AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Biology topics

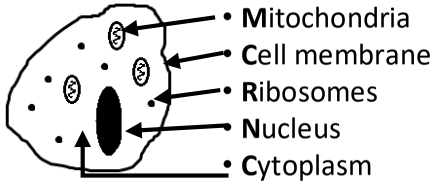
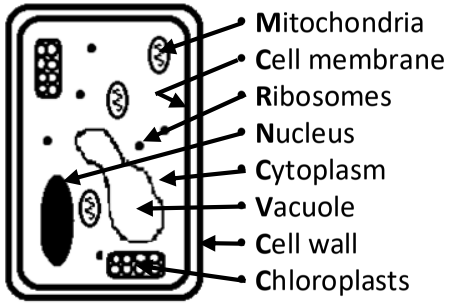
- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Paper 2 Biology topics

- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - Variation and evolution
  - Genetics and evolution

CASTLE MANOR · CHURCHILL SCHOOL · NEWMARKET ACADEMY · SAMUEL WARD · SYBIL ANDREWS ACADEMY · TGS

Key points to learn

1. Early light microscopes	Use light and lenses. Have magnifications of 100 to 2 000
2. Electron microscope	Modern. Use a beam of electrons. Magnifications of up to 2 000 000
3. Magnification	How much bigger an image appears than the real object eg Magnification of 100, image looks 100 times bigger than object
	$magnification = \frac{size\ of\ image}{size\ of\ object}$
4. Resolving power	Smallest size microscope can show
5. Typical Animal cell	
6. Typical Plant cell	
7. Photo-synthesis	Reaction plants use to make glucose from light, H_2O and CO_2
8. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
9. Specialised plant cells	1. Root hair - absorb water and ions 2. Xylem – carry water and minerals 3. Phloem – carry glucose to cells

Key points to learn

10. Mitochondria	Perform respiration to release energy
11Cell membrane	Controls movement in/out of cell
12 Ribosomes	Makes proteins by protein synthesis
13Nucleus	Controls activities of cell. Contains genes to build new cells
14 Cytoplasm	Liquid where most reactions happen
15 Vacuole	Sack filled with sap. Keeps cell rigid
16 Cell wall	Made of cellulose. Supports cell
17 Chloroplasts	Green and full of chlorophyll
18 Chlorophyll	Absorbs light for photosynthesis
19 Eukaryotic cells	Animal cells and plant cells. Have cell membrane, cytoplasm and nucleus
20 Prokaryotic cells	Bacteria. Do not have a nucleus. Genetic material is looped
21 Diffusion	Particles spreading out in gas/liquid Move from high→low concentration
	Dissolved substances like O_2 and CO_2 move in/out of cells by diffusion
22 Factors affecting diffusion	1. Difference in concentration (concentration gradient) 2. Temperature 3. Surface area to diffuse through
23 Osmosis	Diffusion of water through partially permeable membrane (surface that only lets small particles through). Moves from dilute solution → more concentrated solution
24 Active transport	Moves substances from low→high concentration. Needs energy

Trilogy: B1 Cell structure and transport

Part of: Cell Biology

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
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  - Photosynthesis
  - Respiration

Background

Big or small, all organisms are made of cells. Normally too small to see without a microscope, they are the building blocks of all life: animals, plants, insects, microbes and us.

Maths skills

Prefix	Meaning	Standard form
Mega (M)	x 1000000	x 10^6
kilo (k)	x 1 000	x 10^3
milli (m)	÷ 1 000	x 10^{-3}
nano (n)	÷ 1 000 000 000	x 10^{-9}

Key points to learn

1. Cell cycle	Process by which body cells divide. Three stages: 1. Copy: Two copies of chromosomes and internal cell structures 2. Mitosis: Copies of chromosomes move and form two nuclei 3. Split: cytoplasm and cell membranes split to make two identical cells
2. Mitotic cell division	Makes two identical copies of cells. Used in growth and repair
3. Asexual reproduction	Form of reproduction using mitotic cell division to make clone cells
4. Chromosome	Contains large number of genes. Made of DNA molecules
	Human body cells contain 23 pairs of chromosomes
5. Genes	Instructions for a characteristic
6. DNA	Molecules that make genes
7. Cell differentiation	Stem cells can form different types of specialised cells
	Most animal stem cells differentiate early
	Many plant stem cells can differentiate at any time
8. Clone	Genetically identical copy of a cell or organism

Key points to learn

9. Stem cells	Not differentiated. Can become any type of cell that is needed
10. Human stem cells	1. From embryos can become most types of human cell 2. From adult bone marrow can form many cells like red blood cells
	May be able to help conditions like diabetes and paralysis
	Issues with use: • Potential spread of virus or immune response • Some people have ethical or religious objections
11. Meristem cells	Plant stem cells. Can become any type of plant cell at any time
	Used to clone: • rare plants from extinction • crops with desirable features
12. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
13. Specialised plant cells	1. Root hair - absorb water and ions from soil 2. Xylem – carry water and minerals from roots 3. Phloem – carry glucose to cells
14. Ethical objections	Related to what a person thinks is morally good or ok

Trilogy B2: Cell Division

Part of: Cell Biology

Knowledge Organiser

Big picture (Biology Paper 1)

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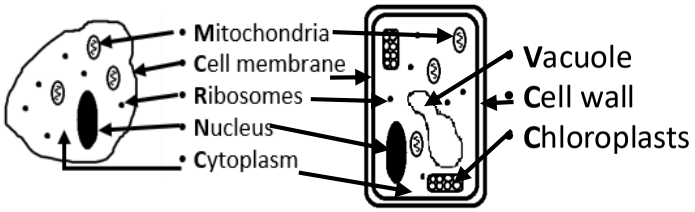
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

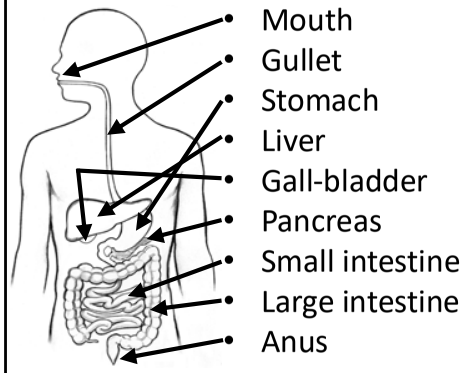
Background

Taste buds are replaced approximately every 10days, skin cells every 14 days and your lungs every 6 weeks. How can this happen and how old are we really?

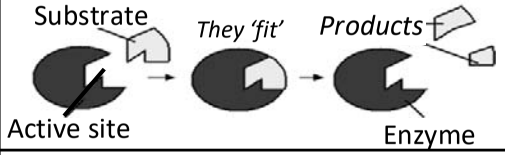
Additional information



Key points to learn

1. Specialised animal cells	1. Sperm – tail to swim 2. Nerve – carry electrical impulses 3. Muscle – contract and relax
2. Tissue	Group of similar cells
3. Organ	Group of tissues working together
4. Organ systems	Group of organs which work together in organism
5. Digestive system	A group of organs that digest and absorb food
6. Digestion	Breaking large food molecules into small soluble ones
7. Human digestive system	
8. Carbohydrate	Types of sugars: glucose, starch, cellulose. Used for energy
	Test: Starch turns iodine bluey black
9. Proteins	Used to make enzymes, tissues and cells. Found in meat, fish, pulses, milk
	Test: Biuret reagent turns from blue to purple
10. Lipids	Fats and oils made of fatty acids and glycerol

Key points to learn

11. Mouth	Chews food, releases saliva
12. Stomach	Churns food. Partial digestion here
13. Liver	Makes bile to be stored in gall bladder
14 Pancreas	Releases enzymes in small intestine
15. Small intestine	Majority of digestion happens here. Makes lots of enzymes
16. Large intestine	Absorbs water
17. Bile	Alkaline to neutralise stomach acid. Added at start of small intestine. Emulsifies fat into small droplets
18. Catalyst	Chemical which speeds up a reaction without being used itself
19. Enzyme	Biological catalysts Like a specific temperature and pH
20. Lock and key theory	Model showing how enzymes work. Substrates fit the enzyme active site, then react, turning into products 
21 Metabolism	The sum of all the reactions in a cell or the body of an organism
22 Protease	Enzyme breaks down protein. Made in stomach, pancreas, small intestine
23 Lipase	Enzyme breaks down lipids. Made in pancreas, small intestine
24 Amylase	Type of carbohydrase enzyme. Breaks down starch. Made in salivary glands, pancreas, small intestine

Trilogy B3: Organisation and the digestive system

Part of: Organisation

Knowledge Organiser

Big picture (Biology Paper 1)

- Cells and organisation
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  - **Organisation and the digestive system**
  - Organising animals and plants
- Disease and bioenergetics
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  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Have you ever wondered why the human body temperature is 37°C or why the male testes are outside the body? The answer is enzymes. They are also crucial for digestion…

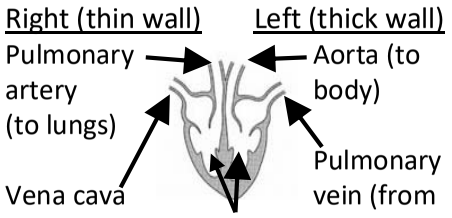
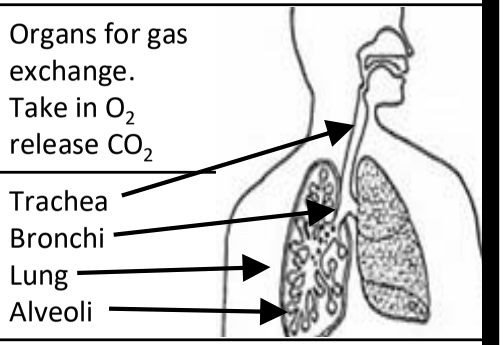
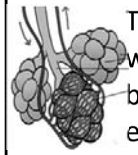
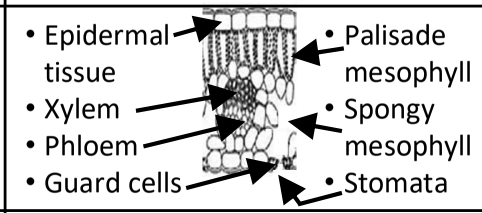
Key points to learn

25. Why you can't kill an enzyme	They are not alive so can't die.
	But they will change shape and 'denature' at the wrong temperature or acidity (pH) Each one has an ideal temperature and pH they work best at.

Key points to learn

1. Blood	A tissue of plasma, red blood cells, white blood cells and platelets
2. Plasma	Yellow liquid that transports: • Red and White Blood cells • Waste carbon dioxide to lungs • Urea from liver to kidneys • Digested nutrients to cells
3. Red blood cells	Biconcave discs with no nucleus. Packed with red haemoglobin that carries oxygen to body cells
4. White blood cells	Part of the body's defence against microorganisms
5. Platelets	Small pieces form clots over cuts
5. Circulatory system	Transports substances to/from body cells. Made up of: • Blood • Blood vessels (arteries, veins and capillaries) • The Heart
6. Arteries	Carry blood away from your heart at high pressure
7. Veins	Carry blood back to your heart. Use valves to stop reverse blood flow
8. Capillaries	Network of tiny, thin vessels connecting to every individual cell. Substances diffuse in/out of blood
9. Coronary arteries	Blood vessels that supply heart with oxygen
10. (Aerobic) Respiration	Process by which all living things get energy from glucose and oxygen
	Glucose + Oxygen → Carbon + Water dioxide

Key points to learn

11. The Heart	Organ made of muscle that pumps blood in two loops around body
	
12. The Lungs	Organs for gas exchange. Take in O_2 release CO_2
	
13. Alveoli	 Thin sac-like structures within the lungs. Covered in blood vessels to help gas exchange
14. Plant organs	Leaf – carries out photosynthesis Stem – supports Roots – take in water and minerals
15. Leaf structure cross-section	
16. Transport within plant	• Phloem – moves sugars • Xylem – moves water and ions
17. Transpiration	Evaporation from leaf pulls water through plant xylem. Affected by temperature, humidity, wind, light

Trilogy B4: Organising animals and plants

Part of: Organisation

Knowledge Organiser

Big picture (Biology Paper 1)

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  - **Organising animals and plants**
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

All living cells need glucose and oxygen for respiration. Getting these ingredients to the cells, keep them and get rid of waste products? This topic finds out

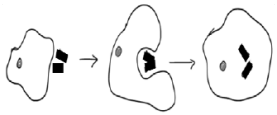
Additional information

The heart was first labelled from behind. This means the left and right sides are reversed.

Key points to learn

1. Bacteria	Large microbe Living 
	Divide by splitting in two
	May produce toxins to make us ill
	Cause: • Salmonella – food poisoning • Gonorrhoea – sexually transmitted disease (STD)
2. Viruses	Smallest microbe Not alive 
	Live and reproduce inside cells
	Cause: • Measles – can be fatal • HIV – can turn into AIDS • Tobacco mosaic virus (TMV) affects photosynthesis in plants
3. Fungi	The other type of microbe. Living
	Cause: • Rose black spot – affects photosynthesis in plants
4. Pathogens	Microbes/microorganisms that cause diseases
	Spread by air, contact and water
5. Communicable diseases	Infectious diseases that can be passed from one person to another
	Caused by pathogens
6. Malaria	Is a protist disease. Spread by mosquito bites

Key points to learn

7. Causes of ill health	Pathogens, diet, stress, life situations/conditions
8. Non-communicable diseases	Cannot be transmitted from one person to another
	Eg heart disease, arthritis
9. Ignaz Semmelweis	Doctor in mid-1850s who persuaded doctors to wash their hands
10. Louis Pasteur	Showed that microbes caused disease. Developed vaccines
11. Vaccines	An inactive form of a pathogen used to prepare your immune system
12. Human defences against pathogens	1. Skin barrier - covers your body 2. Nose - hair and mucus act as trap 3. Trachea and bronchi – covered in cilia and mucus 4. Stomach - makes acid to destroy 5. Immune system – white blood cells defend us in three ways
13. Trachea	Pipe from mouth to bronchi
14. Bronchi	Pipe into each lung
15. Cilia	Tiny hair-like cells
16. White blood cells	1. Phagocytosis ingest microbes 
	2. Produce antibodies chemicals to destroy microbes 
	3. Produce antitoxins chemicals to cancel-out toxins made by pathogens 

Trilogy B5: Communicable diseases

Part of: Infection and response

Knowledge Organiser

Big picture (Biology Paper 1)

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- Disease and bioenergetics
  - **Communicable diseases**
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - Respiration

Background

Nobody likes getting ill. To better avoid diseases, we need to understand what causes and how our bodies try and defend us from them.

Additional information

This topic links really well with B6 which is all about how we can further defend against these diseases.

Key points to learn

1. Bacteria	Large microbe. Living
	Divide by splitting in two
	May produce toxins to make us ill
	Cause: - Salmonella - Gonorrhoea
2. Viruses	Smallest microbe. Not alive
	Live and reproduce inside cells
	Cause: - Measles - HIV - Tobacco mosaic virus (TMV)
3. Pathogens	Microbes/microorganisms that cause diseases
	Spread by air, contact and water
4. Communi-cable diseases	Infectious diseases that can be passed from person to person
	Caused by pathogens
5. Louis Pasteur	Showed that microbes caused disease. Developed vaccines
6. Painkillers	No effect on the pathogens but do reduce the symptoms of illness. Eg aspirin and paracetamol
7. Destroying viruses	Is very difficult without damaging body tissue as they live inside cells
8. Discovery of new drugs	Medicines used to be extracted from plants and microorganisms eg • Heart drug *digitalis* from foxglove • Painkiller aspirin from willow tree • Penicillin from mould
9. Placebo	A tablet with no active medicine content

Key points to learn

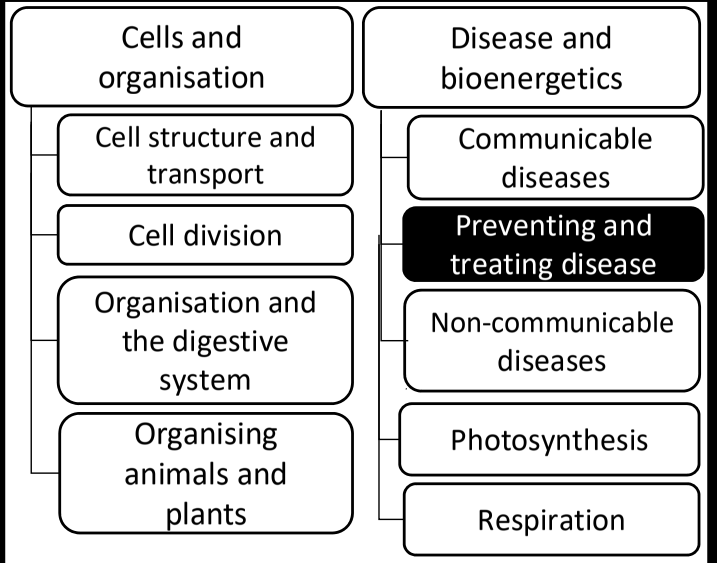
10. Vaccines	An inactive form of a pathogen used to prepare your immune system
	White blood cells are able to respond quickly to prevent infection
	MMR is a vaccine against mumps, measles and rubella
11. Antibiotics	Medicines that kill specific bacteria. Greatly reduced deaths from bacterial diseases
	Cannot kill viruses
	Some bacteria are becoming resistant which is very concerning
	Alexander Fleming discovered penicillin
12. Making new medicines	Need to be checked for toxicity (safety), efficacy (effectiveness) and dose
	First trials are done using cells, tissues and live animals
	Clinical trials use healthy volunteers and patient: 1. Very low doses at start of trial 2. If safe, more trials done 3. In double blind trial some patients given placebo
13. White blood cells	1. Phagocytosis ingest microbes 
	2. Produce antibodies chemicals to destroy microbes 
	3. Produce antitoxins chemicals to cancel-out toxins made by pathogens 

Trilogy: B6 Preventing and treating diseases

Part of: Infection and response

Knowledge Organiser

Big picture (Biology Paper 1)



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Key points to learn

1. Non-communicable diseases	Cannot be transmitted from one person to another
	Eg heart disease, arthritis
2. Causes of ill health	Pathogens, diet, stress, life situations/conditions
3. Communicable diseases	Infectious diseases that can be passed from one person to another
	Caused by pathogens (microbes)
4. Coronary heart disease	Layers of fat build up inside coronary arteries, reducing blood flow and oxygen for the heart
	Stents used to keep arteries open
	Statin medicines used to reduce blood cholesterol levels which reduces rate of fatty build up
5. Heart failure	A failed heart can be replaced by a donor heart
6. Faulty heart valves	Can be replaced by biological/mechanical valves
7. Coronary arteries	Blood vessels that supply the heart
8. Cancer	Uncontrolled growth and division of cells
	Lifestyle and genetic factors can increase risks of some cancers
9. Tumour	Lump or growth in a part of the body
10. Health	State of physical and mental well-being

Key points to learn

11. Malignant tumour	Are cancers
	Invade neighbouring tissues and spread throughout body forming secondary tumours
12. Benign tumour	Not cancers
	Growths of abnormal cells in one area that do not invade other parts of the body
13. Different diseases can interact	• A defective immune system can lead to more infections • Viruses can trigger cancer • Pathogens can trigger allergies • Physical ill health can lead to depression and mental illness
14. Smoking and risk of disease	Carbon monoxide harms unborn babies
	Carcinogens increase risk of cancers
	Increases risk of coronary heart disease
	Increases risk of lung disease and lung cancer
15. Risks of diet, exercise and obesity	Increases risk of coronary heart disease and high blood pressure
	Obesity can lead to Type 2 diabetes
16. Alcohol and risk of disease	Damages the liver and carcinogens increase risk of liver cancer
	Affects brain function
	Passes to and harms unborn babies
17. Exposure to ionising radiation	EM Waves (UV rays, X-rays Gamma rays) and radioactive material
	Can increase risk of cancers

Trilogy B7: Non-communicable diseases

Part of: Infection and response

Knowledge Organiser

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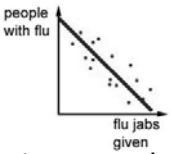
  - Photosynthesis
  - Respiration

Background

A reported 25% of people in the UK are now obese. Around 17% of adults smoke and many more consume alcohol. So, what are the risks of these lifestyle choices?

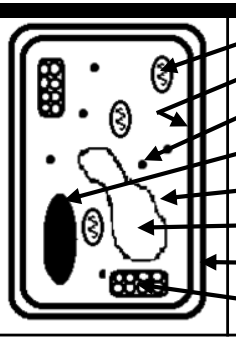
Maths skills

Use scatter diagrams to identify correlation between factors.

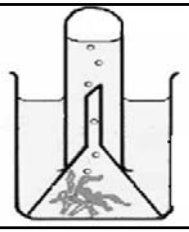
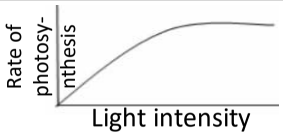
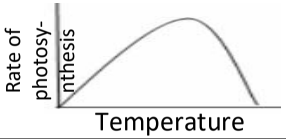


Using samples to estimate population trends

Key points to learn

1. Plant leaf cell	 • **M**itochondria • **C**ell membrane • **R**ibosomes • **N**ucleus • **C**ytoplasm • **V**acuole • **C**ell wall • **C**hloroplasts
2. Mitochondria	Perform respiration to release energy
3. Cell membrane	Controls movement in/out of cell
4. Ribosomes	Makes proteins by protein synthesis
5. Nucleus	Controls activities of cell. Contains genes to build new cells
6. Cytoplasm	Liquid where most reactions happen
7. Vacuole	Sack filled with sap. Keeps cell rigid
8. Cell wall	Made of cellulose. Supports cell
9. Chloroplasts	Green and full of chlorophyll
10 Chlorophyll	Absorbs light for photosynthesis
11. Photosynth-esis	The process of chloroplasts making their food (glucose) using light
	The reverse of respiration
	Absorbs light energy Carbon + Water → Glucose + Oxygen dioxide
	Endothermic reaction – light energy is absorbed

Key points to learn

12. Leaf adaptations for photosynth-esis	• Big surface area – to catch light • Thin - helps diffusion of gases • Chloroplasts – contain chlorophyll • Veins – bring water through xylem and move glucose through phloem • Air spaces – help diffusion of gases • Guard cells – open and close stomata to control gas movement
13. Rate of Photosynth-esis	Can be measured by using pond weed and counting number of oxygen bubbles released 
	Affected by light intensity 
	Affected by CO_2 concentration 
	Affected by temperature 
14. How plants use glucose	In respiration – provides energy Glucose + Oxygen → Carbon + Water dioxide
	Store it as insoluble starch
	Make fat or oil for storage
	Make cellulose to strengthen cell wall
	To produce amino acids for protein synthesis and making DNA
15 Nitrate ions	Also needed to make amino acids

Trilogy B8: Photosynthesis

Part of: Bioenergetics

Knowledge Organiser

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  - Non-communicable diseases
  - **Photosynthesis**
  - Respiration

Background

Plants and algae are both amazing as they can make their own food. This process means that they are an essential part of every food chain.

Maths skills

Interpreting sketch graphs

Additional information

The photosynthesis and respiration equations are the same, but the arrow is reversed. This means you only really need to remember one of them! *(Topics in italics are Higher Tier only.)*

Trilogy B9: Respiration

Part of: Bioenergetics

Knowledge Organiser

Key points to learn

1.Breathing	Not the same as respiration. Method of obtaining oxygen from the air
2. Aerobic respiration	Process by which all living things get energy from glucose and oxygen
	Happens continuously in plants an animals. Provides lots of energy
	Glucose + Oxygen → Carbon + Water dioxide
	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
	Exothermic reaction - gives off heat
	Occurs within mitochondria in cells
3. Response to exercise	During exercise body needs more energy so rate of aerobic respiration increases. This needs: 1. Heart rate increases - blood carries glucose and oxygen faster 2. Breathing rate and volume increases – lungs obtain more oxygen 3. Glycogen stores turned into glucose – more glucose available
	More respiration means you get hotter and may need to cool down
4 Anaerobic respiration	Provides energy from glucose if there is not enough oxygen available
5. Anaerobic respiration in plants and yeast	Called fermentation. Used to make bread and alcohol
	Glucose → Ethanol + Carbon dioxide
6. Enzymes	Biological catalyst. Helps reactions to happen in living things

Key points to learn

7. Anaerobic respiration in animal cells	Glucose → Lactic acid
	Much less energy provided than aerobic respiration
8. Lactic acid	Leads to an oxygen debt which requires more oxygen after exercise is complete to break down the lactic acid
	Causes muscles to tire and cramp
9. Metabolism	The sum of all the reactions in a cell or the body of an organism
	Energy provided by respiration is used in these metabolic reactions to make new molecules
10. Metabolic reactions	Includes these 5 reactions: 1. Turning glucose into starch, glycogen and cellulose 2. Making lipids from glycerol and fatty acids 3. Using glucose and nitrate ions to make amino acids 4. Respiration 5. Turning excess proteins into urea
11. Metabolic rate	The rate at which reactions happen in an organism
12. Lipids	Fats and oils
13. Starch	Carbohydrate store in plants
14. Glycogen	Carbohydrate store in animals
15. Cellulose	Makes cell walls in plants
16. Urea	Waste product from liver

Big picture (Biology Paper 1)

- Cells and organisation
  - Cell structure and transport
  - Cell division
  - Organisation and the digestive system
  - Organising animals and plants
- Disease and bioenergetics
  - Communicable diseases
  - Preventing and treating disease
  - Non-communicable diseases
  - Photosynthesis
  - **Respiration**

Background

It is one of the R's in MRS GREN. All living things do it, all of the time. Every single one of your 10 trillion living body cells are doing it right now. As are the 100trillion microbes living in your intestines!

Additional information

The five metabolic reactions are all covered in more detail in this course. Remember that they all use enzymes.

'Aerobic respiration' is often known as just 'respiration'. It is photosynthesis in reverse.