# AQA GCSE INHERITANCE VARIATION AND EVOLUTION PART 3

Year 11 – Biology / Inheritance Variation and Evolution – HT4

Variation and evolution L114-124

## Evolution

**A change in the inherited characteristics of a population over time through the process of natural selection.**

Over time this results in the formation of new species.

**The theory of evolution by natural selection.**

*Species of all living things have evolved from simple life forms that first developed 3 billion years ago.*

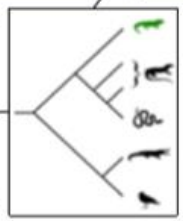
Through natural selection of variants (genotypes) that give rise to phenotypes best suited to their environment or environmental change e.g. stronger, faster. This allows for variants to pass on their genotype to the next generation.

If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.

Darwin's finches

## Classification of living organisms

Use current classification data for living organisms and fossil data for extinct organisms



**Evolutionary trees are a method used by scientists to show how organisms are related**

## Selective breeding

**The process by which humans breed plants/animals for particular genetic characteristics**

Humans have been doing this for thousands of years since they first bred food from crops and domesticated animals.

**Selective breeding**

*Choosing parents with the desired characteristics from a mixed population*

Chosen parents are bred together.

From the offspring those with desired characteristics are bred together.

Repeat over several generations until all the offspring show the desired characteristics.

**Choosing characteristics**

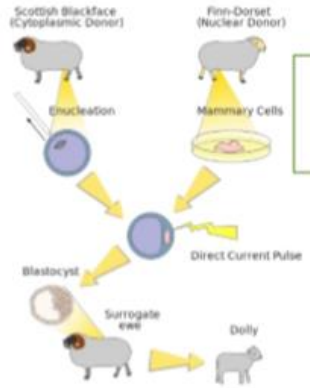
*Desired characteristics are chosen for usefulness or appearance*

| | |
|---|---|
| Disease resistance in food crops. |  |
| Animals which produce more meat or milk. |  |
| Domestic dogs with a gentle nature. |  |
| Large or unusual flowers. |  |

Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects e.g. British Bulldogs have breathing difficulties.

*Concern:* effect of GMO on wild populations of flowers and insects.

## Cloning (Biology only)




**Adult cell cloning**

1. Nucleus is removed from an unfertilised egg.
2. Nucleus from body cell is inserted into egg cell.
3. An electric shock stimulates the egg to divide into an embryo
4. Embryo cells are genetically identical to adult cells.
5. When embryo has developed into ball of cells it is inserted into host womb.

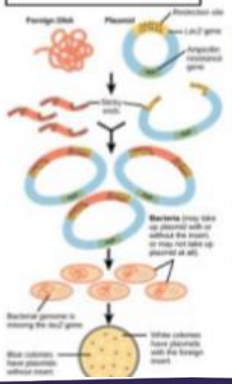
**Cloning techniques in plants/animals**

| | |
|---|---|
| *Tissue culture* | Small groups of cells to grow new plants. Important for preservation of rare plants and commercially in nurseries. |
| *Cuttings* | Part of a plant is cut off and grown into full plant. |
| *Embryo transplants* | Splitting apart cells from animals embryo before they become specialised. New clone embryos are inserted into womb of adult female. |

*Concern:* some people have ethical objections to adult cell cloning e.g. welfare of the animals.

## Genetic engineering

Modern medical is exploring the possibility of GM to over come inherited disorders e.g. cystic fibrosis



*Concern:* effect of GMO on human health not fully explored

**Genetic engineering process (HT only)**

1. Enzymes are used to isolate the required gene.
2. Gene is inserted into a vector – bacterial plasmid or virus.
3. Vector inserts genes into the required cells.
4. Genes are transferred to plants/animals/microbes at an early stage of development so they develop the required characteristics.

**Genes from the chromosomes of humans or other organisms can be 'cut out' and transferred to the cells of other organisms.**

**Genetically modified crops (GMO)**

*Crops that have genes from other organisms*

- To become more resistant to insect attack or herbicides.
- To increase the yield of the crop.

# AQA GCSE INHERITANCE VARIATION AND EVOLUTION PART 4

Variation and evolution L114-124

## Theory of evolution (Biology only)

**Charles Darwin** – *Theory of evolution by natural selection.*

- Individual organisms within a particular species show a wide range of variation for a characteristic.
- Individual most suited to the environment are more likely to breed successfully.
- Characteristics enable individuals to survive are then passed on to the next generation.

Developed since its proposal from information gathered by other scientists.

**Alfred Wallace** – *Independently proposed the theory of evolution by natural selection*

- Published joint writings with Darwin in 1858.
- Worked worldwide gathering evidence.
- Best know for work on warning colouration in animals and his theory of speciation.

Did much pioneering work on speciation but more evidence over time has lead to our current understanding.

**Evidence from around the world, experimentation, geology, fossils, discussion with other scientists (Alfred Wallace) lead to:**

**Charles Darwin 'On the Origin of the Species' (1859)** – *Published the theory of evolution by natural selection*

Slowly accepted; challenged creation theory (God), insufficient evidence at time, mechanism of inheritance not yet known.

Other theories e.g. Lamarckism are based on the idea that changes occur in an organism during its lifetime which can be inherited. We now know that in the vast majority of cases this cannot occur.

## Speciation (Biology only)

Allows biologists to understand the diversity of species on the planet.

**Speciation**

*Due to isolation of a population of a species e.g. species are split across far apart islands.*

Environmental conditions differ for populations e.g. types of food available, habitat.

⇩

Individuals in each population most suited to their environments are more likely to breed successfully.

⇩

Over long periods of time each population will have greater differences in their genotype.

⇩

If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.

## Classification of living organisms

The full human classification

**Carl Linnaeus classified living things**

| | |
|---|---|
| *Kingdom* | Animalia |
| *Phylum* | Chordata |
| *Class* | Mammalia |
| *Order* | Primates |
| *Family* | Hominidae |
| *Genus* | *Homo* |
| *Species* | *sapiens* |

Organisms are named by the binomial system of genus and species. Humans are *Homo sapiens*

Due to improvements in microscopes, and the understanding of biochemical processes, new models of classification were proposed.

**Carl Woese**

*3 domain based on chemical analysis.*

Archaea (primitive bacteria), true bacteria, eukaryota.

## Evidence for evolution

**Fossils and antibiotic resistance in bacteria provide evidence for evolution.**

**Antibiotic resistant bacteria** – *Mutations produce antibiotic resistant strains which can spread*

- Resistant strains are not killed.
- Strain survives and reproduces.
- People have no immunity to strain and treatment is ineffective.

**Extinction**

*When no members of a species survive*

Due to extreme geological events, disease, climate change, habitat destruction, hunting by humans.

Fossils tell scientists how much or how little different organisms have changed over time.

Evolution is widely accepted. Evidence is now available as it has been shown that characteristics are passed on to offspring in genes.

## The understanding of genetics (biology only)

**Gregor Mendel** – *In the mid 19th century carried out breeding experiments on plants*

Inheritance of each characteristic is determined by units that are passed on to descendants unchanged.

**Fossils**

*'remains' of ancient organisms which are found in rocks*

Parts of organism that have not decayed as necessary conditions are absent.

Parts of the organism replaced by minerals as they decay.

Preserved traces of organisms such as footprints, burrows and rootlet traces.

Early forms of life were soft bodied and few traces are left behind and have been destroyed by geological activity, cannot be certain about how life began.

Led to gene theory being developed but not until long after Mendel died.

**Further understanding of genetics**

*Improving technology allowed new observations.*

- Late 19th century: behaviour of chromosomes in cell division.
- Early 20th century: chromosomes and Mendel's 'units' behave in similar ways. 'units' now called genes must be located on chromosomes.
- Mid 20th century: structure of DNA determined. Mechanism of gene function worked out.