An energy-yeilding nutrient. Macronutrients are those nutrients that together provide the vast majority of metabolic energy to an organism. The three main macronutrients are carbohydrates, proteins, and fat.

Micronutrients
: Microminerals or trace elements, are dietary minerals needed by the human body in very small quantities (generally less than 100mg/day) as opposed to macrominerals which are required in larger quantities.

Functions

Glucose it is the most easily used by the body. It is a simple carbohydrate that circulates in the blood and is the main source of energy for the muscles, central nervous system, and is the ONLY source of energy for the brain.

Carbohydrates are made of organic compounds carbon, hydrogen, and oxygen.

There are three sizes of carbohydrate and they are distinguished by a classification of two that is, *Simple carbohydrates* (mono saccharides and disaccharides) and *complex carbohydrates* (polysaccharides). Polysaccharides are the most abundant carbohydrate in the body along with glycogen.

The break down of polysaccharides goes as follows: Polysaccharides are digested into monosacchorides including glucose which goes into the intestinal epithelium and into the bloodstream. The molecules of glucose are taken by glucose transporters and delivered into the cells of the body. While glucose is in the cells it can be oxidized for energy or provide substrates to other metabolic reactions or of course into glycogen for storage.

A. Monosaccharides = Single carbohydrate unit, such as, Glucose, Fructose, and Galactose.

B. Disaccharides = Two single carbohydrates bound together these are Sucrose, Maltose, and Lactose.

C. Polysaccharides = Have many units of monosaccharides joined together such as, Starch and Fiber.

Proteins

Functions

Protein forms hormones, enzymes, antibodies; it is part of fluid and electrolyte regulation, the buffering effect for pH, and transporter of nutrients. A good example of a protein is the oxygen carrying hemoglobin found in red blood cells.

Proteins are made of carbon, hydrogen, oxygen, and nitrogen, an inorganic molecule, the thing that clearly distinguishes them form the other macronutrients.

A. Amino acids are the building blocks of proteins.

B. Polypeptide a group of amino acids bonded together 1000 or more.

The body requires amino acids to produce new body protein (protein retention) and to replace damaged proteins (maintenance) that are lost in the urine.

Proteins are relatively large molecules made of amino acids joined together in chains by peptide bonds. Amino acids are the basic structural building units of proteins. They form short polymer chains called peptides or longer poly-peptides which in turn formstructures called proteins. The process of protein synthesis is controlled by an mRNA template. In this process tRNA transfers amino acids to the mRNA to form protein chains.

There are twenty standard amino acids used by cells in making proteins. Vertebrates, including humans, are able to synthesize 11 of these amino acids from other molecules. The remaining nine amino acids cannot be synthesized by our cells, and are termed "'essential amino acids'". These essential amino acids must be obtained from foods.

The **9 Essential Amino Acids** have the following names: **H**istidine, **I**soleucine, **L**eucine, **L**ysine, **M**ethionine, **P**henylalanine, **T**hreonine, **T**ryptophan, **V**aline

You can remember these with this saying "Hey It's Like Lovely Material; Please Touch The Velvet".

The **11 Non-essential Amino Acids** are as follows:

Alanine, **A**rginine, **A**spartic acid, **C**ysteine, **C**ystine, **G**lutamic acid, **G**lutamine, **G**lycine, **P**roline, **S**erine, T**ryosine**

How about this memory device, "Almost Always Aunt Cindy Can Get Great Gum Popping Sounds Together"

The 20 Amino Acids and What They Do!

Amino Acid	Abbrev.		Remarks
Alanine	A	Ala	Very abundant, very versatile. More stiff than glycine, but small enough to pose only small steric limits for the protein conformation. It behaves fairly neutrally, can be located in both hydrophilic regions on the protein outside and the hydrophobic areas inside.
Cysteine	C	Cys	The sulfur atom binds readily to heavy metal ions. Under oxidizing conditions, two cysteines can join together in a disulfide bond to form the amino acid cystine. When cystines are part of a protein, insulin for example, this stabilises tertiary structure and makes the protein more resistant to denaturation; disulphide bridges are therefore common in proteins that have to function in harsh environments including digestive enzymes (e.g., pepsin and chymotrypsin) and structural proteins (e.g., keratin). Disulphides are also found in peptides too small to hold a stable shape on their own (eg. insulin).

Aspartic acid	D	Asp	Behaves similarly to glutamic acid. Carries a hydrophilic acidic group with strong negative charge. Usually is located on the outer surface of the protein, making it water-soluble. Binds to positively-charged molecules and ions, often used in enzymes to fix the metal ion. When located inside of the protein, aspartate and glutamate are usually paired with arginine and lysine.
Glutamate	E	Glu	Behaves similar to aspartic acid. Has longer, slightly more flexible side chain.
Phenylalanine	F	Phe	Essential for humans. Phenylalanine, tyrosine, and tryptophan contain large rigid aromatic group on the side chain. These are the biggest amino acids. Like isoleucine, leucine and valine, these are hydrophobic and tend to orient towards the interior of the folded protein molecule.
Glycine	G	Gly	Because of the two hydrogen atoms at the α carbon, glycine is not optically active. It is the smallest amino acid, rotates easily, adds flexibility to the protein chain. It is able to fit into the tightest spaces, e.g., the triple helix of collagen. As too much flexibility is usually not desired, as a structural component it is less common than alanine.
Histidine	H	His	In even slightly acidic conditions protonation of the nitrogen occurs, changing the properties of histidine and the polypeptide as a whole. It is used by many proteins as a regulatory mechanism, changing the conformation and behavior of the polypeptide in acidic regions such as the late endosome or lysosome, enforcing conformation change in enzymes. However only a few histidines are needed for this, so it is comparatively scarce.
Isoleucine	I	Ile	Essential for humans. Isoleucine, leucine and valine have large aliphatic hydrophobic side chains. Their molecules are rigid, and their mutual hydrophobic interactions are important for the correct folding of proteins, as these chains tend to be located inside of the protein molecule.
Lysine	K	Lys	Essential for humans. Behaves similarly to arginine. Contains a long flexible side-chain with a positively-charged end. The flexibility of the chain makes lysine and arginine suitable for binding to molecules with many negative charges on their surfaces. E.g., DNA-binding proteins have their active regions rich with arginine and lysine. The strong charge makes these two amino acids prone to be located on the outer hydrophilic surfaces of the proteins; when they are found inside, they are usually paired with a corresponding negatively-charged amino acid, e.g., aspartate or glutamate.
Leucine	L	Leu	Essential for humans. Behaves similar to isoleucine and valine. See isoleucine.
Methionine	M	Met	Essential for humans. Always the first amino acid to be incorporated into a protein; sometimes removed after translation. Like cysteine, contains sulfur, but with a methyl group instead of hydrogen. This methyl group can be activated, and is used in many reactions where a new carbon atom is being added to another molecule.
Asparagine	N	Asn	Similar to aspartic acid. Asn contains an amide group where Asp has a carboxyl.
Proline	P	Pro	Contains an unusual ring to the N-end amine group, which forces the CO-NH amide sequence into a fixed conformation. Can disrupt protein folding structures like α helix or β sheet, forcing the desired kink in the protein chain. Common in collagen, where it often undergoes a posttranslational

			modification to hydroxyproline. Uncommon elsewhere.
Glutamine	Q	Gln	Similar to glutamic acid. Gln contains an amide group where Glu has a carboxyl. Used in proteins and as a storage for ammonia.
Arginine	R	Arg	Functionally similar to lysine.
Serine	S	Ser	Serine and threonine have a short group ended with a hydroxyl group. Its hydrogen is easy to remove, so serine and threonine often act as hydrogen donors in enzymes. Both are very hydrophilic, therefore the outer regions of soluble proteins tend to be rich with them.
Threonine	T	Thr	Essential for humans. Behaves similarly to serine.
Valine	V	Val	Essential for humans. Behaves similarly to isoleucine and leucine. See isoleucine.
Tryptophan	W	Trp	Essential for humans. Behaves similarly to phenylalanine and tyrosine (see phenylalanine). Precursor of serotonin.
Tyrosine	Y	Tyr	Behaves similarly to phenylalanine and tryptophan (see phenylalanine). Precursor of melanin, epinephrine, and thyroid hormones.

Dietary proteins fall into two categories: complete proteins and incomplete proteins. Complete proteins include ample amounts of all essential amino acids. What I can eat that will include these great complete proteins include meat, fish, poultry, cheese, eggs, and milk. Incomplete proteins contain some but not all of the essential amino acids required by the human body. Examples of incomplete proteins include legumes, rice, and leafy green vegetables. Someone who chooses a vegan lifestyle must be careful to combine various plant proteins to obtain all the essential amino acids on a daily basis, but it can be accomplished.

Ingested proteins are broken down into amino acids during digestion. They are then absorbed by the villi of the small intestine and enter the blood stream. Our cells use these amino acids to assemble new proteins that are used as enzymes, cell receptors, hormones, and structural features. Each protein has its own unique amino acid sequence that is specified by the nucleotide sequence of the gene encoding that protein (see Genetics and Inheritance). If we are deficient in even a single amino acid then our cells cannot make the proteins they require.

Lipids

Macronutrient

Provide 9 Kcalories per gram; it is an energy-yielding nutrient

Functions are stored energy (adipose tissue), organ protection, temperature regulator, insulation such as myelin that covers nerve cells, lipid membrane around cells, and emulsifiers to keep fats dispersed in body fluids.

Lipids are made of organic molecules carbon, hydrogen, and oxygen. Fats consist of glycerol fatty acids joind by an ester bond.

- **A.** Triglycerides composed of three fatty acids and one glycerol molecule.
- **B.** Saturated fatty acid fatty acid with carbon chains fully saturated with hydrogen.
- **C.** Monounsaturated fatty acid fatty acid that has a carbon chain with one unsaturated