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

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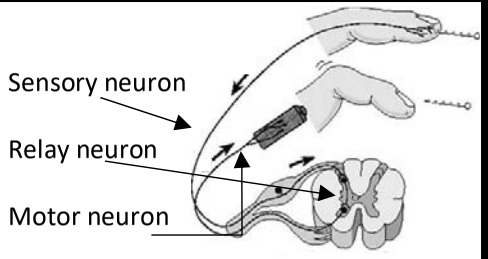
Key points to learn

1. Catalyst	Increase rate of reaction without being used up themselves
2. Enzyme	Biological catalysts. Work at a specific temperature and pH
3. Homeostasis	Automatic control of conditions inside a cell or organism so that enzymes and cells work effectively
	In the human body it controls: 1. Blood glucose concentration 2. Body temperature 3. Water levels
	Uses receptors, coordination centres and effectors
4. Receptors	Cells that detect changes (stimuli)
5. Coordination centres	Use information from receptors
	Brain, spinal cord and pancreas
6. Effectors	Bring about response to changes
	Muscles or glands
7. Pancreas	Monitors and controls blood glucose levels
8. Glands	Make hormones which act as chemical messages in the body
9. Stimuli	A change noticed by a sensory receptor. Can be changes in: 1. Temperature 4. Sound 2. Taste 5. Light 3. Touch 6. Smell
10. Neuron	Specialised cell that carries electrical impulse in nervous system

Key points to learn

11. CNS	Central Nervous System. Brain and spinal cord
12. Reflex actions	Automatic, rapid actions that do not use conscious part of brain
	Safety mechanism for our body
	Eg. Blinking, jumping at loud sounds
13. Reflex arc	The sequence in a reflex action eg tasting something sour 1. Stimulus – sour taste 2. Receptor – taste bud cell 3. Sensory neuron – carries impulse to coordinator 4. Relay neuron in Coordinator – spinal cord 5. Motor neuron – carries impulse to effector 6. Effector – muscle in face 7. Response – muscle contracts
	
14. Synapse	Gap between two neurons. Chemicals diffuse across gap instead of electrical impulse
15. Muscle	Tissue that can contract or relax to cause movement

Trilogy B10: The human nervous system

Part of: Homeostasis and response

Knowledge Organiser

Big picture (Biology Paper 2)

- 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

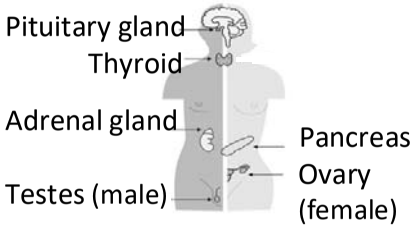
Background

Cells in the body need very specific conditions to survive and operate. How does our nervous system ensure that these conditions are monitored and controlled?

Additional information

Remember that our bodies operate at 37°C. It's so that our enzymes work best and do not denature.

Key points to learn

1. Endocrine system	Contains glands that secrete hormones into the bloodstream
	
2. Hormones	Chemical messages in the body
3. Pituitary gland	'Master gland' that secretes hormones that act on other glands
4. Pancreas	Monitors and controls blood glucose levels
	Releases insulin hormone if blood glucose concentration too high
	Releases glucagon if blood glucose concentration too low
5. Insulin (hormone)	Causes cells to take glucose from blood. Liver and muscle cells store as glycogen
6. Glucagon (hormone)	*Converts glycogen into glucose. Interacts with insulin in negative feedback cycle to control glucose*
7. Adrenaline (hormone)	From adrenal gland. Increases heart rate in fight or flight response
8. Contraception (to stop pregnancy)	• Oral (pill) - FSH stops eggs maturing • Injection/implant – progesterone to stop maturation and release of eggs • Spermicides – chemicals kill sperm • Barrier – stop sperm reaching egg • Abstinence – No sexual intercourse • Surgical – remove/cut reproductive organs

Key points to learn

9. Type 1 diabetes	Pancreas does not produce enough insulin when glucose concentration too high. Needs insulin injections
10. Type 2 diabetes	Body no longer responds to insulin. Controlled by diet and exercise
	Obesity a risk factor for this diabetes
11. Thyroxin (hormone)	From the thyroid gland. Controls they body's metabolic rate. Important in growth and development Controlled by negative feedback
12 Oestrogen (hormone)	Main female reproductive hormone. From ovaries
13. Ovulation	Once a girls has gone through puberty she releases an egg every 28days during the menstrual cycle
14. Hormones during menstrual cycle	FSH (Follicle Stimulating Hormone) causes and egg to mature in ovary. *Stimulates ovary to make oestrogen*
	LH (Luteinising Hormone) triggers release of egg (ovulation)
	Oestrogen: causes uterus lining to grow; *stops release of FSH; starts release of LH*
	Progesterone: maintains uterus *lining; stops production of both FSH and LH*
Testosterone 15 (hormone)	Main male reproductive hormone. From testes. Starts sperm production
16. Infertility treatment (to help pregnancy)	• FSH and LH can be taken to stimulate egg development and release. • IVF (In Vitro Fertilisation) uses eggs that are removed, fertilized and re-implanted into uterus

Trilogy B11: Hormonal coordination

Part of: Homeostasis and response

Knowledge Organiser

Big picture (Biology Paper 2)

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    - **Hormonal coordination**
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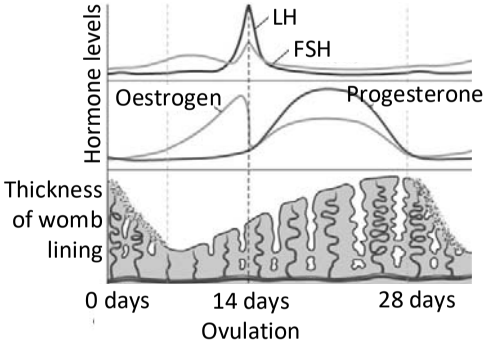
        - Reproduction
        - Variation and evolution
        - Genetics and evolution

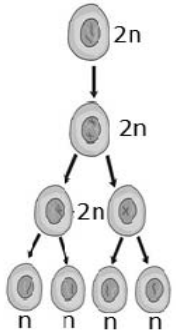
Background

The journey from a child into an adult is (adolescence) is a difficult time for all living things. It's all because of our hormones.

Here are the hormones that change and control the female menstrual cycle.



Key points to learn

1. Asexual reproduction	1. Only one parent 2. Cells divide by mitosis 3. Offspring are clones of parent
2. Sexual reproduction	1. Two parents 2. Fusing of male and female gametes which mixes genetic information from parents. 3. Variation between offspring
3. Gametes	Male and female sex cells: • Male: Sperm (animals) and pollen (plants) • Female: Egg (animals and plants)
	Half chromosomes of normal cell
4. **Mit**osis	One parent cell divides into two identical versions . **M**aking **i**dentical **t**wo. Used in growth/repair
5. Meiosis	Cell divides to make gametes (sex cells) 1. Copies genetic information 2. Cell divides into two each with full set of chromosomes 3. Two cells divide into four gametes - each with a half set of chromosomes 4. Gametes are genetically unique 
6. Fertilisation	Male and female gametes fuse together – now have full set of chromosomes for offspring
	Fusing half mothers chromosomes with half of fathers
7. Clone	Genetically identical
8 Characteristics	Features of an individual

Key points to learn

9. DNA	Chemical that makes chromosomes
	Polymer made of two strands. Double helix shape 
10. Gene	Small section of DNA in a chromosome. Codes for a certain amino acid to make certain protein
11. Chromosome	Made of genes. Carry all genetic information on how to make organisms what they are. Humans have 23 pairs of chromosomes
12. Genome	All the genetic material of an organism. The whole human genome has been studied and will have great importance for future medicine
13. Using the human genome	1. Search for genes related to certain diseases 2. Treating inherited disorders 3. Study human migration patterns
14. Allele	Single gene that controls one inherited characteristic eg fur colour
15. Genotype	Allele version present eg BB, Bb or bb
16. Phenotype	Characteristic displayed eg green eye
17. Dominant	Allele that wins if present eg B
18. Recessive	Allele that submits to dominant eg b
19 Heterozygous	Both alleles are identical eg BB or bb
20 Homozygous	Both alleles are different eg Bb
21 Inherited disorders	1. Polydactyl – extra fingers or toes. Caused by dominant allele 2. Cystic fibrosis - recessive allele
22. Gender	Females – XX. Males - XY

Trilogy B12: Reproduction

Part of: Inheritance, variation and evolution

Knowledge Organiser

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  - Genetics and evolution

Background

Why is there such variation between humans? How are some characteristics inherited from mothers and some from fathers? This topic explores.

Punnet squares

Predict outcomes of genetic crosses. Parents genotype outside. Possible offspring genotypes in middle.

Hair colour	B	B
b	Bb	Bb
b	Bb	Bb

	B	b
b	Bb	bb
b	Bb	bb

	B	b
B	BB	Bb
b	Bb	bb

Phenotypes

Brown: 100%
blonde: 0%

Brown: 50%
blonde: 50%

Brown: 75%
blonde: 25%

Key points to learn

1.Variation	Differences between individuals in a species. Caused by combination of genes and environment
2. Inherited characteristics	Features from genes you inherit eg hair colour, tongue rolling
3 Environmental characteristics	Features caused from conditions you have grown up in eg accent
4. Mutations	Changes in DNA code. Occur continuously
	Responsible for all different phenotypes
5. Phenotype	Characteristic displayed due to a genetic allele eg green eye
6. Evolution	Change in inherited characteristics over time due to natural selection
7. Darwin's Theory of evolution through natural selection	All living things evolved from simple life forms over 3 billion years ago
	1. Different phenotypes in species 2. Some phenotypes are better suited to environment 3. Individuals with better suited phenotypes survive and breed 4. Successful phenotypes are passed on to next generation Mutation of gene → Better at surviving → Breed → Pass on genes
8. Genome	All genetic information in organism

Key points to learn

9. New species	Evolve such different phenotypes that they can no longer breed
10. Selective breeding (artificial selection)	Choosing parents with desired characteristics so that their offspring show those characteristics
	Takes many generations to obtain desired characteristic reliably
	Desirable characteristics include: Disease resistant crops; more milk or meat; dogs with gentle nature; large or unusual flowers
11. Inbreeding	Selective breeding can lead to this. Where breeds are prone to disease or inherited defects
12. Genetic engineering	Modifying the genome of an organism by adding a gene from another organism. Examples: 1. Bacteria to produce insulin 2. *Possibly curing human inherited disorders*
13. GM Crops	**G**enetically **M**odified crops can be resistant to disease or have higher yield
	Concerns over effect on wild plants and insects. Also long term effects on human health
14. Processes of genetic engineering	*1. Enzyme isolates gene* *2. Gene loaded into vector eg virus* *3. Vector inserts gene into cell* *4. Genes transferred at early stage of development so organism develops with desired characteristics*

Trilogy B13: Variation and evolution

Part of: Inheritance, variation and evolution

Knowledge Organiser

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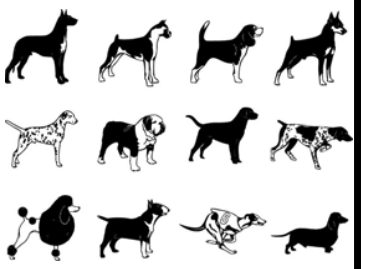
  - Genetics and evolution

Background

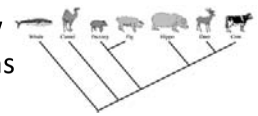
It is hard to imagine that all life on Earth shares the same ancestors. The process of evolution through natural (and artificial) selection have both been in action for a very, very long time.

This topic considers how living things have and continue to evolve.

(Italicised statements are Higher Tier Only)



Key points to learn

1. Darwin's Theory of evolution through natural selection	All living things evolved from simple life forms over 3 billion years ago	
	1. Different phenotypes in species 2. Some phenotypes are better suited to environment 3. Individuals with better suited phenotypes survive and breed 4. Successful phenotypes are passed on to next generation	Mutation of gene Better at surviving Breed Pass on genes
	Theory is now widely accepted	
2. Evidence for evolution	1. From looking at fossils 2. Antibiotic resistance in bacteria 3. Understanding of genetics	
3. Fossils	Remains of organisms from millions of years ago found in rocks.	
	Formed by: 1. Conditions needed for decay were not present 2. Parts of organism replaced by minerals as they decayed 3. Preserved traces eg footprints,	
4. Why so few fossils?	Many life forms had soft bodies. Geological activity destroyed some	
5. Extinct	No more surviving individuals of a species	
6. Evolutionary trees	Used to show how we think organisms are related 	

Key points to learn

7. Extinction	Permanent loss of all members of a species. Can be caused by: 1. Changes in environment eg climate 2. New predators 3. New diseases 4. New competition eg for food
8. Bacterial evolution	Can evolve quickly as the reproduce at such a fast rate
9. Resistant bacteria	Some bacteria have a mutation that makes them resistant to anti-biotics. This means we cannot kill them
	MRSA is resistant to antibiotics
10. Reducing development of resistant bacteria	1. Humans to not use antibiotics as often 2. Patients should always complete their courses of antibiotics so all bacteria are killed 3. Reduce use of antibiotics in agriculture
11 Developing new antibiotics	Is expensive and slow. It is unlikely to be done quick enough to cope with resistant bacteria
12 Classification	Putting living things into similar groups
13. Linnaean system	Carl Linnaeus's classification system **K**ingdom; **P**hylum; **C**lass; **O**rder; **F**amily; **G**enus; **S**pecies
	Keeping **P**recious **C**reatures **O**rganised **F**or **G**rumpy **S**cientists
14. Three Domain system	Classification developed by Carl Woese. • Archaea – primitive bacteria • Bacteria – true bacteria • Eukaryota – everything else living

Trilogy B14: Genetics and evolution

Part of: Inheritance, variation and evolution

Knowledge Organiser

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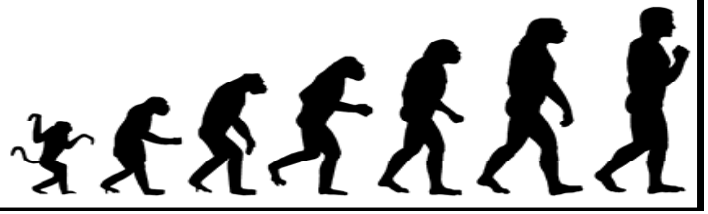
Background

Understanding where we come from may be far more useful than satisfying our curiosity. It might help us fight the emergence of anti-biotic resistant bacteria - described as one of the greatest current threats to humanity.
So what is evolution all about?



Key points to learn

1 Communities	Group of interdependent plants or animals living together
2. Ecosystem	A system that includes all living organisms (biotic) in an area as well as non-living (abiotic) factors
3. Plants compete for	1. Light and space 2. Water 3. Mineral ions from soil
4. Animals compete for	1. Food 2. Mates – for reproduction 3. Territory
5. Interdepend-ence	Different species relying on each other for food, shelter, pollination, seed dispersal
	Changes to one species affect the whole community
6. Energy source for ecosystems	The sun is the source of energy in all food webs
	Plants use photosynthesis to convert light into chemical energy in glucose
7. Abiotic factors	Non-living factors that affect communities: 1. Light intensity 2. Temperature 3. Moisture levels 4. Soil pH and mineral content 5. Wind intensity and direction 6. Carbon dioxide levels – plants 7. Oxygen levels – aquatic animals
8. Aquatic	Lives in water
9. Food chain	A single path in a food web

Key points to learn

10. Biotic factors	Living factors that affect communities: 1. Availability of food 2. New predators 3. New pathogens (microorganisms that cause disease) 4. One species outcompeting leading to numbers too low to breed
11. Adaptations	Features which make an organism better suited to its environment
12. Structural adaptations	Physical features eg fur, beak shape, foot size, sharp claws, thick blubber, big leaves, long roots, camouflage
13 Behavioural adaptations	Changes in behaviour to help survive eg migration, tools, pack hunting
14. Functional adaptations	Biological processes such as reproduction or metabolism eg giving birth to lots of young; hibernation; a chameleons adaptive camouflage
15. Extremo-philes	Organisms that live in very extreme environments such as high pressure / temperature / salt concentrations
	Example: Bacteria in deep sea vents
16. Example plant adaptations	Long roots collect water; small leaves reduce water loss; big leaves increase light captured
17. Example animal adaptations	Camouflage to hide/hunt; big surface area increases heat loss; blubber reduces heat loss
18. Quadrat	Randomly chosen small area (often $1m^2$). Used to estimate total numbers
19. Line transect	A line along which you measure distribution of organisms

Trilogy B15: Adaptations, interdependence and competition

Part of: Inheritance, variation and evolution

Knowledge Organiser

Big picture (Biology Paper 2)

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Background

A study recently estimated there to be 8.7 million different species of organism on our planet. They all compete for the limited resources available and nearly all rely on the Sun as their ultimate source of energy.

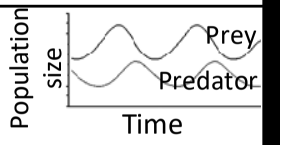
Maths skills

Find the mean, mode and median for a set of data

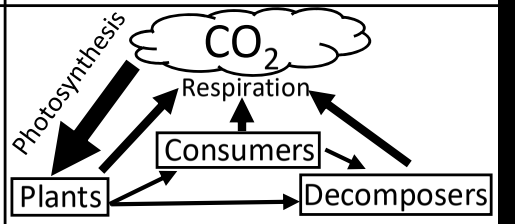
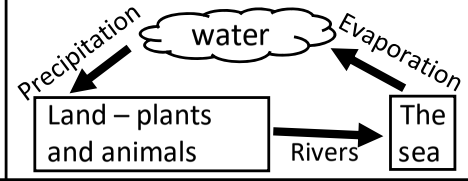
eg. 1, 2, 3, 4, 5, 5, 6

- Mean = (1+2+3+4+5+5+6) ÷ 7 = **3.7** (2sf)
- Median (middle number) = **4**
  Mode (most common number) = **5**

Key points to learn

1. Food chains	Producer → Primary consumer → Secondary consumer
2. Biomass	Amount of biological mass in an organism
3. Producers	Green plants or algae. Always first organism in a food chain. Produce most of the biomass for life on Earth eg phytoplankton
4. Primary consumers	Eat producers eg fish
5. Secondary consumers	Eat primary consumers eg seal
6. Tertiary consumers	Eat secondary consumers eg killer whale
7. Predators	Consumers that kill and eat other animals
8. Prey	Consumers that get eaten by predators
9. Predator-prey cycles	Numbers of both rise and fall in cycles 
	1. Lots of plants means prey numbers increase 2. Lots of prey means predator numbers increase 3. Lots of predators means prey numbers decrease 4. Less prey means predator numbers fall 5. Less predators means prey numbers increase

Key points to learn

10 Distribution	Where things are
11 Abundance	How many there are
12. Decomposers	Microorganisms that feed on dead organisms and waste
	Release carbon back into atmosphere and minerals ions into soil
13. Carbon cycle	
14. Photosynthe-sis	Chemical reaction in which chloroplasts make glucose and oxygen
	The reverse of respiration
	Carbon dioxide + Water → Glucose + Oxygen *Using light*
15. Respiration	Process by which all living things get energy from glucose and oxygen
	Glucose + Oxygen → Carbon dioxide + Water
16. Water cycle	
17 Material recycling	Many materials are recycled to provide building blocks for future
18 Combustion (burning)	Fuel + Oxygen → Carbon dioxide + Water

Trilogy B16: Organising and ecosystem

Part of: Ecology

Knowledge Organiser

Big picture (Biology Paper 2)

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Background

All living and non-living things are made of atoms. These atoms have been around for millions of years and have been continuously cycled over that time. It is amazing to thing that the carbon in us could once been part of Einstein, a cloud, a grasshopper, Cleopatra, a tree or even a piece of tyrannosaurs rex dung. This process of cycling material (and energy) is essential to all life on Earth.

Key points to learn

1. Biodiversity	The variety of all different species in a particular ecosystem
2. Ecosystem	A system that includes all living organisms (biotic) in an area and non-living (abiotic) factors
3. High biodiversity	Ensures stability of ecosystems by reducing one species dependence on another
	Future of human species on Earth relies on high biodiversity
4. Negative human impact on biodiversity	Human actions are reducing biodiversity. Actions such as: • More waste • More land use • Population growth • Using resources
	Only recently have we tried to reduce impact of these actions
5. Pollution from waste	Pollution kills plants and animals which can reduce biodiversity
	• In water, from sewage, fertiliser or toxic chemicals • In air, from smoke and acidic gas • On land, from landfill and from toxic chemicals
6. Land use	Humans reduce land available for animals by: • Building • Quarrying • Farming • Dumping waste

Key points to learn

7. Destruction of peat bogs	Used for compost. Leads to reduction in size of this habitat.
	Decay or burning of peat releases carbon dioxide
8. Deforestation	Removal of forests to : • grow cattle and rice fields • grow crops for biofuels
9. Causes of global warming	Carbon dioxide and methane in the atmosphere contribute to global warming
10. Biological impact of global warming	• Loss of habitat through flooding • Changes in distribution of organisms as temperatures, rainfall and climate change • Changes in migration patterns as climates and seasons change • Reduced biodiversity as many organisms become extinct
11. Maintaining biodiversity	Actions humans are taking to reduce loss of biodiversity: • Breeding programmes for endangered species • Protection and regeneration of rare habitats • Reintroduction of field margins and hedgerows • Reduce deforestation • Reduce carbon dioxide emissions • Recycling rather than dumping in landfill

Trilogy B17: Biodiversity and ecosystems

Part of: Ecology

Knowledge Organiser

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Background

In order to ensure our future health, prosperity and well being we need to take some actions now. Humans need to survive in the environment in a sustainable way.
This topic explores the negative and positive impact we are having on biodiversity and the natural systems that support it.