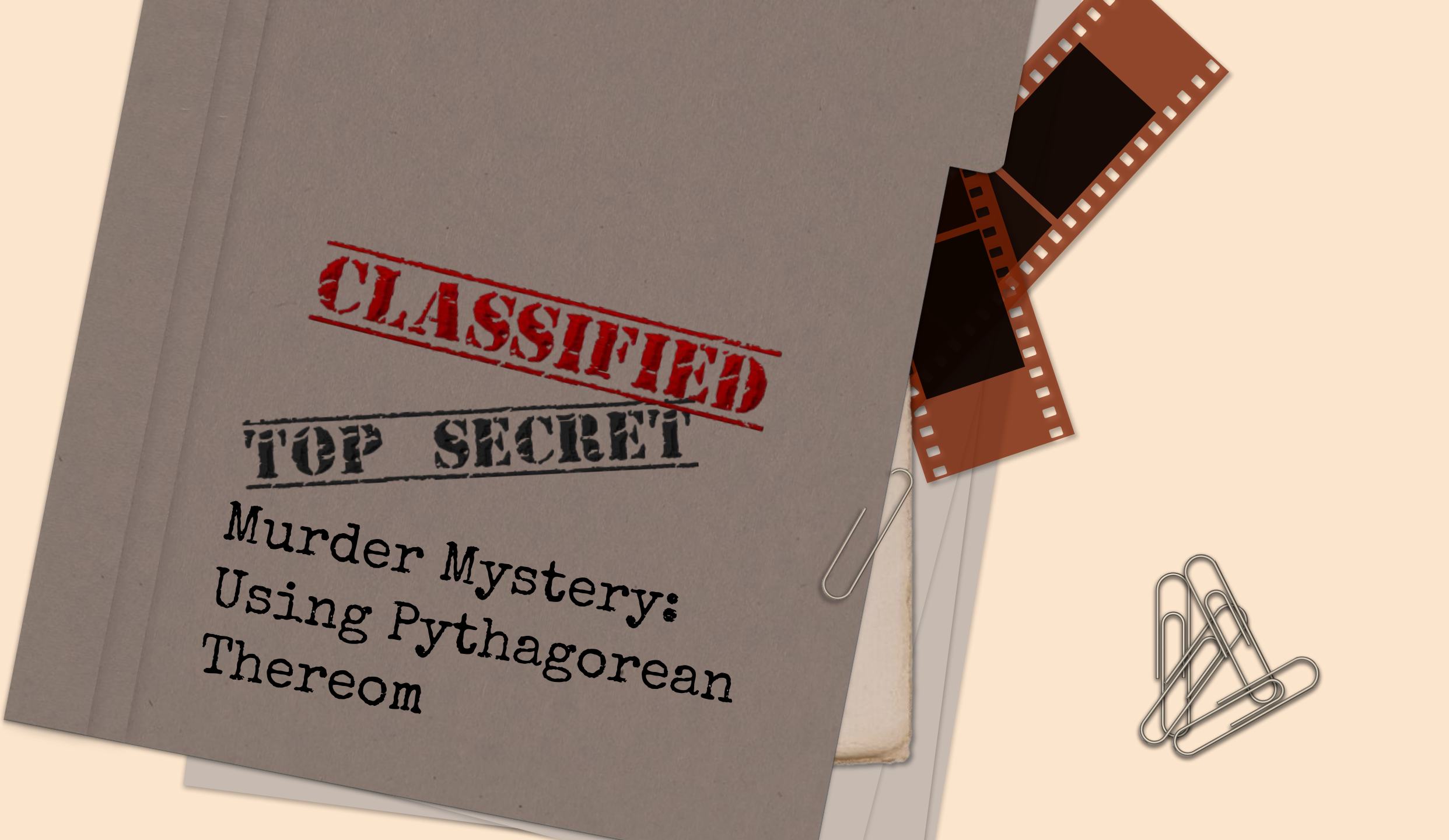


Objectives:
-Students will understand and calculate the mean value of the data they collected for the distance a nerf bullet travels.
-Students will use the Pythagorean Theorem to identify which triangle is a Right Triangle

Goals: Students will successfully solve the murder mystery and identify which suspect is the killer by creating a perfect Right Triangle.

Important Vocabulary:

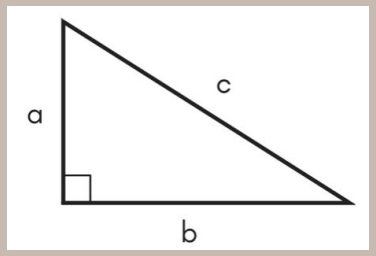
Mean- is the same as the average value of a data set and is found using a calculation. Add up all of the numbers and divide by the number of numbers in the data set.

Right Triangle- consists of two legs and a hypotenuse. The two legs meet at a 90° angle (Perpendicular) and the hypotenuse is the longest side of the right triangle and is the side opposite the right angle.

Pythagorean Theorem- the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides.

Formula:

$$a^2 + b^2 = c^2$$



Who killed Professor Fothergill?

CONFIDENTIAL

TOP SECRET

Professor Fothergill was found murdered from one gunshot wound to the foot that bleed out. There were no eyewitnesses to the murder, however, people did identify 3 possible suspects fleeing from the scene.

Case Details

According to the crime lab, each possible building that the suspect was standing on is exactly **7 feet** from where Professor Fothergill was standing. In order for the shot to be pulled off correctly you have to find the bullet trajectory from the Nerf Gun (Elite 2.0 Volt) that was identified as the murder weapon. Each one of the suspects was seen on top of the 3 surrounding buildings **(18ft tall, 12ft tall, and 17ft tall**). Each Building is perpendicular to the floor. **By calculating the trajectory of the bullet and the height at which the person pulled off the shot (using the Pythagorean Theorem) you can figure out which suspect committed the crime.

Possible suspects

1. **Cassie Adams:** 21 years old, criminal record (petty theft, and aggravated assault). Brown eyes, curly brown hair **4 feet tall.** Was seen on top of the Pizza Shop (12 feet tall) at the time of the crime.
2. **Josh Johnson:** 22 years old, criminal record (aggravated assault, drug trafficking). Brown eyes, brown hair **6 feet tall.** Was seen on top of the Market (18 feet tall) at the time of the crime.
3. **Madison Smith:** 24 years old, criminal record (Money Laundering, Robbery). Brown eyes, dirty blonde hair **5 feet tall.** Was seen last on top of the Target building (17 feet tall) at the time of the crime.

Procedure:

Step 1: Take a Measuring Tape and measure a Distance of 100ft, mark the distance every 12 ft for a reference. (Here I used sticks as my place holders).

Step 2: Take the Nerf Gun and stand at 0ft, shoot the Nerf Gun ten times and measure where the bullets land.

Step 3: Record Data in terms of Feet.

Step 4: Calculate the Mean Distance the Nerf Bullet can Travel 10 times.

Step 5: Test mean length for Accuracy for hitting a Target. Make adjustments if necessary to find the most accurate length that the bullet hits a target.

Number of times the nerf gun was fired	Distance the Nerf Bullet traveled in feet
Shot 1	35ft 8in= 35.667ft
Shot 2	33ft= 33ft
Shot 3	75ft=75ft
Shot 4	42ft 5in= 42.417ft
Shot 5	55ft 5in=55.417ft
Shot 6	63ft 3in= 63.25ft
Shot 7	24ft=24ft
Shot 8	24ft=24ft
Shot 9	32ft=32ft
Shot 10	54ft 4 in = 54.333ft

Average distance Nerf Bullet traveled:

35.667+33+75+42.417+55.417+63.25+
24+24+ 32+ 54.333= 439.084

$$\frac{439.084}{10} = 43.9084 \text{ ft}$$

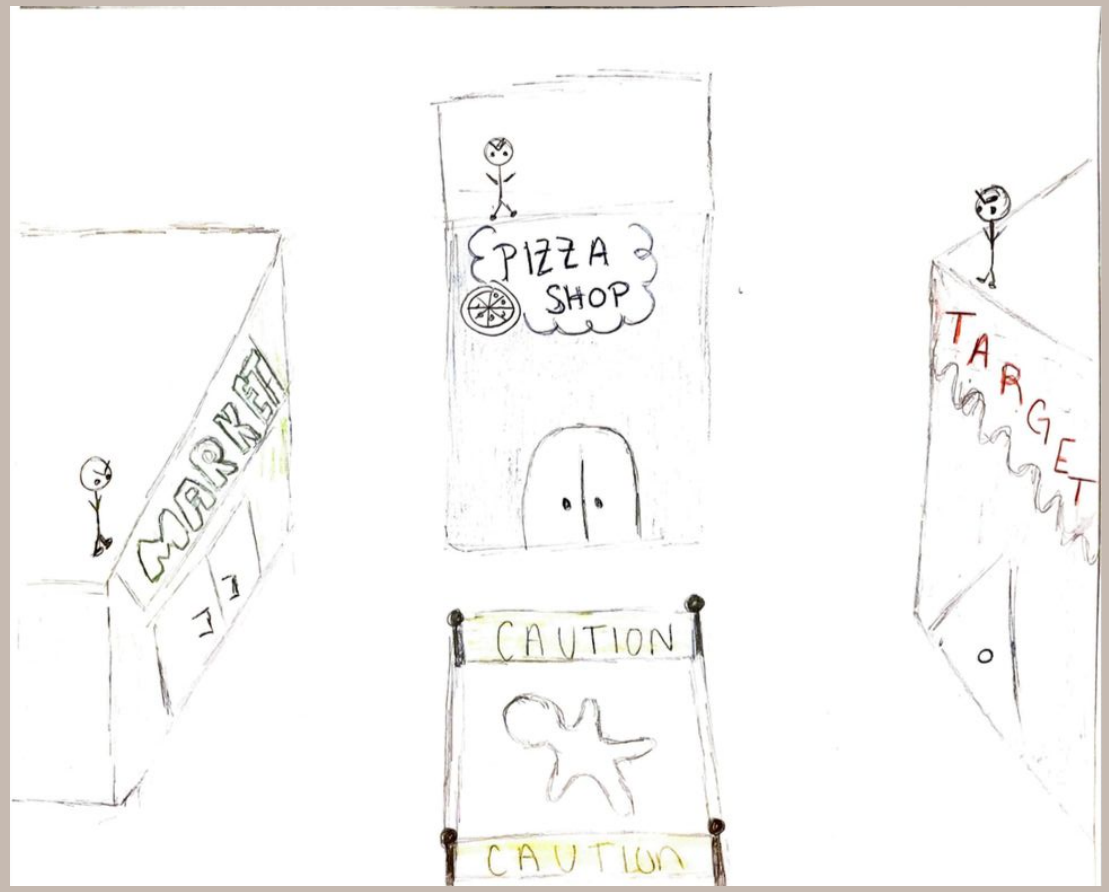
Accuracy of the Nerf Bullet shot at different lengths

Distance of the Target in ft	Number of times the Bullet hit the target out of 10
43.9048	0/10
40ft	1/10
35ft	2/10
30ft	6/10
25ft	9/10

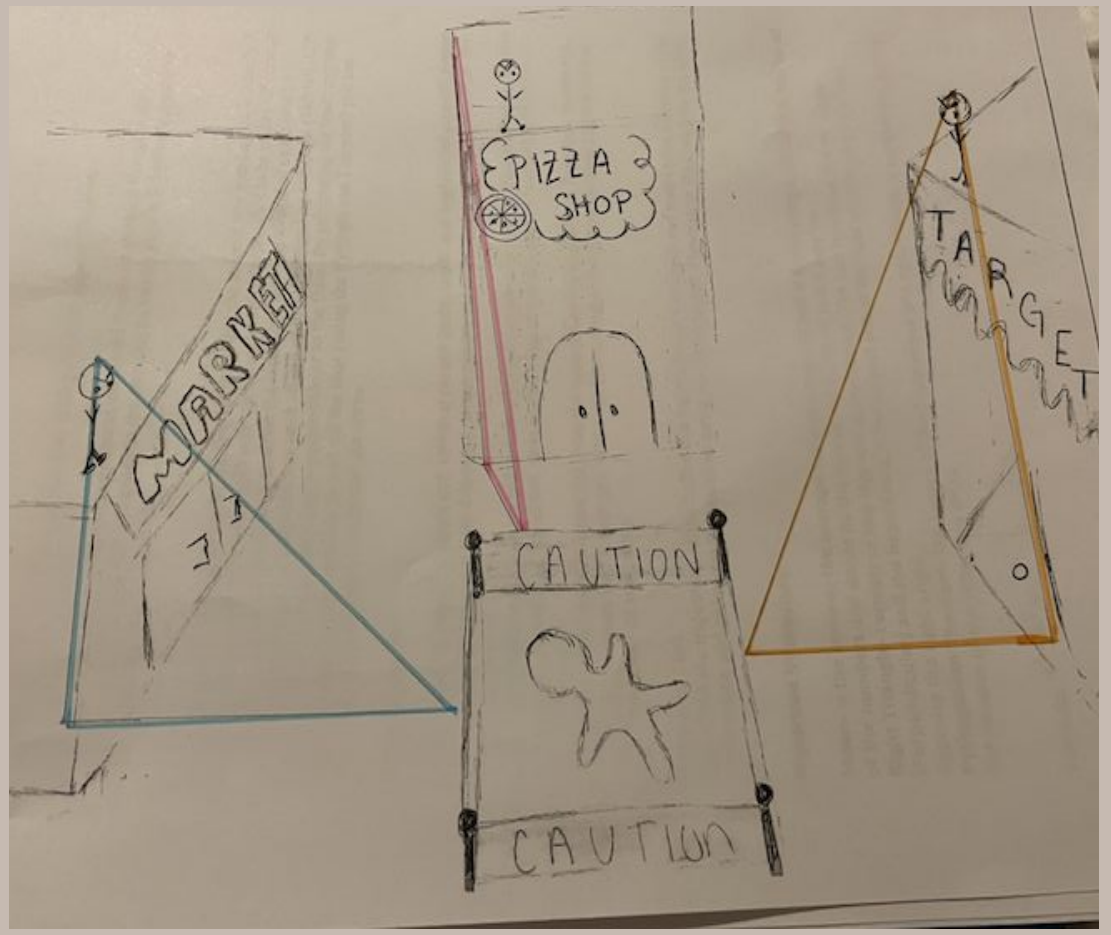
Here we can see although the mean distance of the nerf bullet traveling at 43.9084ft is not a very accurate shot. The Nerf Bullet is more accurate traveling a distance of 25ft. So we know the trajectory of the Nerf Bullet is **approximately 25ft.**

Predictions

Who do you think the killer with be?

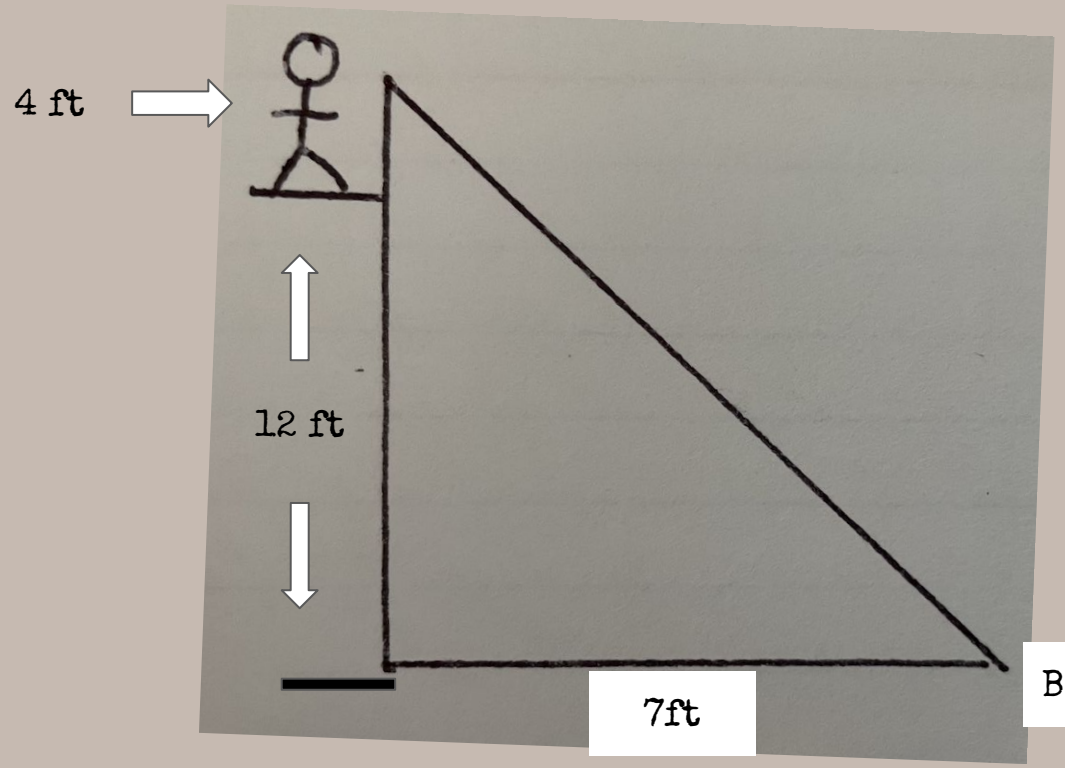


Have students: Draw triangles that would provide a visual representation of the shot that killed Professor Fothergill. Then label the sides of the triangles with the correct measurements.



Suspect 1 Cassie Adams

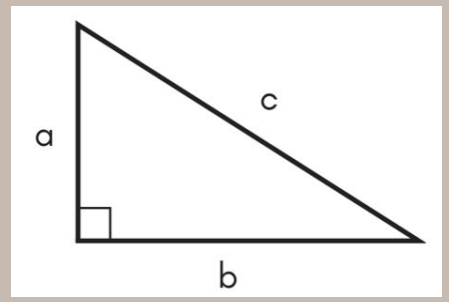
Brown eyes, curly brown hair 4 feet tall. Was seen on top of the Pizza Shop (12 feet tall) at the time of the crime.



We calculated the projected trajectory of the bullet was 25 Ft. Using the Pythearem theorem plug into the formula and see if a right triangle is created.

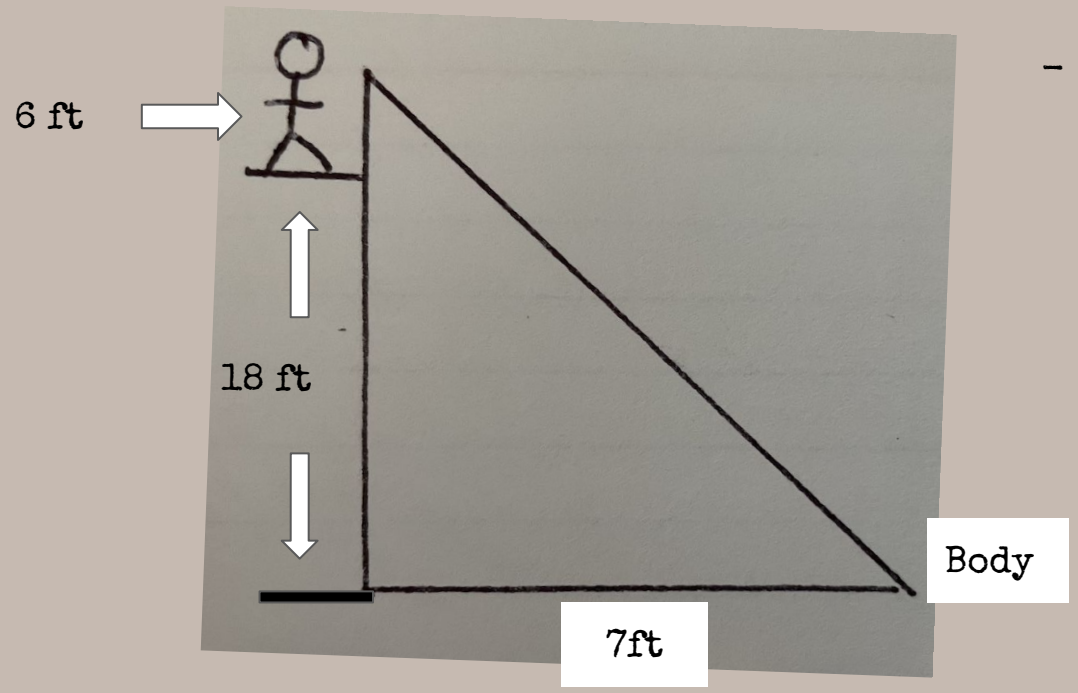
Remember the formula:

$$a^2 + b^2 = c^2$$



Suspect 2 Josh Johnson

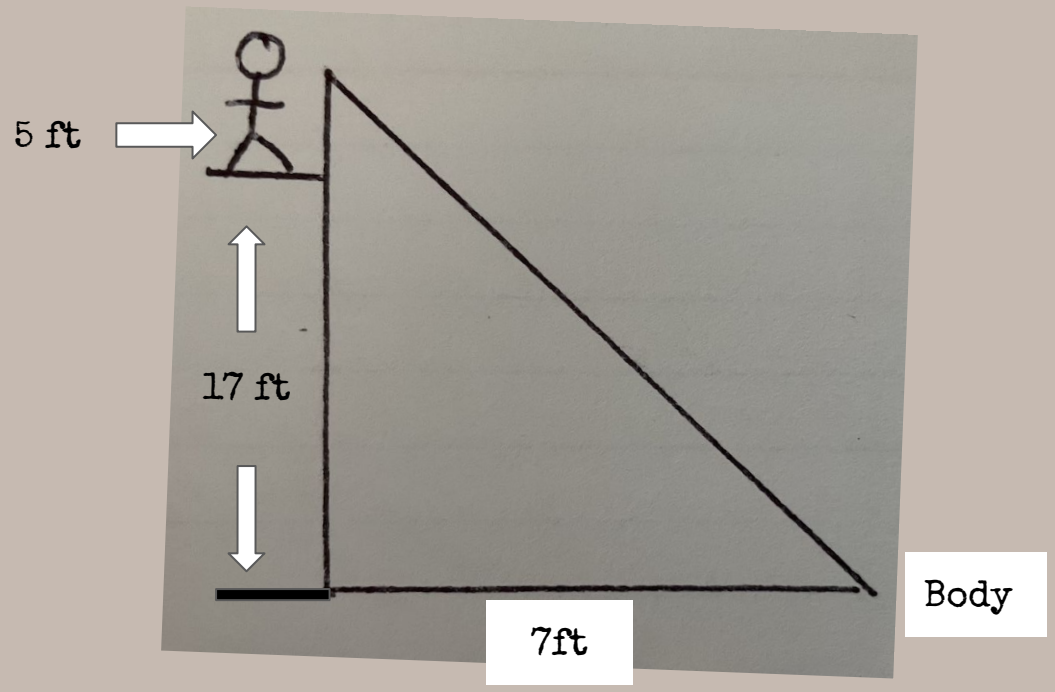
Brown eyes, brown hair 6 feet tall. Was seen on top of the Market (18 feet tall) at the time of the crime.



- Projected gun shot is 25ft
- Plug into the Pythagorean Theorem formula to solve if these dimensions form a perfect right triangle.

Suspect 3 Madison Smith

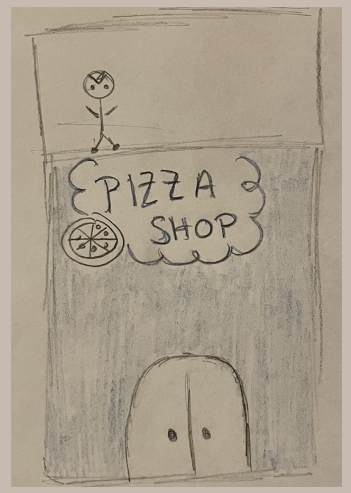
Brown eye, dirty blonde hair 5 feet tall. Was seen last on top of the Target building (17 feet tall) at the time of the crime.

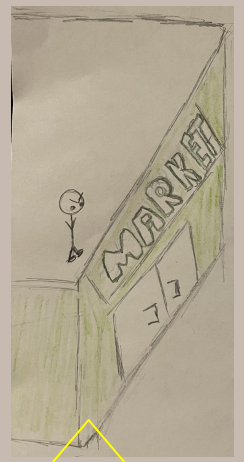


- Projected gun shot is 25ft
- Plug into the Pythagorean Theorem formula to solve if these dimensions form a perfect right triangle.

Calculations

$$a^2 + b^2 = c^2$$





Cassie

$16^2 + 7^2 = 25^2$

$256 + 49 = 625$

$305 \neq 625$

Josh

$24^2 + 7^2 = 25^2$

$576 + 49 = 625$

$625 = 625$

Madison

$24^2 + 7^2 = 25^2$

$484 + 49 = 625$

$533 \neq 625$

Challenge Question

How to form Pythagorean Triples?

Given we know the number can be odd or even

Case 1: Let us assume the number be “x”.
If “x” is odd, then the Pythagorean triple = $(x, (x^2/2) – 0.5, (x^2/2) + 0.5)$

Consider an example (7, 24, 25). Now, let us discuss how to form this Pythagorean triple.

Here, x = 7, which is an odd number.

$(x^2/2) – 0.5 = (49/2) – 0.5 = 24.5 – 0.5 = 24$

$(x^2/2) + 0.5 = (49/2) + 0.5 = 24.5 + 0.5 = 25$

Hence, the Pythagorean triple formed is (7, 24, 25).

How to form Pythagorean Triples?

Given we know the number can be odd or even

Case 2 : If the number is even:

If “x” is even, then the Pythagorean triple = $(x, (x/2)^2-1, (x/2)^2+1)$

Let us assume an example, (16, 63, 65). Now, we will check how to form the Pythagorean triple.

Here, x = 16, which is an even number.

$(x/2)^2 -1 = (16/2)^2 – 1 = 8^2 – 1 = 64 – 1 = 63$

$(x/2)^2 +1 = (16/2)^2 +1 = 8^2 + 1 = 64 + 1 = 65.$

Thus, the Pythagorean triple formed is (16, 63, 65)