

2 The chemistry of living things

1. All matter consists of elements
 - *Atoms are the smallest functional units of an element*
 - *Isotopes have a different number of neutrons*
2. Atoms combine to form molecules
 - *Energy fuels life's activities*
 - *Chemical bonds link atoms to form molecules*
 - *Living organisms contain only certain elements*
3. Life depends on water
 - *Water is the biological solvent*
 - *Water helps regulate body temperature*
4. The importance of hydrogen ions
 - *Acids donate hydrogen ions, bases accept them*
 - *The pH scale expresses hydrogen ion concentration*
 - *Buffers minimize changes in pH*
5. The organic molecules of living organisms
 - *Carbon is the common building block of organic molecules*
 - *Macromolecules are synthesized and broken down within the cell*
6. Carbohydrates: Used for energy and structural support
 - *Monosaccharides are simple sugars*
 - *Oligosaccharides: More than one monosaccharide linked together*
 - *Polysaccharides store energy*
7. Lipids: Insoluble in water
 - *Tryglycerides are energy-storage molecules*
 - *Phospholipids are the primary component of cell membranes*
 - *Steroids are composed of four rings*
8. Proteins: Complex structures constructed of amino acids
 - *Protein function depends on structure*
 - *Enzymes facilitate biochemical reactions*
9. Nucleic acids store genetic information
10. ATP carries energy

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3 Structure and function of cell

1. Cells are classified according to their internal organization
 - *Eukaryotes have nucleus, cytoplasm and organelles*
 - *Prokaryotes lack a nucleus and organelles*
2. Cell structure reflects cell function
 - *Cells remain small to stay efficient*
3. A plasma membrane surrounds the cell
 - *The plasma membrane is a lipid bilayer*
4. Molecules cross the plasma membrane in several ways
 - *Passive transport: Principles of diffusion and osmosis*
 - *Passive transport moves with the concentration gradient*
 - *Active transport requires energy*
 - *Endocytosis and exocytosis move materials in bulk*
 - *Information can be transferred across the plasma membrane*
 - *The sodium-potassium pump helps maintain cell volume*
 - *Isotonic extracellular fluid also maintains cell volume*
5. Internal structures carry out specific functions
 - *The nucleus controls the cell*
 - *Ribosomes are responsible for protein synthesis*
 - *The endoplasmic reticulum is the manufacturing center*
 - *The Golgi apparatus refines, packages and ships*
 - *Vesicles: Membrane -bound storage and shipping containers*
 - *Mitochondria provide energy*
 - *Fat and glycogen: Sources of energy*
6. Cells have structures for support and movement
 - *The cytoskeleton supports the cell*
 - *Cilia and flagella are specialized in cell division*
7. Cells use and transform matter and energy
 - *Glucose provides the cell with energy*
 - *Fats and proteins are additional energy sources*
 - *Anaerobic pathways make energy available without oxygen*

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4 From cells to organ systems

1. Tissues are groups of cells with a common function
2. Epithelial tissues cover body surfaces and cavities
 - *Epithelial tissues are classified according to cell shape*
 - *The basement membrane provides structural support*
3. Connective tissue supports and connects body parts
 - *Fibrous connective tissues provide strength and elasticity*
 - *Specialized connective tissues serve special functions*
4. Muscle tissues contract to produce movement
 - *Skeletal muscles move body parts*
 - *Cardiac muscle cells activate each other*
 - *Smooth muscle surrounds hollow structures*
5. Nervous tissue transmits impulses
6. Organs and organ systems perform complex functions
 - *The human body is organized by organ systems*
 - *Tissue membranes line body cavities*
 - *Describing body position or direction*
7. The skin as an organ system
 - *Skin has many functions*
 - *Skin consists of epidermis and dermis*
8. Multicellular organisms must maintain homeostasis
 - *Homeostasis is maintained by negative feedback*
 - *Negative feedback helps maintain core body temperature*
 - *Positive feedback amplified events*

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5 The skeletal system

1. The skeletal system consists of connective tissue
 - *Bones are the hard elements of the skeleton*
 - *Bone contains living cells*
 - *Ligaments hold bones together*
 - *Cartilage lends support*
2. Bone development begins in the embryo
3. Mature bone undergoes remodeling and repair
 - *Bones can change in shape, size and strength*
 - *Bone cells are regulated by hormones*
 - *Bones undergo repair*
4. The skeleton protects, supports and permits movement
 - *The axial skeleton forms the midline of the body*
 - *The appendicular skeleton: Pectoral girdle, pelvic girdle and limbs*
5. Joints form connections between bones
 - *Joints vary from immovable to freely movable*
 - *Ligaments, tendons and muscles strengthen and stabilize joints*
6. Diseases and disorders of the skeletal system
 - *Sprains mean damage to ligaments*
 - *Bursitis and tendinitis are caused by inflammation*
 - *Arthritis is inflammation joints*
 - *Osteoporosis is caused by excessive bone loss*

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6 The muscular system

1. Muscles produce movement or generate tension
 - *The fundamental activity of muscle is contraction*
 - *Skeletal muscles cause bones to move*
 - *A muscle is composed of many muscle cells*
 - *The contractile unit is a sarcomere*
2. Individual muscle cells contract and relax
 - *Nerves activate skeletal muscles*
 - *Activation releases calcium*
 - *Calcium initiates the sliding filament mechanism*
 - *When nerve activation ends, contraction ends*
 - *Muscles require energy to contract and to relax*
3. The activity of muscles can vary
 - *Isotonic versus isometric contractions: Movements versus static position*
 - *The degree of nerve activation influences force*
 - *Slow-twitch versus fast-twitch fibers: Endurance versus strength*
 - *Exercise training improves muscle mass, strength and endurance*
4. Cardiac and smooth muscles have special features
 - *How cardiac and smooth muscles are activated*
 - *Speed and sustainability of contraction*
 - *Arrangement of myosin and actin filaments*
5. Diseases and disorders of the muscular system
 - *Muscular dystrophy*
 - *Tetanus*
 - *Muscle cramps*
 - *Pulled muscles*
 - *Fasciitis*

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7 Blood

1. The components and functions of blood
 - Plasma consists of water and dissolved solutes
 - Red blood cells transport oxygen and carbon dioxide
 - Hematocrit and hemoglobin reflect oxygen-carrying capacity
 - All blood cells and platelets originate from stem cells
 - RBC's have a short life span
 - RBC production is regulated by a hormone
 - White blood cells defend the body
 - Platelets are essential for blood clotting
2. Hemostasis: Stopping blood loss
 - Vascular spasms constrict blood vessels to reduce blood flow
 - Platelets stick together to seal a ruptured vessel
 - A blood clot forms around the platelet plug
3. Human blood types
 - ABO blood typing is based on A and B antigens
 - Rh blood typing is based on Rh factor
 - Blood typing and cross-matching ensure blood compatibility
4. Blood disorders
 - Blood poisoning: Infection of blood plasma
 - Mononucleosis: contagious viral infection of lymphocytes
 - Anemia: Reduction in blood's oxygen-carrying capacity
 - Leukemia: uncontrolled production of white blood cells
 - Multiple myeloma: Uncontrolled production of plasma cells
 - Thrombocytopenia: Reduction in platelet number

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8 Heart and blood vessels

1. **Blood vessels transport blood**
 - *Arteries transport blood away from the heart*
 - *Arterioles and pre-capillary sphincters regulate blood flow*
 - *Capillaries: Where blood exchanges substances with tissues*
 - *Lymphatic system helps maintain blood volume*
 - *Veins return blood to the heart*
2. **The heart pumps blood through the vessels**
 - *The heart is mostly muscle*
 - *The heart has four chambers and four valves*
 - *The pulmonary circuit serves the rest of the body*
 - *The cardiac cycle: The heart contracts and relaxes*
 - *Heart sounds reflect closing heart valves*
 - *Cardiac conduction system coordinates contraction*
 - *Electrocardiogram records the heart's electrical activity*
3. **Blood exerts pressure against vessel walls**
 - *Measuring blood pressure*
 - *Hypertension: High blood pressure can be dangerous*
 - *Hypotension: When blood pressure is too low*
4. **How the cardiovascular system is regulated**
 - *Baroreceptors maintain arterial blood pressure*
 - *Nerves and hormones adjust cardiac output*
 - *Local requirements dictate local blood flows*
 - *Exercise: Increased blood flow and cardiac output*
5. **Cardiovascular disorders: A major health issue**
 - *Angina: Chest pain warns of impaired blood flow*
 - *Heart attack: Permanent damage to heart tissue*
 - *Heart failure: The heart becomes less efficient*
 - *Embolism; Blockage of a blood vessel*
 - *Stroke: Damage to blood vessels in the brain*
6. **Reducing your risk of cardiovascular disease**

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9 The immune system and mechanisms of defense

1. Pathogens cause disease
 - *Bacteria: Single-celled living organisms*
 - *Viruses: Tiny infectious agents*
 - *Prions: Infectious proteins*
 - *Transmissibility, mode of transmission and virulence determine health risk*
2. The lymphatic system defends the body
 - *Lymphatic vessels transport lymph*
 - *Lymph nodes cleanse the lymph*
 - *The spleen cleanses blood*
 - *Thymus gland hormones cause T lymphocytes to mature*
 - *Tonsils protect the throat*
3. Keeping pathogens out: The first line of defense
 - *Skin: An effective deterrent*
 - *Impeding pathogen entry in areas not covered by skin*
4. Nonspecific defenses: The second line of defense
 - *Phagocytes engulf foreign cells*
 - *Inflammation: Redness, warmth, swelling and pain*
 - *Natural killer cells target tumors and virus-infected cells*
 - *The complement system assists other defense mechanisms*
 - *Interferons interfere with viral reproduction*
 - *Fever raises body temperature*
5. Specific defense mechanisms: The third line of defense
 - *The immune system targets antigens*
 - *Lymphocytes are central to specific defenses*
 - *B cells: antibody-mediated immunity*
 - *The five classes of antibodies*
 - *Antibodies' structure enables them to bind to specific antigens*
 - *T cells: Cell-mediated immunity*
6. Immune memory creates immunity
7. Medical assistance in the war against pathogens
 - *Active immunization: An effective weapon against pathogens*
 - *Passive immunization can help against existing or anticipated infections*
 - *Monoclonal antibodies: Laboratory-created for commercial use*
 - *Antibodies combat bacteria*
8. Tissue rejection: A medical challenge
9. Inappropriate immune system activity causes problems
 - *Allergies: A hypersensitive immune system*
 - *Autoimmune disorders : Defective recognition of « self »*
10. Immune deficiency: The special case of AIDS
 - *HIV targets helper T cells of the immune system*
 - *HIV is transmitted in body fluids*
 - *AIDS develops slowly*
 - *The AIDS epidemic: A global health issue*
 - *Risky behaviors increase your chances of getting AIDS*
 - *Sex can be safer*
 - *New treatments offer hope*

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10 The respiratory system: Exchange of gases

1. Respiration takes place throughout the body
2. The respiratory system consists of upper and lower respiratory tracts
 - *The upper respiratory tract filters, warms and humidifies air*
 - *The lower respiratory tract exchanges gases*
3. The process of breathing involves a pressure gradient
 - *Inspiration brings in air, expiration expels it*
 - *Lung volumes and vital capacity measure lung function*
4. Gas exchange and transport occur passively
 - *Gases diffuse according to their partial pressures*
 - *External respiration: The exchange of gases between air and blood*
 - *Internal respiration: The exchange of gases with tissue fluids*
 - *Hemoglobin transports most oxygen molecules*
 - *Most CO₂ is transported in plasma as bicarbonate*
5. The nervous system regulates breathing
 - *A respiratory center establishes rhythm of breathing*
 - *Chemical receptors monitor CO₂, H⁺ and O₂ levels*
 - *We can exert some conscious control*
6. Disorders of the respiratory system
 - *Reduced air flow of gas exchange impedes respiratory function*
 - *Microorganisms can cause respiratory disorders*
 - *Lung cancer is caused by proliferation of abnormal cells*
 - *Pneumothorax and atelectasis: A failure of gas exchange*
 - *Congestive heart failure impairs lung function*

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13 The endocrine system

1. The endocrine system produces hormones
2. Hormones are classified as steroid or non-steroid
 - *Steroid hormones enter target cells*
 - *Non-steroid hormones bind to receptors on target cell membranes*
 - *Hormones participate in negative feedback loops*
3. The hypothalamus and the pituitary gland
 - *The posterior pituitary stores ADH and oxytocin*
 - *The anterior pituitary six key hormones*
 - *Pituitary disorders; hyper-secretion or hypo-secretion*
4. The pancreas secretes glucagon, insulin, and somatostatin
5. The adrenal glands comprise the cortex and medulla
 - *The adrenal cortex: Glucocorticoids and mineralocorticoids*
 - *The adrenal medulla: Epinephrine and norepinephrine*
6. Thyroid and parathyroid glands
 - *The thyroid gland: Thyroxine speeds cellular metabolism*
 - *Parathyroid hormone (PTH) controls blood calcium levels*
7. Testes and ovaries produce sex hormones
 - *Testes produce testosterone*
 - *Ovaries produce estrogen and progesterone*
8. Other glands and organs also secrete hormones
 - *Thymus gland hormones aid the immune system*
 - *The pineal gland secretes melatonin*
 - *Endocrine functions of the heart, the digestive system and the kidneys*
9. Other chemical messengers
 - *Histamine is important in inflammation*
 - *Prostaglandins: Local control of blood flow*
 - *Nitric oxide has multiple functions*
 - *Growth factors regulate tissue growth*
10. Disorders of the endocrine system
 - *Diabetes mellitus: Inadequate control of blood sugar*
 - *Hypothyroidism: Underactive thyroid gland*
 - *Hypothyroidism: Overactive thyroid gland*
 - *Addison's disease: Too little cortisol and aldosterone*
 - *Cushing's syndrome: Too much cortisol*

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14 The digestive system and nutrition

1. The digestive system brings nutrients into the body
 - *The walls of the GI tract are composed of four layers*
 - *Five basic processes accomplish digestive system function*
 - *Two types of motility aid digestive processes*
2. The mouth processes food for swallowing
 - *Teeth bite and chew food*
 - *The tongue positions and tastes food*
 - *Saliva begins the process of digestion*
3. The pharynx and esophagus deliver food to the stomach
4. The stomach stores food and protein, and regulates delivery
 - *Gastric juice breaks down proteins*
 - *Stomach contractions mix food and push it forward*
5. The small intestine digests food and absorbs nutrients and water
6. Accessory organs aid digestion and absorption
 - *The pancreas secretes enzymes and NaHCO_3*
 - *The liver produces bile and performs many other functions*
 - *The gallbladder stores bile until needed*
7. The large intestine absorbs nutrients and eliminated wastes
8. How nutrients are absorbed
 - *Proteins and carbohydrates are absorbed by active transport*
 - *Lipids are broken down, then reassembled*
 - *Water is absorbed by osmosis*
 - *Vitamins and minerals follow a variety of paths*
9. Endocrine and nervous systems regulate digestion
 - *Regulation depends on volume and content of food*
 - *Nutrients are used or stored until needed*
10. Nutrition: You are what you eat
 - *MyPyramid plan offers a personalized approach*
 - *Carbohydrates: A major energy source*
 - *Lipids: Essential cell components and energy sources*
 - *Complete proteins contain every amino acid*
 - *Vitamins are essential for normal function*
 - *Minerals: Elements essential for body processes*
 - *Fiber benefits the colon*
11. Weight control: Energy consumed versus energy spent
 - *BMR: Determining how many calories we need*
 - *Energy balance and body weight*
 - *Physical activity: An efficient way to use calories*
 - *Healthy weight improves overall health*
12. Disorders of the digestive system
 - *Disorders of the GI tract*
 - *Disorders of the accessory organs*
 - *Malnutrition: Too many or too few nutrients*
 - *Obesity: A worldwide epidemic?*
13. Eating disorders: Anorexia nervosa and bulimia

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15 The urinary system

1. The urinary system contributes to homeostasis
 - *The kidneys regulate water levels*
 - *The kidneys regulate nitrogenous wastes and other solutes*
2. Organs of the urinary system
 - *Kidneys: The principal urinary organs*
 - *Ureters transport urine to the bladder*
 - *Urinary bladder stores urine*
 - *Urethra carries urine from the body*
3. Nephrons produce urine
 - *The tubule filters fluid and reabsorbs substances*
 - *Special blood vessels supply the tubule*
4. Formation of urine: Filtration, reabsorption, and secretion
 - *Glomerular filtration filters fluid from capillaries*
 - *Tubular reabsorption returns filtered water and solutes to blood*
 - *Tubular secretion removes other substances from blood*
5. The kidneys can produce dilute or concentrated urine
 - *Producing dilute urine: Excreting excess water*
 - *Producing concentrated urine: conserving water*
6. Urination depends on a reflex
7. The kidneys maintain homeostasis in many ways
 - *ADH regulates water balance*
 - *Aldosterone regulates salt balance*
 - *The renin-angiotensin system controls blood volume and blood pressure*
 - *Atrial natriuretic hormone protects against blood volume excess*
 - *Kidneys help maintain acid-base balance and blood pH*
 - *Erythropoietin stimulates production of red blood cells*
 - *Kidneys activate vitamin D*
8. Disorders of the urinary system
 - *Kidney stones can block urine flow*
 - *Urinary tract infections are often caused by bacteria*
 - *Acute and chronic renal failure impair kidney function*
 - *Dialysis cleanses the blood artificially*
 - *Kidney transplants are a permanent solution to renal failure*

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16 Reproductive systems

1. The male reproductive system delivers sperm
 - *Testes produce sperm*
 - *Accessory glands help sperm survive*
 - *Sperm production requires several cell divisions*
 - *Testosterone affects male reproductive capacity*
2. The female reproductive system produces eggs and supports pregnancy
 - *Ovaries release oocytes and secrete hormones*
 - *The uterus nurtures the developing embryo*
 - *The vagina: Organ of sexual intercourse and birth canal*
 - *Mammary glands nourish the infant*
3. Menstrual cycle consists of ovarian and uterine cycles
 - *The ovarian cycle: Oocytes mature and are released*
 - *The uterine cycle prepares the uterus for pregnancy*
 - *Cyclic changes in hormone levels produce the menstrual cycle*
4. Human sexual response, intercourse, and fertilization
 - *The male sexual response*
 - *The female sexual response*
 - *Fertilization: One sperm penetrates the egg*
5. Birth control methods: Controlling fertility
 - *Abstinence: Not having intercourse*
 - *Surgical sterilization: Vasectomy and tubal ligation*
 - *Hormonal methods: Pills, injections, patches and rings*
 - *IUDs are inserted into the uterus*
 - *Diaphragms and cervical caps block the cervix*
 - *Chemical spermicides kill sperm*
 - *Condoms trap ejaculated sperm*
 - *Withdrawal and periodic abstinence*
 - *Pills that can be used after intercourse*
 - *Elective abortion*
 - *The future in birth control*
6. Infertility: Inability to conceive
 - *Infertility can have many causes*
 - *Enhancing fertility*
7. Sexually transmitted diseases
 - *Bacterial STDs: Gonorrhea, syphilis and chlamydia*
 - *Viral STDs: HIV, hepatitis B, genital herpes and HPV*
 - *Other STD's: Yeast infections, trichomoniasis and public lice*
 - *Protecting yourself against STDs*

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17 Cell reproduction and differentiation

1. The cell cycle creates new cells
2. Replication, transcription and translation: An overview
 - *Replication: copying DNA before cell division*
 - *Mutations are alternations in DNA*
 - *Mechanisms of DNA repair*
 - *Transcription: Converting a gene's code into mRNA*
 - *Translation: Making a protein from RNA*
3. Cell reproduction: One cell becomes two
 - *Mitosis: Daughter cells are identical to the parent cell*
 - *Cytokinesis divides one cell into two identical cells*
 - *Mitosis produces diploid cells and meiosis produces haploid cells*
 - *Meiosis: preparing for sexual reproduction*
 - *Sex differences in meiosis: Four sperm versus one egg*
4. How cell reproduction is regulated
5. Environmental factors influence cell differentiation
 - *Differentiation during early development*
 - *Differentiation later in development*
6. Cloning an organism requires an undifferentiated cell
 - *Embryo splitting: Producing identical offspring*
 - *Somatic cell nuclear transfer: cloning an adult*
7. Therapeutic cloning: Creating tissues and organs

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 - ⇒ MJ'S HUMAN BIOLOGY BLOG: Re-creating undifferentiated cells

18 Cancer: Uncontrolled cell division and differentiation

1. Tumors can be benign or cancerous
2. Cancerous cells lose control of their functions and structures
3. How cancer develops
 - *Mutant forms of proto-oncogenes, tumor suppressor genes and mutator genes contribute to cancer*
 - *a variety of factor can lead to cancer*
 - *the immune system plays an important role in cancer prevention*
4. Advances in diagnosis enable early detection
 - *Tumor imaging: X-rays, PET and MRI*
 - *Genetic testing can identify mutated genes*
 - *Enzyme tests may detect cancer markers*
5. Cancer treatments
 - *Conventional cancer treatments: Surgery, radiation and chemotherapy*
 - *Magnetism and photodynamic therapy target malignant cells*
 - *Immunotherapy promotes immune response*
 - *"Starving" cancer by inhibiting angiogenesis*
 - *Molecular treatments target defective genes*
6. The 10 most common cancers
 - *Skin cancer: Look for changes in your skin*
 - *Lung cancer: Smoking is leading risk factor*
 - *Breast cancer: Early detection pays off*
 - *Prostate cancer: Most common after age 50*
 - *Cancers of colon and rectum: Tests can detect them early*
 - *Lymphoma: Cancers of lymphoid tissues*
 - *Urinary bladder cancer: Surgery is often successful if done early*
 - *Kidney cancer: Detected during examination for a renal-related problem*
 - *Cancer of the uterus: Unusual bleeding is major symptom*
 - *Leukemia: Chemotherapy is often effective*
7. Most cancers can be prevented

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 - ⇒ **MJ'S HUMAN BIOLOGY BLOG: A DNA test for cervical cancer**

21 Development and aging

1. Fertilization begins when sperm and egg unite
 - *The journeys of egg and sperm*
 - *One sperm fertilizes the egg*
 - *Twins may be fraternal or identical*
2. Development: Cleavage, morphogenesis, differentiation, and growth
3. Pre-embryonic development: The first two weeks
4. Embryonic development: Weeks three to eight
 - *Extra-embryonic membranes*
 - *The placenta and umbilical cord*
 - *The embryo develops rapidly*
5. Gender development begins at six weeks
6. Fetal development: Nine weeks to birth
 - *Months three and four*
 - *Months five and six*
 - *Months seven through nine*
7. Birth and the early postnatal period
 - *Labor ends in delivery*
 - *Cesarean delivery: Surgical delivery of a baby*
 - *The transition from fetus to newborn*
 - *Lactation produces milk to nourish the newborn*
8. From birth to adulthood
 - *The neonatal period: a helpless time*
 - *Infancy: Rapid development and maturation of organ systems*
 - *Childhood: Continued development and growth*
 - *Adolescence: The transition to adulthood*
9. Aging takes place over time
 - *What causes aging?*
 - *Aging well*
10. Death is the final transition

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