Electricity & Electronics Merit Badge

Class 1

emeritbadges.org

Name _____

IEEE

CLASS 1 – What is Covered

1. Careers.
2. Basic electronics/electricity tools.
3. Safety and electronics/electricity.
4. Voltage and Current and Power
5. You will build and/or try:
    a. Switches, lights, buzzers, leds.
    b. Draw a circuit to turn on light.
    c. Build circuit with circuit box.
6. You can get these slides from the Internet at http://www.emeritbadges.org/

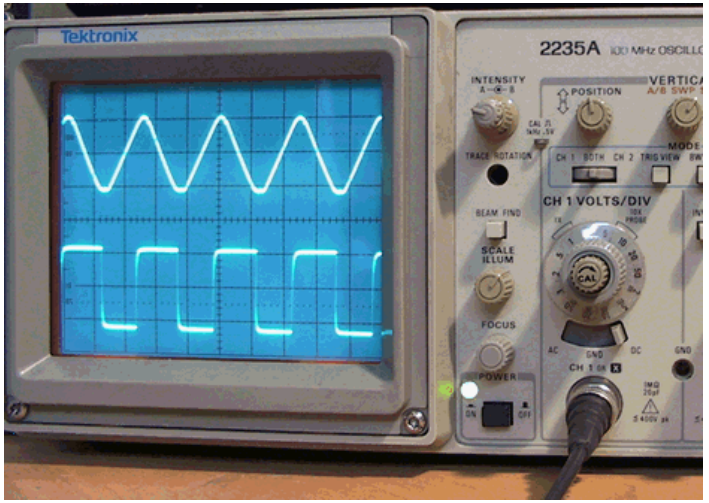
Equipment Used

Volt/Ohm/Amp Meter

Usually referred to as meter.
With this we can measure current, voltage and resistance.

Oscilloscope

Usually referred to as scope.
With this we can ‘see’ voltages.
This is very useful when voltage is changing, as a meter is no good to us when this is happening.



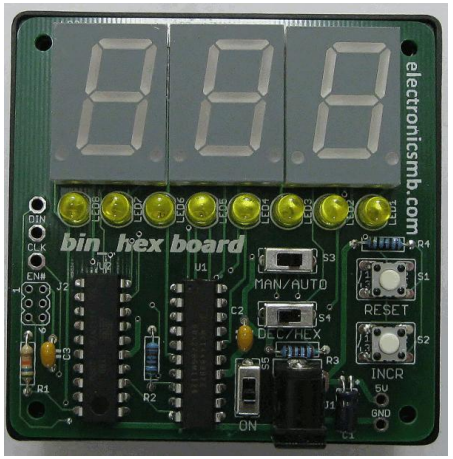
Computer

Computers are used heavily for research, for drawing schematics, for writing programs, for assisting in fixing broken circuits, etc…

Frequency Generator

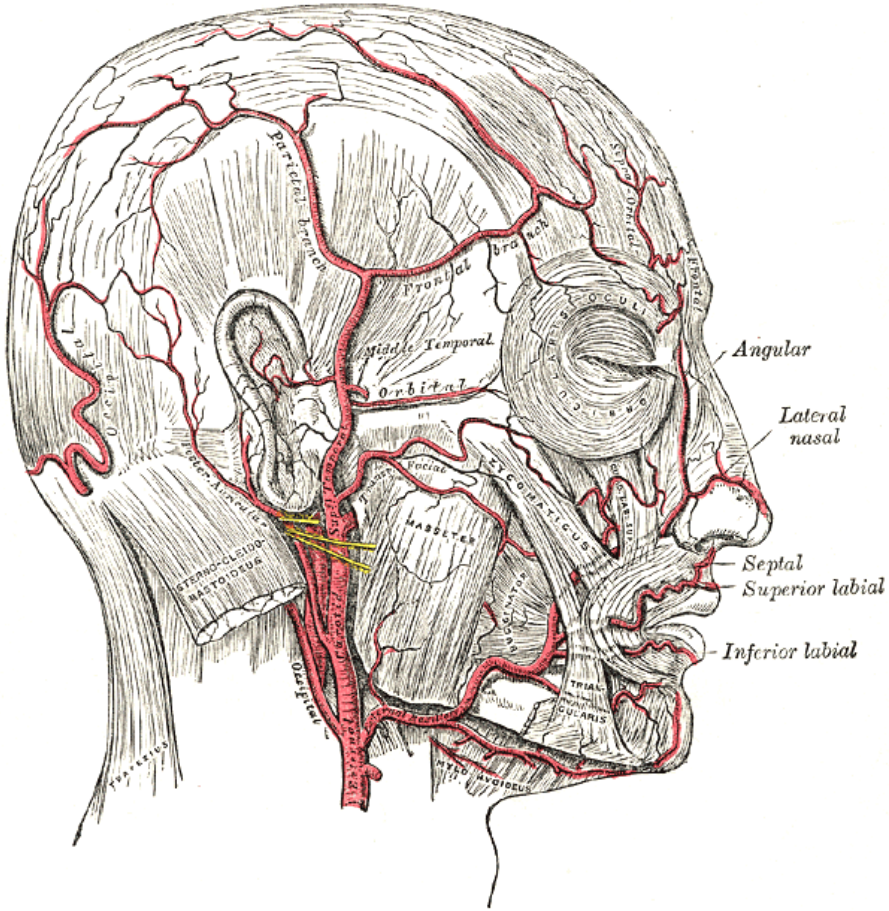
Frequency Counter

Circuit Boards



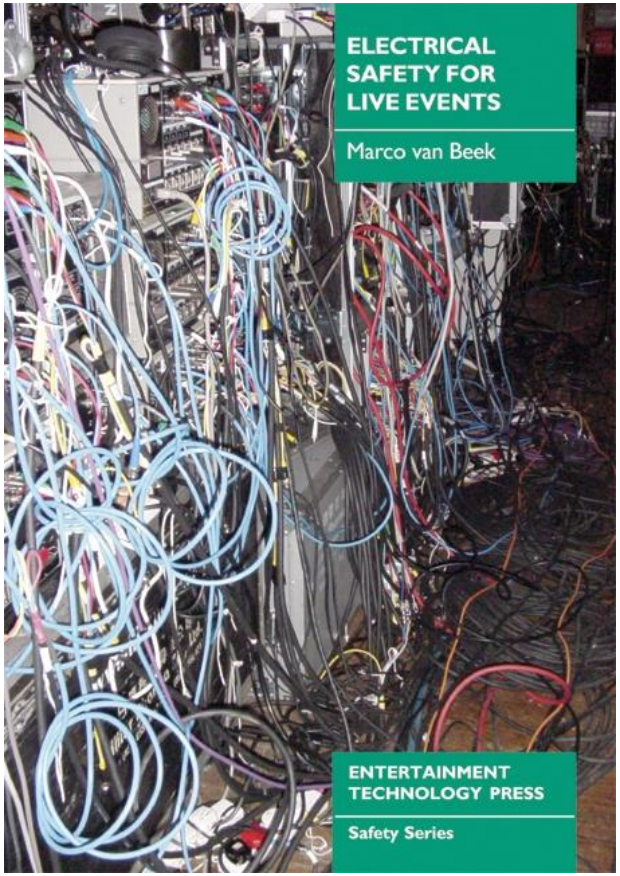
Two of the most important kinds of equipment

Your Brain



A brain assistant.

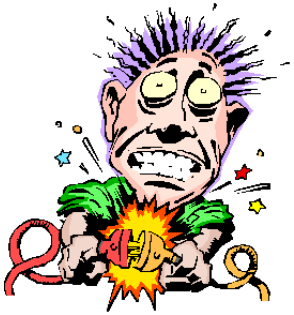
Safety with Electricity and Electronics



Electricity Safety

- High Voltage (<u>120V AC or greater</u>) – Safety mainly about not touching the wrong thing.

- <u>Current kills</u> – Only 16 volts can kill when current flows through heart or head.
- Ventricular fibrillation - Current passing through heart causes muscles to seize, causing death.
- If the shock doesn't kill you, you can still be badly burned from touching the wrong thing.



How to avoid shock.

- Turn power off before working on equipment.
- Don’t touch circuits that could have high voltage on them.
- Do not allow current to flow through heart (or maybe mouth, in this case).

Electronics Safety

- Electronics generally uses lower voltages (less than 48 volts). You are usually working with DC battery voltage instead of AC line voltage.
- You are usually more concerned with sparks from connecting wrong wires together, or burning yourself with a soldering iron, or some similar event.
- Even when working with lower voltages, you may still receive an electrical shock from equipment you are using, especially when they are plugged into a high voltage outlet.

Personal Safety

- Be aware of what you are doing, and where you are placing equipment and yourself.
- Pay attention to hot soldering irons. Keep a good distance between you those next to you.
- Know when you are working with high current and/or high voltage circuits.
- THINK before you do something.
- <u>Wear safety glasses when soldering.</u>

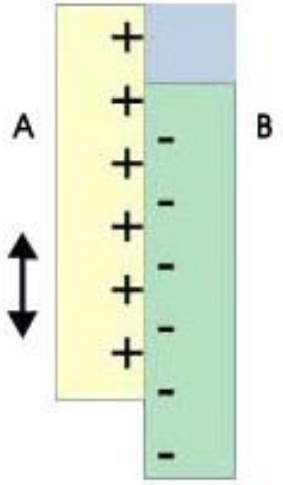
Types of Electricity

Static Electricity

Static electricity is usually created when materials are pulled apart or rubbed together, causing positive (+) charges to collect on one material and negative (−) charges on the other surface.. Sparks may result!

Examples of static electricity:

1. Lightning.
2. Combing hair.
3. Walking across carpet and getting shocked.
4. Pulling out scotch tape.

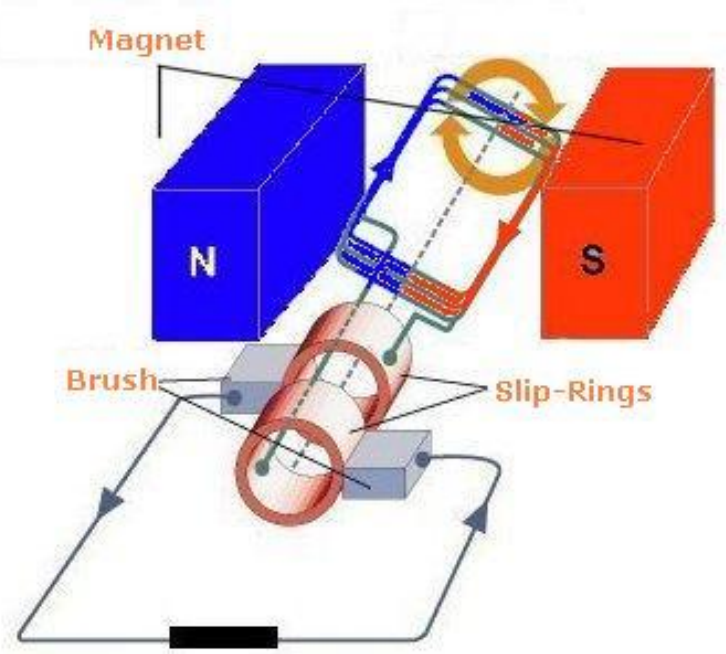


Generation Of Static Electric

Types of Electricity

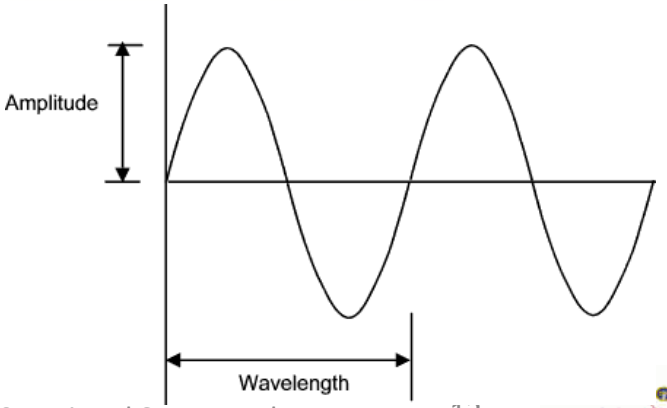
Alternating Current (AC)

The common form of electricity from power plant to home/office. Its direction is reversed 60 times per second in the U.S.; 50 times in Europe.



Examples of AC usage:

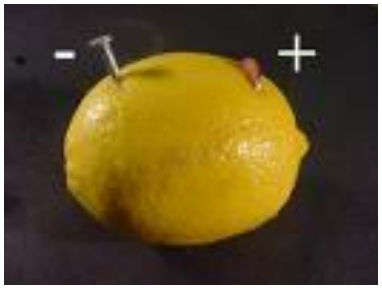
1. Kitchens: Stoves, ovens, mixer, etc.
2. Computers (the plug)
3. Lights in house
4. Home air conditioners.

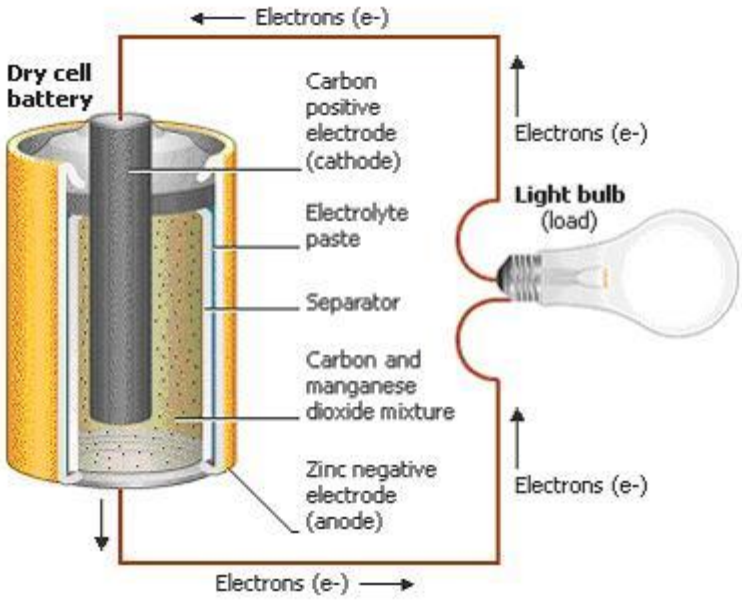


Types of Electricity

Direct Current (DC)

Type of electricity used in most, if not all electronics we have today.
Current only flows in one direction (not both directions, like AC).





Examples of DC usage:

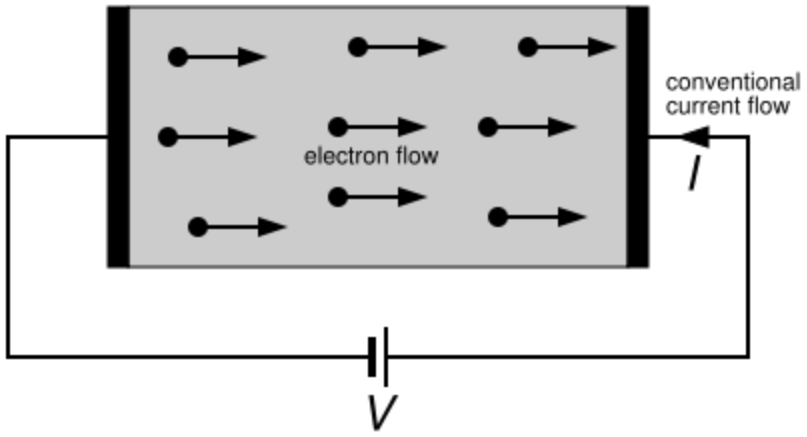
1. MP3 players
2. Radios
3. Electricity in cars.
4. Anywhere you use a battery for power.

Electrical Terms

- Current
  - It does the work of spinning motors, lighting bulbs
  - It is measured in AMPS, abbreviated A
  - The symbol used in math is I (eye)
- Voltage
  - The pressure that pushes the current
  - It is measured in VOLTS, abbreviated V
  - The symbol in math is E

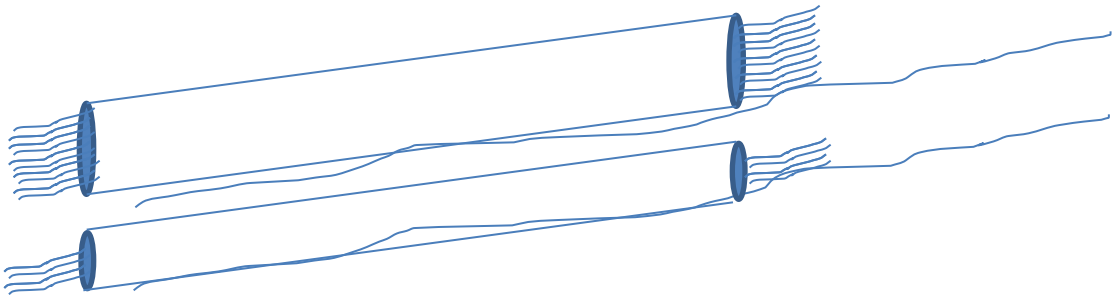
Basics of Electronics

- Current: Defined as "flow of electrons".



- Current: Units of current is AMPS.
- Current: Electrical symbol for current is I (eye).

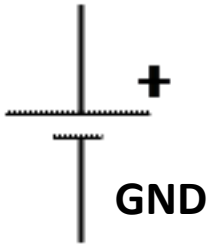
Current Flow – Water Analogy



1. Water flows in the hose, entering at the top and exiting the bottom.
2. The water is the “current” ; the flow of electrons.
3. The more water flowing in the pipe, the more current is flowing in the wire.
4. Different pipe diameters illustrates different resistance to water flow, which correlates to different resistor values.

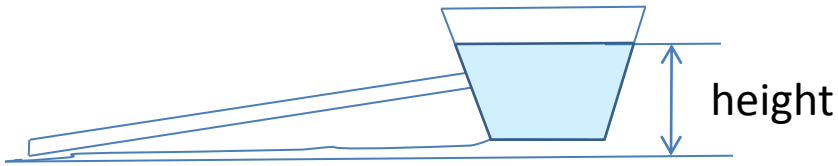
Voltage

- Volts is the electrical force that causes electrons (current) to flow.
- Voltage can also be thought of as the electrical pressure that pushes electrons in a wire.
- Units for voltage is VOLTS.
- The symbol for voltage is E.
- The schematic symbol for voltage is generally shown as a battery



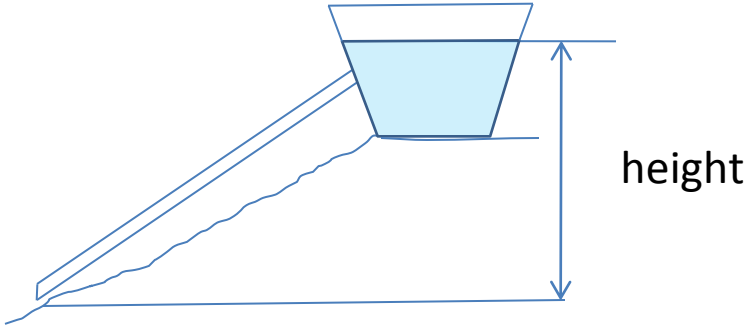
Voltage – Water Analogy

Small height = low voltage



1. Gravity provides the force for water (current) to flow.
2. This illustrates a small voltage, so current flow is small.
3. You can increase water (current) flow by making the pipe larger as well.

Big height = high voltage



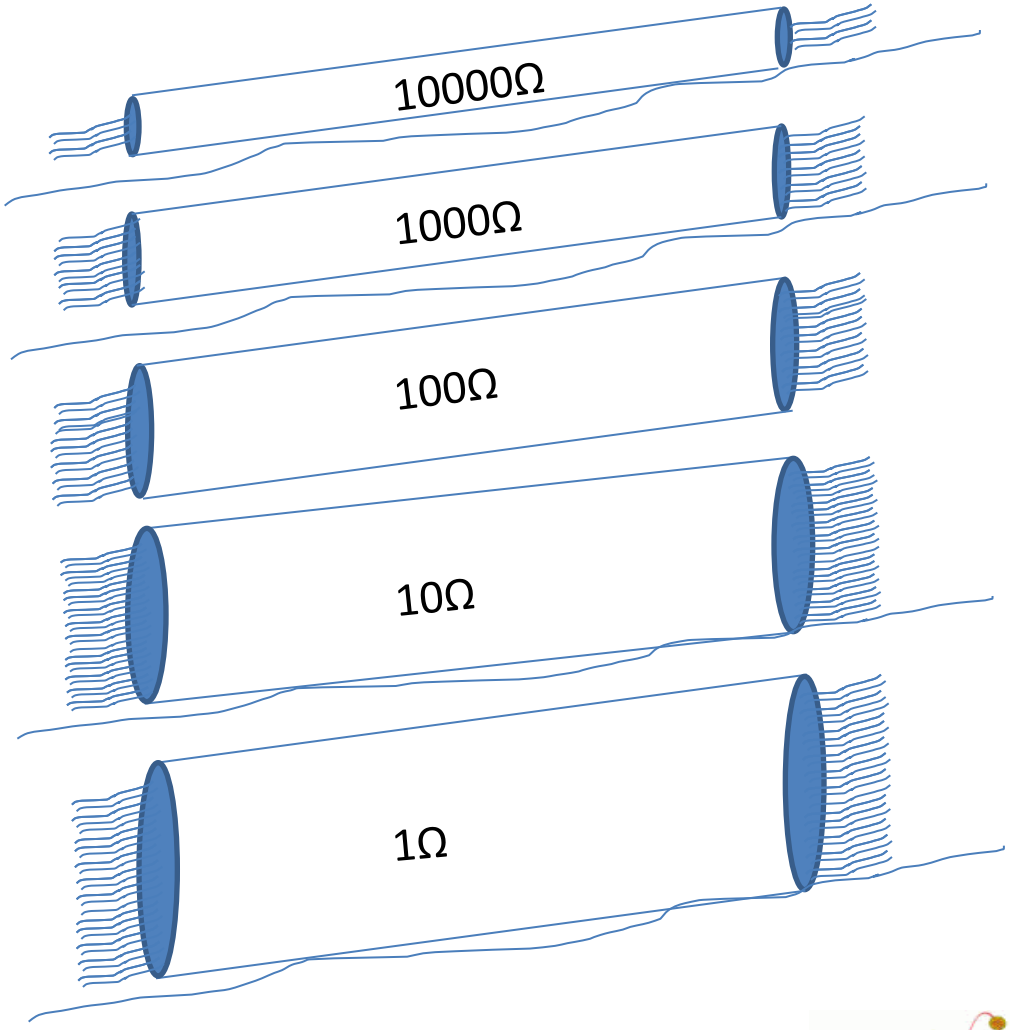
1. Gravity provides the force for water (current) to flow.
2. This illustrates a larger voltage, so current flow is larger.
3. You can increase water (current) flow by making the pipe larger as well.

Resistance

- Resistance is the electrical property of a substance to resist the flow of electrons.
- The units of resistance is OHMS (Ω).
- The symbol for resistance is R.
- The schematic symbol is 
- The larger the resistance, the more resistance to current flow.

Resistance – Water Analogy

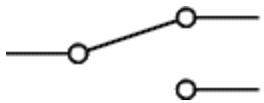
- Different pipe diameters represents different resistor values.
- The smaller the diameter of the pipe, the larger the resistance.



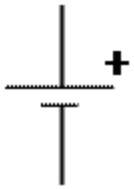
Ohms Law

- E = I x R : Volts = Current x Resistance
- Units
  - Volts is in volts
  - Current is in amps
  - Resistance is in ohms

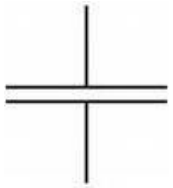
Electronic Symbols



Single Pole, Double Throw Switch (SPDT)

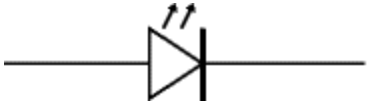


Battery

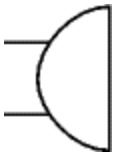


Capacitor

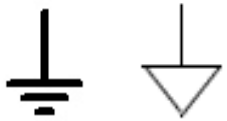
Resistor



Light Emitting Diode (LED)



Buzzer



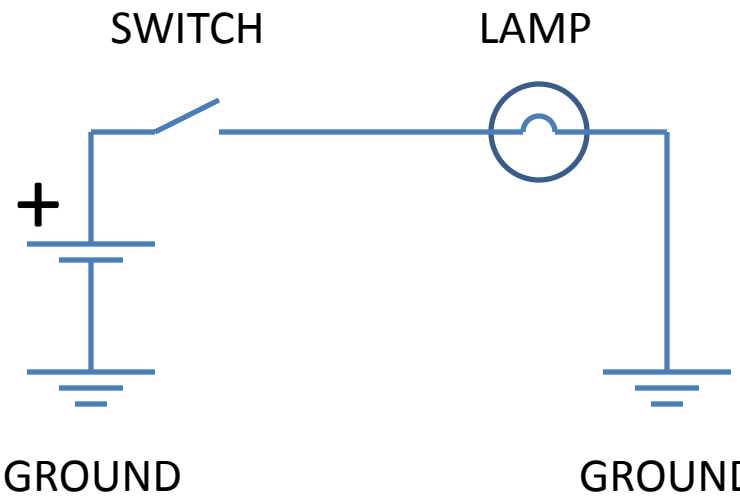
Ground

Fuse

Lamp

CIRCUIT DIAGRAM (SCHEMATIC)

FLASHLIGHT



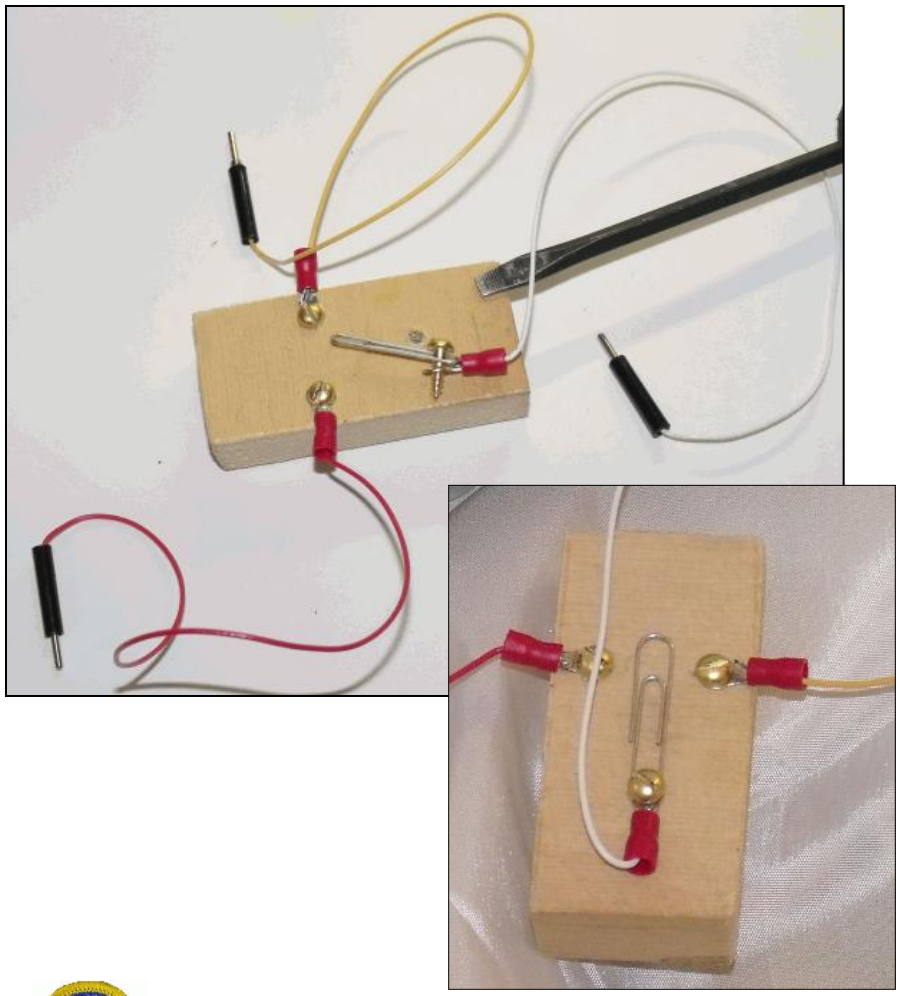
TWO GROUND SYMBOLS IS THE SAME AS CONNECTING WITH A WIRE

GROUND = 0 VOLTS

Put On The Safety Glasses

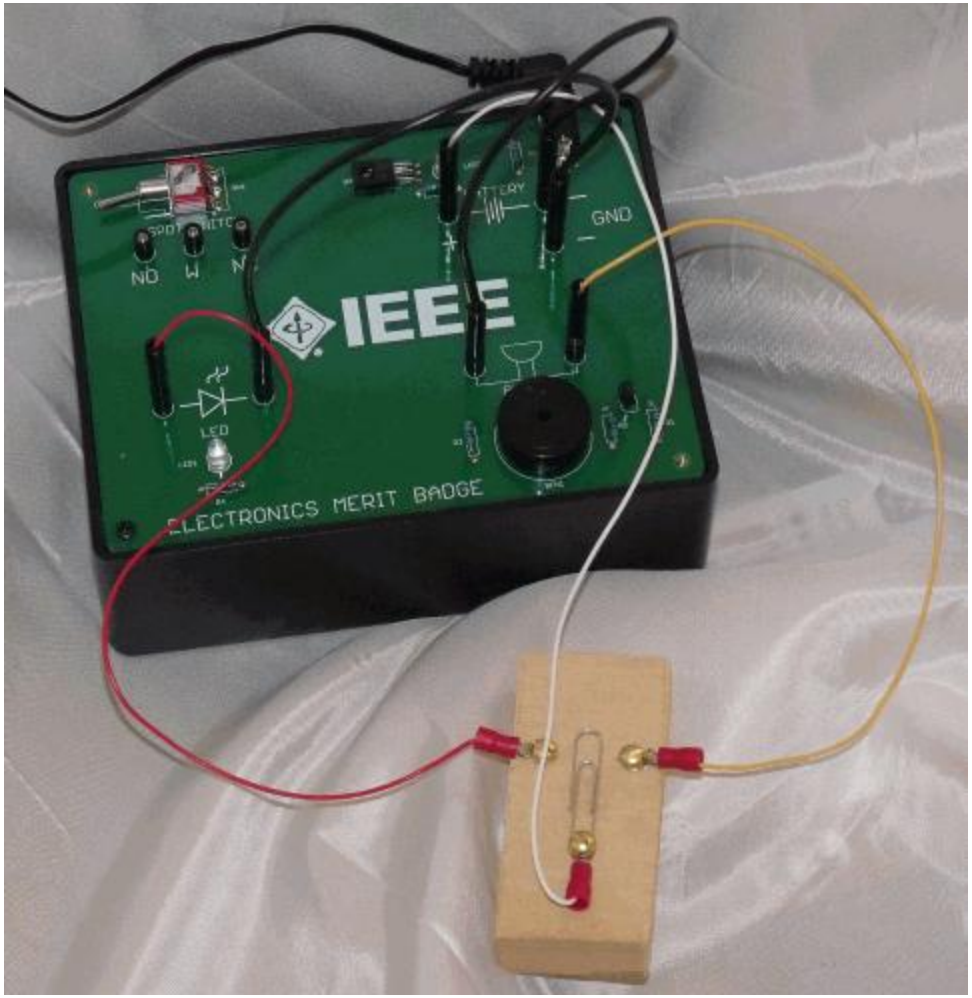
- You will be working with sharp, pointy objects
- We don't want you poking something into your eye.

Build SPDT Switch with a Paperclip



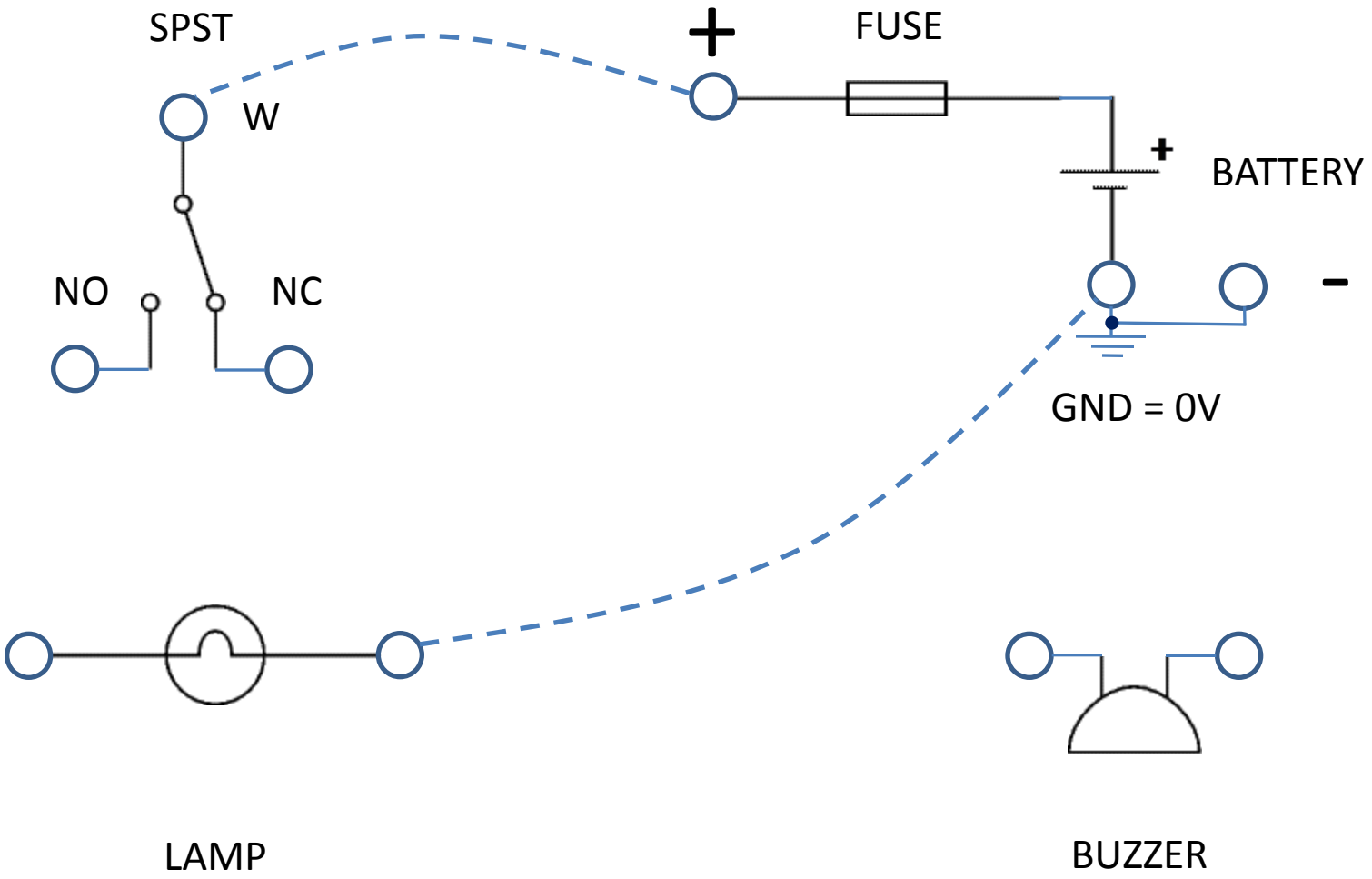
- Use brass screws, paperclip, wires to build switch
- Which color for which connection is not important
- SPDT means Single Pole Double Throw

Use Paperclip Switch in Next Diagrams



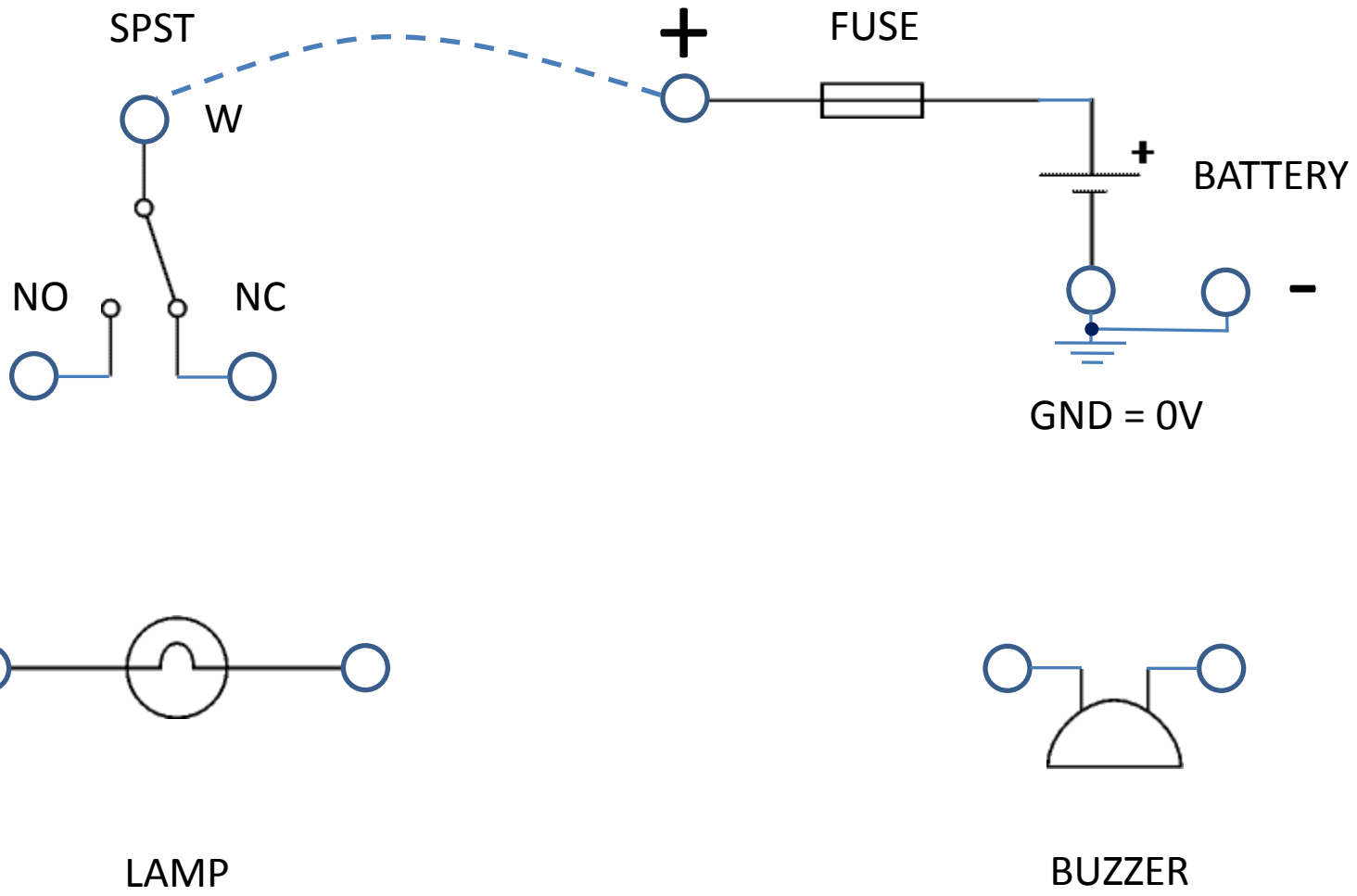
CIRCUIT CONNECTION BOX

Wire circuit to use switch to turn on lamp.



CIRCUIT CONNECTION BOX

Wire circuit to use switch to turn on lamp AND buzzer.



Now Use Factory-Made SPDT Switch