Week_4

Trinity Robotics

09/06/2023

Today we are going to learn from the slide about a couple topics,
With a focus on Electronics.
We will watch a short video, take a in class quiz,
And have a Hands On Demonstration.

Nanorobots

Nano-robots or nanobots are robots scaled down to microscopic size in order to put them into very small spaces to perform a function. Currently nanobots are still in the developmental stage. Future nanobots could be placed in the blood stream to perform surgical procedures that are too delicate or too difficult for standard surgery. Nanobots could fight bacteria by tracking down and eliminating each bacterial cell or could repair individual organ cells in the body.

Imagine if a nanobot could target cancer cells and destroy them without touching healthy cells nearby. Nanobots would probably carry medication and surgical tools on board. They would need to be able to navigate through the human body and then find their way out too. Nanobots could be used in other situations too. Tiny nanobot gears and tools could allow construction of objects at the tiniest of scale. Some of the things we only imagine in science fiction could one day be reality. Maybe you will one day be a scientist who works with nanobots.

Artificial intelligence is also known as machine intelligence or AI for short. Some computers and robots have been given the opportunity to act with human-like behavior. Face recognition software, complicated scheduling software, or computer games that give players a response based on the players actions are all forms of artificial intelligence. The goal for AI was, at one time, to recreate the intelligence of a human being. At the present time, insect intelligence is the focus of research and development because insects and their behavior are easier to mimic. Nanobots could be based on insect behavior, working in swarms together to perform a function.

Some robots and computers have been given the ability to learn and to use information from previous activities to make future decisions. A

previous activities to make future decisions. A robot that fills a box with cookies might be able to "count" the number of cookies in the box, or a computer could determine the amount of traffic on a street to calculate when to change the light. This science is in the early stages, but robots are being developed that can make decisions in order to serve food, translate words from one language to another, and get information from outside resources to solve problems.

Robot Limitations

Unlike in the movies, Robots are unable to think or make decisions; they are only tools to help us get things done. Robots are machines with programed movements that allow them to move in certain directions or sequences. Artificial intelligence has given robots more ability to process information and to "learn." But, they are still limited by the information that they are given and the functions they are given to perform.

A robot contains many components, and electronics plays an important part.

What is electronics?

Electronics is the branch of science that deals with the study of flow and control of electrons (electricity) and the study of their behavior and effects in vacuums, gases, and semiconductors, and with devices using such electrons.

What is Electricity?

Electricity is a type of energy that can build up in one place or flow from one place to another. When electricity gathers in one place it is known as **static electricity** (the word static means something that does not move); electricity that moves from one place to another is called **current electricity**.

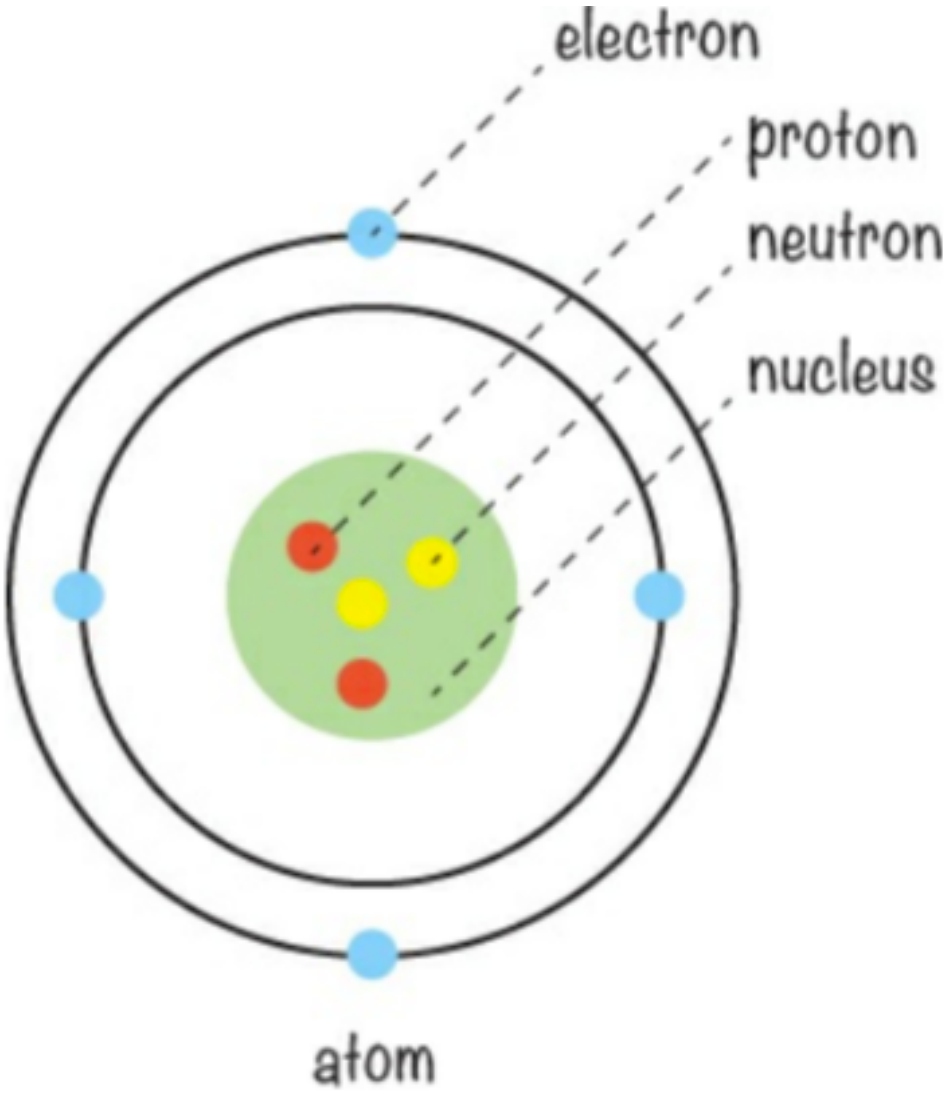
If you've ever sat watching a thunderstorm, with mighty lightning bolts darting down from the sky, you'll have some idea of the power of electricity. A

bolt of lightning is a sudden, massive surge of electricity between the sky and the ground beneath. The energy in a single lightning bolt is enough to light 100 powerful lamps for a whole day or to make a couple of hundred thousand slices of toast!

Electricity is the most versatile energy source that we have; it is also one of the newest: homes and businesses have been using it for not much more than a hundred years. Electricity has played a vital part of our past. But it could play a different role in our future, with many more buildings generating their own renewable electric power using solar cells and wind turbines. Let's take a closer look at electricity and find out how it works!

Current electricity

When electrons move, they carry electrical energy from one place to another. This is called **current electricity** or an **electric current**. A lightning bolt is one example of an electric current, although it does not last very long. Electric currents are also involved in powering all the electrical appliances that you use, from washing machines to flashlights and from telephones to MP3 players. These electric currents last much longer.



What Is an Electron?

Everything you see around you is made of *atoms*, which are particles so small you can't see them without a special type of microscope. But atoms are made of even smaller particles, called *protons*, *neutrons*, and *electrons*.

Protons and neutrons form an atom's *nucleus* (its center), and electrons orbit the nucleus like planets orbiting the sun. Protons and electrons are both *electrically charged*: protons have a positive charge, and electrons have a negative charge. That's why the electrons stick with an atom in the first place. The positive and negative charges act like opposite sides of a magnet and attract each other.

Now lets watch a short video about ATOMs.

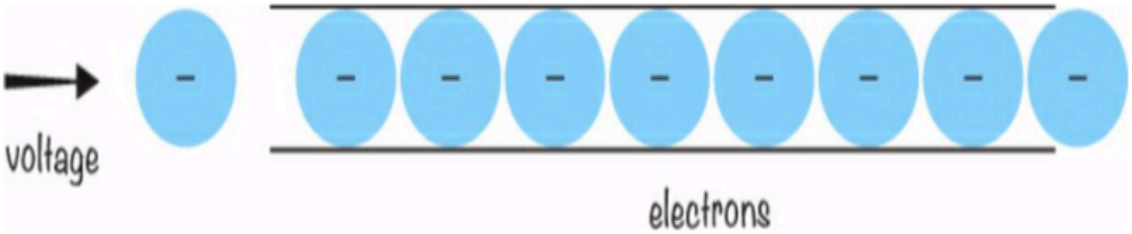
1https://www.youtube.com/watch?v=pNroKeV2fgk

[What is an atom | Matter | Physics | FuseSchool]

Voltage Pushes Electrons

When you attach a battery to the light bulb, you're applying a *voltage* across the filament inside. Voltage pushes electrons through the wire and is measured in *volts (V)*. The higher the voltage, the more electrons will flow through the wire.

Think of a wire like a tube filled with marbles: when you put a marble in on one side, a marble pops out on the other side at the exact same time, with no delay.



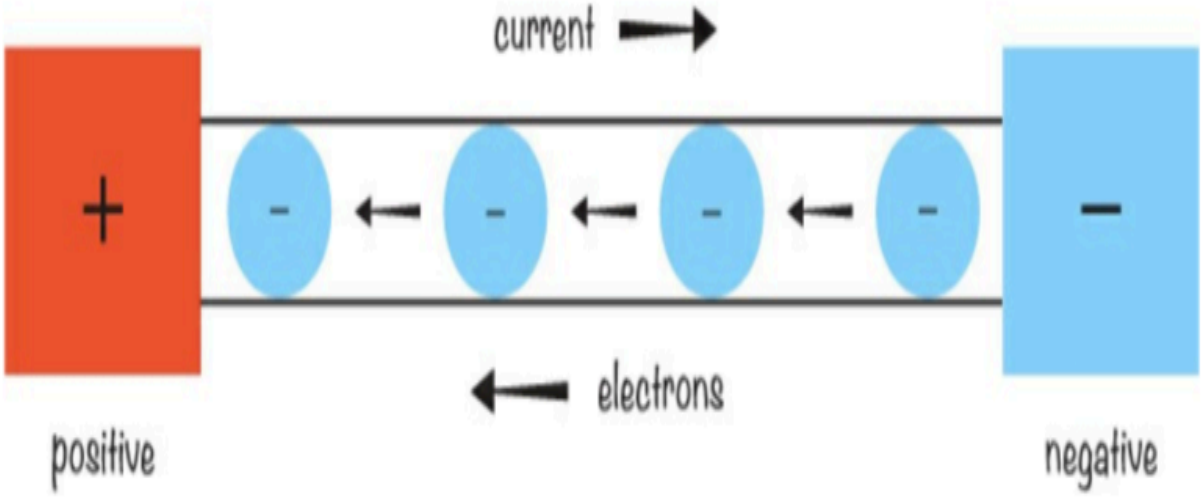
The more marbles you push in one side, the more pop out of the other. That's how electrons behave inside a wire, when a voltage is applied to them.

Current Flows

Current is the amount of electrons flowing through a wire, and it's measured in *amperes (A)*, which we usually shorten to *amps*. You might have also heard the word *current* used to describe a river, as in "This river has a strong current." That means there's a lot of water moving down the river.

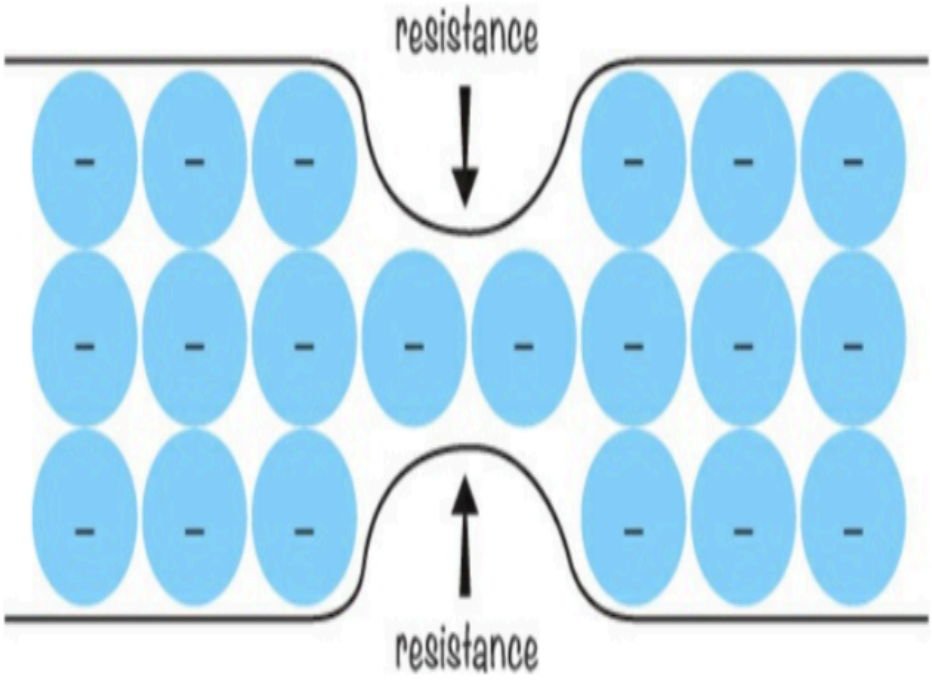
Electrical current is similar: a strong current means there are a lot of electrons flowing through a wire. When you increase the voltage in a circuit, the current also increases.

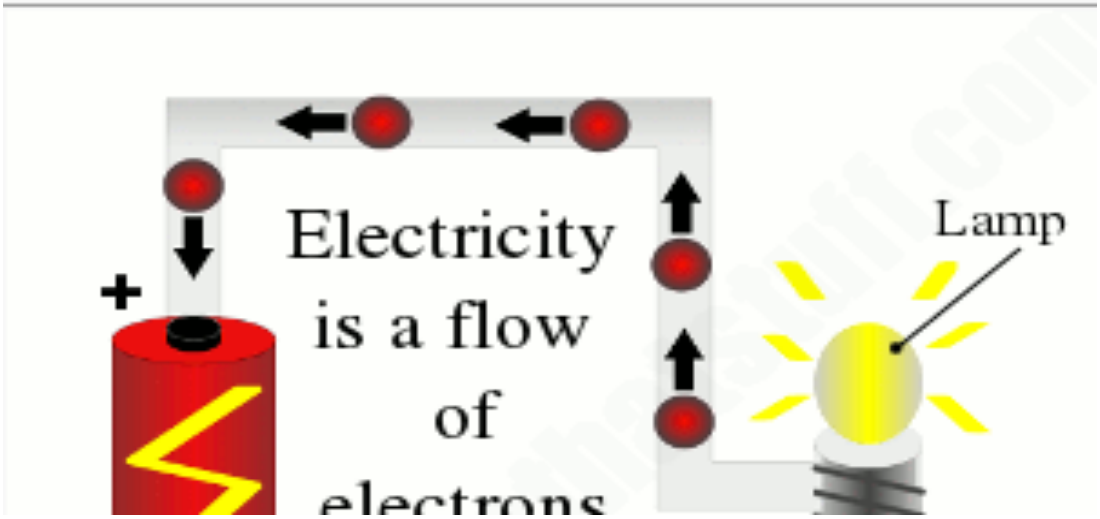
Just as water flows downhill due to gravity, electric current flows from the positive battery terminal toward the negative battery terminal. Actually, the electrons themselves flow in the opposite direction, from the negative side of your battery to the positive side.* But when we talk about electrical current, we say that it flows from positive (+) to negative (–).

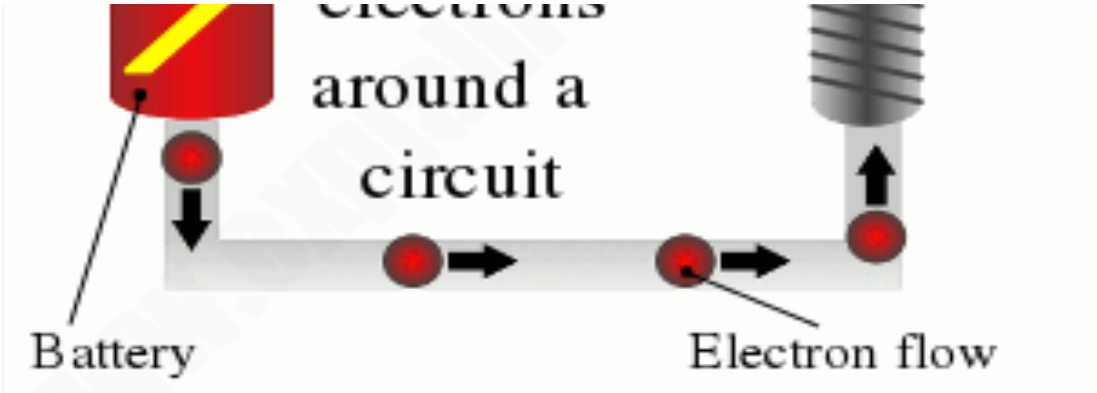


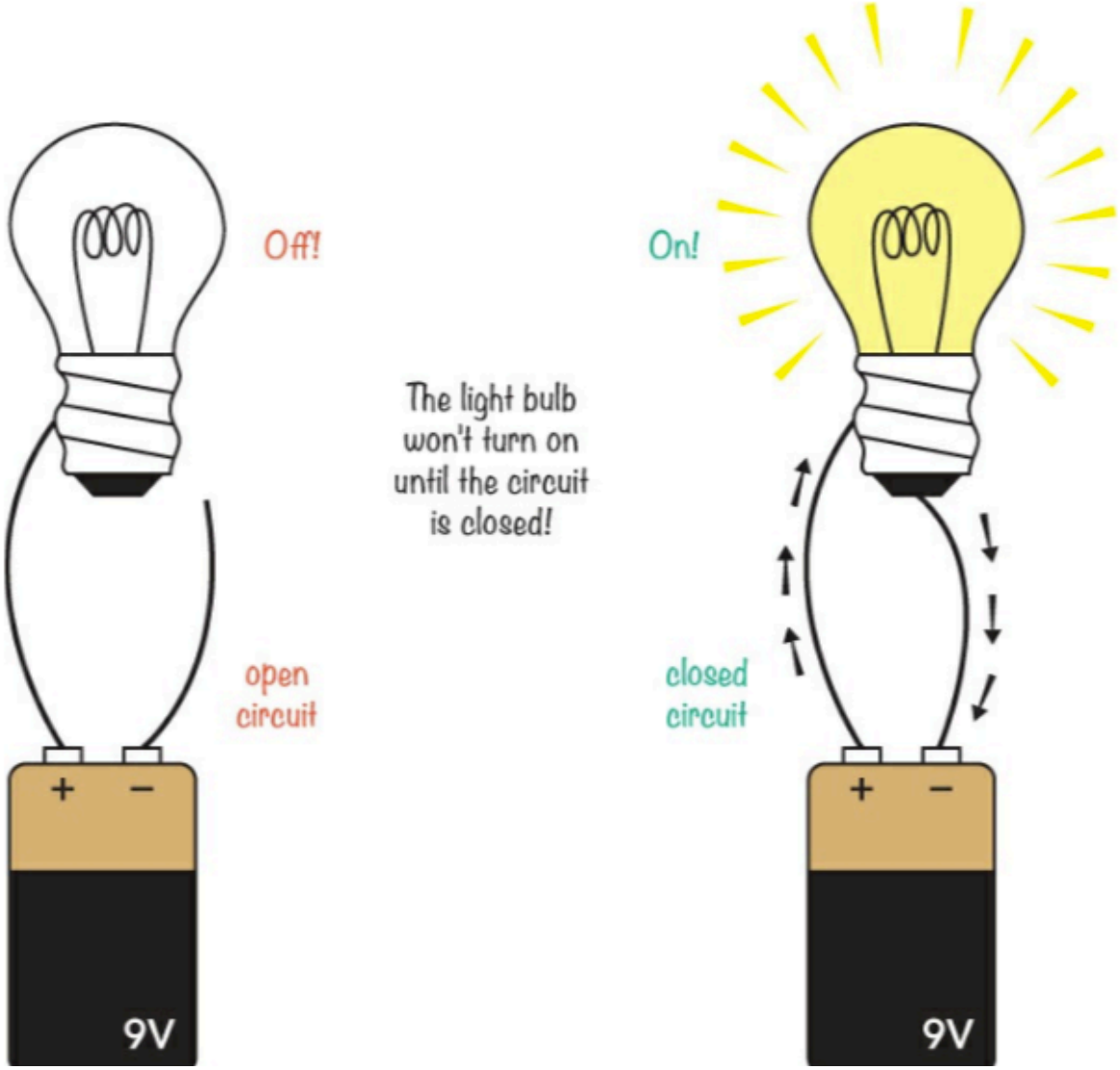
Resistance Reduces Current

Voltage pushes electrons to form a current, and *resistance* restricts the current. It's like playing with a garden hose: if you squeeze the hose, you add resistance to the flow of water so that less water comes out. But if you turn the tap more (like increasing the voltage), the pressure increases, and more water flows even though you're still squeezing the hose in the same way. Resistance in electricity works just like this, and it's measured in *ohms* (Ω).






around a
circuit
Battery
Electron flow


Off!
open
circuit
+
−
9V
The light bulb
won't turn on
until the circuit
is closed!
On!
closed
circuit
+
−
9V

Ohm's Law

One of the most important and basic laws of electrical circuits is Ohm's law which states that the current passing through a conductor is proportional to the voltage over the resistance.

Equation

Ohm's law may sound a bit confusing when written in words, but it can be described by the simple formula:

$$V = i * R$$

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

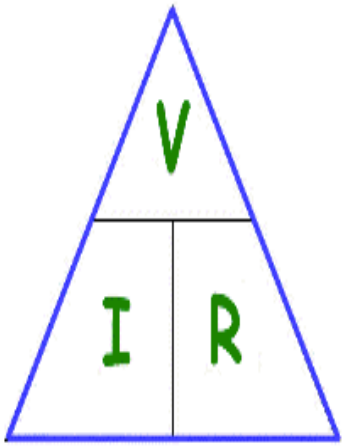
where I = current in amps, V = voltage in volts, and R = resistance in ohms

This same formula can be also be written in order to calculate for the voltage or the resistance:

$$I = \frac{V}{R} \quad \text{or} \quad V = IR \quad \text{or} \quad R = \frac{V}{I}$$

Triangle:

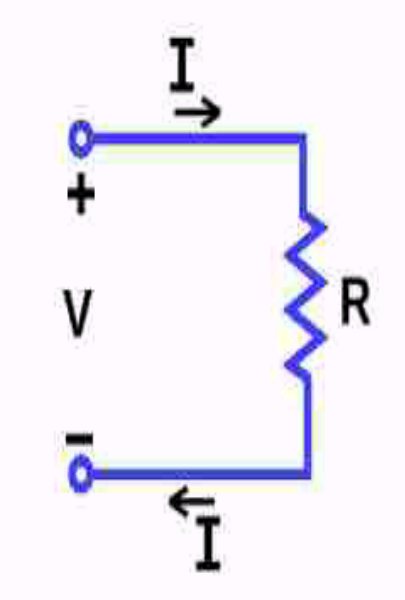
If you ever need help in remembering the different equations for Ohm's law and solving for each variable (V, I, R) you can use the triangle below.



As you can see from the triangle and the equations above, voltage equals I times R, current (I) equals V over R, and resistance equals V over I.

Circuit Diagram

Here is a diagram showing I, V, and R in a circuit. Any one of these can be calculated using Ohm's law if you know the values of the other two.



How Ohm's Law Works

Ohm's law describes the way current flows through a resistance when a different electric potential (voltage) is applied at each end of the resistance. One way to think of this is as water flowing through a pipe. The voltage is the water pressure, the current is the amount of water flowing through the pipe, and the resistance is

the size of the pipe. More water will flow through the pipe (current) the more pressure is applied (voltage) and the bigger the pipe is (lower the resistance).

Example Problems

1. If the resistance of an electrical circuit is increased, what will happen to the current assuming the voltage remains the same?
$I = V / R$

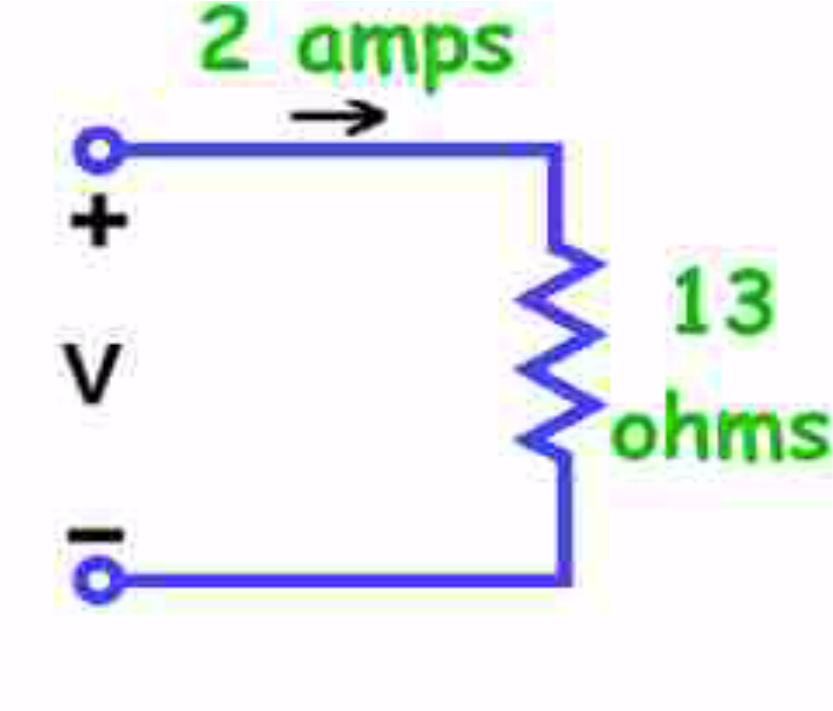
Answer: The current will decrease.

2. If the voltage across a resistance is doubled, what will happen to the current?

Answer: The current will double as well.

Explanation: If you look at the equation V= IR, if R stays the same then if you multiple V*2 (double the voltage), you must also double the current for the equation to remain true.

3. What is the voltage V in the circuit shown?



Answer: V = I * R = 2 x 13 = 26 volts

Interesting Facts about Ohm's Law

- It is generally applied only to direct current (DC) circuits, not alternating current (AC) circuits. In AC circuits, because the current is constantly changing, other factors such as capacitance and inductance must be taken into account.
- The concept behind Ohm's law was first

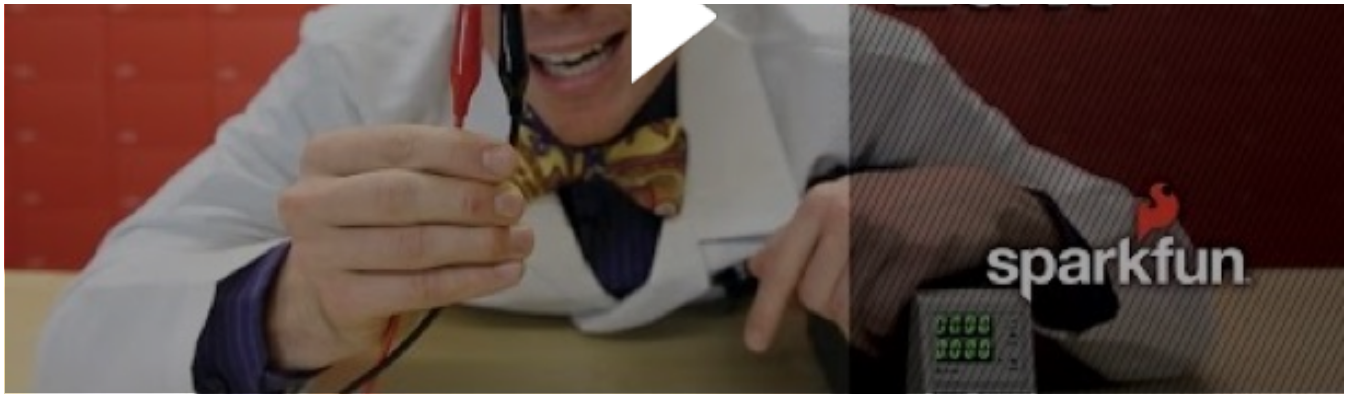
explained by German Physicist Georg Ohm who the law is also named after.

- The tool for measuring volts in an electric circuit is called a voltmeter. An ohmmeter is used for measuring resistance. A multimeter can measure several functions including voltage, current, resistance, and temperature.

1https://youtu.be/8jB6hDUqN0Y

What does the word impede mean?

Answer: to reduce or prohibit.



1) According to Ohm's Law, current equals the voltage divided by the _____.

- Resistance
- Inductance
- Capacitance
- Power
- Conductance

2) What equation would you use to solve for voltage?

- V = I/R
- V = PR
- V = CI

- V = IR
- V = R/I

3) What does the letter 'I' stand for in Ohm's Law?

- Resistance
- Inductance
- Capacitance
- Voltage
- Current

4) What does the letter 'R' stand for in Ohm's Law?

- Resistance
- Inductance
- Capacitance
- Reactance
- Rate of change

V = I * R

5) If the current in an electrical circuit is constant, what will happen to the voltage if the resistance is increased?

- The voltage will decrease
- The voltage will increase
- The voltage will stay the same

V = I * R
V / R = I
10 / 5 =

6) If there are 10 Volts across a 5 Ohm resistor, what is the current?

- 0.5 Amps
- 1 Amp
- 2 Amps
- 15 Amps
- 50 Amps

7) If there are 40 Volts and 5 Amps running through an electrical circuit, what is the resistance of the circuit?

R=V / I
R = 40 / 5

- 1 Ohm
- 2 Ohms
- 4 Ohms
- 6 Ohms
- 8 Ohms

V = I * R
V = 7 * 3

8) If there are 7 Amps running through a 3 Ohm resistor, what will the voltage be across the resistor?

- 2.5 Volts
- 10 Volts
- 17 Volts
- 21 Volts
- 42 Volts

V = I * R
I = V / R

I = V / R
R = V / I

9) If you increase the voltage across a resistor, what will happen to the current?

- The current will decrease
- The current will increase
- The current will stay the same

10) If you increase the size of the resistor and keep the voltage the same, what will happen to the current?

- The current will decrease
- The current will increase
- The current will stay the same

Hands On Demonstration -

Next we are going to do a hands on demonstration
I would like some volunteers to help me with this.

1) Make an Atom using pennies
(Lets see the electrons going around).

2) Now make a 2nd atom similar to the first, and lets see an electron flowing between the two atoms showing a small current.

3) Our Goal is to simulate:
** Electronic Current - (Flow of Electrons)

Also to understand how resistance works.

4) (Time permitting) - multimeter demonstration <resistance>