

# **ENGR 3030: Science for Grade 6 Students**

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**Western Michigan University**

**Becky Behrendt, Matt Bruski, and Lisa Noftsger**

## **Introduction**

Western Michigan University engineering students were asked to hold a workshop to heighten the interest of fifth and sixth grade girls at Pine Street Elementary School in science and engineering-related subjects. With the low numbers of women in science related fields, it is important to provide girls with opportunities to experience science and encourage their pursuit of science-related careers. This was done by creating a number of activities for girls to participate in by bringing them to their school for a Saturday science workshop. The activities were regarding heat transfer between materials, model rockets based on a chemical reaction, and using chemicals to change the properties of a material.

The contact for the project was Lori Howell, a teacher at Pine Street Elementary School. She provided information about the class and what they have studied thus far in school. She also gave feedback about the ideas for activities and had many ideas of her own. The school welcomed WMU warmly and the girls enjoyed the activities that were planned for them. The students, principal, and teacher all hoped it could happen again next year.

## **Project Description**

To encourage girls to look at careers in math, science, or technology, a one day workshop is scheduled to take place at Pine Street Elementary. It will be presented to both fifth and sixth grade female students. Experiments and information were provided for these students to help encourage them to become more interested and continue their education in math and science. This project is important because there is a devastating minority of females in the engineering (math and science) industries.

## **Workshop Details**

Mrs. Lori Howell was the teacher contact in charge of the workshop in Wayland. Lisa Noftsger was the group member who maintained direct contact with Mrs. Howell. The workshop occurred on Saturday, November 11<sup>th</sup> from 9:00 to 11:00 in the morning. There were two sessions, which lasted approximately forty-five minutes each with a snack break in the middle. There were two groups of three WMU students working at

Wayland in separate classrooms which allowed for the students to rotate between the two for different experiments.

There were many available resources at the elementary school. There was a computer lab with thirty computers. Typical school supplies such as paper, pencils, glue, etc. were also readily on hand. If needed, ten simple LEGO kits were available as well.

Some education guidelines were given by Mrs. Howell. The students needed to have current knowledge in math and science which helped to create some fun and educational experiments. The students were already familiar with math skills in division work, such as rates and ratios, introductory algebra, and some fraction work. Their science knowledge included units on matter, sound and light, plants and animals, earth science, simple machines, circulatory and respiratory units, and astronomy.

### **Project Constraints**

The constraints for this project were mostly related to the type of audience and the environment where the experiments took place. The female audience was between the ages of ten and twelve. Their level of thinking was taken into consideration when designing and implementing the experiments. The specific science units that were covered throughout the semester were given to the WMU student team. These were used as a basis for experiment design so that the project goal could be met as well as reiterating their science lessons. There was a limited amount of chemicals and equipment that was utilized because the students were only at the higher elementary level. The materials or chemicals used were very basic, such as household products and non-volatile substances. Time was a constraint at the beginning of the project because it was uncertain if multiple after-school sessions would be attainable. It was decided to do the one Saturday afternoon workshop where several experiments could be implemented within a few hours.

### **Project Information**

The work needed to prepare for the workshop required research, organization, and communication with Lori Howell, the teacher contact. Experiment ideas were researched and our group selected several of them. A document was sent to Mrs. Howell with all of the ideas, including the procedure and materials needed for each experiment. This Word document can be seen in Appendix 1. She was given the opportunity to choose the experiments that were of most interest to her or that would be the most beneficial to the girls. The three experiments that were chosen included Melting Moments (a look at both thermal conductors and insulators), Alka-Seltzer Rockets (model rockets based on a chemical reaction), and Disappearing Eggshells (that displayed change in properties of a material using chemicals). From the experiments that she chose, a rough budget was created in Table 1.

Table 1. Wayland Workshop Initial Budget.

<b>Experiment</b>	<b>Materials</b>	<b>Cost (\$)</b>	<b>Quantity</b>	<b>Subtotal (\$)</b>
<b>Melting Moments</b>	Chocolate candy	7	3	21
	Stop watches	4	10	40
	Aluminum foil	3	4	12
	Newspapers	2	4	8
	Balloons	5	2	10
	Plastic bags	0	20	0
	Cotton wool	2	20	40
	Pencils	3	2	6
<b>Alka-Seltzer Rockets</b>				
<b>Alka-Seltzer Rockets</b>	Film canisters	0	40	0
	Alka-Seltzer	5	10	50
	Paper	4	1	4
	Scissors	n/a	n/a	n/a
	Crayons	n/a	n/a	n/a
	Water jugs	4	2	8
<b>Disappearing Eggshell</b>				
<b>Disappearing Eggshell</b>	Eggs	2	1	2
	Vinegar	3	1	3
<b>Snacks</b>				
<b>Snacks</b>	100% Juice boxes	6	6	36
	Pretzels	4	4	16
	Grapes	4	5	20
				<b>TOTAL</b>
				<b>\$276</b>

The cost values for each material were approximated from general knowledge. The quantity is expected to account for 40 girls. The original number of girls expected to attend the workshop was 30. A flyer, which will be discussed in more detail briefly, was sent home with all the girls. There was a greater interest in the workshop than previously anticipated, so the number of attendees was increased to 40. This affected the budget; Table 1 does reflect the increase in students. Table 2 below reflects the final budget after shopping. It includes the quantities and actual costs of everything that was purchased.

Table 2. Wayland Workshop Final Budget.

<b>Experiment</b>	<b>Materials</b>	<b>Cost (\$)</b>	<b>Quantity</b>	<b>Subtotal (\$)</b>	<b>Tax (\$)</b>	<b>Total (\$)</b>
<b>Melting Moments</b>	Chocolate candy	2.50	4	10.00	0.00	10.00
	Stop watches	4.96	7	34.72	2.08	36.80
	Stop watches	14.99	3	44.97	2.70	47.67
	Aluminum foil	2.56	2	5.12	0.31	5.43
	Balloons	1.47	1	1.47	0.09	1.56
	Plastic bags	2.16	1	2.16	0.13	2.29
	Cotton wool	1.67	1	1.67	0.10	1.77
	Pencils	3.88	2	7.76	0.47	8.23
<b>Alka-Seltzer Rockets</b>	Film canisters	0	40	0.00	0.00	0.00
	Alka-Seltzer	6.98	1	6.98	0.42	7.40
	Paper	1.50	1	1.50	0.09	1.59
	Water jugs	0.64	2	1.28	0.00	1.28
	Tape	2.00	2	4.00	0.24	4.24
<b>Disappearing Eggshell</b>	Eggs	1.99	2	3.98	0.00	3.98
	Vinegar	1.28	1	1.28	0.00	1.28
	Vinegar	1.99	4	7.96	0.00	7.96
	Aluminum Foil	6.25	1	6.25	0.38	6.63
	Plastic Cups	2.99	2	5.98	0.36	6.34
	Rubber Bands	1.49	2	2.98	0.18	3.16
<b>Snacks</b>	100% Juice boxes	2.66	5	13.30	0.00	13.30
	Pretzels	2.14	4	8.56	0.00	8.56
	Grapes	41.83	1	41.83	0.00	41.83
<b>Cleaning Supplies</b>	Paper Towel	3.50	1	3.50	0.21	3.71
	Disinfectant Wipes	5.29	1	5.29	0.32	5.61
						<b>TOTAL</b>
						<b>\$230.60</b>

### Workshop Flyer

A flyer was created with general information about the workshop. This flyer can be seen in Appendix 2. Mrs. Howell provided some guidelines as to what specific information needed to be included, such as her presence and parental permission. Some different

things that are on the flyer include the experiments that were done on Saturday, who put it on, that snacks will be provided, and a parental permission section.

### **Wayland Workshop Results**

The workshop was very successful on Saturday morning. The initial plan was to set up all experiments a day ahead, which was Friday, November 10, but that turned out to be inconvenient for Mrs. Howell. Consequently, both WMU groups met at Pine Street Elementary an hour before the workshop began to set-up. In preparation for the clinic, experiment was organized by placing all the supplies needed for it into its own zip lock bag or container. Each girl or group of two was given the supplies needed for all experiments at the beginning of the morning so time was not wasted during the session.

At the beginning of the workshop, each WMU student was introduced to the girls and a small discussion followed. Topics discussed included what college was attended and what was being studied including likes about college.

During the experiments, it was found that some of the girls had a higher level of knowledge than others through interactive questioning. During the experiments, one person would generally lead the activity while the other two would circulate around the room. This allowed for individual discussions about what was happening and why so that all the girls were able to somewhat visualize and grasp the theory behind it all.

All of the experiments were successful. The girls showed an extreme amount of enthusiasm and seemed to enjoy the day. Western Michigan University was encouraged to come back not only by the students, but also by the principal and Mrs. Howell. It was their opinion that a workshop such as this was a great way to introduce the girls to science and math related things.

### **Recommendations**

There were a few recommendations that could be implemented into this project. First, it would be very reasonable to take as much time as allowed to perform the experiments and discussion. This way the experiments are not rushed and there is adequate time to thoroughly complete the experiments with extra time for questions and comments. Also, it would be very beneficial to meet with the teacher contact at the school prior to workshop day to have more time to set and get acquainted with the environment. This was something that was attempted, but unfortunately could not be met for this workshop.

### **Conclusion**

A Saturday workshop was planned at Pine Street Elementary school to establish the desire for further learning in the subjects of math, science, and technology for forty fifth and sixth grade female students. It was demonstrated in a fun and exciting way that

science and math can be a school path that girls might be interested in following. The teacher contact, Mrs. Howell, was very helpful in finishing this project. It was found that the students were very enthusiastic to learn and participate. There were many invitations to return for another workshop. Overall, it was a very successful workshop.

**Appendix 1**  
**Experiment Ideas**

## Experiment 1: Melting Moments

### Thermal Conductors and Insulators

A good thermal conductor allows heat to pass through it easily.

A good thermal insulator stops heat from passing.

### Supplies

- 7 pieces of chocolate
- Timer
- Aluminum Foil
- Newspaper
- Rubber Balloon
- Plastic bag
- Cotton Wool

### Procedure

1. Hold a piece of chocolate in your hand and see how long it takes to melt.
2. Wrap chocolate in a single thickness of each material.
3. Predict whether the chocolate will melt, partly melt, or stay solid
4. Hold the wrapped up chocolate in your hand for the same amount of time, then check the result and fill out the column of the table.
5. Use your results to decide if each material is a good insulator, a good conductor, or in between

Material	Prediction	Result	Conductor or Insulator?
Aluminum Foil			
Newspaper			
Rubber Balloon			
Plastic Bag			
Cotton Wool			

## **Experiment 2: Alka-Seltzer Rockets**

Students build model rockets folding construction paper (they often like to color their rockets first) around 35mm plastic film canisters. They then take their rockets outside and experiment with different mixtures of rocket fuel (Alka-Seltzer and water) to see how high they can make their rockets fly. Students keep track of their rocket's performance in a table and later transfer the table values to a graph. This is a great activity for teaching data recording, plotting, statistics, and error analysis. (Students often quickly find out that they can get their rocket -film cap- to fly higher by taking the paper rocket off).

### **Supplies**

- Film canisters
- Alka-Seltzer
- Paper
- Scissors
- Crayons
- Water

## **Experiment 3**

Explore how the earth naturally filters water. For this experiment we could make water filtration tubes using clear PVC tubing approx. 8 in wide. We could fill the tubes with different types of dirt, rocks, sand, or whatever the student may find outside. Then, using water with dissolved particles and other matter in it, a test could be made to find out which media filters the water most efficiently. The tubes could also utilize screens on the bottom so they can be cleaned and re-used with different substances. This could give students an idea of why not to dump certain things on the ground (gasoline, oil, etc). Keep in mind we can use any types of materials to pack the tubes and fluids other than water can be used to filter.

### **Supplies**

- PVC tubing
- Dirt/rocks/etc
- Screens
- Water

## **Experiment 4**

Disappearing-eggshell experiment. Place uncooked eggs in a solution of acetic acid (vinegar) and the next day the shell is dissolved! This can give students a chance to study

a chemical reaction and/or see the membrane inside of an eggshell, therefore it could have both biology and chemistry implications. This experiment could be started Friday by us and then we would be able to illustrate the before and after effects of the experiment Saturday with the students. A discussion could follow.

### **Supplies**

- Eggs
- Acetic acid (vinegar)
- Screens
- Water

### **Experiment 5**

Fill one balloon with air and one with water. Then hold a flame first to the balloon containing air. The result will be the balloon popping. Next hold a flame to the balloon with the water. This time the result would be the balloon withstanding the heat. For entertainment purposes, the balloon could be held above one of our heads to add to the suspense.

### **Supplies**

- Balloons
- Water
- Flame resource (lighter, match, etc)
- Water

### **Experiment 6**

Heat a glass container and then before it cools stretch a balloon over the end of it. The balloon will be drawn inside the container and be forced against the inner walls. A discussion could follow that talks about the relationship between air pressure and heat.

### **Supplies**

- Bottle, volumetric flask, etc
- Heating source
- Balloons

### **Experiment 7**

Vinegar + Baking soda = foam!!! Many different things we could do here.



**WMU Students at the Wayland Middle School Workshop, December 2006**

