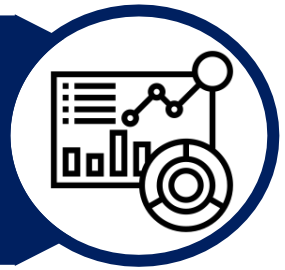
Knowledge Organisers



Term 1 and 2

Year 10

WINTERSTOKE HUNDRED ACADEMY

Contents List

Maths
English
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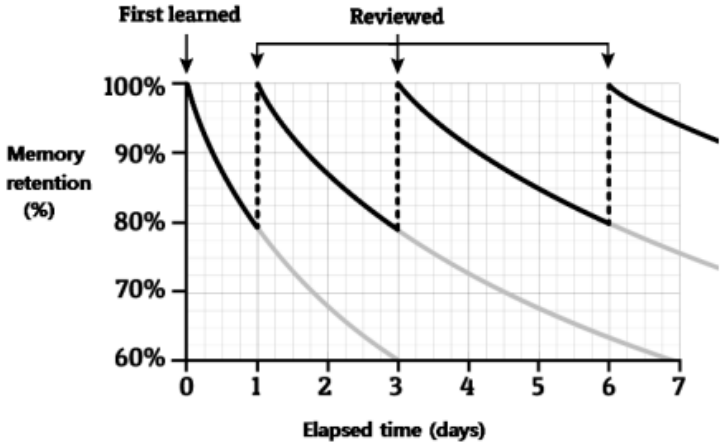
How to revise

Successful Learning Takes Place Over Time

It's rare for anyone to be completely comfortable with something they learn for the first time. This could be a new piece of music, dance move, language or chemistry. We all have to practice. In most instances, the aim is to be at your optimum on the day it matters, e.g. the performance, race or exam. Everything leading up to this point is part of the process of improving. It's about the long-term rather than the short-term, which also means there are no quick fixes. During this period, it's okay to make mistakes; it's okay to feel frustrated. What matters is what you do about it.

Space out your learning on a subject

Spacing out your learning over time is far more effective than last-minute cramming. This is based on research into how we forget and how we remember. The speed at which we forget something will depend on many factors such as the difficulty of the material, how meaningful it was to us, how we learned it and how frequently we relearn or remember it. The last factor tells us that when we learn something for the first time, we need to review it quickly afterwards. The more times we force ourselves to remember something, the longer the gap between reviews, which the diagram below illustrates nicely. The Leitner system and Cornell Notes mentioned earlier provides a wonderful way of achieving this, but the principle applies to all of the learning strategies mentioned in this booklet



Revision strategies

List It

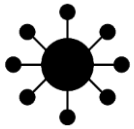
This is a simple free recall task that is very versatile. It can feel challenging, but this is a good thing, and it provides clear feedback on what you do and don't know. Choose a topic, set yourself a time limit and…

- List as many keywords as you can
- List as many facts as you can
- List as many key events/quotes/individuals as you can
- List as many causes of X as you can
- List as many consequences of Y as you can

Flashcards

Flashcards have the potential to be a powerful learning aid. However, how successful this is will depend on the thought you put into making them in the first place and then how they're used. It's very important to remember that they're for testing, not summarising

Mapping



Mapping is a brilliant way of organising and learning information, demonstrated on various pages in this booklet. It helps you break down complex information, memorise it, and see the connections between different ideas.

Self-testing

Research has shown that every time you bring a memory to mind, you strengthen it. And the more challenging you make this retrieval, the greater the benefit. Self-testing improves the recall of information, transfer of knowledge and making inferences between information. Equally, there are many indirect effects, such as a greater appreciation of what you do and don't know, which helps you plan your next steps.

Flashcards

Flashcards are small sheets of paper or card with matching pieces of information on either side. They are a useful tool for learning facts and allow you to quickly check whether you have remembered something correctly.

When making and using flashcards:

Do:

- ✓ …make flashcards quickly.
- ✓ …put a single piece of information of each flashcard.
- ✓ …sort your flashcards according to your confidence with them (see below).
- ✓ …test yourself on the flashcards from memory.

Don't:

- X …spend more time making flashcards than actually using them.
- X …put lots of information onto each flashcard.
- X …revise the flashcards in the same order every time that you use them.
- X …only read through flashcards.

1861	groynes	osmosis	Where is the pharmacy?
Pasteur published his paper about germ theory.	A low wall on the coastline which slows longshore drift	Net movement of water from a high concentration to low concentration across a partially permeable membrane	Où est la pharmacie?

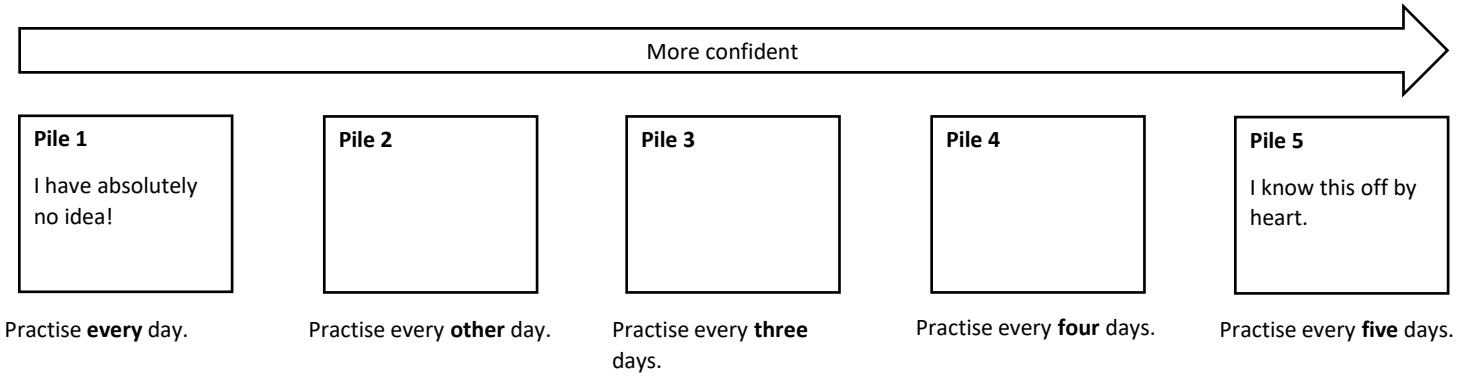
How to make flashcards:

- You can by a set of flashcards or use a free website such as Quizlet.
- Find the information you want to put onto flashcards using your existing revision resources (e.g. a knowledge organiser).
- Fold a piece of A4 paper into 10.
- Write the questions on the top half of the paper.
- Write the answers on the bottom half of the paper.
- Cut the paper along the dotted lines shown here.
- Fold the strips of paper so that the writing is on either side.

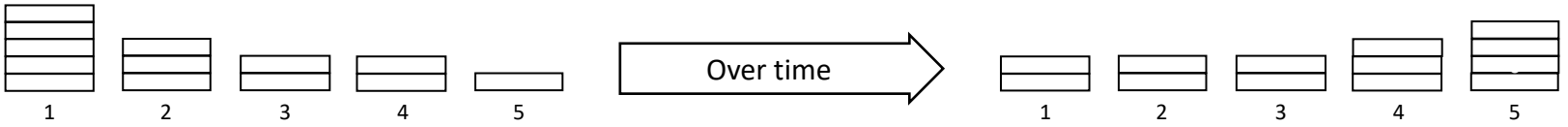
Definition 1	Definition 2	Definition 3	Definition 4	Definition 5
Answer 1	Answer 2	Answer 3	Answer 4	Answer 5

How to use flashcards:

1. Test yourself using the flashcards.
2. As you test yourself, sort the flashcards into up to five piles according to how confident you are with the content.
3. Put the piles into numbered envelopes (1-5).
4. Test yourself on the different piles on different days (see below):



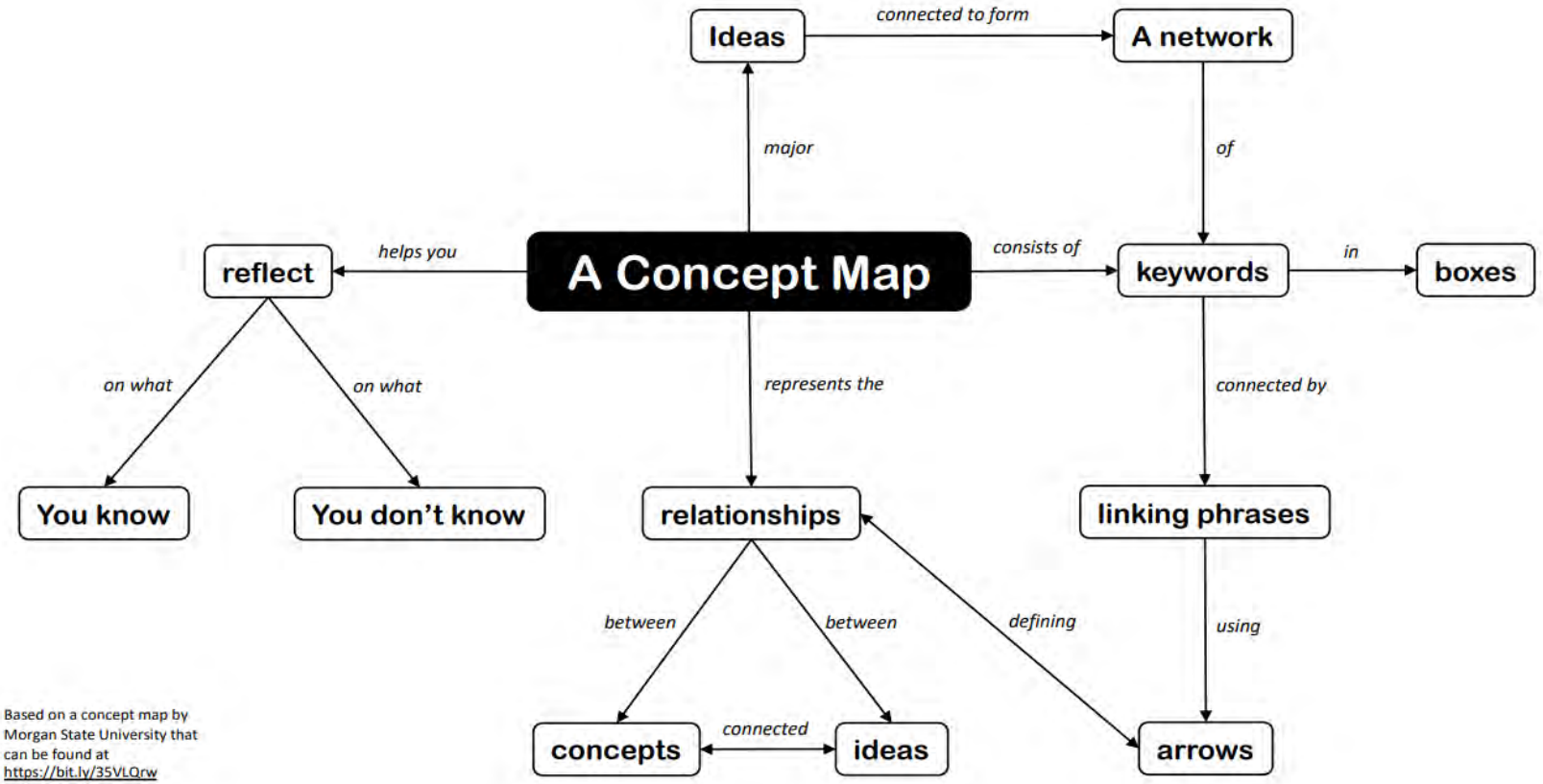
5. As you test yourself on the different piles, move the cards into different piles as you become more confident.



Useful resources:

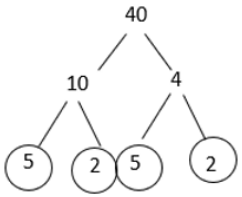
www.quizlet.com – This free website allows you to quickly create flashcards which you can print, use on a computer, or use on your phone.

Mapping

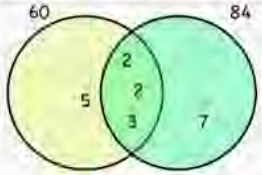

Ideas
connected to form
A network
major
of
reflect
helps you
A Concept Map
consists of
keywords
in
boxes
on what
on what
represents the
connected by
You know
You don't know
relationships
linking phrases
between
between
defining
using
concepts
connected
ideas
arrows
Based on a concept map by Morgan State University that can be found at https://bit.ly/35VLQrw

Maths

Factors, Multiples and Primes

1	Factors of 16 are:	16 1 x 16 2 x 8 ~~3 x~~ 4 x 4 1, 16, 2, 8, 4 (5 factors)
2	Which sentence is correct? 5 is a multiple of 15 15 is a multiple of 5	15 is a multiple of 5 because 15 = 5 x 3
3a	A prime number is…	A whole number with only two factors, one and itself.
3b	List the first 10 prime numbers	2, 3, 5, 7, 11, 13, 17, 19, 23, 29
4b	1 is not a prime because…	It has only one factor: 1. A prime has exactly two factors.
5	15 is not a prime because…	It has four factors: 1, 3, 5, 15. A prime has exactly two factors.
6	Product means…	Multiply
7	If it says "write 40 as a product of its prime factors the method is…	 Answer: 2 x 2 x 5 x 5 Index form: $2^2 \times 5^2$
7	Express 30 as a product of its prime factors	$30 = 2 \times 3 \times 5$
8	Write $2 \times 2 \times 2 \times 3 \times 5 \times 5$ in index form	$2^3 \times 3 \times 5^2$
9	First three multiples of 10:	10, 20, 30
10	Which sentence is correct? 2 is a multiple of 8 8 is a multiple of 2	8 is a multiple of 2 because 8 = 2 x 4
11	How to spot a multiple of 10	It ends in 0
12	How to spot a multiple of 5	It ends in 0 or 5
13	How to spot a multiple of 2	It is even, it ends in 0, 2, 4, 6 or 8

HCF and LCM

1	HCF stands for…	Highest Common Factor
2	LCM stands for …	Lowest Common Multiple
3	Find the LCM of 6 and 10	6 : 6, 12 , 18 , 24 , (30), 36 , … 10 : 10 , 20 , (30) The LCM of 6 and 10 is 30
4	Find the HCF of 12 and 30	Factors of 12 : 1, 2, 3, 4, (6), 12 Factors of 30: 1, 2, 3, 5, (6), 10, 15, 30 The HCF of 12 and 30 is 6
5	Imagine you are finding the HCF and LCM of 60 and 84. You have written them both as a product of primes using factor trees so that $60 = 2 \times 2 \times 3 \times 5$ $84 = 2 \times 2 \times 3 \times 7$ What would this look like in a Venn diagram?	
6	Using the Venn diagram above. How would you find the HCF of 60 and 84?	Multiply the numbers in the intersection 2 x 2 x 3 = 12 (HCF)
7	Using the Venn diagram above. How would you find the LCM of 60 and 84?	Multiply the numbers in the union (all of them) 2 x 2 x 3 x 5 x 7 = 420 (LCM)

Laws of Indices

1	*Simplify* $x^3 \times x^4$	x^7 (add powers)
2	Simplify $3x^2 \times 4x^9$	$4 \times 3 \times x^2 \times x^9 = 12x^{11}$
3	You cannot apply the power rule to $3^4 \times 5^4$ *because …*	The base numbers are not the same
4	*Simplify* $x^{12} \div x^4$	x^8 (subtract powers)
5	Simplify $\frac{12x^8}{4x^4}$	$3x^4$
6	Simplify $(x^5)^2$	x^{10} *(multiply powers)*
7	Simplify $(4x^5)^2$	$(4)^2 \times (x^5)^2 = 16x^{10}$
8	Anything to the power of zero is	1

Maths

GCSE Higher

Negative & Fractional Indices

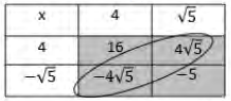
1	Anything to the power of zero is	1
2	$25^{\frac{1}{2}} =$	$\sqrt{25} = \pm 5$
3	$8^{\frac{1}{3}} =$	$\sqrt[3]{8} = 2$
4	$8^{\frac{2}{3}} =$	2 is power (on top and in charge) 3 is root (bottom of tree) $(\sqrt[3]{8})^2 = (2)^2 = 4$
5	5^{-1}	$\frac{1}{5^1} = \frac{1}{5}$
6	5^{-2}	$\frac{1}{5^2} = \frac{1}{25}$
7	$25^{-\frac{1}{2}}$	$\frac{1}{\sqrt{25}} = \frac{1}{5}$
8	$8^{-\frac{1}{3}} =$	$\frac{1}{\sqrt[3]{8}} = \frac{1}{2}$

Surds

1	A surd is	A square root that cannot be simplified
2	Which of these is a surd? $\sqrt{2}$ $\sqrt{4}$ $\sqrt{10}$ $\sqrt{15}$ $\sqrt{16}$	$\sqrt{2}$ $\sqrt{10}$ $\sqrt{15}$ *are surds*
3	$\sqrt{3} + \sqrt{3}$	$2\sqrt{3}$
4	$6\sqrt{3} - 2\sqrt{3}$	$4\sqrt{3}$
5	$4\sqrt{3} + 2\sqrt{5}$ cannot be simplified because…	They are not like terms
6	$\sqrt{5} \times 3 =$	$3\sqrt{5}$ (number first, surd second)
6	$\sqrt{3} \times \sqrt{5}$	$\sqrt{15}$
7	$6\sqrt{3} \times 2\sqrt{5}$	$12\sqrt{15}$
8	$\sqrt{3}^2 = \sqrt{\ } \times \sqrt{\ } = \sqrt{\ } = \_\_\_$	$\sqrt{3}^2 = \sqrt{3} \times \sqrt{3} = \sqrt{9} = 3$
9	$\sqrt{5}^2 =$	5
10	$\sqrt{5} \times -\sqrt{5}$	-5

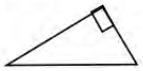
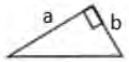
Surds continued

10	$\frac{10\sqrt{5}}{5} =$	$2\sqrt{5}$
11	$\frac{12 - 8\sqrt{6}}{2} =$	$6 - 4\sqrt{6}$
12	$\frac{12\sqrt{5}}{\sqrt{5}}$	12
13	$\frac{12\sqrt{10}}{6\sqrt{2}}$	$2\sqrt{5}$
14	Write $\sqrt{75}$ *in the form* $a\sqrt{3}$	Choose $\sqrt{largest\ square}$ x $\sqrt{3}$ $\sqrt{75} = \sqrt{25} \times \sqrt{3}$ $= 5 \times \sqrt{3} = 5\sqrt{3}$
15	Write $\sqrt{80}$ *in the form* $a\sqrt{b}$	Choose $\sqrt{largest\ square}$ x *surd* Largest square factor of 80 = 16 $\sqrt{48} = \sqrt{16} \times \sqrt{5}$ $= 4 \times \sqrt{5} = 4\sqrt{5}$

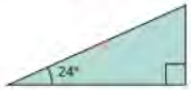
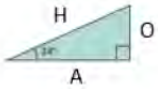
16	What method could you use to expand $(4 + \sqrt{5})(4 - \sqrt{5})$	Draw a grid  $16 + 4\sqrt{5} - 4\sqrt{5} - 5 = 11$
16	Rationalise the denominator means	Ensure there is no surd on the bottom of a fraction
17	What would you do to rationalise $\frac{3}{\sqrt{5}}$	$\frac{3}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{5}}{\sqrt{25}} = \frac{3\sqrt{5}}{5}$
18	What could you multiply by to rationalise the denominator of $\frac{5}{5+\sqrt{2}}$	Change the sign on the denominator to cancel surds $\frac{5}{5+\sqrt{2}} \times \frac{5-\sqrt{2}}{5-\sqrt{2}}$

Maths

Pythagoras

1	Conditions needed to use Pythagoras	Right angled triangle Finding a length 2 other lengths known
2	Hypotenuse means	Longest side (opposite the right angle)
3	Pythagoras' theorem formula is	$a^2 + b^2 = c^2$
4	Label a, b and c where c is the hypotenuse 	
6	Finding the hypotenuse (longest side c) use…	Square Add Square root
5	Finding a shorter side (a or b) use	Square Subtract Square root

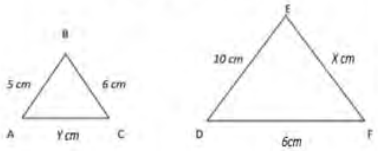
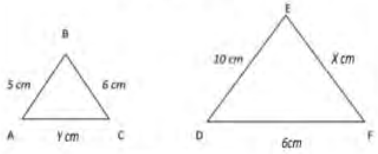
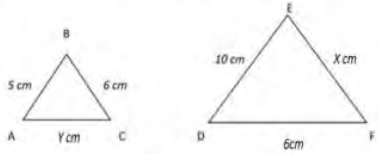
Trigonometry

1	A useful mnemonic for trigonometry is	SOH CAH TOA
2	Conditions for when to use the SOH CAH TOA method are	Right angled triangle Finding a side – angle and one other side given OR Finding an angle – 2 sides given
6	Label this triangle using O,A and H 	
7	Use SOH CAH TOA TO write the three equations for sin, cos and tan	$\sin(\theta) = \frac{O}{H}$ $\cos(\theta) = \frac{A}{H}$ $\tan(\theta) = \frac{O}{A}$
8	What would you type in to find x? $\cos(20) = \frac{x}{12}$	$\cos(20) \times 12$
9	What would you type in to find x? $\cos(20) = \frac{12}{x}$	$\frac{12}{\cos(20)}$
10	When finding the angle θ you need to press	SHIFT $\sin^{-1}(\frac{O}{H})$ $\cos^{-1}(\frac{A}{H})$ $\tan^{-1}(\frac{O}{A})$

Maths

Similar Shapes

GCSE Higher

1	A scale factor is	The number we multiply by to enlarge a shape's lengths
2	If the scale factor is 2…	All the lengths are multiplied by 2
3	If the scale factor is ½	All the lengths are halved (divided by 2)
4	Positive integer scale factors make the shape	Larger
5	Positive scale factors between 0 and 1 make the shape	Smaller
6	Two shapes are similar if they have	Same corresponding angles Lengths enlarged by the same scale factor
7	These two shapes are similar Work out the scale factor 	10 and 5 correspond to each other $10 \div 5 = 2$
8	Work out the length x 	Scale factor = 2 X = 6 x 2 = 12 cm
9	Work out the length Y 	Scale factor = 2 $6 \div 2 = 3\ cm$
10	Which of these angles is the angle ABC equal to in the larger triangle? EDF DEF EFD	DEF
11	The area scale factor of similar shapes is the length scale factor _____	The area scale factor of similar shapes is the length scale factor **squared** $ASF = LSF^2$
12	The volume scale factor of similar shapes is the length scale factor _____	The area scale factor of similar shapes is the length scale factor **cubed** $VSF = LSF^3$

Maths

Non-Calculator Percentages

1	To find 10%	Divide by 10
2	To find 1%	Divide by 100
3	To find 50%	Half it
4	To find 25%	Half it and half it again (divide by 4)
5	To find 75%	Add together 50% and 25% (or divide by 4 x by 3)
6	How can I find 35%?	Find 30% - Calculate 10%, x by 3 Find 5% - Calculate 10% and half it 35% = 30% + 5%
7	How could I find 90%?	Find 10% and x by 9 OR find 10% and subtract it from the original number (100%)
8	What about 160%?	Find 10%, x by 6 then add it on to the original number (100%)
9	Increase by 10%	Find 10% and add it on
10	Decrease by 20%	Find 10%, double it then subtract it
11	Write 35 out of 50 as a percentage	Make the denominator 100 $\frac{35}{50} = \frac{70}{100} = 70\%$
12	What about when the denominator is not a factor of 100?	Simplify it Make the denominator out of 100
13	Write 18 out of 30 as a percentage	Simplify $\frac{18}{30}$ to $\frac{6}{10}$ Make the denominator 100 $\frac{6}{10} = \frac{60}{100} = 60\%$

Calculator Percentages

1	To calculate a percentage of an amount you…	Divide it by 100 and write as a decimal Multiply by it by the number
2	Calculate 23% of 520	0.23 x 520
3	Calculate 6% of 520	0.06 x 520
4	Calculate 6.5% of 520	0.065 x 520
5	Calculate 18.9% of 520	0.189 x 520
6	To **increase** an amount by a percentage, you…	Add the percentage to 100 Divide by 100 and write as a decimal Multiply it by the number
7	Increase 520 by 23%	100% + 23% = 123% 1.23 x 520
8	Increase 520 by 6%	100% + 6% = 106% 1.06 x 520
9	Increase 520 by 6.5%	100% + 6.5% = 106.5% 1.065 x 520
10	Increase 520 by 18.9%	100% + 18.9% = 118.9% 1.189 x 520
11	To **decrease** an amount by a percentage, you…	Subtract the percentage from 100 Divide by 100 and write as a decimal Multiply by the number
12	Decrease 520 by 23%	100% – 23% = 77% 0.77 x 520
13	Decrease 520 by 6%	100% – 6% = 94% 0.94 x 520
14	Decrease 520 by 6.5%	100% – 6.5% = 93.5% 0.935 x 520
15	Decrease 520 by 18.9%	100% – 18.9% = 81.1% 0.811 x 520

Maths

GCSE Higher

Percentages : Profit / Loss

1	Profit means	Money you earn is more than money you spend
2	Loss means	Money you earn is less than the money you spend
3	To calculate percentage change	$\frac{new\ value - original\ value}{original\ value} \times 100$
4	Calculate the percentage profit if I buy a TV for £150 and sell it for £180	$\frac{180-150}{150} \times 100 = 0.2 = 20\%$ profit
5	Calculate the percentage loss if I buy a TV for £150 and sell it for £112.50	$\frac{112.50 - 150}{150} \times 100 = -0.25 = 25\%\ loss$

Reverse Percentages

1	To reverse a percentage change, you…	Find the decimal used to increase/decrease Divide by the decimal
2	A price has increased by 20% to £72. What was the price before the increase?	Decimal used to increase by 20% 1.20 $72 \div 1.20 = £60$
3	In a sale the price has decrease by 20% to £64 (sale price). What was the price before the decrease? (normal price)	Decimal used to decrease by 20% 0.80 $64 \div 0.80 = £80$

Repeated Percentage Change & Interest

1	The compound interest formula can be found…	On my exam aid $p\left(1+\frac{r}{100}\right)^n$
2	If I invest £3000 at 3.9% compound interest for 5 years. Using the formula form my exam aid… what is the value of p, r and n?	p = 3000 r = 3.9 n = 5
3	What would this look like typed in?	$3000\left(1+\frac{3.9}{100}\right)^5$
4	What is the answer when you type this in written as an answer that makes sense for money?	3632.444542 = £3632.44 (rounded to 2 decimal places as money)
5	How can I calculate the amount of interest I have earnt?	Answer – original 3632.44 – 3000 = £632.44 (interest earnt)
6	How can I change the formula if there is a decrease?	Change the plus to a minus $p\left(1-\frac{r}{100}\right)^n$
7	A car is valued at £20 000 and depreciates at a rate of 20% per year. How much will it cost in 4 years? Using the exam aid, what is the value of p, r and n?	p = 20 000 r = 20 n = 4
8	What would this look like typed in?	Change the plus to a minus $20000\left(1-\frac{20}{100}\right)^4$ = £8192.00

Maths

Recurring Decimals

GCSE Higher

1	$0.\dot{3}\dot{6}$ *means*	0.36363636… 36 recurs
2	$0.3\dot{6}$ *means*	0.36666666… 6 recurs
3	$0.5\dot{3}\dot{6}$ *means*	0.536363636… 36 recurs
4	$0.\dot{5}3\dot{6}$ *means*	0.536536536… 536 recurs
5	What should you write if it says convert $0.\dot{3}\dot{6}$ to a fraction	Let x = 0.36363636… 10x = 3.63636363… 100x = 36.36363636… 1000x = 363.63636363…
6	Which two equations should you subtract? $x = 0.45454545$ $10x = 4.54545454$ $100x = 45.45454545$ $1000x = 454.5454545$	$x = 0.\mathbf{45454545}$ $10x = 4.54545454$ $100x = 45.\mathbf{45454545}$ $1000x = 454.5454545$ 100x and x match up after the decimal point So 100x - x
7	Which two equations should you subtract? x = 0.306306306… 10x = 3.06306306 100x = 30.6306306 1000x = 306.306306	x = 0.**306306** 10x = 3.063063 100x = 30.630630 1000x = 306.**306306** 1000x and x match up after decimal point So 1000x - x
8	Which two equations should you subtract? x = 0.054545454 10x = 0.545454545 100x = 5.454545454 1000x = 54.545454545	x = 0.054545454 10x = 0.**545454545** 100x = 5.454545454 1000x = 54.**545454545** 1000x and 10x match up after the decimal point So 1000x – 10x
9	Ben has subtracted two equations and got 990x = 450 What is the fraction you write in its simplest form	$\frac{450}{990} = \frac{5}{11}$

English

Unit 1 Poetry

Checkin' Out Me History by Jon Agard

John Agard

John Agard (born 1949) is an Afro-Guyanese poet and playwright who now lives in the UK.

When he moved to the UK in the 1970s, he began teaching people about Caribbean culture and worked in a library.

He often conveys his Caribbean voice in his poems, using nonstandard spelling to represent his accent.

His poems are often rebellious in nature, challenging common ways of thinking.

Guyana

Guyana is a country on the northern mainland of South America. However, it is often considered as a Caribbean region because of its strong cultural and historical links to Anglo Caribbean nations.

It was governed by Britain from the late 18th Century and known as British Guiana until the 1950s.

The Battle of Hastings and Dick Whittington

The event that the speaker mentions as taking place in 1066 (line 6) is the Battle of Hastings.

It is the event in which William of Normandy defeated King Harold.

It is a staple topic of history lessons in the UK. Dick Whittington is another commonly-taught history folklore – concerning the rise from poverty of a man who sold his cat to a rat-infested country

Toussant L'Ouverture and Nanny de Maroon

Toussant L'Ouverture was a leader in the Haitian Revolution.

He showed strong political and military skill, which resulted in the first free colonial society – race was not considered the basis of social standing.

Nanny of the Maroons was an outstanding Jamaican leader, who became known as a figure of strength in fights against the British. Neither of these figures are commonly discussed in the British education system.

Colloquialism

Agard uses colloquial language throughout the poem, creating a number of effects. Primarily, it is used to reflect his lack of conformity to 'standard' ideas (e.g. speaking Standard English)

Non-Standard Spelling

Agard deliberately uses nonstandard spellings throughout the poem in order to reflect the Caribbean accent of the speaker. For example, Agard uses 'dem' in a number of lines across the poem, rather than 'them.'

Storm on the Island by Seamus Heany

Seamus Heaney

Seamus Heaney (1939-2013) was a Northern Irish poet and playwright, who received the 1995 Nobel Prize in Literature.

His poems were usually written in a traditional style about passing ways of life.

Heaney often used his poetry to reflect upon 'The Troubles', which plagued the country throughout his early adulthood.

The Troubles

The Troubles is the name given to the conflict in Northern Ireland during the late 20th Century.

It was settled in the Good Friday agreement of 1998.

Extended Metaphor

Storm on the Island, on a literal level, details an event perfectly summarised by the title.

However, on a deeper, more figurative level, the storm is representative of the political storm that raged across Northern Ireland at the time.

The storm pummeling the island is a metaphor for the violence that was taking place in Northern Ireland.

This is evident even in the title (island is a homophone of Ireland).

The first 8 letters of the poem's title spell out the word 'Stormont.'

Stormont is the name given to the government buildings in Northern Ireland in Belfast.

Personification/Similes

In order to demonstrate the sheer power of nature throughout the poem, Heaney chooses to personify several aspects of storm.

For example, the speaker shares that the storm 'pummels' the houses – presenting the storm as some kind of fighter or bully.

The sea is personified as it is presented that it 'spits like a tame cat turned savage' – also using a simile to demonstrate that all of nature appears to be against them.

English

Unit 1 Poetry

Kamikaze by Beatrice Garland

Beatrice Garland

Beatrice Garland is an English poet that won the 2001 National Poetry Prize for her poem 'Undressing.'

She wrote no poetry for some time after, instead focusing her attention on her other work, as a physician for the National Health Service and a teacher.

Kamikaze Pilots D

During the Second World War, the term 'kamikaze' was used to describe pilots who were sent on suicide missions.

They were expected to crash their planes into enemy targets, e.g. ships, forcing heavy damage and casualties to the enemy, but also killing themselves.

The word 'kamikaze' translates as 'divine wind.' The tradition of facing death rather than capture and defeat was deeply engrained in Japanese culture, meaning pilots would face this with loyalty.

Imagery

Garland creates imagery through a range of techniques: the 'huge' flag, 'little' board and 'translucent' sea being prime examples.

Garland also utilises powerful colour imagery, noting the 'green-blue' of the ocean, the flashing 'silver', and the 'dark shoals.'

Form/Structure

The poem has a consistent, regular form throughout.

There are 7 stanzas, each containing 6 lines. This regular structure could be seen to represent the regimented order of Empirical Japan.

However, there is no apparent consistent rhyme scheme, meaning a lack of flow. This could represent the confusing influences in the pilot's mind.

Personal Consequences of War

Rather than focusing upon bloody details or evoking violent imagery, this poem deals with the lasting effects that war can inflict on people, families, and communities. This poem not only deals with the kamikaze pilot's own story, but the implications for those around him.

Courage/ Honour

In the Empirical Japanese context, demonstrating courage and honour for one's country are deemed as a compulsory commitment.

By seemingly neglecting this, and opting to live, the kamikaze pilot is described as being 'dead' to those around him anyway. The reader is encouraged to consider: Is this what honour/ courage

The Prelude by William Wordsworth

William Worsdsworth

William Wordsworth (1812-1889) is one of the most famous poets in English Literature.

He was born and raised in the Lake District, a beautiful natural area of the UK which clearly influenced the subject matter and themes in his writing.

Romanticism

Romanticism was an artistic, literary, musical, cultural and intellectual movement that originated in Europe in the latter half of the 18th Century.

Romanticism is characterised by its emphasis on emotions, as well as glorifying nature and past events

Imagery

Wordsworth uses vivid imagery to create the night-time atmosphere throughout the opening of the extract, using vocabulary associated with peace to describe the tranquil natural phenomena. For example, words such as 'stealth', 'idly', and 'glistening' paint a quiet, peaceful scene in the mind of the reader.

Personification

Wordsworth chooses to personify several aspects of nature at different points in the extract.

For example, nature itself (she) guided him to take the boat that evening.

Later on, the mountain peak that so terrifies the speaker is heavily personified, for e.g. through the terms 'voluntary power instinct' and 'upreared its head' – giving it purpose

Nature

Humanity is only one part of nature. The natural world can make man feel extremely small and insignificant.

Loneliness

Wordsworth is often on his own, and this is important to him. He thinks more clearly when he is alone, and is more affected by experiences and places.

English

Unit 1 Poetry

London by William Blake

William Blake

William Blake (1757-1827) was an English poet and painter. He is known as being one of the leading figures of the Romantic Movement, as well as for his personal eccentricities.

Blake rejected established religious and political orders for their failures, particularly in how children were made to work – this was one of many things that he viewed as being a part of the 'fallen human nature.'

He lived in London for his whole life, barring three years in which he resided in Felpham.

London in 1792

London was already a large city with nearly a million people.

The Industrial Revolution had brought new machinery that saved time, making some very rich, however it put many out of jobs. Machinery was often hazardous to operate, and those working with it were paid poorly. There was no government support for these people, so many lived in total poverty. For every 1,000 children born, almost 500 died before they were 2.

Most children couldn't go to school, and had to work.

Repetition/ Anaphora

Blake repeats words and phrases to emphasise their importance.

For example, the word 'charter'd' is repeated throughout the opening stanza to show how rigid and unchanging London is.

The anaphora used in stanza 2 of 'In every' emphasises the frequency and consistency of the pain and suffering – it is happening all over and is clear to see and hear.

Sound Imagery

The pained and anguished sounds of London also accompany the reader as they are guided through the city by the speaker. Particularly from stanza 2 onwards, the reader is shown how helpless and destitute the citizens feel through the sounds that they make, from the 'cry' of men and infants, to the 'sigh' of the soldiers, and the 'curse' and 'blast' of the harlots at night

Form/Structure

The poem is written in four equal stanzas of four lines, each in iambic tetrameter.

Alternating rhyme is used throughout in the scheme of ABAB.

The rhyme creates deliberate emphasis on words that underline the tone of the poem, e.g. 'cry' and 'sigh.' The poem is told from the viewpoint of a first person narrator who is walking the streets

Metaphors

Figurative language is highly prevalent throughout the poem, particularly in lines 3 and 4 of each stanza.

For example, the soldiers' blood does not literally run down the walls of the palace; this is a means of showing that those in power have caused the soldiers to experience pain and suffering. In the same way, the 'manacles' that the citizens wear are in fact shackles of the mind

Poetry Key Words

Enjambment	The running over of a sentence from one line to the next without a piece of punctuation at the end of the line.	**Form**	The physical structure of a poem e.g. it's shape or systems used
Rhythm	The beat or pace of a poem	**Imagery**	The words used to convey images to the reader, could be sound images, not just visual
Anaphora	A repetition of words, phrases or clauses to have an emotional impact on the reader	**Structure**	The organisation of a poem including stanzas, rhyme scheme or meter
Theme	An idea explored within a text	**Plosive**	"b," "p," "t" and "d" sounds – which can be harsh, aggressive or shocking
Oxymoron	A figure of speech in which two contradictory things are placed together in a way which makes peculiar sense. For example, "friendly fire."	**Onomatopoeia**	Words which attempt to imitate sounds.

English

Unit 1 A Christmas Carol

Context

Charles Dickens

Charles Dickens was born in 1812 and spent the first years of his life in Kent, England.
At 9, he moved to London.
At 12, his father was sent to debtors' prison for racking up huge debts, and Charles was given a painful job labelling bottles near the prison.
He found this period in his life hellish, and it doubtlessly led him to draw readers' attention to the plight of the poor when he later found success as an author. Many of his works are about social hardships and inequalities.

The Victorian Era

The Victorian era describes the period in which Queen Victoria sat on the English throne – between 1837 and 1901 (most of Dickens' life).
Whilst this was a time of industrial revolution, it was also an extremely harsh time to live, and the differences between the lives of the richest and the poorest were exacerbated.
The Victorian era was a period of great change. In this time, the population of England doubled – from 16.8 million 1851 to over 30 million in 1901.

Christmas

We now associate Christmas as being a time of seasonal goodwill, love and friendship. However, before the Victorian era, when writers such as Dickens spread these messages through their novels, there was no Santa Claus, Christmas cards, and no holidays from work! Christmas Day was a far more low-key affair.

Class Divides

Despite industrial changes altering the social landscape, there were still relatively distinct social classes in operation: the nobility upper class, the middle class, and the working class. Life was terrible for the poorest

Workhouses

A workhouse was a place where a person went if they could not afford to financially support themselves and their families.
Men, women and children (mostly orphans) lived and worked in the workhouses, which were very crowded – making living conditions unhealthy and unpleasant.

Health and Medicine

Healthcare was more of a luxury at the time, and medicine was nowhere near as advanced today.
Many diseases were rife, and childbirth and poverty were very real dangers to people living in the era.
As a result, a middle class person may expect to live to 45 at the time, whereas a working class person would have been lucky to have lived half that time.

Characters

Ebenezer Scrooge – Scrooge is the lead protagonist of the novella. He is a miserly owner of a counting house (what would now be called an accountant's office). Initially greedy, selfish and cold, Scrooge hates Christmas and lacks any form of Christmas spirit. He experiences a moral and psychological transformation through his visits from the Ghosts of Christmases Past, Present and Yet to Come

Jacob Marley – Joseph Marley is Scrooge's late business partner, and Joseph Marley symbolises the limitations of a life-lived focused on greed and selfishness. After his death, Joseph Marley has been condemned to wander the world as a miserable ghost.

The Cratchits– Bob Cratchit is Scrooge's kind, mild-mannered clerk, who is treated terribly by his employer. He is a very poor man, with a large family, including Tiny Tim. Tiny Tim is a young boy who has been born with physical disabilities that his family are too poor to have treated. Despite these hardships, the family are cheery and determined to enjoy the few positives that they can get from life.

Fred- Fred is Scrooge's nephew. Fred's life appears fulfilled through his perpetual joy, kindness and interactions with others.

English

Unit 1 A Christmas Carol

Characters- The Ghosts

The Ghost of Christmas Past – This is the first spirit to visit Scrooge. He is a curious child-like figure that has an illuminated head, symbolising how shining a light on memories from the past can be used to illuminate one's thoughts and behaviours in the future. The Ghost of Christmas Past takes Scrooge to a number of places from his childhood and early adulthood, including his old school, hometown, and the scene of his engagement being broken off

The Ghost of Christmas Present – The Ghost of Christmas Present is the second of the three ghosts to visit Scrooge. He is a majestic jolly giant, who is dressed in a green robe. His lifespan is restricted to Christmas Day, and he has 'over 1800 brothers', representative of the other Christmas Days that were once in the present. He escorts Scrooge on a tour of how his contemporaries spend Christmas day, to force him to contemplate his own solitary existence. He also shows him the need to consider 'Want' and 'Ignorance.'

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Plot Summary

English

Unit 1 A Christmas Carol

Plot Summary		
Stave 1	It is a foggy Christmas Eve, and Scrooge is working in his counting house. He refuses to buy another lump of coal to heat Bob Cratchit's (his clerk's) office. Scrooge's cheerful nephew, Fred, enters, inviting Scrooge to Christmas party, but he declines. After he leaves, two gentlemen enter, asking if Scrooge is willing to make a charitable donation to the poor. Scrooge again declines. He begrudgingly gives Bob Cratchit the day off. Scrooge follows his usual routine on the way home. At home, he sees the ghost of his old business partner (Jacob Marley) in the knocker. Marley is in chains as punishment for his selfishness and greed when living. He says that he seeks to save Scrooge from the same fate, and hence Scrooge will be visited by 3 ghosts over the next 3 nights.	"Marley was dead: to begin with. There is no doubt whatever about that. The register of his burial was signed by the clergyman, the clerk, the undertaker, and the chief mourner. Scrooge signed it."
Stave 2	Scrooge is confused to wake at midnight, as it was after 2am when he went to sleep. At one o clock, Scrooge is visited by a strange child-like figure that emanates wisdom – The Ghost of Christmas Past. The spirit touches Scrooges heart, granting the power to fly. The ghost takes Scrooge back to where he was raised – Scrooge is touched by memories of his childhood. He sees himself as a schoolboy spending Christmas alone, being visited by his sister, being at a party held by Scrooge's old boss Fezziwig, and with his old partner Belle, who is breaking off their engagement on account of his greed. He sees Belle in a more modern time, with her husband, discussing how Scrooge is now 'quite alone in the world.' Scrooge is upset by the visions, and begs with the ghost to take him back home. Scrooge finds himself back in his bedroom, where he once again falls asleep almost instantly	"But the strangest thing about it was, that from the crown of its head there sprung a bright clear jet of light, by which all this was visible; and which was doubtless the occasion of its using, in its duller moments, a great extinguisher for a cap, which it now held und
Stave 3	The bell strikes one, and Scrooge is awake once more. At fifteen minutes past one, he wanders into the next room, where he finds the Ghost of Christmas Present waiting for him. He is a majestic jolly giant, and sits atop of a mountain of food. The spirit takes Scrooge to the bustling streets on Christmas morning, where passers-by joyfully greet each other. The spirit then takes Scrooge to the home of Bob Cratchit, where the family savour the Christmas that they can afford. Their visibly-ill son, Tiny Tim, is cheering despite his ailments. Scrooge begs to know whether he will survive. They also visit Fred's Christmas party, which Scrooge enjoys (though no one can see him). Eventually, Scrooge is brought to a vast expanse, where two sickly children, 'Want' and 'Ignorance' emerge. When Scrooge asks if there is anything that can be done, the spirit mocks his prior selfishness.	"Its dark brown curls were long and free; free as its genial face, its sparkling eye, its open hand, its cheery voice, its unconstrained demeanour, and its joyful air."
Stave 4	Scrooge is approached by a hooded phantom. The spirit is silent, and Scrooge is terrified by him. Scrooge pleads with him to provide his next lesson. The ghost takes him to the stock exchange, where men discuss the accounts of a rich man, a dingy pawn shop, where the rich man's stolen goods are being sold, and the Cratchit household, where the family struggles with the death of Tiny Tim. Scrooge is then taken to a freshly dug grave in a graveyard. The gravestone reveals that it is his own grave. Appalled, Scrooge begs with the spirit to give him another chance to show that he has learnt his lesson. The phantom begins to tremble and disappears, and once again Scrooge finds himself in the relative safety of his own bed.	I fear you more than any spectre I have seen. But as I know your purpose is to do me good, and as I hope to live to be another man from what I was, I am prepared to bear you company, and do it with a thankful heart"
Stave 5	Scrooge realises that he has been returned to Christmas morning, and is utterly overjoyed. He pays the first boy that he meets a huge sum to deliver a great big turkey to Bob Cratchit's household. He bumps into the gentlemen collecting for charity, apologises for his prior behaviour, and promises to donate lots of money to the poor. He attends Fred's party and is so happy and kind that the other guests can barely believe his behaviour. The next morning, he pretends to scold Bob Cratchit for arriving late, before promising to give him a large raise and to care for his family. As time passes by, he stays true to his word – he helps the Cratchits and becomes like a second father to Tiny Tim, who does not die. Scrooge brings Christmas cheer to every day, and shrugs off the doubts that others have about his changed behaviour. The narrator concludes by suggesting that Scrooge's changed attitude and behaviour should be shared by everyone.	"He had no further intercourse with Spirits, but lived upon the Total Abstinence Principle, ever afterwards; and it was always said of him, that he knew how to keep Christmas well, if any man alive possessed the knowledge….God bless us all, every one!"

English

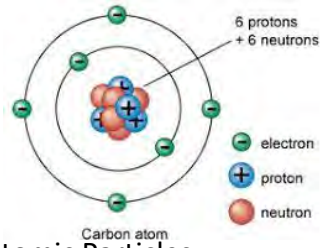
Unit 1 A Christmas Carol

Key Words 	
Novella	A short story- A Christmas Carol only has five chapters (staves)
Apparition	A ghost or ghost-like person.
Omniscient narrator	A storyteller that knows everything – the all-knowing voice
Symbolism	The use of a symbol (image) to represent an idea
Redemption	The action of being saved from sin,error or evil
Allegory	A story or poem that can have a hidden meaning, usually a moral or political one
Social responsibility	A way of acting and thinking for the benefit of all in society not just oneself
Justice	Just behaviour or treatment
Ignorance	Lack of knowledge of information
Want	Being without something that you need
Protagonist	Main character

Themes	
Greed and Selfishness – Characters such as Scrooge represent the selfish middle classes, who sought to amass, rather than share their wealth. Jacob Marley demonstrates the burden that such a selfish life will inevitably bring. Through these characters and the events of the novel, Dickens criticises how wealth had become associated with the root of happiness, at the expense of close relationships and goodwill.	**Time** – Time is stretched by the ghosts – the events that Scrooge experiences appear to have taken days, and yet all takes place in the space of one night. A race against time is also taking place, as the spirits work to prevent Scrooge (and in turn, Tiny Tim) from experiencing their fateful demise. The reader is taught to value the time that we have, and use it to spread happiness to others.
Divisions– Divisions are evident throughout the novel, as those with power and money seek simply to exert and recycle their advantages over those without (rather than aiding them). The book shines a light on the plight faced by poor families such as the Cratchits, which demonises the negative attitudes towards the poor held by the rich.	**Transformation** – Physical transformations are evident throughout A Christmas Carol, as objects, settings, and characters appear and vanish under the manipulation of the ghosts. Spiritual transformations take place too, as the reader witnesses a lonely boy's transformation into an embittered old man, and the efforts made to transform his character to reconnect with those around him.

Atom Structure

Diagram

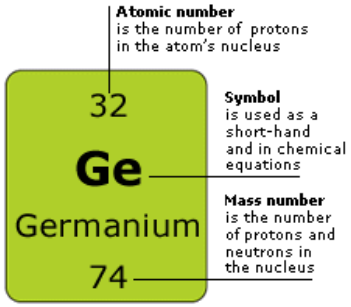


Subatomic Particles

Subatomic particle	Location	Mass	Charge
Proton	Nucleus	1	+1
Neutron	Nucleus	1	No charge
Electron	Shells	0 (negligible)	-1

Atom Symbols

Bigger number is the mass number.
To find neutrons subtract the smaller number



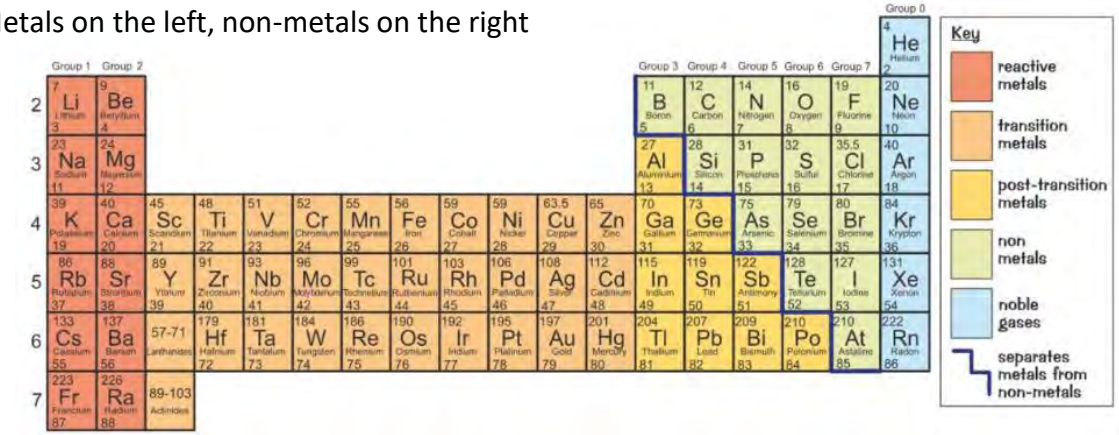
History of Atom

<u>Dalton</u>
Solid sphere
<u>Thompson</u>
Protons/ electrons randomly arranged

<u>Rutherford/Bohr</u>
Positive nucleus with electrons around

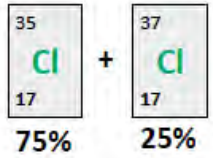
Modern Periodic Table

- Arranged by increasing atomic mass (proton number) in rows called periods
- Metals on the left, non-metals on the right

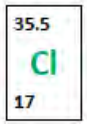


Isotopes

- Elements with the same number of protons but different numbers of neutrons
- This explains why relative atomic mass (Mr) isn't always a whole number



H - e.g. M_r of Cl is calculated using
The abundance of each of the
Atomic masses of the isotope
(35 x 75/100) + (37 x 25/100) = 35.5

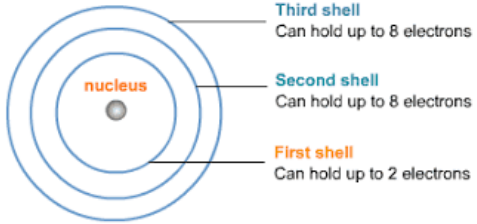


History of Periodic table

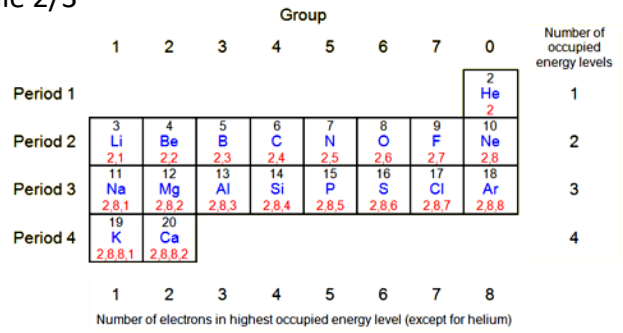
- Dimitri Mendeleev was the first to publish an organised table of elements
- He arranged by relative atomic mass
- But he also left gaps so that elements with similar properties were in the same group
- Using the gaps he was able to predict elements that had not been discovered yet

Electronic Configuration

- Using the rules to draw the first 20 elements
- Rule 1



- Rule 2/3



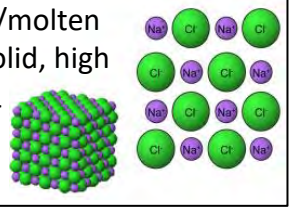
EDEXCEL 9-1 Chemistry | **Topic 1 – Key Concepts in Chemistry** |

Ions

- Atoms are more stable with full outer electron shells
- Metals lose electrons resulting in a positive ion. E.g. sodium in group 1 → Na^+ ion and calcium in group 2 → Ca^{2+} ion
- Non-metals gain electrons resulting in a negative ion, e.g. oxygen in group 6 → O^{2-} ion and chlorine in group 7 → Cl^- ion

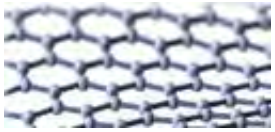
Ionic Compounds

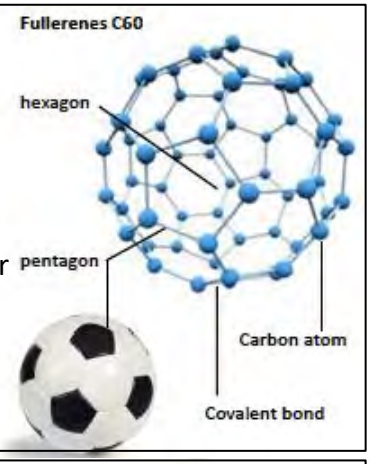
- Positive and negative ions arrange in a regular lattice
- This explains properties including ability to dissolve, conduct electricity when dissolved/molten but not solid, high melting & boiling points



Fullerenes, Allotropes

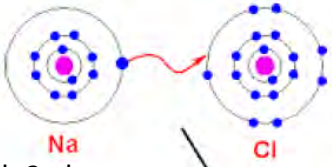
<u>C60</u>
Strong, weak intermolecular forces (like graphite)
Can be used as lubricants
<u>Graphene</u>
Strong, light, good electrical conductor
Can be rolled into tubes

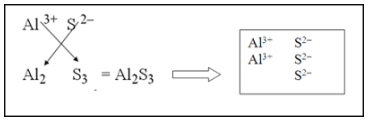


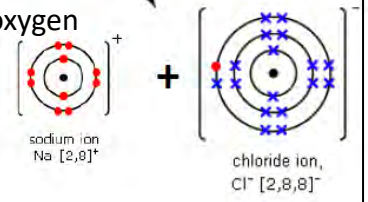


Ionic Bonding

- Positive and negative ions are attracted and form a compound
- Compound name –ide with 2 elements, -ate with 3 elements including oxygen
- Use the crossover method to determine the formula

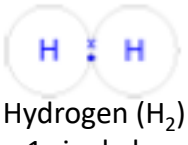




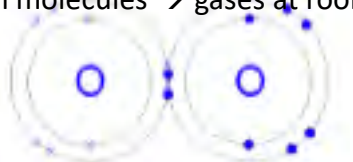


Covalent Bonding

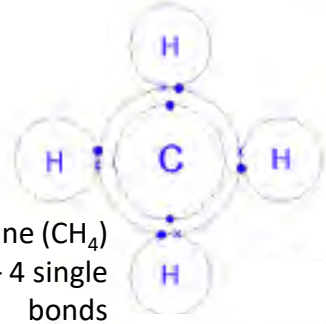
- Electrons are shared to complete the outer shell
- Simple molecular, strong bonds between atoms
- Weak between molecules → gases at room temp



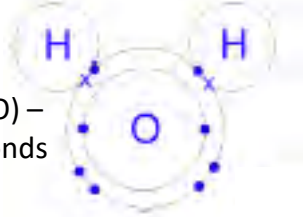
Hydrogen (H_2) – 1 single bond



Oxygen (O_2) – 1 double bond



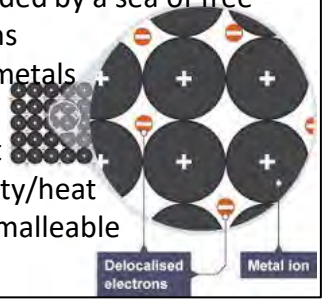
Methane (CH_4) – 4 single bonds



Water (H_2O) – 2 single bonds

Metallic Bonding

- Metal atoms lose electrons to become positive ions surrounded by a sea of free electrons
- Allows metals to conduct electricity/heat and be malleable

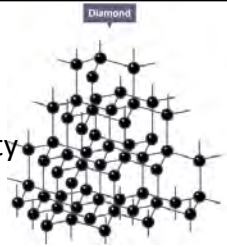


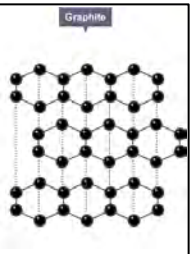
Bonding Models

Ball and stick models are limited: they don't show electrons and appear to have large gaps between atoms. Dot and cross diagrams are limited: they are 2D and don't show bond angles.

Giant Covalent Structures, Allotropes

- Bonding between many non-metal atoms
- <u>Diamond</u>, each C atom forms 4 bonds
- Rigid, strong and doesn't conduct electricity
- Used for cutting tools
- <u>Graphite</u>, each C forms 3 bonds leaving a free electron and weak bonds between layers
- Soft, good electrical conductor
- Used as a lubricant





WHA Science EDEXCEL 9-1 Chemistry | **CC6 Calculations with masses** | Required Knowledge

Empirical formulae	The smallest ratio of atoms in a compound

Experiment to determine empirical formulae

A. We heat some magnesium to produce magnesium oxide.
B. We work out the mass of oxygen that reacted
C. We use the masses of magnesium and oxygen to work out the empirical formula of magnesium oxide

To find the **empirical formula from the molecular formula**, we divide by the highest common factor.

E.g. 1

Ethane $C_2H_6 \rightarrow CH_3$

E.g. 2:Hydrogen Peroxide

$H_2O_2 \rightarrow HO$

Relative Masses (M_r)

- To find M_r add the relative atomic mass (A_r) of the elements making up a compound
- E.g.

H_2O

H=1 O=16

(1x2)+16=18

A substance has empirical formula of CH_2 and a relative formula mass (M_r) of 42. What is the **molecular formula?**

Work out the empirical mass	C H_2 12+(1 x 2)= 14
Divide the M_r by the empirical mass	$\frac{42}{14} = 3$
Multiply each atom in the empirical formula by this number	CH_2 X 3 = $C_{(1x3)}H_{(2x3)}$
Write the molecular formula	C_3H_6

Reacting masses calculation

Calculate the mass of magnesium oxide that can be made by completely burning 6.0 g of magnesium in oxygen.

Step 1: Write the balanced equation and add a ✓ and a ?	2 Mg	+ O_2 →	2 MgO ✓ ?
Step 2: Write the M_r and units	24 g		40 g
Step 3: Multiply by coefficients to get mass ratio	2 x 24 = 48 g		2 x 40 = 80g
Step 4: Find the mass of ? for 1 g of ✓	48 ÷ 48 = 1g		80 ÷ 48 = 1.66 g
Step 5: Scale up for the mass given in the question	6g		6 x 1.66 = 10 g

Calculate the **percentage by mass** of every element in H_2SO_4.

Step 1: calculate total Mr	H_2SO_4 H H S O O O O (1 x 2) + 32 + (16 x 4) = 98
Step 2: calculate Mr of one of the elements	Hydrogen: there are two hydrogens, each with a mass of 1 so total of 1 + 1 = 2.
Step 3: divide M_r of the elements by total M_r and multiply by 100	$\frac{2}{98} \times 100 = 2\%$
Step 4: Repeat for other elements if required	Sulfur: $\frac{32}{98} \times 100 = 33\%$ Oxygen: $\frac{4 \times 16}{98} \times 100 = 65\%$

Suppose a compound contains 10 g of hydrogen and 80 g of oxygen. **What is its empirical formula?**

	H	O
Write out the masses or percentages for each element	$\frac{10}{1}$	$\frac{80}{16}$
Divide by atomic mass	$= 10$	$= 5$
Divide each number by the smallest number	$\frac{10}{5}$ $= 2$	$\frac{5}{5}$ $= 1$
Write the empirical formula	H_2O	

WHA Science EDEXCEL 9-1 Chemistry | **CC6 Calculations with masses** | Required Knowledge

43g of sodium chloride is dissolved in 500cm^3 of water. **What is the concentration?**	
Convert volume to dm^3	$500\ ^{cm^3} \div 1000 = 0.5\ dm^3$
Substitute into concentration equation	$concentration = \frac{mass}{volume} = \frac{43\ g}{0.5} = 86\ g/dm^3$

$$Concentration = \frac{mass}{volume}$$

1 dm^3 = 1 litre = 1000 cm^3

$$moles = \frac{mass}{Mr}$$

How many moles are in 30 g of CO_2 ?		
Work out the M_r	Moles = ? Mass = 30 g M_r= 44	Calculate M_r C O O 12 + (2 x 16) = 44
Substitute into mole equation	$moles = \frac{mass}{Mr} = \frac{30}{44} = 1.65$	

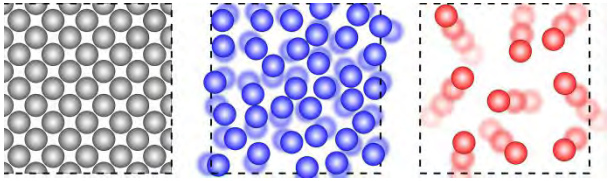
Using masses to balance an equation				
Sodium nitrate, $NaNO_3$, decomposes to give sodium nitrite, $NaNO_2$, and oxygen gas. When 8.5g of sodium nitrate is used, 6.9g of sodium nitrite and 1.6g of oxygen is produced. **Construct and balance an equation for this reaction.**				
Step 1: write the equation	$NaNO_3$	→	$NaNO_2$	+ O_2
Step 2: work out the Mr	85		69	32
Step 3: work out the moles	8.5/85 = 0.1		6.9/69 = 0.1	32/1.6 = 0.05
Step 4: divide by smallest number and turn to whole number ratio	0.1/0.05 = 2		0.1/0.05 = 2	0.05/0.05 = 1
Step 5: balance	$2NaNO_3$	→	$2NaNO_2$	+ O_2
Step 6: check	Correctly balanced			

A_r	Relative atomic mass	Sum of the number of protons and neutrons in an atom
M_r	Relative molecular mass	Sum of the relative atomic masses of atoms in a molecule
Relative formula mass		Sum of the relative atomic masses of atoms in a formula
Empirical mass		Sum of the relative atomic masses of atoms in an empirical formula
Limiting reagent		The reactant that is used up first in a reaction
Excess reagent		The reactant that is not completely used up in a reaction
Conservation of mass		In a closed system, the total mass of the substances doesn't change in a chemical reaction
Why might mass decrease?		A gas is released into the atmosphere during a reaction
Why might mass increase?		A gas is taken in from the atmosphere during the reaction

Moles	
A mole	A number of particles. = 6.02 x10^{23} particles
Mass of one mole	= the A_r or M_r of that substance in grams
Avogadro's number	= 6.02 x10^{23}
number of particles = moles × Avogadro's number	

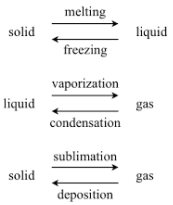
States of Matter (Pg 97)

- Arrangement of particles in the three GCSE states of matter

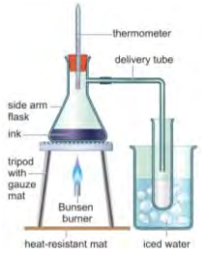


State	Arrangement of particles	Movement of particles	Attractive forces (None/Few/Many)
Gas	Random Far apart	Fast in all directions	None
Liquid	Random Close together	Move around each other	Few
Solid	Regular Close together	Vibrate around fixed positions	Many

Changes of state (Pg 98)



Distillation (Pg 100) (Core Prac)



Predicting states (Pg 98)

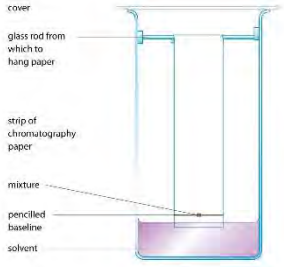
- When given data regarding the melting and boiling point of a substances, you need to be able to predict which state these substances are in given a temperature.
- What state is substance D in at 1000^{O}C?

Substance	Melting point / °C	Boiling point / °C
A	−218.4	−183.0
B	1535	2750
C	1410	2355
D	801	1413

- D is a solid below its' melting point of 801^{O}C and a gas above its' boiling point of 1413^{O}C.
- Therefore, at 1000^{O}C, substance D is a liquid.

Chromatography (Pg 102) (Core Prac)

Uses the different **solubilities** of **solutes** in the same **solvent** to separate them

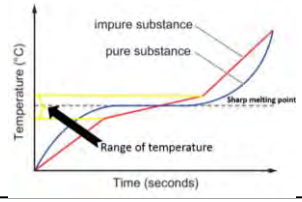


Rf measured from baseline

$$Rf = \frac{\text{distance moved by chemical}}{\text{distance moved by solvent}}$$

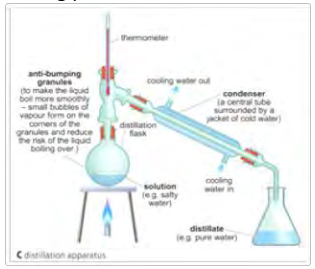
Purity (Pg 99)

- **Purity** is the word used to describe a substance where its composition…
  - Cannot be changed
  - Is the same in all parts of the substance.
  - Has a sharp melting point.
- **Mixtures** contain elements and/or compounds that are NOT chemically bonded together.
  - Use a physical process to separate mixtures
  - Mixtures do not have a fixed composition.
  - Melts over aa range of temperatures.

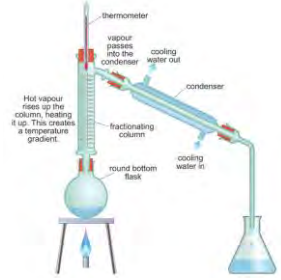


Distillation (Pg 100)

To separate two liquids with different boiling points



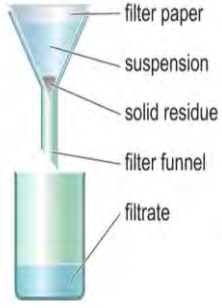
Fractional Distillation (Pg 100)



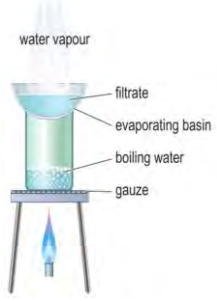
Filtration & crystallisation (Pg 101) (Core Prac)

To separate a solid and a liquid

Filtration to separate an **insoluble** solid from a liquid

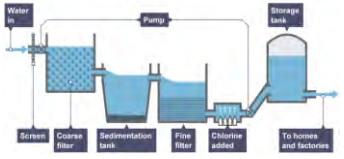


Crystallisation to separate a solid **dissolved** in a liquid.



Water purification (Pg 104)

Ground water, waste water and surface water all need **purification**.
Filtration to remove solid matter
Sedimentation to remove finer particles
Chlorination to kill bacteria



Sea water is purified by distillation.
Water for chemical tests must be purified or dissolved ions etc. will interfere with the tests.

WHA Science — EDEXCEL 9-1 Combined Science | **Chemistry Topic 3 – Chemical Changes** | Required Knowledge

Acids :

Source of hydrogen ions (H^+) when in solution.

pH 1 – pH 6 (neutral = pH 7)

Strong acids are corrosive and can be harmful to humans.

Examples: Vinegar; citrus fruits; bee stings.

Alkalis & bases : pH 8 – pH 14.

Alkalis are sources of hydroxide ions (OH^-) when in solution.

Bases are any substances that react with acids to form salt and water only.

All alkalis are soluble bases.

Examples: Wasp stings; bleach; indigestion tablets; toothpaste.

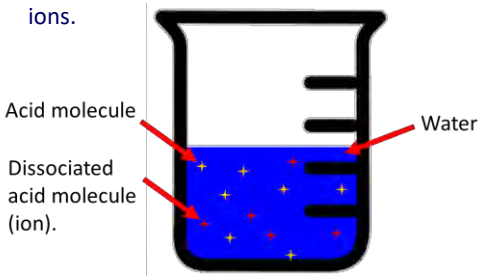
Acid strength :

The pH scale shows the strength of an acid (or alkali).

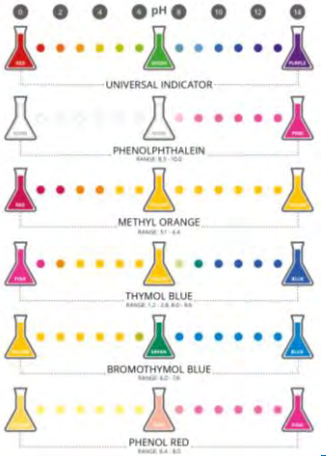
The strength of an acid is determined by the proportion of ions which dissociate (split) in solution, e.g. $HCl \rightarrow H^+ + Cl^-$.

Strong acids: High proportion of dissociated ions.

Weak acids: Low proportion of dissociated ions.



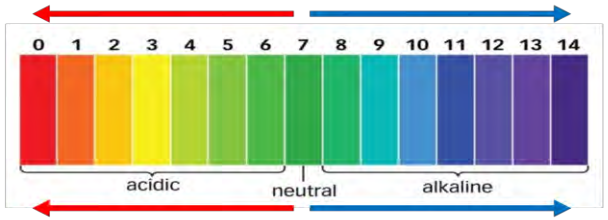
Indicators : Different chemicals can be used to test the pH of solutions.



pH scale : A measure of the proportion of hydrogen ions or hydroxide ions in a solution.

Increasing concentration of hydrogen ions

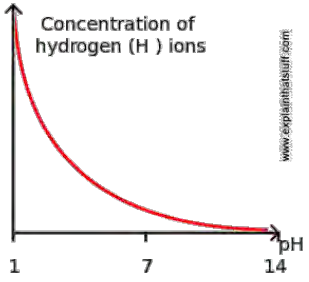
Increasing concentration of hydroxide ions



More acidic

More alkaline

As hydrogen ion concentration increases 10x, pH of the solution decreases by 1.



Acid concentration :

Acids are sources of hydrogen ions when in solution.

The concentration of the solution is determined by the amount of acid dissolved in a volume of solvent.

Measured in moles (e.g. 1M, 2M).

Concentrated acid: Large amount of acid per litre of solvent.

Dilute acid: Small amount of acid per litre of solvent.

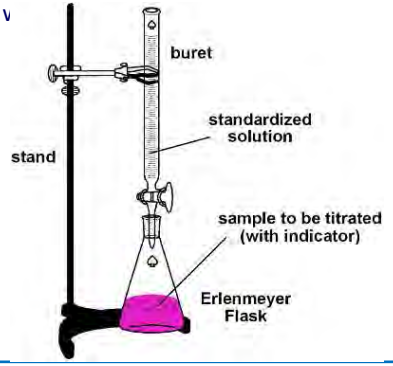
Soluble salts & titration :

When a neutralisation reaction produces a soluble salt, it can be extracted by crystallization (evaporating the solvent).

To create a neutral product (pH7), exactly the right amount of acid and alkali must be used.

Titration measures exact amounts of acid added to an alkali.

Single-colour indicators show clearly w



Neutralisation : Chemical reaction between acid (pH1-6) and alkali (pH8-14) produces a salt and water (neutral at pH7).

Neutralisation happens because of reactions due to ionic charges of atoms.

Acids and alkalis dissociate (split) into ions (charged atoms) in solution.

Hydrochloric acid: $HCl \rightarrow H^+ + Cl^-$

Sodium hydroxide (alkali): $NaOH \rightarrow Na^+ + OH^-$

The hydrogen and hydroxide ions react to form water: $H^+ + OH^- \rightarrow H_2O$

The sodium and chlorine atoms react to form sodium chloride (salt): $Na^+ + Cl^- \rightarrow NaCl$

Acids & metals : Acid + metal → salt + hydrogen

Evidence: Effervescence, or the production of hydrogen bubbles. Testing with a lit splint should produce a squeaky pop.

Strength of reaction depends on metal's place in reactivity series.

Magnesium + sulfuric acid → magnesium sulfate + hydrogen

$Mg\ (s) + H_2SO_4\ (aq) \rightarrow MgSO_4\ (aq) + H_2(g)$

Acids & carbonates : Acid + metal carbonate → salt + water + carbon dioxide

Evidence: Bubbling the carbon dioxide through limewater will turn the limewater cloudy.

E.g.: Copper carbonate + sulfuric acid → copper sulfate + water + carbon dioxide

$CuCO_3(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l) + CO_2(g)$

Insoluble salts & precipitates :

Some salts produced by an acid-alkali reaction are not soluble – they do not dissolve in any solvents.

These are called precipitation reactions, as they cause precipitate to form.

Precipitate is insoluble particles of solid which form in the solvent.

Preparation of insoluble salts:

1. Mix the two solutions;
2. Filter the mixture to remove most of the precipitate;
3. Rinse the beaker with distilled water and pass this through the filter to retain any remaining precipitate.

Soluble	Insoluble
All nitrates	None
Most sulfates	Lead sulfate, barium sulfate and calcium sulfate
Most chlorides, bromides and iodides	Silver chloride, silver bromide, silver iodide, lead chloride, lead bromide, lead iodide
Sodium carbonate, potassium carbonate, ammonium carbonate	Most other carbonates
Sodium hydroxide, potassium hydroxide, ammonium hydroxide	Most other hydroxides

State symbol **(s)** indicates a precipitate. Example: reaction of limewater with carbon dioxide:

Calcium hydroxide (limewater) + carbon dioxide → calcium carbonate + water

$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(\boldsymbol{s}) + H_2O(l)$$

Ions & electrolytes :

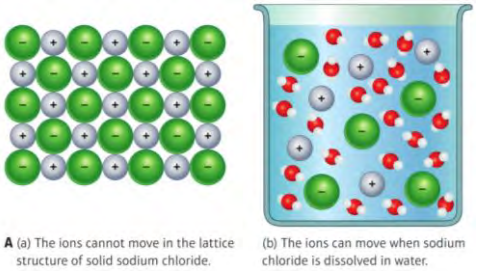
Atoms which have lost or gained electrons.

Charged (positive or negative).

Ionic solids dissolve into free ions in water.

Any liquid with free ions in solution is called an **electrolyte**.

Electrolytes can conduct electricity.



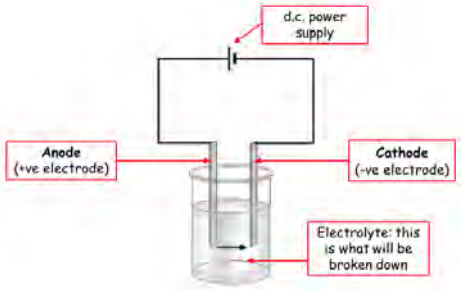
A (a) The ions cannot move in the lattice structure of solid sodium chloride. (b) The ions can move when sodium chloride is dissolved in water.

Electrolysis :

Means of separating out ionically-bonded compounds.

Negative ions collect at the anode (positive electrode).

Positive ions collect at the cathode (negative electrode).



H – Reactions at electrodes :

OIL RIG: **O**xidation **I**s **L**oss, **R**eduction **I**s **G**ain.

At the anode, negative ions lose electrons (oxidation).

At the cathode, positive ions gain electrons (reduction).

Example:

Zinc chloride electrolyte

Cathode reaction: $Zn^{2+} + 2e^- \rightarrow Zn$

Anode reaction: $2Cl^- \rightarrow Cl_2 + 2e^-$

H - Ionic equations :

All salts are ionically bonded.

Ionic equations show only the ions which change.

For example:

Lead nitrate + sodium chloride → lead chloride + sodium nitrate

Full equation: $Pb(NO_3)_2(aq) + 2NaCl(aq) \rightarrow PbCl_2(s) + 2NaNO_3\ (aq)$

Ionic equation: $\boldsymbol{Pb^{2+}(aq) + 2Cl^- \rightarrow PbCl_2(s)}$

All ions which do not change are called **spectator ions**.

Acids & metal oxides / metal hydroxides :

Metal oxide + acid → salt + water

E.g.: Copper (II) oxide + hydrochloric acid → copper chloride + water

$$CuO + 2HCl \rightarrow CuCl_2 + H_2O$$

Metal hydroxide + acid → salt + water

E.g.: Calcium hydroxide + nitric acid → calcium nitrate + water

$$Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$$

Naming salts :

Acid	*Salt formed*
Hydrochloric Acid	→ Chloride
Sulfuric Acid	→ Sulfate
Nitric Acid	→ Nitrate

State symbols :

In chemical equations, state symbols can be included after every chemical to show the state (solid, liquid, gas) of the chemical.

(s) = solid

(l) = liquid

(g) = gas

(aq) = in solution / dissolved.

Oxidisation (Pg 114)

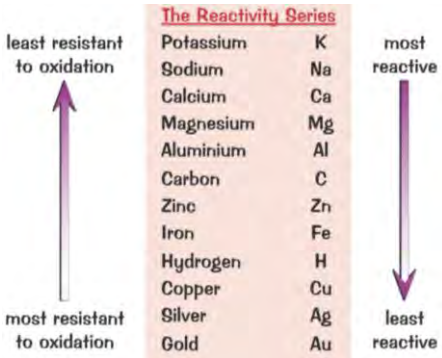
- A reaction involving oxygen.
- **Oxidisation** is the addition of oxygen, **reduction** is the loss of oxygen.

E.g. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

- Iron oxide is reduced to iron (as oxygen is removed).
- Carbon monoxide is oxidised to carbon dioxide (as oxygen is added).

Reactivity (Pg 114)

- Shows how easily metals are oxidised.
- A reactivity series shows metals in order of reactivity.



Also a measurement of saying how easily a metal atom gives up electrons to become an ion.
More reactive = gives up electrons more easily.

Oxidisation & reduction (Pg 116)

- **Oxidisation** is also the **loss** of **electrons**.
- **Reduction** is the **gain** of **electrons**.

O I L R I G

When dealing with electrons: Oxidation Is Loss, Reduction Is Gain.

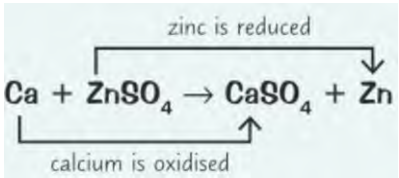
Metal reactions (Pg 115)

- Metals with different reactivity react to acids and water in different ways:

Metal	Reaction with water	Reaction with dilute acid	Tendency of metal atoms to form cations
potassium	react with cold water to form hydrogen and a metal hydroxide	react violently	increasing ability of metal atoms to form positive ions
sodium			
calcium		react to form hydrogen and a salt solution	
magnesium	react very slowly, if at all, with cold water but react with steam to form hydrogen and a metal oxide		
aluminium			
zinc			
iron			
copper	do not react with cold water or steam	do not react	
silver			
gold			

Displacement reactions (Pg 116)

- Metals differently with metals salts, depending on the reactivity of the metals.
- The more reactive element takes the place of the less reactive element.
- The more reactive metal loses electrons (is oxidised) while the more reactive metals gains electrons (is reduced).
- Remember OILRIG.



- Calcium is more reactive than zinc, and takes it's place in the metals salt to become calcium sulfate leaving pure zinc on it's own.

Ore (Pg 117)

- A rock containing enough metal in in to make it **economically worthwhile** to extract the metal.

Metal extraction (Pg 117)

- Unreactive metals, e.g. gold, removed from the Earth's crust in pure form.
- More reactive metals form metals compounds, e.g. bauxite (aluminium oxide) the source of aluminium.
- The method for extracting metals from ores depends on the reactivity of the metal.

Metal	Method of extraction
potassium	electrolysis of a molten compound
sodium	
calcium	
magnesium	
aluminium	
(carbon)	
zinc	heat an ore with carbon
iron	
copper	
silver	found as the uncombined element
gold	

increasing reactivity

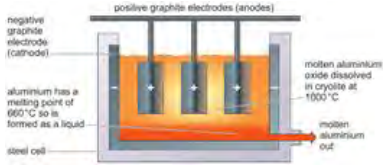
Method 1: Reduction with carbon (Pg 117)

- The ore is reduced, the carbon replacing the less reactive metals, leaving pure metals behind.
- Iron oxide (haematite) is the source of pure iron.

$2Fe_2O_3$ + 3C → 4Fe + $3CO_2$
iron oxide + carbon → iron + carbon dioxide

Method 2: Electrolysis (Pg 118)

- The ore is melted and an electrical current passed through it. The pure metal forms on the negative electrode.



Method 3: Biological methods (Pg 118)

- **Bioleaching** uses bacteria grown on copper ore which produce a solution containing the metals ions.
- The copper is extracted by reduction with iron and purified by electrolysis.

- **Phytoextraction** uses plants that grow and absorb the metal compounds. When burned they form an ash which the metal can be extracted from.
- Advantages/disadvantages:

Process	Advantages	Disadvantages
both bioleaching and phytoextraction	no harmful gases (e.g. sulfur dioxide) are produced causes less damage to the landscape than mining conserves supplies of higher grade ores	very slow
bioleaching	does not require high temperatures	toxic substances and sulfuric acid can be produced by the process, and damage the environment
phytoextraction	can extract metals from contaminated soils	more expensive than mining some ores growing plants is dependent on weather conditions

Recycling (Pg 119)

- Reusing materials already extracted from the Earth is cheaper and has environmental benefits.

- Recycling aluminium cans is 95% more energy efficient per tonne over extracting it from ore.
- Prevents environmental damage from further mining
- Prevents landfill of cans.

Life cycle assessments (Pg 120)

- New planned products are assessed using and LCA.
- Each aspect is considered to see if it impacts the environment too significantly.

Example: **Car B** is the most logical choice to manufacture based on the statistics considered…

Car	CO_2 emissions (tonnes)	Waste solid produced (kg)	Water used (m^3)	Expected lifespan of product (years)
A	17	10 720	8.2	11
B	21	5900	6.0	17
C	34	15 010	9.5	12

Least solid waste and water used.
Second best for CO2 emissions
Longest lifespan

Reversible reactions (Pg 121)

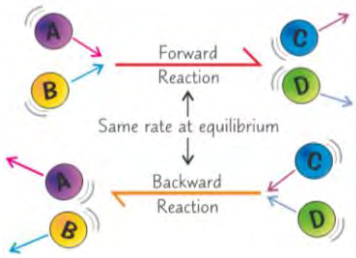
Reactions where products can react to form the original reactants.
Reactions go **both** ways!

$$A + B \rightleftharpoons C + D$$

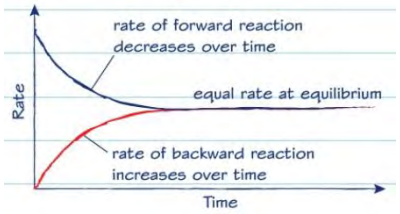
Note the arrow points in both directions, showing this is a reversible reaction.

Dynamic Equilibrium (Pg 121)

- In a closed system, reversible reactions reach **dynamic equilibrium**.
- This means the rate of the forward reaction is equal to the rate of the backwards reaction.



- The dynamic bit means that these reactions do NOT stop, products are formed from reactants and reactants react to form products…it just means the concentrations of the reactants and products does not change.



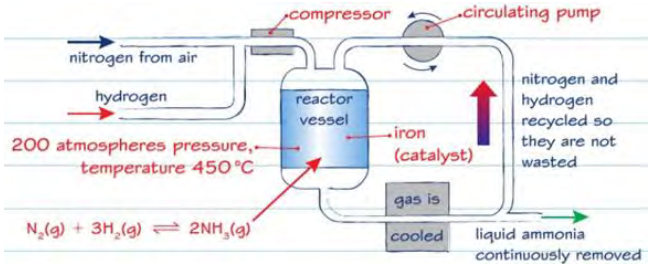
Factors effecting the equilibrium position (Pg 121)

Different factors can be used to shift the position of the equilibrium point…either to produce more product or more reactants.
The factors are **temperature**, **pressure** (for reactions involving gasses) and **concentration** (of the reactants and products).

The Haber process (Pg 121)

Reaction between hydrogen and nitrogen to form ammonia.
You need to remember the conditions for the process…

Pressure of 200 atmospheres
Temp of 450 ^{O}C
Iron catalyst



Le Chatelier's Principle (Pg 122)

The principle states, any change to either temp, pressure or concentration in a reversible reaction and the equilibrium position will move to counteract that change.
This means we can adjust these factors to get more product or more reactant, if that's what is needed.
Details of how each change effects the reaction can be found below, using the Haber process as an example.

TEMPERATURE All reactions are exothermic in one direction and endothermic in the other (see page 134).

1) If you decrease the temperature, the equilibrium will move in the exothermic direction to produce more heat.
2) If you increase the temperature, the equilibrium will move in the endothermic direction to absorb the extra heat.

For example: $N_2 + 3H_2 \rightleftharpoons 2NH_3$
This reaction is exothermic in the forward direction. If you decrease the temperature, the equilibrium will shift to the right (so you'll make more product).

PRESSURE Changing this only affects equilibria involving gases.

1) If you increase the pressure, the equilibrium will move towards the side that has fewer moles of gas to reduce pressure.
2) If you decrease the pressure, the equilibrium will move towards the side that has more moles of gas to increase pressure.

For example:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$
This reaction has 4 moles of gas on the left and 2 on the right. If you increase the pressure, the equilibrium will shift to the right (so you'll make more product).

CONCENTRATION

1) If you increase the concentration of the reactants, the equilibrium will move to the right to use up the reactants (making more products).
2) If you increase the concentration of the products, the equilibrium will move to the left to use up the products (making more reactants).
3) Decreasing the concentration will have the opposite effect.

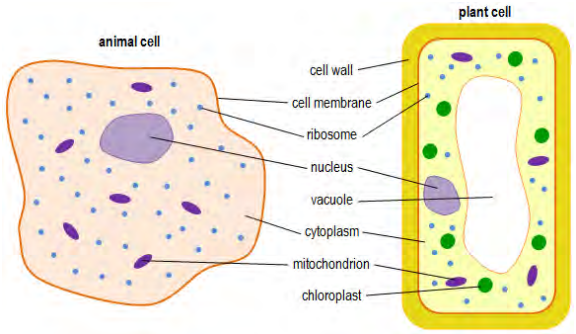
For example:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$
If you increase the concentration of N_2 or H_2, the equilibrium will shift to the right to use up the extra reactants (so you'll make more product).

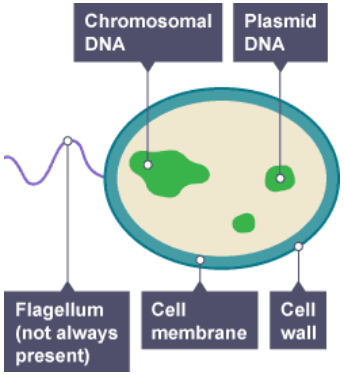
WHA Science

Biology Topic 1. Key concepts

Cell Structure

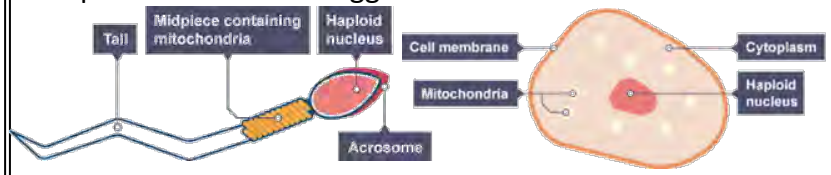
- Animal cell - Plant cell -Bacterial cell



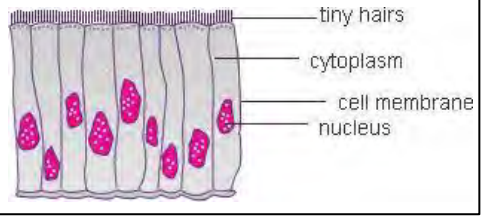


Specialised Cells

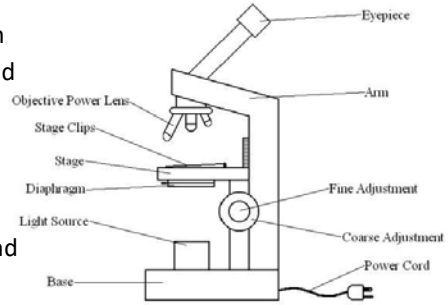
- Sperm cell - Egg cell



- Ciliated epithelial cell



Making Microscope Slides



1. Take a thin **slice** of a sample/specimen
2. Put a drop of water on a **glass slide** and use tweezers to add the sample to the slide
3. Add a drop of **stain** e.g. iodine (stains the cell to make it visible)

Use a tweezer to lower a **cover slip** and press down firmly (make sure there are no bubbles)

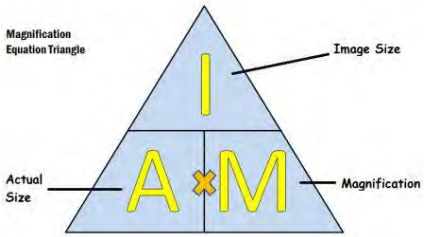
Put the slide on the stage and secure using the clips

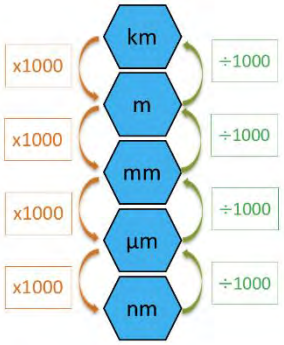
6. Choose the lowest powered **objective lens**
7. Use the focusing wheel to move the stage up and down while looking through the **eyepiece lens** (this is to focus the image)
8. Put a clear ruler on the state to measure the diameter of your field of view *(this will allow you to estimate the size of the specimen)*
9. Repeat focusing with higher-powered objective lens if needed

Magnification

- Equation - Unit conversion

Magnification = image size ÷ actual size



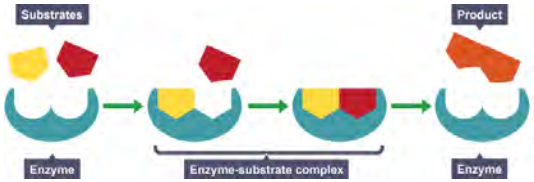


Light vs. Electron Microscopes

Light microscope	Electron microscope
Inexpensive to purchase and operate	Expensive to purchase and operate
Simple and easy specimen preparation	Complex and lengthy specimen preparation
Magnifies up to 2000×	Magnifies over 500 000×
Specimens may be living or dead	Specimens are dead, and must be fixed in a plastic material

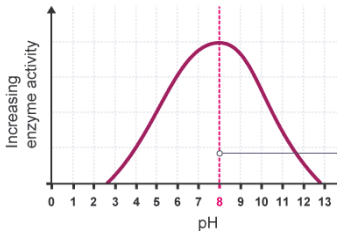
Biology Topic 1. Key concepts

Enzyme Structure

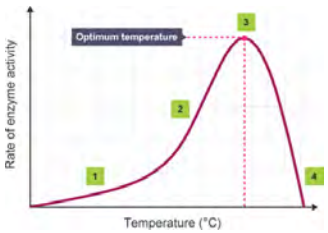


Enzymes are a **biological catalyst**. They speed up chemical reactions where things are split apart or joined together. Enzymes only work with one substrate, they have a high specificity due to the shape of the active site. The substrate's shape has to match the active site's shape exactly. This is called the 'lock and key' model.

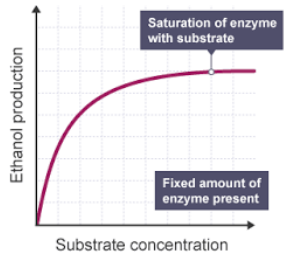
Factors affecting enzymes



As the enzyme experiences conditions away from the optimum the shape of the active site begins to change meaning the substrate can't fit as well and less reactions will occur.



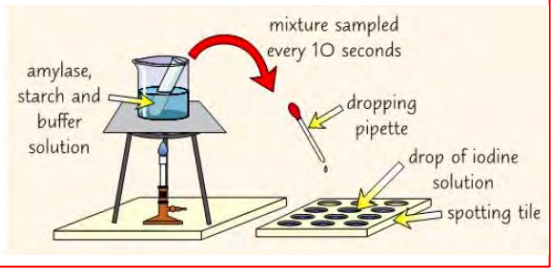
As the enzyme experiences warmer conditions it (and the substrate) will move more quickly, there will be more collisions and more reactions. After the optimum the heat causes the shape of the active site to change in the same way as pH.



As more substrate is added the more collisions there will be with available enzymes and more reactions, up until a certain (saturation point), where all of the enzymes are already working at their maximum rate.

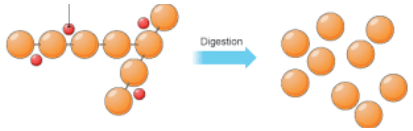
Investigating Enzymes

The enzyme amylase catalyses the breakdown of the starch into glucose (sugar). The enzyme is added to buffer solutions of different pHs. The time it takes for the enzyme to work is calculated by continuously sampling the mixture and adding it to iodine (test for starch). When all of the starch has been broken down, the iodine will stop changing colour. Calculation needed: Rate = 1 ÷ time



Specific digestive enzymes

Amylase (a carbohydrase)



Starch Glucose

Protease

Protein Amino acids

Lipase

Lipids Fatty acids + glycerol

All of these digestive processes can happen in reverse = synthesis.

Investigating Osmosis

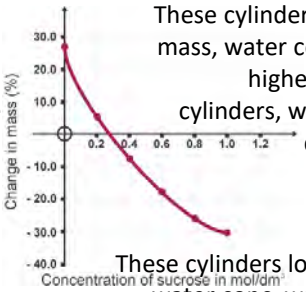
1. Prepare sucrose solutions of 5 concentrations
2. Measure the mass of potato cylinders
3. Put one cylinder into a test tube of each solution
4. Leave for 40 mins
5. Pat dry and reweigh

Results

Calculate percentage change in mass.

Percentage change = final mass – initial mass x100
initial mass

The point where the line crosses the x-axis means the concentration inside and outside of the potato cylinder were the same.



These cylinders gained mass, water conc. was higher than in cylinders, water was drawn in

These cylinders lost mass, water conc. was lower than in cylinders, water was drawn out

Transport

Diffusion
Movement of particles from high concentration to low concentration e.g. carbon dioxide into plant leaves

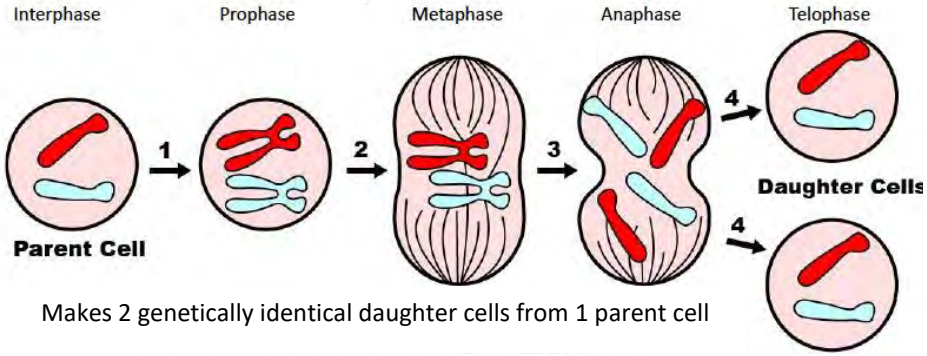
Osmosis
Movement of water particles across a partially permeable membrane from high water concentration to low water concentration e.g. water into plant roots

Active Transport
Movement of particles across a membrane from high concentration to lower concentration, using energy transferred during respiration e.g. nitrates into plant roots

Biology Topic 2. Cells and control

Mitosis

Type of cell division used for growth and repair



Makes 2 genetically identical daughter cells from 1 parent cell

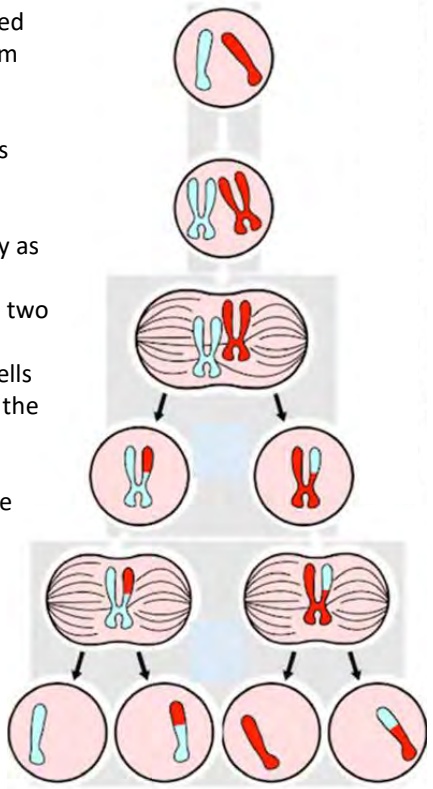
Interphase – cell makes extra sub-cellular components. DNA replication occurs,
Prophase – nucleus breaks down and spindle fibres appear. Chromosomes become visible
Metaphase – chromosomes use spindle fibres to line up along the **m**iddle of the cell.
Anaphase – chromosome copies are separated and move **a**part to each end of the cell using spindle fibres.
Telophase – a new nuclear membrane forms around each set of chromosomes.
Cytokinesis – new cell membrane forms to separate the 2 daughter cells.

IPMAT

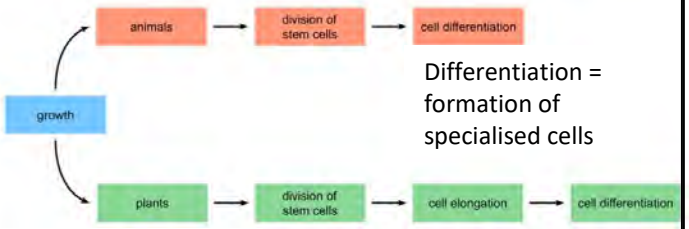
"Mitosis in my toes, meiosis in my ovaries"

Meiosis

Type of cell division used to form gametes (sperm and egg cells)
Produces 4 genetically different daughter cells from 1 parent cell
The chromosomes are copied in the same way as mitosis
Unlike mitosis, there is two rounds of cell division.
This leaves 4 haploid cells (haploid means half of the original number of chromosomes – in this diagram 1 chromosome instead of 2)



Growth

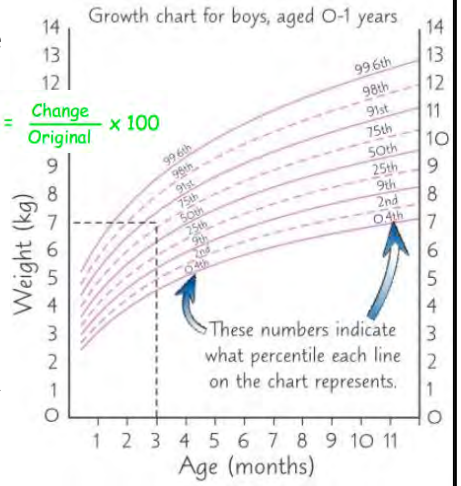


Differentiation = formation of specialised cells

Measure growth using percentage change

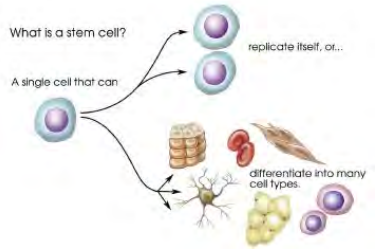
$$\text{Percentage change} = \frac{\text{Change}}{\text{Original}} \times 100$$

Or using percentile charts which divide a measurements from a large group into 100 equal sections →



E.g. a three-month-old who weighs 7 kg is just above 75th percentile — roughly 75% of three-month-olds are lighter and 25% are heavier.

Stem Cells



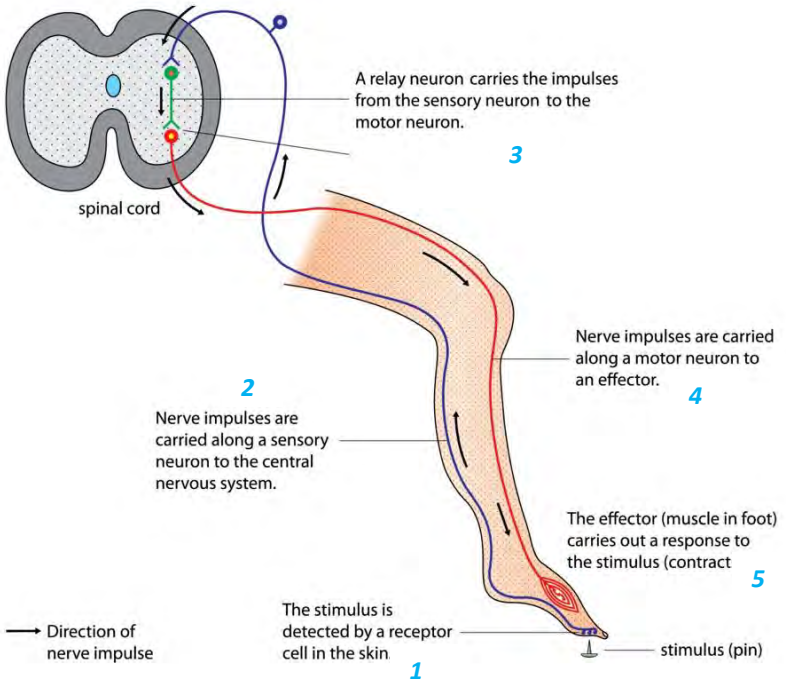
Embryonic stem cells found in embryos can differentiate into any specialised cell
Adult stem cells are limited in the type of cell they can differentiate into
Lots of potential uses
Ethical issues

Plant stem cells called meristem cells are found in shoots and roots and can differentiate into any cell type

Biology Topic 2. Cells and control

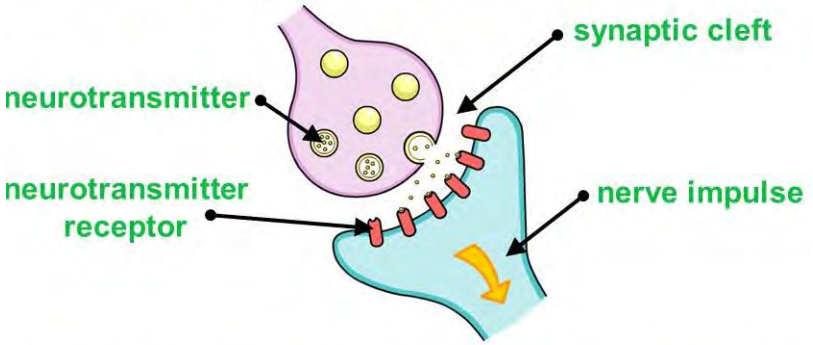
Reflexes

- An automatic response to a stimulus



Synapses

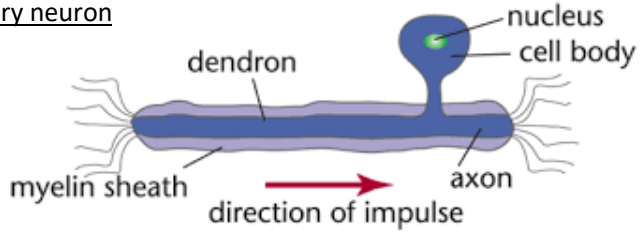
A synapse is a junction between two neurones across which electrical signals must pass.



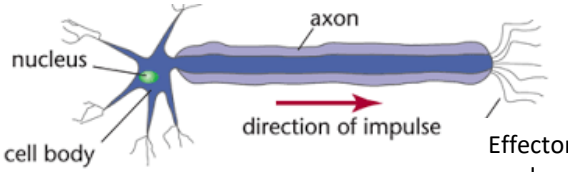
Neurotransmitter molecules diffuse from vesicles towards the neurotransmitter receptors, moving from an area of high concentration to low concentration.

Nervous System

- Central nervous system = brain and spinal cord
- Peripheral nervous system = all other neurons (nerve cells) around the body, including sensory motor and relay neurons
- <u>Sensory neuron</u>



- <u>Motor neuron</u>

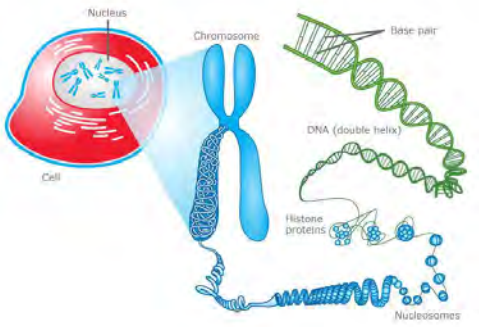


WHA Science

Biology Topic 3. Genetics

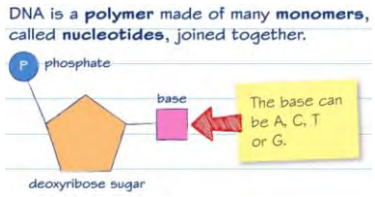
DNA

- **DNA** is the genetic material contained in the **nucleus** of a cell
- The entirety of the human DNA is called the **genome**.
- DNA is contained within the **chromosomes** inside the nucleus.



DNA structure

- Double helix
- Four base pairs:
  - **A** (adenine)
  - **T** (thymine)
  - **C** (cytosine)
  - **G** (guanine)
- **Hydrogen bonds** between base pairs
- **A always bonds with T, C always bonds with G**
  - These are known as complementary base pairs
- Each base is attached to a **sugar** and **phosphate** backbone.
- A base, a sugar and a phosphate make a **nucleotide**.



Extracting DNA

1. Mix detergent **(breaks down cell membranes)** and salt **(clumps DNA together)**
2. Crush/grind fruit (to make a **homogeneous** solution)
3. Filter **(to remove solid lumps of fruit)**
4. Gently add ice-cold ethanol **(DNA is insoluble in ethanol, so precipitates out to be collected).**

Genes & Alleles

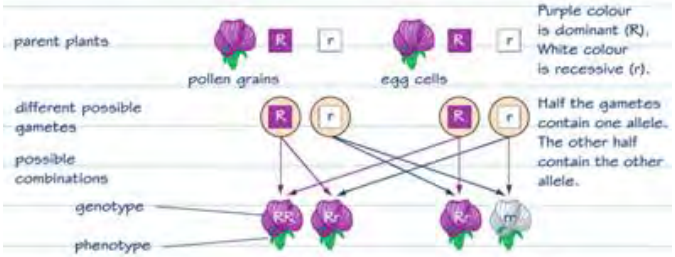
- Genes are short lengths of DNA that code for a specific protein.
- This means they control certain features (e.g. eye colour)
- Alleles are different versions of the same gene (e.g. blue eye gene or brown eye gene.)
- **Each gene has two alleles**, one from biological mother, and the other from biological father
- Alleles can be **dominant** (use a capital letter) or **recessive** (use a lower-case letter)
  - Aa

Genetics keywords

Key word	Definition
Gene	A section of DNA that codes for one thing.
Allele	A different version of the same gene.
Offspring	The 'children' of an organism.
Dominant	The stronger allele.
Recessive	The weaker allele.
Homozygous	Having 2 of the same allele.
Heterozygous	Having 2 different alleles.
Genotype	The different alleles that an organism has e.g. Rr
Phenotype	The characteristic the organism has. E.g. purple flowers

Genetic diagrams

- Used to predict the possible outcomes of a cross depending on the parents genotypes.



- Punnett squares:

Father's genotype

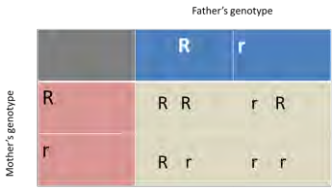
Mother's genotype	R	r
R	R R	r R
r	R r	r r

  - The offspring has a 25% chance of being RR or rr
  - The offspring has a 50% chance of being Rr

Biology Topic 3. Genetics

Probabilities

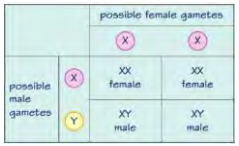
- Possible outcomes are represented as probabilities.



- RR = 1/4 = 25% = 0.25
- Rr = 2/4 = 50% = 0.50
- Rr = 1/4 = 25% = 0.25

Sex determination

- The sex of a child is dependent on the 23rd pair of chromosomes (either X or Y)
  - XX = woman
  - XY = Man
- Use a Punnett square to show the probability of having a boy or girl.



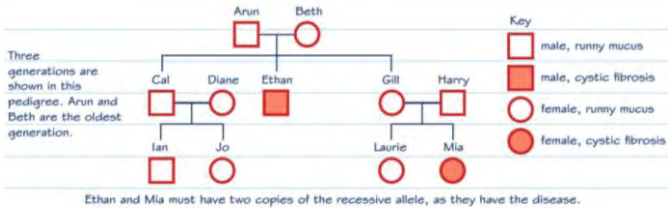
- XX = 2/4 = 50% chance girl
- XY = 2/4 = 50% chance of boy

Variation

- Differences in the same species is known as **variation**.
- Variation can be **inherited** from parents (e.g. eye colour)
- Variation can be **environmental** (e.g. a scar or tattoo)
- Variation can be a combination of **both** inheritance and environment. (e.g. weight)

Pedigree charts

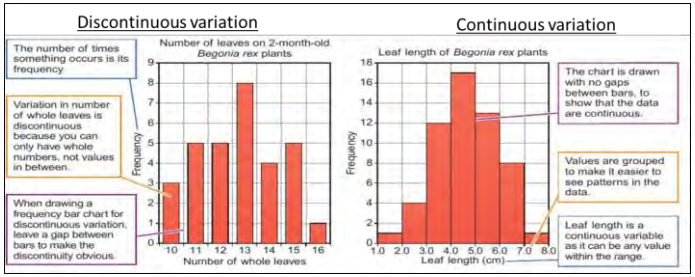
- Used to track genetic disorders which can be passed from parent to child.
- Parents can be carrier of the gene that causes the disease but not suffer with the disease.



Ethan and Mia must have two copies of the recessive allele, as they have the disease.

Studying variation

- Data gathered can be either **continuous** (data can be any value in a range) or **discontinuous** (data can only take on a limited number of values)
- Plotted on bar graphs with differences in how each is plotted.



Mutation

- Mutations are caused by changes to the original DNA code in an organism.
- Mutations can cause changes in phenotype if the code of certain genes is changed.
- These changes to specific genes bring about different alleles.
- The majority of mutations cause no change to phenotype at all.

Human Genome Project

- Complete map of the human genome.
- Decoding the base pairs making up all the genes in our DNA.
- Took 13 years to complete.

- Advantages
  - Predicting and preventing inherited diseases (see if genes known to interact to cause like heart disease or cancer present – make changes to lifestyle accordingly)
  - Testing and treatment for inherited disorders (look to see if disease exists before baby is born)
  - Development of new drugs where known interactions between drugs and genes is known.
- Disadvantages
  - Stress/worry (if you possess a known disease gene)
  - Gene-ism (people pressured not to have a baby of they have a known gene)
  - Discrimination (people with known genes prevented from getting jobs or health insurance)

WHA Science

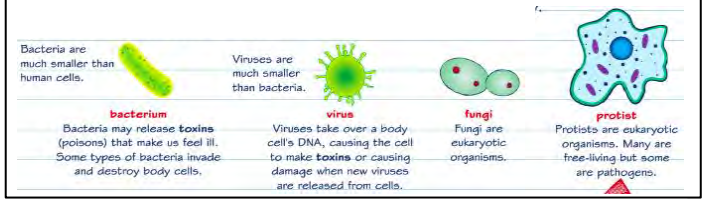
Biology Topic 5. Health and disease

Health as defined by the WHO

"A state of complete physical, mental, and social well-being, not just the absence of disease or infirmity"

Pathogens

Microorganisms which cause disease. There are 4 different types: **viruses**, **bacteria**, **fungi** and **protists**



Sexually transmitted diseases (STDs)

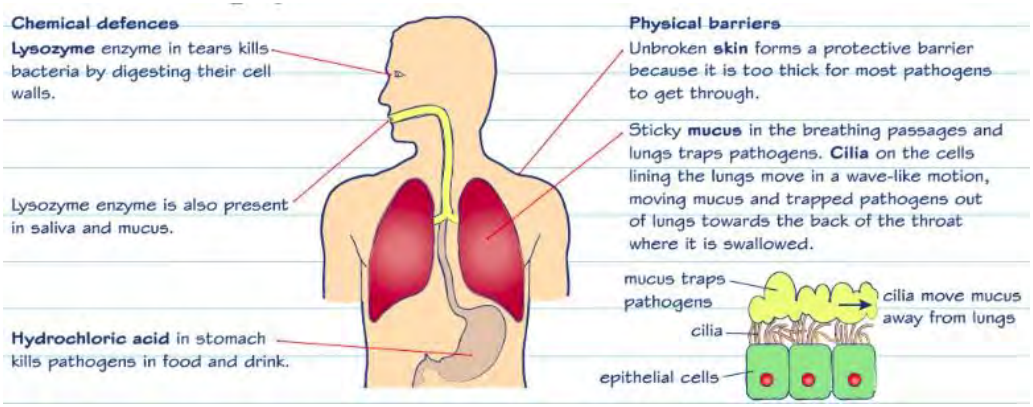
- Infections spread through sexual contact
- **Chlamydia**: a bacterium, can cause infertility in men and women but doesn't always cause symptoms, spread reduced by using a condom and screening individuals so they can be treated, can also be passed to babies during birth
- **HIV** (human immunodeficiency virus): a virus, kills white blood cells, leads to AIDS where a person's immune system fails making them vulnerable to infections by other pathogens,
- Spread reduced by using a condom, not sharing needles during drug use, screening and medication

Communicable diseases/spreading pathogens

Diseases that can be spread between individuals.

Disease	Pathogen	Symptoms/ Effects	How it spreads	How to reduce/prevent transmission
Cholera	A bacterium called *Vibrio cholerae*.	Diarrhoea.	Via contaminated water sources.	Making sure that people have access to clean water supplies.
Tuberculosis	A bacterium called *Mycobacterium tuberculosis*.	Coughing and lung damage.	Through the air when infected individuals cough.	Infected people should avoid crowded public spaces, practise good hygiene and sleep alone. Their homes should also be well-ventilated.
Malaria	A protist.	Damage to red blood cells and, in severe cases, to the liver.	Mosquitoes act as animal vectors (carriers) — they pass on the protist to humans but don't get the disease themselves.	Use of mosquito nets and insect repellent to prevent mosquitoes carrying the pathogen from biting people.
Stomach ulcers	A bacterium called *Helicobacter pylori*.	Stomach pain, nausea and vomiting.	Oral transmission, e.g. swallowing contaminated water or food.	Having clean water supplies and hygienic living conditions.
Ebola	Ebola virus.	Haemorrhagic fever (a fever with bleeding).	Via bodily fluids.	By isolating infected individuals and sterilising any areas where the virus may be present.
Chalara ash dieback	A fungus that infects ash trees.	Leaf loss and bark lesions (wounds).	Carried through the air by the wind. (It also spreads when diseased ash trees are moved between areas.)	Removing young, infected ash trees and replanting with different species. Restricting the import or movement of ash trees.

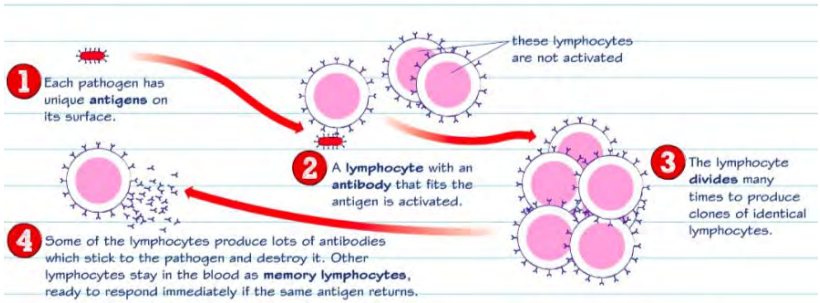
Physical and Chemical Barriers



Biology Topic 5. Health and disease

Immune System

- When pathogens make it past body defences your immune system aims to destroy them
- White blood cells are a key part of this response



Antibiotics

Antibiotics kill bacteria by stopping processes in their cells, they don't affect host organisms or viruses

Drug Testing

Preclinical testing

1. On human cells and tissues
2. On live animals (to test if it works and find out how toxic/harmful it is)

Clinical testing

3. On healthy volunteers (side-effects)
4. On people suffering from the disease (to see if it works)

2 groups used, 1 given a placebo, both blind so patient (and sometimes doctor) doesn't know if they have the medicine or placebo

Non-communicable diseases

- Cannot pass between people
- Risk is affected by genes, age, gender, environment and lifestyle

Communicable	Non-communicable
rapid variation in number of cases over time	number of cases changes only gradually
cases are often localised	cases may be more widely spread
e.g. malaria, typhoid, cholera	e.g. cancer, diabetes, heart disease

Diet and Disease

- A diet with too many or too few nutrients can lead to malnutrition e.g. obesity
- Obesity is caused by a diet high in fats and sugars

Alcohol and Disease

- Alcohol is a major risk factor for liver disease. The worst form of liver disease is cirrhosis (scarring of the liver)
- Alcohol is broken down by enzymes in the liver and produces toxic products
- This damage can be permanent

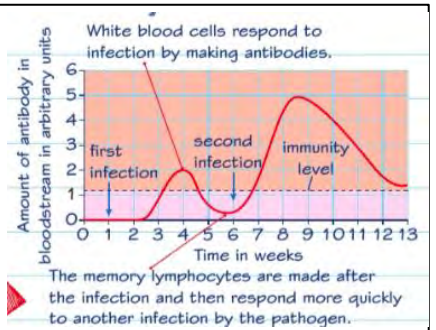
Measures of Obesity

- **BMI** values are compared to tables to give a classification e.g. underweight, normal, overweight, obese
- **Waist:hip ratio**. A higher ratio = more weight around the middle, and a greater risk of health problems (should be <1)

$$\text{BMI} = \frac{\text{weight (kg)}}{(\text{height (m)})^2}$$

$$\text{waist-to-hip ratio} = \frac{\text{waist circumference}}{\text{hip circumference}}$$

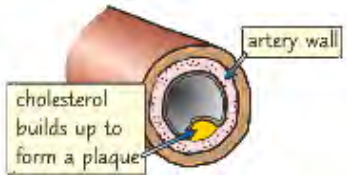
Immunity/immunisation



- Once your body has been through the immune response once, it is able to respond quicker to a second infection if the pathogen enters the body again. This is called the **secondary response.**
- Immunisation (vaccination) involves injecting dead or inactive pathogens into the body to allow memory lymphocytes to be made
- This means the first infection can be dealt with a secondary response

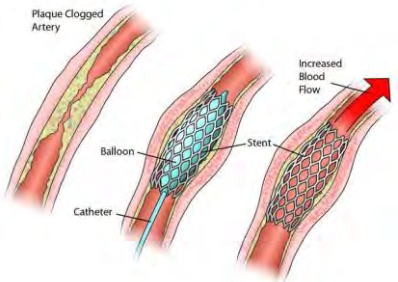
Smoking and Disease

- Smoking is a major risk factor for cardiovascular disease
- Harmful substances from tobacco smoke can damage arteries and lead to build up of fatty deposits and the development of blood clots
- These reduce blood flow and increases risk of heart attack or stroke



Treatment of cardiovascular disease

- **Lifestyle changes** e.g. weight loss and exercise
- **Medicines** e.g. statins to reduce cholesterol, anticoagulants to reduce blood clots and antihypertensives to reduce blood pressure
- **Surgery** e.g. **stents** to keep arteries open or **heart bypass surgery**



Science

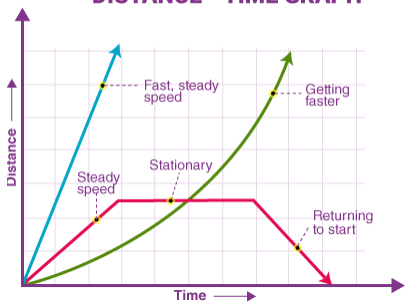
Physics 1. Motion and Forces

Force = mass x acceleration

$F = m \times a$

Vector	Scalar
A property with magnitude (size) & direction.	A property with magnitude (size) only.
Velocity	Speed
Displacement	Distance
Weight	Mass
Acceleration	
Force	

DISTANCE - TIME GRAPH

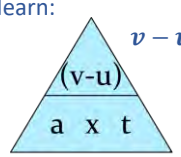


Average speed is calculated using this equation:

$$\text{Speed (m/s)} = \frac{\text{total distance (m)}}{\text{total time (s)}}$$

formula triangle

Acceleration: units: m/s^2. Speeding up or slowing down. Two equations to learn:



$$v - u = a \times t$$

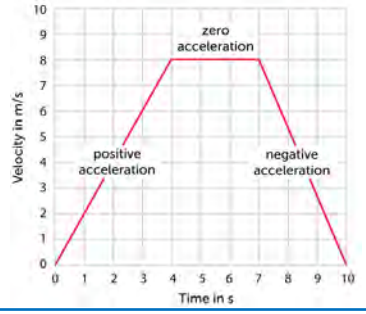
a = acceleration
v = final velocity
u = initial velocity
t = time taken

And:

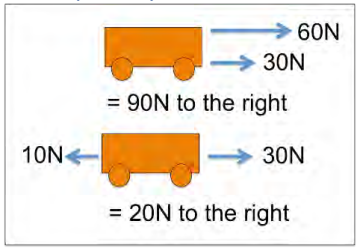
$$v^2 - u^2 = 2 \times a \times s$$

Where s = distance.
Slowing down is negative acceleration, **not** deceleration.

Velocity-time graph: Area under the line = distance travelled.



Resultant forces: Forces acting on an object can be added together to give the resultant force. Remember some forces are **negative** because force is a **vector**. Horizontal and vertical forces must be treated separately.

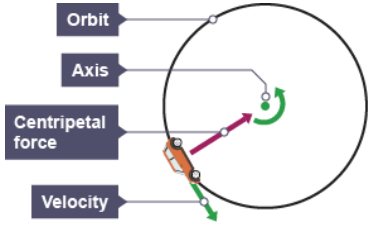


Newton's First Law: An moving object will continue to move at the same velocity (speed and direction) until acted on by a resultant force.

Or:

A stationary object will remain at rest until acted on by a resultant force.

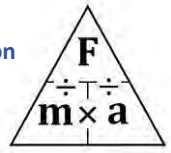
H – Circular motion: An object moving in a circle is constantly changing direction. Change in direction means change in velocity, and therefore the object is accelerating (positive or negative) even if its speed does not change. This means a force is required to keep the object moving in a circle. This force is called the **centripetal force.**



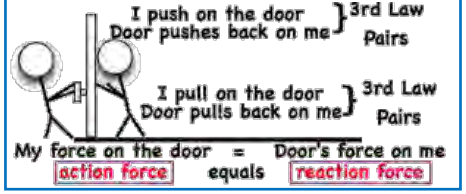
Newton's Second Law:

Force = mass x acceleration

$F = m \times a$



Newton's Third Law: Two objects interacting with one another experience equal forces in opposite directions.



Mass	Weight
How much matter there is.	The force of gravity acting on the mass.
Same regardless of location.	Changes depending on location (e.g., different planets).
Measured in kilograms (kg).	Measured in Newtons (N).
Scalar (size only).	Vector (size and direction).

Weight = mass x gravitational field strength

$W = m \times g$

On Earth, $g = 10\ N/kg$.

H – Momentum: A measure of how hard it is to stop an object moving. Vector. Units: kg.m/s.

Momentum = mass x velocity

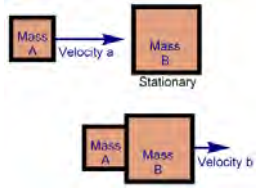
$p = m \times v$

To change the momentum of an object, a resultant force is needed:

$$\text{Force} = \frac{\text{Change in momentum}}{\text{time}}$$

$$F = \frac{mv - mu}{t}$$

Collision between two objects: The total momentum is conserved before and after the collision.



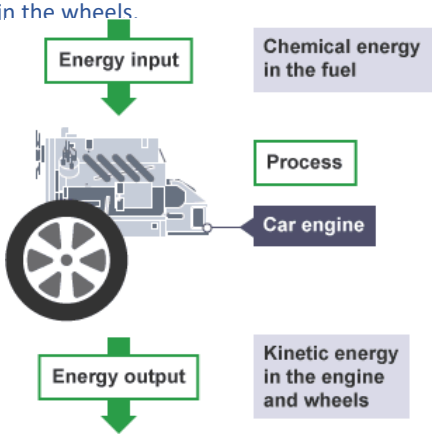
Combined Science

Combined Science
Physics 2. Energy

Energy stores: Energy is stored in different ways.

- **Chemical energy:** Stored in chemical form, e.g.: food, fuel (e.g. petrol), batteries.
- **Kinetic energy:** Stored in moving objects, e.g. car, train, sprinter.
- **Thermal energy:** Stored as heat, e.g.: hot water.
- **Elastic potential energy:** Stored in stretched materials, e.g.: springs, rubber bands.
- **Gravitational potential energy:** Stored in objects raised a height above ground, e.g. a ball held above the ground.
- **Nuclear energy:** Stored inside atoms.

Conservation of energy: Energy cannot be created or destroyed. It can only be transferred from one store to another. For example, a car transfers energy from the chemical store (fuel) to the thermal store (in the engine) and then to the kinetic store (in the wheels). The total amount of energy stays constant. This is the **law of conservation of energy**. Some of the energy is transferred to the thermal store as friction and not to the kinetic store in the wheels.



Energy: Energy is a body's capability to have an effect on its surroundings. For example: A hot cup of tea will heat the air around it and the table top it sits on. Units: Joules (J).

Stopping distance = thinking distance + braking distance.

Thinking distance:

The distance travelled in the time between the driver seeing the situation and reacting.

Affected by: tiredness; drugs; alcohol; illness; distractions (e.g. using a mobile phone).

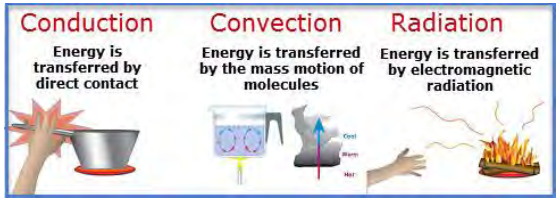
Braking distance:

The distance travelled while the brakes are applied.

Slows the car down by friction.

Affected by: Road conditions (e.g. loose gravel, wet); tyre conditions; weight of the vehicle.

Transferring heat: Heat is transferred in three ways:



Kinetic energy = ½ x mass x (velocity)^2

$$KE = \frac{1}{2} \times m \times v^2$$

Gravitational potential energy = mass x gravitational field strength x height.

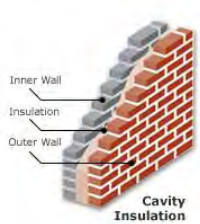
$$\text{GPE} = m \times g \times h$$

Non-renewable resources include coal, oil and gas, known as fossil fuels. When burnt they release carbon dioxide and other gases, which contribute to climate change. Nuclear fuel (uranium) is also non-renewable but contributes less to climate change. Instead it leaves nuclear waste, which remains dangerous for thousands of years.

Renewable resources include solar cells, hydroelectricity, wind turbines and tidal power. Renewable resources will not run out. They do not generate carbon emissions. Renewable resources are being increasingly used as they become cheaper and as non-renewable resources begin to run out. Bio-fuels are made from animal waste or plants. They are burned to generate energy.

Keeping warm: It is difficult to keep a house warm because heat energy tends to spread. Insulation stops heat spreading.

Cavity wall insulation reduces heat loss because the air gaps stop heat energy being conducted from inside to outside.

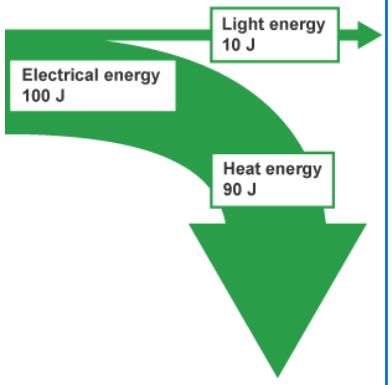


Energy diagrams:

Energy transfers between energy stores can be represented by Sankey diagrams.

In a Sankey diagram, the width of the arrow represents the amount of energy transferred. The arrow splits into different directions for transfers to different energy stores.

The Sankey diagram opposite shows energy transfers in a filament light bulb. It shows that most of the energy is wasted as heat.



Energy efficiency: Energy cannot be created or destroyed. Some energy is transferred to the useful store (light in the case of the lightbulb). Some of the energy is transferred to a different store and is wasted (heat in the case of the lightbulb).

$$\text{Efficiency} = \frac{\text{Useful energy transferred by the device}}{\text{Total energy transferred by the device}}$$

A lightbulb which consumes 100 J of electrical energy and outputs 10 J of light energy has an efficiency of 0.10.

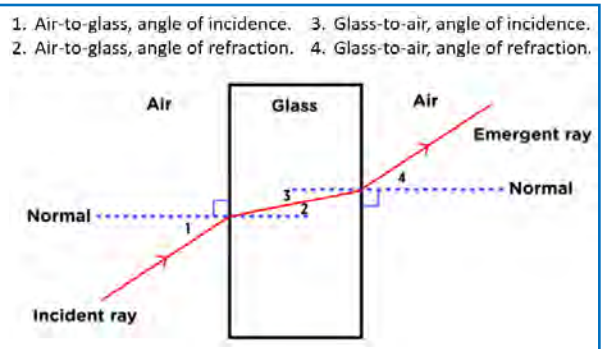
Combined Science | Physics Topic 2 – Waves |

Refraction :

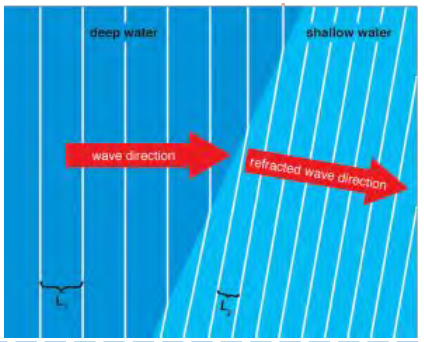
Normal line is at 90° to the material surface.

From less dense to a more dense material: light bends towards the normal.

From more dense to less dense material: light bends away from the normal.



H – Refraction : Speed of waves depends on depth of water. Shallow water causes waves to slow down and refract. Wavelength is also reduced. For all types of waves (including EM), different wavelengths refract by different amounts.

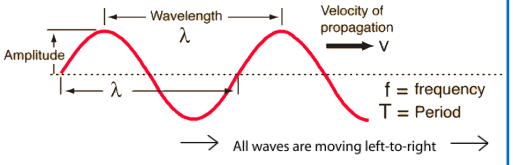


Describing waves

Frequency f: num ıvelengths passing a point per second (Hz).

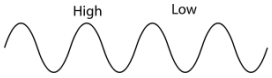
Wavelength λ : Distance between two consecutive peaks (m).

Period T: Time taken for one wavelength to pass a point (s).

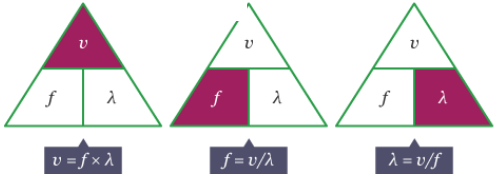


Longitudinal Waves
Waves "pile up" left to right

Transverse Waves
Waves "pile up" up-and-down



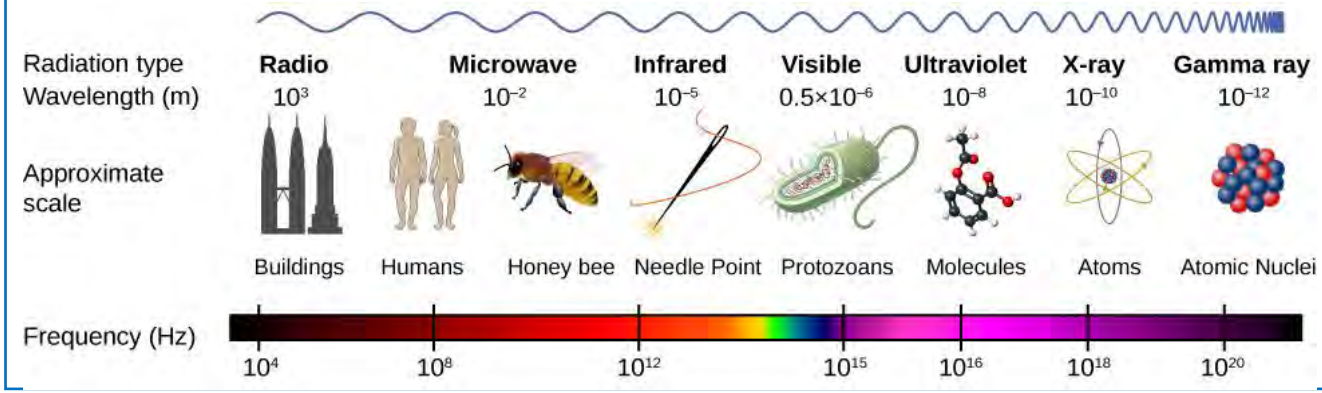
Wave speed



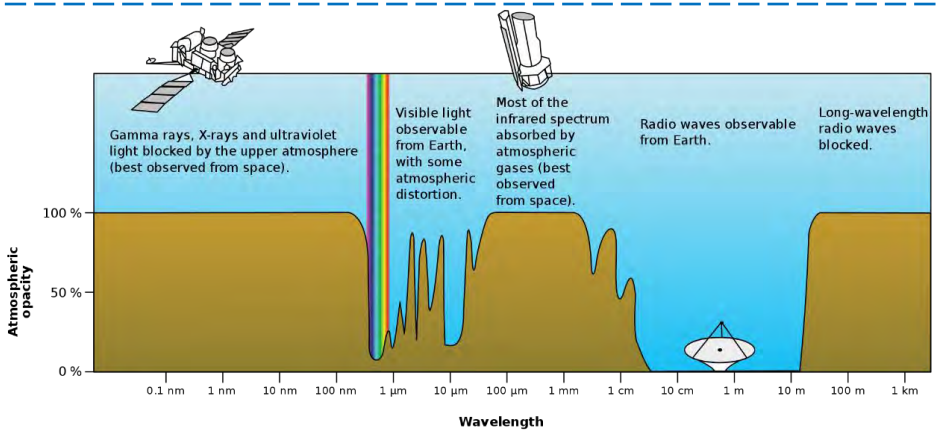
Speed of light (vacuum) = 300 000 000 m/s

Speed of sound in air = 330 m/s

Electromagnetic waves): All EM waves are transverse and all travel at the speed of light.



H – Electromagnetic waves through space : Stars and other space objects emit EM waves at all wavelengths. Some EM waves are absorbed by the atmosphere, making it difficult to detect EM radiation at those wavelengths. For example, radio waves can be observed on Earth, but gamma rays and x-rays cannot.



Uses of radation : Listed in order from lowest frequency (longest wavelength) to highest frequency (shortest wavelength).

Radio waves: Transmitting radio & TV broadcasts; aircraft communication systems; some satellite communications.

Microwaves: Communications & satellite transmissions; mobile phones; microwave ovens.

Infrared: Short range communication (e.g. TV remote); optical fibres (phone lines & internet); grilling or toasting food; heaters.

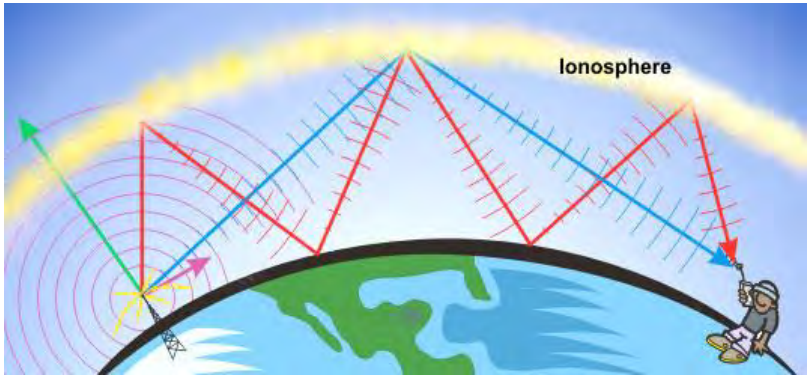
Visible light: Eyes; cameras; TV.

Ultraviolet (UV): UV rays carry more energy and are capable of damaging living tissue. Kills micro-organisms (e.g. at a sewage treatment plant) and is used in fluorescent material (e.g. security markings on valuable products and cash).

X-rays: Produces images of the skeleton (absorbed by bone but not by flesh or muscle); used to examine luggage in airport security scanners.

Gamma rays: Transfers a lot of energy and can kill cells. Used to kill cancer cells during radiotherapy, as gamma rays are focused onto cancerous cells. Chemicals that emit gamma rays are injected into the body and collect within cancerous cells, allowing the cancer to be precisely located.

H – Uses of radiation – Atmospheric reflection : Radio waves are used to transmit signals around the world, including over the horizon, without using satellites. Waves travel in a straight line, so how is this possible? Some radio waves are reflected by the ionosphere, an outer layer of the atmosphere. This means they can be transmitted from one location and reflected by the ionosphere and the ground many times until they reach their destination (see below).

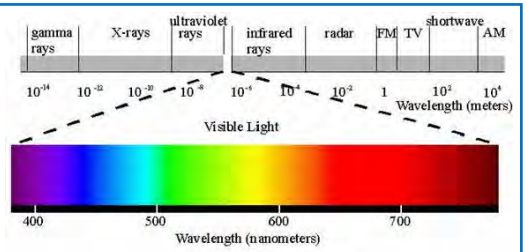


Radiation & temperature

Intensity = amount of radiation emitted by an object.

Intensity increases as temperature increases.

Higher temperature = shorter wavelength emitted. Therefore hotter objects emit blue light while cooler objects emit red light.



Dangers of EM radiation : All waves transfer energy. If the wave is absorbed by a material then the energy is absorbed into that material, possibly causing damage or causing the material to heat up.

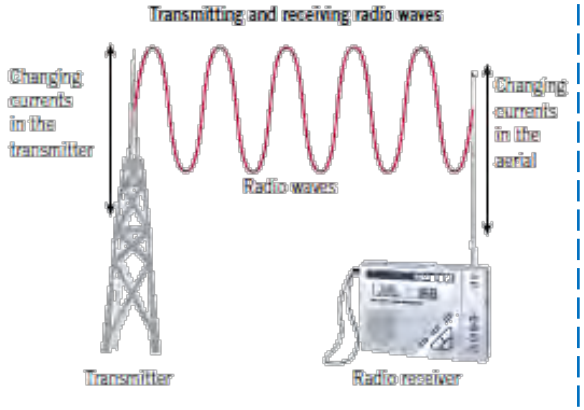
Infrared: Our skin absorbs infrared radiation, which we feel as heat. Too much infrared radiation can burn the skin and kill cells.

Ultraviolet (UV) radiation: Higher frequency and therefore higher energy. Sunlight contains UV radiation. Too much UV radiation causes sunburn and can damage the skin's DNA, causing skin cancer.

X-rays: Very high frequency, therefore very high energy levels. Too much exposure to x-rays causes cancer. This is why radiographic nurses (who administer x-rays in hospitals) wear lead aprons. The lead absorbs the x-rays and stops them reaching the radiographic nurse. A few x-rays in hospital will not harm you, but constant exposure to x-rays (as the nurse experiences) could cause long-term damage.

Gamma rays: Highest possible energy levels. Gamma rays are highly ionizing, which means that they can cause atoms to lose electrons. Atoms that have lost electrons become charged ions and react in different ways. If this happens in the body, this can lead to cancer or genetic mutations.

H – Uses of radiation – Aerials : Radio waves are produced by oscillations (variations in current & voltage) in electrical circuits. Aerials transmit these radio waves as current oscillates up and down them. An incoming radio wave generates an oscillating (varying) current in a receiving aerial (like your TV aerial), which can be decoded to reproduce the signal that was originally sent.

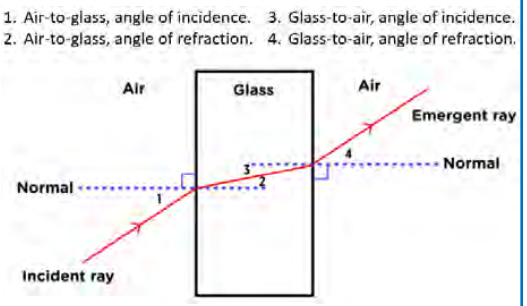


Refraction

Normal line is at 90° to the material surface.

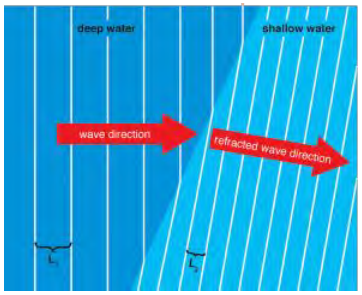
From less dense to a more dense material: light bends towards normal.

From more dense to less dense material: light bends away from the normal.



H – Refraction:

Speed of waves depends on depth of water. Shallow water causes waves to slow down and refract. Wavelength is also reduced.



Waves crossing boundaries :

Waves can be:

Reflected: the wave "bounces off".

Refracted: Wave passes into new material, but its direction changes.

Transmitted: Wave passes through new material.

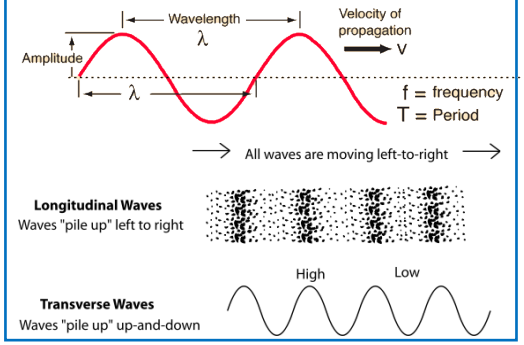
Absorbed: Wave disappears and its energy is transferred to the material.

Describing waves

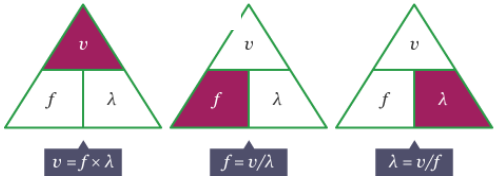
Frequency f: number of wavelengths passing a point per second (Hz).

Wavelength λ : Distance between two consecutive peaks (m).

Period T: Time taken for one wavelength to pass a point (s).



Wave speed

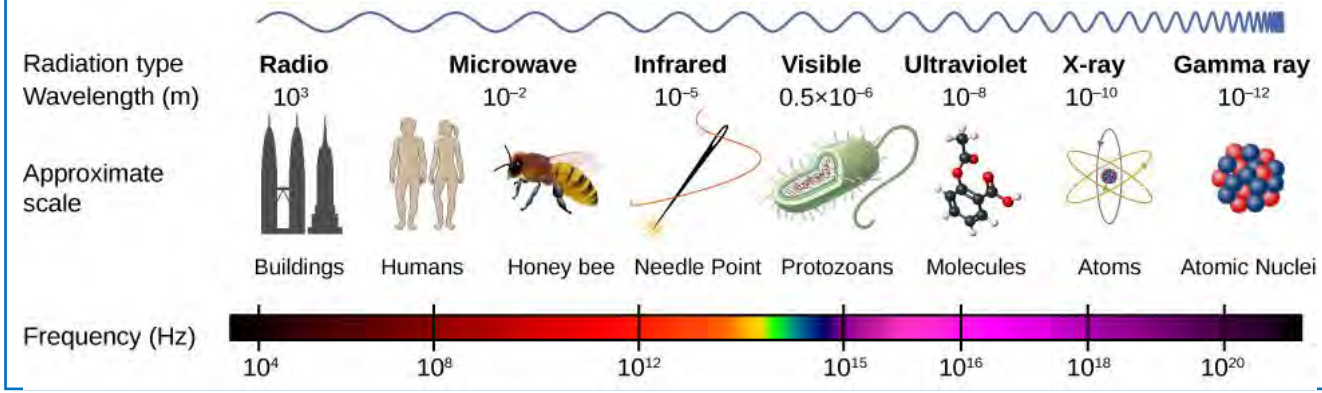


Speed of light (vacuum) = 300 000 000 m/s

Speed of sound in air = 330 m/s

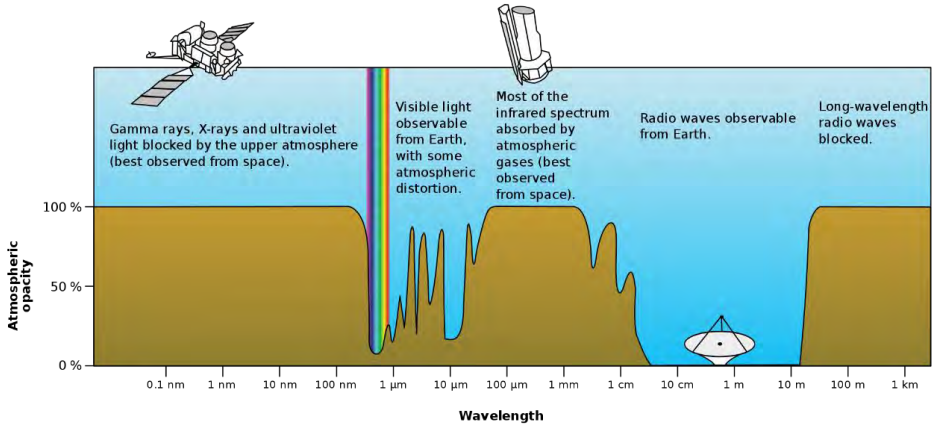
Electromagnetic waves :

All EM waves are transverse and all travel at the speed of light.



H – Electromagnetic waves through space:

Stars and other space objects emit EM waves at all wavelengths. Some EM waves are absorbed by the atmosphere, making it difficult to detect EM radiation at those wavelengths. For example, radio waves can be observed on Earth, but gamma rays and x-rays cannot.



Uses of radiation : Listed in order from lowest frequency (longest wavelength) to highest frequency (shortest wavelength).

Radio waves: Transmitting radio & TV broadcasts; aircraft communication systems; some satellite communications.

Microwaves: Communications & satellite transmissions; mobile phones; microwave ovens.

Infrared: Short range communication (e.g. TV remote); optical fibres (phone lines & internet); grilling or toasting food; heaters.

Visible light: Eyes; cameras; TV.

Ultraviolet (UV): UV rays carry more energy and are capable of damaging living tissue. Kills micro-organisms (e.g. at a sewage treatment plant) and is used in fluorescent material (e.g. security markings on valuable products and cash).

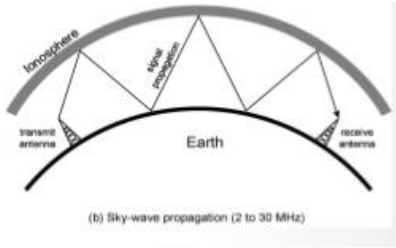
X-rays: Produces images of the skeleton (absorbed by bone but not by flesh or muscle); used to examine luggage in airport security scanners.

Gamma rays: Transfers a lot of energy and can kill cells. Used to kill cancer cells during radiotherapy, as gamma rays are focused onto cancerous cells. Chemicals that emit gamma rays are injected into the body and collect within cancerous cells, allowing the cancer to be precisely located.

H – Uses of radiation – Aerials : Radio waves are produced by oscillations (variations in current & voltage) in electrical circuits. Aerials transmit these radio waves as current oscillates up and down them. An incoming radio wave generates an oscillating (varying) current in a receiving aerial (like your TV aerial), which can be decoded to reproduce the signal that was originally sent.

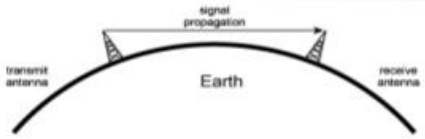
Sky propagation:

- Radio waves radiate to the ionosphere then they are reflected back to earth.

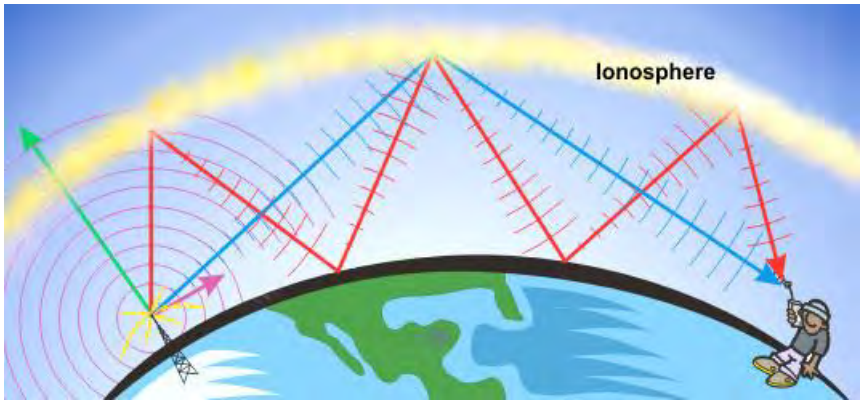


Line-of-Sight Propagation:

- In straight lines directly from antenna to antenna.



H – Uses of radiation – Atmospheric reflection: Radio waves are used to transmit signals around the world, including over the horizon, without using satellites. Some radio waves are reflected by the ionosphere, an outer layer of the atmosphere. This means they can be transmitted from one location and reflected by the ionosphere and the ground many times until they reach their destination.



Dangers of EM radiation : All waves transfer energy. If the wave is absorbed by a material then the energy is absorbed into that material, possibly causing damage or causing the material to heat up.

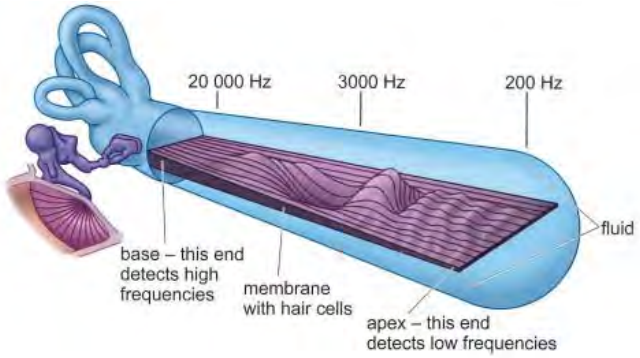
Infrared: Our skin absorbs infrared radiation, which we feel as heat. Too much infrared radiation can burn the skin and kill cells.

Ultraviolet (UV) radiation: Higher frequency and therefore higher energy. Sunlight contains UV radiation. Too much UV radiation causes sunburn and can damage the skin's DNA, causing skin cancer.

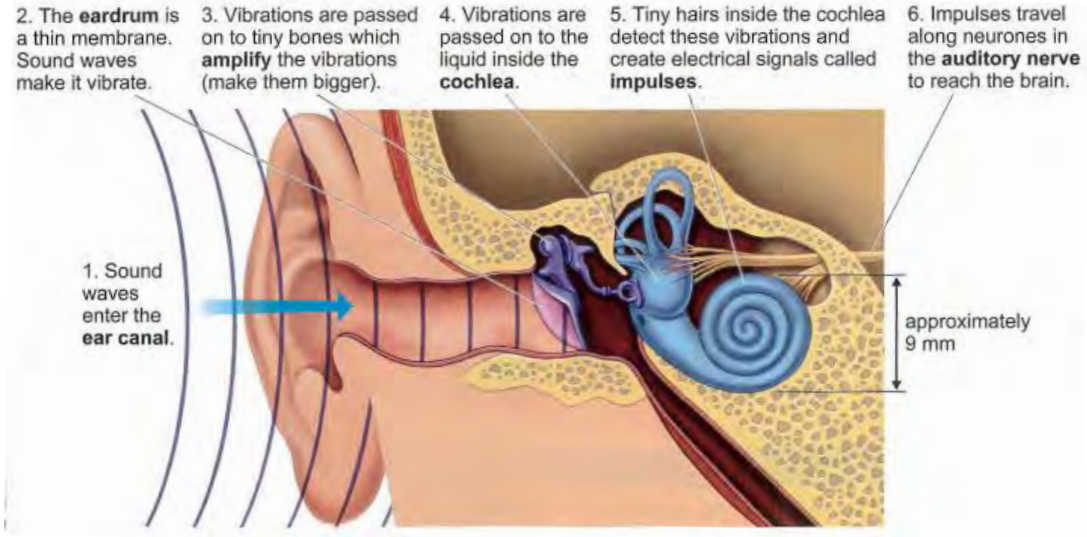
X-rays: Very high frequency, therefore very high energy levels. Too much exposure to x-rays causes cancer. This is why radiographic nurses (who administer x-rays in hospitals) wear lead aprons. The lead absorbs the x-rays and stops them reaching the radiographic nurse. A few x-rays in hospital will not harm you, but constant exposure to x-rays (as the nurse experiences) could cause long-term damage.

Gamma rays: Highest possible energy levels. Gamma rays are highly ionizing, which means that they can cause atoms to lose electrons. Atoms that have lost electrons become charged ions and react in different ways. If this happens in the body, this can lead to cancer or genetic mutations.

H - Ears and hearing - How the cochlea works : The cochlea detects the different frequencies arriving at the human ear. The thickest part of the cochlea vibrates at the highest frequencies. The thinnest parts vibrate at the lowest frequencies. The cochlea is rolled up like a carpet, but is shown below unrolled:



H – Ears and hearing : Human ears detect sound waves in the environment, allowing us to hear.

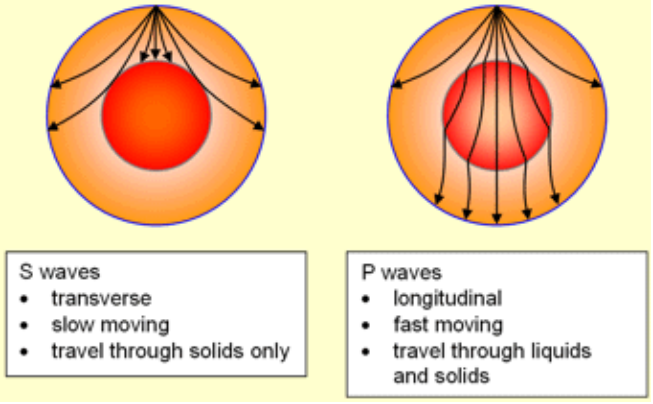


H – Infrasound : Frequencies lower than 20 Hz (lower than the range of human hearing). Examples include waves generated by earthquakes. Earthquakes consist of:

P waves: Longitudinal; can travel through Earth's core.

S waves: Transverse, cannot travel through Earth's core.

Both types of waves leave shadow zones around parts of the Earth's surface.



H – Ultrasound : Frequencies higher than 20 000 Hz (beyond human hearing) are called ultrasound. Some animals such as dolphins or bats use it to communicate and to "see" their surroundings. It is also used to make images of things inside the body, such as a foetus (unborn baby).