Wjec BY2.1 Evolution

* Biodiversity - **a measure of the number of species on the planet**. The number of species per square kilometre **increases** as one move from the **poles to the tropics**. Tropical rain forests and coral reefs are the **most diverse** habitats on the planet.
* Reasons for decline in numbers and extinction:
	+ **Loss of habitat** due to Deforestation/pollution/drainage of wetlands
	+ **Over hunting** by humans
	+ Competition from **introduced species**
* Species - **members of a species** share a large number **of common characteristics** and interbreed to **produce fertile offspring**.
* Evolution - process by which **new species** are formed from **pre-existing ones** **over a period of time.**
* Variation - change in the organism’s **genotype and phenotype**.

Evolutionary history shows that biodiversity has gone through several bottlenecks called mass extinctions followed by radiations of new species:

Darwin’s observations on natural selection:

* + Darwin recognized that **species changed**
	+ Proposing the theory of natural selection to explain why it happened
	+ So that there is **a large variation of genotypes** in population
	+ Organisms **overproduce offspring**
	+ However, numbers on the population **remain constant**
	+ Therefore there is a **high mortality rate**
	+ Because only those individuals with **beneficial alleles** have a **selective advantage** e.g. white fur in arctic
	+ **Can withstand selection pressures** i.e. a factor which increases the chances of a beneficial allele being passed onto the next generation e.g. competition, predation, disease
	+ These individuals then **reproduce**
	+ Offspring are likely to **inherit** the **beneficial alleles,** therefore characteristic
	+ This process **repeats generation after generation**
	+ Therefore the **beneficial allele frequency increases** within the **gene pool**
	+ e.g. Darwin found **adaptive radiation** in the finch population of the Galapagos islands**,** which describes the **evolutionary** **diversification** of many species from a **single common ancestor**

In **1832** Darwin travelled to **South America**, aged 22, to carry out a scientific study – studied the **finches** on the **Galapagos Islands.**

He suggested **a common ancestor finches** reached the islands by chance and developed and **evolved** from this finch so over time each finch had a **different beak adapted** to exploit a **particular food supply. (Selective pressure)**

* **The variation of beak sizes can be represented in normal distribution curves. The curves below compare the variation in beak sizes found on:**
	+ **A large island where 2 species of finch coexist**
	+ **A small island where only one species exists**

Key

G.fuliginosa

G.fortis

Large island Small island

Frequency Frequency

 0 5 10 15 20 0 5 10 20

Beak size mm Beak size mm

* The beak size on the small island shows:
	+ **Greater variation**
	+ With a **higher mean**
	+ Because there is **less competition for food** (with other finches)
	+ Therefore there is a **smaller selective pressure**

**Classification:**

* Helps understand relationships between **ancestors**

* + **Phylogenetics**:
		- Based on **Evolutionary History** of the organisms
		- It shows the **Ancestry** of groups or **Points of Divergence**
		- E.g. mammals and birds are **more closely related** than fish
		- Organisms are classified on the basis of **similar or shared characteristics e.g.** phenotype/DNA Fingerprinting)
		- **DNA Fingerprinting** can be used to assess how related organisms are i.e. more closely related, fewer number of differences / high number of shared genes

**Evidence for Common ancestry and natural selection:**

* Closely related species are recognised by their **similar morphology** (body structure), e.g. the **fossil record**
	+ **Homologous** **structures** like that of the **pentadactyl limb** in vertebrates can be used as evidence to show that organisms evolved from **common ancestors**.
	+ **Analogous** **structures** such as the wings of a bird and insect are **not** an indication of relatedness:

**Homologous** structure - pentadactyl limb. **Analogous** structures - dorsal fin (shark and dolphin)



* Biochemical techniques
	+ Compare the **sequence of bases in DNA of genes** (**DNA Fingerprinting**) - the **more similar the sequence** the **more closely related the species** \*N.B. The best/most accurate technique for establishing relatedness



DNA is most similar, so most

closely related

* + Compare the **sequence of amino acids in proteins** – the **more similar the sequence** the **more closely related the species**
* The most commonly used classification is:
	+ **K**ingdom **K**ing e.g. Animalia
	+ **P**hylum **P**rawn Chordata/Vertebrata
	+ **C**lass **C**urry Mammalia
	+ **O**rder **O**r Primates
	+ **F**amily **F**at Hominidae
	+ **G**enus **G**reasy Homo
	+ **S**pecies **S**ausages sapiens

**Binomial system:** The last two taxa, Genus and species are used to give the organism a name:-

* + *Homo sapien* = man
	+ *Rattus norvegicus* = Brown rat
	+ *Rattus rattus* = Black rat
* Binomial system is used to avoid confusion of local common names and different languages – uses the Latin name

**Kingdom** Animal

**Phylum**  Chordata (Non-chordata)

Arthropods Annelids

**Class**  Millipedes/ Spiders Insects Crustacea

 Centipedes

**Characteristics of the 5 Kingdoms (excluding viruses):**

* Animal Kingdom e.g. dog, spider, starfish
* **Eukaryotic cells**
* **Heterotrophic** feeding
* **Multicellular**
* **Specialised organ systems**
* **Nervous system**
* Cells do **not** have cell walls
* Plant Kingdom e.g. tree, daisy
* **Eukaryotic cells**
* **Autotrophic** feeding (Light energy converted to chemical energy)
* **Multicellular**
* **Specialised structures** e.g. leaves, stems , roots
* Cells have **cellulose cell walls**
* Fungi Kingdom e.g. mushrooms, yeast
* **Eukaryotic cells**
* Made up of **hyphae threads** forming a **mycelium**
* Cells have **Chitin cell walls**
* **Heterotrophic** feeding (often saprophytic)
* Reproduce using **spores**
* Protoctist Kingdom e.g. slime moulds, algae
* **Eukaryotic cells**
* Unicellular organisms that are Heterotrophic or Autotrophic
* Multicellular organisms are autotrophic (Seaweed)
* **No specialised structures**
* Have **cell walls**
* Prokaryote Kingdom (Bacteria) e.g. salmonella
* Much **smaller** than Eukaryotic cells
* Most are **unicellular**
* **Murein** Cell wall (not made from cellulose)
* **No nucleus** (or any membrane bound organelles)
* **Loop of DNA** (not Linear)
* **Smaller Ribosomes** than Eukaryotic cells (70S)
* Saprophytic/Autotrophic feeders

**More characteristics:**

**Annelids** e.g. earthworms, leeches, lugworms.

* a long, thin **segmented body**, the segments being visible externally as rings
* a **closed circulatory system i.e. blood vessels**
* a **hydrostatic skeleton** and **fluid filled body cavity**
* a head end with a **primitive brain** and a **nervous system** running the length of the body
* a **thin permeable skin**, through which **gaseous exchange** occurs
* a **closed circulatory system** containing an oxygen carrying **pigment** e.g. haemoglobin

**Arthropods** e.g. millipedes and centipedes, crustaceans, spiders and insects.

* a body **divided into segments**
* a body further divided into **head, thorax and abdomen**
* a well-developed **brain**
* a hard outer **exoskeleton made of chitin**
* paired **jointed legs**
* an **open circulatory system**
* a cavity which surrounds the body organs called **(haemocoel)**
* Two important evolutionary developments are:
* **jointed legs** - modified to perform a variety of functions, including walking, swimming, jumping, feeding, reproduction and where present, ventilation of the gills.
* **exoskeleton** - the outermost layer of cells of the body secretes a thick cuticle, which consists mainly of chitin. This performs several functions:
* **protection of internal organs**
* **protection from predators**
* provides a **point of attachment for muscles**
* **support** -for small animals a hollow tubular structure surrounding the body provides greater support than a solid cylindrical rod within it (an endoskeleton as in vertebrates) made from the same quantity of material
* in most terrestrial arthropods the exoskeleton is covered with a layer of wax which **reduces water loss.**

The one main disadvantage of the exoskeleton is that it **is fixed in size** and **does not grow** with the animal. In order to grow an arthropod must **periodically shed its exoskeleton** (ecdysis). This leaves the animal especially vulnerable as the new exoskeleton hardens.

**Chordate features: (all have vertebral column/backbone and well developed brain enclosed in cranium)**

* Fish- **scales, fins** and **gills.**
* Amphibians- partly terrestrial and partly aquatic. **Soft, moist skin**. The **eggs are fertilised** **externally in water**, where they also develop. **Young are aquatic.**
* Reptiles- **mainly terrestrial** and have **dry skin with scales**. They have **lungs.** The eggs are **fertilised internally**, covered with a **shell** and **laid on land.**
* Birds- they **can fly** and have **feathers.** Forelegs develop as **wings**. They have **lungs** and their eggs have **hard shells.**
* Mammals- **have skin with hair.** Young are **born alive** and are **fed on milk.** They have **lungs.** They are subdivided into 2 groups:
* Marsupials- young are born at a very immature stage and develop in femals pouch.
* Placentals- young undergo considerable development in the mother's womb.