Biology Double Award Unit 4 - Topic 1 Classification & Biodiversity

GCSE Exam Specifications:

Topic 1	***Revision completed***
Higher tier content is written in ***bold***	
(a) living organisms showing a range of sizes, features and complexity; the broad descriptive grouping into plants, - non-flowering and flowering; animals - invertebrates and vertebrates	
(b) the means by which organisms which have similar features and characteristics are classified into groups; the need for a scientific system for identification and the need for scientific as opposed to 'common' names	
(c) the fact that organisms have morphological and behavioural adaptations which enable them to survive in their environment	
(d) individual organisms needing resources from their environment e.g. food, water, light and minerals; how the size of a population may be affected by competition for these resources along with predation, disease and pollution	
(e) the term biodiversity: the variety of different species and numbers of individuals within those species in an area; why biodiversity is important; the ways in which biodiversity and endangered species can be protected including issues surrounding the use of legislation	
(f) how quadrats can be used to investigate the abundance of species	
(g) the principles of sampling: the need to collect sufficient data	
(h) the principles of capture/recapture techniques including simple calculations on estimated population size	
(i) the use of biological control agents and possible issues surrounding this; the introduction of alien species and their effects on local wildlife	

Details of Specified Practical work	***Revision completed***
Investigation into the distribution and abundance of organisms	

Classification

Living organisms show differences in their size, features and complexity

There is a range of living organisms and they are divided into major groups:

non-flowering plants – do not produce flowers e.g. ferns and mosses;

flowering plants – produce flowers;

invertebrates – do not have a backbone e.g. insects;

vertebrates – have a backbone.

Why should organisms be classified?

Classification means putting living organisms into groups

Scientific names e.g. *Vulpes vulpes* (fox) are used so

- ***The name is the same in all countries***
- ***The name is the same in all languages***
- ***This avoids the confusion and duplication caused by local or common names.***

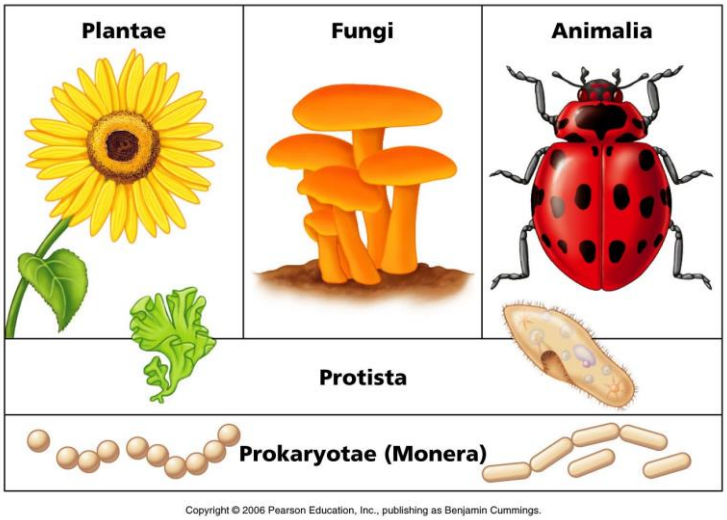
The names are written in Latin and an international committee decides on the name.

How do we classify organisms?

The system for classification is divided into different levels-

kingdom
phylum
class
order
family
genus
species

The first rank in this system is called a kingdom. There are ***five kingdoms***, based upon their morphological features (size, shape, and structure)



Animals

Plants

Fungi

Bacteria

Single celled organisms

For example, lions (Panthera leo) have the following classification:

Kingdom **Animals,**

Phylum **Vertebrates**

Class **Mammals,**

Order **Carbnivora,**

Family **Felidaae,**

<u>Genus</u> **Panthera,**

<u>Species</u> **leo.**

e.g. Hedgehog (*Erinaceus europaeus*)

Kingdom **Animals,**

Phylum **Vertebrates**

Class **Mammals,**

Order **Insectivores,**

Family **Erinaceidae,**

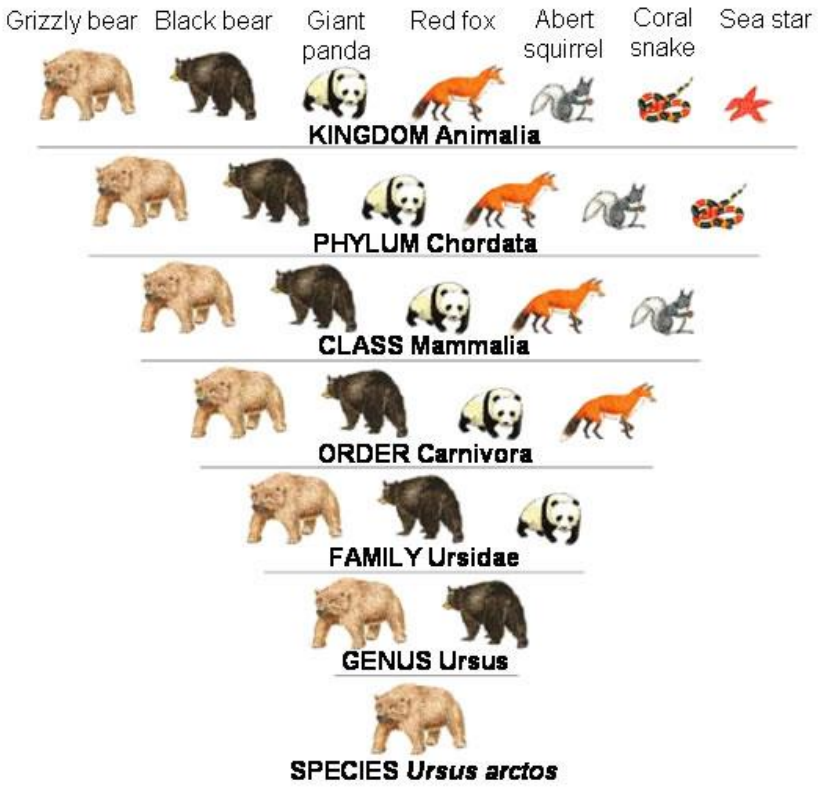
<u>Genus</u> **Erinaeceus,**

<u>Species</u> **europaeus.**

<u>Genus and species are used in the scientific name</u>

Another example – *Homo sapiens* = human

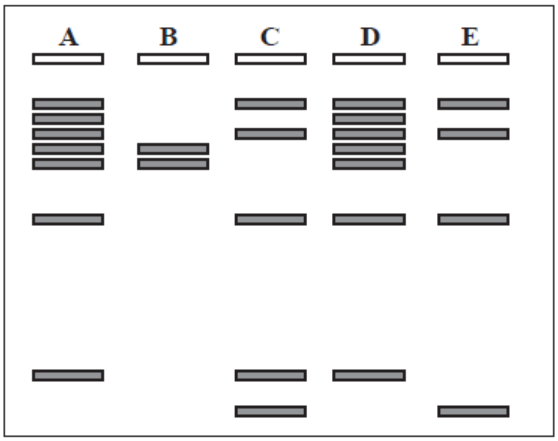
A systematic system helps in the understanding of the variety of living things, their trends and relationships.



DNA analysis and classification?

Analysing DNA shows us a clearer relationship between different organisms.

Which organisms are the most closely related? – you need to look at the number of bands on the DNA profile that are common to the individuals – in this example A and D are the most closely related



Adaptations

All organisms living today have morphological (shape) adaptations and behavioural adaptations. Organisms have to be able to obtain resources such as food, water, light, (plants).

Arctic fox

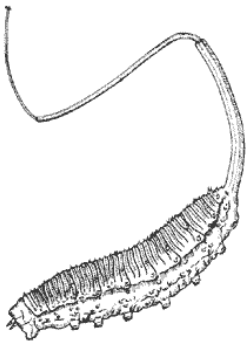
Red fox from temperate regions

Desert fox

- The smaller ears of the Arctic fox reduce the surface area and allow it to retain as much heat as possible and reduce heat loss.
- The red fox has ears that are not obviously large or small because it does not have to survive at extreme temperatures.
- Coat colour is also important e.g. the arctic fox is white for camouflage from its prey when hunting.
- **Behavioural adaptation e.g. nocturnal animals** – why are some animals more active at night in hot climates = cooler/ availability of prey

Another example-

e.g. Rat-tailed maggots have a telescopic breathing siphon - acts like a snorkel, allowing the larva to breathe air while submerged.



Populations

Population size is affected by – **competition for food, space and light; predation, disease, pollution and availability of minerals**

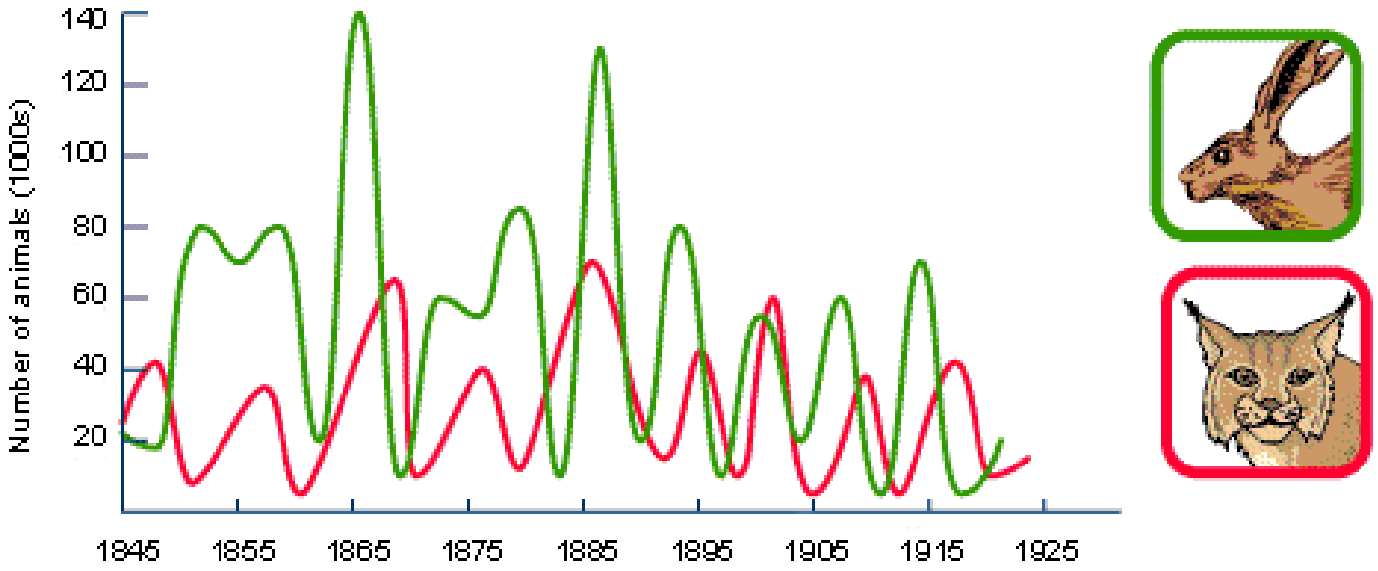
Plants also compete for resources such as **light, space and minerals from the soil**

Competition may occur between members of the same species – intra specific competition

E.g. lions when there are far more offspring produced than can possibly survive – there is a 'survival of the fittest to breed'. The most successful survive to produce more offspring

The American grey squirrel competes with the native red squirrels for food and carries a deadly virus which has meant that red squirrels - have disappeared from many areas of the UK. Conservation efforts have focused on identifying large conifer woodlands as red squirrel refuges.

Interspecific competition – competition between different species



Prey are animals that are eaten by predators, e.g. a rabbit is prey for a fox which is the predator. The numbers of predators and prey affect each other.

The graph shows how the numbers of prey (the hare) are affected by the predator (lynx –a type of wild cat) over time.

•When the numbers of prey (hare) increase, there is more food available for the predator (lynx) and so the predator (lynx) numbers increase.

•As the predator numbers increase, there is more competition within the lynx species for food and so the numbers of predators begin to fall.

•As the predator numbers fall, the prey numbers rise as they are not being hunted as much and then there is more food available for the predators and the cycle continues.

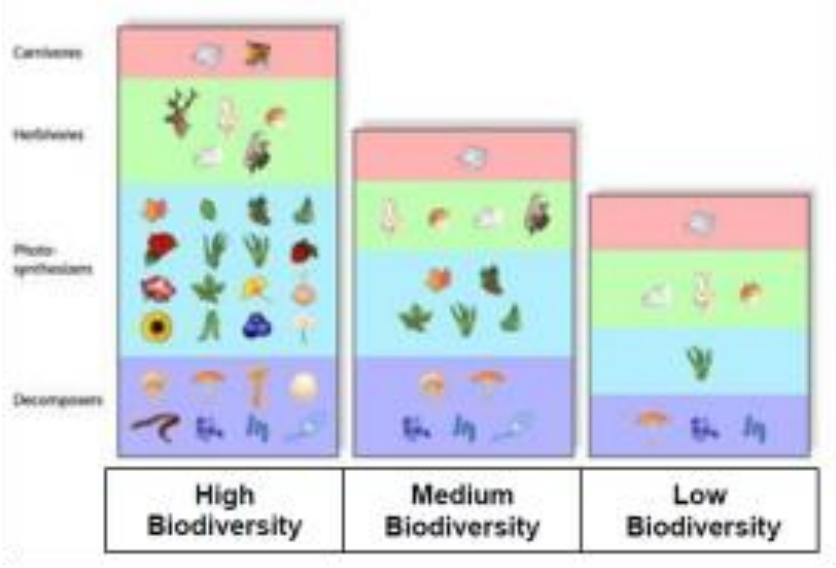
Biodiversity is defined as

‘***the variety or number of***

different species in an area’.

Or ***‘the numbers of types of***

species in a given habitat’



In general, the greater the biodiversity, the greater the stability of the environment.

Biodiversity is important as it provides food, potential foods, industrial materials, new medicines and for human well-being.

Biodiversity leads to stable ecosystems Ecosystems help to regulate the atmosphere, water supply, nutrient cycles, and provide fertile soil.

Habitat destruction (often by human) and loss of species can be caused by increased land use for *building, quarrying, dumping of waste and agriculture (for food production)*. This leads to a **decrease** in biodiversity.

How do we maintain biodiversity and protect endangered species?

An **endangered species** is a population of an organism which is at risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predators

Convention on International Trade in Endangered Species (CITES) – this establishes world-wide controls over trade in endangered species and their products e.g. ivory, tiger skin, rhino horn

Sites of Special Scientific Interest (SSSi) – these are protected and remain free from human influence and are often set aside for scientific research

Captive breeding programmes – e.g in zoos and wildlife parks

National Parks e.g. Snowdonia – these aim to conserve the environment whilst allowing public access

Seed banks – these are collections of stored seeds e.g. at Kew Gardens that aim to ensure that people in the future will be able to grow the varieties of plants that exist on earth today

Local biodiversity action plans – some local people may form a group to conserve and protect a particular species in their area e.g. red squirrels, orchids, some newts and toads and other vulnerable organisms.

How can we find out the numbers of different species within an ecosystem?

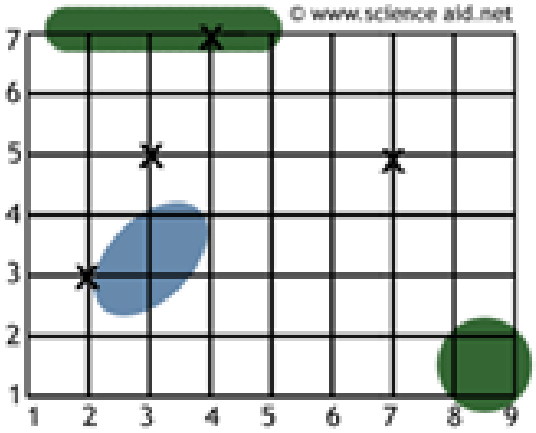
- Scientists usually investigate large areas of land or sea so they are not able to count or measure all of the living organisms in one area.
- To get around this problem, they have to ***sample*** the area – this means that they study a small area in great detail and then use a mathematical formula to calculate the numbers in the larger area. It is important when the scientists are sampling that –

1. The sample area is typical of the larger area
2. The method of sampling must not affect the results
3. The bigger the sample area the better

Quadrat sampling

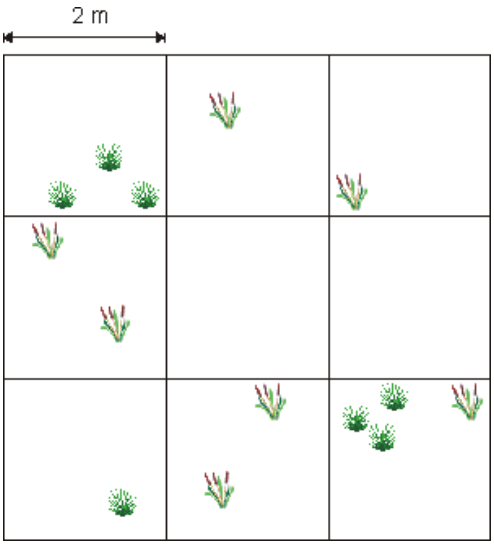
A quadrat is a square frame, usually with sides 0.5m^2 in length

A quadrat can be used to count –



- The number of species of a plant inside the quadrat e.g. daisies/dandelions
- The percentage cover of a plant e.g. grass
- Quadrats can be used to see if the numbers of organisms in an area change over time by sampling and calculating the number of organisms at the start and then sampling the same area after a set period (weekly, monthly, every year) and seeing if there are any changes that you can identify when you have recalculated.

How to use



1. Place the quadrat using random sampling – this is important so that the person placing the quadrat does not introduce any bias into the results. For instance, in the example shown here, point (2,3) has been chosen to be sampled.

2. Count the number percentage cover of living organisms in the quadrat

3. Repeat the count, calculate an average and multiply by the total size of the area sampled

Sample calculation - A quadrat is 1 m × 1 m, or 1 m^2. Its area might be small compared to the area of a field.

For example, there are 4 dandelion plants inside a 1 m^2 quadrat. The whole field is 50 m^2 in area , the estimated population size of dandelions in the field would be:

4 × 50 = 200 dandelion plants

When using a quadrat:

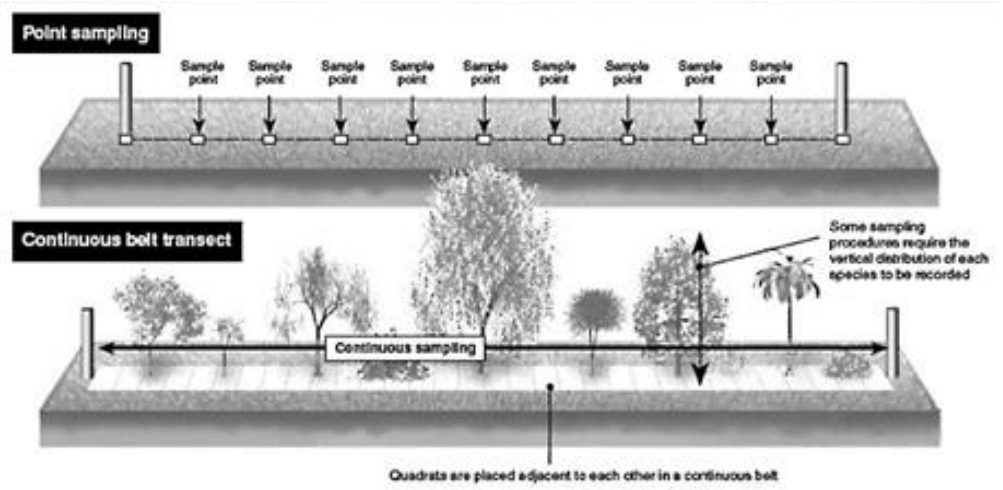
It should be placed randomly so that a representative sample is taken

The validity increases as the results from more quadrats are analysed

Samples cannot be absolutely accurate so scientists often use statistical tests or analysis to take account of sample size to test the validity of a conclusion.

What other sampling methods can be used?

- Scientist often want to know **how many** animals and plants are in a particular environment and also how the animals and plants are **distributed**.
- The numbers and frequency of organisms may change when the conditions change e.g. from one side of a wood to another or along a sloping meadow - for this a method called transect sampling is used



Transect Sampling

1. A tape measure is used and laid out along the line to be sampled
2. A quadrat may be used to sample at regular, **measured** intervals or each species may be recorded along the length of the line
3. The species present are recorded and the results analysed and the results can show the frequency and distribution of a species in a habitat.

How can we improve the accuracy of the sampling method?

- **The method of sampling must not affect the results (e.g. humans may cause some animals to move out of an area)**
- **The sample area must be typical of the whole area**
- **A larger sample area of preferable to a smaller one (very small areas might have some unusual features that are not representative of the whole area**

How can we measure the population of animals that move around within an area?

Animals are more difficult to count and study as they move around and do not always stay in the same area. You might **count the same animal twice** or **miss some completely**. To overcome these problems, Biologists use a technique called the **capture-recapture method** to estimate the population of an animal species.

How does this method work?

1. Some animals of a particular species are captured from an area
2. The animals are marked in some way (e.g. paint) so that they can be identified easily if recaptured in the future and distinguished from the rest of the population
3. The animals are released back into their natural habitat
4. After a time period has elapsed, another sample of the species is captured
5. The numbers of marked individuals in the second sample is counted
6. The proportion of marked individuals in the second sample is estimated to be the same as the proportion of those marked initially in the total population

The population of the species being investigated is estimated using the following equation

$$\frac{\text{number in 1st sample} \times \text{number in 2nd sample}}{\text{number in 2nd sample previously marked}}$$

Important points for this method to work effectively

1. The marking of the individuals in the species must be done carefully so that the marked individuals are not-

(i). more noticeable to predators which could affect the survival chances of the individual

(ii). More noticeable to the collector which could affect the chances of recapture by the person collecting

2. Enough time must have elapsed between the two samples for the marked individuals to mix with the rest of the population

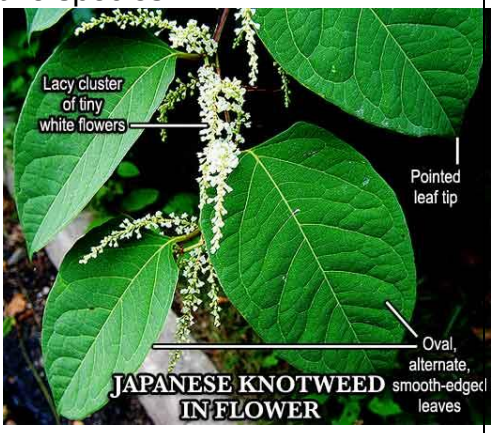
3. There is no there is no death, immigration or emigration

Alien species

ALIEN SPECIES = an animal or plant that has been introduced into a country that it does not originate from

The introduction of alien species to ecosystems where they have not previously existed is a growing threat to **BIODIVERSITY** –

- they may become **INVASIVE** as they may have no natural predators and its population may grow out of control
- may grow faster than the native species and the native species may not be able to compete.
- the alien species may prey on existing species, reducing their numbers
- the alien species may carry a disease that could affect the native species



e.g. ***Japanese Knotweed was introduced into Britain as an ornamental plant and is now a pest species in many parts of Britain***.

It is a large vigorous weed that has no natural enemies in Britain. Research is taking place to investigate how an insect (biological control) may be used to control the knotweed.

Biological Control

BIOLOGICAL CONTROL is a potential method of control for alien species that uses **an organism that is a predator of the pest to control its numbers**

The biological control organism is not present in the environment and is often a species from another country

There have been many disasters in biological control.

Biological control programmes that now take place must go through the following stages:

1. ***Biologists search the native country for suitable predators or parasites of the pest.***
2. ***Trials are carried out to ensure that the control organisms will only attack the pest, will not spread any new disease and can breed successfully. Escape before the completion of the trials must be prevented.***
3. ***Control organisms are bred in large numbers and are released where the pest is.***
4. ***Progress is closely monitored.***

Scientists must research the use of biological control agents on a world-wide basis, in order to understand how best to control alien species.

During the research, trials are needed to assess the effects of biological control agents particularly on non-targeted native species.

Advantages of biological control

1. Chemicals are not used – this means that they cannot enter the food chain (bioaccumulation).

2. The pest population is reduced to manageable levels rather than eliminating the entire pest – this leads to a more stable ecosystem.

3. The biological control organism should just reduce the numbers of the pest species and no other species (chemical control often affects other species as well)

Disadvantages of biological control

1. Often more complicated and more expensive

2. The species used for biological control may cause other problems and may become a pest itself – ***may affect non-target species***

3. Difficult to use outdoors – keeping the biological control agent in one area is difficult (often used in greenhouses for this reason).