RAFT IDEAS

Topics: Electricity

Materials List

- ✓ Battery or batteries of the same size (D, C, AA, or AAA)
- ✓ Binding comb of a suitable diameter to hold the selected size battery or batteries
- ✓ Index card or equal
- ✓ Pencil or equal
- ✓ Aluminum foil sections, about 8 cm x 30 cm (3" x 12") - pop-up box foil sheets work well - see assembly
- ✓ Optional: Stiff, thin cardboard such as pressboard folders or covers

This activity can be used to teach:

- Energy can be transferred from place to place and converted from one form to another (Next Generation Science Standards, Grade 4, Physical Science 3-2 & 3-4)

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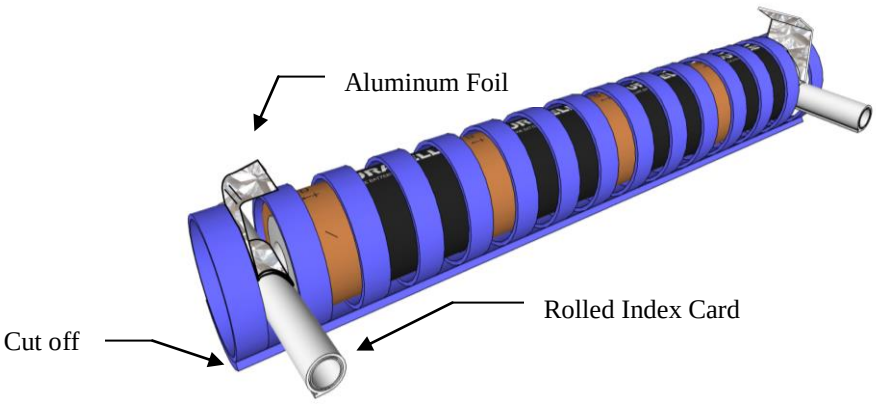
Binding Comb Battery Holder

A quick easy holder for many different battery sizes



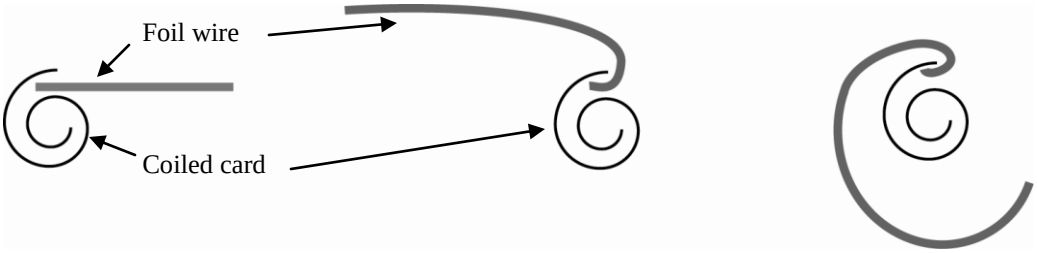
A plastic binding comb is easily transformed into a holder for from 1 to 4 batteries. A holder with more than one battery can provide several different voltages.

Assembly

1. Select the size and number of batteries that need to be held: D, C, AA, or AAA.
2. Obtain a binding comb of the correct diameter so the selected battery or batteries can be inserted inside.

	Binding Comb Size			Binding Comb Size	
Battery size	mm	inches	Battery size	mm	Inches
D	32	1-1/4	AA	12.5	1/2
C	25	1	AAA	10	3/8

3. Cut an index card in half, starting on a long side. Roll each half around a pencil to make a tight coil. One coiled card will be needed for each end of the holder.
4. Create a foil wire by folding over a 30 cm x 7.5 cm (12" x 3) section of aluminum foil to create a flat ribbon 30 cm (12") long and 1 cm (3/8") or so wide. A short length can be made if easier to fold. See direction on page 2 for an easy way to create folded foil wires.
5. Cut the foil wire to the length needed to make 2 leads. A single or double battery holder will need leads of 1/4 or 1/2 the length of the uncut foil wire, respectively, when the uncut length is 30 cm (~12")
6. Insert about 1 cm (3/8") of the end of foil wire into the coiled card. Bend the foil over the edge of the coiled card and wrap the foil around the card until the foil is all rolled up. Repeat for the second foil lead and coiled card as shown.

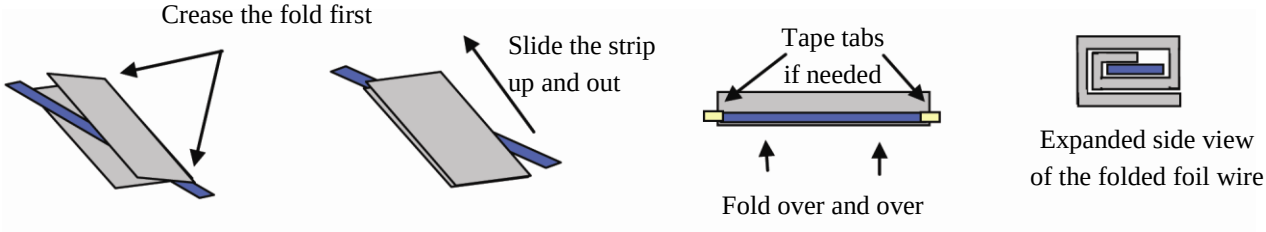


Created and written by Michael Pollock (RAFT)

7. Insert the battery or batteries into the binding comb. Multiple batteries will need to be oriented in the same direction when inserted into the binding comb.
8. Place a coiled card and wire between the first and second "fingers" at one end of the binding comb. Move the battery, or batteries, until one end is pressing against the coiled foil. Insert the other coiled card between the fingers where the other end of the battery, or the end of the series of batteries, is visible between the comb's fingers.
9. Cut between the fingers of the binding comb at a point on the other side of the finger that is pressing the second coiled card to the battery, as shown at the top of the idea sheet.
10. To obtain additional voltages for a holder with 2 or more batteries place a ¼ length (7.5 cm) folded foil wire, folded in half, between 2 of the batteries. Slightly press the 2 batteries apart to make inserting the foil wire easier. Repeat for each pair of batteries as needed.

Foil wire preparation

1. Cut stiff, thin cardboard into a strip that is about 1 cm (3/8") wide and a little longer than ~31 cm (12-1/4"). *If the strip is less than 31 cm (12-1/4") long then add tape tabs to the ends to lengthen the strip, as shown.
2. Follow the pictured instructions below for one method to cut the foil sections that utilizes the cardboard strip as a cutter as well as a folding form. Alternately the foil can be cut on a paper cutter or with scissors.
3. Lay the cardboard strip by the long rougher edge, if any, of an 8 cm (~3") wide by 30 cm (12") long section of foil and fold the foil around the strip to form a flat ribbon, as shown below.
4. Pull out the cardboard strip. If the strip is hard to pull out from one end then pull out from the other end of the folded foil wire.



To Do and Notice

1. To unwind the foil leads to the length required pull on the exposed end of each foil wire while rotating the coiled card to unwind the foil wire. Be careful not to let the leads touch each other as this will create a short circuit that will heat the wire and "drain" the battery.
2. Connect the leads to the item (bulb, motor, fan, or buzzer for example) or to a circuit to be powered.
3. When the battery power is no longer needed remove each coiled card from the binding comb, coil up the foil wire until fully wound up, and put the coiled card and foil wire back into the same place on the binding comb.

The Science Behind the Activity

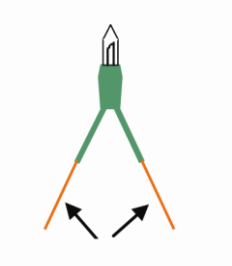
Batteries contain chemicals that interact to provide a "push" and a "pull" for external electrons that are connected in a continuous path from one contact (**negative -**) of a battery to the other contact (**positive +**) of the same battery. This continuous path is called a **circuit**. Students need to know that batteries, solar cells, generators, fuel cells, and other **power sources** create forces to **move electrons**; these items **do not create electrons!**

Essentially all things contain electrons. Metal objects contain many electrons that can easily be made to move in one direction. Electrons can move within a metal object and over to other touching (connecting) metal objects. **Conductors** are materials, like metal wires, that can provide a path for electrons to move along or, more accurately, to bump into their neighbors so the bumping moves along. Wires are often covered with a **non-conducting** or insulating material that does not allow electrons to move about easily.

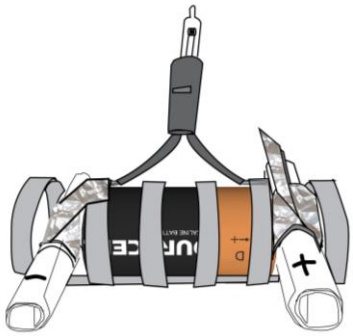
While the movement of electrons goes from the negative charged area that has a net excess of electrons to the positively charged area with a net deficit of electrons, most circuits are designed using a concept that has the current going in the opposite direction! The reason for the 2 directions is due to Benjamin Franklin's historic investigations in which he had no way of knowing which of the 2 types of electrical charges, negative or positive, was actually moving from place to place. He decided to assumed that the positive charges were moving from the positively charged area to the negatively charge area. Since that was the convention for many years the concept of flowing positive charges is called **conventional current** and is still used by electrical engineers to this day. When scientists discovered that the negatively electrons were actually doing the moving and thus moving in the opposite direction the current needed a different name and was called "electron flow" or "electron current".

Taking it Further

A holiday mini bulb can be cut from a string of mini bulbs and added to a binding comb battery holder for a single battery powered circuit. See the steps below under bulb preparation. Position the leads under the comb fingers near the ends of the battery as shown below on the right. Wrap the bare wire around each plastic finger. Insert one of the folded foil wires from one end of the battery under a wrapped wire. Pull out enough foil wire from the other end of the battery so that the foil wire will touch the other wire lead of the bulb when the foil end is pressed downward to the wrapped plastic finger. When the downward pressure is removed the bulb should go out as the foil wire springs back up. A single battery will light a 2.5 volt incandescent (has a glowing wire filament) mini holiday bulb.



Twist a lead's strands together, and then repeat for the other



Bulb preparation (Cut from strings of 50, 100, or 150 mini holiday bulbs.)

1. Cut the wires between the bulbs so the bulbs have 2 leads of equal length.
2. Strip about 1.5 - 2 cm (½"- ¾") of insulation from each of the leads.
3. Do not use the bulb sockets with 3 leads, due to the risk of creating a short circuit.
4. Twist the strands of a lead together to give a string like appearance.

Web Resources (Visit www.raft.net/raft-idea?isid=621 for more resources!)

- Batteries – http://electronics.howstuffworks.com/battery.htm/printable.