



Standard Benchmarks and Values

- **Benchmark SC.PS.7.4** - Explain the magnetic and electric forces in the universe. (*reinforce*)
- **RST.9-10.3** - Follow Precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. (*practice*)
- **RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (*practice*)
- **SL.9-10.4** - Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. (*practice-master*)
- **Team work.**

ELECTRICITY GENERATORS AND MAGNETISM

Nicole McKamey

9th Grade

2 - 3 Weeks

How can we produce electricity using a magnet, wire, and local source of clean energy?

Enduring Understandings

- Students will understand that electricity and magnetism are units of the same force. (Electromagnetic Force)
- Students will understand how a moving magnet can produce an electric current in a wire.
- Students will learn how different forms of mechanical energy found in nature and in society can be transformed into electric energy.

Critical Skills and Concepts

- Students will be able to make their own electricity.
- They will practice hands-on skills and communication.
- They will learn to work more effectively with their teams.
- Students will understand how we what is involved in powering the electrical devices in our homes and businesses.

Authentic Performance Task

Students can work individually or in groups of no more than 3.

Students will create electricity using magnet and loop of wire, and will design a way to transfer available energy from their surroundings to mechanical energy to operate their generators.

Students will measure the voltage that their design generates.

Students will create a google or power point presentation, and a 5 paragraph essay or narrative to go along with it, and present their design and findings to the class.

Presentations and narratives must include:

1. Problem question or clearly stated objective including quantitative electricity requirements to be met
2. A brief description of how an electromagnetic generator works
3. Pictures or video of generator in action, or a plan for implementation of specific generator at specific place
4. Materials and costs
5. Findings- did it work or not? How much electricity was produced? (or, if doing alternative, estimated and compared to goals)

Alternate Plan (if resources not available for students to actually build their generator):

Students will plan out an electricity generator that can be used in a specific location for a specific purpose, with an imaginary budget of \$10,000.

Rather than measuring voltage, students will research possible generator outputs and come up with an estimate of how much electricity their generator could produce, and compare that amount to the amount of electricity they would need for their specific purpose (be it a device, appliance, home, neighborhood)

Authentic Audience

Teacher, other students, possibly other teachers and students (if teaching same or similar curriculum)

Role of Audience in assessment: Teacher will grade using rubric, and students will provide feedback in the form of “I like...” statements or suggestions for design improvement, or implementation strategies.

Other Evidence

Students will answer focus questions from their textbooks in order to show basic understanding of concepts and background knowledge.

Students will describe how their generator could be used on a larger scale.

Learning Plan

The Basics:

- Students need to know the basics of electricity and magnetism. Text book work and some hands on activities are first assigned to help lay that foundation.
- They will also need to know how to use and share google docs and presentations, and also how to research sources and images. If student are just learning these skills, take it slow and guide them closely with this part.

Book work:

- Lessons begin with learning the essentials of electricity and magnetism separately.
- Students read from text book, learn vocabulary, take notes, and answer focus questions related to electricity and magnetism. Students learn the path of electricity as it moves from generator to appliances in our homes.

Magnetism Lab:

Students use iron filings and magnets to observe magnetic field lines.

Setup: Teacher gives student groups 3 bar magnets, a circle (doughnut) magnet, a piece of white paper, and a small pile (1tbsp) of iron filings.

Procedure: Students place a magnet on the table and a piece of white paper over the top. Then gently sprinkle (like salting food) the iron filings onto the paper. Magnetic fields become apparent and students then sketch the field lines in their notebooks, also noting which end is north and south on the magnets. They do this for 4 scenarios: single bar, two bars with like poles facing each other (about 3 cm apart), two bars with opposite poles facing each other, and the doughnut. With each scenario, students also place a compass either right over or on the paper in three different locations, so see how the magnetic field affects the compass needle orientation. They also write down their observations and conclusions with regards to how the field exerts force on the iron filings to create the patterns they see.

Electric Circuit Lab:

Students construct electric circuits using a kit. Kits are readily available and come with

a number of activity suggestions. In my class, students make a number of adjustments to their circuits and record observations. Simple vs parallel circuits, clipping different things into the circuit to test conductivity, adding and removing batteries, resistors, etc..

Then, they use a compass, placing it around the circuit in different locations to observe how an electric current can produce a magnetic field. Conclusion should emphasize that just as the magnetic field had an effect on the compass, the electric current also did.

Make Electricity Demo:

Students are shown a demonstration of how a bar magnet rotating in a loop of copper wire can produce electricity. If time and resources permit, they will construct a simple generator themselves, with magnets, wire, a nail, a small light bulb, and a cardboard box. There are many internet sources of simple “how to” videos on this, which you can either just look at yourself, or have the students watch.

Final Assessment:

Students will apply their new knowledge by designing their own clean electricity generator to be used for a specific purpose.

They work with computers or chromebooks for about a week and a half, using the computers to research and work on their google docs and presentations. During that time I will visit each group of students and collaborate with them, helping them to understand what they are creating, and helping them find resources to use. They will learn about energy calculators and turbine output calculators, and use these things to estimate how much electricity they will need and how much their generator is able to produce. They will also learn about some cost of materials. They will learn about how many possibilities there are for clean energy production, and get tuned in with how much electricity is used by different devices.

Learning Strategy Bonus:

Slides can act as outline for narrative, or narrative can guide design of slides. (I find that some students prefer one way, and others prefer the other).

LESSON