

## More on Energy

### Forms of Energy: The Big 6

Energy comes in six basic forms: **chemical, electrical, radiant, mechanical, thermal** and **nuclear**. In other research, you may find additional forms mentioned such as electrochemical, sound, electromagnetic and others. However, many additional forms are combinations of these six basic categories.

Each of these six forms can be converted, or changed, into the other forms. For example, when you have a fire burning in your fireplace, the chemical energy in the wood changes into thermal (heat) energy and radiant (light) energy. For something a little more complex, think about a car. The chemical energy of a fuel (gasoline or natural gas) is converted into mechanical energy so the car can move.

**Chemical energy** is energy that is stored within the connections (the bonds) between tiny parts of a substance (molecules). Some common examples of chemical energy are contained in fuels such as coal, gasoline, natural gas and even sugar! When our bodies burn sugar during exercise, the sugar components are “reorganized” and release the energy that was in the chemical bonds of the original substance.

**Electrical energy** is energy from moving electrons. All matter is made up of atoms, and atoms are made up of smaller particles, called protons (which have positive charge), neutrons (which have neutral charge), and electrons (which are negatively charged). Protons and neutrons are found in the center, or nucleus of an atom. Electrons orbit around the nucleus, like the moon orbits the Earth. Some materials, particularly metals, have electrons that are only loosely attached to their atoms. They can easily be made to move from one atom to another if an electric or magnetic field is applied to them. When those electrons move among the atoms of matter, a current of electricity is created.

**Radiant energy** is the form of energy associated with the movement of light, electromagnetic waves or particles. Radiant energy includes visible light as well as other things that are not visible to the unaided eye like x-rays, gamma rays and radio waves. Light, like the light from the Sun, is one type of radiant energy. This energy is what makes life on Earth possible.

**Mechanical energy** is the energy possessed by an object due to its movement or position. In other words, an object possesses mechanical energy when it has the ability to do work due to its position or motion. Mechanical energy can take the form of either *kinetic energy*, which is energy due to an object's motion, or *potential energy*, which is stored energy due to an object's position. More about kinetic and potential energy a bit later.

**Nuclear energy** is the energy released when the nuclei of atoms are split or fused. Check out the [Nuclear Energy](#) section of this curriculum to learn more about the energy released by splitting atomic nuclei. Fission, the splitting of atoms, is used to produce usable nuclear energy. Fusion, the fusing or combining of atoms, takes place in stars like our Sun.

**Thermal energy** is heat energy, or the energy of moving or vibrating molecules. Heat and thermal energy are directly related to temperature. Adjacent objects that are different temperatures will spontaneously transfer heat to try to come to the same temperature. A hot cup of coffee in a cool room loses some of its thermal energy as heat flows from the coffee to the room. The molecules in the coffee slow their vibrating as the coffee loses heat, and over time, the coffee cools to the same temperature as the room.

## States of Energy

All energy can be in one of two states: **potential energy** or **kinetic energy**.

**Potential energy** is stored energy – energy that is ready to go. A lawn mower filled with gasoline, a car on the top of a hill, and a book on the edge of a table are all examples of potential energy. Potential energy can be used in combination with other terms like “gravitational potential energy,” which is the energy an object has due to height in comparison to a lower elevation (like the book on the edge of a table).

**Kinetic energy**, simply put, is energy something has because of its motion. A more complex concept for kinetic energy is that it is equal to one half the product of the mass of the object and the square of its velocity ( $KE=1/2 mv^2$ ). Obviously, for younger students, the simple definition is sufficient, but be sure to check out our resource page for activities related to the formula for kinetic energy.

## Energy Transformations

Energy can be changed, converted, or *transformed*, from one form or state to another. That book we mentioned in the previous section, the one on the edge of the table, has gravitational potential energy. Let's say the book is knocked off the table. As the book falls to the ground, it has kinetic energy. When the book hits the ground, some of the energy becomes thermal energy due to the collision. Some of the energy is transformed into mechanical energy in the form of sound waves, as you hear the “SMACK!” of the book's collision with the ground.

If you apply this idea to water going over a waterfall, you can take it even further! The kinetic energy of the falling water can be transformed into mechanical (rotational) kinetic energy that is used to turn a turbine shaft (mechanical energy) – which is then turned into electrical energy by way of a generator and then into other forms such as thermal, by using the electricity and a resistor to heat a house.

The reason we transform energy from one form or state to another is because of its *end use*, or the desired result we want from the transformation. By harnessing the energy of falling water, and transforming that energy, eventually, into thermal energy, we can keep our homes warm in the winter. By transforming the potential energy in a piece of wood into radiant energy, we create light and heat.

## Law of Conservation

A basic understanding of the transformation concept helps to explain the Law of Conservation of Energy. Basically, energy cannot be created or destroyed. It is transformed into other forms of energy. This law means that when we use energy, it is not being “used up,” but rather, it is changing into something else.

The word “conservation” may throw some students, since there is a major push to conserve energy, meaning to save and not waste it. The Law of Conservation is officially stated as: The total amount of energy in a system remains constant, although energy within the system can be changed from one form to another, or transferred from one object to another. In a billiards game, energy is transferred from one ball to another, as the cue ball collides with stripes and solids around the table. Friction between the balls and surface of the billiards table cause some of the energy to be transformed into heat energy as well. These transfers and transformations explain why the balls stop rolling eventually. The balls lose energy (thus speed) as they collide and transfer energy to other balls, as well as losing energy as it is transformed into heat.

### **Classroom Activities**

[Conservation of Energy Activity Page](#)

[Potential and Kinetic Energy Investigations](#)

[Interactive Energy Transfer Activities](#)

[STEM: Heat Loss Project](#)

[STEM: Roller Coaster Project](#)