



Air Rocket Lab



INTRODUCTION

The Arbor Scientific Air-Powered Projectile (rocket) is fired straight upwards. As it goes up, four or five different groups of students collect data that becomes the class data for analysis. Three or four different values for the maximum height of the rocket are calculated and the results compared. In addition to multiple runs using the same thrust washer (Low, Medium, High or Super), runs can be done using different washers.

Concepts covered in this lab: impulse, momentum, kinematics of free fall, kinetic energy, trigonometry. In addition, students have to deal with several different measurements of the same quantity and how to work with averages.

This lab is carried out in a relatively large, open area of campus. For most schools, the football field would be a logical place to conduct the work. Use of a laptop computer and battery-powered LabPro is required.

MATERIALS

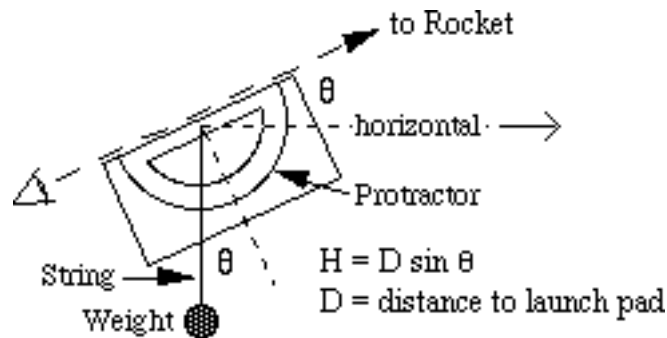
Air Rocket, Bicycle Air Pump, Force Plate, LabPro, Portable Computer with Logger Pro Software, Stop Watches, Altimeters, Measuring Tape. Optional: Video Camera, preferably digital.

GROUPS

(1) Launch Team: This group of 2-3 students is responsible for readying the air rocket for launch, then launching it in coordination with the other teams. Note that masking tape or electrical tape could be used to keep the rocket launch base in contact with the Force Plate and reduce errant launches.

(2) Timing Team: This group, armed with stop watches, records the total time in the air of the rocket. They are also responsible for developing and carrying out the calculations of maximum height of the rocket and stating their assumptions. They will present their results to the class.

(3) Trig Team: This group, equipped with altimeters as shown below, will move a measured distance away from the launch area so they can observe the vertical flight of the rocket. They record the angle at the highest point of the trajectory and calculate the height. The group will present its results to the class.



(4) Impulse Team: Using Vernier LabPro, Logger Pro and Force Plate, this group of 2-3 students will determine the impulse applied to the rocket during launch. Then based on the mass of the rocket, they will determine the maximum height. They will present their results to the class.

(5) Video Team: An optional group that trains a video camera on the launch pad as the rocket launches. Then they will attempt to follow its flight, recording the exact time when it lands on tape. By using frame-by-frame advancement of the tape, this group can verify the values obtained by Team 2. They can also record the lab for posterity. Members of the team can also use digital cameras to photograph different teams gathering and processing their data. They might also be assigned the task of producing a final presentation of the class' efforts and results.

EXTENSION

The pressure in the launch tube is several atmospheres at the point the rocket leaves. The Vernier Gas Pressure Sensor (GPS-BTA) has a maximum of 2 atmospheres. However, the older Pressure Sensor goes up to 6 atmospheres. A hole can be drilled in the launch tube and the rubber stopper and pressure fitting installed. Now you can measure the pressure vs. time during the launch. Determine the area inside the front of the rocket body. Force equals pressure times area, so you can determine the impulse a second way. This could be done at the same time that Team 4 is using the Force Plate or in place of the previously described group.

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