Magnesium is a chemical element, meaning it is a pure substance made of only one type of atom and cannot be broken down into simpler substances by ordinary chemical reactions. It has the symbol Mg on the periodic table and an atomic number of 12, which means each atom of magnesium contains 12 protons in its nucleus. The number of protons determines what element a substance is. Magnesium belongs to the group called the alkaline earth metals, a family of elements that includes calcium, beryllium, strontium, barium, and radium. These elements are metals that tend to react easily with other elements and form positively charged ions, meaning atoms that have lost electrons.

Magnesium is one of the most abundant elements on Earth. In the Earth's crust it ranks around the eighth most abundant element, meaning large amounts exist naturally in rocks and minerals. It is also extremely common in seawater, where dissolved magnesium ions make up a significant portion of the salts in the ocean. Because magnesium easily forms compounds with oxygen, carbon, and other elements, it is usually found combined with other elements in minerals rather than as pure metal in nature. Minerals such as magnesite (magnesium carbonate), dolomite (calcium magnesium carbonate), and olivine (a magnesium iron silicate mineral found in volcanic rock) are important natural sources of magnesium.

Magnesium metal itself is lightweight but strong, which makes it useful in manufacturing. Its density—the amount of mass contained in a given volume—is much lower than most structural metals. Magnesium is about one-third lighter than aluminum and about four times lighter than steel. Because of this property, magnesium alloys are used in industries where reducing weight is important, such as aircraft manufacturing, automobile parts, and electronics. An alloy is a mixture of metals designed to combine useful properties, such as strength, durability, or resistance to corrosion.

One of magnesium's most visually noticeable chemical properties is how it reacts when heated in oxygen. When magnesium metal burns, it produces a very bright white flame. This occurs because the magnesium atoms react rapidly with oxygen to form magnesium oxide, releasing energy in the form of heat and light. The brightness of the reaction is so intense that early photographers used magnesium powder as a flash source before electric flash bulbs existed. The light was strong enough to briefly illuminate dark scenes for photography.

Magnesium also reacts with water and acids. When magnesium metal comes into contact with certain acids, such as hydrochloric acid, a chemical reaction occurs that releases hydrogen gas. A chemical reaction is a process in which atoms rearrange to form new substances. In this reaction magnesium atoms lose electrons and form magnesium ions while hydrogen atoms combine to form hydrogen gas molecules. This behavior is typical for reactive metals that easily lose electrons.

Magnesium is not only important in geology and industry; it is also a vital mineral for living organisms. In biology, a mineral refers to an inorganic chemical element required by living systems for normal function. Magnesium is essential for almost every form of life because it plays a central role in many biochemical processes inside cells. In humans, magnesium is involved in hundreds of enzyme-driven reactions. Enzymes are specialized proteins that act as catalysts, meaning they speed up chemical reactions that would otherwise occur very slowly.

One of magnesium's most important biological roles involves cellular energy production. Cells generate energy through chemical reactions that produce a molecule called adenosine triphosphate (ATP). ATP acts as the main energy carrier inside cells. Many enzymes that produce or use ATP require magnesium in order to function properly. Magnesium binds to ATP molecules and stabilizes them so they can release energy in a controlled way. Without magnesium, many of the reactions that power cellular activity would occur inefficiently.

Magnesium is also crucial for DNA and RNA stability. DNA (deoxyribonucleic acid) is the molecule that stores genetic information inside cells. RNA (ribonucleic acid) helps carry out instructions from DNA to produce proteins. Magnesium ions help stabilize the structure of these molecules and assist enzymes involved in copying DNA during cell division. This role makes magnesium important for growth, repair of tissues, and reproduction of cells.

In the human body, magnesium is distributed throughout several tissues. About 50 to 60 percent of total body magnesium is stored in bones. Bone is composed mainly of calcium phosphate crystals, but magnesium is incorporated into these structures and influences bone formation and mineral balance. Roughly 40 to 50 percent of magnesium is located inside cells in muscles and organs. Only about 1 percent of the body's magnesium circulates in the blood.

Magnesium plays a critical role in muscle function. Muscles contract when calcium ions enter muscle cells and trigger protein fibers to slide past one another. Magnesium helps regulate this process by controlling calcium movement. It also assists in relaxing muscle fibers after contraction. Because of this balance between calcium and magnesium, proper levels of both minerals are necessary for coordinated muscle movement.

The heart, which is a specialized muscular organ that pumps blood throughout the body, also depends on magnesium for proper function. The heartbeat is controlled by electrical signals that travel through cardiac muscle tissue. Magnesium influences the movement of charged particles such as calcium, sodium, and potassium across cell membranes. These particles create electrical signals that regulate heart rhythm. Maintaining proper ion balance helps ensure that the heart contracts and relaxes in a consistent pattern.

Magnesium also affects the function of blood vessels. Blood vessels contain smooth muscle cells in their walls. These muscles can contract to narrow the vessel or relax to widen it. The widening of a blood vessel is called vasodilation, which means an increase in vessel diameter that allows blood to flow more easily. Magnesium can influence this process by affecting how calcium enters smooth muscle cells in the vessel wall.

Magnesium is also a central element in chlorophyll, the molecule plants use to capture sunlight. Chlorophyll is the green pigment responsible for the color of leaves. In the chlorophyll molecule, a magnesium atom sits at the center of a ring-shaped structure that absorbs energy from sunlight. This energy powers photosynthesis, the biological process by which plants convert carbon dioxide and water into sugars and oxygen using sunlight. Because magnesium is essential for chlorophyll, it is necessary for plant growth and agricultural productivity.

Many foods contain magnesium because plants absorb it from soil as they grow. Foods naturally high in magnesium include leafy green vegetables, nuts, seeds, beans, and whole grains. These foods contain magnesium as part of their cellular structures or stored nutrients. When humans consume these foods, magnesium is absorbed primarily through the small intestine, a section of the digestive system specialized for nutrient absorption.

The body regulates magnesium levels through the kidneys, which filter blood and control how much magnesium is excreted in urine. If magnesium intake increases, the kidneys can remove excess amounts. If intake decreases, the kidneys reduce excretion to help maintain balance. This regulation is part of a process called homeostasis, meaning the maintenance of stable internal conditions within the body.

Magnesium is also used in medicine and industry in various compound forms. Magnesium oxide is commonly used as a dietary supplement or antacid. Magnesium sulfate, known as Epsom salt, is used in medicine and agriculture. Magnesium citrate is another compound used for digestive treatments. These compounds consist of magnesium combined with other elements to create stable chemical substances with specific properties.

Magnesium therefore exists as both a fundamental chemical element in nature and a biologically essential mineral in living organisms. Its roles range from forming minerals in rocks and seawater to enabling energy production in cells, supporting muscle and nerve function, stabilizing genetic molecules, and powering the photosynthesis that sustains plant life on Earth.