Electronics Merit Badge

Class 1

Engineering Jobs

Industries

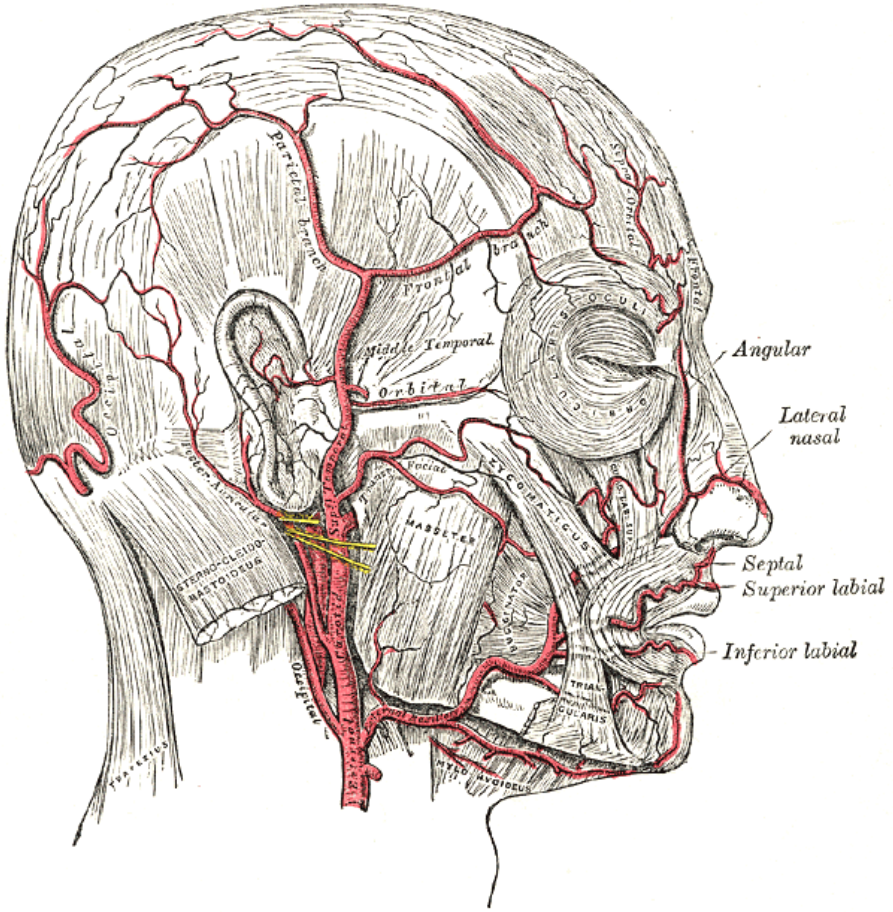
1. Semiconductors
2. Computers
3. Automotive
4. Aerospace
5. Entertainment
6. Robotics
7. Energy

Jobs in Engineering

1. ASIC Design Engineer
2. Digital Design Engineer
3. Electronic Design Engineer
4. CAD Engineer
5. Hardware Design Engineer
6. Test Engineer
7. Maintenance Technician
8. Electronics Technician
9. Field Service Engineer
10. Software Design Engineer
11. Application Design Engineer

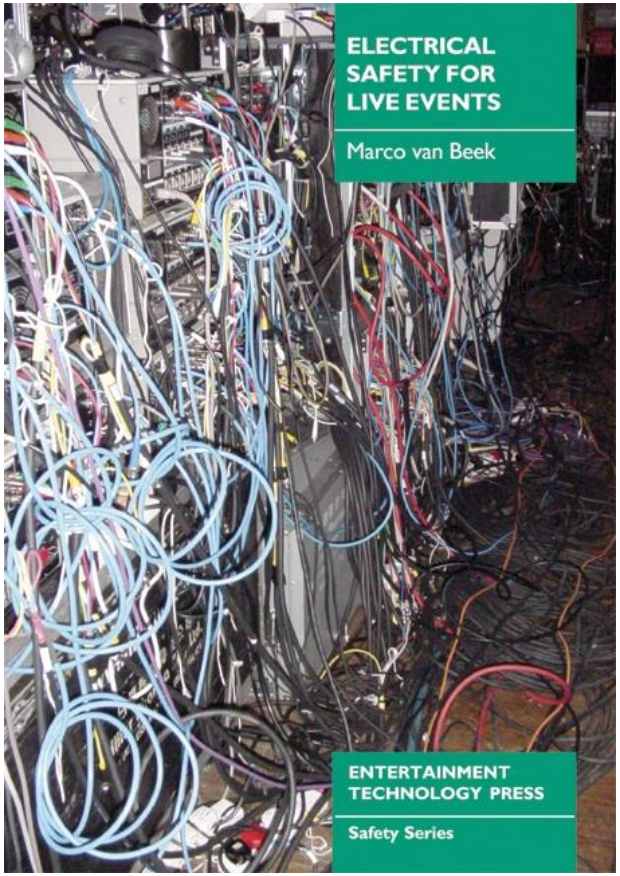
Engineering Education

Your Brain



A brain assistant.

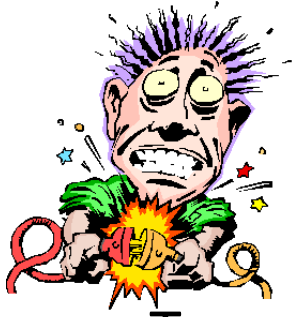
Safety with Electricity and Electronics



Electricity Safety

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

- Current kills – Only 16 volts can kill when enough electrons flow through the heart or head.
- Ventricular fibrillation – Electrons passing through the 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 electrons to flow through the heart. I don’t think the snake knew about this detail.

Electronics Safety

- Electronics generally uses lower voltages (less than 48 volts). You are usually working with DC voltage instead of AC voltage.
- You are usually more concerned with sparks from connecting the 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.

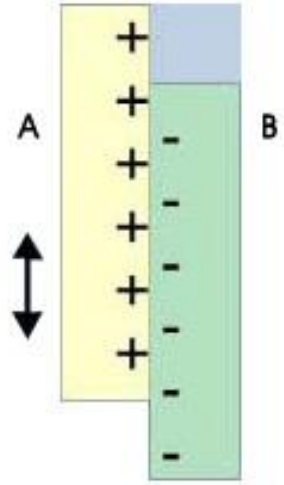
Personal Safety

- 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!



Generation Of Static Electric

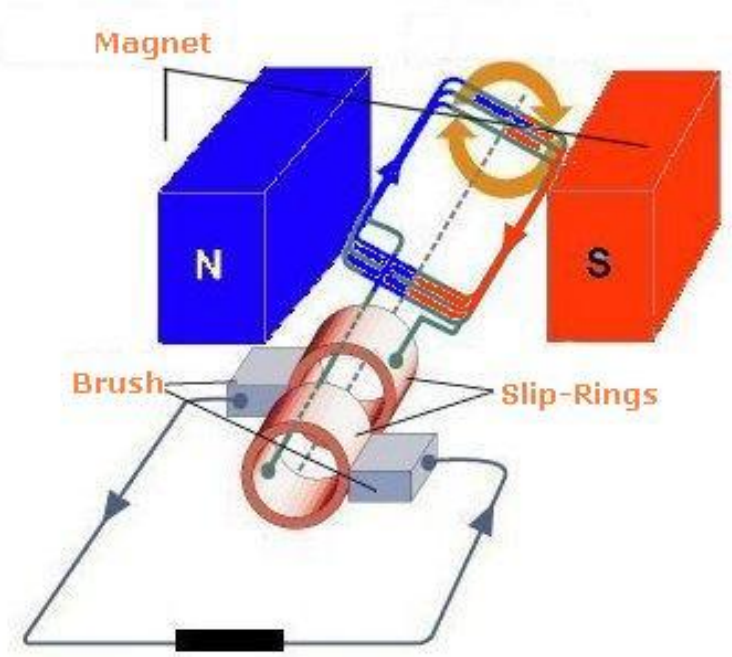
Examples of static electricity:

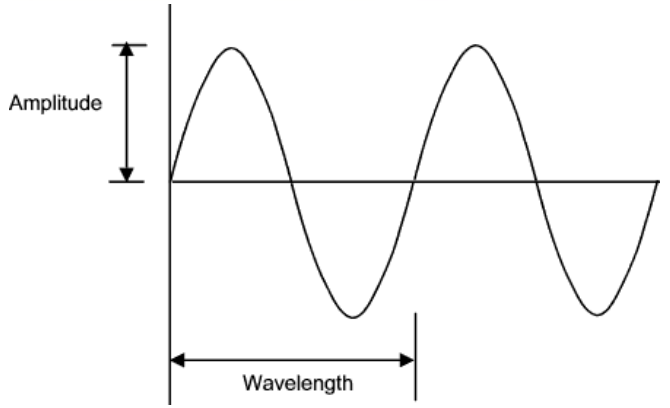
1. Lightning.
2. Combing hair.
3. Walking across carpet and getting shocked.
4. Pulling out scotch tape.

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.





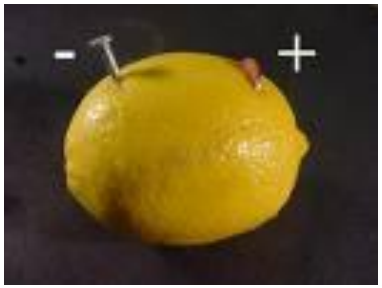
Examples of AC usage:

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

Types of Electricity

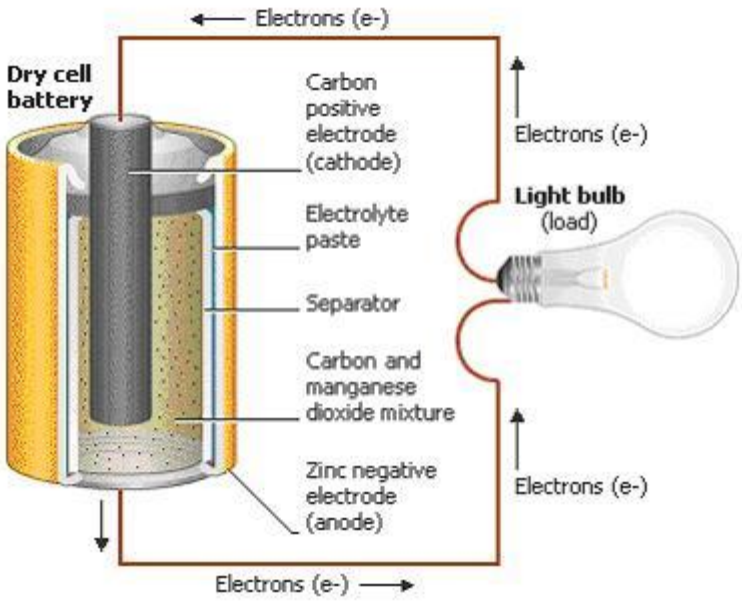
Direct Current (DC)

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



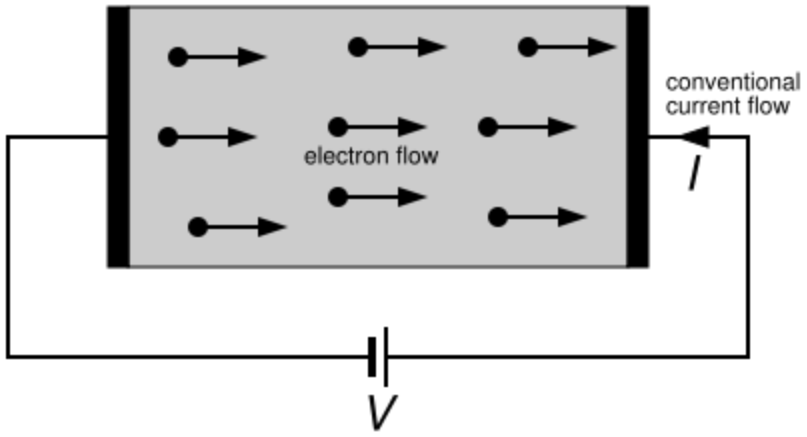
Examples of DC usage:

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



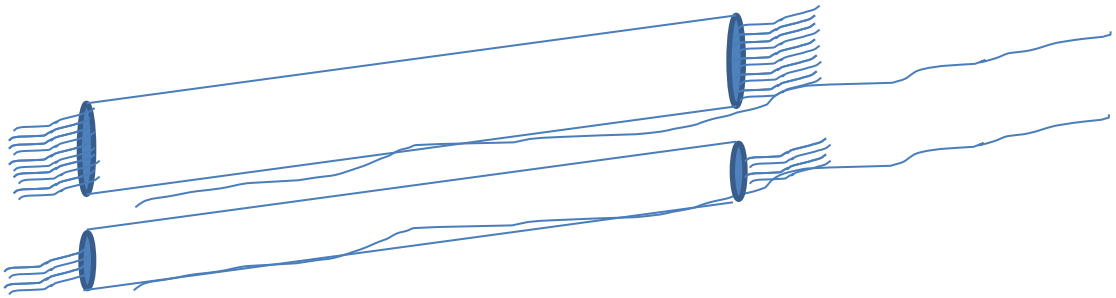
Basics of Electronics

- Current: Defined as "flow of electrons".



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

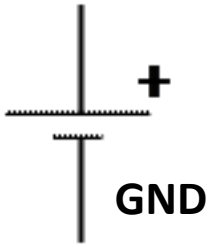
Current Flow – Water Analogy



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 electrons are flowing in the wire.
4. Different pipe diameters illustrates different resistance to water flow, which correlates to different resistor values.

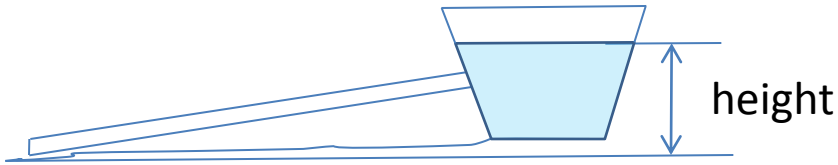
Voltage

- 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



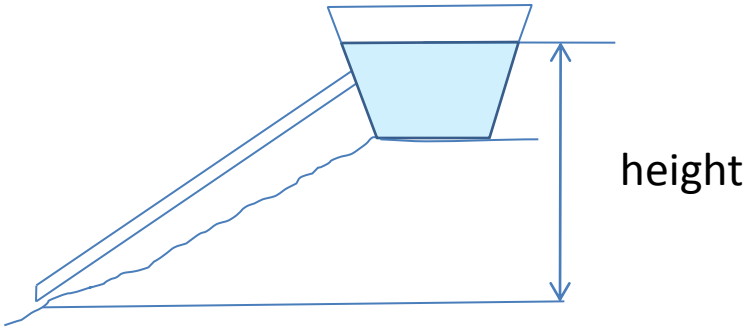
Voltage – Water Analogy

Small height = low voltage



1. Gravity provides the force for water (current) to flow.
2. This illustrates a small voltage, so electron flow is small.

Big height = high voltage



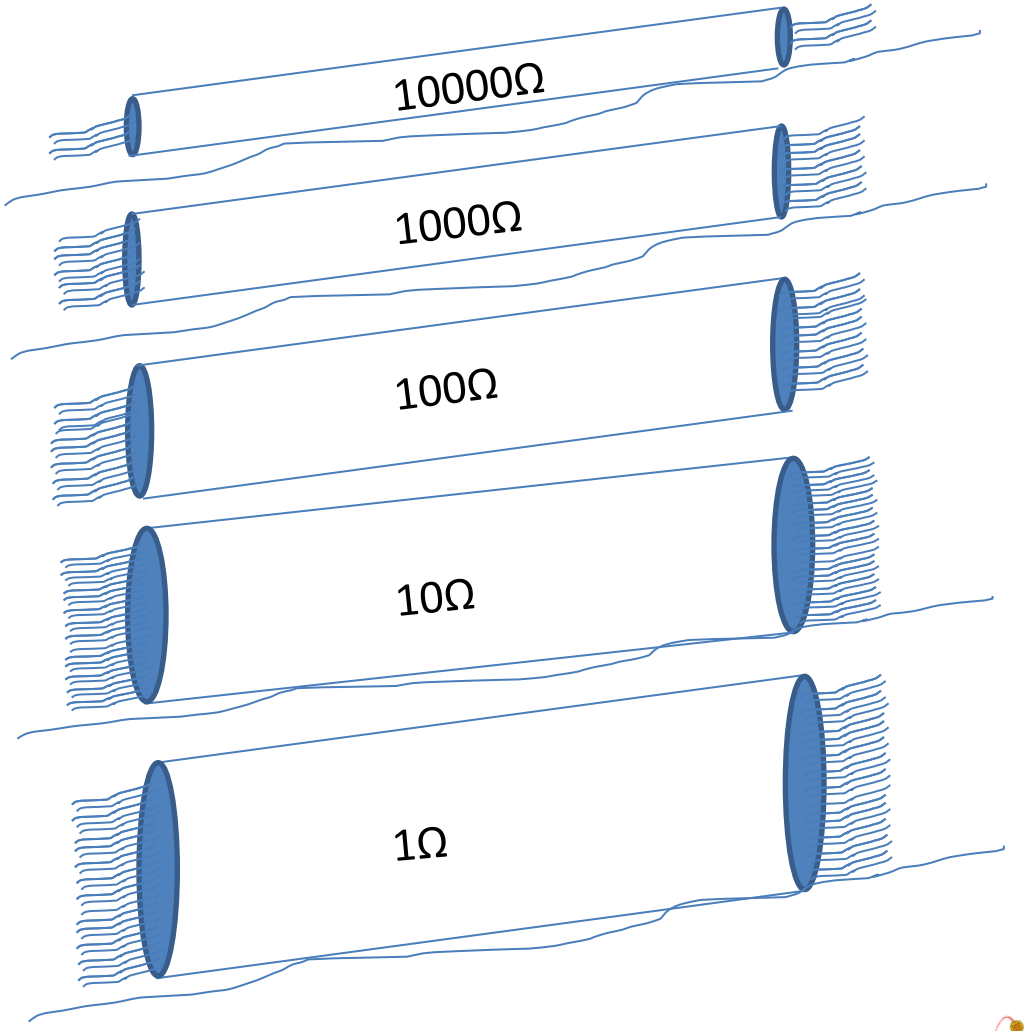
1. Gravity provides the force for water (current) to flow.
2. This illustrates a larger voltage, so electron flow is larger.

Resistance

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

Resistance – Water Analogy

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



Power – Water Analogy

In electronics, power is equal to current X voltage.
The units for power is WATTS.
The symbol for power is W.

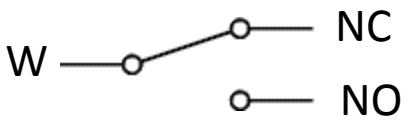
In our water analogy, power is equal to water flow X pressure.

You can see from the picture that more water flow will mean more force, and more pressure will mean more force.

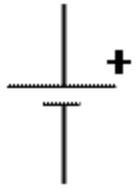
Ohms Law

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

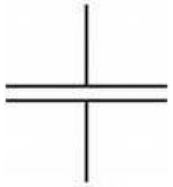
Electronic Symbols



Single Pole, Double Throw Switch (SPDT)

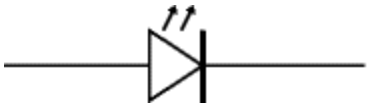


Battery

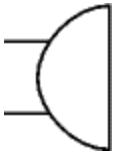


Capacitor

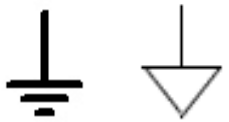
Resistor



Light Emitting Diode (LED)

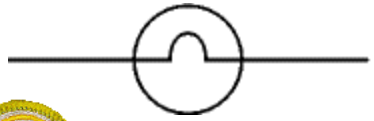


Buzzer



Ground

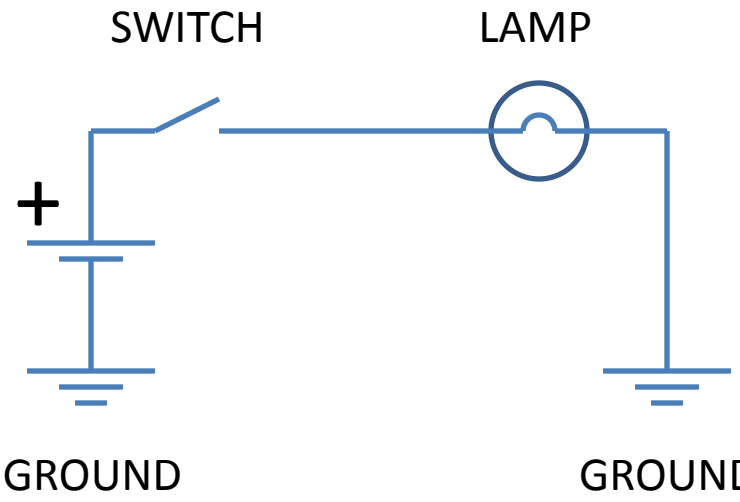
Fuse



Lamp

CIRCUIT DIAGRAM (SCHEMATIC)

FLASHLIGHT

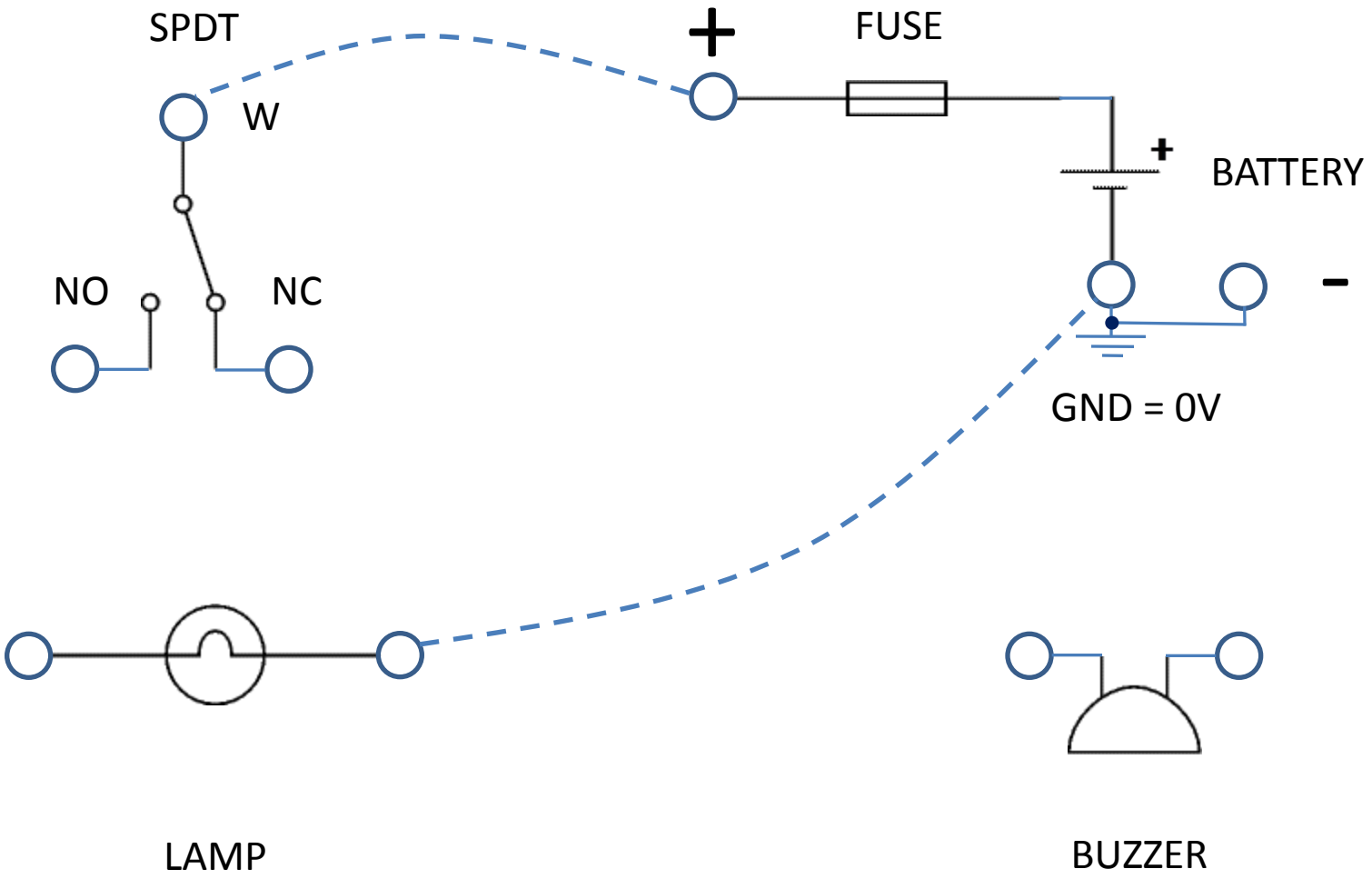


TWO GROUND SYMBOLS IS THE SAME AS CONNECTING WITH A WIRE

<u>GROUND = 0 VOLTS</u>

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.