

Activity: Dart Gun Projectiles

Motion in Two Dimensions

(AI Level 1 unless producing a formal lab report. Formal lab reports are partial AI Level 2)

Problem: Measure the total travel time for a rubber dart shot straight upward. Use that information to determine launch velocity and maximum height traveled by the dart.

Questions to consider:

How will I keep the measurements controlled well enough for them to be repeatable?

How many trials will I need to conduct in order to be sure of the measurement?

How are vertical time and velocity with gravitational acceleration related?

How can distance be determined from vertical time and launch velocity when the dart is falling under the influence of gravity?

Why might the measured results and calculated results be different?

Analysis:

What is the total time the dart was in the air?

How much time did it take for the dart to fall from its maximum height to the launch point?

What is the velocity of the dart at the maximum height (peak)?

What is the velocity of the dart when it returns from the peak to the same height of launch?

What was the velocity of the dart the instant it left the gun (launch velocity)?

How high did the dart travel?

Using research, find the angle at which to fire the dart so that it will achieve maximum range (horizontal displacement).

Draw a vector diagram to show the horizontal and vertical components of the calculated initial dart velocity when it is fired at the maximum range angle.

Draw a vector diagram to show the horizontal and vertical components of displacement at this angle.

Determine mathematically the horizontal and vertical velocity vector quantities.

Calculate the time for half of the trip (launch to peak or peak to ground).

Calculate the predicted horizontal displacement.

Discrepancy: Position the gun at the angle that will provide for maximum range and launch the dart. Measure the distance that the dart traveled and the total time it was in the air (time of flight). Determine the percent discrepancy between the actual and the calculated prediction.

Targets for Learning:

00-01 I can write lab reports using a style appropriate for science.

00-02 I can collect quantitative and qualitative data with accuracy and precision.

00-03 I can analyze and interpret data and mathematical relationships.

01-01 I can use math and graphs to describe motion.

02-01 I can interpret graphically and mathematically motion in two directions.

02-02 I can analyze the trajectory of a projectile.