B2a

Grouping organisms

Biologists organise living things based on similarities and differences. Organisms with many similarities are grouped together to make them easier to study. This is called **classification.**

All living things are put into one of five major groups, called **kingdoms**.

|  |  |  |
| --- | --- | --- |
| **Kingdom** | **Characteristic** | **Example organisms** |
| Plants | -Multicellular  -Cellulose cell wall  -Chloroplasts  -Make food from sunlight | Flowers, trees, moss, grass |
| Animals | -Multicellular  -no chloroplasts  -eat other organisms for food  -Most can move | Humans, insects, fish, birds |
| Fungi | -Chitin cell wall  -reproduce with spores  -Do not photosynthesise | Mushrooms, yeast |
| Protoctista | -Mostly single celled | Amoeba, algae, seaweed |
| Prokaryotes | -no nucleus  -single celled | Bacteria |

Organisms are classified based on physical characteristics (artificial classification) and similarities in DNA and evolutionary history (Natural classification). e.g. the animal kingdom can be divided up into **vertebrates** (animals with backbones) and **invertebrates** (animals without backbones). **Arthropods** are the largest group of animals (a **Phylum**) with nearly 75% of animals. The arthropod phyla includes arachnids, insects, crustacean (crabs) and millipedes and is characterised by animals having a segmented body.

Organisms which are very closely related are in the same species. A species is a group of similar organisms that can interbreed to produce fertile offspring. Members of a species are not identical, there is **variation**, or small differences. e.g. dogs all look different but are the same species. However species which look similar may be not very related at all, e.g. a dolphin and a shark. This is because they have evolved to fit the same habitat, so need similar physical features.

Some species can bred with each other, but their offspring is not fertile, it cannot have offspring of its own. This happens with a donkey and a horse to produce a mule. These mixed sterile offspring are called **hybrids.**

B2b

A **food chain is** a way of representing the flow of energy through a biological system. It shows what organisms eat other organisms; the arrows show the direction of the flow of energy. Each link in the food chain is a separate feeding level called a **Trophic level.**

e.g.

Grass Wildebeest Hyena Lion

|  |  |  |  |
| --- | --- | --- | --- |
| **Trophic level 1** | **Trophic level 2** | **Trophic level 3** | **Trophic level 4** |
| **Producer** | **Primary consumer** | **Secondary Consumer** | **Tertiary Consumer** |
| **Plant** | **herbivore** | **carnivore** | **Top carnivore** |

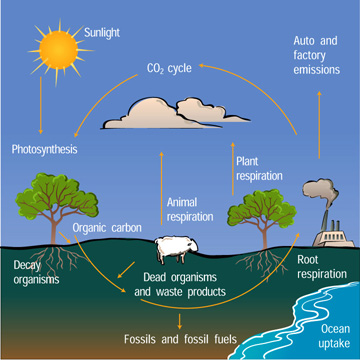
Food chains generally only show part of the true picture as they show each consumer only eating one food source. In reality each organism will have many sources of food, these can be shown with a **food web.**

Food chains and webs only show the feeding relationships between organisms. In order to get more useful information, we use **food pyramids.** A **pyramid of numbers** shows the number of each organism at each level in the food chain. Each organism is plotted as a separate block, with the size o each block related to the number of organisms. The producer is always at the bottom, with increasing trophic levels above. Pyramids of number are not always pyramid shapes, for example when there is a small number of large producers such as trees or large plants. A better representation can be given by a **pyramid of biomass,** these are always pyramid shaped and each block represents the total mass of the organisms in that trophic level.

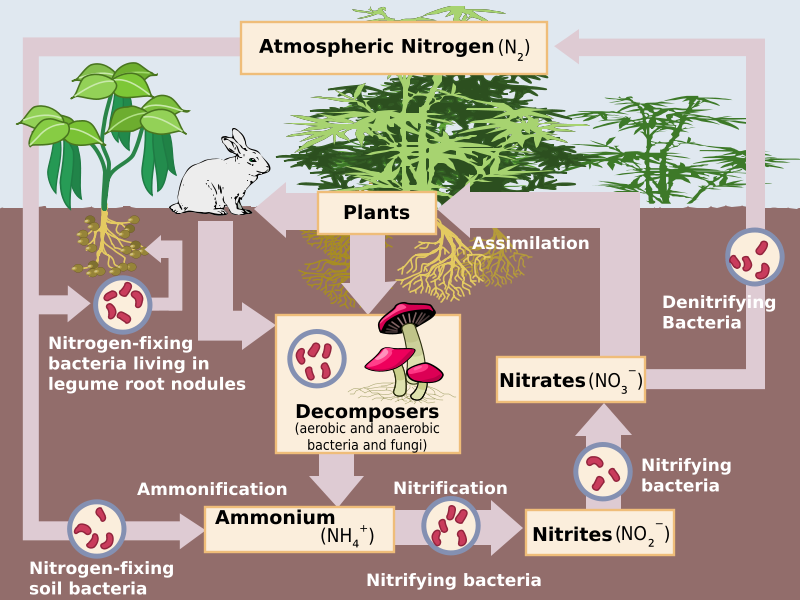
Energy flow

Energy enters a food chain when plants capture energy from the sun via photosynthesis, this means that all organisms rely on plants to start the chain. Energy flows through the food chain, but not all of the energy reaches the top of the chain. Energy is lost at each level via **respiration, excretion (sweat, urine and breathing) and egestion (droppings).** At leach level the consumer will not eat the whole organism, so some energy is left behind. Energy transfer in a food chain is very inefficient, often less than 0.1% of the initial sunlight energy captured by the plant will make it to the top predator.

B2c- Carbon and Nitrogen cycles



**(Decomposers)**



B2d- competition

All organisms compete for **resources** such as light, space, water, minerals, CO2, food, territory, mates, water, shelter.

A **population**  is the number of organisms of a species living in the same area, e.g. a population of turtles in a river, a population of fleas on a dog, a population of pondweed in a pond etc. If conditions are good, the organisms can reproduce and the population gets larger, but if the conditions are bad the organisms die and the population gets smaller. Population size is determined by competition. A **niche** is the unique way an organism has of surviving in its environment and minimising competition. For example two species of bird compete for the same food, so they hunt in slightly different areas to avoid competition, they each have their own niche.

Interdependence

All organisms depend on other organisms to survive. Interactions between organisms are called **relationships.** There are several kinds of relationships:

-**predator and prey relationship** one organism eats another, each is adapted to its role either for hunting or to avoid being hunted, the size of one population directly affects the size of the other, and the population levels are often in a cycle.

-**Mutualism** both organisms benefit from the relationship

-**Parasitism** one organism benefits at the cost of the other.

B2e

Animals are adapted to survive their environment. An **adaptation** is a feature of an animal’s body which helps it to live in it environment, or compete for limited resources. You should know the major adaptations to hot and dry environments, and to cold environments. An important adaptation for hot/cold environments is an organism’s **surface area to volume ratio.** In hot environments animals have an increased surface area to volume ratio, such as an elephants large ears, which helps them to lose heat, but in a cold environment animals have a smaller surface area to colume ratio, to retain heat.

In dry environments plants try to reduce their surface are, such as needles instead of leaves. This reduces water loss.

Some animals are well suited to their environment but cannot survive very well elsewhere, they are called **specialists.** Other organisms are able to live in a range of habitats, they are called **generalists.**

B2f surviving in a changing environment

World habitats are constantly changing, in order to survive in the changing environments organisms must change with them. **Evolution** is the gradual change of an organism over time, sometimes eventually into one or more new species.

The theory of evolution by **Natural Selection** was proposed by Charles Darwin to explain his observations from his round-the-world voyage on the HMS Beagle.

Evolution by natural selection occurs very slowly over multiple generations, following these steps:

1. A large population of organisms exists, as each organism has lots of offspring
2. The population stays roughly the same size, as not all of the offspring survive long enough to reach adulthood and reproduce themselves. This is due to the environment, some die due to disease, some are eaten, and some are outcompeted for resources by the other members of their species. If all of the organisms of a species die, that species is **extinct.**
3. There is natural **variation** in a species- not all of the organisms are identical. This variation is caused by random **mutations** in the genes. Some of these variations will give the organism an advantage e.g. bigger muscles, thicker fur, longer necks.
4. The organisms with an advantage are more likely to survive to pass on their genes and their beneficial adaptations, so over a long period of time the population is made up of individuals who have the beneficial adaptation, and the species has changed.

Making new species

Sometimes two different groups of the same species can gradually change in different ways, which can form a new species. The groups become separated, either physically or by behaviour. Each group adapts to its new conditions in different ways and they can no longer interbreed, this is a new species.

Examples of evolution:

-peppered moth adapted to changes in the colouring of the trees in its environment

-Bacteria are developing resistance to antibiotics e.g. MRSA

Lamarck’s theory

Before Darwin, a theory of evolution was proposed by Jean Lamarck, a French biologist. He thought that physical changes acquired during the life of the organism (such as a giraffe stretching its neck to reach higher leaves) can be passed down to that organisms offspring. This has now been discredited. This can be shown to be untrue as people who get tattoos or suffer injuries do not pass these on to their children!

B2g Humans and pollution

Because of better medical and farming technology, the human birth rate has increased massively in the last few hundred years, especially since 1990, at the same time the death rate dropped. This has led to an enormous increase in the human population in the last hundred years, in a pattern called **exponential growth.** All of these new people need homes, food, power, fuel, jobs and lots of other resources. This is putting pressure on the planet and has led to:

-Food shortages

-Increased **pollution**

-Resources (such as fossil fuels and land) being used up very quickly

The current pattern of growth is not **sustainable**

Some examples of pollutants:

**Air pollutants**

Sulphur dioxide and nitrogen oxides, created by burning fossil fuels, can cause acid rain

Carbon dioxide, created by burning fossil fuels, is a greenhouse gas which traps heat, warming the atmosphere

CFC’s uses in refrigerators and aerosols, destroy the ozone layer, letting in harmful UV radiation

**Water pollutants**

Sewage- from human activity, houses and factories, also fertilisers from farming, can cause diseases in rivers and lakes, killing plants and animals.

Detergents- can kill water organisms and change the chemistry of the water.

Pollution indicators

Water pollution can be tested for by looking at what species live there. Some species, such as the rat tailed maggot or bloodworm, thrive in heavily polluted water, others such as mayfly larvae can only live in clean water.

Air pollution can be determined using lichens- a crusty moss type organism that grows on rocks and trees. Bushy lichens can only grow in very clean air, where crusty lichens can be found in polluted air.

B2h- sustainability

**Sustainable development** means using the earths resources to meet human need, but in a way that means future generations will be able to continue using the same resources without harming the environment.

Humans affect the environment in a number of ways, sometimes causing species to go extinct. This can be through over hunting/fishing, damaging or destroying the habitat of the organism, pollution which can kill organisms, or competition for food or space.

Species which are under threat of going extinct but are not yet gone are known as **endangered species**. E.g. Pandas, tigers, whales. Scientists are working on ways to **conserve** these endangered species and stop them going extinct. People think that we should conserve species for many reasons:

* Future uses e.g. medical technology, research
* Future food supplies
* Extinction may lead to damage in the wider food chain
* Moral/cultural reasons i.e. we have a duty to preserve the world for future generations