Here's the extremely short answer. Voltage pushes electric charges through wires, and also through an electrical resistance, which heats up the resistive object. The flow of the charges is measured in amperes, the flow of electrical energy into the resistive object and the heat output is measured in watts, and the resistance is measured in ohms. Amperes and Watts are two different kinds of flow, yet both happen in circuits.

How are Watts different than Amps?
Amps and Watts are not the same, because charge is not energy. Huh? It's because Amps are a measure of the flow rate of charge, while Watts are a measure of the flow rate of energy.
Watts are a measure of *energy* flow, and a "watt" is just a shorthand name for "Joules of energy per second." Keep in mind that Watts are not like a stuff, watts do not flow, watts are a measurement of the flow of something else: electrical energy. Joules of electrical energy can flow along, and their rate of flow is called "Watts." If you have twenty Joules of energy flowing in a circuit per second, then that's a flow of twenty Joules/second, also called twenty Watts. (Maybe it would be less confusing if we stopped using the word "watts" entirely, and just said "joules per second" all the time.)
Amperes are a measure of *charge* flow, and an "amp" is just a shorthand name for "Coulombs of charge flowing per second." Keep in mind that Amps are not like a stuff, ampls do not flow, amps are a measurement of the flow of something else. Coulombs of charge can flow along inside of wires, and their rate of flow is called "Apms." If you have twenty Coulombs of charge flowing in a circuit per second, then that's a flow of twenty Coulombs/second, also called twenty Amps.
Another way to think about it: In power lines and in AC cords, "amps" are a wiggling flow, while "watts" are a one-way flow. The charge within an AC wire is 'alternating', or wiggling back and forth while sitting in place. The back-and-forth wiggling is measured in terms of amperes. On the other hand, electrical energy in an AC cord does not wiggle, and it does not sit in place. Instead it flows from the source to the load at almost the speed of light. This fast energy flow is measured in terms of Watts. Also see:

1. Charge vs. Energy, two things are flowing

- If we know the precise amount of electricity flowing per second through a wire (the Amperes,) this tells us nothing about the amount of energy being delivered per second (the Watts.) An electric current is not a flow of energy; they are two different things.
- In an electric circuit, the flow of the *electricity* is measured in Coulombs per second (Amperes.) The flow of *energy* is measured in Joules per second (Watts.) A Coulomb is not a Joule, and there is no way to convert from Coulombs to Joules or from Amperes to Watts. A quantity of electricity is not a quantity of energy.

A battery or generator is like your heart: it moves blood, but it does not create blood. When a generator stops, or when the metal circuit is opened, all the electrons stop where they are, and the wires remain filled with electric charges. But this isn't unexpected, because the wires were full of vast quantities of charge in the first place.

First watts and amperes. These are somewhat confusing because they are the names off lows, but we never talk about the STUFF that flows. Electric current isn't a stuff, electric current is the flow *of* a stuff. What is the name of the stuff? Charge.

AMPERES

What flows in wires?

- Charges
- Electrons
- "Charge-stuff"

A quantity of charge is measured in units called COULOMBS, and the word "ampere" means the same thing as "coulomb of charge flowing per second." Why do I think amperes are confusing? Well, suppose you had no name for water, yet your teachers wanted you to learn about "fluid flow". Suppose you had to learn about "gallons-per-second," but without knowing anything about water, or about gallons. If you'd never learned the word "gallon", and if you had no idea that water even existed, how could you understand "fluid flow?" That's the problem with electricity and amperes. You can only understand the flow (the amperes) if you first understand the stuff that flows in wires: the charge, the coulombs.

CHARGE

"Charge" is the stuff inside wires, but usually nobody tells you that ALL METALS are full of charge. Always. A hunk of metal is like a tank full of water, and the "water" is the movable electric charge inside it. In physics classes we call this "the electron sea" or even "electric fluid." This charge is part of all metals. In copper, the electric fluid is the outer electrons of all the copper atoms.
The movable charge-stuff within metals gives them their silvery color. We could even say that charge-stuff is like a silver liquid (at least it is silver when it's in metals.)
Note that this charge is "uncharged", it is neutral. Is this impossible? No. The charge inside of metals is neutral because each electron has a corresponding proton nearby, and the fields from the opposite charges cancel out. The charge is cancelled, but this doesn't mean that the charge-stuff is gone! Even though the charge inside a metal is cancelled out, we can still force it to flow along. We can make the electrons flow past the protons.

ELECTRIC CURRENT

When the charge-stuff within metals is forced to flow, electric currents are created. We measure the currents in terms of amperes. The faster the charge-stuff moves, the higher the amperage. Also, the MORE charge-stuff that flows (through a bigger wire) the higher the amperage. A fast flow of charge through a narrow wire can be the same current as a slow flow of charge through a bigger one.
Here's a way to visualize it. Bend a metal rod to form a ring, and weld the ends together. Remember that all metals are full of "liquid" charge. If you push a magnet's pole into this ring, the magnetic forces will cause the electron-stuff within the ring to turn like a wheel (as if the ring contained a movable drive-belt). By moving the magnet, we pump the charges, and the charges flow. That's how electric generators work.
Generators are magnet-driven charge pumps. The moving magnetic fields push the wire's charges, creating the amperes, but this only occurs when a complete circuit is present. Break the ring and you create a blockage, since the charges can't easily jump across the break in the ring. A complete ring is a simple electric circuit. Cut the ring and install a battery in the cut, and the battery can pump the ring's charge-stuff in a circle. Make another cut, install a light bulb, and the "friction" of the narrow filament against the flowing charge-stuff creates high temperatures, and the wire filament inside the bulb glows white-hot.
Important note: the charge-stuff flows extremely slowly through the wires, slower than centimeters per minute. Amperes are an extremely slow, circular flow. See SPEED OF ELECTRICITY for info.

WATTS

"Watts" have the same trouble as amperes. They are the name of an electrical flow, but what does the flowing? Energy. A "watt" is just a fancy way of saying "quantity of electrical energy flowing per second." But what is a quantity of energy? Quantities of energy are measured in Joules. A joule of electrical energy can move from place to place along the wires. When you transport one joule through a channel every second, the flow-rate of energy is 1 Joule/Sec, and "one Joule per second" means "one watt."
What is power? The word "power" means "energy flow." It might help you to avoid thinking about "power" at the start. If you first practice thinking in terms of energy flow instead of power, and joules per second instead of watts, eventually you'll gain a good understanding. Once you know what you're talking about, then you can start speaking in shorthand. To use the shorthand, don't say "energy flow", say "power." And say "watts" instead of "joules per second." But if you begin by saying "power" and "watts", you might never really learn what these things are, because you never really learned about energy flow.

FLOWING ELECTRICAL ENERGY

OK, what then is electrical energy? It has another name: electromagnetism. Electrical energy is the same stuff as radio waves and light. It is composed of magnetic fields and electrostatic fields. A joule of radio waves is the same as a joule of electrical energy. What does this have to do with understanding electric circuits? Quite a bit! But I'll come back to this later.
How is electric current different than energy flow? Let's take our copper ring again; the one with the battery and the light bulb. The battery injects joules of energy into the ring, and the light bulb takes them out again. Joules of energy

flow between the battery and the bulb. They flow at nearly the speed of light, and if we stretch our ring until it's thousands of miles long, the light bulb will still turn off immediately when the battery is removed. Well, not IMMEDIATELY. There will still be some joules moving along the wires, so the bulb will stay on for a tiny fraction of a second, until all the energy arrives. Remove the battery, and the light bulb goes dark ALMOST instantly.

AMPERES ARE NOT A FLOW OF ENERGY

Note that the joules of energy flowed ONE WAY, down BOTH wires. The battery created them, and the light bulb consumed them. This was not a circular flow. The energy went from battery to bulb, and none returned. At the same time, the charge-stuff flowed slowly in a circle within the ring. There you have the difference between amperes and watts. The coulombs flow slowly in a circle, while the joules flow rapidly from an "energy source" to an "energy sink". Amperes are slow and circular, while watts are fast and one-way. Amperes are a flow of copper charges, while watts are a flow of energy created by a battery or generator.

But WHAT ARE JOULES? That's where the electromagnetism comes in. When joules of energy are flying between the battery and the bulb, they are made of fields. The energy is partly made up of magnetic fields surrounding the wires. It is also made from the electric fields which extend between the two wires. The electrical ENERGY flows in the space around the wires, while the electric CURRENT flows inside the wires.

VOLTS

There is a relationship between amperes and watts. They are not totally separate. To understand this, we need to add "voltage". You've probably heard that voltage is like electrical pressure. What's usually not taught is that voltage is part of static electricity. If I grab electrons from a wire, that wire will have excess protons left behind. If I place those electrons into another wire, then my two wires have oppositely imbalanced charge. They have a voltage between them too, and a static-electric field extending across the space between them. THIS FIELD IS THE VOLTAGE. Electrostatic fields are measured in terms of volts/distance, and if you have a field, you always have a voltage. To create voltage, take charges out of one object and stick them in another.

Remember the battery in the copper ring from above? The battery acted as a charge pump. It pulled charge-stuff out of one side of the ring, and pushed it into the other side. This caused a voltage-difference to appear between the two sides of the ring. It also caused an electrostatic field to appear in the space surrounding the ring. And finally, it caused the charge-stuff inside the light bulb filament to begin flowing. In this way the voltage is like pressure. By pushing the charges from one wire to the other, a voltage causes the two wires to become positive and negative. The light bulb provided a path to discharge them again, and this created the flow of charge in the light bulb filament. The battery pushes charge through itself, and this also forces charge to flow through the light bulb filament. But where does energy fit into this? To understand that, we have to know about electrical friction or "resistance" to.

OHMS

Imagine a pressurized water tank. Connect a narrow hose to it and open the valve. You'll get a certain flow of water because the hose is a certain size and length. Now the interesting part: make the hose twice as long, and the flow of water decreases by exactly two times. Makes sense? If we imagine the hose to have "friction", then by doubling its length, we double its friction. (This happens whether the water is flowing or not.) Now suppose we connect a very thin wire between the ends of a battery. The battery will supply its pumping pressure (its "voltage"), and this will cause the charge-stuff of the thin wire to start moving. Double the length of the wire, and you double the friction. The extra cuts the charge flow (the amperes) in half. THE FRICTION IS THE "OHMS", IT IS THE ELECTRICAL RESISTANCE. To change the charge-flow, we can change the resistance of our pice of wire by changing its length. But we can also change the flow by changing the pressure. Add another battery in series. This gives twice the pressure-difference applied to the wire ends. Which doubles the flow. We've just discovered "Ohm's Law", which says that the flow is directly proportional to the pressure difference, and if the pressure goes up, the flow goes up in proportion. It also ways that if the resistance goes up, the flow goes DOWN by a proportional amount. The harder you push, the faster it flows. The bigger the resistance, the smaller the flow (if the push is kept the same.) That's Ohm's law.

Whew. NOW we can get back to energy flow.

VOLTS, AMPS, OHMS, ENERGY FLOW

Lets go back to the ring with the battery and bulb. Suppose the battery grabs charge-stuff out of one side of the ring and pushes it into the other. This makes charges flow around the circle, and also sends energy to the light bulb. It takes voltage to force the charges to flow, and the light bulb offers "friction" or resistance to the flow. All these things are related, but how?

Here's the simplest electrical relation: THE HARDER THE PUSH, THE FASTER THE FLOW. This is called "Ohm's Law", and it is usually written like this:

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        VOLTS/OHMS = AMPERES
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Voltage divided by resistance equals current. Make the voltage twice as large, then the charges flow faster, and you get twice as much current. Make the voltage less, and the current becomes less.

Ohm's law has another feature too: THE MORE FRICTION YOU HAVE, THE SLOWER THE FLOW. If you keep the voltage the same (in other words, keep using the same battery to power your light bulb), and if you double the resistance, then the charges flow slower, and you get half as much current.