

Curriculum Units and Learning Outcomes

Content Area: Conceptual Physics	Grade Level: 12
Unit Title: Projectile Motion	
Unit Summary: Projectile motion (2 Dimensional motion) can be described by the horizontal (x) and vertical (y) components of motion. Classroom discussion will include the importance that in the absence of friction; the horizontal component remains unchanged, whereas the vertical component changes due to gravity. Students will be introduced to the analysis of 2D motion by applying the equations of kinematics to motion situations in the x and y planes. Students should recognize the independence of x and y quantities and the application of vector analysis. Students will demonstrate knowledge of 2D kinematics by analyzing projectile motion situations. Lab experiences will include analyzing the trajectory of a projectile fired both horizontally and at an angle.	
Massachusetts Standards: <ul style="list-style-type: none">● HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion is a mathematical model describing change in motion (the acceleration) of objects when acted on by a net force.<ul style="list-style-type: none">○ Clarification Statements: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, and a moving object being pulled by a constant force. Forces can include contact forces, including friction, and forces acting at a distance, such as gravity and magnetic forces● HS-PS2-10(MA). Use free-body force diagrams, algebraic expressions, and Newton’s laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations.<ul style="list-style-type: none">○ Clarification Statements: Predictions of changes in motion can be made numerically, graphically, and algebraically using basic equations for velocity, constant acceleration, and Newton’s first and second laws. Forces can include contact forces, including friction, and forces acting at a distance, such as gravity and magnetic forces.	

- (Note: Projectile Motion; 2 Dimensional Motion is not part of the grade 9-10 Mass Frameworks, but Should be taught in a Junior/ Senior Level Physics Course)

Enduring Understandings: Students will understand that:

- Projectile Motion can be described by the “constant” horizontal and “accelerated” vertical components of motion.
- Perpendicular vectors quantities act independently of each other.

Essential Questions:

- How is motion analyzed in two dimensions?

Students will demonstrate KNOWLEDGE of:

- 2D kinematics by analyzing situations of motion in the x and y plane such as projectile motion and river crossings.
- The independence of x and y quantities and the application of vector analysis.

Students will be SKILLED at:

- Resolving vectors into perpendicular components
- Describing how the components of a vector affect each other
- Describing the components of projectile motion (horizontal and vertical)
- Applying kinematic equations to 2D motion
- Analyzing symmetry of trajectories

Estimated Duration: 3-4 weeks