Name _____ Date _____ Period _____

Lab: Designing a Water Rocket

C O N C E P T U A L P H Y S I C S

Directions: Follow the directions below to construct a high-quality rocket that will allow you to successfully complete your Engineering Challenge and demonstrate your understanding of forces, motion, momentum and energy transformations.

Purpose:

- Construct a water-powered rocket from the given materials.
- Assess the physics principles necessary to safely protect your payload, an egg, from the forces involved in "re-entry."
- Maximize launch height, while minimizing the forces during impact.

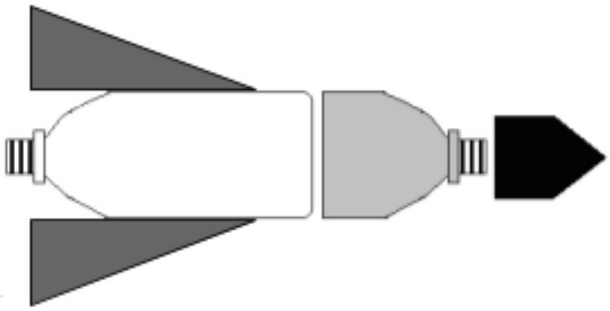

Figure 1: Sketch of Sample Rocket

Materials: *(If you cannot provide them for yourself, let your teacher know and we will provide them)*

- 2 2-liter soda bottles (empty)
- 1 egg (not hard boiled; wait till the last build day to bring this)
- Cardboard or other material to construct the fins // nose cone
- Decorations
- Duct tape
- Hot glue gun (optional - it helps put things together)
- Whatever materials you need for your insulation device.

Pay close attention to your design. Sketch it first, and then construct it. Be sure to photograph the process, as you will want to include these photos in your final report. You will want to make sure that your insulating device is intentionally designed to protect the payload, so make sure that your design is based on scientific principles and within your means to create.

Safety:

We will be launching rockets on **February 15th**. Try to have your rocket ready by the first day. If you are caught being unsafe during the construction and launching process, points will be deducted from your final score. Points withdrawn will vary depending on the severity of the infraction.

Your final report for your Chapter Challenge is due on February 22nd. We are on a tight schedule; so late rockets will not be accepted. If you are not prepared to launch by February 15th, you will automatically lose those points.

Essay Portion:

The majority of your grade will come from the essay portion of the Engineering Challenge; be sure to do your best on this section, as it will be a major portion of your grade for the semester!

For each of the selected sections in the book, you will respond to the Essential Questions; be sure to:

1. Fully explain the concept
2. Provide appropriate diagrams/pictures (include explanations that demonstrate their relevance).
3. Connect the concept to the design of your rocket or the observations from launch.

Part of your essay includes a section titled "**Reflection on Essay Design**." You will include the appropriate calculations to show how much energy your design did (or did not!) absorb; I will show you how to do this before the launch. You need to make sure that you include elements of your design and whether or not they worked. Be sure to include an explanation as to why you think your rocket performed the way it did! Make sure that you meet the following criteria:

- Provides a clear connection between concepts
- Appropriate amount of explanation
- Photographs of before/after with explanation of function.

As usual, take care to not make any spelling errors and following the appropriate format:

- Arial or Times New Roman; size 12 font.
- Single Spaced
- Section headers are in bold and underlined.
- Pictures/diagrams are labeled (ex. "Figure 1: Sketch of Sample Rocket")

Best of luck, scientists! Have fun!

ROCKET LAUNCH DATA SHEET

Name of Rocket:

Mass of rocket:

Without fuel: _____

With fuel: _____ *(700 ml = 0.7 kg)*

Total time of flight (t):

t=

Time of flight to max height (t_{up}):

t_{up}=

How fast was the rocket launched (v):

$v = g\ t_{up}$
Calculations:

Maximum Vertical height (d):

$d = ½\ g\ t_{up}^2$
Calculations:

Energy of impact:

$PE_g = mgh$
Calculations:

Velocity of Impact:

$V = t_{up}g$

Momentum of impact:

$P = mv$

Impulse of impact:

You will first need to find the KE at impact via conservation of energy, and then find the velocity of the rocket. Use this velocity and the mass to determine what the change in momentum was.