THE DUSTON SCHOOL
Knowledge itself is power
4-19

Year 11 Science Knowledge Booklet

Term 2

Name:	Class:

Year 11 Knowledge and Pillars Test Timetable and Workbook Deadlines		
Homework 1	18th November	C5 Energy Changes
Homework 2	2nd December	B7 Ecology
Homework 3	9th December	P6 Waves

Science Homework 1

Complete the section of the homework workbook identified on the front of this Knowledge organiser and learn the key knowledge questions and answers ready for the knowledge quiz.

P6 Waves

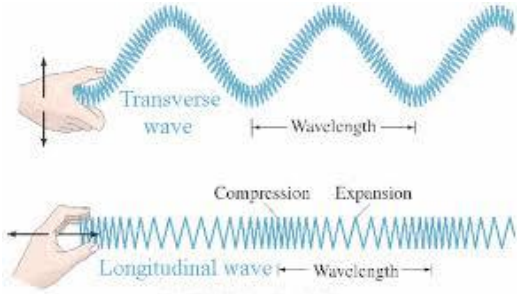
Big questions: Waves

What are waves and how do we describe them?
How are the speed, frequency and wavelength of a wave related?
How are the speed, frequency and wavelength of a wave measured?
How can we measure the speed of sound?
What is the electromagnetic spectrum of waves?
What happens to waves when they cross a boundary that changes their speed?
Which surfaces are best at absorbing or emitting electromagnetic waves?
How are radio waves and other electromagnetic waves produced?
What are the harmful effects of electromagnetic waves?

Key vocabulary

Wave	Ways of transferring energy and information through a medium without overall movement of the medium.
Wavelength	The length of one complete wave. Measured in metres.
Amplitude	The maximum displacement of a point on the wave. (measured form the undisturbed position)
Frequency	The number of complete waves passing every second. Measured in hertz, Hz
Transverse wave	A wave whose vibrations are at right angles to the wave direction. Light and all electromagnetic radiations are transverse waves.
Longitudinal wave	A wave whose vibrations are along the direction of wave travel. Sound waves are longitudinal waves.
Wave speed	The speed that wave crests travel. In metres per second
Refraction	The change of direction of a wave when it crosses a boundary. Caused by a change in wave speed.
Reflection	When a wave bounces off a surface.
Normal	A line drawn at right angles to a boundary where the wave crosses the boundary. All angles of waves are measured from the normal.
Specular reflection	Reflection from a smooth surface like a mirror. All waves coming from the same direction are reflected at the same angle.
Electromagnetic spectrum	The range of radiations in the same family as visible light. All electromagnetic radiations are transverse waves and travel at the speed of light.

What are waves and how do we describe them?



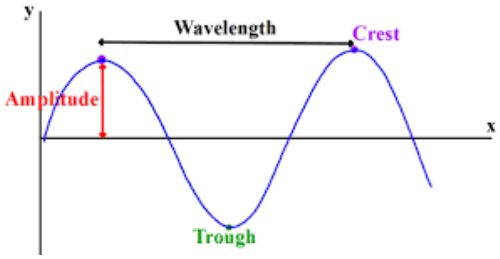
Waves **transfer energy** and information without the transfer of matter

Transverse waves – have vibrations at right angles to the wave direction.

-eg. Light is transverse wave.

Longitudinal waves –have vibrations are along the wave direction.

- eg. Sound is longitudinal wave.



- **Wavelength (m)** – length of one complete wave.
- **Amplitude (m)** – height of one crest measured from the centre (rest postion).
- **Frequency (Hz)** – number of complete

How are the speed, frequency and wavelength of a wave related?

$$v = f\lambda$$

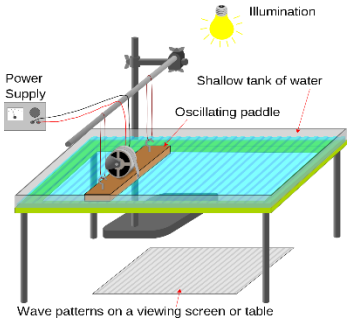
v = wave speed (metre per second, m/s)
f = frequency (hertz, Hz)
λ = wavelength (metres, m)

$$f = \frac{1}{T}$$

f = frequency (hertz, Hz)
T = period (seconds, s)

How are the speed, frequency and wavelength of a wave measured?

Wave can be shown by ripples on water in a ripple tank. The crests of the waves cast shadows called wavefronts.

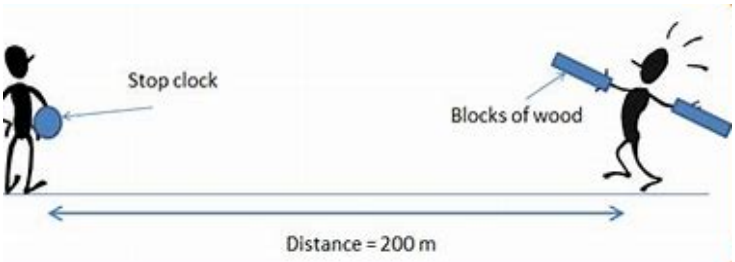


Can measure the wavelength on water. Accuracy is improved by:

- Measure 10 waves and divide by 10
- Photograph the waves with a ruler in view and check the measurement with a still picture

How can we measure the speed of sound?

The speed of sound can be measured by making a loud sound a large distance away:

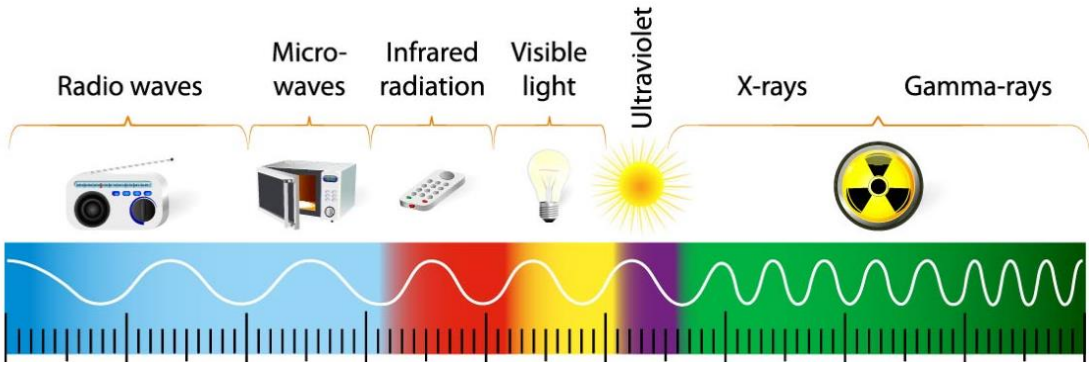


- Measure the distance
- Start the clock when you see the clap.
- Stop the clock when you hear the sound.

Use: speed = distance/time to find the speed.

What is the electromagnetic spectrum of waves?

Visible light is an electromagnetic wave.
It is a small part of the electromagnetic(EM) spectrum of waves.
All EM waves travel at the speed of light.

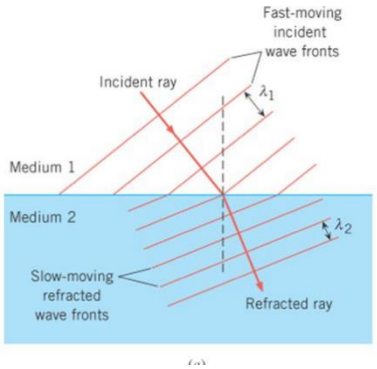


EM radiation	Source	Example of Use
Radio wave	Radio transmitter	Carry radio and tv signals.
Micro-wave	Mobile phone	Carry mobile phone calls, messages and data.
Infra-red radiation (IR)	Hot objects	Carry heat energy away from hot things. Used to toast bread in a toaster.
Visible light	Lights	Allow us to see things.
Ultra violet (UV)	Sun and UV lamps	Tan our skin.
X-rays	X-ray machines	Take X-ray photograph or scan bags at airports.
Gamma rays	Nuclear reactors	Used in gamma cameras to scan patients in hospitals.

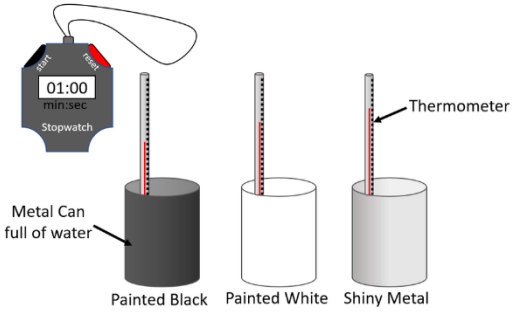
What happens to waves when they cross a boundary that changes their speed?

Waves are **refracted** when they change speed.
When light enters glass:

- The wave speed slows down in the glass.
- The wavelength gets shorter in the glass.
- The wave refracts to keep wave-fronts together.



Which surfaces are best at absorbing or emitting electromagnetic waves?



- Matt and black surfaces are the best emitters and absorbers of radiation.
- Shiny and white surfaces are the worst absorbers and emitters of radiation.
- The wave refracts to keep wave-fronts together.

How are radio waves and other electromagnetic waves produced?

Radio waves are electromagnetic, transverse waves produced by oscillations in electrical circuits .

- Radio, television and wi-fi, are carried by radio waves.
- Bluetooth and mobile phone signals are carried by microwaves. Microwaves are short wavelength radio waves.
- Radio waves refract in the atmosphere (ionosphere) and can travel long distances. Longer wavelengths are refracted most and travel furthest.
- Micro waves have short wavelengths and can be sent through the atmosphere. They can be passed around the Earth by satellites.

What are the harmful effects of electromagnetic waves?

EM radiations are ionising. Ultra violet(UV), X-rays and gamma-rays are most ionising. They can damage human cells and cause cancers.

Humans can protect themselves from ionising radiations by:

- Monitoring and minimising their exposure.
- Shielding themselves behind lead or thick concrete.

Science Homework 2

Complete the final section of the homework workbook identified on the front and learn the key knowledge questions and answers for all of the areas covered in this knowledge organiser ready for the end of term test.

Key knowledge question	**Answer**
What is meant by a transverse wave	The vibrations are perpendicular to the direction of energy transfer
What is meant by a longitudinal wave	The vibrations are parallel to the direction of energy transfer
Give an example of a transverse wave	Radio waves, Microwaves, Infra-red, Light, Ultraviolet, X-rays, Gamma Rays
Give an example of a longitudinal wave	Sound, ultrasound
Give the equation that links wave speed, frequency and wavelength for a wave	Wave speed = frequency x wavelength
Define wavelength of a wave and give the units	The distance from one point on a wave to the same point on the next wave, metres, m
Define amplitude of a wave	The maximum displacement of a wave from its undisturbed position
Define frequency of a wave and give the units	The number of waves passing a point each second, hertz, Hz
Define period of a wave and give the units	The time taken for one complete wave to pass, seconds, s
Define wave speed and give the units	The speed at which energy is transferred through the medium
Name the seven regions of the electromagnetic spectrum	Radio waves, Microwaves, Infra-red, Visible light, Ultraviolet, X-rays, Gamma Rays
Name the part of the EM spectrum with longest wavelength	Longest wavelength = Radio waves
The part of the EM spectrum with the highest frequency	Highest frequency = Gamma Rays
Give two properties of all waves in the electromagnetic spectrum	Travel at the speed of light, are transverse waves, reflect, refract
Give two electromagnetic waves that can increase the risk of cancer in humans	UV, X-ray, gamma

B6 Inheritance, Variation and Evolution

Big questions:

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?

What is selective breeding?

What is evolution?

What is the evidence for evolution?

Why do bacteria become resistant?

What are Frankenfoods?

How do we genetically modify organisms?

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 organism.
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

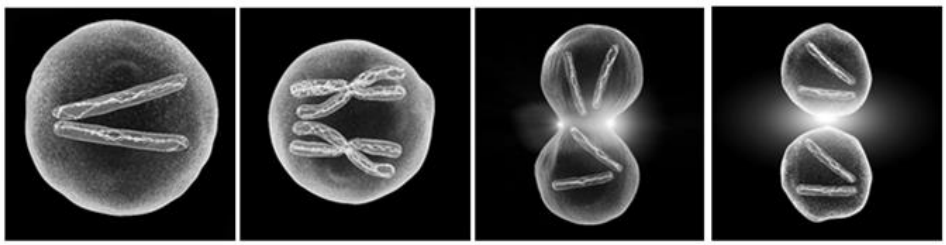
Advantages of Sexual reproduction

- 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.



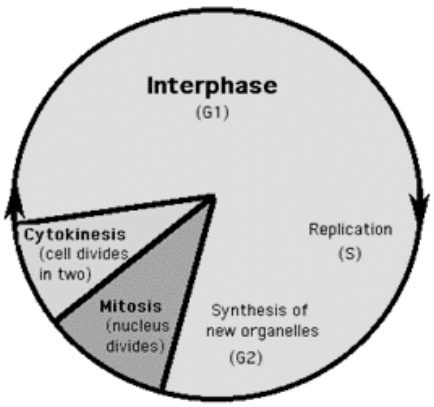
Normal cell before division. This is the parent cell.

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.

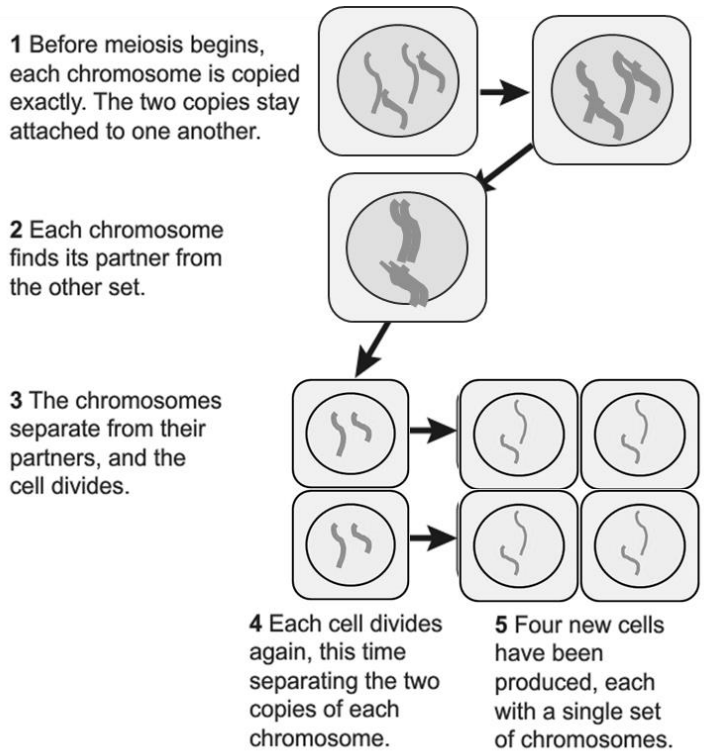


What is meiosis?

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

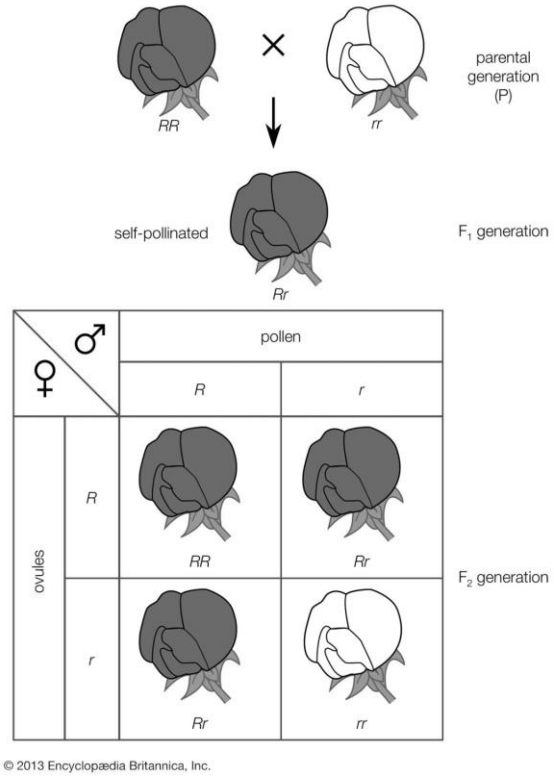
- Capital letter if the allele is dominant (A)
- Lower case letter if the allele is recessive (a)

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



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

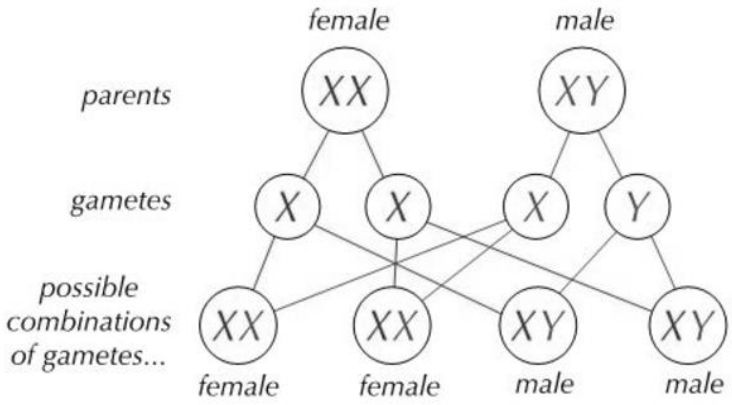
The recessive allele that codes for the faulty gene must be inherited from both parents in order for an offspring to develop cystic fibrosis. Parents can carry the recessive allele, if two parents who are both carriers have a baby, the baby has a ¼ chance of developing cystic fibrosis.

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 desire 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

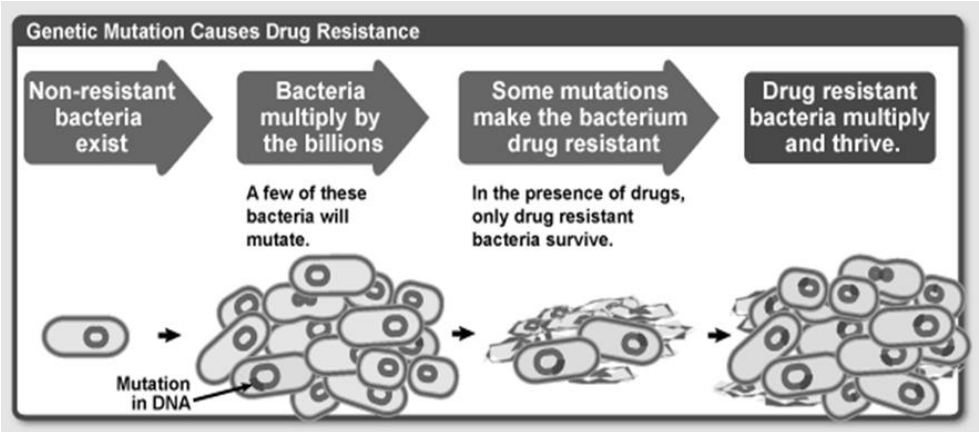
This can show how closely related to each other species are and how long ago they had a common ancestor.

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.

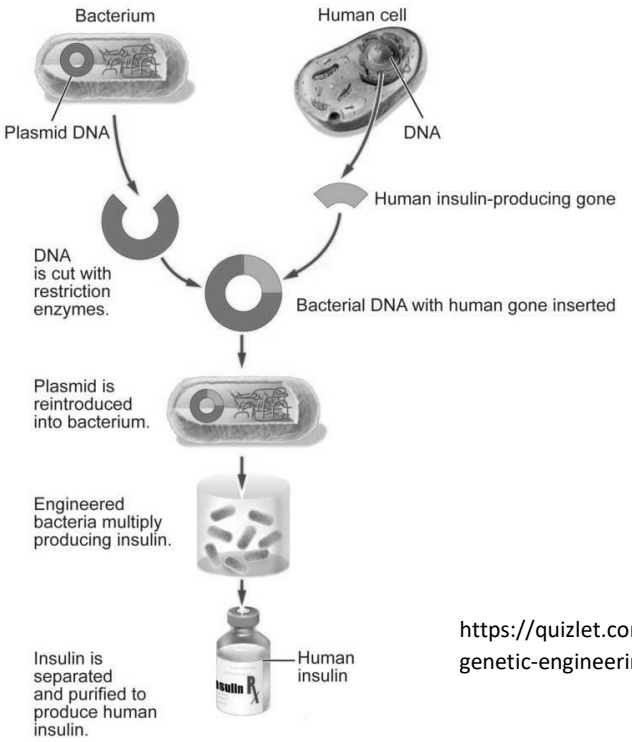
Gene modification of crops

- 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

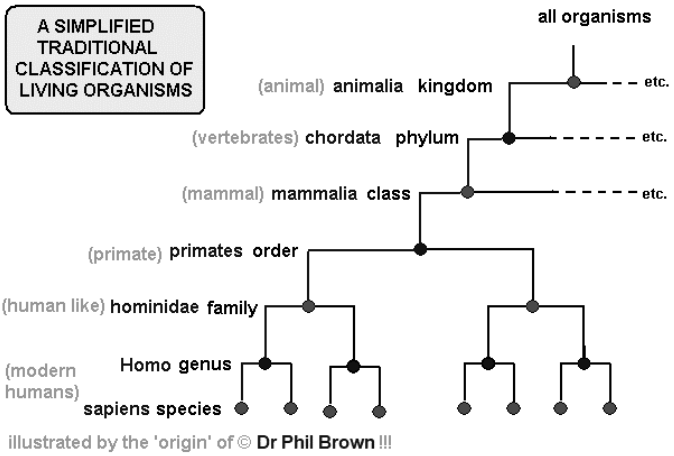
Classification is important because:

- 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

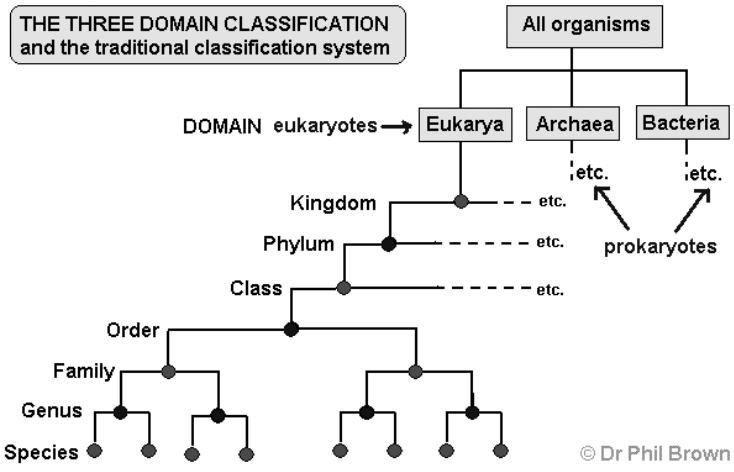
Organisms are grouped by common features into increasingly smaller groups until the species level is reached.
The groups are called taxa, with 7 taxa in total.

- 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.



Science Homework 3

Complete the final section of the homework workbook identified on the front and learn the key knowledge questions and answers for all of the areas covered in this knowledge organiser ready for the end of term test.

Key knowledge question	Answer
How many chromosomes do humans have in body cells?	46 (23 pairs)
What do we call an organism with two different versions of a gene?	Heterozygous
Name the gametes in humans	Sperm and egg
Which type of reproduction involves the fusion of gametes?	Sexual
Which type of cell division forms gametes?	Meiosis
How many chromosomes are found in gametes?	23
Define evolution	The change in the genes of a species over time
How many copies of a recessive allele are needed for the trait to be expressed?	2
Define genotype	The entire genetic makeup of an organism.
What do we call different versions of the same gene?	Allele

Wider reading

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
<u>You tube channels:</u>
Fuse school
Ted talks
Free science lessons
Primrose Kitten
<u>Shows on Netfilx</u>
Our planet
Tiny creatures
A life on our planet