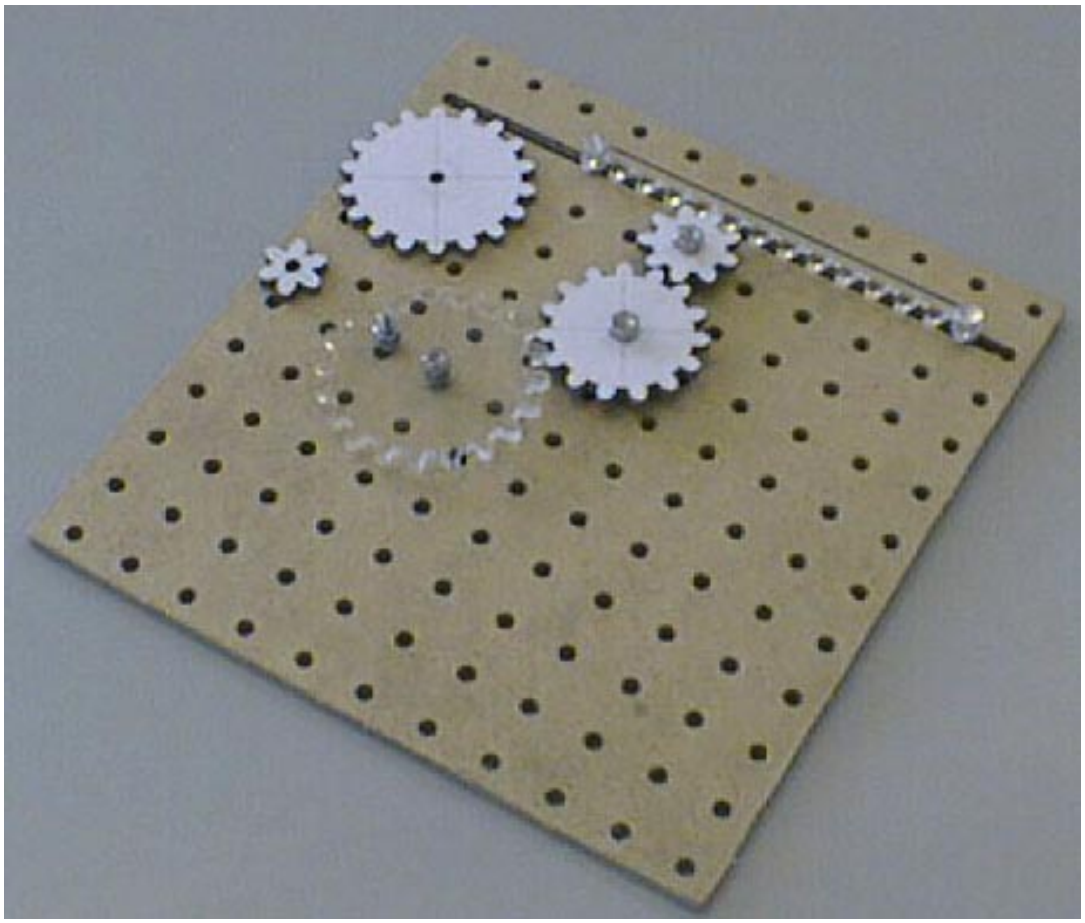
GEARS



From:

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To:

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Date:

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Introduction:

The purpose of this final proposal for the Rapid Prototyping class is to design and build an activity box that persons involved with outreach activities could take into an elementary or junior high school classroom to teach the children something about engineering.

Problem + Objectives:

This proposal must fulfill the following requirements:

- engage the children in an engineering activity,
- teach them something about what engineers do,
- appeal to all types of children (not just competitive children who like to blow things up),
- engage about 30 children simultaneously,
- be safe, durable, and suitable for an indoor classroom,
- employ principles of universal design, and
- be transportable in a compact car.

Solution:

What is the engineering activity the children will engage in?

The activity we propose will teach children, through experimentation, how gears work. Through discovery, the children will learn the concepts of revolution with corresponding direction, gear reduction, and linear velocity. The children will break up into groups of 2 - 3, and each group will be given a peg board, pegs, and gears (initially, 2 gears will be handed out, then a third, then the rest (see problems below)). The children solve the below problems by arranging various gears placed on the peg board, using the pegs. This activity is designed for children of about 10 years of age.

What will the children do and how will they learn by doing your activity?

The children will be given 3 or 4 problems to figure out, while working in groups of 3. The first problem would require the children to, by using two same size gears, help Jack to climb a tree and reach an apple. Jack would be a figure that is placed upon the linear gear, and the tree is a drawing that is attached directly to the board. By doing this, they will learn the relationship between revolution and linear motion (direction - between two gears). The second problem would require the children to, by using three same size gears, help Jack to climb back down the tree. By doing this, they will discover that the addition of another gear will reverse the direction previously discovered. The third problem would have the children move Jack up and down the tree again, using only two gears - but of different sizes. This will allow the children to observe the concepts behind gear reduction. The fourth, and final problem, will be much less structured. The children are given two points - A and B - and are shown that on the other side of the board is a clock face, with it's hands at point B. The children are allowed to use as many gears as they want to try and make the clock hands rotate in the proper direction. Note: initial gear will always be turned in the same direction (clockwise). Included within the activity box will be:

- 10 peg boards
- few hundred pegs
- 10 linear gears (racks)
- 40 each of 2" and 4" sized gears

- 10 arm attachments for clock face

Gears would be produced through a rapid prototyping system (LaserCamm). The peg boards will either be from scrap material or cut from bought material, but may need to be hand drilled for the pegs prior to use. The pegs are to be made from ¼" diameter PVC rod, cut down to 1" lengths. This is a hands on activity, and since the children will be in groups of only 3, all children will have to participate in the problem solving process.

Materials to be presented.

This is just a rough outline of a handout that will be elaborated on by us, and supplied to the instructor and/or the children at the time of the activity.

- Introduction to how gears work
  - Angular velocity translated into a linear velocity
  - Problems 1 and 2
- Discussion on gear reduction
  - Problem 3
- Problem 4
- Discussion on problem 4
  - Different gear combinations to solve the same problem
- Conclusion/discussion/feedback

Plan:

What needs to be built out of what materials and out of what processes.

Materials needed per group:

- 4 each of 2" and 4" gears, along with 1 linear gear. These items will be made through use of LaserCamm.
- 10 pegs, made out of PVC rod, cut to lengths of approximately 1".
- 1 12"x12" peg board, obtained either from the lab, or from cutting of 4'x8' sheet of peg board.
- clock hands made from .050" thick aluminum sheet.
- clock face, man, and tree, drawn on and cut from chip board.

Division of Labor

Rob:
- order PVC rod from McMaster Carr by 4/8/98 – DONE.
  - Should arrive by next weekend - cut to length then.
- modify drawings of gears in ProE by 4/6/98 – DONE.
  - Print views of gears, and send out file to LaserCamm by 4/16/98.
- order .050" aluminum sheet - DONE.
  - Draw up and cut out clock arms out of aluminum, and make special pegs, by 4/21/98.

Jaclyn:
- draw clock face, tree, and man, by 4/21/98.

Frank:
- if need be, cut down pegboard sheet to 12"x12" pieces, by 4/13/98.
- re-drill holes in pegboard by 4/21/98

Jointly:

- handouts for children, and possibly for instructor, by 4/21/98.

Budget:

Item	Quantity	Price/per	Total
PVC rod (pegs)	10’	$.35/foot	$3.50
Aluminum Sheet	2’ x 2’		$25
Peg Board	10 - 12" x 12"		free
Gears (2", 4", Linear	90 total		free
lone by LaserCamm)			
Chipboard	2	$.35/sheet	$0.70
Paint	7	$3.50/tube	$24.50
Poster Board	2	$1.19/sheet	$2.38
Total			$56.08