

Knowledge Organisers



Term 5 and 6

Year 10

Contents List

Maths

English

Science

Options subjects



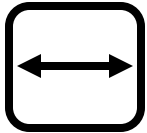
How to revise

Successful Learning Takes Place Over Time

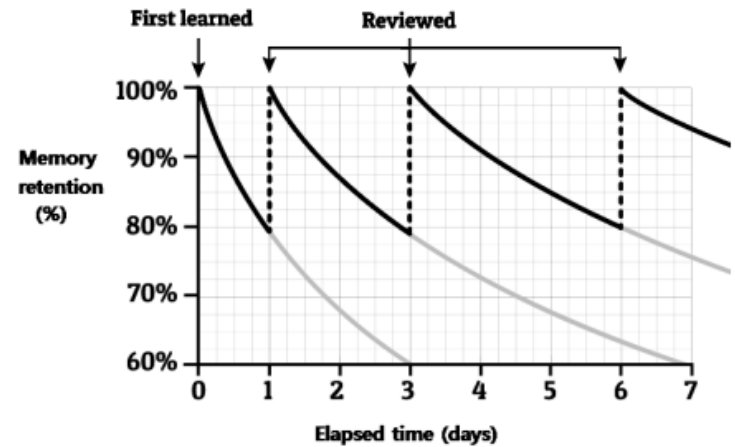


It's rare for anyone to be completely comfortable with something they learn for the first time. This could be a new piece of music, dance move, language or chemistry. We all have to practice. In most instances, the aim is to be at your optimum on the day it matters, e.g. the performance, race or exam. 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...

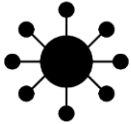
- List as many keywords as you can
- List as many facts as you can
- List as many key events/quotes/individuals as you can
- List as many causes of X as you can
- List as many consequences of Y as you can

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: | Don't: |
| ✓ ...make flashcards quickly. | X ...spend more time making flashcards than actually using them. |
| ✓ ...put a single piece of information of each flashcard. | X ...put lots of information onto each flashcard. |
| ✓ ...sort your flashcards according to your confidence with them (see below). | X ...revise the flashcards in the same order every time that you use them. |
| ✓ ...test yourself on the flashcards from memory. | 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?

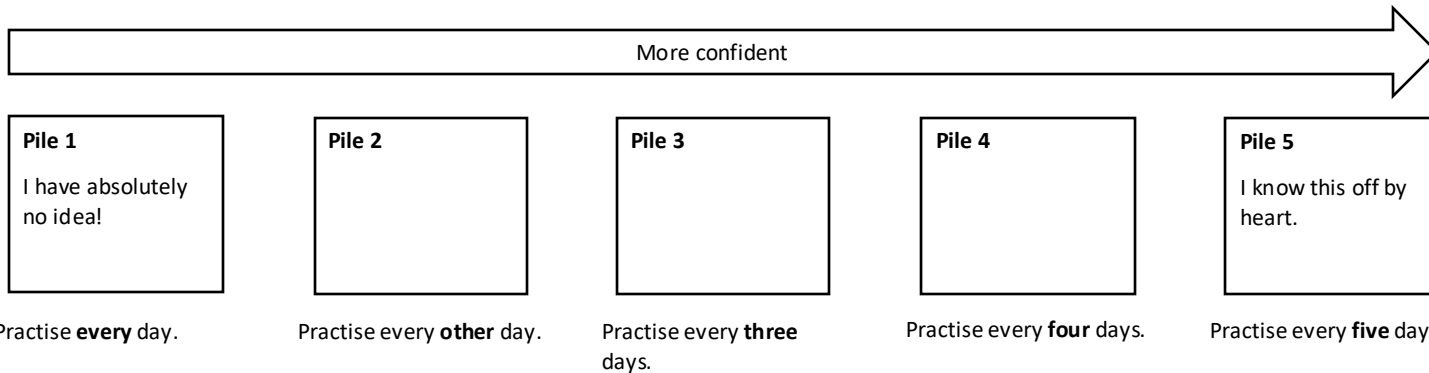
How to make flashcards:

- You can buy 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.

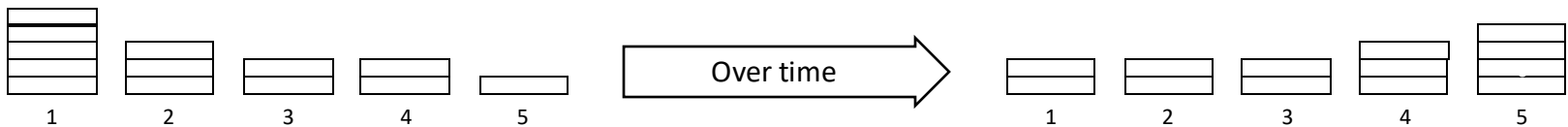
Definition 1	Definition 2	Definition 3	Definition 4	Definition 5
Answer 1	Answer 2	Answer 3	Answer 4	Answer 5

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):



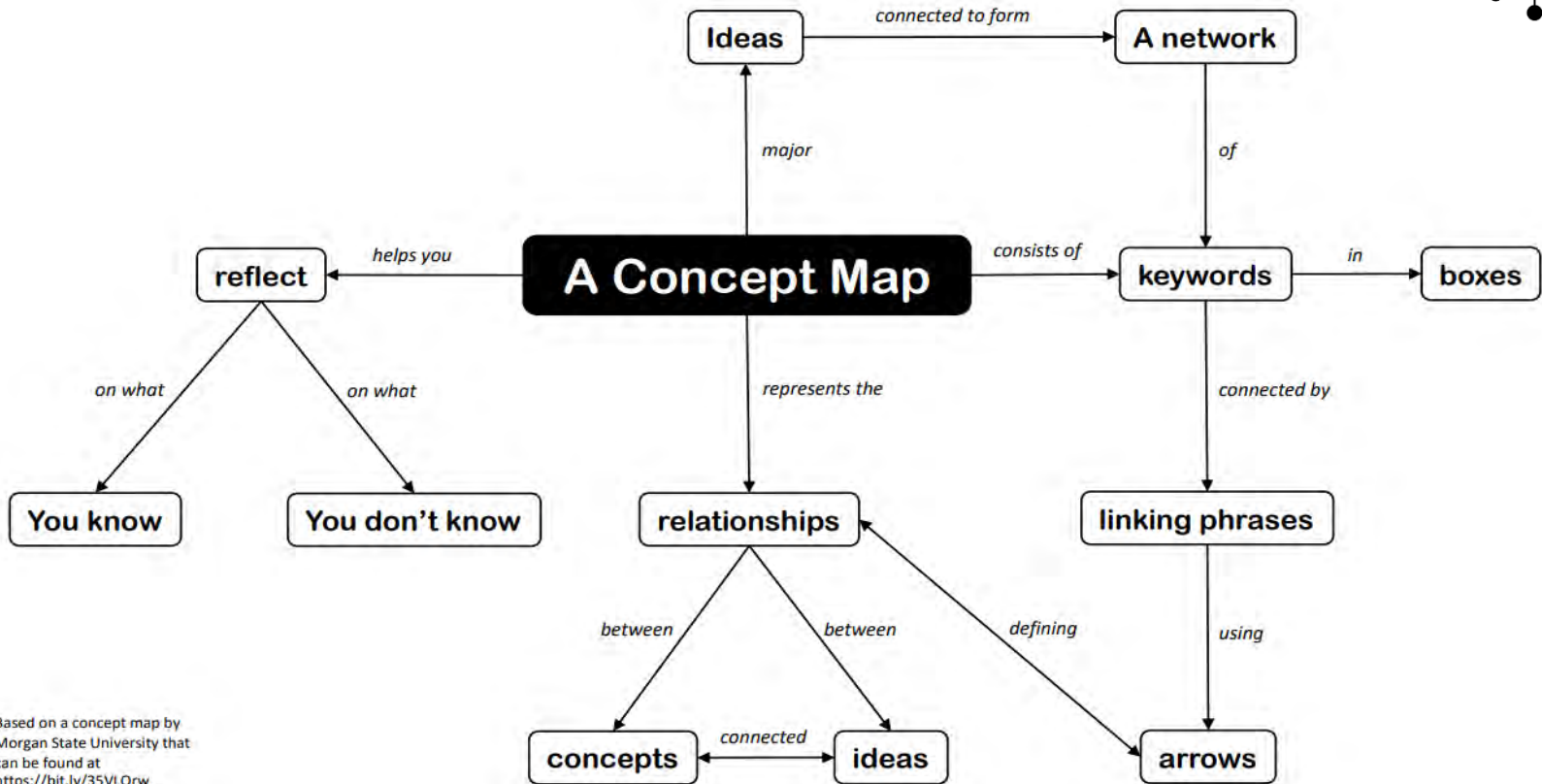
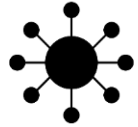
5. As you test yourself on the different piles, move the cards into different piles as you become more confident.



Useful resources:

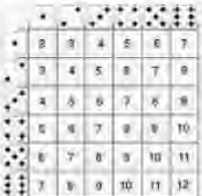
www.quizlet.com – This free website allows you to quickly create flashcards which you can print, use on a computer, or use on your phone.

Mapping

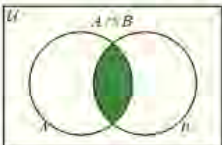


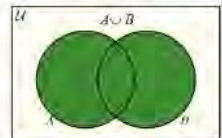
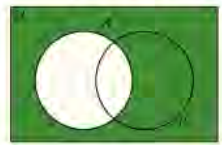
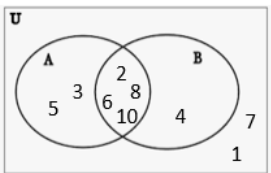
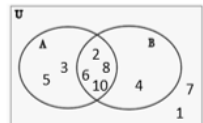
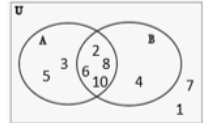
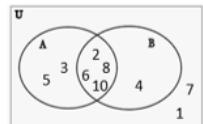
Based on a concept map by Morgan State University that can be found at <https://bit.ly/35VLQrw>

Sample Space Diagrams

Two coins are flipped, what is the probability of throwing HH?	$\begin{matrix} \text{HH} & \text{HT} & \text{TH} & \text{TT} \\ \hline & & & \\ & & & \\ & & & \\ & & & \end{matrix}$ $\frac{1}{4}$
Here is a sample space diagram of rolling two dice and finding the sum (adding) their scores	
	
How many outcomes are there?	$6 \times 6 = 36$
$P(\text{scoring a 3})$	$\frac{2}{36}$
$P(\text{scoring a 7})$	$\frac{6}{36}$
$P(\text{scoring a prime number})$	Primes: 2, 3, 5, 7, 11 $\frac{15}{36}$

Venn Diagrams

Set notation uses _____ brackets	Curly brackets $\{ \}$
ξ means	The universal set (all the elements allowed to be used)
$\xi = \{\text{numbers less than 20}\}$ $P = \{\text{multiples of 4}\}$ List the elements of set P	$\{4, 8, 12, 16\}$
$A \cap B$ means How would this be shaded on a Venn diagram?	Intersection of A and B 

$A \cup B$ means How would this be shaded on a Venn diagram?	Union of A and B 
What does A' mean? How would this be shaded on a Venn diagram?	The complement of A (not A) 
$\xi = \{1 \leq x \leq 10\}$ Set A = $\{2, 3, 5, 6, 8, 10\}$ Set B = $\{2, 4, 6, 8, 10\}$ Complete a Venn diagram for set A and B	$\xi = \{1 \leq x \leq 10\}$ Set A = $\{2, 3, 5, 6, 8, 10\}$ Set B = $\{2, 4, 6, 8, 10\}$ 
What does $P(A \cap B)$ mean?	Probability of choosing an element in in the intersection
 What is $P(A \cap B)$?	$\frac{4}{10}$
 What is $P(A \cup B)$?	$\frac{8}{10}$
 What is $P(A')$?	$\frac{3}{10}$

Product Rule (independent events)

Systematic: done in an order or following a particular method or plan

Independent events: the outcome (result) of one event, does not effect the outcome (result) of another event

Product rule for counting: if there are m ways of choosing from group A, and n ways of choosing from group B, and these choices are independent events, then there are $m \times n$ ways of choosing one item from each group.

Combinations:
number of ways

A restaurant offers 3 courses:

Starter	Main	Dessert
Tomato Soup Samosas	Pizza Cheeseburger Salad	Ice Cream Tiramisu

List all the different 3 course meal combinations.

TPI	TCI	TSI	SPI	SCI	SSI
TPT	TCT	TST	SPT	SCT	SST

In a class there are 16 girls and 14 boys. How many ways are there of picking 1 girl and 1 boy?

$$16 \times 14 = 224 \text{ different pairs.}$$

Product Rule (dependent events)

Dependent events: the result of one event *has* an effect on the result of another event.
E.g. when you choose 2 items from the same group, without replacing the first item, then for your second choice you have less things to choose from - the first event (choice) has restricted your choices for the second event.

If you choose 3 letters from the alphabet, how many 3 letter 'words' can you make?

$$26 \times 26 \times 26 = 17,576$$

The choices here are independent of each other because you can choose the same letter each time, so you always have 26 choices

If you choose 3 **different** letters from the alphabet, how many 3 letter 'words' can you make?

$$26 \times 25 \times 24 = 15,600$$

The choices here are dependent on each other because you cannot use the same letter twice, so if you choose 'a' for your first letter, on your second pick you only have 25 other choices

Product Rule (the effect of order)

The number of different outcomes we count depends on whether we care about the order of the items chosen. For example, we might consider the outcome ABC equivalent to BCA - you still end up with the same 3 letters. If we count these as the 'same outcome' it means there are fewer different outcomes in total.

Sally wants to choose 2 digits from the following:

2	3	4	5
---	---	---	---

How many ways can she do this if...

She is happy to use the cards more than once, so she allows 33 and she considers 34 different to 43

*These are independent events & order matters:
 $4 \times 4 = 16$ ways*

She does not allow repeats and she considers 43 different from 34.

*These are dependent events & order matters:
 $4 \times 3 = 12$ ways*

She does not allow repeats and she doesn't care about the order she picks in, so she considers 34 to be the same result as picking 43.

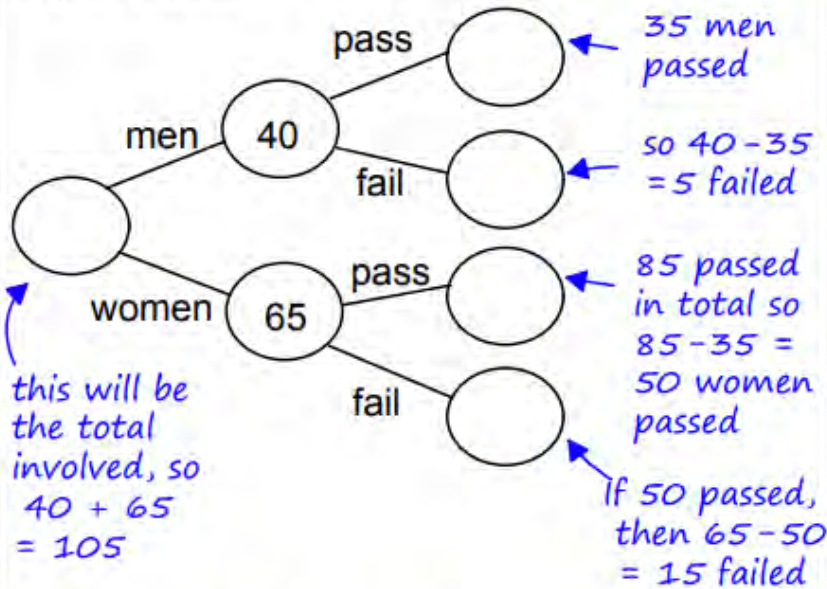
*These are dependent events & order does not matter:
 $(4 \times 3) \div 2 = 6$ ways*

We can divide by 2 because half the outcomes are the same as the other half \rightarrow 43 is the same as 34

A frequency tree or a two-way table can help us to sort information so that we can see how many items are in a particular group, or combination of groups.

A group of 40 men and 65 women were asked whether they had passed their GCSE in English. In total 85 people passed their GCSE in English, including 35 men.

Complete the frequency tree and work out the probability that a person in this group failed their English GCSE.



$$P(\text{failing}) = \frac{5+15}{105} = \frac{20}{105}$$

A group of 280 students had to choose whether to study French, German or Spanish. There were 150 girls and 82 girls chose French.

25 students chose German, 15 of whom were boys.

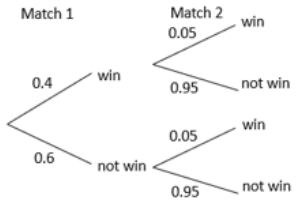
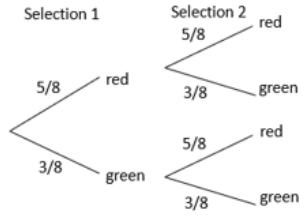
Complete the table and work out the probability that a girl will choose spanish.

	Girls	Boys	Total
French	82		
German		15	25
Spanish			
Total	150		280

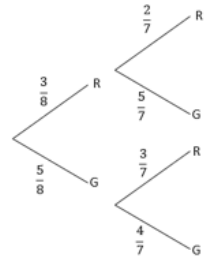
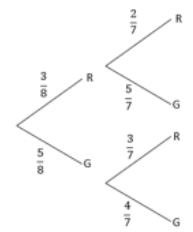
Girls taking German = $25 - 15 = 10$
 Girls taking Spanish = $150 - 82 - 10 = 58$,
 so $P(\text{female taking spanish}) = \frac{58}{150}$

[Notice this is out of 150 because we are asked the probability that a girl will take Spanish - so we are only considering girls]

Probability Trees (independent events)

<p>A team plays two matches</p> <p>The probability of winning match 1 is 0.4</p> <p>The probability of winning match 2 is 0.05</p> <p>Draw and label a probability tree</p>	
<p>Two find the probability of two outcomes occurring- you _____ the branches</p>	<p>multiply</p>
<p>Two counters are selected and replaced back into the bag each time.</p>	
	
<p>What calculation would you do for selecting both red?</p>	$\frac{5}{8} \times \frac{5}{8}$
<p>What calculation would you do for selecting one red?</p>	$(\text{red, green}) = \frac{5}{8} \times \frac{3}{8} = \frac{15}{64}$ $(\text{green, red}) = \frac{3}{8} \times \frac{5}{8} = \frac{15}{64}$ $\frac{15}{64} + \frac{15}{64} = \frac{30}{64}$
<p>What calculation would you do for selection at least one red</p>	$1 - (\text{green, green})$ $(\text{green, green}) = \frac{3}{8} \times \frac{3}{8} = \frac{9}{64}$ $1 - \frac{9}{64} = \frac{64}{64} - \frac{9}{64} = \frac{55}{64}$

Probability Trees (dependent events)

<p>A bag has 3 red and 4 green counters in it</p> <p>One is chosen at random and is not replaced.</p> <p>Another is then chosen.</p> <p>Draw and label a probability tree</p>	
<p>Two find the probability of two outcomes occurring- you _____ the branches</p>	<p>multiply</p>
<p>Two counters are selected and not replaced back into the bag each time.</p>	
	
<p>What calculation would you do for selecting both red?</p>	$\frac{3}{8} \times \frac{2}{7}$
<p>What calculation would you do for selecting one red?</p>	$(\text{red, green}) = \frac{3}{8} \times \frac{5}{7} = \frac{15}{56}$ $(\text{green, red}) = \frac{5}{8} \times \frac{3}{7} = \frac{15}{56}$ $\frac{15}{56} + \frac{15}{56} = \frac{30}{56}$
<p>What calculation would you do for selection at least one red</p>	$1 - (\text{green, green})$ $(\text{green, green}) = \frac{5}{8} \times \frac{4}{7} = \frac{20}{56}$ $1 - \frac{20}{56} = \frac{56}{56} - \frac{20}{56} = \frac{36}{56}$

Circles

The perimeter of a circle is called	Circumference
	Diameter – passes through the centre
	Radius – half of the diameter
	Chord – cuts through the circle
	Tangent – touches the circle
	Arc – a fraction of the circumference
	Segment – area between a chord and the circumference
	Sector – area between 2 radii and the circumference
π means	Pi (3.14 to 2 decimal places)
To find the circumference of a circle	$\pi \times \text{diameter} \quad C = \pi d$
To find the area of a circle	$\pi \times \text{radius}^2 \quad A = \pi r^2$
If the radius is 5, the diameter is	10
If the diameter is 12, the radius is	6

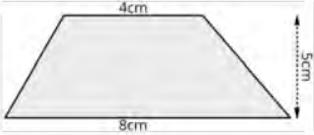
“Leave your answer as a multiple of Pi or in terms of Pi” means...	Leave the Pi symbol in your answer
Find the circumference of this circle in terms of Pi 	$r = 6$ $d = 12$ $\pi \times 12 = 12\pi \text{ cm}$
Calculate the area of this circle as a multiple of Pi 	$d = 12$ $r = 6$ $\pi \times 6^2 = 36\pi \text{ cm}^2$

**GCSE
Higher**

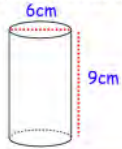
The formula to find an arc length of a circle is...	$\frac{\text{angle}}{360} \times \pi \times \text{diameter}$
The formula to find the area of a circle sector is...	$\frac{\text{angle}}{360} \times \pi \times \text{radius}^2$
Calculate the arc length of this sector to 1 dp 	Angle = 120 $r = 8 \quad d = 16$ $\frac{120}{360} \times \pi \times 16 = 16.7 \text{ cm}$
Find the area of this circle sector 	Angle = 120 $r = 8 \quad d = 16$ $\frac{120}{360} \times \pi \times 8^2 = 66.98 = 67.0 \text{ cm}^2$
When finding the perimeter of sectors don't forget to...	Add the radii or diameter on at the end
Find the perimeter of this semi circle in terms of Pi 	Angle = 180 $r = 6 \quad d = 12$ $\frac{180}{360} \times \pi \times 12 = 6\pi$ Add on the diameter $6\pi + 12$

Area, Perimeter, Volume & Surface Area

The perimeter of a shape is	The total of the lengths around the shape
The area of a shape is	The space the shape covers
The perpendicular height of a shape forms ...	Right angle with the base
Area of a rectangle	Base x perpendicular height
Area of a triangle	Base x perpendicular height ÷ 2
Area of a parallelogram	Base x perpendicular height
Area of a trapezium (given on exam aid)	$A = \frac{1}{2}(a + b)h$
Using the formula for the trapezium above which lengths are a, b and h?	<p>a=4</p> <p>b=8</p> <p>h=5</p>
What calculation would you do to find the area of the trapezium above?	<p>a+b 8+5 = 13</p> <p>x h 13 x 5 = 65</p> <p>÷ 2 65 ÷ 2 = 32.5cm²</p>



To find the surface area of a 3d object	Find the area of each face and add them together
You work out surface area when the question talks about	Painting the shape Covering the shape
The units of surface area are	Units squared e.g. cm ² or m ²
Surface area of a cylinder	$2\pi r^2 + 2\pi rh$
Find the surface area of this cylinder	<p>Use $2\pi r^2 + 2\pi rh$</p> <p>d=6 r=3 h=9</p> <p>$(2 \times \pi \times 3^2) + (2 \times \pi \times 3 \times 9)$</p> <p>= 18π + 54π</p> <p>= 72π cm²</p>



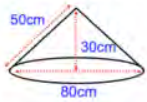
GCSE Higher

Volume of a cone can be found by	$\frac{1}{3} \times \pi \times \text{radius}^2 \times \text{height}$
Name the radius, length and height of this cone	<p>r = 40</p> <p>h = 30</p> <p>l = 50</p>
Volume of a sphere can be found by	$\frac{4}{3} \times \pi \times \text{radius}^3$
Volume of a square based pyramid can be found by	$\frac{1}{3} \times \text{area of square base} \times \text{height}$
1 litre = ___ cm ³	1000



Units of volume are	<i>units cubed e.g. cm³ m³</i>
A prism is	A 3d object where the cross-section is the same shape throughout. If you cut it, it will look the same throughout
Volume of a prism can be found by	<p>Area of cross section x length</p>
Volume of a cuboid can be found by	Length x width x height
Volume of a triangular prism can be found by	Length x width x height ÷ 2
Volume of a cylinder can be found by	$\pi \times \text{radius}^2 \times \text{height}$

Surface area of a cone can be found using	$\pi r^2 + \pi rl$
Find the surface area of this cone	<p>Use $\pi r^2 + \pi rl$</p> <p>r = 40 l = 50</p> <p>$\pi \times 40^2 + \pi \times 40 \times 50$</p> <p>= 1600π + 2000π</p> <p>= 3600π cm²</p>



Straight Line (Linear) graphs

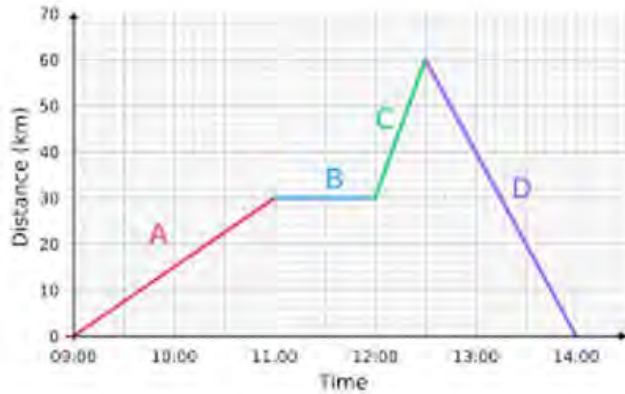
Linear graphs are	Straight lines												
The general equation for a straight line is	$y = mx + c$												
M is the	Gradient (steepness)												
C is the	y-intercept (where it crosses the y-axis)												
y-intercept co-ordinates always start with	0 e.g. (0, 4)												
To plot a <u>straight line</u> graph from $x=-2$ to $x=2$	Draw a table of values <table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 10%; padding: 2px;">x</td> <td style="width: 10%; padding: 2px;">-2</td> <td style="width: 10%; padding: 2px;">-1</td> <td style="width: 10%; padding: 2px;">0</td> <td style="width: 10%; padding: 2px;">1</td> <td style="width: 10%; padding: 2px;">2</td> </tr> <tr> <td style="padding: 2px;">y</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> </tr> </table>	x	-2	-1	0	1	2	y					
x	-2	-1	0	1	2								
y													
$y=3x + 2$ means	Multiply the x by 3 then add 2												
What will the graph of $y = 6x + 5$ look like?	A straight line, going up from left to right Gradient of 6 Y-intercept of (0, 5)												
What will the graph of $y = -6x + 5$ look like?	A straight line, going down from left to right Gradient of -6 Y-intercept of (0, 5)												
$y = 3x + 2$ Gradient = y-intercept =	Gradient = 3 y-intercept = (0, 2)												
$y = 2 + 3x$ Gradient = y-intercept =	Gradient = 3 y-intercept = (0, 2)												
$y = 2 - 3x$ Gradient = y-intercept =	Gradient = -3 y-intercept = (0, 2)												
To find the gradient from a plotted graph with a positive gradient	Draw a triangle joining 2 points - up is positive $\frac{\text{difference in } y}{\text{difference in } x} = \frac{12}{3} = 4 \text{ (positive slopes up)}$												

To find the gradient of a plotted graph with a negative gradient	Draw a triangle joining 2 points - down is negative $\frac{\text{difference in } y}{\text{difference in } x} = \frac{-9}{3} = -3 \text{ (negative slopes down)}$
To find the gradient between two co-ordinates (x_1, y_1) and (x_2, y_2)	$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$
The formula is	$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$
Find the gradient between $(-4, 3)$ and $(2, -9)$	(-4, 3) and (2, -9) LABEL (x_1, y_1) and (x_2, y_2) CALCULATE GRADIENT using formula above $\frac{-9 - 3}{2 - -4} = \frac{-12}{6} = -2$
Parallel lines have the same _____	gradient

GCSE Higher

Show that (3,5) lies on the line $y = 2x - 1$	$x = 3 \quad y = 5$ $5 = 2 \times 3 - 1$
Two lines are perpendicular if...	They cross at a right angle
Gradients are perpendicular if they	Multiply to make -1
To find a perpendicular gradient	Find the negative reciprocal
What are the perpendicular gradients to:	a) $\frac{1}{5}$ b) -3 c) $\frac{3}{2}$ d) $-2.5 = -\frac{5}{2}$ so $\frac{2}{5}$ would be perpendicular

Real Life Graphs



Which part of the graph shows when the car is stationary for?

B

How long was the car stationary for?

30 mins

Which part of the journey is a faster speed A or C?

C as it steeper (higher gradient)

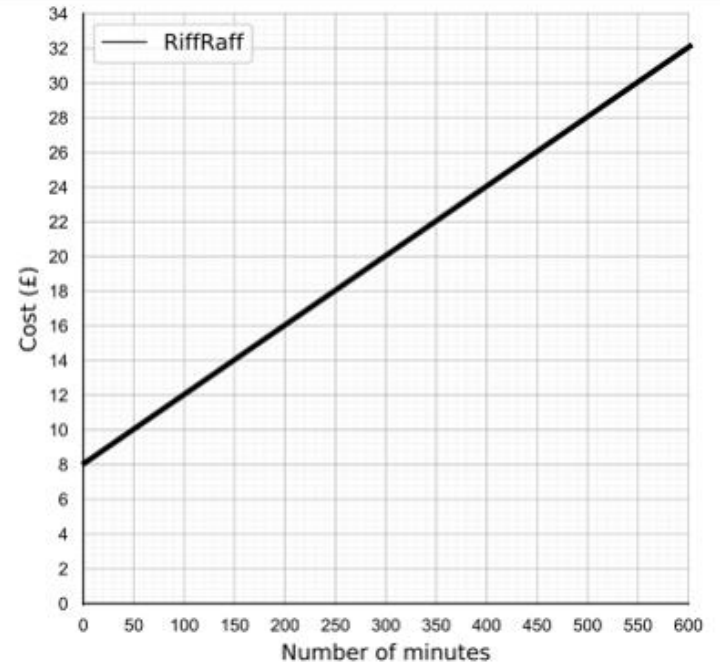
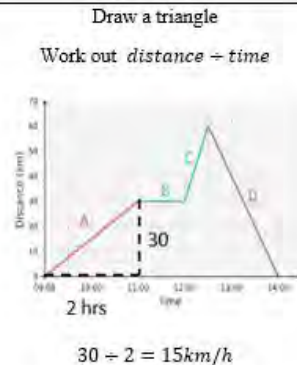
How far away from the starting destination did the car travel before returning home?

60km

How would you work out the average speed of the journey?

Total distance (60) divided by total time (5 hours)
 $60 \div 5 = 12$

How would you work out the average speed of section A?



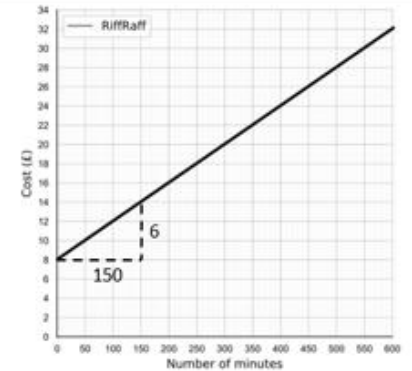
What is the standing charge for the mobile phone tariff?

£8

What is the cost when 300 minutes are used?

£20

How would you work out the cost per minute?

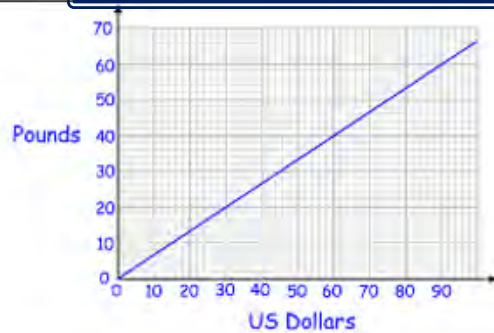


Draw a triangle and find the gradient

$$\frac{\text{change in } y}{\text{change in } x} = \frac{6}{150} = 0.04$$

4p per minute

Real Life Graphs cont.

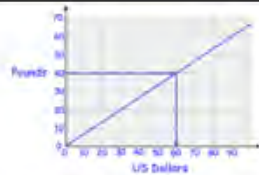


Convert \$40 to pounds (£)



Use a ruler Be accurate £26

Convert £40 to dollars (\$)



Use a factor of 400 and scale up

Convert \$400 to pounds (\$400 is not on the graph)

$$\$400 = £260$$

$$\$400 = £260$$

Calculate the exchange rate £1 = \$ _____



£40	\$60
£1	\$1.50

Exchange rate £1 = \$1.50

Function Notation

GCSE
Higher

$f(x) = 3x + 1$ Work out $f(2)$	<i>Substitute $x=2$ into the function</i> $3(2) + 1 = 7$
$f(x) = 3x + 1$ Solve $f(x) = 2$	<i>Form an equation equal to 2 and solve by balancing and elimination</i> $3x + 1 = 2$ $3x = 1$ $x = \frac{1}{3}$

Equation of a Circle

GCSE
Higher

The equation of a circle with centre $(0,0)$ is	$x^2 + y^2 = r^2$
The equation of a circle is $x^2 + y^2 = 100$ What is the centre?	$(0,0)$
The equation of a circle is $x^2 + y^2 = 100$ What is the radius?	$\sqrt{100} = 10$
The equation of a circle is $x^2 + y^2 = 100$ Show that the point $(8,6)$ lies on the line	$x = 8 \quad y = 6$ $8^2 + 6^2 = 64 + 36 = 100$
A circle with centre $(0,0)$ and a radius is 6 What is the equation of the circle?	$x^2 + y^2 = 6^2$ $x^2 + y^2 = 36$
Write the equation of the circle below	 Radius = 2 $x^2 + y^2 = 2^2$ $x^2 + y^2 = 4$

Explain the steps to solve $10x^2 = 250$	Divide both by sides by 10 to give $x^2 = 25$ Square root $x = \sqrt{25}$ Include +5
To factorise $x^2 + 5x + 6$ into two brackets you...	List factor pairs of 6... 1,6 2,3 Choose the pair that sum to 5 $(x + 2)(x + 3)$
To solve a quadratic equation by factorising it must equal	= 0
To solve a quadratic equation	1. Check it =0 2. Factorise 3. Set each bracket =0 and solve by balancing
Solve $x^2 + 5x + 6 = 0$	$(x + 3)(x + 2) = 0$ $(x + 3) = 0$ and $(x + 2) = 0$ $x = -2$ and $x = -3$
Solve $x(x - 3) = 0$	$x = 0$ and $x - 3 = 0$ so $x = 3$
Solve $(2x + 3)(2x - 5) = 0$	$2x + 3 = 0$ so $x = -\frac{2}{3}$ $2x - 5 = 0$ so $x = \frac{5}{2}$

Complete the square form is	$(x + a)^2 + b$
Write $y = x^2 + 6x - 3$ in the form $y = (x + a)^2 + b$	$a = 3$ (half the 6x term)
What is a?	
How do you find b?	Expand the squared bracket $(x + 3)^2 = (x + 3)(x + 3)$ $= x^2 + 6x + 9$ Now find the difference $x^2 + 6x - 3$ $\underline{-x^2 + 6x + 9}$ $\underline{\quad\quad\quad -12}$ $b = -12$
Write the in form $(x + a)^2 + b$	$(x + 3)^2 - 12$
If the completed square form is $(x + 3)^2 - 12$	Opposite inside Copy outside $(-3, -12)$
What is the co-ordinate of the turning point?	

1) Factorising

GCSE Higher

2) Using the formula

The quadratic formula is	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
We use the quadratic formula when we cannot...	Factorise into brackets
To solve a quadratic equation, it must equal	= 0
Name a, b and c for $2x^2 - 8x - 3 = 0$	$a = 2$ $b = -8$ $c = -3$
I need to be careful with b when	When it is negative
What would the formula look like for $2x^2 + 8x - 3 = 0$	$a = 2$ $b = 8$ $c = 3$ $\frac{-8 \pm \sqrt{(8)^2 - 4(2)(-3)}}{2(2)}$
What would the formula look like for $2x^2 - 8x - 3 = 0$	$a = 2$ $b = -8$ $c = 3$ $\frac{8 \pm \sqrt{(8)^2 - 4(2)(-3)}}{2(2)}$ $-- 8 = 8$








GCSE Higher

3) Completing the square

Solving Quadratics cont.

GCSE
Higher

4) Graphically

<p>The shape of a quadratic graph is</p>	<p>A smooth bell <u>curve</u></p> 
<p>In this quadratic graph x^2 is...</p> 	<p>Positive</p>
<p>In this quadratic graph x^2 is...</p> 	<p>Negative</p>
<p>The roots of a quadratic graph are...</p>	<p>The values where it crosses the x axis (when $y=0$)</p> 
<p>The turning point of a quadratic graph is ...</p>	<p>the bottom or top of the curve</p> 
<p>A cubic graph has the highest power of __</p>	<p>3 e.g. $y = x^3 + 3x - 2$</p>
<p>The shape of a cubic graph is</p>	<p>A snake <u>shape</u></p> 
<p>A reciprocal graph like $y = \frac{1}{x}$ looks like...</p>	



Characters

Macbeth	A loyal warrior who becomes duplicitous as he becomes obsessed with the witches' prophecies of power.
Lady Macbeth	Macbeth's wife who drives his ambition in the beginning but loses her control by the end.
Banquo	Macbeth's close friend and ally who also receives prophecies.
Fleance	Banquo's son who represents innocence and justice.
Duncan	King of Scotland at the beginning of the play - a strong, respected leader.
Malcolm	Duncan's oldest son and next in line to the throne. Joins the English army to defeat Macbeth at the end of the play.
Donalbain	Duncan's youngest son disappears (to Ireland) after Duncan's murder.
Macduff	Macbeth's antagonist: A brave warrior who defeats Macbeth

Key Vocabulary

Ambition	A strong desire to achieve something
Apparition	A ghost or ghost-like image
Betrayal	Being disloyal
Hallucination	A vision of something which isn't there
Jacobean	Relating to the reign of King James I
Kinsman	A relative or blood relation
Regicide	The murder of an Anointed king
Noble	Belonging to aristocracy
Remorseless	Without guilt or regret
Usurp	To take a throne illegally
Thane	A man with land granted by the king
Treason	Betraying one's country
Virtuous	Having high standards

Writer's Methods

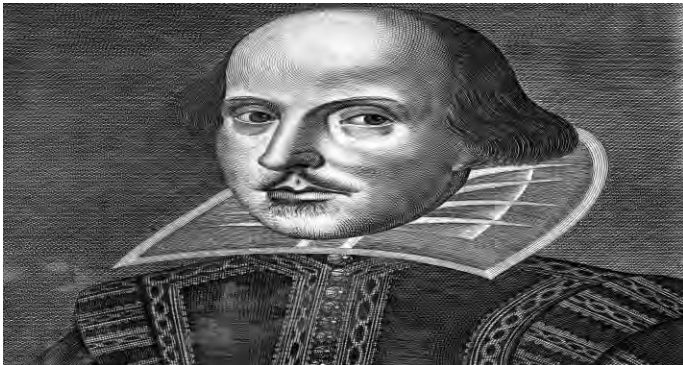
Use of soliloquy/ aside	Soliloquies are often used when characters have a decision to make. It shows characters in turmoil. Usually by the end they have made a decision.
Pathetic Fallacy	The weather reflects the mood. e.g. the play opens with 'thunder and lightning' -Shakespeare immediately sets an ominous mood.
Symbolism/ motif	When an object is used to represent a deeper more significant meaning. E.g. blood as a symbol of guilt in the play and sleep (or lack of) reveal the deterioration of Lady Macbeth and Macbeth's turmoil too.
Dramatic irony	When the audience knows something that one or more characters do not e.g. We know Duncan shouldn't trust Macbeth.

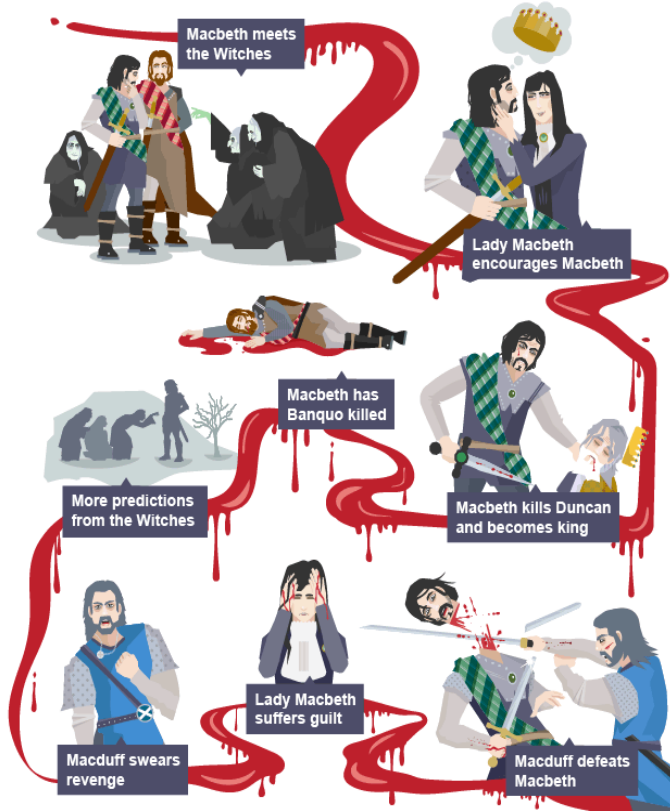
Conventions of Tragedy

Hamartia	The fatal flaw of the hero e.g. ambition
Tragic hero	High status character with a good reputation is led to his downfall through his hamartia
Catharsis	Sense of relief experienced by the audience when you know the hero's errors and don't make them yourself
Death	There are several murders throughout the play but order is restored at the end

Context

Divine Right	The belief that the King was chosen by God. Thus, to commit regicide meant disobeying the will of God. A Jacobean audience believed people who committed regicide would be punished by God.
Natural Order / The Great Chain of Being	A religious hierarchy where everything on earth was awarded a 'rank'. God was at the top, followed by angels, humans, animals and plants etc A Jacobean audience believed that if this hierarchy was interfered with then the natural order would be thrown into chaos.
The Gunpowder plot	King James I was the intended victim of Guy Fawkes' Gunpowder plot. This made him nervous of future regicide attempts. Shakespeare's 'Macbeth' would have been popular with King James because it shows that those who commit regicide are greatly punished / mentally tortured
Witchcraft	King James I was obsessed with magic and witchcraft and ordered several witch-hunts during his reign as King.





Key Themes

Ambition	Despite being a loyal and brave soldier at the beginning of the play, Macbeth cannot resist the power of his ambition (his fatal flaw). Lady Macbeth's ambition also knows no bounds. Both characters are willing to disobey God to fulfil their ambitions.
Appearance and reality	The Witches chant 'Fair is foul and foul is fair' in the very first scene. This is a play where people's outward appearances cannot be trusted. What might initially appear good, often turns out to be evil...
Guilt	Both Macbeth and Lady Macbeth are plagued by guilt after the regicide. As a result of this, the mental stability of both characters suffers a dramatic decline.
Power	The battle for power can be seen throughout the play. The power of God cannot be ignored or the power of the rightful king. Are Macbeth and Lady Macbeth punished for committing regicide (a sin against God)?
Order and chaos	At the beginning of the play, everything is in order. However, when Divine Right is challenged, with the murder of King Duncan, the balance of The Great Chain of Being is offset. The play's events that succeed the regicide are marked by chaos and disorder, Order is only restored at the very end of the play when the King is returned to its rightful owner: Malcolm (the eldest son of Duncan).

Key Quotes

'Look like the innocent flower but be the serpent underneath it'
Lady Macbeth Act 1 scene 5

'Pour my spirits in thine ear' 'come you sprits...unsex me here'
Lady Macbeth Act 1 scene 5

'I have no spur to prick the sides of my intent., only vaulting ambition'
Macbeth Act 1 scene 7

'A little water clears us of this deed'
Lady Macbeth Act 2 scene 2

'Would all great Neptune's ocean wash this blood from my hands?'
Macbeth Act 2 scene 2

"Thou has it now: king, Cawdor, Glamis, all, As the weird women promised, and, I fear, Thou play'dst most foully for't:"
Banquo Act 3 scene 1

"To be thus is nothing But to be safely thus."
Macbeth Act 3 scene 1

'Dead butcher and his fiend-like queen'
Malcolm Act 5 scene 9

Remains by Simon Armitage		Ozymandias by Percy Bysshe Shelley	
<i>probably armed, possibly not.</i>	Plosives and rhythmic balance of caesura hints at internal conflict of the soldier.	"look on my works ... and despair!" Nothing beside remains"	Juxtaposition of the statue's declaration of 'despair' and the emptiness around him shows how little the statue's work now means.
<i>his bloody life in my bloody hands.</i>	Repetition of adjective shows how narrator finds it difficult to separate himself from the looter or his guilt.	"sneer of cold command"	"Sneer" signifies that the statue was a cruel leader. "Cold command" alliteration intensifies effect of the word "cold"; connotations of brutality, a lack of caring.
<i>One of my mates goes by and tosses his guts back into his body.</i>	Contrast with the formality of 'tosses' and the horrific imagery of 'guts' shows his dehumanisation of the looter and his PTSD.	"that colossal wreck"	Contrast of "colossal" with implications of power, and "wreck" shows how time has ruined the statue. It is now a spectacle for the wrong reasons.
<i>I see every round as it rips through his life –</i>	Irony shown as the looter has been ripped apart by bullets but also a metaphor for how this incident has ripped through the life of the narrator.	"Half sunk a shattered visage lies"	"shattered visage" the statue's face has been destroyed over time. It is "half sunk", both the physical statue and the leader's reputation have been buried.
<i>Three of a kind all letting fly, and I swear</i>	Figure of speech shows casual nature of the retelling. The loss of individuality with 'three of a kind' shows he is trying to mitigate his guilt by saying he was a part of a group, rather than own up to his own actions.	"I met a traveller from an antique land"	"antique" creates intrigue and a mysterious atmosphere.

Tissue	
<i>our lives like paper kites</i>	<i>Metaphor highlights the significance that humanity has put on money.</i>
<i>Living tissue</i>	Volta here is when the poem is in fact revealed to be about living flesh
<i>Let the daylight break through capitals and monoliths</i>	Metaphor demonstrates the overwhelming power of daylight –something people cannot control



Charge of The Light Brigade

"Into the Valley of Death Rode the Six Hundred"	A metaphor to describe the opposition-dominated battlefield.
"Boldly they rode and well, Into the jaws of Death, Into the mouth of Hell"	The adverb 'boldly' reflects their undeterred demeanour, even though the extension of the metaphor (becoming the 'jaws of death') makes this appear more and more like a suicide mission.
"Someone had blundered."	Someone had made a mistake.
"Stormed at with shot and shell, While horse and hero fell. They that had fought so well Came through the jaws of Death,"	The use of rhyme in this stanza, stressing 'shell', 'fell', 'hell' and 'well.' These four words alone emphasise how horrific and dangerous the battle was, yet how the Light Brigade fought strongly and were prepared to die for their country in the face of it.

My Last Duchess

My last duchess painted on the wall	'my' is a possessive pronoun which suggests that the Duke 'owns' his wife. He sees her as an object
Flush that dies along her throat	This suggests that the Duke was jealous of his wife. He believed she was flirting with other men.
I gave commands and all smiles stopped	The personal pronoun 'I' tells us that he gave an order that caused her to lose her personality. Did he have her killed?
A heart – how shall I say- too soon made glad	Again, the suggestion here is that the Duke is jealous of his wife. He feels that his wife does not appreciate the social status that her marriage to the Duke gives her.
My gift of a nine-hundreds-year-old name	The Duke boasts about his status in society . It also shows us the loss of power that women encountered when they married. She has taken on his name and lost her own identity.

Poetic Techniques

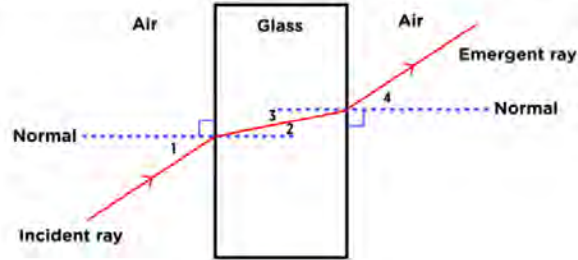
Anaphora	Repeated words at the start of lines of poetry
Rhyme and rhythm	Use in 'Charge of the Light Brigade' to recreate the sound of the charge
Metaphor and symbolism	Used in 'Tissue' to suggest and explore ideas

Plosives	Used to recreate the sound of explosions in 'Remains'
Dramatic monologue	Imagined speech by a character in 'My Last Duchess'
Colloquial language	Informal language used in 'Remains'

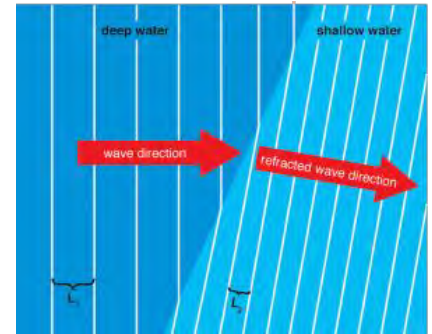
Refraction :

- 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.

1. Air-to-glass, angle of incidence.
2. Air-to-glass, angle of refraction.
3. Glass-to-air, angle of incidence.
4. Glass-to-air, angle of refraction.



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.

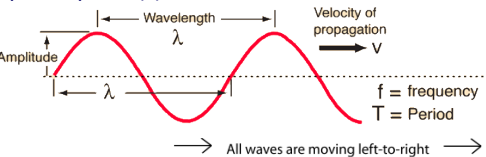


Describing waves

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

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

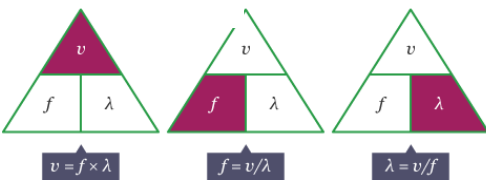
Period T : Time taken for one wavelength to pass a point (s).



Longitudinal Waves
Waves "pile up" left to right

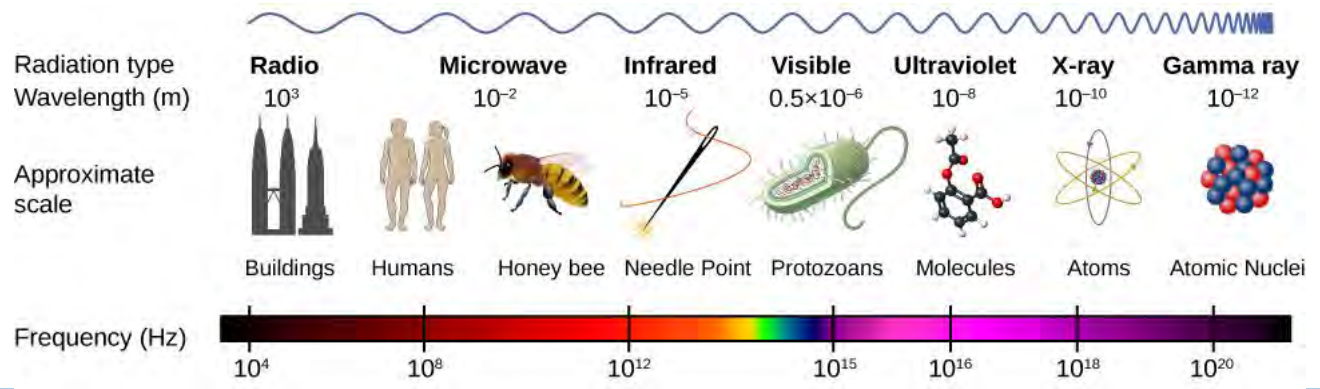
Transverse Waves
Waves "pile up" up-and-down

Wave speed

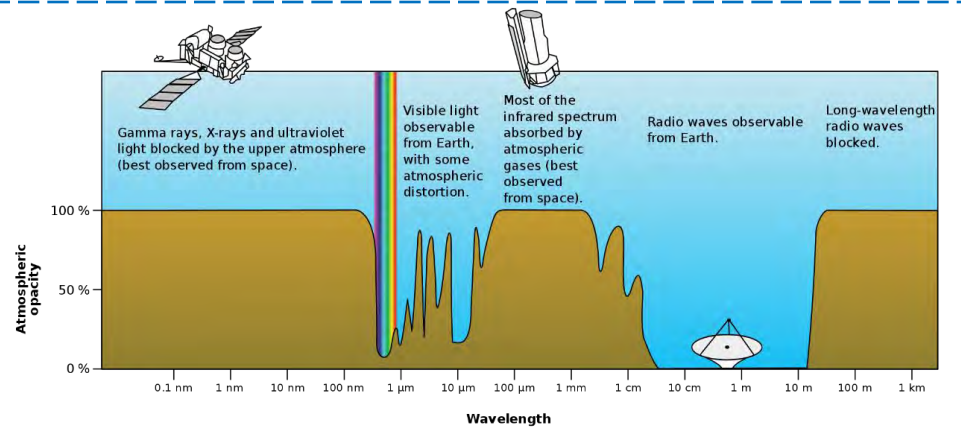


Speed of light (vacuum) = 300 000 000 m/s
Speed of sound in air = 330 m/s

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



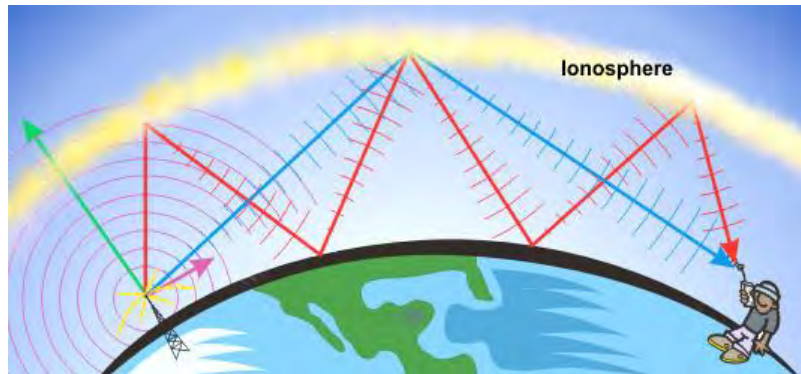
H – Electromagnetic waves through space : Stars and other space objects emit EM waves at all wavelengths. Some EM waves are absorbed by the atmosphere, making it difficult to detect EM radiation at those wavelengths. For example, radio waves can be observed on Earth, but gamma rays and x-rays cannot.



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

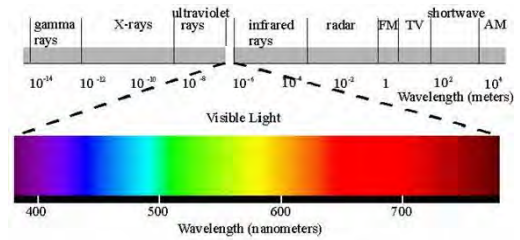
- **Radio waves:** Transmitting radio & TV broadcasts; aircraft communication systems; some satellite communications.
- **Microwaves:** Communications & satellite transmissions; mobile phones; microwave ovens.
- **Infrared:** Short range communication (e.g. TV remote); optical fibres (phone lines & internet); 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 – 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

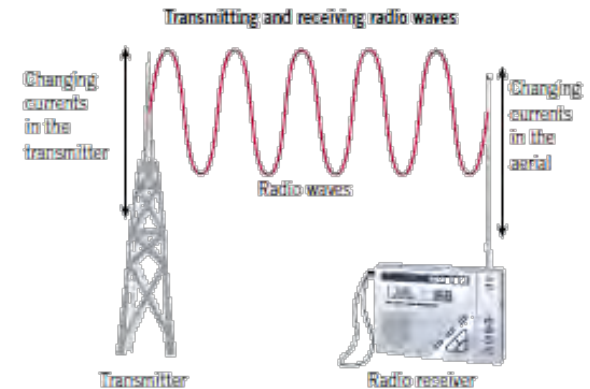
- Intensity = amount of radiation emitted by an object.
- Intensity increases as temperature increases.
- Higher temperature = shorter wavelength emitted. Therefore hotter objects emit blue light while cooler objects emit red light.



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.

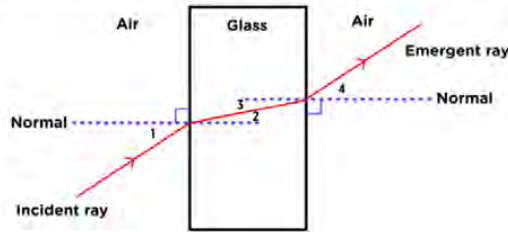
H – Uses of radiation – Aerials : Radio waves are produced by oscillations (variations in current & voltage) in electrical circuits. Aerials transmit these radio waves as current oscillates up and down them. An incoming radio wave generates an oscillating (varying) current in a receiving aerial (like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



Refraction

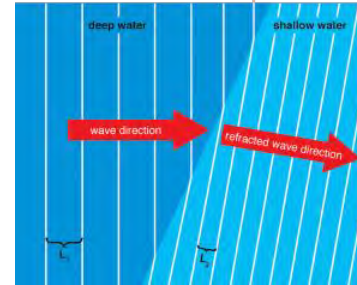
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H – Refraction:

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Waves crossing boundaries : Waves can be:

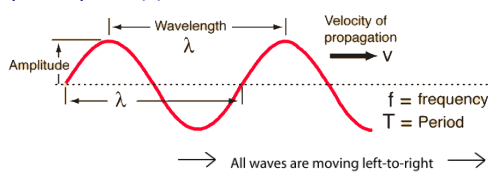
- **Reflected:** the wave “bounces off”.
- **Refracted:** Wave passes into new material, but its direction changes.
- **Transmitted:** Wave passes through new material.
- **Absorbed:** Wave disappears and its energy is transferred to the material.

Describing waves

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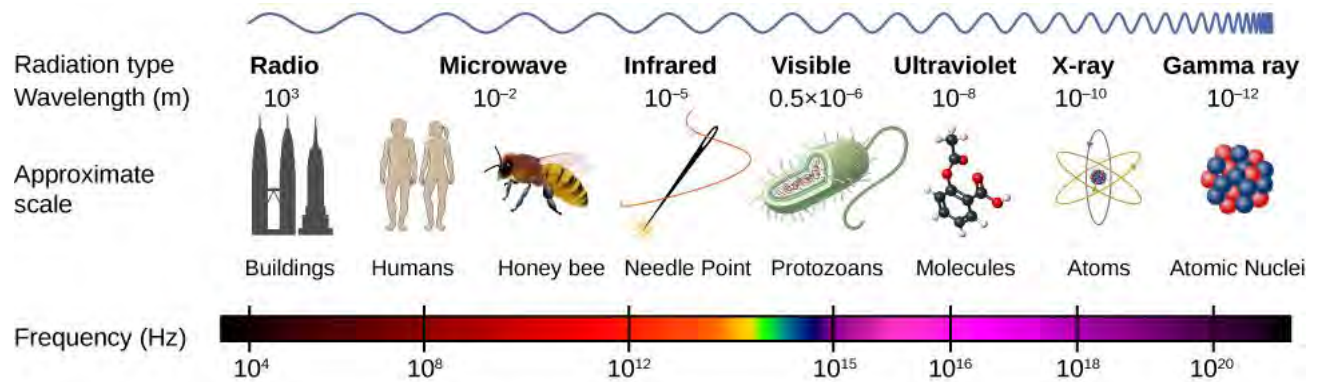
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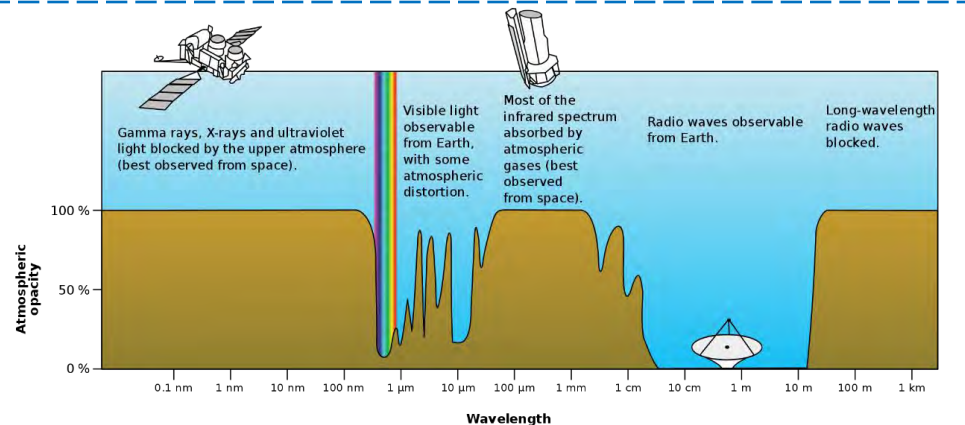
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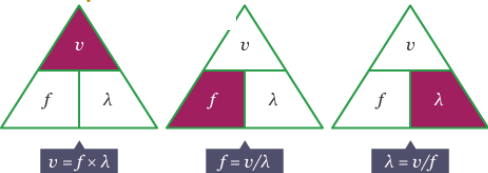


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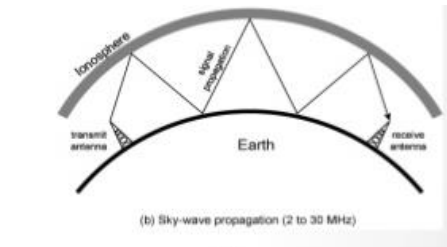
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- **Gamma rays:** Transfers a lot of energy and can kill cells. Used to kill cancer cells during radiotherapy, as gamma rays are focused onto cancerous cells. Chemicals that emit gamma rays are injected into the body and collect within cancerous cells,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

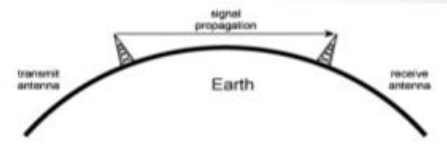
Sky propagation:

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



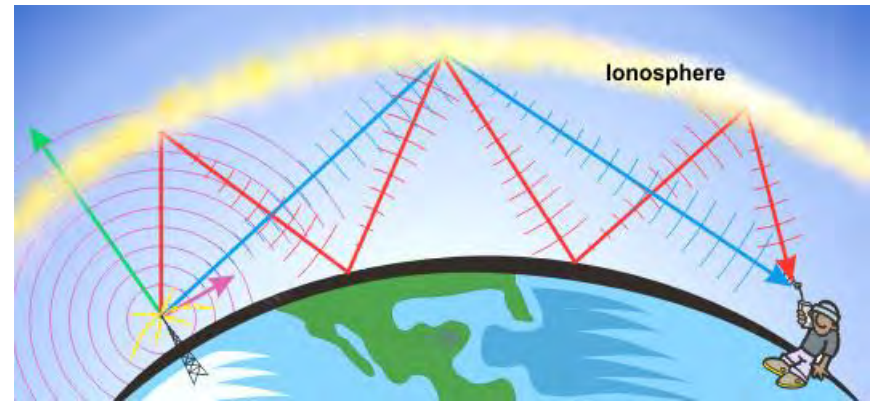
Line-of-Sight Propagation:

- In straight lines directly from antenna to antenna.



H – Uses of radiation –

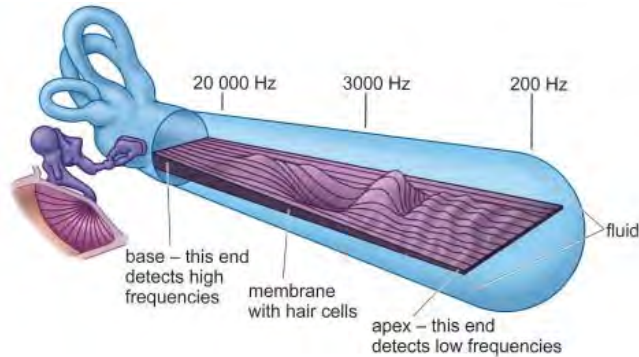
Atmospheric reflection: Radio waves are used to transmit signals around the world, including over the horizon, without using satellites. Some radio waves are reflected by the ionosphere, an outer layer of the atmosphere. This means they can be transmitted from one location and reflected by the ionosphere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



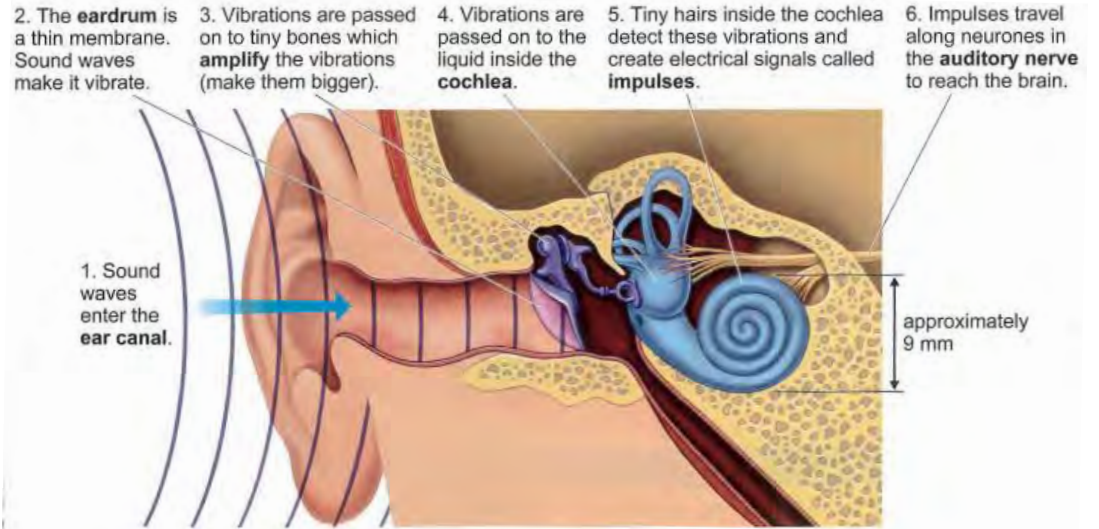
Dangers of EM radiation : All waves transfer energy. If the wave is absorbed by a material then the energy is absorbed into that material, possibly causing damage or causing the material to heat up.

- **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:



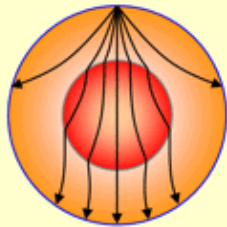
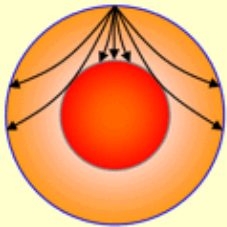
H – Ears and hearing : Human ears detect sound waves in the environment, allowing us to hear.



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.

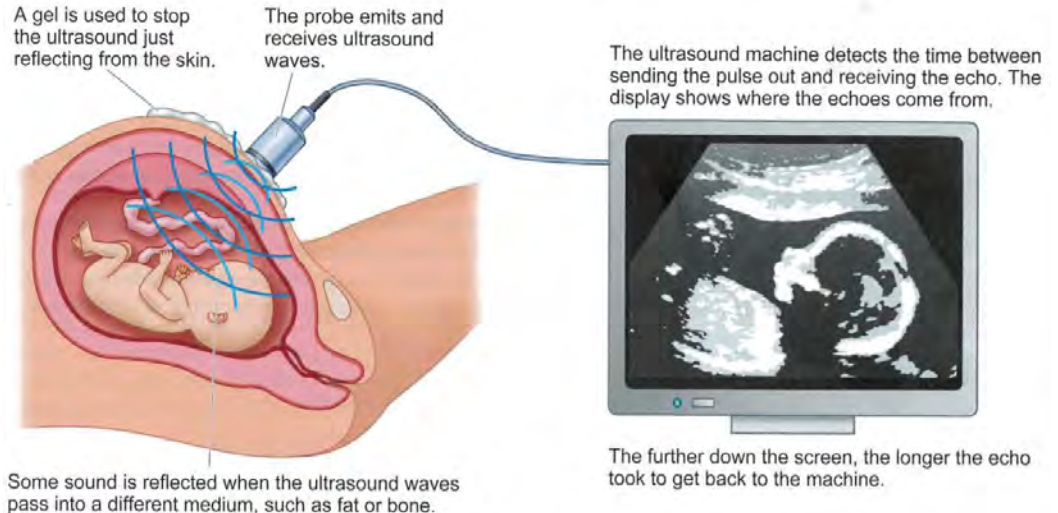
Both types of waves leave shadow zones around parts of the Earth’s surface.



- S waves**
- transverse
 - slow moving
 - travel through solids only

- P waves**
- longitudinal
 - fast moving
 - travel through liquids and solids

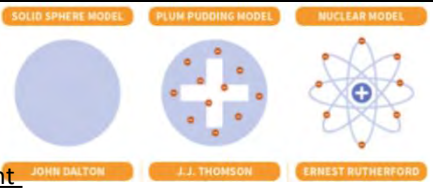
H – Ultrasound : Frequencies higher than 20 000 Hz (beyond human hearing) are called ultrasound. Some animals such as dolphins or bats use it to communicate and to “see” their surroundings. It is also used to make images of things inside the body, such as a foetus (unborn baby).



The further down the screen, the longer the echo took to get back to the machine.

Atomic Models

Ideas about the structure of atoms have changed over time

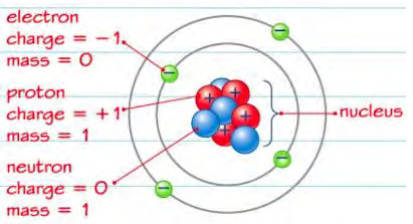


JOHN DALTON J.J. THOMSON ERNEST RUTHERFORD

Rutherford's experiment

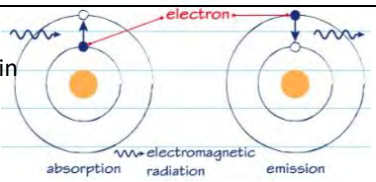
He used gold foil to show that most + alpha particles passed straight through so the positive charges within an atom must be concentrated in one area, the nucleus

Atomic Structure



Electrons and Orbits

- Electrons are arranged in shells with different energy levels
- When electrons gain energy they can move to a higher energy level
- When they fall back to the original energy level, the energy is emitted as light

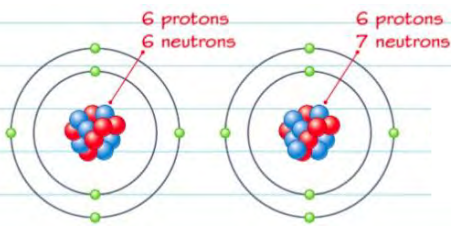


Ionisation

- If an electron gains enough energy it can be lost from the atom altogether
- This leaves the atom as a positive ion, the process is known as ionisation

Isotopes

Elements with the same number of protons but different numbers of neutrons. Some isotopes are more stable than others.



Types of Radiation

Radiation is emitted from some isotopes to make them more stable

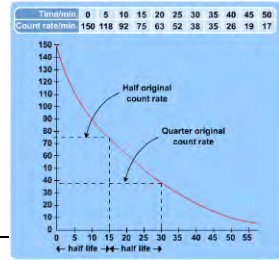
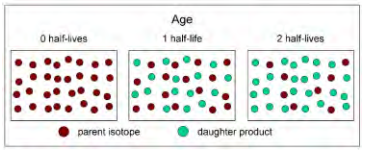
Type of radiation emitted	Relative charge	Relative mass	Ionising power	Penetrating power	Affected by magnetic fields?
alpha, α (helium nucleus, two protons and two neutrons)	+2	4	heavily ionising	very low, only ~5 cm in air	yes
beta, β^- (an electron from the nucleus)	-1	1/1840	weakly ionising	low, stopped by thin aluminium	yes, but in the opposite direction to α and β^+
positron, β^+ (a particle with same size as electron but an opposite charge)	+1	1/1840	weakly ionising	low, stopped by thin aluminium	yes
neutron, n	0	1	not directly ionising	high	no, since neither are charged
gamma, γ (waves)	0	0	not directly ionising	very high, stopped only by thick lead	no, since neither are charged

Measuring Radiation

- Geiger-Muller tube is used to detect radiation, connected to a counter to show the amount of radiation detected
- Dosimeters are a film badge used to monitor radiation received by its wearer, worn by people taking x-rays in hospitals etc.

Half Life

The time taken for the number of radioactive nuclei in a substance to fall to half the original number



Dangers of Radioactivity

- We are all exposed to some radiation, background radiation
- It comes from many sources and the level is different depending on where we live
- Radiation can enter living cells and ionise molecules within them leading to tissue damage
- Lower doses = minor damage, but can give rise to mutated cells which divide uncontrollably (cancer)
- Higher doses = cells killed, radiation sickness and potential death

Irradiation and Contamination (p177)

Irradiation

- Exposure to radioactivity from outside the body
- Exposure stops once you leave the area

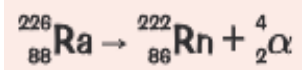
Contamination

- Exposure to radioactive materials on the skin or inside the body
- Exposure does not stop by moving away from an area

Nuclear Equations

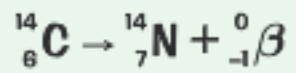
Alpha

Loss of 2 protons and 2 neutrons
Mass \downarrow by 4
Atomic number \downarrow by 2



Beta-minus

Neutron changes into a proton and an electron
Mass no change
Atomic number \uparrow by 1



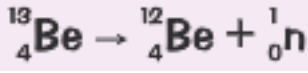
Beta-plus (positron)

Proton changes into a neutron and a positron
Mass no change
Atomic number \downarrow by 1



Neutron

Neutron is emitted
Mass \downarrow by 1
Atomic number no change



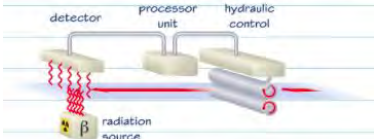
Gamma

Energy emitted as a ray
No change to mass or atomic number 29

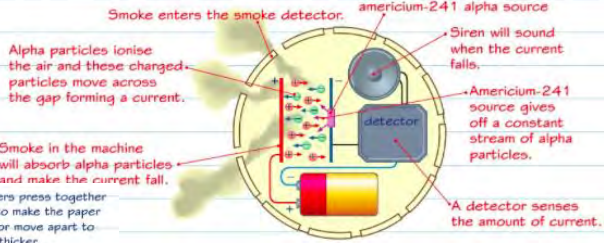
Using Radiation

Beta particles are used to control thickness of materials in manufacture

If the paper is too thick, not as many beta particles get through. → The rollers press together harder to make the paper thinner or move apart to make it thicker.



Alpha particles are used in smoke alarms



Gamma rays are used to sterilise surgical instruments and preserve food

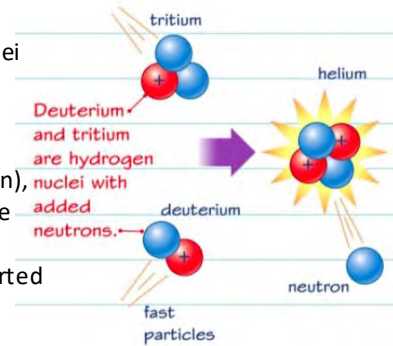
Medical Uses of Radiation

Gamma rays are used to:

- Treat tumours internally. A radioactive source is injected and builds up in the affected part of the body killing the cells there
- Treat tumours externally. Radiotherapy uses beams of gamma rays directed towards the cancer to damage it.
- Diagnose cancer. A tracer solution which contains a radioactive substance is injected and taken up by abnormally growing cells. The places in the body where the tracer builds up are detected using a 'gamma camera'
- PET scanners. A tracer is used which decays to produce positrons, these collide and produce gamma rays which are detected by a scanner to produce an image on a screen

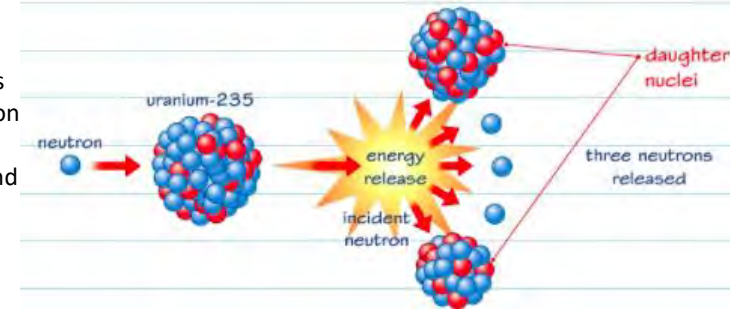
Nuclear Fusion

- The joining of smaller nuclei to form larger nuclei
- It releases energy
- But nuclei need to get very close to each other before this can happen, normally the positive charges repel each other (electrostatic repulsion), only at high temperatures and pressures are the nuclei moving fast enough to overcome this repulsion e.g. in stars where hydrogen is converted to helium (a heavier element) using fusion

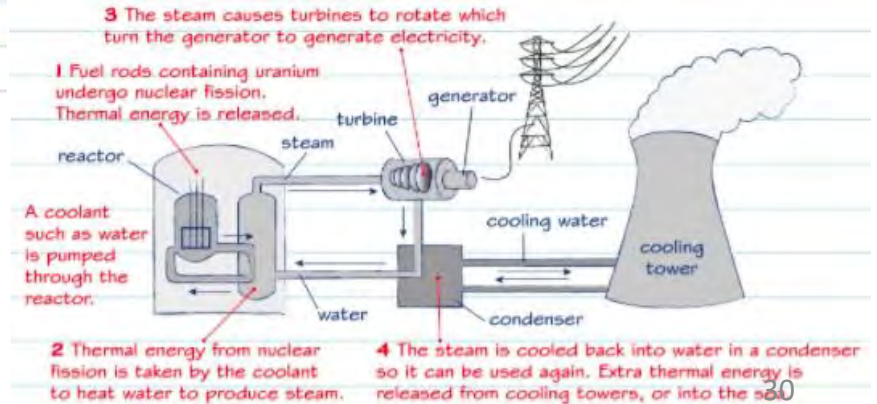
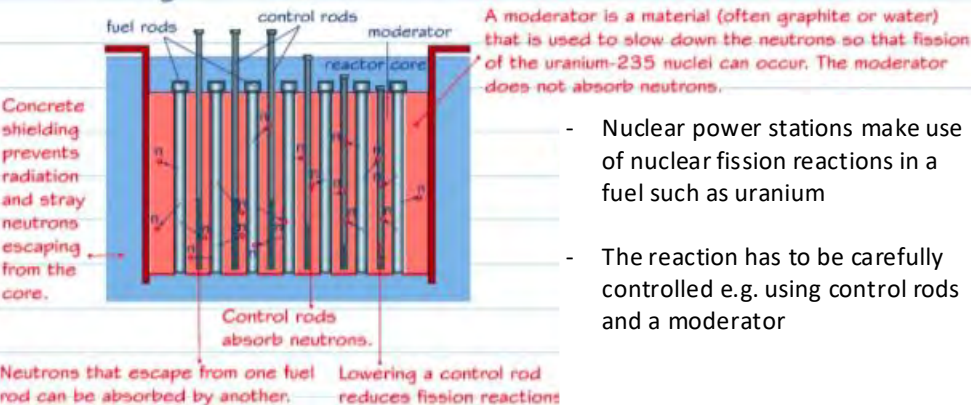


Nuclear Fission

- When a large, unstable nucleus absorbs a neutron it splits into 2 smaller nuclei and 2 or more neutrons
- It also releases energy
- The neutrons produce form a chain reaction when they are absorbed by other nuclei
- Nuclear reactors make use of controlled chain reactions



Nuclear Power

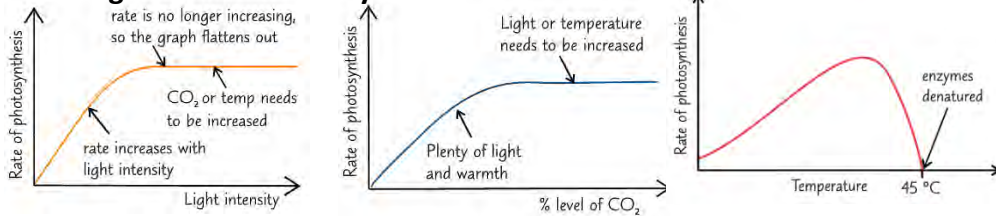


Photosynthesis

- The endothermic process where green plants/algae absorb energy from the Sun to make glucose
- Some of the glucose is used to make larger, complex molecules for growth (cellulose, starch) → biomass
- Happens inside chloroplasts with chlorophyll to absorb light



Limiting Factors in Photosynthesis



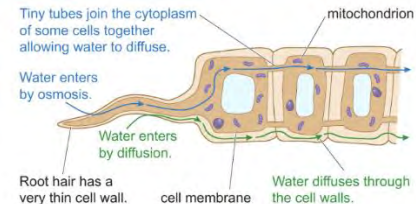
Light transfers the energy needed for photosynthesis. At first, as light level is raised, the rate of photosynthesis increases, but this is only true up until a point. Beyond that it won't make a difference, there will be another limiting factor.

CO₂ is one of the raw materials needed for photosynthesis, it shows the same pattern as light intensity affecting the rate of photosynthesis.

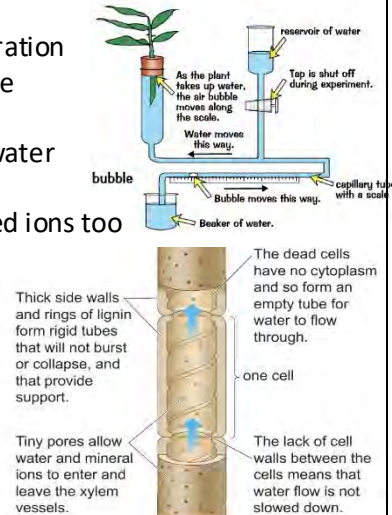
Usually if temperature is a limiting factor it's because it is too low – the enzymes needed for photosynthesis are working too slowly. If the plant gets too hot (around 45°C), the enzymes it needs for photosynthesis will be denatured.

Transpiration

- The loss of water from a plant caused by the evaporation and diffusion of water from a plant's surface (can be measured using a potometer)
- This creates a shortage of water in the leaf and so water is drawn up from the roots through xylem
- This creates a transpiration stream carrying dissolved ions too
- Increasing temperature and air flow increase rate of transpiration, increasing light intensity decreases rate of transpiration

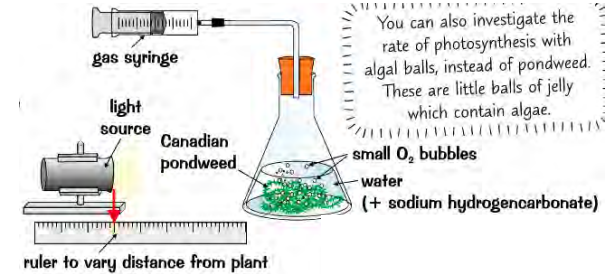


Root hair cells – absorb water (by osmosis) and nutrients (by active transport) from the soil



Photosynthesis Core Practical

- Effect of light intensity on rate of photosynthesis
- A source of white light is placed at specific distances and the organism left to photosynthesise for a set time
- Either measure oxygen collected or measure change in pH due to the organism using CO₂ making the solution less acidic



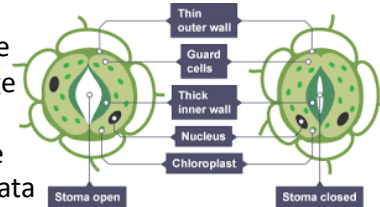
H: Mathematical Relationships

$$\text{light intensity} \propto \frac{1}{\text{distance (d)}^2}$$

- Distance from lamp and light intensity are inversely proportional to each other, as distance increases, light intensity decreases.
- Light intensity decreases in proportion to the square of the distance (inverse square law)

Stomata

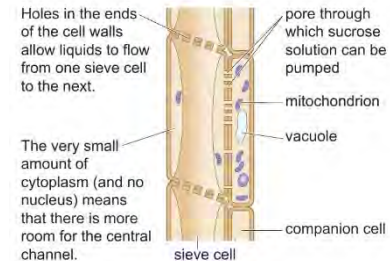
- Tiny pores on the lower surface of leaves allowing gas exchange when open
- Light causes water to enter the guard cells and open the stomata



Translocation

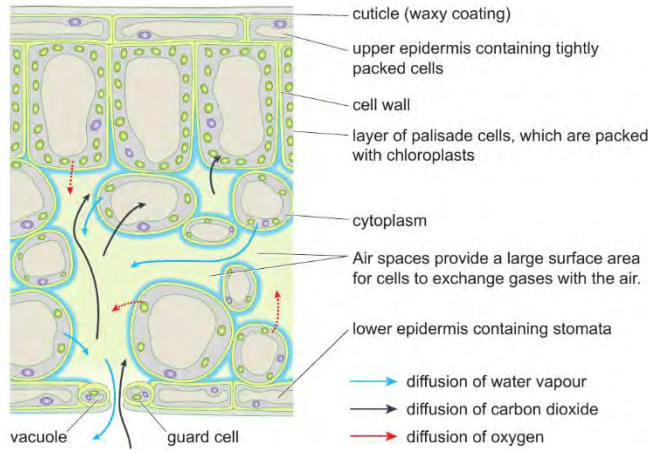
- The process of transporting sugars (mainly sucrose) made in the leaves to the rest of the plant for immediate use (e.g. in growing regions) or for storage
- Requires energy from respiration
- Goes in both directions

Phloem – adapted for translocation



Adaptations of Leaves

- Broad leaves → larger surface area to absorb light
- Palisade layer has lots of chloroplasts → near top of leaf to absorb light
- Upper epidermis is transparent → allows light to pass through it to the palisade layer
- Waxy cuticle → prevents water loss
- Xylem and phloem form a network of vascular bundles → water and glucose transported around the plant efficiently
- Lower epidermis has stomata → let gases diffuse directly into the leaf
- Spongy mesophyll has air spaces → increases rate of diffusion of gases in and out of the leaf's cells

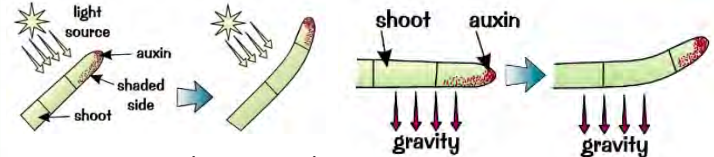


Plant Hormones

- Auxin is a plant hormone which controls growth at the tips of shoots and roots.
- It is produced in the tip and diffuses backwards to stimulate cell elongation process

Auxin promotes growth in the shoot

- Shoots are positively phototropic (grow towards light) but negatively gravitropic (grow away from gravity)

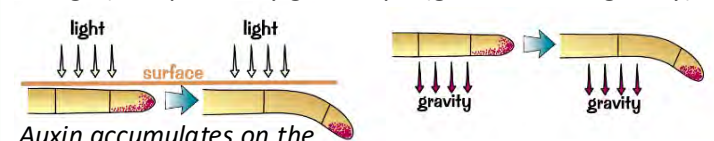


Auxin accumulates on the shaded side, making cells elongate **faster** and shoot bends towards the light

Auxin accumulates on the lower side, making cells elongate **faster** and shoot bends upwards

Auxin inhibits growth in the root

- Roots are negatively phototropic (grow away from light) but positively gravitropic (grow towards gravity)



Auxin accumulates on the shaded side, making cells elongate **slower** and shoot bends down away from the light

Auxin accumulates on the lower side, making cells elongate **slower** and shoot bends downwards

Adaptations of Plants

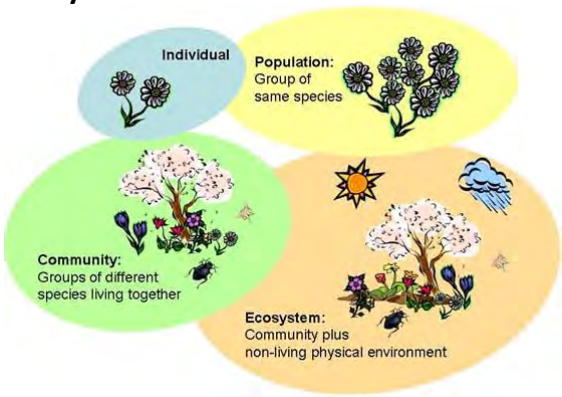


- Plants living in hot/dry conditions are adapted to preserve water by reducing transpiration
- Stomata are fewer in number, close when light or are found sunk in pits to reduce water loss by transpiration
- Waxy cuticle is thicker to prevent water loss by evaporation/diffusion
- Leaves are smaller to reduce surface area for transpiration
- Leaves can be rolled to trap water vapour near stomata, reducing diffusion gradient and reducing transpiration

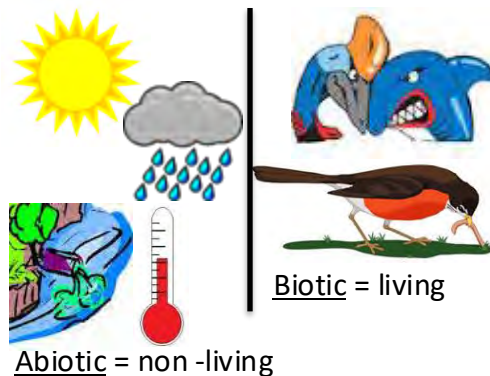
Commercial Uses of Plant Hormones

- Ethene – controlling the ripening of fruits. Fruits are picked when they are still unripe making them firmer and easier to transport. They are ripened by applying ethene just as it reaches the shelves.
- Gibberellins - controlling seed germination. Seeds can be treated with gibberellins to make them germinate at times when they usually wouldn't (cold or dryness).
- Gibberellins – producing seedless fruits. Gibberellins are applied to unpollinated flowers causing fruit to grow but no seeds.
- Gibberellins – controlling flower and fruit formation. Gibberellins stimulate seed germination which can be used to make plants flower earlier.
- Auxins – growing from cuttings with rooting powder. Auxins cause plants to produce rapidly and start growing as new plants (clones).
- Auxins – as selective weedkiller. Auxins only affect broad-leaved plants, disrupting normal growth patterns, narrow leaved grasses and cereals (crops) are unaffected.

Ecosystems



Abiotic and Biotic Factors



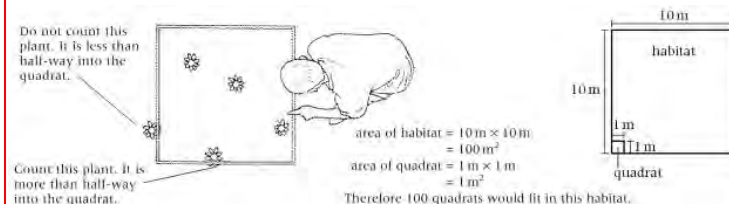
Investigating Ecosystems

Using quadrats to compare distribution

1. Place a 1m² quadrat randomly in area 1 and count the organisms in the quadrat.
2. Repeat lots of times and calculate a mean.
3. Repeat for 2nd area

Using quadrats to calculate abundance

1. Work out the mean number of organisms per m² (with a 1m² quadrat this is the same as counting, with 0.5m² quadrat multiply the counted number by 2 etc.)
2. Then multiply the mean by the total area.



Interdependence

- Organisms depend on each other for things like food and shelter to survive and reproduce
- **Mutualism** – a relationship where 2 organisms benefit e.g. bees and flower, clownfish in sea anemone
- **Parasitism** – a relationship where only the parasite (not the host) benefits e.g. fleas on dogs

Conservation

Reasons to protection biodiversity

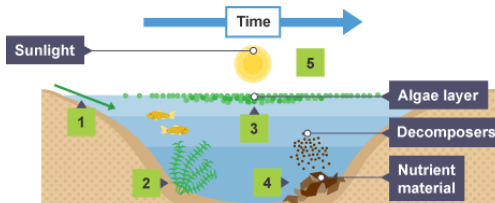
- Human food supply
- Protecting food chains
- Future medicines
- Cultural aspects
- Ecotourism
- New jobs

Ways to protect biodiversity

- Reforestation with species variety
- Zoos and nature reserves
- Seed banks

Human Impacts on Ecosystems

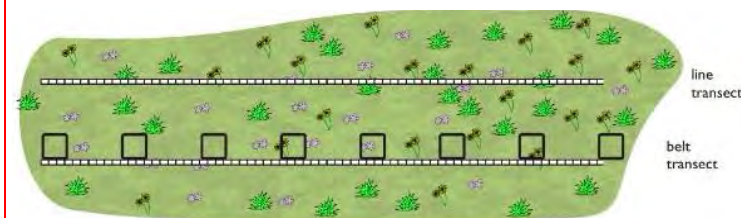
1. **Eutrophication** caused by using fertilisers



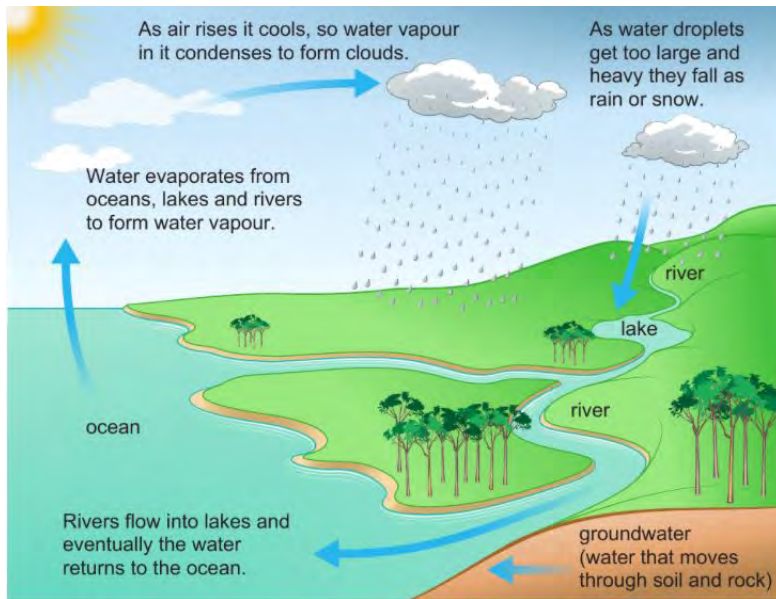
2. Introducing non-indigenous species which out-compete indigenous species
3. Fish-farming using nets in open water, food added produces lots of waste which can cause eutrophication, breeding ground for parasites, predators attracted and trapped, non-indigenous fish can escape

Transects to investigate changes in ecosystems

1. Mark out a line using a tape measure
2. Either place quadrats next to each other along the line (line transect) or at regular intervals along the line (belt transect)
3. Collect data by counting organisms or estimating percentage cover
4. Record abiotic factors e.g. light intensity
5. Repeat several times and calculate means
6. Plot graphs to see if there is a correlation between abiotic factor and distribution in species

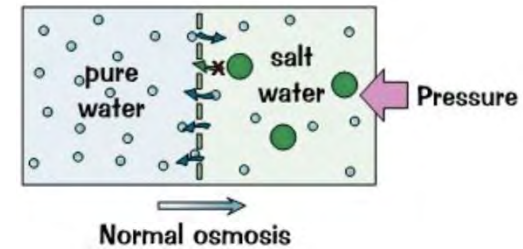


Water Cycle

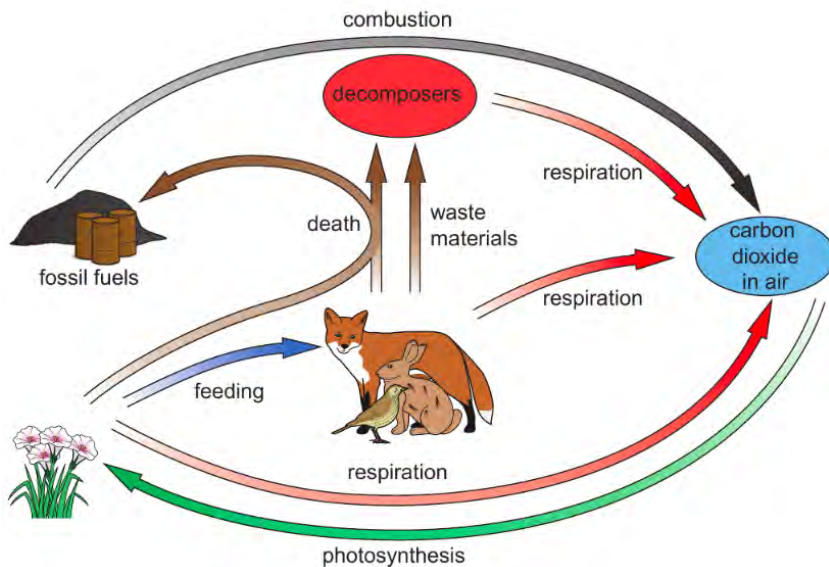


Making Potable Water

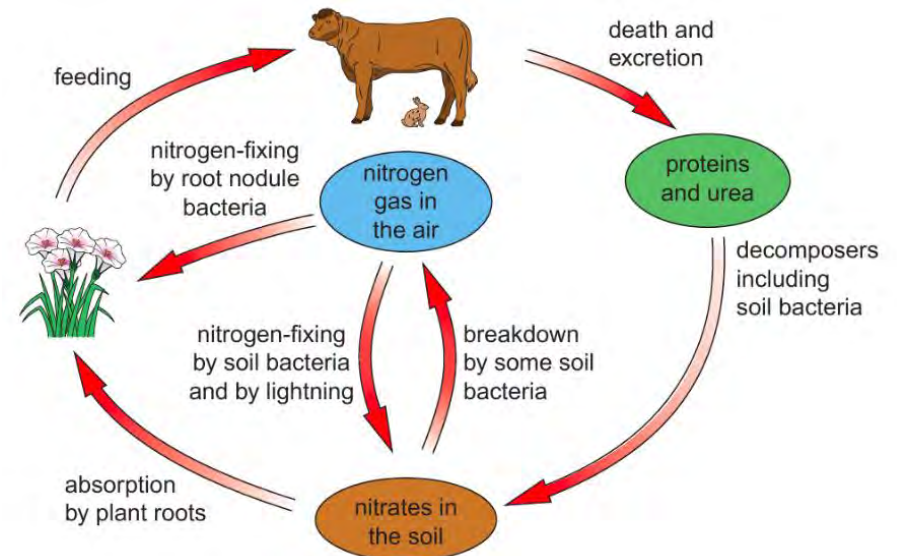
- In times of drought we can use desalination to remove salt from water and produce potable water suitable for drinking
- Method 1: boil water so that it evaporates, collect and condense steam
- Method 2: reverse osmosis (*Biology Topic 1*), salt water is fed into a vessel with a partially permeable membrane at very high pressure, this causes the water molecules to move in the opposite direction to osmosis, from higher salt concentration to lower salt concentration



Carbon Cycle

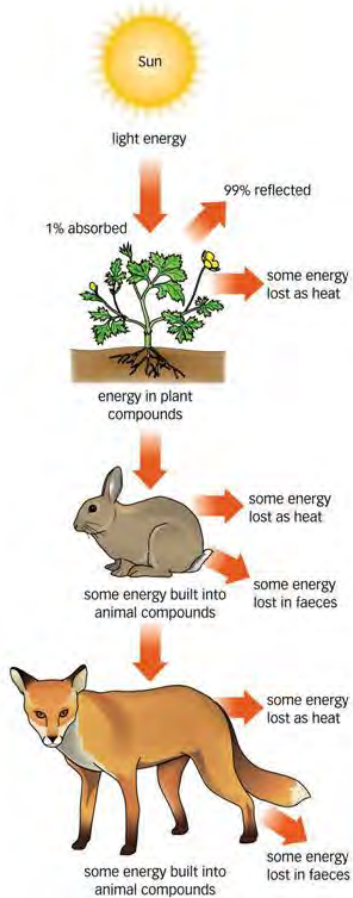


Nitrogen Cycle



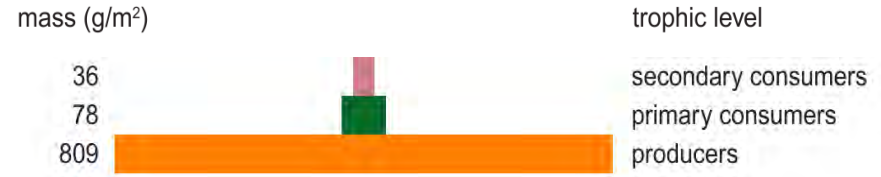
Ecosystem Energy Transfers

- Food chains are limited due to loss of energy
- Many process contribute: not all energy absorbed from sun, energy used for life processes e.g. respiration, lots of energy lost as heat, energy from undigested parts lost in faeces, some uneaten animal parts



Pyramids of Biomass

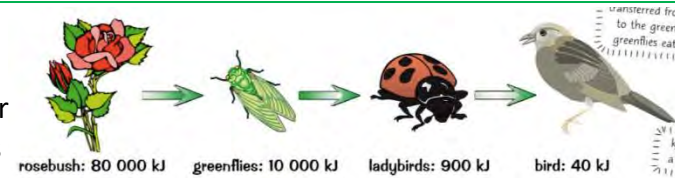
- Shows how much all of the organisms at one trophic level would weigh
- Also represents energy at each level
- Draw to sensible scale, producers at the bottom



Food chain calculations

Calculation 1 – energy loss:

- Subtract energy at one trophic level from another
- e.g. 70,000 kJ lost between rosebush & greenflies



Calculation 2 – efficiency between levels:

$$\text{efficiency} = \frac{\text{energy transferred to next level}}{\text{energy available at previous level}} \times 100$$

greenfly 2.5% efficient

Food Security

Factor	How it is affecting food security
Increasing human population	The world's population is growing, we need to produce more food so each person still has the same amount of food to eat.
Increasing consumption of meat and fish, and increasing animal farming	As these animals are further up the food chain there's less energy and biomass, meaning more crops could be grown in a given area of land. Also animals eat crops that could be eaten by humans e.g. corn. And there is a risk of over fishing.
Environmental changes caused by human activity	Global warming causes climate change e.g. changes in rainfall patterns. This may affect the growth of crops and reduce yields.
Use of biofuels	As fossil fuels run out we need to look for alternatives e.g. biofuels which require growth of crops such as corn and sugar cane. This takes up land that could be used for food crops
Rising price of farming	The price of fertilisers, fuel and machinery is increasing. This might make it too expensive for farmers in some areas to continue farming.
New pests and pathogens	If a new disease spreads to a crop, lots of the population may not be resistant to disease. This means a large number of the crop plants will be damaged, reducing the yield and the amount that can be sold as food.

Oxidisation (Pg 114)

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



- **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.

The Reactivity Series		
least resistant to oxidation	Potassium	K
	Sodium	Na
	Calcium	Ca
	Magnesium	Mg
	Aluminium	Al
	Carbon	C
	Zinc	Zn
	Iron	Fe
	Hydrogen	H
	Copper	Cu
	Silver	Ag
most resistant to oxidation	Gold	Au
		least reactive

- 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.

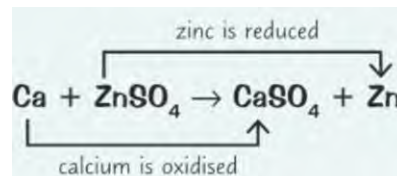
Metal reactions (Pg 115)

- 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.

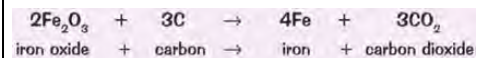
Metal extraction (Pg 117)

- 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	found as the uncombined element
silver	
gold	

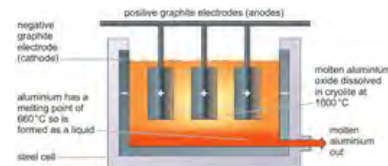
Method 1: Reduction with carbon (Pg 117)

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



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:

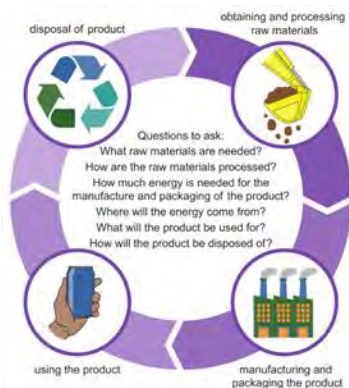
Process	Advantages	Disadvantages
both bioleaching and phytoextraction	no harmful gases (e.g. sulfur dioxide) are produced causes less damage to the landscape than mining conserves supplies of higher grade ores	very slow
bioleaching	does not require high temperatures	toxic substances and sulfuric acid 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 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)

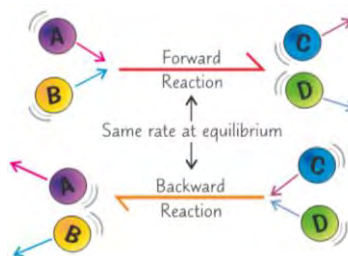
- Reactions where products can react to form the original reactants.
- Reactions go **both** ways!



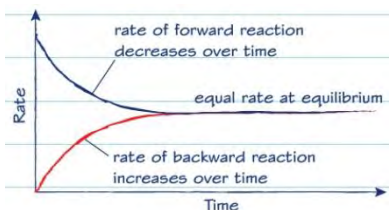
- Note the arrow points in both directions, showing this is a reversible reaction.

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.

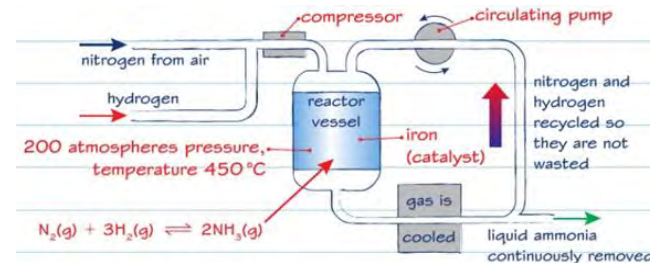


Factors effecting the equilibrium position (Pg 121)

- 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 °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).

Group 1 – Physical properties of alkali metals

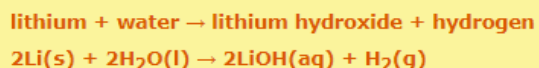
- Low melting points and boiling points (decreases down the group)
- Very soft
- Can test for chlorine gas using damp blue litmus paper which turns red, then bleaches white



Group 1 – Reaction of alkali metals with water

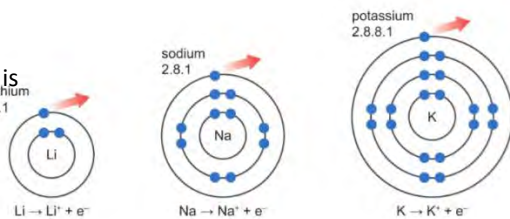
- React vigorously with water
- Reactivity increases down the group (because the outer electron is lost more easily)

reactivity ↓	lithium + water	bubbles fiercely on the surface
	sodium + water	melts into a ball and fizzes about the surface
	potassium + water	bursts into flames and flies about the surface



Group 1 – Reactivity

- Reactivity increases down the group
- Alkali metals need to lose one electron to form a 1+ ion
- The bigger the atom the easier it is to lose an electron so the more reactive the atom
- This is due to a greater distance (weaker attraction) between the positive charge of nucleus and outer shell electrons



Group 0 – Properties of noble gases

- Non-metals
- Inert (very unreactive)
- Non-flammable
- Colourless
- Monatomic (exist as single atoms)
- Boiling point, melting point and density all increase down the group

Group 0 – Uses of noble gases

Helium

Used in balloons and airships to make them float as it is much less dense than air.



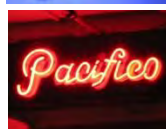
Argon

Used in light bulbs, as it is unreactive it stops the hot filament burning away.



Neon

Used in signs as it glows when electricity passes through it.



Group 7 – Physical properties of halogens

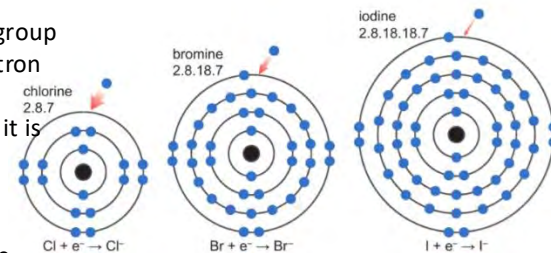


Group 7 – Reaction of halogens with metals and hydrogen

- Halogen + metal → metal halide
E.g. chlorine (g) + sodium (s) → sodium chloride (s)
- Halogen + hydrogen → hydrogen halide
E.g. chlorine (g) + hydrogen (g) → hydrogen chloride (g)
- Hydrogen halides dissolve in water to form acids
E.g. hydrogen chloride (g) → hydrochloric acid (aq)

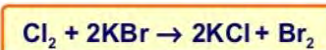
Group 7 – Reactivity

- Reactivity decreases down the group
- Halogens need to gain one electron to form a 1- ion
- The bigger the atom the harder it is to gain an electron so the less reactive the atom
- This is due to a greater distance (weaker attraction) between the positive charge of nucleus and outer shell electrons



Group 7 – Displacement reactions

- Displacement reaction is where a more reactive element 'pushes out' (displaces) a less reactive element from a compound
- H - Redox reactions: halogens gain electrons (reduction) while halide ions in the salt lose electrons (oxidation)
- Shows order of reactivity: **Chlorine, bromine, iodine**



Chlorine is reduced (gains electrons)



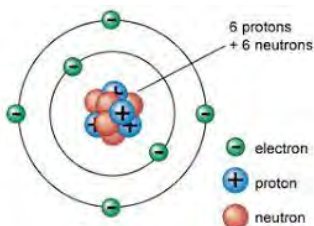
Bromide is oxidised (loses electrons)

- O** Oxidation
- I** Is
- L** Loss
- R** Reduction
- I** Is
- G** Gain

salt (aq) halogen	potassium chloride	potassium bromide	potassium iodide
chlorine	X	$2\text{KCl} + \text{Br}_2$	$2\text{KCl} + \text{I}_2$
bromine	no reaction	X	$2\text{KBr} + \text{I}_2$
iodine	no reaction	no reaction	X

Atom Structure

Diagram



Carbon atom

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

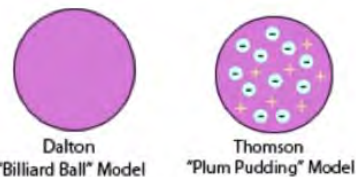
Atomic number is the number of protons in the atom's nucleus

Symbol is used as a short-hand and in chemical equations

Mass number is the number of protons and neutrons in the nucleus

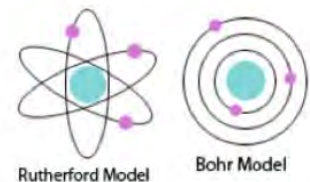
32
Ge
Germanium
74

History of Atom



Dalton
Solid sphere

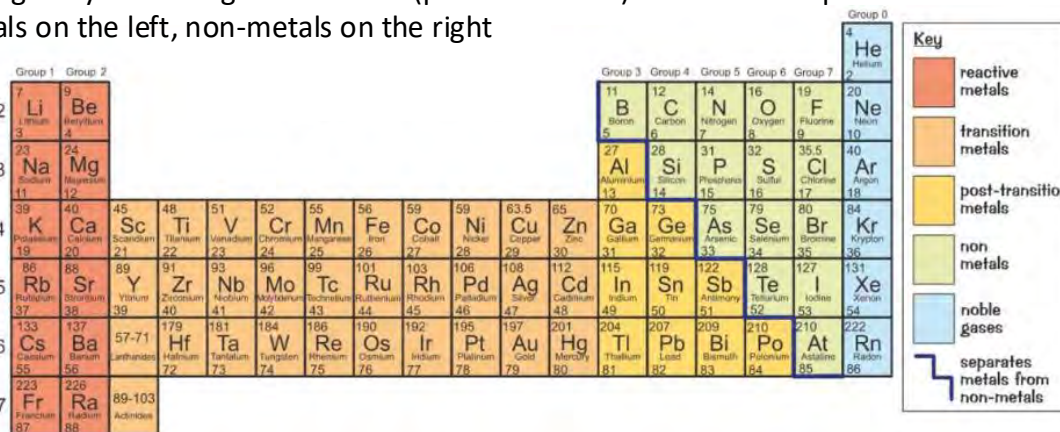
Thomson
Protons/
electrons randomly
arranged



Rutherford/Bohr
Positive nucleus
with electrons
around

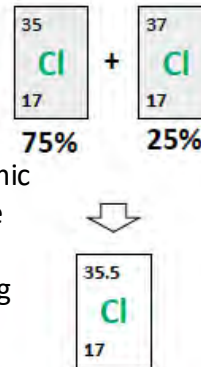
Modern Periodic Table

- 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 (M_r) 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
 $(35 \times 75/100) + (37 \times 25/100) = 35.5$

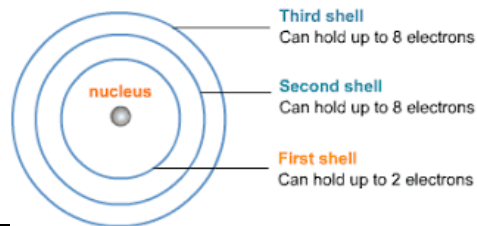
History of Periodic table

- 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

- Rule 2/3

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



	Group								
	1	2	3	4	5	6	7	0	Number of occupied energy levels
Period 1								2 He 2	1
Period 2	3 Li 2.1	4 Be 2.2	5 B 2.3	6 C 2.4	7 N 2.5	8 O 2.6	9 F 2.7	10 Ne 2.8	2
Period 3	11 Na 28.1	12 Mg 28.2	13 Al 28.3	14 Si 28.4	15 P 28.5	16 S 28.6	17 Cl 28.7	18 Ar 28.8	3
Period 4	19 K 288.1	20 Ca 288.2							4
	1	2	3	4	5	6	7	8	

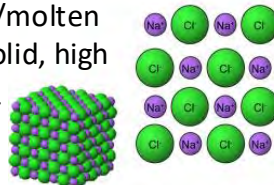
Number of electrons in highest occupied energy level (except for helium)

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 → Ca²⁺ ion
- Non-metals gain electrons resulting in a negative ion, e.g. oxygen in group 6 → O²⁻ 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

C60

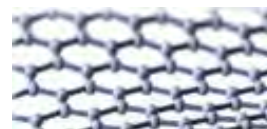
Strong, weak intermolecular forces (like graphite)

Can be used as lubricants

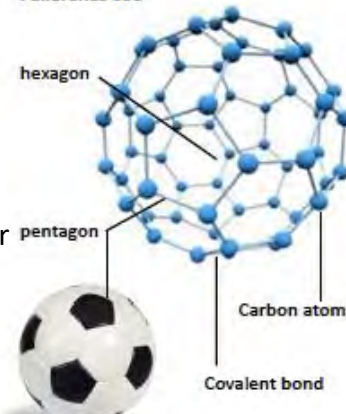
Graphene

Strong, light, good electrical conductor

Can be rolled into tubes

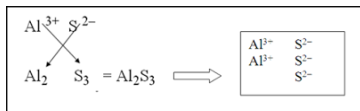
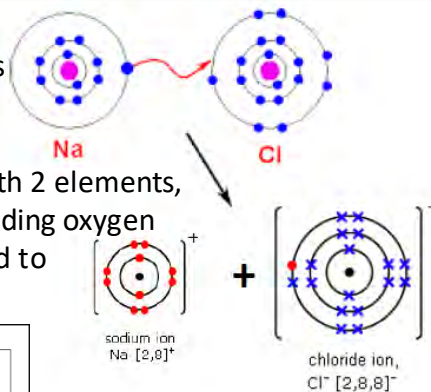


Fullerenes C60



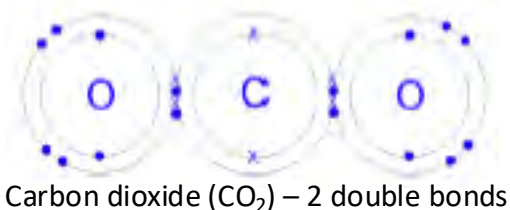
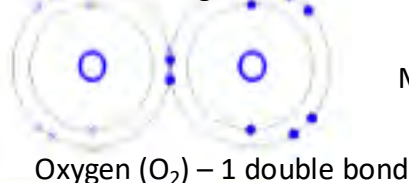
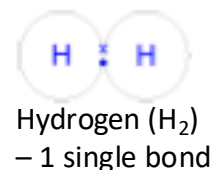
Ionic Bonding

- 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



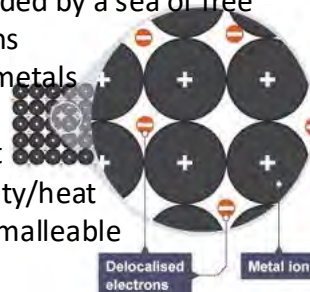
Methane (CH₄)

– 4 single bonds

Water (H₂O) – 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

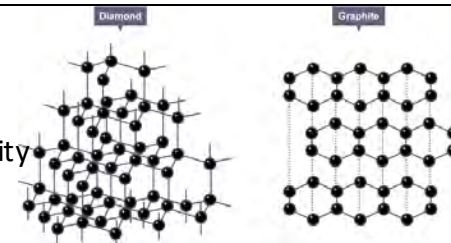


Bonding Models

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



Business aims and objectives:

Financial aims and objectives:	Survival, profit, sales, market share, financial security
Non-financial aims and objectives:	Social objectives, personal satisfaction, challenge, independence, control

Key Term	Definition
Profit	The money left over once all of the expenses incurred running a business have been paid. Profit = sales revenue – total costs
Loss	When total expenses exceed (are more than) the total revenue.
Break-even point (BEP)	The point where a business is not making a profit or a loss. Break-even point = fixed costs ÷ (selling price – variable costs)
Break-even level of output	The number of products needed to be sold in order to reach the break-even point (BEP). E.g. 100 T-shirts. (See the red box on page 2)
Margin of safety	The amount sales can fall before the BEP is reached. Margin of safety = actual sales – break-even sales
Cash flow	The movement of money in and out of a business over a period of time.
Cash-flow forecast	Predicting the future cash flow in and out of a business' bank account.
Net cash flow	The difference between all cash inflows and cash outflows of a business. Net cash flow = cash inflows – cash outflows (see cash flow diagram on page 2)
Opening balance	The amount of money a business starts with at the beginning of a reporting period. Opening balance = closing balance of previous period
Closing balance	The amount of money the business has at the end of the reporting period. Closing balance = net cash flow + opening balance

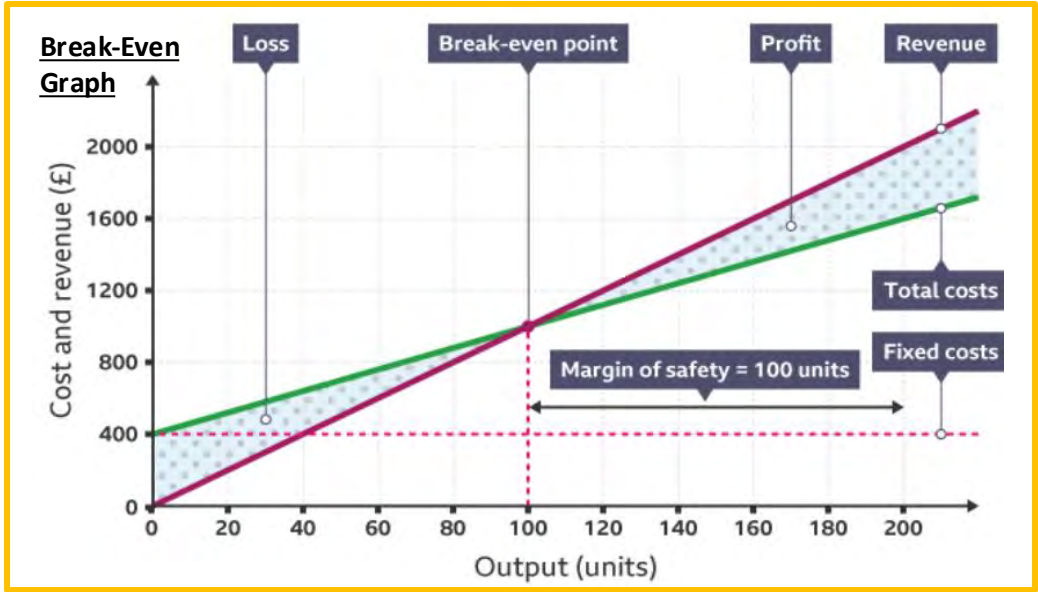
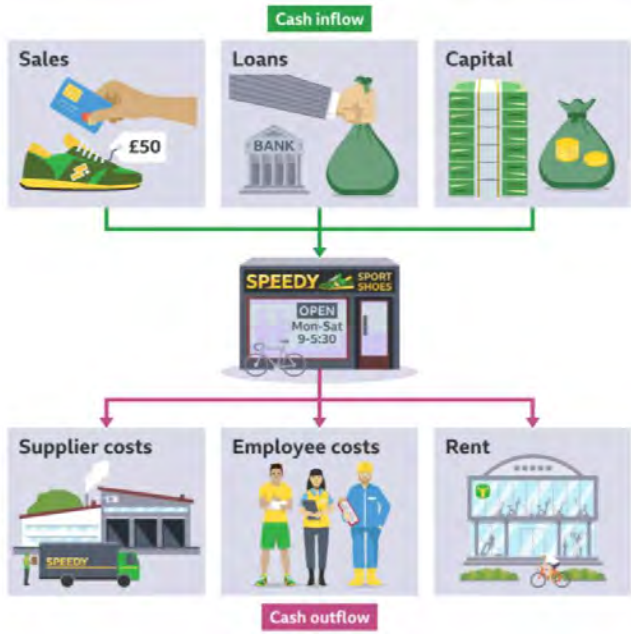
Profit = sales revenue – total costs

Price x units sold Fixed costs + variable costs

- Short Term Finance:**
- overdrafts
 - trade credit
- Long Term Finance:**
- Personal savings
 - Bank loan
 - Venture capital
 - Retained profit
 - Share capital
 - Crowd funding

Cash is important to a business:

- to pay suppliers, overheads and employees
- to prevent business failure (insolvency).



Insolvent = unable to pay debts owed.



$Break\text{-}even = \frac{\text{fixed costs}}{\text{selling price} - \text{variable costs}}$

A business that sells T-shirts wants to find out what its BEP is.

Its fixed costs are £400.

The selling price (per unit) is £10.

The variable costs (per unit) are £6.

Therefore:

$$Break\text{-}even = \frac{£400}{£10 - £6}$$

$$= \frac{£400}{£4}$$

$$= 100$$

So this business breaks even when it sells 100 T-shirts.



Key Term	Definition
Limited liability	The owner is legally separate from the business. If the business becomes insolvent, the owner(s)'s assets are cannot be repossessed to pay for debts. Limited liability only applies to certain types of business, such as <i>private limited companies</i> .
Unlimited liability	The owner is not legally separate from the business. If the business becomes insolvent (cannot pay its debts), the owner is responsible for paying this and could lose assets such as their home.



The 4Ps of the Marketing Mix

PRODUCT QUALITY PACKAGING DESIGN BRAND

PRICE RETAIL PRICE DISCOUNTS PAYMENT PLANS CREDIT TERMS

PROMOTION ADVERTISING PERSONAL SELLING EMAILS PUBLIC RELATIONS

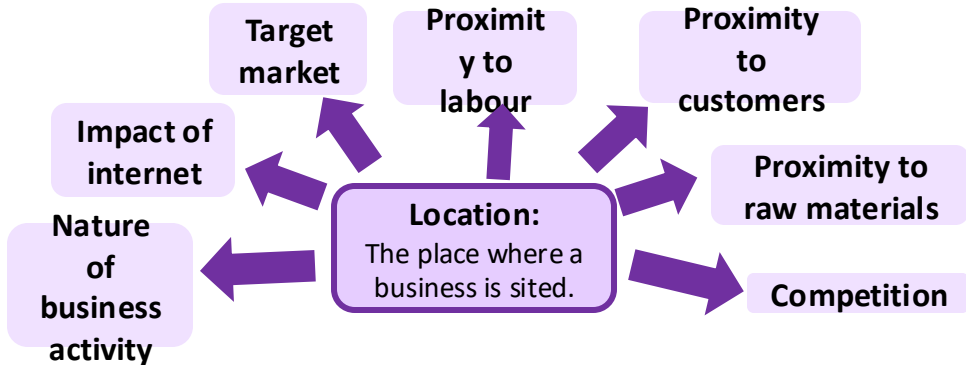
PLACE RETAIL LOCATION DISTRIBUTION DELIVERY DOWNLOADS



A **Business Plan** details how a business aims to achieve its objectives. It is used to:

- To reduce the risk of starting a business
- To help a business succeed
- Used to attract investors/ apply for bank loans.

Features include:
 The business idea, forecast revenue, sources of finance, marketing mix, cost and profit, location, cash flow forecast, aims and objectives, target market and competition.



Key Term	Definition	Advantages	Disadvantages
Sole trader	A business that is owned and run by one person. Sole traders are usually start-ups or small businesses e.g. photographers, electricians, hairdressers.	<ul style="list-style-type: none"> ☐ Easy to set up ☐ Little finance required ☐ Full control ☐ Keep all the profits ☐ Financial information is private 	<ul style="list-style-type: none"> ☐ Unlimited liability ☐ Business stops if ill or on holiday ☐ Long working hours ☐ Shortage of capital ☐ Skills shortage ☐ No continuity
Partnership	Business that has 2 or more owners. They decide to set up and run a business between them.	<ul style="list-style-type: none"> ☐ More capital available ☐ Easy to set up ☐ More skills available ☐ Shared workload ☐ Financial information is private 	<ul style="list-style-type: none"> ☐ Shared profit ☐ Unlimited liability ☐ Shortage of capital ☐ Slower decision making ☐ No continuity
Private limited company (Ltd)	Has <i>limited liability</i> and often have 'Ltd' after the business name e.g. Green Construction Ltd- examples lawyer, dentist, accountant	<ul style="list-style-type: none"> ☐ Limited liability ☐ Continuity ☐ Can raise capital more easily ☐ Control over share sale 	<ul style="list-style-type: none"> ☐ Financial information available to the public ☐ Complex and expensive to set up ☐ Sale of shares is restricted ☐ Dividends to be paid
Franchise	A business that gives the right to another person or business to sell <i>goods</i> or <i>services</i> using its name.	<ul style="list-style-type: none"> ☐ Smaller risk of failure ☐ No need to plan/create a product as the business is already established 	<ul style="list-style-type: none"> ☐ % of profits are paid to the owner of the franchise as royalties even if sales and profits are falling ☐ Less control over the business ☐ Unlimited liability



Paper 2: Early Elizabethan England

KT1: Queen, government and religion 1558-69

KEY TERMS

Elizabethan Society	
Social hierarchy	See table below
Yeomen	Men who held a small amount of land
Craftsmen	Skilled employees including apprentices
The Government	
Monarch	A king or queen – had the right to rule by the ‘grace of God’
Secretary of State	Head of the Privy Council, monarch’s closest advisor
Privy Council	Leading courtiers and advisers, who advised the monarch
Court	The inner social circle of the queen, based in her palaces
Parliament	Senior political figures whose duty was to advise queen
Lord Lieutenants	Maintained monarch’s power and England’s defences
JPs	Justices of the Peace kept law and order
Courtiers	Members of the nobility who attended court (see above)
Militia	A military force of ordinary people, rather than soldiers

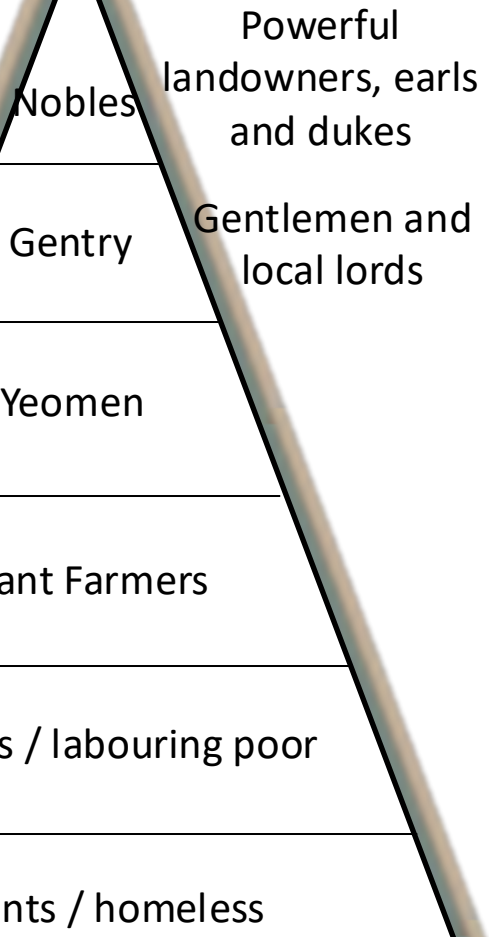
KEY TERMS

The Monarch	
Divine Right	Belief that the monarch's right to rule came from God
Patron	Someone who provides encouragement or financial support
Crown	With a capital 'C' – the monarch and government
Roman Catholic Church	
Papacy	The system of Church government ruled by the pope
Heretics	Held religious beliefs different to those accepted by society
Martyr	Someone killed for his/her beliefs

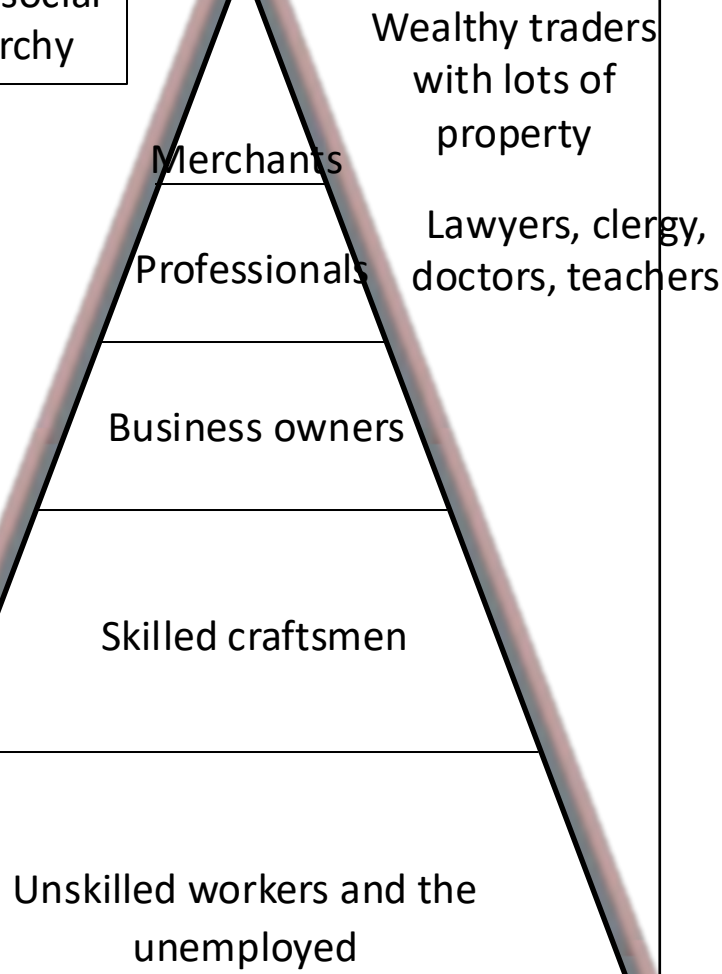
KEY TERMS

Religion	
Mass	Catholic service involving the miracle of the bread and wine
Reformation	Challenge to the teachings and power of the Catholic church
Sacraments	Special Church ceremonies
Holy Communion	Another name for mass, often used in Protestant churches
Clergy	Religious leaders, such as bishops and priests
Diocese	An area looked after by a bishop
Ecclesiastical	Things to do with the Church
Royal Supremacy	When the monarch is head of the Church
Recusants	Catholics who were unwilling to attend church services

Rural social hierarchy



Urban social hierarchy



Elizabeth's problems in 1558

Legitimacy:

In the view of the Catholics, Elizabeth was illegitimate as Henry VIII's divorce from Catherine of Aragon was never agreed by the pope.

Gender & marriage:

Most people thought women were not capable of ruling alone. Women were seen as the weaker sex. Elizabeth was being pushed to marry by her advisers.



Religion

England was in a period of religious instability since Henry VIII's break with Rome. Mary I, Elizabeth's sister had been Catholic and had heavily persecuted Protestants.

Financial weakness:

The Crown was £300,000 in debt due to the expensive war with France that Mary I had fought. This was a huge sum in 1558.

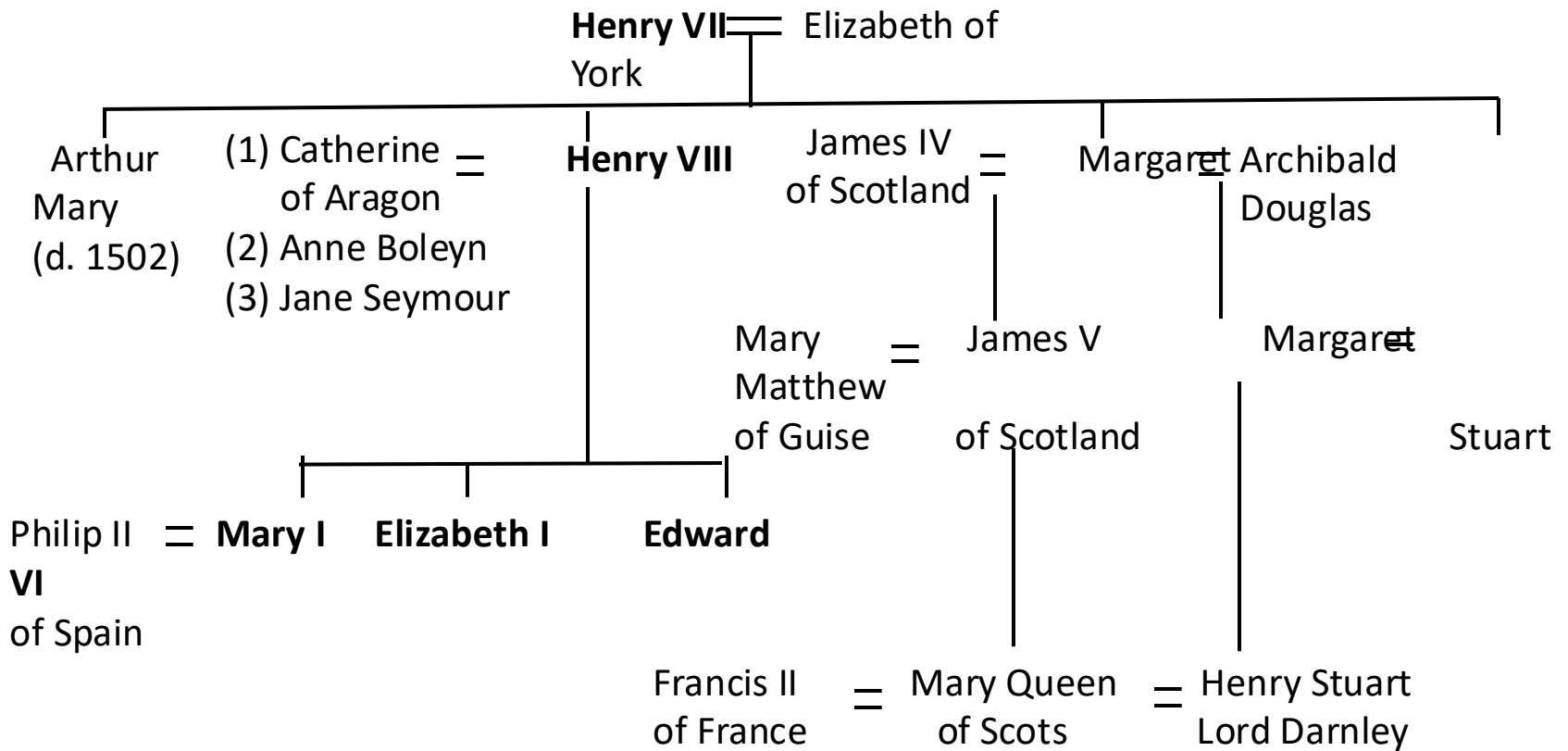
Mary Queen of Scots:

Claimed that she was the legitimate Catholic heir to the throne and was married to the Catholic king of France.

Foreign threat:

England was isolated, surrounded by Catholic enemies in both France (who they had been at war with) and Spain (who Elizabeth had refused a marriage proposal from).

Mary Queen of Scots' claim to the throne



Comparison between Catholicism and Protestantism

Roman Catholic	Protestant
The pope is the head of the Church	There should be no pope
The Bible and church services should be in Latin	The Bible and church services should be in your own language
The Church can forgive sins	Sins can only be forgiven by God
During mass a miracle occurs when the bread and wine become the body and blood of Christ	The bread and wine simply represent the Last Supper in the Bible. There is no miracle
Priests are special and should wear special clothing (vestments)	Priests are not special and should not wear special clothing
Churches should be highly decorated in honour and glory of God	Churches should be plain and simple so as not to distract from worshipping God
Priests are forbidden to marry	Priests are permitted to marry if they wished

The Religious Settlement 1559

The Act of Uniformity

Established what churches should look like. Moderate decoration was allowed. Hymns could be sung. All services, bibles and prayers books were in English. Miracle at Communion left ambiguous. Priests still wore vestments.

The Act of Supremacy

Elizabeth was named Supreme Governor of the Church of England. All clergy members swore an oath of allegiance to her.

Royal Injunctions

Set of instructions on how to reinforce the acts of Uniformity and Supremacy. Included instructions on how people should worship God.

Puritan challenge:

Fell into two categories 1. The crucifix controversy (as Puritans did not believe the image of Christ dying on the cross should be present in churches). 2. The vestment controversy (as Puritans did not believe that priests should wear any special clothing).

Foreign challenge:

Both France and Spain were Catholic powers abroad and were not supportive of Elizabeth's Protestant rule.

Challenges to
the Religious
Settlement

The Catholic challenge:

Although the papacy did not offer direct leadership to England's Catholics, the pope did issue instructions forbidding Catholics from attending Church of England services. Many of the ancient families in England were Catholic, most notably the Dukes of Norfolk and a number continued to worship in their own homes.

Question types

'Describe two features of...' [4]

(2 x 2 = 4 marks total)

Identify 2 features and support with evidence.

Useful phrases: "One feature was..." "For example ..."

'Explain why...' [12]

3 PEE paragraphs about the reasons for an event/change/threat. The paragraphs must show a link to the question.

Useful phrases: "This shows that...because..." "Another reason is...this is because..."

'How far do you agree..' [16]

A balanced answer discussing both sides of the argument with an overall conclusion.

Useful phrases: "It is debatable whether..." "Some might agree that..."

"This is shown by..."

Sample exam questions – 4 and 12 marks

‘Describe two features of Elizabethan society in 1558’. [4]

‘Describe two features of the Elizabethan social hierarchy’. [4]

‘Describe two features of the Privy Council’. [4]

‘Describe two features of Catholic beliefs about the organisation of the Church’. [4]

‘Describe two features of the Religious Settlement of 1559’. [4]

‘Describe two features of Puritan challenges to the Religious Settlement of 1569’. [4]

‘Explain why religion was a problem for Elizabeth when she became queen in 1558’. [12]

‘Explain why Catholics abroad were a problem for Elizabeth 1558-1569’. [12]

‘Explain why Catholics challenged the Religious Settlement of 1569’. [12]

‘Explain why Mary Queen of Scots created a problem for Elizabeth upon her arrival in 1568’. [12]

Sample exam questions – 16 marks

“Financial issues were the main cause of Elizabeth’s domestic challenges between 1558-69”.

How far do you agree? [16]

“The threat of invasion was the main problem Elizabeth faced when she became queen in 1558”. How far do you agree? [16]

“Elizabeth was successful in dealing with the problems she faced between 1558-69”. How far do you agree? [16]

“English Catholics represented the most significant threat to Elizabeth’s Religious Settlement”. How far do you agree? [16]

A1 Human growth and development across life stages

Life stages and their expected key characteristics in each of the PIES classifications

Infancy (birth to 2 years): **physical:** rapid physical growth of weight and height, development of gross and fine motor skills, following the same pattern of growth and development but at different rates
intellectual: rapid development of language and thinking skills such as memory/recall
emotional: attachments are formed, emotional wellbeing is based on bonding/attachment, security and contentment
social: strong dependence on adults/carers, socialisation through family, engage in solitary play



Early childhood (3–8 years): **physical:** continued growth of weight and height, mastery of gross and fine motor skills
intellectual: increased curiosity, language fluency develops, strong grasp of memory/recall
emotional: increased independence, wider range of relationships are formed, emotional wellbeing is based on attachment, security and contentment
social: social circle widens and close friendships are formed, socialisation continues through family and also friends/carers, social play develops



Adolescence (9–18 years): **physical:** onset of puberty, differences between males and females, primary and secondary sexual characteristics
intellectual: complex and abstract thinking develops
emotional: independence increases further, more freedom to make own decisions, concerns over self-image and self-esteem may increase, emotional wellbeing is based on attachment, security and contentment
social: wide range of formal/informal relationships develop and have influence, intimate relationships are formed.



A1 Human growth and development across life stages

Life stages and their expected key characteristics in each of the PIES classifications

Early Adulthood (19-45 years): **physical:** peak physical fitness, full height and sexual maturity reached, women at their most fertile **intellectual:** mastery of abstract and creative thinking, careers become important, may return to education **emotional:** independent living and control over own lives, emotional wellbeing is based on attachment, security and contentment **social:** intimate and long-lasting relationships are formed



Middle Adulthood (46–65 years): **physical:** at the end of this life stage the ageing process begins, menopause occurs for women **intellectual:** can use knowledge and experience for complex decision making, may retire **emotional:** may experience changes in self-image and self-esteem linked to retirement or ageing process, emotional wellbeing is based on attachment, security and contentment **social:** may have more time to socialise

Later Adulthood (65+ years): **physical:** ageing process continues, decline in strength and fitness, loss of mobility, loss of muscle tone and skin elasticity **intellectual:** may experience decline in cognitive ability such as loss of memory/recall **emotional:** may start to become more dependant on others, emotional wellbeing is based on attachment, security and contentment **social:** may experience bereavement and reduction of social circle



A2 Factors affecting growth and development

Different factors will impact on different aspects of growth and development

Physical Factors: **inherited conditions:** sickle cell disease, cystic fibrosis, muscular dystrophy, Marfan syndrome and Huntington's disease **experience of illness and disease**
mental ill health: anxiety, stress **physical ill health:** cardiovascular disease, obesity, type 2 diabetes **disabilities**
sensory impairments

Social Factors: **supportive and unsupportive relationships with others** - friends
family, peers and colleagues
social inclusion and exclusion **bullying** **discrimination**

Environmental Factors: **housing needs, conditions, location home environment** – living with a high level of parental conflict **experiences of abuse and neglect**
exposure to pollution – air, noise and light

Emotional Factors: **fear, anxiety/worry, upset/sadness, grief/bereavement, happiness/contentment, security attachment**

Lifestyle Factors: **nutrition, physical activity, smoking, alcohol, substance misuse**

Cultural Factors: **religion gender roles and expectations gender identity sexual orientation community participation race**

Economic Factors: **employment situation financial resources** – income, inheritance, savings

What is development?	
Development is an improvement in living standards through better use of resources.	
Economic	This is progress in economic growth through levels of industrialisation and use of technology.
Social	This is an improvement in people's standard of living. For example, clean water and electricity.
Environmental	This involves advances in the management and protection of the environment.

Measuring development	
These are used to compare and understand a country's level of development.	
Economic indicators examples	
Employment type	The proportion of the population working in primary, secondary, tertiary and quaternary industries.
Gross Domestic Product per capita	This is the total value of goods and services produced in a country per person, per year.
Gross National Income per capita	An average of gross national income per person, per year in US dollars.

Social indicators examples	
Infant mortality	The number of children who die before reaching 1 per 1000 babies born.
Literacy rate	The percentage of population over the age of 15 who can read and write.
Life expectancy	The average lifespan of someone born in that country.
Mixed indicators	
Human Development Index (HDI)	A number that uses life expectancy, education level and income per person.

Variations in the level of development	
LICs	Poorest countries in the world, GNI per capita is low and most citizens have a low standard of living.
NEEs	These countries are getting richer as their economy is progressing from the primary industry to the secondary industry. Greater exports leads to better wages.
HICs	These countries are wealthy with a high GNI per capita and standards of living. These countries can spend money on services.



Causes of uneven development

Development is globally uneven with most HICs located in Europe, North America and Oceania. Most NEEs are in Asia and South America, whilst most LICs are in Africa. Remember, development can also vary within countries too.

Unit 2b The Changing Economic World

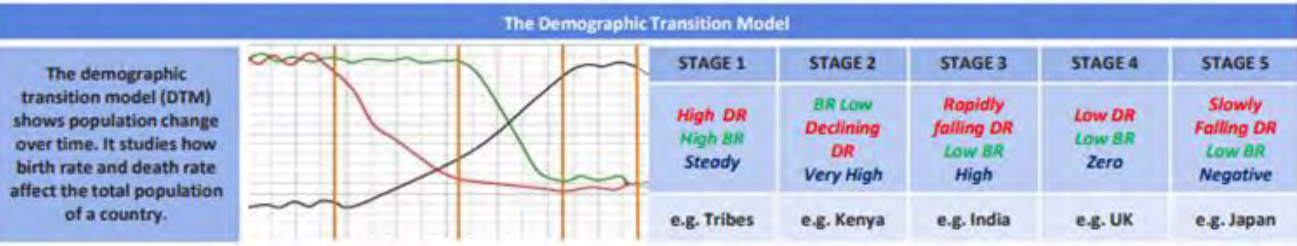
Physical factors affecting uneven development	
Natural Resources <ul style="list-style-type: none"> Fuel sources such as oil. Minerals and metals for fuel. Availability for timber. Access to safe water. 	Natural Hazards <ul style="list-style-type: none"> Risk of tectonic hazards. Benefits from volcanic material and floodwater. Frequent hazards undermines redevelopment.
Climate <ul style="list-style-type: none"> Reliability of rainfall to benefit farming. Extreme climates limit industry and affects health. Climate can attract tourists. 	Location/Terrain <ul style="list-style-type: none"> Landlocked countries may find trade difficulties. Mountainous terrain makes farming difficult. Scenery attracts tourists.

Human factors affecting uneven development	
Aid <ul style="list-style-type: none"> Aid can help some countries develop key projects for infrastructure faster. Aid can improve services such as schools, hospitals and roads. Too much reliance on aid might stop other trade links becoming established. 	Trade <ul style="list-style-type: none"> Countries that export more than they import have a trade surplus. This can improve the national economy. Having good trade relationships. Trading goods and services is more profitable than raw materials.
Education <ul style="list-style-type: none"> Education creates a skilled workforce meaning more goods and services are produced. Educated people earn more money, meaning they also pay more taxes. This money can help develop the country in the future. 	Health <ul style="list-style-type: none"> Lack of clean water and poor healthcare means a large number of people suffer from diseases. People who are ill cannot work so there is little contribution to the economy. More money on healthcare means less spent on development.
Politics <ul style="list-style-type: none"> Corruption in local and national governments. The stability of the government can effect the country's ability to trade. Ability of the country to invest into services and infrastructure. 	History <ul style="list-style-type: none"> Colonialism has helped Europe develop, but slowed down development in many other countries. Countries that went through industrialisation a while ago, have now develop further.

Consequences of Uneven Development

Levels of development are different in different countries. This uneven development has consequences for countries, especially in wealth, health and migration.

Wealth	People in more developed countries have higher incomes than less developed countries.
Health	Better healthcare means that people in more developed countries live longer than those in less developed countries.
Migration	If nearby countries have higher levels of development or are secure, people will move to seek better opportunities and standard of living.



GCSE Geography

Reducing the Global Development Gap

Microfinance Loans

This involves people in LICs receiving smalls loans from traditional banks.

+ Loans enable people to begin their own businesses

- Its not clear they can reduce poverty at a large scale.

Foreign-direct investment

This is when one country buys property or infrastructure in another country.

+ Leads to better access to finance, technology & expertise.

- Investment can come with strings attached that country's will need to comply with.

Aid

This is given by one country to another as money or resources.

+ Improve literacy rates, building dams, improving agriculture.

- Can be wasted by corrupt governments or they can become too reliant on aid.

Fair trade

This is a movement where farmers get a fair price for the goods produced.

+ Paid fairly so they can develop schools & health centres.

- Only a tiny proportion of the extra money reaches producers.

CS: Reducing the Development Gap In Jamaica

Location and Background

Jamaica is a LIC island nation part of the Caribbean. Location makes Jamaica an attractive place for visitors to explore the tropical blue seas, skies and palm filled sandy beaches

Tourist economy

-In 2015, 2.12 million visited.
-Tourism contributes 27% of GDP and will increase to 38% by 2025.
-130,000 jobs rely on tourism.
-Global recession 2008 caused a decline in tourism. Now tourism is beginning to recover.

Multiplier effect

-Jobs from tourism have meant more money has been spent in shops and other businesses.
-Government has invested in infrastructure to support tourism.
-New sewage treatment plants have reduced pollution.

Development Problems

- Tourists do not always spend much money outside their resorts.
- Infrastructure improvements have not spread to the whole island.
- Many people in Jamaica still live in poor quality housing and lack basic services such as healthcare.

Case Study: Economic Development in Nigeria

Location & Importance

Nigeria is a NEE in West Africa. Nigeria is just north of the Equator and experiences a range of environments.

Nigeria is the most populous and economically powerful country in Africa. Economic growth has been based on oil exports.

Influences upon Nigeria's development

Political

Suffered instability with a civil war between 1967-1970. From 1999, the country became stable with free and fair elections. Stability has encouraged global investment from China and USA.

Cultural

Nigeria's diversity has created rich and varied artistic culture. The country has a rich music, literacy and film industry (i.e. Nollywood). A successful national football side.

The role of TNCs

TNCs such as Shell have played an important role in its economy.
+ Investment has increased employment and income.
- Profits move to HICs.
- Many oil spills have damaged fragile environments.

Environmental Impacts

The 2008/09 oil spills devastated swamps and its ecosystems. Industry has caused toxic chemicals to be discharged in open sewers - risking human health. 80% of forest have been cut down. This also increases CO₂ emissions.

Effects of Economic Development

Life expectancy has increased from 46 to 53 years. 64% have access to safe water. Typical schooling years has increased from 7 to 9.



Case Study: Economic Change in the UK

UK in the Wider World

The UK has one of the largest economies in the world. The UK has huge political, economic and cultural influences. The UK is highly regarded for its fairness and tolerance. The UK has global transport links i.e. Heathrow and the Eurostar.



Causes of Economic Change

De-industrialisation and the decline of the UK's industrial base. Globalisation has meant many industries have moved overseas, where labour costs are lower. Government investing in supporting vital businesses.

Towards Post-Industrial

The quaternary industry has increased, whilst secondary has decreased. Numbers in primary and tertiary industry has stayed the steady. Big increase in professional and technical jobs.

Developments of Science Parks

Science Parks are groups of scientific and technical knowledge based businesses on a single site.

- Access to transport routes.
- Highly educated workers.
- Staff benefit from attractive working conditions.
- Attracts clusters of related high-tech businesses.

CS: UK Car Industry

Every year the UK makes 1.5 million cars. These factories are owned by large TNCs. i.e. Nissan.

- 7% of energy used there factories is from wind energy.
- New cars are more energy efficient and lighter.
- Nissan produces electric and hybrid cars.

Change to a Rural Landscape

Social

Rising house prices have caused tensions in villages. Villages are unpopulated during the day causing loss of identity. Resentment towards poor migrant communities.

Economic

Lack of affordable housing for local first time buyers. Sales of farmland has increased rural unemployment. Influx of poor migrants puts pressures on local services.

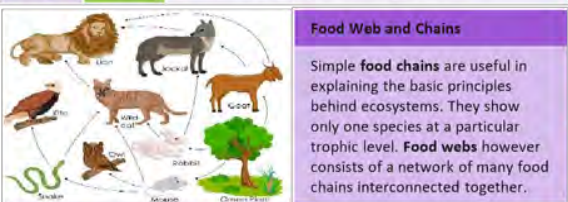
Improvements to Transport

A £15 billion 'Road Improvement Strategy'. This will involve 10 new roads and 1,600 extra lanes. £50 billion HS2 railway to improve connections between key UK cities. £18 billion on Heathrow's controversial third runway. UK has many large ports for importing and exporting goods.

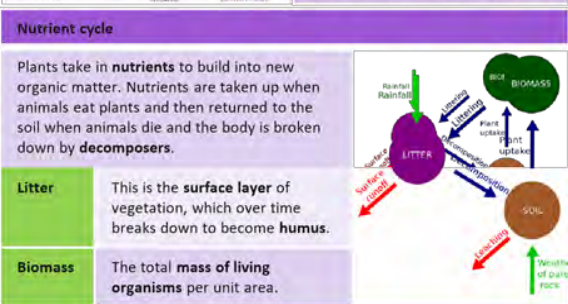
UK North/South Divide

- Wages are lower in the North.
- Health is better in the South.
- Education is worse in the North.
+ The government is aiming to support a Northern Powerhouse project to resolve regional differences.
+ More devolving of powers to disadvantaged regions.

What is an Ecosystem?	
An ecosystem is a system in which organisms interact with each other and with their environment.	
Ecosystem's Components	
Abiotic	These are non-living , such as air, water, heat and rock.
Biotic	These are living , such as plants, insects, and animals.
Flora	Plant life occurring in a particular region or time.
Fauna	Animal life of any particular region or time.



Biome's climate and plants						
Biome	Location	Temperature	Rainfall	Flora	Fauna	
Tropical rainforest	Centred along the Equator.	Hot all year (25-30°C)	Very high (over 200mm/year)	Tall trees forming a canopy; wide variety of species.	Greatest range of different animal species. Most live in canopy layer	
Tropical grasslands	Between latitudes 5°- 30° north & south of Equator.	Warm all year (20-30°C)	Wet + dry season (500-1500mm/year)	Grasslands with widely spaced trees.	Large hoofed herbivores and carnivores dominate.	
Hot desert	Found along the tropics of Cancer and Capricorn.	Hot by day (over 30°C) Cold by night	Very low (below 300mm/year)	Lack of plants and few species; adapted to drought.	Many animals are small and nocturnal: except for the camel.	
Temperate forest	Between latitudes 40°- 60° north of Equator.	Warm summers + mild winters (5-20°C)	Variable rainfall (500-1500mm /year)	Mainly deciduous trees; a variety of species.	Animals adapt to colder and warmer climates. Some migrate.	
Tundra	Far Latitudes of 65° north and south of Equator	Cold winter + cool summers (below 10°C)	Low rainfall (below 500mm/ year)	Small plants grow close to the ground and only in summer.	Low number of species. Most animals found along coast.	
Coral Reefs	Found within 30° north – south of Equator in tropical waters.	Warm water all year round with temperatures of 18°C	Wet + dry seasons. Rainfall varies greatly due to location.	Small range of plant life which includes algae and sea grasses that shelters reef animals.	Dominated by polyps and a diverse range of fish species.	



Litter This is the **surface layer** of vegetation, which over time breaks down to become **humus**.

Biomass The total **mass of living organisms** per unit area.

Biomes

A biome is a **large geographical area of distinctive plant and animal groups**, which are adapted to that particular environment. The climate and geography of a region determines what type of biome can exist in that region.

Coniferous forest	Deciduous forest	Tropical rainforests	Tundra	Temperate grasslands	Tropical grasslands	Hot deserts.
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The **most productive biomes** – which have the greatest biomass- grow in climates that are **hot and wet**.

Unit 1b The Living World

AQA

Tropical Rainforest Biome

Tropical rainforest cover about **2 per cent** of the Earth's surface yet they are home to **over half** of the world's plant and animals.

Interdependence in the rainforest

A rainforest works through **interdependence**. This is where the plants and animals **depend on each other** for survival. If one component changes, there can be **serious knock-up effects** for the entire ecosystem.

Distribution of Tropical Rainforests

Tropical rainforests are **centred along the Equator** between the Tropic of Cancer and Capricorn. Rainforests can be found in South America, central Africa and South-East Asia. **The Amazon** is the world's largest rainforest and takes up the majority of northern South America, encompassing countries such as Brazil and Peru.

Rainforest nutrient cycle

The **hot, damp conditions** on the forest floor allow for the **rapid decomposition** of dead plant material. This provides plentiful nutrients that are easily absorbed by plant roots. However, as these nutrients are in high demand from the many fast-growing plants, they do not remain in the soil for long and stay close to the surface. If vegetation is removed, the soils quickly become **infertile**.

Climate of Tropical Rainforests

- Evening temperatures rarely fall below **22°C**.
- Due to the **presence of clouds**, temperatures rarely rise above **32°C**.
- Most afternoons have heavy showers.
- At night with no clouds insulating, temperature drops.

CASE STUDY: UK Ecosystem: Epping Forest, Essex

This is a typical English lowland deciduous woodland. **70% of the area** is designated as a **Site of Special Scientific Interest (SSI)** for its biological interest, with **66 %** designated as a **Special Area of Conservation (SAC)**.

Components & Interrelationships	Management
Spring Flowering plants (producers) such as bluebells store nutrients to be eaten by consumers later.	- Epping has been managed for centuries. - Currently now used for recreation and conservation .
Summer Broad tree leaves grow quickly to maximise photosynthesis .	- Visitors pick fruit and berries, helping to disperse seeds .
Autumn Trees shed leaves to conserve energy due to sunlight hours decreasing.	- Trees cut down to encourage new growth for timber .
Winter Bacteria decompose the leaf litter, releasing the nutrients into the soil.	

Layers of the Rainforest

Emergent	Highest layer with trees reaching 50 metres .
Canopy	Most life is found here as it receives 70% of the sunlight and 80% of the life .
U-Canopy	Consists of trees that reach 20 metres high .
Shrub Layer	Lowest layer with small trees that have adapted to living in the shade .

Temperature (°C) and Rainfall (mm) by month: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sept, Oct, Nov, Dec.

Tropical Rainforests: Case Study Malaysia



Malaysia is a LIC country in south-east Asia. 67% of Malaysia is a tropical rainforest with 18% of it not being interfered with. However, Malaysia has the fastest rate of deforestation compared to anywhere in the world.

Adaptations to the rainforest

Orangutans	Large arms to swing & support in the tree canopy.
Drip Tips	Allows heavy rain to run off leaves easily .
Lianas & Vines	Climbs trees to reach sunlight at canopy.

Rainforest inhabitants

Many tribes have developed sustainable ways of survival. The rainforest provides inhabitants with...

- **Food** through hunting and gathering.
- **Natural medicines** from forest plants.
- **Homes and boats** from forest wood.

Issues related to biodiversity

Why are there high rates of biodiversity?

- **Warm and wet climate** encourages a wide range of vegetation to grow.
- There is **rapid recycling of nutrients** to speed plant growth.
- Most of the rainforest is **untouched**.

Main issues with biodiversity decline

- **Keystone species** (a species that are important of other species) are extremely important in the rainforest ecosystem. Humans are threatening these vital components.
- **Decline in species** could cause tribes being unable to survive.
- **Plants & animals** may become **extinct**.
- Key medical **plants** may become **extinct**.

Impacts of deforestation

Economic development

- + Mining, farming and logging creates employment and tax income for government.
- + Products such as palm oil provide valuable income for countries.
- The loss of biodiversity will reduce tourism.

Soil erosion

- Once the land is **exposed by deforestation**, the soil is more **vulnerable to rain**.
- **With no roots to bind soil together**, soil can **easily wash away**.

Climate Change

- When rainforests are cut down, the climate becomes **drier**.
- Trees are **carbon 'sinks'**. With greater deforestation comes more greenhouse emissions in the atmosphere.
- When trees are burnt, they **release more carbon in the atmosphere**. This will enhance the **greenhouse effect**.

What are the causes of deforestation?

Logging

- Most widely reported cause of destructions to biodiversity.
- Timber is harvested to create **commercial items** such as furniture and paper.
- **Violent confrontation** between indigenous tribes and logging companies.

Mineral Extraction

- **Precious metals** are found in the rainforest.
- Areas **mined** can experience **soil and water contamination**.
- **Indigenous people** are becoming **displaced** from their land due to roads being built to transport products.

Energy Development

- The **high rainfall** creates ideal conditions for **hydro-electric power (HEP)**.
- The **Bakun Dam** in Malaysia is key for creating energy in this developing country, however, both people and environment have suffered.

Sustainability for the Rainforest

Uncontrolled and unchecked exploitation can cause irreversible damage such as loss of biodiversity, soil erosion and climate change.

Possible strategies include:

- **Agro-forestry** - Growing trees and crops at the same time. It prevents soil erosion and the crops benefit from the nutrients.
- **Selective logging** - Trees are only felled when they reach a particular height.
- **Education** - Ensuring those people understand the consequences of deforestation
- **Afforestation** - If trees are cut down, they are replaced.
- **Forest reserves** - Areas protected from exploitation.
- **Ecotourism** - tourism that promotes the environments & conservation

Agriculture

- Large scale **'slash and burn'** of land for ranches and palm oil.
- Increases **carbon emission**.
- **River siltation and soil erosion** increasing due to the large areas of **exposed land**.
- Increase in **palm oil** is making the **soil infertile**.

Tourism

- **Mass tourism** is resulting in the building of hotels in extremely **vulnerable areas**.
- Lead to **negative relationship** between the government and indigenous tribes
- Tourism has **exposed animals** to human **diseases**.

Road Building

- **Roads** are needed to bring supplies and **provide access** to new mining areas, settlements and energy projects.
- In Malaysia, logging companies use an **extensive network of roads** for heavy machinery and to transport wood.

Cold Environments: Case Study Svalbard



Svalbard is a Norwegian territory in the Arctic Ocean and the most northern permanently inhabited group of islands in the world.

Distribution of the world's cold environments

Most of the world's cold environments are located in the polar regions. The latitude of these regions is 66° N/S.

Major characteristics of cold environments

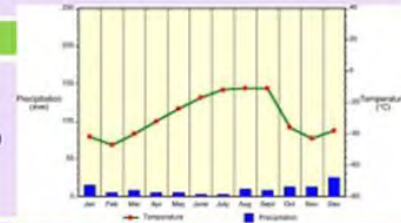
- **Polar:** Soil permanently covered by ice, low precipitation, temperatures in winter falling below -50 °C.
- **Tundra:** Winter temperatures -20 °C, Soil is generally infertile and frozen in winter, precipitation high in coastal areas.

Cold environment inhabitants

- People at a serious risk of frostbite
- Wear thermal underwear, winter jackets and boots.
- Outdoor work can be *very slow and dangerous*.

Climate of Cold environments

- **Polar:** Low precipitation and temperatures in winter falling below -50 °C.
- **Tundra:** Winter temperatures -20 °C and precipitation is high in coastal areas.



Adaptations to cold environments

Polar bears

- Thick fur to retain heat.
- Insulating layer of fat.
- Black nose and foot pads absorb sun light



Bearberry

- Very low growing to survive strong winds.
- Small leathery leaves help retain water
- Bright red berries eaten by birds and owls and this helps distribute seeds.

Interdependence

Different parts of the cold environments ecosystem are **closely linked together and depend on each other**, especially in a such a harsh environment.

Opportunities and challenges in Cold environments

Opportunities

- **Mineral extraction:** Svalbard is rich in coal. It is the main economic activity and employs over 300 people.
- **Energy developments:** Coal is used to power one power station, however Svalbard is increasingly looking at Geothermal energy and Carbon capture.
- **Fishing:** The cold waters near Svalbard are one of the richest fishing grounds in the world.
- **Tourism:** In 2011 70,000 people visited Svalbard.

Challenges

- **Extreme temperatures:** Make it challenging for humans to complete outdoor work.
- **Construction:** The frozen ground has to be protected from melting and there are issues with the quality of dirt/gravel roads.
- **Services:** Water/Energy are generally provided to individual buildings and have to be kept off the ground (to avoid freezing)

Causes of environmental damage

Fragile environments are environments that are delicate and easily damaged.

Climate Change
Rising temperatures has resulted in temperature change and melting of ice in polar regions.

Vehicle damage
People driving off-road vehicles erodes the soil which is often soggy in summer (as it melts)

Economic Development
Exploiting resources leads to environmental damage as coal has to be mined from underground.

Oil pollution
Pollutes rivers, leaks into the environment and infrastructure construction causes damage.

Tourism
Puts pressure on resources which can result in land being cleared for buildings/roads/

Strategies to reduce Desertification

- **Technology:** Raising oil pipelines to avoid it melting the permafrost and pumping stations to keep the oil moving.
- **Action by governments:** Alaska has strict policies on protecting the environment from resource exploitation.
- **International Agreements:** The Antarctica Treaty (1959) protects the natural environment.
- **Conservation Groups:** The WWF provides scientific information, expertise and resources.

R181 (Topic Area 2): Principles of Training

The following two principles work in tandem to ensure that training remains specific and relevant to their sport and goals.

SPOR PRINCIPLE

S - Specificity	Specificity means that training should be specific to the sporting activity being trained for.
P – Progression	Progression means to make training gradually harder.
O – Overload	Overload is linked to progression. When a person overloads their body, they are working harder than normal. (FITT)
R – Reversibility	Reversibility refers to the concept of 'use it or lose it'. If training stops then fitness levels will reverse/be lost.

FITT PRINCIPLE

F – Frequency	How often the person trains, therefore train more often to overload.
I – Intensity	How hard/intense the training is, therefore make training hard to overload.
T – Time	How long the session should last to make training hard and create overload.
T - Type	The type of training of training being used (make sure training remains specific)

To achieve goals and to effectively implement these principles of training (above), it is important to set **SMART** targets.

S – Specific, M – Measurable, A – Achievable, R – Realistic & T – Time Bound.

Continuous Training: This involves working at a 'continuous' intensity throughout, for a sustained period of time (30mins+) without rest.

Continuous training tends to be performed at a lower or moderate intensity and typically involves activities such as running, cycling & swimming, which improves our CV fitness.

Advantages

- No need for equipment/facilities.
- Many health benefits and a good place to start for beginners.

Disadvantages

- Can become tedious as no change of pace.
- Higher chance of injury when running long distances on a hard surface

Sporting Examples

Marathon/Long Distance Runners (e.g., Mo Farah)
Long Distance Cyclists (e.g., Chris Frome – Tour De France)

Circuit Training: In circuit training, different exercises (stations) are set up around a room. Each station has a different activity and works on either aerobic endurance, muscular endurance, strength or all 3. Athletes carry out each station for a set time (e.g., 1min), with a rest period between stations. To avoid fatigue, consecutive stations should work on different muscle groups (e.g., repeated sprints (legs) then press-ups (upper body))

Advantages

- Different stations reduce boredom and allow all/specific muscles to be targeted

- Easily adaptable to increase **overload** and **progression**

Disadvantages

- Equipment can be costly and can take time to set up

Sporting Examples

Adaptable to any sport/performer.

Fartlek Training

This involves changing the intensity of training according to the athlete's requirements. That may be done by changing terrain (e.g., sand, hills) or by running at a sustained pace to a landmark (e.g., a lamppost). Fartlek training is more sport-specific and can be altered to improve aerobic, anaerobic, & muscular endurance. Like continuous, there is no rest.

Advantages

- No need for equipment/facilities.
- Change of pace allows athletes to control pacing & prevent boredom.

Disadvantages

- Easy to avoid high intensity
- Hard to find safe route of terrains.

Sporting Examples

Can be adapted to many sports, but traditionally team game sports such as Football, Rugby,

Interval Training

Interval training improves both anaerobic and aerobic endurance by varying the intensity and length of work periods. However, this training type involves a rest period. Typical work time can be from 30seconds to around 5 minutes depending on sport and intensity, followed by a rest period.

Advantages

- Can be used to improve both health and fitness
- Easy to apply **overload** and **progression** to the **training**

Disadvantages

- Can cause injury to the high intensity nature of **training**

Sporting Examples

100m sprinter (e.g., Usain Bolt) and long jump (e.g., Greg Rutherford)

Weight Training

This form of training can incorporate many different methods (e.g., free weights, resistance machines). It improves muscular strength, muscular endurance, & power. It is important to perform actions correctly & safely to avoid injury, and will typically include both 'reps' (how many times you perform exercise) & 'sets' (how many times you repeat the exercise)

Advantages

- Easy to target specific **body parts**

Disadvantages

- Can cause injury with poor technique & can be very **expensive**

Sporting Examples

Sports that requires strength, such as weightlifting & **boxing**

Plyometric Training

One of the best ways to increase power (combination of speed and strength). Plyometric training involves taking part in repeated exercises such as bounding/hopping over hurdles to create fast, powerful movements. Plyometric exercises make the use of the elastic properties of muscles.

Advantages

- Effective to improve power.
- Requires little to no equipment.

Disadvantages

- Puts stress and strain on muscles and joints.
- Can lead to sore muscles.

Sporting Examples

Excellent for jumping events and for events that require leg power, such as basketball.

High-Intensity Interval Training

One of the most common forms of interval training is high-intensity interval training (HIIT). HIIT involves periods of work and rest like normal interval training, however the periods of work are at a very intense level. A common work to rest ratio is 2:1.

Advantages

- Has aerobic and anaerobic events.
- Burns calories and uses fat quickly.
- Can be completed quickly.

Disadvantages

- High-intensity work can lead to injury.
- High levels of motivation are needed.
- Can lead to dizziness/nausea.

Sporting Examples

Can be adapted to any sport that has a change in intensity, for example team games and racket sports.

Aerobic Training: Is when exercise is steady and in the presence of oxygen. A marathon runner would train aerobically as it improves cardiovascular (CV) fitness.

Low Intensity → Long Duration → Enough Oxygen
Continuous and Fartlek Training Methods

Anaerobic Training: is exercising in short, fast bursts without oxygen. A sprinter would train anaerobically to improve power/speed without oxygen.

High Intensity → Short Duration → Not Enough Oxygen
HIIT, Interval, Plyometric & Resistance Training Methods

Genres			Music Technology Terms			Key terms for analysing music		
1	60's to 70's	Folk revival, Psychedelic, Heavy Metal, Soul, Motown, Disco, Punk, Reggae	1	Multi-tracking	Recording several parts one at a time and layering them using a DAW	1	Dynamics	How loud or quiet the music is. Does it change in certain sections and why?
2	80's to 90's	Synth pop, Post punk, Thrash Metal, Grunge, Britpop, Hip hop, House, Rave	2	Overdubbing	Doubling up the recording of a part to make it sound bigger / Thicker in texture	2	Rhythm	The pattern of notes used. Does the instrument play a repetitive rhythm or a complex one?
3	00's to present day	Pop Punk, EDM, Dubstep, K-pop, Reggaeton, Grime, Trap	3	Sampling	Taking a small section of an existing audio recording and using it in own work	3	Structure	The sections of the music. Into, Verse, Chorus, Bridge, Outro. How the music is put together
4	World music and Fusion	African drum music, Indian Raga, Afrobeat, Jazz fusion	4	Synthesiser	Computer created instrument or sound			
5	Music for Media	Film, TV, Computer games, Ambient music, Foley	5	Sequencing	Composing music using MIDI	4	Melody	The main tune. Think about if it moves in steps or leaps.
6	Western Classical	Romantic, Orchestral, Minimalism	6	MIDI	Musical notation for DAW	5	Instrumentation	The instruments used
7	Jazz and Blues	Bebop, Big band, Blue note, Country blues, Delta blues	7	Looping	Continuous playback of musical phrase / sound	6	Texture	The layers of instruments / Sound
Industry Products			8	Turntablism	Manipulating sounds and beats using DJ equipment	7	Timbre	Describes the characteristics of the sound. Eg. Bright or Gritty.
1	Live Performance	Performing to a live audience (video)	9	Phasing and distortion	Guitar effects used to manipulate audio	8	Harmony	The Key the music is written in. Major or Minor.
2	Audio recording	Audio recording of your piece	1	DAW	Digital Audio Workstation. Software used to create music	9	Syncopation	A rhythm the used the off beat (beats 2 and 4)
3	Composition for media	Own composition for TV, Film or game	1	Quantise	A automated movement of performed notes	1	BPM	Beats per minute, used to measure the tempo (speed)
4	DAW Project	Project using sequencing, synthesis and sampling	2	Analogue	Recording onto a physical format. Before digital age			
5	Original song	Own song / composition idea						



Component 1 – Exploring Music Styles and Products

Melody – Knowledge Organiser			
<p>Pitch</p> <p>How high or low a note is</p>	<p>Interval</p> <p>The distance between any two notes.</p>	<p>Motif</p> <p>A fragment of a melody.</p>	<p>Range</p> <p>The difference between the lowest and highest notes</p>
<p>Phrase</p> <p>A longer melodic idea. Musical "sentences" are constructed from phrases.</p>		<p>Hook/riff</p> <p>A memorable repeated melodic idea designed to catch the ear of the listener.</p>	
<p>Melodic movement</p> <p>Steps – movement between notes that are next to each other in the scale Skips – movement equal to two steps. You "skip" over a note in the scale Leaps – any movement that is larger than a skip Scale – when a section of a melody moves along using notes in scale order Chromatic – movement using steps including notes that are not in the key Passing note – notes which link chord tones</p>			
<p>Counter melody</p>		<p>Compositional devices</p> <p>Repetition – repeat a melodic idea Sequence – repeat a melodic idea but starting on a different note Imitation – repeat a melodic idea in another instrument Variation – change the melodic idea slightly Ostinato – constant repetition of a melodic idea Inversion – turn the melodic idea upside down Retrograde – play the melodic idea backwards</p>	
<p>Scale/mode</p> <p>A group of notes which a melody is based on e.g. major, minor, blues, chromatic, dorian</p>			

Harmony – Knowledge Organiser					
<p>HARMONY – how chords are used in a piece of music.</p>					
<p>Triad</p> <p>A basic type of chord made up of three notes</p>	<p>Inversion</p> <p>Rearranging the order of the individual notes of a chord</p>	<p>Power Chord</p> <p>G5</p> <p>A chord using only the 1st and 5th scale degrees; no 3rd</p>			
<p>Chord Functions in a Key – Roman Numeral System</p>			<p>Building Chords Using Scale Degrees</p> <p>C D E F G A B</p> <p>Example: Minor triads are built using the 1, b3 and 5 degrees of a scale so a C minor triad contains the notes: C Eb G</p>		
<p>Major Triad</p> <p>1 3 5</p>	<p>Minor Triad</p> <p>1 b3 5</p>	<p>Major 7th chord</p> <p>1 3 5 7</p>	<p>Minor 7th chord</p> <p>1 b3 5 b7</p>	<p>Dominant 7th chord</p> <p>1 3 5 b7</p>	
<p>Perfect Cadence "The strongest one"</p>	<p>Plagal Cadence "The Amen one"</p>	<p>Imperfect Cadence "The cliffhanger one"</p>	<p>Interrupted Cadence "The hidden twist one"</p>	<p>Chord Symbol</p>	
<p>Arpeggio – playing the individual notes of a chord one after another Cadence – a movement between two chords at the end of a phrase Chromatic – music that uses chords that are not naturally found in the key Diatonic – music that use only chords that belong to the key Dominant – the fifth chord (V) of a key Harmonic rhythm – the rate at which the chords change in a piece Modulation – when the harmony shifts to a new key Primary triads – chords I, IV and V in a key Progression – a sequence of chords put together Seventh – adding the 7th degree of the scale to a triad Tonic – the first chord (I) in a key</p>					



Component 1 – Exploring Music Styles and Products

Structure and Form – Knowledge Organiser			
STRUCTURE - the different sections of a piece or music and how they are ordered.			
Typical Pop Song Structure			
Intro – Verse 1 – Verse 2 – Chorus – Verse 3 – Middle 8/Bridge – Verse 4 – Chorus – Outro			
Intro	Binary Form	Ternary Form	Rondo Form
The introduction sets the mood of a song. It is often instrumental but can occasionally start with lyrics.	Music that has two sections. These are labelled A and B. A B	Music that has three sections. The A section is heard again after B. A B A	A recurring theme (A) contrasted by different sections. A B A C A D A E
Verses	Theme & Variation		
Verses introduce the song theme. There are usually new lyrics for each verse which helps to develop the song's narrative	A composition can be developed using the VARIATION technique. A main theme is composed then the following sections vary this theme in some way, by altering for example: MELODY – RHYTHMS – CHORDS – TEMPO – INSTRUMENTATION – KEY		
Choruses	Strophic Form		
All the choruses usually have the same lyrics. This section relays the main message of the song. Middle 8/Bridge	When all of the verses are sung to the same music.		
This section adds some contrast to the verses and choruses by using a different melody and chord progression.	Through Composed		
Instrumental Solo	When each section has different music. No section is repeated.		
Solos are designed to show off an instrumentalists skills. Rock, jazz and blues often feature solos on instruments such as piano, sax, guitar and drums			

Rhythm – Knowledge Organiser			
145			
When you combine any two or more notes or rests you create a RHYTHM.			
Basic Note and Rest Lengths			
Semibreve 4 Beats	Minim 2 Beats	Crotchet 1 Beat	Quaver ½ Beat
Rest	Note	Adjacent quavers can be joined together with a BEAM	
Types of Rhythms			
This bass line would be described as having a CROTCHET rhythm		DOTTED MINIM and SEMIQUAVER rhythm	
POLYRHYTHM			
Two or more different rhythms with the same METRE played at the same time			
CROSS RHYTHM			
Two or more rhythms played at the same time but with conflicting ACCENTS often in different METRES			
Dotted Notes and Rests			
A dot placed after a note or rest tells you to increase the note or rest by HALF ITS ORIGINAL VALUE			
1 Beat		2 Beats	
1 and a half beats		3 Beats	
Ties			
A TIE joins two notes of different values			
Here you would play the first note and hold it for 3 beats (2+1)			
Triplets			
A TRIPLET is 3 notes played where there is usually only space for 2			

Component 1 – Exploring Music Styles and Products

Texture – Knowledge Organiser

TEXTURE is what we call the different layers and parts of a musical piece and how they fit together.

Monophonic



A single melodic voice or instrument

Counterpoint



Two or more different melodies playing together.

When two or more voices or instruments sing/play exactly the same thing at the same time

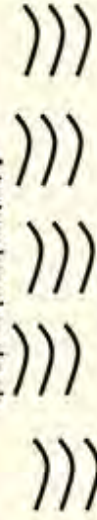
Unison



Polyphonic

Different musical lines that interweave with each other

Homophonic



A texture based on chords

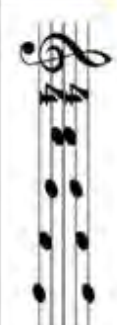
Parallel Motion

Notes moving in the same direction keeping the same interval.



Contrary motion

Notes moving in opposite directions; one up, the other down.



Examples of THIN texture

Solo instrument
Acoustic guitar and vocal
Piano and cello

Examples of THICK texture

An orchestra
A rock band
A samba ensemble

Instrumentation (Rock and Pop) – Knowledge Organiser



Electric Guitar



Acoustic Guitar



Bass Guitar



Drum Kit



Lead Vocals



Backing Vocals



Brass Section



String Section



Piano



Electric Piano



Organ

Technology



Synthesizer



Guitar Effects



Sampling/
Looping



MIDI Sequencing/Recording
Software



Autotune
Effects Processors



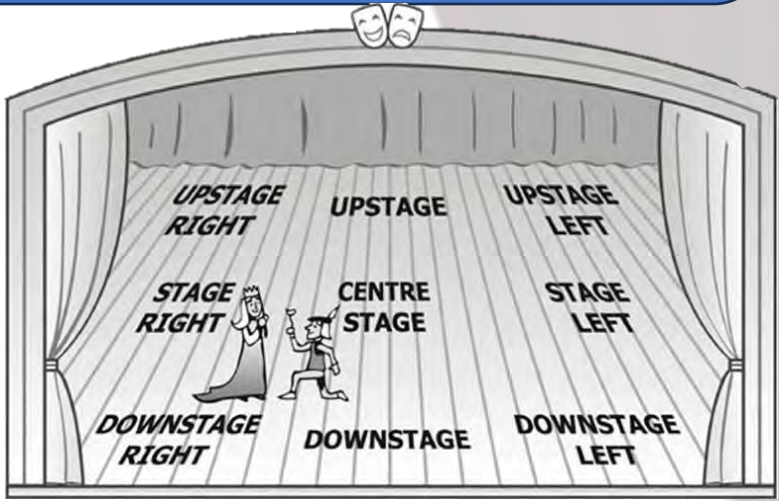
Amplifier

- ★ Genre – The type of story being told - • comedy • tragedy • melodrama • commedia dell’arte • naturalism • epic theatre • documentary theatre • physical theatre
- ★ Structure - The way the play is divided up into parts
- ★ Character - A person portrayed in a drama
- ★ Form - The overall style of the drama
- ★ Style – How the story is told
- ★ Language – The words that are used when spoken
- ★ Sub-text - The underlying and often unspoken thoughts and motives of characters – what they really think and believe
- ★ Character motivation and interaction - The reason behind a character's behaviour and actions in a given scene
- ★ The creation of mood and atmosphere - The tone or feeling of the play, often created by the music, setting, or lighting
- ★ The development of pace and rhythm - The speed at which someone or something moves, or with which something happens or changes & Strong, regular repeated pattern of movement or sound
- ★ Dramatic climax - Turning point of a drama, its point of highest tension, or it is the time when the action starts during which the solution is given
- ★ Stage directions - Part of the script of a play that tells the actors how they are to move or speak their lines
- ★ The practical demands of the text – what the script is asking the actors to do

Social, cultural and historical contexts; the social, cultural and historical context in which the performance texts studied are set

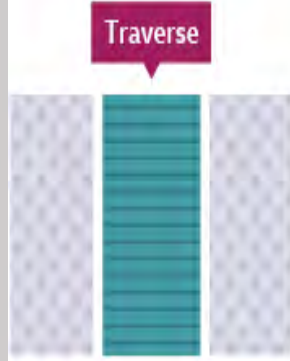
- ★ The theatrical conventions of the period in which the performance texts studied were created.
- ★ How meaning is interpreted and communicated
- ★ Performance conventions
- ★ Use of performance space and spatial relationships on stage
- ★ Actor and audience configuration
- ★ Relationships between performers and audience
- ★ Design fundamentals such as scale, shape, colour, texture
- ★ The design of props and the design of sets such as revolves, trucks, projection, multimedia, pyrotechnics, smoke machines, flying
- ★ The design of costume including hair and makeup
- ★ The design of lighting such as direction, colour, intensity, special effects
- ★ The design of sound such as direction, amplification, music, sound effects both live and recorded
- ★ Performers' vocal interpretation of character such as accent, volume, pitch, timing, pace, intonation, phrasing, emotional range, delivery of lines
- ★ Performers' physical interpretation of character such as build, age, height, facial features, movement, posture, gesture, facial expression

Drama and theatre terminology and how to use it appropriately; Students should have a general understanding of the implications of the below stage configurations on the use of the performance space.



★ Stage positioning

★ Staging configurations



-  Stage
-  Audience
-  Apron

The roles and responsibilities of theatre makers in contemporary professional practice

- ★ Playwright
- ★ Performer
- ★ Understudy
- ★ Lighting designer
- ★ Sound designer
- ★ Set designer
- ★ Costume designer
- ★ Puppet designer
- ★ Technician
- ★ Director
- ★ Stage manager
- ★ Theatre manager

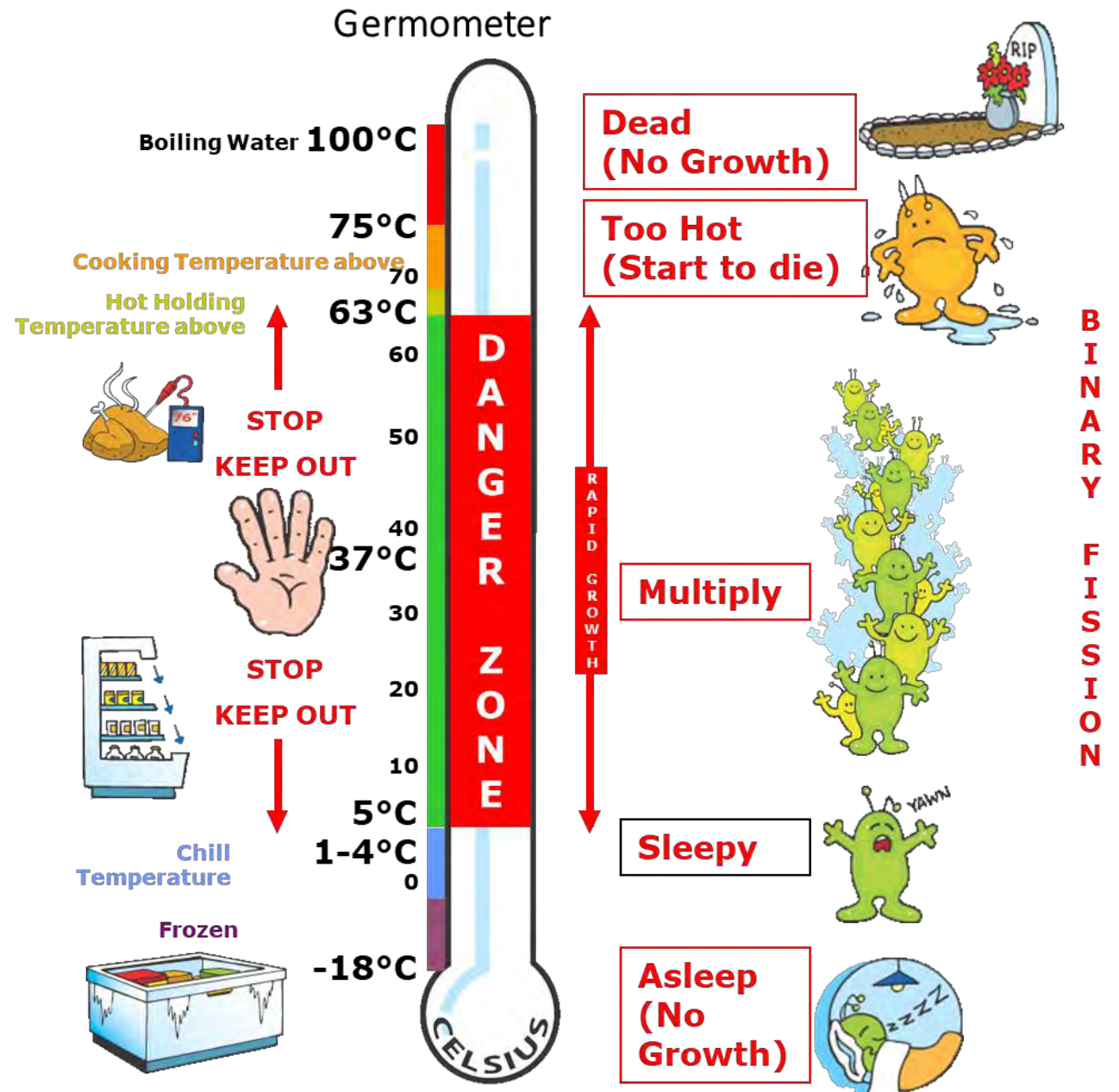
Knowledge and understanding should cover: The activities each may undertake on a day-to-day basis, & the aspect(s) of the rehearsal/performance process each is accountable for (their contribution to the whole production being a success)

Food Poisoning

How can temperature prevent food poisoning? :

If food is chilled or frozen bacteria are less likely to multiply, as they like it to be warm. This reduces the risk of food poisoning. If food is too hot bacteria will start to die, reducing or removing the risk of food poisoning.

The danger zone is:
The zone in which the temperature is ideal for bacteria to multiply, increasing the risk of food poisoning.



We know that Bacteria need Food, moisture, time and warmth to grow. We can help to prevent food poisoning and make foods safe by controlling temperature. Here are the rules:

- Foods need to be cooked to a temperature of above **70°C**. Cooking above this temperature **kills most bacteria**.
- Once cooked foods should be stored at a temperature of **63°C** and can only be served for **2 hours** after cooking. Holding food like this is known as **hot holding**.
- Chilled or cold foods need to be stored below **5°C** and can only be served for up to **4 hours** after preparation. When chilled the rate of bacterial growth **slows**.
- Frozen foods need to be stored below **-18°C** in a home freezer and **-32°C** in an industrial freezer. In a freezer bacteria become **dormant = go to sleep** (grow very slowly)

Food Packaging

Packaging functions
The main purposes of food packaging are:

- To preserve the product/ minimise bacteria.



- To protect the product from damage.



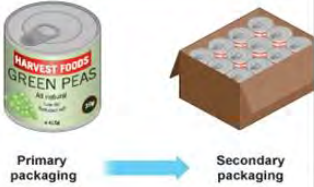
- To provide information on allergies and nutrition, cooking and storage.



- To make the product more attractive to the consumer.



- To make it easier to transport the product.



Type of packaging material

- Paper 
- Board 
- Laminated paper or board 
- Plastic 
- Metal 
- Glass 



10.2 Technology in everyday life SPANISH

2.1F ¿Cómo prefieres mantenerte en contacto?	
comunicarse	to communicate
desafortunadamente	unfortunately
empezar	to start
escoger	to choose
genial	great
gratis	free of charge
el hecho	fact
el inconveniente	drawback/disadvantage
interactivo/a	interactive
el jefe/la jefa	boss
la letra	letter (of alphabet)
mandar	to send
los medios sociales	social media
el móvil	phone
ofrecer	to offer
el ordenador	computer
la pantalla	screen
poder	to be able to
por desgracia	unfortunately
por mi parte	as far as I'm concerned
la revista	magazine
sencillo/a	simple
tampoco	neither/nor

2.1H Las redes sociales	
a mi juicio	in my opinion
acosar	to bully
el acoso	bullying
apasionar	to excite
aun	even
bajo/a	low
compartir	to share
el comportamiento	behaviour
el desarrollo	development
la desventaja	disadvantage
divertirse	to have a good time
gratuito/a	free of charge
mejorar	to improve
el riesgo	risk
el/la seguidor(a)	follower
tener éxito	to be successful
el/la usuario/a	user
la ventaja	advantage

2.2F La tecnología portátil	
andar	to walk
el archivo	file
borrar	to delete
la canción	song
cargar	to load
contestar	to answer
el correo basura	spam/junk mail
cualquier	any
de vez en cuando	from time to time
el disco duro	hard drive
el espacio	space
igual	same
el ordenador portátil	laptop computer
sacar fotos	to take photos
sentir	to feel
la tableta	tablet

2.2H ¿Podrías vivir sin el móvil y la tableta?	
la conexión inalámbrica	wireless connection
chatear	to chat online
correr	to run
darse cuenta de	to realise
en vez de	instead of
las felicidades	best wishes / congratulations
felicitar	to send best wishes / to congratulate
hasta	until
imprescindible	essential
preocupar	to worry
raras veces	rarely
la sala de chat	chat room
la señal	signal
la tarjeta de crédito	credit card
todo lo contrario	the exact opposite

THE PERFECT TENSE

HABER

he (I have)

has (you have)

ha (he/she have)

hemos (we have)

habéis (you have)

han (they have)



The present continuous

- The present continuous tense is the Spanish equivalent of the English form 'I am ...ing, you are ...ing' etc. It indicates something that is happening at the time of speaking. It is formed by adding the *gerund* to the present tense of *estar*:

¿Qué **estás leyendo**? What **are you reading**?

Estoy leyendo un libro estupendo.

I'm reading a fantastic book.

The gerund

- The gerund (or present participle) is formed by replacing the infinitive verb ending *-ar* with *-ando*, and the *-er* and *-ir* verb endings with *-iendo*:

hablar > *hablando*

Estoy **hablando**. I am **talking**.

comer > *comiendo*

¿Qué **estás comiendo**? What are you **eating**?

salir > *saliendo*

Ana **está saliendo**. Ana is **going out**.

- Some irregular gerunds are:

dormir > *durmiendo*

leer > *leyendo*

oír > *oyendo*

preferir > *prefiriendo*

sentir > *sintiendo*

vestir > *vistiendo*

Note that where in English we often use the gerund of a verb in sentences like:

I love swimming. My brother prefers going on bike rides.

Spanish uses the infinitive.

Me gusta **nadar**. Mi hermano **prefiere dar** paseos en bici.

10.3 Free time

SPANISH



3.1F ¿Qué haces en tu tiempo libre?

cenar	to have dinner
charlar	to chat
el coro	choir
descansar	to rest
los dibujos animados	cartoons
el documental	documentary
el fin de semana	the weekend
genial	great
las noticias	news
policíaco/a	police/detective (adjective)
por lo general	in general
el teatro	theatre
la telenovela	soap opera
terminar	to finish
tonto/a	stupid/silly
una vez	a time/occasion

3.1H Hablando del tiempo libre y de los planes

aburrido/a	boring
agradable	pleasant
al aire libre	outdoors
la batería	drums
la canción	song
dar un paseo	to go for a walk
de vez en cuando	from time to time
desafiante	challenging
divertido/a	fun
emocionante	exciting
entretenido/a	entertaining
la entrevista	interview
estar en forma	to be fit
grabar	to record
la letra	lyrics
relajante	relaxing
la rutina	routine
la tarde	afternoon/evening
el terror	horror

3.2F Vamos a comer fuera

el atún	tuna
el bacalao	cod
la barra	loaf
el bistec	steak
los calamares	squid
el cerdo	pork
la cerveza	beer
los champiñones	mushrooms
la chuleta	chop
el cordero	lamb
la fresa	strawberry
las gambas	prawns
el gazpacho	cold vegetable soup
los guisantes	peas
el jamón serrano	cured ham
las judías verdes	green beans
los mariscos	seafood
el melocotón	peach
la piña	pineapple
el plátano	banana
la ración	portion
la salsa	sauce
el vino	white/red wine
blanco/tinto	

10.3 Free time SPANISH

3.2H Una cena especial

la aceituna	olive
el arroz	rice
atento/a	attentive
la basura	rubbish
el bocadillo	sandwich
el/la camarero/a	waiter/waitress
chino/a	chinese
la comida	lunch/food
dejar	to leave/to let/to allow
después	after
escoger	to choose
los espaguetis	spaghetti
el/la esposa/a	husband/wife
el gusto	taste (preference)
el helado	ice cream
el huevo	egg
indio/a	indian
la lata	can
las legumbres	pulses (vegetables)
la mantequilla	butter
el matrimonio	marriage
optar por	to opt for
el perrito caliente	hot dog
el pescado	fish
picante	spicy
ponerse de acuerdo	to reach an agreement
por eso	therefore/so
postre	dessert
rico	rich

3.3F ¿Qué deportes harás?

el alpinismo	rock climbing
la carrera	race
el concurso	competition
contestar	to answer
durante	during
el ejercicio	exercise
el	training
entrenamiento	
entrenar	to train
el equipo	team
el esquí	skiing
ganar	to win
el jugador	player
el miembro	member
el partido	match
probar	to try (to test out)
relajarse	to relax
la salud	health
seguro	sure
sabroso/a	tasty
salado/a	salty
simpático/a	nice/kind
la sopa	soup
el té	tea
tomar	to have (food and drink)
la tortilla	omelette
la tostada	toast
traer	to bring
el vaso	glass
Las verduras	(green) vegetables

3.3H El deporte en el mundo

bajar	to go down
el beneficio	benefit
el campeón/la campeona	champion
caro/a	expensive
contar con	to rely on
cualquier(a)	any
dejar de + infinitive	to stop ___ing
los demás	the rest, the others
la derrota	defeat
desarrollar	to develop
diariamente	daily
disfrutar	to enjoy
duro/a	hard, difficult
empezar	to start
equilibrado/a	balanced
el esfuerzo	effort
fomentar	to promote, to encourage
jubilarse	to retire
junto con	together with
llevar	to take/to carry/to wear
pasar	to spend (time)
pasarlo bien	to have a good time
la pelota	ball
la pista	track/slope
la regla	rule
romper	to break
sano/a	healthy
seguir	to follow

la selección	national team/squad
la suerte	luck
tanto/a(s)	so much/so many
la tentación	temptation
vale la pena	it is worth it
las zapatillas de deporte	trainers



Verbs and the future tense in Spanish

To say what **will** happen

To form the future tense in Spanish take the infinitive (**-ar, -er or -ir**) and add the following endings depending on the pronoun:

*A few verbs have an irregular stem in the future tense but follow the same endings:

- Hacer (to do/make) – har_
- Poder (to be able to) – podr_
- Poner (to put) – pondr_
- Tener (to have) – tendr_
- Hay (there is are) – habr_

yo (I)	-é
tu (you)	-ás
él/ella (he/she)	-á
nosotros/as (we)	-emos
vosotros/as (you all)	-eis
ellos/ellas (they)	-án

Adverbs

- Adverbs are used with a verb or adjective to express how, when, where or to what extent something happens
- Adverbs are typically formed in English by adding “ly” to the end of an adjective, e.g., slowly, sadly, fortunately, etc.
- Most Spanish adverbs are formed by making an adjective **feminine** and adding “**mente**” to the end
 - triste – sad, **tristemente** – sadly
 - rápido – quick, **rápidamente** – quickly
- Some irregular adverbs
 - **bien** – well
 - **mal** - badly

Hacer and jugar in present tense

Both verbs are somewhat irregular in present tense

When we use **jugar** for a sport, it needs to be followed by **al** – juego al fútbol, jugamos al netball, etc.

We use jugar for ball sports, hacer for other sports

hacer (to do/make)	
hago	I do/make
haces	you do/make
hace	he/she/it does/makes
hacemos	we do/make
hacéis	you (all) do/make
hacen	they do/make

jugar (to play)	
juego	I play
juegas	you play
juega	he/she/one plays
Jugamos	we play
jugáis	you (all) play
Juegan	they play