The lab entitled "Launching Lab" has been designed to help aid in the visualization and application of various linear and projectile motion equations used in Physics II class at ERHS. The linear motion equations we have already explored and this lab could be used as an introduction to, or in support of, projectile motion. Only a few new formulas and concepts will be introduced in the projectile motion unit. Those new ideas introduce few new variables in combination with a dissection of the previous equations. Many of the students will be able to utilize these new concepts without support. I like to use this activity to see which students will be able to move on independently, and then to assist those who need it.

As in any classroom, the diversity of learners is always a problem. Being able to reach all the students with all the different types of learning can be a difficult task. This hands-on outdoor lab has proven helpful for those students that need to do rather than see or hear. The ideas and formulas can be understood back in the classroom by visualizing the rockets flight path motion. Plus, this lab is so sweet!!! These rockets travel hundreds of feet in the air, and can fly the length of a football field. It's really a ton of fun.

The assessment for the activity is multi tiered. I would expect them to complete the lab in the time allotted. Sometimes being outside is a distraction for some students. I also ask that they use the previous equations to solve for variable in this activity. Everyone should be able to do this. Then, I ask them to try to solve the equations for projectile motion, offering assistance if needed. Sometimes it is only a few students, sometimes I have to address the whole class. Lastly, I ask them to check to see if their answers make sense. There will be groups that will need to recalculate at this point. The last thing I ask them to produce is a brief write-up for the lab. This, coupled with the actual lab report, has students explaining their calculations and will inevitably shed light on student comprehension.

The assessment of this unit is based on a few things. First, is to see if the numbers they have calculated fall in the accepted values for velocity, distance, time and acceleration (lab). Then, they need to explain how the new formulas are tied into the old explaining any variations (write-up). Lastly, they are evaluated on how well they "crunch the data" offering explanations and suggestions for the future. A point total is awarded for the generation of the numbers in the lab, and the answers to any questions. Then the lab report is graded based of the standard lab report format discussed in previous units.

LAUNCHING LAB!!

Name: _____ Date: _____ Hour: _____

Take it from Louie, one small step for mankind, and one giant leap for Physics at ERHS!! In an effort to support the linear motion equations from last chapter, and to introduce new equations from the current chapter, we will use air powered rockets to prove that projectile motion has its own unique set of equations. These equations can be used to calculate some of the same variables from last chapter, but they can also be used introduce new some new ideas.

Once you have gathered all your data, you will submit your labs to me and I will look them over to see if we are all on the same rocket ship. When everyone has received the green light, we will apply our data to the new projectile motion equations. We will calculate how high our rockets traveled, the horizontal and vertical velocities of our rockets, the horizontal and vertical accelerations and the forces of our rockets at impact and ignition. Plus anything else you might want to calculate, just for fun. Good luck and good hunting!!!!

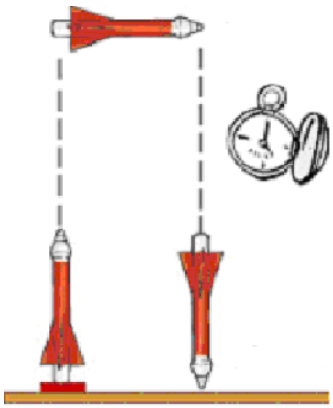
Launch 1

1) Obtain a pair of safety glasses. You must wear these at all times.

2) Select a launching site clear of obstructions and preferably about 50 meters in diameter. Attach the air pump. Set the rocket in launching position.

3) Select a thrust washer: Low, Medium, High, and Super. Snap the thrust washer onto the launcher top (be sure it snaps).

4) Push the rocket completely onto the launcher and attach the nose cone.



5) Stretch the air pump hose as far as you can so that you are away from the rocket. DO NOT lean over the rocket while pumping. Stand sideways to pump. Pump until the rocket launches automatically.

6) Have one team member time the rocket from take off till it hits the ground. Have another team member time the rocket from the time the rocket hits it's maximum altitude till it hits the ground. Record your results.

TRIAL	Full Trip Time	Full Trip Time/2	Half Trip Time
Trial 1			
Trial 2			
Trial 3			
Trial 4			
Average			

7) Have a teammate retrieve the rocket and nose cone.

8) Hypothetically, the rocket should land in the same location it took off from. We are assuming that there is no air resistance and the motion is in only **one** direction. You can now calculate the average velocity at which the rocket will travel using your selected washer. (Hint: you know acceleration)

9) Push the thrust washer out of the end of the rocket with your thumb or finger. If the washer is stuck, do not break it to push it out. Ask for help, please.

Calculations:

Average Velocity _____

Launch 2

1) Use the same thrust washer that you used in the first launch.

2) Obtain an angle wedge and insert into the base of the launch pad.

3) Launch projectile per directions above.

   a. Angle of wedge _____

4) Have one team member time the projectile from the time it launches to the time it hits the ground. Have another team member time the projectile starting when the projectile reaches its maximum height. Record the times in the table below

TRIAL	Full Trip Time	Full Trip Time/2	Half Trip Time
Trial 1			
Trial 2			
Trial 3			
Trial 4			
Trial 5			
Average			

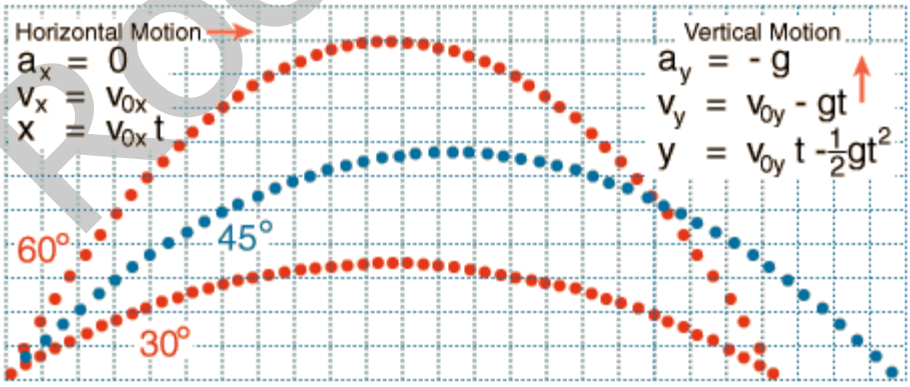
5) Have team members measure out the distance the projectile hit the ground. **Do not measure to the location the projectile bounced to**.

TRIAL	DISTANCE (m)
Trial 1	
Trial 2	
Trail 3	
Trial 4	
Trial 5	
Average	

6) What is the initial velocity in the x direction? What is the initial velocity in the Y direction? Hint: you know the initial velocity from Launch 1. Here are some general equations and diagrams if needed.

General Ballistic Trajectory

The motion of an object under the influence of gravity is determined completely by the acceleration of gravity, its launch speed, and launch angle provided air friction is negligible. The horizontal and vertical motions may be separated and described by the general motion equations for constant acceleration. The initial vector components of the velocity are used in the equations. The diagram shows trajectories with the same launch speed but different launch angles. Note that the 60 and 30 degree trajectories have the same range, as do any pair of launches at complementary angles. The launch at 45 degrees gives the maximum range.



http://hyperphysics.phy-astr.gsu.edu/Hbase/traj.html#tra2