Nutrients

- nutrients: substances in food that supply the energy and raw materials your body uses for growth, repair, and maintenance
- nutrients body needs: water, carbohydrates, fats, proteins, vitamins, minerals

Water

- water makes up blood, lymph, and other bodily fluids
- water is lost during sweating when it evaporates to cool the body
- water vapor is also lost from the body with every breath you exhale & in urine
- humans need to drink at least 1 liter/per day
- dehydration leads to problems with circulatory, respiratory, and nervous systems

Carbohydrates

- simple & complex carbohydrates are main source of energy
- simple carbohydrates or monosaccharides disaccharides are found in fruits, honey, & sugar cane
- simple carbohydrates do not need to be digested or broken down
- complex carbohydrates, or starches, are found in grains, potatoes, and vegetables
- complex carbohydrates need to be broken down into simple sugars before they can be used
- these molecules are broken down into complex carbohydrate glycogen
- sugars not immediately used are converted to complex carbohydrate glycogen, which is stored in liver & skeletal muscles

Fiber

- fiber contains complex carbohydrate cellulose
- bulk supplied by fiber helps muscles keep food and wastes moving through your digestive and excretory systems
- whole-grain breads and many fruits and vegetables have fiber

Fats

- Fats are needed:
• to produce cell membranes, myelin sheaths
around neurons, and certain hormones
• to help the body absorb fat-soluble vitamins
• to protect body organs and insulate the body
- fats are saturated or unsaturated
- single bonds between carbon atoms in the fatty acids -> saturated.
- most saturated fats are solids at room temperature (butter, animal fats)
- at least one double bond in fatty acid chain -> unsaturated
- unsaturated fats are usually liquids at room temperature
- vegetable oils have more than one double bond -> polyunsaturated
- recommended 30% of calories from fat & 10& from unsaturated
- too much fat -> bp, heart disease, obesity, diabetes

Proteins

- proteins supply raw materials for growth and repair of structures such as skin and muscle; have regulatory and transport functions
- ex: hemoglobin transports oxygen
- proteins are polymers of amino acids; body can synthesize only 12 of the 20 amino
acids used to make proteins & the other 8 amino acids are called essential amino acids; they must come from food
- animal products, including meat, fish, eggs, and milk, contain all 8 essential amino acids
- foods from plants, such as grains and beans, do not

Vitamins

- vitamins: organic molecules that help regulate body processes, often working with enzymes
- most vitamins must be obtained from food
- a diet lacking certain vitamins can have serious, even fatal, consequences
- two types of vitamins:
• fat-soluble
• water-soluble
- fat-soluble vitamins A, D, E, and K can be stored in the fatty tissues of the body
- body can build up stores of these vitamins for future use
- water-soluble vitamins dissolve in water and cannot be stored in the body

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Minerals

- inorganic nutrients that the body needs, usually in small amounts, are called minerals
- ex: calcium, iron, magnesium
- calcium: major component of bones & teeth; iron makes hemoglobin
- calcium, sodium, & pottasium are required for normal functioning of the nerves

Nutrition and a Balanced Diet

- food pyramid: grains, vegetables, fruits, milk, meat and beans, fats, sugars, and salts
- need at least 30 minutes of exercise each day
- food label: information about nutrition.
- daily values are based on a 2000-Calorie diet, and nutrient needs are affected by age, gender, and
lifestyle
- when you choose a food, it should be high in nutrition and low in Calories

Food and Energy

- you need to eat food to obtain energy.
- energy in food is measured in Calories
- one Calorie = 1000 calories or 1 kilocalorie
- one calorie: amount of heat needed to raise the temperature of one gram of water by one
degree Celsius
- average-sized female teen: needs about 2200
Calories a day
- average-sized male teen: needs about 2800
Calories a day
- regular exercise = need more calories

Mouth

- chewing begins mechanical digestion, which is the physical breakdown of large pieces of food into
smaller pieces
- the teeth cut, tear, and crush food into small fragments
- as the teeth cut and grind the food, salivary glands secrete saliva, which moistens food and makes it
easier to chew
- saliva helps ease the passage of food through the digestive system and also begins the process of
chemical digestion
- saliva contains amylase, an enzyme that breaks the chemical bonds in starches and releases sugars
- saliva also contains lysozyme, an enzyme that fights infection

Digestive System Disorders

- stomach acids sometimes damage the organ’s own lining, producing a hole in the stomach wall (peptic ulcer)
- most peptic ulcers are caused by the bacterium H. pylori.
- other digestive disorders include diarrhea and constipation

Large Intestine

- chyme leaves the small intestine -> enters the large intestine or colone
- large intestine removes water from the chyme
- water is absorbed quickly, leaving undigested materials behind

Large Intestine (cont)

- concentrated waste material passes through the rectum and is eliminated from the body

Absorption in the Small Intestine

- small intestine is adapted for the absorption of nutrients
- folded surfaces of the small intestine are covered with fingerlike projections called villi
- cell surfaces of villi have more projections called microvilli
- these provide an enormous surface area for the absorption of nutrient molecules
- slow, wavelike contractions of smooth muscles move the chyme along this surface
- nutrient molecules are absorbed into the cells lining the small intestine
- most products of carbohydrate and protein digestion are absorbed into the capillaries in the villi
- molecules of undigested fat are absorbed by lymph vessels

The Small Intestine

- as chyme is pushed through the pyloric valve, it enters the duodenum
- duodenum: first of three parts of the small intestine, and is where most digestive enzymes enter the intestine
- most chemical digestion & absorption of food occurs in the small intestine
- just behind the stomach is the pancreas
- during digestion, the pancreas:
• produces enzymes that break down carbohydrates, proteins, lipids, and nucleic acids

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The Small Intestine (cont)

• produces sodium bicarbonate, a base that neutralizes stomach acid so that these enzymes
can be effective
- assisting the pancreas is the liver, which produces bile
- bile dissolves and disperses droplets of fat in fatty foods -> enables enzymes to break down smaller
fat molecules
- bile is in the gallbladder

The Stomach

- food from the esophagus empties into the stomach
- the stomach continues mechanical and chemical digestion
- alternating contractions of three smooth muscle layers churn food
- chemical digestion: the stomach lining has millions of gastric glands that release substances into the stomach
• some glands produce mucus (lubricates & protects stomach wall)
• other glands produce hydrochloric acid (makes stomach contents very acidic)
• other glands produce pepsin (enzyme that digests protein)
- pepsin and hydrochloric acid start protein digestion
- pepsin breaks proteins into smaller polypeptide fragments
- other enzymes are denatured by stomach acid

The Stomach (cont)

- mechanical digestion: stomach contracts to churn fluids and food, gradually producing a mixture known as chyme
- after 1–2 hours, the pyloric valve between the stomach and small intestine opens and chyme
flows into the small intestine

The Esophagus

- from the throat, the chewed food passes through the esophagus, or food tube, into the stomach
- food is moved along by contractions of smooth muscle
- these contractions (peristalsis) squeeze the food through the esophagus into the stomach
- cardiac sphincter closes the esophagus after food -> passes into stomach

Process of Digestion

- digestive system: mouth, pharynx, esophagus, stomach, small intestine, and large intestine
- salivary glands, pancreas, and liver add secretions to the digestive system, and aid in digestion
- digestive system: help convert foods into simpler molecules that can be absorbed and used by the cells of the body

Functions of the Excretory System

- every cell produces metabolic wastes
- the process where these wastes are eliminated is called
- skin excretes excess water & salts in the form of sweat; lungs excrete carbon dioxide
- kidneys also play a major role in excretion

The Kidneys

- the kidneys: remove waste products from the blood, maintain blood pH, and regulate the water content of the blood & blood volume
- kidneys (either side of the spinal column near the lower back)
- a tube (ureter) leaves each kidney, carrying urine to the urinary bladder (saclike organ where urine is stored before excreted)
- blood enters kidney through renal artery
- kidney removes urea, excess water, & other waste products and passes them to ureter
- clean, filtered blood leaves the kidney through renal vein & returns to circulation
- renal medulla: inner part of kidney
- renal cortex: outer part of kidney
- functional units of the kidney are called nephrons
- nephrons are located in the renal cortex, except for their loops of Henle, which descend into the renal
medulla
- each nephron has its own blood supply: arteriole, venule, network of capillaries connecting them
- each nephron releases fluids to a collecting duct -> leads to the ureter.
- blood enters a nephron through the arteriole -> impurities are filtered out and emptied into the collecting duct
- purified blood exits the nephron through the venule
- blood purification involves filtration and reabsorption

The Kidneys (cont)

- filtration (happens in glomerulus): passing a liquid or gas through a filter to remove wastes
- glomerulus is a small network of capill-aries encased in the top of the nephron by a hollow, cup-
shaped structure called Bowman's capsule
- fluid from blood flows into Bowman’s capsule
- materials filtered from the blood include water, urea, glucose, salts, amino acids, & some vitamins
- plasma proteins, cells, and platelets remain in the blood b/c they are too large to pass through
capillary walls
- reabsorption: process in which liquid is taken back into a vessel
- almost 99% of the water that enters Bowman’s capsule is reabsorbed into the blood
- filtrate drains in the collecting ducts -> most water and nutrients have been reabsorbed into the blood
- remaining material (urine) is emptied into a collecting duct
- urine is primarily concentrated in the loop of Henle (a section of the nephron tubule where water is conserved & volume of urine minimized)
- kidney works -> purified blood is returned to circulation while urine is collected in the urinary
bladder
- urine is stored here until released from the body through a tube called urethra

Control of Kidney Function

- activity of kidneys is controlled by composition of blood
- regulatory hormones are released in response to the composition of blood
- you drink a liquid -> absorbs into blood through digestive system -> concentration of water in blood goes up -> rate of water reabsorption in the kidneys goes down -> less water is returned to the blood & excess water is sent to urinary bladder to be excreted as urine
- if kidneys detect an increase in salt -> return less salt to the blood by reabsorption
- excess salt the kidneys retain is excreted in urine -> maintaining the composition of the blood

Kidney Disorders

- humans have two kidneys, but can survive with only one
- if both kidneys are damaged by disease or injury -> kidney transplant, kidney dialysis
- kidney dialysis:
- Blood is removed by a tube & pumped through special tubing that acts like nephrons
- tiny pores in the tubing allow salts and small molecules to pass through
- wastes diffuse out of the blood into the fluid-filled chamber, allowing purified blood to be returned to
the body