Name: _____ Period: _____ Date: _____
Literacy Lab #17: "Series and Parallel Circuits" Richmond Hill High School: Physics

"Series and Parallel Circuits"

Directions: Take a few minutes to read the article on the following pages. Write responses to the statements or questions below. Reflect on reading – use your own words and thoughts, based on research, if needed. Use full sentences.

Fact-finding: List three facts that you learned in the reading.

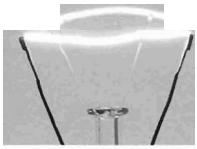
1.

2.

3.

Vocabulary: List and define three unfamiliar words in the space below.

Implications: What are your feelings about the reading? What is difference between series and parallel circuits? Fully explain your answers.



Series and Parallel Circuits

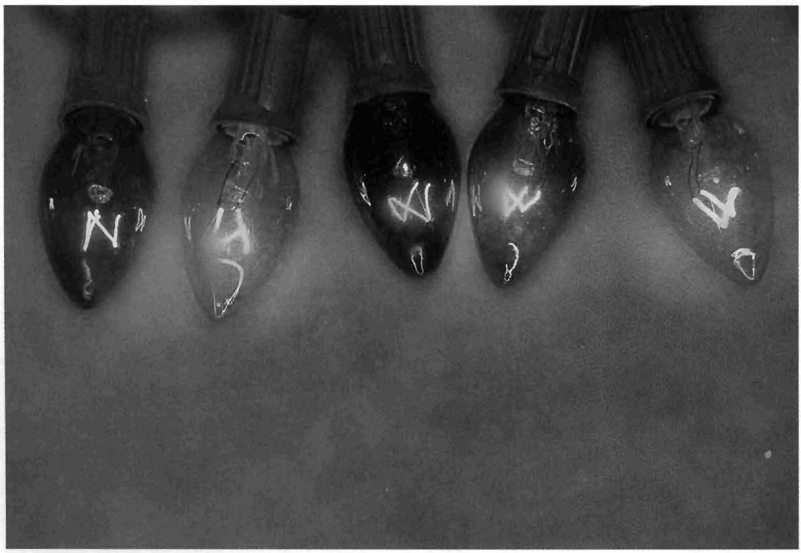
Two types of circuits are used in electricity: series and parallel. The simplest is the series circuit. In any series circuit there are three main components: a battery or source of voltage, a load or resistance, and conducting wire that connects them (see figure opposite).

So far we have considered the current to be a fluid of some sort; but as we will see in the next chapter, what actually flows in the wire is negatively charged particles called electrons. These electrons are attracted to a positive charge, and therefore they move toward the positive pole of the battery. But as we saw earlier, Benjamin Franklin suggested that current flows from positive to negative, which is opposite the flow of the electrons, and this is the direction that is still assumed for the flow of current (it is called the conventional current direction).

In the circuit shown we have a battery, which we can assume has a voltage of 12 volts, and a resistance, which can take many forms (a lightbulb is a good example). Assume it has a resistance of 6 ohms; the current that flows will be, according to Ohm's law, $I = 12/6 = 2$ amps.

Now assume we have several resistances in our circuit; call them R_1, R_2, and R_3. Assume they are all linked in series. How do we determine the current in this case? As it turns out, resistances in series add, so if the three resistances were 2, 4, and 6 ohms, we would have a total of 12 ohms and could again determine the current from Ohm's law. It would be 1 amp.

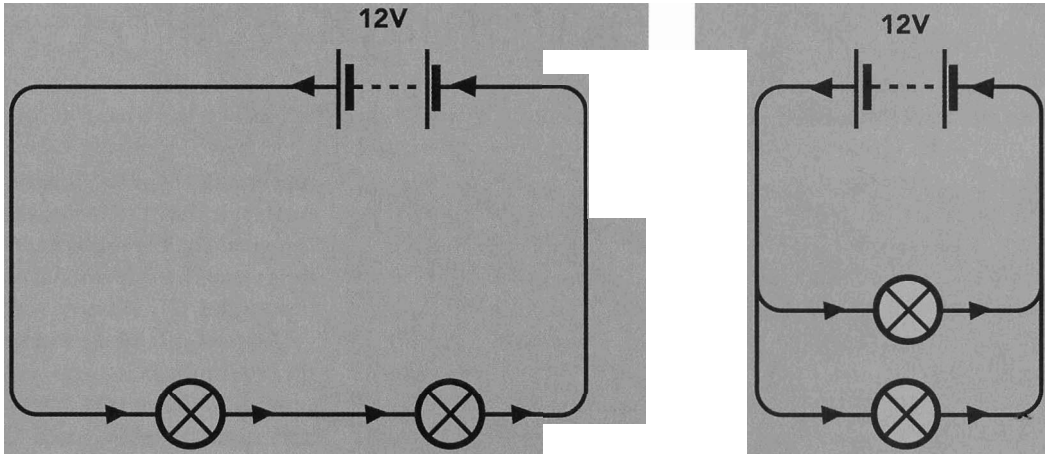
It is also important to note that the total voltage drop across the three resistances has to equal the voltage of the battery. This was not a problem with one resistance, but with three resistances it is important to know the voltage drop across each resistance. Again, this can be calculated from Ohm's law. Across the 2-ohm resistance we get $V = IR = 2$ volts. Similarly, across the 4-ohm resistance it is 4 volts, and across the 6-ohm resistance it is 6 volts. Note that the three add up to 12 volts, the voltage of the battery.



Above: Older Christmas lights were frequently wired in series. If one light burnt out, the whole string went out. Top left: An incandescent light. The filament acts as a resistor.

PARALLEL CIRCUITS

The second type of circuit is the parallel circuit. An example is shown in the figure. The current in the main line now splits into two separate currents. Water flow is again a useful analogy. You know that if a water pipe splits into



These two diagrams show a series circuit showing battery and resistors (left) and a parallel circuit showing batteries and resistors (right). Arrows indicate direction of current.

two pipes, part of the water goes into one of the pipes and the rest goes into the other. We can still use Ohm's law to calculate the currents in the two branches, but first we have to know how to "add" the resistances.

The rule for resistances in parallel is

$$R = 1/(1/R_1 + 1/R_2)$$

Therefore, if R_1 is 4 ohms and R_2 is 6 ohms, we get $R = 1/(1/4 + 1/6) = 2.4$ ohms. The current that flows in the main line is therefore $(12/2.4) = 5$ amps.

Electrical current behaves like water. When water in a pipe comes to a junction with two pipes ahead, part of the water goes into one pipe and the other part into the other pipe, depending on the diameters of the pipes.

We can also use Ohm's law to find the current through each of the resistors (the voltage is the same across both of them, namely 12 volts). The current through the 4-ohm resistance is $12/4 = 3$ amps, and the current through the 6-ohm resistance is $12/6 = 2$ amps, which adds to 5 amps, the current in the main line.

A third possibility is a combination of series and parallel in the same circuit. In practice this is not as common as the previous cases.