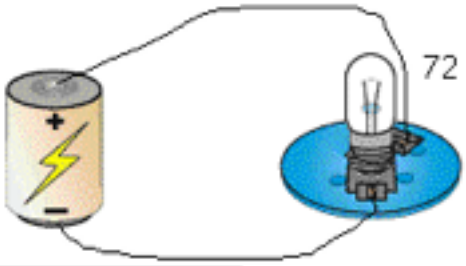
# ACTIVITY 2 HW: Multi-bulb Circuits and Energy

Name:_____ Date:_____ Group: _____

## Purpose

In activity 2 you analyzed a simple circuit with one battery and one bulb in terms of energy. Below is a snapshot from the simulator, showing the circuit and the energy bar graphs for the battery and bulb. The simulator was run for 10 seconds.




| Battery 1 | |
|---|---|
| **ENERGY INPUT** | |
| | |
| **ENERGY OUTPUT** | |
| Electrical | 0.72 |
| Heat | 0.01 |
| **ENERGY CHANGES IN SYSTEM** | |
| -0.75 Chemical | |
| Thermal | 0.02 |

| Bulb 1 | |
|---|---|
| **ENERGY INPUT** | |
| Electrical | 0.72 |
| **ENERGY OUTPUT** | |
| Visible Light | 0.07 |
| Heat | 0.63 |
| **ENERGY CHANGES IN SYSTEM** | |
| Thermal | 0.02 |

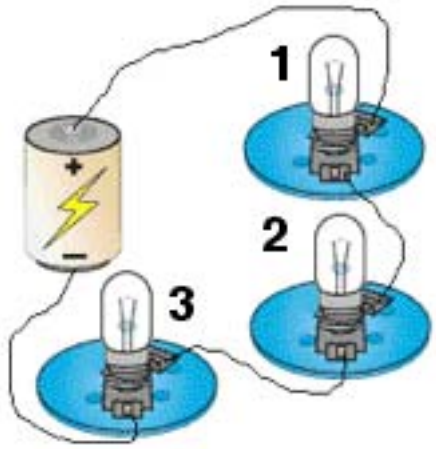
The **rate** at which electrical energy is transferred out from the battery is the total electrical energy transferred divided by the time (10 seconds). It is measured in units of watts. So,

Rate = 0.72 J/10 s = 0.072 watts.

In activity 1 you constructed two different circuits with one battery and more than one bulb. One was a single loop or series circuit and one was a multi-loop, or parallel circuit. In this homework we want to analyze series and parallel circuits in terms of energy.

## Initial Ideas

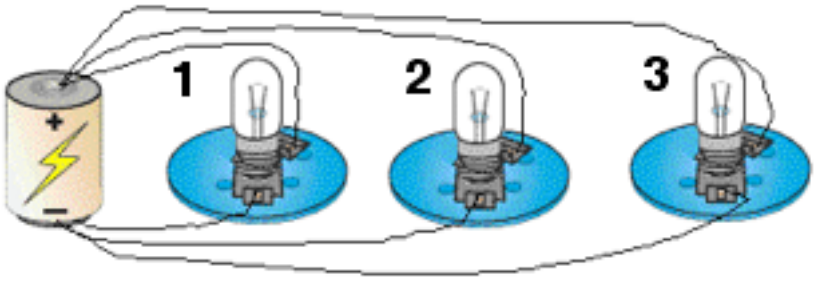
To the right is a series circuit consisting of one battery and three bulbs. Suppose this circuit were run for 10 seconds.




Predict whether you think the **rate** of electrical energy output from the battery would be greater than the rate in the one-bulb circuit, equal to the rate, or less than the rate. Why do you think so?

Predict how you think the total electrical energy transferred out from the battery in ten seconds is divided among the three bulbs in the series circuit. Does each bulb receive the same total amount of electrical energy transferred out from the battery, or does each bulb receive only a percentage of the total electrical energy from the battery (and, if so, what percentage)? Why do you think so?

To the right is a parallel circuit consisting of one battery and three bulbs. Suppose this circuit were run for 10 seconds.

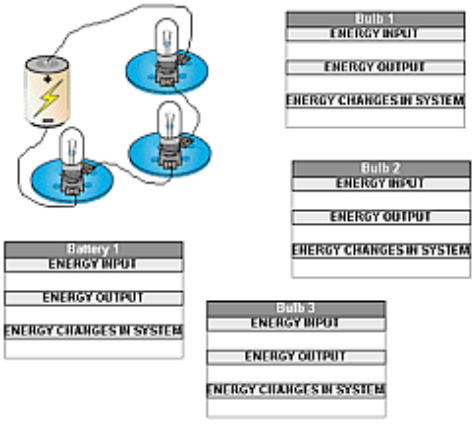


Predict whether you think the rate of electrical energy output from the battery would be greater than the rate in the one-bulb circuit, equal to the rate, or less than the rate. Why do you think so?

Predict how you think the total electrical energy transferred out from the battery in ten seconds is divided among the three bulbs in the parallel circuit. Does each bulb receive the same total amount of electrical energy transferred out from the battery, or does each bulb receive only a percentage of the total electrical energy from the battery (and, if so, what percentage)? Why do you think so?

## Collecting and Interpreting Evidence

To check your predictions, open *Chapter 5 Activity 2 Homework Setup*. Construct the circuit as shown here and set out energy bar graphs for each of the three bulbs and the battery. (You may need to readjust the position of the energy bar graphs after running the simulator so they don't overlap too much.)




Run the simulator for 10 seconds, and then pause it.

What is the electrical energy output from the battery? How does that compare with the output for the one-bulb circuit?

 How does the electrical energy input to each of the three bulbs compare to each other? How does each compare to the total electrical energy output from the battery?

 Calculate in watts the rate of electrical energy transferred from the battery and the rate of electrical energy transferred to **each** bulb. (For each bulb, the rate in watts equals electrical energy divided by time, in this case 10 seconds.)

As you saw in Activity 2, the rate of electrical energy transferred into a bulb determines the brightness of the bulb: the greater the rate, the brighter the bulb.

Returning to the simulator, delete everything and then construct the three-bulb parallel circuit. Place an energy bar graph for the battery and one for each of the three bulbs. Run the simulator for 10 seconds, and then pause it.

 What is the electrical energy output from the battery? How does that compare with the output for the one -bulb circuit?

 How does the electrical energy input to each of the three bulbs compare to each other. How does each compare to the total electrical energy output from the battery?

 Calculate in watts the rate of electrical energy transferred from the battery and the rate of electrical energy transferred to each bulb.

## Summarizing Questions

Compare the three-bulb parallel circuit with the three-bulb series circuit by answering these questions.

**S1**. For both series and parallel circuits, how is the total electrical energy from the battery divided among the bulbs in the circuit?

**S2**. Does a battery transfer electrical energy at a greater rate in a parallel or a series circuit? What is your evidence?

**S3**. In which circuit, the parallel or series, would the battery *die* first? Explain your reasoning.

**S4**. In terms of the rate of electrical energy transferred, why is each bulb in the parallel circuit just as bright as the bulb in the one-bulb circuit, but each bulb in the series circuit is much dimmer?