THE GREAT COTTON BALL LAUNCHER

OBJECTIVES

1) Create a catapult that will toss a projectile onto a target 3 m away using only the supplies provided on the supply list.
2) Practice calculating kinetic & gravitational potential energy and observe the relationship between them.
3) Continue using Newton's Laws to explain motion.
4) Conduct research of catapults to help refine brainstorm design.

CATAPULT CONSTRUCTION (20 points—Group—1ST draft DUE 11/29/07, Official DUE 11/30/07)

Supplies Allowed:

- Popsicle Sticks (≤ 2 dozen)
- Straws (≤10)
- String/Yarn (1 m)
- Rubber bands, 4 (≤ 30 cm diameter)
- 1 Dixie cup (≤ 88 ml size)
- Small Nails (up to 2)
- Pipe cleaners
- Wooden clothespins
- Glue sticks and Glue Gun (Some glue guns are available)
- Masking Tape (≤ 1 roll of 1" width)
- Paper Clips- small (≤ 5)
- Cardboard (≤ 30.5 cm x 30.5 cm)
- 1 cotton ball for projectile from teacher

Bring in a storage box for materials and project to help keep your supplies together.
At least 9 of the supplies above (excluding the projectile) must be used in your design. The supplies must have a function other than decoration.

Guidelines:

1) Your project must not exceed 30.5 cm in width by 30.5 cm in length by 48 cm in height at the time of the launch.
2) The catapult must be set and ready to launch in 60 s or less (including 2nd & 3rd trials).
3) The catapult must be powered by something other than human force.
4) There must be some kind of trigger to set the launch in motion. You may not just let go of a string or remove a piece of tape. The trigger cannot add any additional force to the catapult. The trigger must be attached to the machine.
5) The projectile must land at least 1 m from the starting point.
6) The distance will be measured from the final landing point (after rolling, sliding, etc.) to the center of the target.
7) Any repairs after the first trial must be done with in the 60 s time window.
8) The group with the smallest combined distance (all three trials included) away from the center of the target wins 5 bonus points and a homework pass. Group with the second smallest distance away from the center gets a homework pass. Only groups that fulfill ALL guidelines are eligible for these bonuses.
9) Teacher is final judge in all measurements and launches. Any will result in point penalties.

TIMELINE (Timeline will also be reflected/updated on weekly plan sheets)

Day	Date	Item
MON	11/19/07	Project Kickoff, Turn in partner choices
TUES	11/20/07	Hypothesis: Brainstorms **due**; Library Day: Research types of catapults 10 minute team meetings for supply lists
MON	11/26/07	Supplies Due: 1st building day
TUES	11/27/07	Catapult History Report/Brochure **due**, 2nd building day
WED	11/28/07	3rd building day, practice course available for trials
THUR	11/29/07	1st Draft of Catapult **due**: practice trials & troubleshooting
FRI	11/30/07	OFFICIAL CATAPULTS **due** for inspections, practice trials, and impound
MON	12/03/07	OFFICIAL CATAPULT TRIALS & Portfolio Work Day (1 laptop/group)
FRI	12/07/07	Catapult Portfolios **due**

WORK ETHIC GRADING (10 points—Individual—graded during in-class work days)

- stay on task: focus on catapult building or portfolio work at all times
- participate fairly: contribute equally, does not take over project
- keep other members on task: delegate responsibility, trust other group members

PORTFOLIO GRADING (40 points—Group and Individual DUE 12/07/07)

GRADED ITEM (Individual parts are identified. Other parts are one per group.)	Points
Title, Purpose/Problem (must be typed)	1
INDIVIDUAL BACKGROUND: HISTORY REPORT OR BROCHURE **DUE TUES 11/27/07** Type a coherent catapult history report or create a brochure about the 3 types of catapults: Ballista, Mangonel, Trebuchet • Discuss the history of the catapult. • Provide a brief description of each catapult. • Explain the good and bad points of each. • Include a picture of each type of catapult. • Discuss the differences similarities and differences between three types of catapults • Include references at the end of the paper (including references for pictures) using MLA format (for help see www.easybib.com or knightcite.com) • Paper/brochure should be in your own words. • Plagiarism (e.g. copying and pasting into your report) results in a zero.	8
INDIVIDUAL HYPOTHESIS (BRAINSTORM) **DUE TUES 11/20/07** Include each person's brainstorm. Brainstorms without initials will be given 50% credit. Brainstorms should include a top view, side view, approximate dimensions, and labeled supplies.	2
EXPERIMENTAL PROCEDURE (must be typed) • Discuss attempts made before deciding on final design • Materials tested that were adjusted or changed before final design • Detailed numbered step-by-step procedure of final design • Drawings of final design including top view, side view, supplies labeled, and dimensions.	5
DATA Computer generated table should include the following measurements for each of three trials. • mass of projectile • initial height of projectile • distance projectile travels • time of projectile's movement • initial velocity • distance from target where projectile stops	6
DATA ANALYSIS Calculate the following information using the data gathered. Place results in a computer generated table with a title and appropriate units. Show all of your work neatly (work can be hand written). • average velocity • approximate final velocity (take average velocity x 2) • acceleration of the projectile • momentum of projectile • weight of the projectile • force of projectile on the ground • initial gravitational potential energy of projectile • kinetic energy of projectile (use final velocity)	8
INDIVIDUAL CONCLUSION AND ERROR ANALYSIS (must be typed) Answer the following questions with complete sentences in coherent paragraphs. 1. Why did your group choose the final design of your catapult? 2. Explain how the catapult set the projectile in motion—from the trigger to the launch. 3. Give at least three specific examples of the forces that acted upon the projectile. Explain how and when they acted on the projectile. 4. What helped the catapult work as well as it did? 5. Explain thoroughly how each of Newton's Three Laws affected your catapult's motion. Give specific examples. 6. Explain the impact friction had on your project, including the type of friction 7. Explain how conservation of energy is used in your catapult. Identify the types of energy that exist and list all the energy transformations that occur. 8. What are at least three things that you could have done to make the catapult better (physical things, not things like having a different group to work with)? In other words, what are at least three things that could have made your catapult launch the projectile to land closer to the target? 9. What other experiments might you want to do with your catapult?	10