Transparent Alternator Kit

OHM-150

About the Transparent Alternator Kit:

The Transparent Alternator Kit (TAK) enables students to build their own source of electrical energy. In less than 20 minutes, students working individually or in pairs create a device that will not only produce the energy to light up an LED, but will also teach them how electricity is produced. With this kit, you can:

- introduce types of energy such as potential, kinetic, mechanical, and radiant energy.
- introduce the concept of conductivity using the magnet, copper wire, and LED.
- start a discussion about energy and electricity on a larger scale, including the history of electricity and power generation in the context of climate change.

Lesson 1:
Discovering the Types of Energy

Pre-Lesson Set-Up:

Before introducing the Transparent Alternator Kit (TAK) to your class, we suggest the following steps:

- Become familiar with the different parts in this kit.
- Watch the How-To video at **https://www.youtube.com/watch?v=YbOYNYQdvug**. Show it to your class to illustrate the correct assembly process.
- Build a Transparent Alternator yourself. Determine how much time will be required and what kind of help your students might need to accomplish the task.
- Consider pairing your students so they can help and encourage each other. Working in pairs also expedites the winding of the copper wire.
- Adapt this lesson to suit your curriculum needs and grade level.

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Lesson Plan:

Action/Basic Instruction

Teacher Introduction:

1. Ask your students if they can identify things in the classroom that run on electricity.
2. Ask students if they can tell you how electricity is produced.
3. Present them with the information on Michael Faraday (page 5).
4. Hold up a finished Transparent Alternator and ask your students to tell you what they see.
5. Ask them if they know what the Transparent Alternator represents.
6. Introduce them to the idea of building their own electrical motor.
7. Ask them to brainstorm what they would need in order to do this.
8. Move to the suggested student activities and questions below.

Suggested Student Activities/Questions

During Class:

1. After your initial introduction, distribute a Transparent Alternator kit to each student or pair of students. Don't allow them to open up the kits yet.
2. Have students open the kits and arrange the parts in front of them.
3. Using the included instruction sheet, have students identify each of the parts.
4. Students should read the instructions on how to assemble their Transparent Alternator. This might also be a good time to use the video link provided on page 1. (**https://www.youtube.com/watch?v=YbOYNYQdvug)**
5. Instruct students to begin to assemble their own Transparent Alternators.

To the Next Level	Suggested Student Activities/Questions
Knowledge/Comprehension (define, name, memorize, repeat, label, record, list, restate, describe, explain, identify, translate, tell etc.)	What different parts were included in the Transparent Alternator Kit?
Application (apply, show, illustrate, demonstrate, use, practice, relate, recall, dramatize)	What happened when you turned the spindle of the Transparent Alternator? What kind of energy are you using when you turn the spindle? (mechanical energy) Give other examples of mechanical energy (hand crank old car etc.)
Analysis (distinguish, debate, compare, question, calculate, solve, inventory, analyze, appraise, criticize, examine etc.)	What will happen if you turn the spindle faster or slower? What are the limitations of the amount of electrical energy that can be produced by a Transparent Alternator? How could you overcome these limitations?
Synthesis (compose, set up, collect, propose, create, formulate, plan, assemble, design, construct, arrange etc.)	In what ways do we produce electrical energy in our society? How does a Transparent Alternator represent how electrical energy is produced? What would happen if your Transparent Alternator was hooked up to a PowerWheel? Would it produce more or less electrical energy?
Evaluation (estimate, measure, compare, assess, predict, score, rate, appraise etc.)	How would you measure how much electricity is produced by a Transparent Alternator? Enough to charge your cell phone? What do you think a Transparent Alternator would be good for?

Lesson 2: Discovering Electrical Energy

Pre-Lesson Set-Up:

- Adapt this lesson to suit your curriculum needs and grade level.

- Watch the YouTube video links provided below and decide which one(s) would be appropriate for your class. The grade level distinctions provided are suggestions only.

  Grades 4-6:
  https://www.youtube.com/watch?v=dNXdF12U4wo

  Grades 7-12:
  https://www.youtube.com/watch?v=TEVEBzNSwTU&list=PL6OlU9BSyIbA_ExPn71LqL2hd3gL2ij-e

  https://www.youtube.com/watch?v=yVDHKKTC4tA

- Review the Michael Faraday information provided on page 5.

Lesson Plan:

Action/Basic Instruction

Teacher Introduction:

1. Ask your students if they can identify things in the classroom that run on electricity.
2. Ask students if they can tell you how electricity is produced.
3. Present them with the information on Michael Faraday (page 5).
4. Show them the video(s) on Faraday.
5. Move to the suggested student questions in the next level section (page 4).

Suggested Student Activities/Questions

During Class:

After your introduction and viewing of the videos, have students respond to the following questions as provided in the next level section (page 4).

Lesson 2: Discovering Electrical Energy

continued

To the Next Level	Suggested Student Activities/Questions
Knowledge/Comprehension (define, name, memorize, repeat, label, record, list, restate, describe, explain, identify, translate, tell etc.)	1. Who was Michael Faraday? 2. When did Michael Faraday live? 3. Where did Michael Faraday live? 4. What was Michael Faraday's background? Was he rich or poor? Well educated or poorly educated? 5. What was Michael Faraday's first job? 6. What was Faraday's real passion?
Application (apply, show, illustrate, demonstrate, use, practice, relate, recall, dramatize)	1. What fascinated Faraday about science? 2. What was the event that helped him follow his passion for science?
Analysis (distinguish, debate, compare, question, calculate, solve, inventory, analyze, appraise, criticize, examine etc.)	1. What were the beliefs of most scientists during that period of time? 2. From what economic class of people did scientists come during that period of time? 3. What did Faraday believe that was different from most scientists of that time? 4. What methods did he use that were different from most scientists of that period of time?
Synthesis (compose, set up, collect, propose, create, formulate, plan, assemble, design, construct, arrange etc.)	1. What were the major discoveries provided by Faraday and his work? 2. How did Faraday's work affect other scientists of the day?
Evaluation (estimate, measure, compare, assess, predict, score, rate, appraise etc.)	1. What did Faraday contribute to contemporary science? 2. How is our scientific world different because of Faraday and his work?

Post-Lesson Thoughts
Suggestions for Next Time

- Have students prepare short biographies of other scientists whose work and discoveries have had an impact on our current world.
- Have students identify the impact of Faraday's work on our current world. What would we be missing today if he had not been successful in his discoveries?

Michael Faraday, Inventor of the Electric Motor

By Tuan Nguyen

Michael Faraday was a British physicist and chemist, best known for his discoveries of electromagnetic induction and of the laws of electrolysis. His biggest breakthrough in electricity was his invention of the electric motor.

Born in 1791 to a poor family in London, Michael Faraday was extremely curious, questioning everything. At age 13, he became an errand boy for a bookbinding shop in London. He read every book that he bound, and decided that one day he would write a book of his own.

He became interested in the concept of energy, specifically force. Because of his early reading and experiments with the idea of force, he was able to make important discoveries in electricity later in life. He eventually became a chemist and physicist.

In 1821, Michael Faraday built two devices to produce what he called electromagnetic rotation—that is, a continuous circular motion from the circular magnetic force around a wire.

Ten years later, in 1831, he began his great series of experiments in which he discovered electromagnetic induction. These experiments form the basis of modern electromagnetic technology.

In 1831, using his "induction ring," Michael Faraday made one of his greatest discoveries: **electromagnetic induction**, which is the "induction" or generation of electricity in a wire by means of the electromagnetic effect of a current in another wire. The induction ring was the first electric transformer.

In a second series of experiments, he discovered **magneto-electric induction**: the production of a steady electric current. To do this, Faraday attached two wires through a sliding contact to a copper disc. By rotating the disc between the poles of a horseshoe magnet, he obtained a continuous direct current. This was the first generator. From his experiments came devices that led to the modern electric motor, generator, and transformer.

Michael Faraday continued his electrical experiments. In 1832, he proved that the electricity induced from a magnet, voltaic electricity produced by a battery, and static electricity were all the same. He also did significant work in electrochemistry, stating the First and Second Laws of Electrolysis. This laid the basis for electrochemistry, another great modern industry.

Faraday passed away in his home in Hampton Court on August 25th, 1867 at the age of 75. He was buried at Highgate Cemetery in North London. A memorial plaque was set up in his honor at Westminster Abbey Church, near Isaac Newton's burial spot.

Faraday's influence extended to many leading scientists. Albert Einstein had a portrait of Faraday on his wall in his study, hung alongside pictures of legendary physicists Sir Isaac Newton and James Clerk Maxwell. Among those who praised his achievements include Earnest Rutherford, the father of nuclear physics. Of Faraday he once stated:

"When we consider the magnitude and extent of his discoveries and their influence on the progress of science and of industry, there is no honour too great to pay to the memory of Faraday, one of the greatest scientific discoverers of all time."

Source: **http://inventors.about.com/od/famousinventors/fl/Michael-Faraday-Inventor-of-the-Electric-Motor.htm**

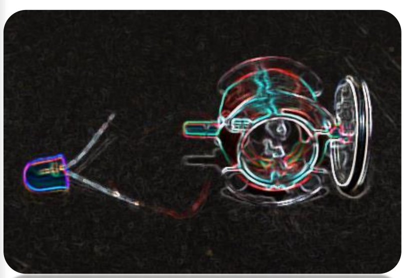
NGSS Correlations

Our Transparent Alternator Kit and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

4-PS3-2
Students can make observations of the Transparent Alternator to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4
Students can use the Transparent Alternator in an investigation to apply scientific ideas to design, test, and refine a device that converts energy from one form to another.



Middle School

MS-PS2-3
Students can make observations of the Transparent Alternator and use the data collected in an investigation to ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS2-5
Students can make observations of the Transparent Alternator and conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

MS-PS3-5
Students can use the Transparent Alternator in an investigation to construct, use, and present arguments to support the claim that when the motion energy of any object changes, energy is transferred to or from the object.

High School

HS-PS2-5
Students can plan and conduct an investigation with the Transparent Alternator to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-1
Students can plan and conduct an investigation with the Transparent Alternator to collect data for use in a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-3
Students can plan and conduct an investigation with the Transparent Alternator to design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-5
Students can plan and conduct an investigation with the Transparent Alternator to develop and use a model of two objects interacting through electric or magnetic fields to illustrate forces between objects and the changes in energy of the objects due to the interaction.

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons.
For us, "*Teachers Serving Teachers*" isn't just a slogan—it's our promise to you!

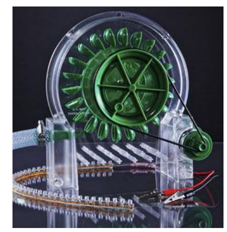
Please visit our website for more lesson ideas:

TeacherSource.com/lessons

Check our blog for classroom-tested teaching plans on dozens of topics:

http://blog.TeacherSource.com

To extend your lesson, consider these Educational Innovations products:



The PowerWheel (GRN-200)
The PowerWheel is a micro hydro generator—an amazing tool for teaching lessons about energy, hydro-power and other renewable sources of energy. Now you can charge cell phones or power laptops all from the power from your faucet. The PowerWheel can be used to enhance lessons for students from kindergarten through 12th grade.

Light Bulb Experiment Kit (OHM-300)
Demonstrate the difference between parallel and series circuits in a way that students can easily understand. This kit contains 4 Light Bulb Holders with Fahnestock Clips, 4 pairs of wires with alligator clips, 10 Miniature Light Bulbs, 8 D Cell Battery Holders, and 8 D batteries.

Build Your Own Light Bulb Kit (LIT-100)
Retrace the steps of Edison and other inventors as you build a working light bulb using the filament materials of your choice. Learn about electricity, light, properties of matter, energy, and the scientific method. Test the effects of vacuum on the life of your bulb. Perform exciting experiments. Experiments are suited to elementary, middle school, and high school level science and technology classes with extension activities for history and social studies.

HomoMotor Kit (KIT-700)

Introduce your students to one of the simplest devices, the homopolar or 'one pole' electric motor. Credited to Michael Faraday, it does not involve the polarity change of more complex motors. Includes instructions to make three styles of HomoMotors: pinwheel, spiral, and butterfly. Students build the motor, make it run, and can then break it down to make a different one. They can even design and build their own variations.

Hand-Powered Flashlight (SS-234)
Change kinetic energy from your hand into light energy. This hand-held 'dynamo' is easily visible. It clearly demonstrates how electrical energy can be produced by moving an electrical conductor through a magnetic field—a discovery made by Michael Faraday in 1831. This unit has a built in non-rechargeable, non-replaceable battery that can provide light for many hours showing the efficiency of modern LED lighting technology. However, no batteries are ever required—no bulbs to replace.