**Potato Launcher Project!!!**

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 **Purpose:** To develop understanding of energy, momentum conservation laws, projectile motion, and demonstrate their power in explaining everyday motion.

**Background Questions to Research (be sure to add any information you also looked up here as well):**

1. What is ballistics?
2. Describe the difference between Interior, Exterior, Impact, and Target Ballistics. Which will we be analyzing in this lab?
3. What is work?
4. How do we calculate energy?
5. What equations are necessary in order to carry out this project?
6. What variables do we need to record in order to complete this project?
7. Is it acceptable to ignore air resistance in this project?
8. What else will you need to consider when completing this project?

**Hypothesis:** Write a hypothesis of which angle you think will go the furthest and why.

**Process and Ultimate Goal:**

In this lesson, students will be divided into groups of 2 or 3. Groups will fire the launcher at **multiple angles** and record the mass of the potato, the flight time, launcher angle and the flight distance. Students will create a digital presentation (Prezi, Powerpoint, etc.) where they must calculate the following values from their measurements.

* Δy (max height)
* Muzzle velocity
* Work done by the cannon to reach Δy
* Kinetic energy of the potato at the muzzle
* **Ultimate Goal:** to predict at what angle will have the maximum distance traveled and test it!
	+ Winners will receive a prize!

**Materials Needed (supplies, hand-outs, resources):**

* Potato launcher w/ fuel and potatoes 🡪 we may be building this as a class
* Protractor w/ plumb line
* A small saw horse

**Project Relevance:**

Collisions occur often in everyday life, and it is often desirable to know the initial velocities of objects before a collision. Forensic scientists can use conservation laws to determine the conditions before and after a collision, such as a car wreck or gunshot.

**Guided Practice:**

The following roles need to be filled at each launch point:

1. Data recorder/Δt measurer: Records all data/measures the flight time
2. Angle measurers/Δx measures: before loading, sets the launcher to 5 predetermined angles and marks (the sidewalk with) the location of the butt of the launcher/measures flight distance
3. Spotter: spots the potato’s landing
4. Potato Loader: Loads the potato down into the barrel just before the firing chamber
5. Firing Team: Fuels, sets the angle wand fires the launcher

**Presentation Requirements:**

*You must include the following in your presentation. Be sure that each individual also writes this information in his or her lab books as a rough draft.*

1. **Introduction:** In this section, you will frame the problem, make a hypothesis, and provide the necessary background for any classmate to understand your procedure. Your introduction needs to address the following:
	1. **Problem Statement:** Clearly state the problem you are trying to solve.
	2. **Hypothesis:** Your hypothesis should be directly related to the problem and be testable.
	3. **Background:** Give a brief (1-2 paragraphs) description of the process involved as well as the overall procedure. This is not a step-by-step procedure, but rather a narrative of what is important. Someone should be able to read this section and understand how you intend to solve the problem.
2. **Procedural Sections:**
	1. **List of Materials Used**
	2. **Safety Precautions**
	3. **Procedure:** Make sure that any modifications or adjustments to the procedure are reflected in your final draft and written in the presentation.
3. **Data Section:**
	1. **Data:** Make sure you record all of your data in a neat and organized manner.
		1. Note: Can be graphically, in a table, etc.
	2. **Observations:** Record observations that you made throughout the lab.
	3. **Significant figures and units:** Ensure that all measurements include the appropriate number of significant figures and that all values have units. Someone should be able to look at your data section and know what each piece of data means.
4. **Analysis and Interpretation:**
	1. **Calculations:** Show all calculations you have made with the data you collected. Clearly show all units and significant figures.
	2. **Identify the Angle:** Include a short paragraph in which you identify the angle and explain your reasoning. Describe whether your calculations gave you results that exactly matched what you expected. If they didn’t, how were they different?
	3. **Experimental Errors:** Include another paragraph in which you assess experimental error – include a discussion of what errors might have been made in the performance of the experiment and how they might have affected the outcome. Someone reading this section should be able to follow your reasoning for identification of the unknown and understand what errors you felt were important.