Lesson Title	Potato Launcher Energy Lab
Length of Lesson	2 Days
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Subject	Physics
Grade Level	11-12
State Standards	Physics: 3 a, b; 4 a;
DOK Level	DOK 3
DOK Application	Investigate, Draw Conclusions
National Standards	9-12: B (physical);
Graduate Research Element	Conservation of Energy and Momentum

Student Learning Goal: Develop student understanding of energy and momentum conservation laws and demonstrate their power in explaining everyday motion.

Physics: 3. Develop an understanding of concepts related to work and energy: (a) Explain and apply the conservation of energy and momentum; (b) Analyze real-world applications to draw conclusions about mechanical potential energy (the energy of configuration) - Concept of conservation of energy with simple examples.

National Science Education Standards of Content 9-12
B (Physical): Conservation of energy and the increase in disorder: All energy can be considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.

Materials Needed (supplies, hand-outs, resources):
Potato launcher w/ fuel and potatoes, protractor w/ plumb line, a small saw horse, and some sidewalk chalk.

Lesson Performance Task/Assessment:
In this lesson, students will be divided into large groups of ten. 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 write a lab report 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
- Power output of the launcher (KE/(barrel length/0.5*Vo))
- The initial recoil of the cannon

Lesson Relevance to Performance Task and Students:
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.

Anticipatory Set/Capture Interest:
"Today you will be trained how to operate and evaluate the Funderburk Mark III spud launcher."

Guided Practice:
Since the setup for this lab is a bit complicated, the teacher should set up all equipment before class. The teacher will then spend the first day to demonstrate the method for taking data and running and example lab with the claculations. The teacher should then divide student groups into groups of 10.

Each person will have one of the following roles:

(1)Data recorder/Δt measurer : Records all data/measures the flight time
(1)Δt measurer : Also 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
(1)Potato cutter/Spotter : cuts the potato to equal lengths/spots the potato's landing
(2)Spotter : spots the potato's landing
(1) Potato Loader : Loads the potato down into the barrel just before the firing chamber
(2) Firing Team : Fuels, sets the angle with a sidewalk mark, and fires the launcher

Independent Practice:
Day 2: Students will follow their roles and fire the cannon and collect their data.

Remediation and/or Enrichment:
R: individual IEP; partner help throughout lesson

E: Students can attach the pendulum arm in the middle and analyze the resulting motion using the equations of rotational motion.

Check(s) for Understanding:
During what parts of the experiment is energy conserved? Why do we need to use conservation of momentum?

Closure:
What are some of the applications of an experiment like this one?

Possible Alternate Subject Integrations:
*Math- Trigonometry is used in both calculations of muzzle velocity.