Aerospace Back to School Grant Lesson Plan

Class: Physics, William Siefert (teacher)	**Grade: 11th**
Unit: Kinematics, Dynamics and Engineering Design	**Lesson Title:** ***Exploring rocketry with compressed air, it's a blast!***

Lesson Rationale:

This lesson plan promotes student engagement in the topics of aeronautics, rocketry and projectile motion through a hands-on construction activity, observation, and experimentation with model rockets using a compressed air launcher. Reliable, safe, and sustainable launching equipment is necessary for the success of this plan. If awarded, funds will be used to purchase a Precision Air-Powered Projectile launcher which is designed to launch consistently and be durable enough to last through many trials.

NGSS (Next Generation Science Standards) Alignment:

HS-PS2-1 Motion and Stability: Forces and Interactions

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. 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 sliding down a ramp, or a moving object being pulled by a constant force.

HS-ETS1-2 Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.

Lesson Objectives:

Students will:

» design, build, and test a rocket/projectile to be launched using a compressed air precision launcher

» collect launch data and then apply the kinematic equations to quantitatively compute the characteristics of their rocket flight

» observe and document the effectiveness of their rocket design, make adjustments and test new versions of their design

Materials:

Precision Air-Powered Projectile launcher kit (Arbor Scientific)
Rockets for Precision Air-Powered Projectile launcher kit (Arbor Scientific)
Paper, adhesives, and supplies for student-made rockets (school materials)

Instructional Methods:

1. **Focus and review of background information**

   Students have been introduced to the study of motion and the mathematical equations used to describe an object's motion (kinematics) through class lecture and individual practice. Concepts to review include velocity, acceleration, free fall and gravity. The methods of the engineering design process are defined and discussed as a way to problem solve, develop solutions, test and make adjustments to prototypes to meet design criteria.

2. **Activity #1: Student construction and launching of paper model rocket**

   Students will learn about the structural features of a model rocket and the teacher will demonstrate the techniques used to make a paper rocket with the materials available in class. The challenge is to make a rocket that will fly the highest from a compressed air launcher. As students design their model, they will have to decide which variables to adjust based on the affect these variables will have on aerodynamics and flight time, like mass of the rocket, length, nose cone shape, and stabilizing fin design.

   Students will launch their rockets vertically using the projectile launcher kit and record flight time for their model. This data will be used to make calculations to determine initial velocity and height of flight.

   Students will then make and document modifications to their rockets and have another chance to launch their models.

   Assessment of student work will include checking their calculations for accuracy and a review of the completeness of their explanations and justifications for any adjustments made to their original rocket design.

3. Activity #2: Predicting trajectory range of a rocket

In this activity, students will explore projectile motion by changing the launch angle of a standardized rocket (provided in the kit). The basics of projectile motion as well as all calculations involved, will be explained and documented in class. By using the measured launch angle settings from the kit, along with launch velocity values calculated from previous launches, students will be able to predict the range of travel for the rocket from a known angle or compare that theoretical range with the measured range after the launch.

Assessment of student work will be based upon the accuracy of student generated calculations for this activity.

Differentiation According to Student Needs:

For students identified as having IEPs in place, the teacher will check for understanding, give guidance during construction and employ questioning techniques to enhance understanding of concepts as students carry out the activities.

List of Materials	Quantity	Price	Total
Rockets for Precision Air-Powered Projectile	4	$ 16.75	$ 67.00
Precision Air-Powered Projectile (launcher)	2	$199.00	$398.00
Shipping			$ 47.23

Total: $512.23*

*amount over covered by teacher