NUTRIENTS

OBJECTIVES: List the four organic nutrients needed by the human body. Identify foods containing each of the organic nutrients. Explain the importance if inorganic molecules. Summarize the functions that the Six Nutrients perform in the body. Explain why water is an important nutrient?

I. Humans are HETEROTROPHS; We eat other organisms for Food and Energy.

FOOD CONTAINS NUTRIENTS, OR MOLECULES THAT PROVIDE ENERGY AND MATERIAL FOR GROWTH AND REPAIR.

- NUTRIENTS: CHEMICAL SUBSTANCES NEEDED BY THE BODY FOR GROWTH, REPAIR, AND MAINTENANCE.
- FOODS CONTAIN at least ONE of SIX KINDS OF NUTRIENTS: CARBOHYDRATES, PROTEINS, LIPIDS (FATS), VITAMINS, MINERALS AND WATER.
- FOUR of these Nutrients- Carbohydrates, Proteins, Fats, and Vitamins-are ORGANIC COMPOUNDS (they contain the Elements Carbon, Hydrogen, and Oxygen.)
- TWO Remaining Nutrients-Minerals and Water-are INORGANIC COMPOUNDS.

II. Nutrition is the Science or Study of how our bodies obtain Energy, Build Tissue, and Control Body Functions using materials supplied in the Food We Eat.

- FOOD IS FUEL. It supplies us with Energy not only to do Work but to generate the HEAT that Maintains our body Temperature.
- To MEASURE the Amount of Energy that can be obtained from food, Biologist and Chemists use the unit known as a calorie.
- A calorie IS THE AMOUNT OF ENERGY NEEDED TO RAISE THE TEMPERATURE OF 1 GRAM OF WATER BY 1 DEGREE CELSIUS. Because the Energy needs of the body are great, Nutritionist usually refer to the Energy content of food in terms of the kilocalorie or kcal, which is 1000 calories. Written as Calorie, a capital C.
- The calories you see listed on food labels really are kilocalories, or simply Calories.
- The basic Energy needs of an Average-sized Adult Human is about 1500 Calories per day.
- Energy needs vary depending on the KIND OF WORK YOU DO, HOW ACTIVE YOU ARE, YOUR GENDER, AND YOUR AGE.MEN GENERALLY HAVE HIGHER ENERGY NEEDS THAN WOMEN.

a) If you measure your body's Metabolism, (the sum of all the chemical processes that take place within an organism), the results would be expressed in a number called the BASAL METABOLIC RATE (BMR).

b) This number (BMR) is equal to the number of kilocalories an animal must use in a set amount of time just to maintain life. The BMR for females is 1300 to 1500 kcal per day. A male has a BMR of 1600 to 1800 kcal per day.
III. Food supplies building materials - the substances required by the cells in our body for proper growth and development. Tissue throughout the body must be repaired and replaced.

- Proteins and Nucleic Acids cannot be synthesized unless key compounds are supplied by a Complete Diet.

A Balanced Diet includes foods from the **FOUR BASIC FOOD GROUPS OR FOOD PYRAMID:**

**THE FOOD PYRAMID**

A. VEGETABLES AND FRUITS, 5 TO 9 SERVINGS  
B. GRAIN PRODUCTS, SUCH AS BREAD AND CEREALS, 6 TO 11 SERVINGS  
C. DAIRY PRODUCTS, 2 TO 3 SERVINGS  
D. PROTEIN-RICH FOODS SUCH AS MEAT, FISH, AND BEANS, 2-3 SERVINGS

According to the Food Pyramid, a Healthy Diet consists of many more servings of breads, fruits, and vegetables each day than meats and dairy foods.

**THE SIX ESSENTIAL NUTRIENTS:**  
CARBOHYDRATES, PROTEINS, LIPIDS (FATS), VITAMINS, MINERALS, AND WATER.

**CARBOHYDRATES**

1. The cells of the human body obtain MOST of their ENERGY from CARBOHYDRATES.

2. CARBOHYDRATES ARE COMPOUNDS MADE OF CARBON, HYDROGEN, AND OXYGEN IN APPROXIMATELY 1:2:1 RATION. (C6 H12 O6)

3. Sugars and Starches are Carbohydrates.

4. Before your body can use energy in carbohydrates, the carbohydrates must first be broken down. The Digestion System breaks most of the Carbohydrates that we eat into **GLUCOSE**.

5. Glucose provides most of the energy used by cells.

6. If you eat more carbohydrates than your body needs for energy, the excess is changed to **Glycogen**. The body stores Glycogen in the Liver and the Muscles. If the Glycogen stores are full, the body then converts the excess into **FAT** for long-term storage.

7. There are THREE TYPES of Carbohydrates, grouped according to complexity: MONOSACCHARIDES, DISACCHARIDES, AND POLYSACCHARIDES.

A. MONOSACCHARIDES ARE SINGLE SUGARS SUCH AS GLUCOSE AND FRUCTOSE, A SUGAR FOUND IN FRUITS.

B. DISACCHARIDES, OR DOUBLE SUGARS, CONSIST OF TWO SINGLE SUGARS LINKED TOGETHER. Common disaccharides include SUCROSE, OR TABLE SUGAR; LACTOSE, OR MILK SUGAR; AND MALTOSE; A SUGAR CONTAINED IN CEREAL GRAINS.

C. POLYSACCHARIDE IS A CARBOHYDRATE MADE OF LONG CHAINS OF SUGARS. The prefix POLY means "Many". Starches, such as those in BREAD, PASTA, AND POTATOES, ARE POLYSACCHARIDES.
8. Digestion system must break down starches before they can be used in cellular respiration: long Polysaccharide chains into disaccharides; disaccharides into to make Simple Sugars such as Glucose.

9. Plants convert excess sugars into Starches for long-term storage. Starches take longer than most sugars to break down in the Digestion System. *Starches provide the body with energy over a longer period of time than sugars.*

10. **Cellulose** is a Polysaccharide contained in the cell walls of plants. The cellulose you eat comes from VEGETABLES, FRUITS, AND WHOLE GRAIN BREADS AND CEREALS.

11. Your body CANNOT break down cellulose, so it has NO VALUE AS A NUTRIENT. **Cellulose passes through the body unchanged until it is eliminated as a waste product.** Cellulose is also referred to as **FIBER**, (BULK, ROUGHAGE) an important part of the diet. Fiber aids in Digestion may provide some protection against heart disease and certain types of cancer.

**PROTEINS**

1. Carbohydrates and Fats provide the body with Energy, but these nutrients DO NOT provide many of the materials the body needs for **GROWTH and REPAIR**.

2. **GROWTH AND REPAIR REQUIRE THE MATERIALS CONTAINED IN PROTEINS.**

3. **PROTEINS** ARE THE CONSTRUCTION MATERIALS FOR THE BODY PARTS SUCH AS MUSCLES, SKIN, AND BLOOD.

4. Our cells need proteins to make other proteins, such as enzymes.

5. Proteins are made up of smaller units called **AMINO ACIDS**.

6. Our bodies contain thousands of different proteins. All these proteins are made from about 20 Different Amino Acids.

7. Most Amino Acids are made in the body (12), but there are **EIGHT ESSENTIAL AMINO ACIDS, WHICH CAN ONLY BE OBTAINED IN THE FOODS WE EAT.**

8. Proteins that contain all eight essential Amino acids are called **COMPLETE PROTEINS.** **COMPLETE PROTEINS** are found in food that comes from ANIMALS, (meat, eggs, and dairy products.

9. Most plant products lack some of the Essential Amino Acids and are called **INCOMPLETE PROTEINS.**

10. Before our bodies can use the Proteins in foods, the Proteins must be broken down into their component Amino Acids. Cells then use the **Amino Acids** to synthesize new proteins.
LIPIDS OR FATS

1. Although too much Fat is not healthy, your body does need some fat.

2. Fats are important for several reasons:
   A. They are a concentrated source of energy.
   B. Fats store other nutrients, such as Vitamin A.
   C. Fats protect vital organs.
   D. Help keep our skin from drying out.
   E. Lipids, a kind of fat, are important parts of the cell membrane.
   F. Fats help to insulate the body against changes in environmental temperature.

3. A FAT IS MADE OF THREE FATTY ACIDS JOINED TO A GLYCEROL MOLECULE.

4. Fatty Acids are Chains of Carbon and Hydrogen Compounds with a Weak Acid Group attached to one end.

5. When you eat foods containing Fats, the body must first break the fats down into their basic components of Glycerol and Fatty Acids. From these raw materials, other lipids can be made.

6. The body uses lipids to make Cell Membranes, Hormones, and the Oils on your skin and hair.

7. Fatty Acids are Classified as either SATURATED OR UNSATURATED. The classification depends on the proportion of Hydrogen Atoms to Carbon - Carbon Bonds in the molecule.

8. The FEWER the Hydrogen Atoms the MORE Double Bonds there will be connecting the Carbons. Double Bonds can be broken and more Hydrogen's Added.

9. FATS WITH DOUBLE BONDS ARE CALLED UNSATURATED FAT. MOST UNSATURATED FATS ARE A LIQUID AT ROOM TEMPERATURE, COME FROM PLANTS, AND ARE USUALLY REFERRED TO AS OILS. However, some Vegetable oils, such as Palm Oil and Coconut Oil, are composed of primarily of saturated fats.

10. FATS WITH MANY DOUBLE BONDS IS A POLYUNSATURATED FAT.

11. SATURATED FATS HAVE NO DOUBLE BONDS BETWEEN THE CARBONS AND CONTAIN THE MAXIMUM NUMBER OF HYDROGEN ATOMS.

12. SATURATED FATS ARE USUALLY SOLID AT ROOM TEMPERATURE, AND MOST COME FROM ANIMAL PRODUCTS.

13. A FAT WITH ONLY ONE DOUBLE BOND IS CALLED A MONOUNSATURATED FAT.

14. Fats provide TWICE as many Calories per gram as Carbohydrates. Fats are an excellent way to store energy for future use.

15. When a person eats more food than is needed, the body stores extra energy by producing fat. It is deposited in a layer just under the skin.
1. **VITAMINS** are complex **ORGANIC MOLECULES** that are needed by the body in very small amounts that serve as COENZYMES.

2. **VITAMINS DO NOT CONTAIN** energy.

3. Most Vitamins are enzyme helpers, and play a role in Cellular Reactions.

4. With the single exception of **Vitamin D**, Vitamins are not made by the body and must be obtained from food.

5. Vitamin D can be made in the skin under direct sunlight. This synthesis involves the conversion of cholesterol to Vitamin D by intestinal enzymes and sunlight.

6. There are two main types of vitamins: (Table 49-1)
   - **A. WATER-SOLUBLE** - Vitamins that CANNOT be stored in the body, should be included in a balanced diet every day. Includes vitamins B and C.
   - **B. FAT-SOLUBLE** - Vitamins that CAN be stored in the fatty tissue of our bodies. Includes vitamins A, D, E, and K.

7. Like other essential nutrients, most vitamins can be obtained naturally by eating a balanced diet that includes fresh fruits, vegetables, and meats.

8. When the body does not receive a sufficient supply of vitamins, it can develop vitamin deficiency diseases.

9. **SCURVY** once common among sailors, was caused by a lack of Vitamin C in the diet.

**MINERALS** (Table 49-2)

Minerals are **INORGANIC SUBSTANCES** required for the normal functioning of the body. Many bodily functions rely on minerals.

**EXAMPLES:** Calcium, a mineral in dairy products, is a major component of bones and teeth. Iron is essential for transporting oxygen in blood. Nerves and muscles need Potassium, Sodium, Calcium, and Magnesium to function properly. Many bodily functions rely on minerals.

- We obtain minerals from the food we eat. The body does not destroy the minerals it takes in; it does lose many of them in SWEAT, URINE, AND OTHER WASTE PRODUCTS.
- The body cannot store most minerals. Minerals must be included regularly in the diet.
- Some minerals come from plants, which absorb minerals from the soil. Other minerals can be obtained by eating animal products or other foods.
- A Balanced Diet usually provides all the minerals the body needs.
WATER (TABLE 49-3)

1. Water is one of the simplest of the ESSENTIAL NUTRIENTS and also the MOST Important.

2. Animals will die from a lack of Water long before they will Starve from Lack of Food.

3. Most of the weight of our bodies is Water. Water accounts for at least half of your total body mass.

4. Blood plasma, the liquid part of blood, is more than 90 percent water.

5. Water is the solvent in which Food and Enzymes are dissolved in the Digestion System.

6. Water also helps to regulate Body temperature. It absorbs the heat released in Cellular Respiration and distributes the Heat throughout the body. When the body needs to Cool, PERSPIRATION-a water based substance-evaporates from the skin, and heat is drawn from the body.

7. Water **dissolves the waste materials** that are eliminated in Urine. **Sweat Glands** also remove water from our tissues to cool the body. Each time we take a breath we lose water.

8. Water is constantly being lost from the body, so a steady supply of this liquid is required.

9. Every day your body loses between 3 and 5 L of water through Sweat, Urine and Exhaled Air.

10. Most water is replaced by drinking liquids, but we can also obtain small quantities water from the foods we eat and as by-products of cellular respiration.

11. A condition referred as **DEHYDRATION** can occur and cause Death if you lose as much as 12 percent of your body water.

DIGESTIVE SYSTEM

Before your body can use nutrients in the food you consume, the nutrients must be broken down physically and chemically. This process of breaking down food into molecules the body can use is called digestion.

**OBJECTIVES:** List the major organs of the digestion system. Distinguish between mechanical and chemical digestion. Relate the structure of each digestive organ to its function in mechanical digestion. Identify the source of each major digestive enzyme, and describe the function of the enzyme. Summarize the process of absorption in both the small and large intestines.

THE GASTROINTESTINAL TRACT

1. DIGESTION IS THE BREAKDOWN OF FOOD INTO SIMPLER MOLECULES THAT CAN BE ABSORBED AND USED BY THE BODY.

2. The Digestion System is actually a LONG, HALLOW TUBE called the **GASTROINTESTINAL TRACT** or **GI TRACT** or **DIGESTIVE TRACT.** It begins with the Mouth and winds through the body to the Anus. - "In one end and Out the other end."
3. THE DIGESTION SYSTEM INCLUDES THE MOUTH, PHARYNX, ESOPHAGUS, STOMACH, SMALL INTESTINE, AND LARGE INTESTINE.


5. THREE ACTIVITIES ARE INVOLVED IN THE DIGESTIVE PROCESS:
   A. MECHANICAL DIGESTION
   B. CHEMICAL DIGESTION
   C. ABSORPTION.

6. The FIRST TASK of the Digestion System is to BREAK DOWN food into a fine PULP (MECHANICALDIGESTION), to INCREASE it's surface area and expose more food molecules to the actions of Digestive Chemicals.

7. The process of Mechanical Digestion breaks food into tiny pieces WITHOUT changing the CHEMICAL STRUCTURE of the food.

8. The SECOND TASK of the Digestion System is to CHEMICALLY act on Food, breaking it down into smaller and smaller particles. The molecules must be small enough and chemically simple enough to be absorbed into the Bloodstream. EXAMPLES: STARCHES to SIMPLE SUGARS, PROTEINS to AMINO ACIDS.

9. The LAST TASK of the Digestion System is to ABSORB the small molecules and pass them to the BLOODSTREAM AND LYMPH VESSELS for distribution to the rest of the body.

10. Humans are OMNIVORES who eat both PLANTS and ANIMALS for ENERGY and our Digestion System is adapted to process both vegetable and animal materials.

THE MOUTH

1. MECHANICAL AND CHEMICAL DIGESTION BOTH BEGIN IN THE MOUTH.

2. CHEWING is the FIRST step in Mechanical Digestion.

3. During Chewing, SALIVARY GLANDS produce SALIVA, a mixture of water, mucus, and a Digestive Enzyme called SALIVARY AMYLASE, which mixes with the chewed food. Enzymes in the saliva KILL Bacteria and BEGIN the process of CHEMICAL DIGESTION by breaking down STARCHES to SUGARS. (Figure 49-5) Saliva is produced by three sets of glands located near the mouth.

4. The mucus in the saliva softens and lubricates food and helps hold the food together. The Salivary Amylase begins the Chemical Digestion of Carbohydrates by braking down some Starch into Disaccharide Maltose.
5. Human **TEETH** are well adapted for chewing many kinds of food. The 32 Teeth of the normal adult have **THREE BASIC SHAPES, EACH WITH A DIFFERENT FUNCTION:**

   A. **INCISORS** - SHARP FRONT TEETH USED FOR BITING INTO AND TEARING PIECES OF FOOD.

   B. **CANINES** - POINTED TEETH (VAMPIRE) NEXT TO INCISORS, USED TO TEAR OR SHRED FOOD.

   C. **MOLARS** - TEETH AT THE BACK OF THE MOUTH, HAVE LARGE FLAT SURFACES THAT CRUSH AND GRIND FOOD.

6. Every Tooth has TWO main parts: the CROWN and the ROOT.

7. **A Tooth is made of FOUR LAYERS of Tissue:** ENAMEL, DENTIN, CEMENTUM, AND **PERIODONTAL MEMBRANE (LIGAMENT).**

8. The CROWN is covered by **ENAMEL**, a calcium-containing material THAT IS THE HARDEST SUBSTANCE IN THE BODY.

9. **DENTINE** a bone like tissue makes up most of the inside of a tooth.

10. **CEMENTUM** in a tine layer covers the dentine of the Root.

11. The **Periodontal Ligament** holds the tooth in its Socket.

12. The Tongue helps to keep the food between the Chewing surfaces of the Upper and Lower Teeth by manipulating it against the HARD PALATE, the Bony Membrane-covered roof of the mouth. This structure is different from the SOFT PALATE, an area located just behind the Hard Palate.

**ESOPHAGUS**

1. Once the teeth and salivary glands have completed the initial processing, the food is ready to be SWALLOWED.

2. Gathering the food together in a ball called a **BOLUS**; the TONGUE pushes it toward the back of the Mouth and INTO the **PHARYNX**.

3. **THE PHARYNX IS AN AREA AT THE BACK OF THE THROAT THAT CONNECTS THE NOSE AND MOUTH TO THE DIGESTION AND RESPIRATORY TRACTS.**

4. In the Pharynx, the GI TRACK AND THE RESPIRATORY SYSTEM CROSS EACH OTHER.

5. As the tongue moves food into the Pharynx, it presses down on a SMALL FLAP of Cartilage called the **EPIGLOTTIS**. When the Epiglottis is Depressed, it CLOSES the entrance to the Respiratory Track and Guides the Food down the GI Track.

6. **FOOD (The Bolus) MOVES FROM THE PHARYNX INTO THE ESOPHAGUS, A 25 cm LONG MUSCULAR TUBE THAT CONNECTS THE PHARYNX WITH THE STOMACH.**
7. Once the Bolus enters the Esophagus, MUSCLES in the Esophagus Wall move food toward the Stomach. The Esophagus has Two Muscle Layers: a Circular Layer that wraps around the Esophagus and a Longitudinal Layer that runs the length of the tube.

8. WAVES OF MUSCULAR CONTRACTIONS CALLED PERISTALSIS (payr-ih-STOL-sis) MOVE FOOD THROUGH THE DIGESTIVE TRACK. (Figure 40-7)

9. Contractions of the muscles move the Bolus to a Valve called the CARDIAC SPHINCTER VALVE where the Esophagus joins the Stomach. The Sphincter allows food to pass into the stomach but usually NOT Letting it move Back Up into the Esophagus.

THE STOMACH

1. The Partially Digested food is now in the Stomach.

2. The STOMACH IS A J-SHAPED MUSCULAR SAC WITH THICK EXPANDABLE WALLS LOCATED IN THE UPPER LEFT SIDE OF THE ABDOMINAL CAVITY, JUST BELOW THE DIAPHRAGM. (Figure 49-8)

3. THE STOMACH IS INVOLVED IN BOTH MECHANICAL AND CHEMICAL DIGESTION.

4. The Stomach Walls are made of layers of Muscles that Contract in OPPOSITE DIRECTION.

5. Mechanical Digestion occurs when the Stomach Walls Contract Strongly, Mixing and Churning the food. These contractions are responsible for the "Growling" noises our stomach makes, they are the loudest when we have an empty stomach.

6. Chemical Digestion in the Stomach begins with the actions of HYDROCHLORIC ACID AND AN ENZYME CALLED PEPSIN. BOTH SUBSTANCES ARE SECRETED BY GASTRIC GLANDS IN THE STOMACH. THESE FLUIDS THAT CARRY OUT CHEMICAL DIGESTION IN THE STOMACH ARE KNOWN AS GASTRIC FLUIDS.

7. PEPSIN Breaks Down PROTEINS INTO SHORTER CHAINS OF AMINO ACIDS CALLED PEPTIDES, Pepsin works best in an Acidic Environment, which is provided by the Hydrochloric Acid.

8. Another fluid secreted by glands in the Stomach is MUCUS. Mucus lubricates food so that it can travel through the digestive tract more easily.

9. Mucus also COATS the walls of the Stomach, protecting the muscle tissue from being broken down by other digestive fluids.

10. The inner lining of the Stomach is a Thick, Wrinkled Mucous Membrane composed of Epithelial Cells. This Membrane is dotted with small openings called GASTRIC PITS, they are the open ends of GASTRIC GLANDS that release secretions into the Stomach. Some of these Glands secret Mucus, some secrete Digestive Enzymes, and still others secret Hydrochloric Acid. The Mixture of these fluids form the Acidic Digestive Fluid.

11. Lives of stomach wall cells are short; they are replaced about every three days.

12. After about THREE HOURS (3-4 hours) of Mechanical and Chemical Treatment in the Stomach, food is reduced to a SOFT PULP CALLED CHYME (KYM).
13. CHYME IS A THICK LIQUID MADE UP OF PARTIALLY DIGESTED PROTEINS, STARCHES, VITAMINS, MINERALS, AND ACIDS, AND UNDIGESTED SUGARS AND FATS.

14. At this point, the **PYLORIC SPHINCTER VALVE** between the Stomach and Small Intestine opens, allowing small amounts of Chyme to pass into the Small Intestine.

15. By the time Chyme has left the Stomach, MOST PROTEINS have been Broken down into smaller Polypeptides. Sugars and Fats have NOT YET been Chemically altered. Some Starch Molecules have been broken down into Disaccharides.

**THE SMALL INTESTINES**
1. As Chyme is pushed through the Pyloric Valve, it enters the **DUODENUM**, first part of the Small Intestine.

2. The Small Intestine performs THREE Major functions on Chyme that enters from the Stomach.

3. **THE SMALL INTESTINES DIGEST CARBOHYDRATES AND FATS, COMPLETES THE DIGESTION OF PROTEINS, AND ABSORBS DIGESTED NUTRIENTS.**

4. The Small Intestine is long (7m), but its diameter (2.5cm) is smaller than the Large Intestines. The Small Intestines consists of Three Parts
   - A. DUODENUM - THE FIRST SECTION (25 cm)
   - B. JEJUNUM - THE MIDDLE SECTION (2.5 m)
   - C. ILEUM - MAKE UP THE REMAINING PORTION.

5. Some of the digestive Fluids and Enzymes that digest Food in the Small Intestine come from Glands located in the Small Intestines.

6. These Glands produce Enzymes that digest Proteins and Carbohydrates.

7. The **PANCREAS**, an organ located behind the stomach, secretes **Pancreatic Fluid** into the Small Intestine. The Pancreatic Fluid enters the Small Intestines through the Pancreatic Duct, which joins with the common Bile Duct just before it enters the Intestine.


9. Pancreatic Fluid also contains **SODIUM BICARBONATE**, which neutralizes the Hydrochloric Acid in Chyme (from and acid to a base), protecting the Small Intestine.

10. The **LIVER** is a large brownish organ that lies above the Stomach in the Abdominal Cavity. One of the Functions of the Liver is to Secrete a Yellow-Brown Liquid called **BILE**.

11. Bile is stored in a Small Sac called the **GALLBLADDER**. The entrance of food into the Small Intestines stimulates the release of Bile to the Small Intestines through a Duct.

12. Bile is produced by the Liver and Stored in the Gallbladder until needed.

13. FATS in the Small Intestine are broken down into smaller droplets by Bile.

14. One of the main functions of **Bile is to dissolve Cholesterol**. Bile is a salt containing detergent and if the amount of salt in the bile is insufficient, sharp, painful crystals can form, known as **GALLSTONES**.
**ABSORPTION**

1. MOST NUTREINTS ARE ABSORBED INTO THE CIRCULATORY SYSTEM THROUGH THE CELLS THAT LINE THE SMALL INTESTINE.

2. THE INTERNAL SURFACE OF THE INTESTINE IS LINED WITH FINGERLIKE PROJECTIONS CALLED **VILLI**. The cells covering the Villi, in turn have extensions on their Cell Membranes called **MICROVILLI**.

3. Villi increase the surface area of the lining of the small intestine, making absorption more efficient.

4. NUTREINTS ARE ABSORBED THROUGH **CAPILLARIES** AND TINY LYMPH VESSELS CALLED **LACTEALS** IN THE VILLI.

5. CAPILLARIES absorb the Carbohydrates (Monosaccharides) and Proteins (Amino Acids) and are carried to the Liver. 

6. The Liver Neutralizes many toxic substances in the blood and removes excess Glucose, converting it to Glycogen for storage (FAT). The Filtered Blood then carries the nutrients to all the parts of the body.

7. The Tiny Lymph Vessels called Lacteals absorb Glycerol and Fatty Acids, which are carried through the Lymph Vessels and eventually to the Bloodstream through Lymphatic Vessels near the Heart.

8. **MOST OF THE NUTREINTS USED BY THE BODY ARE ABSORBED THROUGH THE LINING OF THE SMALL INTESTINES.**

**LARGE INTESTINE**

1. AFTER ABSORPTION IN THE SMALL INTESTINES IS COMPLETE, UNDIGESTED MATERIAL LEAVES THE SMALL INTESTINE THROUGH A VALVE AND ENTERS THE **LARGE INTESTINE OR COLON**.

2. It is the Final Organ of Digestion and consists of Four Major Parts: **ASCENDING COLON, TRANSVERSE COLON, DESCENDING COLON, AND SIGMOID COLON**.

3. An organ called the **Appendix** is located near the junction of the small and large intestine. The Appendix is a finger-shaped pouch, which does not serve any known function. If the Appendix becomes infected with Bacteria, resulting in appendicitis, the appendix must be removed.

4. The Large Intestine, also called the Colon, is about 6 cm wide and 1.5 m long.

5. **THE LARGE INTESTINE ABSORBS WATER FROM THE MATERIAL REMAINING IN THE DIGESTIVE TRACT.**

6. WATER-SOLUBLE VITAMINS ARE ABSORBED ALONG WITH THE WATER. Vitamin K.

7. When most of the water has been removed from the undigested material, a solid waste matter, called **FECES** remains.

8. **PERISTALSIS** propels the feces through the large intestine and into The **RECTUM**, the last few inches of the large intestine. Feces collected in the rectum are eliminated through the **ANUS**.

9. Sometimes a Disease or Disorder prevents the Large Intestine from absorbing Enough Water - The Result is Diarrhea, or Watery Feces. Severe Diarrhea can result in a loss of Water, or Dehydration, that can be FATAL.