Bay Area Scientists in Schools
Presentation Plan

Lesson Name Electricity, Magnetism, and Motion
Presenter(s) Electrical Engineering Graduate Student Association Outreach @ UC Berkeley

Grade Level K—5 targeting standards in 3. Material can be altered to teach at a 6-8 level.
Standards Connection(s) Link between Electricity, Magnetism, and Motion

Teaser:
Why does a light turn on when we plug it into the wall? Electricity defines our life from charging our iPhones to washing our clothes, but where does it come from? This lesson explores the link between electricity and magnetism by answering that question through a series of 3 activities: 1. Students in small groups will build a motor (electricity + magnetism = motion) 2. Students in small groups will create magnets with batteries and a wire coiled around a sanded down nail (electricity + motion = magnetism), and 3. Students will understand the workings of how generators can work and make electricity (magnetism + motion = electricity). These three activities illustrate the fundamentals of how electricity, magnetism, and motion are related and will be used to explain power and energy, critically important parts of our everyday experience.

Objective: As a result of your lesson, what will students learn? What will they be able to do?
Students should be able recognize that there's a tight link between electricity and magnetism. They will understand that moving magnets can make electricity, moving currents (electricity) can create magnetism, and that by combining electricity with magnets in special ways we can create physical motion.

Vocabulary/Definitions:
3 – 6 important (new) words
Electricity, Magnet, Battery, Motor, Generator

Materials:
What will you bring with you?
Batteries, 20+ metal paper clips, tape, 6+ permanent magnets, fine wire, Plasma globe, 6 hand-built motor setups, hand crank generator (to be used by a graduate student for demonstration purposes).

What should students have ready (pencils, paper, scissors)?
No external materials required.

Classroom Set-up:
Students should be split into 3 groups, ideally as soon as we arrive. There will be a central presentation area where we will introduce ourselves, and the major topics to be discussed during the visit.

The whole class should be formed into 3 rotatable groups with their desks pushed together. This provides a large surface for each of the 3 sub-modules we will be presenting, and fosters collaboration between students.

Classroom Visit

1. Personal Introduction: ______5____ Minutes
   Who are you? What do you want to share with students and why? How will you connect this with students’ interests and experiences?

   We’ll introduce ourselves as engineers from Berkeley, talk about what we do as scientists and also talk a little bit about where we come from to help establish a more personal connection.

   Topic Introduction: ______5____ Minutes
   What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge...

   The first and most important question is to ask what students know about electricity. This is followed by asking what they know about magnetism. This section will be handled as a Q&A. Regardless of whether the students have been introduced to these concepts we will use this as an opportunity to define electricity (a force that comes out of batteries and the wall) and magnetism (an invisible force that can move electricity or other magnets). Finally, we will make an explicit point of introducing a “triangular relationship” between electricity, motion, and magnetism (with 2 out of 3 points on the triangle, you can always create the remaining point). A short demo to introduce the concept of magnetism induced by a current is performed with the entire class.

2. Learning Experience(s): ______40____ Minutes
   What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring... Describe in order, including instructions to kids.

   At this point, the class must be split into 3, rotating groups. (~12 minutes at each table) 1 – 2 graduate students will be at each table.

   Sub-group 1: We will explain to students how to combine a C-battery, paper clips and wire to make magnetism. The student groups will then be given the parts to attempt this themselves.

   Sub-group 2: We will explain to students how to combine electricity from a battery combined
with magnetism from a magnet to make a copper coil (motor) spin. Here we define motors – a device that combines electricity and magnetism to make motion.

Sub-group 3: Here, the students will be given simple generators (a shake flashlight, a windup flashlight, etc.), and will be taught about the relationship between motion and magnetism to create electricity. We also have a hand-crank generator (to be operated by the graduate student) for this section to further demonstrate how electricity can be generated.

The groups will rotate every 12 – 15 minutes.

3. Wrap-up: Sharing Experiences
   Putting the pieces together – how will students share learning, experience, build vocabulary?

At each sub-station, students will be asked about what they learned at the last station before we begin the next sub-lesson. We will emphasize the unifying idea of the magnet/motion/electricity triangle we introduce at the beginning of the lesson.

4. Connections & Close:
   What else might kids relate this to from their real-life experience? How can they learn more?

This will be a quick, spoken summary of what we did and the major ideas of the day: 1. We built motors, which used electricity and magnetism to make motion, 2. We made magnets using batteries and nails to create a magnet, and 3. We looked at generators, which use motion and magnetism to make electricity. The key point to take away is that motion, electricity and magnetism are linked. We will go back to our introductory demo and ask students about what they had learned.

Total 55 – 60 Minutes

Follow-up – After Presentation

Suggest students write a letter explaining, “What we learned about Electrical Power Generation/ Magnetism Generation/ Motion Generation?” List or attach examples of activities, websites, connections for additional learning. Study alternative energy sources (solar, chemical, wind, etc). Look at http://electronics.howstuffworks.com/ (a treasure trove) on the subjects of motors, batteries and generators. Buy motors at Radio Shack (~$5 to $10) and play around with the motors and batteries.