

NATIONAL 5 BIOLOGY - LIFE ON EARTH SUMMARY

Biodiversity and the distribution of life

- *Identify what is meant by the terms biotic and abiotic, and name examples of each.*
- *Identify the impact that biotic and abiotic factors have on biodiversity.*
- *Identify the impact human influence has had on biodiversity.*
- *Explain what is meant by a biome.*
- *Identify factors which can influence a biome.*
- *Explain what is meant by the term ecosystem.*
- *Explain what is meant by the term niche.*

An **abiotic factor** is a physical non-living factor in an ecosystem which can affect the lives of organisms and their distribution. Light, moisture, pH, oxygen concentration and temperature are examples of abiotic factors.

Biotic factors are living factors that affect distribution, for example, grazing, disease, food supply and presence of predators.

Abiotic factors, biotic factors and human influences can all have a positive, negative or neutral impact on the range of species that can survive therefore having an influence over biodiversity.

A **biome** describes a region of the planet that has a similar climate, animals and plants living there. Examples include freshwater, marine, desert, forests, grassland and tundra. Biomes can be influenced by temperature and rainfall.

An **ecosystem** is a natural biological unit made up of living and non-living parts. Example of ecosystems include rainforests, deserts, arctic tundra and coral reefs. It is the term used to describe the habitat and all the living organisms (community) in that area.

A **niche** is the role of an organism within its community, it describes how it interacts with other living organisms and the resources that it makes use of. Availability of food can often lead to variation as individuals with different shaped beaks will be able to access different food from their competition. The role that an animal plays within its community i.e. what food it eats is known as its niche. Humans can interfere with animals and their habitats (place where an organism lives) through activities like deforestation and pollution. When populations (number of individuals of one species) die off this reduces biodiversity (reduces the range/number of organisms).

Energy in ecosystems

- Explain how energy can be lost from a food chain.
- Define what is meant by pyramid of biomass, pyramid of numbers and pyramid of energy.
- Compare a pyramid of biomass, pyramid of energy and a pyramid of numbers.
- Explain the significance of the nitrogen cycle in an ecosystem.
- Identify and explain the sequence of stages of the nitrogen cycle.
- Identify the role of microorganisms in the nitrogen cycle.
- Explain what is meant by competition.
- Identify what is meant by the terms interspecific and intraspecific completion.

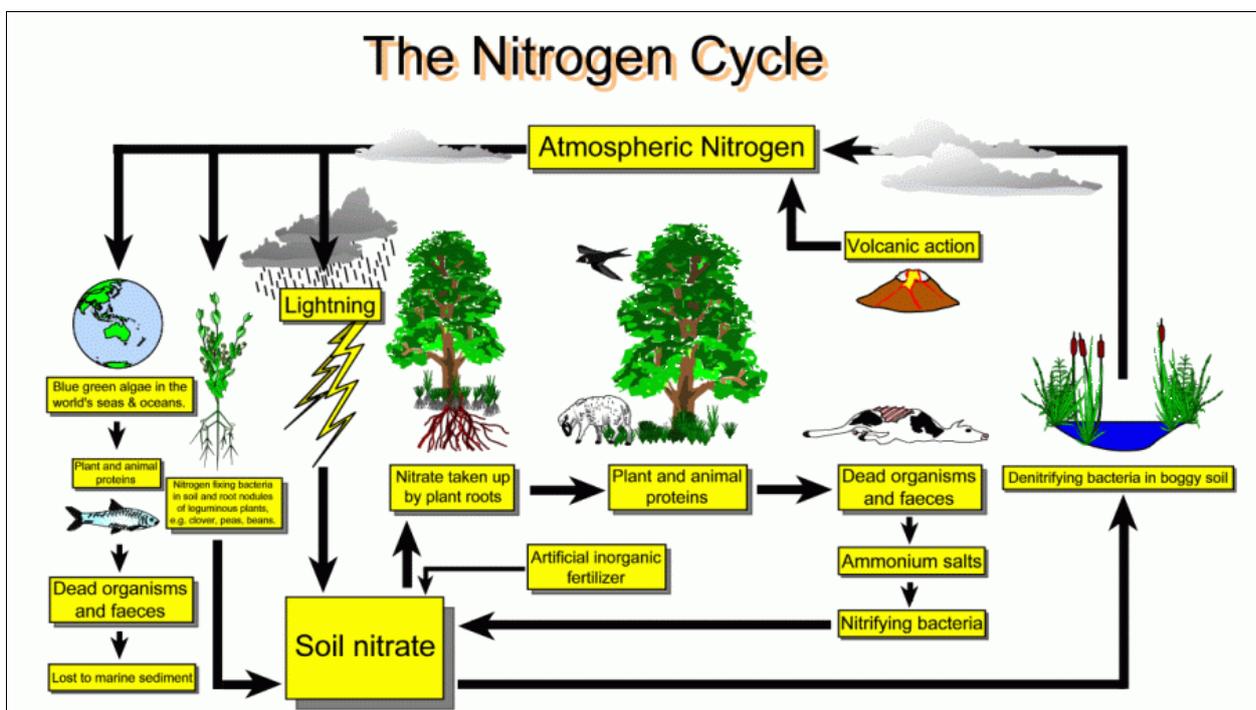
Energy can be lost from a food chain as heat, movement or undigested material. Around 90% of energy is lost at each stage in a food chain.

Pyramid of biomass - total dry mass of the organisms at each stage of a food chain.

Pyramid of numbers - population of each organism at each stage of a food chain.

Pyramid of energy is a graphical model of energy flow in a community. Each level of the pyramid shows how much useful energy enters each level of the food chain.

Nitrogen is essential in an ecosystem as without it organisms would be unable to make protein which is essential for growth and repair.



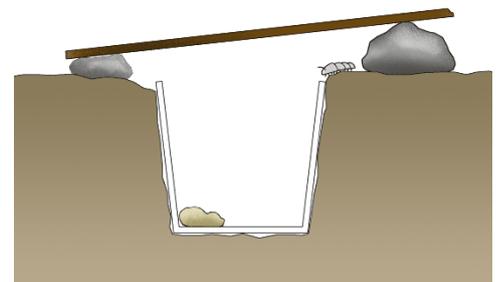
Competition happens when two populations both need the same resource for example food. If one population is removed then the other one will increase in number as it has more resources. All food chains start with a producer (green plant that can photosynthesise) and show the feeding relationships and therefore which animals are in competition with each other. Plants also compete for resources like water, space, light and nutrients.

Interspecific competition exists between members of different species who are competing for the same resources. Whilst **intraspecific** competition occurs between members of the same species who are competing for exactly the same resources.

Sampling techniques and measurement of abiotic and biotic factors

- *Identify a technique used to sample plants within a habitat.*
- *Identify a technique used to sample animals within a habitat.*
- *Explain the limitations and sources of error associated with a sampling technique.*
- *Identify ways in which abiotic factors can be measured.*
- *Explain how abiotic factors influence the distribution of an organism.*
- *Using a biological key, be able to identify an unknown organism.*

Plants and animals in an ecosystem can be studied using a range of sampling techniques. Plants can be sampled using quadrats and transects whilst animals can be sampled using pit-fall traps, tullgren funnels, pooters, tree beating, sweep netting and pond netting. When carrying out these investigations scientists are trying to obtain a **representative sample** and must carry out adequate replication. There are limitations and sources of error with sampling techniques and these must be taken into consideration.



Factor	Measured using	Precaution
Temperature	Thermometer	Time for probe to adjust
Light	Light meter	Shadows
Moisture	Moisture meter	Dry probe between samples
pH	pH meter	Dry probe between samples

Biological keys

Biological keys are used to identify unknown organisms based on their characteristics. Questions are asked to which the answers are yes or no, that lead through some stages until you have identified the organism.

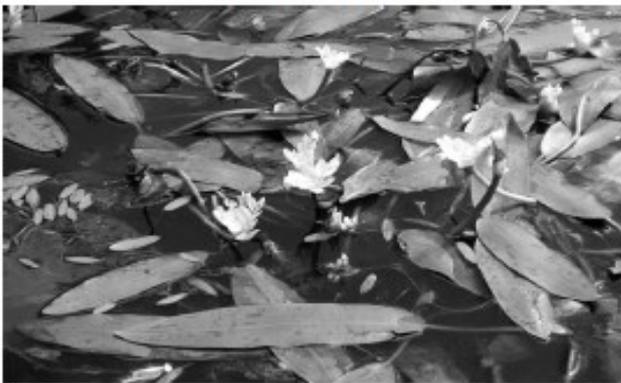
Shown below is an example of a paired statement key

The key gives information about some water plants growing in a pond.

- 1 Plant is fully submerged in waterGo to 2
Plant has leaves on or above surface.....Go to 3
- 2 Grows in deep water*Elodea*
Grows in shallow water.....*Starwort*
- 3 Plant has roots in soil.....Go to 4
Plant is free floating on water surface.....*Water hyacinth*
- 4 Long and thin leaves*Water hawthorn*
Round leavesGo to 5
- 5 Resistant to frost*Water lily*
Cannot survive frost*Lotus*

The key can be used to identify the plant below:

Photograph



Description

The plant has its roots in the soil at the bottom of the pond and does not tolerate frost very well.

How to work through the key

Question 1: this plant has leaves on or above the water, go to question 3

Question 3: this plant has roots in the soil, go to question 4

Question 4: this plant has long and thin leaves it must be a *water hawthorn*

In your question the first decision you have to make is which question asks about those which have no legs - what are the characteristics of those with no legs? A snail has a shell whilst an earthworm does not. The next decision is which animal has less than 12 legs and no spots on the body.

To find the features of an organism identified in a key you just have to work backwards from the named animal. For example a *water lily* is resistant to frost, has round leaves, has roots in the soil and leaves on or above the surface.

Adaptation, natural selection and the evolution of species

- *Explain what is meant by a mutation.*
- *Identify the impact a mutation can have.*
- *Identify the nature of a mutation and factors which influence their occurrence.*
- *Explain what is meant by variation when applied to a population.*
- *Describe the effect variation has on the evolution of a population over time.*
- *Explain what is meant by the terms Natural Selection and Survival of the Fittest.*
- *Describe what is meant by the term speciation.*

A **mutation** is a permanent change in the DNA sequence of a gene. They occur at random and are spontaneous and the only source of new alleles. They can be an advantage to some species as they can increase **variation**. In other cases mutations can be negative or neutral. **Mutagenic agents** increase the rate at which a mutation takes place. They include radiation, chemicals and UV light.

Variation is the term used to describe the differences between individuals in a population, this allows them to evolve over time in response to changing environmental conditions. A range of inherited characteristics will mean that certain individuals will be better suited to the change in environment than others. This inherited characteristic is described as an adaptation.

Natural selection is a process where those organisms who are better adapted to the environment survive, breed and pass on their characteristics. In non-polluted areas light coloured peppered moths blend in, survive, breed passing on these favourable genes and become the dominant form. Where as in polluted areas this happens to the dark coloured moths. They are said to enjoy a selective advantage.

Speciation is the name given to the formation of a new species. This process starts when a population becomes divided into two sub-populations by a barrier which prevents them from breeding and therefore exchanging genes. Each sub-population experiences different mutations which gives rise to different variation from the other group. This changes the gene pool in that group. Each sub-population may be in a different environment and the variations that they show because of the mutations may give them a selective advantage, the ones with the characteristics which are best suited to that environment survive, reproduce and pass them on. This also changes the gene pool. If the barrier was removed and the two sub-populations could no longer breed and produce fertile offspring this would confirm that they had become two different species.

Human impact on the environment

- *Describe how the increasing human population has changed the demands for food yields and farming methods.*
- *Explain the impact fertilisers can have on a freshwater supply.*
- *Explain what is meant by an algal bloom, and how an algal bloom can affect the oxygen levels in a freshwater supply.*
- *Identify the role of pesticides in farming methods.*
- *Explain the negative impact pesticide use can have on food chains*
- *Identify what is meant by an indicator species.*
- *Explain the significance of the presence of an indicator species.*
- *Investigate the role of biological control and explain how it can reduce the effects of intensive farming on the environment.*
- *Investigate the role of GM crops and explain how it can reduce the effects of intensive farming on the environment.*

The increase in the human population has led to an increase in demand for food and therefore its production through farming. This has led to the development of farming methods to increase the food yield. One method farmers have employed is the use of fertilisers, these are chemicals rich in nutrients (such as nitrates and phosphates) which they add to the soil. However excess fertilisers can run off the land into fresh water in a process called leaching. Food production can also be increased by using pesticides, herbicides and non chemical means such as GM crops and biological control.

An **algal bloom** is a rapid increase or accumulation in the population of algae (typically microscopic) in an water system.

The algal bloom can be caused by excess nutrients (such as nitrates and phosphates) being added to a water supply. The excess nutrients can be added through fertilisers and untreated sewage being added to the water.

Some algae may harm other species. Some algae reproduce rapidly and form blooms on the surface of the water. These algae may produce toxins which can kill fish in the water.

Algae also has a very short life cycle, so they die quickly and in areas where they have increased significantly in numbers, there will be high levels of decay and decomposition by micro-organisms. The process of **decay** uses up dissolved oxygen from the water, decreasing the oxygen availability for other water species.

Pesticides are chemicals sprayed onto crops to kill pest that are endangering the farmers crop. However these chemicals cannot be broken down to harmless substances by the organisms who consume them and they then accumulate in the tissues of those who consume it directly or indirectly. The levels of the pesticide accumulate as they are passed along food chains, the toxicity increases and can reach fatal levels. DDT is an example of a chemical that show bioaccumulation.

Indicator species are those that by their presence or absence indicate the level of pollution in the surrounding environment. Organisms can tolerate a range of environmental conditions such oxygen concentration outwith this range they are unable to survive. Their presence signifies the environmental quality.

Biological control is when one organism is used to control the numbers of another. A natural predator is introduced to control the numbers of prey. For example the ladybird eats aphids (greenfly) so one way of treating a plant covered in aphids is to put ladybirds on it. Sometime viruses can be introduced the disease myxomatosis was introduced to control rabbit numbers. Caterpillar moths can be used to kill cacti.

Genetically modified crops are genetically modified to be resistant to pests and diseases then chemicals like pesticides and insecticides and biological control would not need to be used. The pests and diseases would be unable to harm the crops.

Problem solving

Graphs

Label axes (remember units) and provide a suitable scale. Scales must be evenly spaced out e.g. 75, 80, 85 etc and use up as much of the graph paper as possible. Plots points carefully and join with a ruler.

Variables

Only one variable is changed in an investigation this is the factor that you are investigating, all of the others remain the same to allow a valid conclusion to be made.

Investigating organisms

When capturing living organisms like moths it is not always possible to catch exactly the same number of each kind. When the numbers of things are different and we want to compare them we convert them to a percentage as this allows us to compare them fairly. For example if two people lost £5 each, it seems like they have lost the same amount of their money. However if one person had £100 to start with and the other £10 then using percentages we get a different picture. One person has lost 5% whilst the other has lost 50%.

Control - a control should show that nitrates is the factor affecting the results. Each experiment should be the same with the exception of the variable being investigated.

Conclusion

This is what you find out from carrying out your investigation, look at the graph, what pattern does the line show and can you form a sentence to describe it using the labels on the graph?

Ratio

This is used to compare numbers, write down the two numbers that you are have been asked about, for example 5:40, then simplify them, this just means you divide both of them by the same number until you can't make them any smaller. So 5:40 - divide both sides by 5 and the answer is 1:8.

Percentage

Divide the factor that you are interested in by the total and times the answer by 100. For example:

$$\frac{20}{40} \times 100 \qquad \frac{\text{factor}}{\text{total}} \times 100$$

Describing a relationship

When one factor changes in the table, look to see what happens to the other factors in the table. Use the terms, **INCREASES**, **DECREASES** or **STAYS THE SAME**.

You need to identify patterns in a graph - as you see one line on the graph changing, you need to describe what effect it has on the other lines. Try and quote values from the graph where you can.

Reading a graph

Select the appropriate values from the question and find it on the graph. Read the corresponding value from the graph that has been asked for in the question. **Clue** - have a look at the units at the end of the answer line, that will give you a clue as to what value to read from the graph.

Pie chart

Use a ruler and draw dividing lines exactly from the centre of the pie chart to the segment line. Remember to label each section of the pie chart.

Controlling variables

Imagine carrying out the experiment and try and think about the physical aspects of the experiment, which if you were to vary them would have an impact on the results. These would be variables you have to control.

Repeating experiments increases the **reliability** of **results**.

Reading a passage - read all of the information carefully, underline the key words in the questions and look for those in the passage. Read the information surrounding these words. Read the question and your answer together to check it makes sense and that you have answered everything. All of the answers are in the passage!