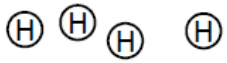
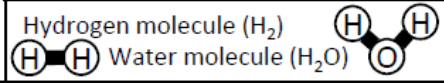
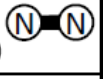
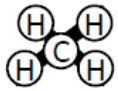
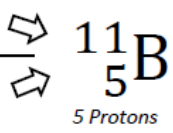
Trilogy C4: Chemical calculations

Collins rev. guide: Quantitative chemistry

Knowledge Organiser

Key points to learn

1. Atom	Smallest part of an element that can exist
	Hydrogen atoms (4H) 
2. Molecule	Two or more atoms chemically bonded
	Hydrogen molecule (H_2)  Water molecule (H_2O)
3. Element	Only one type or atom present. Can be single atoms or molecules
	Both examples of the Nitrogen element (N_2) (N) 
4. Compound	Two or more different elements chemically bonded
	Carbon dioxide (CO_2)  Methane  (CH_4)
5. Mass number	Number of neutrons + protons *6 Neutrons + 5 Protons*
6. Atomic number	Number of protons  *5 Protons*
7. Relative Atomic Mass	A_r The mass number of an atom. Eg A_r of O is 16 and H is 1
8. Relative Formula Mass	M_r The mass of all the atoms of a molecule added together. Eg M_r of H_2O is (2 x 1) + 16 = 18
9. Mole	An amount where either the A_r or M_r is written in grams. Eg one mole of water has a mass of 18g
10. Solute	Solid that has been dissolved

Key points to learn

11. Isotope	Same number of protons different number of neutrons
12. Numbers in reaction equations	Big numbers in front of a chemical tell us how many molecules/atoms of that chemical there are
13. Balancing equations	The number of atoms in the reactants must equal the number of atoms in the products
	Steps to balance an equation 1) $Mg + O_2 \rightarrow MgO$ *Needs another O on product side* 2) $Mg + O_2 \rightarrow \mathbf{2}MgO$ *Only add big numbers in front* *Now needs more Mg on reactants* 3) $\mathbf{2}Mg + O_2 \rightarrow 2MgO$ *Only add big numbers in front*
	The table you will have drawn to help Mg: ~~1~~ 2 → ~~1~~ 2 O: 2 → ~~1~~ 2
14. Chemical reaction	Reactants → Products *'turn into'*
15 Conservation of mass	In a chemical reaction the total mass of reactants = total mass of products
16 If mass seems to be lost/gained	Conservation of mass always applies but sometimes the mass of a gas being used/made is missed
17. Concentration	The mass of solute in a given volume of solution
	Concentration = mass of solute [g] / volume of solution [dm^3] [g/dm^3]
18. Solution	Liquid containing dissolved solute

Big picture (Chemistry Paper 1)

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - **Chemical calculations**
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Background

Want to make enough pancakes for everyone? Then you need to know quantities. Chemical reactions are the same (cooking is a chemical reaction!). This topic explores in more detail.

Maths skills

Steps to balance an equation:

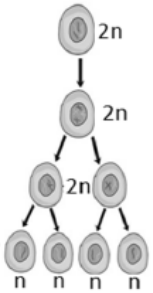
1. Write down the symbols of each element then count how many are on each side of the equation
2. Leave Hydrogen and Oxygen till last if it's complicated
3. Start with an element that appears in the least molecules first (usually a metal)
4. Only add big numbers to the left of each chemical. You can't change molecules

Trilogy B12: Reproduction

Collins Revision Guide: inheritance, variation and evolution

Knowledge Organiser

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

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

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

Phenotypes: **B**rown: 100% **b**londe: 0%

	B	b
b	Bb	bb
b	Bb	bb

Phenotypes: **B**rown: 50% **b**londe: 50%

	B	b
B	BB	Bb
b	Bb	bb

Phenotypes: **B**rown: 75% **b**londe: 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

Collins Revision Guide: inheritance, variation and evolution

Knowledge Organiser

Big picture (Biology Paper 2)

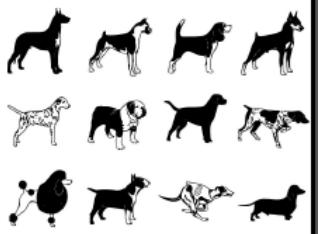
- Biological response
  - The human nervous system
  - Hormonal coordination
- Ecology
  - Adaptations, interdependence and competition
  - Organising an ecosystem
  - Biodiversity and ecosystems
- Genetics and reproduction
  - Reproduction
  - **Variation and evolution**
  - Genetics and evolution

Background

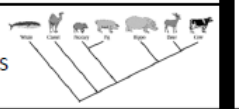
It is hard to imagine that all life on Earth shares the same ancestors. The process of evolution through natural (and artificial) selection have both been in action for a very, very long time.

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

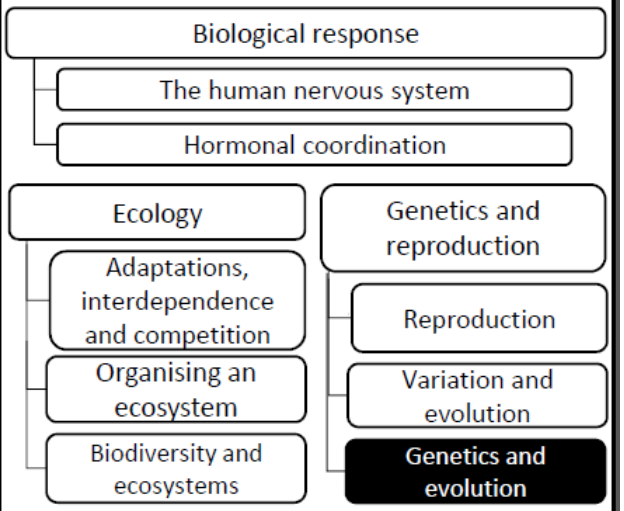
7. Extinction	Permanent loss of all members of a species. Can be caused by: 1. Changes in environment eg climate 2. New predators 3. New diseases 4. New competition eg for food
8. Bacterial evolution	Can evolve quickly as the reproduce at such a fast rate
9. Resistant bacteria	Some bacteria have a mutation 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

Collins Revision Guide: inheritance, variation and evolution

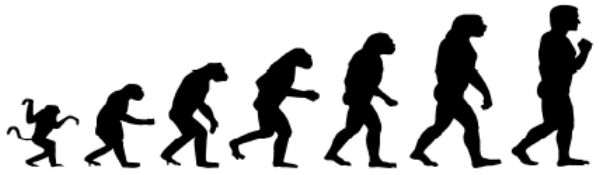
Knowledge Organiser

Big picture (Biology Paper 2)



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?

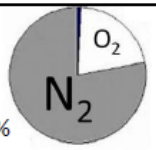


Trilogy C11: The Earth's atmosphere

Collins revision guide: Chemistry of the atmosphere

Knowledge Organiser

Key points to learn

1 Atmosphere	Layer of gas around Earth
2. Earth's early atmosphere theory	Volcanos released carbon dioxide (CO_2), water vapour (H_2O) and nitrogen (N_2)
	Similar to Mars and Venus
3. Photosynthesis	We think it was responsible for changing early atmosphere
	Removes carbon dioxide and makes oxygen
	Carbon + Water → Oxygen + Glucose Dioxide
4. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
5. Carbon 'locked into' rock	Carbon stored in shells and skeletons turned into limestone
	Carbon in living things was also locked away as fossil fuels
6. Ammonia and methane	Removed from atmosphere by reactions with oxygen
7. Earth's atmosphere today	Nitrogen: 78% Oxygen: 21% Argon: 0.9% Carbon dioxide: 0.04% Trace amounts of other gases 
8. Ozone layer	Nothing to do with Global warming or the Greenhouse Effect. A layer of O_3 protecting us from UV rays
9. Incomplete combustion	If not enough oxygen is available then poisonous carbon monoxide and soot are produced

Key points to learn

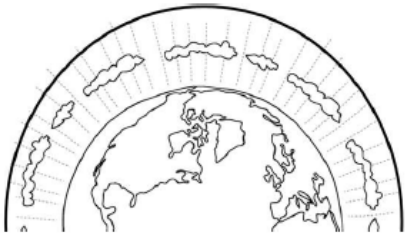
10. Greenhouse effect	Greenhouse gases stop heat escaping from the Earth into space. This results in Earth getting hotter
11. Greenhouse gases	1. Carbon dioxide: released from burning fossil fuels 2. Methane: released from swamps, rice fields 3. Water vapour (eg steam and clouds)
12. Risks of global climate change	1. Rising sea levels as a result of melting ice caps 2. Extreme weather eg storms 3. Changes to temperature and rainfall patterns 4. Ecosystems under threat
13 Issues with reducing greenhouse gas emission	1. It will cost money 2. There is still disagreement that it is a problem 3. It is difficult to implement
14. Carbon footprint	The CO_2 released as a result of a persons activities over a year
15. Ideas for reducing our carbon footprint	1. Burn less fossil fuels 2. Carbon capture 3. Reduce demand for beef 4. Planting more trees
16. Carbon capture	Pumping and storing CO_2 underground in rocks
17. Nitrogen oxide	Released by burning fossil fuels. Causes acid rain and breathing issues
18 . Sulfur dioxide	Released by burning fossil fuels. Causes acid rain

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - **The Earth's atmosphere**
  - The Earth's resources

Background

The bubble of gas around our planet that we call Earth's atmosphere does far more than provide the oxygen we need for respiration. In Europe, winters are almost two weeks shorter than they were 40 years ago. Extreme weather seems more common than ever. Cases of asthma and respiratory difficulties increase year-on-year and we are always looking at ways of making our air cleaner .



Trilogy C12: The Earth's resources

Collins rev guide: Using resources

Knowledge Organiser

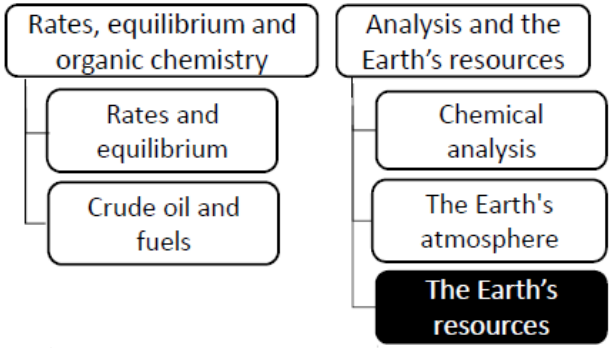
Key points to learn

1. Natural resources	Can be found in their natural form. Some are finite and will run out.
2. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
3. Non-renewable	Finite. Are used quicker than they are made. So will run out
4. Renewable	Made quicker than they are used. Will not run out
5. Sustainable development	Meets current demands without affecting future generations.
6. Potable water	Water that is safe to drink. Not pure as it contains dissolved substances
7. Pure water	No dissolved substances. Only H_2O
8. Normal way of making potable water	1. Choose source of water 2. Filter the water in filter beds 3. Sterilise the water with chlorine, ozone or ultraviolet light
9. Desalination	Method for treating salty water. Two methods both energy intensive 1. Distillation – evaporate water then condense steam 2. Reverse osmosis. Uses membranes
10. Life cycle assessments (LCAs)	Product environmental impact in: 1. Extracting raw materials 2. Manufacturing and packing 3. Use during life 4. Disposal at end of life
11. Recycling	Saves energy and finite resources. Less pollution from making new

Key points to learn

12. Aerobic	With oxygen (exposed to air)
13. Anaerobic	Without oxygen
14. Treating waste water	1. Remove lumps – screening 2. Let sludge sink – sedimentation 3. Bacteria added to clean - Aerobic treatment
15. Treating sludge	Anaerobic digestion by bacteria Can be used as fertiliser or as biofuel
16. Ore	*Rock containing enough metal compounds to be worth extracting*
17. Copper Ores	*Contain copper compounds. Becoming scarce so much harder to find large quantities. Main ways of extracting copper:* *1. Mining – dig up rocks* *2. Phytomining* *3. Bioleaching* *4. Electrolysis* *5. Displacement with iron*
18. Phytomining	*Plants absorb coppers compounds. Plants then burned and copper obtained from ash*
19. Bioleaching	*Bacteria pumped underground absorb copper. Produce leachate solutions containing copper compounds*
20. Electrolysis	*Breaking down a substance in a liquid using electricity*
21. Displacement	*A more reactive metal will displace a less reactive metal*
22. Economic issues	The cost of doing something

Big picture (Chemistry Paper 2)



Background

Up to 60% of the rubbish in the average dustbin could be recycled. This wasteful approach has big environmental and economic impact for us all.

What are natural resources and why are they important? This topic looks at some of the issues that affect all of humankind.

Additional information

Content in *italics* is Higher Tier only.

Look back at Topic C5 and C6 for more on displacement reactions and electrolysis.