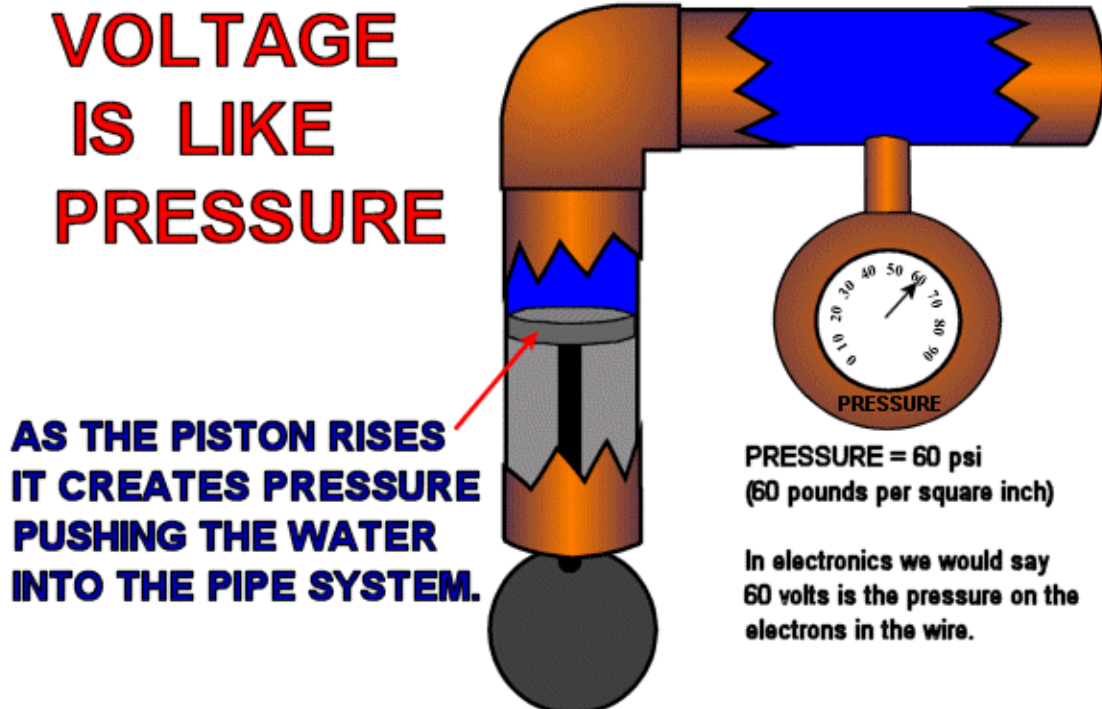


Basic Electricity and the Water Pipe Analogy

Let's start by first defining a few electronic parameters and compare them to their water pipe counterparts. The Figure below shows that Voltage in Electronics is similar to Water Pressure in a water pipe.



A GENERATOR PUSHES ELECTRONS INTO A WIRE.

Voltage = Force that Moves Electrons (sometimes called the electromotive force or EMF)

Pressure = Force that moves water (sometimes called pounds per square inch or psi.)

Now let's look at another electronic parameter called current and compare it to the flow of water in a water pipe. Current in Electronics is similar to Water Flowing in the water pipe shown above.

Current in Electronics = A measure of electron movement (Amperes or Amps is a measure of the number of negative charges per second that are passing a given point in an electronic circuit)

Flow Rate = A measure of water movement (GPM or Gallons per Minute is the measure of the amount of water that passes a given point in a mechanical system each minute)

A few basic electronic components and their mechanical counterparts:

SWITCH SYMBOLS

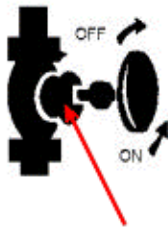


Normally Closed Switch



Normally Open Switch

THE SWITCH TURNS VOLTAGE ON & OFF



**THE WATER VALVE
TURNS WATER
PRESSURE ON & OFF**



The Switch: Since you don't want to waste water when you are not using it, you have a faucet or valve to turn the water on and off. Similarly, an electronic switch turns the electricity on and off in an electrical circuit. A switch connects ("on") or disconnects ("off") the wires in a circuit from the battery or other voltage source. This removes ("off") or connects ("on") the force that pushes the electrons through the wires in the electronic circuits.

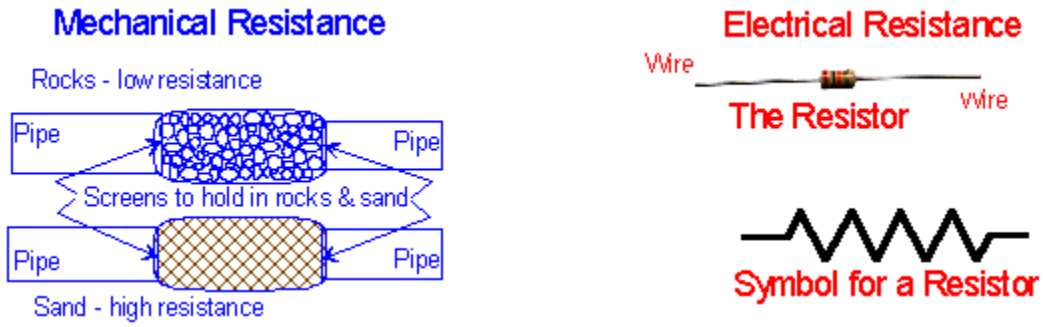


Figure 4

The Resistor: Why is the water pipe that goes to your kitchen faucet smaller than the one that comes to your house? And why is it much smaller than the main water pipe that supplies water to your entire town? Because you don't need that much water! The pipe size limits the amount of water you can get per minute (Gallons per Minute or GPM). Electricity works in a similar manner, but wires have so little resistance they would have to be super thin to limit the flow of those very, very tiny electrons. Water flow through a pipe can also be restricted by filling the pipe with rocks. This would reduce the gallons per minute that would pass through the pipe for the same pressure at the input of the pipe. If the pipe was filled with sand it would offer even greater *Resistance* to the flow of water. In electronics there is a component called the *Resistor* that is the counterpart of the rock and sand filled pipes. Resistors control how many electrons per second can flow through the resistor for a given voltage across the resistor. Electrical resistance is measured in ohms in honor of an electronic scientist named George Simon Ohm (1787-1854). His formulation of the relationship between current, voltage, and resistance is the basic law of current flow. To increase the gallons per minute through a pipe you would increase the pressure across the pipe or reduce the resistance of the pipe. To increase the **amps** through a **resistor** you need to increase the **voltage** across the resistor or reduce the value (**ohms**) of the resistor. This phenomenon is known as "Ohm's Law". Mathematically Ohm's law is written as:

$$V = I R$$

Where V = Voltage, I = Current, and R = Resistance

Open circuits are the same as pinching a hose and preventing the water from flowing. **AN OPEN CIRCUIT IS NOT THE SAME AS AN OPEN WATER PIPE!** An open water pipe is equivalent to a short circuit because water flows freely and the pressure drops to zero.