



BASIC CIRCUITS KIT

CAT NO. FSC 1043 DC



Experiment Guide

REQUIRED COMPONENTS (INCLUDED)

<i>Name of Part</i>	<i>Quantity</i>
D cell batteries	2
D cell battery holders	2
Insulated wire	1
Bulb holders	2
Bulbs	5
Knife switch	1

RECOMMENDED COMPONENTS (NOT INCLUDED)

<i>Name of Part</i>	<i>Quantity</i>
Wire cutter and stripper	1
Multimeter or voltmeter and ammeter	1

SAFE HANDLING OF APPARATUS:

Warning: creating a short circuit and leaving it connected for even a short amount of time can cause the wires and battery to heat up. This can cause burns, start fires and even cause battery acid to leak. Do not allow students to leave a circuit connected for a long while. Insist on using the knife switch to connect and disconnect circuits.

BREAKABLE WARNING: The light bulbs are glass and should be treated with care. Also if too much current is supplied to the bulbs the filament will burn and the bulb will be useless. Use only two batteries maximum to light the bulb.

ASSEMBLY OF APPARATUS:

Before beginning the experiments with your students, you must first set up the batteries and the wires. Remove all plastic wrapping and throw away. Take the batteries out of the battery holders and remove the red plastic caps on the positive end of the batteries. These caps can be replaced later for storage if desired. Replace the batteries so that the negative end of the batteries is pressed against the spring. Cut and strip a small 1" piece of wire and connect the metal bracket on the outside positive end of one battery holder to the negative bracket out the other battery holder. **DO NOT CONNECT POSITIVE TO POSITIVE OR NEGATIVE TO NEGATIVE.**

Cut six 4" pieces of wire and remove about ½" of plastic casing from both ends of each wire.

Place one end of a wire through the small hole on the end of the battery holder and twist the ends together like a twist tie. Do the same thing on the other end of the chain of batteries with the other wire.

Take one of the exposed ends of wire connected to the battery holder and attach it to the knife switch by doing the following. Loosen the thumb screws on the knife switch to expose the metal underneath. Take the wire connected to the battery holder and wrap the exposed end around the metal screw under the thumb screw and then tighten the screw back down. Repeat this step with another wire on the other end thumb screw so that two wires are attached, one on each thumb screw.

Screw the light bulbs into the light bulb holder base. Make sure that the metal tip of the base is in complete contact with the bottom metal plate on the bulb holder.

You should now have a chain of two batteries connected in series to a knife switch and two bulbs in a bulb holder and three free wires with exposed ends. You are now ready to let the students conduct their experiments. See diagram 1.

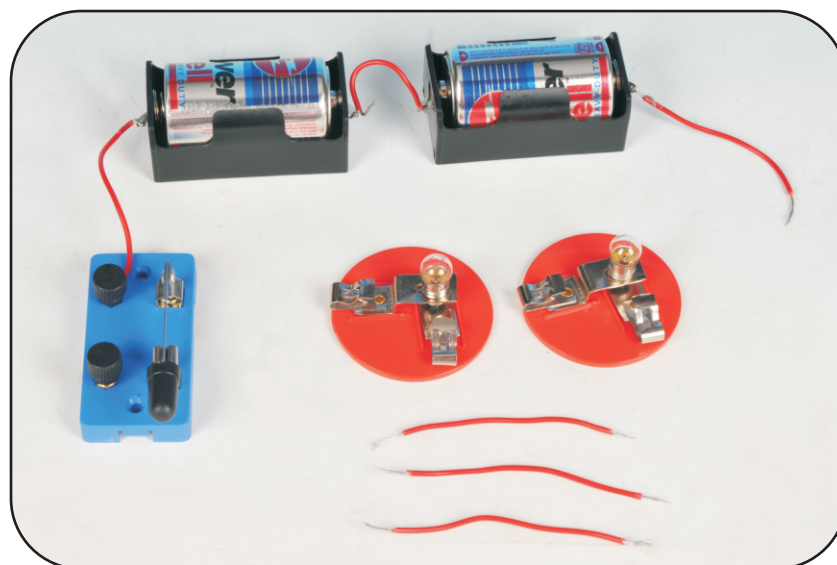


Diagram 1

ACTIVITY 1: HOW TO LIGHT A LIGHT BULB

Explain to your students how the knife switch works. When the switch is down, then the circuit is connected and potentially dangerous. When the switch is up, the circuit is disconnected. All work should be done while the circuit is disconnected. After wires have been connected then students may test their circuit by closing the knife switch and seeing if the bulb lights. After a few second, the knife switch should be opened again to disconnect the circuit.

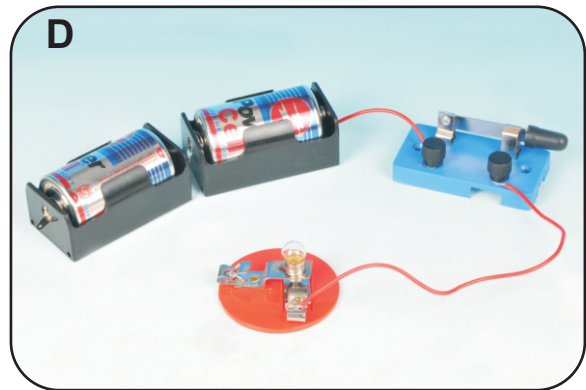
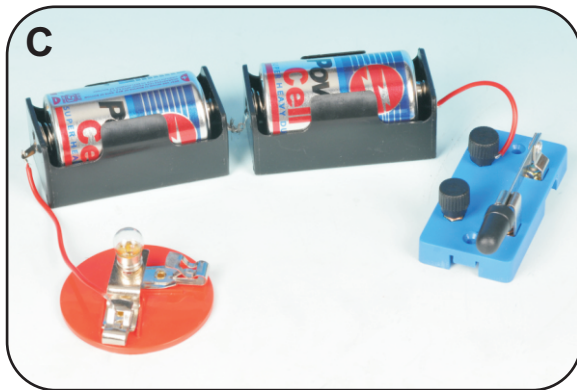
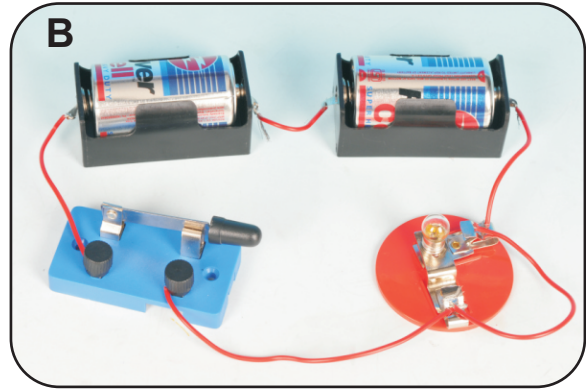
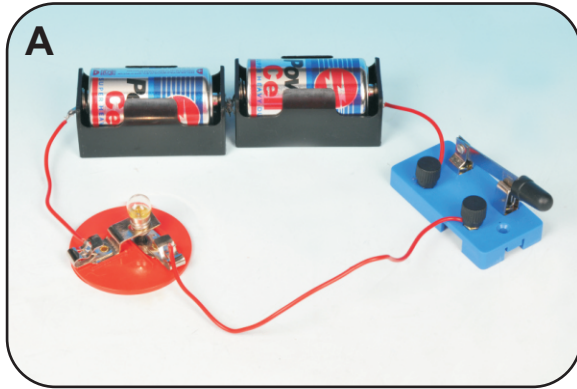
“A” should be the only one that works. “B” is the short circuit. This one can get hot if left connected for more than a few seconds.

The rule the students come up with as a class should include that there must be a path that goes from the negative side of the battery to the positive side of the battery and there should be only one path through the filament of the light bulb.

Name: _____ Date: _____

HOW TO LIGHT A LIGHT BULB

1. Look at the following arrangements of circuits. Circle which light bulb and battery configurations will make the light bulbs light up when the knife switch is closed. Write a sentence explaining your reasoning.



Why you think the way you do:

2. Now make each circuit and decide which circuits cause the light bulb to light. Set up the circuit first with the knife switch open. Then close the knife switch, observe for a few seconds and then open the knife switch up again. Do not leave the circuits connected for more than a few seconds!!!

OBSERVATIONS:

Which circuits worked and which did not?

ANALYSIS:

Write a rule for other students to follow to help them determine which light bulbs will light. Be prepared to share your rule with the class.

CLASS RULE:

ACTIVITY 2: SERIES AND PARALLEL CIRCUITS

BACKGROUND:

Before this activity talk about series and parallel circuits in general terms. Talk about turning lights on and off in your house, if one goes off, do all of them go off? You do not need to introduce the terms series and parallel circuit yet, but talk about wiring in a house. Old fashioned Christmas tree lights are a good example of series circuits. So are fuses in fuse boxes. Have students talk about their different experiences with circuits in their own lives.

ACTIVITY:

Give students two bulbs in the bulb holders the battery and knife switch already connected to each other and the wires. Tell students that you want them to build a circuit so that both bulbs light and that if you unscrew one light bulb, the other light bulb will go out. This is similar to old fashion Christmas tree lights. Have the students be very careful when unscrewing the light bulbs as they might be hot and could burn their fingertips.

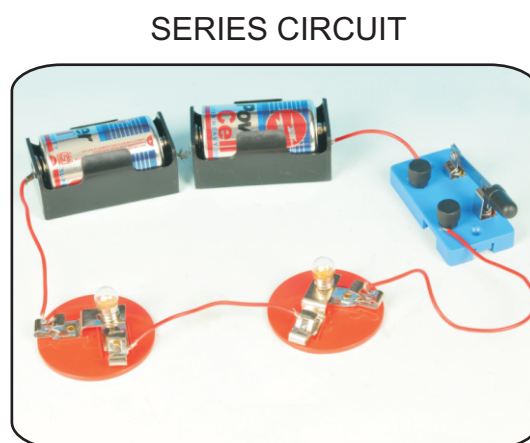


Diagram 2

Next have students draw their circuit. Here is a good place to introduce drawing schematic diagrams if this is something you would like to do with your students.

Use a voltmeter to measure the voltage across the batteries and across each device. Have the students come up with a rule as to how voltage behaves in a series circuit. Talk about the World Series, one game after another, and how each game affects the next, or a television series, and how one affects the other, and order is important.

The rule should be that the voltage of the batteries is the sum of the voltage across each individual bulb.

Show students how to measure the current by placing the ammeter into the middle of the circuit path. Have students come up with a rule about how the current behaves in a series circuit.

The rule the students come with up should be that the current of the whole circuit is the current through each individual bulb.

Next have students build a circuit where turning one bulb off the second bulb still lights. This is called a parallel circuit. Talk about how you can turn kitchen and bedroom lights in your house on and off without affecting the other light bulbs. Have the students write a rule about how voltage behaves in a parallel circuit.

The rule should be that the voltage across the batteries is the same as the voltage across each individual bulb.

Have the students measure the current in the whole circuit and in each branch of the parallel circuit. Have them come up with a rule about how the current behaves in a parallel circuit.

The rule should be that the sum of the current in each branch is the total current in the whole circuit.

PARALLEL CIRCUIT

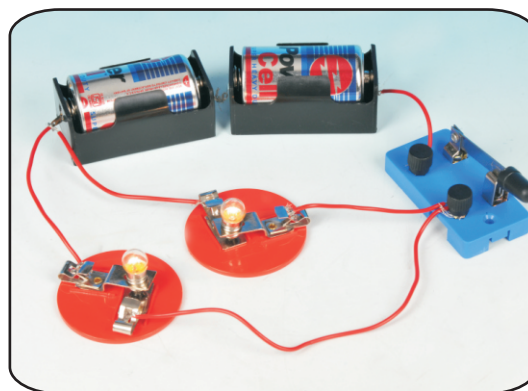


Diagram 3

Name: _____ Date: _____

SERIES AND PARALLEL CIRCUITS

SERIES CIRCUITS:

A series circuit is a circuit in which each device is connected one after the other. If one light bulb goes out, all the light bulbs go out. Use your bulbs and batteries to make a series circuit and draw a picture of your circuit in the space provided below.

1. Measure the voltage across your batteries and across each of the light bulbs using a multi-meter or a voltmeter. Record your values in the space provided below.

Voltage total: _____ Bulb 1: _____ Bulb 2: _____

2. Write a rule that describes how the voltage behaves in a series circuit.

3. Now measure the current by breaking your circuit and inserting an ammeter into the circuit right after your batteries, right after your first bulb and right after your second bulb and record your observations below.

Current total: _____ Bulb 1: _____ Bulb 2: _____

4. Write a rule that describes how the current behaves in a series circuit.

PARALLEL CIRCUITS:

Now disconnect your circuit and create a new circuit in which unscrewing one light bulb will allow the other light bulb to stay on and vice versa. Draw a picture of your circuit in the space provided below.

Measure the voltage across your batteries and across each of the light bulbs using a multi-meter or a voltmeter. Record your values in the space provided below.

Voltage total: _____ Bulb 1: _____ Bulb 2: _____

Write a rule that describes how the voltage behaves in a parallel circuit.

Now measure the current by breaking your circuit and inserting an ammeter into the circuit right after your batteries, right after your first bulb and right after your second bulb and record your observations below.

Current total: _____ Bulb 1: _____ Bulb 2: _____

Write a rule that describes how the current behaves in a parallel circuit.

FOLLOW UP QUESTIONS:

1. Christmas tree lights are what type of circuits? Explain why you think the way you do.
2. The lights in your house are connected in what type of circuits? Explain why you think the way you do.
3. In your own words describe a series circuit
4. In your own words describe a parallel circuit