RADIOLOGIC PHYSICS:
AN INTERACTIVE APPROACH

By Shelley Cox MSRS, (R)(M)

- **Objectives**
- **Why do we have to take this class?**
  *Understanding how the equipment is working separates the button pushers from the professionals***.**
- **Desired Outcomes: Student Proficiency**
  - General Physics
  - X-ray Circuitry
  - X-ray Tube Components
- **Proficiency**
- **Learning Difficulties?**
  - Problems with conceptual visualization
  - Daily conceptualization vs physics concepts
  - Area, volume
  - Assumed college level students handle this
  - In fact, 40% entry level physics students have little control over this ability
- **Student Learning Styles**
  - Passive
  - Student takes in what instructor is saying
  - Active
  - Student has an active role in learning
- **Cognitive Load**
  - "Research shows amount of material typically presented is far more than a typical person can process."
- **Not Just "What" but "Why"…**
  "Competence is likely to develop if student is actively thinking and the instructor can monitor and guide that thinking."
- **Lectures…..**
  - Lecturns
  - Overheads
  - PowerPoints
  - PowerPoint
  - Incorporate learning labs
  - Consoles
  - Hands on equipment dissection
- **Quizzes: Interactive**
  - Visible Quiz
  - Questions flashed on screen DURING lecture
  - Master cards with A,B,C,D
  - Jeopardy or Millionaire
  - Powerpoint Templates
  - http://www.elainefitzgerald.com/Jeopardy1Template.ppt
- **Quizzes: Interactive**
  - Net Surfing Quiz
  - Physics term or image
  - Student reports back to class with site information
  - Image
  - **Definition**
  - Web Quest
- **Effectiveness of Computer Simulations**
  - Study conducted using CCK during lecture
  - 47% larger gain on conceptual understanding than traditional demonstration
- **Learning Management Systems**

- Supplemental
- Post Lecture Notes
- Give on-line quizzes
- Interactive study tools
- Websites
- Discussions

- **Where to Start?**
  - MERLOT
  - Search engine for educational websites
- **Internet: General Physics**
  - Physics Animations –
  - Radquiz.com
  - Physicsclassroom.com
- **Internet: Motors/ Generators**
  - Physics Education Techology (PhET)
- **Electricity & Magnetism**
- **Circuitry**
- **Electronic Learning Labs**
  - Radioshack
  - Demonstrates
  - Circuit rules
  - Resistance
  - Simple motors
  - Short exercises
  - Fit limited lab times
- **Electronics Learning Labs**
- **Tube Dissection**
  - Book schematics
  - Glass tube
- **What's in Your Tube Housing?**
  - Try to obtain a tube in the housing
  - Let the students work through disassembly
- **Department of Tube Procurement..**
  - Begging works!!
  - X-ray tube housings
  - $975 for lot of 13
- **Conclusion:**
  - "Active learning methods and models are limited only by the imagination and creativity of the instructor"
    - Melissa Armentor MSRS R.T
  - Physics: It's not just the registry anymore.
- **References**

- Armentor, M. (2003). Active learning strategies for radiologic science education [Electronic version]. *Radiologic Science and Education* , 8, 15-34.
- Barton, R., (2005). Supporting teachers in making innovative changes in the use of computer-aided practical work to support concept development in physics education. *International Journal of Science Education*, 27, 345-365. Retrieved February 25 2008, from the Academic Search Complete database.
- Keller, C., Finkelstein, N., Perkins, K., & Pollock, S. (2006). Assessing the effectiveness of a computer simulation in introductory undergraduate environments. *Proceedings of the 2006 Physics Education Research Conference*. 121-126. Retrieved February 26, 2008, from http://www.google.com.
- Maharshak, A., & Pundak, D. (2003-2004). Active physics learning- Combining the marketing concept with information technology. *Journal of Educational Technology Systems*, 32, 3994-18. Retrieved February 25, 2008, from the Academic Search Complete database.
- Weiman, C., & Perkins, K. (2005). Transforming physics education. *Physics Today*, 58, 36-41. Retrieved February 25, 2008, from the Academic Search Complete database.

Physics websites

http://physics-animations.com/Physics/English/el.htm good electricity animations

http://www.upscale.utoronto.ca/PVB/Harrison/Flash/#misc electricity

http://www.dctech.com/physics/animations.php general link to various animations

http://www.physicsclassroom.com/Class/newtlaws/u2l1a.html

http://www.ndt-ed.org/EducationResources/HighSchool/highschool.htm

http://physics-online.com/

http://evolve.elsevier.com/staticPages/i_index.html

http://webquest.org/index.php

http://www.merlot.org/merlot/materials.htm?category=2736

http://www.dctech.com/physics/animations.php

http://radquiz.com/physics.htm

http://www.physicsclassroom.com/

http://www.radioshack.com/sm-electronics-learning-lab--pi-2102913.html

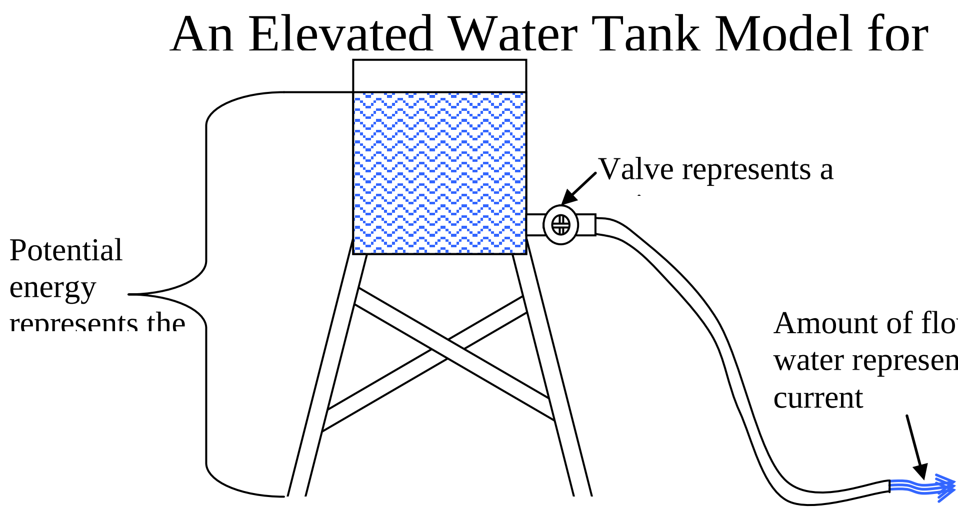
http://www.pemed.com/radparts/radparts.htm

Circuit Construction Kit: Series and Parallel – Current Flow

Teacher Pages

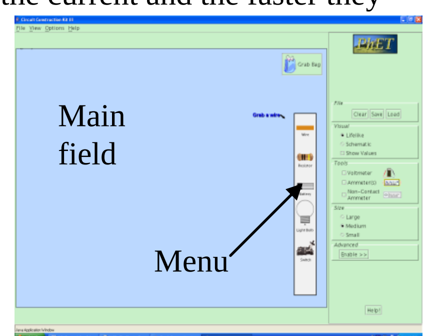
Prior Knowledge – The students should know:

- The basic construction of a series and a parallel circuit.
- What a resistor is and what it does.
- What current is
- The model for electricity used in my class is of an elevated water tank
    - The voltage is the potential energy of the top of the water in the tank in relation to the ground.
    - The current flow is the amount of water coming out of the hose connected to the tank.
    - A resistor is a valve that lets more or less water pass through it.



Activity & Simulation Instructions-

- This assignment is intended as an assignment the students will complete outside of class either at home or in a library.
- Explain that in the simulation the balls moving in the wire represent the current and the faster they travel the greater the current.
- Explain that the way to build a circuit is to click on the item they need in the menu and drag it out into the main field
- Talk about how to change resistor values by right clicking on the resistor.
- Review the definitions of current, resistor and voltage in terms of the elevated water tank model used above.

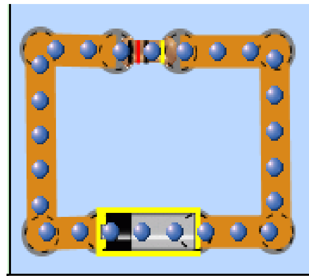


Learning Goals – The students will:

- Develop a general rule regarding how resistance affects current flow when voltage is constant.
- Learn how changing resistance values affect current flow in both series and parallel circuits.

Student Pages

Background – Everyday we use devices that have electric circuits in them; they perform different tasks for us. It is the design of the circuit that enables them to perform these different tasks. We will look at the two basic designs of circuits and learn a little about how they are different.



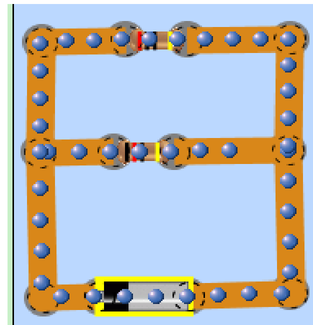
Circuit A

Learning Goals – The students will:

- Develop a general rule regarding how resistance affects current flow.
- Learn how changing resistance values affect current flow in both series and parallel circuits.

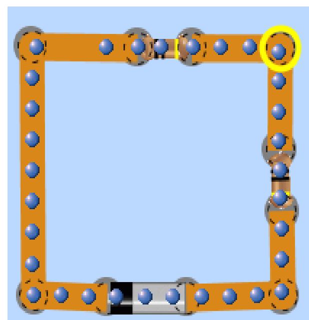
Procedure – do the following activity using this web site

http://www.colorado.edu/physics/phet/simulations/cck/cck.jnlp



Circuit B

1. **Build a circuit. -** Using 1 resistor and a battery, construct a circuit like you see to the right, Circuit A.
2. **Make observations & draw conclusions.** By right clicking on the resistor, change the value of the resistor and observe what happens to the rate that the electrons move through the circuit. The rate at which the electrons move is called current. Make a general rule about the relationship between current and resistance. For instance: The higher the resistance the ________ the current.
3. **Build another circuit. -** Add another resistor to your circuit, making it a parallel circuit like you see to the right. It should look like Circuit B.
4. **Make observations & draw conclusions. -** By right clicking on the resistors, change the values of the resistors, making one very high and one very low and visa versa. Look for what happens to the current flow through the different resistors.
   With regards to circuit B write a brief statement to;
   - Describe the current flow at different locations in the circuit, concentrating on the rate of the current and the value of the resistors.
   - Explain your observations of the current flow in terms of the water tank model of electricity given to you in class
   - Describe how your general rule from step 2 relates to your observations.



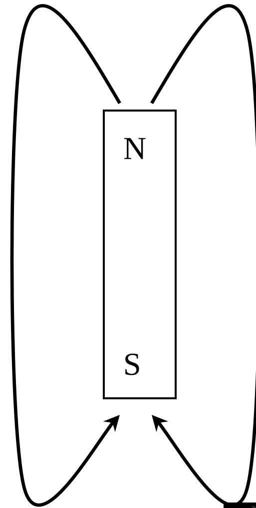
Circuit C

5. **Build another circuit. -** Next to the parallel circuit B, build a second circuit making it a series circuit using 1 battery and 2 resistors. It should look like Circuit C.
6. **Make observations & draw conclusions. -** By right clicking on the resistors, change the values of the resistors, making one very high and one very low, and visa versa. Look for what happens to the current flow through the different resistors.
   Write a few brief statements about what you see regarding;
   - Describe the current flow at different locations in the circuit, concentrating on the rate of the current and the value of the resistors.
   - Explain your observations of the current flow in terms of the water tank model of electricity given to you in class
   - Describe how your general rule from step 2 relates to your observations?

Apply what you learned. Write a few brief statements about how series and parallel circuits are similar and how they are different, by looking at your work in steps 4 & 6. Include the following

- Possible pathways the electric current can move in the series and parallel circuits,
- How different resistance values for the individual resistors affects the current in the series and parallel circuits.

Teacher Pages

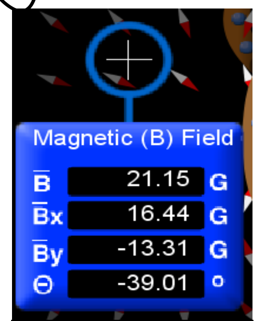


Prior Knowledge – The students should know:

- What current is
- That a magnet has to have both a north pole and a south pole
- The basic rules of magnetism
  - Bi-polar
  - Rules for attraction and repulsion
  - Basic magnetic field shape and polarity
- That a compass can show the magnetic field lines

Activity & Simulation Instructions-

- This assignment is intended as an assignment the students will complete outside of class either at home or in a library.
- Talk about the balls moving in the wire representing the current and the faster they travel the greater the current.
- Talk about the field meter and how the top measurement gives the overall field strength. For you advanced learners talk about the angle Ө, and the force acting as a vector which is why there are the x and y components for $\overline{B}$ .You might also what to tell them about the unit G standing for Gauss, the scientific unit of magnetic field strength



Field Meter

Learning Goals – The students will:

- Develop an understanding of the difference between AC and DC current.
- Develop an understanding of how an electromagnet works
- Develop an understanding of how AC and DC current affect the magnetic field of an electromagnet

Student Pages

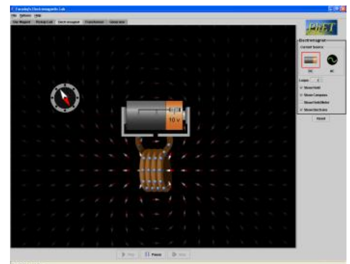
Background – Electromagnets and the principles that make them work are in many of the electrical appliances we use daily. The electricity we use is mostly generated using electromagnets. All electric motors use this technology and charging your cell phone uses a transformer that is based on the concepts that make electromagnets work. Today we will look at two types of current and how they affect with an electromagnet

Learning Goals – The students will:

- Develop an understanding of the difference between AC and DC current.
- Develop an understanding of how an electromagnet works
- Develop an understanding of how AC and DC current affect the magnetic field of an electromagnet

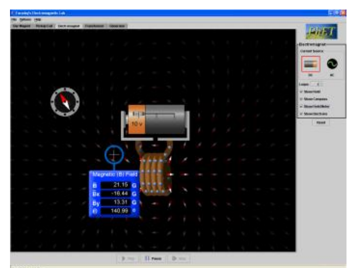
Procedure – do the following activity using this web site
http://www.colorado.edu/physics/phet/simulations/faraday/faraday.jnlp

7. **Getting started.** Open the website listed above and on the top of the screen select the tab marked electromagnet.



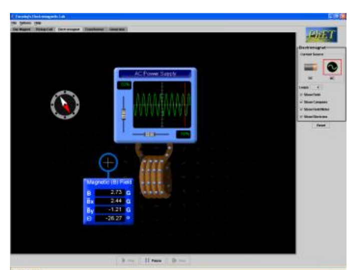
Screen 1

8. **Make observations & draw conclusions.** Change the current source back and forth from DC to AC looking for how the electrons move in the wire. AC current is distinguished from DC current by the motion of the current. In this applet the current is represented by the balls moving in the wire. Based on your observations write a general rule for how current moves in AC verses how current moves in DC.
9. **Make observations & draw conclusions.** Set up the applet so it is using a DC current and place a compass near the electromagnet. Your screen should look something like what you see to the right, on Screen 1. Using the slider on the battery, observe how changing the voltage changes the current flow and what happens to the compass needle. Write down your observations regarding the voltage, the current flow and the change in the compass. What does changing the current flow do to the magnetic field?



Screen 2

10. **Make observations & draw conclusions.** Insert a field meter into your screen. Your screen should now look something like what you see to the right, Screen 2. move the battery slider back and forth and observe what happens to the strength of the magnetic field, the top number on the field meter. Write a general rule for how the voltage affects the magnetic field's strength.
11. **Make observations & draw conclusions.** Using the same setup as you used in step 4 change the number of loops and observe how this affects field strength. Write a general rule for how the number of loops affects the magnetic fields strength.



Screen 3

12. **Make observations & draw conclusions.** Using the same setup as you used in step 4 move the filed meter from place to place and observe how the field strength changes. Write a general rule for how changing the distance from the magnet affects the magnetic fields strength.
13. **Make observations & draw conclusions.** Use the same setup as you used in step 4 but change the source of current to AC. Your screen should look something like what you see to the right, Screen 3. Observe how the AC changes the compass and the magnetic field strength. Write down your observations regarding the change in the strength and direction of the magnetic field. Describe a way to get a DC supplied electromagnet to change the direction of the magnetic field, like the AC does.

- **Apply what you learned.**
  1. In an industrial situation where you are using an electromagnet to pick up heavy objects, you want an unchanging magnetic field. What type of current would you want to use to create that electromagnet? Support your answer using your observations and conclusions from above. that would have a steady constant magnetic field
  2. In an electrical motor you use an electromagnet that is constantly changing its magnetic field. What type of current would you want to use to create that electromagnet? Support your answer using your observations and conclusions from above.

Student Directions: *Faraday's #2 using Faraday Law (Flash) and Electromagnet Lab(Java):* Induction – http://phet.colorado.edu

Learning Goals:
Students will be able to:

- Identify equipment and conditions that produce induction
- Predict how the current will change when the conditions are varied.
- Compare and contrast how both a light bulb and voltmeter can be used to show characteristics of the induced current.
- Explain practical applications of Faraday's Law
- Explain what is the cause of the induction

Directions: Start a Word document to turn in with the proper header/footer.

1. Open the ***Faraday Law*** simulation and discover what you can about induction. Make a list of ways to cause induction.

2. What made you think that induction had occurred?

3. Open ***Faraday's Electromagnet Lab***. Investigate using the window called ***Pickup Coil***. See if you can discover more things that effect induction and add them to your list.

4. In this simulation, there is another way to show that induction is happening. Explain why this method may not have been used in the simpler simulation.

5. Describe in your own words what induction means.

6. Write a comparative paragraph to meet the third learning goal. Make sure to consider the strengths and weaknesses of each as an indicator of current.

7. Design an experiment to determine how the size and direction of the induced current will change when the conditions are varied. Collect data, make observations and record your information in a table.

8. Write a summary that demonstrates that you can meet the first two learning goals.

9. The magnet is not touching the electrons, yet something is causing them to move. Explain what you think is happening.

10. Research how generators and transformers are used. Explain how Faraday's Law is applied and why the designs are practical and therefore widely used.

Names:

Design a CR Laboratory Experiment

- Your group will design a laboratory experiment to be included in future classes.
- You may choose to prove anything from either IP&E2 or EOM.
- Please send images to a workstation so I can save for future use.

I

Purpose:

Materials:

Procedure:

Results:

Questions:

Electronics Learning Lab Exercises

You will work in groups of 4.
The objective is to build different working circuits on the electronic console.
When you have completed the assigned circuits, you may build a circuit of your choice. This will require critical thinking and teamwork.
The most original circuit will be displayed for the class.
In each group, rotate jobs with every two or three experiments.

- **Assembly**
- **Instructions**
- **Gather components**

Begin by reading 11-13 for basic assembly instructions and diagram symbols.

<u>Experiments</u>:
Basic Circuits
Pg. 22, Exp. 9 – Series Circuit
Exp. 10 – Parallel Circuit
Exp. 12 -Selector Switches
Adding a relay (electromagnet)
Pg. 23 Exp.4 Relays
Resistance:
Pg. 25 Exp. 1 – Ohm's current
Exp. 2 – Ohm's voltage
Pg. 27 Exp. 1 – Resistors in series
Exp. 1 – Resistors in parallel (bottom of page)
Pg. 28 Exp. 1- Variable resistors, light potentiomters
Transformers:
Pg. 42 Exp. 1 – Transformers
Motors:
Motors in series:
Motor- 46 (blue)
Motor – V6 (blue)
47 – ground (blue)
Motor in Parallel with buzzer and LED
46- T21 (red)
47- ground (red)
67- T25 (blue)
66 – A30 (blue)
12 – A28 (blue)
Motor- A27 (blue)
Motor – T24 (blue)
11 – T23 (blue)
V6 – A26

Humor Presentation

Each group of students will be designated a radiographic concept for a class presentation.
The group will have 10 minutes to communicate the concept to the class using "HUMOR" and visual aids; this will require critical thinking as well as creativity. Grading will be based on participation, humor, use of visual aids, length and providing written materials to the audience.

Find a connection between the radiographic concept and <u>your practicum duties</u>. Use your imagination to present each topic in the best way possible.

3 STUDENTS PER GROUP

<u>Group 1 Wednesday of the 3rd Wk. AEC</u>

<u>Group 2 Wednesday of the 4th Wk. Inv. Sq. Law</u>

<u>Group 3 Monday of the 6th Wk. Ohm's Law</u>

<u>Group 4 Wednesday of the 8th Wk. X-ray tube/unit</u>

<u>Group 5 Monday of the10th Wk. Fluoroscopy</u>

Evaluation Process for RADR 2309 Presentation

Name of Presenter(s)______________________________

Date:____

Evaluation Process

Oral Presentation		Possible Points	Points Earned
1.	Captured audience (no direct reading allowed; participated in oral presentation)	20 pts	__________
2.	Covered topic using humor and visual aids	20 pts	__________
3.	*Provided an outline/ written materials to instructor and students*	*20 pts*	__________
4.	Minimum of 10 minutes for presentation	20 pts	__________
COMEDY USED			
4.	Dress attire, atmosphere, etc.	20 pts	__________

Instructor's Comments:

Physics Experiment Design

The semester project will be a lab experiment designed by you. This project will comprise 10% of the final course grade in the Participation/ Lab Project category.

The class will be divided into 4 groups. Each group will design and demonstrate a lab experiment reinforcing a concept learned in the course. As we will be discussing many general physics principles, I have included a few websites for ideas. To eliminate duplication, the concept your group decides to investigate must be approved by me on or before the planning day.

There will be one class period set aside for the groups to meet and organize their thoughts and begin to plan. After that meeting, the work will be completed outside of class time as needed.

There will be a final presentation day where each group will present their experiment to the class. Each group will have 20 minutes. Presentations should include the following components:

- A brief presentation of the concept at least 5 minutes in length and can be lecture, powerpoint, or any other means suitable for delivery of the information
- Experiment set up (demonstration).
- Experiment procedure (perform the experiment)
- Class involvement
- Handout for the class with details, post experiment questions, findings etc.
- Handout for the instructor to include:
  - Design/ Set up page
  - Procedure
  - Class Handout
  - Rubrics

Projects will be graded on the following criteria:

- Relevance to concept
- Design and effectiveness
- Group Participation
- Presentation
- Handouts

http://apphysicsb.homestead.com/labsoe.html
http://www.practicalphysics.org/go/Topic_39.html?topic_id=39

Student: ______________________

Rubric: Physics Experiment Design

Students are to design an experiment which can be conducted in the classroom. Projects must be relevant to a concept covered over the course of the semester, and include a short presentation, demonstration, class involvement, and handouts for the class and instructor.

Experimental Design	Excellent 20 pts	Good 15 pts	Fair 10 pts	Poor 5 pts
Relevance to Concept	Excellent Focus is clearly stated and explains the reason for the experiment.	Good Focus is stated but minor details are missing.	Fair Focus is stated but does not fully explain the reason for experiment.	Poor Focus does not relate to experiment.
Design and Effectiveness	Excellent Experiment design effectively conveys the concept. There are complex elements present reflecting a high level of preparation.	Good Experiment design effectively conveys the concept. Few complex elements present suggesting a moderate level of preparation	Fair Experiment design vaguely conveys the concept. No complex elements are evident.	Poor Experiment design and complexity absent. Minimal level of preparation evident.
Group Participation	Excellent Actively included the class in experiment. Incorporated interactive components.	Good Somewhat included the class in the experiment. Some interactive components.	Fair Did not include the class in the experiment. Few interactive components.	Poor Did not include the class in the experiment. No interactive components.
Presentation	Excellent Student presents all elements of experimental design including concept. Student goes above and beyond expectations. Presentation is adequate length	Good Student presents all elements of experimental design. Presentation is of adequate length.	Fair Student presents most elements of experimental design and is missing components that make presentation exact, specific, and detailed. Presentation is not with in adequate length	Poor Student presentation is missing most elements of experimental design. Detail is also lacking. Presentation is not within adequate length.
Handouts	Excellent Handouts are excellent enhancements for understanding the experiment. Grammatically correct and include all required components.	Good Handouts are adequate enhancements for understanding the experiment. Grammatically correct and include all required components.	Fair Handouts are missing elements for adequately understanding the experiment. Some grammatical errors are present. Lacking a required component.	Poor Handouts are missing entirely or Grammatical errors are present througout. Lacking several required components.