Rube Goldberg Lesson Plan

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Introduction/Background Info

Tailor the following information based on the age group/education level. Start with this introduction and make it relevant to their lives. Make sure they understand the unnecessary complexity of a Rube Goldberg machine and why he was doing this.

Simple and compound machines are used to make tasks easier. On the other hand, Rube Goldberg took a simple, easy task and made it more complex. Rube Goldberg was an American cartoonist, sculptor, author, engineer, and inventor. He graduated from UC Berkeley in 1904 with a MSE degree. His cartoons depicted complex machines that would complete a simple task in an indirect and convoluted way such as the one below. He made this to poke fun at other machines that were made overly complicated and could have been done in a much simpler fashion.

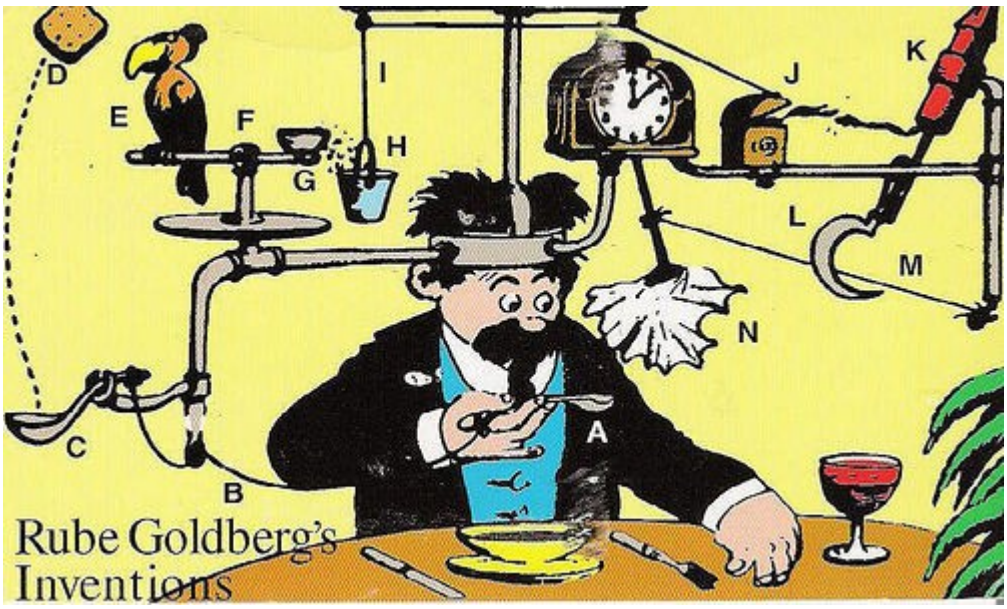

Fig 1. A Rube Goldberg cartoon of a "self-operating napkin"

In general engineering, the best design is the simplest design for many reasons. Even in complex machines, the simpler the individual components are, the easier it is to make the machine, the more reliable it is, and the easier the maintenance. One way that engineers assess the usefulness of a machine is its mechanical advantage. *Mechanical advantage* is the number of times a force exerted on a machine is multiplied by the machine. A simple machine that has a mechanical advantage can stand on its own or can be added to other simple machines. When two simple machines are combined, their mechanical advantages are multiplied together, not added. Often times, these machines have a positive and useful meaning in your life.

However, mechanical advantage cannot always be the best way to assess usefulness because a Rube Goldberg machine has a large mechanical advantage, but is overly complex.

What are some examples of machines that you use in your life? [i.e. a bicycle (gets you places), blender (makes you delicious drinks), video games (fun), etc.]

A fun example of a Rube Goldberg machine:
http://www.youtube.com/watch?v=qybUFnY7Y8w
And here is one done by MythBuster's:
http://www.youtube.com/watch?v=lCYg_gz4fDo&feature=related

These videos are good to look at for some ideas.

Design Process:

In the process of inventing, there are several steps regardless of the machine.
1. Determine what needs to be accomplished (What is the problem? Who is the device for?).
2. What are the constraints, materials, time allotted, safety, etc? Meet the given specifications.
3. Brainstorm! What simple machines can you use? Write and draw your ideas to save time and materials!
4. Make sure your ideas meet the design requirements. Materials lists are a good idea.
5. Once all the steps above are met, build! Try to utilize materials.
6. Test and troubleshoot!
7. Rebuild!

Student Objectives:

1) Understand the basic ideas of machines and mechanical advantages.
2) Understand the Engineering Design Process.
3) Learn to troubleshoot.

Topic(s):

- Mechanical Advantage – The number of times a force exerted on a machine is multiplied by the machine (mechanical advantage = output/input).
- Simple Machines – Machines that make work easier for people.
- Compound Machine – Two or more simple machines combined together to make one unit or machine to further simplify work.
- Design – To form a plan.
- Specifications – An exact and detailed statement of something to be built.

Overview of Lesson Process:

Example format: If possible, pose a problem with a storyline to make it interesting. For example: the story could be a clinical case where someone comes in with a kidney failure.
1) Discuss who Rube Goldberg is and what he did. Talk about his machines.
2) Talk about the basics of machines (i.e. mechanical advantage, simple and compound machines).
3) Discuss the competition and the guidelines.
4) Break up into several teams and get started!
5) Review what was learned. Also, go over what worked and what could have been improved.

Materials:

Rubber Bouncy Balls
Paper Cup
Paper clips

String
Cardboard
Straws
Rubber bands
Balloons
Masking Tape
Dominoes (~30 per school)
Mousetraps*

Optional:
Glue gun +Glue sticks
Marbles

*All mousetraps must be monitored by mentors. No setting of traps or triggering of traps are allowed by elementary students. High school students are allowed to handle them, as long as they do so responsibly.

Procedures:

Tips:
- Compartmentalize: phase 1, phase 2, etc then within each phrase you break the procedure down step-by-step.
- Number the steps
- Describe steps in simple words, use pictures and diagrams when you think they are helpful
- Make it as clear as possible.

Phase I
1. Discuss Rube Goldberg and his work.
2. Describe his machines.
3. Talk about the ideas of simple and compound machines and mechanical advantage.
4. Discuss why Rube Goldberg is counter-intuitive.
5. What are some examples of useful machines?
6. Briefly discuss the engineering design process

Phase II
Goal: Pop a balloon.
*Goal of the lesson can be
Guidelines:
- Meet end goal
- At least 4 steps prior to achieving goal (add more steps if time allows)
- Break kids into smaller groups within teams to build simple machines that can flow together.
- Have mentors handle hot glue guns.
- Each site leader in charge of getting cardboard.
- Can create mid-way goals (i.e. make a ball into a cup).
- Optional: Bring your own ideas for materials!
- Let the kids' creativity flow! Try not to step in too much!

Example Steps: Swinging ball hits other ball down ramp. This rolling ball hits line of Dominoes. End Domino has paper clip. Falls on balloon and pops it.

Resources
- http://www.teachengineering.org/view_lesson.php?url=http://www.teachengineering.org/collection/cub_/lessons/cub_simp_machines/cub_simp_machines_lesson05.xml
- http://www.youtube.com/watch?v=qybUFnY7Y8w