

Balloon Drop Physics: It's the (Water) Bomb!

Mr. McChesney - AP Physics: 2020/21

PROJECTS DUE: Tuesday, May 18, 2021

This project was given to students on March 26, 2021

Purpose:

Groups of 2 to 4 people are allowed

- 1) To drop a water balloon on a bed of nails and not have it burst until it is dropped from exactly 10 feet above. Drops will begin at 2 feet and progress like so: 2, 4, 6, 7, 8, 8.5, 9, 9.5 and 10 feet. Any balloon that fails to burst at 10 feet or above will be disqualified.
- 2) To analyze and write up the performance of your project, keeping in mind that the goal is to avoid the large impulse in such a short amount of time UNTIL you want the balloon to break. Think of things that keep you safe in collision and how they do that. Did you adequately test your device under real-world conditions? Also, to see how risk-averse you are when it comes to a project.

Rules o' the game are

1. The competition will be held outside. Teams of 2-4 students are allowed.
2. Balloons will be filled by a member of your group under Mr. McChesney's supervision, and you will be allowed 2 per group. The balloons will all be filled with approximately the same amount of water (demonstrated in class, a little more than a handful). You will have access to the balloons for about 5 minutes prior to dropping. You may only use the second balloon if you tie with another group on your first balloon. Unless requested to be otherwise ahead of time, drops will be from 2, 4, 6, 7, 8, 8.5, 9, 9.5 and 10 feet. Distances are measured from the bed of nails on the ground up to the bottom of device.
3. You are not allowed to modify the bed of nails. Any modifications to the balloon must remain attached to the balloon and must be within a 1 cubic foot volume (not more than 1' x 1' x 1' - so no long skinny objects allowed). The attachments must only be attached to the balloon. Also, the balloon must remain in the container – **if the balloon falls out, the testing will be suspended and your balloon will be considered to have popped.**
4. Heights will be measured from the bottom of the balloon and the balloons must burst within five seconds of the drop.
5. Other than height, devices must be dropped in the exact same manner each time, so no 'pulling a string' one time but not the next. Any adjustments to the container for each drop must be simple, caused by a single action or motion and in the exact same manner for each drop and the action must be part of the drop itself. These adjustments may not cause part of the device to fall or drop off by their action alone. QUESTIONS? Ask me before you risk being disqualified!

GRADING FOR "Balloon Drop Physics" TOTAL VALUE: Up to 65 points

- 1) 5 points just being ready when I ask you to go, not later in the class - no excuses.
- 2) Engineering of the design. Will it allow the balloon to absorb force upon impact?

0	1	2	3	4	5	6	7	8	9	10
None				Built at lunch today?						An engineering marvel!

- 3) Efficiency. Is the balloon protecting device efficient in size and mass? Is it an 'elegant' solution to the problem?

0	1	2	3	4	5	6	7	8	9	10
Doesn't even work				Works, but it's ugly engineering						Excellent design

- 4) Competitive performance grade.

Best group performance:	10/10	2 nd best performance:	9/10	3 rd best performance:	8/10
4 th best performance:	7/10	5 th best performance:	6/10	6 th best performance:	5/10
7 th best performance:	4/10	8 th best performance:	3/10		

- 5) Overall performance grade.

Balloon breaks at a height of 10.0 feet exactly:	25/15	Balloon breaks at a height of 8.0 to 9.9 feet:	15/15
Balloon breaks at a height of 6.0 to 7.9 feet:	13/15	Balloon breaks at a height of 4.0 to 5.9 feet:	11/15
Balloon breaks at a height of 2.0 to 3.9 feet:	9/15	Balloon breaks at a height of < 2.0 feet:	7/15
Doesn't break at drop from 10.0 feet:	0/15	→ <i>This happened in 2015 and was NOT a fun experience!</i>	

High-tech or low-tech?

An interesting question. Nothing prohibits you from using a remote control device to pop the balloon, but could it work? But that device must be trigger on each drop. Generally, simple is good.

6) Lab write-up / Documentation & a Google Doc of build process filled out as the group works on the project. Based on your analysis and correct explanation of the physics concepts involved. Due 1 week after the drop on Sept. 27. Documentation must include video and photos of the build and testing process. The write up also needs to include a reflection on what your team did and changes you would make if you did the project a second time.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Modify

Retest – Rebuilds can qualify for up to a 93% **OR** if your grade is above a 93% you can qualify for the next highest drop score above what you earned the first time.

7) Retest option, if want to try to improve your project that option is available, on retesting no bonus points will be awarded. You must present a written document of the changes you plan to make and why you plan to make them. And document the process of changing the device, also include a reflection on the project.

Retest Overall performance grade.

Balloon breaks at a height of 10.0 feet exactly:	14/15	Balloon breaks at a height of 8.0 to 9.9 feet:	10/15
Balloon breaks at a height of 6.0 to 7.9 feet:	9/15	Balloon breaks at a height of 4.0 to 5.9 feet:	8/15
Balloon breaks at a height of 2.0 to 3.9 feet:	6/15	Balloon breaks at a height of 2.0 feet:	4/15

Retest must be schedule to occur within a 10 days of original test day.