Nutrition is the biochemical and physiological process by which an organism uses food to support its life. It includes ingestion, absorption, assimilation, biosynthesis, catabolism and excretion.

The science that studies the physiological process of nutrition is called nutritional science (also nutrition science).

Organisms primarily provide themselves with carbon in one of two ways: autotrophy (the self-production of organic food) and heterotrophy (the consumption of existing organic carbon). Combined with the source of energy, either light (phototrophy) or chemical (chemotrophy), there are four primary nutritional groups for organisms.

Nutrients are substances used by an organism to survive, grow, and reproduce. The seven major classes of relevant nutrients for animals (including humans) are carbohydrates, dietary fiber, fats, proteins, minerals, vitamins, and water. Nutrients can be grouped as either macronutrients (carbohydrates, dietary fiber, fats, proteins, and water needed in gram quantities) or micronutrients (vitamins and minerals needed in milligram or microgram quantities).

In nutrition, the diet of an organism is the sum of foods it eats, which is largely determined by the availability and palatability of foods.

Animal nutrition focuses on the dietary nutrients needs of animals, often in comparison (or contrast) to other organisms like plants. Carnivore and herbivore diets are contrasting, with basic nitrogen and carbon proportions vary for their particular foods. Many herbivores rely on bacterial fermentation to create digestible nutrients from indigestible plant cellulose, while obligate carnivores must eat animal meats to obtain certain vitamins or nutrients their bodies cannot otherwise synthesize. Animals generally have a higher requirement of energy in comparison to plants.

Plant nutrition is the study of the chemical elements that are necessary for plant growth. There are several principles that apply to plant nutrition. Some elements are directly involved in plant metabolism. However, this principle does not account for the so-called beneficial elements, whose presence, while not required, has clear positive effects on plant growth.

A nutrient that is able to limit plant growth according to Liebig's law of the minimum is considered an essential plant nutrient if the plant cannot complete its full life cycle without it. There are 16 essential plant soil nutrients, besides the three major elemental nutrients carbon and oxygen that are obtained by photosynthetic plants from carbon dioxide in air, and hydrogen, which is obtained from water.

Plants uptake essential elements from the soil through their roots and from the air (consisting of mainly nitrogen and oxygen) through their leaves. Green plants obtain their carbohydrate supply from the carbon dioxide in the air by the process of photosynthesis. Carbon and oxygen are absorbed from the air, while other nutrients are absorbed from the soil. Nutrient uptake in the soil is achieved by cation exchange, wherein root hairs pump hydrogen ions (H+) into the soil through proton pumps. These hydrogen ions displace cations attached to negatively charged soil particles so that the cations are available for uptake by the root. In the leaves, stomata open to take in carbon dioxide and expel oxygen. The carbon dioxide molecules are used as the carbon source in photosynthesis.

Although nitrogen is plentiful in the Earth's atmosphere, very few plants can use this directly. Most plants, therefore, require nitrogen compounds to be present in the soil in which they grow. This is made possible by the fact that largely inert atmospheric nitrogen is changed in a nitrogen fixation process to biologically usable forms in the soil by bacteria.

Plant nutrition is a difficult subject to understand completely, partially because of the variation between different plants and even between different species or individuals of a given clone. Elements present at low levels may cause deficiency symptoms, and toxicity is possible at levels that are too high. Furthermore, deficiency of one element may present as symptoms of toxicity from another element, and vice versa.

Metabolism is the set of life-sustaining chemical reactions in organisms. The three main purposes of metabolism are: the conversion of food to energy to run cellular processes; the conversion of food/fuel to building blocks for proteins, lipids, nucleic acids, and some carbohydrates; and the elimination of metabolic wastes. These enzyme-catalyzed reactions allow organisms to grow and reproduce, maintain their structures, and respond to their environments. The word metabolism can also refer to the sum of all chemical reactions that occur in living organisms, including digestion and the transport of substances into and between different cells, in which case the above described set of reactions within the cells is called intermediary metabolism or intermediate metabolism. In various diseases, such as type II diabetes, metabolic syndrome, and cancer, normal metabolism is disrupted.

Metabolic reactions may be categorized as catabolic – the breaking down of compounds (for example, the breaking down of glucose to pyruvate by cellular respiration); or anabolic – the building up (synthesis) of compounds (such as proteins, carbohydrates, lipids, and nucleic acids). Usually, catabolism releases energy, and anabolism consumes energy.

The chemical reactions of metabolism are organized into metabolic pathways, in which one chemical is transformed through a series of steps into another chemical, each step being facilitated by a specific enzyme. Enzymes are crucial to metabolism because they allow organisms to drive desirable reactions that require energy that will not occur by themselves, by coupling them to spontaneous reactions that release energy. Enzymes act as catalysts – they allow a reaction to proceed more rapidly – and they also allow the regulation of the rate of a metabolic reaction, for example in response to changes in the cell's environment or to signals from other cells.

The metabolic system of a particular organism determines which substances it will find nutritious and which poisonous. For example, some prokaryotes use hydrogen sulfide as a nutrient, yet this gas is poisonous to animals. The basal metabolic rate of an organism is the measure of the amount of energy consumed by all of these chemical reactions.

A striking feature of metabolism is the similarity of the basic metabolic pathways among vastly different species. For example, the set of carboxylic acids that are best known as the intermediates in the citric acid cycle are present in all known organisms, being found in species as diverse as the unicellular bacterium Escherichia coli and huge multicellular organisms like elephants. These similarities in metabolic pathways are likely due to their early appearance in evolutionary history, and their retention is likely due to their efficacy. The metabolism of cancer cells is different from the metabolism of normal cells, and these differences can be used to find targets for therapeutic intervention in cancer.

Most of the structures that make up animals, plants and microbes are made from four basic classes of molecule: amino acids, carbohydrates , nucleic acid and lipids (often called fats). As these molecules are vital for life, metabolic reactions either focus on making these molecules during the construction of cells and tissues, or by breaking them down and using them as a source of energy, by their digestion. These biochemicals can be joined together to make polymers such as DNA and proteins, essential macromolecules of life.

Proteins are made of amino acids arranged in a linear chain joined together by peptide bonds. Many proteins are enzymes that catalyze the chemical reactions in metabolism. Other proteins have structural or mechanical functions, such as those that form the cytoskeleton, a system of scaffolding that maintains the cell shape. Proteins are also important in cell signaling, immune responses, cell adhesion, active transport across membranes, and the cell cycle. Amino acids also contribute to cellular energy metabolism by providing a carbon source for entry into the citric acid cycle (tricarboxylic acid cycle), especially when a primary source of energy, such as glucose, is scarce, or when cells undergo metabolic stress.

Lipids are the most diverse group of biochemicals. Their main structural uses are as part of biological membranes both internal and external, such as the cell membrane, or as a source of energy. Lipids are usually defined as hydrophobic or amphipathic biological molecules but will dissolve in organic solvents such as alcohol, benzene or chloroform. The fats are a large group of compounds that contain fatty acids and glycerol; a glycerol molecule attached to three fatty acid esters is called a triacylglyceride. Several variations on this basic structure exist, including backbones such as sphingosine in the sphingomyelin, and hydrophilic groups such as phosphate as in phospholipids. Steroids such as sterol are another major class of lipids.

Carbohydrates are aldehydes or ketones, with many hydroxyl groups attached, that can exist as straight chains or rings. Carbohydrates are the most abundant biological molecules, and fill numerous roles, such as the storage and transport of energy (starch, glycogen) and structural components (cellulose in plants, chitin in animals). The basic carbohydrate units are called monosaccharides and include galactose, fructose, and most importantly glucose. Monosaccharides can be linked together to form polysaccharides in almost limitless ways.

The two nucleic acids, DNA and RNA, are polymers of nucleotides. Each nucleotide is composed of a phosphate attached to a ribose or deoxyribose sugar group which is attached to a nitrogenous base. Nucleic acids are critical for the storage and use of genetic information, and its interpretation through the processes of transcription and protein biosynthesis. This information is protected by DNA repair mechanisms and propagated through DNA replication. Many viruses have an RNA genome, such as HIV, which uses reverse transcription to create a DNA template from its viral RNA genome. RNA in ribozymes such as spliceosomes and ribosomes is similar to enzymes as it can catalyze chemical reactions. Individual nucleosides are made by attaching a nucleobase to a ribose sugar. These bases are heterocyclic rings containing nitrogen, classified as purines or pyrimidines. Nucleotides also act as coenzymes in metabolic-group-transfer reactions.

Metabolism involves a vast array of chemical reactions, but most fall under a few basic types of reactions that involve the transfer of functional groups of atoms and their bonds within molecules. This common chemistry allows cells to use a small set of metabolic intermediates to carry chemical groups between different reactions. These group-transfer intermediates are called coenzymes. Each class of group-transfer reactions is carried out by a particular coenzyme, which is the substrate for a set of enzymes that produce it, and a set of enzymes that consume it. These coenzymes are therefore continuously made, consumed and then recycled.

One central coenzyme is adenosine triphosphate (ATP), the universal energy currency of cells. This nucleotide is used to transfer chemical energy between different chemical reactions. There is only a small amount of ATP in cells, but as it is continuously regenerated, the human body can use about its own weight in ATP per day. ATP acts as a bridge between catabolism and anabolism. Catabolism breaks down molecules, and anabolism puts them together. Catabolic reactions generate ATP, and anabolic reactions consume it. It also serves as a carrier of phosphate groups in phosphorylation reactions.

A vitamin is an organic compound needed in small quantities that cannot be made in cells. In human nutrition, most vitamins function as coenzymes after modification; for example, all water-soluble vitamins are phosphorylated or are coupled to nucleotides when they are used in cells. Nicotinamide adenine dinucleotide (NAD+), a derivative of vitamin B3 (niacin), is an important coenzyme that acts as a hydrogen acceptor. Hundreds of separate types of dehydrogenases remove electrons from their substrates and reduce NAD+ into NADH. This reduced form of the coenzyme is then a substrate for any of the reductases in the cell that need to reduce their substrates. Nicotinamide adenine dinucleotide exists in two related forms in the cell, NADH and NADPH. The NAD+/NADH form is more important in catabolic reactions, while NADP+/NADPH is used in anabolic reactions.

Inorganic elements play critical roles in metabolism; some are abundant (e.g. sodium and potassium) while others function at minute concentrations. About 99% of a human's body weight is made up of the elements carbon, nitrogen, calcium, sodium, chlorine, potassium, hydrogen, phosphorus, oxygen and sulfur. Organic compounds (proteins, lipids and carbohydrates) contain the majority of the carbon and nitrogen; most of the oxygen and hydrogen is present as water.

The abundant inorganic elements act as electrolytes. The most important ions are sodium, potassium, calcium, magnesium, chloride, phosphate and the organic ion bicarbonate. The maintenance of precise ion gradients across cell membranes maintains osmotic pressure and pH. Ions are also critical for nerve and muscle function, as action potentials in these tissues are produced by the exchange of electrolytes between the extracellular fluid and the cell's fluid, the cytosol. Electrolytes enter and leave cells through proteins in the cell membrane called ion channels. For example, muscle contraction depends upon the movement of calcium, sodium and potassium through ion channels in the cell membrane and T-tubules.

Transition metals are usually present as trace elements in organisms, with zinc and iron being most abundant of those. Metal cofactors are bound tightly to specific sites in proteins; although enzyme cofactors can be modified during catalysis, they always return to their original state by the end of the reaction catalyzed. Metal micronutrients are taken up into organisms by specific transporters and bind to storage proteins such as ferritin or metallothionein when not in use.

Catabolism is the set of metabolic processes that break down large molecules. These include breaking down and oxidizing food molecules. The purpose of the catabolic reactions is to provide the energy and components needed by anabolic reactions which build molecules. The exact nature of these catabolic reactions differ from organism to organism, and organisms can be classified based on their sources of energy and carbon (their primary nutritional groups), as shown in the table below. Organic molecules are used as a source of energy by organotrophs, while lithotrophs use inorganic substrates, and phototrophs capture sunlight as chemical energy. However, all these different forms of metabolism depend on redox reactions that involve the transfer of electrons from reduced donor molecules such as organic molecules, water, ammonia, hydrogen sulfide or ferrous ions to acceptor molecules such as oxygen, nitrate or sulfate. In animals, these reactions involve complex organic molecules that are broken down to simpler molecules, such as carbon dioxide and water. In photosynthetic organisms, such as plants and cyanobacteria, these electron-transfer reactions do not release energy but are used as a way of storing energy absorbed from sunlight.

The most common set of catabolic reactions in animals can be separated into three main stages. In the first stage, large organic molecules, such as proteins, polysaccharides or lipids, are digested into their smaller components outside cells. Next, these smaller molecules are taken up by cells and converted to smaller molecules, usually acetyl coenzyme A (acetyl-CoA), which releases some energy. Finally, the acetyl group on the CoA is oxidised to water and carbon dioxide in the citric acid cycle and electron transport chain, releasing the energy that is stored by reducing the coenzyme nicotinamide adenine dinucleotide (NAD+) into NADH.