

Year 11 Science Knowledge Booklet

Term 1

Name:

Class:

Year 11 Mini Test Timetable and Workbook Deadlines	
20/9/2022	B5
4/10/2022	C5
18/10/2022	P5



Big questions: Why do living things vary?

What are the different types of reproduction?

What do you remember about mitosis and the cell cycle?

What is meiosis?

What is DNA?

Why do we need to understand the human genome?

What is inheritance?

Can you inherit diseases?

How is sex inherited?

What is variation and how is it caused?

What is selective breeding?

What is evolution?

What is the evidence for evolution?

Why do bacteria become resistant?

What are Frankenfoods?

How do we use genetic engineering in medicine?

What causes extinction?

How do we classify living things?

Key vocabulary

Sexual Reproduction	Reproduction involving the fusion of gametes.
Gamete	A sex cell that contains half the genetic information of a body cell. E.g. Sperm and egg cell in animals. Pollen and ovaries in plants.
Meiosis	The type of cell division that produces gametes. Four daughter cells are produced from one original cell. Each cell is genetically different and contain half the genetic information of a body cell.
DNA	Genetic material, it is a polymer made up of two strands forming a double helix. DNA makes up chromosomes.
Chromosome	A long coil of DNA. Found in the nucleus.
Genome	The entire genetic makeup of that organism.
Allele	Different versions of the same gene - dominant and recessive.
Dominant	A dominant allele is always expressed. Only one copy is needed.

Recessive	Only expressed if two copies are present.
Homozygous	Both alleles for the gene are the same (i.e both dominant or both recessive).
Heterozygous	Both alleles for the gene are different (one is dominant, one is recessive).
Genotype	The alleles present for a particular gene.
Phenotype	The physical feature expressed for a particular gene.
Variation	The differences between organisms. Can be caused by genes, the environment or both. All variation in genes is caused by mutations
Mutation	Mutations are changes in genes. Most have no effect on the phenotype. Occasionally mutations have a positive effect on phenotype and organisms with these mutations are more likely to survive.
Evolution	The change in the genes of a population over time. Occurs through natural selection.
Natural selection	The process by which the individuals best adapted to the environment survive and pass on their genes.
Selective breeding	The process by which humans breed plants and animals for particular genetic characteristics (traits).
Genetic Engineering	A process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic.
GM crop	Crops that have been produced by genetic engineering.
Vector	Something that can carry a gene into another organism e.g. a bacterial plasmid or a virus.

What are the different types of reproduction?

Sexual reproduction involves the joining (fusion) of nuclei of male and female gametes, sperm and eggs in animals and pollen and ovule cells in flowering plants.

Asexual reproduction is a type of reproduction by which offspring arise from a single organism, and inherit the genes of that parent only; it does not involve the fusion of gametes.

Advantages of Asexual reproduction

- Only one parent needed
- All offspring are clones
- Quick and cost effective

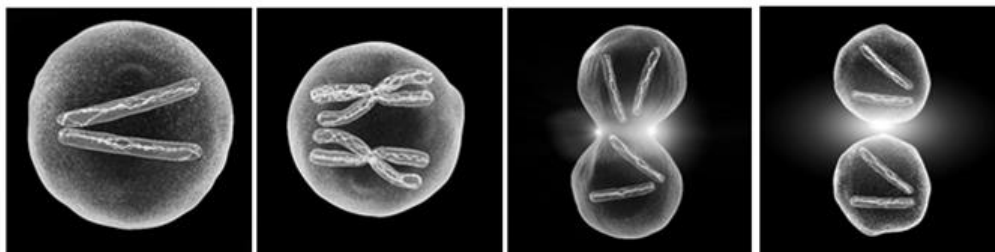
Advantages of Sexual reproduction

- All offspring are genetically different – variation

What do you remember about mitosis and the cell cycle?

Mitosis is a form of cell division in which genetically identical cells are produced from the parent cell.

In order for organisms, such as humans, to grow, repair and reproduce their cells must divide to produce new cells.



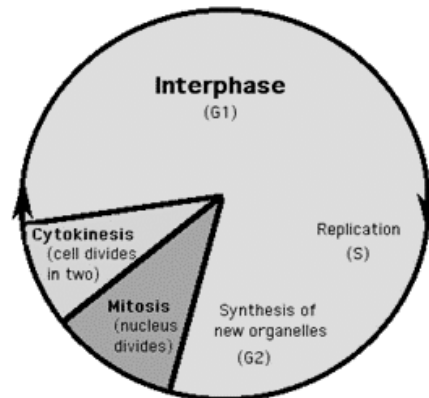
Normal cell before division. This is the parent cell.

Each chromosome makes a copy of itself.

Each copy of a chromosome migrates to opposite ends of the cell. The cytoplasm also replicates.

The cell divides into two. Each cell has the same number of chromosomes as the original cell and is usually an exact copy. These are daughter cells.

A cell that is actively dividing goes through a series of stages called the **cell cycle**. The cycle involves the growth of the cell and the production of new cell components and division for growth, repairing tissue and replacing cells. The cell cycle has 3 main phases: interphase, mitosis and cytokinesis.

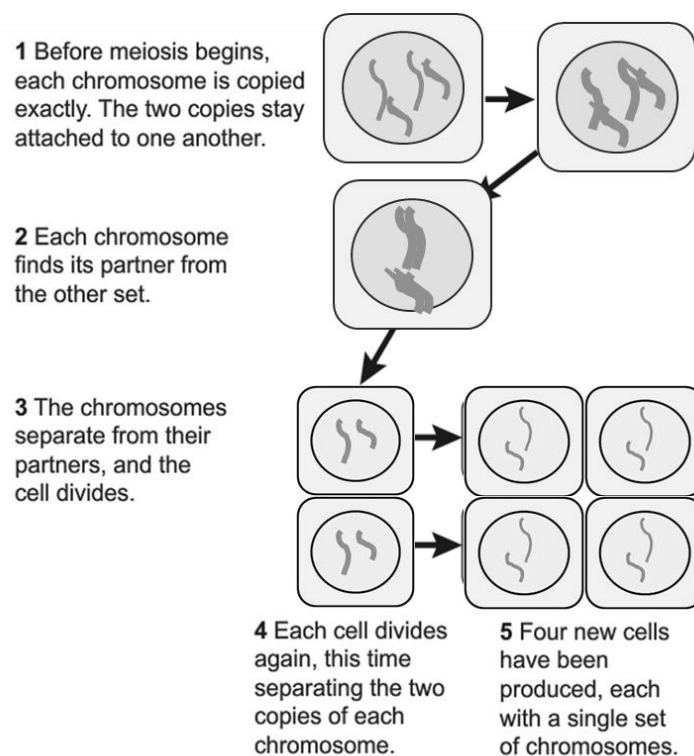


What is meiosis?

The cells that are formed by meiosis have half as many chromosomes as the cell that formed them. Human body cells contain 23 pairs of chromosomes, while human gametes contain 23 single chromosomes. This stops the number of chromosomes doubling every generation and creates variation.

The main features of meiosis are:

- the chromosomes are copied
- the cell divides twice, forming four gametes



What is DNA?

Deoxyribonucleic acid (DNA) is the biochemical molecule that carries all your genetic information in neat little packages called chromosomes.

Each of your chromosomes contain thousands of genes, each coding for a different sequence of amino acids to make a specific protein.

DNA - Deoxyribonucleic Acid, an instruction manual for protein production (the genetic code)

Chromosomes - coiled thread of DNA found in the nucleus

Gene - a length of DNA that codes for the making of a particular protein (unit of inheritance)

Genome – the complete set of genes of an organism

Why do we need to understand the human genome?

The human genome has been sequenced. This was achieved by unravelling the DNA double helix and finding out every base pair that made up every gene on every chromosome.

Possible uses of the human genome

Example	Description of application
Inherited disorders	Uncovering the human genome helps us to understand inherited disorders such as cystic fibrosis and sickle cell anaemia.
Production of medicines	The more we understand about an inherited disease the better chance we have at designing drugs to treat diseases.
Disease susceptibility	Some genes are linked to increasing the risk of developing other diseases such as type 2 diabetes. Knowing which genes are involved can help predict the risk for individuals.
Evolution	By comparing patterns in DNA across the world we can understand historic/ancient migration patterns of humans and show the relationships of modern man to Neanderthals.
Embryonic screening	Embryonic screening for genetic diseases to reduce incidence of unwanted diseases.

What is inheritance?

Inheritance, is the passing on of traits from parents to their offspring; either through asexual reproduction or sexual reproduction, the offspring cells or organisms acquire the genetic information of their parents.

- A characteristic is controlled by the two forms of a gene present in an individual.
- The different forms of a gene are called alleles
- The combination of alleles determines what our characteristics will be
- Alleles can be either **Dominant** or **Recessive**
- You will always see the effect of the dominant allele over the recessive one.
- The characteristic you see is called the **Phenotype**

Genotypes and symbols

Each allele is represented by a letter

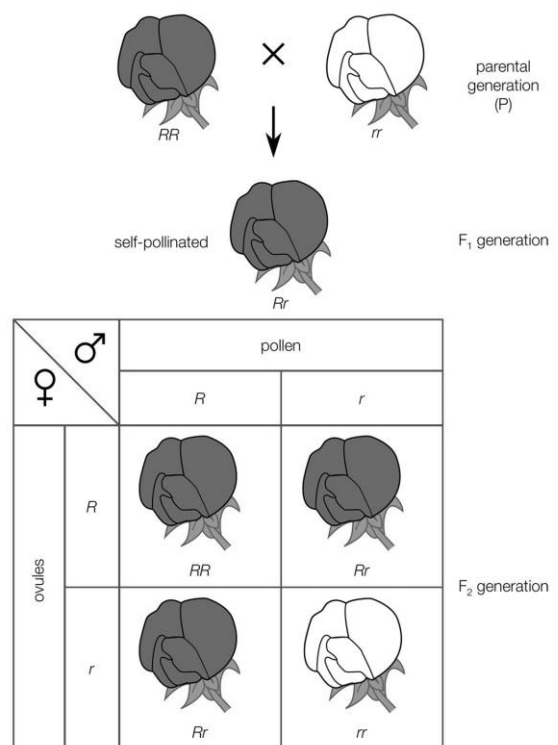
- Capital letter if the allele is dominant (A)
- Lower case letter if the allele is recessive (a)

Each organism will have two letters

- 1 represents the allele it receives from its mother
- 1 represents the allele it receives from its father

The combination of alleles can either be:

- Heterozygous
- Homozygous recessive
- Homozygous dominant



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Can you inherit diseases?

Some disorders are the result of an alteration in the bases or coding of genes, this can be passed on from parent to child and are known as inherited disorders.

Polydactyly is when a baby is born with an extra finger or toe.

The most common form of polydactyly is caused by a dominant allele. This allele only needs to be inherited from one parent. If you have polydactyly and you are heterozygous, you have a 50% chance of passing this disorder onto any child you have.

Cystic fibrosis is a genetic condition in which the lungs and digestive system become clogged with thick, sticky mucus.

Symptoms usually start from childhood and include:

- Persistent cough
- Recurring chest and lung infections
- Poor weight gain

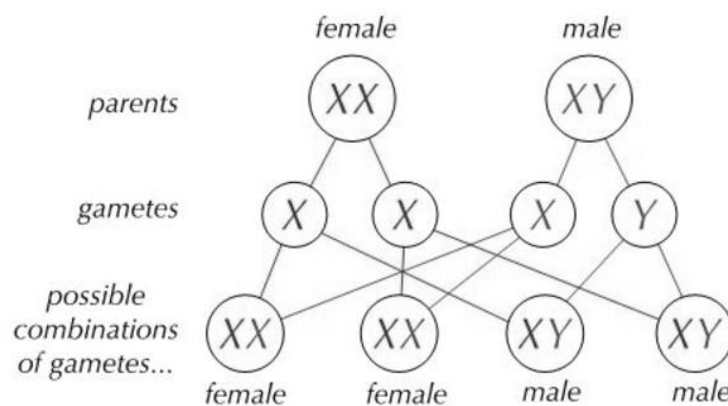
The recessive allele that codes for the faulty gene must be inherited from both parents in order for an offspring to develop cystic fibrosis. Parents can carry the recessive allele, if two parents who are both carriers have a baby, the baby has a $\frac{1}{4}$ chance of developing cystic fibrosis.

How is sex inherited?

Only one pair of your chromosomes carries the genes that decide your sex- male or female.

Females have two X chromosomes, males have one X and one Y chromosome.

Egg cells always have the X chromosome, sperm cells will have either an X or a Y in a 1:1 ratio.



What is variation and how is it caused?

A characteristic is a feature of an organism. It can be something we can see (like hair colour) or something we can't see (like blood group).

This difference in our characteristics is called variation

Differences in the characteristics of individuals may be due to:

- Genes they have inherited
- Environmental causes
- A combination of genetic and environmental causes

What is selective breeding?

For many hundreds of years farmers have used selective breeding to ensure that they get the characteristics of animals and plants that they want.

Selective breeding is when humans breed plants and animals for particular genetic characteristics

- Organisms with the desired traits from a mixed population are selected and bred together.
- The offspring with the desired characteristics are then bred together, eventually all of the offspring will show the desired characteristic.

Examples include disease resistance in crops, animals that produce more meat or milk, domestic dogs and farm animals with a good temperament, large or unusual flowers.

Organisms that are interbred can lead to a higher chance of genetic disorders being inherited, a smaller gene pool also means that the organisms have a lower chance of adapting if their environment suddenly changes.

What is evolution?

The idea behind the theory of evolution through the process of natural selection is that all species of living things have evolved from simple life forms over a period of time.

Darwin did not invent the idea of evolution, but he did think of a theory for how it may happen.

Main points

- Organisms vary, some variations are genetic
- Some variations will give the organism that has it an advantage
- That advantage will give the organism a greater chance of passing on its genes
- Over time the variation will become more common in the species
- Over a very long time this has produced all the species that have ever existed

Misconceptions (correction)

- Evolution is aiming for something – (it is a process not a destination)
- Darwin said humans evolved from monkeys – (monkeys, apes, humans and all species evolved from a distant common ancestor)

What is the evidence for evolution?

Early life forms

Fossils are the remains of plants and animals that lived millions of years ago. They provide information on animals that no longer exist.

Genome analysis

This can show how closely related to each other species are and how long ago they had a common ancestor.

Current examples

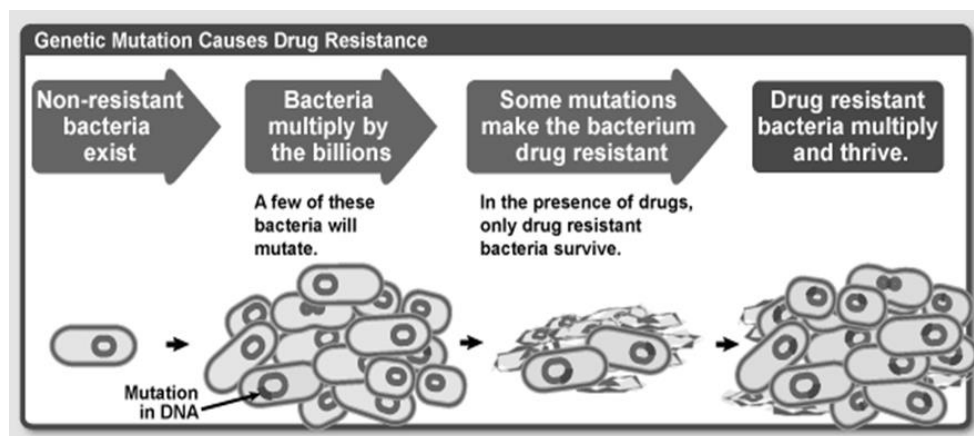
In some organisms we can see that they are changing as a species as time is passing.

Why do bacteria become resistant?

If you are given an antibiotic and use it properly the bacteria that have made you ill will be killed off.

However, some bacteria develop resistance to antibiotics due to random mutations and natural selection.

Bacteria evolve rapidly as they reproduce at a faster rate.



What are Frankenfoods?

Genetic engineering involves changing the genetic material of an organism. This is achieved by cutting the desirable gene from one organism and transferring it to the cells of another organism.

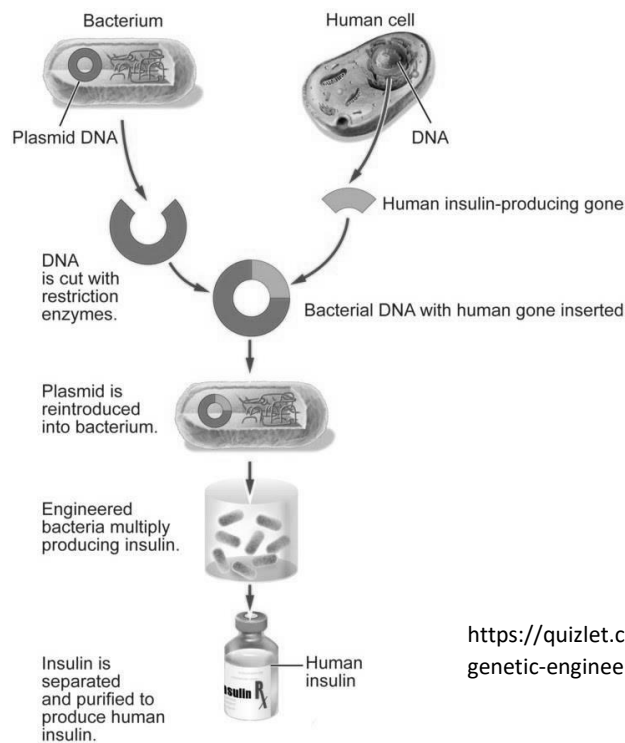
Gene modification of crops

- Crops that have had their genes modified by genetic engineering are known as genetically modified crops, or GM crops.
- Different groups of people have different opinions on the growth and consumption of GM crops.
- Some have used the term “Frankenfoods” to describe food produced from genetically modified organisms.

How do we use genetic engineering in medicine?

Genetically engineered bacteria and fungi can be cultured on a large scale to make huge quantities of protein from other organisms, a good example of this is insulin.

- Insulin used to be collected from the pancreases of pigs
- It is now produced by genetically engineered microorganisms
- This means that the insulin used to treat diabetes is now identical to natural human insulin and causes less side effects.



<https://quizlet.com/371346535/ats-gcse-biology-genetic-engineering-diagram/>

What causes extinction?

Extinction is the dying out of a species. Extinction plays an important role in the evolution of life because it opens up opportunities for new species to emerge.

However:

- The rapid loss of species we are seeing today is estimated by experts to be between 1,000 and 10,000 times higher than the natural extinction rate.
- Many scientists suggest we are going through the 6th major extinction of the Earth.

Possible causes of extinction

- Natural disasters
- Habitat destruction
- Introduced species
- Hunting and fishing
- Environmental change
- New diseases

How do we classify living things?

Placing organisms into group based on their shared features is known as classification or taxonomy

Classification is important because:

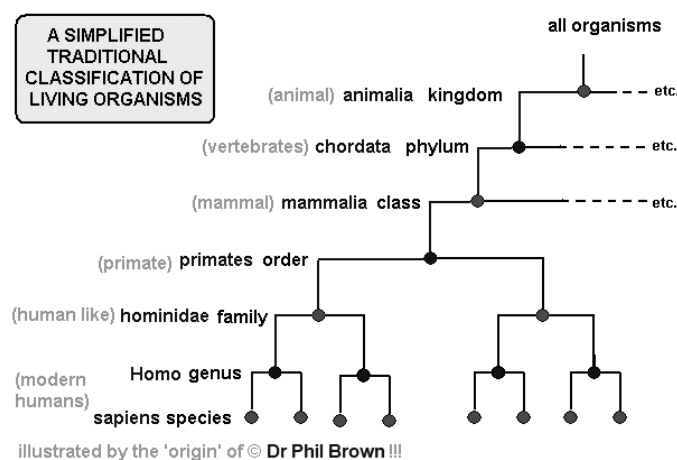
- It helps us to understand how different groups of organisms are related to each other
- It enables us to recognise the biodiversity present in the world
- Give scientists a common language in which to talk about different organisms

The Binomial system

Organisms are grouped by common features into increasingly smaller groups until the species level is reached.

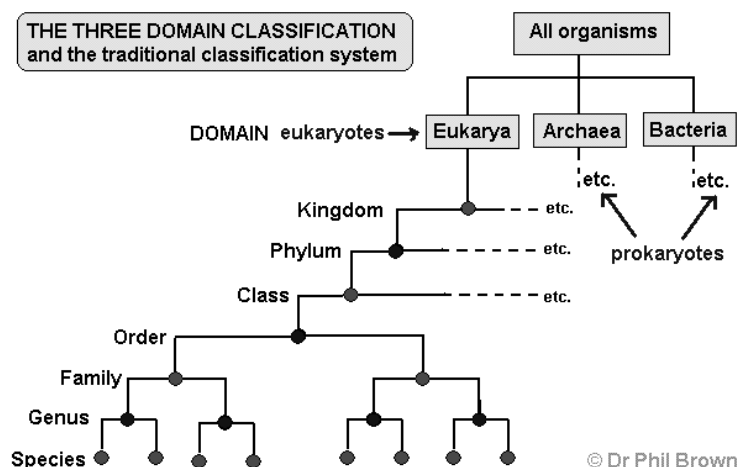
The groups are called taxa, with 7 taxa in total.

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species



The Three Domain system Carl Woese's classification system

- In the 1960's a scientist called Carl Woese aimed to find the evolutionary relationships between prokaryotes.
- How did he do this? Woese pioneered RNA sequencing of bacteria to compare groups of bacteria.
- What did he find? He noticed that one group – the methanogens – lacked some RNA sequences which are characteristic of bacteria.
- Conclusions? In 1977, Woese proposed that this group belongs to a new category of organisms – the Archaea – forming a third branch alongside the prokaryotes and eukaryotes. Woese proposed a new system of classification based upon these 3 domains.



Key knowledge question	Answer
Explain the difference between dominant and recessive alleles.	Dominant allele is expressed when two different alleles or dominant alleles are present- Recessive allele is the allele which is only expressed when two recessive alleles are present.
Give the definition for a genotype.	The genetic makeup of an organism for a particular gene.
How many chromosomes do humans have in body cells?	46 (23 pairs)
What are chromosomes and where are they found?	Long threads of DNA contained inside the cell's nucleus.
What do we call an organism with two different versions of a gene?	Heterozygous
What do we call different versions of the same gene?	Alleles
What is a gene?	A unit of DNA that is usually located on a chromosome and that controls the development of one or more traits.
What is a genetic disorder?	A genetic disorder is a disease that is caused by a change, or mutation, in an individual's DNA sequence.
What is the name of the genetic disease that causes thick mucus in the lungs?	Cystic fibrosis
Where is DNA found in animal cells?	In the nucleus
Define evolution.	The process by which different kinds of living organism are believed to have developed from earlier forms during the history of the earth.
Which scientist developed the theory of evolution based on his observations of birds on the Galapagos Islands?	Charles Darwin

Big questions: What affects the rate of a reaction?

What is the rate of reaction?

How can we increase the rate of reaction?

Why does putting food in the fridge keep it fresher for longer?

Why does concentration affect the rate of reaction?

Why do medicines come in pill form?

How do we easily increase rate in industry?

Do all reactions go to completion?

How can we control reversible reactions part?

Key vocabulary

Collisions	Particles need to come together in order for a reaction to occur. For these collisions to be successful, they must have an energy greater than the activation energy
Reactant	A substance that is used up in a reaction. It is on the left hand side of the equation
Pressure	Pressure is calculated by Force / area. In gases it is linked to the number of collisions per second with the container
Concentration	The number of particles present in a certain volume. Typical units are g/dm ³ or mol/dm ³
Plateau	The level (horizontal section) on a graph
Kinetic energy	The energy associated with movement. Particles with more kinetic energy are more likely to result in successful collisions
Activation energy	The minimum amount of energy needed for a collision to be successful to form the product.
Product	A substance that is formed in a reaction. It is on the right hand side of the equation
Catalyst	A chemical that lowers the activation energy by providing an alternative route for the reaction to take place by. It is not used up in the reaction
Limiting reactant	Whichever reactant is present in the smallest number of moles
Dynamic equilibrium	When a reversible reaction reaches a point where the rate of the forward reaction equals rate of the reverse reaction in a closed system
Moles	A term used to describe the amount of a substance.
Temperature	A measure of the average kinetic energy of the molecules. Increasing the temperature increases the average kinetic energy
Rate of reaction	The speed at which a reactant is converted into a product.
Surface Area	The surface area is a measure of how many exposed particles are available to react.
Gradient	The steepness of the curve calculated by the change in y / the change in x (rise over run)
Reversible	When the reactants can react to form the products but the reverse reaction can also take place.
Closed system	Where the reactants and products cannot escape, e.g in a sealed container.

What is the rate of reaction?

Rate of reaction is the speed at which a reaction takes place. It measures the change in amount of substance per unit time.

When calculating rate of reaction, it depends on the reactant and products how this can be measured.

Typically if gases are involved, then we use one of two equations:

Change in amount of reactant / time

- This is typically where mass appears to decrease as gas escapes.

Change in amount of product / time

- This is typically where volume of gas is collected.

If no gas is produced, there is often a colour change or precipitate forms.

In this case the equation to calculate rate is:

$$\text{Rate} = 1 / \text{time}$$

How can we increase the rate of reaction?**Collision theory**

Not all collisions between reactants results in the product being formed, this is because not all collisions are successful. **For a reaction to happen reactants –**

- need to collide with correct orientation (right way round)
- need to collide with an energy greater than the activation energy

In order to increase the rate of reaction, we need to change one of two things either the:

- Number of collisions per second
- The proportion of particles with energy greater than the activation energy
-

This can be affected by the following:

- Concentration (of acid / alkali) or Pressure (gas)
- Temperature
- Surface area (of solid)
- Catalysts

Why does putting food in the fridge keep it fresher for longer?

Temperature is a measure of the average kinetic energy of the particles in a substance, by increasing the temperature we increase the average kinetic energy of the particles.

Increasing the temperature a reaction is happening at causes 4 things to happen.

1. Increases the number of collisions per second
2. Increases the proportion of particles with energy greater than activation energy
3. Increases frequency of successful collisions
4. These combine to increase the rate of reaction

At cooler temperatures chemical reactions happen more slowly, that is why food keeps better in a fridge.

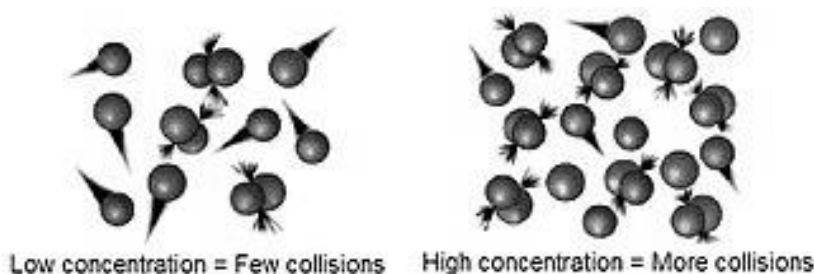
Why does concentration affect the rate of reaction?

Concentration is the number of particles per unit of volume.

The greater the concentration, the more reactant particles there are per unit of volume.

This causes:

1. More collisions per second
2. More successful collisions per second
3. These combine to increase the rate of reaction



https://en.wikipedia.org/wiki/Collision_theory

Why do medicines come in pill form?

The **surface area** is important when using solids in a chemical reaction, as it affects the number of exposed particles that are available to react from the start of the reaction. Increasing the surface area increases the number of exposed particles from the start of the reaction, this causes:

1. More collisions per second
2. More successful collisions per second
3. These combine to increase the rate of reaction

A medicine in the form of a pill will have a smaller surface area than the same medicine as a powder, so it enters your system in a more controlled way.

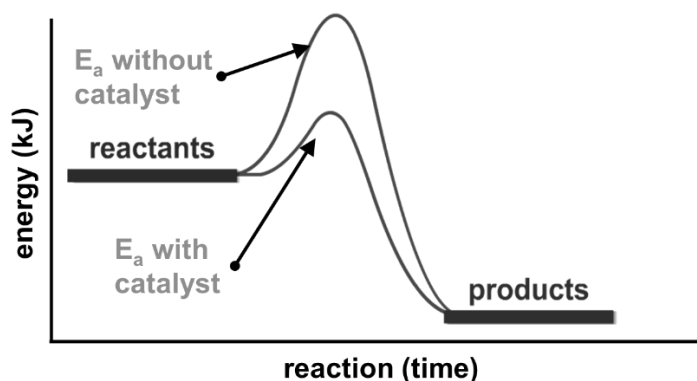
How do we easily increase rate in industry?

A **catalyst** is a substance that lowers the **activation energy** by providing an **alternative** route for the reaction to take place by. The particles do not have any extra energy, nor are there more particles.

A catalyst works by:

1. Energy required for a successful collision is reduced
2. Increases the proportion of particles with energy greater than activation energy
3. Increases frequency of successful collisions
4. These combine to increase the rate of reaction

Finding the right catalyst for a reaction is an expensive and time consuming process in industry. Billions are spent finding the right catalyst, but once it's found only a small amount is needed, and it's not used up in the reaction so as long as it can be easily isolated, it can be removed and used again.



Do all reactions go to completion?

In chemical reactions, we typically represent the equation using an \rightarrow to show the reactants react to form the products. This arrow suggests that the reaction is irreversible.

However some reactions are reversible and we use this symbol to show this \rightleftharpoons

Reversible reactions are those where the products can react or breakdown to reform the reactants.

If a reaction is reversible, and left in a sealed container, eventually a point is reached in the reaction where it is in dynamic equilibrium.

- The rate of the forward reaction is equal to the rate of reverse reaction
- The concentration of each substance doesn't change

How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then self-testing.
- There are several different things you can do
 - Look, cover, write, check, correct
 - Read through the organisers
 - Mind maps
 - Key spellings
 - Make a glossary
 - Missing out key words
 - Questions/answers answers/questions
 - Flash cards
 - Revision clock learning
 - Mnemonics

Science Learning Tools and wider study:

The Oak Academy – Online Science lessons

BBC Bitesize science

You tube channels:

Fuse school

Ted talks

Free science lessons

Primrose Kitten

Shows on Netflix

Our planet

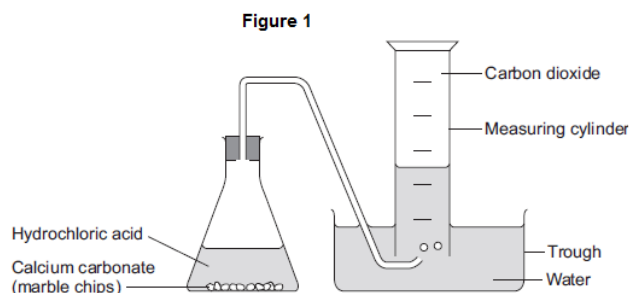
Tiny creatures

A life on our planet

This is an example of the sort of question you might be asked about the rate and extent of chemical change.

A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student used the apparatus shown in **Figure 1**.



The student:

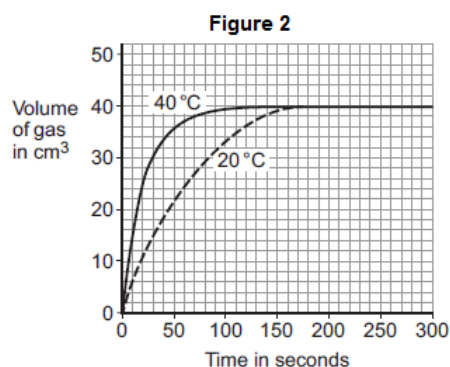
- recorded the volume of gas collected every 5 seconds
- repeated the experiment using hydrochloric acid at different temperatures.

The equation for the reaction is:



- (a) The student plotted results for the hydrochloric acid at 20 °C and 40 °C on a graph.

Figure 2 shows the student's graph.



Use information from **Figure 2** to answer these questions.

- (i) State **one** conclusion the student could make about the effect of temperature on the rate of the reaction.

(1)

- (ii) Give **one** reason why the student could make this conclusion.

(1)

Key knowledge question	Answer
For a chemical reaction to take place, the reactant particles must hit each other, we call this?	Collision theory
How do you calculate the gradient of a line graph?	The change in y / the change in x (rise over run)
How does concentration affect the rate of reaction?	Increasing concentration increases the rate of reaction
How does surface area affect the rate of reaction?	Increasing surface area increases the rate of reaction
How does temperature affect the rate of reaction?	Increasing temperature increases the rate of reaction
What do we call the level (horizontal section) on a graph?	A plateau
What do we mean by rate of reaction?	The speed at which a reactant is converted into a product.
What is activation energy?	The minimum amount of energy needed for a collision to be successful
What that lowers the activation energy by providing an alternative route for the reaction to take place?	A catalyst