Name: _____ Date: _____

**Simulation: PHET PROJECTILE MOTION Part 1**

**Part 1: HORIZONTAL PROJECTILE**

**Purpose:** You will investigate what happens to projectile motion as objects are launched horizontally at different initial speeds (how fast they leave the cannon) from the same height above the ground.

Go to the website:
https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html

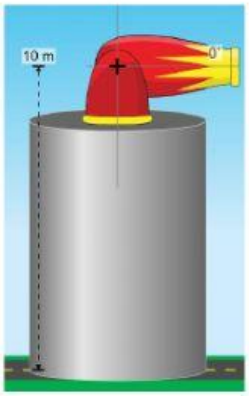
Choose the option: INTRO

**Instructions**

1. Choose the projectile: **Cannonball.** Do not choose any other options (air resistance, velocity vectors, acceleration vectors) from the pale yellow menu in the upper right corner of the screen.


2. Click on the cannon. Drag the cannon upward to a height of 10 meters. All launches will be from 10 m above the ground. **Do not change this setting.**

3. Rotate the barrel of the cannon to 0º. All launches will be at 0º angle. **Do not change this setting.**



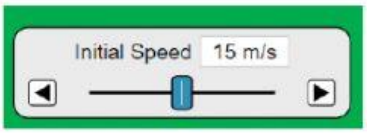

4. Pull the blue Time, Range, Height crosshair device from the upper right corner into the blue field.

5. Starting from an initial launch speed of 0 m/s, launch the projectile. The projectile will move from the cannon to the ground.


6. Position the crosshairs of the crosshair device over the dot where projectile where it impacted the ground. Record the range (horizontal distance) and time (time of flight).


7. **Do not clear the screen.** Change the initial launch speed to 5 m/s, and repeat.


8. Continue the activity, increasing the initial launch speed by increments of 5 m/s up to 30 m/s.




9. You can zoom in or out using the magnifying glasses with + or – to see the trajectory.

## DATA TABLE

| Launch Height (m) | Initial speed (m/s) | Launch Angle | Range (m) | Time of Flight (s) |
|---|---|---|---|---|
| **10 m** | **0 m/s** | 0 | | |
| **10 m** | **5 m/s** | 0 | | |
| **10 m** | **10 m/s** | 0 | | |
| **10 m** | **15 m/s** | 0 | | |
| **10 m** | **20 m/s** | 0 | | |
| **10 m** | **25 m/s** | 0 | | |
| **10 m** | **30 m/s** | 0 | | |

| | |
|---|---|
| Which parameter did you manipulate in this activity? How did you manipulate that parameter? | |
| Compare the ranges of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Compare the time of flights for of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Finish the sentence about this simulation | If you launch a horizontal projectile from the same height above the ground, but you increase the initial launch speed… |

## Part 2: HORIZONTAL PROJECTILE

**Purpose:** You will investigate what happens to projectile motion as objects are launched horizontally at the same initial speed (how fast they leave the cannon) from the different heights above the ground.

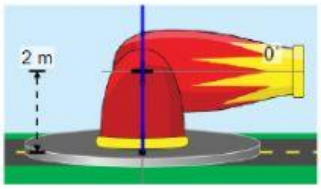
Go to the website:
https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html

Choose the option: INTRO

### Instructions

1. Choose the projectile: **Cannonball.** Do not choose any other options (air resistance, velocity vectors, acceleration vectors) from the pale yellow menu in the upper right corner of the screen.


2. Click on the cannon. Drag the cannon upward to a height of 2 meters. This height will change as you complete this simulation.

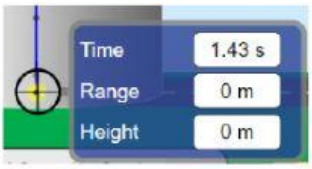



3. Rotate the barrel of the cannon to 0º. All launches will be at 0º angle. **Do not change this setting.**

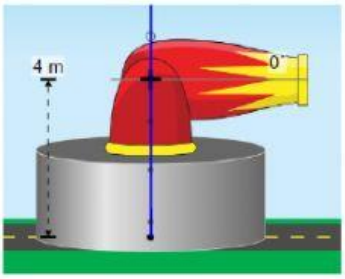
4. Pull the blue Time, Range, Height crosshair device from the upper right corner into the blue field.


5. Starting from an initial launch speed of 15 m/s, launch the projectile. The projectile will move from the cannon to the ground. **Do not change this setting**.

6. Position the crosshairs of the crosshair device over the dot where projectile where it impacted the ground. Record the range (horizontal distance) and time (time of flight).




7. **Do not clear the screen.** Continue the activity, increasing the cannon's height above the ground by increments of 2 m up to a height of 12 meters above the ground. Repeat the steps.




8. You can zoom in or out using the magnifying glasses with + or – to see the trajectory.

**DATA TABLE**

| Launch Height (m) | Initial Speed (m/s) | Launch angle | Range (m) | Time of flight (s) |
|---|---|---|---|---|
| 2 m | 15 | 0 | | |
| 4 m | 15 | 0 | | |
| 6 m | 15 | 0 | | |
| 8 m | 15 | 0 | | |
| 10 m | 15 | 0 | | |
| 12 m | 15 | 0 | | |

| | |
|---|---|
| Which parameter did you manipulate in this activity? How did you manipulate that parameter? | |
| Compare the ranges of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Compare the time of flights for of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Finish the sentence about this simulation | If you launch a horizontal projectile from different heights above the ground, but you keep the launch speed the same… |

## Part 3: VERTICAL PROJECTILE

**Purpose:** You will investigate what happens to projectile motion as objects are launched vertically at the different initial speeds (how fast they leave the cannon) from the same height above the ground.

Go to the website:
https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html

Choose the option: INTRO

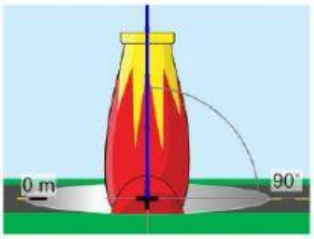
**Instructions**

**Instructions**

1. Choose the projectile: **Cannonball.** Do not choose any other options (air resistance, velocity vectors, acceleration vectors) from the pale yellow menu in the upper right corner of the screen.


2. Click on the cannon. Drag the cannon downward to 0 meters. Do not change this setting.

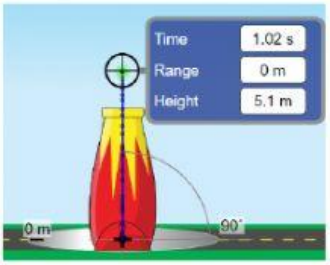
3. Rotate the barrel of the cannon to 90°. All launches will be at 90° angle. **Do not change this setting.**



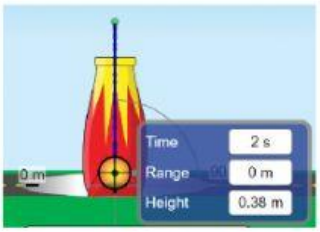

4. Pull the blue Time, Range, Height crosshair device from the upper right corner into the blue field.


5. Starting from an initial launch speed of 5 m/s, launch the projectile. The projectile will upward, reach the highest position above the ground, then fall to the ground.

6. Position the crosshairs of the crosshair device over the projectile's trajectory at the highest position above the ground (a green dot). Record the maximum height.

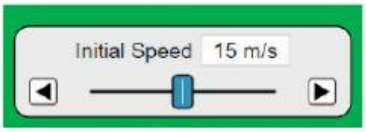



7. Position the crosshairs of the crosshair device over the project where it impacted the ground. Record the range (horizontal distance) and time (total total time of flight).




8. **Clear the screen.** Change the initial launch speed to 10 m/s, and repeat the steps.


9. Continue the activity, increasing the initial launch speed by increments of 5 m/s up to 30 m/s.




10. You can zoom in or out using the magnifying glasses with + or – to see the trajectory.

## DATA TABLE

| Launch Height (m) | Initial Speed (m/s) | Launch angle | Maximum Height (m) | Range (m) | Time of flight (s) |
|---|---|---|---|---|---|
| 0 m | 5 | 90 | | 0 | |
| 0 m | 10 | 90 | | 0 | |
| 0 m | 15 | 90 | | 0 | |
| 0 m | 20 | 90 | | 0 | |
| 0 m | 25 | 90 | | 0 | |
| 0 m | 30 | 90 | | 0 | |

| | |
|---|---|
| Which parameter did you manipulate in this activity? How did you manipulate that parameter? | |
| Compare the maximum heights of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Compare the total time of flight of the projectiles.<br>• What is the pattern?<br>• Why do you see this pattern? | |
| Finish the sentence about this simulation | If you launch a vertical projectile from the same place, but increase the initial launch speed… |