

Inheritance, Variation and Evolution

How are genetic disorders inherited?

Polydactyly – caused by dominant allele
Cystic fibrosis – caused by recessive allele

Can we screen for genetic disorders?

IVF – remove cell from embryo and analyse genes

In vitro – remove cells from embryo in the womb

Against screening: implies people with genetic problems are undesirable – prejudice. Pick desirable characteristics and its expensive. Lead to termination or destruction of embryo.

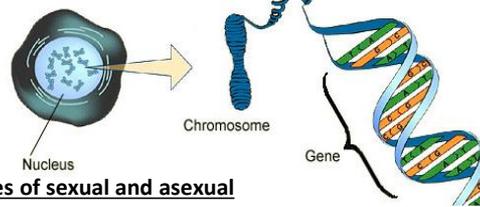
For genetic screening: Stop people suffering, treating disorders costs tax payers money and there are laws to stop it going to far.



START

Each cell in the body contains a nucleus. This holds chromosomes made of DNA.

Small sections of DNA that code for a characteristic are called genes. Genes code for a sequence of amino acids which then make a protein.



Advantages of sexual and asexual reproduction.

Sexual	Asexual
Produces variation	Only 1 parent needed
Variation gives survival advantage by natural selection	More time and energy efficient as do not need to find a mate
Natural selection can be speeded up by humans in selective breeding to increase food production	Faster
	Many identical offspring can be produced.

Some organisms do it both ways; sexual and asexual.

Malarial parasites; asexual in human, sexual in mosquito.
Fungus; asexual spores and sexual too.
Plants like the strawberry and daffodil have flowers (sexual) and runners or bulbs (asexual)

Genetic information is passed from parents to children using the **egg and sperm cells**.

These sex cells are also called **gametes**.

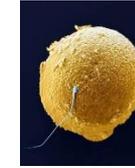
This means half the information comes from each parent and explains why you might look like your parents. Gametes are produced by **MEIOSIS**

Plants have gametes too; these are known as **eggs and pollen**.

Reproduction can be **sexual** or **asexual**.

Sexual reproduction produces **variation**.

Asexual reproduction produces **clones**.



In **sexual** reproduction **two parents** are involved. A mixture of genes is created.

This **variety** is good as it helps us **cope with changes** and diseases as a species.

Asexual reproduction involves **only one parent**. So there is **no genetic variety**, they are **identical**.

However this works really well if you need to **grow or repair your cells**. This happens by **MITOSIS**



Who was Gregor Mendel?

Mid - 19th century monk carried out breeding experiments on plants. He observed that the inheritance of characteristics determined by "units" that are passed to descendants unchanged. His discovery not recognised until later because it was only in late 19th century was cell division observed. Then in the early 20th century was the link between Mendel's units and chromosomes made. The unit were genes.

Cross: Aa x Aa

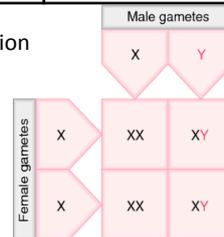
	A	a
A	AA	Aa
a	Aa	aa



How does inheritance work?

- In sexual reproduction both parents provide half the genetic material of their offspring
- Humans have 46 chromosomes- 23 come from the father, 23 from the mother
- Genes code for characteristics but these can be influenced by the environment too
- Diagrams called punnet squares can be used to show inheritance. Use them!

Sex determination

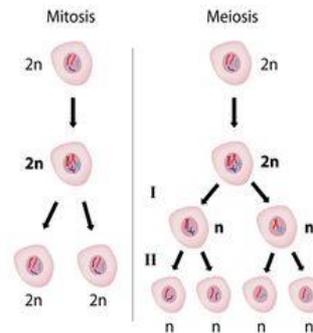


What happens in meiosis?

- When a cell divides to form gametes copies of the genetic information are made, the cells divide twice to form four gametes, each with single set of chromosomes and all the gametes are genetically different from one another.

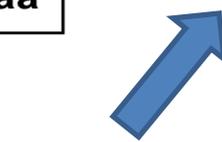
What happens during fertilisation?

- Gametes join to restore the number of chromosomes. New cells divide by mitosis. Number of cells increase and start to differentiate.



What is Cell Division?

- A process that leads to the creation of new cells.
- Mitosis is a process used for growth and repair and happens in body cells. It involves a single division and produces diploid (two copies of each chromosome) cells.
- Meiosis creates gametes (sex cells). It involves two divisions and produces haploid cells (one copy of each chromosome).



What is speciation?

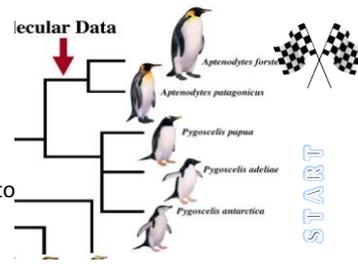
Speciation is the process by which a new species is formed

Every species has variation and different characteristics

When a group gets isolated from the rest of the species, it cannot breed. Over time, natural selection occurs and the species changes to adapt to its environment

Eventually, the group is so different that it cannot breed with other members of the species to produce viable offspring. A new species is made.

Alfred Russel Wallace also proposed theory of evolution but his best know work is speciation. Current understanding based on evidence and his theories.



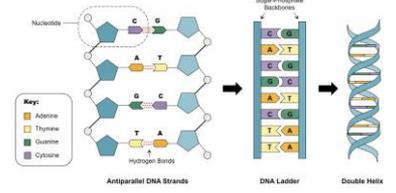
Each new branch shows where a new species appeared.

The structure of DNA

DNA is a polymer made up of two strands of repeating nucleotide units forming a double helix
Strands consist of alternating sugar and phosphate sections. Attached to each sugar is a base.

Made up of four nucleotides. Nucleotide consists of sugar, phosphate group with of the four following bases attached; A, C, G or T.

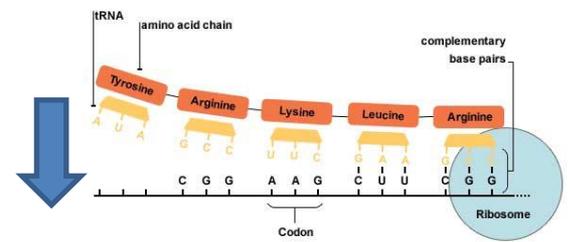
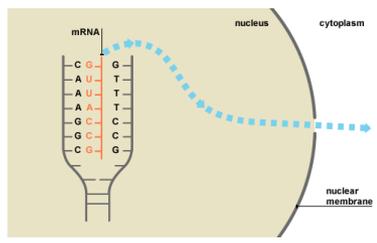
Three bases code for an amino acid. The order of bases codes for the order in which amino acids are assembled to make a protein.



What is a genome?

The entire genetic material found in an organism. Whole human genome has been studied and has helped us search for genes linked t different types of disease, understand and treat inherited disorders, to show migration patterns.

How do genes code for proteins?



Protein synthesis: DNA is used to code for proteins in the ribosome. DNA too big to leave the nucleus. **mRNA** carries code from nucleus to **ribosomes**.

The correct amino acids are brought to the ribosomes in correct order by **carrier molecules**.

Key words:

- Variation:** The differences between individuals in a species. Often caused by mutations.
- Inheritance:** The process that enables parents to pass on their genes (and characteristics) to their offspring.
- Evolution:** The gradual change over time of a species.
- Natural Selection:** The process that enables evolution to happen.
- Gene:** A unit of inheritance, codes for a single characteristic.
- Allele:** A version of a gene.
- Chromosome:** A circular piece of DNA containing thousands of genes. Humans have 46 chromosomes found in the nucleus.
- Speciation:** A process that results in a new species.
- Dominant:** an allele that is always expressed, even if one copy is present.
- Recessive:** an allele that is only expressed when two copies of the allele are present (no dominant allele present).
- Homozygous:** when two copies of the allele are present.
- Heterozygous:** when the two alleles are different.
- Genotype:** the alleles that are present
- Phenotype:** the characteristic that is expressed.

Darwin had a lot of trouble getting his ideas excepted because...
People believed in god and felt his ideas went against this.
He couldn't show them any evidence.
He couldn't really explain how it worked. (no one knew about genes)

Natural Selection and Evolution

Darwin suggested that certain traits would help an organism to **survive and reproduce**. They would then **pass this useful trait to their offspring**.

The environment would **naturally select** which traits were more useful.
If two populations of one species become so different in phenotype they can no longer interbreed to produce fertile offspring may result in two new species.

What causes variation?

The phenotype of an organism is an interaction between the genome and the environment. Variation caused by:

- Genes they have inherited (genetic causes)
- Conditions in which they have developed (environmental causes)
- A combination of both.

Species usually have great genetic variation and most variation occurs due to mutations.

Most characteristics are controlled by multiple genes interacting. Some are only controlled by one; mice fur colour and red-green colour blindness in humans.

What is EVOLUTION?

All living things evolved from simple life forms that developed more than 3 billion years ago.

New traits/genes are caused by **mutation of DNA**. Some of these traits are best suited to the **environment**. **MUTATIONS** happen all the time, most don't alter a protein at all. Some mutations might alter an enzyme shape and some might change non-coding DNA which may affect which genes are expressed.

What is the evidence for evolution?

Fossils

Remains of organisms from millions of years ago. Formed by; parts of organisms that have not decayed, parts of the organism replaced by minerals as they decay or preserved traces such as footprints, burrows and rootlets. We can learn from fossils have much or little organisms have changed as life developed.

Lack of evidence?

Many early animals soft-bodies and therefore left few traces and most traces have been destroyed by geological activity. This is why scientists cannot be certain how life began.

Extinction

When there no remaining individuals of species still alive. Caused by environmental changes, new predators or disease, can't compete or catastrophic event.



Antibiotic resistance and evolution

Bacteria evolve rapidly because they reproduce so quickly. Mutations of bacterial pathogens produce new strains. Some strains may be resistant to antibiotics and are not killed. This strain survives, reproduces and spreads as people are not immune and there is no treatment. MRSA is resistant. To reduce the development of resistant bacteria doctors should not prescribe antibiotics inappropriately, patients should complete their course of antibiotics so are killed and the agricultural use of antibiotics should be restricted.

What is selective breeding (artificial selection)?

Humans breed animals and plants for certain characteristics.

The process: Choose parents with correct characteristic, bred them together. Breed from the offspring that have the characteristic and continue for many generations until all offspring have desired characteristic.

Disease resistance.

More milk/meat

Dogs with more gentle nature

Large of unusual flowers.

Can lead to inbreeding (susceptible to disease/inherited defects).



Examples and issues:

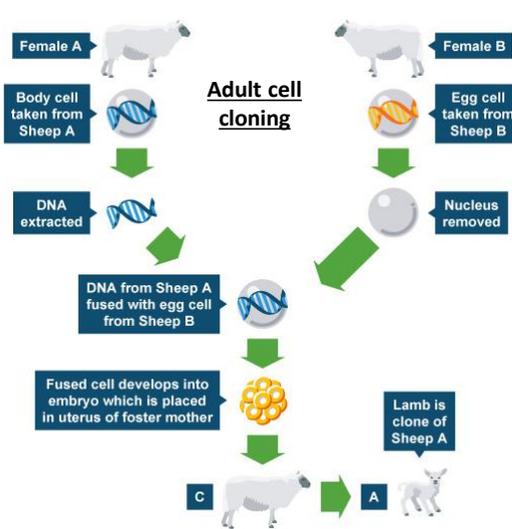
Plant crops have been GE'd to be resistant to disease or produce better fruits. They are called genetically modified and usually show increased yields. Concerns are they may effect wild populations of flowers and insects and that long-term effect on human health not identified. Future uses include modifying human genome to overcome inherited disorders – gene therapy.

What is cloning?

Producing genetically identical copies of organisms.

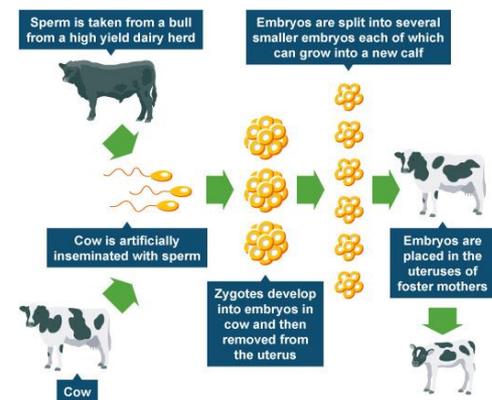
IN PLANTS

Cuttings are an old method to produce many identical plants from parent plant.

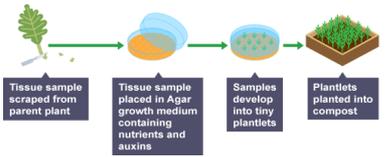


In ANIMALS

Embryo transplants.



Tissue Culture



How are organisms classified?

Traditionally organisms classified in a system developed by Carl Linnaeus based on their characteristics and structure. Living things are classified into KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS and SPECIES. Named by the binomial system of genus and species.

Development of classification systems

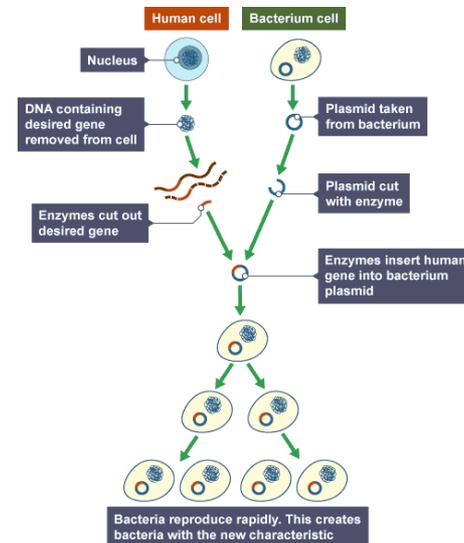
New models have been developed based on advances in microscopes to see internal structure and a progression in the understanding of biochemical processes.

The three domain system

Developed by Carl Woese and organisms are divided into archaea (primitive bacteria), bacteria (true bacteria and eukaryota (which includes everything else).

What is genetic engineering?

Involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic.



Sometimes vector used to insert gene into cells and then the cells are transferred to organism in early stage so they develop desired characteristics.