How Does it Flow?

Major Topic: Electricity

Science SOL PS.1b,d,j,l, PS.11a,b,c,d

Length of Unit: 7 - 60 minute classes (you may need an additional day)

Major Understandings

Students will understand that:

- Electricity must be conducted in a complete circuit unless it is static.

Essential Questions

- What materials do you think make the best insulators?
- What materials do you think make the best conductors?
- How can you describe static?
- How can you describe an electrical circuit?
- What are some examples of series circuit?
- What are some examples of parallel circuit?

Student Objectives

The students will…..

- investigate and understand basic principles of electricity and magnetism.

Bloom's Taxonomy Skills	**21st Century Learning Skills**
• Creating • Evaluating • Analyzing • Understanding • Remembering • Applying	• Critical Thinking • Problem Solving • Communication • Collaboration • Contextual Learning • Global/Multicultural Research

Assessment Evidence

Other Evidence

- Discussion (written and oral)
- Class Participation
- Graphic Organizer
- Teacher Observations
- Laboratory assignments/reports
- Group Work

Technology Computers, Internet Connection, Projector System, Temperature Probe, Laptop, Calculators, Logger Lite, Internet, Web Browser, Printer

Internet Resources:

- Benjamin Franklin Simulation: http://www.pbs.org/benfranklin/shocking/

Supplies/Materials:

- Activities (attached)
- Paper
- Boiling Water
- Pan (to hold water)
- 2 Spoons (wooden, plastic, metal)
- 3 pats of butter or 10m of butter
- Various Cups (paper, plastic, Styrofoam, glass, metal, etc.)
- Metal coffee cans
- Ruler
- String
- Metal tacks
- Wool
- Silk
- Materials that are insulators
- Materials that are conductors
- Batteries
- Wire
- Long Nail
- Batteries
- Battery Holders (optional)
- Switches
- Paperclips
- Bulb holders
- Bulbs
- Colored Pencils

Lesson 1: The Great Butter Race (1- 60 minute classes)

Engage:

- Have students draw a Venn Diagram labeled insulator, semi-conductor, and conductor in small groups.

- Explain you are going to melt butter on three different types of spoons while holding them over a pan of boiling water.
- Have the students record a hypothesis (attached).

Explore:

- Demonstrate The Great Butter Race to the class.:
  - Get a pan of boiling water and 3 spoons (wooden, plastic, and metal)
  - 3 pats of butter or 10 m of butter.
  - Place butter on each spoon.
  - Place spoons over boiling water.
  - Time melting process and have students record
- Students will be instructed to finish the questions on The Great Butter Race in their groups.

Explain:

- Review the difference between an insulator and a conductor.

Elaborate:

- Discuss insulators and conductors in real life.

Evaluate:

- Review questions verbally from The Great Butter Race.
- Have students update their Venn Diagrams and turn them in.

Lesson 2: Best Insulators (1 to 2-60 minute classes)

Engage:

- Have a discussion with the class: *Why are there so many different materials to make cups (paper, plastic, Styrofoam, glass, metal, etc.)?*

Explore:

- Students will get into groups and do the *Best Insulators* experiment (attached).
- Be sure to have students answer questions 1-3 on the experiment handout.

Explain:

- Review group findings with students verbally (#1-3). Discuss question #4 together and have students record their answer.

Elaborate:

- Have students answer question #5 in their groups and record their answers.
- Have students join a second group and discuss their answers to question #5.

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Evaluate:

- The teacher will collect the lab reports and group graphs.

Lesson 3: Ringing Cans (2- 60 minute classes)

Engage:

- Have the students draw a picture of what they think static electricity is.
- Have them get into small groups and compare pictures to identify/agree on which ones are correct.

Explore:

- In small groups, have students conduct the following Ringing Coffee Cans activity (attached) and answer all the questions, minus the *Extend*.

Explain:

- Discuss Benjamin Franklin's experiment and how he completed this exact experiment.
- Discuss what he might have been looking for.

Elaborate:

- Have student get on computers and do the *Extend* portion of the handout (attached).
- Have them review the simulation on Benjamin Franklin.
- Review the class findings.

Evaluate:

- Discuss how static electricity and current electricity differ.
- Have students improve or change their original static electricity drawing and turn it in.

Lesson 4: Electromagnets (1- 60 minute classes)

Engage:

- Have students explore various magnets and discuss characteristics.

Explore:

- In small groups, have students conduct the following *Prove the Relationship between Electricity and Magnetism* activity (attached) and answer all the questions.

Explain:

- Have each group discuss their findings. Talk about how they are similar or different.
- Discuss how electromagnets are temporary magnets that work only when electricity is used.

Elaborate:

- Compare characteristics of permanent and temporary magnets.
- Discuss the relationship between electricity and magnetism.
- Show an electromagnet with a wire that is NOT insulated (demo). What will happen (note – do not touch the wire!)?

Evaluate:

- Collect and assess the activity handout from the students.

Lesson 5: Creating Circuits (2- 60 minute classes)

Engage:

- Talk about a scenario of a winter storm and loss of power.
- What is significant about current electricity?
- Discuss the dependence upon current electrical needs.

Explore:

- In small groups, have students conduct the *Creating Circuits* activity (attached).

Explain:

- Have each group discuss their findings.
- Discuss the difference between a parallel, series, open and closed circuit.

Elaborate:

- Have students brainstorm and record on the back of their activity sheet *real life* examples of different types of circuits and how they are used.
- Share group's brainstorming.

Evaluate:

- Collect group activity sheets and assess for understanding and growth.
- Make sure to incorporate what was observed during the hands-on part of the activity (i.e. lit light bulbs, short circuits).

The Great Butter Race (Lesson 1)

Name _____ Date_____

Hypothesis: The _____spoon will allow the butter to melt first because _____.

Spoon	Wooden	Plastic	Metal
Time			

What does the melting time tell you?

What do manufacturers make pots with wooden or plastic handles?

What would be a good substitute lab for this lab?

What vocabulary words could you use to explain this activity?

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The Best Insulators (Lesson 2)

Name_____ Date _____

Materials:

- Cups (3-5) made from various materials
- Computer
- Temperature Probe

Procedure:

1. Use a computer, temperature probe, and Logger Lite software to measure the temperature of hot water (provided by the teacher) in each type of cup.
2. Be sure to check the temperature of water in each cup every minute for 5 minutes.
3. Print your results.

Questions:

1. From graph which material is the best insulator?

2. How can you justify your answer in number 1?

3. What other materials are cups made out of? If they were used, how would the results be different?

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4. What does it mean to insulate something?

5. If you were to walk across a floor that was carpeted and one that tiled, which one(s) would be insulated? Explain.

Ringing Coffee Can Activity (Lesson 3)

Name_____ Date _____

Materials:

- 2 metal coffee cans
- Ruler
- Tack
- String
- Wool
- Silk

Procedure:

1) Place two metal coffee cans on table approximately 3 centimeters apart.
2) Tie a tack with a string onto the middle of a ruler.
3) Place the ruler on top of both cans so that the tack dangles between the two cans.
4) Rub both cans on opposite sides with wool. Observe and record what happens on the data table.
5) Rub both cans on opposite side with silk. Observe and record what happens.
6) Rub one can with wool and one with silk on opposite sides. Observe and record what happens.

Data Table:

Variable	Observations
Both wool	
Both silk	
One wool, one silk	

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Questions:

What do your observations tell you about electricity?

How is this experiment related to clothes in a dryer?

How is this experiment related to walking across a floor with carpet, touching a metal door handle?

Extend: This experiment originated with Benjamin Franklin. How could this have led to his famous kite experiment? Use the computer to research the kite experiment if you need to and record your thoughts.

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Prove the Relationship between Electricity and Magnetism (Lesson 4)

Name _____ Date_____

Materials:

- Insulated wire
- Battery
- Long Nail
- Paper Clips

Procedure:

1. Connect insulated wires to both ends of a battery and coil the wire around a nail 5 times.
2. Try to pick up paper clips. Count the number of paper clips and record.
3. Repeat #1, but increase the coils to 10, 15, 20, 25, 30, etc.
4. Repeat using a different size battery.

Data Table:

Battery 1	# coils	0	5	10	15	20	25	30	35
	#paperclips	0							
Battery 2	#coils	0	5	10	15	20	25	30	35
	#paperclips	0							

What does your data tell you?

What is the relationship between electricity and magnetism?

How can magnetism be increased?

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What are real life uses of electromagnets?

Are there other ways to make the electromagnet work?

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Creating Circuits (Lesson 5)

Name_____ Date _____

Materials:

- Batteries
- Wire
- Bulbs
- Bulb Holders
- Batter Holders (optional)
- Switch

Procedure:

1. Create the following circuits and sketch what it looks like. Use battery, wire, bulb, switch

Simple Circuit (no switch)	Open Circuit
Closed Circuit	Series Circuit

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Parallel Circuit	Use color pencils, trace the two separate electrical paths of electricity in the parallel circuit.

2. Explain the difference between a parallel and a series circuit and an open and a closed circuit:

Parallel Circuit vs. Series Circuit –

Open Circuit vs. Closed Circuit -