Interdependence of Organisms

Name	______________________________
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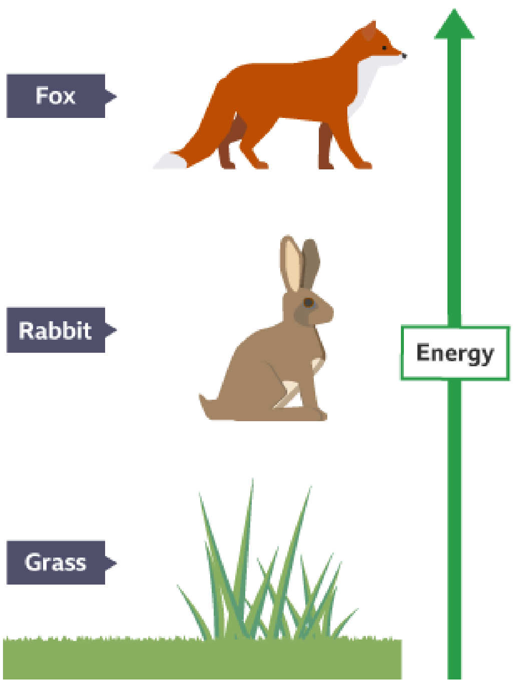
Teacher	______________________________

L1 Food chains and webs

- All organisms in an ecosystem depend on each other.
- Food chains show the flow of energy from one organism to another.
- Food chains show the feeding relationships between organisms.
- Food webs show how all the food chains in an ecosystem interact.

Ecology is the study of living organisms and the places that they live. An ecologist studies the number and distribution of living organisms in an *ecosystem*. Knowing this is essential to allowing us to protect the organisms that need help to survive.

A food chain is a list of organisms in a *habitat* that shows their feeding relationship, i.e what eats what. The organisms are joined by arrows which show the transfer of energy in food between them. The stages in food chains are called trophic levels.



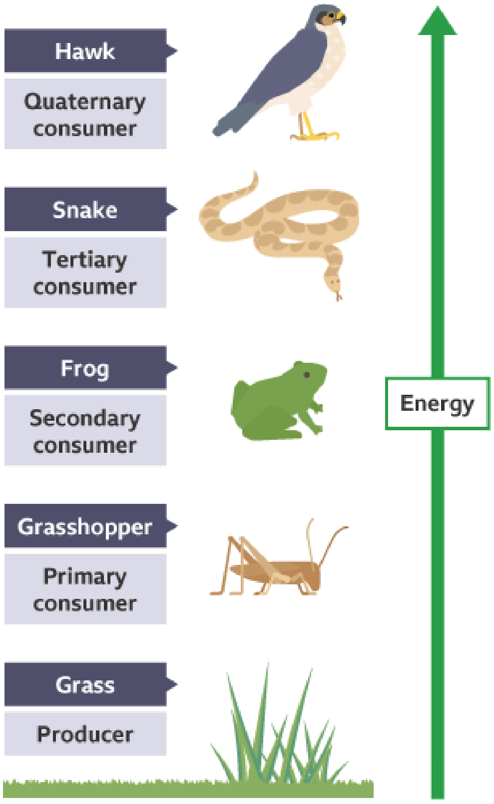
Food chains always start with a producer. This is usually a green plant or algae that completes *photosynthesis* to store energy from sunlight as glucose. Grass is the producer in the grass → rabbit → fox food chain. Photosynthesis provides the energy for most life on Earth.

A primary consumer eats a producer. The rabbit is the primary consumer in the example food chain. This is in turn eaten by a secondary consumer, which is the fox.

After this might be a tertiary consumer (which eats a secondary consumer) and possibly a quaternary consumer (which eats a tertiary consumer), but not in this example.

Animals that are hunted and eaten are prey, and these are consumed by predators. The final consumer at the top of the food chain is called a top (or apex) predator and is not eaten by anything else.

What is the final consumer in this food chain?



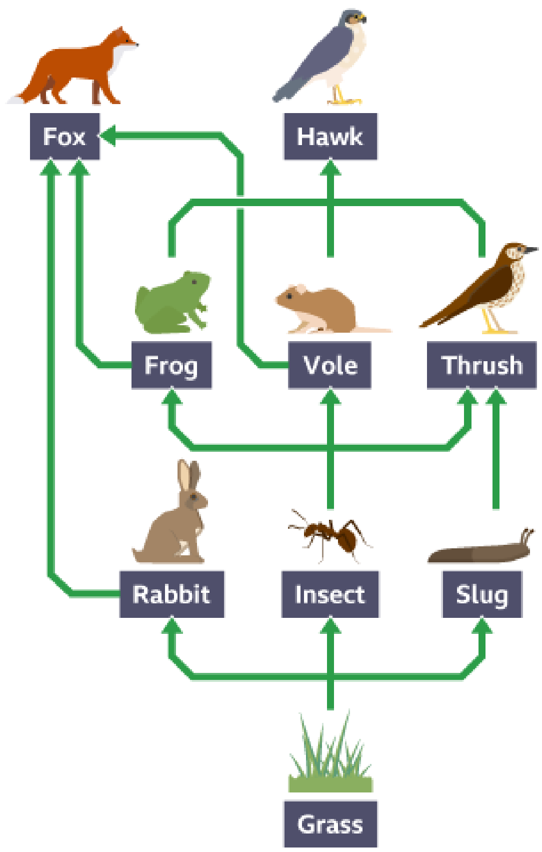
There are volcanic vents at the bottom of the oceans where it is so dark that no plant or algae could live. Places like this are the only food chains on Earth that don't start with photosynthesis.

The producers are bacteria which feed directly on the chemicals released from the vents and use a variety of chemical reactions to make glucose. This process is called chemosynthesis.

Most *populations* of organisms that live in a habitat usually have more than one food source. They usually consume more than one organism from the trophic level below. This means that there are almost always more than one food chain and these are interlinked into a food web.

This food web is made up of lots of food chains, including:

- grass → insect → vole → hawk
- grass → insect → frog → fox
- grass → insect → vole → fox

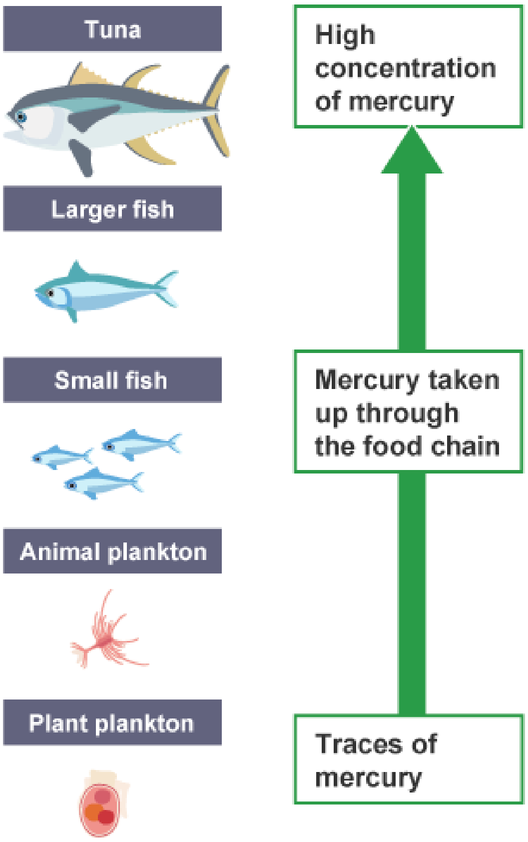


Some organisms, like the rabbit and slug, have just one consumer. Others, like the frog and vole, have two.

Toxic materials are poisonous. Some quickly break down into harmless substances in the *environment*. Others are persistent (they stay in the environment and do not break down). These substances *accumulate* in the food chain and damage the organisms in it, particularly in the predators at the end of the chain. This is because accumulating compounds cannot be excreted.

In the past, mercury compounds were used to make insecticides (substances that kill the insects that damage crops), and special paints that stop barnacles growing on the hulls of ships.

Unfortunately, when mercury gets into a food chain, it damages the *nervous systems* and *reproductive systems* of mammals, including humans. The diagram shows how mercury can accumulate in the food chain.



In the sea, tiny animals and plants called plankton absorb the mercury compounds. When the plankton are eaten by small fish, the mercury they contain stays in the fish. As the fish need to eat a lot of plankton, the concentration of mercury in them becomes higher than its concentration in the plankton.

Larger fish eat the small fish, and larger ones still (such as tuna fish) eat them. This creates a high concentration of mercury in the tuna. People eating contaminated tuna may get mercury poisoning. Mercury is now banned from many chemical products and mercury use in industry is carefully regulated.

<u>Independent Practice</u>

1. What do food chains show?
2. What do food webs show?
3. What is ecology the of?
4. Why is ecology useful to us?
5. What does the direction of the arrows in a food chain/web tell us?
6. What are trophic levels?
7. What do food chains always start with?
8. Where do plants get their energy from?
9. What is the final consumer at the top of the food chain called?
10. Extended writing; compare the producers on land with those in volcanic vents
11. Extended writing; explain the bioaccumulation of Mercury.

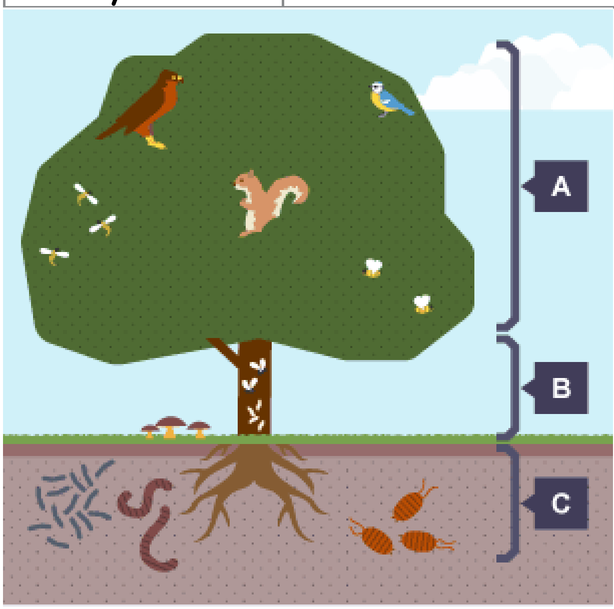
L2 Communities

Key terms:

An *ecosystem* is the interaction between a *community* of living organisms and their environment.
A community is two or more *populations* of organisms.
An ecosystem is two or more populations of organisms (usually many more) in their environment.
A population is all the organisms of the same or closely-related *species* in an area.

<u>Levels of organisation within an ecosystem</u>
Organisms within an ecosystem are organised into levels.

Producer	Producers are plants and algae, which photosynthesise.
Primary consumer	Primary consumers are herbivores, which eat producers.
Secondary consumer	Secondary consumers are carnivores, which eat primary consumers.
Tertiary consumer	Tertiary consumers are also carnivores. They eat secondary consumers.



A	Branches and leaves	Bees, wasps, moths, squirrels, bluetits and hawks
B	Trunk	Insects and larvae
C	Root and Litter zone	Bacteria, earthworms, wood lice and fungi

Interdependence
All organisms in an ecosystem depend upon each other. If the population of one organism rises or falls, then this can affect the rest of the ecosystem.
A simple food chain is:
grass → rabbit → fox
If the foxes in the *food chain* above were killed, the population of rabbits would increase because they are no longer prey to the foxes. As a result the amount of grass would decrease because the increased population of rabbits would be eating it.

Often very small changes to ecosystems have large consequences, which can be difficult to predict. This means that all the organisms in an ecosystem are dependent upon each other. We call this *interdependence*.

Competition

All *photosynthesising* plants and algae in an ecosystem compete for light, space, water and minerals from the soil. Animals in an ecosystem compete for food, mates and their territory. Organisms which have more of these resources tend to grow more healthily and are more likely to have offspring. Competition can be interspecific or *intraspecific* depending on whether organisms from different species or the same species are competing for resources.

Stable communities

A stable community is one in which the size of the populations of all species remain relatively constant over time. In the example above the amount of grass, and the numbers of rabbits and foxes all remain relatively constant. The different populations are living in a healthy balance with their environment.

Independent Practice

1. What is an ecosystem?
2. What is a community?
3. What is a population?
4. Create a simple food chain including one example for each level of organisation
5. Define interdependence
6. What would happen to the populations of the organisms in this food chain if the Foxes died out? *grass* → rabbit → fox
7. What do all plants compete for?
8. What do all animals compete for?
9. What is a stable community?
10. What could happen if a stable community is not maintained?
11. Extended writing: explain what rabbits do to maintain a stable community

L3 Abiotic factors

The abundance is the number of organisms in an *ecosystem* and their distribution is affected by *abiotic* factors. These are factors that are non-living.

They include:

Light intensity

Some plants have evolved for *optimum* growth in bright sunlight. An example of this is a cactus houseplant. Cacti originally come from deserts where they grow in bright sunlight. Other plants have evolved to grow in shade.

Many orchids, which are also kept as houseplants, grow on trees in the rainforest and have evolved for optimum growth in darker conditions. If you were to put an orchid on a bright windowsill and a cactus in a dark corner of your room neither plant would grow well.

Temperature

Both animals and plants have evolved to grow healthily at their optimum temperatures. If you planted either your cactus or orchid houseplants outside in cold temperatures, they would die. Similarly, animals that have evolved to live at the North Pole, such as the polar bear, could not survive in warmer conditions.

Moisture levels

More people kill houseplants by overwatering than by under-watering them. Many plants cannot survive in waterlogged soils. Their roots are unable to *respire*, they rot and the plant dies. Other plants, such as pitcher plants, grow best in bogs where the moisture levels are high. Soil moisture meters can accurately determine how wet an area is.

Soil pH content

The pH of soils can have a huge effect on the plants that are able to grow in them. Some plants, like azaleas, grow best in acidic soils and will quickly die if planted in alkaline soils. Others, like clematis, prefer alkaline soils. Some, like the hydrangea, can grow in both. These plants are unusual in that their flower colour changes in different soils. Just like universal indicator paper, hydrangea flowers are blue in acidic soils and pink in alkaline soils.

The pH of water can also affect the aquatic organisms that are found there. Different species have evolved to survive at different pH levels found within water.

Soil mineral content

Many plants require high levels of soil minerals to grow well. An example of this is magnesium, which is required to produce chlorophyll. Plants with unnaturally yellow leaves may have a magnesium *deficiency*. Carnivorous plants, such as pitcher plants, have evolved to catch insects to supplement the low levels of minerals found in the soils in which they grow.

Wind intensity and direction

The strength of the wind and its direction has a huge impact on where organisms are found within ecosystems. Many organisms prefer more sheltered locations. Plant seeds are more likely to settle and germinate there, and animals which depend upon these are more likely to live close to where they grow. The strength of the wind can also affect the growth of individual organisms.

Carbon dioxide levels for plants

Carbon dioxide is a reactant in *photosynthesis* which means plants need it to survive. Areas with higher levels of carbon dioxide are more likely to have healthy plants growing. Farmers often release carbon dioxide within their greenhouses to maximise their *crop yield*. Woodlands often have higher carbon dioxide levels than open grassland, so many plants living in open areas have evolved mechanisms to overcome a shortage of carbon dioxide.

Oxygen levels for aquatic animals

Oxygen from the air and oxygen produced by aquatic plants dissolves in water. Without this, aquatic animals would suffocate and die. Healthy lakes and rivers have high levels of oxygen, and polluted waters often have low levels of oxygen. This pollution means that only certain *species* can survive there such as sludgeworms. These are bioindicator species because their presence or absence informs us about the condition of the habitat.

These are bioindicators of oxygen levels within water.

<u>Independent Practice</u>

1. What does the word abundance refer to?
2. What are Abiotic factors?
3. how does light intensity effect Cacti and Orchids differently?
4. Why would a polar bear struggle to survive in warmer conditions?
5. Where do Pitcher plants grow?
6. What device can be used to determine soil moisture?
7. What is interesting about the hydrangea plant?
8. What causes plants to have yellow leaves?
9. What is a bioindicator?
10. Extended writing; what kind of habitat would a squirrel choose to live in? justify your answer giving reasons for all factors.

L4 Biotic factors

Biotic factors affecting the abundance & distribution or organisms
The abundance and distribution of organisms are affected by *biotic* factors, which are factors that are living.
They include:
Availability of food
All animals require food to live. The availability of food is a major factor in how many animals live in an *ecosystem*. Areas like rainforests with rich food supplies have more *species* of life than other areas like deserts and the Polar Regions where there is less food.
New predators
The arrival of new *predators* in an ecosystem can have a devastating effect. In balanced ecosystems, predators and *prey* have evolved together. Predators can catch enough prey to survive, **but not so many that they kill all of their food**.
The arrival of a new predator can upset this balance. An example of this is the introduction of the red fox to Australia, which has caused concern over their effect on native birds and small mammals. Introducing new predators can cause a rapid decline in the numbers of prey, which then reduces the food supply for existing predators.
New pathogens
When organisms inhabit new ecosystems they often bring new *pathogens*. As an example, Europeans first colonised North America, and introduced new pathogens, like the influenza virus. Many Native Americans had not developed immunity to new diseases such as this, and so many were killed by them. There are many examples of new pathogens being introduced to the UK. Ash dieback is a disease caused by a fungus which has killed many ash trees since it was first found in the UK in 2012.
Pathogens have also been introduced on purpose. Myxomatosis is a disease that affects rabbits. It is caused by a virus and infected rabbits develop skin tumours and may go blind. In the 1950s it was purposefully released into the wild in the UK to reduce the *population* of rabbits. It did exactly this and some people estimate that more than 99 per cent of rabbits in the UK died. However, our rabbits developed immunity to it and the population has now returned to previous levels.
Out-competition
The introduction of a new species into an ecosystem can result in it out-competing another native species. Several hundred years ago grey squirrels were brought over from North America by wealthy people and let free in their grounds. Our smaller native red squirrel couldn't compete with the newer, larger grey squirrel. Because grey squirrels are larger they can store more fat and survive harsher winters. So the numbers of red squirrels and the places they live has reduced dramatically.
Other examples of out-competition of native species by newly introduced species include the Canada goose in Europe and the cane toad in Australia, Himalayan balsam in Cambodia and harlequin ladybirds are also current concerns.

Independent Practice

1. What are Biotic factors?
2. What kind of environment would be rich in food for animals?
3. In what way has the predator/prey relationship evolved?
4. How can a new predator upset this balance?
5. What is a pathogen?
6. How has Myxomatosis effected the rabbit population?
7. Explain how the red squirrel was out-competed by the grey squirrel.
8. Extended writing; describe the ideal living environment for a penguin. Take into consideration all of the Biotic and Abiotic factors involved.