

# Shortest Distance: Volcanoes and the Pythagorean Theorem

**Author** Renuka Sangwan  
**Grade Level** 8th  
**Duration** 3 class periods

## National Standards

### GEOGRAPHY

#### Element 1: The World in Spatial Terms

1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information

#### Element 2: Places and Regions

4. The physical and human characteristics of places

## AZ Standards

### ELA

#### Reading

#### Range of Reading and Level of Text Complexity

8.RI.10 By the end of the year, proficiently and independently read and comprehend informational texts and nonfiction in a text complexity range determined by qualitative and quantitative measures appropriate to grade 8.

#### Writing

#### Production and Distribution of Writing

8.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

### MATHEMATICS

#### Geometry

8.G.B.8 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world context and mathematical problems in two and three dimensions.

## Arizona Social Science Standards

### Geography

The use of geographic representations and tools helps individuals understand their world.

8.G1.1 Use geographic tools and representations to analyze historical and modern political and economic issues and events. Key tools and representations such as maps, globes, aerial and other photos, remotely sensed images, tables, graphs, and geospatial technology

## SIOP Elements

### Preparation

Adapting content  
 Linking to background  
**Linking to past learning**  
 Strategies used

### Scaffolding

Modeling  
**Guided practice**  
 Independent practice  
**Comprehensible input**

### Grouping Option

Whole class  
 Small groups  
 Partners  
 Independent

### Integrating Processes

Reading  
 Writing  
 Speaking  
 Listening

### Application

Hands on  
**Meaningful**  
 Linked to objectives  
 Promotes engagement

### Assessment

**Individual**  
 Group  
**Written**  
 Oral

## Arizona English Language Proficiency Standards

Grade 6-8

Basic

Listening and Reading

Standard 1 By the end of each language proficiency level, an English learner can construct meaning from oral presentations and literary and informational text through grade appropriate listening, reading, and viewing.

B-1: determine the central idea or theme and explain how they are supported by using some text evidence.

B-2: recount specific details and information in a variety of texts.

Standard 2 By the end of each language proficiency level, an English learner can determine the meaning of words and phrases in oral presentations and literary and informational text.

B-3: apply context clues, information from visual aids, reference materials, and a developing knowledge of grade-appropriate English morphology to determine meaning of unknown words.

### **Speaking and Writing**

Standard 3 By the end of each language proficiency level, an English learner can speak and write about grade appropriate complex literary and informational texts and topics.

B-1: deliver short oral presentations that include some details to develop a topic.

B-3 compose informational text that includes details to develop a topic while using appropriate conventions.

B-5: use examples of precise language and domain-specific vocabulary within informative texts.

### **Listening, Speaking, Reading, and Writing**

Standard 7 By the end of each language proficiency level, an English learner can conduct research and evaluate and communicate findings to answer questions or solve problems.

B-1: gather information from multiple provided resources to answer questions.

B-2: paraphrase observations/information notes with labeled illustrations, diagrams, or other graphics, as appropriate.

B-3: cite sources used in research.

B-4: restate the main idea using evidence from text or presentations.

## **Overview**

People travel throughout the world every day and perhaps never realize how far they have traveled. You just jump in the vehicle and off you go. In fact, time spent traveling may be more of a concern than the distance. Students should be aware of distances between places on Earth and should be aware that mathematics can solve real world problems. They should also know that active volcanoes still erupt and can impact our lives.

## **Purpose**

In this lesson, students will be able to find the hypotenuse (shortest distance between two points) using volcanoes as their lesson topic. They will research two active volcanoes and then determine their distance apart by using the Pythagorean Theorem. Students will practice their mapping as well as their research skills using Google Earth and other websites.

## **Key Vocabulary**

**Pythagorean Theorem-** in a right triangle, the sum of the squares of two smaller sides is equal to the square of the longest side

**hypotenuse:** the long side opposite the right angle of a triangle

**right triangle-** a three sided shape with one of the angles measuring 90 degrees

**volcano:** a mountain with a hole in the top or side that sometimes sends out rocks, ash, lava, etc., in a sudden explosion (called an eruption)

## **Materials**

- Shortest Distance PowerPoint
- Projection device, computer, internet
- Calculators
- Home to School Map
- Vocabulary Cards
- Rulers
- Protractors
- Computers or hand held devices for each student
- World map  
<https://geoalliance.asu.edu/sites/default/files/maps/World-at.pdf>
- Volcano Information graphic organizer
- Scoring Guide for map work and graphic organizer
- Vocabulary Test and Answer Key

## **Objectives**

Students will be able to:

- Use the Pythagorean Theorem to solve a distance problem.

- Use the internet to gain information.
- Locate places on a map and use map scale.
- Use Google Earth to locate places and describe them.

## Procedures

*Prerequisites for this lesson: This lesson is a review of the following math skills:*

- How to find square roots.
- How to calculate the missing side of a right triangle.
- How to use a protractor.
- Working on a coordinate plane.

### SESSION ONE

1. Project slides 1- 3 of the Shortest Distance PowerPoint and review how to find square roots. **(Scaffolding: Comprehensible input, Preparation: Linking to past learning)**
2. Play the video on slide 4 to remind students how to use a calculator on finding square roots that are not perfect squares. Have student practice on the problems on slide 5. **(Scaffolding: Guided Practice)**
3. Use slide 6 to set up a real-world problem of figuring out the distance between two places (home and school). Have students share ideas on how to solve the problem. (One could measure by footsteps or car odometer, use a drone, use Google Earth or other mapping tool, etc.). **(Application: Meaningful)**
4. Distribute the Home to School Map. Explain that in this example, on a coordinate plane, if you move on x axis and y axis, you could count the blocks from school to home.  $x = 7$  units,  $y = 6$  units Does this give you the shortest distance?
5. Ask the students if they could use a triangle to find the shortest distance. Project slide 7 and discuss the two kinds of triangles.
6. Project slide 8 of the map again. Have students create a right-angle triangle on the Home to School map using the x and y axes and a diagonal from school to home. Ask these questions: What do you observe about the triangle? What dimensions do you already know? Which is the missing dimension? How can you find that missing dimension? **(Application: Meaningful)**
7. Project slide 9 and discuss the theorem and its formula. Explain the Pythagorean Theorem through a couple of examples focusing on finding the hypotenuse (shortest distance between two points). Allow time for students to practice solving a few problems.
8. Have students work with a partner and figure

out the hypotenuse of the triangle (shortest distance to travel) on the Home to School Map.

**(Scaffolding: Guided practice)**

9. End the session by projecting the Vocabulary Words (slides 10-11). Explain that in the next session they will be learning about volcanoes. **(Scaffolding: Comprehensible input, Preparation: Linking to past learning)**

### SESSION TWO

10. Project slide 12 and have students share with their partner what they know about volcanoes and name an active volcano. Have groups share with the whole class. Have students discuss what they know about **(Integrating Processes: Listening, Speaking)**
11. Project slides 13 and 14 and discuss the map work. Distribute a World map, a ruler, and a protractor to each student.
12. Project slide 15 and discuss how they will collect information on two volcanoes and complete the Volcano Information graphic organizer. Distribute the Volcano Information graphic organizer. Explain the assignment.
13. Project slide 16 giving the 3 recommended resources but others can be used as well.
14. Project slide 17 and explain how the map work and graphic organizer will be graded.
15. Allow time for students to work. **(Integrating Processes: Reading, Writing)**

## Assessment

### Social Studies, ELA, and Mathematics

The World map work and Volcano Information graphic organizer will be graded using the Scoring Guide. Mastery will be considered a score of 80 points or higher.

The Vocabulary Test can be given to measure language acquisition. Mastery will be considered a score of 80% or higher. **(Assessment: Written, Individual)**

## Extensions

Students could create real world problems whose solutions can be found by using the Pythagorean Theorem. They will exchange their problems with partners who will find the solutions.

Students could use Google Earth to calculate distance from one location to another.

<https://www.online-tech-tips.com/google->

[softwaretips/how-to-measure-distance-on-google-earth/](https://www.softwaretips.com/how-to-measure-distance-on-google-earth/)

Students could give oral presentations about what they learned about the 2 volcanoes.

Students could make a Venn diagram and compare the 2 volcanoes.

## Sources

<https://interestingengineering.com/a-closer-look-at-the-worlds-9-most-active-volcanoes>

<https://earth.google.com>

<https://en.wikipedia.org/>