Biology: Ecology – Pre-IB

Assignment 1 – Due 26 June 2021

Adaptations and interdependence

Read the following and complete the activities associated with it.

To survive and reproduce, organisms require access to resources from their surroundings and other organisms. A community is made up of all the populations of living organisms in the same habitat. These populations are interdependent – each species depends on other species for things including food, shelter, pollination, and seed dispersal. For example, some animals eat plants for energy and nutrients, and use them to make nests for shelter or breeding. In turn, some plants rely on animals for pollination and to spread their seeds. Without the plants, the animals would have no food source. Without the animals, the plants would not be able to reproduce successfully. The different organisms rely on each other. This is called interdependence. If just one organism is removed from a community it can affect the whole community.

A stable community is one where all of the species and environmental factors are in balance, so that the sizes of the populations remain fairly constant over time. For the long term survival of populations, it is important that communities remain stable. Good examples of stable communities are tropical rainforests and ancient oak woodlands.

An ecosystem is the interaction of a community of living organisms with the physical environment in a particular habitat. Communities are affected by both biotic and abiotic factors of an ecosystem. Biotic factors are living components of an ecosystem that affect communities. Examples of biotic factors are availability of food, new predators, new pathogens, and competition between species. Abiotic factors are the non-living components of an ecosystem. Examples of abiotic factors are light intensity, temperature, moisture levels, soil pH and mineral content, wind intensity and direction, oxygen availability, and carbon dioxide availability for photosynthesising plants. Any change in a biotic or abiotic factor will have an effect on how the populations in a community interact and compete with each other. For example, if the light intensity of an ecosystem decreases, plants will carry out less photosynthesis, and so the rate of plant growth will decrease. This would mean there would be less plant matter available for some animals to eat.

Within an ecosystem there are limited resources available. As such, all organisms compete with each other for access to resources. Individuals that are best adapted to the ecosystem will out-compete individuals that are not so well adapted, and will therefore be more likely to survive and reproduce. **Inter**specific competition occurs between individuals of **different** species. **Intra**specific competition occurs between individuals of the **same** species. Many organisms are successful because they avoid competition with other species as much as possible by using different resources with the habitat.

Animals compete for many things, such as food. Herbivores feed on plants. A herbivore that feeds on a variety of plant species is more likely to survive than one that only feeds on one type of plant. Carnivores feed on other animals. Carnivores that eat the same prey compete with each other. Those with adaptations that make them better hunters makes will be more

successful competitors. These individuals are more likely to survive and reproduce, and pass on their adaptive characteristics to their offspring. In turn, prey are adapted to escape or evade predators, to avoid being eaten.

Animals also compete for space, for example, a place to build a nest or where food is obtained. As animals reproduce in their territory, their population size will increase. Many animals cannot reproduce if they don't have a good enough territory to attract a mate, or if their territory isn't large enough to provide enough food for offspring. This means animals compete for the best spaces. Animals of the same species also compete for mates. Often this involves males competing with each other for access to females, by fighting with each other for dominance, or performing elaborate courtship displays to attract a female.

Plants also compete with each other for resources. They compete for:

- light in order to produce food through photosynthesis
- water, which is needed for photosynthesis and to prevent wilting
- mineral ions, which are used in chemical reactions
- and space for growth.

Many plants are adapted to compete for sunlight by growing taller than the other nearby plants. Others have defence mechanisms that help protect them against herbivores. Some plants have adaptations to avoid competition with each other. For example, different species of plants within an ecosystem may grow or flower at different times during the year. This helps reduce interspecific competition. Seed dispersal is designed to spread the seeds away from the parent plant so that is does not compete with its own offspring, for space or water, as the seedling grows. This reduces intraspecific competition.

Some adaptations may be structural, for example, the leaf of a plant has a waxy cuticle to prevent water loss. Some may be behavioural, for example, birds migrating to a warmer environment over winter. Others are functional, for example, some plants and animals, that live in very cold climates, have special antifreeze proteins in their cells to stop them freezing and dying.

Some organisms have adaptations that allow them to live in extreme environments, and are known as extremophiles. These organisms may live in environments with high temperatures, high pressures, or high salt concentrations. A good example is a type of bacteria which live in deep ocean vents. These bacteria can live in temperatures of over 100 °C, high pressure, no light, and an acid pH of about 2.8.

We can study communities and ecosystems to investigate the distribution and abundance of the organisms, or to look at the effect of changes in the environment on organisms. Distribution describes where a type of organism is found within a habitat, whereas abundance is a measure of how many of a type of organism is in a habitat. We can determine the distribution and abundance of an organism, within an ecosystem, by using quadrats and transects to sample an area.

A quadrat is used to count the numbers of organisms found in a sample area of ground. During an investigation, it is important to use the same size quadrat for each sample, to ensure validity. The quadrat should be placed on the ground at random to reduce bias. It is

also important to lay down the quadrat enough times to get a representative sample of the whole population, and to reflect its true distribution. This is the sample size. Using results obtained from a quadrat we can calculate the mean number of organisms per metre squared. This is called quantitative sampling. This method enables us to compare results from different habitats, or in the same habitat, but at different times, to see if an ecosystem has changed.

A line transect is useful for measuring the distribution of organisms in a habitat that is not uniform and varies a lot. Transects are not random. A tape measure is laid out through the habitat between two points. Sampling occurs at regular intervals along the tape, using a quadrat to take measurements. Abiotic factors, like light levels and soil pH, can also be measured along the transect to investigate how they might vary within the habitat. Any changes in physical environmental factors might help explain the distribution and abundance of organisms along the transect.

Questions

1. A type of extremophile bacteria are found in hot springs, where the water temperature can reach 80°C.
   Explain why the bacteria need to have specially adapted enzymes.
2. Explain why in an ecological study that it's important to use the same size quadrat for all the sampling done.
3. Name the type of competition that occurs between grey and red squirrels.
4. Explain how the introduction of the grey squirrel affected the population of red squirrels.

Watch the clip on Sampling

https://www.bbc.co.uk/bitesize/guides/zqh2v9q/video

Plan an investigation to sample the population density of daisies in a shady garden and bright sunny garden. You can make the assumption that both gardens have the same size grassy area which contains daisies.

Suggest a hypothesis for the investigation.

State the independent and dependent variables.

How will you control the investigation to make the results comparable between areas?

Write a simple method.

Organising Ecosystems

Listen to the podcast and make notes to help you complete the questions that follow. To do this effectively, it is suggested you listen once without making notes, then play again pausing to make notes. You may also find it helpful to research Predator-prey relationships.

Predator-Prey relationships

Scientists study how different organisms depend on each other within a community. This is known as interdependence. The interactions between organisms are known as ecological relationships.

One type of relationship between organisms is called predation – this is the name given to the relationship between a predator and a prey species. The size of the predator population directly affects the size of the prey population.

Scientists can plot the population of the predator and prey on a graph to see how they change over time.

How to interpret a predator–prey graph

1 Identify the data line that represents the prey.

2 Describe the first trend shown by this data set.

3 Identify the data line that represents the predator.

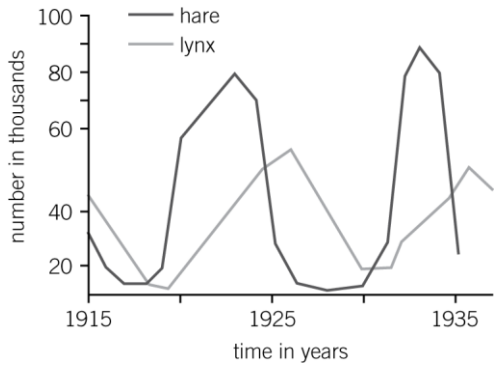
4 Describe the trend shown by this data set.

5 Explain why these changes occur.

6 Repeat these steps for the next section of the graph.

Worked example

The following graph shows how the population of hares (prey) and lynx (predator) affect one another.



Identify the data line representing the prey: The hare is the prey and is shown by the darker line.

Describe the first trend shown by this data set: The population of hares dramatically increased between 1919 and 1923.

Tip – If possible use measurements on your graph to support your statements.

Identify the data line representing the predator: The lynx is the predator and is shown by the lighter line.

Describe the trend shown by this data set: The population of lynx increased between 1925 and 1926.

Explain why this occurs: If the population of hares increases, there is a larger food supply for the lynx. This means that more lynx survive and reproduce, increasing the lynx population.

Repeat for the next section of the graph: After 1923 the population of hares decreased dramatically until 1926. The population of lynx decreased between 1926 and 1930. As the population of lynx grew, an increasing number of the hare population were eaten, leading to a decrease in their numbers. Eventually there is not enough of the prey population available to support the population of predators, so the lynx population also decreases.

In 1930, the hare population increased again followed by an increase in the lynx population in 1931. This is because the lynx population was low in 1930, allowing more hares to survive and reproduce, and therefore increasing the prey population. The cycle starts again.

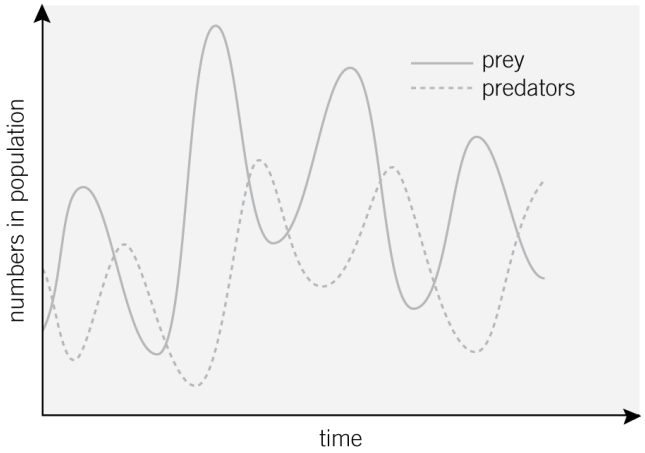
Questions

1 State what is meant by a:

a predator species

b prey species

2 Complete the paragraph below to explain the general trends shown in a predator–prey graph:



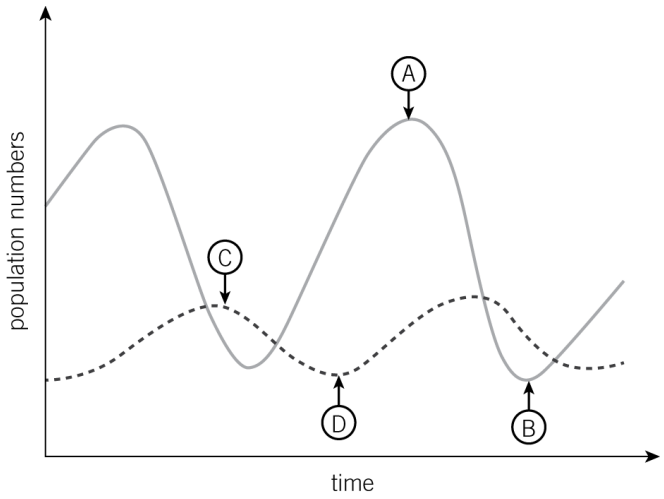
An increase in the prey population provides more food for the ....., allowing more to survive and ..... This is turn results in an ..... in the predator population.

The larger predator population eats more prey organisms, causing a ..... in the prey population. The death rate of the prey is larger than its ..... rate.

The reduced prey population can no longer support the large predator population. ..... for food increases, resulting in a ..... in the size of the predator population.

Reduced predator numbers results in less of the prey population being killed. More prey ..... and reproduce so the prey population ..... again.

3 Look at the graph below:



a Identify which line represents the predator and which line represents the prey.

b Match each statement below to the section of the graph it represents.

i The prey population is at its maximum size.

ii The predator population is at its minimum size.

c Explain what is happening after point B on the graph.

Cycles

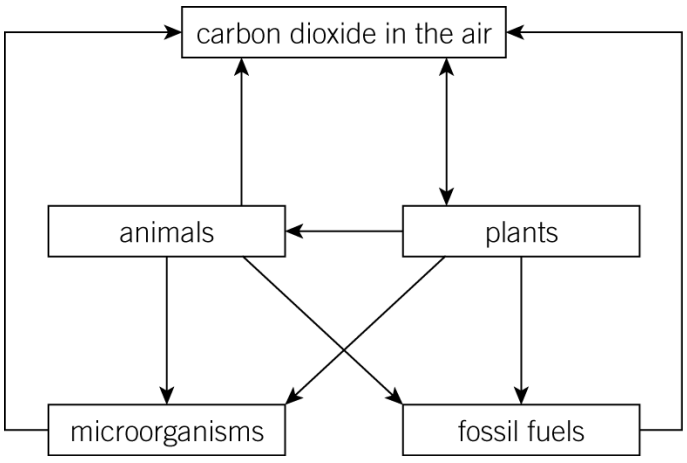
Watch the two clips on Cycles and with the knowledge you have gained from the podcast and your independent research answer the following question.

https://www.youtube.com/watch?v=n_svwXrzMMs

https://www.youtube.com/watch?v=UrP1E-yM7Cs

1. **The diagram** shows part of the carbon cycle.

Figure 2



Use the information in the diagram and your own knowledge to describe in detail how carbon is cycled between living organisms and the air.

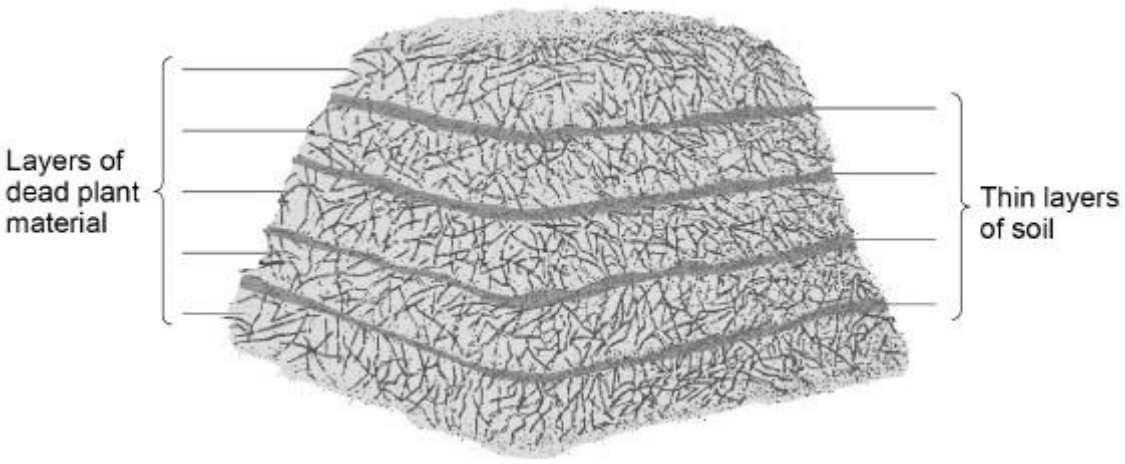
Your answer should include the names of any processes involved. (6 marks)

2. Gardeners sometimes make compost heaps from dead plant material.

The dead plants decay in the compost heap.

Figure 1 shows a compost heap.

Figure 1



(a) The thin layers of soil contain organisms that cause decay.

Which **two** types of organism cause decay?

- Bacteria ☐
- Fungi ☐
- Grass ☐
- Insects ☐
- Worms ☐

The rate of decay in the compost heap depends on several environmental factors.

(b) Explain how the rate of decay would be affected by:

- an increase in oxygen concentration
- a temperature increase from 5 °C to 25 °C

(3 marks)

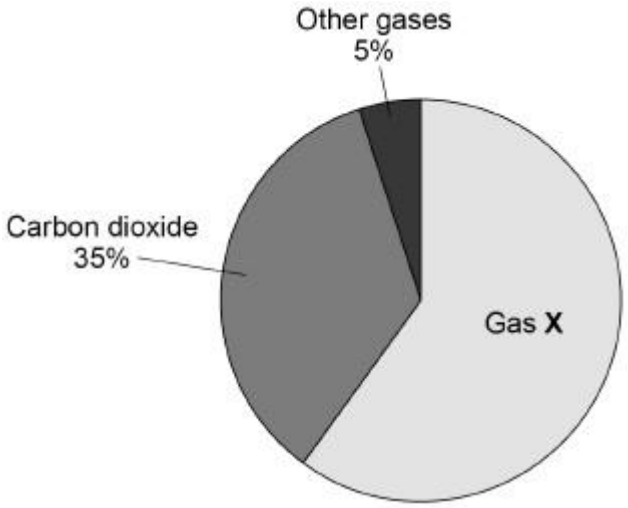
(c) Give **one** environmental factor needed for decay.

Do **not** refer to oxygen or temperature in your answer. **(1 mark)**

Dead plant material can also be decayed in a biogas generator.

Figure 2 shows the percentages of the gases found in a sample of biogas.

Figure 2



(d) Gas **X** is the main fuel gas found in the biogas. What is gas **X**?

Carbon monoxide ☐

Hydrogen ☐

Methane ☐

Nitrogen ☐

(1 mark)

(e) What is the percentage of gas **X** in the biogas?

Percentage = _____%

(1 mark)

(f) The dead plant material in the compost heap and biogas generator does **not** decay completely.

Explain why a farmer might spread the remaining dead plant material onto his fields.

(2 marks)