

## Physics of Sports Project: projectile launcher!

**Idea:** You must construct a projectile launch of your own design to hit a target. Your launch must be powered by a falling weight and must launch a projectile at a sufficiently long range and be accurate. You are also asked to demonstrated team spirit, your knowledge of physics. Read the rubric & rules carefully!

### Rules:

1. Your launch must be energized via a falling weight. No springs, rubber bands, gentle pushes, etc.
2. There are two basic designs: cup designs and pouch designs. The pouch design can go farther if done right, but is much harder to do. Cup designs are much easier than pouch designs and as such are marked down 3 points compared to pouch. This small point penalty may be worth it if you are struggling to much with a pouch design.
3. You may launch any object which is safe and neat. Examples include coins, small stones, ping pong balls, etc.
4. Dimensions cannot exceed 50 cm in any direction. Small violations of this rule incur small penalties, larger violations incur larger penalties. This measurement is made with the in any orientation. If in doubt, see your teacher.
5. Classroom floors and tables do not get along with hammers. Please don't bring one to school. The same goes with sharp instruments, such as saws and drills.
6. Drills may be used with permission and caution. You must discuss exactly how you would use the drill, get your teacher's permission and have some kind of sturdy surface protection to protect the flooring from becoming scratched and marked up. Be careful and please clean up after yourself.
7. Show good teamwork. If you cannot meet to work on it with other group members, communicate with them how you can contribute to the effort. If the team agrees you did not try to do your fair share, you may lose points.
8. You will hit a target a t distance you will not know until the day of the competition. The target distance is measured from the front of your trebuchet base and the front wall of the target. This distance will be between 2.5 and 4.0 meters.
9. **IMPORTANT:** Get to know your trebuchet. The sooner you build it and have time for testing and small revisions, the better your outcome tends to be.
10. You must have at least one variable you vary to change launch distance. Example include: drop weight, pivot arm length (vary the location of the axle hole), vertical release distance, etc.
11. There will be practice runs on the day of the launch. You will get plenty of practice launches prior to launch day.
12. Have some theme and name for your trebuchet.
13. **COMPUTATIONS:**
  - a. Measure release height, max height, and horizontal distance.
  - b. From these measurements, find:  $t_u$ ,  $t_d$ ,  $t_h$ ,  $V_x$ ,  $V_{yi}$ . Launch angle, launch velocity
  - c. Launch angles cannot be  $0^\circ$  or negative (flung toward the ground). A trebuchet is not about flinging projectiles into the dirt; they're about flings projectiles long distances by giving them loft (a positive vertical velocity component). Expect a point penalty on the computation if your trebuchet does not fling your projectile somewhat upward.

## Projectile Physics Project: Grade Sheet

Trebuchet Name: \_\_\_\_\_

Group Members: \_\_\_\_\_

### Accuracy & Precision – 10 pts

You will do three launches in the physics room from at least 2.5 m away. You will be given the exact distance at launch time (you need to know how to adjust to different target lengths). The target will be a bucket (or something similar, trash can, etc.). You will get NO “warm-up” launches after being given your target distance.

Accuracy points are as follows:

- 10 pts – hit target on the fly all three launches
- 9 pts – hit target on the fly once and come within 1 m on other two
- 8 pts – come within 1 m of hitting the target at least twice
- 7 pts – shoot ping pong at least 1 m all three times
- 6 pts – shot ping pong at least 1 m once

### Workmanship – 10 pts (BEST designs get 10 points)

10 pts – rugged, durable, well-decorated, solidly built (not fragile), steady and does not wobble easily  
0 - 9 pts and less: lacking some/all of the above characteristics to varying degrees. Cup designs are marked down a few points compared to pouch designs.

### Physics – 10 pts (hardest category of points)

Turn in the following sheets:

1. Hand drawn sketch (this is not art class, but must be reasonable) of your launcher including name of launcher and names of participants.
2. Data table showing various trial runs including the factor that was varied. Trial runs are numbered to make referencing them easy. You should have at least 10 trial runs where your adjusted variable (see #6 in rules) was changed to see its effect.
3. Computations outlined in item 10 (previous page)

### Spirit/Rules/Effort – 10 pts (whole group needs to make sure that whole group is using class time wisely INCLUDING presentation day itself...please don't hold up launches with last minute work)

1. Time given in class was used for this project and/or physics: All members used time in class wisely to work on project (did not over socialize, work on Spanish, say “I did it at home”, etc.)
2. All members contributed to project as agreed upon by fellow group members (your group is satisfied with your contribution)
3. Group was positive and got along with each other and rest of class.
4. Launcher had a cool name, theme and so did group

**TOTAL POINTS :** \_\_\_\_\_ **(40 possible)**

**Grade Percentage:**

**Comments:**