**The Rocket:**

**An Application of Mechanics  
100 pt Test Grade**

**Description:**

Create an aerodynamic rocket out of a 2-L bottle that is propelled by water and air pressure.

**The Challenge**

How do you maximize water pressure within the bottle? How can the weight of the bottle be minimized? How can the nose of the bottle be maximized to “pierce” through the air (think inside the nose as well as outside the nose)?

**The Requirements:**

1. Bottle must move 45 m forward.
2. Bottle must look like a rocket.
3. Rocket must include mL scale on side for easy-fill.

**The Restraints:**

1. Maximum team size: 3 (must be within your block)
2. 2-L Bottle
3. Use water pressure only to launch the rocket.
4. No objects within the bottle that could turn into shrapnel should the bottle break.
5. 2 bottle cannot be cut and then glued/taped together to extend the interior space of the bottle.
6. The rocket cannot be constructed using hot glue.

**The Grade**

* Documentation of the “Brainstorm” and “Design” portion of the design process must be submitted on Edmodo by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 11:59 PM.
* Documentation of the “Test & Evaluate” portion of the design process must be submitted on Edmodo by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 11:59 PM.
* The FINAL prototype will be tested on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ during class.
* A poster, PowerPoint, or Prezi is due on Edmodo by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at 11:59 PM. This visual aide should include documentation of every design step as well as calculations concerning the rocket’s: launch impulse, initial momentum of the rocket, range of the rocket, time the rocket is in the air, gravitational potential energy at max height, kinetic energy at max height, total mechanical energy of the system, final speed of rocket just before it hits the ground.

**The Rubric**

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| --- | --- | --- |
| Part 1: |  | Points Earned |
| Brainstorm | *Be sure to include answers to the following:* |  |
| 1.5 | How do you maximize water pressure? (3 idea minimum) |  |
| 1.5 | How can the weight of the bottle be minimized? (3 idea min) |  |
| 1.5 | How can the nose of the bottle be maximized? (3 idea min) |  |
| Design |  |  |
| 1 pt | Design is sketched. |  |
| 1pt | Sketch includes labels for each part. |  |
| 2 pt | Function of each part as it pertains to the aerodynamics of flight is included. |  |
| 1 pt | FBD of bottle during impulse is drawn & labeled. |  |
| 1 pt | FBD of bottle during flight is drawn & labeled. |  |
| 1pt | Velocity & Momentum Vectors for bottle during impulse are drawn and labeled. |  |
| 1pt | Velocity & Momentum Vectors for bottle along flight path are drawn & labeled.  \_\_ initial \_max height \_final |  |
| Part 2 |  |  |
| Test |  |  |
| 1.5 | At least 3 trials are conducted.  1 2 3 |  |
| Evaluation |  |  |
| 1.5 pts | A Pro/Con list is made for each of the 3 trials. \_\_\_1 \_\_\_\_2 \_\_\_\_3 |  |
| 6 pts | A description for HOW to improve the design AND it connection to aerodynamics is included for each of the 3 trials. 1 2 3 |  |
| Part 3 |  |  |
| Final Test |  |  |
| 1 pt | Rocket is brought to class on time with no adjustments needing to be made. |  |
| 1 pt | Rocket has mL marks for easy fill. (+5 + 3 +1) |  |
| 1 pt | Rocket looks like a rocket. (+5 +3 +1) |  |
| 5.5 pts | Rocket moves forward 45 m. |  |
| 1 pt | Rocket does not have air leaks. |  |
| Part 4 |  |  |
| Visual Presentation |  |  |
| 3 pts | All 6 steps of the design process are included. 1 2 3 4 5 6  Identify the Problem, Brainstorm, Design, Build, Test/Evaluate, and Redesign |  |
| 18pts | Each step includes documentation of all items listed above either with description, pictures, or sketches. |  |
| 3pts | Presentation is visually appealing- colors, design, no typos, easy to read, etc. |  |
| 3 pts | Data collected from launch is included.  \_\_\_\_ altitude \_\_\_\_range \_\_\_ time rocket is in air \_\_\_pressure \_\_\_\_area of bottle opening |  |
| Visual Presentation (Calculations) |  |  |
| 6pts | FBD during Impulse is included with calculations for Impulse & Momentum Change Included |  |
| 6 pts | Flight Path for Projectile is document with ME Pie Charts included. |  |
| 6 pts | Calculation for Gravitational Potential Energy at Max Height is displayed. |  |
| 4 pts | Calculation for Vx is displayed. |  |
| 6pts | Calculation for KE at Max Height is displayed. |  |
| 6 pts | Calculation for ME of System is displayed. |  |
| 6 pts | Calculation for V just before it hits the ground is displayed. |  |