I Got Caught

Algebra 2: Functions

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Grade Level	11th Grade	**Time Frame**	2-3 class period(s)
Subject	Mathematics		
Course	Algebra 2		

Essential Question

How can mathematical expressions represent physical phenomena?

Summary

Students will use their knowledge of graphing, linear, and quadratic functions to interpret a tortoise - hare scenario.

Snapshot

Engage

Students will watch short clip of the tortoise and hare race or any other similar race, such as student-appropriate car chase scenes, or have them read the Aesop fable. Ask students where they find math in the clip or story.

Explore

Students will be given equations for the hare and for the tortoise. Students will graph the equations and determine when and where the hare catches up to the tortoise.

Explain

Students will solve their problem in an alternate way using their equations after the teacher models the process.

Extend

Students will write a story using equations and interpret a different story using graphs.

Evaluate

Students will evaluate each other's stories and share solutions.

Standards

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

A2.A.1.9: Solve systems of equations containing one linear equation and one quadratic equation using tools that may include graphing calculators or other appropriate technology.

Attachments

- Tortoise and Hare Scenes—I Got Caught - Spanish.docx
- Tortoise and Hare Scenes—I Got Caught - Spanish.pdf
- Tortoise and Hare Scenes—I Got Caught.docx
- Tortoise and Hare Scenes—I Got Caught.pdf

Materials

- Video similar to the tortoise and hare race given in resources or the Aesop fable
- Tortoise and Hare scenes (one scene per pair of students)
- "Police and the Car" graph with equations as a picture or transparency to display from projector, smartboard, or overhead projector
- Graph paper
- Graphing calculator

Engage

Show students a short clip of the tortoise and hare race or any other similar race, such as student-appropriate car chase scenes, or have them read the Aesop fable.

Ask students where they find math in the clip or story.

- Sample student responses: rates, hare is fast and tortoise is slow, motion, speed, acceleration, distance

Teachers Note

The tortoise equations in this lesson are linear following the form of g(x) = mx + b. The g(x) represents the distance in km covered as a function of x, which is time in hours. In an algebra-based physics class students will see this equation as x = xo + vot , where the slope (m) represents the initial speed (vo) of the tortoise and xo represents the y-intercept (b) or the initial position of the tortoise.

Teacher's Note

The hare equations are non-linear following the form of f(x) = ax2 + bx + c. The f(x) represents the distance covered in km of as a function of x, which is time in hours. In an algebra-based physics class students will see this equation as x = xo + vot + ½at2, where xo represents the y-intercept (c) or the initial position of the hare, vot represents the distance travelled if the hare was travelling at a constant initial speed, ½at2 represents the distance covered by the hare due to an acceleration (changing speed).

Explore

Give each pair of students a tortoise and hare scene (A, B, C, or D).

Teahcer's Note

This lesson differs slightly from the classic story due to the difficulty of a true tortoise – hare scene replication.

Ask students to graph the equations for each animal and write a CER Statement about where the tortoise and the hare will meet or pass.

Instructional Strategy

CER Statements require students to give a claim (where they think the two will meet or pass), provide the evidence (the mathematical point at which that happens), and then state the reason (why they know that point means the two will pass).

- An sample student response might be: The animals met at 5 min because both equations have a solution of 5 minutes and 20 feet which means that after 5 minutes both animals will have traveled 20 feet but after that point, the turtle will begin to pass the tortoise.

Teacher's Note

You may have students use a graphing calculator or desmos.com (free online graphing calculator) either in addition to or in place of hand graphing the equations.

Using a clothesline activity, have students discuss the process they used to answer the question. Clothesline is a strategy that can be used to explore, clarify, and develop knowledge by having students evaluate their thoughts, opinions, and understanding. Divide students into two groups. Have group "A" stand shoulder to shoulder; group "B" will then go stand in front of a student in group "A." Students in group "A" will explain their thoughts/solutions to the student standing in front of them. Group "B" students will then evaluate and discuss the thoughts/solutions that were shared. After two minutes, students in Group "B" rotate to the next person and the process continues.

Pose the following questions to the class:

- Did either animal have a head start and how do you know?
- What differences do you see in the trajectory of the hare versus the tortoise?
- Why is the tortoise linear and the hare quadratic?
- What is the difference in the speed of the tortoise and the hare? How does that difference show up in the graph and the equation?
- What else can you tell from the constants in the equations?

Explain

Show students the graph of the "Police and the Car" along with the equations.

Teacher's Note

To make this a little more interesting you can make up a story about getting pulled over when driving to work today and you wondered how far you drove before the cop caught up to you.

Model how to solve the equations simultaneously, setting f(x) = g(x) and solving for x.

Compare your calculated x value with the graph value.

Teacher's Note

This is a good time to discuss errors in measurement (accuracy) due to instrument limitations (precision).

Have students, using their original tortoise and hare scene, determine mathematically (solving the two equations simultaneously) when and where the hare catches the tortoise.

Have two pairs form a larger group and discuss their solutions.

Ask the groups to compare the answer from their graphs to the answer they calculated and discuss any similarities/differences.

Differentiation Idea

Only linear or only quadratic functions could be used. The teacher can also differentiate the stories based on levels of students.

Extend

Engage students in a brainstorming session using think/pair/share by asking students to think about objects that demonstrate linear and quadratic behaviors then have students discuss their answers in pairs then have the pairs share with the whole class.

Instructional Strategy

Think-pair-share fosters collaborative conversation by providing students time to develop their ideas during class discussion. There are three steps to a think-pair-share: (1) Students independently contemplate a response to a question or prompt. (2) Students pair up to discuss and refine their ideas. (3) Student pairs share their discussions with the entire class. This discussion serves as a sort of pre-write, helping students visualize how equations represent real phenomena.

Ask students to write a story using equations similar to the tortoise and hare story.

Share the story guidelines with students: the story must involve at least two characters and there should be at least two equations. At the end of the story, a question must be asked that can be solved using the information from the story.

After writing the story, each student should come up with a solution and place it on a separate sheet of paper.

Evaluate

Have students Commit and Toss their stories.

Teacher's Note

Commit-and-Toss is apeer evaluation and writing strategy structured to encourage students toevaluate eachother'seffort and discourage them from evaluatingeach other. Ina commit-and-toss, studentsfirst respond in writingto a question or prompt. Second, they crumple thepaper and toss it across the room or into a box. Eachstudent then collects a crumpled paper, reading it silentlyor aloud in a guided class discussion and then they revise, edit or comment upon the original statement.

Each student will read and work the story received from the Commit and Toss.

Allow time for students to get with the writer of the story and compare solutions.

Have students complete a three-minute free write over the essential question: how did you use mathematical expressions to express physical phenomena?

Resources

- Tortoise – Hare videohttp://www.youtube.com/watch?v=YubN1MPVN-4
- Printed version of Tortoise and Hare (Aesop)http://www.eastoftheweb.com/cgi-bin/version_printable.pl?story_id=TorHar.shtml
- C.E.R. Instructional Strategy: K20 Center. (n.d.). Instructional Strategies. Copyright 2015, Board of Regents of the University of Oklahoma. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f506fc09
- Commit and Toss Instructional Strategy: K20 Center. (n.d.). Instructional Strategies. Copyright 2015, Board of Regents of the University of Oklahoma. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f505b3d0