Under Pressure

Submitted to: Professor Susan Finger

Submitted by:

Mark Bartolomeo
Koshiko Delaney-Karell
David C. Garner
Michael P. Malito

Carnegie Mellon University, Carnegie Institute of Technology

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Introduction

Often, engineers are asked to introduce concepts of engineering to elementary and junior high children. The purpose of our project is to design and build an activity box that one could take into an elementary or junior high school classroom to teach students an aspect of engineering. Examples of this at Carnegie Mellon are the Role Models Program, Take Our Daughters to Work Day, Society of Women Engineers High School Day, and I Have a Dream Foundation. Our activity box will be a tool for teachers, helping them to teach children an engineering principle.

Our project will teach students the concept of pressure by having the students construct their own pressure-controlled toy. This toy will be made from common everyday supplies and is easy to assemble. We will also introduce the concept of pressure through other examples, giving the students a better understanding of the engineering principle.

Objectives

This activity engages the students in a both fun and educational engineering activity that teaches the students about what engineers do and appeals to all types of children. Additionally, this activity engages about 30 children simultaneously for one half-hour duration. It also is safe, durable, and suitable for an indoor classroom, employing principles of universal design. In order to be transportable in a compact car, the size is limited. Our activity also incorporates a part from a rapid manufacturing technology.

Creation of an activity box that fits within these parameters allows teachers to replicate the process easily. In addition, the activity is very versatile, allowing for a variety of situations such as class size, activity time, environment, and even age.

Solution

We will create 30 toys, which will be partially assembled by the students. Along with this assembly period, the teacher and students will discuss pressure, at the end; the students will have time to play with the toy that they just created.

Before arrival, paper bags with all the necessary parts will be made (see Appendix B). In the beginning of the activity, we will demonstrate several examples of pressure:

- Balloon: the teacher will blow up the balloon, and explain how the balloon expands
- Exploding Paper Bag: the teacher will blow up paper bag and pop it
- Pacal's Law (short lecture): P1/A1=P2/A2, pressure tube will be used to demonstrate this

After we explain how pressure relates to each of the examples, we will ask the students to give some examples of their own (tire, basketball pump, volcano, etc.). We will then begin to explain to the students how to build the toy (see Appendix D). Once we have completely explained how to assemble they toy, parts will be distributed, and students can begin construction. Once construction is complete, students can play with their toy. The objective of the toy is to launch a cork-basketball and catch it through the plastic hoop attached to the PVC.

The following parts will be distributed:

1 PVC pipe (10" long, _" ID)
1 Dowl rod (12" long, _" D) (1 cork attached)
1 cork ball (painted to look like basketball; _" D)
1 net (1" x 4")
1 String (42")
1 Combo Clip Hoop
Gaffer's Tape

Appendix A:

Budget			
PVC	30 pieces	10" 3/4" D	$25
Dowl Rods	30 pieces	12" 5/8" D	$20
Cork	30 pieces	5/8" D spherical	$10
Cork	30 pieces	5/8" D cylindrical	$10
String	1 Spool	100’	$5
Gaffer’s Tape	1 Roll		$10
Paint	1 Can orange		$5
Balloons	1 Bag colored		$5
Netting		square yard	$2
Paint Brush	1		$1

Appendix B: Preparation Instructions

1. Cut the 10-3’ long dowls into 30-12" long pieces of wood.
2. Cut the 3-10’ long PVC into 10-10" long pieces of PVC.
3. Paint the 30 Cork balls orange.
4. Repeat 30 times: Glue 1 cylindrical cork pieces to one end of the wooden rod with gluegun.
5. Cut the string into 30-36" long pieces.
6. Cut 30 9"x2" pieces of woven material.
7. Repeat 30 times:

Put the following materials in one paper bag:

1-12" long wooden dowl with glued cork piece glue

1-10" long PVC pipe

1-orange cork ball

1-36" long string

1-rapid prototyped clip

1 piece 9"x2" woven material

Appendix C: Class Agenda

Lecture 12 min

Blow up balloon, explain pressure buildup

Blow air into paper bag, then pop (explain)

Give other examples (Pascal's Law, bicycle pump, etc.)

Assembly 20 min

Begin distributing paper bag of parts to each student

Explain how to build the pressure toy, step by step

Assist the students as needed

Play time 10 min

Make sure each student has finished construction of toy

Make sure students play safely

Wrap Up 3 min

Summarize pressure lecture

Give other possible everyday components to make toy

Appendix D: Instructions for Construction of Toy

1. Tear two 1/2" pieces of Gaffers Tape.
2. Tape on end of string to part of the cork top with one of the pieces of Gaffers Tape.
3. Tape the other end of the string to the bottom of the wooden rod.
4. Thread the pipe cleaner through the woven material (basketball hoop part).
5. Attach the smaller end of the pipe cleaner to the middle of the PVC pipe.
6. Tape around the wooden rod 1" from the end with the string to create a handle, about 1/8" thick.
7. Put the end of the wooden dowl without the string into the PVC pipe.
8. Put the cork in the other end of the PVC Pipe.
9. Push the wooden rod through the PVC pipe quickly, watch the ball fly, and then try to catch the ball through the basketball hoop!

Appendix E: Tasks

	Quantity	Size	Assignment
Buy			
Balloons	1 bag	large	Dave
CPVC	3	10’ L 3/4"ID	Mark
Dowl Rods	10	36" L 5/8"OD	Mark
Cork	30	5/8" D spherical	Mark
	30	5/8" D cylindrical	Mark
String	1	100 ‘ roll	Dave
Gaffer’s Tape	1	1 roll	Dave
Netting	1	1 sq. yard	Dave
Paint	1	1 can of orange	Dave
Glue	10	Hot Glue Stick	Dave
Cut			
PVC	30	10"	Mike
Dowl Rods	30	12"	Mike
Netting	30	4" by 1"	Mike
Glue cork to Dowl rods			Koshi
Decorate tops			Koshi