Name: _____ Date: _____

Simulation: PHET PROJECTILE MOTION Part 2
Part 4: PARABOLIC PROJECTILE

Purpose: You will investigate what happens to projectile motion as objects are launched at different launch angles (the initial direction) from the same height above the ground and with the same initial launch speed.

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

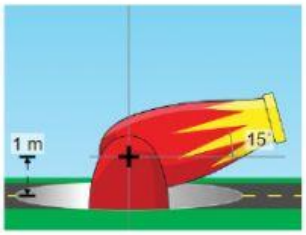
Choose the option: INTRO

Instructions

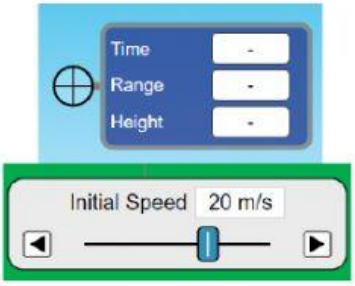
1. Choose the projectile: **Cannonball.** Do not choose any other options (air resistance, velocity vectors, acceleration vectors) from the pale yellow menu in the upper right corner of the screen.

2. Click on the cannon. Drag the cannon downward such that the cannon's height is 1 m.

3. Rotate the barrel of the cannon to 15º.

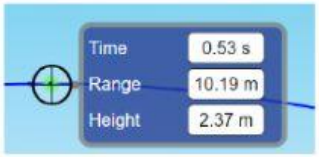


4. Pull the blue Time, Range, Height crosshair device from the upper right corner into the blue field.

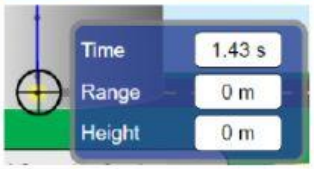


5. Starting from an initial launch speed of 20 m/s, launch the projectile. The projectile will move from the cannon to the ground. (20 m/s launch speed is the same for all in this part).

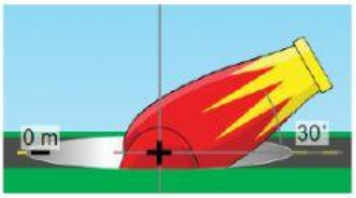
6. Position the crosshairs of the crosshair device over the green dot where the projectile was the highest above the ground. Record the maximum height



7. 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. **Clear the screen.** Lower the cannon to 0 m. The height of 0 m will be used for the rest of this part. Do not change the height.



8. Rotate the barrel to 30°, and then launch the projectile.

9. Measure the maximum height, the range, and the time of flight with the crosshairs device as described in steps 6 & 7.

Change the launch angle to 45°, 60° & 75° and repeat the steps.

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

DATA TABLE

DATA TABLE

Launch Height (m)	Initial Speed (m/s)	Launch angle	Maximum Height (m)	Range (m)	Time of flight (s)
1 m***	20	15°			
0 m	20	30°			
0 m	20	45°			
0 m	20	60°			
0 m	20	75°			

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

Part 5: PARABOLIC PROJECTILE

Purpose: You will investigate what happens to projectile motion as objects are launched at different initial launch speeds (how fast) from the same height above the ground and at the same initial launch angle.

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

Choose the option: INTRO

Instructions

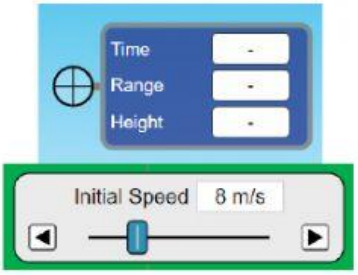
1. Choose the projectile: **Cannonball.** Do not choose any other options (air resistance, velocity vectors, acceleration vectors) from the pale yellow menu in the upper right corner of the screen.

2. Click on the cannon. Drag the cannon downward such that the cannon's height is 0 m. **Do not change the height setting.**

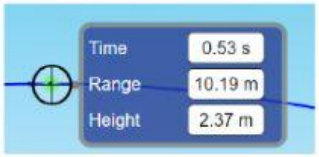
3. Rotate the barrel of the cannon to 45°

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

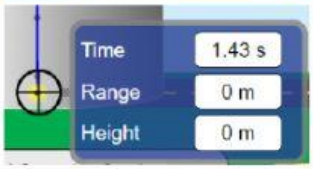
5. Starting from an initial launch speed of 8 m/s, launch the projectile. The projectile will move from the cannon to the ground.



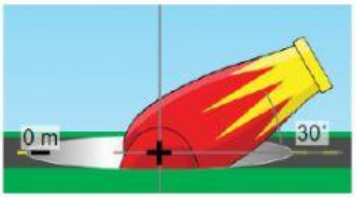
6. Position the crosshairs of the crosshair device over the green dot where the projectile was the highest above the ground. Record the maximum height



7. 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).



8. **Clear the screen.** Change the initial launch speed to 12 m/s. Repeat the steps to measure maximum height, range, and time of flight.



Change the initial launch speed to 16, 20, 24, and 28 m/s and repeat the steps.

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

DATA TABLE

DATA TABLE

Launch Height (m)	Initial Speed (m/s)	Launch angle	Maximum Height (m)	Range (m)	Time of flight (s)
0 m	8	45°			
0 m	12	45°			
0 m	16	45°			
0 m	20	45°			
0 m	24	45°			
0 m	28	45°			

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