

IGCSE Biology (0610) – Complete Revision Sheet

Aligned with CAIE Syllabus (all 21 chapters)

<https://igcsegradecalc.site>

1. Characteristics & Classification

MRS GREN

Movement, **R**espiration, **S**ensitivity, **G**rowth, **R**eproduction, **E**xcretion, **N**utrition.

Classification

- **Species:** interbreeding fertile offspring.
- **Binomial:** genus + species (e.g. *Homo sapiens*).
- **Dichotomous key:** paired statements for identification.
- **DNA sequencing:** more similar bases = closer relation.

Five Kingdoms

- Animals – no cell walls, ingest food.
- Plants – cellulose walls, chloroplasts, photosynthesis.
- Fungi – hyphae, chitin walls, saprophytic/parasitic.
- Prokaryotes – no nucleus (bacteria).
- Protocists – single-celled, nucleus.

Arthropod Classes

Class	Key features
Insects	3 pairs legs, 2 pairs wings, 1 pair antennae
Crustaceans	2 pairs antennae, compound eyes
Arachnids	4 pairs legs, cephalothorax + abdomen
Myriapods	1 or 2 pairs legs per segment

Vertebrate Classes

Fish	cold-blooded, gills, scales
Amphibia	moist skin, lungs + skin,
Reptiles	dry scaly skin, shelled eggs
Birds	warm-blooded, feathers, beak
Mammals	hair, mammary glands, diaphragm

Viruses

Not cells – DNA/RNA core with protein coat; reproduce only inside host.

2. Cell Structure

Animal vs Plant

Structure	Animal	Plant	Function
Membrane			controls entry/exit
Cytoplasm			reactions
Nucleus			controls activities
Cell wall		(cellulose)	support
Chloroplasts			photosynthesis
Vacuole	small	large (sap)	turgor / storage

Bacterial Cell

- Cell wall (not cellulose), circular DNA (no nucleus), plasmids.
- Ribosomes (smaller), may have flagella.

Specialised Cells

Ciliated (mucus movement), root hair (absorption), palisade (photosynthesis), neurone (impulses), red blood (O transport), sperm (fertilisation), egg (nutrition).

Levels of Organisation

Cell → Tissue → Organ → Organ System → Organism.

Magnification

$$\text{Magnification} = \frac{\text{image size}}{\text{actual size}}$$

1 mm = 1000 μm .

3. Movement into/out of cells

Diffusion

Net movement high → low concentration (down gradient).
Factors: surface area, temperature, gradient, distance.
Examples: O/CO exchange.

Osmosis

Net movement of water from high water potential (dilute) to low (concentrated) through a partially permeable membrane. **Turgid** (full, firm), **plasmolysis** (water loss, cytoplasm pulls away), **flaccid** (limp).

Active Transport

Movement low → high concentration (against gradient) using energy (respiration). Requires protein carriers. Examples: mineral uptake in roots, glucose reabsorption in kidney.

4. Biological Molecules

Carbohydrates

- Elements: C, H, O.
- Mono: glucose, fructose; Di: maltose, sucrose; Poly: starch, glycogen, cellulose.

Fats

C, H, O. Glycerol + 3 fatty acids.

Proteins

C, H, O, N (sometimes S). Chains of amino acids.

DNA

Double helix, nucleotides (phosphate + deoxyribose + base). Bases: A–T, C–G.

Food Tests

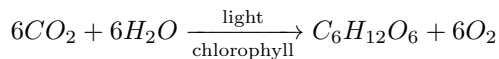
Substance	Test (positive result)
Starch	Iodine → blue-black
Reducing sugar	Benedict's (heat) → brick-red precipitate
Protein	Biuret → purple
Fat	Ethanol emulsion → milky
Vitamin C	DCPIP (blue) → decolourises

5. Enzymes

- **Catalyst:** speeds reaction, unchanged.
- Enzymes are proteins, biological catalysts.
- **Active site:** complementary shape to substrate (lock-and-key).
- **Specificity:** one enzyme – one substrate.
- **Temperature:** rate increases to optimum, then denatures (typically beyond 50°C).
- **pH:** optimum; extremes denature.
- Enzyme–substrate complex → product released.
- Examples: amylase, pepsin, catalase.

6. Plant Nutrition

Photosynthesis



Chlorophyll absorbs light energy in chloroplasts.

Uses of Glucose

- Starch (storage, insoluble).
- Sucrose (transport in phloem).
- Respiration (energy).
- Cellulose (cell walls).
- Amino acids (with nitrates) → proteins.

Mineral Requirements

- **Nitrates (NO):** for amino acids/proteins – deficiency: stunted growth, yellow leaves.
- **Magnesium (Mg²⁺):** for chlorophyll – deficiency: interveinal chlorosis.

Limiting Factors

Light intensity, CO concentration, temperature – rate limited by the factor in shortest supply.

7. Human Nutrition

Balanced Diet

Carbohydrates, fats, proteins, vitamins, minerals, fibre, water.

Digestive System

Mouth → oesophagus → stomach → small intestine (duodenum + ileum) → large intestine → anus. Accessory organs: salivary glands, liver (bile), pancreas.

Physical Digestion

Chewing, churning, emulsification by bile.

Chemical Digestion (Enzymes)

Enzyme	Substrate	Product
Amylase (saliva/pancreas)	Starch	Maltose
Protease (pepsin, trypsin)	Protein	Peptides/amino acids
Lipase (pancreas)	Fats	Fatty acids + glycerol

Absorption in Ileum

Villi + microvilli increase surface area; glucose and amino acids absorbed by active transport; fatty acids and glycerol by diffusion.

8. Transport in Plants

Xylem

- Dead cells, lignified walls.
- Transports water and minerals (upwards).

Phloem

- Living sieve tubes + companion cells.
- Transports sucrose and amino acids (upwards and downwards) – translocation.

Transpiration

Loss of water vapour from leaves through stomata. Factors: temperature, humidity, wind, light intensity.

Root Structure

Root hair cells absorb water by osmosis; mineral ions by active transport.

Leaf Structure

Epidermis, palisade (photosynthesis), spongy mesophyll (gas exchange), stomata, xylem, phloem.

9. Transport in Animals

Circulatory System

Double circulation: pulmonary (lungs) and systemic (body).

Heart

Four chambers: atria (receiving), ventricles (pumping). Valves prevent backflow. Septum separates oxygenated/deoxygenated blood.

Blood Vessels

	Arteries	Veins
Capillaries		
Wall	thick, muscular	thin, valves
one cell thick		
Flow	away from heart	towards heart
connects arteries/veins		
Pressure	high	low
very low		

Blood

- **Plasma:** transports dissolved substances (CO, urea, hormones).
- **Red blood cells:** haemoglobin carries O; no nucleus.
- **White blood cells:** phagocytes (engulf pathogens), lymphocytes (produce antibodies).
- **Platelets:** blood clotting.

10. Diseases & Immunity

Pathogens

Bacteria, viruses, fungi, parasites.

Transmission

Air, water, food, contact, vectors.

Defences

- Physical: skin, mucus, cilia.
- Chemical: stomach acid, lysozyme.
- Immune: phagocytes (engulf), lymphocytes (antibodies specific to antigens).
- Vaccination: dead/weak pathogens stimulate antibody production and memory cells.

11. Gas Exchange in Humans

Structure

Trachea → bronchi → bronchioles → alveoli.

Alveoli

Thin walls, large surface area, moist, rich blood supply – for efficient gas exchange.

Mechanism of Breathing

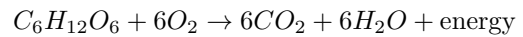
- **Inspiration:** diaphragm contracts (flattens), intercostal muscles raise ribs → volume ↑, pressure ↓, air rushes in.
- **Expiration:** diaphragm relaxes, ribs lower → volume ↓, pressure ↑, air forced out.

Composition Changes

Inspired: O₂ 21, CO₂ 0.04; Expired: O₂ 16, CO₂ 4.

12. Respiration

Aerobic



(in mitochondria).

Anaerobic

- In muscles: glucose → lactic acid + energy (causes oxygen debt).
- In yeast: glucose → ethanol + CO₂ + energy (fermentation).

Uses of Energy

Muscle contraction, active transport, cell division, maintaining body temperature.

13. Excretion in Humans

Kidneys

- **Nephron:** filtration (glomerulus), reabsorption (proximal tubule, loop of Henle, collecting duct).
- **Ultrafiltration:** blood pressure forces water, urea, salts, glucose into Bowman's capsule.
- **Selective reabsorption:** glucose (active transport), water, salts (osmosis/diffusion).

Liver

Deamination of excess amino acids → urea (excreted in urine).

14. Coordination & Response

Nervous System

- **Neurones:** sensory (to CNS), motor (from CNS), relay (within CNS).
- **Reflex arc:** receptor → sensory → relay → motor → effector (fast, involuntary).

Hormones

Chemical messengers transported in blood. Examples: insulin (lowers blood glucose), adrenaline (fight-or-flight).

Homeostasis

- Blood glucose: insulin/glucagon.
- Temperature: hypothalamus, sweating, shivering, vasodilation/vasoconstriction.

Tropisms

Plant growth responses: phototropism (shoots bend towards light), gravitropism (roots bend downwards). Caused by auxin distribution.

15. Drugs

- **Medicinal:** antibiotics (kill bacteria), painkillers.
- **Misuse:** alcohol (liver damage, addiction), nicotine (addiction, cancer), cannabis, heroin.
- Effects on nervous system, heart, liver, etc.

16. Reproduction

Asexual

One parent, genetically identical offspring (e.g. runners, tubers, bulbs).

Sexual

Two parents, gametes fuse (fertilisation) – genetic variation.

Plant Reproduction

- Flower parts: sepals, petals, stamens (male – anther/pollen), carpels (female – ovary/ovule).
- Pollination: insect (bright, scent, nectar) or wind (small, light pollen).
- Fertilisation: pollen tube grows down style, nuclei fuse.
- Seed dispersal: wind, water, animals, explosive.

Human Reproduction

- Male: testes (sperm), penis, sperm ducts.
- Female: ovaries (eggs), oviducts, uterus, cervix, vagina.
- Menstrual cycle: FSH → oestrogen → LH → ovulation; progesterone maintains uterus lining.
- Fertilisation in oviduct; implantation in uterus; placenta exchanges materials.
- STIs: HIV, syphilis – prevention (condoms, abstinence).

17. Inheritance

- **Chromosomes:** DNA + proteins, in nucleus.
- **Gene:** section of DNA coding for a protein.
- **Allele:** alternative form of a gene.
- **Genotype:** genetic makeup; **Phenotype:** physical expression.
- **Mitosis:** cell division for growth/repair – two identical diploid cells.
- **Meiosis:** gamete formation – four haploid cells, genetic variation.
- **Monohybrid inheritance:** using Punnett squares, dominant/recessive (e.g. TT, Tt, tt).
- **Co-dominance** and sex-linked inheritance (optional).

18. Variation & Selection

Variation

- **Genetic:** mutation, meiosis, fertilisation.
- **Environmental:** climate, diet, etc.
- Continuous (e.g. height) vs discontinuous (e.g. blood groups).

Natural Selection

Individuals with advantageous adaptations survive, reproduce, pass on genes – evolution.

Adaptive Features

Structures/behaviours that increase survival (e.g. camouflage, drought resistance).

19. Organisms & their Environment

Ecosystem

Community + non-living environment.

Energy Flow

Sun → producers (plants) → consumers (herbivores → carnivores) → decomposers.

Food Chains/Webs

Energy lost at each trophic level (heat, movement, undigested).

Nutrient Cycles

- **Carbon cycle:** photosynthesis, respiration, decomposition, combustion.
- **Nitrogen cycle:** nitrogen fixation (bacteria), nitrification, denitrification, decomposition.

Population

Factors: birth/death rate, immigration/emigration. Limiting factors (food, space, disease).

20. Human Influences on Ecosystems

- **Food supply:** monoculture, fertilisers, pesticides – benefits and drawbacks.
- **Habitat destruction:** deforestation, urbanisation – loss of biodiversity.
- **Pollution:** air (CO, SO – acid rain), water (eutrophication from fertilisers), land (waste).
- **Conservation:** protected areas, sustainable resources, reforestation.

21. Biotechnology & Genetic Modification

Biotechnology

- **Fermentation:** yeast → ethanol (beer, wine) or bread (CO); bacteria → yoghurt, insulin.
- **Enzymes:** biological washing powders, pectinase in fruit juice.

Genetic Modification (GM)

- Transferring genes from one organism to another using enzymes (restriction, ligase).
- Examples: GM crops (herbicide-resistant,

insect-resistant); bacteria producing human insulin.

- **Advantages:** higher yield, reduced pesticide use.
- **Disadvantages:** potential harm to non-target organisms, ethical concerns.

Created for IGCSE Biology Candidates – all 21 chapters
Free Revision Resource:

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