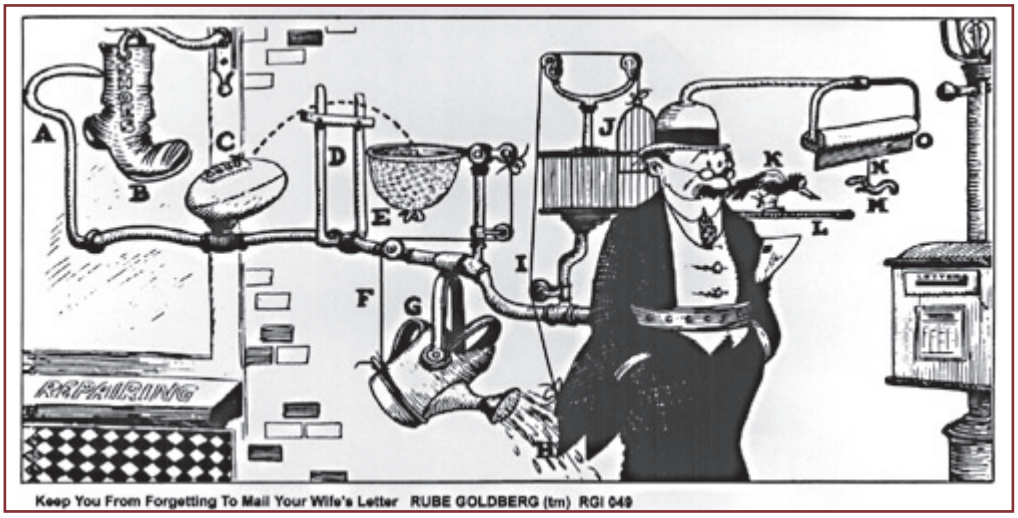
Rube Goldberg Challenge

This lab was taken from Professor Howard Choset's General Robotics class at Carnegie Mellon University. (http://generalrobotics.org)

In this lab you will design a simple Rube Goldberg Machine. The idea is that this machine should perform an overly complex process in order to complete a simple task. The images below should clarify this idea.

For more information on Rube Goldberg machines, including an annual national contest, visit the official Rube Goldberg website at:

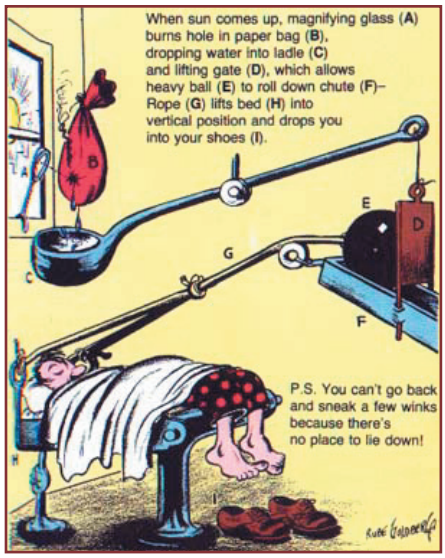
www.rgmc.com



As you walk past cobbler shop, hook (A) strikes suspended boot (B), causing it to kick football (C) through goal posts (D). Football drops into basket (E) and string (F) tilts sprinkling can (G), causing water to soak coat tails (H). As coat shrinks, cord (I) opens door (J) of cage, allowing bird (K) to walk out on perch (L) and grab worm (M), which is attached to string (N). This pulls down window shade (O), on which is written, "YOU SAP, MAIL THAT LETTER."

Challenge Statement

Build a Rube Goldberg Machine that will dispense a ball when a quarter is inserted. Your machine should consist of at least 5 energy transfers (steps). You may generate your own electrical potential, or utilize more creative sources of same, as long as you do not use a commercial product (like a battery, power supply, or outlet power). You may use any materials you can find except for those involving commercial sources of electrical potential as indicated above. Each step should be unique and contribute to the goal. Basically this means you can't, for example, have some rolling ball hit a few pins on its way down a ramp and have those actions count as steps. If you have questions now is the time to ask.



Rube Goldberg Challenge

Up to two human interventions are permitted: one to start the machine, and one to intervene if something unexpected occurs.

Bonus points – 5 bonus points will be awarded when two teams can get their Goldberg machines to work together.

Size constraints:

1. Base: 3' x 4' maximum

2. Height: 5' maximum

Hand in

1. Your group's Rube-Goldberg Machine
2. A hard copy of an html-based presentation that
    a. Depicts your Group's name and members' names.
    b. Contains pictures of your Rube-Goldberg Machine
    c. Lists the energy transfers
3. A copy of the grading sheet, below.

Evaluation

1. A (95): 5 energy transfers (steps)

2. B (85): 4 energy transfers (steps)

3. C (75): 3 energy transfers (steps)

4. D (65): 2 energy transfers (steps)

5. F (55): < 2 energy transfers or it doesn't work

6. F- (0): No machine at all

Five bonus points will be awarded if your machine can be attached to another group's machine and the two machines can run in SERIAL to create a larger (10+ transfers) Rube Goldberg machine. If three or more machines can be attached serially (15+ transfers), two additional points will be given for each successfully attached machine. For example, if four machines connected in serial successfully complete the goal, each team will receive 5 + 2 + 2 = 9 bonus points for a total grade of 104 per team!

A serially connected Rube Goldberg Machine is defined as one whose first energy transfer is initiated by the final energy transfer of the previous machine.

A parallel connected Rube Goldberg Machine is defined as one whose final energy transfer triggers multiple energy transfers.

Update for connected machines:

Each machine must operate independently with a quarter, spitting out a ball. When the machines are connected, the ball from the first machine may trigger that which the quarter would have triggered on the second machine. You may also choose to have the ball from the first machine push a quarter into the second machine. Either solution is fine, as long as each machine operates independently (when not connected) with a quarter.

The VEX Goldberg Perpetual Motion Machine Cooperative Challenge

The spirit of Rube Goldberg, Vex Goldberg's uncle, lives on in this engineering problem solving activity. Read carefully and envision your solution to solve the Vex Goldberg Perpetual Motion Engineering Challenge.

OVERVIEW

The class will be responsible for working together to design a "Perpetual Motion Machine." The class will be broken into multiple teams. Each team must design, fabricate, and demonstrate their part of the "Vex Goldberg Perpetual Motion Machine." Each subsystem within the larger system must integrate with the other subsystems to make up the whole system. It will be up to the class to determine which subsystem fits where. Each part of the machine should consist of at least three steps. A step is a linear process, not a parallel process. If an action causes a reaction, it is an example of one complete step. If an action causes two things to happen, it would be a parallel result and would only count as one step. Your solution may use a combination of potential energy and electromechanical energy provided by the Vex robotic kit. Each step must be unique and contribute to the solution. Each design team must build a mechanism that is part of the larger mechanism that moves a ball from one point to another.

Evaluation is based on the following criteria:

1. The ball begins travel through the mechanism after only one human intervention.

2. The human cannot touch the mechanism once the system starts.

3. Teams are limited to one Vex kit. They may also use Vex accessories and recycled materials. Absolutely no new materials may be used to solve this problem.

4. Each team's mechanism must fit within a 3 foot cube.

5. The ball must move through the whole system twice to demonstrate perpetual motion concept.

COOPERATIVE GROUPS

Students will work in teams of 2 or 3.

BEGINNING STEPS

Each group will:

1. Select a project manager

2. Brainstorm solutions to the challenge

3. Present their ideas to the whole group

4. Participate in a class discussion determining

   a. Order of systems

   b. Modification of subsystems

   c. Overall strategies to control the system

5. Design and fabricate solutions

6. Test subsystem

7. Help other groups get their subsystems operational

8. Integrate and test subsystem communication

9. Test integration of subsystems into overall system

Rube Goldberg Challenge

It is extremely difficult to get a diverse group of people to agree on many things. It becomes impossible if all members of the team want to have things their way. Below are general rules that apply to all team oriented problem solving situations. If the team would like to maintain good group dynamics, it is important that they spend several minutes talking about these important rules.

Listening tips for your team

- Listen; easy to say, hard to do. Listening is hard work, work at it!
- Never assume anything.
- Don't jump to conclusions. Listen to all opinions before you form your own.
- Focus on the problem; it is easy to get sidetracked.
- Be positive.
- If you aren't getting it, listen harder to your teammates.
- Ask questions.

Brainstorming ideas

Students need to understand that there are no bad ideas. All ideas are to be treated with respect. Often, one idea will lead to another idea. What may seem "off the wall" to the group may stimulate an idea from someone else. Many people are shy and won't share their opinions, particularly if they feel they will be ridiculed.

Be flexible

There is more than one way to solve any problem. Team members must be prepared to compromise, combine good ideas, listen to others opinions, and treat all suggestions fairly and with respect.

Consider resources

All problem solvers have a limited set of resources. When problem solving, your two biggest resources are people and information. If you know someone with expertise in the area on which you are working, consult them. Put in time up front, researching how others have solved similar problems; there is no reason to "reinvent the wheel." Time is the one resource that is in your control at the beginning of the problem, but becomes totally out of your control as the project moves along. There is a saying that "time waits for no one." That becomes extremely important when you have a fixed deadline.

Test multiple solutions

Students often select the first idea that comes to mind without thinking about other options. It is important for the team to take the time to look at several options if they want to come up with the best solution.

Be positive

Do you see yourself as "part of the solution" or "part of the problem?" We all would like to see ourselves as part of the solution. Unfortunately it doesn't always work out the way that we would like and this can lead to unhappy teammates. It is imperative that you understand how important it is to be positive when you are working in teams.

Rube Goldberg Challenge Lab Grading Sheet

Introduction to Engineering

Team _____ **Final Grade** _____

Member _____

Member _____

Member _____

Member _____

Minimal Standards

1. Size: no bigger than 3' x 4' x 5'

2. At least two energy transfers occur

3. There can be ONLY two human interventions. One that originally starts the machine, and one just in case something unusual happens.

4. This printed grading sheet must be filled in with team and member information and presented to the grader

Grading

Grading only occurs if the minimal standards were met completely.

Trial number of human interventions (Circle one): 1 2 3

Number of Energy transfers (Circle one): 1 2 3 4 5

Final Grade: _____

Scale (circle and total)

5 energy transfers: 95
4 energy transfers: 85
3 energy transfers: 75
2 energy transfers: 65

+5 bonus for one connected machine (with 5 transfers): _____

+2 bonus for each additional connected machine (with 5 transfers): _____

Notes