

GCSE Biology

Full Specification - Spec Cheat Sheet · Papers 1 & 2

AQA Biology (8461)

Papers 1 & 2

171 spec points

Every specification point for **Full Specification**, in spec order - tick each one off as you revise. Codes match the official AQA specification. Nothing here is optional.

1. Cell biology

- 4.1.1.1 Eukaryotic cells (plants and animals) have a true nucleus; prokaryotic cells (bacteria) do not.
- 4.1.1.1 Prokaryotic cells are much smaller than eukaryotic cells.
- 4.1.1.2 Animal cell parts: nucleus, cytoplasm, cell membrane, mitochondria and ribosomes, with their functions.
- 4.1.1.2 Plant cell extras: cell wall (cellulose), permanent vacuole and chloroplasts, with their functions.
- 4.1.1.3 Bacterial cell structure: cytoplasm, cell membrane, cell wall, plasmids and a single loop of DNA (no nucleus).
- 4.1.1.4 Cells differentiate to form specialised cells (e.g. sperm, nerve, muscle, root hair, xylem, phloem).
- 4.1.1.4 Most animal cells differentiate early; many plant cells keep the ability to differentiate.
- 4.1.1.5 Order of magnitude calculations and use of standard form for cell sizes.
- 4.1.1.5 Magnification = image size / real size; rearrange to find any value.
- 4.1.1.6 RP1: use a light microscope to observe, draw and label cells with a magnification scale.
- 4.1.1.7 Compare light and electron microscopes; electron microscopes give higher magnification and resolution.
- 4.1.2.1 Chromosomes are made of DNA and carry genes; nuclei normally hold pairs of chromosomes.
- 4.1.2.2 The cell cycle and mitosis: DNA replicates, then the cell divides to make two identical cells.
- 4.1.2.2 Mitosis is needed for growth, development, repair and replacement of cells.
- 4.1.2.3 Stem cells are undifferentiated cells that divide to give cells that can differentiate.
- 4.1.2.3 Sources of stem cells: embryos, adult bone marrow and plant meristems.
- 4.1.2.3 Therapeutic cloning and uses of stem cells in medicine and agriculture; benefits and risks.
- 4.1.2.3 Evaluate the practical and ethical issues of using stem cells in research and treatment.
- 4.1.3.1 Diffusion is the net movement of particles from high to low concentration.
- 4.1.3.1 Factors affecting rate of diffusion: concentration gradient, temperature and surface area.
- 4.1.3.1 Surface area to volume ratio and the need for exchange surfaces in larger organisms.
- 4.1.3.2 Osmosis is the diffusion of water across a partially permeable membrane to lower water concentration.
- 4.1.3.2 RP3: investigate the effect of solution concentration on the mass of plant tissue.
- 4.1.3.3 Active transport moves substances against a gradient using energy from respiration.
- 4.1.3.3 Examples: mineral uptake in root hairs and sugar absorption in the gut.

2. Organisation

- 4.2.1.1** Cells form tissues, tissues form organs, and organs form organ systems.
- 4.2.2.1** The digestive system is an organ system that digests and absorbs food.
- 4.2.2.1** Enzymes are biological catalysts; the lock and key model and the active site.
- 4.2.2.1** Effect of temperature and pH on enzyme activity, including denaturing.
- 4.2.2.1** RP4: investigate the effect of pH on the rate of amylase breaking down starch.
- 4.2.2.2** Carbohydrases, proteases and lipases break down starch, proteins and lipids.
- 4.2.2.2** Products of digestion: sugars, amino acids, fatty acids and glycerol.
- 4.2.2.2** Bile is made in the liver, stored in the gall bladder, neutralises acid and emulsifies fats.
- 4.2.2.2** Food tests: iodine (starch), Benedict's (sugars), biuret (protein), ethanol (lipids).
- 4.2.2.3** Structure of the heart, blood vessels and the double circulatory system.
- 4.2.2.3** Resting heart rate is controlled by a natural pacemaker; artificial pacemakers correct irregular rhythms.
- 4.2.2.4** Arteries, veins and capillaries: structure related to function.
- 4.2.2.5** Blood is a tissue of plasma carrying red cells, white cells and platelets.
- 4.2.2.5** Functions of red blood cells, white blood cells, platelets and plasma.
- 4.2.2.6** Coronary heart disease: fatty deposits, stents and statins as treatments.
- 4.2.2.6** Faulty heart valves can be replaced; artificial hearts can keep a patient alive.
- 4.2.2.7** Health is physical and mental wellbeing; communicable and non-communicable diseases.
- 4.2.2.7** Different diseases may interact (e.g. immune defects, viruses triggering cancer).
- 4.2.2.8** Risk factors for non-communicable disease, including lifestyle and substances.
- 4.2.2.8** Effects of diet, smoking and exercise on cardiovascular disease; alcohol and carcinogens.
- 4.2.2.9** Cancer: benign and malignant tumours; risk factors for cancer.
- 4.2.3.1** Plant tissues: epidermal, palisade and spongy mesophyll, xylem, phloem and guard cells.
- 4.2.3.2** Leaf structure as an organ for photosynthesis; root, stem and leaf organ systems.
- 4.2.3.2** Transpiration and translocation; transport of water, mineral ions and food.
- 4.2.3.2** Factors affecting the rate of transpiration: temperature, humidity, air movement and light.
- 4.2.3.2** Stomata and guard cells control gas exchange and water loss.

3. Infection and response

- 4.3.1.1** Pathogens are microorganisms (bacteria, viruses, protists, fungi) that cause communicable disease.
- 4.3.1.1** How pathogens spread and ways to reduce or prevent their spread.
- 4.3.1.2** Viral diseases: measles, HIV/AIDS and tobacco mosaic virus.
- 4.3.1.3** Bacterial diseases: salmonella food poisoning and gonorrhoea.
- 4.3.1.4** Fungal disease: rose black spot and its effect on plants.
- 4.3.1.5** Protist disease: malaria, spread by mosquito vectors.
- 4.3.1.6** Human defences: skin, nose, trachea, bronchi and stomach acid.
- 4.3.1.6** White blood cells defend by phagocytosis, antibody production and antitoxins.
- 4.3.1.7** Vaccination introduces dead or inactive pathogen to trigger antibody production and immunity.
- 4.3.1.7** Herd immunity: high vaccination rates reduce the spread of a disease.

- 4.3.1.8 Antibiotics kill bacteria inside the body; painkillers treat symptoms only.
- 4.3.1.8 Antibiotic resistance and why specific bacteria need specific antibiotics.
- 4.3.1.9 Drugs originally from plants and microorganisms (digitalis, aspirin, penicillin).
- 4.3.1.9 New drugs are tested for toxicity, efficacy and dose in preclinical and clinical trials.
- 4.3.1.9 Use of placebos, double-blind trials and peer review of results.
- 4.3.2.1 (Biology only) Monoclonal antibodies are produced from a single clone of cells.
- 4.3.2.2 (Biology only) Uses of monoclonal antibodies in pregnancy tests, diagnosis and treatment.
- 4.3.2.2 (Biology only) Monoclonal antibodies create more side effects than expected; evaluate their use.
- 4.3.3.1 (Biology only) Plants are damaged by ion deficiencies such as nitrate and magnesium.
- 4.3.3.2 (Biology only) Plant diseases identified by symptoms or with diagnostic testing.
- 4.3.3.2 (Biology only) Plant defences: physical, chemical and mechanical adaptations.

4. Bioenergetics

- 4.4.1.1 Photosynthesis is endothermic; word and symbol equation, taking in light energy.
- 4.4.1.2 Rate of photosynthesis is affected by light intensity, carbon dioxide, temperature and chlorophyll.
- 4.4.1.2 Limiting factors interact to control the rate of photosynthesis.
- 4.4.1.2 Inverse square law and its effect of light intensity on photosynthesis rate (HT).
- 4.4.1.2 RP6: investigate the effect of light intensity on the rate of photosynthesis.
- 4.4.1.3 Glucose from photosynthesis is used for respiration, stored as starch, made into fats, cellulose and proteins.
- 4.4.2.1 Respiration is exothermic and occurs continuously in all living cells.
- 4.4.2.1 Aerobic respiration: word and symbol equation, releasing energy from glucose.
- 4.4.2.1 Cell energy is transferred for movement, warmth and building larger molecules.
- 4.4.2.2 Anaerobic respiration in muscle produces lactic acid and releases less energy.
- 4.4.2.2 Anaerobic respiration in plants and yeast (fermentation) produces ethanol and carbon dioxide.
- 4.4.2.3 Metabolism is the sum of all chemical reactions in a cell or the body.
- 4.4.2.3 Examples of metabolic reactions: making and breaking down carbohydrates, lipids and proteins.
- 4.4.2.4 (HT) Response to exercise: increased heart rate, breathing rate and breath volume.
- 4.4.2.4 (HT) Oxygen debt and removal of lactic acid after vigorous exercise.

5. Homeostasis and response

- 4.5.1 Homeostasis keeps internal conditions constant for cells and enzymes to function.
- 4.5.1 Control systems have receptors, coordination centres and effectors.
- 4.5.2.1 The nervous system: stimulus, receptor, sensory neurone, CNS, motor neurone, effector.
- 4.5.2.1 Reflex actions are automatic and rapid; structure of the reflex arc.
- 4.5.2.1 RP7: investigate the effect of a factor on human reaction time.
- 4.5.2.2 (Biology only) Brain structure and function: cerebral cortex, cerebellum and medulla.
- 4.5.2.2 (Biology only) Difficulties of investigating and treating brain damage and disease.
- 4.5.2.3 (Biology only) The eye as a sense organ; structure and function of its parts.

- 4.5.2.3** (Biology only) Accommodation for near and distant objects; long and short sightedness and corrections.
- 4.5.2.4** (Biology only) Thermoregulation by the thermoregulatory centre; vasodilation, sweating, shivering.
- 4.5.3.1** The endocrine system uses hormones in the blood; the pituitary as the master gland.
- 4.5.3.2** Blood glucose is controlled by insulin; glucagon and glycogen in negative feedback (HT).
- 4.5.3.3** Type 1 and type 2 diabetes: causes and treatments.
- 4.5.3.4** (Biology only) Water and ion balance; loss through skin, lungs, gut and urine.
- 4.5.3.5** (Biology only) The kidney filters and reabsorbs; production of urea from excess amino acids.
- 4.5.3.5** (Biology only) ADH controls water reabsorption by negative feedback (HT).
- 4.5.3.5** (Biology only) Kidney failure treated by dialysis or transplant; pros and cons of each.
- 4.5.3.6** Hormones in human reproduction: oestrogen and testosterone in puberty.
- 4.5.3.6** The menstrual cycle and the roles of FSH, LH, oestrogen and progesterone (HT).
- 4.5.3.7** Hormonal and non-hormonal methods of contraception; benefits and drawbacks.
- 4.5.3.8** (HT, Biology only) Use of FSH and LH in fertility treatment and IVF; evaluation.
- 4.5.3.9** (HT, Biology only) Adrenaline and thyroxine; negative feedback control of thyroxine.
- 4.5.4.1** (Biology only) Plant hormones (auxins) control growth in response to light and gravity.
- 4.5.4.1** (Biology only) RP8: investigate the effect of light or gravity on seedling growth.
- 4.5.4.2** (Biology only) Uses of plant hormones: weedkillers, rooting powder, ripening and tissue culture.

6. Inheritance, variation and evolution

- 4.6.1.1** Sexual reproduction mixes genes from two parents; meiosis produces gametes.
- 4.6.1.1** Asexual reproduction needs one parent and only mitosis; offspring are clones.
- 4.6.1.2** Meiosis halves chromosome number to form gametes, increasing variation.
- 4.6.1.3** (Biology only) Advantages of sexual and asexual reproduction; organisms using both.
- 4.6.1.4** DNA is a polymer of two strands forming a double helix, contained in chromosomes.
- 4.6.1.5** (Biology only, HT) DNA structure: nucleotides, bases, complementary pairing and the genetic code.
- 4.6.1.5** (Biology only, HT) Protein synthesis: transcription, translation and protein folding.
- 4.6.1.5** (Biology only, HT) Mutations may alter proteins; non-coding DNA can affect gene expression.
- 4.6.1.6** Genetic terms: gene, allele, dominant, recessive, homozygous, heterozygous, genotype and phenotype.
- 4.6.1.6** Genetic crosses with Punnett squares; single gene inheritance and ratios.
- 4.6.1.6** Polydactyly and cystic fibrosis as inherited disorders; embryo screening ethics.
- 4.6.1.7** Sex is determined by the X and Y chromosomes; use of a genetic cross diagram.
- 4.6.2.1** Variation arises from genes, the environment, or a combination of both.
- 4.6.2.2** Evolution by natural selection over long periods leads to new species.
- 4.6.2.3** Selective breeding (artificial selection) of plants and animals for desired traits.
- 4.6.2.4** Genetic engineering transfers genes to give desired characteristics; uses and concerns.
- 4.6.2.5** (Biology only, HT) Steps of genetic engineering using enzymes and vectors.
- 4.6.2.6** (Biology only) Cloning: cuttings, tissue culture, embryo transplants and adult cell cloning.
- 4.6.3.1** (Biology only) Theory of evolution by Darwin; evidence and the slow acceptance of his ideas.

- 4.6.3.2 (Biology only) Lamarck's theory of inheritance of acquired characteristics.
- 4.6.3.3 (Biology only) Speciation; Wallace's contribution to evolutionary theory.
- 4.6.3.4 (Biology only) Mendel's experiments and how genetics was later understood.
- 4.6.3.5 Fossils form in different ways and provide evidence for evolution.
- 4.6.3.6 Extinction is caused by factors such as new predators, disease and environmental change.
- 4.6.3.7 Bacteria evolve rapidly; antibiotic resistant strains such as MRSA arise and spread.
- 4.6.3.7 Reducing antibiotic resistance by careful prescribing and completing courses.
- 4.6.4.1 Classification by Linnaeus into kingdom, phylum, class, order, family, genus and species.
- 4.6.4.1 Binomial naming system using genus and species.
- 4.6.4.1 The three-domain system proposed by Woese using molecular evidence.
- 4.6.4.1 Evolutionary trees show relationships using current and fossil data.

7. Ecology

- 4.7.1.1 Communities, habitats, populations, ecosystems and the levels of organisation.
- 4.7.1.1 Interdependence: organisms rely on each other for food, shelter and reproduction.
- 4.7.1.1 Abiotic factors and how they affect communities.
- 4.7.1.2 Biotic factors and how they affect communities.
- 4.7.1.3 Adaptations: structural, behavioural and functional; extremophiles.
- 4.7.1.4 Levels of organisation and the use of food chains; producers and consumers.
- 4.7.1.4 RP9: measure population size and distribution using quadrats and transects.
- 4.7.1.4 Predator-prey cycles and how populations affect one another.
- 4.7.2.1 The carbon cycle returns carbon through respiration, combustion and decomposition.
- 4.7.2.2 The water cycle provides fresh water through evaporation, condensation and precipitation.
- 4.7.2.3 (Biology only) Decomposition rate is affected by temperature, water and oxygen.
- 4.7.2.3 (Biology only) RP10: investigate the effect of temperature on the rate of decay of milk.
- 4.7.2.3 (Biology only) Use of compost and biogas generators in recycling and energy production.
- 4.7.3.1 (Biology only) Environmental change affects the distribution of species.
- 4.7.3.2 Biodiversity and the importance of maintaining a wide range of species.
- 4.7.3.2 Human population growth and increasing use of resources raise pollution.
- 4.7.3.3 Pollution of land, water and air reduces biodiversity.
- 4.7.3.4 Land use by humans through building, quarrying, farming and dumping waste.
- 4.7.3.5 Deforestation for farming and biofuels reduces biodiversity and stored carbon.
- 4.7.3.6 Global warming from greenhouse gases and its biological consequences.
- 4.7.3.7 Programmes to maintain biodiversity: breeding, habitat protection and reducing waste.
- 4.7.4.1 (Biology only) Trophic levels in food chains and the role of decomposers.
- 4.7.4.2 (Biology only) Pyramids of biomass and how to construct and interpret them.
- 4.7.4.3 (Biology only) Transfer of biomass and efficiency between trophic levels.
- 4.7.5.1 (Biology only) Food security and the biological factors threatening it.

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| 4.7.5.2 | (Biology only) Improving farming efficiency by limiting energy transfer and using biotechnology. |
| 4.7.5.3 | (Biology only) Sustainable fisheries through controlling net size and fishing quotas. |
| 4.7.5.4 | (Biology only) Role of biotechnology and modern food production, including mycoprotein. |
| 4.7.5.4 | (Biology only) Genetically modified bacteria producing human insulin; GM crop benefits and concerns. |