MILESTONE 4: LASER TRIANGLE DESIGN

Question:

Can we test and utilize both the pythagorean theorem and the law of reflection by using right angle triangles?

Hypothesis:

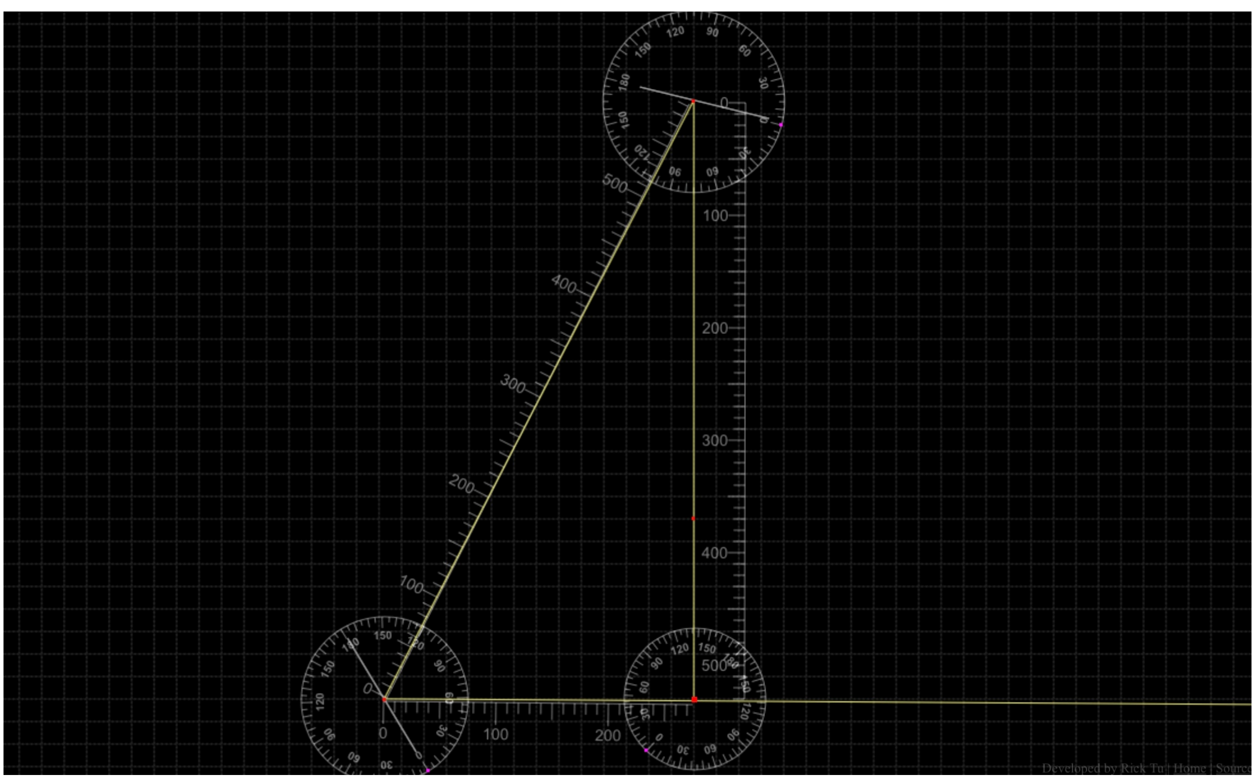
I hypothesize that we can test the Pythagorean theorem and the law of reflection by creating a laser right angle triangle design that utilizes both concepts.

Materials:

- https://ricktu288.github.io/ray-optics/simulator_old/
- Canva (labeling)

Procedure:

1. Open the application (https://ricktu288.github.io/ray-optics/simulator_old/)
2. Select the "single ray" option, and create a ray beam
3. Select the "mirror" option, and then select "line segment"
4. Create two mirrors and reflect the ray beam to make a right angled triangle
5. Select the "ruler" tool, measure the legs of the triangle
6. Select the "protractor" tool, measure the angles of all the vertices while using the law of reflection and the normal
7. Use the measurements of the legs to find the hypotenuse, measure the length of the hypotenuse on the triangle and compare
8. Label the triangle using Canva or another editing software

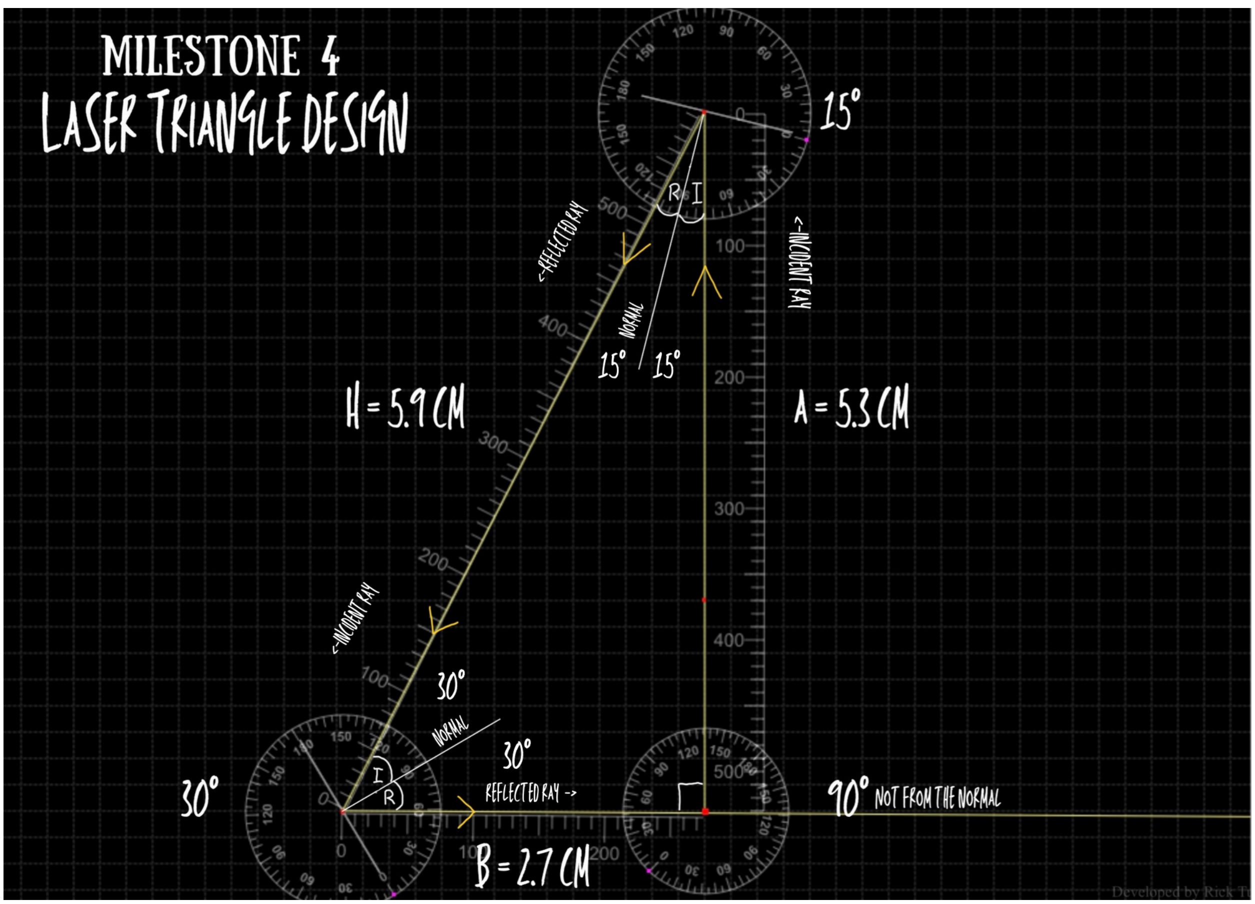


Data/Analysis:

The Pythagorean theorem predicts the length of the **hypotenuse** (or a leg), and finds the accurate measurement that can be used to make a **right angle triangle (90º)**. To do this, the theorem uses the other available measurements on the triangle, and adds (or subjects) them against one another to find the area of the missing measurement. Next, the theorem finds the **square root** of the missing measurement to find the **hypotenuse** (or a leg). This allows us to easily create an accurate **right angle triangle.**

The Law of Reflection predicts what equivalent angle the **incident ray** will reflect off as a **reflected ray**. To do this, **the law of the reflection** states that the **reflected angle** WILL be the same angle as when it bounced onto the reflective surface. The measurement of the angle will be how far it is from the **normal**, and they will be equivalent on both sides. This ensures that we can replicate the design in real life.

Leg Measurements	**Angles**	**Hypotenuse**
a = 5.3 cm b = 2.7 cm a = 28.09 b = 7.29	a,b = 30º from the normal (mirror) b,h = 90º NOT from the normal (no mirror) h,a = 15º from the normal (mirror)	h = a^2 + b^2 h = 5.3^2 + 2.7^2 h = 28.09 + 7.29 h = 35.38 h = 5.9 cm Ruler Measurement: 5.9 cm



To **extend** my understanding of these concepts, I decided to use the **pythagorean theorem** to see if using the **hypotenuse** to find one of the triangle's **leg lengths** would affect my current data. To do this, I simply "changed up" the typical **pythagorean theorem** equation to suit my objective.

5.9^2 = 2.7^2 + a
35.38 = 7.29 + a
a = 35.38 - 7.29
a = 28.09

a = 5.3 cm
measured length: 5.3 cm

I discovered that my data from before was **equivalent** to the measurement I found here. Since all the **leg lengths** in a **right angled triangle** are **equivelent** to the **hypotenuse (h = a^2 + b^2)**, the **pythagorean theorem** would be an easy and accurate way to interpret a missing measurement.

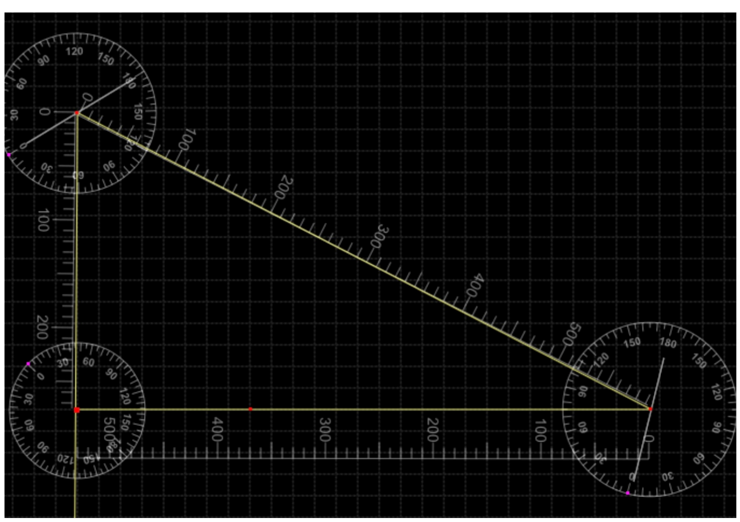
This solution can also work with the other leg length as the missing measurement.

5.9^2 = 5.3^2 + b
35.38 = 28.09 + b
b = 35.38 - 28.09
b = 7.29

b = 2.7 cm
measured length: 2.7 cm

To further **extend** my prior knowledge, I decided to flip the triangle over to see if my data would change. However, all the measurements maintained the same **(h = 5.9, a = 5.3, b = 2.7, etc.)**

The reasoning behind this, is because the triangle is still equivalent to the shape it was before, therefore the overall shape **DID NOT** change. If I were to change the core measurements of the triangle, such as the angle or the side lengths, the triangle would be completely different. Since I simply flipped the triangle over, the shape was the same as it was before.



Conclusion:

To start off the conclusion, I will begin with my question for this experiment; can we test and utilize both the **pythagorean theorem** and the **law of reflection** by using **right angle triangles**? My hypothesis was that we can test the **pythagorean theorem** and the **law of reflection** by creating something that can use both concepts, which was the main creation for this milestone; a laser triangle design.

Through my experiment, I've discovered that my hypothesis was correct, and that it is possible to properly test and utilize both the **pythagorean theorem** and the **law of reflection** to create an accurate representation of a laser triangle design. Fortunately, I have some evidence from my experiment that can be used to back up my claims.

First off, I needed to use the **pythagorean theorem** to properly create a **right angle (90º) triangle** with accurate side lengths. I eyeballed the triangle with the "stick to grid" option on the application to make the measurements correct, but I still needed to guarantee that my design was as accurate as possible. To do this, I measured the proper lengths of the legs, and added them together to find the **hypotenuse**.

After, I compared the **hypotenuse** measurement I got from using the **pythagorean theorem** with the measurement I received from the ruler tool against the actual design. This showed that I did create a **right angle triangle**, because the **hypotenuse** is accurately **equivalent** to the total of two legs' areas.

Furthermore, this is proof from my results that the **pythagorean theorem** is a necessary part in creating this design diagram, and ensuring it's accuracy.

Secondly, I also needed to use the **law of reflection** to predict where the light would reflect onto the next mirror, and what angle I would need to measure to accurately depict this design with material objects. To do this, I used the **protractor** tool within the application. I first realized where the **normal** stood within the **vertices**, and then measured the space from the **normal** to the mirror **(0º)** to get the **degrees**. For example, the **reflected angle** for a,b was **30º**, and the **reflected angle** for h,a was **15º**.

In conclusion, it is possible to test and utilize the **Pythagorean theorem** and the **law of reflection** in a right angle triangle by evaluating the integrity of it's measurements/angles.