OCR (A) Biology A-level

Topic 4.2: Biodiversity

Notes

Biodiversity is the **variety of living organisms**, over time the variety of life on Earth has become more extensive but now it is being **threatened by human activity** such as deforestation and agriculture as well as climate change. Biodiversity can be measured in terms of:

- **Species richness** is the **number of different species in a community** and can be measured by simply counting the number of species present via methods such as **random sampling** which is carried out with the purpose of obtaining a representative sample of an area under investigation.

  Other methods of sampling include **systematic sampling** such as a transect where a particular pattern is followed, for instance a sample is taken every few metres. **Opportunistic sampling** is a type of sampling where a sample is taken when a source is encountered therefore it is based on ease of access. Whereas **stratified sampling** is a method of sampling where the population is subdivided into smaller groups known as strata based on common characteristics and subsequently a random sample is taken from each stratum of a size proportional to the proportion of that particular strata in the whole population.

- **Species evenness** which is a comparison of **abundance** of different species in a habitat.

- **Genetic diversity** is a measure of the **genetic variation** found in a particular species, in other words it is the **number of alleles in a gene pool**. It can be determined by calculating the **heterozygosity index (H) ,** the higher the heterozygosity index (H), the more genetically diverse the species
  H= number of heterozygotes / number of individuals in the population

Biodiversity can also be measured using the **index of diversity (D)** which can be calculated as following:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

D = Diversity index
N = total number of organisms
n = total number of organisms of each species

Maintaining biodiversity is important for **ecological, economic and aesthetic** reasons such as protecting landscapes.

There are various methods of conserving biodiversity including **in situ** methods such as **marine conservation zones** and **wildlife reserves** which serve to protect the wildlife. Whereas **ex situ** conservation methods include **zoos, seeds banks and botanic gardens**.

Zoos use various methods to **conserve endangered species and their genetic diversity,** some of the methods used include:

- **Scientific research** such as studying the behaviour of animals, working on improving breeding success to increase the population size and controlling and eradicating diseases that have the potential to be lethal to animals

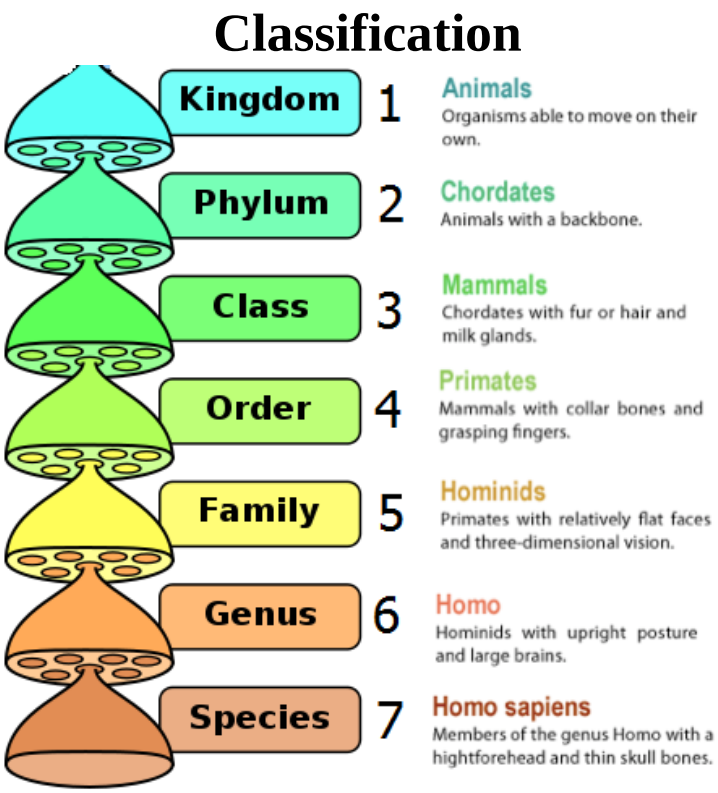
- **Captive breeding programmes** in which endangered species are carefully bred to increase genetic diversity and population size

- **Reintroduction programmes** which aim to release animals bred in captivity into their natural habitat as well as to restore lost habitats

- **Education programmes** which aim to educate people about the importance of maintaining biodiversity, captive breeding programmes as well as illegal trade of animal products.

Seedbanks store a large number of seeds in order to **conserve genetic diversity** and prevent plant species from going **extinct**. Storing seeds instead of plants means that a **large variety of species can be conserved**; it's also cheaper than storing whole plants as it takes up **less space**. The seeds are stored in **cool, dry conditions** as this maximises the amount of time they can be stored for and they are **periodically tested for viability**.

Biodiversity conservation needs international co-operation. There are historic and current agreements, including the Convention on International Trade in Endangered Species (**CITES**), the **Rio Convention** on Biological Diversity (CBD) and the **Countryside Stewardship Scheme** (CSS)



Classification is the process of **naming and organising organisms into groups based on their characteristics.** Organisms can be grouped into one of the five kingdoms: **animals, plants, fungi, prokaryotes and protoctists**. They can then be grouped further into **phylum, class, order, family, genus and species**. Each species is named according to the **binomial system**, the first part of the name is the genus and the second part of the name is the species.

The analysis of molecular differences in different organisms to determine the extent of their evolutionary relatedness is known as **molecular phylogeny**. The data obtained by molecular phylogeny (looking at DNA sequences, RNA sequences and protein structure) has been accepted by scientists and this gave rise to new taxonomic groupings – all organisms can be separated into one of the **three domains: Bacteria, Archaea and Eukaryota.**

Evolution

The **niche** of a species is **its role within the environment**. Species which share the same niche compete with each other and a better adapted species survive. The idea that better adapted species survive is the basis of **natural selection**.

Organisms are adapted to their environment in various ways:

- **Anatomical adaptations** are **physical adaptations**, either external or internal e.g. presence of loops of Henlé which allow desert mammals to produce concentrated **urine and minimise water loss**
- **Behavioural adaptations** are **changes in behaviour** which improve the organism's chance of survival e.g. mating calls
- **Physiological adaptations** are **processes inside an organism's body** that increase its chance of survival e.g. regulation of blood flow through the skin

Natural selection is the process in which **fitter individuals** who are betted adapted to the environment **survive and pass on the advantageous genes to future generations**. Evolution is the process by which the **frequency of alleles in a gene pool changes over time as a result of natural selection.**

Evolution via natural selection:

- There's a **variety of phenotypes** within a population
- An **environmental change occurs** and as a result of that the **selection pressure changes**
- Some individuals possess **advantageous alleles which give them a selective advantage and allow them to survive and reproduce**
- The **advantageous alleles are passed on to their offspring**

- Over time (and many generations), **the frequency of alleles in a population changes** and this leads to evolution

If two populations become **reproductively isolated**, new species will be formed due to accumulation of different genetic information in populations over time due to different environments and selection pressures.

Evidence for Evolution

Observations

Charles Darwin and many other scientists' observations have provided evidence for the theory of evolution. Darwin observed many different types of finch on the Galapagos Islands but he believed they must be related due to many similarities. He concluded a bird born with a beak more suited to the food available would be more likely to survive than one whose beak was less well suited. Those that survive pass the trait to their offspring and over time all the finches in that area would share that shape of beak.

Alfred Wallace had very similar ideas to Darwin and they published their theory together.

Fossils – looking at the remains of extinct organisms and comparing to those alive today. Dating the rocks can give a timeline to the changes seen.

Molecular biology – looking at the similarities and differences between DNA sequences in different organisms

Comparative anatomy – comparing the anatomy of different organisms by looking at homologous structures (do species share a similar physical structure?)

Variation

Each population shows natural variation in characteristics. Each characteristic varies in either a **continuous** or **discontinuous** fashion.

Discontinuous variation is where there are **no intermediates** (such as the shape of bacteria as they are spherical, rod shaped, spiral etc). These are represented by **bar charts**. Most characteristics showing discontinuous variation are **controlled by a single gene**.

Continuous variation is when a characteristic can **take any value** within a range (such as height of animals). These are represented by **histograms** and usually display a **normal distribution curve**. These characteristics tend to be **controlled by more than one gene** and are often **influenced by environmental factors**.