

# Ballistic Projectile Post Lab

PHYSICS 203: PROFS. MARTENS YAVERBAUM, BEAN, LU  
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## 1. The Epistemological Table

Claim	Type of Knowledge
The height of the table was 1.12 meters.	
After it is released from the gun, the bullet experiences a constant, downward acceleration, due to gravity.	
This constant acceleration due to gravity is approximately $9.8 \text{ m/s}^2$ .	
The initial vertical velocity of the bullet is zero.	
The amount of time it should take for the ball to fall from its initial height to the ground is 0.58 seconds.	
The bullet took 0.012 seconds to pass through the light gate(s).	
The distance between the light gates was 0.17 meters.	
$\bar{v} = \frac{x - x_0}{t - t_0}$	
The average velocity of bullet through the light gate(s) was 5.53m/s.	
Velocity in the x-direction will be (approximately) constant throughout the experiment.	
The initial horizontal velocity of the bullet was 5.53 m/s	
$x = \frac{1}{2}at^2 + v_0t$	
The gun should be placed 2.49 meters away from the target.	

## 2. Research Design Chart

We are returning to our normal, non-mutated Research Design Chart. The measurement you are to use for this lab is:

*The initial height of the bullet above the ground when the gun is placed on the table from which it will be fired at the cup.*

## 3. The Counter-Factual

- A. Imagine that your group performs this lab again with a different ballistic pendulum gun. The size of the bullet is the same, the height of the table is the same, and the height of the bullet above the table in the new gun is the same as it was with your original gun. You arrange your light gate(s) exactly how you did in the original experiment (i.e. the same distance apart, the same height, etc.) and you find that the bullet fired from the new gun takes TWICE AS MUCH TIME to pass through the light gate(s) as the bullet from your original gun. How would your answer to your research question for this gun be different from your answer for the gun you used in the actual lab? Explain as clearly as possible the chain of logic that determines the change in your answer.
- B. Imagine that, instead of firing the gun perfectly horizontally, you fired upwards at a slight angle.
- i. When you performed the experiment with perfectly horizontal shot in lab, you made a number of assumptions: horizontal velocity is constant; horizontal velocity is equal to the velocity measured through the light gates; vertical acceleration is constant; vertical initial velocity is zero; etc.  
**Which of these assumptions would remain true in the new, tilted scenario? Which would not? Explain.**
  - ii. **Would you expect the bullet to fly farther or not as far. Would you expect the bullet to be in the air for longer or not as long? Explain.**

#### 4. The Wild Card

After an exhausting battle on the Verrazano Bridge on a hot summer day, Spiderman, and the Green Goblin take a break from fighting each other to search for some way to cool themselves down. Looking at the sparkling body of water directly below them, they decide to race each other into the water. Spiderman, who is standing at the edge, steps right off the bridge and drops straight down. The Green Goblin hops on his motorcycle and rides off the bridge. At the moment he goes off the edge, he has an instantaneous horizontal velocity of 20 m/s. They both leave the bridge at the same instant.

- A. Who hits the water first?
- B. At the same instant that Spiderman and the Goblin jump off the bridge, a woman *throws* (not drops but *throws*) a baseball *straight downwards* at the water. When will the baseball hit the water? Explain why the baseball's time to reach the water is or is not different from that of the two super-humans.

#### The Formal Report

You may have noticed that there's a significant difference between this lab and the last two labs. Lab 2 and even lab 3, in its weird way, were about discovering something *as researchers*. In both cases, your Research Question might have centered on something general, like the nature of falling objects. This lab is more about *applying* the principles of physics to complete a practical task. Your Research Question should reflect this. However, along the way, you *as students* (rather than as researchers) hopefully discovered some things about physics. In particular, you may have come to understand *independence of perpendicular axes*. This concept is important, and it should definitely appear somewhere in your lab report.