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**Part A: The Simplest Circuit (Not using the circuit board setups!)**

**A.1.** Challenge: Light a light bulb with one battery and one wire. Draw how:
(Don't use the circuit boards for this challenge! You have exactly one battery, one light bulb, and one wire, and nothing else!)

Questions:
**A.2.** What part of the light bulb *must* be touching the battery?

**A.3.** What part of the light bulb *must* but touching the wire?

**A.4** Can you *reverse* these two and still get the light bulb to light? (try it!)

**A.5.** While attempting the challenge, was there ever a time that your wire became very hot? Draw the setup that makes the battery very hot.
(If it didn't happen to you, find someone else. It *definitely* happened to someone in the class).

| **Electric Circuit**<br><br>A closed loop in which electrons can move continuously. |
|---|
| **Short circuit**<br><br>A circuit with no resistance (only batteries and wires).<br>Quickly overheats. |

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**Part B: The Mouse Detector**

Materials:
- battery and holder
- light bulb and holder
- wires
- small piece of paper (cheese)

The challenge:
Build a circuit and stick the "cheese" somewhere in the circuit so that it *doesn't* light.
When you remove the "cheese," the light bulb should turn on.

Draw, or explain, how you did it:

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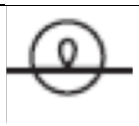
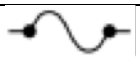
**Part C:** Circuit diagram symbols:

A circuit diagram is a very specific way of drawing a circuit.
With a circuit diagram, anybody, anywhere in the world, (who has learned how to read circuit diagrams) could read your circuit.

| Element | Symbol | Function |
|---|---|---|
| Wire |  | Conductor that allows electric current (electrons) to flow. |
| Battery |  | Converts chemical potential energy to electrical energy, Provides energy for the circuit |
| Resistor |  | Slows down electric current, converts electrical energy to other forms of energy. |
| Light Bulb |  or  | A specific type of resistor, converts electrical energy to thermal and electromagnetic (light) energy |
| Switch |  | When opened, stops current flow in a circuit |
| Fuse |  | When current is to great, burns out and then stops the circuit. |

*** there are many different symbols for a light bulb. I personally prefer just the normal resistor symbol. The one there is the symbol that appears on the MCAS.

Which *two* symbols could be a light bulb?

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Symbol for closed an open circuit:

| | | |
|---|---|---|
| Open Switch |  | Stops current |
| Closed Switch |  | Allows current to flow |

Typically, when you are drawing circuits in this class, you will draw switches open so it is clear they are there.

*Draw the symbol for each element:*

Light bulb:

Wire:

Battery:

Open Switch:

Resistor:

Something that converts electrochemical potential energy to electrical energy:

Something that converts electrical energy to light energy:

Something that controls the circuit:

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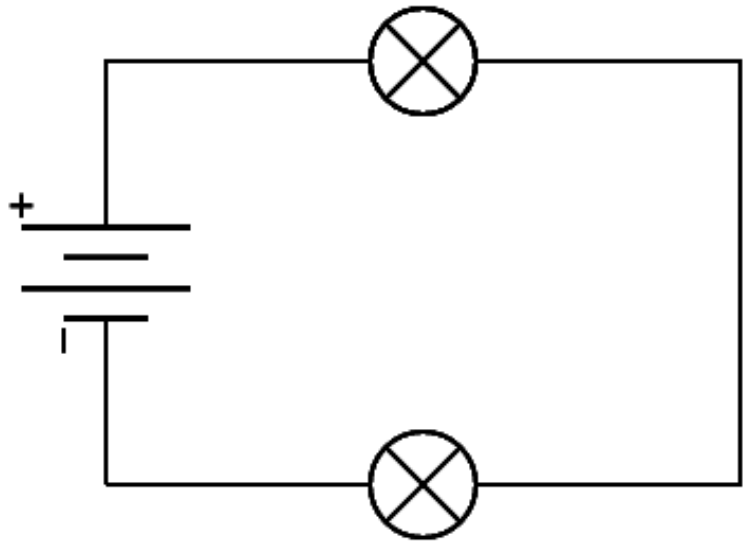
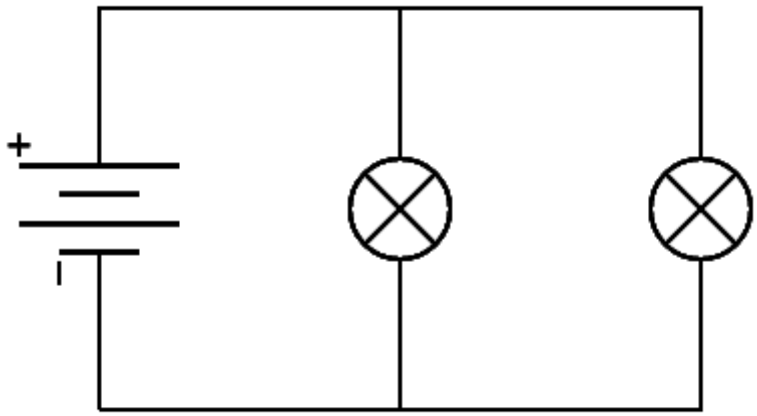
**Part D: Series and Parallel Circuits**

**D.1** Build a simple series circuit:




Unscrew a light bulb from the holder. What happens to the other light bulb?

**D.2** Build a simple parallel circuit




Again, unscrew a light bulb from the holder. What happens to the other light bulb?

If you use the same battery and bulbs, which has brighter light bulbs, the series circuit or the parallel circuit?

**D.3** If you were designing the wiring in your house, do you think series of parallel wiring would be better? Give two reasons why:

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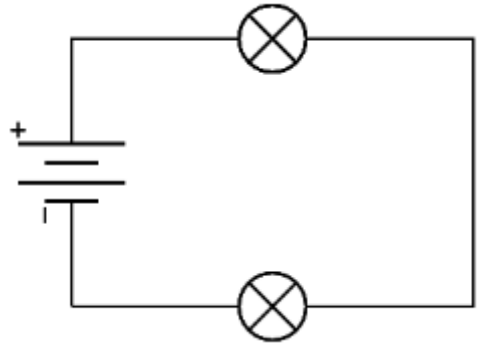
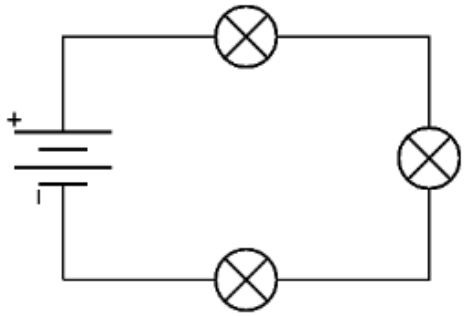
**D.4** Build a three different series circuits:

- two batteries and two light bulbs
- two batteries and three light bulbs
- two batteries and four light bulbs

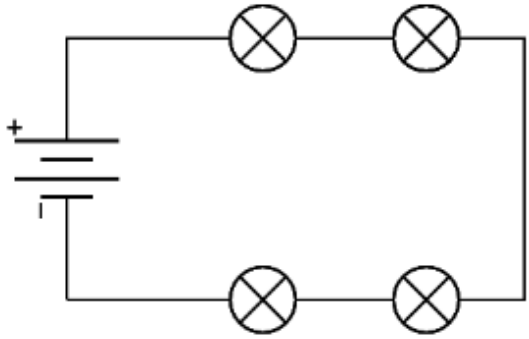
Two batteries and two light bulbs in series



Two batteries and three light bulbs in series



Two batteries and four light bulbs in series



As you add each light bulb, what happens?

Can you add so many bulbs that nothing lights up at all? If so, how can you fix this problem?

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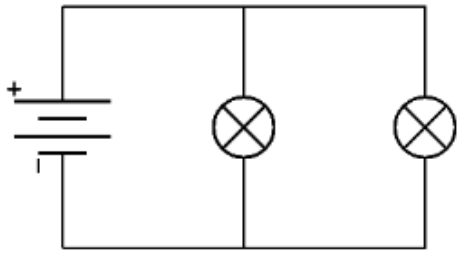
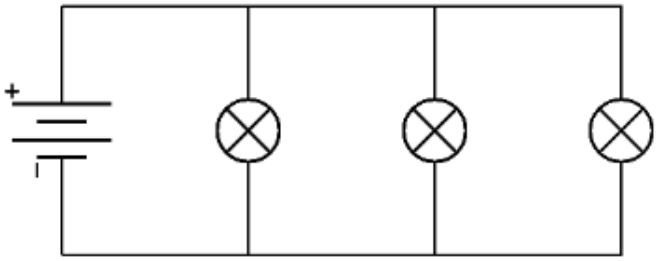
**D.5** Build three different parallel circuits:

- two batteries and two light bulbs
- two batteries and three light bulbs
- two batteries and four light bulbs

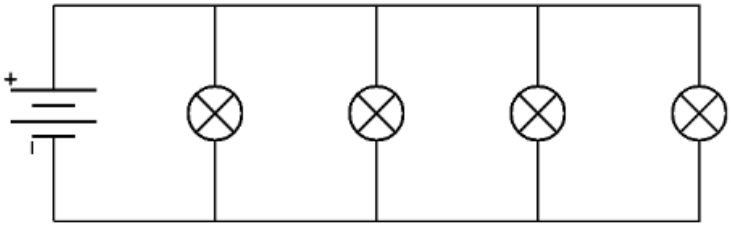
Two batteries and two light bulbs in parallel



Two batteries and three light bulbs in parallel



Two batteries and four light bulbs in parallel.



When you add a new bulb, what happens?

**D.6** Which circuit do you think would run out the battery more quickly, a series circuit with 4 light bulbs or a parallel circuit with four light bulbs? Why?

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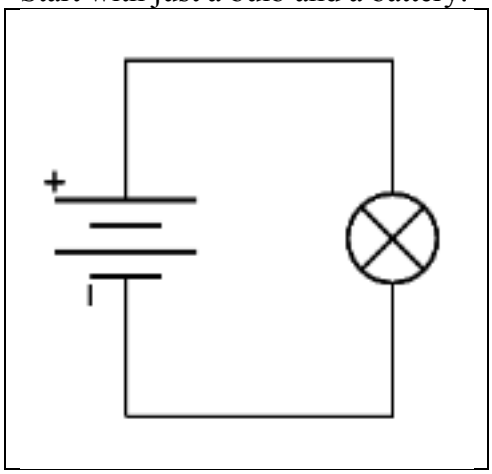
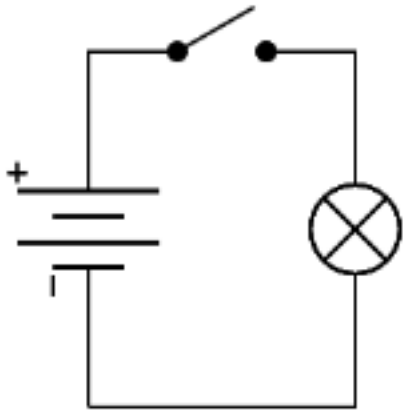
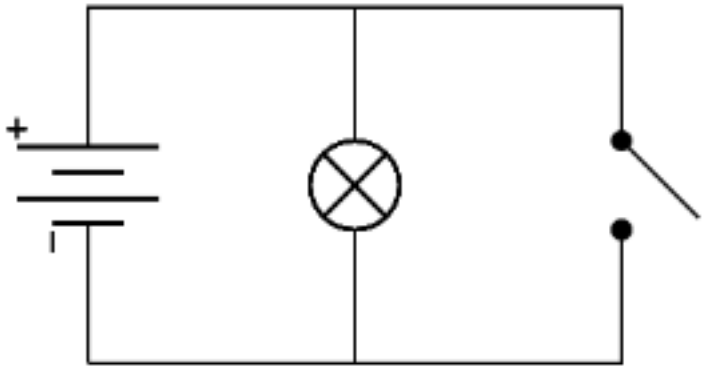
**Lab E: Switch Questions**

**E.1** What is the proper way to connect a switch?

Start with just a bulb and a battery:



From this, there are two ways you *could* connect a switch:

| Switch Connected in Series | Switch Connected in Parallel |
|---|---|
|  |  |

Both switches work! However, there is a *very important* difference.

One switch works *properly*: When the switch is down, the light is on. When the switch is up, the light is off.
Which switch is this?

The other switch works *in reverse*: When the switch is down, the light is off. When the switch is up, the light is on.
Which switch is this?

The wrong switch (the reverse switch) is dangerous because it creates a *short circuit*.

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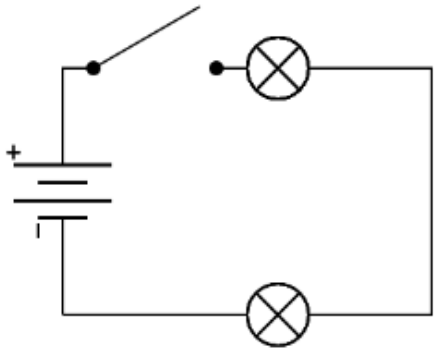
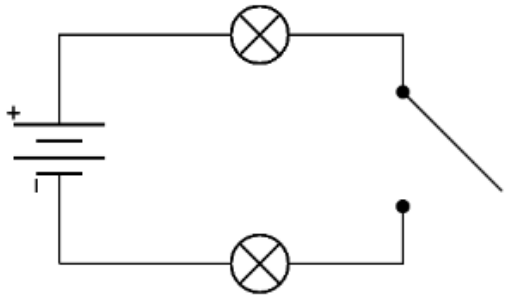
The "reverse switch" is dangerous because it means you have created a *short circuit*. More about short circuits later, for now know they are very bad and you never want to build them. Always connect the switch the proper way and never create a reverse switch?

**E.2** Switches in a series circuit.
Build a series circuit with two light bulbs and a switch. Try putting the switch into 3 different locations:

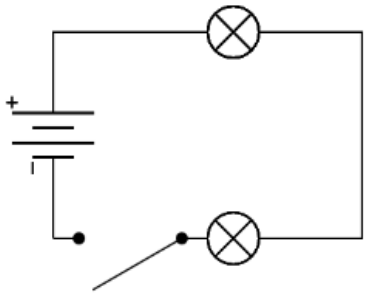
Option 1



Option 2



Option 3



Does each switch control *one light bulb* or *both light bulbs*?

Test out each circuit.
Does it matter where you put the switch in a series circuit?

Explain why this makes sense.

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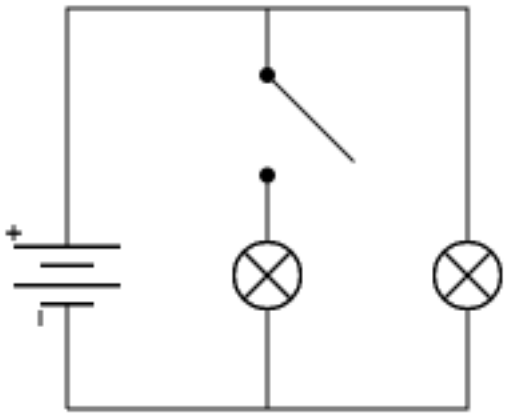
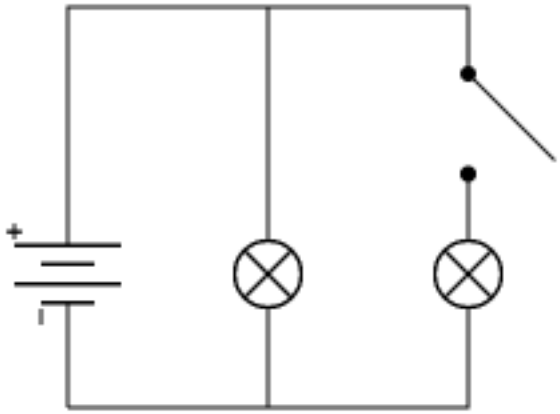
**E.3** Switches in a parallel circuit.
Build a parallel circuit with two light bulbs and a switch. Place the switch in three different locations:

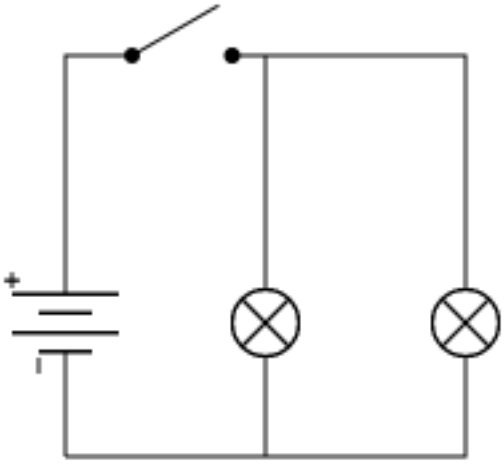
Switch Option 1



Switch Option 2



Switch Option 3



Which light bulbs does Switch Option 1 control?

Which light bulbs does Switch Option 2 control?

Which light bulbs does Switch Option 3 control?

Does it matter where you place a switch in parallel?

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**Part F: Switch Challenges**

For each challenge, figure out how to build the circuit. Then, draw the circuit diagram. Make sure you label the switches A, B, and C. There may be more than one possible solution.

(note: No more building short circuits! be careful not to build them. I want you to try out different things to try and meet these challenges, but in your trying, don't build a short circuit).

**F.1.** Build a circuit with 2 light bulbs and two switches.
Switch A controls one light bulb.
Switch B controls both light bulbs.

Draw a solution. Make sure you label the switches A, B, and C.

**F.2.** Build a circuit with 2 light bulbs and two switches.
Switch A controls one light bulb.
Switch B controls *the other* light bulb.

Draw a solution. Make sure you label the switches A, B, and C.

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**F.3.** Build a circuit with 3 light bulbs and 3 switches.
Switch A controls one light bulb.
Switch B controls two light bulbs
Switch C controls all three light bulbs.

Draw a solution.
Make sure you label the switches A, B, and C.

**F.4.** Build a circuit with 3 light bulbs (A, B, and C) and 3 switches (I, II, and III).

Switch A controls *only* light bulb I.
Switch B controls light bulbs I and II, but not III.
Switch C controls *only* light bulb III.

Draw a solution. Make sure you label the switches and the light bulbs.