NREL
Transforming ENERGY

EXPERIMENTS

Electrons

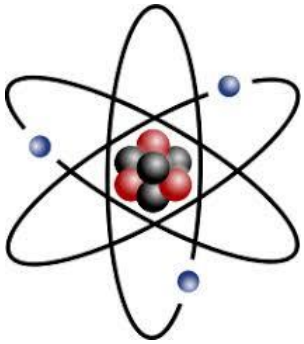
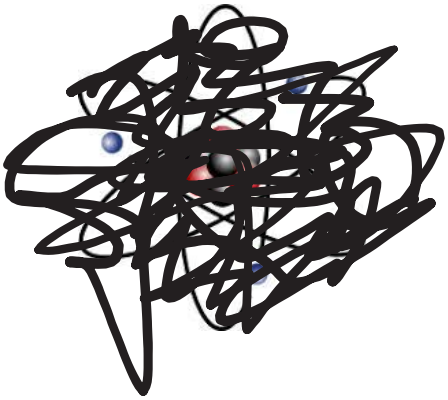


Image from Wikipedia, CC BY-SA 3.0

The above image is what most of us are used to seeing when we think of an atom, but in reality, the Bohr model is a bit outdated. While we used to believe that electrons traveled around the nucleus in neat orbitals, we now know that the electrons fly around the nucleus with no such pattern, increasing and decreasing their energy as they get closer and farther from the center. In picture form, it would look more like the one below, but since we rarely let four year olds design textbook diagrams (for obvious reasons), we stick to the old faithful Bohr model.



These tiny particles are so small that when we talk about them in high school chemistry classes, we often describe them as having no mass. While this can't be true, they are 1000 times smaller than their positive and neutral siblings, so it makes it more practical to discuss them this way. This is the same ratio as the size of an adult human to a rocket ship.

Despite being the smallest of the subatomic particles, electrons are responsible for every reaction that takes place in the universe. They move around in between elements and molecules creating little pockets of negative charge that attract pockets of positive charge created by another electron's vacancy.

Electrons and Electricity

It is not a coincidence that electricity sounds like electron. Electricity is the energy created by the flow of electrons through a substance. An electron's ability to flow is dependent on what substance it is trying to move through.

Substances that make it very easy for electrons to flow are known as conductors. Metals and dissolved metal compounds are the most common conductors. Metals like copper wires or iron rods are billions and billions of the metal atom being held together by metallic bonds.

Metallic bonds create a “sea of electrons” which allows for electrons to easily move around in the metal. Metal compounds are usually held together by an ionic bond. An ionic bond is the attraction between a positive ion like sodium (Na^+) and a negative ion like chlorine (Cl^-). When dissolved in water, these compounds maintain a positive end and a negative end that also allows for electrons to easily flow. Other substances—like pencil lead, carbon bonded together in a special type of covalent bond—can also be conductors but it is dependent on how the electrons are used in the bonding. We use metals like copper and zinc for wiring because they allow for all the electrons coming from a power source (such as a battery or power plant) to easily travel to the item needing to be powered.

Substances that do not allow electrons to flow are known as insulators. These include plastics, ceramic, glass, rubber, and other materials made up of non-metal atoms. Most of these substances are held together by covalent bonds. Covalent bonds are true bonds between two atoms with shared electrons. The electrons are not able to move freely, therefore electricity cannot be created. We use rubber or other plastics to coat the outsides of wires to protect ourselves from electrical shock because the electrons will not flow through them.

Normally in renewable energy, we are working with substances that allow electrons to flow under specific circumstances—semi-conductors. Semi-conductors allow for the transformation of energy from one type to another, for example, solar energy to electrical energy. In a solar panel, the energy from the sun is able to energize electrons within the semiconducting glass made of silicon dioxide (SiO_2). These energized electrons can start to flow through the glass, creating electricity.

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