Module 7: Electricity - Currents and Circuit
Topic 3 Content: Current and Ohm's Law

Current

Electric current is the rate of charge flow, or the number of coulombs of charge that pass a point per second.

The symbol for electric current is capital I. Current is calculated by dividing charge by time. The S I unit of current is the Ampere and 1 Ampere is equal to 1 coulomb of charge per second.

Often ampere is shortened to amp when people talk about current.

The unit of electric current is the Ampere, named after Andre-Marie Ampere. Ampere was one of the discoverers of electromagnetism.

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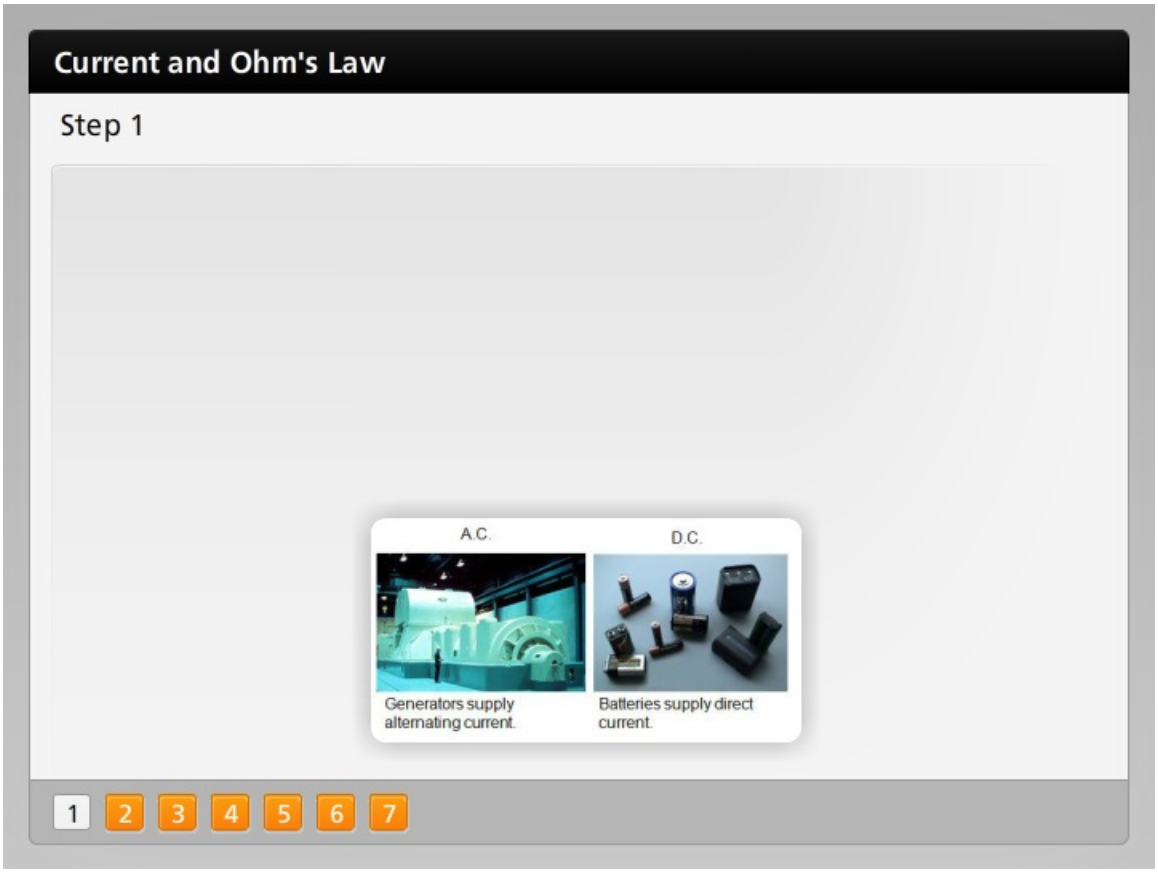
Step 1

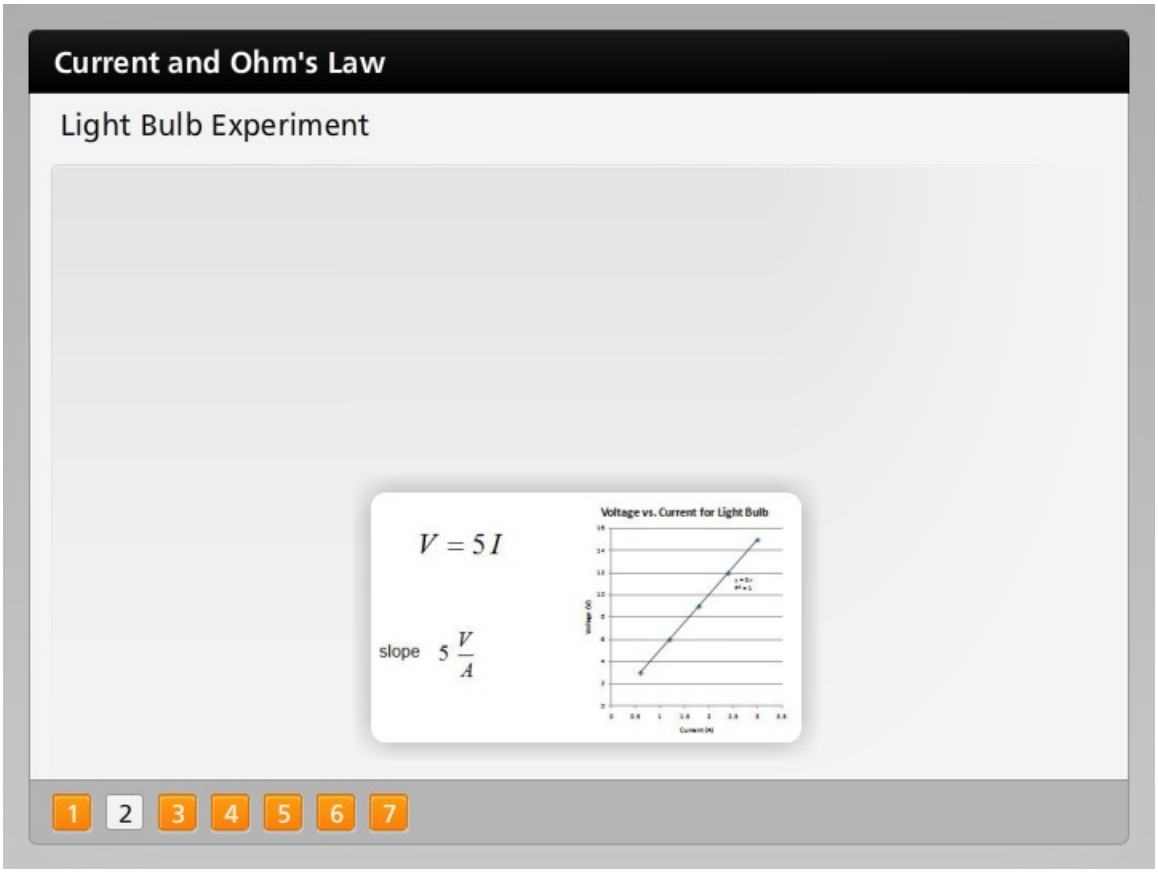


There are two different types of current. D C stands for direct current. Direct current is electric current that flows in one direction. This is the type of current provided by batteries.

A C stands for alternating current. Alternating current is electric current that changes direction. In the United States, our household appliances operate on alternating current. Our alternating current changes direction sixty times per second. Alternating current is supplied by generators.

In this module you will analyze circuits that use direct current.

Light Bulb Experiment



From your analysis of the voltage and current data for the light bulb in the warm up activity, you should have seen that there is a linear relationship between voltage and current. This type of relationship is also called a direct proportion. In the example graph, the five is the constant of proportionality or the slope of the graph. The slope of the graph tells you how difficult it is for the voltage source to push charges through the circuit. If we did the experiment again for another light bulb, the slope could be bigger or smaller. The bigger the slope, the harder it is to push charge through the circuit. The physics term we use to describe how difficult it is to push charge through something is resistance. In this example, the resistance of the bulb is five. But what are the units?

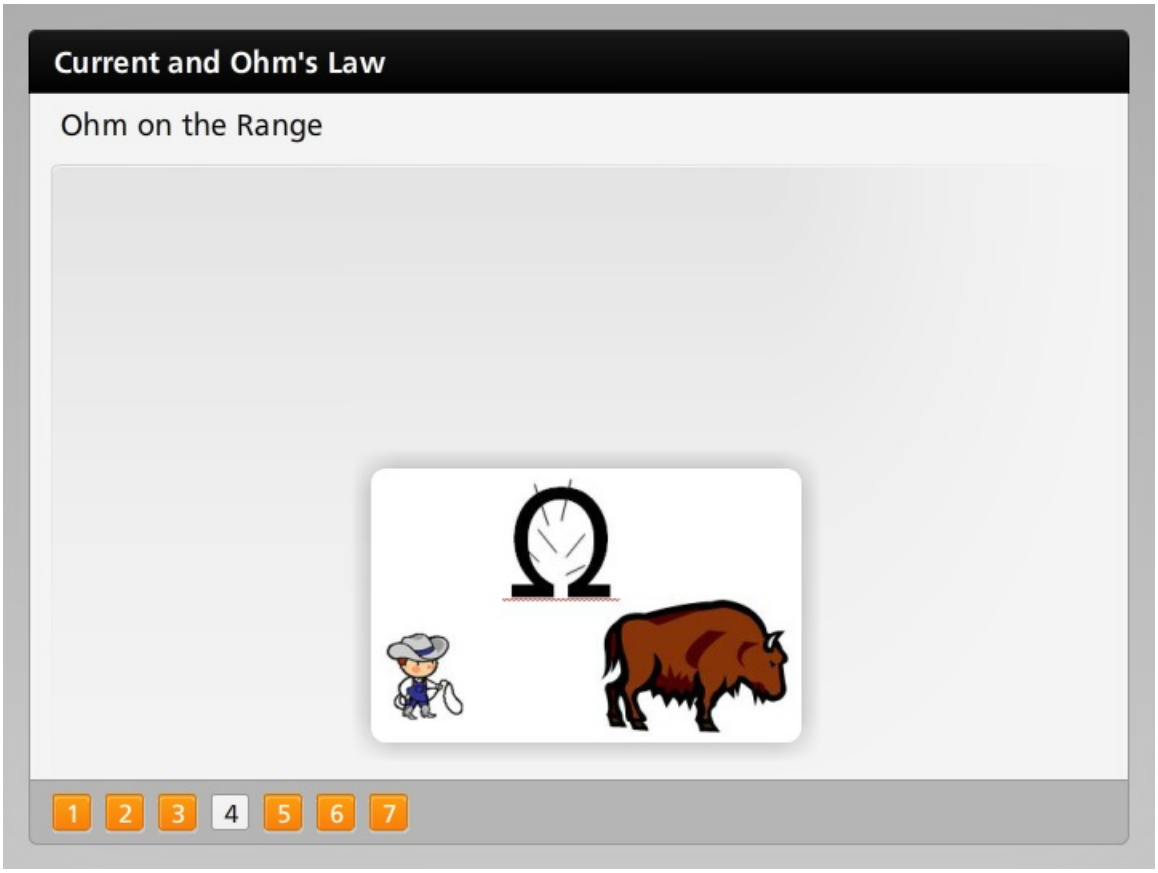
You may recall from previous graph analysis that the units of the slope are always y-axis units divided by x-axis units. In this case, the units are volts divided by amperes.

The Ohm

Georg Simon Ohm discovered the relationship between current and voltage that we call Ohm's Law in 1827. The unit of electrical resistance is named for him. One ohm is defined as one volt per ampere. The symbol for ohm is the capital greek letter omega.

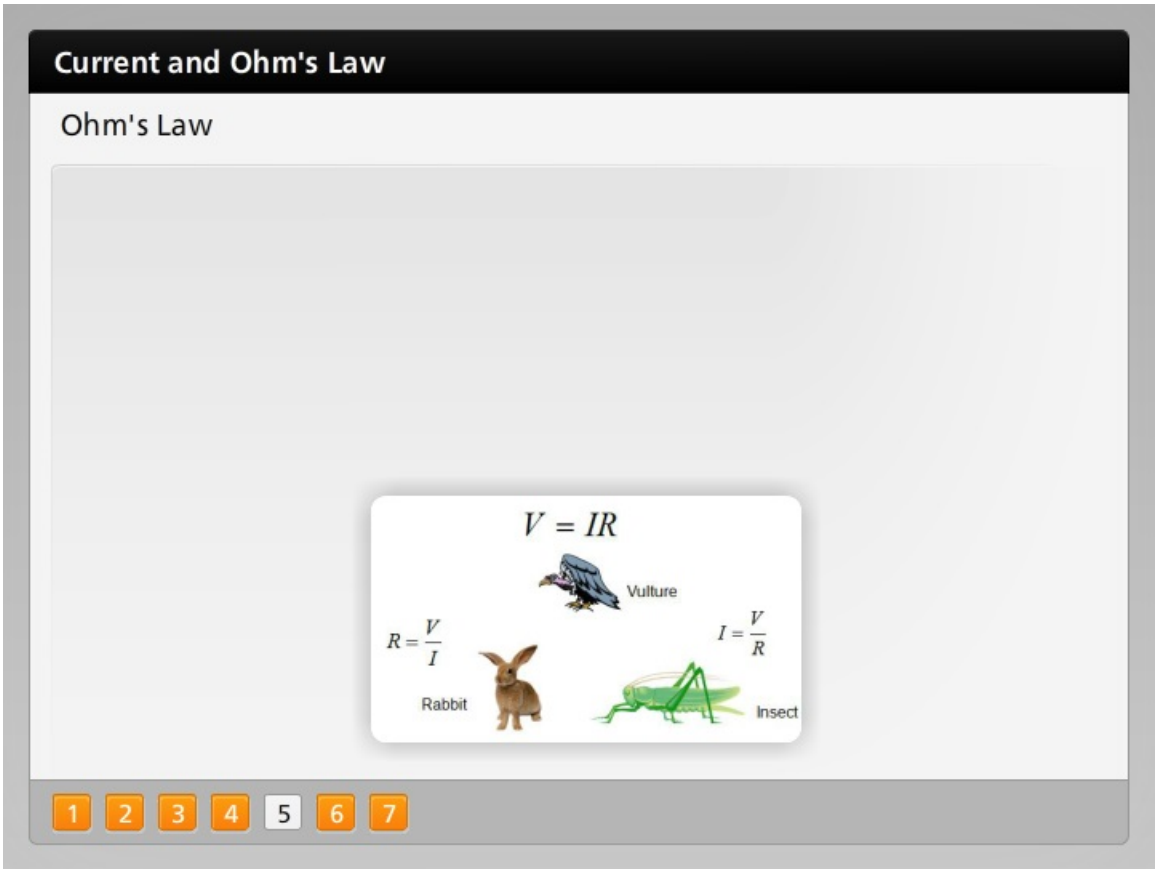
So we can see that the units of the slope on our previous graph were ohms. The slope of the graph represents the resistance of the light bulb.

Ohm on the Range



If you have trouble remembering the names of these strange symbols, here is a little cartoon. What do you call this? I call it ohm on the range because the ohm reminds me of a cactus.

Ohm's Law



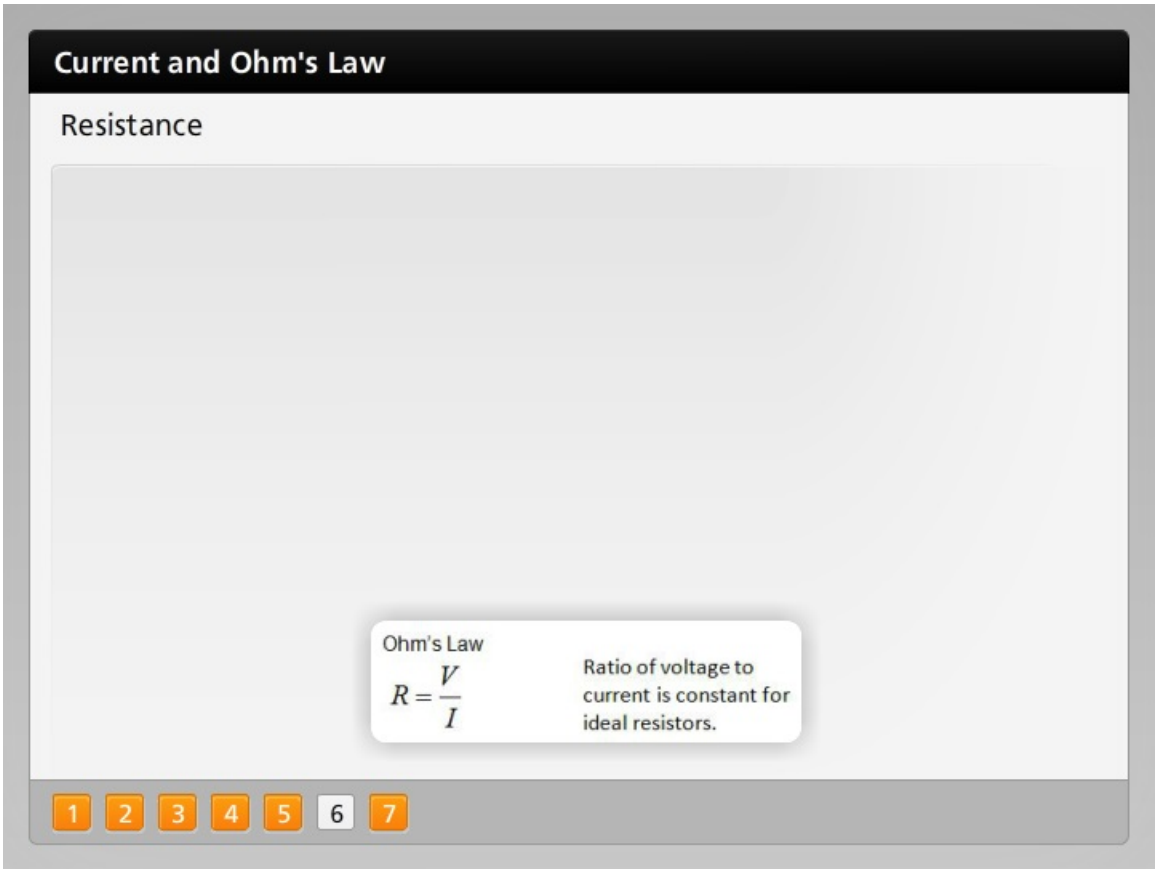
The relationship between current, voltage and resistance is called Ohm's Law. Ohm's law is usually written as V equals I times R.

Here is a silly mnemonic for remembering Ohm's Law. Let's let the v be a vulture, the r be a rabbit, and the I be an insect. The vulture is a bird so he is in the air, while the rabbit and the insect are on the ground. So, when the Vulture looks down he sees the insect next to the rabbit, or V equals I times R.

The usefulness of the mnemonic is for when you need to use Ohm's Law to find I or R. If you think about what each creature sees, you can remember it. For example, the rabbit looks over and sees the vulture over the insect, or R equals V over I. And the insect sees the vulture over the rabbit, I equals V over R.

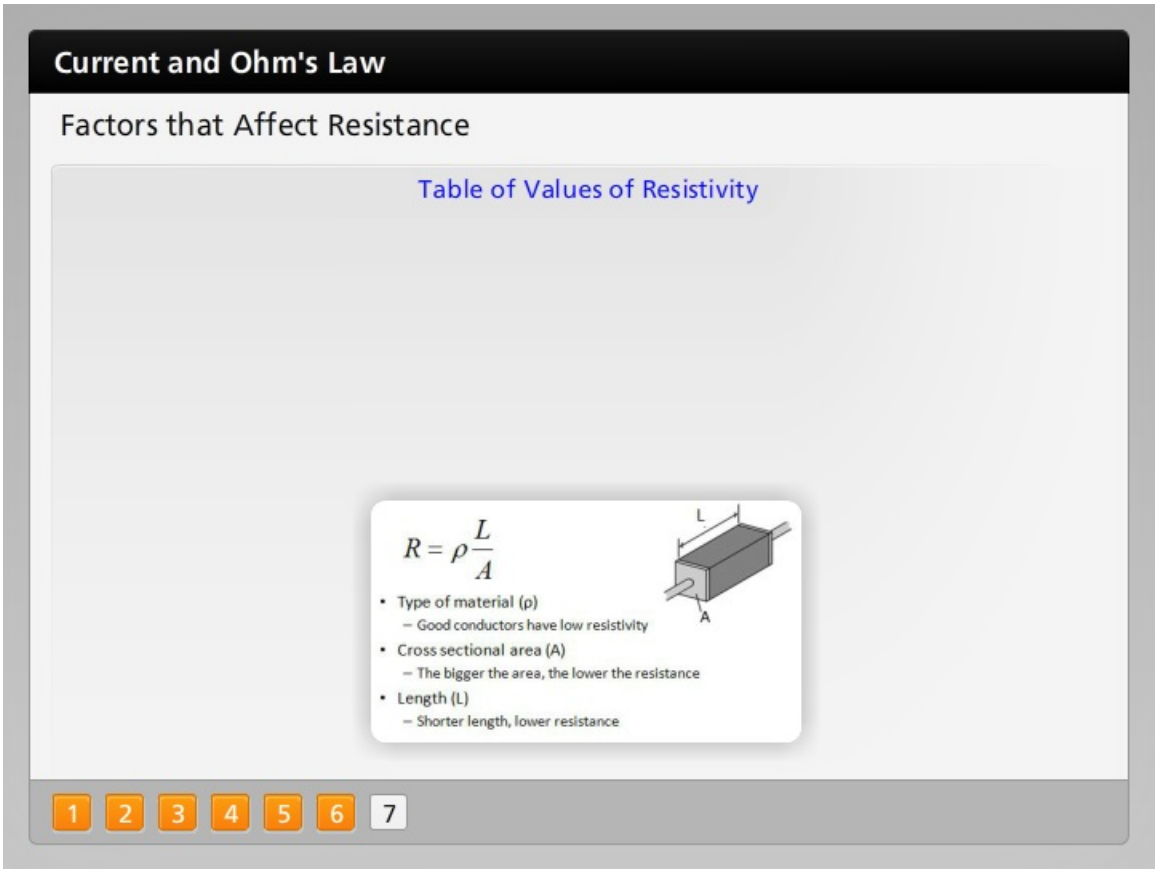
You will use this equation a lot in this module so it will be easier if you can remember the different versions without solving the equation each time.

Resistance



So now we know that resistance is the ratio of voltage to current, or R equals V over I. This way of finding resistance is based on measuring voltage and current. For ideal resistors, this ratio of voltage to current stays constant according to Ohm's Law. But resistance is determined by physical properties, not by voltage and current.

Factors that Affect Resistance



What physical properties affect resistance? The type of material is a factor, you probably already know that some materials are better conductors than others. For example, you would not use a rubber band to conduct electricity because rubber is not a good conductor. Instead we use copper because copper is a good conductor. The property that distinguishes rubber from copper by their resistance to current flow is called resistivity.

The resistivity of the material, represented by the greek letter rho, describes how strongly a material opposes the flow of current. Materials with high resistivity are poor conductors of electricity. So rubber has a much higher resistivity than copper. You can click on the link to look at this table of values of resistivity.