

The Scientific Method

- **Scientific Method** is a process of investigation where problems are identified, and their explanations are tested by carrying out experiments.
- **Observation** : An unbiased, accurate report of an event.
- **Hypothesis** : An educated guess based on observations.
- **Experiment** : An experiment is designed to test a hypothesis.
- **Data** : Consists of measurements, observations/information gathered during an experiment.
- **Replicate** : A repeat of an experiment.
- **Control** : A comparison used to provide a standard against which the actual experiment can be judged.
- **Theory** : A hypothesis that has been supported by different experiments.
- **Principle/Law** : A theory that has shown to be valid against long-term testing.
- **Ethics** : Refers to whether issues are right or wrong

Characteristics of Life

- **Continuity of life** : Living things that arise from other living things of the same type (Biogenesis)
- **Metabolism** : Sum of all the chemical reactions in an organism.
- **Characteristics of life** : The common features shared by living organisms.
- **Organisation** : Living things are composed of cells, tissues, organs, and organ systems.
- **Nutrition** : Process by which an organism obtains and uses food.
- **Excretion** : Removal of waste products of metabolism.
- **Response** : The reaction of organisms to stimuli in their environment.
- **Reproduction** : The production of new individuals.

Nutrition

- **Biomolecules** : Molecules found in living things are composed of atoms where elements bonded together in different ratios to form biomolecules. Such as Carbohydrates, Lipids, Proteins and Vitamins.
- **Organic Compounds** : Carbon atoms bonded together make up most of the chemical compounds in living things.
- **Monosaccharides** : Single sugar molecules such as Glucose.
- **Disaccharides** : 2 sugar molecules bonded together such as Sucrose, Lactose and Maltose.

- **Polysaccharides** : Made up of many sugar molecules bonded together. Eg - Starch, Glycogen and Cellulose
- **Phospholipids** : Fat-like substances where one of the fatty acids is replaced/added a phosphate group.
- **Anabolic reactions** : Convert smaller molecules into larger ones. (Using energy)
- **Catabolic reactions** : Complex molecule is broken down to simple molecules. (Releasing energy)

Ecology

- **Ecology** : The study of the relationships of living organisms with one another and with the environment.
- **Ecosystem** : A community of organisms and their abiotic environment.
- **Biosphere** : Part of the earth in which life can occur.
- **Habitat** : Place in the environment where an organism lives.
- **Population** : All the member of the same species living in an area.
- **Community** : Plants and animals sharing the resources of a particular habitat.
- **Niche** : The functional role of an organism in an ecosystem. Eg – How it feeds, what it eats, who eats it etc.
- **Abiotic Factors** : Non-living factors.
- **Biotic Factors** : Living Factors.
- **Climatic Factors** : Refers to weather over a long period of time.
- **Edaphic factors** : Aspects of the soil that influence an ecosystem such as the soil pH, soil type, moisture, air and mineral content of soil.
- **Producers** : Autotrophs that carry out photosynthesis.
- **Consumers** : Organisms that take in food from another organisms.
- **Primary Consumers** : Organisms which feed directly on producers. E.g. – Rabbits
- **Secondary Consumers** : Carnivores that feed on primary consumers. E.g. – Fox
- **Tertiary Consumers** : Carnivores that feed on secondary consumers. E.g. – Badger
- **Food chain** : The pathway along which energy is transferred in an ecosystem.
- **Food web** : 2 or more interlinked food chains.
- **Trophic level** : Is a feeding stage/energy level in a food chain.
- **Pyramid of numbers** : Based on numbers of organisms at each trophic level in a food chain.
- **Nutrient recycling** : The way in which elements (Carbon and Nitrogen) are exchanged between the living and non-living components of an ecosystem.
- **Nitrogen Fixation** : Conversion of nitrogen gas into ammonia (NH₃), ammonium (NH₄⁺) or nitrate (NO₃⁻)
- **Nitrification** : The ammonia is converted to nitrites and then to nitrates by nitrifying bacteria.

- **Denitrification** : Conversion of nitrates to nitrogen gas. It is carried out by denitrifying bacteria in the soil.
- **Pollution** : Any harmful addition to the environment.
- **Pollutants** : Substances that cause the undesirable change to the environment.
- **Conservation** : The wise management of our natural resources.
- **Competition** : Occurs when organisms actively struggle for a resource that is in short supply.
- **Intra-specific competition** : This takes place between members of the same species. E.g. – Buttercups compete for light, water and minerals.
- **Inter-specific competition** : Occurs between members of different species. E.g. – Foxes and thrushes compete for earthworms.
- **Contest competition** : Involves an active physical contest between 2 individuals. E.g. – Robins actively defend a territory for feeding nesting and reproduction.
- **Scramble competition** : Involves all the competing organisms getting some of the resources. E.g. – Seedlings competing for space around parent plant.
- **Adaptations** : Ways in which organisms are specialised in structure/behaviour to survive competition.
- **Predation** : An organism that lives by killing and consuming other living things. E.g. – Ladybirds kill greenfly.
- **Parasitism** : Living organism that feeds on another living organism of a different species known as host, generally causing harm to the host.
- **Ectoparasites/Exoparasites** : Live on the body of the host. E.g. – greenfly on rose bushes.
- **Endoparasites** : Live on the inside of the body of the host. E.g. – Disease causing bacteria in the human body (Streptococcus)
- **Symbiosis** : Relationship between 2 organisms of different species that live in close association to the benefit of both organisms.
- **Saprophytes** : Lives on dead organisms.
- **Quantitative study** : A study to find out the number of organisms that exist in an ecosystem.
- **Qualitative study** : A study to find out the type(s) of organism that exist in an ecosystem.

Cells

- **Protoplasm** : Is all the living parts of a cell.
- **Ultrastructure** : The fine detail of a cell as seen as with an electron microscope.
- **Chromatin** : Name given to chromosomes when they are not dividing.
- **Ribosomes** : Very small organelles made of protein and RNA. Function is to make proteins.
- **Organelles** : Distinct structures suspended in cytoplasm.

- **Prokaryotic cells** : Cells do not have a nuclear membrane surrounding their DNA. E.g. – Monera
- **Eukaryotic cells** : These cells have a membrane bound nucleus and organelles.
- **Tissue** : A group of similar cells specialised to carry out the same function.
- **Tissue culture** : Cells grown on a sterile nutrient medium outside an organism.
- **Organ** : A structure, containing different tissues, which has a specific function.
- **Organ system** : A group of organs and tissues working together to carry out a specific function.
- **Catalyst** : A substance that speeds up the rate of a chemical reaction(metabolism) without itself taking part in the reaction.
- **Enzymes** : Defined as biological catalysts, protein in nature. Enzymes speed up the reactions in the cell without being used up in the reaction.
- **Substrate** : The substance an enzyme reacts with.
- **Product** : Is formed when an enzyme reacts with a substrate.
- **Active site** : The region of the enzyme that binds with the substrate.
- **Denatured enzyme** : An enzyme which has lost its shape and can no longer carry out its function.
- **Bioprocessing** : Use of enzyme-controlled reactions to produce a product.
- **Bioreactor** : A vessel used to carry out enzyme-controlled reactions.
- **Batch processing** : Fixed amount of nutrients added at beginning and emptied at the end of production.
- **Immobilised enzymes** : Enzymes that are fixed/attached to each other or to an inert material.
- **Phosphorylation** : Addition of phosphate to a molecule.
- **Protease** : An enzyme which digests protein.
- **Cell continuity** : All cells develop from pre-existing cells.
- **Chromosome** : Coiled threads of DNA and protein that become visible in the nucleus at cell division.
- **Haploid cell** : A cell which contains one of every chromosome type or pair.
- **Diploid cell** : A cell which contains two of each type of chromosome (in homologous pairs).
- **Homologous pair** : Consists of 2 chromosomes that each have genes for the same features at the same positions.
- **Interphase** : The phase in the cell cycle when the cell is not dividing.
- **Mitosis** : A form of cell division that produces two daughter cells, genetically identical to each other and to the parent cell.
- **Meiosis** : A form of cell division that produces four genetically different daughter cells, each of which has half the number of chromosomes of the parent cell.
- **Cancer** : Group of disorders in which certain cells lose their ability to control both the rate of mitosis and the number of times mitosis takes place.
- **Selectively permeable** : Cell membranes allow the passage of some materials but not others.

- **Diffusion** : The movement of a substance from its area of higher concentration to its area of lower concentration. (Passive process)
- **Active transport** : The movement of a substance(usually ions) from its area of lower concentration to its area of higher concentration. (Opposite of diffusion)
- **Osmosis** : The diffusion of water across a selectively permeable membrane, from its area of higher concentration to its area of lower concentration.
- **Hypotonic sol** : Has a low concentration of solutes and thus a higher concentration of water than another solution.
- **Hypertonic sol** : Has a higher concentration of solutes and thus a lower concentration of water than another solution.
- **Isotonic sol** : Has the same concentration of solutes and water as another solution.
- **Turgor / Turgor pressure** : Is the pressure of the cytoplasm and vacuole against the cell wall.
- **Phagocytosis** : Process where large particles are engulfed by the cell and become incorporated into a vacuole within the cell.

Genetics

- **Species** : A group of similar organisms capable of interbreeding and producing fertile offspring.
- **Variation within a species** : In a group of successfully interbreeding organisms the individual members show different characteristics.
- **Heredity** : The transmission of traits from parents to offspring.
- **Mutation** : Is a spontaneous inheritable change in the structure of the genetic material.
- **Mutagens** : Agents that cause mutations.
- **Gene(point) mutations** : Are changes in a single gene.
- **Chromosome mutations** : large changes in the number and structure of the chromosomes.
- **Evolution** : Defined as a change of a population of 1 species that gives rise to 1 or more new species.
- **Natural selection** : A mechanism of evolution whereby the best-adapted individuals survive and produce more offspring. Or inheritable change within a population in response to change in the environment by natural selection over time.
- **Gene** : Part of a chromosome, made of DNA and controls a single characteristic/trait.
- **Gene expression** : The process whereby genetic information, encoded in a gene, is transferred to its functional product.
- **DNA profiling** : A process of making unique patterns in the non-coding regions of an individual's DNA. Or examining DNA for a pattern or band to compare.
- **Genetic screening** : Testing DNA to identify the presence or absence of particular genes.
- **Transcription** : Copying of a sequence of genetic bases from DNA onto mRNA. (Making mRNA using DNA template)

- **Translation** : Conversion of a sequence of genetic bases on mRNA into a sequence of amino acids.
- **Chromosome** : Found in the nucleus, made of DNA and protein, and contain genes along their length.
- **Homologous chromosomes** : Pairs of chromosomes that contain genes for the same characteristics at the same positions on the chromosomes.
- **Gametes** : Haploid cells that are capable of fusion.
- **Allele** : Different forms of the same gene. They occupy the same position(locus) on homologous chromosomes.
- **Locus** : The position of the gene on the chromosome.
- **Genotype** : The genotype is the kind of genes present in the cell.
- **Phenotype** : This is the expression of the gene in the environment. This is how genes affect the appearance of the organism.
- **Progeny** : Refers to offspring that are produced.
- **Homozygous** : When 2 alleles for a particular characteristic are the same. E.g. – TT = Tall and tt = short
- **Heterozygous** : When 2 alleles for a particular characteristic are different. E.g. – Tt = Tall
- **Dominant** : A dominant allele is one that is always expressed in the phenotype. Generally written with a capital letter.
- **Recessive** : A recessive allele is not expressed in the presence of the dominant allele, but only when both recessive alleles are present. Generally written with a small letter.
- **Incomplete dominance** : The condition in which both alleles in the heterozygous condition are expressed in the phenotype, and an intermediate phenotype results.
- **Fertilisation** : Fusion of a haploid sperm and an egg to form a diploid zygote.
- **The Law of Segregation** : An individual has 2 genes for a character. These segregate at gamete formation. Only 1 of a pair of such genes can be carried in a single gamete. At fertilisation, the new organism will have 2 genes for each trait, one from each parent.
- **The Law of Independent Assortment** : When gametes are formed, each member of a pair of alleles can be inherited with any one from another allele pair.
- **Linkage** : That genes are located on the same chromosome.
- **Sex linkage** : A characteristic is controlled by a gene on an X/Y chromosome.
- **Pedigree** : A diagram showing the occurrence and appearance of a particular genetic trait from one generation to the next.
- **Genetic engineering** : The artificial manipulation/alteration of genes.
- **DNA Ligase** : An enzyme that is used to stick DNA molecules from sources firmly together.
- **Restriction enzymes** : Enzymes that DNA at specific places.
- **Genetically Modified organisms (GMOs)** : Living things whose DNA has been altered artificially.

Diversity of Organisms

- **Autotrophs** : Organisms which can make their own food from simple inorganic substances. E.g. – Green plants
- **Photosynthetic** : A type of nutrition where organisms make their own food using light energy. E.g. – purple sulphur bacteria
- **Chemosynthetic** : A type of nutrition where organisms make their own food using energy from chemical reactions. E.g. – nitrifying bacteria.
- **Heterotrophs** : Organisms which cannot make their own food. E.g. – Animals, fungi
- **Saprophytes** : Organisms that take in food from dead organic matter. E.g. – Bacteria of decay
- **Parasites** : Organisms that take in food from a live host and cause harm. E.g. – Disease-causing bacteria
- **Pathogens** : Micro-organisms that cause disease.
- **Antibiotics** : Chemicals produced by some bacteria and fungi that inhibit the growth or reproduction of other bacteria and fungi.

Fungi/Protista(Amoeba)/Viruses

- **Mycology** : Study of fungi.
- **Hypha** : Tube/filament in a fungus.
- **Mycelium** : Made up of network of fine tubular filaments(Hyphae)
- **Chitin** : Fungus' have rigid cell walls containing chitin.
- **Sporulation** : Process of making spores.
- **Aseptic/Asepsis** : The exclusion of micro-organisms.
- **Sterile** : The absence of micro-organisms/ free from micro-organisms.
- **Osmoregulation** : The control of water and salt balance in an organism.
- **Bacteriophage** : A virus that infects bacteria.
- **AIDS (acquired immunodeficiency syndrome)** : A collection of disorders following infection by the HIV (Human Immunodeficiency Virus). HIV virus contains RNA.

Plants

- **Meristem** : Zone of active cell division in plants.
- **Dermal tissue** : A single layer of cells covering the different parts of the plant. E.g. – epidermis
- **Vascular tissue** : The tissues involved in transport within the plant, xylem, and phloem.
- **Ground tissue** : All the other tissues within the plant.
- **Cuticle** : Living cells often with a waxy layer covering over the outer surface.
- **Herbaceous** : Plants do not contain wood/lignin. E.g. – buttercup
- **Woody** : They possess woody tissue E.g. – Oak

- **Transpiration** : Loss of water vapour from the leaves and other aerial parts of a plant.
- **Lenticels** : Openings in the stems of plants that allow gas exchange.
- **Stimulus** : Anything that brings about a response in an organism.
- **Response** : The effect the stimulus has on the organism activity. Plants respond to light by growing.
- **Tropism** : The growth response of a plant to an environmental stimulus.
- **Phototropism** : Growth of plants in response to light.
- **Geotropism** : Growth of plants in response to gravity.
- **Thigmotropism** : Growth of plants in response to touch.
- **Hydrotropism** : Growth of plants in response to water.
- **Chemotropism** : Growth of plants in response to chemicals.
- **Growth regulators** : A chemical that controls growth in plants.
- **Phytoalexins** : When a plant is infected by a micro-org, the plant is able to produce stress proteins.
- **Asexual** : Reproduction involves only 1 parent.
- **Sexual reproduction** : Involves the union of 2 sex gametes.
- **Gametes** : Haploid cells capable of fusion.
- **Stamens** : Male parts of the flower.
- **Carpels** : Female parts of the flower.
- **Pollination** : The transfer of pollen from an anther to a stigma of a flower from the same species.
- **Self-Pollination** : The transfer of pollen from an anther to a stigma on the same plant.
- **Cross-Pollination** : The transfer of pollen from an anther to a stigma on a different plant of the same species.
- **Fertilisation** : Union of the male and female gametes to form a diploid zygote.
- **Non-endospermic seed** : Has no endosperm when fully formed.
- **Endospermic seed** : Contains some endosperm when fully formed.
- **Dispersal** : The transfer of a seed/fruit away from the parent plant.
- **Dormancy** : Resting period when seeds undergo no growth and have reduced cell activity/metabolism.
- **Germination** : The regrowth of the embryo, after a period of dormancy, if the environmental conditions are suitable.
- **Vegetative propagation** : Asexual reproduction in plants. E.g. – Strawberry
- **Clone** : A group of cells/organisms that are genetically identical to each other and are produced by mitosis.
- **Runners** : Horizontal stems that run and grow above ground and from which new plants grow.
- **Root tuber** : A swollen, underground root that remains dormant during winter and from which new plants may grow.
- **Bulb** : Modified bud.

- **Micropropagation** : Involves growing large numbers of plant from small pieces of plant tissue(single cells).
- **Tissue culture** : The growth of tissues outside the organism on an artificial medium. E.g. – Micropropagation of plants
- **Leaf venation** : The way in which veins in the leaf are arranged is called leaf venation.

Blood

- **Serum** : Is plasma with fibrinogen removed. This prevents plasma from clotting and serum can be stored by hospitals for transfusions.
- **Granulocytes** : Formed in the red bone marrow. They are phagocytic (Actively seek out and engulf bacteria)
- **Monocytes** : Non granular and are also phagocytic. They often leave the capillaries in search of foreign material.
- **Lymphocytes** : Formed in the bone marrow and matured in the lymph nodes. They recognise proteins(antigens) on the cell membranes of invading organisms and respond by making antibodies which kill the invaders.
- **Blood pressure** : The force the blood exerts against the wall of a blood vessel.
- **Pulse** : Contraction of a wall of an artery/ The rate at which the heart beats.
- **Valves** : Control the direction of blood flow.
- **Portal system** : A blood pathway that begins and ends in capillaries.
- **Hepatic portal vein** : Carries blood rich in food form from the small intestines to the liver.
- **Diastole** : When heart chambers relax.
- **Systole** : When heart chambers contract.
- **Lymphatic System** : A secondary circulatory system consisting of fine tubes ending blindly among the tissues.
- **Lymph nodes** : Along the lengths of these tubes are swellings called lymph nodes.
- **Lymphatic vessels** : The tubes that carry lymph.

Excretion

- **Homeostasis** : The ability of an organism to maintain a constant internal environment.
- **Ectotherms** : Gain/Lose heat from or to their external environment.
- **Endotherms** : Generate their own heat from metabolic reactions.
- **Active transport** : Energy is used to move molecules against a concentration gradient. E.g. – low concentration to high concentrations

The Nervous System

- **Neuron** : A nerve cell
- **Threshold** : The minimum stimulus needed to cause an impulse to be carried.
- **The 'All or nothing Law'** : States that if the threshold is reached an impulse is carried, but if the threshold is not reached no impulse is carried.
- **Refractory period** : short timespan after a a neuron has carried an impulse during which a stimulus fails to cause a response.
- **Synapse** : A region where 2 neurons come into close contact.
- **Synaptic cleft** : The tiny gap between the 2 neurons at a synapse.
- **Reflex action** : An automatic, involuntary, unthinking response to a stimulus.

Endocrine System/Skeleton

- **Exocrine glands** : Release their product into ducts/tubes.
- **Endocrine glands** : A ductless gland that produces hormones which are released directly into the bloodstream.
- **Hormone** : A chemical messenger produced by an endocrine gland and carried by the bloodstream to another part of the body where it has a specific effect.
- **Ligaments** : Strong, fibrous, slightly elastic tissues that connect bone to bone.
- **Tendons** : Strong, flexible, inelastic fibres that connect muscle to bone.
- **An antagonistic pair** : 2 muscles that have opposite effects to each other.

The Human Defence System

- **Pathogen** : An organism that causes disease.
- **Immunity** : The ability to resist infection.
- **The general defence system** : Acts against all potential pathogens attempting to gain entry to the human body and is divided into 2 lines of defence.
- **The specific defence system** : Attacks particular pathogens.
- **Antigen** : A foreign molecule that stimulates the production of antibodies.
- **Antibody** : A protein produced by white blood cells (lymphocytes) in response to an antigen.
- **Induced immunity** : The ability to resist disease caused by specific pathogens.
- **Active immunity** : The person produces antibodies in response to invading antigens. This gives long lasting production.
- **Natural active immunity** : When a pathogen enters the body in the normal way.
- **Artificial active immunity** : When a pathogen is medically introduced into the body.
- **Vaccine** : Injected or taken orally into the body, is a small quantity of a microbe that is dead or is treated in some way to reduce its effect. The vaccine stimulates the

production of the corresponding antibody, giving resistance to the microbe, e.g. – polio, whooping cough.

- **Passive immunity** : Antibodies produced in another individual are given to the person.
- **Natural passive immunity** : Antibodies pass from mother to child across the placenta and in the milk.
- **Artificial passive immunity** : Antibodies produced in another animal/human are given, e.g. – anti tetanus injection.

Human Reproduction

- **Gamete** : A haploid cell.
- **Gonad** : An organ that produces sex cells in animals.
- **Ejaculation** : The release of semen from the penis.
- **Secondary sexual characteristics** : Are features that distinguish males from female apart from the sex organs.
- **Infertility** : The inability to produce young.
- **Ovulation** : The release of an egg from the ovary.
- **The menstrual cycle** : Series of events that occurs every 28 days on average in the female if fertilisation has not taken place.
- **Insemination** : The release of semen into the vagina, outside the cervix.
- **Fertilisation** : Occurs when the nucleus of the sperm fuses with the nucleus of the egg, forming a diploid zygote.
- **Birth control** : Involves methods to limit the number of children born.
- **Abortion** : Termination of pregnancy.
- **Contraception** : The deliberate prevention of fertilisation/pregnancy.
- **Implantation** : The embedding of the fertilised egg into the lining of the uterus.
- **In vitro fertilisation (IVF)** – Involves removing eggs from an ovary and fertilising them outside the body.
- **Morula** : A solid ball of cells formed from a zygote by mitosis.
- **Blastocyst** : A hollow ball of cells formed from a morula.
- **Germ layers** : Basic layers of cells in the blastocyst from which all adult tissues and organs will form.
- **Gestation** : The length of time spent in the uterus from fertilisation to birth.
- **Lactation** : The secretion of milk from mammary glands(breasts) of the female.