UNIT OVERVIEW

Submitted by Morgan Snyder

Title of Unit: An Energizing Experience!

Recommended Grade: 4th Grade

Time Frame: 10 fifty minute class periods

Unifying Theme: Energy

Integration Model:

Language Skills – Reading
Language Skills – Writing
Family and Consumer Science – Reading a nutrition labels
Mathematics – Measurement
Mathematics – Data Analysis

Essential Questions:

What is an electrical circuit and what are the necessary parts of circuit? How could you create a circuit?
What is the difference between a series circuit and a parallel circuit?
Why do magnets attract some materials and repel others? Identify and explain the two magnetic poles.

Unit Questions:

What materials are magnets attracted to? Explain attraction and repulsion.
Can you draw and label the parts of a series circuit?
How does a flashlight work?
What materials make good conductors/insulators?
Which type of circuit should be used to make a strand of holiday lights?
What is an electromagnet and how can you create one?

PA Academic Standard Addressed in the Unit:

Physical Sciences: Chemistry and Physics (3.2)
Physics (3.2.B)
Electrical and Magnetic Energy (3.2.B4)

Apply knowledge of basic electrical circuits to the design and construction of simple direct current circuits.
Compare and contrast series and parallel circuits.
Demonstrate that magnets have poles that repel and attract each other.

Description of Unit:

In Pennsylvania, fourth grade students are expected to know the concepts of electrical and magnetic energy. Through "An Energizing Experience" students will participate in activities, investigations, discoveries, and hands-on experiences in order to gain a comprehensive understanding of multiple components of electrical and magnetic energy. Constructivist learning will focus on the establishment of applicable knowledge of electrical circuits including series and parallel circuits, and will guide students in the demonstration of magnetic properties emphasizing repulsion and attraction.

When implementing this unit into a pre-existing science program of study, it should follow instruction on motion and forces. Students need to have a basic understanding of these concepts before magnetism is introduced. Students should also have knowledge about the different forms and types of energy prior to being involved in this in-depth unit on electrical and magnetic energy.

Day 1 Introduction Day…

- Introduction to "An Energizing Experience" / Engage and excite the students
  - Place various materials that you will use for your activities at different places around the classroom.
    - Ex: Batteries, Lemons, Wires, Magnets, Light Bulbs, Magna Doodle, Strand of Christmas Lights, Paperclips, Pennies, etc.
  - Group students and have them walk around the classroom to investigate the random materials.
  - Have groups work together to make predictions about the new science unit of study and then ask them to share their ideas with the class. (Write their predictions on a large poster and put on display in the room.)
  - Reveal the lesson and a few key/fun activities students will get to do.

- Assess students prior knowledge of Electric Energy and Magnetic Energy
  - Give each student in half the class a light bulb and a battery
    - Ask students how they can make the bulb light up and have them write their answers on a worksheet paper.
  - Give each student in the other half a magnet, a plastic paper clip, and a metal paper clip.
    - Ask students to explain on their worksheet why one paper clip sticks to the magnet and why the other one does not.
  - Give students a few minutes to collaborate and then call on one student from each group to share their assignment and findings with the other half of the class.

Day 2 "Help! It's stuck." – Learning about magnetic forces

- Engaging Question: Are magnets just for refrigerators?
- Explore: What sticks to Magnets?
  - Group students into small groups (2-3 children per group) and give each group a magnet. Give students about 10 minutes to explore the room and find things that stick to the magnet and things that don't stick to the magnet. They should find at least 5 things in each category and record their findings in their student data books.
  - Reconvene the class and ask groups to share their findings with the class. Make a class list of "Stick" and "Doesn't Stick".
- Explain
  - Have other objects on hand and ask students to predict whether a magnet will stick or not. Students should write their predictions in their student data books.
  - After predictions are made have students use their magnets and the objects to demonstrate whether their predictions were correct or incorrect.
  - Use the think-pair-share method of cooperative learning to discuss why some things stick and some things do not.
  - Use questions to lead students to the understanding that magnetic properties are linked to what the object is made of.
    - Compile a list of possible properties (students will probably conclude that metal is magnetic)
- Expand

- Give each student a magnet to take home and ask them to examine 10 items in their homes and record on their worksheet whether the objects stuck to the magnet or did not.

Day 3 "Help! It's stuck!" - Continued

- Explain
  - Ask children to share the findings of their take home assignments.
  - Talk again about what properties make things stick to magnets.
- Explore: Why is cereal sticking?
  - Teacher crushes total cereal and slowly passes a bar magnet over it. Tiny pieces of iron will separate and stick to the magnet.
  - Students should record their observations in their data books.
- Explain
  - Guide student's explanation of this phenomenon.
    - Why is this happening?
    - What's in the cereal that's making this happen?
  - Give each student a copy of the nutrition facts for the cereal and ask them to look at the ingredients and guess which material was sticking to the magnet. Students should recognize iron as a metal and make the conclusion that magnets are attracted to objects that have iron in them.
    - Use this time to introduce new vocabulary words (attract, repel, force)
- Explore: Understanding attraction and repulsion
  - Allow students to practice using large horseshoe magnets to attract and repel.
  - Students should find that opposite ends attract while similar ends repel.
- Explain
  - Guide discussion about magnetic poles and their properties.
- Evaluate
  - Students should think of other objects they have not already tested and explain why they think they will be attracted to a magnet. They should record their thoughts in their data books.
- Expand
  - Allow students to use a MagnaDoddle™ during free time and ask them to think about how it works and write down their explanations in their journals for homework.

- Encourage students to visit http://www.howstuffworks.com/magna-doodle.htm to get some ideas.

Day 4 "Let's get wired up!" – Learning about simple electrical circuits

- Engaging Question: "How does that flashlight work?"
- Engage
  - Turn off the lights and turn on a flashlight. Using the flashlight for light, ask students engaging questions.
    - "How does a flashlight work?"
    - "Have you ever had a flashlight that didn't work?" "Why didn't it work?"
  - Teacher turns the lights on and takes apart the flashlight to reveal its make-up.
- Explore: "Let there be light!"
  - Students should be grouped in groups of 4 or 5
  - Each group gets a battery, two wires, and a light bulb
  - Students should work together and use the provided materials to make their light turn on. (Do not tell the students how to do this; they should explore different options by themselves.)
- Explain
  - After successfully accomplishing their task, students should draw a picture of the circuit in their data book and explain in writing how they made the light bulb come on. If time allows, students should return to their groups and come up with other ways to connect their materials and make the light come on.
  - When all groups have created and recorded at least one circuit, reconvene the class and ask the reporter from each group to explain (by drawing) one of their successful solution to the class.
  - Teacher will write the following words on the board; energy source, energy conductor, energy receiver. Ask students to return to their groups and discuss with parts of the circuits should be labeled with these words.
  - After students have made conclusions about the labels ask students to share with another group and then regroup the class and ask the reporter to share with the entire class.
  - Using the students' responses, copy key words on the board to form a definition for the three words.

Day 5 "Let's get wired up!" – Continued

- Explore
  - As a class repeat the activity from the prior activity with some variations.
    - This time use a battery, 2 wires, a light bulb, a battery holder, and a light bulb holder (note that the last two items are additions).
- Explain
  - Ask the class to identify the differences between today's activity and the other activity. Ask a student to label the parts.
  - Introduce and explain the term Series Circuit
- Explore
  - Students return to their groups and repeat the activity with the addition of a third wire and a switch (students should not know that this item is a switch).
- Explain
  - After pictures have been drawn and appropriate parts have been labeled in the student data books, students should return to their seats.
  - Lead class discussion about the new added object (the switch).
    - What is it? - Switch
    - What does it do? – Makes the light turn on and off
    - Why does it do that?
      - Allow children to discuss this question and then introduce and explain the terms Open and Closed Circuit.
- Evaluate
  - Take out the flashlight used at the start of this lesson. (Might want to have multiple flashlights for student use.)
  - In their student data books, ask students to explain how a flashlight works (using the appropriate vocabulary).
- Expand
  - Pose an everyday situation where a flashlight won't work.
  - Use the think-pair-share method to have students discuss reasons for why a flashlight might not work.

Day 6 "All aboard! All about conductors!" - Electrical conductors/nonconductors

- Engaging Question: What connects an energy source to an energy receiver?
- Engage
  - Use the game Operation™ and have students predict when the buzzer will go off. (Touching the metal, touching the plastic, touching the cardboard?)
- Explore – "Will the motor run?"
  - Group students in groups of 4 or 5.
  - Have each group create a simple circuit using a motor, three wires, and a battery. The third wire will serve as the switch. (Students should already know how to do this; this is not the focus of the lesson, so teacher can help if needed to be efficient with the time.)
  - Give each group a test bag filled with items they should test as conductors or not. After testing each item, students will record their findings in their data book.
- Explain
  - Make a class list of items that carries the electricity and items that did not.
  - Ask students why they think some items worked others did not.
  - Introduce and explain the word conductor and nonconductor/insulator
  - Return to the operations board. Remove the cardboard and plastic covering to reveal the motor. Demonstrate what happens to the motor when the tweezer touches the metal.
- Expand
  - Have students make a list of things around the classroom that they think could be used as conductors.
  - Allow them to experiment with these items.
- Evaluate
  - Place ten items (some that were tested and other that were not) in a paper bag.
  - Have students number their papers from 1-10. Pull items out one at a time and ask students to determine whether they think the item will be a conductor or insulator. Ask them to explain their answers.

Day 7 "Getting series about parallel circuits!" – Series & Parallel circuits

- Engaging Question: How do strands of lights work?

- Engage
  - Have a strand of Christmas lights (test lights before class to make sure you have a double wired strand).
  - Ask students what they think will happen if you remove a light. Most students will predict that all the lights will go out.
  - Remove a light and demonstrate that only half the lights turn off. Ask students why they think this occurs.
- Explore
  - Group students and give each group a battery, four wires, two light bulbs.
  - Ask students to first create a series circuit using just one of the light bulbs and two of the wires. (This is just a review)
  - Then ask students to add the other light bulb using whatever materials necessary. Both bulbs should glow brightly!
  - There are three possible ways to create this circuit (1 series, 2 parallel). Students should experiment with the materials until they have created all three designs.
- Explain
  - After each successful circuit they must check with the teacher, draw, and label in their data books.
  - Reconvene class and review the term Series Circuit and introduce and explain the term Parallel Circuit.

Day 8 "Getting series about parallel circuits!" – continued

- Engage
  - Pull out the strand of Christmas lights from the previous day and plug them, remove one light (half go out).
  - Use another strand (one wired), show that they all work, remove one light (all go out)
- Engaging Question: Why did all of the lights go out in the second strand?
- Explore
  - Using the same groups from the prior activity, group 2 groups together (there should be 8-10 students per group)
  - Give each group a battery, 10 bulbs, and 22 wires. Ask them to create a series circuit. After they have completed this task, have them draw and record in their data books.
  - Students should remove one light from their circuit.
- Explain
  - In their data books students should:

        - Record what happened
        - Explain why this happened (they should discuss this with their original groups)
- Explore
    - Groups will now create a parallel circuit using the same materials. Students should draw and record in their data books.
    - Students will remove one light from their circuit.
- Explain
    - In their data books students should:
        - Record what happened
        - Explain why this happened (they should discuss this with their original groups)
- Expand/Evaluate
    - Ask students to identify the two strands of lights used in the classroom. Ask them which one they would use if they were decorating their homes. Make sure they explain their answer.

Day 9 Making the connection between magnets and electricity

- Engaging question – What do magnets have to do with electricity?
- Engage
    - Give each student a magnet, a nail, and some paperclips.
    - Ask them to try to pick of the paperclips with the nail. (It is impossible).
    - Then demonstrate rubbing the nail against the magnet, and try to pick of clips (it works)
    - Allow students to experiment with their materials (ex: rubbing longer)
- Explore
    - Group students in groups of 4 or 5.
    - Give each group a battery, iron nail, 40 inches of copper wire, and about 30 paper clips.
    - Students will be guided to wrap the wire around the nail leaving a few inches of excess wire at each end. They will then attach the nail to the battery using the excess wire.
    - Students should now see how many clips they can pick up.
- Explain
    - Students should record their findings in their data books.
    - Ask students to share what happened. And why they think it happened.

- Teacher should introduce and explain the term temporary magnet.

- Expand
  - Ask students for ideas and suggestions on how they can pick up more paper clips.
  - Use these suggestions and assign each group an idea to put to the test. The group reporter will then have to share the results with the class.
- Evaluate
  - Students will draw a picture of the electromagnet they made and write a summary of how they turned the nail into an electromagnet.

Day 10 Conclusion to unit – A day of exploration

- Explore/Expand
  - Teacher will set up stations around the room and provide a set of direction/rules for each station
  - Students will rotate between the stations using the knowledge they gained from this unit to experiment and investigate with the various activities.
    - A lemon battery (and other fruit)! Station
      - Students will test different fruits/substances to see if they can produce a charge
    - Magnet fishing! Station
      - Given the necessary materials, students create a fishing game
    - It's flying! Station
      - Given the necessary materials, students create a flying object (butterfly/bird/airplane/balloon)
    - Stop in the name of the law! Station
      - Students will experiment with open circuits to create a burglar alarm

References

Badders, W., Carnine, D., Feliciani, J., Jeanpiere, B., Sumners, C., & Valentino, C. (2007).

Electrical energy. In *Houghton Mifflin science* (chap. 18). Boston: Houghton Mifflin

Company.

This resource is a fifth grade science textbook that I found in the Gingrich Library. The book includes a unit on "Forms of Energy" which will be very helpful. Within this particular unit, topics such as magnetic and electrical energy are covered in detail. Each individual lesson is accompanied by a "reading link", lesson wrap-up, activities, and reviews. The book came with supplementary materials for teacher use including worksheets and activity guides.

California Energy Commission (2004). Circuits. *The energy story*. Retrieved Feb. 25, 2010 from

http://www.energyquest.ca.gov/story/chapter04.html.

This website is extremely kid friendly and provides educational information in a factual, yet simple, way. The site goes into great detail describing simple circuits and parallel circuits. There are helpful, visually appealing diagrams and models that demonstrate the electrical flow in the different types of circuits. The site also provides information regarding the construction of a simple circuit using wires, batteries, and light bulbs. Lastly, there are a variety of science games and activities for students to play.

Commonwealth of Pennsylvania (2010). *Pennsylvania department of education*. Retrieved Feb. 25,

2010 from http://www.pdesas.org/.

The PDE website is helpful when preparing any unit or lesson. The site provides state standards and assessments, along with intervention and curriculum information. This website helps teachers focus their instruction and assures that students are learning the essential materials they are expected to know for each grade level. This website presents the information in a clear way that is easy to use and understand.

English, Tanya (n.d.). Electromagnets. *Teachnology*. Retrieved March 14, 2010 from

http://mypages.iit.edu/~smile/ph9528.html.

Tanya English is a teacher from an elementary school in Illinois. The resource is a short four to five day unit focused on electromagnets. I used this website to find an experiment that can be done using a nail, wires, and a battery to demonstrate the

concept of electromagnetic. The experiment was accompanied by a complete list of materials and suggested questions to check for understanding. English also includes a list of assessments to be used at the end of each activity.

Martin, R., Sexton, C., & Franklin, T. (2009). *Teaching science for all children: Inquiry methods for constructing understanding* (4th ed.). Boston: Pearson Education Inc.

This is the textbook used in EDU 362. I used my as a guide for preparing effective science lessons. I plan to use the techniques outlined in the reading to establish a constructivist teaching atmosphere. The book also outlined a lesson on electrical circuits. Although I did not use any specific information from the sample lesson, it did provide me with a good example and helped me to better understand the appropriate use of the five "Es".

NASA (n.d.). Circuits. *The NASA science files*. Retrieved Feb. 25, 2010 from http://scifiles.larc.nasa.gov/text/kids/Problem_Board/problems/electricity/circuits2.html.

The NASA Science Files are a great resource to use in any classroom. Almost every concept covered in science can e found on this website. The purpose of these "files" is to provide information for elementary school students. The information is presented in a fun and eye catching manor, using a little dog character as your personal guide. There are many diagrams and pictures, and the information is very simple and informative. This particular "file" teaches about circuits. First, it explains the parts of a circuit, and then it goes on to compare and contrast parallel and series circuits. This site provides safety tips and also a section which encourages the integration of math into the science of circuits.

NASA (n.d.) Understanding electricity. *The NASA science files*. Retrieved Feb. 25, 2010 from http://scifiles.larc.nasa.gov/text/kids/ProblemBoard/problems/electricity/electricity2.htm.

This NASA Science File is called Understanding Electricity and is mainly focused around the movement of electrons to produce electrical currents. While I don't think I will need this information when teaching my lesson, it was helpful review. This "file" does include a detailed picture of copper wire explaining its conductivity and insulated cover. I might use this picture to teach the students about the wire we will be using in many of our experiments.

Public Schools of North Carolina (2010). Magnetism and electricity. *K-5 curriculum units*.

Retrieved March 15, 2010 from http://www.dpi.state.nc.us/curriculum

/science/units/elementary/.

This resource was the most helpful piece of information I used to develop this unit. Produced by the state of North Carolina, this fourth grade unit on magnetism and electricity was a great guide. After reviewing this unit I was given a clear idea of what my unit would turn out to look like. This unit was made with a six week time frame, so it was obviously much longer than mine needed to be, but it provided age appropriate experiments and activities. The great thing about this unit was that it used the "five Es" in each of its lesson plans. I was able to get a lot of useful material and ideas from this unit. The only thing that was a bit confusing when referencing this unit, was that it was developed around the North Carolina standards which are slightly different then the Pennsylvania education standards.

Tilton, K. C., Cemeron, T., Durbin, D. H., Echerd, A. R., Johnston, S., & Wert, T. (2002).

Science for fun experiments: understanding electricity. In *The student handbook* (Vol. 1,

chap. 5, pp 118-133). Connecticut: The Millbrook Press.

The Student Handbook series is a comprehensive multi-volume resource material for students in grade k-12. I've had these books for a few years now, and I seem to always use them for science help. They provide an entire 200 page section on science experiments and activities. This section is especially kid friendly. There are bright, colorful pages with graphics and diagrams. There is another section of this book that is made for an older audience and provides more detailed, complex information and descriptions. I think this book is a great resource that can be used by students and teachers. There are about fifteen pages in this book devoted to electrical energy experiments. I will definitely use this as a resource when planning classroom activities.