE collects and discusses the closure activity.	SE checks for understanding during practice. GE collects and grades the Flying Quadratics worksheet. GE collects and discusses the closure activity.
Homework	Team Teaching	No homework is assigned	No homework is assigned

Specially Designed Instruction

- Using both visual (linear regression examples drawn on board) and auditory (discussion) cues, (GE and SE) activates prior knowledge.
- Using the Catapult activity incorporates kinesthetic connections to mathematical concepts (GE and SE).
- Using real-world situations in the closure activity allows the SE to help students transfer knowledge from class activity to real-world situations.

Accommodations

- Read aloud for all instructions.
- Allow extra time for written work.
- Allow discussion response for students with written expression deficits.
- Providing a shortened Flying Quadratics assignment for those who need it.
- Allowing students unable to fling the catapult to use other students' data.

Modifications

- For those students requiring a modified curriculum, content could be modified to include only linear functions.

Notes

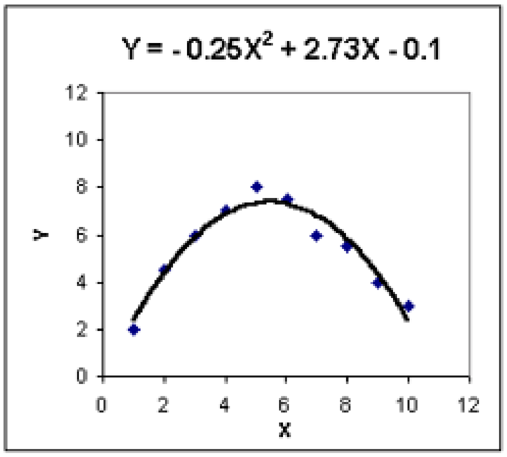
- "Special educator" as noted in this lesson plan might be an EL teacher, speech pathologist, or other specialist co-teaching with a general educator.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Quadratic Regression (Curve of Best Fit)

Name____

Quadratic Regression (Curve of Best Fit)



The Curve of Best Fit is

Use your calculator to find the curve of best fit for the data.
Remember:

$y = ax^2 + bx + c$

\# \# \#

1.

Month	Jan (1)	March (3)	May (5)	July (7)	Sep (9)	Nov (11)
Avg. High	68	76	87	91	88	76

$$y = \square x^2 + \square x + \square$$

2.

Month	0	1	2	3	4	5
Sales	5.6	5.8	6.2	6.9	7.9	9.0

Quadratic Regression (Curve of Best Fit)

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3.

Mrs. Grieser's class did an experiment by rolling a marble down different length slanted boards and timing how long it took. The results are shown below:

sec.	0	4.5	11	13.4	10	8.9	14.1	9.5	12.6
cm.	0	10	60	90	50	40	100	45	80

Based on the curve of best fit, how far will the marble roll in 3 seconds?

4. Find the curve of best fit.

$$\{(^-4, ^-4.8), (^-3, ^-8.2), (^-2, ^-9.1), (^-1, ^-8.1), (0, ^-4.7), (1, 0.3)\}$$

5.

A scientist dropped an object from a height of 200 feet. She recorded the height of the object in 0.5-second intervals. Her data is shown.

Height of Dropped Object

Time (seconds)	Height (feet)
0.0	200
0.5	195
1.0	185
1.5	165
2.0	135
2.5	100

Based on a quadratic model, which best approximates the height at 3 seconds?

A 52 feet

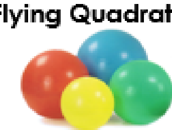
B 55 feet

C 65 feet

D 80 feet

Flying Quadratics

Flying Quadratics

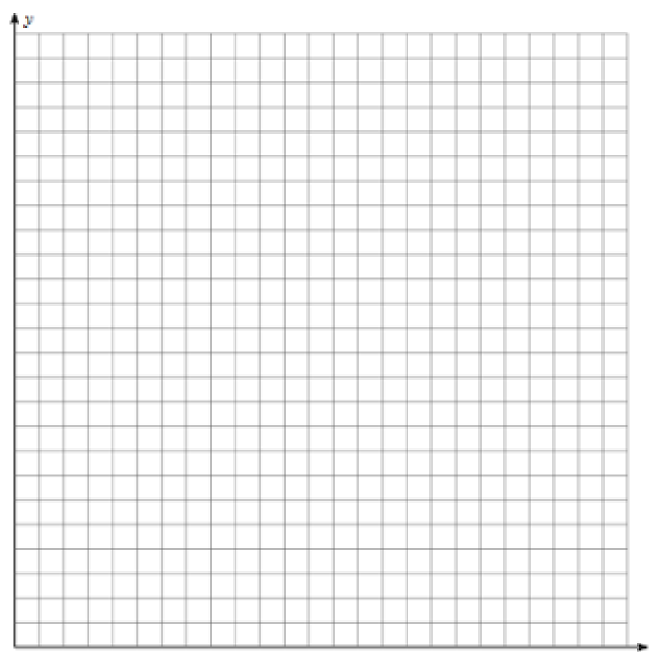


A catapulted object will create a ________________________ shape.
Therefore, we can assume a catapulted ball's height and distance have a _________________ relationship.

1. Record the ball with your phone on SLOW-MO. Choose 7 points along the trajectory, pause the video, and record the results.

Distance							
Height							

2. Sketch the results below.



Flying Quadratics, cont.

3. Determine the curve of best fit that relates height to distance.

4. Use the equation for curve of best fit to determine the vertex of the parabola.

5. How does your calculated vertex compare to the vertex on the graph?

6. Using the curve of best fit, estimate the height of a ball after 32 inches.