Toy Car Manufacturing

An Engineering Outreach Activity

Proposed By:

Courtney Marrett
Ryan Parzick
Tony Yu
Carnegie Mellon University

Presented To:

Elementary teachers
Persons taking engineering projects into elementary classrooms

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Introduction

Our goal is to design a fun and safe activity that will teach elementary children about the important aspects of engineering. Most engineering activities focus on the design process or the physical principles that correspond to these activities. Manufacturing and building a model are aspects of engineering often neglected. We want children to realize the importance of being able to build a working prototype of engineering designs. We also want them to have a better understanding of all the steps involved in using a rapid prototyping technique.

For our project, children create and fill molds of car parts. Then they combine their pieces with other students' parts to construct a toy car.

Problem

In school, children solve multitudes of science and math problems. Often they are not provided with examples of how their learning is applied in the "real world." Engineering outreach activities can form this link between formal instruction and outside application. These activities need to be safe, fun, and encourage cooperation between the students. Activities need to be formulated that provide hands-on learning, develop problem solving skills, and present the opportunities of engineering. Younger students tend not to understand the whole manufacturing process of products. They believe that the finished goods in the stores just appear there. This way of thinking, obviously, is completely wrong. Engineers work hard to come up with new, faster methods of production for all products.

Objectives

Design an activity that:

- Educates about engineering issues (especially the manufacturing and design process)
- Involves hands-on learning
- Is simple to execute with 30 children
- Can be transported easily
- Is appropriate for elementary school students (most likely 4^{th} or 5^{th} graders)
- Forces the students to think about how the products they use are created. Our toy car will allow them to see the molding process at work and also allow the students to receive hands-on experience of the process

Solution

We propose a toy car manufacturing activity for 4^{th} and/or 5^{th} graders. The children will use the molding process to create car parts and then combine the pieces to form a working toy car. Making this car, they will see that products don't just appear, but that there is a manufacturing process that goes along with the creation of the product. By creating the molded parts, the children will understand that there have to be smaller parts that are designed and built in order to create a final, larger product. Our activity will show them that there are many steps in creating even a simple toy.

A Car Modeling Classroom Session

First, a brief introduction of what engineers do will be discussed with the 4th and/or 5th grade students. The discussion will then move towards the manufacturing process, dealing mainly with molding. The children will be told that first a mold is created, then another material is poured into the mold. Upon setting, the molded piece is removed and combined with other molded pieces to form a working model.

Next, give each group of six children molding materials and a set of instructions. They will form clay rectangles for each mold to be made out of. Then they will press the car part models into the clay. Each group will have to coordinate their work to make sure they have the right number of each pieces to complete a car.

Then, the teacher/facilitator will have each group place their molds on trays and take them to a separate part of the room. During this time the children will be engaged in an engineering/ manufacturing process related exercise (the discussion of how everyday products are made and what they're made of). Meanwhile the facilitator will melt the Protowax chunks over a hotplate or stove. Then he/she will pour the Protowax into the molds, the children can watch from a safe distance so they understand all the process steps. An assistant needs to put axel holes into the wheels just after those molds are filled.

Once the liquid plastic has cooled and solidified (5-10 minutes) the groups need to reclaim their filled molds. They will need to remove the part from the mold and scrap off any stuck clay. Then the car can be assembled, by following the instructions, with the glue and rubber bands included.

Finally, the class can play with their cars. They can discuss features of the car that they made and aspects of the molding process that they liked and disliked.

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Since each child will produce 1-2 parts of the car from their own mold(s), everyone will be occupied and involved in the hands-on manufacturing experience. Then the groups of children will have to cooperate in their groups to assemble the final car model.

Each group's modeling kit will include:

- 6 pieces of clay
- Rectangular clay mold
- 3 car part models
- 2 axels
- 1 foam insert for between car faces
- Rubber-bands
- Glue
- Scrapers to remove extra clay
- Set of instructions

Also needed for activity:

- 2 hotplates

8 pounds of Protowax
Coffee cans for melting Protowax
Ladle for pouring Protowax
Metal stirring rods
Trays for mold carrying
Instruction sheet for facilitator
Activity sheets for students

Explicit instructions for student and facilitator should make the activity easy to execute. The materials are numerous but fairly compact so they will fit easily into a small car. The presenter only has to make a couple of trips from the car to the classroom to transfer all of the materials.

Plan

Task	Person Responsible	Date of completion
CAD drawings of car parts	Tony, Ryan, Courtney	4/15/98
Instructions for students	Courtney	4/17/98
Instructions for teacher	Ryan	4/17/98
Find/Buy materials for construction	Tony	4/17/98
Buy more clay	Ryan	4/17/98
Order more Protowax	Ryan	4/15/98
Buy blue foam	Tony	4/17/98
Cut foam inserts	Tony	4/21/98
Cut axles	Ryan	4/21/98
Collect scrapers, coffee cans	Courtney	4/21/98
Final Testing	All	4/21/98
Any revisions	All	4/22/98

Budget

Part	Method Obtained	Amount needed	Cost
Protowax	Buy from dealer	8 lbs. ($5.75/lbs.)	$46
Clay	Buy from store	9 packs ($2/pack)	$18
Blue Foam	Get from rapid lab	2’ x 1’ piece	---
Axels (made from coat hangers)	Ryan’s room	1 hanger	---
Glue	Courtney’s rubber cement	1 bottle	---
Rubber bands	Buy from store		< $1
Trays for molds to be carried on	Ryan’s room	3	---
Hotplate	At school *	1	$20 *
Scrapers	Courtney’s popsicle sticks	10 popsicle sticks	---
Coffee cans (to melt Protowax)	Tony’s room	2	---
Stirring rod (coat hanger)	Ryan’s room	2 hangers	---
Copies for instructions	Kinko’s	2 for teachers	
		7 for students	$.50
Total			$85.50*

*denotes uncertainty towards the need to purchase the hotplate

Sketch