

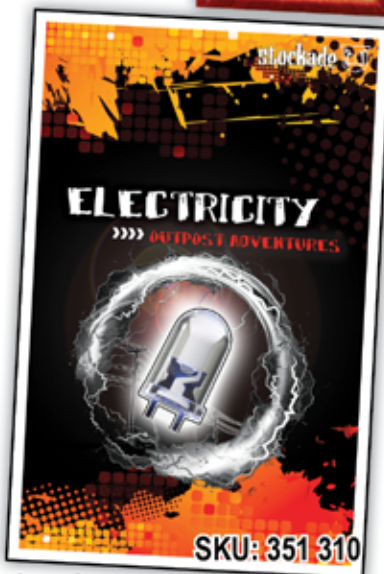
ELECTRICITY OUTPOST ADVENTURE

Achievement Sampler #7

Use this sampler to complete some CSB Achievement at home. Your parent, another relative or a family friend can help you with the memory verses and the individual Achievements. When you are done, show your completed work to your Stockade Ranger. He can help you get the entire Outpost Adventure and earn the Patch and Honor Star.

Print this pdf as a “Booklet” or “Multiple” using Adobe Reader.

You can obtain ELECTRICITY from:
CSB US - store.csbministries.org
CSB Canada - store.christianservicebrigade.ca



Builder Memory Verse: Colossians 1:16a

“For by him all things were created, in heaven and on earth, visible and invisible.”

Sentinel Memory Verse: Hebrews 11:3

“By this we know that we love the children of God, when we love God and obey his commandments. For this is the love of God, that we keep his commandments. And his commandments are not burdensome.”

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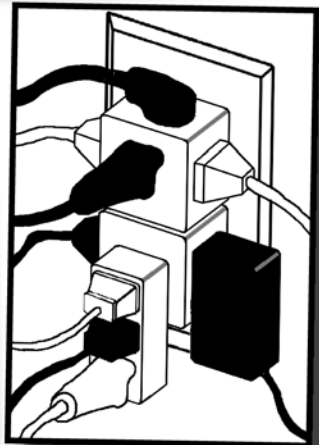
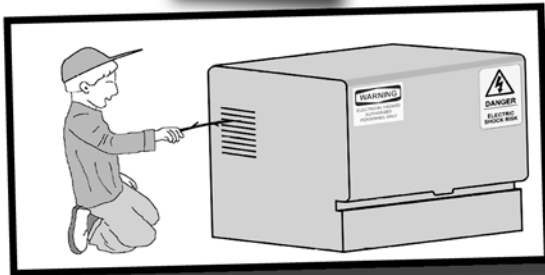
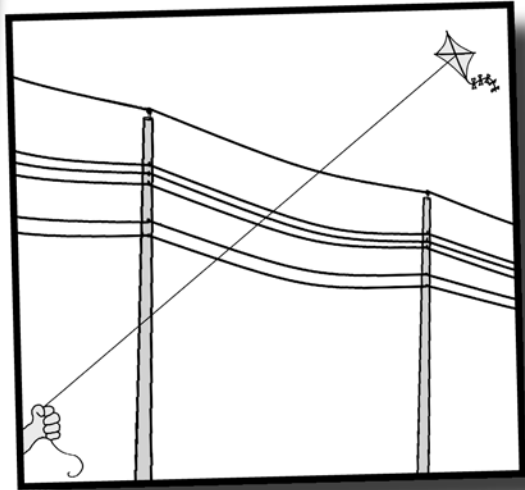
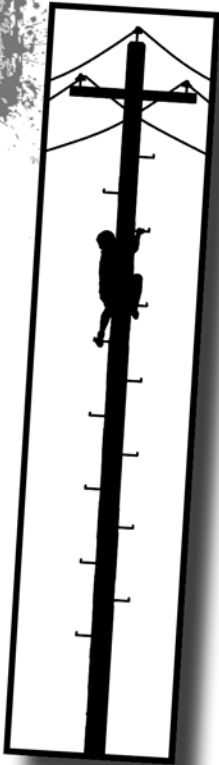
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SPOT THE DANGERS



Read the “Electrical Safety Rules” in the Resource section of this guide and then look at the four situations shown below. For each one, tell your Ranger which Safety Rules are being broken:



Electricity Safety Rules

KNOW THESE RULES - THEY CAN SAVE YOUR LIFE

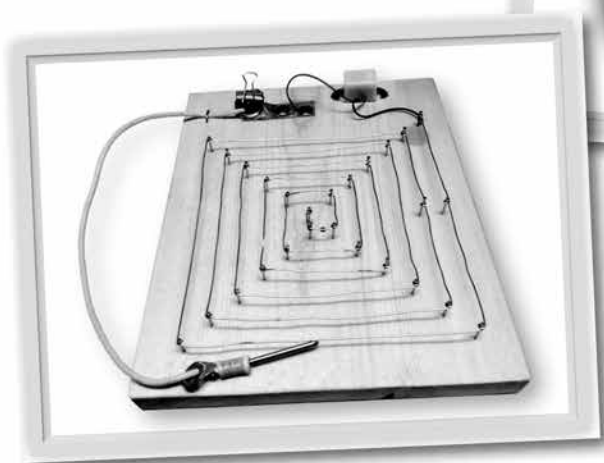


- 1. Shocking but true: Electricity can KILL you.**
- 2. Whenever near an electrical device, unless you are sure it is switched off, treat it as being live and possibly dangerous.**
- 3. Treat electrical appliances, wiring and extension cords with respect.** Damaged appliances and extension cords can kill or seriously injure you.
- 4. Turn off, or unplug, any electrical switches, wires, plugs or outlets that are hot to the touch.**
- 5. Never stick anything into electrical appliances, power bars or outlets.**
- 6. Do not overload wall outlets, power bars or extension cords.** They can overheat and cause a fire.
- 7. Electricity and water don't mix.** Keep electrical appliances, components and wiring dry.
- 8. Never touch a person who may be electrocuted or an electrical apparatus that doesn't seem "right" until you turn off the power first.**
- 9. Look up and look out for power lines before flying a kite, climbing a tree or moving a ladder.** The electricity can travel through kite strings, tree branches and the metal parts of ladder, and then through you.
- 10. Don't ever climb power poles, play on electrical power vaults or transformers, or go into electrical substations.**

ELECTRICAL PROJECT

Build an electrical project. Check out the ones listed in the Resource Pages of this Guide and see if there's one that you'd like to build. Check with your parent, then with the library or Internet for other options.

Build the project and show it to your Ranger and the Post.



CONDUCTORS & INSULATORS

Some materials, like metal, allow electricity to travel through them. Others do not. Some, like air, resist the flow of electricity until the voltage is so high that a spark jumps through it.



Ask a parent or friend to help you use a multimeter to test the objects shown below.

Set the multimeter to the middle range of the Ohms " Ω " scale (say, 200K). Turn on the meter, and test the objects.



A reading of "0" is "zero" resistance – a conductor.
A reading of "1" is "infinite" resistance – an insulator.

Write **CON**
beside conductors.

Write **INS**
beside insulators.



MEN OF SCIENCE & GOD

Many scientists who have made some of the biggest discoveries in electricity believe in God and His Son, Jesus Christ. Here are just a few of those great men:

Michael Faraday (1791–1867) discovered the principles of electromagnetic induction, diamagnetism and electrolysis. He built the first electric motor and electrical transformer. He was a dedicated believer in Jesus and was noted for his faith in the unity of God and nature that the Lord created.

Samuel Finley Breese Morse (1791-1872) was a painter and inventor. After years of being a successful portrait painter, Morse invented the single-wire electromagnetic telegraph system. He co-invented the Morse code. He faithfully declared of God, "It is His work. 'Not unto us, but to Thy Name, O Lord, be all the praise.'"



James Prescott Joule (1818–1889) discovered the relationship between heat and mechanical work (the First Law of Thermodynamics). He believed in God. He wrote, "After the knowledge of, and obedience to, the will of God, the next aim must be to know something of His attributes of wisdom, power and goodness as evidenced by His handiwork."

James Clerk Maxwell (1831-1879) formulated the theory of electromagnetic radiation, which tied electricity, magnetism, and light together. Maxwell's equations have been called the "second great unification in physics"; the first being discovered by Isaac Newton. He wrote this prayer: "Almighty God... teach us to study the works of Thy hands... so to receive Thy blessed Word, that we may believe on Him Whom Thou hast sent, to give us the knowledge of salvation and the remission of our sins."



John Ambrose Fleming (1849–1945) invented the first vacuum tube, the basis of modern electronics. He discovered the left hand rule for electric motors. He was a devout Christian and once preached on the evidence for the resurrection of Jesus.



Portraits are public domain

This Battery Assembly is used for each of the three subsequent projects. It is built during Meeting 1 and is used in the meetings after that. For some projects, the Aluminum Pie Plate base is replaced with one specific to that project. All projects will have the "Negative Lead" replaced at the appropriate time. Each project's instructions show how this is handled.

TIP LIGHT PROJECT

Components:

- 1 of Clear Glass Jar with screw-top Lid
- 1 of Aluminum Pie Plate (cut to fit inside Jar Lid)
- 1 of 3 volt LED Bulb (Christmas light replacement bulb is good*)
- 6" 24AWG Stranded Wire - from bulb to battery*
- 8" 24AWG Stranded Wire from bulb to fishing weight* (cut to length needed)
- 2 of 18-22AWG Butt Splice Connectors (if not using Christmas light socket*)
- 1 of Split Shot Fishing Weight
- 1 of Popsicle Stick (broken to length needed)
- 1 of Battery Assembly (described earlier)
- 1 roll Electrical Tape



ASSEMBLY INSTRUCTIONS

MEETING 1:

- Make Battery Assembly Project as shown on that page. (Don't worry about the pie plate base. A proper one will be cut in Meeting 2.)
- Ask the boys to bring in a "fancy jar" similar to the one in the photo. Note: Baby Food Jars may be too small.

MEETING 2:

- Cut the aluminum pie plate to just fit inside the lid of the jar. Cut 3/8" off one edge.
- Swap out the aluminum base of the Battery Assembly with this one.
- Place completed Battery and base into the lid and screw Lid onto Jar.

MEETING 3:

- Strip 3/8" from each end of the 6" Wire.
- Connect one end of this Wire to the short lead of the LED using a Butt Splice Connector.
- Strip 3/8" from each end of the 8" Wire.
- Connect one end of this Wire to the long lead of the LED using a Butt Splice Connector.

MEETING 4:

- Attach the Fishing Weight** to the other end of the 8" Wire.
- Break the Popsicle Stick to be about 1-1/2" shorter than the Jar.
- Tape the LED (just below the bulb) to the Popsicle Stick keeping the Bulb over the top.
- Swap out the end of the 6" Wire with the Negative Lead of the Battery Assembly.
- Carefully place all components into the Jar and screw on the Lid.
- Turn Jar upside-down. Jiggle until the light stays on.
- Adjust as needed. (See **Fishing Weight note, below.)

Notes:

* **Christmas Light Socket, Bulb and Wires.** Save a lot of time and effort by buying a 20-light string of *Battery Powered* LED Christmas Lights, and cut off individual light assemblies.

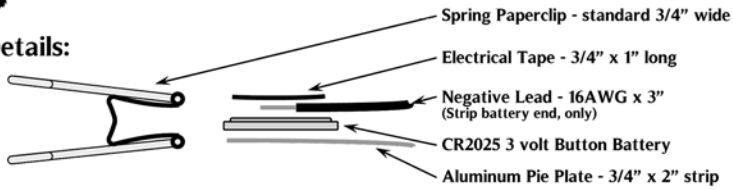
** **Fishing Weight.** To improve the electrical contact between the Fishing Weight and the Pie Plate, try wrapping the weight with Aluminum Foil.



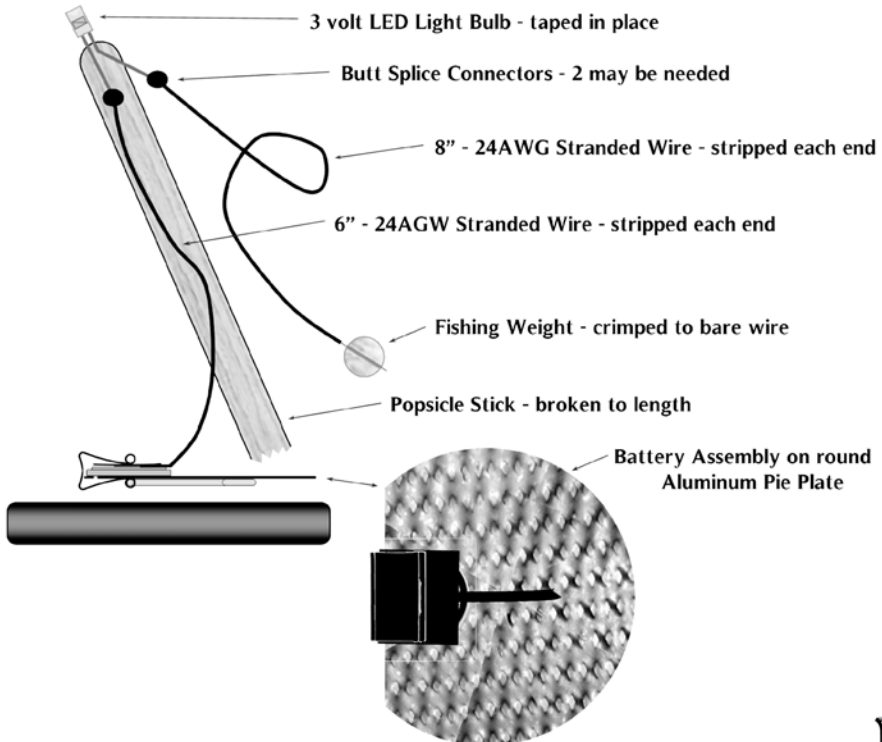
PROJECT

Components:

Details:



TIP LIGHT ASSEMBLY

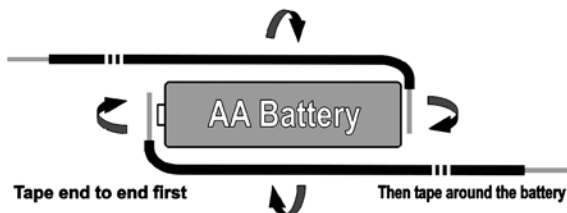


EXPERIMENTS WITH...

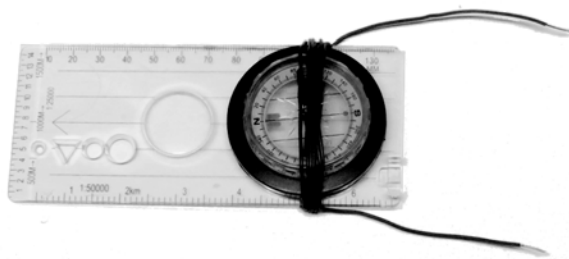


Electricity is a very useful form of energy. Do these three experiments to learn more about it. Share your observations with your Ranger.

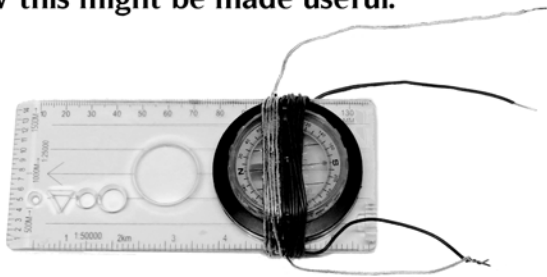
Battery Assembly – Start these experiments by building a AA Battery Assembly shown here. It's important to get the wires firmly touching the battery terminals, so start with that wrap of tape first. It may take a couple of tries to get it right.



Experiment 1 – Using 4 feet of (red) bell wire, wind a tight coil around a magnetic compass over the pivot point of the compass needle. Place the compass on a table and turn it so that the compass needle is mostly hidden by the wires. Touch the two ends of the coil wire to an AA battery; both ends at the same time. Observe the compass needle. Swap the ends of coil wire on the battery. **Tell your Ranger what this reveals about electromagnetism.**



Experiment 2 – Using 4 feet of (white) bell wire, wind another tight coil around the compass over the (red) wire. Twist one end of the white wire with an end of the red wire. Place the compass on a table, so that the compass needle is mostly hidden by the wires. Attach one lead of the AA battery assembly to the twisted red-white wires. Touch other end of each coil to the battery assembly. If the north end of the compass points in the same direction each time, then untwist the red-white wires and swap the ends of the red wire. With the twisted ends of the coil wires attached to one lead of the AA battery assembly, quickly touch the other lead back and forth to the end of each coil. **Tell your Ranger what you observed and how this might be made useful.**

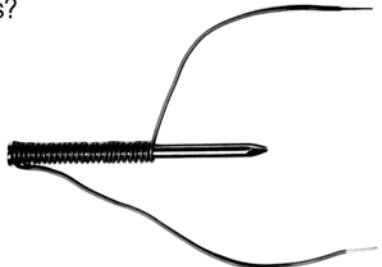


Experiment 3 – Wrap 4 feet of bell wire around a 3” common nail. Leave about 6” of wire for attaching to the battery. Suspend the nail above several paperclips and hold the leads to each side of: a CR2025 button battery; an AA battery; a “D” battery.

WARNING: The wires can get hot enough to burn your fingers, so be careful.

Tell your Ranger the answers to the following questions:

- Which battery attracted the most paperclips?
- Which battery has the highest voltage?
- What battery has the most amperage?
- What does this tell you about electricity?



TRICKY SITUATIONS



Tell your Ranger which of the following situations are safe or unsafe. Be sure to be able to tell him “why”, if he asks.

- 1.** A man walks up to a car that has crashed into a power pole. A power line has dropped across the car. **Is this a safe or unsafe situation?**
- 2.** A man unscrews the cover of the electrical panel in a flooded basement. There is half a foot of water on the floor. **Safe or unsafe?**
- 3.** A man is staring up into the sky at the kite he is flying. The wind is blowing towards some power lines at least 300 feet away at the other end of the soccer field. The kite is flying very high at the 350 foot limit of its string. **Safe or unsafe?**
- 4.** A man is looking at the electrical panel for his house. There is smoke pouring out of it and he can hear electricity arcing. The box is very hot and the wood around it is starting to burn. He has the garden hose in his hand ready to put out any fire. He pulls the handle. **Safe or unsafe?**
- 5.** A man smells a strange rubbery odour near the TV and investigates. He finds the extension cord is too hot to touch. He does a quick count – ten plugs are attached to this cord. He steps on the wire and prepares to kick the other end out of the wall socket. **Safe or unsafe?**