Chapter 5: Physiological Structure and Life Process

Introduction to Life Processes

Life processes maintain, repair and energize organisms; the four essentials are Nutrition, Respiration, Transportation and Excretion. Each delivers raw materials, removes wastes or provides energy, enabling cellular survival.

Nutrition in Plants

Through photosynthesis plants turn inorganic CO2, H2O and sunlight into glucose and O2 inside chloroplasts. Carbon dioxide enters via stomata, water rises from roots, light activates chlorophyll which splits H2O (releasing O2); hydrogen then reduces CO2 to glucose. Nitrogen-fixing bacteria convert atmospheric N2 into soil nitrites/nitrates used for protein synthesis. Overall equation: 6CO2 + 6H2O {sunlight,\ chlorophyll} C6H{12}O6 + 6O2

Nutrition in Humans

Food passes mouth → oesophagus → stomach → small intestine → large intestine → anus. Salivary amylase begins starch digestion; peristalsis moves bolus. Gastric juice (pepsin, *HCl*, mucus) starts protein digestion and keeps acidic pH while mucus protects stomach lining. Pyloric sphincter releases chyme into small intestine, where pancreatic, bile and intestinal juices finish digestion: carbohydrates → sugars, proteins → amino acids, fats → fatty acids & glycerol. Villi absorb nutrients into blood/lymph; large intestine reclaims water, ejects waste.

Respiration (Cellular)

Aerobic respiration requires O2 + glucose → 2 pyruvic acid (cytoplasm) → CO2 + H2O + ATP (mitochondria); summarized by C6H{12}O6 + 6O2 → 6CO2 + 6H2O + ATP. ATP (adenosine triphosphate) stores usable energy. Anaerobic respiration occurs without oxygen, yields less ATP; in muscles pyruvic acid → lactic acid (causing soreness), in yeast → ethanol (alcoholic fermentation).

Human Respiratory System

Air enters nostrils → nasal cavity (filters, humidifies) → trachea (C-shaped cartilage) → bronchi → bronchioles → alveoli. Gas exchange occurs across alveolar capillaries: O2 diffuses into blood (bound by haemoglobin), CO2 diffuses out (transported mainly as bicarbonate in plasma). Efficient ventilation maintains concentration gradients.

Human Circulatory System

Heart, blood and vessels transport materials. Four-chambered heart enables double circulation: right side collects deoxygenated blood → lungs; left side distributes oxygenated blood → body. Arteries carry high-pressure oxygenated blood away (thick, elastic walls); veins return low-pressure deoxygenated blood (thin walls, valves); capillaries mediate exchange. Platelets clot at injuries. Lymphatic system returns interstitial fluid and absorbs intestinal fats; lymph eventually rejoins veins.

Plant Transport System

Xylem moves water/minerals upward via root pressure and transpiration pull through vessels/tracheids. Phloem translocates sucrose and other solutes bidirectionally using pressure generated by active loading (ATP-dependent). Transport meets growth demands, e.g., supplying buds in spring.

Human Excretory System

Kidneys filter nitrogenous wastes (urea, uric acid, creatinine) from blood. Each nephron contains a glomerulus within Bowman's capsule where plasma is filtered; useful solutes are reabsorbed along tubule. Urine (wastes + water) drains kidney → ureters → bladder → urethra for elimination when bladder stretches.

Balanced integration of nutrition, respiration, transport and excretion sustains homeostasis; disruption in any compromises survival.