

Math In Motion

Visual Approach to Parabolas

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Grade Level	9th – 12th Grade	**Time Frame**	100
Subject	Mathematics	**Duration**	2-3
Course	Algebra 2		

Essential Question

What do real life events look like when graphed?

Summary

Students will use their knowledge of real world scenarios to graph a situation. After graphing, the students will use prior knowledge to connect vocabulary terms to the graphs that were created before practicing their own scenario to be graphed. This lesson is intended to introduce the basics of quadratics, including name, visual representation, and common vocabulary.

Snapshot

Engage

Students work in groups to bounce a ball in specific ways. As pairs bounce the ball, the other group members analyze and sketch the movement.

Explore

Students are shown a set of images and must describe what is happening in the images before graphing the movement of the ball as the distance from the ground over time. Students will share their work with the class.

Explain

Students work in pairs to analyze a given graph and describe predetermined characteristics of the graph before the teacher shares the correct answers.

Extend

Students brainstorm their own scenario of what would create a parabola and graph the motion as a function over time.

Evaluate

Groups exchange scenarios with one another and determine the characteristics of the students' work.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

AF705: Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$

Oklahoma Academic Standards Mathematics (Algebra 2)

A2.F.1.3: Graph a quadratic function. Identify the domain, range, x- and y-intercepts, maximum or minimum value, axis of symmetry, and vertex using various methods and tools that may include a graphing calculator or appropriate technology.

Attachments

- Interpreting Math in Motion—Math in Motion - Spanish.docx
- Interpreting Math in Motion—Math in Motion - Spanish.pdf
- Interpreting Math in Motion—Math in Motion.docx
- Interpreting Math in Motion—Math in Motion.pdf
- Lesson Slides—Math in Motion.pptx
- Math in Motion Student Edition—Math in Motion - Spanish.docx
- Math in Motion Student Edition—Math in Motion - Spanish.pdf
- Math in Motion Student Edition—Math in Motion.docx
- Math in Motion Student Edition—Math in Motion.pdf
- Math in Motion Teacher Edition—Math in Motion.docx
- Math in Motion Teacher Edition—Math in Motion.pdf
- Movement Test—Math in Motion - Spanish.docx
- Movement Test—Math in Motion - Spanish.pdf
- Movement Test—Math in Motion.docx
- Movement Test—Math in Motion.pdf

Materials

- Lesson Slides (attached)
- Bouncing Balls (example: Tennis ball) (1 per pair of students)
- Interpreting Math in Motion (attached; 1 per student)
- Movement Test Handout (attached; 1 per group)
- Math in Motion (attached; 1 per student)
- Math in Motion Teacher Edition (attached; optional)
- Writing utensils
- Blank paper or index card (1 per student)
- Graph paper (digital)
- Device with recording capabilities
- Blank or lined paper (optional)

15 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson.

Display **slide 2-4** to introduce the lesson, essential question, and lesson objectives.

Put students into groups of four, display **slide 5**, and pass out **Movement Tests** handout. Inform students that they will be working in groups to bounce balls and observe the path the ball takes when it bounces. They will take turns completing the series of tests twice. One time they will be the student to bounce the ball. The other time, they will draw the path of the ball on their handout. Once students are in groups, have them spread out around the room and go through the series of tests. Remind students to take turns: one pair watches as the other creates the motion. Have students sketch the path of the ball each time.

Teacher's Note

If you do not have space in the classroom, consider taking students outside or into the hallway for this activity.

25 minutes

Explore

Teacher's Note

Preparing the Lesson:

The students will be sharing graphs with the class during Explore.

If you want the students to share their graphs digitally, unhide **slides 9–12**. Ask students to upload an image of their graph or use an interactive whiteboard to draw their graphs for the class.

Transition to **slide 6**, and pass out the **Interpreting Math In Motion** handout. Direct students' attention to the interpreting portion of the handout, asking students to look at the sequence of images on the slide and use complete sentences to describe what they believe is happening.

After students have had the opportunity to complete the description, move to **slide 7**, direct students' attention to the graphing portion of the Interpreting Math In Motion handout, and ask students to independently graph the distance of the ball from the ground as a function of time on the graph provided.

Once students complete their graph, move to **slide 8**, and introduce the Think-Pair-Share strategy. Ask students to turn to the person sitting next to them and compare graphs, analyzing what is similar and different. Ask students to consider if their partner's graph matches the description that they wrote.

Using the hidden **slides 9–12**, facilitate a whole class conversation about the graphs that the students created. Emphasize the connections between the written description and the graph by asking the class to analyze if they displayed the same information.

25 minutes

Explain

Teacher's Note

Guiding the Lesson:

If you do not have the ability to write directly on the slides, unhide **slides 19** and **21** to show the correct answers.

Transition to **slide 13**, and introduce this graph as one interpretation of the pictures. Explain to the students that this graph will be used for the next part of the lesson so that everyone is learning from the same graph.

Transition to **slide 14**, and point out the area between the red lines, informing the students that they will be focusing on a small portion of the graph. Then display **slide 15**; this will show the class the smaller portion of the graph they will focus on for the activity.

Display **slide 16** to introduce the class to the basic facts and identification of the graph. Play the Khan Academy video to introduce the origins of this type of graph, stop the video at 1 minute 38 seconds.

Embedded video
https://youtube.com/watch?v=BGz3pkoGPag

Transition to **slide 17**, and pass out the **Math in Motion Student Edition** handout. Introduce the Elbow Partners strategy to the class as you assign partners. Instruct the students to use the graph at the top of the handout to answer the questions in the table with their partner. Tell the students they have at least 10 minutes to complete the table and then you will be going over the answers as a class.

Start the timer on the slide. Using the **Math in Motion Teacher Edition**, display **slides 18** and **20** and write directly on the slides to fill in the missing parts of the table. Instruct the students to correct answers on their handout as necessary.

Teacher's Note

Guiding the Lesson:

Students may or may not recall the vocabulary of “vertex” from Algebra 1. If students need help with this vocabulary word, ask them to think of a graph that has a highest or lowest point but is more like a mountain than a hill in shape (or more linear). As students recall absolute value graphs, ask them what they called that lowest or highest point.

20 minutes

Extend

Move to **slide 22**, and combine sets of elbow partners to create groups of 4. Have the groups brainstorm a scenario that illustrates a parabola, asking students to choose one of three ways listed on the slide to create their set up. They can illustrate the scenario, write a narrative, or digitally record it. Provide students with the materials and time needed to work on their scenarios. Once all groups have created the description of their situation, provide each group with graph paper and have them graph the action.

Inform the students that when they are finished, they will be presenting their work to another group.

Guiding the Lesson

If a group is having a difficult time deciding on a strategy that illustrates a quadratic, encourage them to use a device with internet accessibility (like a smart phone or tablet) to research possible applications.

Teacher's Note

Recording the Scenario:

If students chose to record a video, they will need a sharable form. Consider a format such as Padlet, or create a discussion board on your Learning Module System (LMS) for students to post on.

15 minutes

Evaluate

Once all groups have had enough time to complete their graph, move to **slide 23**, and ask each group to exchange their work with another group. Groups will present their scenario to each other and then trade their graphs to compare. On a piece of scratch paper, ask each group to review the other groups' work and answer/identify the 6 prompts on the slide based on the other groups' information. These responses can be turned in as an Exit Ticket for assessment purposes.

Resources

- Dyke, F. V. (1998). *A visual approach to algebra*. Dale Seymour Publications.
- K20 Center. (n.d.). Elbow Partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). Exit Ticket. Strategies. https://learn.k20center.ou.edu/strategy/125
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- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139
- K20 Center. (2021, September 21). *K20 Center 10 minute timer* [Video]. YouTube. https://www.youtube.com/watch?v=9gy-1Z2Sa-c&list=PL-aUhEQeaZXLMF3fltNDxiuSkEr0pq0c2&index=12
- Khan Academy. (2017, April 3). *Visual introduction to parabolas* [Video]. YouTube. https://www.youtube.com/watch?v=BGz3pkoGPag