Objective  In this project, your three-person team will design and build a device that will place a small flag as close as possible to a precise point on the elevated part of a course to be laid out on the floor. At the end of the semester, you will compete in a single-elimination tournament where your device will be judged on the speed and accuracy with which it completes the task.

Design teams  Teams will consist of three students from the same lab section. These teams have been chosen at random and were announced in the labs on November 5 and 6.

Rules

1.  Course

   a.  The course will consist of two parallel, rectangular lanes, each 4 feet wide and 10 feet long. The lanes will be separated by 2 feet. The course will be marked on white paper and laid on the floor of the competition site.
   b.  One of the short sides of the course will be designated the start line.
   c.  A raised platform, three inches high, will span the width of each lane and cover the last two feet of the lane.
   d.  On the raised platform, a target point will be marked 18 inches from the front and equidistant from the sides.
2. Device

a. The flag will consist of a spherical base, made of hollow polypropylene plastic 1.5 inches in diameter, with a thin plastic ‘flagpole’, to which a banner fashioned from a white labeling sticker will be affixed. The total height of base and flagpole is 3 inches. The flag is self-righting, so that at rest the flagpole will always point upwards. The self-righting is achieved by internally weighting the base with silicone. The total flag mass is approximately 9 grams.

b. The aim of the device is to place the flag so that it rests as closely as possible to the target point for the given lane of the course.

c. Each team will be given two mousetraps and six rubber bands. These are the only energy sources or energy storage devices allowed. Use of non-issued mousetraps or rubber bands is grounds for disqualification from the competition.

d. The mousetrap may not be modified, except to fasten it to the device or to remove the triggering mechanism.

e. Primary materials should be chosen from stock materials that will be available in the freshman lab room (Wyman 145). You may also use additional parts, but their documented value may not exceed $15. (More on this below.)

f. At the start of each head-to-head match, each device (including the flag) must fit entirely in a box one foot wide, two feet long, and one foot tall.

g. The device may not be fixed to the floor in any way. This means that tape, glue, suction cups etc. are not allowed. The device may be held steady through its own mass and by friction.

3. Competition

a. There will be 20 teams in the competition. Eight teams will be chosen by public, random draw to compete in a play-in round of four head-to-head matches. The four winning teams in this play-in round will join the remaining 12 teams for four rounds of head-to-head matches to determine the overall winning team. The draw for these final 16 teams will also be randomly determined through a public draw.

b. The teams with the four highest scores in the second round of design notebook evaluations will be exempt from the random draw for the play-in round.

c. There will be no consolation bracket or matches for losing teams.

d. After each match is announced, teams have one minute to set up their devices on the course before the start command is given. Devices must start the heat (i.e. some elements of the device must go into motion) within one minute of the start command.

e. Prior to each match, the team members may touch the device, e.g. to hold the mousetraps and rubber bands in the open position. Once the match begins, physical contact with the device by the team members must cease for the duration of the match.
f. All elements of the device, flag included, must be stationary at the start of each match.
g. Also prior to each match, all parts of the device (including the flag) must sit behind a vertical plane intersecting the start line.
h. A false start will be charged to any team for which any element of the device goes into motion prior to the start command for a given heat. Two false starts for a given team in a given heat will result in disqualification.
i. A team will be judged to have completed a heat when (a) its flag sits stationary and unsupported on the surface of the course, or (b) if its flag is not stationary and unsupported on the course surface, but all elements of the device are stationary.
j. The heat will be judged to be complete when both teams have completed the heat.
k. The winning team will be that team whose flag rests on the course surface, unsupported, closest to its respective target point. If one team’s flag rests unsupported on the course surface but the other team’s remains on the device or supported by the device, the former team is the winning team. If neither flag rests unsupported on the course surface, the flag whose base is closest to its respective target point will be declared the winner.
l. If a winner cannot be determined based on flag proximity because the flags are equidistant from their respective target points at the end of the heat, the team whose flag came to rest first is the winning team. If neither team wins based on that criterion, the heat shall be re-run.
m. Devices need not remain within the lane boundaries during the heat, but if a device leaves its lane (meaning, any part of the device is outside of its lane) and interferes with the other device when that device is within its lane, the device that left its lane will be disqualified. If the devices interfere with each other with both having some part outside of their respective lanes, the heat shall be re-run.
n. All judgments are in the hands of the professor and TAs.

4. Miscellaneous

a. Minor modifications, adjustments, and tuning of the devices are permitted between rounds of the tournament. No significant construction work may be performed after the first heat in which the team competes.
b. Devices may not modify or mar the course. For example you may not damage the paper surface of the lanes, and you may not push the raised platform.
c. The professor and TAs may modify existing rules or add new rules in response to the progress of the competition at any time.

**Design Notebook** Each student is required to keep a design notebook (which will be provided to you in class next week) in which you will record the ideas and actions of your group. Document in writing each design change, prototype, and the outcomes of your testing. Use ink as much as possible. 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. For detailed drawings, you may draw on white paper and tape, staple, or glue the drawing into the notebook. The design notebook will be examined periodically by the professors and the TAs and will be handed in after the project competition. The only written material that will count toward your project grade is the contents of the notebook.

**Grading** Individual grades will be given. The final standing in the competition will count for 15% of the grade; the general functionality of the team’s device independent of the final standing will count for 25%; the contribution of the individual as observed by the instructor and the TAs will count for 30% of the grade; and the quality of the design notebook will count for 30% of the grade.

**Lab Access and Materials** The design project completely occupies the lab periods of two weeks: November 5/6 and December 3/4. In addition, there will be some time for your team to work on the project during the labs on November 12/13 and November 19/20. All students will also be given J-card access to the Wyman 145 laboratory to use the facility throughout the project period. The laboratory must be kept clean and functional. Teams that do not adhere to this will be disqualified.

Useful materials and tools, including tape, glue, foamcore, wood dowels, X-acto knives, plus a hacksaw, drill press, scroll saw, and hammers, will be placed in Wyman 145 for your use. Use the tools following the safety procedures described in the lab section; wear safety goggles as necessary and do not work alone. In order to be fair to other teams; do not waste materials or take more than you need, and do not remove tools from the room.

**Supplies** You will be allowed to specify up to $15 worth of additional supplies for your device beyond what will be available in the lab. Taxes and shipping charges will not count against the $15 limit. You can specify parts from McMaster-Carr, Home Depot, or Michael’s (craft supplies) prior to November 30, and we will order for overnight or two-day delivery and cover the cost. You may also go and purchase supplies on your own, but you will still be held to the $15 limit (keep your receipts), and you will not be reimbursed for those purchases.

Be aware that the spirit of this rule is not specifically to restrict your total expenditures, but to ensure that all of the devices have a similar level of technology.

**Clarifications:**

- If you purchase parts that need to replaced prior to the competition because of breakage, only those parts that make it on the final vehicle will count against the $15 limit.
- If you purchase parts that you subsequently decide not to use, those will not be counted against the $15 limit; however, we will not order parts on your behalf that go beyond $15 even if you subsequently decide not to use parts previously ordered through us.
- If you use parts cannibalized from something you already own (say, wheels from your kid sister’s ten-year-old, long-dormant toy truck) you must provide an estimate of the cost of those wheels if new, which will then count against the $15 limit.
**Project Schedule and Milestones**

**November 5/6**
- Project is assigned
- Teams formed
- Calculations of energy storage performed
- Low-tech rapid prototyping skills practiced
- Initial brainstorming and decision making

**November 12/13**
- Vehicle name finalized
- Team leader identified
- Design information in notebook should be plentiful, including sketches
- Task Planning
- Safety review

**November 19/20**
- **Design notebook review #1** (in lab)
- Solution prototyping in progress
- Part orders due by November 30

**November 26/27**
- Thanksgiving holiday

**December 3/4**
- Final design established
- Prototyping completed
- **Design notebook review #2** (submit notebooks at end of lab; they can be picked up from the lab by Friday 5 pm)

**December 7**
- **1:30 pm – Competition (location TBD)**
- Arrive early to set up. Bring any necessary backup parts and tools.

**December 9**
- Add reflections on design and competition to notebook
- **Submit final design notebook** for review to the Lester’s office