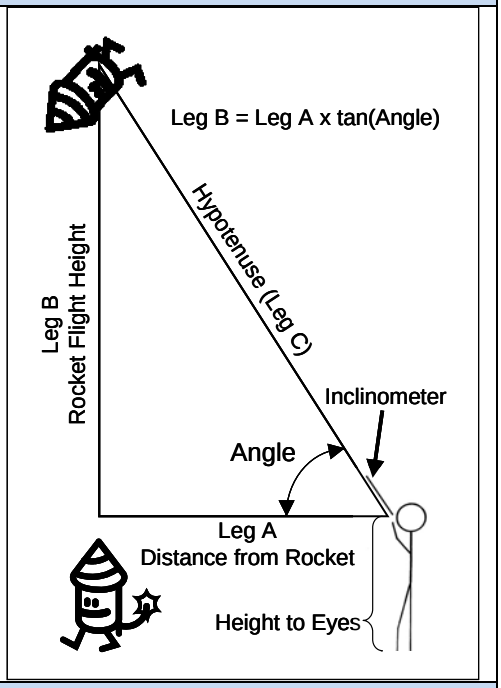
How high did my rocket go?

Breeann Tonnsen
Creighton Middle School – 8th grade
Interdisciplinary
Time length: 45 minutes

OVERVIEW

This lesson is intended to teach the students how to use an inclinometer (a tool that measures angles) to calculate out how high their rockets fly. We start with the basics of right triangle trigonometry. They will create different triangles given a defined angle and the length of one leg for each triangle they will draw. They will discover that all of the other leg lengths and hypotenuses for each triangle will be the same for everyone in the class. Next, I introduce the idea of tangent, without going into much detail, and discuss how this information could help us discover how high the rockets travel. I will provide the formula that uses the tangent of an angle to find the length of a leg, given the length of one leg and an angle on a right triangle. Then I will show them the inclinometer and demonstrate how it works. Lastly, we will go outside and use the inclinometer to measure angles and a meter stick or tape measure to measure distances to determine the height of surrounding objects such as buildings, lampposts, or trees.



PURPOSE

This is part of an interdisciplinary lesson where they will be building rockets in science class and measuring how high they travel when launched. To measure the rocket's height, they will need to be able to use an inclinometer and the tangent formula. In addition, this is a good example of how math is used to support science when direct measurement is impossible.

OBJECTIVES & STANDARDS MET

Students will be able to use the inclinometer and formula to measure the height of a building or tree.

Standard 4: Geometry
1. Construct two- and three-dimensional models using a variety of materials and tools.
2. Describe, analyze, and reason informally about the properties (for example, parallelism, perpendicularity, congruence) of two- and three-dimensional figures.
3. Apply the concepts of ratio, proportion, and similarity in problem-solving situations.

BACKGROUND INFORMATION & REFERENCES

Students should know the definition of right triangle, how to measure distance and angles, and be able to use a calculator.

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VOCABULARY, MATERIALS, PREPARATION, SAFETY

Vocabulary:

Inclinometer
Angle
Right triangle
Tangent
Leg, Hypotenuse

Materials:

Calculator
Ruler
Meter stick
Inclinometer
Paper
Protractor

Preparation:
This involves making sure that the classroom is equipped with all of the materials needed.

METHOD: 5 E'S MODEL

Describe the step-by-step procedures for each E of the 5 E's model:

Engage:

To engage the students, I am going to tell them that we are going to learn how to measure how high our rockets go today (they will be making the rockets in science class).

Explore:

I will tell the students to get into groups of 2 and make 3 right triangles with the following dimensions:

1. Leg A = 4 inches; Angle between Leg A and Hypotenuse = 25 degrees
2. Leg A = 3 inches; Angle between Leg A and Hypotenuse = 40 degrees
3. Leg A = 2 inches; Angle between Leg A and Hypotenuse = 60 degrees

After making the three right triangles, I will ask them to measure (using their ruler) the length of Leg B in each case.

Explain:

After measuring the legs, we will have a group discussion of our findings. They will have found that everyone's measurements are approximately the same lengths. I will pose the question as to why the answers are the same. Then, I will ask them how this information might help us to discover the height that their rockets will travel. We will create a drawing of a person and a rocket launcher to help them understand how right triangles will help us determine the height of travel for each rocket. Once we have discussed these principles, I will provide them the tangent formula [tangent(Angle) = Opposite Leg/Adjacent Leg] for use with a calculator, and demonstrate how to use the inclinometer. Both if these tools are new to the students.

Elaborate:

Armed with meter sticks, paper, and inclinometers, we will then go outside. I will have them measure the distance from a tree and use the inclinometer and the formula to determine the height of the tree. We will then break up into groups to find the height of other things.

Evaluate:

The students will be evaluated informally on participation and formally on their ability to determine the height of their individual rockets (which will be evaluated in their science class).

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ADAPTATIONS OR DIFFERENTIATED LEARNING

Students will be strategically grouped to facilitate everyone's understanding.

EXTENSIONS & CONNECTIONS

I won't be discussing the details of the tangent, but rather giving it to them as a black box formula. Therefore, gifted students could explore the details of the tangent (and sine and cosine) formulas.

HANDOUTS & PRESENTATIONS

The students will use their own paper. The presentation will be on the whiteboard.

PEER REVIEW COMMENTS

This lesson was developed from discussions surrounding the launch of the rockets and the math they needed in support of that.

REFLECTIONS (COMPLETED AFTER LESSON IS IMPLEMENTED]

Overall, the lesson was a success. The students seemed engaged and excited to learn about the inclinometer. Furthermore, the students were able to use the inclinometer and determine the height of their rockets on the days following the lesson. To improve the lesson, I would get a video of a rocket launching to get them excited about the lesson. Also, I would tape off different distances from the building for them to stand on when using the inclinometer. Having the students measure the distance took a lot of time. Time which could have been better used in the classroom for more discussion. Furthermore, their measurements were very inaccurate, which lead to much variation in the final calculations.

Most of my lessons this year have been about getting students excited about the beauty of mathematics. This lesson was more about exploring the power of mathematics. We had a discussion about the relationship between science and mathematics. Many students came to the conclusion that there would be no science without the tools of mathematics to support it. This was a good learning experience for me. In the future, I will remember to emphasize that mathematics is both a thing of beauty on its own and also a powerful tool for creating and understanding the world around us.

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STUDENT WORK EXAMPLES (COMPLETED AFTER LESSON IS IMPLEMENTED]

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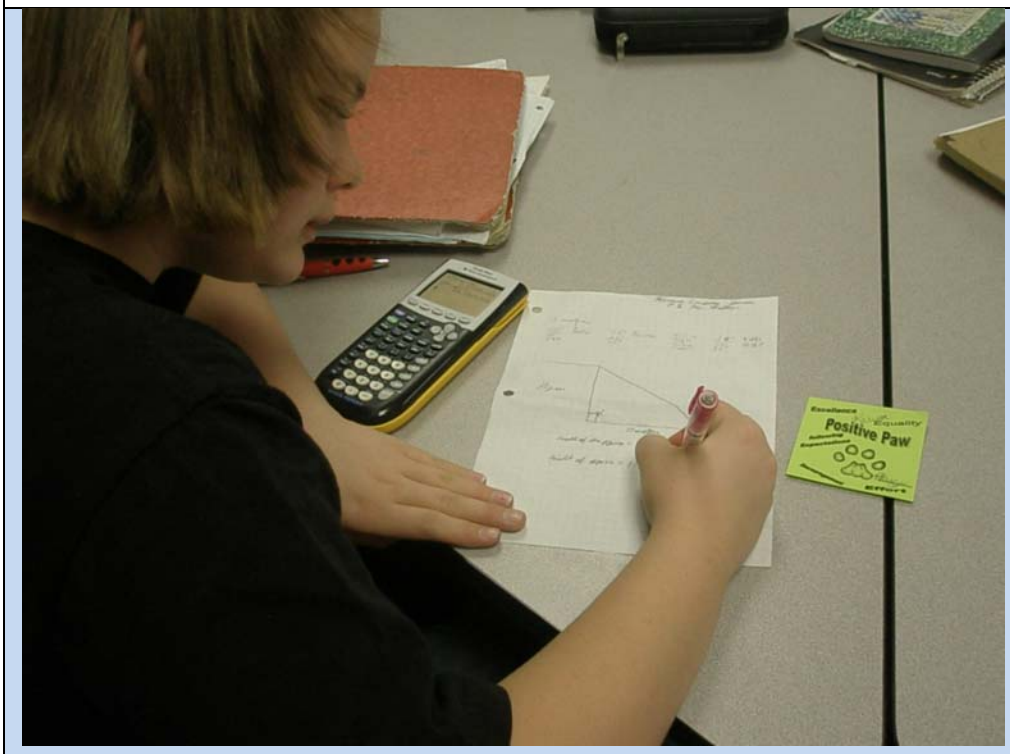

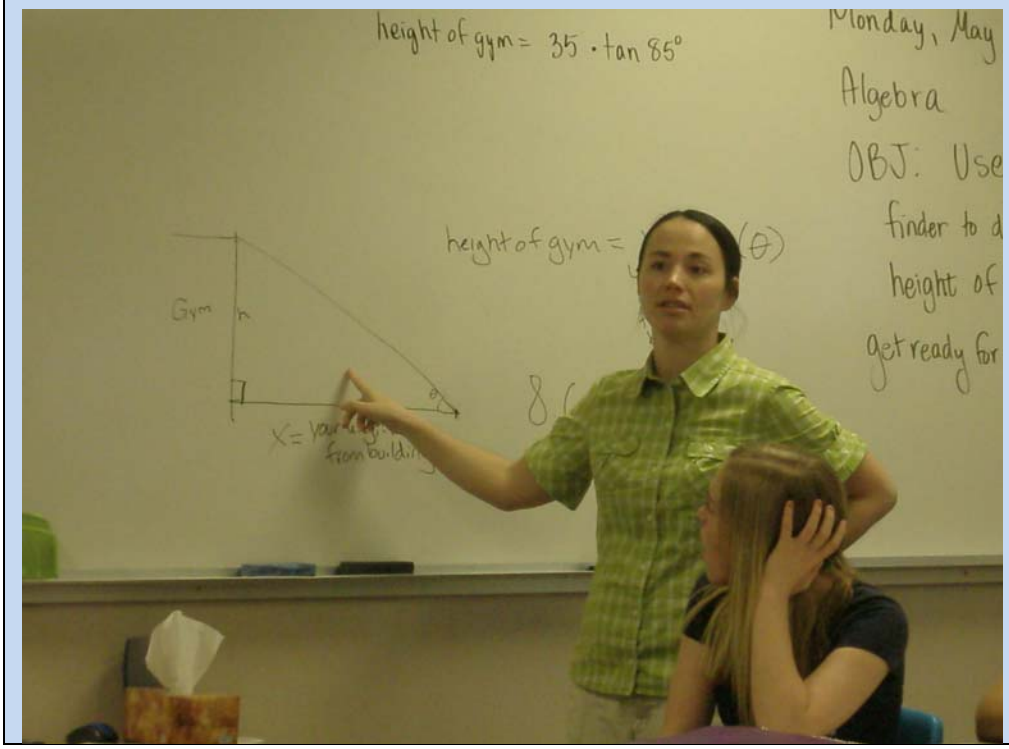

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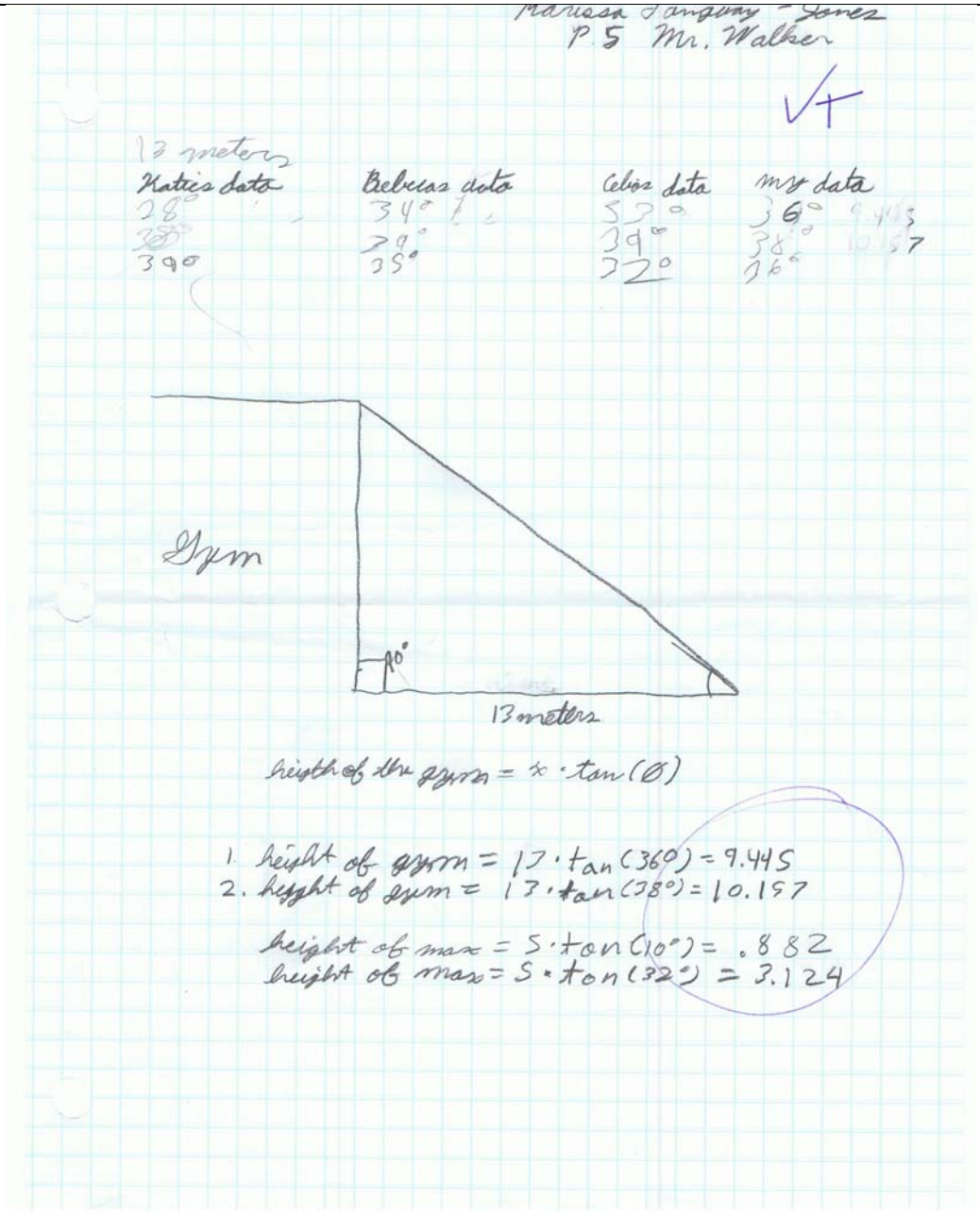

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