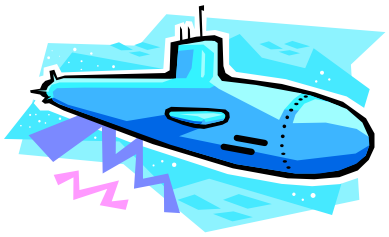


"On October 15th, 1863, the *Hunley* is practicing how to attack an enemy ship. It heads toward its target - really a friendly ship, the *Indian Chief* - and dives below it. When the submarine surfaces on the other side, a dummy torpedo towed behind it bumps up against the ship's hull. If this were a real attack, the torpedo would explode."

You Wouldn't Want to Be in the First Submarine!
By Ian Graham

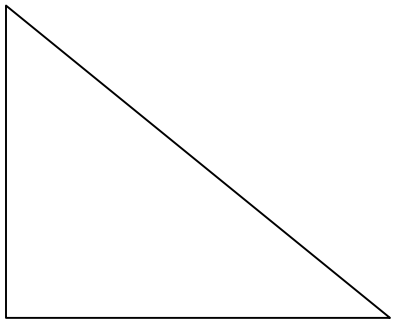
Problem!

If the *Hunley* was 1200 ft away from the opposite side of the *Indian Chief* and it was submerged 200 ft, at what angle should the angle of elevation be so that the *Hunley* will emerge on the opposite side to the *Indian Chief*?

Solution

Draw a picture of the submerged *Hunley* and the *Indian Chief* floating 1200 ft away. Label your measurements.

What kind of shape is made?
You can solve this problem by using trigonometry ratios!



A

Take out your right triangle and measure the opposite and adjacent sides.

Write a ratio of the opposite to the adjacent side. Measure the angles of your triangle. We will compare our answers.

What did we find?

The ratio of the opposite side to the adjacent side has the name **tangent**.

We have studied similar triangles. Because two similar right triangles will have proportional sides, the ratios of the opposite sides' lengths to the adjacent sides' lengths will be equal. If we know the ratio of the opposite and the adjacent side, we can use **tangent** to figure out the angle of elevation.

Tangent A = opposite/adjacent = _____

Use your calculator to find A.

Does this answer make sense?

Write your own story problem that requires the use of tangent. Include your solution and an explanation.

Extension: Explain how you could figure out the distance between the *Hunley* and the *Indian Chief*?

Following Ian Graham's example of why he would not want to be in the first submarine in his book mentioned earlier, complete the following sentence. Give at least four reasons explaining your opinion.

I would **not** want to have been the first person to …

Teacher Directions
Edgewood: Stage at Southern History
Math Activity

Grade Level 8th
Core Curriculum Standards
GSRT.6 Understand that by similarity, side ratios in right triangles are properties of the angle's in the triangle, leading to the definitions of trigonometric ratios for acute angles.

GSRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Materials Needed:
You Wouldn't Want to Be in the First Submarine! By Ian Graham
Similar right triangles cut from cardstock
Rulers

Start the lesson by reading excerpts from Grahams's book. Discuss the history of the *Hunley*.

Pass out the activity sheet. Discuss the problem and have students draw a picture of the situation.

Discuss the terms *opposite side , adjacent side, and hypotenuse*. Emphasize that these terms only apply to right triangles, and the opposite and adjacent side depends on which acute angle you are using.

Have the students find the ratio of the opposite side and the adjacent side of the marked angle. Change the fraction to a

decimal and have the students discuss why the ratios are equal no matter the size of the triangles.

Explain the term *tangent.*

Explain how to use the inverse tangent button on the calculator.

Have students complete the activity sheet in their groups.

Possible Science Extension:

The Student's Civil War Resource Book by Carole Marsh
Page 11

Students build a pen cap model of a submarine and write about why the model works.