

Entry To Biology Notes

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1 Definitions

1.1 Trace elements

Trace elements are just elements that are found in small amounts in biological systems. They are usually not important to biological processes.

1.2 Electronegativity

Electronegativity describes the relative ability of an atom to attract electrons in a covalent bond. It is a dimensionless quantity, which means it is not quantifiable.

1.3 Polarity

Polarity refers the difference in electronegativity between two atoms in a covalent bond.

A polar bond is one that has two atoms of different electronegativities, which will result in the more electronegative atom pulling the electrons towards its nucleus, increasing the electron density around itself and making the bond polar.

A non-polar bond is one that has two atoms of similar electronegativity, which results in the atoms exerting a similar pull on the electrons, making the bond non-polar.

1.4 Ionic bond

Oppositely charged ions formed through the loss or gain of electrons are strongly attracted to each other, forming ionic bonds. Compounds with ionic bonds usually form a **lattice** structure, which allows the positive ions to be surrounded by as many negative ions as possible, and vice versa.

1.5 Covalent bond

Covalent bonds are formed when two molecules share electrons to fill the outermost electron shell (usually 8 electrons). Covalent bonds have no net charge and have no free electrons as well. A molecule sharing a single pair of electrons is considered to have a single bond, and a molecule sharing two pairs of electrons is considered to have a double bond, and a molecule sharing three pairs of electrons is considered to have a triple bond.

1.6 Hydrogen bond

A hydrogen bond is the electrostatic attraction between polar molecules, one of which **must have a hydrogen atom bonded to a highly electronegative atom** like **nitrogen** and **oxygen**. When this hydrogen atom experiences attraction to some other nearby **highly electronegative atom**, a hydrogen bond is formed.

1.7 Hydrophobes

Hydrophobes are non-polar molecules and usually have a long chain of carbon atoms that do not interact with water molecules.

1.8 Hydrophobic interaction

Hydrophobic interaction describes the interaction between water and **hydrophobes**, which are molecules that have low solubility in water. Hydrophobic groups cluster together to exclude water from their interior.

1.9 Van der Waals forces (intermolecular attraction)

Van der Waals forces refer to the collection of forces that occur between atoms and molecules that are very close to each other. These include the attractions and repulsions between atoms, molecules and surfaces as a result of electrostatic interactions and differing polarity of molecules.

1.10 Cohesion

Cohesion is the self-adhesion of water molecules. At the surface of water, this cohesive force is called surface tension.

1.11 Macromolecules

Macromolecules refer to large and complex molecules that serve as the building materials of life-forms, and they can be classified into 4 groups:

- Carbohydrates
- Nuclei Acid
- Proteins
- Lipids

1.12 Natural selection

Natural selection states that some aspect of the environment selects traits that are more apt to be passed on to the next generation. The reason for this is that individuals with favourable traits produce a greater number of offspring that survive and reproduce.

1.13 Taxonomy

The branch of biology that identifies, names, and classifies organisms. This is necessary to handle information on diversity.

1.14 Systematics

They study of evolutionary relationships between organisms.

1.15 Binomial nomenclature

- Two-part name.
- First word is the genus and the first letter is always capitalised.
- Second word is the species designation (or specific epithet), which is written in lowercase.
- Both words are italicised when typed and underlined if handwritten.

Examples: *Homo sapiens* (humans), *Zea mays* (corn).

1.16 Biosphere

The zone of air, land, and water where organisms exist.

1.17 Population

All the members of a species (or a strain of a species if the strain is diverse) within an area.

1.18 Community

A collection of interacting populations within the same environment.

1.19 Ecosystem

An ecosystem is a community plus its physical environment.

1.20 Tissue

A tissue is a group of cells of the same type that performs a particular function.

1.21 Organ

An organ is a body structure that comprises several different tissues grouped together into a larger structural and functional unit.

1.22 Organ system

An organ system is a group of organs that work together to carry out an important function.

1.23 Hormone

A hormone is a chemical signal produced in the body. It is stable enough to be transported in active form from where it is produced, and it typically acts at a distant site. Most hormones are produced in glands that are completely enclosed in tissue called endocrine glands.

1.24 Endocrine glands

Endocrine glands are glands that secrete their hormones directly into the blood stream (no ducts).

1.25 Exocrine glands

Exocrine glands are glands that have ducts to bring the secretion to the surface they are serving, such as sweat glands, salivary glands and mammary glands.

1.26 Blood

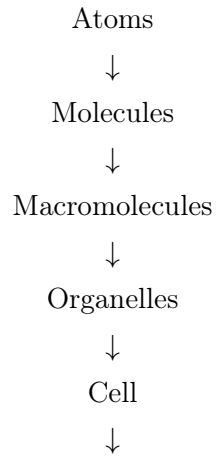
Blood carries a clear liquid base called plasma, red blood cells (erythrocytes), white blood cells (leukocytes) and platelets. The plasma makes up 55% of blood, while the erythrocytes make up 45% of blood. There are also trace amounts of leukocytes and platelets that make up less than 1% of blood.

2 Common attributes of living things

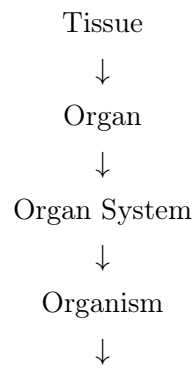
1. Cellular organisation.
2. Metabolism, which is the ability to process energy to power other processes within the living thing itself.
3. Homeostasis, which is the ability to maintain relatively stable internal environments to provide optimal conditions for biological processes.
4. Growth and reproduction.
5. Heredity, which is the ability to pass heredity (genetic) information to future generations.

3 Levels of organisation

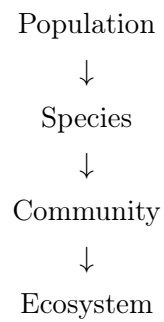
3.1 Cellular level



3.2 Organismal level



3.3 Populational level



4 Biological elements

Below is a periodic table with the list of biological elements highlighted:

LEGEND:

- Synthetic Elements
- Bulk Biological Elements
- Trace Elements
- Possible Trace Essential Elements

5 Bonds and interactions

The table below is based on the **average** values of bond strength. A reversal of the relative strengths is often found as each bond might have higher or lower strength than the average bond strength.

Name	Basis of interaction	Strength
Covalent bond	Sharing of electron pairs	Strongest
Ionic bond	Attraction of opposite charges	Strong
Hydrogen bond	Sharing of hydrogen atom	Relatively strong
Hydrophobic interaction	Forcing of hydrophobic portions of molecules together in the presence of polar substances	Weak
Van der Waals attraction	Weak attractions between atoms due to oppositely polarised electron clouds	Weakest

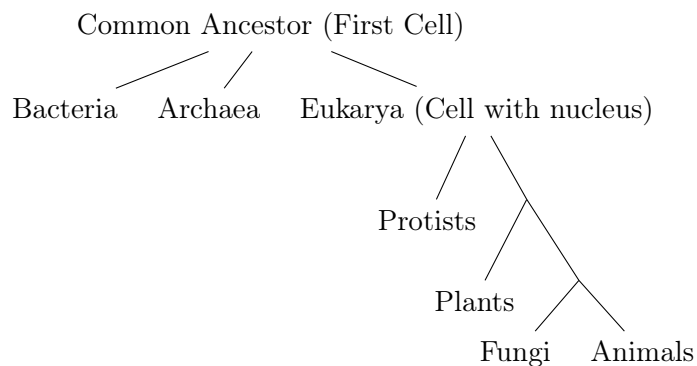
6 Properties of water

- Adhesion
- Cohesion (self-adhesion of water molecules)
- Solubilising ionic compounds
- High specific heat capacity
- High heat of vapourisation

7 Common weak acids

Acid	Conjugate Base	pK _a	K _a (M)
H_3PO_4	$H_2PO_4^-$	2.14	7.24×10^{-3}
$H_2PO_4^-$	HPO_4^{2-}	6.86	1.38×10^{-7}
HPO_4^{2-}	PO_4^{3-}	12.4	3.98×10^{-15}
H_2CO_3	HCO_3^-	6.37	4.27×10^{-7}
HCO_3^-	CO_3^{2-}	10.25	5.62×10^{-11}

8 Diversification over time



9 Classification Categories

The mnemonic to remember the taxonomic classifications is:

Dear Kevin, please come over for gay sex.

Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species.

Species

⊂

Genus

⊂

Family

⊂

Order

⊂

Class

⊂

Phylum

⊂

Kingdom

⊂

Domain

9.1 Domains

The domains of life are:

- Archaea domain
- Bacteria domain
- Eukarya domain

9.1.1 Archaea domain

Contains unicellular **prokaryotes** that live in extreme environments.

9.1.2 Bacteria domain

Contains unicellular **prokaryotes** that live in all environments. Prokaryotes **lack** a membrane-bound nucleus.

9.1.3 Eukarya domain

Contains unicellular and multicellular **eukaryotes**. Eukaryotes **contain** a membrane-bound nucleus.

9.2 Kingdoms

The kingdoms of life are:

- Plantae kingdom
- Animalia kingdom
- Protists kingdom
- Fungi kingdom

9.2.1 Plantae kingdom

The plantae kingdom includes certain algae, mosses, ferns, conifers, and flowering plants. They are multicellular, usually with specialised tissues containing complex cells. They also photosynthesise food.

9.2.2 Animalia kingdom

The animalia kingdom include sponges, worms, insects, fishes, frogs, turtles, birds, and mammals. They are multicellular with specialised tissues containing complex cells. They ingest food.

9.2.3 Protist kingdom

The protist kingdom include algae, protozoans, slime moulds, and water moulds. They are complex single cell organisms, and they absorb, photosynthesis or ingest food.

9.2.4 Fungi kingdom

The fungi kingdom include moulds, mushrooms, yeasts and ringworms. They are mostly multicellular filaments with specialised, complex cells and absorb food.

10 Virus

10.1 Similarities to living things

- It has hereditary material in the form of DNA or RNA.
- Its offspring are carrying these material.

10.2 Similarities to non-living things

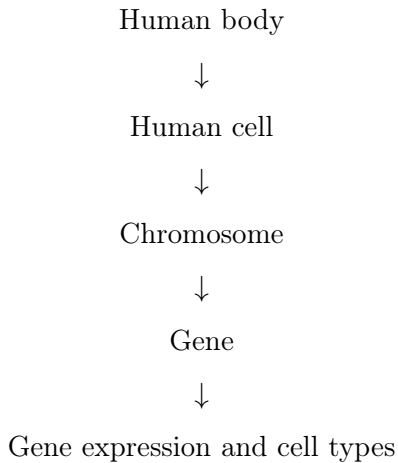
- It does not have a cell.
- The structure of a virus is a protein shell with a core of genetic material.
- It can only reproduce by using the machinery of others' cells.

10.3 Naming of viruses

Viruses are not given genus and species names, because of its "living and non-living" nature. It follows the format, XXX virus, where XXX can be:

- Name of the place where the first case appeared, like Ebola (a river a Zaire), Lassa (town in Nigeria), West Nile (West of Nile River, Egypt).
- Name of the disease or symptoms it causes, like Influenza Virus, Bird Flu Virus (Avian Influenza), SARS virus, Human Immunodeficiency Virus (HIV).
- Others, like the name of the discoverer (Epstein-Barr virus), or the biological characteristics of the virus (vesicular stomatitis virus) etc.
- The main name can be followed by a subtype or strain name, like Influenza A H1N1.

11 Levels of organisation in the human body



12 Mammalian body cavities

12.1 Ventral cavities

12.1.1 Thoracic cavity

The thoracic cavity contains the heart, lungs, and esophagus.

12.1.2 Abdominal cavity

The abdominal cavity contains digestive and other organs, such as the stomach, liver, spleen, pancreas, and intestines.

12.1.3 Pelvic cavity

The pelvic cavity contains certain reproductive organs.

12.2 Dorsal cavities

12.2.1 Cranial cavity

The cranial cavity contains the brain.

12.2.2 Vertebral cavity

The vertebral cavity contains the spinal cord.

12.2.3 Diaphragm

The diaphragm is a membrane-like structure of muscle, tendons and fibrous tissue that separates the thoracic cavity from the abdomen.

13 The organ systems of humans

13.1 Nervous system

The nervous system functions to sense and process incoming environmental stimulus to bring about appropriate responses.

13.2 Integumentary system

The integumentary covers the body and consists of the skin, hair and the accessory structures of skin. It serves to protect underlying tissues against drying, physical trauma and from pathogens. It also regulates body temperature and is embedded with receptors that are responsible for sensing by the nervous system.

13.3 Respiratory system

The respiratory system is the breathing machinery of the body.

13.4 Endocrine system

The endocrine system regulates all biological processes in the body, such as the growth and function of the reproductive system and the development of the brain and nervous system, as well as the metabolism and blood sugar levels.

The endocrine system is also known as the hormone system.

13.5 Urinary system

The urinary system contains two kidneys and functions to remove metabolic waste from the body.

13.6 Digestive system

The digestive system is responsible for breaking down food substances into simpler molecules that can be absorbed.

13.7 Reproductive system

The reproductive system is responsible for reproduction.

13.8 Muscular system

The muscular system is responsible for bringing about motions.

13.9 Immune system

The immune system consists of lymphoid organs, such as the spleen and thymus, as well as the lymphatic vessels and lymph nodes.

13.10 Skeletal system

The skeletal system forms the scaffold upon which the muscular system is layered on.

13.11 Circulatory system

The circulatory system consists of heart and blood vessels and functions to transport materials such as oxygen, nutrients and wastes around the body via blood.