Advanced Manufacturing & Prototyping Integrated to Unlock Potential

8TH GRADE MATH

Data Visualization

RESCUE THE HOTSHOTS!

Hotshot Challenge

Teacher Preparation Guide

Fall 2017

8DVM

Advanced Manufacturing & Prototyping Integrated to Unlock Potential

8th Grade Math Data Visualization (8DVM)

Hot Shot Challenge

Module Description	Students simulate a Hotshot firefighters planning team to define extraction logistics using the Pythagorean Theorem and rate. They construct a coordinate graph of different Hotshot team positions and determine each teams' pacing so that all teams meet at the helicopter extraction point at the same time. The module introduces GSE concepts in Pythagorean Theorem and partially introduces rate, such as distance and time. This module should be used as an introductory lesson to the Pythagorean Theorem. Reinforcement lessons that further develop student understanding of Pythagorean Theorem can be embedded within this module and are indicated throughout the Teacher Prep Guide and the Annotated Teacher's Edition.	
Related Mathematics Georgia Standards of Excellence	***MGSE8.G.7*** *Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.* ***MGSE8.G.8*** *Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.* ***MGSE8.EE.5*** *Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.*	
Module Timeline	**50-minute class periods:** 4 days Day 1: Section 1 Day 2: Section 2 Day 3: Sections 2, 3 Day 4: Section 3	**90 minute blocks:** 3 days Day 1: Sections 1, 2 Day 2: Sections 2, 3 Day 3: Section 3
Documents Included in the Download	<u>Student Materials Folder</u> • Student Edition (recommended to be printed double sided) • Student Worksheet Packet (recommended to be printed single sided) <u>Teacher Materials Folder</u> • Materials List • Annotated Teacher's Edition • Teacher's Edition • Videos	

5E Stage	Student Activities How will students engage actively in the three dimensions throughout the lesson?	Teacher Activities How will the teacher facilitate and monitor student learning throughout the lesson?
Engage How does the lesson capture student interest, activate prior knowledge, and connect to a complex question, global issue, or real world problem?	• Students are introduced to the challenge (determining the best evacuation route for the Hotshot Advance Planning Team member) (*1.1, 1.2*)	• Guide students through the text to check for understanding • Highlight the idea of firefighters creating simulations to fight fires or to prepare for emergencies • Facilitate discussion regarding information needed for Hot Shots to safely evacuate the forest
Explore How does the lesson allow students to develop a common base of experiences by actively investigating the phenomenon or problem?	• Students will measure the length of paths the Hot Shots could travel to arrive at the evacuation point. Students will also use the Pythagorean Theorem formula to verify the distances. *(1.3)* • Students will be divided into teams to calculate their average pace for different terrains. Students will walk at a normal pace to represent the road. Walking backwards represents walking through brush. *(2.1)*	• Facilitate as students measure the length of the routes provided • Model how students can use the Pythagorean Theorem formula to explain a proof of the Pythagorean Theorem and its converse. • Mark areas for students to determine their team's pace • Divide students into groups of 3-4, assign areas for students to determine their pace • Facilitate discussion about pace
Explain How does the lesson allow students to develop, share, critique, and revise their own explanations before connecting those to accepted scientific explanations and terminology?	• Students calculate their pace, or rate, for the road and the brush and determine the average time it will take to travel the distances walking at the calculated pace. *(2.2)* • Students will use the Pythagorean Theorem to determine the distance they will travel on each of the five routes. Students will also adjust their rate, or pace, based on the terrain for each route. *(3.1)* • Using a given starting position, teams will determine the time it will take to travel each route. *(3.2)*	• Provide a starting position on the road for each student team • Facilitate as students use the Pythagorean Theorem to determine the distances they will travel • Model for student groups that have difficulty with calculations • Facilitate discussion about how the terrain rate factor will affect the team's pace • Facilitate as students calculate how long it will take to travel each route. Model, if necessary.
Elaborate How does the lesson allow students to extend their conceptual understanding of the three dimensions through opportunities to apply knowledge, skills, and abilities in new experiences?	• Students will represent their data visually to represent the fastest route and second fastest route to the evacuation point. Teams will graph team results to determine how long it will take for all teams to arrive at the evacuation point. *(3.3)* • Students will use information from the graph to predict an appropriate time for the helicopter to arrive at the evacuation point. *(3.4)*	• Facilitate a discussion on the importance of visualizing data in different ways (data table vs. graph), how more information can be learned from different visuals, and how the class can determine an adequate time that it will take each team to arrive at the evacuation point
Evaluate How does the lesson—through both formative assessments embedded throughout the lesson and a summative assessment that might coincide with the elaborate phase—make visible students' thinking and their ability to use practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions?	**Formative:** Ongoing questioning and discussion *(all sections)* **Summative:** Using data in a bar graph, predict an arrival time for the evacuation helicopter *(3.4)*	

	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4
Engage									
Explore									
Explain									
Elaborate									
Evaluate									

Section 1 – The Hot Shot Challenge *(45 minutes)*

The focus of Section 1 is to provide students with a background of the Hotshot Challenge. Throughout the module, students will act as a member of the Hotshots Advance Planning Team to determine an evacuation plan that will ensure all members are rescued from the forest by helicopter at a designated evacuation point.

Students are also introduced to the role of the United States Forest Service Interagency Hotshot firefighters. They are the most elite wilderness firefighters in the country. While highly trained, there are unpredictable factors that could affect the safety of the firefighters within the crew and alter their planned escape route, if blocked. Students are provided a brief overview of the dangers these firefighters face, specifically those from a 2013 fatal accident that resulted in 19 hotshot firefighters being killed.

The Pythagorean Theorem is also introduced. Students will begin to see the relationship among the legs of a right triangle and how they will use that information to determine the best evacuation route for their team. After Section 1.3B, teachers can deviate from the module to embed further lessons and practice for the Pythagorean Theorem, if necessary.

Preparation

Materials	Student Pages
• Hotshot Challenge Student Booklet • Ruler	• Evacuation Training Investigation Sheet
Prep the Day Before: Review the section and challenge. Review the "What is a Hotshot Firefighter?" video	

Planning

GSE	**MGSE8.G.6**: Explain a proof of the Pythagorean Theorem and its converse. **MGSE8.G.7**: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
CCSSM	**8.G.B.6**: Explain a proof of the Pythagorean Theorem and its converse. **8.G.B.7**: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Pythagorean Theorem • Leg • Hypotenuse • Vertices	How might the terrain in a wildfire affect a Hotshot team's path to evacuate? What is Pythagorean Theorem and when does it apply? What is the relationship among the lengths of the sides of a right triangle?	• Discussion Questions: **Participation**

Section 2 – Determining the Evacuation Time *(45 minutes)*

In order for students to understand the context of their challenge and how to develop an evacuation plan, they need to gather background information and data that will help them determine how terrain will affect the Hotshots ability to reach the evacuation point.

This section reviews the basics of rate, or pace, and introduces how students can utilize that information to compare two or more proportional relationships. Students will create teams to time how quickly they walk a normal pace and simulate a pace walked on a rougher terrain (by walking backwards). Once students determine an average rate, or pace, for their team, they will use the distance formula to determine how long it will take them to travel specific routes. This will help students understand how to calculate travel times for routes that lead to the evacuation point.

Preparation

Materials	Student Pages
• Ruler • Tape • Measuring Tape • Timer or Stopwatch • Calculator	• Pacing Data Collection Sheet • Pacing Analysis Student Sheet

Prep the Day Before:

Find a large, designated area for students to complete the pacing activity (30 – 100 feet)
Measure the determined distance and mark areas for student groups to complete pacing activity
Determine a method that will be employed to divide students into groups
Review the section to anticipate mathematical challenges that students might face

Planning

GSE	MGSE8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. **Compare two different proportional relationships represented in different ways.** (Students will not graph the rates calculated in this section) MGSE8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
CCSSM	**8.EE.B.5.** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. 8.G.B.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Pace • Rate • Terrain	• How can your pace be affected when planning evacuation routes?	• Discussion Questions: Participation

Section 3 – Responding to the Call *(70 minutes)*

During this section, students will determine the quickest route for Hotshot firefighters to travel to reach the evacuation point. In Part A, they will evaluate possible evacuation routes. Five routes are shown on the Evacuation Route Map. Each route would lead the team through various types of terrain, where some were more difficult and slower than others. Students will use the Pythagorean Theorem to determine the distance from a starting position on the road (provided by their teacher) to the evacuation point for each of the five trails. In Part B, students will discover that each route has various types of terrains. They will use the distances calculated in part A to determine how their team's pace will be affected when traveling each route. In Part C, students will use their new pace for each route to determine how long it will take to travel each route. They will use this information to select the most appropriate route that the Hotshots to take to quickly arrive at the evacuation point. The fastest and second fastest routes will be determined. Using the data they computed, students will share the travel times of their team with the class. Each group's results will be graphed to assess how long it will take each team to arrive at the evacuation point. Using the data in the graph, students will predict the time for the helicopter should arrive at the evacuation site to pick up the Hotshot firefighters.

Preparation

Materials	Student Pages
• Ruler • Colored pencils	• Evacuation Route Map • Evacuation Route Data Sheet • Emergency Evacuation Route Planning Sheet • Arrival Timing Data Sheet

Prep the Day Before:
Select starting positions for the number of teams in your class
Predetermine which groups will be provided with the starting positions. (To scaffold, provide lower ability groups with shorter distances)
Review the section to anticipate mathematical challenges that students might face
Select an arrival time for the Hotshots. Students will use this to predict the helicopter arrival time.

Planning

GSE	MGSE8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. MGSE8.G.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. MGSE8.EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. **Compare two different proportional relationships represented in different ways.**
CCSSM	8.G.B.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. 8.G.B.8: Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **8.EE.B.5.** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

Key Terms and Concepts	Essential Questions	Assessment and Grading Opportunities
• Hypotenuse • Leg • Pythagorean Theorem • Terrain Rate Factor	• How can the Pythagorean Theorem be used to solve problems? • Was the shortest route always the fastest route? Why or why not? • How might the terrain in a wildfire affect a Hotshot team's path to evacuate?	• Discussion Questions: **Participation**

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