Environmental Science

Keywords

allele – An alternative form of a gene.

asexual reproduction – The production of offspring from a single parent by mitosis. The offspring are clones of the parent.

chromosome – Structures that contain the DNA of an organism and are found in the nucleus.

cystic fibrosis – A disorder of cell membranes that is caused by a recessive allele.

DNA - A polymer that is made up of two strands that form a double helix.

dominant – An allele that is always expressed, even if only one copy is present.

fertilisation – The fusion of male and female gametes.

gamete – Sperm cell and egg cell in animals; pollen and egg cell in plants.

gene – A small section of DNA that codes for a specific protein.

genome – The entire genetic material of an organism.

genotype – The combination of alleles.

heterozygous – A genotype that has two different alleles, one dominant and one recessive.

homozygous – A genotype that has two of the same alleles. Either two dominant alleles or two recessive alleles.

meiosis – The two-stage process of cell division that reduces the chromosome number of the daughter cells. It makes gametes for sexual reproduction.

mutation – A change in DNA.

phenotype – The characteristic expressed because of the combination of alleles.

polydactyly – Having extra fingers or toes. It is caused by a dominant allele.

recessive – An allele that is only expressed if two copies of it are present.

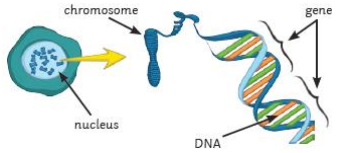
sexual reproduction – The production of offspring by combining genetic information from the gametes of two parents. Leads to variation in the offspring.

DNA

DNA was discovered in 1869, but it took until 1943 before scientists realised that DNA was the genetic material in cells, and that it contained a code for life. The next step was to find out its structure, in order to understand how the gene, the basic unit of heredity, works and how it is passed from one generation to the next.

Crick and Watson were trying to build a 3D model of the DNA molecule. But they were not the only ones working on finding its structure. They were competing with a team at King's College London, who were using a new technique called crystallography to study DNA.

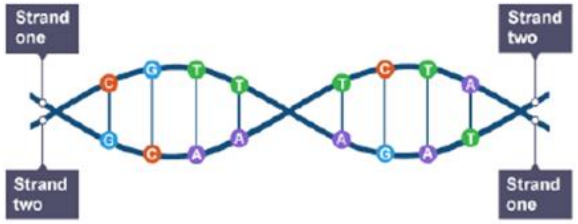
Rosalind Franklin, from the King's College team, made an X-ray diffraction image of DNA, which is known as Photograph 51. This showed that DNA had a helix shape. Without her knowledge, one of her colleagues showed the picture to James Watson. When he saw it, he knew that his and Francis Crick's theory about the structure of DNA was correct.



DNA

DNA is found in the nuclei of cells and organized into romosomes. This genetic information is passed from one neration to the next. It is called heredity and why we resemble ır parents. The genetic information itself is contained in a mplex molecule called DNA.

NA molecules contain two strands. The strands are twisted ound each other to form a double helix. These strands are held gether by bonds between base pairs.



A DNA molecule showing its base pairs, G–C and A–T

Punnet Squares

Sex Determination

dad \ mum	X	X
X	XX	XX
Y	XY	XY

XX = female, XY = male

Females carry two X chromosomes.
Males carry one X and one Y chromosome.

Probability

There are four possible combinations of gametes that offspring can inherit.

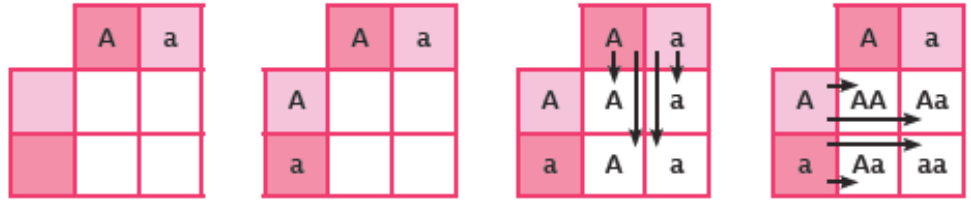
male genotype

female genotype \ male genotype	A	a
A	AA	Aa
a	Aa	aa

One of these four has the genotype aa – that's $\frac{1}{4}$, 25% or 0.25.

The recessive phenotype has a ratio of 1:3 because only one combination will show the phenotype while the other three will not.

How to Complete a Punnet Square



Step 1:

Put the two alleles from one parent into the boxes at the top. This parent is a heterozygote. This means they have one dominant and one recessive allele.

Step 2:

Put the two alleles from the second parent into the boxes on the left. This parent is also a heterozygote.

Step 3:

Put the alleles from the first parent into the two boxes underneath them.

Step 4:

Put the alleles from the second parent into the two boxes to the right of them.

Environmental Science

Evolution

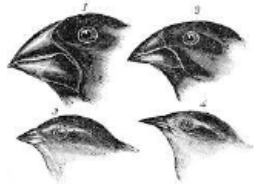
Evolution
Change in the inherited characteristics of a population over time through a process of natural selection, which may result in the formation of a new species.

The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.

Natural selection of variants that give rise to phenotypes best suited to their environment.

- Variation (mutation)
- Adaptation
- Survival

& Reproduction



Extinction

Extinction
The permanent loss of all the members of a species

Reasons for extinction:

- Introduction of a NEW disease
- Introduction of a NEW competitor
- Introduction of a NEW predator / overhunting
- Lack of food / prey
- Environmental change (temp., rainfall, loss of habitat etc.)
- Natural disaster

Adaptations

Adaptations are specific features of an organism which enable them to survive in the conditions of their habitat.
Adaptations can be structural, behavioural or functional:

- **Structural adaptations** are features of the organism's body e.g. colour for camouflage.
- **Behavioural adaptations** are how the organism behaves e.g. migration to a warmer climate during colder seasons.
- **Functional adaptations** are the ways the physiological processes work in the organism e.g. lower metabolism during hibernation to preserve energy.

A plant or animal will not physically change to adapt to its environment in its lifetime. Instead, there is natural variation within the species and only organisms whose features are more advantageous in the environment survive. The survivors then go on to reproduce and pass on their features to some of their offspring. The offspring who inherit these advantageous features are better equipped to survive. Charles Darwin described this process as 'survival of the fittest'.

Keywords

Keyword	Definition
Nucleus	Controls what happens inside the cell. Chromosomes are structures found in the nucleus of most cells.
DNA	Deoxyribonucleic Acid. The material inside the nucleus of cells, carrying the genetic information of a living being.
Double Helix	The shape of DNA molecule with two strands twisted together in a spiral.
Base Pair	The pair of nitrogenous bases that connects the complementary strands of DNA.
Bond	The chemical link that holds molecules together.
Gene	The basic unit of genetic material inherited from our parents. A gene is a section of DNA which controls part of a cells chemistry.
Heredity	Genetic information that determines an organisms characteristics, passed on from one generation to another. To do with passing genes to an offspring from its parent or parents.
Variation	Difference between individuals.
Continuous Variation	Variation that shows a wide range of intermediate values between two extremes. They can be measured. E.g. Hand Span
Discontinuous Variation	Differences between individuals in a characteristic that can only be put into different categories E.g. Eye colour
Environmental Variation	Differences between individuals of a species due to factors in their surroundings.

Environmental Science

Fossils

Fossils

Fossils could be:

- the actual remains of an organism that has not decayed;
- mineralised forms of the harder parts of an organism, such as bones;
- traces of organisms such as footprints or burrows.

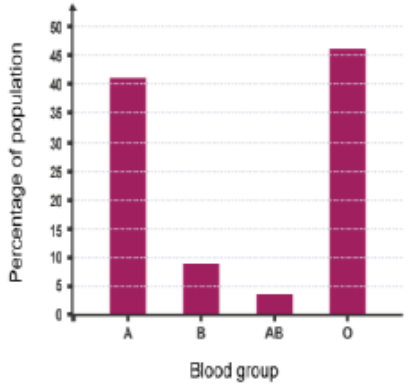
Many early life forms were soft-bodied so have left few traces behind.

Fossils help us understand how much or little organisms have changed as life developed on earth.

Discontinuous Variation

Discontinuous Variation

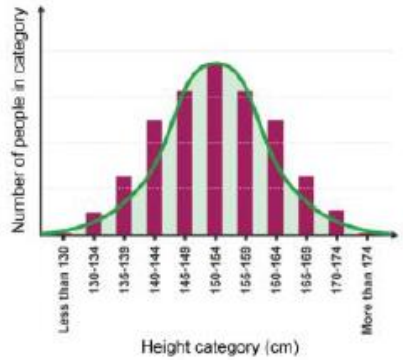
A characteristic of any species with only a limited number of possible values. Eye colour and blood group are examples.



Continuous Variation

Continuous Variation

Human height is an example. It ranges from the smallest person on Earth to the tallest. Continuous variation shows characteristics that change gradually over time.



Inherited Variation

Inherited Variation

Variation in characteristics that is a result of genetic information from parents.

Examples include:

- Eye colour
- Hair colour
- Lobed or lobeless ears
- Ability to roll your tongue.

Environmental Variation

Environmental Variation

Characteristics of animal and plant species can be affected by factors such as climate, diet, accidents, culture and lifestyle.

If you eat too much food then you will become heavier.

Variation caused by the surroundings is called environmental variation. Examples include your language and religion.

Environmental Science

Classification

Classification

Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species.

Organisms are named by the binomial system of genus and species.

Due to evidence from chemical analysis, there is now a 'three-domain system' developed by Carl Woese.

Domain	bacteria	archaea	eukaryota			
Kingdom	eubacteria	archaebacteria	protista	fungi	plantae	animalia

Biodiversity

Biodiversity is the variety of living organisms on the earth or in an ecosystem. It is important in helping to maintain stable ecosystems. Organisms are often interdependent, relying on others as food sources, or to create suitable environmental conditions to survive. Human survival is also dependent on this biodiversity.

The global human population has exceeded 7 billion.
Human population has increased due to modern medicine and farming methods, reducing famine and death from disease.
This means a greater demand for food, resources and water.
It also means more waste and emissions are created.

Sewage, toxic chemicals, household waste and gas emissions pollute the water, land and air, killing plants and animals and reducing biodiversity.

Factors

Abiotic factors are the non-living factors of an environment. E.g. moisture, light, temperature, CO_2, wind, O_2 or pH.

Biotic factors are the living factors of an environment. E.g. predators, competition, pathogens, availability of food.

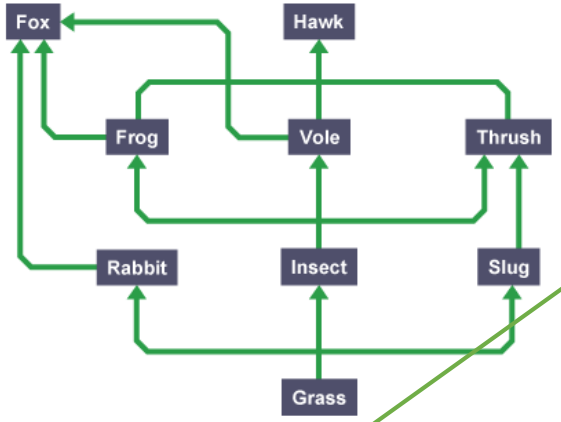
There are many ways that biodiversity and ecosystems are maintained:

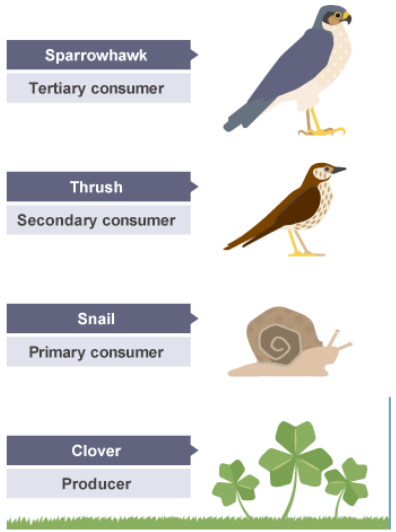
- Breeding programmes can help to protect endangered species from extinction.
- Conservation programmes can help to protect and preserve specialised ecosystems and habitats such as peat bogs and coral reefs.
- Reintroduction of hedgerows and field margins on agricultural land can help improve biodiversity by breaking up the monoculture crops.
- Sustainable forestry programmes help to manage the woodlands and reduce the deforestation to a sustainable rate.
- Societies actively encourage recycling and reusing of products and packaging to reduce the household waste going to landfill sites.

Unfortunately these programmes can be difficult to manage. They are often expensive and are difficult to regulate. People who are employed in certain areas, e.g. tree felling, cannot always transfer their skills to an environmentally friendly role and so become unemployed. It is difficult to maintain biodiversity whilst preventing crops being overrun with pests and weeds, which would affect food security for the human population.

Food Webs

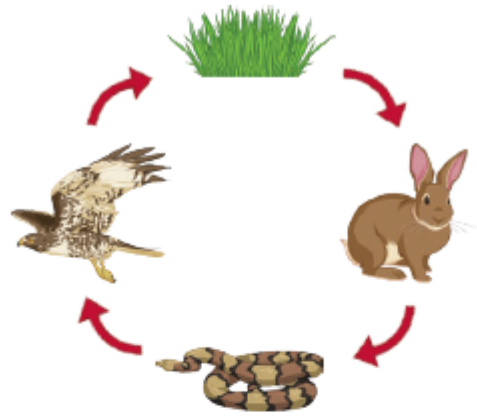
When all the food chains in an ecosystem are joined up together, they form a **food web**. Here is an example of a food web:





Food Chains

The source of all energy in a food chain is the sun's radiation. It is made useful by plants and algae which produce organic compounds through photosynthesis.



The living organisms use the energy to produce biomass and grow.

When a living organism is consumed, some of the biomass and energy is transferred. Some of the energy is lost.

Remember: the arrow in a food chain indicates the direction of the flow of energy.

Populations of predators and prey increase and decrease in cycles. The size of the predator population depends on the size of the prey population and vice versa. Overall, there is a stable community.