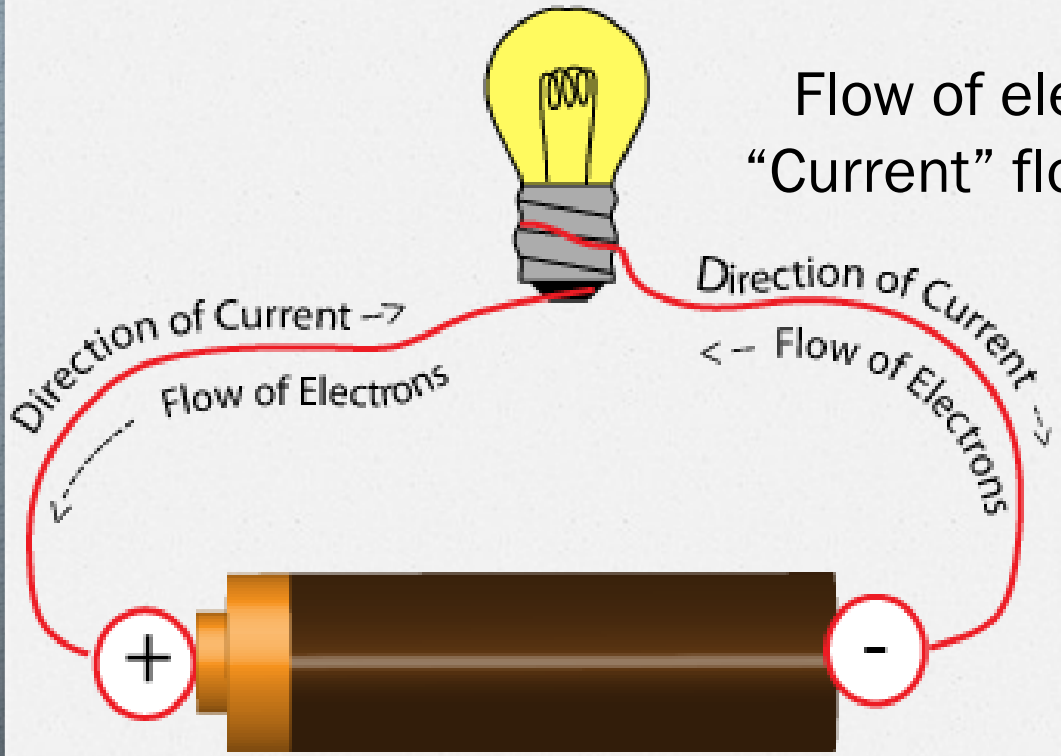
Circuit Wizardry Workshop #2

Presented by:
Optics Society at the University of Michigan

Current



Flow of electrons (like a river)

"Current" flows from (+) side of battery to (-) side

Electrons go the other way

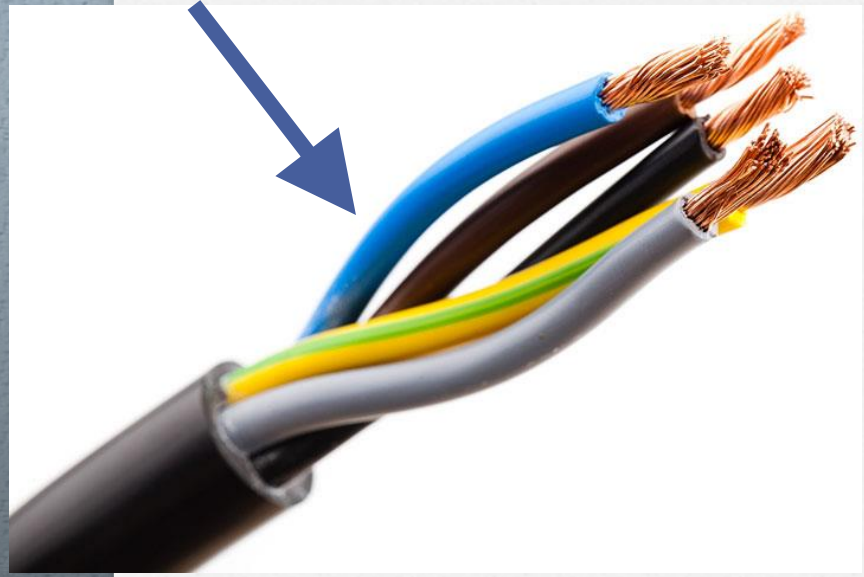
Conductor

Allows easy flow of electrons

Examples: Copper wire(shown in picture), paper clip, any metal

Skin is a “weak” conductor

Insulator

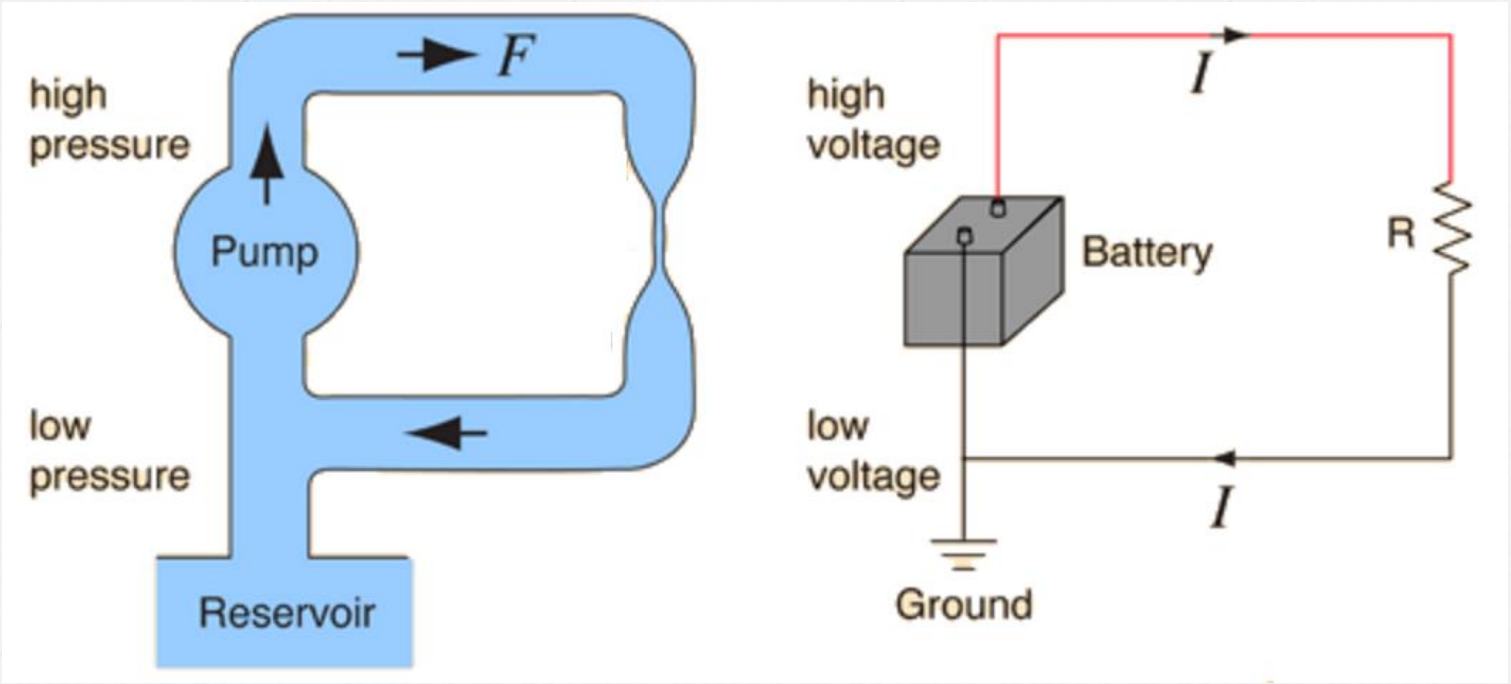


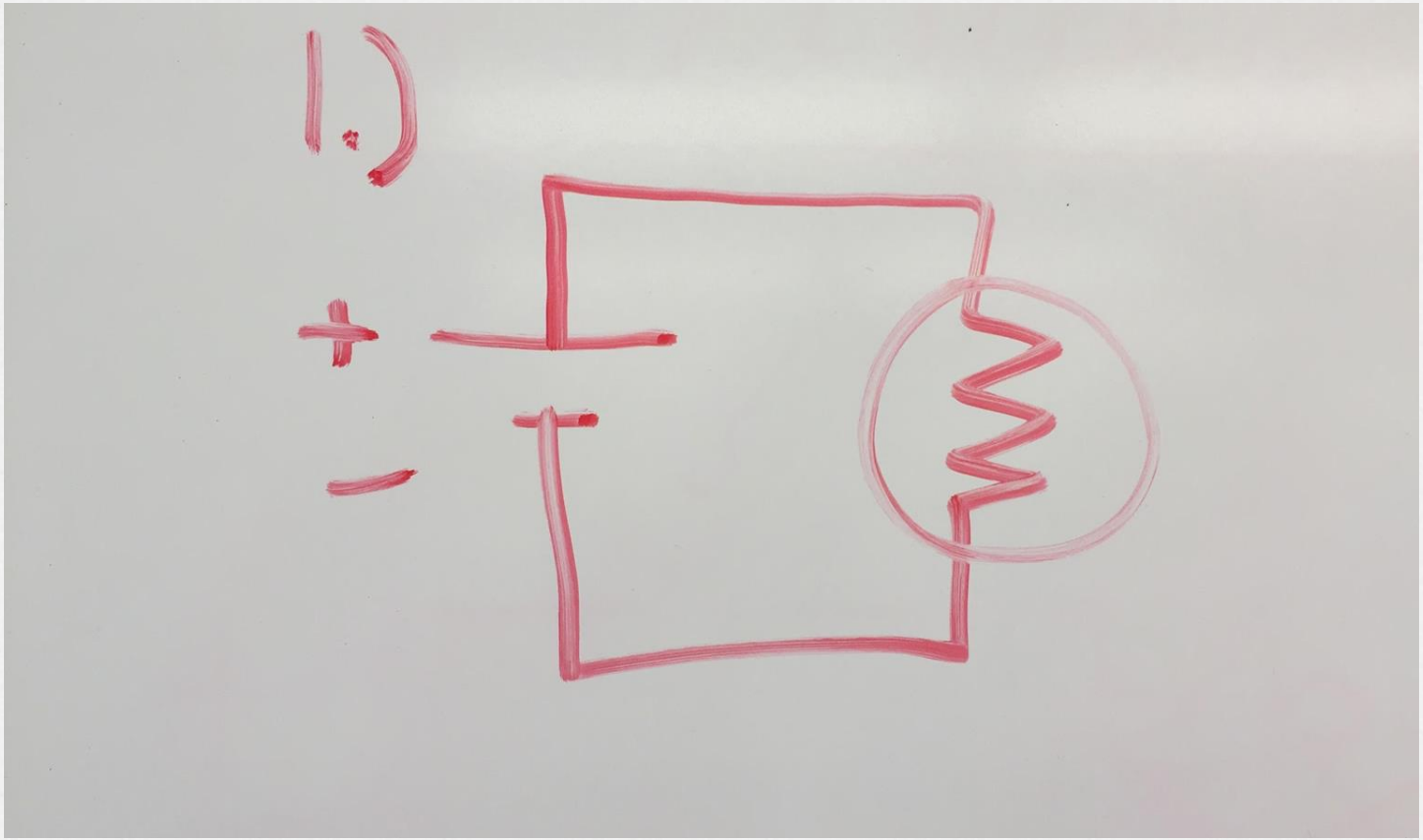
Does NOT allow electrons to flow at all. (No conduction)

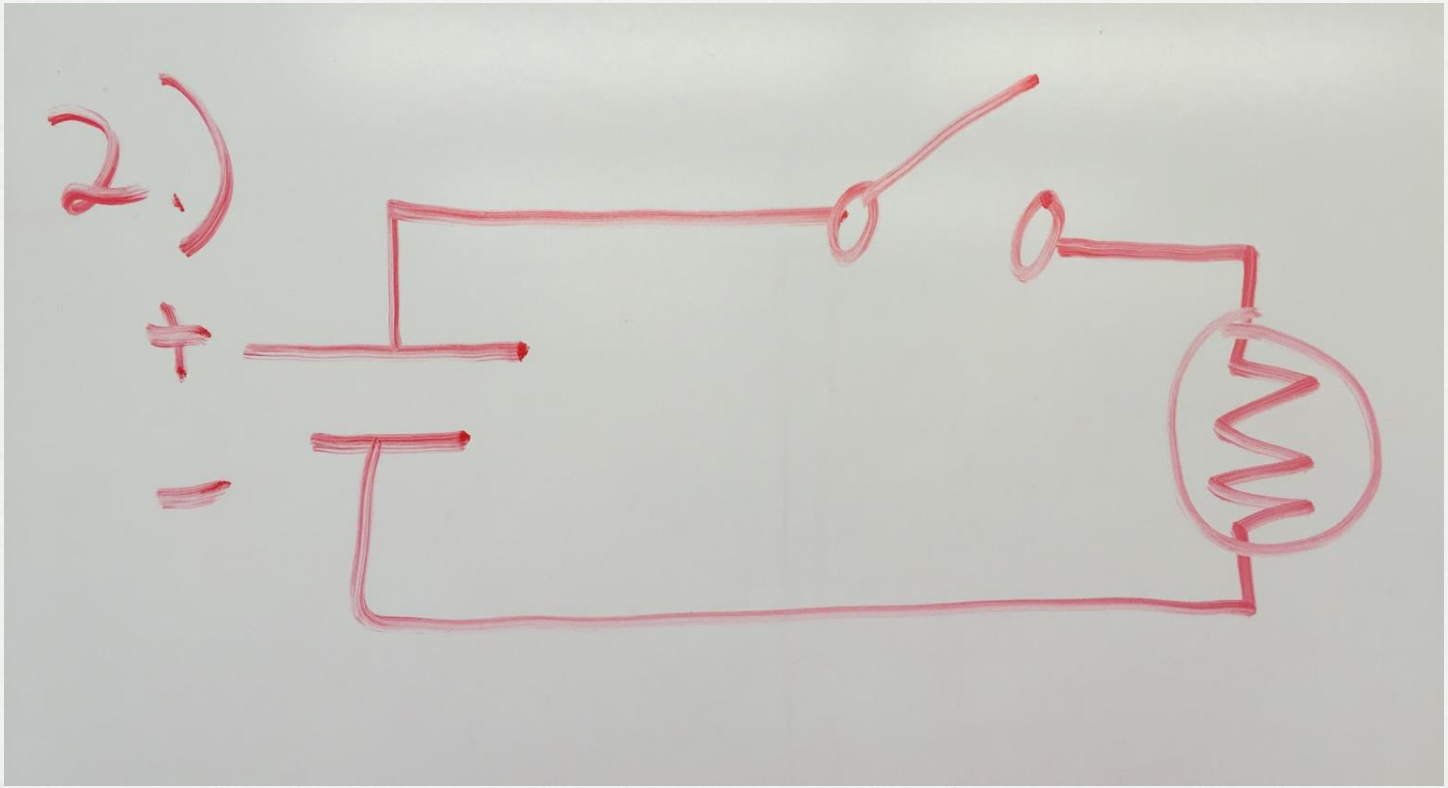
Examples: Rubber (shown in picture), wood, cloth, plastic, cardboard

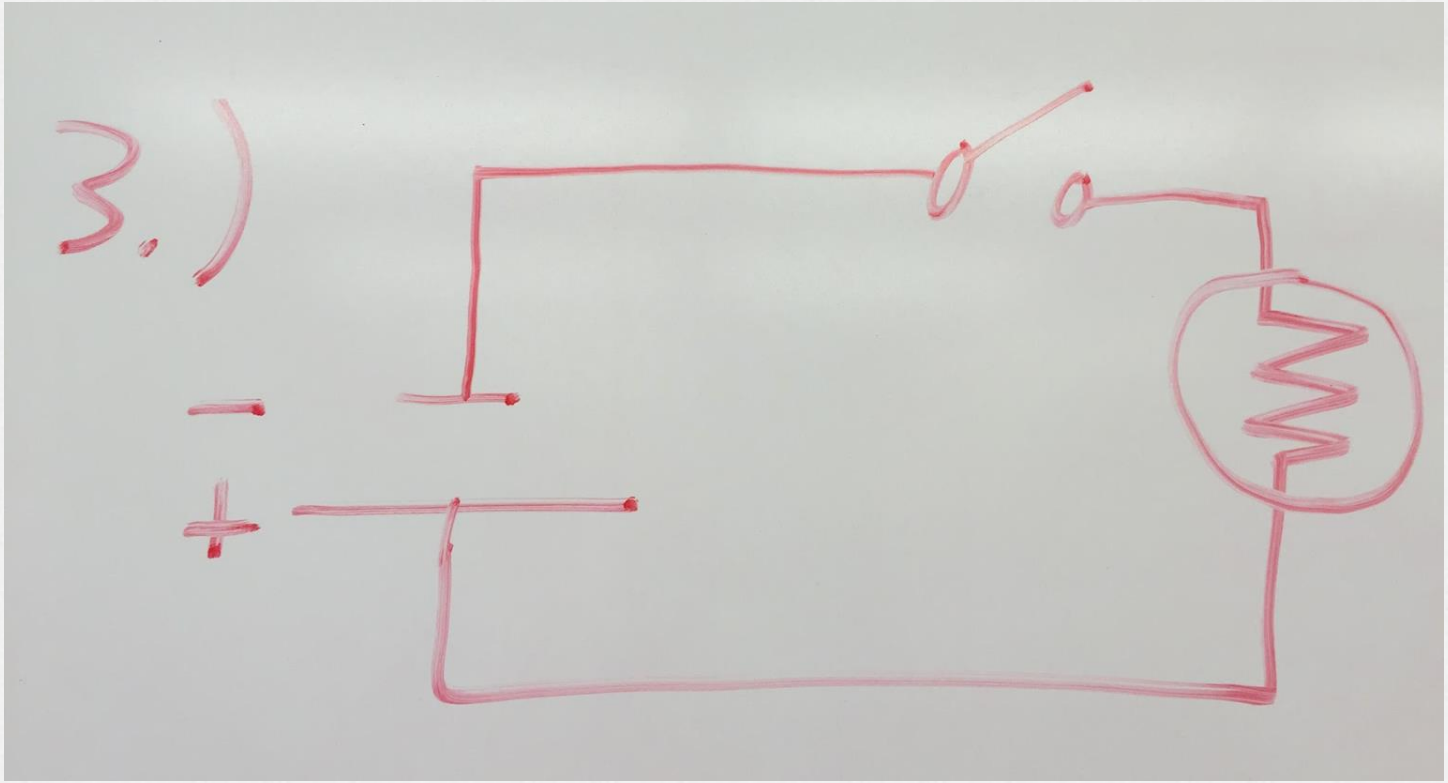
Voltage

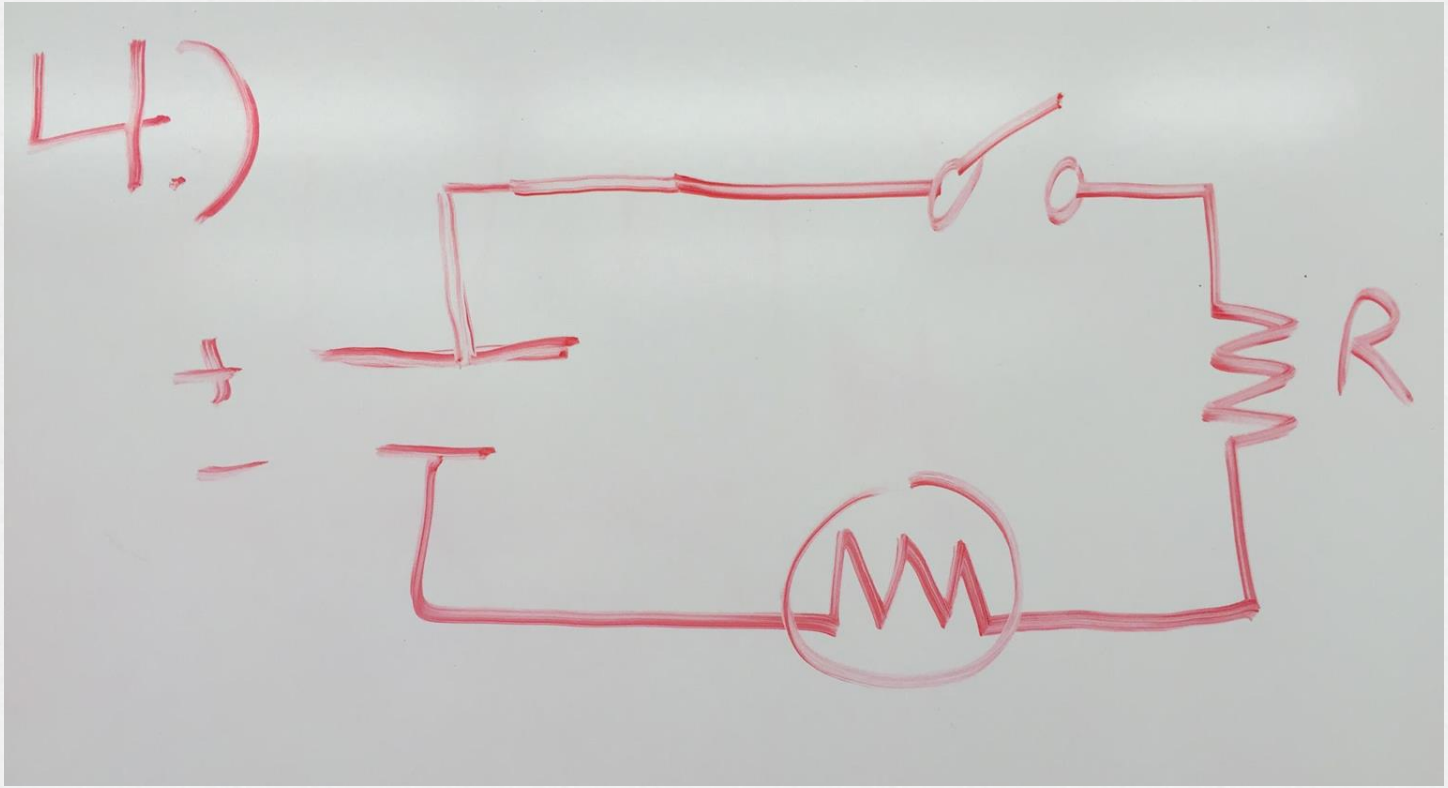
Voltage is like pressure (sort of)

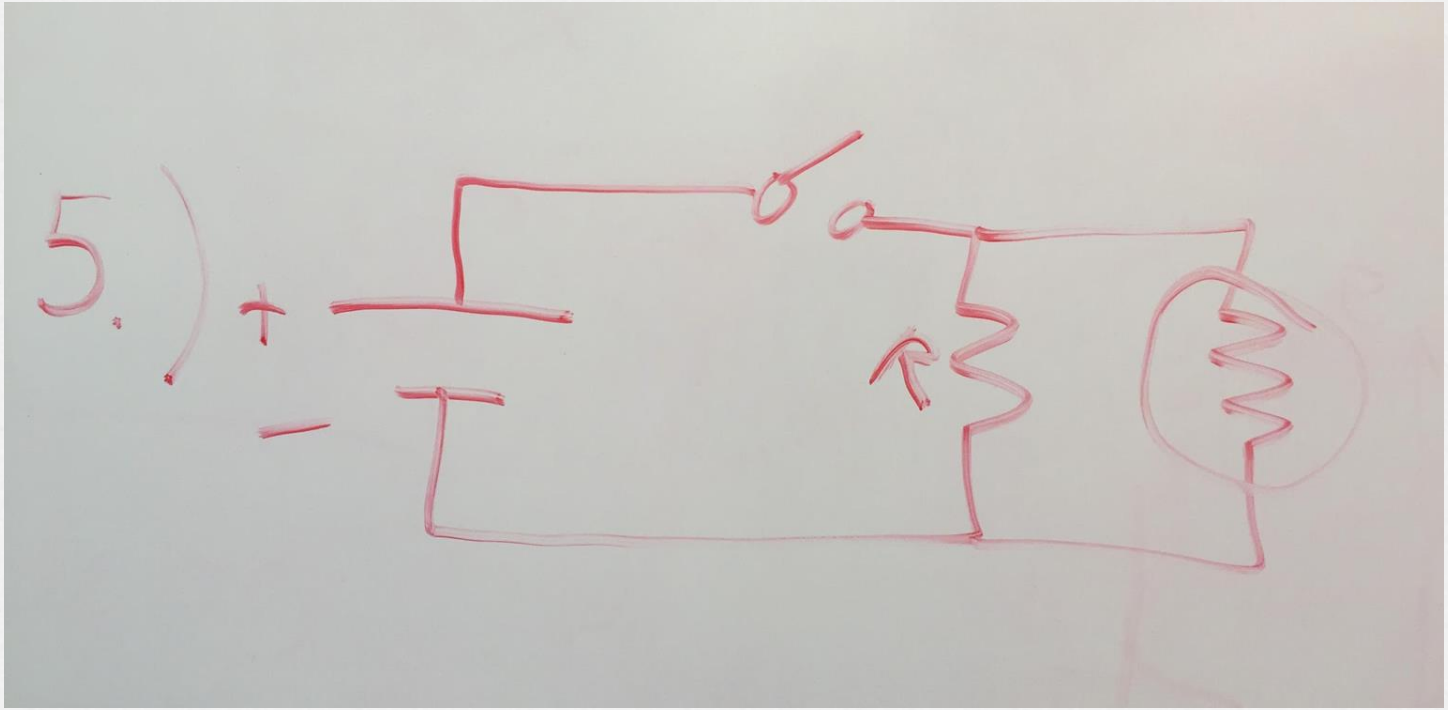



1.)
+
−


2)
+
-

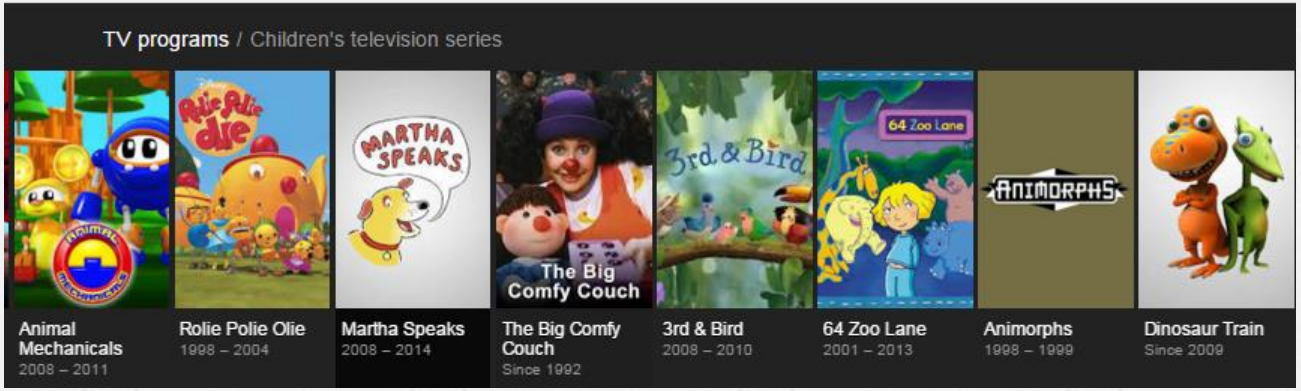

3.)
−
+


4.)
+
-
R


5.)
+
−

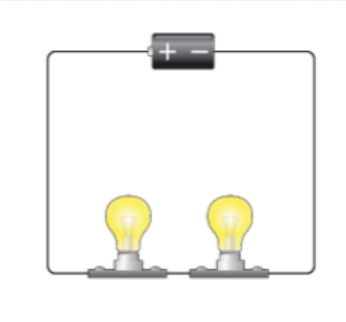
Series & Parallel

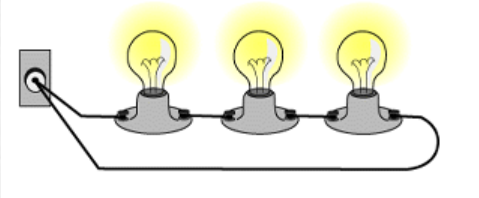
What do you think of when you hear *series*?

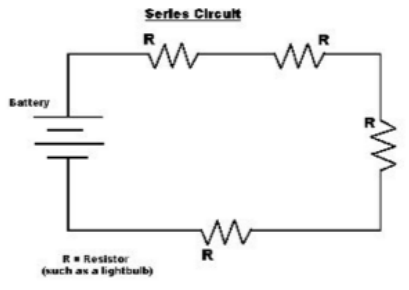


- Like episodes, things in series all go in a line

Series

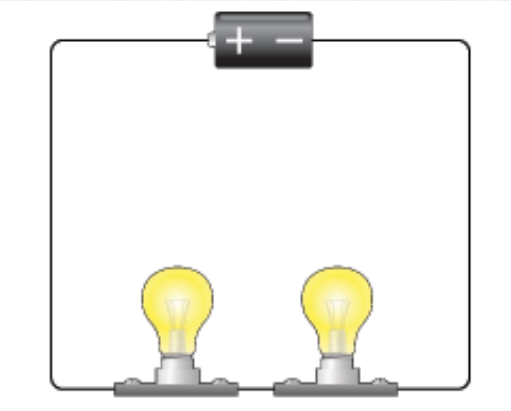




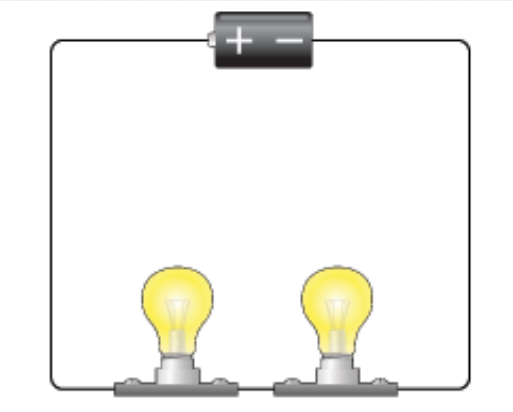


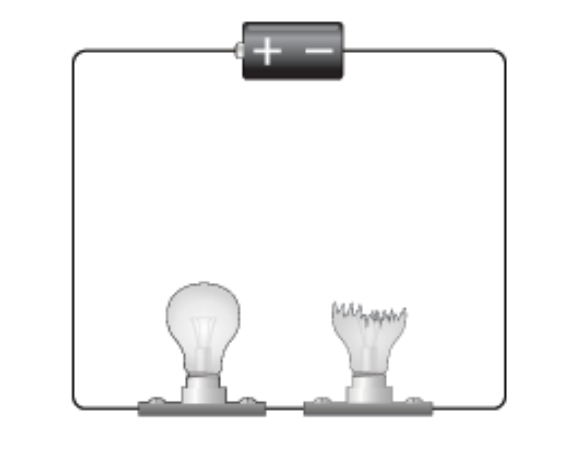
- Light bulbs can be in series, resistors can be in series, batteries can be in series…
- How many things are in series in these pictures?

What happens if a bulb breaks in *series*?



What happens if a bulb breaks in *series*?



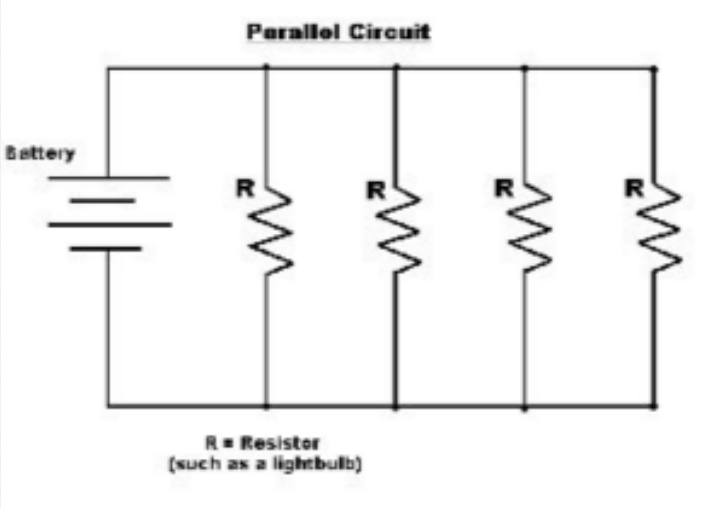


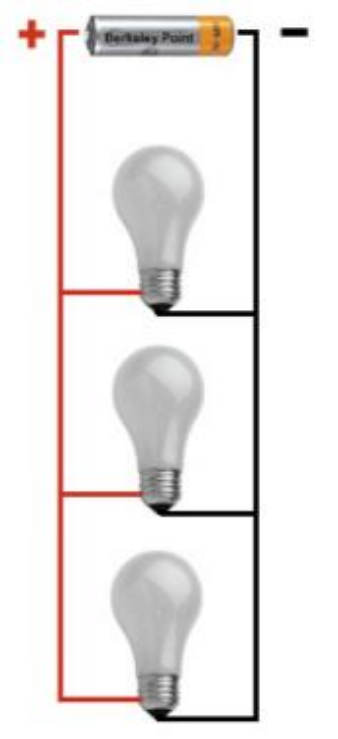
What do you think of when you hear *parallel*?

- Parallel bars, parallel lines

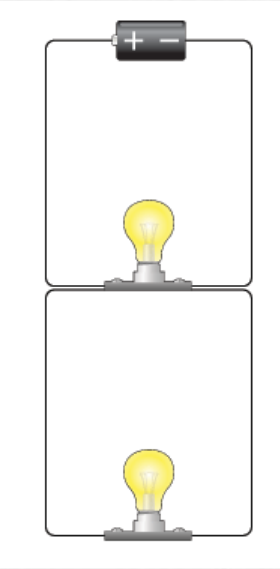
Parallel

- Parallel circuits often look like several boxes, or a ladder.

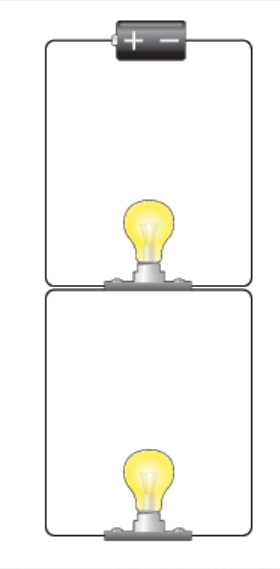


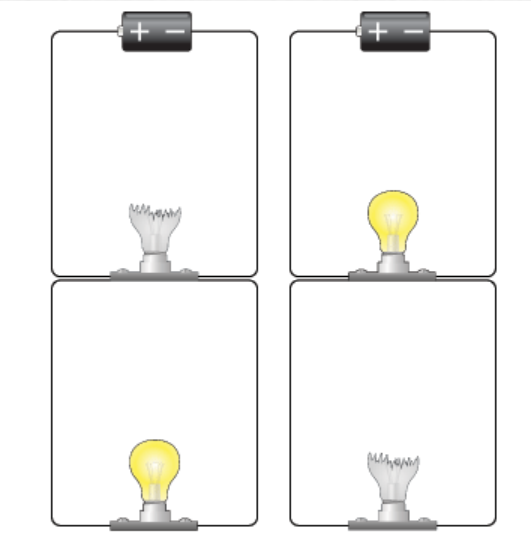


What happens if a bulb breaks in *parallel*?



What happens if a bulb breaks in *parallel*?

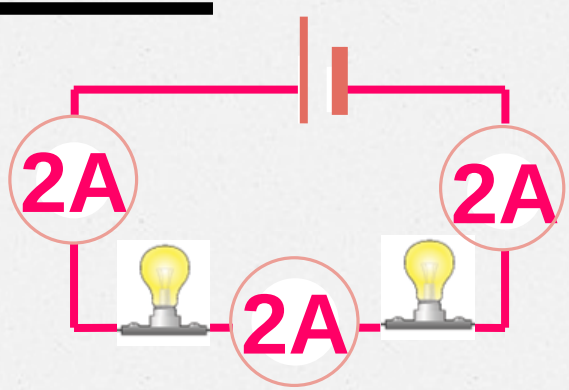




Current

SERIES CIRCUIT

- current is the **same** at all points in the circuit.



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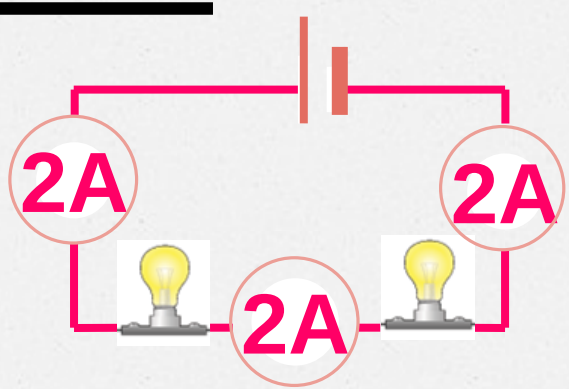
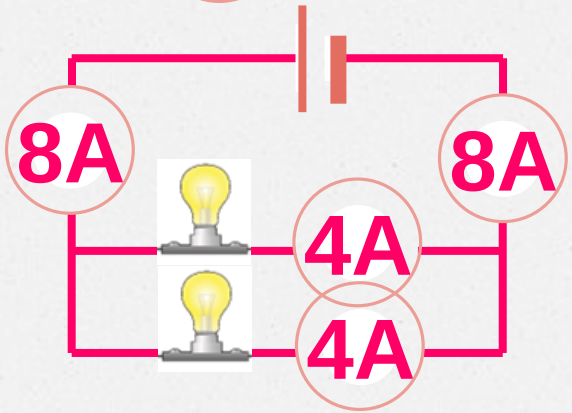


PARALLEL CIRCUIT

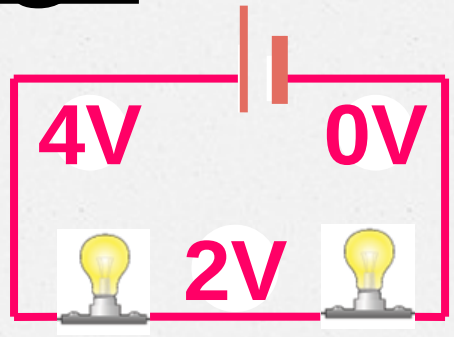
- current is **split** between each branch



Voltage

SERIES CIRCUIT

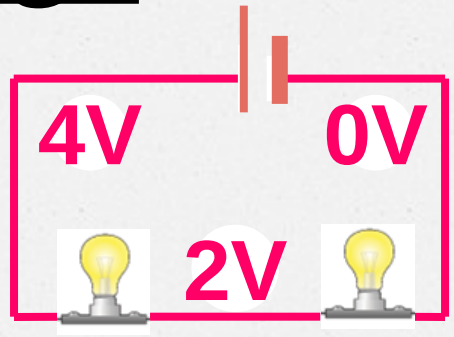
- voltage is the **split** across components



Voltage

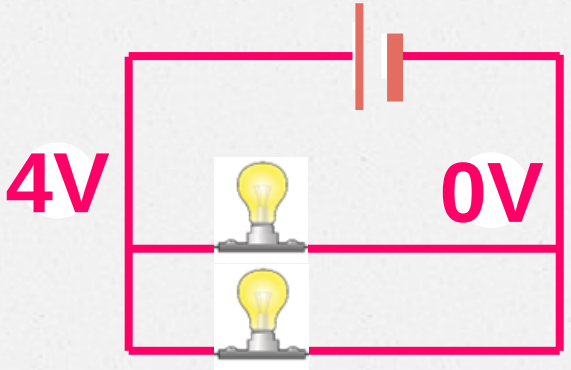
SERIES CIRCUIT

- voltage is the **split** across components



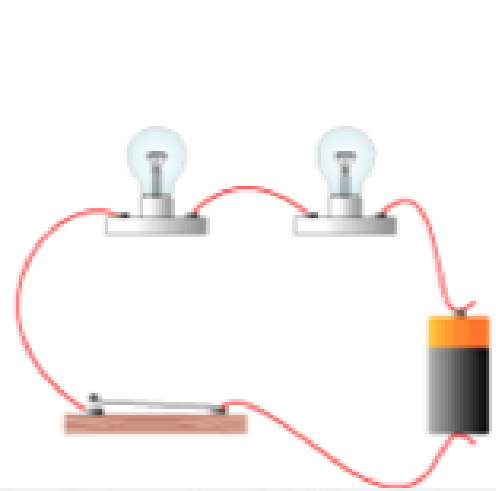
PARALLEL CIRCUIT

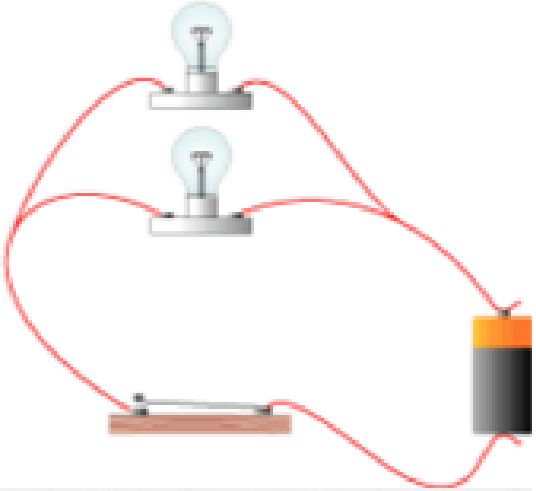
- voltage is **same** across each branch

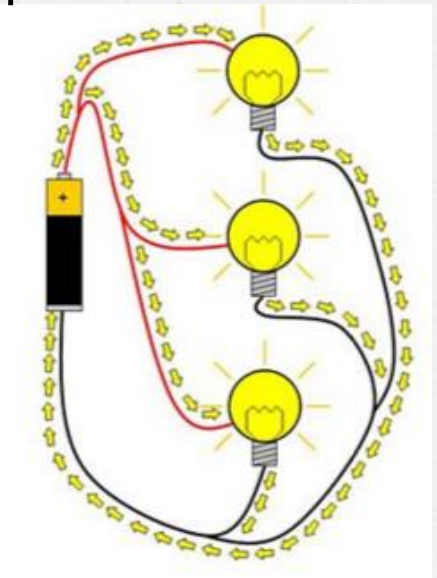


Series and Parallel

- Remember, things in series, will be in a continuous loop, where things in parallel will be in their own loop

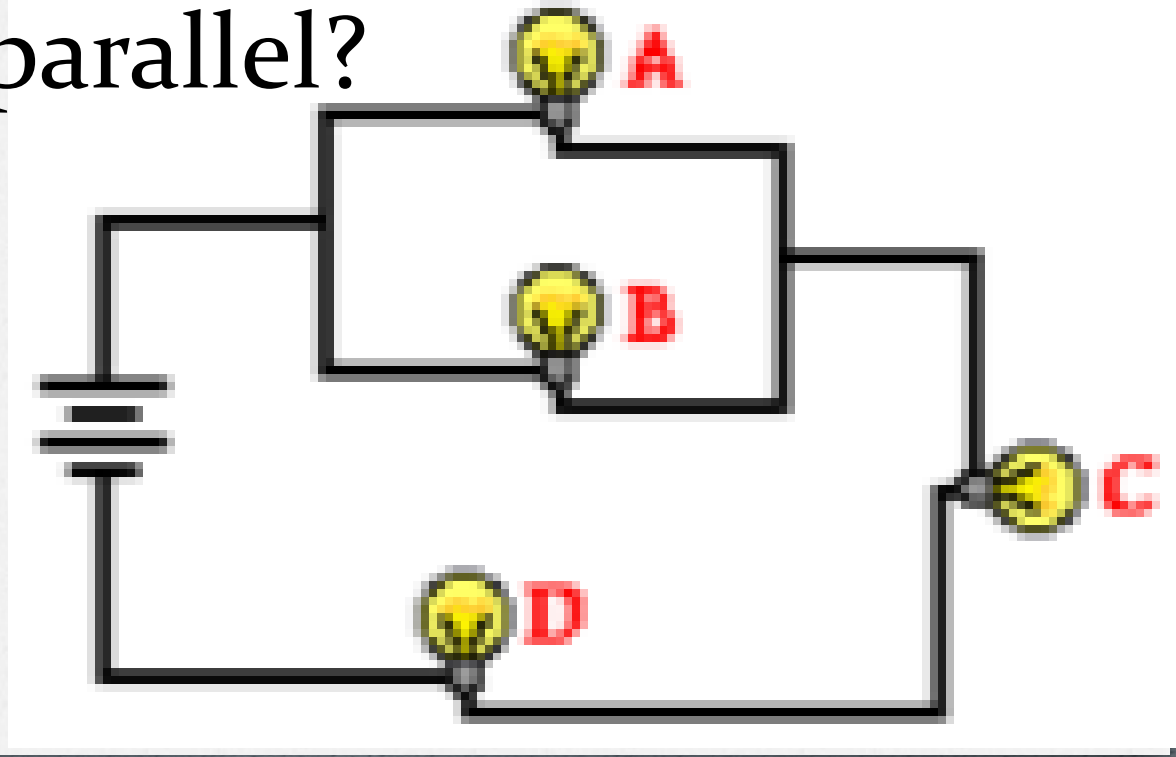




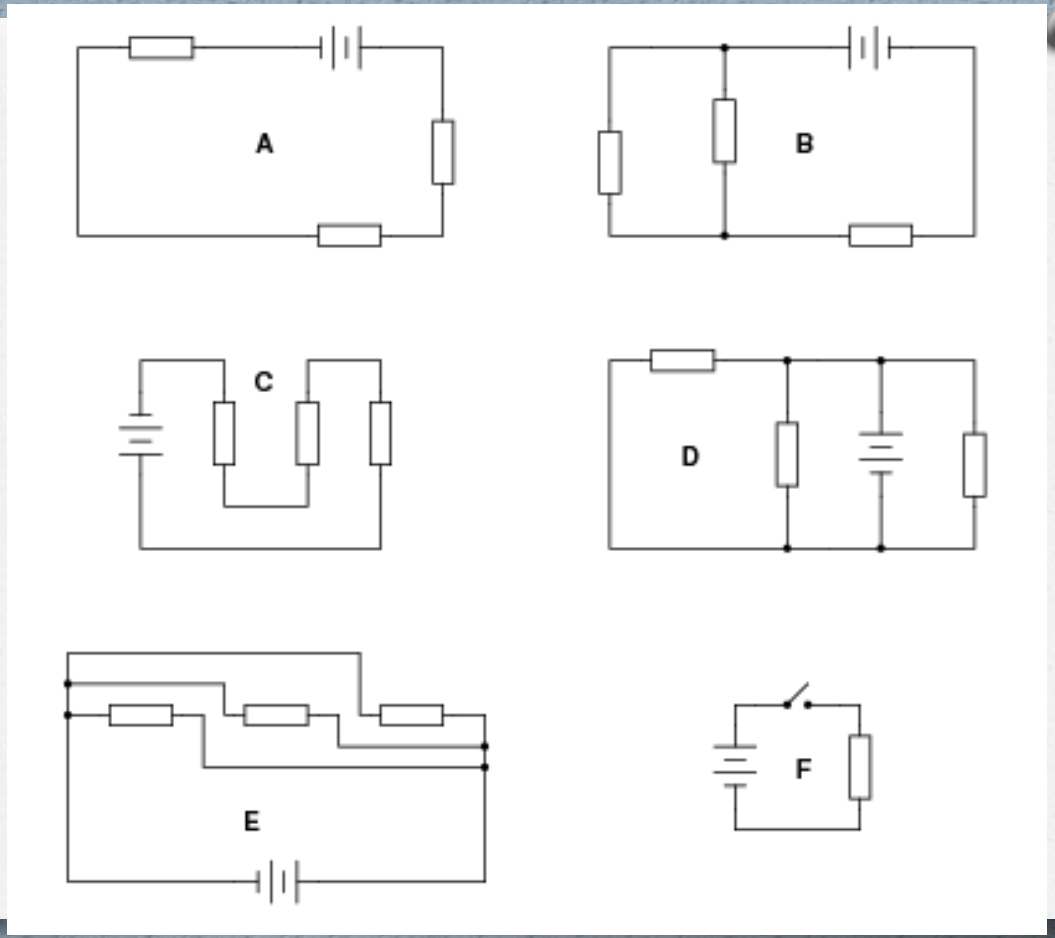


What is in series?

What is parallel?



Series, Parallel, or both?



Let's Compare Series and Parallel Circuits

Series Circuits

- 1 path(s) for current

Parallel Circuits

- multiple path(s) for current

Let's Compare Series and Parallel Circuits

Series Circuits

- 1 path(s) for current
- Current is the same at every point

Parallel Circuits

- multiple path(s) for current
- Current can be different in each branch

Let's Compare Series and Parallel Circuits

Series Circuits

- 1 path(s) for current
- Current is the same at every point
- Voltage drops at each resistor

Parallel Circuits

- multiple path(s) for current
- Current can be different in each branch
- Voltage same across each resistor

Let's Compare Series and Parallel Circuits

Series Circuits

- 1 path(s) for current
- Current is the same at every point
- Voltage drops at each resistor
- Break in circuit stops all current

Parallel Circuits

- multiple path(s) for current
- Current can be different in each branch
- Voltage same across each resistor
- Break in circuit does not affect other bulbs

Let's Compare Series and Parallel Circuits

Series Circuits

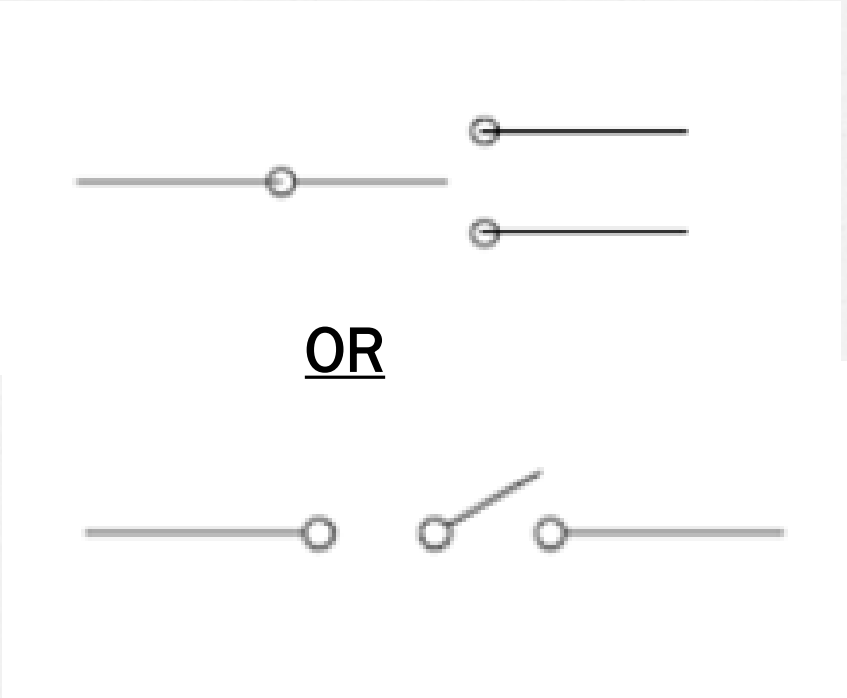
- 1 path(s) for current
- Current is the same at every point
- Voltage drops at each resistor
- Break in circuit stops all current
- Adding resistance in series decreases total current (dimmer light bulbs)

Parallel Circuits

- multiple path(s) for current
- Current can be different in each branch
- Voltage same across each resistor
- Break in circuit does not affect other bulbs
- Adding resistance in parallel increases total current

More Switches!

SPDT switch

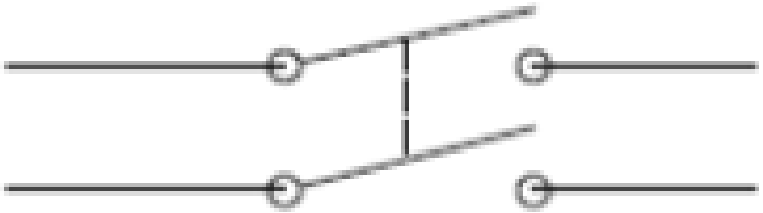


Single **P**ole **D**ouble **T**hrow

One pole in the middle

It has *two* options for where to connect (double throw)

DPST switch

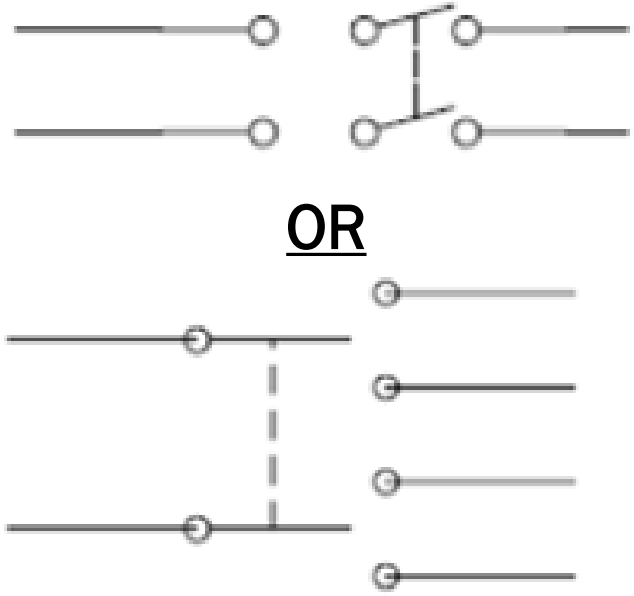


Double Pole Single Throw

TWO poles!
But each pole only has place to go (single throw)

Looks like two SPST switches glued together

DPDT switch



OR

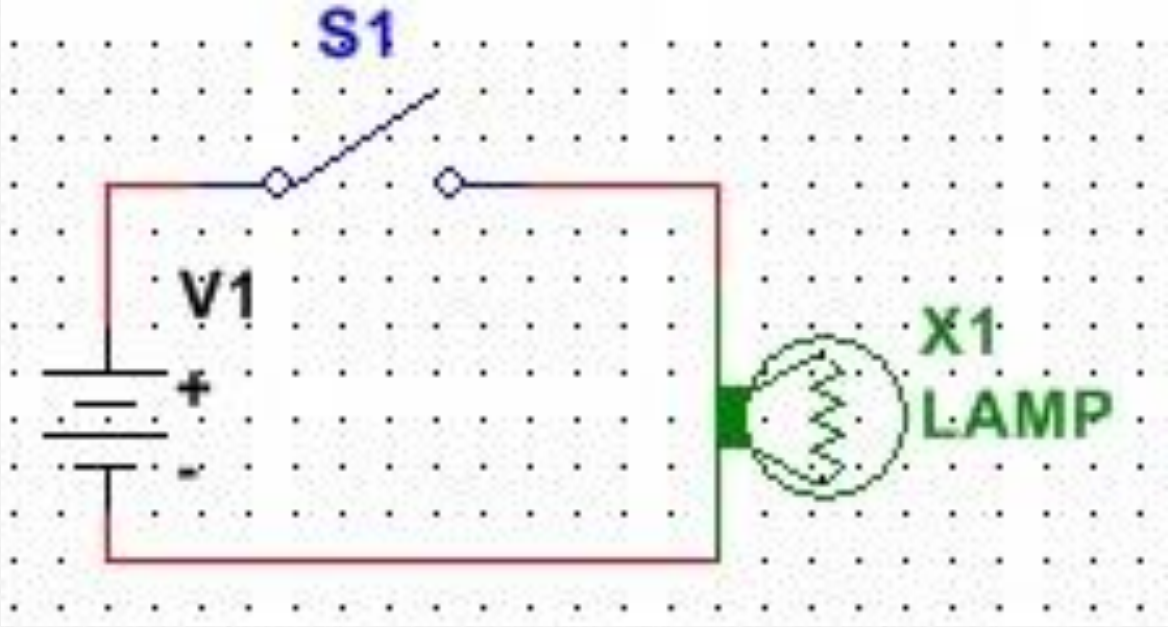
Double Pole Double Throw

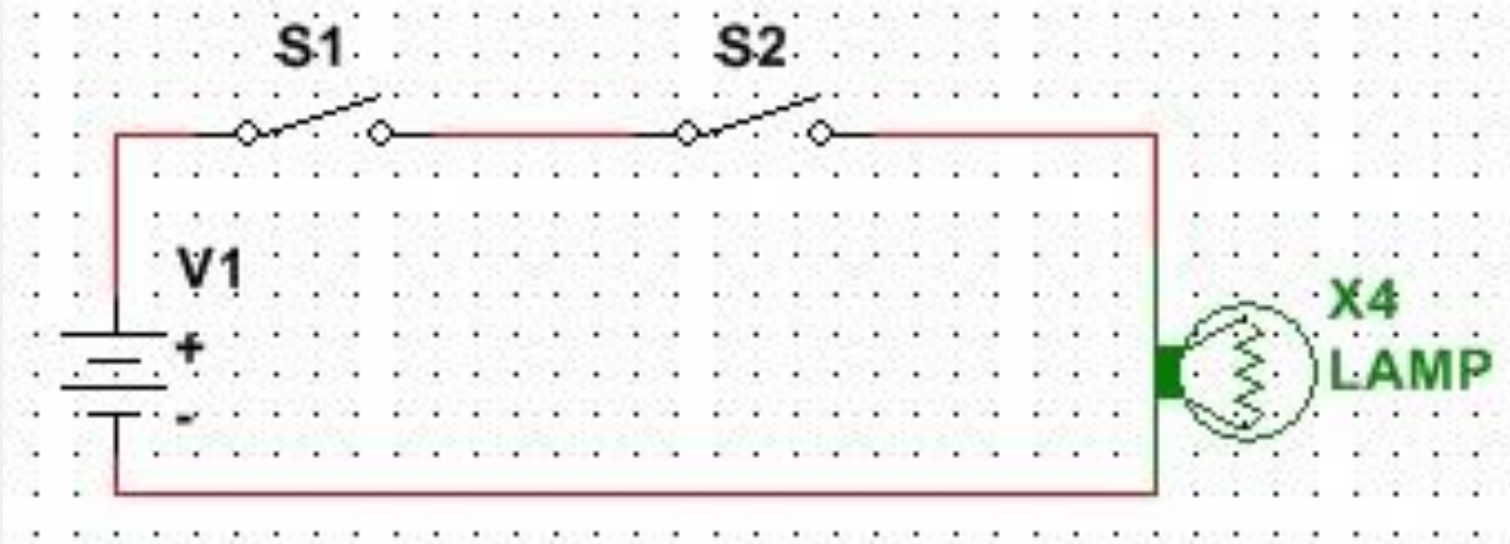
Two poles again

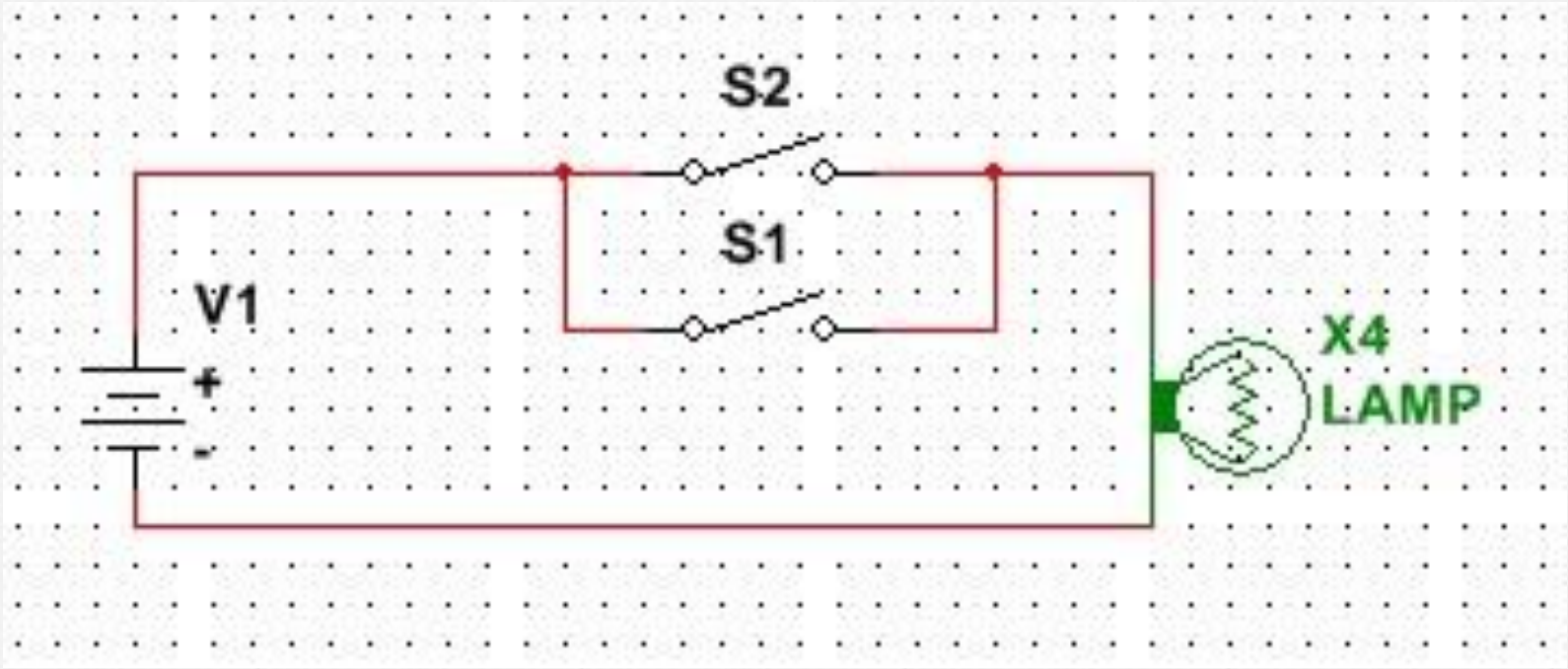
Each pole has TWO options for where to connect (double throw)

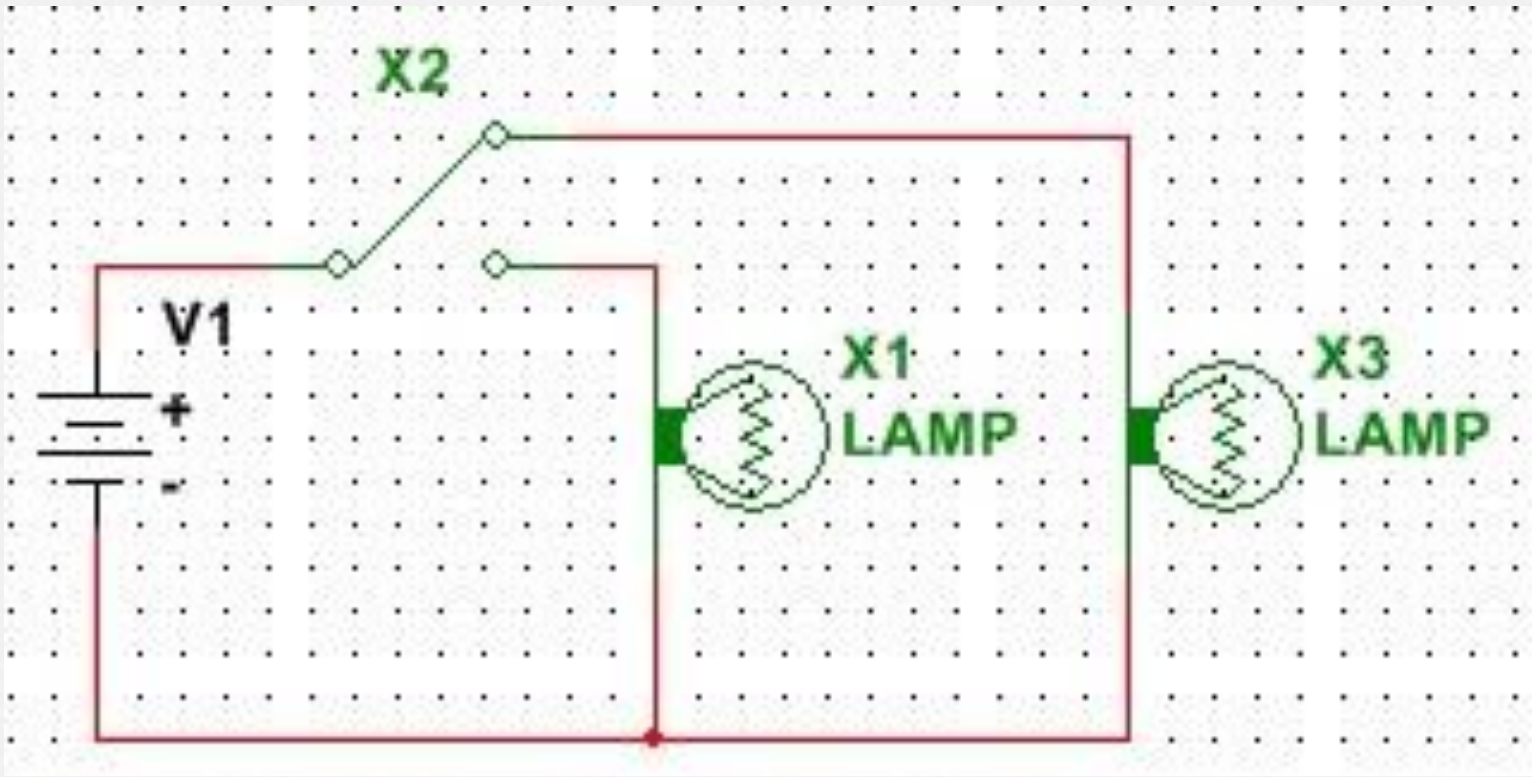
Looks like two SPDT switches glued together

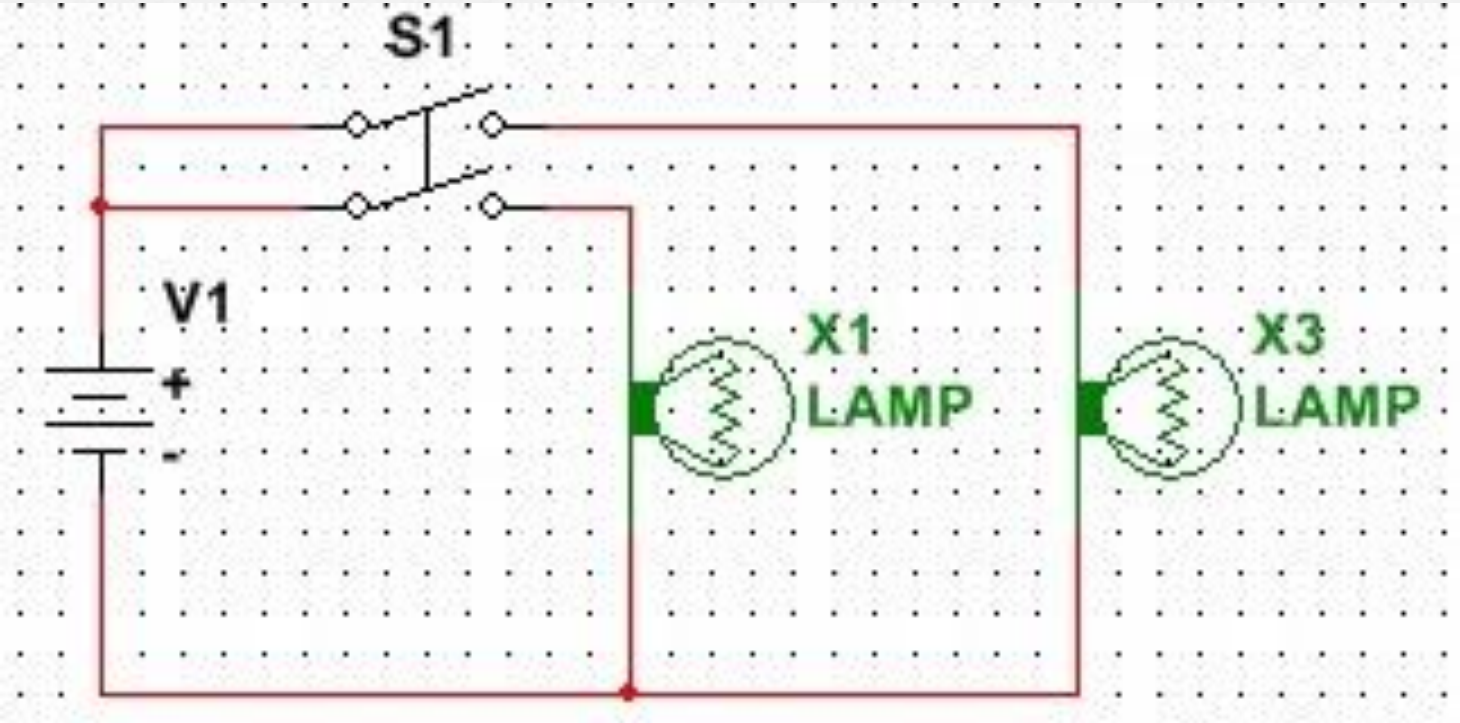
Practice Practice Practice…

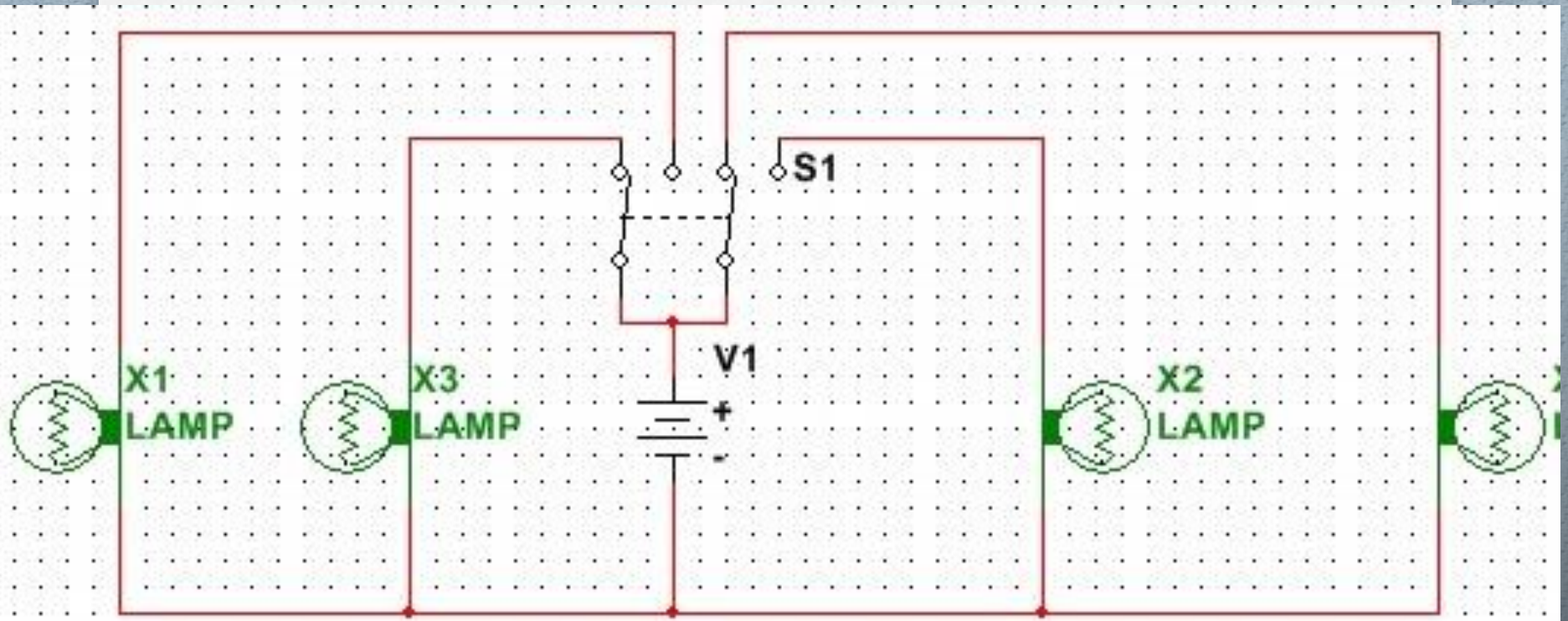

S1
V1
+
-
X1
LAMP


S1
S2
V1
+
-
X4
LAMP

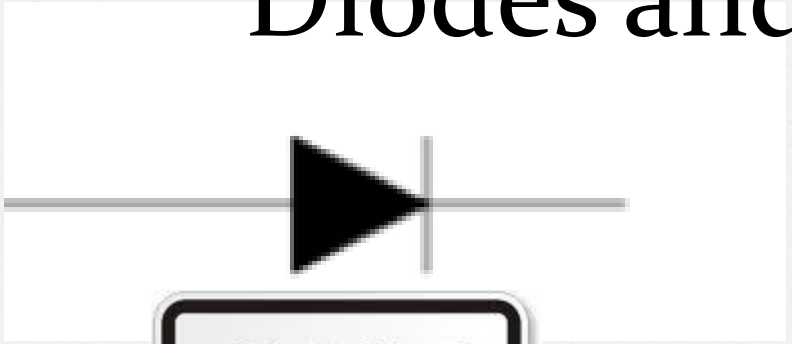

S2
S1
V1
+
-
X4
LAMP


X2
V1
+
-
X1
LAMP
X3
LAMP

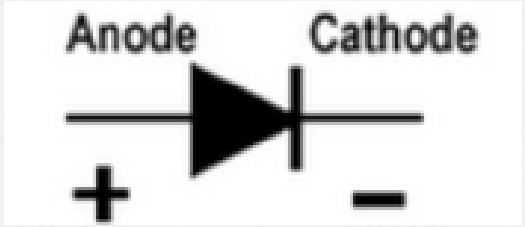

S1
V1
+
-
X1
LAMP
X3
LAMP


S1
V1
+
-
X1
LAMP
X3
LAMP
X2
LAMP

Diodes and LEDs



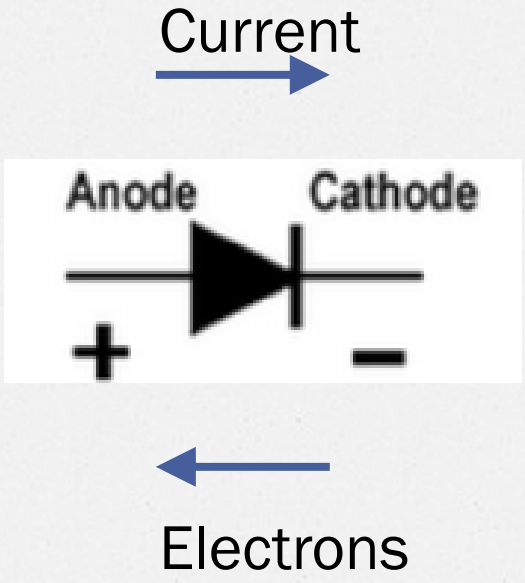
Current

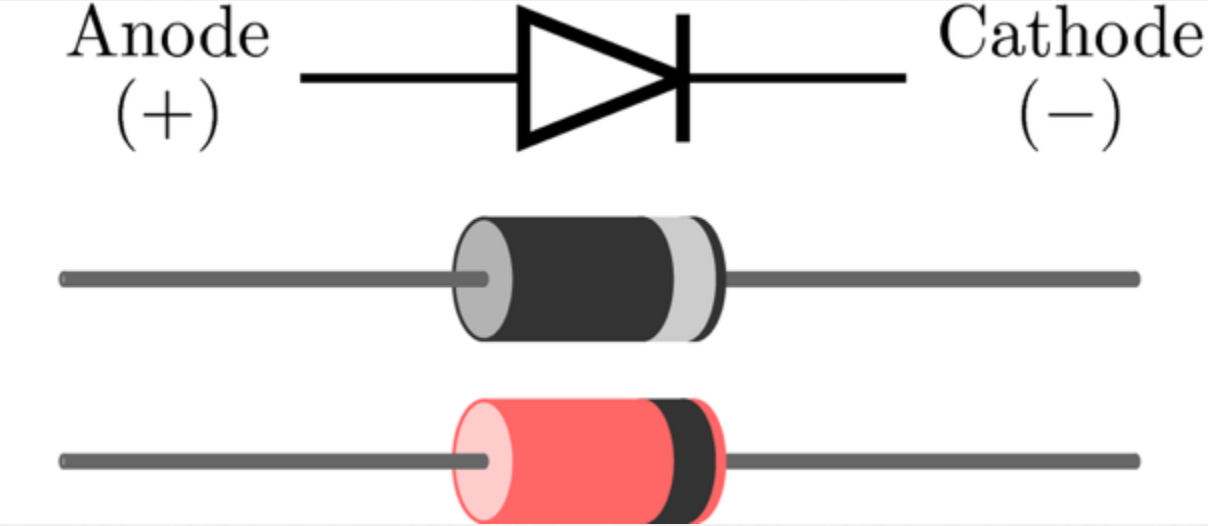


Electrons

ACID:

Anode
Current
Into
Device

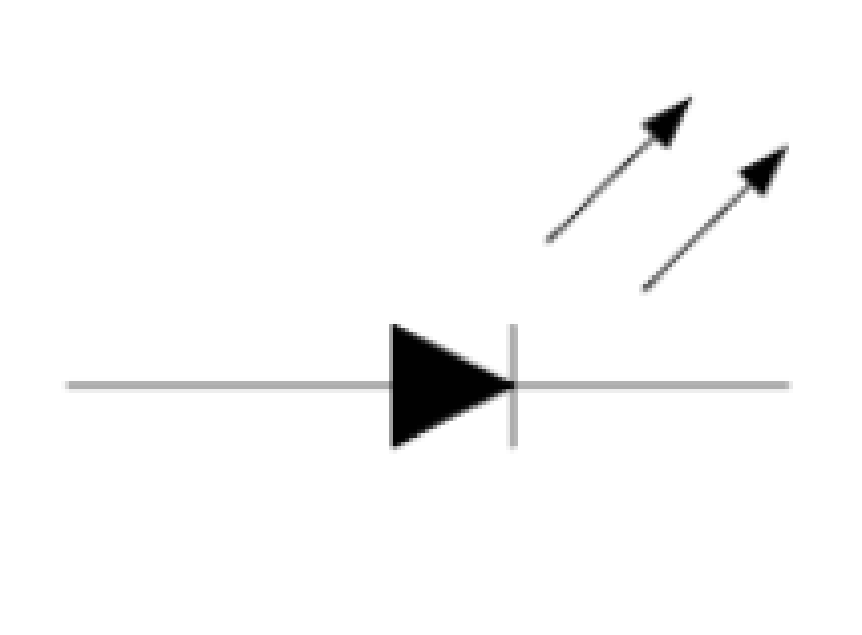


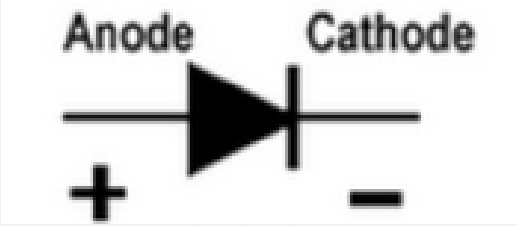

Anode
(+)
Cathode
(−)

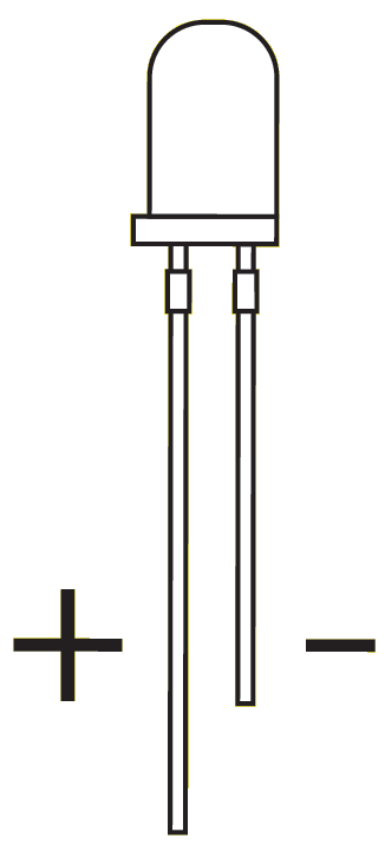
Diodes are mostly used for protection from current going the wrong way.

Light Emitting Diode

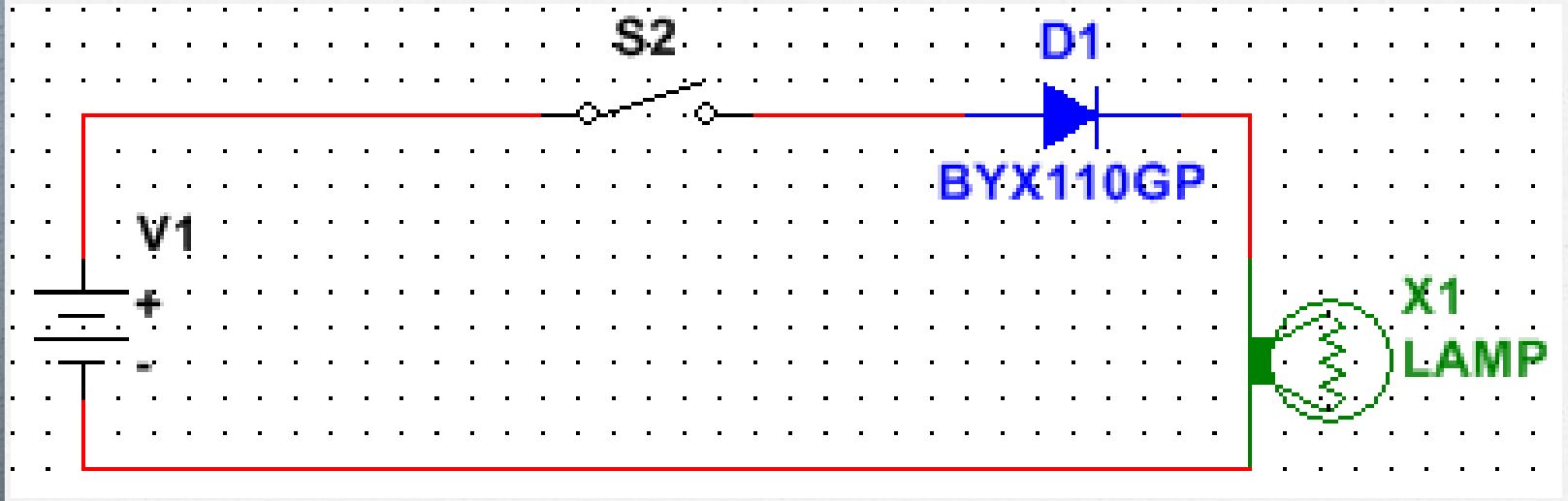
Same as diode but also releases energy (as light)

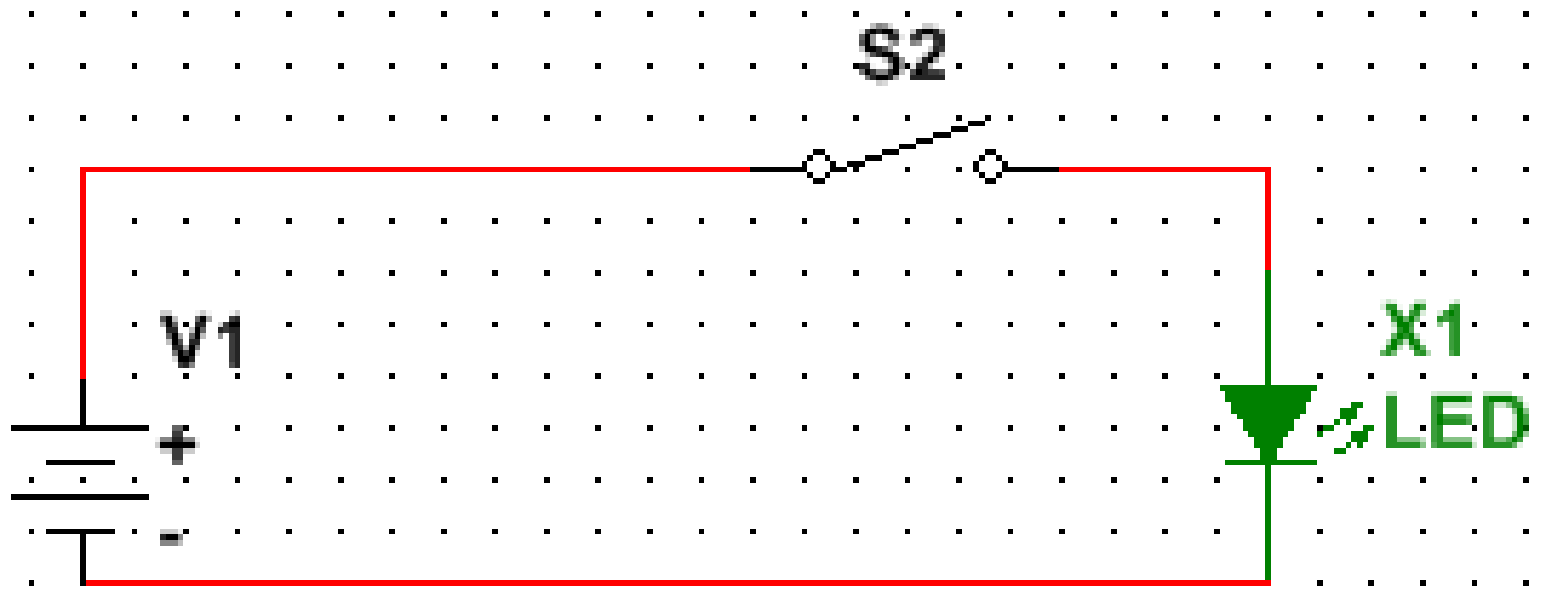


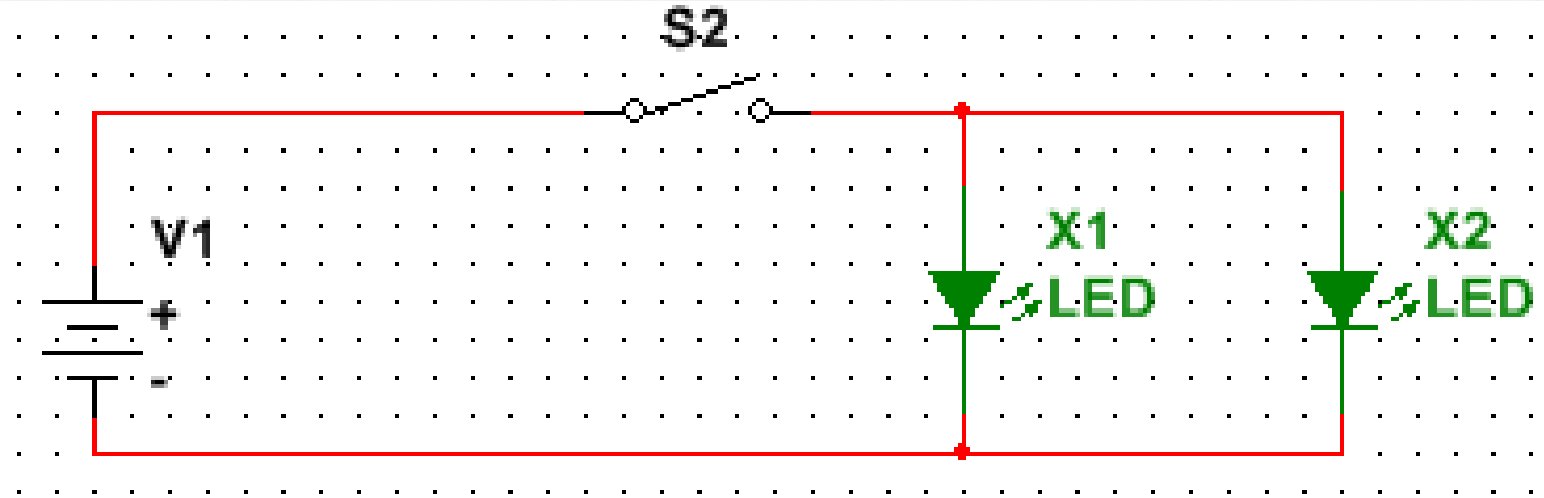


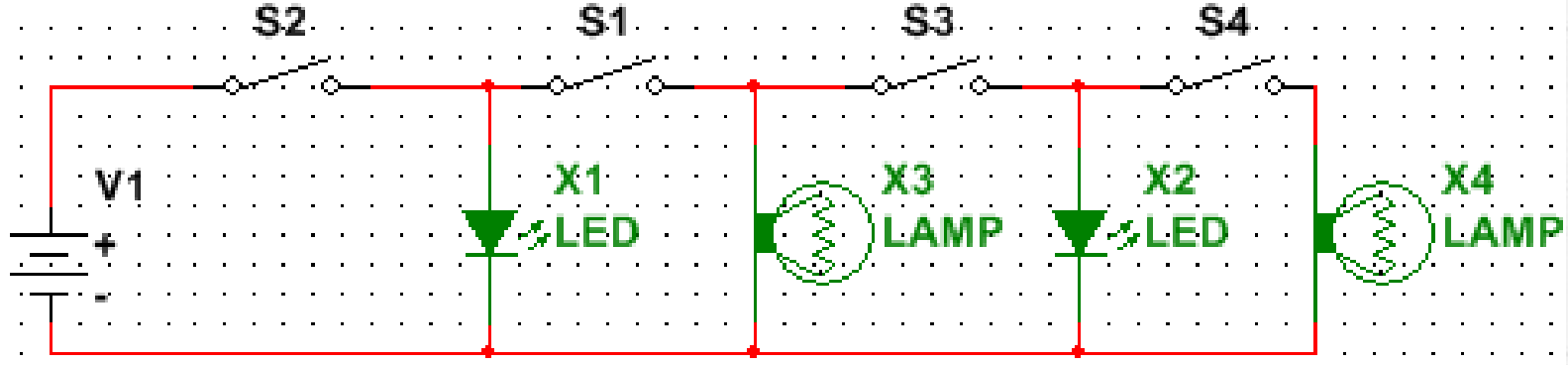


Just like battery, the (+) side is longer


S2
D1
BYX110GP
V1
+
-
X1
LAMP

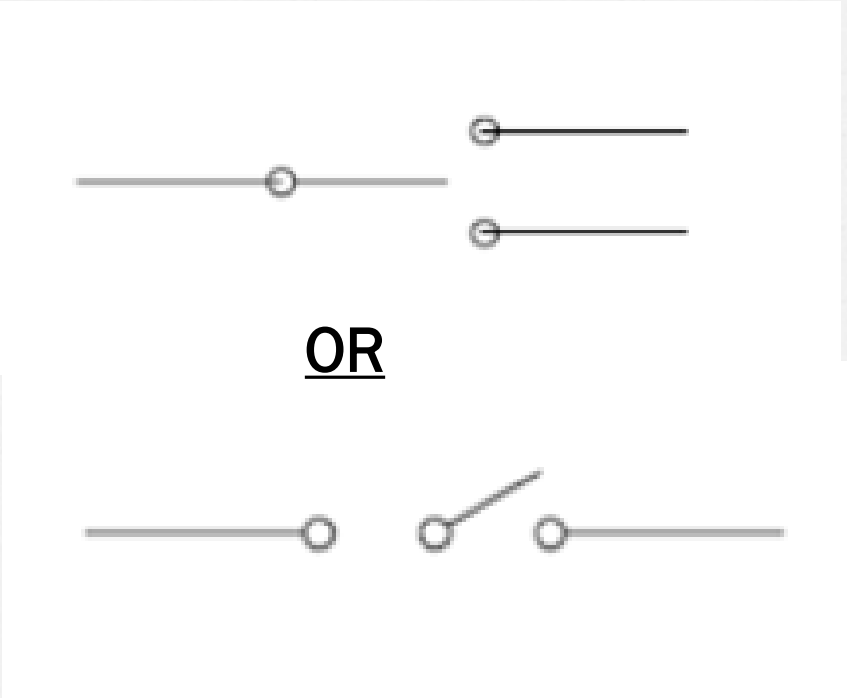

S2
V1
+
-
X1
LED


S2
V1
+
-
X1
LED
X2
LED


S2
S1
S3
S4
V1
+
-
X1
LED
X3
LAMP
X2
LED
X4
LAMP

Flashcards

SPDT switch



Single **P**ole **D**ouble **T**hrow

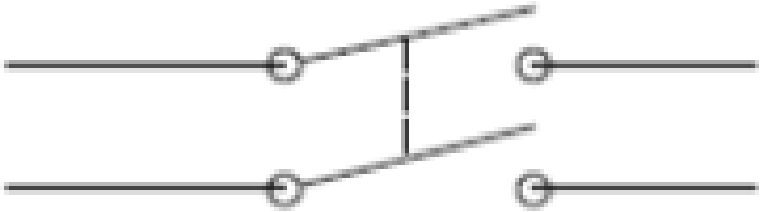
One pole in the middle

It has *two* options for where to connect (double throw)

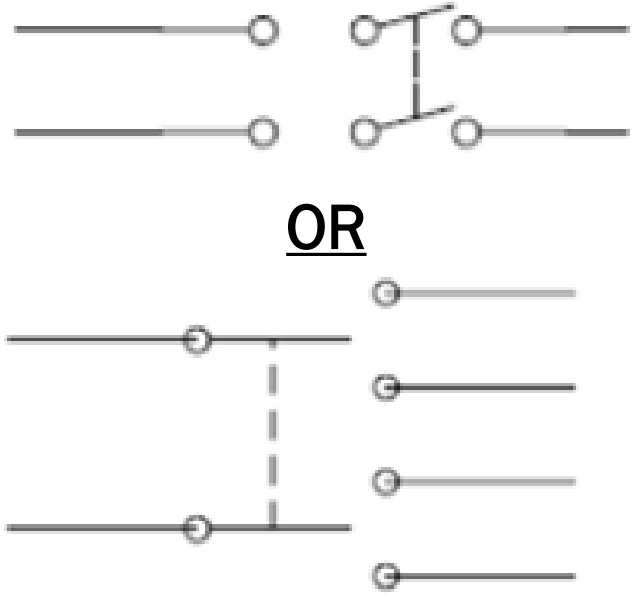
DPST switch

Double Pole Single Throw

TWO poles!
But each pole only has place to go (single throw)



DPDT switch

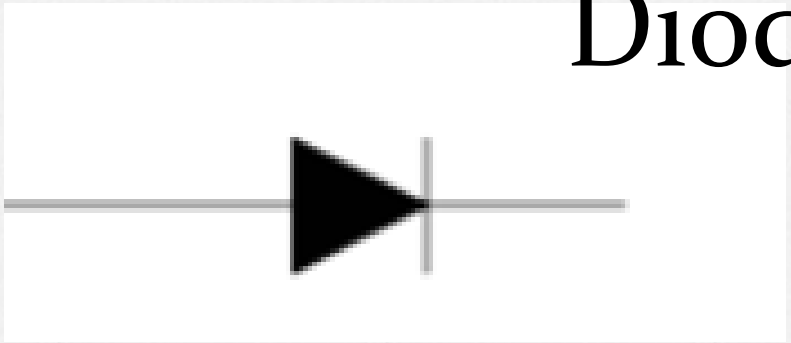


Double Pole Double Throw

Two poles again

Each pole has TWO options for where to connect (double throw)

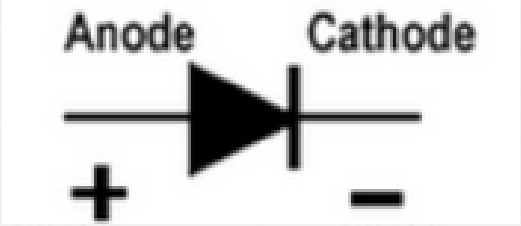
Diode



Only allows current in one direction (it's a one way street!)

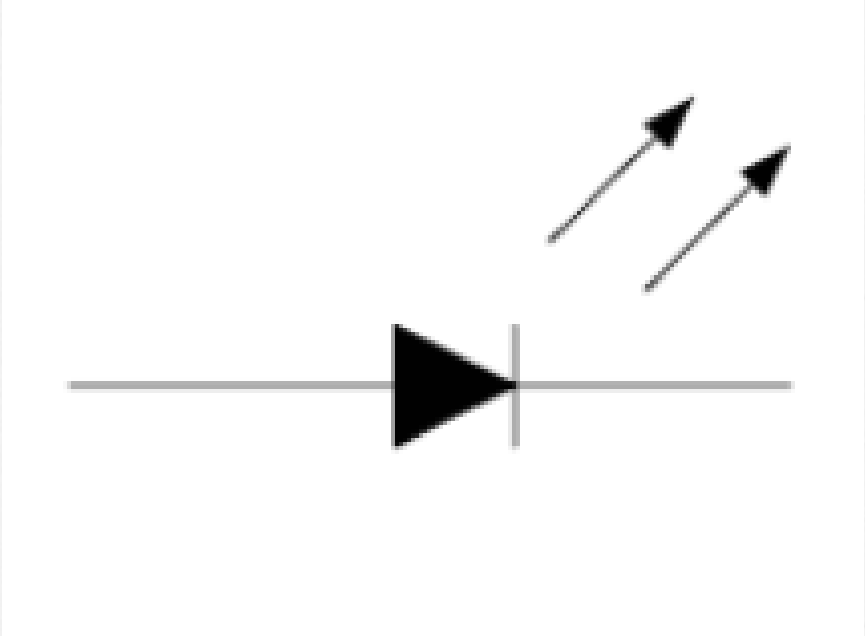
Remember electrons go opposite way as current!

Current



Electrons

LED



Light **E**mitting **D**iode

Same as diode but also releases energy (as light)

To do at home :)

Make sure to:

Memorize flashcards
Build more circuits (start with the ones in this slideshow then be creative and build your own)

Check out these cool videos/apps:

Link #1 – Series and Parallel Circuit Builder (really helpful!)
Link #2 – D is for Diode
Link #3 – Another Circuit Builder (this one shows voltage and current)
Link #4 – Falstad Circuit Builder (fairly advanced, it will make more sense after each workshop)
Link #5 – Switch tutorial (Sparkfun is a great website)