Rube-Goldberg devices and Simple Machines

Background for Teacher

Reuben Lucius Goldberg was a famous cartoonist born in San Francisco in 1883. Many of his cartoons became popular for satirizing the so-called advancement of technology. He depicted the use of many household or relatively simple items in conjunction with each other in order to show a domino effect to complete a relatively menial task. In other words, a Rube Goldberg device is one that tackles a simple task in a roundabout or difficult manner.

Example 1: How to keep shop windows clean?

Passing man (A) slips on banana peel (B) causing him to fall on rake (C). As handle of rake rises it throws horseshoe (D) onto rope (E) which sags, thereby tilting sprinkling can (F). Water (G) saturates mop (H). Pickle terrier (I) thinks it is raining, gets up to run into house and upsets sign (J) throwing it against non-tipping cigar ash receiver (K) which causes it to swing back and forth and swish the mop against window pane, wiping it clean.

If man breaks his neck by fall move away before cop arrives.
Example 2: Keep You From Forgetting To Mail Your Wife's Letter

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."

A simple way to avoid all this trouble is to marry a wife who can't write.

As a result of the cartoons, the term Rube Goldberg device was coined to describe a device that goes through a complex set of operations before completing a relatively simple task. A Rube Goldberg device differs slightly from a Rube Goldberg cartoon. A successful Rube Goldberg device must be set up in order for each step to trigger the next step until the last step is concluded where as a Rube Goldberg cartoon shows a picture which can be somewhat exaggerated of a similar device. The idea is essentially the same; and drawing a cartoon or diagram of a potential device is probably a good idea for the process of planning such a machine.
Some Simple Machines of a Rube Goldberg Device

I. The Pulley

A pulley can accomplish two different mechanical tasks. One is to reverse the direction of a force i.e. when you pull down on one side, an object on the other side moves up. The other task is that it can provide a mechanical advantage. This can be viewed in a few ways. First, changing the direction of the force may be advantageous and second, when pulleys work together in a system less force is needed to move an object (common in weight room machines).

II. Inclined Plane

An inclined plane can assist in making it easier to move an object against the force of gravity, as well as being a tool to use the force of gravity to lower an object in a controlled environment (instead of just dropping it).

III. Lever

A lever is another object that offers a mechanical advantage by needing less force to lift heavy objects (as long as the fulcrum is nearer to the weight and the further from the force). A bottle opener is a good example of this: the pivot point is on the edge of the bottle, the object to be lifted (the cap) is next to the edge, and your hand is 4 to five inches from the pivot point making it much easier to open. If you do not believe me try opening a bottle with your thumb and finger right next to the edge of the bottle and compare.
IV. Wheel and axel

A wheel and axel work by rotating together. They each make one revolution at the same time, but the linear speed of the wheel is greater than the speed of the axel (think of the wheels on a car). Similar to the lever, the further away from the point of rotation, the easier it is to rotate the object (i.e. why a key has a large head for your hand to twist it; same goes with doorknobs too).

V. Wedge

A wedge is two inclined planes back to back (therefore there is no 90 degree angle). A wedge can be used to split things like an axe.

VI. Archimedes Screw

In the above diagram, Archimedes screw is ‘lifting’ water out of a lake when the handle is turned clockwise. The screw can be used to transport objects up or down when turned, or it can simply be a vessel for traveling kind of like a spiral staircase.

And http://en.wikipedia.org/wiki/Archimedes_screw
Rube-Goldberg Projects

I. Introduction

A Rube-Goldberg device is something that goes through a complicated sequence of events in order to complete a simple task. In order to introduce Rube-Goldberg devices, students will look at cartoons and examples on the computer in the classroom. There will also be an introduction to simple machines and activities that dissect actual machines.

II. Choose a task

What do you want your device to do? (Be Creative!!)

Note: It is not necessary for your machine to move mountains or finish your science homework for you. The task can be as simple as picking something up or popping a balloon.

III. Simple Machines

Choose at least 4 different (you may use more than 4 total steps) simple machines to be included in your device

<table>
<thead>
<tr>
<th>Inclined Plane</th>
<th>Wedge</th>
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<tbody>
<tr>
<td>Screw</td>
<td>Pendulum</td>
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<tr>
<td>Lever</td>
<td>Wheel and axel</td>
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<tr>
<td>Pulley</td>
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IV. Assemble materials

Bring in household materials to use in the construction of your device.
V. Design your device

First, design your device on paper using the materials provided plus any simple materials that you will bring in from home. After designing the device, get the okay from the teacher to begin construction.

VI. Build device

With your group, assemble your device according to your design. You may or may not need to make changes to your original design idea.

VII. Test device and make adjustments

VIII. Display working device
Rube Goldberg  
(Possible) Materials and Device List

I. Household Materials

Ball (marble, golf ball etc.)  Funnels
Paper towel roll  Wire hangers
Coffee can  Gears
Coin  Clips (paper clip, close pin etc.)
Plastic containers  Old toys
Aluminum foil  Tacks, small screws, nails
CD’s

II. Materials provided (there may be more)

Mouse trap
String
Base
Rubber bands
Paper

III. Simple devices (and machines)

Pulley  Lever
Inclined plane  Hinge (type of lever)
Pendulum  Screw
Wheel and axel
Wedge
IV. Ideas for task (hopefully you can think of something creative these are just ideas to get the ball rolling).

Pop a balloon

Turn on a light

Pour a glass of water

Pick something up

Turn a page of a book

Web sites that may be helpful:

Examples

Tips
http://www.geocities.com/EnchantedForest/Cottage/6102/tips.html
http://www.geocities.com/sciolyso2/
Rube Goldberg

A Look at an intriguing man, his work, and devices inspired by his cartoons.
Rueben Lucius Goldberg

Born in San Francisco in 1883 (died 1970)
Graduated from University of California at Berkeley with a degree in Engineering
Worked as a cartoonist (won Pulitzer Prize), also an author and a sculptor
Famous for cartoons that show simple tasks being done in a complex manner
How to Keep Shop Windows Clean

Description: Passing man (A) slips on banana peel (B) causing him to fall on rake (C). As handle of rake rises it throws horseshoe (D) onto rope (E) which sags, thereby tilting sprinkling can (F). Water (G) saturates mop (H). Pickle terrier (I) thinks it is raining, gets up to run into house and upsets sign (J) throwing it against non-tipping cigar ash receiver (K) which causes it to swing back and forth and swish the mop against window pane, wiping it clean. If man breaks his neck by fall move away before cop arrives.

Information gotten at www.rube-goldberg.com
Each example consists of a cartoon with a detailed description of the chain reaction of events that complete the task at hand.

Cartoon 1 – How to Keep Shop Windows Clean

Cartoon 2 – Keep the Boss from Knowing You’re Late
Keep the Boss from Knowing
You’re Late
Rube Goldberg Devices

- Rube’s famous cartoons have inspired inventors, students, and bored people to create real devices similar to those shown in his cartoons.
- A Rube Goldberg device performs a simple task (like popping a balloon), but it does it in a round about, complex fashion.
Example Devices

Honda ad:  http://multimedia.honda-eu.com/accord/

Some 8th grade ideas:
http://www.larkspurschools.org/hall/project-s/rgoldberg/
How to build your device

First decide on the purpose of your device

Then, think of different simple machines and steps that you want to include (i.e. pendulum, funnel, pulley, spring, screw, lever etc.)

Make sure you can get the materials for your steps!!

Design your device; then start building!
A Group Exercise

With materials in the classroom each group will be given the task to see how they can make a pulley, a screw, a wedge, an inclined plane, a wheel and axel and a lever.