

## **TRAINING LAB – FIREARMS AND BALLISTICS: HOW TO DETERMINE A BULLET’S TRAJECTORY**

NAME \_\_\_\_\_

**Background:** A shooter walks alone into a large room and fires a single bullet at a wall. The shooter then leaves the room and challenges you to walk in and determine where they were standing when they fired the shot. Could you do it? This Training Lab will help you meet this challenge as you learn about bullet holes and how they can help you locate the position of a shooter.

1. You will be trained to determine a fired bullet’s trajectory when more than one bullet hole is made by the bullet.
2. You will be trained to determine a fired bullet’s trajectory when only one bullet hole is made by the bullet.
3. You will be trained to accurately draw a bullet’s trajectory in a sketch of a crime scene.

### **Procedures:**

#### **Part 1 – Using Two Bullet Holes To Determine A Single Bullet’s Trajectory**

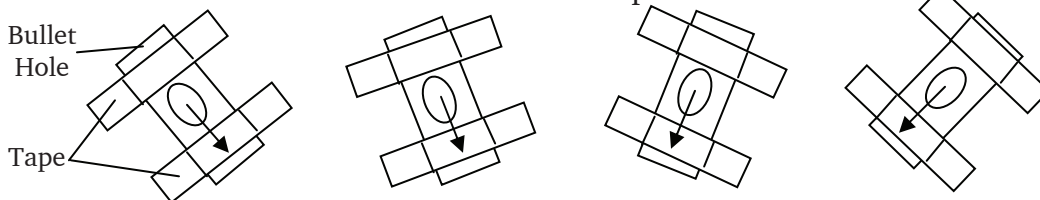
1. A bullet fired from a gun travels in a straight line until it hits a nearby object. However, a bullet that travels for a distance without hitting an object will eventually curve toward the ground due to gravity. A bullet’s line of travel as it flies from a gun and hits an object (or the ground) is called its TRAJECTORY.
2. Bullet holes at a crime scene can help you determine a bullet’s trajectory – even if the shooter is no longer present.
3. Observe the drawing of a crime scene in Figure 1 on your Data Page. A single bullet was fired in the room. The bullet first passed through the back of a chair, then continued on to hit the wall behind the chair. What was the Trajectory of the fired bullet?
4. Notice there are TWO drawings of the crime scene in Figure 1. The sketch on the LEFT shows a TOP VIEW of the crime scene (room) – as if you were hovering above the room looking down on it. This sketch allows you to see how objects were arranged in the room and the direction any bullets may have traveled within the room.
5. Simply use a ruler and draw a long, straight line through the two bullet holes found in this Top View to find the bullet’s trajectory after it was fired.
6. The sketch on the RIGHT shows a SIDE VIEW of the same crime scene – as if a side wall of the room was removed and you are looking in. This sketch allows you to follow the elevation of the bullet and determine if the bullet was shot down toward the ground, up toward the ceiling, or level.
7. Simply use a ruler and draw a long, straight line through the two bullet holes found in this Side View to find the bullet’s trajectory after it was fired.
8. It’s helpful to draw both a Top View and a Side View of a crime scene so you can study the scene from different angles and get a three-dimensional view of what happened.
9. To determine a bullet’s trajectory at a real crime scene you would also “draw” a line through the two bullet holes made by the bullet. The bullet’s straight-line trajectory could easily be illustrated by stretching a string through the bullet holes and the room, placing a long rod through the bullet holes, or using a laser to indicate the trajectory.

10. Complete “Questions For Figure 1” on the Data Page to answer questions about the crime scene you observed in Figure 1.

CONCLUSION: If a bullet passes through TWO (or more) objects you can determine the bullet’s Trajectory by simply drawing a straight line through the bullet holes made by the bullet. The two bullet holes could be in: objects such as windows, walls, floor, furniture – or an object and a person – or even an entry and exit wound of a person.

### Part 2 – Using One Bullet Hole To Determine A Single Bullet’s Trajectory

1. Is it possible to determine a bullet’s Trajectory if it only leaves ONE bullet hole behind? Let’s find out!
2. Pick up a “Bullet Trajectory Kit”, a simulated bullet hole from your supervisor, and a meter stick or similar measuring device.
3. Use masking tape and tape the bullet hole securely to a wall (numbered side of the bullet hole against the wall) about 4 to 5 feet up from the floor. Orient the bullet hole so it is pointed downward toward the floor at one of the angles shown below – as if the shooter was on the floor somewhere and shot upward.



4. Pretend you have just entered a crime scene and notice a single bullet hole in the wall (the one you just placed on the wall). What was the Trajectory of the bullet that made this bullet hole?
5. Remove a **TRAJECTORY ROD** (a pencil) from your trajectory kit and carefully insert it all the way into the bullet hole (insert the pencil end – not the eraser end). Use a small piece of adhesive putty and press it around the Trajectory Rod on the outside of the bullet hole so it will hold the rod in place and keep it from falling out.
6. The Trajectory Rod will now be pointing along the Trajectory Path the bullet was traveling when it hit the wall.
7. Stretch out the string attached to the Trajectory Rod so you can extend the bullet’s path of Trajectory further out in the room. You should ALWAYS site along the string and make sure it is lined up perfectly with the Trajectory Rod (not veering off at an angle) – otherwise, your trajectory results will be inaccurate.
8. This method of illustrating a bullet’s trajectory is sometimes called “**STRINGING**”, since a string can be used to let you see the bullet’s path (a laser can also be used in place of the string). However, this method is only as accurate as the person that “strings” the crime scene.
9. Leave your bullet hole and Trajectory Rod in place and continue on to Part 3.

If a bullet passes through only ONE object you can determine the bullet’s Trajectory by inserting a Trajectory Rod in the single bullet hole made by the bullet and extending a string to illustrate the bullet’s trajectory path.

### Part 3 – Accurately Sketching A Bullet’s Trajectory At A Crime Scene

1. An accurate sketch showing bullet trajectories at a crime scene can be very useful. A sketch can be used to help you analyze a crime scene to determine a shooter’s location, help you tell the story of how a crime occurred, or can be used in court to help a jury see how shots at a crime were fired.
2. You have already worked with crime scene sketches in Part 1 of this Training Lab. These sketches illustrated a Top View and Side View of the crime scene. In this part of the Training Lab you will be sketching a single, three-dimensional view of the crime scene.
3. Complete the following steps to make accurate measurements of the crime scene you constructed in Part 2 of this Training Lab. Make all measurements to the nearest INCH and record your measurements in Table 1 – “Measurements Of Bullet’s Trajectory”. See the sketch below for help in making your measurements.

#### HOW TO MEASURE THE CRIME SCENE

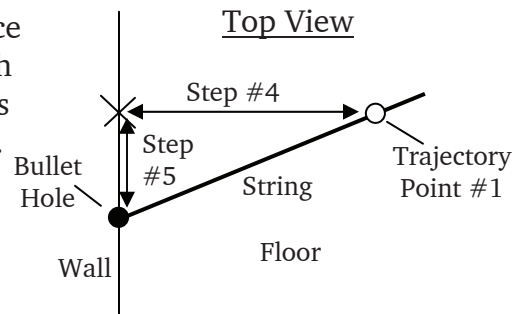
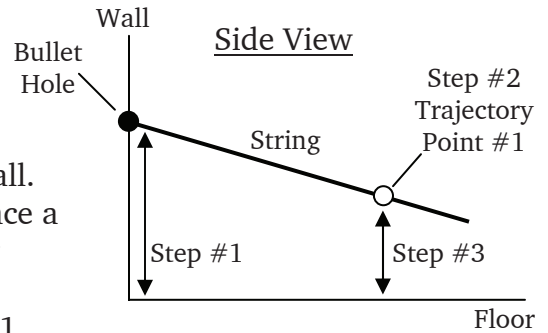
Step #1 – Measure the Height Of The Bullet Hole from the floor.

Step #2 – Extend the string from the Trajectory Rod to show the bullet’s trajectory. Pick a point along the string that is at least 3 feet from the wall. This point will be called Trajectory Point #1. Place a clip on the string at this point to mark Trajectory Point #1.

Step #3 – Measure the Height Of Trajectory Point #1.

Step #4 – Imagine a point on the floor DIRECTLY BELOW Trajectory Point #1. Measure the distance from this point, along the floor, to the wall (which is marked with an “X” in the sketch at right). This is the Distance From Trajectory Point #1 To Wall.

Step #5 – Finally, measure how far to the left or right Trajectory Point #1 is from the bullet hole (Trajectory Point #1 Side Distance). Simply measure along the floor from the “X” (described in Step #4 and shown in the sketch at right) to a point directly below the bullet hole. Also include an arrow with your measurement to remind you if the Side Distance is to the right or left of the bullet hole (examples: 34” → or 16” ← )

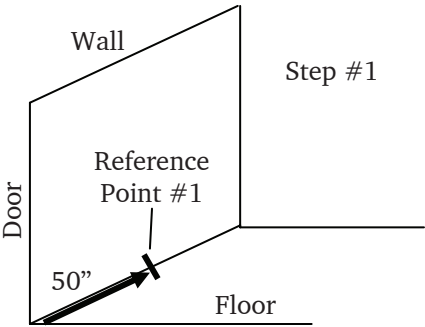


4. When finished observing/measuring the crime scene you should remove your bullet hole and tape from the wall, organize your Bullet Trajectory Kit (make sure you return the adhesive putty to its container, wind the trajectory string around the trajectory rod, and clip the string in place), and return everything to your supervisor.

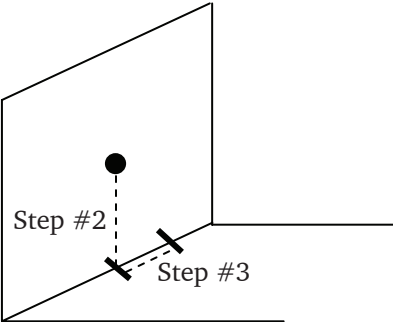
5. You can now use your measurements to help you make an accurate three-dimensional sketch of the bullet's trajectory through the crime scene. Complete your sketch using Figure 2 on your Data Page. The Scale for Figure 2 is: 1 mm = 1 inch. Follow the simple steps below to complete your sketch in Figure 2:

HOW TO SKETCH THE CRIME SCENE

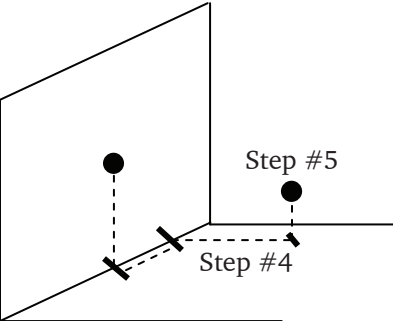
Step #1 – You should always begin your sketch with a REFERENCE OBJECT so your bullet hole can be placed in the correct position along the wall. For this activity we will pretend there was a door located along the left edge of the wall at the crime scene and you measured that the bullet hole was 50 inches to the right of this door. The door will be your Reference Object. On Figure 2, measure “50 inches” over from the left side (where the door is located) along the wall/floor border. Place a small pencil mark at this location and call this mark “Reference Point #1”  
The bullet hole will be located above this mark.



Step #2 – Measure the Height Of The Bullet Hole above the Reference Point (see Table 1) and place a dot where the bullet hole was located on the wall.

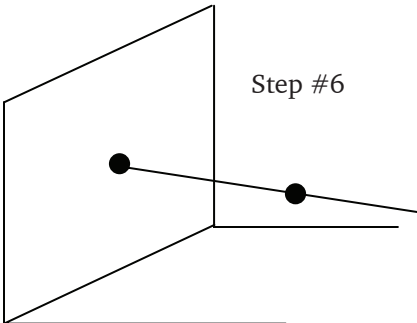


Step #3 – Measure the Trajectory Point #1 Side Distance to the right or left of the Reference Point (see Table 1) and place a small pencil mark at this location.



Step #4 – Begin at the pencil mark you made in Step #3 and measure the Distance From Trajectory Point #1 To Wall (see Table 1). Place a small pencil mark at this location.

Step #5 – Begin at the pencil mark you made in Step #4 and measure the Height Of Trajectory Point #1 (see Table 1). Place a small dot at this location. This is your Trajectory Point #1 location.



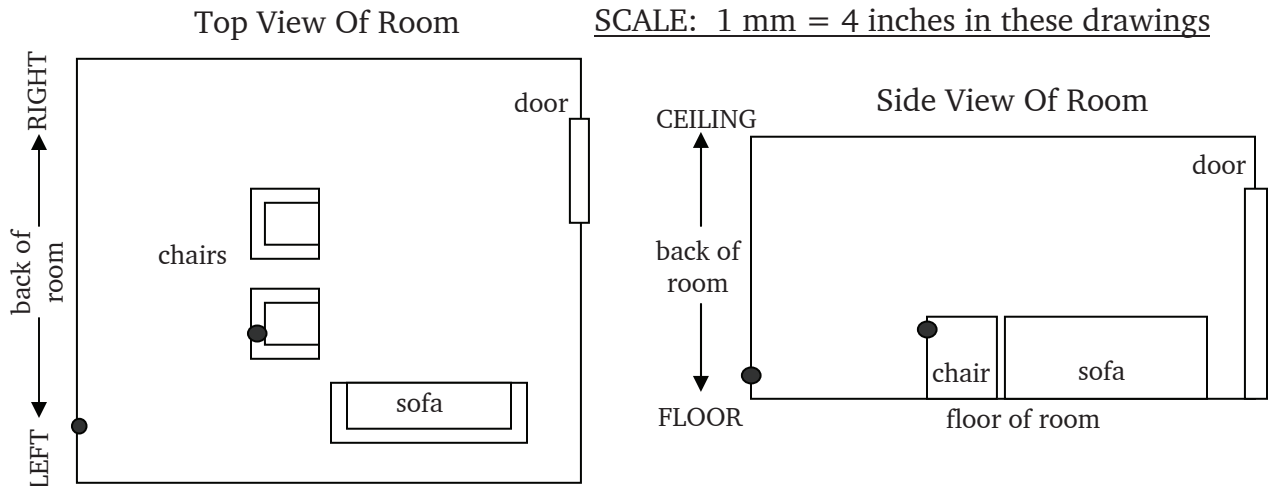
Step #6 – Draw a straight line through the two points on your sketch (the bullet hole point and the Trajectory Point #1 point). This line represents an exact replica of the bullet's trajectory through the crime scene in a three-dimensional view. You should be able to look at your sketch and tell if the bullet's trajectory went up or down, and left or right in the crime scene. You can erase all the small pencil marks you used to make your sketch.

6. Complete “Questions For Figure 2” on the Data Page to answer questions about the crime scene you sketched in Figure 2.

**BULLET TRAJECTORY DATA PAGE** NAME \_\_\_\_\_

PART 1 - DETERMINING BULLET TRAJECTORY BASED ON TWO BULLET HOLES

Figure 1 – Top View and Side View of the crime scene. ● = bullet hole



Questions For Figure 1

1. Did the shooter fire toward the middle, left, or right side of the room? \_\_\_\_\_
2. Did the shooter fire toward the front or back of the room? \_\_\_\_\_
3. Did the shooter fire toward the floor, toward the ceiling, or level? \_\_\_\_\_
4. Assume an innocent bystander was sitting on the sofa at the crime scene when the bullet was fired. Would you expect the bullet to hit the bystander? (yes or no) \_\_\_\_\_
5. Based on the bullet's trajectory (and the Scale of the room: 1mm = 4 inches) do you think it is likely that the shooter was standing in the doorway when the shot was fired? (yes or no) Explain your answer.  
\_\_\_\_\_
6. Assume the shooter was about 6 feet tall and fired the gun from a normal, standing position. First, place an "X" in the Side View of the crime scene where you think the shooter was most likely standing, then place an "X" to show the location of the shooter in the Top View of the crime scene. Explain why you chose this location.
7. Why is it helpful to see TWO views of the crime scene (Top View and Side View)?

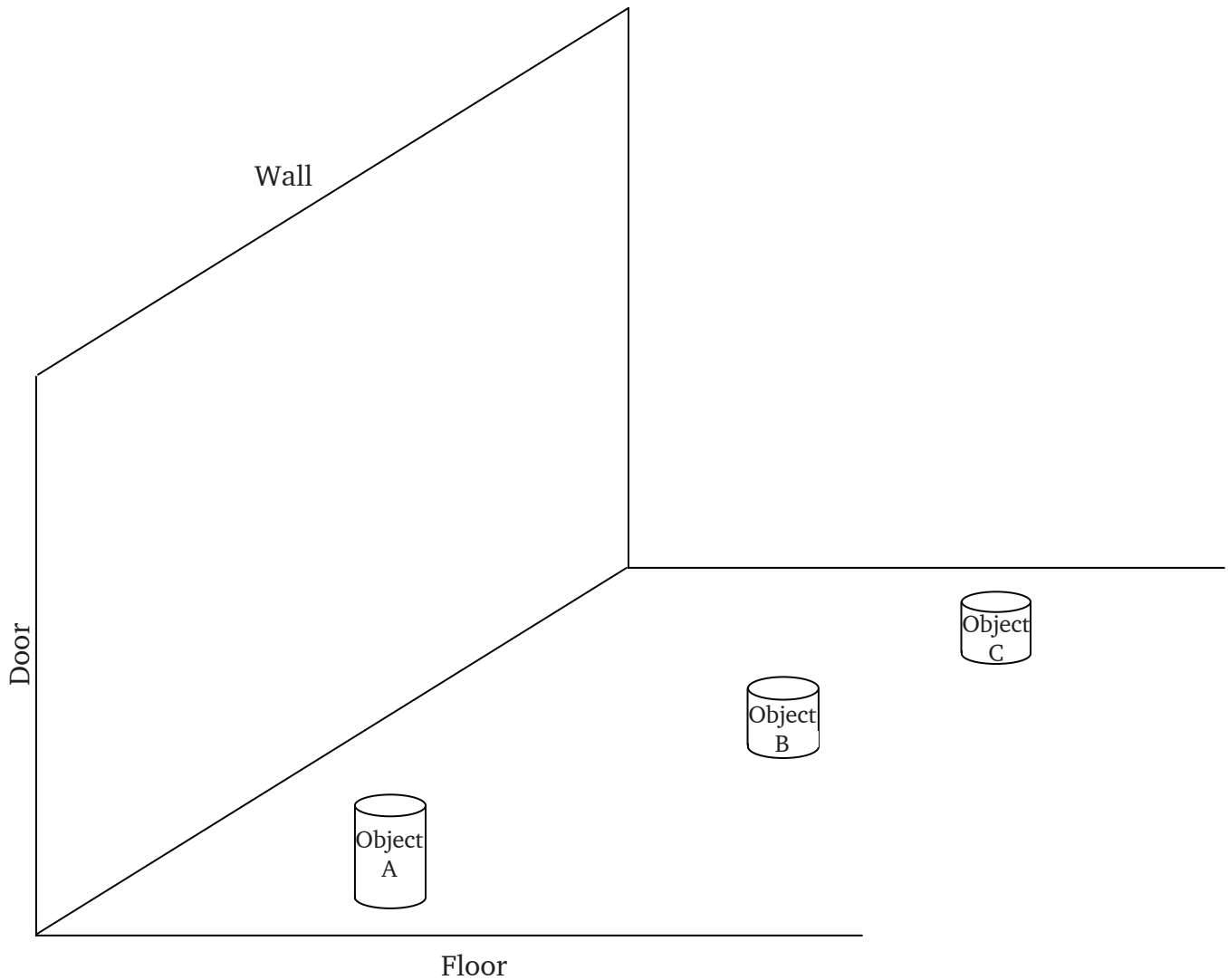
PART 3 - DETERMINING BULLET TRAJECTORY BASED ON ONE SINGLE BULLET HOLE

Table 1 – Measurements of bullet's trajectory

Height Of The Bullet Hole (inches)	Height Of Trajectory Point #1 (inches)	Distance From Trajectory Point #1 To Wall (inches)	Trajectory Point #1 Side Distance (inches) with arrow direction

Figure 2 – Three-dimensional view of the crime scene.

Scale: 1 mm = 1 inch in this drawing



Questions For Figure 2

1. Did the bullet travel toward the middle, left, or right side of the crime scene?

\_\_\_\_\_

2. Did the bullet travel toward the floor, toward the ceiling, or level? \_\_\_\_\_

3. Assume the gun in this crime scene fired accidentally when it was dropped on the floor. Based on the trajectory of the bullet, and using objects “A”, “B”, and “C” (which are sitting on the floor of the crime scene) to help you with perspective, determine the approximate location where you think the gun hit the floor and fired.

Place an “X” on the floor of your crime scene sketch to show the location where you think the gun hit the floor and fired. (simply draw an arrow at the end of your trajectory line if you think the gun hit the floor somewhere beyond the edge of the page)

4. The bullet that was fired at the crime scene \_\_\_\_\_. (circle one of the answers below)

A. hit Object A

C. hit Object C

B. hit Object B

D. did NOT hit any of the objects

5. Explain why it is difficult to determine a shooter’s EXACT location based on the trajectory of a single bullet.

6. Which type of crime scene sketch do you think is easier to use – the Top View + Side View sketch (like in Figure 1) OR the three-dimensional sketch (like in Figure 2). Explain your answer.

Use the following scale for Questions #4-6. Scale = 1 to 10 (10 = highest, 5 = middle)

7. I feel confident that I can determine a bullet’s trajectory at a crime scene \_\_\_\_\_

8. I feel confident that I can accurately take all the measurements at a crime scene needed to recreate a bullet’s trajectory in a sketch

\_\_\_\_\_

9. I feel confident that I can accurately recreate a bullet’s trajectory in a sketch \_\_\_\_\_