

Projectile Motion: The Catapult Lab

Objective:

This lab is designed to allow you to apply the laws of Physics and equations for projectile motion to your own catapult designs. You will test your catapults to determine if you can accurately launch a ball and hit the designated targets. You will compare your experimental data to theoretical data and understand differences between the two.

Materials & Methods:

In this lab you will be building ping-pong ball catapults. Your catapult will need to be able to launch a golf ball to hit a target tower at either at 5 meters or 7 meters. Your catapult must be able to launch the ball at any angle between 0 and 90 degrees.

During this unit, you will work in a group to develop a model to accurately hit a designated target. On testing day you will be given the distance to the target, and you will then have 6 minutes to make adjustments to your catapult. Therefore, you must design and test your catapult so that on testing day you can make whatever adjustments that are needed quickly.

The appearance of the catapult will not be judged, but you should pay careful attention to design elements that affect the ability of your catapult to adjust to new distances.

Turn in one poster per group. However, you will be completing a peer evaluation for every member in your group, so please ensure that each team member is contributing in a meaningful way. You will have 2 class periods to design, build and begin testing the catapult (keep this in mind so that you can work at home if necessary).

You will be graded on the following items:

- 1) Design Plan
 - 2) Data Analysis
 - 3) Conclusion
 - 4) Organization and presentation of poster
- ❖ Please see the rubric for additional details

Your Introduction Must Include:

- 1) Objective for the project.
- 2) A brief history of catapults
- 3) Description of the physics concepts and physics equations used in operation of a catapult.

Your Design Plan Must Include:

- 1) **A list of materials** used (should be bulleted)
- 2) **A diagram of your catapult.** The final diagram should have all dimensions labeled (including units) and should be neatly drawn. Your final diagram should be drawn on plain white paper or graph paper, and should fill most of a single page. (You will attach this to your presentation board.)

Your Data Analysis Must Include:

- 1) **Data table** that includes time of flight(s), distance flown in horizontal direction, and angle of launch. You must test at least 3 different angles using at least 3 replicate trials for each angle.
- 2) **A value** for the average velocity of the ping pong ball and an explanation of how initial velocity of the projectile was determined.
- 3) How did changing the angle affect the characteristics of your trajectory? The initial velocity?

Organization and Presentation:

- 1) Poster information should be neatly written, with all sections well marked.
- 2) No eraser marks or white-outs.
- 3) **All answers are presented in complete sentences excluding the list of materials which may be bulleted.**

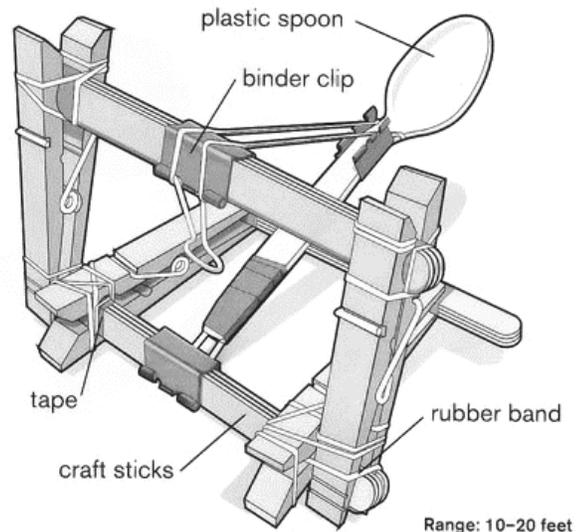
Conclusion:

Your conclusion should include an overview of your findings and describe any sources of error that might be present. Give some examples of real life projectiles whose landing spots must be carefully predicted.

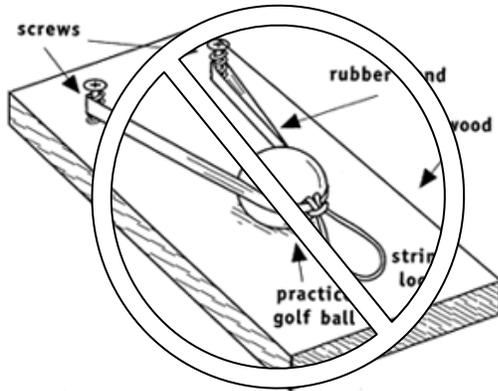
You now have abundant access to technology. Use it! Look up information on catapults and how best to design your own project.

Possible material suggestions:

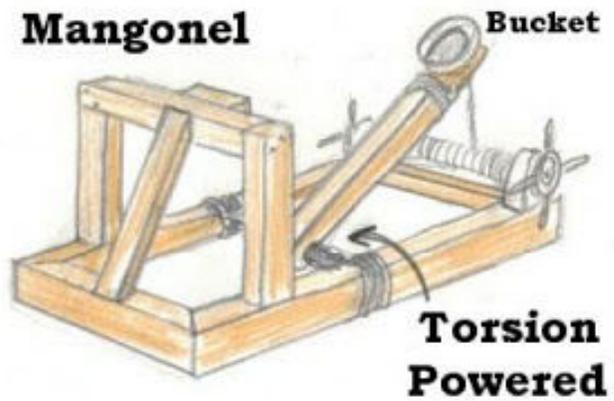
- 1) spring loaded mouse traps
- 2) masking tape
- 3) meter stick
- 4) wood supports (tongue depressors)
- 5) glue
- 6) rubber bands



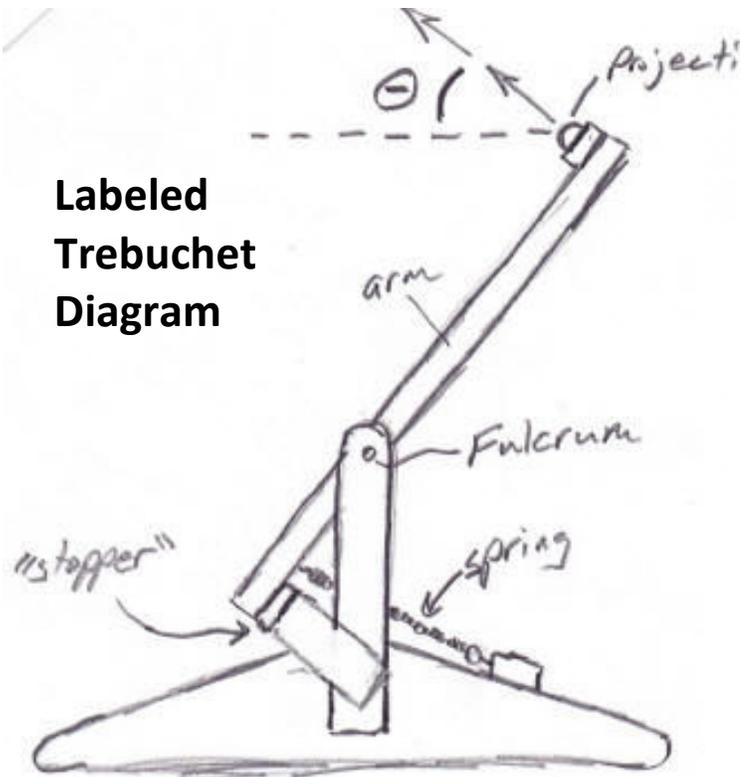
Range: 10-20 feet



A Quick-Build Catapult



Torsion Powered



Labeled Trebuchet Diagram



Rubric for Catapult Laboratory Report & Poster Presentation

Outcomes	Nope!	Below Expectations	Meets Expectations	Exceptional
Statement of Objective: States why the student is doing the investigation and what the goals are. Should be clear and concise.	1	2	3	4
Design Plan: Complete description of the catapult and diagram with all parts labeled and clearly drawn.	1	2	3	4
Data: All data taken should be listed in this section. All data must have units and data tables should be clearly labeled. Must include: time of flight, distance in x-direction, angle of launch and initial velocity.	1	2	3	4
Data Analysis: Correct equations have been used, calculations are correct and appropriate units are used. See laboratory sheet for additional requirements.	1	2	3	4
Conclusion: Results are summarized and the hypothesis addressed. Significant sources of error and suggestions for improvements are addressed.	1	2	3	4
Accuracy: Projectile hit target on testing day.	1	2	3	4
Organization and presentation: Report is neatly typed or written, sections have been well marked, mistakes are either erased or whited out. Poster shows colorful illustrations and is very easy to read.	1	2	3	4