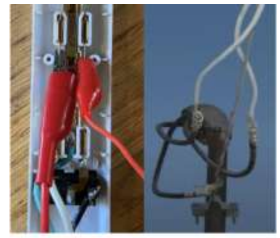
Electricity Related Parts

1. A Complete Circuit



In class, we dissected a power strip to create two separate, unbroken paths of metal: **a path from our battery to each device, and another path from each device back to the battery**. To transfer electrical energy in a building, you also need at least two separate, unbroken paths of metal between the energy source and the device. This is called a **complete circuit** or **closed circuit**. If these paths are broken accidentally or by using a switch, the devices do not work--this is called an **open circuit** or **broken circuit**.

The wires that come into a building are also part of complete circuits. They are connected to power lines like the one shown here--unbroken paths of metal between an energy source and the devices in each building. **Switches** can change a circuit from open to closed and vice versa. We find switches on individual devices, power strips, and even on entire buildings or substations.

2. Circuit Breakers

After wires enter a building, they usually connect to a group of special switches in a panel, called **circuit breakers**, shown to the right.
These switches are usually turned on so the circuits are complete. But they automatically turn off if the energy flowing through the wires becomes unsafe. For example, if there is too much energy flowing into your bathroom when a blow-dryer and a heater are running at the same time, a circuit breaker might flip off, breaking the circuit going to your bathroom and preventing energy flow into those devices. Some outlets have their own circuit breaker installed that's called a **GFCI**--if a person's body starts to receive a shock from that outlet, the GFCI can respond by breaking the circuit before the person is injured.

3. Insulation

The wires that connect electrical outlets in a building to the electrical circuit panel usually run through the walls, ceiling, and/or floors of a building. The rubber material around these wires (white in the photo) does not transfer electrical energy well. We call these sorts of materials **electrical insulators**. If you were to peel off the insulating material on the cables in our walls, you would see two or three separate wires in them--like the three wires we saw inside the cable on the power strip. These wires sometimes have a protective metal casing around them to prevent them from getting accidently cut during construction or renovation.

There are also **insulators** on the infrastructure you see outside of a building. You may have noticed ceramic discs stacked along power lines, like in the photo. These disks do the same thing as the insulating material on the outside of wires. They prevent electrical energy in the wires from accidentally transferring to another structure nearby.

4. The Ground Wire

In the walls of a building, three wires are connected to each outlet. The round hole in the lower middle of the socket is connected to the uninsulated copper wire seen coming out of the bottom of the outlet in the photo. This wire is called the **ground wire**.

A ground wire is connected by an unbroken path of metal to the ground outside the building. Sometimes that connection is a wire buried underground, or it might use something already in the ground, like a water pipe.

The purpose of the path of a ground wire is to give extra electrical energy a safe place to transfer to if the energy flowing through the wires increases to unsafe levels. Without the ground wire, that extra energy could transfer through a person or animal, causing a dangerous shock. Or, it could transfer through building materials like wood framing, causing a fire.

5. Incandescent and LED Light Bulbs

Old-fashioned incandescent light bulbs contain a piece of thin wire, called a filament, inside glass. As electrical energy transfers into the filament, the particles inside that filament move around quickly. We feel the increased **kinetic energy** of the particles in the filament as an increase in **temperature**. Have you ever touched an old-fashioned light bulb when it is on? Don't do it! They get really hot and can burn you.

Only 5%-10% of the energy that transfers into an old-fashioned bulb can be seen as light. The rest of the energy is transferred from the bulb to the surroundings, where it heats up the air, walls, windows, and people in the room.

Many of the lights installed in modern buildings are **LED bulbs**. LED bulbs do not transfer as much energy into the surroundings in the form of heat. A typical LED bulb can transfer 85% of the energy it receives into light. The rest is converted to heat. Because of this, LED bulbs are more **efficient** than incandescent bulbs**--they use less energy to do the same task** of producing light. They are also safer, because they do not get hot enough to burn you.