1. **Observing voltage relationships**

Go to the PhET web site and use the Circuit Construction Kit simulation (CCK). Drag out three batteries. Measure the voltage of each using the voltmeter and record the voltage in a table. To use the voltmeter, drag one tip of each probe to the places between which you are measuring the voltage as shown below. The voltmeter measures the voltage from the black probe to the red probe. If you reverse the probes, the readings will have the opposite sign.

Then move the batteries end to end as below to measure combined voltage.

3

1

2

1

2

 1+2 1+2+3

|  |  |
| --- | --- |
| **Battery**  | **Voltage (V)**  |
| 1 |  |
| 2 |  |
| 3 |  |
| 1+2 |  |
| 1+2+3 |  |

1. Describe the relationship between the number of batteries and the voltage and explain what you think might be happening.
2. **Using voltage**

Use the Circuit Construction Kit simulation to build a circuit with a battery and a light bulb in the *Lifelike* visual mode.

1. How does the voltage of the battery compare to the light bulb voltage? Explain what you think is happening.
2. Vary the voltage of the battery and record your observations about how the brightness is affected by voltage.
3. Consider a real light bulb and battery; explain what you think is happening that causes the changes in brightness.
4. **Using voltage in series circuits**

Use CCK to build the circuits below with a battery at about *12 volts* and light bulbs. Turn on the voltmeter and ammeter to measure voltage of the battery and current into it. The *non-contact* ammeter will give the current reading when it the cross hairs are moved above the point in the circuit. Record bulb brightness as dim, bright, or very bright.

|  |  |  |
| --- | --- | --- |
| Figure 1 | Figure 2 | Figure 3 |

|  |  |  |  |
| --- | --- | --- | --- |
| # of bulbs | Battery Voltage (V) | Battery Current (A) | Bulb brightness(dim, bright, very bright) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. Summarize the relationships you observed and explain what you think is happening.
2. What happens when you take a bulb out of a circuit? Explain what you think is happening.

**IV. Using voltage in parallel circuits**

 Redo Part III but use figures 4-6 for the circuits. Make a new table and answer the questions.

|  |  |  |
| --- | --- | --- |
| Figure 4 | Figure 5 | Figure 6 |

|  |  |  |  |
| --- | --- | --- | --- |
| # of bulbs | Battery Voltage(V) | Battery Current(A) | Brightness of bulbs(dim, bright, very bright) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. Summarize the relationships you observed and explain what you think is happening.
2. What happens when you take a bulb out of a circuit? Explain what you think is happening.