# Honors Rubber Band Powered Ping-Pong Ball Launcher Project

## Due Date: Thursday, December 12, 2019

## Summary:

To learn how Newton's second law of motion applies by analyzing the forces as a launcher is pulled back, and to understand how to make adjustments that affect the *net force* and *range* of a projectile.

## Learning Objectives:

- Recognize that understanding the scientific concepts described by Newton's laws of motion enables engineers to design airplanes, amusement park rides, elevators, and much more.
- Use a catapult model to explore the force exerted on a ping-pong ball and be able to draw the appropriately labeled free body diagram (FBD).

## Design Statement:

(1) Each student will design and build a launcher which can catapult ping-pong balls at a target located **six feet** from the launcher. The launcher must shoot only one ball at a time and should be re-loadable to launch as many balls as possible within a **two-minute** time frame.

(2) Each student will draw a free body diagram (FBD) for each of the following:
   a. ping-pong ball pulled back in the launcher just prior to letting go
   b. ping-pong ball at the highest point of its trajectory in the air

## Materials:

1. Rubber band(s)
2. Wood (e.g. Popsicle sticks, skewers, etc.)
3. Minimum of three ping-pong balls to be turned in
4. Additional "add-on" materials as needed

## Rules and Remarks:

1. Students will build a launcher which can fit on a student desk that can launch ping-pong balls through the air. Only rubber band(s) can be used as the mechanism to propel the ping pong balls. **The frame of the launcher must be made of wood (e.g. Popsicle sticks, skewers, etc.).**

2. The target will be an empty paper box with dimensions 11” x 17” and 8” tall. The target will be placed on a desk so that the center of the paper box is 6 feet from the front edge of the launching desk. The diagram on the top of the next page shows the setup of the box, launcher, and desks as seen from above.

3. Students will operate their own launcher. Points will be earned for each ball remaining in the target at the end of the two-minute time frame.

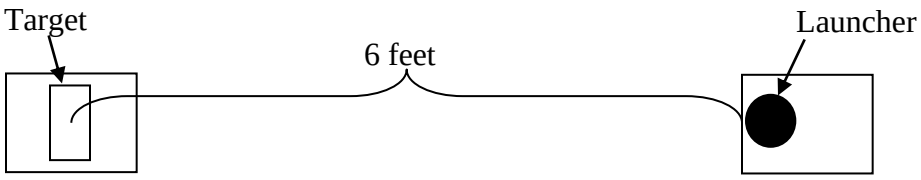
4. The launcher must fit on the desk with no parts extending beyond the surface of the desk.

5. Weight and/or size of the launcher should be heavy enough to remain stable during launches. Attaching launcher to the desk is NOT permitted.

6. The launcher may be hand-held but must rest on the top of the desk during launches. A triggering or tripping mechanism is optional.

7. Ping-Pong balls must enter the target on the fly. Balls that enter the target after bouncing off the desk, ceiling, or wall will not be counted.

8. Multiple attempts and adjustments to the launcher are permitted within the two-minute time frame.




## Project Turn-in:

- Absent students should arrange to have projects dropped off in the front office with student name and teacher's name attached to it; otherwise, a zero will be earned on the project grade. The project must be date stamped by front office personnel.
- Projects are due when the tardy bell rings; any projects not in class or not complete at that time will **not be accepted**.
- Any student earning a zero on the project may take the 9-weeks comprehensive retake **ON THE DUE DATE** to replace the zero on the major project.

## Grading:

| | |
|---|---|
| A ping pong ball launcher which meets all the rules of assembly and capable of launching a ping pong ball | **1.4** |
| A ping pong ball launcher which meets all the rules and can launch a ping pong ball **toward** the target | **2.0** |
| A ping pong ball launcher which meets all the rules and gets 1 ball into the target | **2.4** |
| A ping pong ball launcher which meets all the rules and gets 2 balls into the target | **2.8** |
| A ping pong ball launcher which meets all the rules and gets 3 balls into the target | **3.2** |
| A ping pong ball launcher which meets all the rules and gets 4 balls into the target | **3.6** |
| A ping pong ball launcher which meets all the rules and gets 5 balls into the target | **4.0** |
| A ping pong ball launcher which meets all the rules and gets 6 balls into the target | **4.4** |
| Both free body diagrams are complete and accurate. | **Add 0.6** |

## Extra Credit:

A ping pong ball launcher which meets all the rules and gets more than 6 balls into the target will receive **0.05** extra credit points for each additional ball with a maximum score of **5.5**

## Total Score: _____/5.0

## Free Body Diagrams (FBD):

1. **ping-pong ball pulled back in the launcher just prior to letting go**

2. **ping-pong ball at the highest point of its trajectory in the air**