TEACHER QUEST TAMPA BAY PROGRAM
ACTION PLAN

Author: Amy J Greth
Lesson Title: Shocking Truth About ESD
Grade Level: 7
Subject Area(s): Math, Science
Date: 7/9/10

Summer Work Experience

As the Quality Engineer Auditor, I joined a wonderful team at Raytheon, Quality Systems and Audits organization, which is responsible for maintaining the Largo Manufacturing and Bardmoor/Bldg D Engineering QMS (Quality Management System).

During my time at Raytheon, I observed and assisted in various projects. The team of Quality Systems and Audits conducted an Internal Audit at the Largo Manufacturing Building in preparation for the upcoming corporate audit in August. They wrote up corrective action plans from their findings and collaborated with the different departments/programs in effort to meet necessary manufacturing and engineering processes. I observed and assisted in the various audits of the different programs and departments, learning the importance of safety in manufacturing and engineering processes. I also assisted in the process of organizing and maintaining the findings of the various audits in a spreadsheet. We compared last year's audit data to this year's findings and used the information to produce Corrective Action plans for the departments/programs.

My knowledge of Microsoft Office applications was utilized to plan and implement a schedule of audits over a three week period. I also assisted in organizing data in an Excel worksheet of previous audit findings in preparation for the audit.

Through my experience at Raytheon, I learned many new and exciting things. I was very intrigued by the processes and safety guidelines set in the factory. While on the "floor" (factory area) I was required to wear closed shoes, a special ESD (electrostatic discharge) smock, protective eye wear, and have my Raytheon badge visible at all times. ESD was a great concern to many areas in the factory. Raytheon takes many precautions to preserve the factory products. I found the whole nature of ESD to be interesting and feel students would be intrigued as well. The assemblers in the factory had special ESD tables and grounding wrist bracelets to ensure no ESD damage to the product. All machinery, tools, and

ionizers are calibrated yearly as well to protect the product. As an auditor, these safety guidelines and processes were looked at very closely and monitored on a regular basis.

I also learned additional aspects in computer technology. For example, Raytheon utilizes a different email system, Lotus Notes. It was similar to Microsoft Outlook, but had some features that I felt were more user friendly and appropriate for the workplace. I learned to set up calendar invites and maintain the audit schedule on the calendar. Lotus also had a live chat feature, making work more efficient; especially when communicating with individuals from one of the other Raytheon locations in Pinellas County. In Microsoft Word, I became more familiar with using tables. We utilized the tables in a word document as a calendar for scheduling the various audits. I found this process to be easy and something I could definitely incorporate in my lessons with the students to integrate technology in the curriculum.

The Teacher Quest Program has offered me the unique opportunity to become exposed to STEM in the work place. Raytheon utilized a great deal of technology to communicate and implement their processes. They incorporated Word and Power Point as a communication tool, used Excel for data reporting and organization in all departments/programs, and integrated the different Microsoft applications within one another. Math was everywhere! It ranged from data reports with graphs and percentages to the calibration of machinery for the factory. Science took a large part in daily activities in the factory. An example of this is the awareness of ESD. The full understanding of ESD and its effects were widely communicated and supported. All employees of Raytheon were required to maintain a safe work area and be very knowledgeable of the effects of ESD. Engineering at Raytheon encompassed a large area of topics. I learned about engineers who worked on integrating radars on ships, planes, and land vehicles in order to broaden their radar field for increased security and monitoring. Other engineers worked on missile defense technology, homeland security, and installation of radars on Humvees. As an auditing engineer, they needed to be knowledgeable of all fields of engineering in the factory, in order to accurately observe and access an area for compliance.

I feel this experience has equipped me with the knowledge to integrate industry ideas and practices into my daily lesson plans. Through this integration I hope to make the students' learning more meaningful by using real world applications to learn the curriculum. For example, when teaching my students Scale Drawing, I can incorporate the concept of the radars from a ship, plane, and land vehicle that I learned about at Raytheon. The students will apply the knowledge of Scale Drawing, creating an accurate depiction of what it might look like as the three different radars are integrated. I also look forward to inviting Raytheon employees into my classroom to share their careers with the students in effort to broaden the students' opportunities for career paths and get a better understanding of how math, science, and technology is everywhere! Members from the team I worked with will be visiting my classroom to assist in the lesson plan I have formulated based on my experience at Raytheon. They will share what

they do as a Quality Engineer Auditor and explain the processes that take place. The members of the team have been very helpful, supportive, and wonderful to work with.

Lesson Plan/Unit of Study

Objectives

- Students will make predictions and conduct a series of experiments.
- Students will analyze the results to determine if the experiments are fair or unfair.
- Students will report their findings by using graphical representation and data analysis.

Sunshine Sstate Standards

MA.7.S.6.2, MA.7.A.1.2, MA.7.P.7.1, MA.7.P.7.2, SC.7.N.1.1, SC.7.N.1.2, SC.7.N.1.4

Materials

Introduction materials: thread, yard stick, balloons, wool, scotch tape, computer and projector

Experiment materials: class set of instructions (Appendix A), foam plates, foam cups, drinking straws, clay, aluminum pans, aluminum foil, masking tape, wooden ruler, various experiment materials (silk, nylon, wool, cotton, saran wrap, plastic, tissue paper, etc.)

Wrap up materials: Wint-O-Green & Pep-O-Mint Lifesavers

Follow-up Materials: Additional Experiments Worksheet instructions and Materials List (Appendix B)

Assessment Materials: Class set of essay questions (Appendix C)

Instructional Procedures

Introduction:

As an attention grabber, complete the following demonstration:

1. Have two equal lengths of thread and tape them to a yard stick in the middle about 2.5 cm apart.
2. Have two students hold the yard stick horizontally between them.
3. Using inflated balloons, tie each of the balloons to the end of each thread so that they are hanging at the same height and are resting next to each other.
4. Rub each of the balloons with the wooly material to charge them (one at a time).
5. Ask the students: What happens when the balloons are let go? How do they react to each other?

6. Try to bring the two balloons together after they have been rubbed with the wooly material. What happens when you try to bring the balloons together?
7. Place your hands in between the two balloons, does something different happen?

Explain to the students: Both of the balloons have become negatively charged once they have been rubbed with the wooly material and will push each other away. Items that are made up of the same material will always take on the same charge. If you have a matching charge of static electricity in like items, they will repel each other just like the same poles of magnets will repel each other.

Video: Show the students the Static Electricity Video from Learn 360

Small Group/Independent Instruction

Students will now break into small groups and construct an electroscope to test various materials for static electricity. Each group will be given step-by-step instructions for building their electroscope (Appendix A). Once their electroscope is constructed, they will test various objects for static electricity and record the results.

Using the results of the materials in the experiment, students will construct a graphical representation of the data and analyze the results.

Wrap-Up

As a whole group, students will discuss static electricity and key terms identified in the video and used in the experiment. They will share any “aha” moments they may have had while discovering materials that produce a static electric charge. The students will also discuss the effects of static electricity and how those effects apply to real world experiences. Could the effects be harmful? How? Why? Stress the importance that even though you cannot always see the electrical discharge, it is happening. To support this idea, have the students do the following:

INSTRUCTIONS: Make the classroom dark or move to a dark room and wait a few moments until the students’ eyes get accustomed to the darkness. Then have them place a "Wint-O- Green" or "Pep-O-Mint" lifesaver into their mouths. Have them break up the lifesaver in their mouth with their teeth, keeping their mouth open. Look for sparks. If they do it right, they should see little bluish flashes of light.

WHY? When you break the candy apart, you're breaking apart sugars inside the candy. The sugars release little electrical charges into the air. These charges attract oppositely charged nitrogen in the air. When the two meet, they react in a tiny spark that you can see.

Integration of Summer Work Experience/Follow-up Activities

Quality Engineers from Raytheon will visit the classroom. They will explain to the students how static electricity in the factory is very harmful to the materials they work with and produce. The students will learn about precautions taken in the factory to avoid damage caused by ESD (electrostatic discharge) and view examples of how the ESD can damage sensitive items in the factory. The students will have the opportunity to ask the engineer questions about ESD and other related topics, as well as the opportunity to learn more about the engineer's job.

As a follow-up to the visit from the engineers, the students will have additional opportunities to explore and understand static electricity. They will conduct additional experiments with materials and explore items that protect from static electricity (Appendix B).

Assessment Instrument

The students will write a one page essay, answering various questions in relation to the electroscope and real world applications involving static electricity. They will construct a graphical representation of the electroscope experiment results and give real world examples supporting the importance of their experiment.

References

Learn 360 Video
http://www.learn360.com/ShowVideo.aspx?SearchText=static+electricity&Page=1&ID=149638

Electroscope
http://hubpages.com/hub/Science-Fair-Experiments-that-get-good-grades--Experiment-14---Static-electricity

Making a Spark
http://www.exploratorium.edu/science_explorer/sparker.html

APPENDIX A

Making and Using an Electroscope!

Static Electricity is the building of an electrical charge through objects. Static Electricity sometimes suddenly discharges, like a lightning built. Other times it makes things cling to one another, like clothes fresh out of a dryer. The clinging of the objects is caused when the two objects have opposite charges, negative and positive.

Static electricity can be made by rubbing an object against another, resulting in friction. A negative charge, or electrons, is released through friction, creating a static charge when they build up.

Vocabulary: electrons, friction, negative charges, positive charges, neutrality

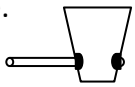
Materials: 1 balloon, 1 foam plate, 1 foam cup, 1 drinking straw, clay, 1 aluminum pan, thread, aluminum foil, masking tape, wooden ruler, experiment materials (provided by teacher) List the materials you will have students use in the activity.

You will be making an electroscope to test if static electricity is present in various materials.

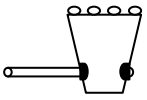
Procedures

1. Make two holes in the Styrofoam cup that are opposite of one another near the cup's bottom.

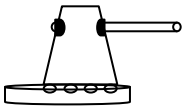
2. Poke the plastic straw through each of the holes that are in your Styrofoam cup. Push it so it is nearly equal to one side of the cup and sticking out as far as it possibly can on the other side.



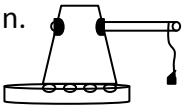
3. On the rim of the cup, stick four small clay balls about a half an inch in diameter.



4. Flip the cup over. Using the clay balls, stick your cup to the inside bottom of your pie plate. Make sure you cup is placed near the edge of the pan so the straw hangs over the edge of the pan.



5. Cut an eight inch long piece of thread. On one end of the thread tie several knots.
6. Using your aluminum foil cut a piece that is 1 inch in length on all sides. Crunch it up into a ball around the knots you tied in the thread. The foil ball should be about the same size as the thread.
7. Tape the other end of the thread to the end of the straw hanging over the edge of the pan. The tin foil ball should fall near the edge of the pan.



8. To prevent movement, tape the straw to the cup.
9. Now you will test if your electroscope works. To do this, you will need to create some static charge. You will need the balloon and Styrofoam plate from your materials. Inflate your balloon and tie it shut. Rub the inflated balloon and the Styrofoam plate together. This charges the plate, meaning you create a build-up of electrons on the plate.
10. Now place the electroscope on top of the Styrofoam plate. Be sure to grip your electroscope by the Styrofoam cup and not the aluminum pan. If you grab it wrong, it will not work. The negative charge easily moves through metal. Because of this, the electrons move through your aluminum pan quickly. The negative charges that are added onto your pan will repel the negative charges that are on the foil ball. This will make the ball move away from the pan.
11. Using the wooden ruler, carefully measure the space between the edge of the aluminum pan and the foil ball. The more of a charge the bigger the distance. Be sure not to touch the foil ball, aluminum pan, or Styrofoam plate with the ruler.

You are now ready to test you materials for static electricity!

1. Rub the item and the Styrofoam plate together.
2. Place the electroscope on the Styrofoam plate. Remember to handle your electroscope by the cup!

3. Measure the distance from the foil ball and the edge of the aluminum pan and record your findings in the table below. Be sure to measure using centimeters (cm)!
4. Remove your electroscope from the Styrofoam plate and discharge it. To discharge the electroscope, simply touch the aluminum pan with your finger.
5. Repeat steps 1 – 4 ten times for each material.
6. Using the data in the table below, find the mean, median, and mode for each material. Then, using the mean data, construct a graphical representation of the static electricity in the materials.

DATA Table

MATERIAL	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	MEAN	MEDIAN	MODE

APPENDIX B

Directions: *Complete each of the experiments below. On a separate sheet of paper, answer the question given at the end of each activity.*

Activity #1: Swinging cereal

Materials: inflated balloon, thread, small pieces of dry cereal

What to do:

1. Tie a piece of the cereal to one end of a 12 inch piece of thread. Find a place to attach the other end so that the cereal does not hang close to anything else. (You can tape the thread to the edge of a table or desk.)
2. Charge the balloon by vigorously rubbing the balloon against your head.
3. Slowly bring the balloon near the cereal. It will swing to touch the balloon. Hold it still until the cereal jumps away by itself.
4. Now try to touch the balloon to the cereal again. It will move away as the balloon approaches.

What Happened: Rubbing the balloon against your head moved electrons from your hair to the balloon. The balloon had a negative static charge. The neutral cereal was attracted to it. When they touched, electrons slowly moved from the balloon to the cereal. Now both objects had the same negative charge, and the cereal was repelled.

ESD Protection: Ground the charged balloon and repeat the steps above.

Activity #1 Question: What happened in the activity after you grounded the balloon and repeated the steps? How were the results different or the same?

Activity #2: Bending water

Materials: plastic comb, a sink and water faucet.

What to do:

1. Turn on the faucet so that the water runs out in a small, steady stream, about 1/8 inch thick.
2. Charge the comb by vigorously rubbing the comb on a piece of wool.
3. Slowly bring the comb near the water and watch the water "bend."
4. This project can also be done using a balloon instead of the comb.

What happened: The neutral water was attracted to the charged comb, and moved towards it.

ESD Protection: Place the comb in an ESD Protective package and repeat the steps above. What happened?

Activity #2 Question: What happened in the activity after you wrapped the comb and repeated the steps? How were the results different or the same?

Activity #3: Sticky Electricity

Materials: Clear scotch tape, pen, smooth flat surface

What to do:

1. Tear three pieces of tape off the roll, each about 8-10 cm long.
2. On each piece of tape, fold a little bit of the tape over at one end so that the sticky part touches the sticky part. This creates a little tab at one end of the tape where you can grab it since it won't stick to your fingers or the table.
3. Stick two of the pieces of tape flat down on the table (sticky side down), and make sure they're smooth and flat against the table. Label one piece of tape A and the other piece of tape B.
4. Stick the last piece of tape down right over top of piece A, and label it C.
5. Peel tape B and tape A (tape C should come off along with tape A, since it's stuck to the front of it) off the table slowly.
6. Move the two pieces of tape together, and they should try to move apart. They repel each other!
7. Peel tape C off the front of tape A slowly.
8. Try to move tape A, tape B and tape C closer to each other now and see how they react. You should see that now tape C and tape B repel each other, but they are both attracted to tape A.

What happened: So, when we peel the tape off the table, it takes some of the electrons with it, but how does that explain why the pieces of tape were repelled or attracted to each other? The answer to that is the golden rule of electric charge: **"**Opposite charges attract, and like charges repel**".** This means that protons will push other protons away, and electrons will push other electrons away, but electrons and protons will pull each other together. So when we peeled the two pieces of tape off the table, they both had extra electrons, and these electrons pushed each other away causing the two pieces of tape to move apart. When we peeled tape C off tape A, tape C took the electrons from tape A. This left mostly protons on tape A, so tape A was then positive, and tape C and tape B had mostly electrons, so they were negative. This explains why tape A was attracted to both tape C and tape B, because they had opposite charges which caused them to attract each other. Tape B and tape C had both negative charges, though, so they still repelled each other! I hope I didn't "repel" you with this long explanation, maybe you'll find the next experiment more "attractive".

Activity #3 Question: You are working on a circuit board and need to secure it. The board has many small ESD sensitive parts to it. Should you use tape to secure it? Why or why not? Be sure to explain your answer in complete sentences.

Home Activity: Static in the Summer

Materials: a balloon, and a watch or clock

What you do:

1. Rub the balloon on your hair. Stick it to a wall and time how long it stays before falling down.
2. Repeat step (1) in the bathroom, just after someone has taken a hot, steamy shower.

What happened: In the bathroom, water in the air and on the walls helped move electrons away from the balloon more quickly. In the summer, the air is more humid, and static electricity does not build up as much as during the winter, when the air is very dry.

Home Activity Question: What states in the United States do you think people would experience static electricity the most and the least during the winter? During the summer? Explain your answers.