PROJECTILE MOTION

Independent horizontal and vertical motion

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **How do the horizontal and vertical launch components affect a projectile's trajectory?**

TIME 30 minutes	SIMULATION BuildPhysics > Projectile motion	UNIT 1 Kinematics

Learning targets

- Separate projectile motion into horizontal and vertical components.
- Determine how v_x affects range and how v_{y0} affects flight time and maximum height.
- Use g = 9.8 m/s² to connect measured motion with kinematic predictions.

Model before you measure

Ignore air resistance. Horizontal acceleration is zero; vertical acceleration is constant and downward.	**Projectile model** $x = x_0 + v_x t$ $y = y_0 + v_{y0} t - \frac{1}{2} g t^2$ $v_y = v_{y0} - gt$
Use throughout: g = 9.8 m/s² downward. The launch and landing surfaces are at the same height in this preset.	

Pre-lab prediction | 4 minutes

1. If v_x increases while v_{y0} stays constant, predict the changes in flight time, maximum height, and range.

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2. If v_{y0} increases while v_x stays constant, predict the same three quantities.

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PART A Change horizontal velocity

Setup | 3 minutes

☐ Load Projectile motion. Select the Projectile.

☐ Turn on trail, vector values, vector components, and graph data.

☐ Keep v_{y0} = +6.0 m/s. Change only v_x using the object velocity controls.

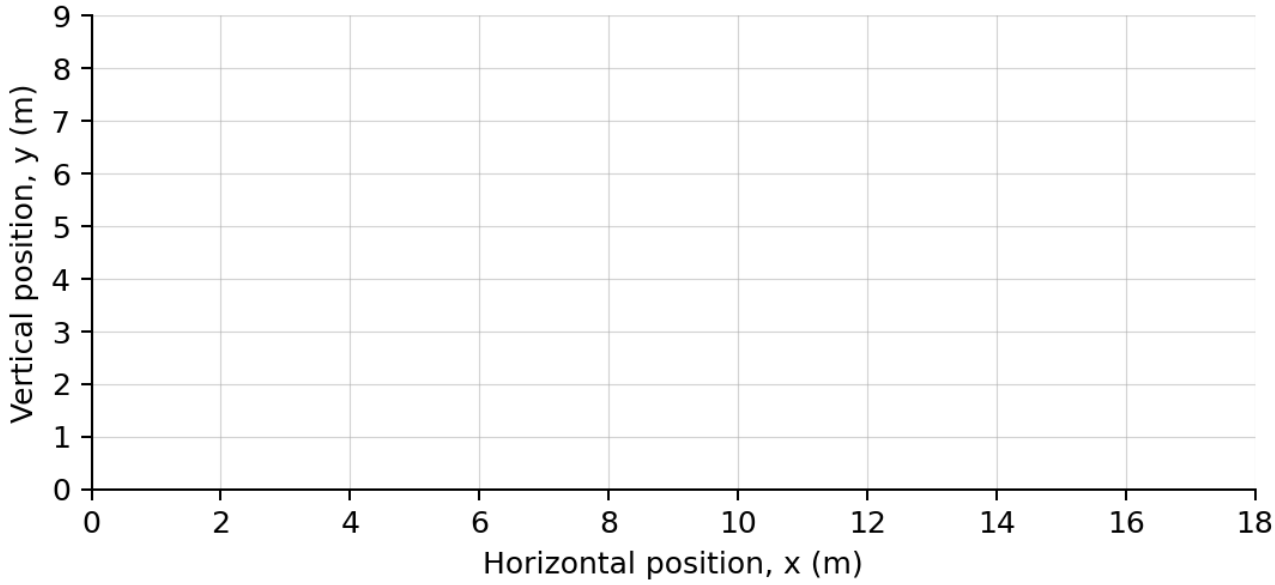
☐ Reset before each trial. Run until the projectile first returns to the ground.

Data table | 8 minutes

Trial	v_x (m/s)	v_{y0} (m/s)	Flight time (s)	Maximum y (m)	Range Δx (m)	v_x before landing
1	4.0	6.0				
2	7.0	6.0				
3	10.0	6.0				

3. Which measured quantities stayed nearly unchanged as v_x changed?

4. Describe the relationship between v_x and horizontal range.



Sketch the three trajectories on the same axes and label each v_x.

PART B Change vertical velocity and analyze

Controlled trials | 8 minutes

Keep v_x = +7.0 m/s. Change only v_{y0}.

Trial	v_x (m/s)	v_{y0} (m/s)	Flight time (s)	Maximum y (m)	Range Δx (m)	v_y just before landing
1	7.0	3.0				
2	7.0	6.0				
3	7.0	9.0				

Analysis | 7 minutes

5. How did increasing v_{y0} affect flight time and maximum height?

6. Why did v_x remain nearly constant throughout each flight?

7. For a same-height landing, compare the magnitude of v_y just before landing with v_{y0}.

8. Use g = 9.8 m/s² to predict the flight time for v_{y0} = 8.0 m/s. Then predict the range if v_x = 5.0 m/s.

Claim-Evidence-Reasoning conclusion

Evaluate this statement: “The horizontal velocity of a projectile changes because gravity pulls the projectile downward.”

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measurements or graph features.
REASONING	Connect your evidence to the kinematics model.

Exit ticket

A projectile has v_x = 6.0 m/s and v_{y0} = 4.0 m/s. State a_x and a_y during flight.