

**Fall 2007 Design Project**

**FLIPPY CAR**



**Objective**

The objective of this design project is to build a vehicle that is powered only by stored elastic potential energy. Your vehicle should be designed to travel 10 feet, flip over, and continue another 10 feet in the original direction of motion. At the end of the semester, your team will compete in head-to-head races against other vehicles in the class during a single-elimination tournament.

**Design Teams**

The vehicles will be designed, built, and operated by design teams of 3 students (2-student groups require permission of the instructor). You will choose the members of your team from within your lab section.

**Rules**

1. Each team will be given two mousetraps and six rubber bands. The vehicle can only use the mousetraps and rubber bands for power storage as supplied to the team by the Professor and the TAs. If used, each mousetrap and rubber band must be an integral component of the vehicle and travel with it from start to finish. Any team that uses a non-issue mousetrap or rubber band will be disqualified.
2. The only power sources allowed are the supplied mousetraps and rubber bands. Energy stored in other elastic elements, or obtained from a change in altitude of the center of mass of a component, must be negligible. The Professor and TAs will make judgments in this regard.
3. No modifications to the mousetrap are allowed, except that (i) you are allowed to provide a means to fasten it to the vehicle, and (ii) you are allowed to remove the trigger mechanism.
4. The weight of the vehicle must not exceed 2.5 pounds.
5. The vehicle must be capable of fitting completely within a 3' x 2' x 2' box at the start of each round of competition.

6. Vehicles that incorporate projectiles of any kind are not allowed. All vehicle parts must cross the finish line together.
7. The course will consist of two parallel lanes, each rectangular in shape, 3.5 feet wide and 20 feet long. The lanes will be separated by 1 foot. The surface will be the hallway floor of the first floor of Latrobe. In each lane, the start line, start of the flip zone, and finish line will be marked on the floor, with 10 feet separating each. The flip zone will be 4 feet in length.
8. The vehicle must start each round completely behind the starting line. An extreme point on the vehicle must be identified as the “front”. At the start of the competition, the front of the vehicle must cross the start line and self-propel down the course, and the front of the vehicle must cross the beginning of the flip zone before any other part of the car. The course is completed when the front of the vehicle crosses the finish line. At the finish line, the front of the vehicle does not necessarily have to lead the rest of the car.
9. The vehicle must flip over within the 4-foot flip zone. A flip is defined as follows: The team will define a right-side-up configuration of the vehicle. While the vehicle is in this configuration, the Professor or a TA will place a sticker with an upward-pointing arrow on the vehicle – anywhere except the wheels. The arrow should point downward after the flip occurs and should still point downward when the vehicle crosses the finish line.
10. Your team’s vehicle must stay within the lane during the entire round. If any part of the vehicle passes outside the side boundaries of the lane during the round, the vehicle will be disqualified, and the round will be forfeited to the opponent. In the event that both teams pass out of bounds, the team that faulted first will forfeit the round. If neither vehicle completes the race, but both stay in-bounds, the one that traveled farthest will win.
11. The vehicle must be durable and reusable. The tournament involves multiple head-to-head races. If the vehicle survives only one run, it will not be able to compete in the subsequent rounds.
12. Purposely tampering with or damaging another team’s vehicle will result in disqualification.
13. Nonfunctional decorations are allowed and encouraged. The appearance, originality, and quality of construction of your vehicle count towards your grade on the design project. Pay attention to *craftsmanship* in the design and construction of your vehicle.
14. You are allowed to obtain, purchase, manufacture, and use any materials and components for your vehicle. Pre-manufactured materials and components are allowed; pre-manufactured assemblies are not. For instance, you can use the wheels off a model car, but you cannot use a purchased wheel, axle, bearing, and frame assembly. Some components such as gears from kits can be used, but a substantial portion of the vehicle cannot be formed of such kit components. The Professor and TAs will make judgments in that regard.
15. Lubricants can be used to reduce friction on bearings or other moving parts within your vehicle. Such lubricants cannot drip onto or contaminate the floor.
16. Minor modifications, adjustments, and tuning of the vehicle between rounds during the tournament are permitted.

17. The two competing teams will be given 60 seconds prior notice to the start of a round. After 60 second, the start command will be given. If your vehicle is not ready at that time, the round will be forfeited to your opponent.
18. No contact between the team and vehicle can occur once the vehicle has crossed the start line.
19. A team will be disqualified after two false starts in any round, and then the round will be forfeited to the opponent.
20. Your vehicle cannot mar or damage the surface of the course. Abrasive materials which enhance friction but which damage the floor cannot be used.
21. Your vehicle must reflect positively on the course and the Department. Your work will be seen and emulated by others.
22. The Professor and TAs reserve the right to judge the qualifications of a vehicle during all stages of design and competition. Practice sounds judgment with your design decisions.
23. The Professor and TAs will make final judgment on all vehicles and rules. Vehicles that do not comply with the rules will be disqualified at their discretion.
24. The Professor and TAs reserve the right to clarify any rule, or to introduce new rules, at any point in the design project.

### **Design Notebook**

Each student is required to keep a design notebook in which you record the ideas and actions of your group. A notebook will be provided and is the only one to be used. Document in writing *in ink* each design change, prototype, and the outcomes of your testing. Label each drawing. Begin notes for each team meeting on a new dated page. Record the dates of each team meeting, even if the team member is not there. Indicate dates of conceptualization. The design notebook will be examined by the Professors and the TAs, will be handed in after the project competition, and will count towards your final grade.

### **Grading**

Individual grades will be given: 25% performance on race day, 25% vehicle design and construction, 25% design notebook, 25% participation. The final standing in the competition will influence these, so a part of the grade will depend on the accomplishments of the group. A part of the grade will depend on the individual participation as observed by the instructor and the TAs. The design notebook will be part of the grade.

### **Lab Access and Materials**

You will note that the design project completely occupies the lab periods of two weeks: November 8/9 and December 6/7. In addition, there will be some time for the team to work on the project during the labs on November 15/16 and November 29/30. In addition, all students will be given J-card access to the Wyman 145 laboratory to use the facility throughout the project period. The laboratory must be kept clean, safe, and functional. Teams that do not adhere to this will be disqualified.

Useful materials and tools, including tape, glue, foamcore, dowels, X-acto knives, hacksaw, drill, hammer, and Dremel tool, will be placed in Wyman 145 for your use. Use the tools following the safety procedures described in the lab section; wear safety goggles and do not work alone. Please be fair to other teams; do not waste materials or take more than you need. Do not remove tools from the room.

### **Project Schedule and Milestones**

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|---------------------------|---|
| November 8/9<br>In lab    | Project is assigned<br>Teams formed<br>Calculations of energy storage performed<br>Low-tech rapid prototyping skills practiced<br>Initial brainstorming and decision making   |
| November 15/16<br>In lab  | Vehicle name finalized<br>Team leader identified<br>Design information in notebook should be plentiful, including sketches<br>Solution prototyping in progress<br>Task Planning<br>Safety review  |
| November 19               | <b>Design notebook review #1</b> (submit notebooks in class on Monday; they can be picked up from the Professor on Tuesday or in class on Wednesday)  |
| <i>November 22/23</i>     | <i>Thanksgiving holiday</i>   |
| November 29/30<br>In lab  | <b>Each team must give a 2-1/2 minute presentation</b> on their design concept to their lab section. Visual aids are only sketches in the design notebook and prototypes to date. All team members must speak.                                  |
| December 6/7<br>In lab    | Final design established<br>Prototyping completed<br><b>Calculations to predict the length of travel of the vehicle</b><br><b>Design notebook review #2</b> (submit notebooks at end of lab; they can be picked up from the lab by Friday 5 pm) |
| December 10<br>In class   | <b>11:00 am – Competition on first floor of Latrobe Hall</b>  |
| December 11<br>By 5:00 pm | Add reflections on design and competition to notebook<br><b>Submit final design notebook</b> for review to the Professor's office   |

***Be creative and have fun!***