Biology Class 02

Previous Class Topic

- **Nutrients and their elements**: carbon, hydrogen, oxygen, and nitrogen in proteins
- **Water-soluble vitamins**: B-complex and C

Fat-Soluble Vitamins

Vitamin A (Retinol)

- *Sources*: milk, fish oil
- *Functions*: Essential for skin and eye health
- *Deficiency*: Causes night blindness

Vitamin D (Calciferol)

- *Sources*: Mainly synthesized by skin exposed to sunlight; minor amounts in fish, milk, and mushrooms
- *Functions*: Critical for calcium absorption and bone health
- *Deficiency*: Leads to rickets in children, deformed bones (bow legs), and osteoporosis in adults
- *Notes*: Supplementation is commonly recommended due to widespread deficiency from lack of sunlight

Vitamin E (Tocopherol)

- *Sources*: Vegetable oils, pumpkin
- *Functions*: Important for muscle and heart function
- *Deficiency*: Causes muscle weakness and heart problems

Vitamin K (Phylloquinone)

- *Sources*: Green leafy vegetables, tomatoes
- *Functions*: Essential for blood clotting; forms clots after vessel injury
- *Deficiency*: Results in delayed blood clot formation and increased blood loss

Overview of Vitamins

Water-Soluble vs Fat-Soluble Vitamins Table

Vitamin Type	Examples	Solubility	Storage in the Body	Deficiency Disease Examples
Water-Soluble	B-complex, Vitamin C	Water	Not stored, excreted	Scurvy, Beriberi
Fat-Soluble	A, D, E, K	Fat	Stored with fats	Night blindness, Rickets

Minerals

General Features

- Minerals are inorganic micronutrients required in small quantities.
- Distinguishing factor: does not contain carbon (inorganic).
- Key for health and well-being.

Classification of Minerals

Macro Minerals

Na, Mg, P, S, Chloride, K, Ca

Macro Mineral	Sources	Main Functions	Deficiency Effects
Calcium	Milk, milk products	Bones and muscles	Brittle bones, rickets
Sodium	Salt	Maintenance of body fluids	Dehydration
Chloride	Salt	Fluid balance	Dehydration
Potassium	Fruits, vegetables	Nerve and muscle function	Muscle weakness
Phosphorus	Milk, pulses	Teeth and bone strength	Weak bones, teeth
Magnesium	Nuts, seeds	Muscle coordination	Poor muscle coordination, tremors
Sulfur	Meat, pulses	Protein structure	Protein deficiency

Micro Minerals

Micro Mineral	Sources	Functions	Deficiency Disease/Effects
Iron	Green vegetables, meat	Component of hemoglobin	Iron deficiency anemia
Fluorine	Drinking water, toothpaste	Tooth decay prevention	Dental caries, fluorosis (excess)
Copper	Almonds, pulses	Immune function, WBCs	Low white blood cell count
Iodine	Iodized salt, seafood	Thyroid hormone synthesis	Goiter, mental retardation in children
Zinc	Beans, eggs	Immune and digestive health	Diarrhea in children

Water and Fat-Soluble Vitamin Functions and Deficiencies

Deficiency Diseases Table

Vitamin/Mineral	Deficiency Disease/Symptom
Vitamin A	Night blindness
Vitamin D	Rickets, osteoporosis
Vitamin E	Muscle weakness, heart problems
Vitamin K	Bleeding, delayed clotting
Calcium	Weak bones, rickets
Iron	Anemia
Iodine	Goiter, mental retardation
Fluorine (excess)	Fluorosis, dental discoloration
Zinc	Diarrhea

Introduction to Cell Biology

The Cell as the Basic Unit of Life

- All living beings are composed of cells.
- The number of cells varies by organism size; e.g., humans have trillions, amoebas have one.
- Functions of living things include food intake, energy production, waste elimination, and reproduction.
- A cell can perform all life functions independently.
- A cell is the basic structural and functional unit of life.

Categories Based on Number of Cells

Unicellular Organisms

- Made up of a single cell performing all functions.
- *Examples*: bacteria, amoeba, Euglena, Paramecium.

Multicellular Organisms

- Composed of multiple cells with division of labor.
- Different cells and organs perform specialized functions.
- *Examples*: humans, plants, animals, insects.

Viruses—Neither Cellular Nor Living

- Viruses are acellular, containing genetic material (DNA or RNA), but cannot produce energy.
- They cannot independently perform life functions; they function only when inside a host cell.
- They exist at the boundary between living and non-living.

Structure of Cells

Classification by Internal Organization

Prokaryotes

- **Features**:
- Unicellular
- No membrane-bound nucleus or organelles
- Circular DNA in a nucleoid region
- **Examples**: bacteria, cyanobacteria (blue-green algae)

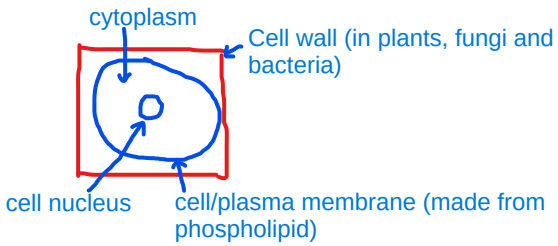
Eukaryotes

- **Features**:
- Can be unicellular or multicellular
- Membrane-bound nucleus and organelles
- Linear, chromosome-based DNA in the nucleus
- **Examples**: amoeba, Euglena, fungi, plants, animals

-> The genetic material DNA is linear and is organized in the form of rod like structures chromosome.
It is present in the nucleus.

Key Differences: Prokaryotes vs Eukaryotes

Feature	Prokaryotes	Eukaryotes
Nucleus	Absent (no membrane)	Present (with membrane)
DNA Structure	Circular (nucleoid)	Linear (chromosomes in the nucleus)
Cell Organelles	Absent	Present (mitochondria, ER, etc.)
Example Organisms	Bacteria, cyanobacteria	Fungi, plants, animals, and amoeba



Basic Cell Components (or Structure of Cell)

- **Cell Membrane (Plasma Membrane)**: Biological barrier separating the cell from the outside environment; made of phospholipids and controls the entry and exit of materials.
- **Nucleus**: Contains genetic material (DNA); directs cell activities, regulates function, and transmits heredity.
- **Cytoplasm**: Fluid medium inside the cell membrane; houses all cell organelles except the nucleus.
- **Cell Wall**: Provides extra protection and support; present in plants, fungi (chitin), and bacteria (peptidoglycans), but absent in animal cells.

Cell Organelles

- **Mitochondria**: Site of energy production; often called the powerhouse of the cell; possesses its own DNA.
- **Ribosomes**: Sites of protein synthesis; can be free-floating or attached to the endoplasmic reticulum.
- **Endoplasmic Reticulum (ER)**: Transports materials inside the cell; consists of:
- *Rough ER*: Has ribosomes; involved in protein synthesis.
- *Smooth ER*: No ribosomes; involved in fat production.
- **Lysosomes**: Contain digestive enzymes to break down waste, foreign substances, or damaged organelles; sometimes referred to as "suicide bags" when they break down the entire cell.
- **Golgi Body**: Processes, packages, and transports substances within and outside the cell.
- **Vacuole**: Storage for extra substances such as starch, oils, and proteins.
- In plant cells, typically one large vacuole for structural support, with the nucleus pushed to one side.
- In animal cells, many small vacuoles are present, with the nucleus remaining central.
- **Plastids (Plant Cells Only)**: Contain pigments to provide color to plant parts; have their own DNA.
- *Chloroplasts*: Contain green pigment (chlorophyll).
- *Chromoplasts*: Contain other colors.
- *Leucoplasts*: Colorless; involved in storage.

Three types of Plastids.

Differences Between Plant and Animal Cells

Feature	Plant Cell	Animal Cell
Cell Wall	Present (cellulose)	Absent
Plastids	Present	Absent
Vacuole	One large vacuole, nucleus, peripheral	Many small vacuoles, nucleus central
Stored Substance	Starch	Glycogen

Classification of Living Organisms

Five-Kingdom System

Kingdom	Cell Type	Cellular Organization	Example Organisms
Monera	Prokaryotic	Unicellular	Bacteria, cyanobacteria
Protista	Eukaryotic	Unicellular	Amoeba, Euglena, Paramecium
Fungi	Eukaryotic	Uni- or Multicellular	Yeast, mushrooms
Plantae	Eukaryotic	Multicellular	All plants
Animalia	Eukaryotic	Multicellular	All animals
Viruses	*Acellular (not grouped)*	*N/A*	*Viruses (outside classification)*

Health and Disease

Definition and Concept of Health

Health signifies a state of complete physical, mental, and social well-being. It is not just the absence of disease but a holistic state of wellness in all aspects.

Dimensions of Health

- **Physical Wellness**: All organs and body systems are functioning properly.
- **Mental Wellness**: Normal cognitive function, and the ability to manage emotions and stress.
- **Social Wellness**: The ability to interact and function within society.

Healthcare: Prevention and Cure

Preventive Healthcare

- Actions taken before disease onset to maintain health.
- Includes nutrition, exercise, yoga, sleep, awareness, hygiene, vaccinations, and sanitation.

Curative Healthcare

- Actions taken after disease onset to treat the illness.
- Includes medicines, surgeries, therapies (physical, mental), and targeted treatments.

Differences Between Preventive and Curative Healthcare

Factor	Preventive Healthcare	Curative Healthcare
Timing	Before disease onset	After the disease appears
Examples	Hygiene, vaccines, exercise	Medicines, surgery, ORS
Purpose	Avoid disease	Treat/manage disease
Accessibility	By all, it does not need specialists	Requires skilled professionals

Disease Classification

Main Categories

- **Congenital Diseases**: Present from birth.
- Examples: Hemophilia (blood clotting disorder), Down syndrome (mental retardation, abnormal development)
- **Acquired Diseases**: Developed after birth during life.

Acquired Disease Subcategories

Category	Cause	Examples
Communicable (Infectious)	Caused by pathogens (bacteria, viruses, fungi, protozoa)	Malaria, COVID-19, tuberculosis, typhoid, AIDS, hepatitis
Non-Communicable (Non-infectious)	Not caused by pathogens; often lifestyle or environmental factors	Diabetes, cancer, asthma, mental disorders, and hypertension

Communicable Diseases (Brief)

- Caused by pathogens, which can be bacteria, viruses, fungi, or protozoa.
- It can be transmitted from one individual to another.
- *Examples*: malaria, tuberculosis, COVID-19, typhoid, AIDS, hepatitis.

Non-Communicable Diseases

- Not caused by pathogens, hence not infectious.
- Typically chronic, lasting long periods or a lifetime.
- It can arise from lifestyle factors (diet, stress), environmental factors (pollution), genetics, or occupational exposures.
- *Examples*:
- Cardiovascular diseases (e.g., hypertension)
- Respiratory diseases (asthma)
- Nutritional deficiency diseases
- Mental disorders
- Pollution and occupational diseases (e.g., Minamata disease from mercury, silicosis from silica exposure)
- Cancer
- Diabetes (lifestyle-related)
- Account for over 70% of deaths globally.
- Increasing incidence in young populations and across economic strata.
- Historically associated with old age and developed countries, but now rising worldwide.

Topic to be Discussed in the Next Class

- Communicable (infectious) diseases, immunity, and vaccination.