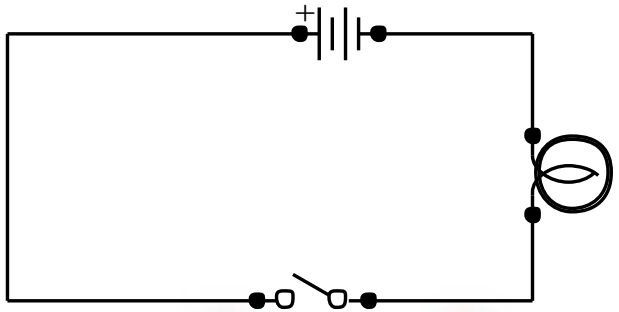
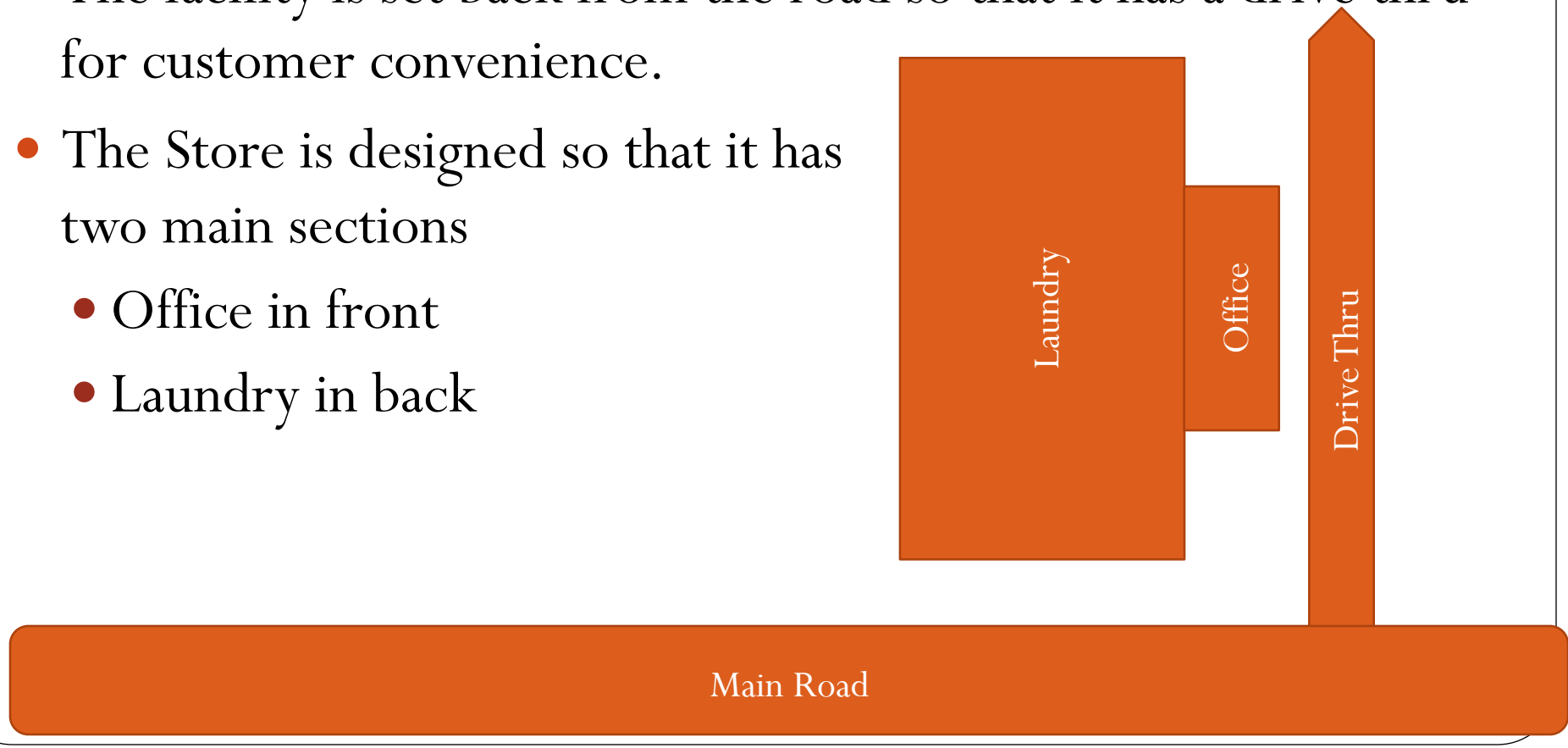
Basic Electronic Circuits



Final Design Challenge: Situation

- The "Stirland Family Drive-Thru Laundry" is located along a busy road.
- The facility is set back from the road so that it has a drive thru for customer convenience.
- The Store is designed so that it has two main sections
  - Office in front
  - Laundry in back



Design Challenge: Problems

- Sometimes only one person is working in the store.
- The laundry is noisy and it is sometimes difficult for workers to hear / see when customers arrive.
- Several customers have complained lately because they pull up to the drive thru and they have to wait because the workers do not know they are there.
- Workers have complained because they are busy and have to hurry back and forth between the laundry and office to see if customers are waiting.

Design Challenge

- Using the materials provided, design an alarm system that will alert the workers when someone drives up to the store
- Materials
  - Lights
  - Buzzer
  - Motor
  - Wires
  - Batteries
  - Various conductors and insulators
  - Construction Materials
    - Cardboard, paper, tape

Challenge #1

- Given the following resources, light the bulb!
  - A battery,
  - a bulb
  - and a jumper wire

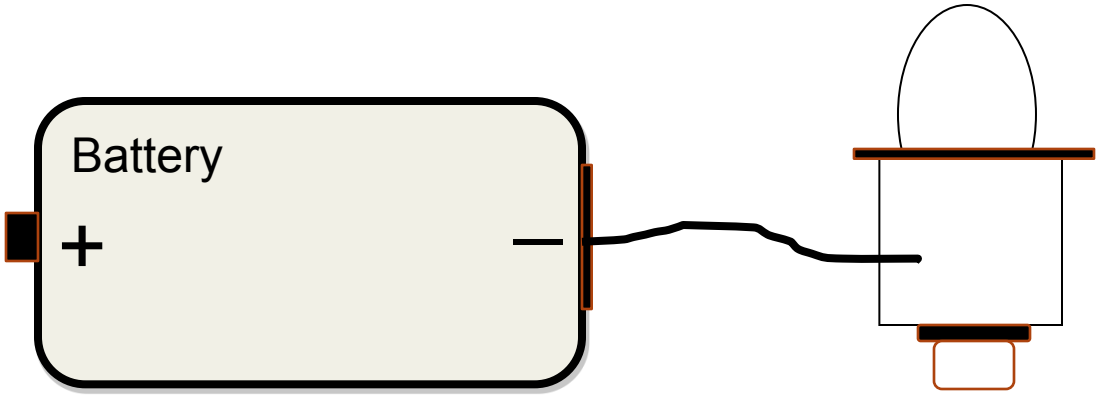
- When you are successful, draw a picture of how you connected your circuit in your notebook and then sign off with the teacher.

Minds of Our Own Video

- http://www.youtube.com/watch?v=Ng5qzH39nyg

If you look close in the video, you will notice that the students connected the circuit like this.

- Why won't this work??



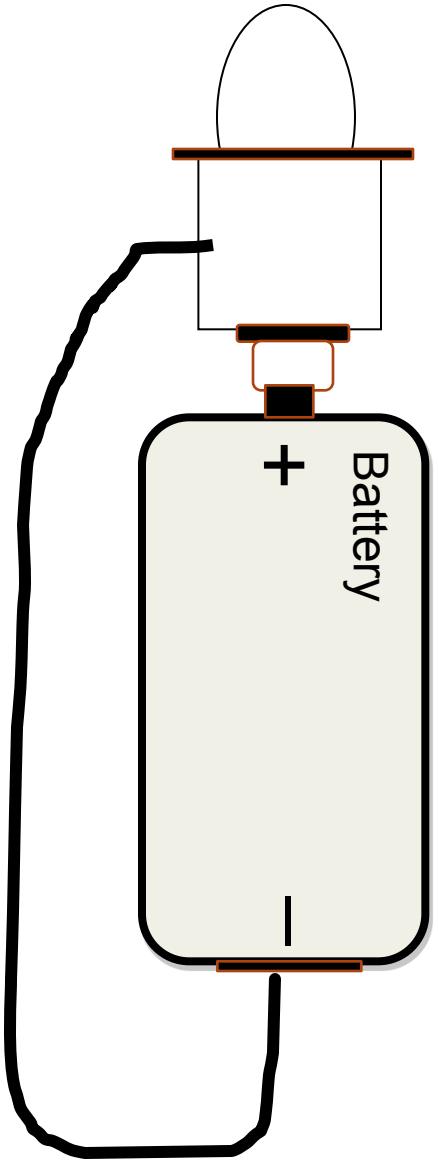
Open Circuit!!!

Complete Circuit

A Complete Circuit Must Have Three Things

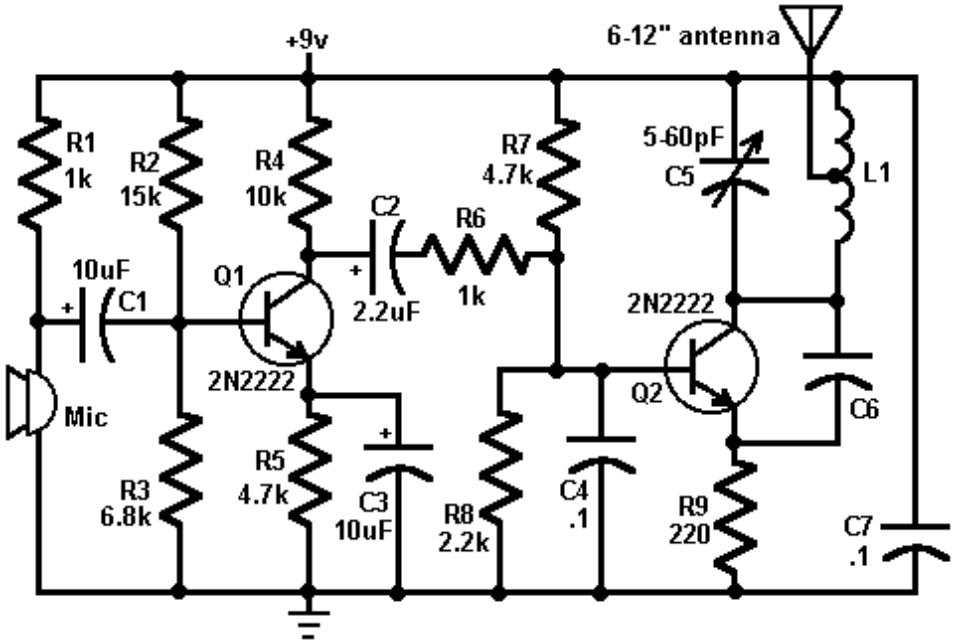
1. Voltage (Energy) Source = Battery
2. Load = Light Bulb
3. Complete path from – to + (Wires / Conductors)

- Note: Many times we also want a switch so we can easily turn the circuit on and off easily



Representing Circuits

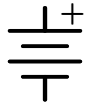
- Questions: What are some ways we could communicate to others how to put this circuit together?
- Answer: Draw a picture, take a picture, verbal description.
- When working with electronic circuits, engineers and technicians use symbols to represent the different components in a circuit. These symbols are called schematic symbols.



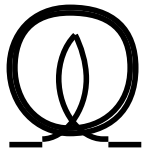
FM Wireless Microphone

Common Schematic Symbols

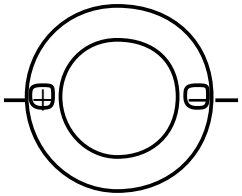
- Battery



- Light Bulb

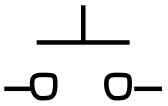


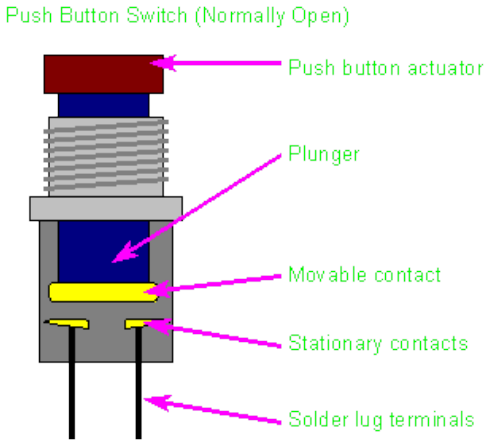
- Buzzer



Switches

- Normally Open





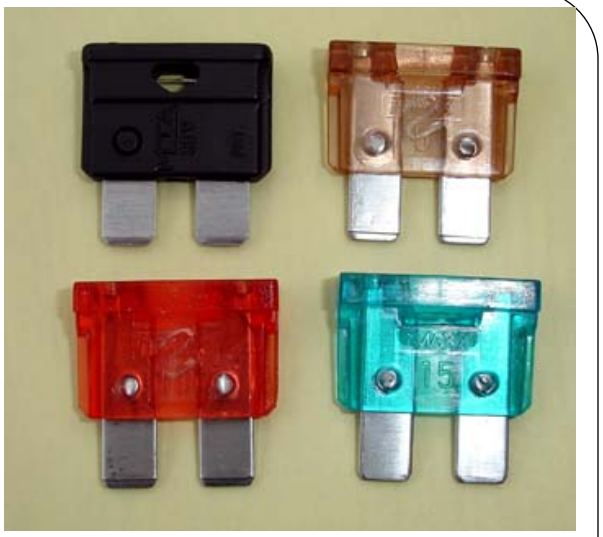
- Normally Closed

- SPST (Single Pole, Single Throw)

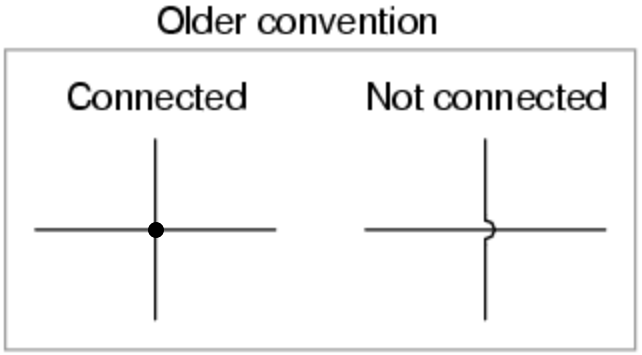
- SPDT (Single Pole, Double Throw)

General

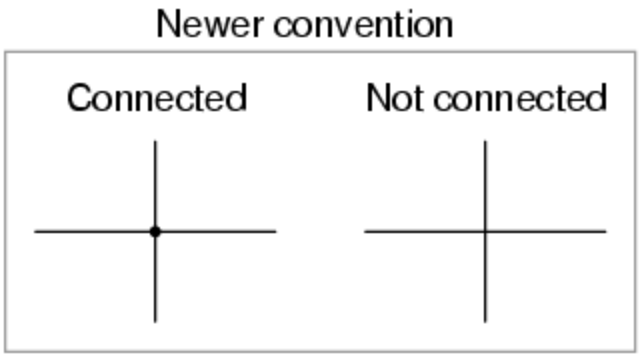
- Fuse



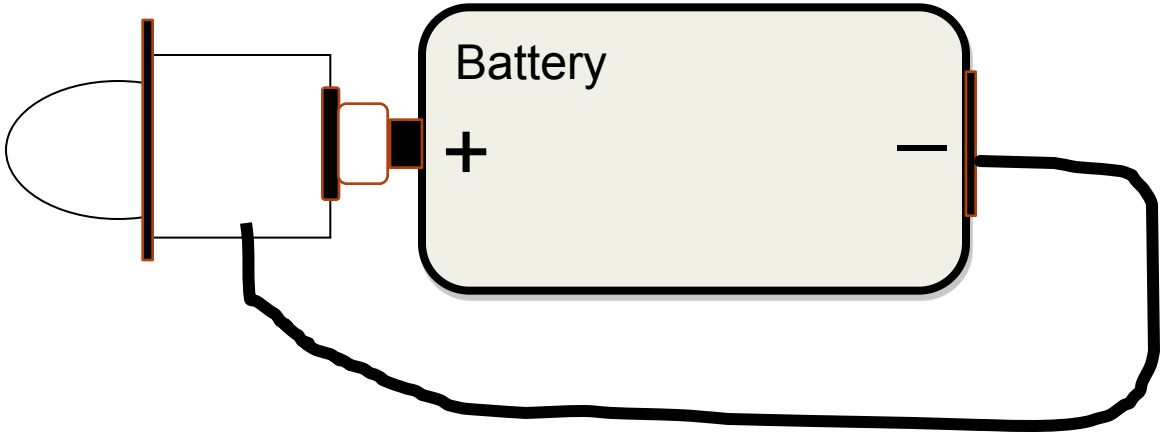
- Wire Crossing not connected

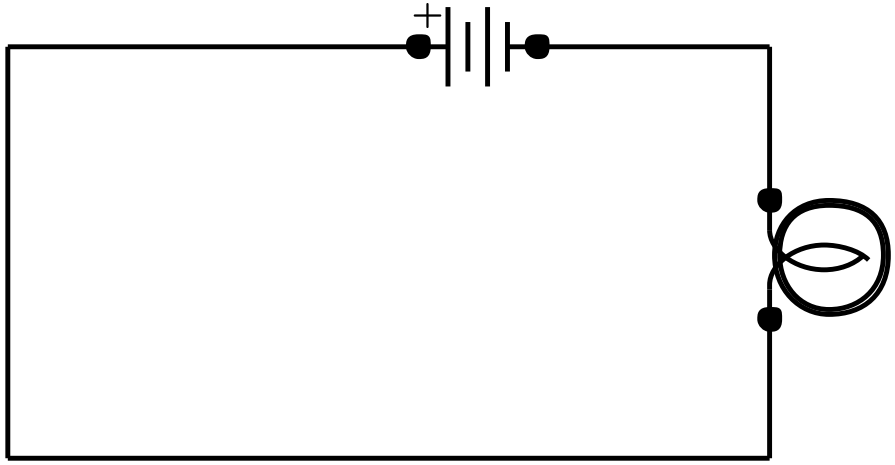


- Wires Crossing & Connected



The Circuit From Challenge #1



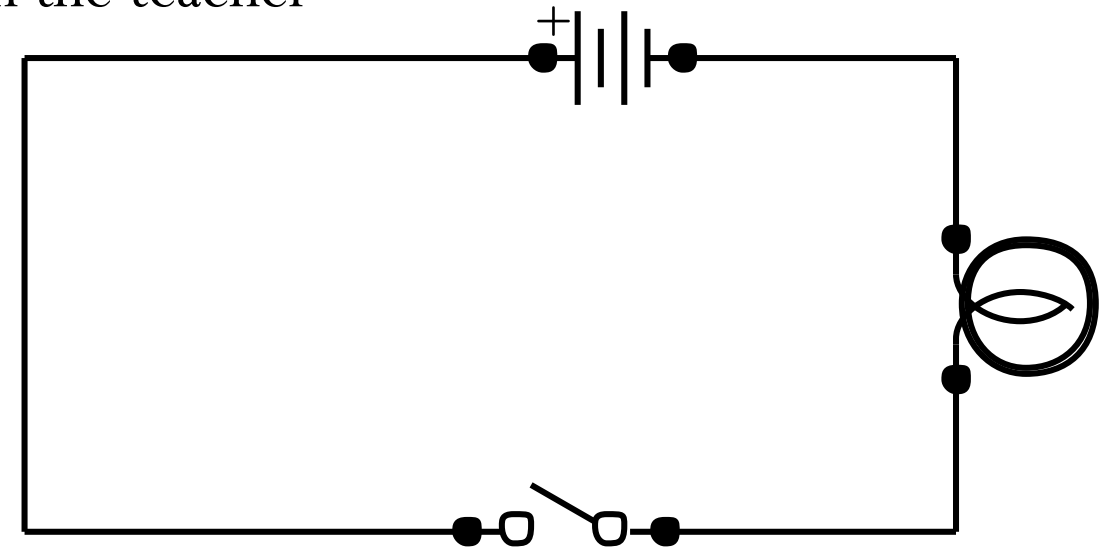


Note to teacher

- When teaching the following section you can use the ppt and formally take the students step by step through all the challenges….
- OR….What I recommend – informally make up/draw the challenges with the students as you go.
- Some challenges to consider
  - Add a switch
  - What would happen if we added another battery?
  - What would happen if we added another light in series?
  - Switch up the arrangement of the series circuit to see if this has an effect on the operation of the circuit? Does it matter where we put the components in series??
  - Switch the bulbs so they are in parallel – what happens?
  - What would happen if we added a buzzer to the circuit?
  - Will this same circuit (with buzzer) work in series? Let's try it?
- Note: try to present the material in such a way that they just see relationships and you don't have to explain Ohm's law at this time – save that for later.

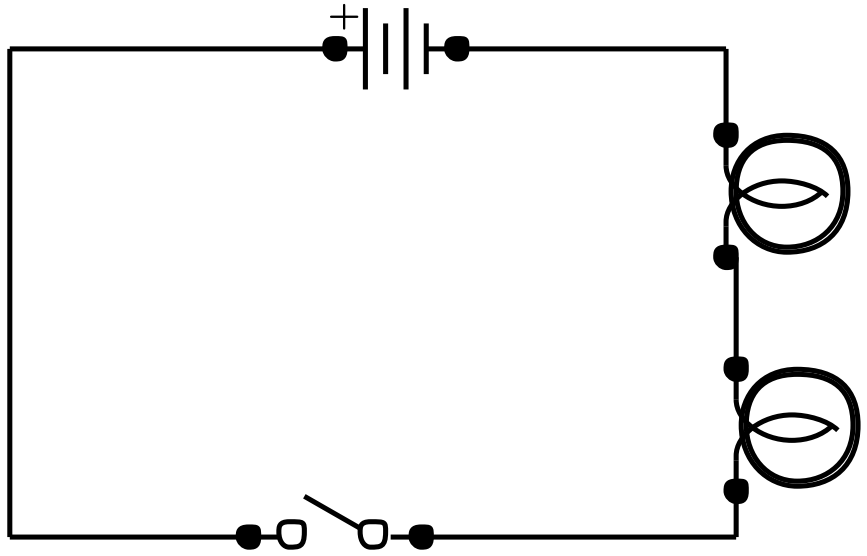
Challenge #2

- Draw the circuit in your notebook
- Tell me what you think will happen in this circuit when the switch is closed: Will the bulb light up?
- Have one person from your group get the components needed.
- Build the circuit
- Check off with the teacher



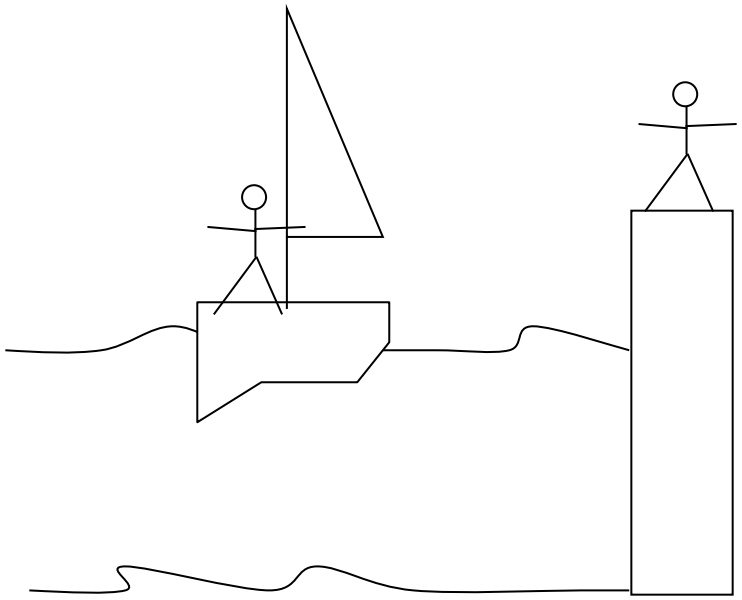
Challenge #3

- Draw the circuit in your notebook
- Tell me what you think will happen in this circuit when the switch is closed: Compared to Challenge #2, will the bulbs be brighter, less bright, remain the same?
- Have one person from your group get the components needed.
- Build the circuit
- Check off with the teacher



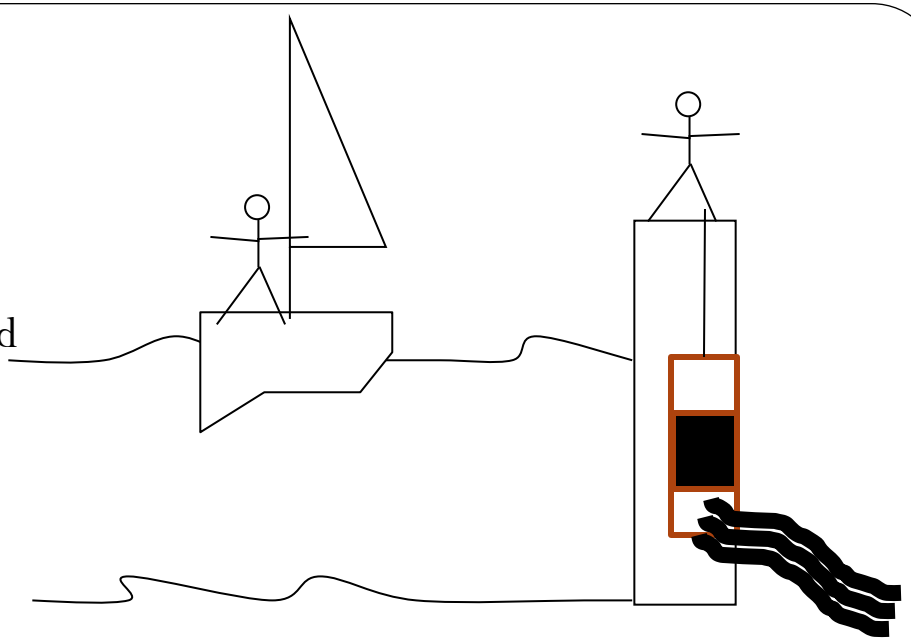
Ohm's Law

Term	Description	Symbol	Unit of Meas.	Symbol
Charge	Quantity of Accumulated Electrons	Q	Coulombs	C
Voltage	Electromotive Force	E/V	Volts	V
Current	Rate of Electron Flow	I	Amps	A
Resistance	Opposition to Electron Flow	R	Ohms	Ω



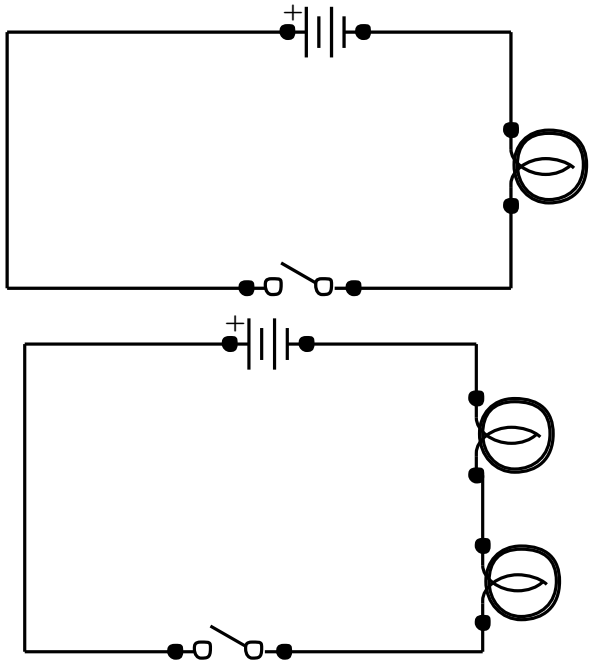
Ohm's Law

The amount of water (current) that will flow Through the dam is determined by the force (height of the water) and how much we have opened the floodgates (resistance) of the dam.



$$I = \frac{V}{R}$$

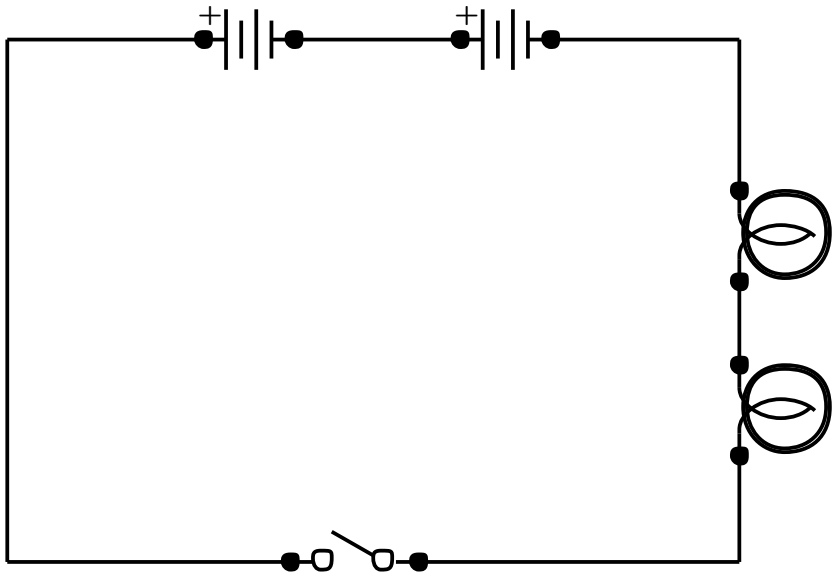
$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$



The amount of current that will flow in a circuit is determined by the force (voltage of the battery) and the resistance of the loads (light bulbs).
Since we have increased the bulbs from one to two, we have increased the resistance. Less current will thus flow and the bulbs are not as bright

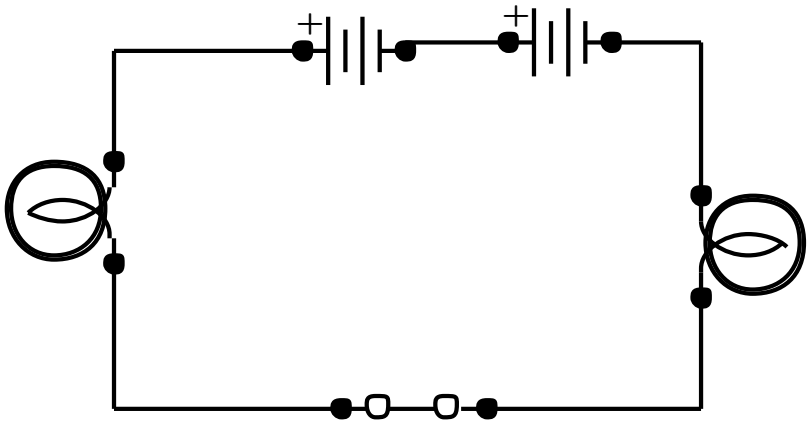
Challenge #4

- Draw the circuit in your notebook
- Notice the polarities of the battery
- What do you think will happen in this circuit when the switch is closed?
  - Will the bulbs be brighter, less bright, remain the same?
  - Compare to Challenge #3
- Have one person from your group get the additional component needed.
- Build the circuit
- Check off with the teacher

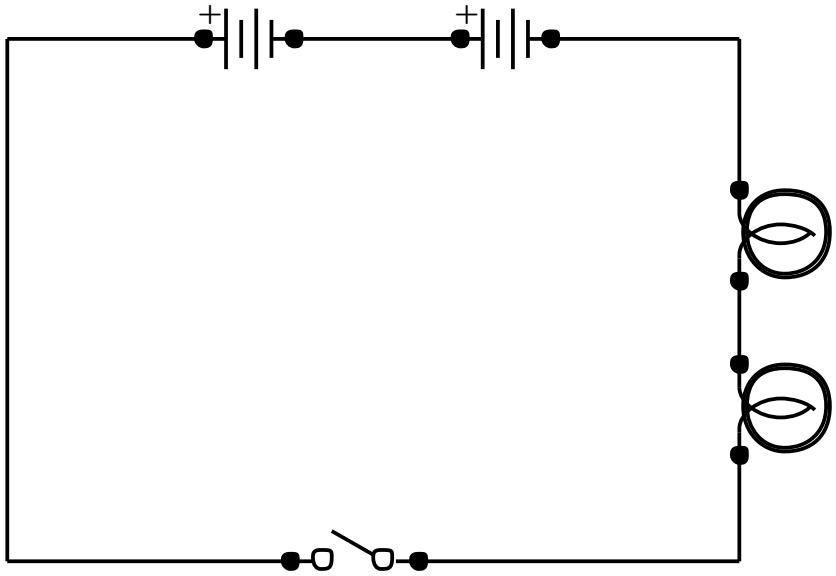


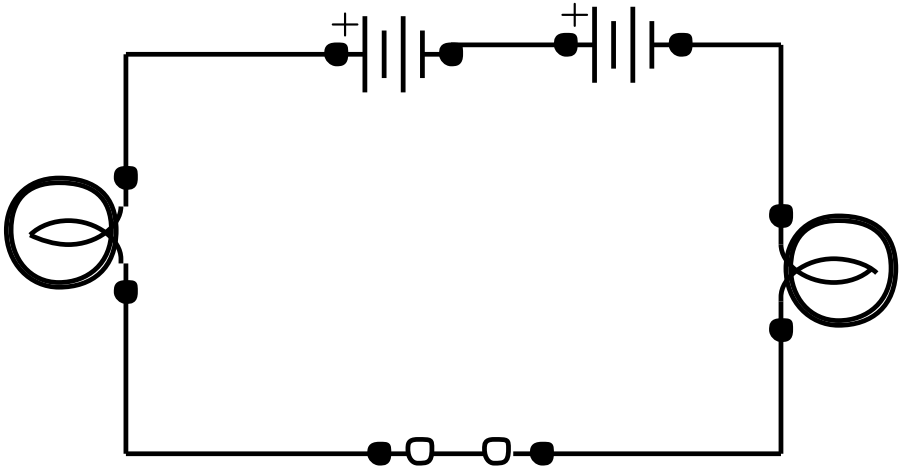
Challenge #5

- Draw the circuit in your notebook
- Notice the polarities of the battery
- What do you think will happen in this circuit?
  - Will the bulbs be brighter, less bright, remain the same?
  - Compare to Challenge #4
- Build the circuit
- Check off with the teacher



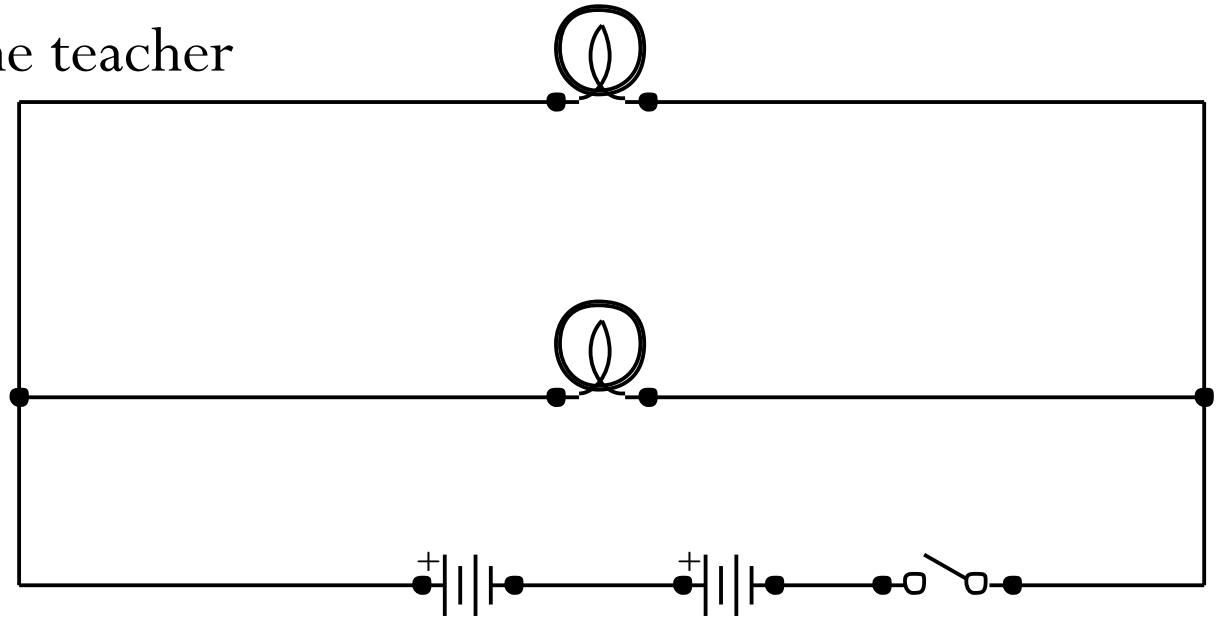
These circuits are the same: Both are called series circuits





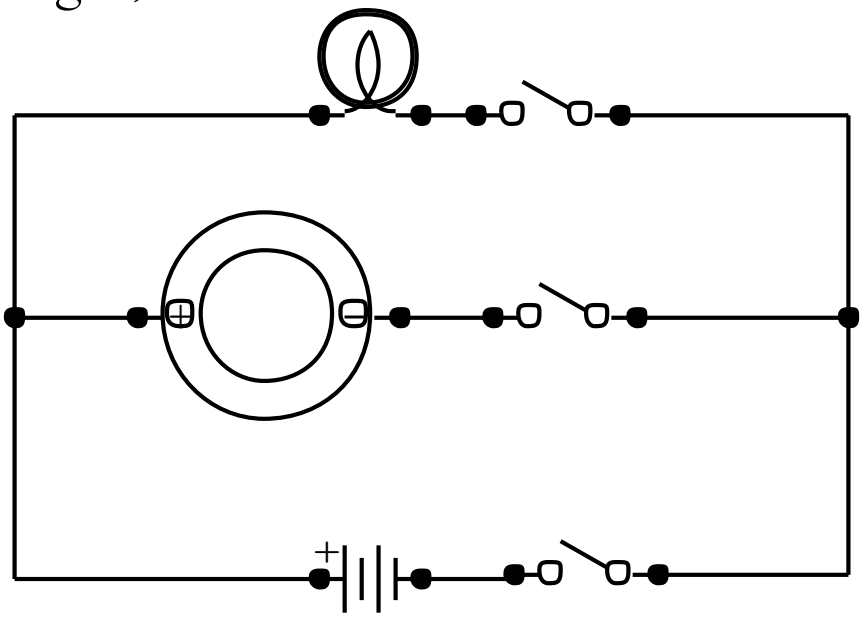
Challenge 6

- Draw the circuit in your notebook
- Notice the polarities of the battery
- What do you think will happen in this circuit when the switch is closed?
  - Will the bulbs be brighter, less bright, remain the same?
  - Compare to Challenge #5
- Build the circuit
- Check off with the teacher



Challenge #7

- Draw the circuit in your notebook
- Notice the polarity of the buzzer
- What do you think will happen in this circuit as we close the various switches?
  - Will the bulb be brighter, less bright, remain the same?
  - Will the buzzer work?
- Build the circuit
- Check off with the teacher

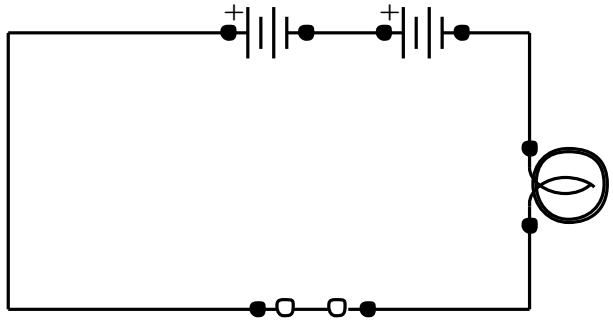


- What do you think would happen if we put the buzzer and light bulb in series??? Try It!!

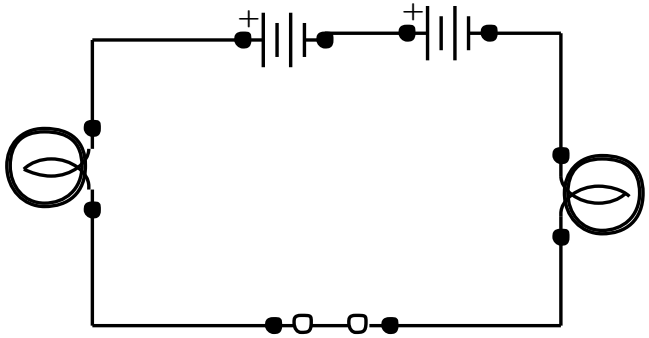
Checking For Understanding

- For the following circuits, determine:
  1. If the bulb(s) will light
  2. If the bulbs will be dim, average brightness, or very bright.

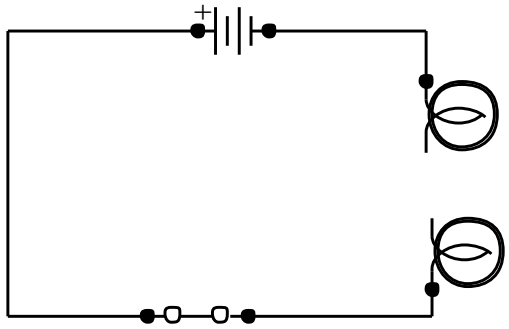
A)



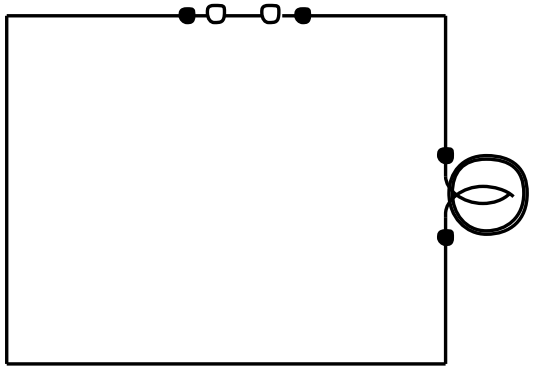
B)



C)



D)



Checking For Understanding

- For the following circuits, determine:
  1. If the bulb(s) will light
  2. If the bulbs will be dim, not light or be bright

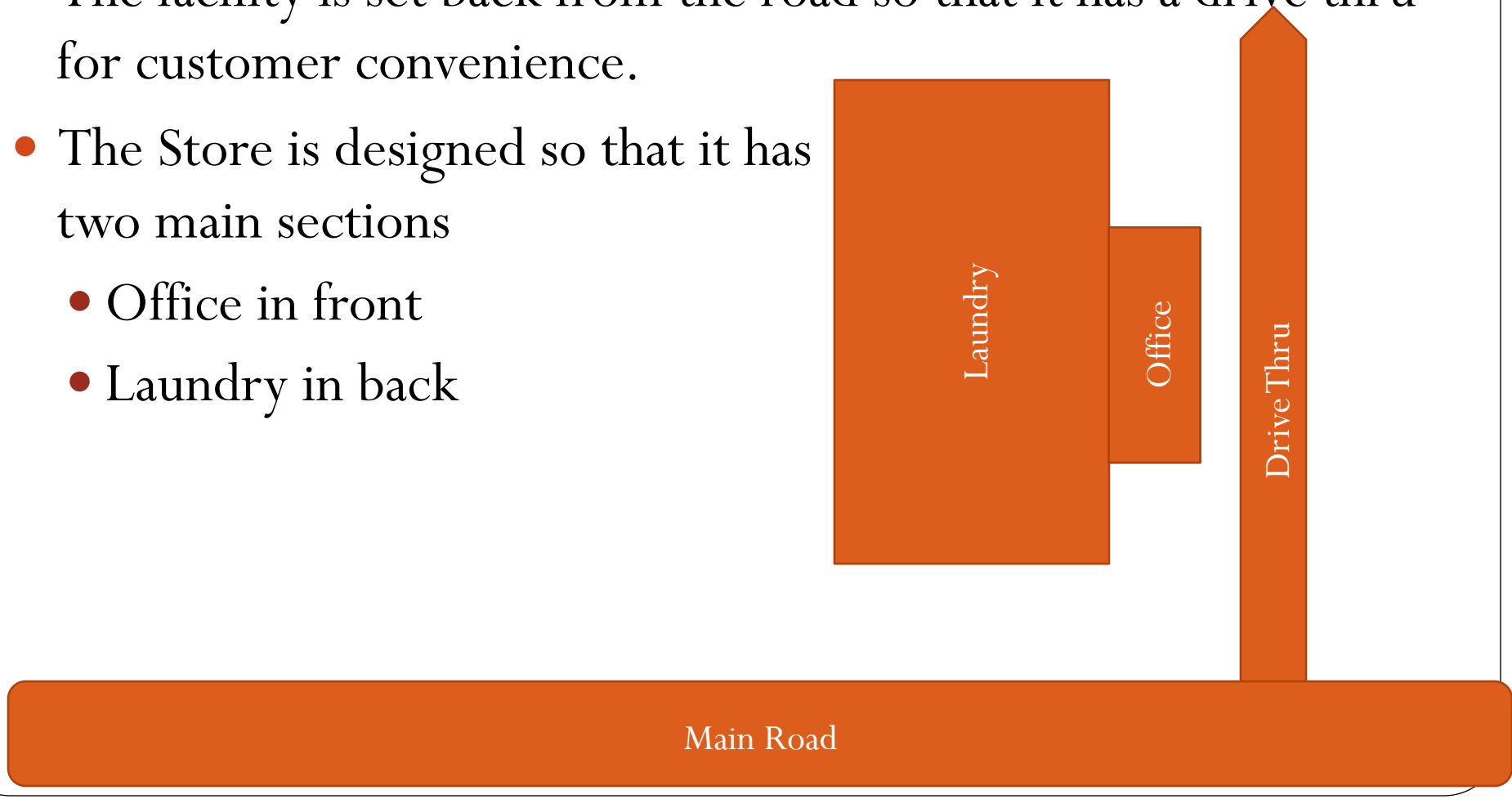
A)

B)

C)

Design Challenge: Situation

- The "Drive Thru Family Laundry" is along a busy road.
- The facility is set back from the road so that it has a drive thru for customer convenience.
- The Store is designed so that it has two main sections
  - Office in front
  - Laundry in back



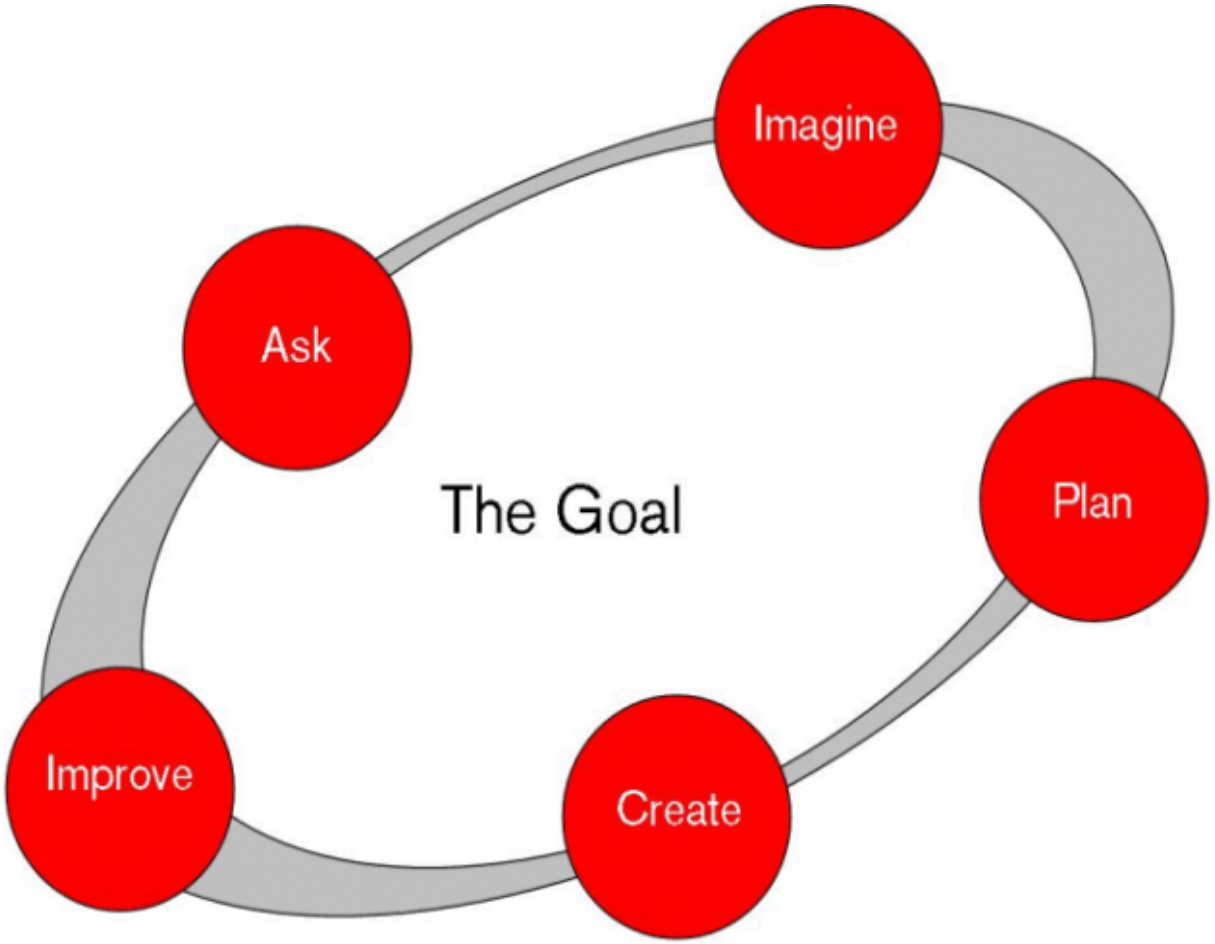
Design Challenge: Problems

- Sometimes only one person is working in the store.
- The laundry is noisy and it is sometimes difficult for workers to hear / see when customers arrive.
- Several customers have complained lately because they pull up to the drive thru and they have to wait because the workers do not know they are there.
- Workers have complained because they are busy and have to hurry back and forth between the laundry and office to see if customers are waiting.

Design Challenge

- Using the materials provided, design an alarm system that will alert the workers when someone drives up to the store
- Materials
  - Lights
  - Buzzer
  - Motor
  - Wires
  - Batteries
  - Various conductors and insulators
  - Construction Materials
    - Cardboard, paper, tape

Engineering Design Cycle:
Boston Museum of Science



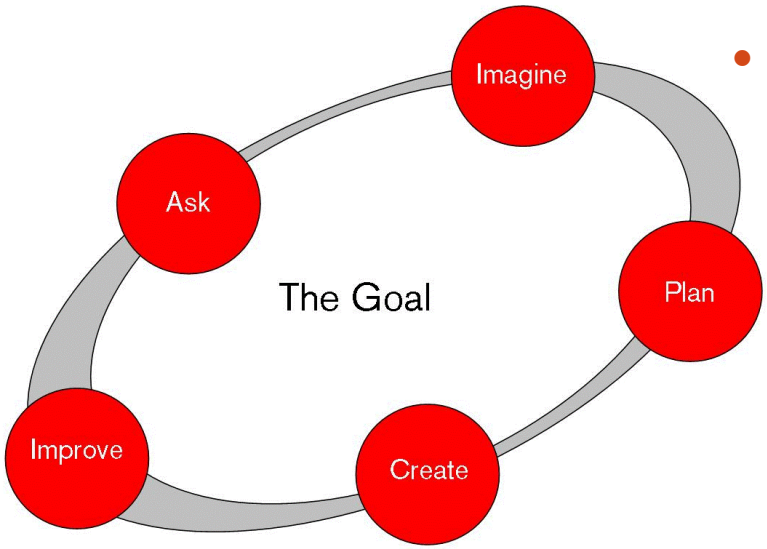
Procedure

1. Put students in groups of two or three;
2. On paper design a circuit that will activate the alarm when the someone drives up to the business.
   - Create a pictorial diagram of your switch including a materials list.
   - Draw your schematic diagram, plan and create a materials list of the parts needed to build the circuit.
3. Have the teacher check your circuit and your switch to make sure that your design is safe.
4. Build and test the alarm circuit to make sure it works!
5. Make any improvements to your design you want to make. Note: If you make improvements to your circuit, then make sure you change your schematic and materials list.
6. Next, take apart your circuit so that nothing is connected.
7. Build the store (office & laundry) but don't wire it yet.

Engineering Design Process: Electronic Circuits - Alarm Lab

- **ASK:**
  - What is the problem?
  - What can I do to sense when someone drives up to the store
  - What type of circuit will I need for the alarm to be activated
  - What makes a circuit complete.
  - Should I use series or parallel or both?
  - What other types of alarms am I familiar with?
  - Do we want to use both a light and a buzzer?
  - What type of switch can I use?
  - What are the constraints?
  - What materials do I have?
  - What is the cost?
  - Is my circuit safe?
  - Is there a size limitation?

Museum of Science
BOSTON



- **IMAGINE:**
  - What are some possible solutions?
  - Brainstorm ideas.
  - Choose the one you think is best.
- **PLAN:**
  - Draw a schematic diagram,
  - Make lists of materials you will need.
- **CREATE:**
  - Follow your plan and create it,
  - Test it out!
- **IMPROVE:**
  - Talk about what works, what doesn't, and what could work better,
  - Modify your design to make it better, test it out!

Procedures: Continued

- Give your components and the schematic drawings with the parts list to another group.
- If you have documented your work really well then the other groups should be able to build your alarm circuit.