AQA Single Sciences GCSE - Topics and Assessments

This document explains how AQA writes the question papers
http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-QUESTIONS-CLEAR.PDF
http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMS-EXPLAINED.PDF

There are six papers in total and this will gain you 3 separate GCSEs (Biology, Chemistry, Physics). 2 papers each for biology, chemistry and physics these will all be taken at the end of Year 11 in the Summer exams.

GCSE Biology (8461)
Each paper is 1hr 45mins – 100 marks (50% of the GCSE)

**Paper 1 – topics 1-4**
- Cell biology
- Organisation
- Infection and response
- Bioenergetics

**Paper 2 – topics 5-7**
- Homeostasis and response
- Inheritance, variation and evolution
- Ecology

GCSE Chemistry (8462)
Each paper is 1hr 45mins – 100 marks (50% of the GCSE)

**Paper 1 – topics 1-5**
- Atomic structure and the periodic table
- Bonding, structure & properties of matter
- Quantitative chemistry
- Chemical changes
- Energy changes

**Paper 2 – topics 6-10**
- The rate and extent of chemical change
- Organic chemistry
- Chemical analysis
- Chemistry of the atmosphere
- Using resources

GCSE Physics (8463)
Each paper is 1hr 45mins – 100 marks (50% of the GCSE)

**Paper 1 – topics 1-4**
- Energy
- Electricity
- Particle model of matter
- Atomic structure

**Paper 2 – topics**
- Forces
- Waves
- Magnetism
- Electromagnetism
- Space physics

Questions in Paper 2 may draw on an understanding of energy changes and transfers due to heating, mechanical and electrical work and the concept of energy conservation from Energy and Electricity.

The specifications can be found here:
http://filestore.aqa.org.uk/resources/biology/specifications/AQA-8461-SP-2016.PDF
http://filestore.aqa.org.uk/resources/chemistry/specifications/AQA-8462-SP-2016.PDF
http://filestore.aqa.org.uk/resources/physics/specifications/AQA-8463-SP-2016.PDF

PiXL Science 2016
**PiXL Partners in Learning**

**Cell**
The smallest structural and functional unit of an organism.

**Nucleus**
A structure that contains genetic material and controls the activities of the cell.

**Chromosome**
A thread-like structure of coiled DNA found in the nucleus of eukaryotic cells.

**DNA**
A polymer made up of two strands forming a double helix.

**Gene**
A section of DNA that codes for a specific protein or characteristic.

**Villi**
Increase surface area, good blood supply to maintain concentration gradient, thin membranes, short diffusion distance.

**Lungs**
Alveoli—increased surface area, good blood supply to maintain concentration gradient, thin membranes, short diffusion distance.

**Gills in fish**
Gill filaments and lamellae—increased surface area, good blood supply to maintain concentration gradient, thin membranes, short diffusion distance.

**Roots**
Root hair cells—increased surface area.

**Leaves**
Large surface area, thin leaves for short diffusion path, stomata on the lower surface to let O\(_2\) and CO\(_2\) in and out.

**Adaptations for Diffusion**
The greater the difference in concentrations, the faster the rate of diffusion.

**Mitosis and the Cell Cycle**

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Growth</th>
<th>Increase the number of sub-cellular structures e.g. ribosomes and mitochondria.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 2</td>
<td>DNA Synthesis</td>
<td>DNA replicates to form two copies of each chromosome.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Mitosis</td>
<td>One set of chromosomes is pulled to each end of the cell and the nucleus divides. Then the cytoplasm and cell membranes divide to form two cells that are identical to the parent cell.</td>
</tr>
</tbody>
</table>

**Cell Division**

**Stem Cells**

<table>
<thead>
<tr>
<th>Human Embryonic stem cells</th>
<th>Can be cloned and made to differentiate into most cell types</th>
<th>Therapeutic cloning uses same genes so the body does not reject the tissue. Can be a risk of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult bone marrow stem cells</td>
<td>Can form many types of human cells e.g. blood cells</td>
<td>Tissue is matched to avoid rejection, risk of infection. Only a few types of cells can be formed.</td>
</tr>
<tr>
<td>Meristems (plants)</td>
<td>Can differentiate into any plant cell type throughout the life of the plant.</td>
<td>Used to produce clones quickly and economically, e.g., rare species, crop plants with pest/disease resistance</td>
</tr>
</tbody>
</table>

**Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants & simple animals.**

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Some people object to the use of stem cells on ethical or religious grounds.
Enzymes catalyse (increase the rate of) specific reactions in living organisms.

The activity of enzymes is affected by changes in temperature and pH.

- Enzymes activity has an optimum temperature.
- Enzyme activity has an optimum pH.

Digestive enzymes speed up the conversion of large insoluble molecules (food) into small soluble molecules that can be absorbed into the bloodstream.

Large changes in temperature or pH can stop the enzyme from working (denature).

- Temperature too high
- pH too high or too low

Enzyme changes shape (denatures) the substrate no longer fits the active site.

AQA GCSE ORGANISATION Part 1

**Principles of organisation**

<table>
<thead>
<tr>
<th>Carbohydrases (e.g. amylase)</th>
<th>Made in salivary glands, pancreas, small intestine</th>
<th>Break down carbohydrates to simple sugar (e.g., amylase breaks down starch to glucose).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteases</td>
<td>Made in stomach, pancreas</td>
<td>Break down protein to amino acids.</td>
</tr>
<tr>
<td>Lipases</td>
<td>Made in pancreas (works in small intestine)</td>
<td>Break down lipids (fats) to glycerol and fatty acids.</td>
</tr>
<tr>
<td>Bile (not an enzyme)</td>
<td>Made in liver, stored in gall bladder.</td>
<td>Emulsifies lipids to increase surface area to increase the rate of lipid breakdown by lipase. Changes pH to neutral for lipase to work.</td>
</tr>
</tbody>
</table>

Cells, tissues, organs and systems

<table>
<thead>
<tr>
<th>Cells</th>
<th>Tissues</th>
<th>Organs</th>
<th>Organ systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. muscle cells</td>
<td>e.g. muscle tissue</td>
<td>e.g. the heart</td>
<td>e.g. the circulatory system</td>
</tr>
</tbody>
</table>

The basic building blocks of all living organisms.

A group of cells with a similar structure and function.

Aggregations (working together) of tissues performing a specific function.

Organs working together to form organ systems, which work together to form an organism.

**Food tests**

- Sugars (glucose) Benedict’s test Orange to brick red precipitate.
- Starch Iodine test Turns black.
- Biuret Biuret reagent Mauve or purple solution.

**The human digestive system**

An organ system in which organs work together to digest and absorb food.

- Mouth
- Oesophagus
- Liver
- Gall bladder
- Stomach
- Small intestines
- Large intestines
- Anus
Blood vessels

- **Artery**: Carry blood away from the heart. Thick muscular walls, small lumen, carry oxygenated blood.
- **Vein**: Carry blood to the heart. Thin walls, large lumen, carry blood under low pressure.
- **Capillary**: Connects arteries and veins. One cell thick to allow diffusion.

The heart is an organ that pumps blood around the body in a double circulatory system.

<table>
<thead>
<tr>
<th>Different structure in the heart with different functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Right ventricle</strong></td>
</tr>
<tr>
<td><strong>Left ventricle</strong></td>
</tr>
<tr>
<td><strong>Pacemaker</strong></td>
</tr>
<tr>
<td><strong>Coronary arteries</strong></td>
</tr>
<tr>
<td><strong>Heart valves</strong></td>
</tr>
</tbody>
</table>

Blood

- **Blood is a tissue consisting of plasma, in which blood cells, white blood cells and platelets are suspended.**

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma (55%)</td>
<td>Transports CO₂, hormones and waste.</td>
</tr>
<tr>
<td>Red blood cells (45%)</td>
<td>Carries oxygen. Large surface area, no nucleus, full of haemoglobin.</td>
</tr>
<tr>
<td>White blood cells (&lt;1%)</td>
<td>Part of the immune system. Some produce antibodies, others surround and engulf pathogens.</td>
</tr>
<tr>
<td>Platelets (&lt;3%)</td>
<td>Fragments of cells. Clump together to form blood clots.</td>
</tr>
</tbody>
</table>

Lungs and gas exchange

- The heart pumps low oxygen/high carbon dioxide blood to the lungs.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trachea</td>
<td>Carries air to/from the lungs. Rings of cartilage protect the airway.</td>
</tr>
<tr>
<td>Bronchioles</td>
<td>Carries air to/from the air sacs (alveoli). Splits into multiple pathways to reach all the air sacs.</td>
</tr>
<tr>
<td>Alveoli</td>
<td>Site of gas exchange in the lungs. Maximises surface area for efficient gas exchange.</td>
</tr>
<tr>
<td>Capillaries</td>
<td>Allows gas exchange between into/out of blood. Oxygen diffuses into the blood and carbon dioxide diffuses out.</td>
</tr>
</tbody>
</table>
Heart failure can be treated with a transplant or artificial heart.

**AQA GCSE ORGANISATION part 3**

**Plant tissues**

<table>
<thead>
<tr>
<th>Tissue Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waxy cuticle</td>
<td>Top layer of the leaf reduces water loss</td>
</tr>
<tr>
<td>Guard cells</td>
<td>Control water loss and allow gas exchange (oxygen and carbon dioxide)</td>
</tr>
<tr>
<td>Palisade mesophyll</td>
<td>Cells close to the surface of the leaf that contain chlorophyll, maximize photosynthesis</td>
</tr>
<tr>
<td>Palisade cells</td>
<td>Cells near surface of leaf, packed with chloroplasts</td>
</tr>
<tr>
<td>Spongy mesophyll</td>
<td>Air spaces in the leaf between cells, increased surface area for gas exchange</td>
</tr>
<tr>
<td>Phloem</td>
<td>Transports dissolved sugars from leaves to rest of plant for immediate storage or transport</td>
</tr>
<tr>
<td>Xylem</td>
<td>Transports water and minerals from roots to stem and leaves</td>
</tr>
</tbody>
</table>

**Non-communicable diseases**

- **Cancer**
  - The result of changes in DNA that lead to uncontrolled growth and division
  - **Benign tumour**
    - Contained in one area of the body (usually by a membrane) - not cancer
  - **Malignant tumour**
    - Invades tissues and spreads to different parts of the body to form secondary tumours

- **Risk factors for heart/lung disease and certain types of cancer**
  - Drinking alcohol, diet, obesity, smoking
  - These factors can also affect the brain, liver and health of unborn babies
  - Some cancers have genetic risk factors
  - Carcinogens and ionising radiation increase the risk of cancer by changing/damaging DNA

**Transpiration**

- A potometer is used to measure the amount of water lost over time (rate of transpiration)
- The rate at which water is lost from the leaves of a plant. The transpiration stream is the column of water moving through the roots, stem and leaves
- Temperature, humidity, air movement and light intensity affect the rate of transpiration
- The shape of the graph for light intensity is the same for temperature (energy)
**AQA GCSE Infection and Response part 1**

**Plants have several ways of defending themselves from pathogens and animals**

<table>
<thead>
<tr>
<th>Physical</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Thick waxy layers, cell walls stop pathogen entry</td>
<td>Thorns, curling up leaves to prevent being eaten</td>
</tr>
</tbody>
</table>

**Chemical**

Antibacterial and toxins made by plant

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**Human defence systems**

- **Pathogens are identified by white blood cells by the different proteins on their surfaces: Antigens.**
- **Human body's immune system**
  - **Immune system**
    - **Nose**
      - Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.
    - **Trachea and bronchi** (respiratory system)
      - Lined with mucus to trap dust and pathogens. Cilia move the mucus upwards to be swallowed.
    - **Stomach acid**
      - Stomach acid (pH 1) kills most ingested pathogens.
    - **Skin**
      - Hard to penetrate waterproof barrier. Glands secrete oil which kills microbes.

**Pathogens may infect plants or animals and can be spread by direct contact, water or air**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Disease</th>
<th>Symptoms</th>
<th>Method of transmission</th>
<th>Control of spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virus</td>
<td>Measles</td>
<td>Fever, red skin rash</td>
<td>Droplet infection from sneezes and coughs.</td>
<td>Vaccination as a child.</td>
</tr>
<tr>
<td>Virus</td>
<td>HIV</td>
<td>Initially flu like systems, serious damage to immune system</td>
<td>Sexual contact and exchange of body fluids.</td>
<td>Anti-retroviral drugs and use of condoms.</td>
</tr>
<tr>
<td>Virus</td>
<td>Measles</td>
<td>Fever, cramp, vomiting, diarrhoea</td>
<td>Enter via wounds in epidermis caused by pests.</td>
<td>Remove infected leaves and control pests that damage the leaves.</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Salmonella</td>
<td>Fever and cramp</td>
<td>Food prepared in unhygienic conditions or not cooked properly.</td>
<td>Improve food hygiene, wash hands, vaccinate poultry, cook food thoroughly.</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Gonorrhoea</td>
<td>Green discharge from penis or vagina</td>
<td>Direct sexual contact or exchange of body fluids.</td>
<td>Use condoms. Treatment using antibiotics.</td>
</tr>
<tr>
<td>Protists</td>
<td>Malaria</td>
<td>Recurrent fever</td>
<td>By an animal vector (mosquitoes).</td>
<td>Prevent breeding of mosquitoes. Use of nets to prevent bites.</td>
</tr>
<tr>
<td>Fungus</td>
<td>Rose black spot</td>
<td>Purple black spots on leaves</td>
<td>Spores carried via wind or water.</td>
<td>Remove infected leaves. Spray with fungicide.</td>
</tr>
</tbody>
</table>

**detected and identification of plant diseases (bio only)**

- Nitrate ions needed for protein synthesis - lack of nitrate = stunted growth.
- Magnesium ions needed to make chlorophyll - not enough leads to chlorosis - leaves turn yellow.

**Bacteria may produce toxins that damage tissues and make us feel ill**

**Viruses**
- e.g. cold, influenza, measles, HIV, tobacco mosaic virus

**Bacteria (prokaryotes)**
- e.g. tuberculosis (TB), Salmonella, Gonorrhoea

**Protists (eukaryotes)**
- e.g. dysentry, sleeping sickness, malaria

**Fungi (eukaryotes)**
- e.g. athlete's foot, thrush, rose black spot
Traditionally drugs were extracted from plants and microorganisms:

- **Digitalis**: A painkiller and anti-inflammatory that was first found in willow bark. Extracted from foxglove plants and used as a heart drug.
- **Aspirin**: Discovered by Alexander Fleming from the Penicillium mould and used as an antibiotic, sometimes this makes them resistant to antibiotic drugs.
- **Penicillin**: Bacteria can mutate.

**Antibiotics and painkillers**

- **Antibiotics**
  -杀灭感染细菌的药物，如penicillin。
  -杀灭细菌，防止感染。
  -对特定细菌的感染需要特定的抗生素。

- **Painkillers and other medicines**
  - 如aspirin, paracetamol, ibuprofen。
  - 用于治疗疾病的症状。它们不杀死病原体。

**New drugs are extensively tested**:

- **Efficacy**: Make sure the drug works.

- **Toxicity**: Check that the drug is not poisonous.

- **Dose**: The most suitable amount to take.

- **Clinical trials** use healthy volunteers and patients.

  - Preclinical trials - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.
  - Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

**Monoclonal antibodies (Biology only HT)**

- Specific to one binding site on the antigen. Can target specific chemicals or cells in the body.

**Monoclonal antibodies can be used in a variety of ways**

- **Diagnosis**
  - 如, pregnancy test - measure the level of hormones.
  - Can detect very small quantities of chemicals in the blood.
  - Fluorescent dye can be attached so it can be seen inside cells or tissues.

- **Detecting pathogens**
  - Bound to radioactive substance.
  - Can detect specific chemicals or cells in the body.

- **Detecting molecules**
  - Cancer cells are targeted to normal body cells are unharmed.

**Vaccination**

- Used to immunise a large proportion of the population to prevent the spread of a pathogen.

  - White blood cells detect pathogens in the body. Antibodies are released into the blood.
  - White blood cells detect pathogens. Antibodies are made much faster and in larger amounts.

  - A person is unlikely to suffer the symptoms of the harmful disease as it spreads, so the population is protected.

**AQA INFECTION AND RESPONSE**

- Antibiotics have greatly reduced deaths from infectious bacterial disease.

  - Antibiotics cannot be used to treat viral pathogens.

  - It is difficult to develop drugs to kill viruses without harming body tissues because viruses live and reproduce inside cells.

**Discovery and drug development**

- Most new drugs are synthesized by chemists in the pharmaceutical industry.

- New drugs are extensively tested for:
  - Efficacy: Make sure the drug works.
  - Toxicity: Check that the drug is not poisonous.
  - Dose: The most suitable amount to take.

- Stage 1: Healthy volunteers try small dose of the drug to check it is safe and record any side effects.

- Stage 2: A smaller number of patients try the drug at a low dose to see if it works.

- Stage 3: A larger number of patients are divided into groups. Some will be given the drug and some a placebo.

- Stage 4: A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.

**A placebo can look identical to the new drug but contain no active ingredients**

- Specific to one binding site on the antigen. Can target specific chemicals or cells in the body.
Respiration, stored as insoluble starch, fats or oils for storage, cellulose for cell walls, combine with nitrates from the soil to form amino acids for protein synthesis.

Plants use the glucose produced in photosynthesis in a variety of ways.

**Photosynthetic reaction**

The plant manufactures glucose from carbon dioxide and water using energy transferred from the environment to the chloroplasts by light.

- Plants make use of light energy from the environment (ENDOTHERMIC) to make food (glucose).

\[
\text{Carbon dioxide + Water} \xrightarrow{\text{light}} \text{Oxygen + Glucose} \\
\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{light}} \text{O}_2 + \text{C}_6\text{H}_12\text{O}_6
\]

**AQA GCSE BIOENERGETICS part 1**

The rate of photosynthesis is affected by temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll.

<table>
<thead>
<tr>
<th>Factor</th>
<th>How the rate is affected</th>
<th>Limiting factors (why the rate stops going up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>As the temperature of the environment the plant is in increases rate of photosynthesis increases up to a point as there is more energy for the chemical reaction.</td>
<td>Photosynthesis is an enzyme controlled reaction. If the temperature increases too much, then the enzymes become denatured and the rate of reaction will decrease and stop.</td>
</tr>
<tr>
<td>Light intensity</td>
<td>Light intensity increases as the distance between the plant and the light sources increases. As light intensity increases so does the rate of photosynthesis up to a point as more energy is available for the chemical reaction.</td>
<td>At point X another factor is limiting the rate of photosynthesis. This could be carbon dioxide concentration, temperature or the amount of chlorophyll.</td>
</tr>
<tr>
<td>Carbon dioxide concentration</td>
<td>Carbon dioxide is needed for plants to make glucose. The rate of photosynthesis will increase when a plant is given higher concentrations of carbon dioxide up to a point.</td>
<td>At point X another factor is limiting the rate of photosynthesis. This could be light intensity, temperature or the amount of chlorophyll.</td>
</tr>
<tr>
<td>Amount of chlorophyll</td>
<td>Chlorophyll is a photosynthetic pigment that absorbs light and allows the reaction between water and carbon dioxide to occur (photosynthesis)</td>
<td>Another factor could limit the rate of photosynthesis. This could be light intensity, temperature or the carbon dioxide concentration.</td>
</tr>
</tbody>
</table>

**Rate of photosynthesis**

- **Graph lines C and D:** If temperature is increased by 10°C then a slight increase in rate of photosynthesis occurs.
- **Graph lines A and B:** If carbon dioxide concentration is increased from 0.01% to 0.1% then a large increase in rate occurs up to a point.
- Light intensity obeys the inverse square law. This means that if you double the distance between the plant and the light source you quarter the light intensity.

Growers must balance the economics of additional costs of controlling the conditions to maximise photosynthesis with making a profit.
During long periods of vigorous activity, muscles become fatigued and stop contracting efficiently. An organism will receive all the energy it needs for living processes as a result of the energy transferred from respiration.

**Respiration**
- **Cellular respiration** is an exothermic reaction which is continuously occurring in all living cells.

**Response to exercise**
- **Heart rate increases**
- **Breathing rate and breath volume increase**
- Top pump oxygenated blood faster to the muscle tissues and cells.
- This increases the amount of oxygen entering the blood stream.

**Metabolism**
- The sum of all the reactions in a cell or the body.
- **The energy transferred by respiration in cells is used by the organism for the continual enzyme controlled processes of metabolism.**
- Conversion of glucose to starch, glycogen and cellulose.
- The formation of lipid molecules from a molecule of glycerol and three molecules of fatty acid.
- The use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins.
- **Respiration**
  - Breakdown of excess proteins to form area for excretion.

The extra amount of oxygen required to remove all lactic acids from cells is called the oxygen debt.

Blood flows through the muscle cells and transports the lactic acid to the liver. The liver oxidises the lactic acid and converts it back to glucose.

Aerobic respiration: Respiration with oxygen. Occurs inside the mitochondria continuously. Glucose is oxidised by oxygen to transfer the energy the organism needs to perform it's functions.

Lactic acid builds up in the muscle cells during exercise. The liver oxidises the lactic acid and converts it back to glucose.

Aerobic respiration releases a large amount of energy from each glucose molecule.

Anaerobic respiration in plant and yeast cells:
- **The end products are ethanol and carbon dioxide.** Anaerobic respiration in yeast cells is called fermentation.
- **glucose → ethanol + carbon dioxide**

**Anaerobic respiration**
- During hard exercise, muscle cells are respiring so fast that blood cannot transport enough oxygen to meet their needs.
- Glucose is partially oxidised to produce lactic acid which builds up in muscle tissue causing them to become painful and fatigued.
- **glucose → lactic acid**

The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt.

Carbon dioxide + water + oxygen → glucose + carbon dioxide + water
The iris can dilate the pupil (aperture) to let in more light in dim conditions.

- **Retina**: Light sensitive cell layer.
- **Optic nerve**: Carries impulse to brain.
- **Sclera**: Protects the eye.
- **Cornea**: Transparent layer that covers the pupil and iris.
- **Iris**: Pigmented layer, controls size of pupil.
- **Ciliary muscles**: Controls thickness of lens.
- **Suspensory ligaments**: Connects lens to ciliary muscles.

The **human control systems include**:
- **Cells called receptors**: Detect stimuli (changes in environment), e.g., brain, spinal cord, and pancreas that receive information from receptors.
- **Coordination centres**: Muscles or glands, which bring about responses to restore optimum levels.

**The Eye (Bio only)**

- **Structure of the eye**
  - Near object
    - Ciliary muscles contract, suspensory ligaments loosen, lens gets thicker, light is more refracted.
  - Far object
    - Ciliary muscles relax, suspensory ligaments pull tight, lens pulls thin, light is only slightly refracted.

- **Hyperopia (long sightedness)**
  - Treated using a convex lens so the light is focused on the retina.
- **Myopia (short sightedness)**
  - Treated using a concave lens so light is focused on the retina.

AQA GCSE HOMEOSTASIS AND RESPONSE part 1

- **The human nervous system**
  - **The brain (Bio only)**
    - **The brain controls complex behaviour.** It is made of billions of interconnected neurones.
  - **CNS**: The brain and the spinal cord.
    - **Stimulus**
      - Lights switch on
      - Cells in retina
      - CNS
      - Muscles connected to iris
    - **Response**
      - Pupils get smaller
      - Typical motor neurone
      - Synapse (gap where two neurones meet)
      - Coordination
      - Effectors
      - Muscles contracting or glands secreting hormones

- **Neuroscientists have been able to map regions of the brain by studying patients with brain damage, electrical stimulation and imaging**.

- **The brain has different regions that carry out different functions**.
  - **Cerebral cortex**: Largest part of the human brain. Higher thinking skills e.g., speech, decision making.
  - **Cerebellum**: Balance and voluntary muscle function e.g., walking, lifting.
  - **Medulla**: Involuntary (automatic) body functions e.g., breathing, heart rate.

**The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult**.

**Reflex arcs**

- **Receptor**: Detect stimuli.
  - Sensory neurone: Long axon carries impulse from receptor to spinal cord.
  - Synapse: Gap where neurones meet. Chemical message using neurotransmitter.
  - Relay neurone: Allows impulses to travel between sensory and motor neurones in the spinal cord.
  - Motor neurone: Long axon carries impulse from receptor to effector.

- **Effector**: Muscle or gland that carries out response.
  - **Reflex actions are automatic and rapid; they do not involve the conscious part of the brain and can protect humans from harm.**

**Training brain damage and disease e.g., lobotomy - cutting part of the cerebral cortex**

- **Benefits**: Thought to alleviate the symptoms of some mental illnesses.
- **Risks**: Blinding in the brain, seizures, loss of brain function. Procedure was abandoned in the 1950s due to risk.

**New technologies now include hard/soft contact lens, laser surgery to change the shape of the cornea and a replacement lens in the eye.**
**In Vitro Fertilisation (IVF) treatment.**
Involves giving a mother FSH and LH to stimulate the maturation of several eggs.
The eggs are collected from the mother and fertilised by sperm from the father in a laboratory.
The fertilised eggs develop into embryos.
At the stage when they are tiny balls of cells, one or two embryos are inserted into the mother’s uterus (womb).

**Potential disadvantages of IVF**
- Emotional and physical stress.
- Success rates are not high.
- Multiple births risk to mother and babies.

**Oral contraceptives**
Contain hormones to inhibit FSH production so that no eggs mature.

**Injection, implant, skin patch**
For slow release of progesterone to inhibit the maturation and release of eggs for months or years.

**Barrier methods**
Condoms or diaphragms which prevent sperm reaching the egg.

**Intrauterine devices**
Prevent implantation of an embryo or release a hormone.

**Spermicidal agents**
Kill or disable sperm.

**Abstaining**
Avoiding intercourse when an egg may be in the oviduct.

**Surgery**
Male or female sterilisation.

**Hormones are used in modern reproductive technologies to treat infertility.**

**Plants produce hormones to coordinate and control growth.**

**Plant responses using hormones (auxins)**

**Light (phototropism)**
Light breaks down auxins and they become unequally distributed in the shoot. The side with the highest concentration of auxins has the highest growth rate and the shoot grows toward the light.

**Gravity (geotropism or gravitropism)**
Gravity causes an unequal distribution of auxins. In roots the side with the lowest concentration has the highest growth rate and the root grows in the direction of gravity.

In new shoots from a seedling the unequal distribution of auxins causes the shoot to grow away from gravity.

**[HT only] Gibberellins are important in initiating seed germination.**

**[HT only] Ethene controls cell division and ripening of fruits.**

**AQA GCSE HOMEOSTASIS AND RESPONSE PART 3**

**Contraception**

**Hormones in human reproduction**

**During puberty reproductive hormones cause secondary sexual characteristics to develop**

<table>
<thead>
<tr>
<th>Oestrogen (main female reproductive hormone)</th>
<th>Testosterone (main male reproductive hormone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced in the ovaries. At puberty eggs being to mature releasing one every 28 days – ovulation.</td>
<td>Produced in the testes stimulating sperm production.</td>
</tr>
</tbody>
</table>

**[HT only] a graph of hormone levels over time**

**Menstrual cycle**

<table>
<thead>
<tr>
<th>Follicle stimulating hormone (FSH)</th>
<th>Luteinising hormone (LH)</th>
<th>Oestrogen and progesterone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causes maturation of an egg in the ovary.</td>
<td>Stimulates release of an egg.</td>
<td>Maintain uterus lining.</td>
</tr>
</tbody>
</table>

**[HT] FSH stimulates ovaries to produce oestrogen.**

**[HT] Oestrogen stops FSH production and stimulates LH production in the pituitary gland.**
The conditions surrounding an organism; abiotic and biotic.

The conditions surrounding an organism; abiotic and biotic.

Environment
Habitat
Population
Community

Organisms require a supply of materials from their surroundings and from the other living organisms.

Bacteria respire when breaking down dead organisms releasing CO₂.

Anaerobic decay in biogas generators produces methane gas, used as a fuel.

Plants in a community or habitat compete with each other for light, space, water and mineral ions.

Animals compete with each other for food, mates and territory.

Species depend on each other for food, shelter, pollination, seed dispersal etc. Removing a species can affect the whole community.

EXAMPLE: Climate change is leading to more dissolved CO₂ in oceans lowering the pH of the water affecting organisms living there.

The carbon cycle

Photosynthetic organisms are the producers of biomass for life on Earth.

Materials are recycled to provide the building blocks for future organisms.

THE CARBON CYCLE

CO₂ taken in during photosynthesis.

Organisms respire releasing CO₂.

Organisms decayed by bacteria and fungi releasing carbon.

Factors affecting rate of decay
Temperature, water, oxygen

Increase the rate of decay. In enzyme-controlled reactions raising the temperature too high will denature the enzymes.

Organisms require minerals. Minerals can find the soil.

Breakdown of dead organisms releases minerals. Minerals can find the soil.

Food chains

Feeding relationships in a community

<table>
<thead>
<tr>
<th>Producers</th>
<th>Primary consumer</th>
<th>Secondary consumer</th>
<th>Tertiary consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
<td>Cassowary</td>
<td>Mouse</td>
<td>Owl</td>
</tr>
</tbody>
</table>

All food chains begin with a producer e.g. grass that is usually a green plant or photosynthetic algae.

Consumers that kill and eat other animals are predators and those eaten are prey.

In a stable community the numbers of predators and prey rise and fall in cycles.

Adaptations

Organisms adaptations enable them to survive in conditions where they normally live.

Adaptations may be structural, behavioural or functional.

Abiotic and biotic factors.

AQA GCSE

ECOLOGY PART 1

Non-living factors that affect a community
Living intensity.
Temperature.
Moisture levels.
Soil pH, mineral content.
Wind intensity and direction.
Carbon dioxide levels for a plant.
Oxygen levels for aquatic organisms.

Living factors that affect a community
Availability of food.
New predators arriving.
New pathogens.
One species outcompeting so numbers are no longer sufficient to breed.

Plants
Cactus in dry, hot desert

Animals
Polar bear in extreme cold Arctic

Extremophiles
Deep sea vent bacteria

No leaves to reduce water loss, wide deep roots for absorbing water.

Hollow hairs to trap layer of heat. Thick layer of fat for insulation.

Populations form in thick layers to protect outer layers from extreme heat of vent.
Factors affecting food security
- Increasing birth rate.
- Changing diets in developing countries.
- New pests and pathogens affecting farming.
- Environmental changes e.g. famine when rains fail.
- Cost of agriculture input.
- Conflicts (war) affecting water of food availability.

Farming techniques
- Increasing efficiency of food production
  - Reduce energy waste, limiting movement, control temperature, high protein diet to increase growth.
- Sustainable fisheries
  - Maintain/grow fish stocks to a sustainable level where breeding continues or certain species may disappear. By controlling net size, fishing quotas.

Biotechnology
- Meeting the demands of a growing population
  - Fungus Fusarium to produce mycoprotein. Requires glucose syrup, aerobic conditions. Biomass is harvested and purified.
  - GM bacteria produces insulin to treat diabetes.
  -GM crops to provide more/nutritional food (golden rice).

Trophic levels can be represented by numbers and biomass in pyramids.

Transfers of biomass
- Biomass is lost between the different trophic levels
  - Producers transfer about 1% of the incident energy from light for photosynthesis.
  - Large amounts of glucose is used in respiration, some material is used as waste e.g. CO₂, water and urea in urine.
  - Decomposers break down dead plants and animal matter by secreting enzymes. Small soluble food molecules then diffuse into the microorganism.
  - Approximately 10% of the biomass from each trophic level is transferred to the level above.

Some people have concerns about the treatment of animals.

AQA GCSE ECOLOGY PART 2

There is a global consensus about global warming and climate change based on systematic reviews of thousands of peer reviewed publications.
Biodiversity is the variety of all different species of organisms on Earth, or within an ecosystem.

Experimental methods are used to determine the distribution and abundance of a species.

**Sampling techniques**
- **Quadrats**: Organisms are counted within a randomly placed square.
- **Transects**: Organisms are counted along a belt (transect) of the ecosystem.

**Processing data**
- **Median**: Middle value in a sample.
- **Mode**: Most occurring value in a sample.
- **Mean**: The sum of all the value in a sample divided by the sample number.

**Environmental changes affecting the distribution of species**
- **Temperature**
- **Availability of water**
- **Composition of atmospheric gases**

**Example**: Several species of bird migrate from cold winter conditions to warmer conditions closer to the equator.

**Ensures the stability of ecosystems**
By reducing the dependence on one species on another for food, shelter, maintenance of the physical environment.

**Future of human species**
Many human activities are reduction biodiversity and only recently measures have been taken to stop it.

**Human activity can have a negative impact on biodiversity**

**Biodiversity and the effect of human interaction on the ecosystem**

**AQA GCSE ECOLOGY PART 3**

**Impact of environmental change (Biology HT only)**

**Waste, land use and deforestation**

**Large scale deforestation**

- **In tropical areas (e.g. rain forest) has occurred to:**
  - Provide land for cattle and rice fields, grow crops for biofuels.
  - Deforestation reduces biodiversity and removes a sink for increasing the amount CO₂ in the atmosphere.
  - This conflicts with conserving peat bogs and peatlands as habitats for biodiversity and reduce CO₂ emissions.

**Land use**
- **Humans reduce the amount of land and habitats available for other plants, animals and microorganisms.**
  - Building and quarrying.
  - Farming for animals and food crops.
  - Dumping waste.
  - Destruction of peat bogs to produce cheap compost for gardeners/farmers to increase food production.

- **Pollution kills plants and animals which can reduce biodiversity.**
  - More resources used and more waste produced.
  - Pollution in water; sewage, fertiliser or toxic chemicals.
  - Pollution in air; smoke or acidic gases.
  - Pollution on land; landfill and toxic chemicals.

- **Rapid growth in human population and higher standard of living**