

# Interactions and Interdependence



## Interdependence

| Key term   | Definition  |
|------------|---|
| Population | A group of organisms of the same species living in an area  |
| Community  | A group of different populations living in the same area and interacting  |
| Ecosystem  | A community of living organisms interacting with each other and their non-living surroundings (e.g. soil, rocks, water, air, light) |

The **size of a population** is the number of organisms of one species living in a particular area and **changes due to births, deaths and migration**. These processes are affected by factors such as **new predators, disease, seasonal changes, natural disasters and human activities** like habitat destruction or conservation.

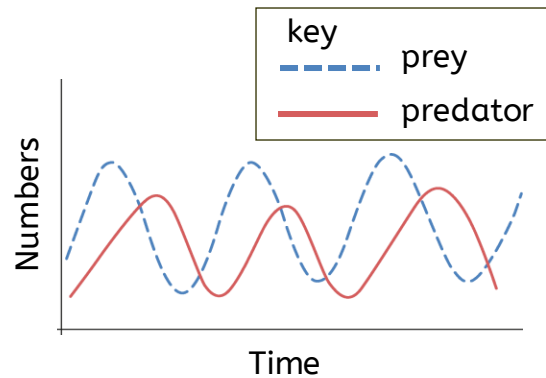
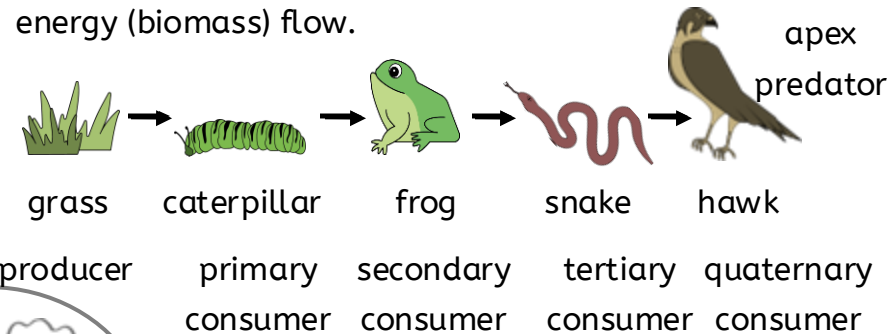
All species in an ecosystem are **interdependent**. They depend on each other for resources like food, shelter, oxygen and minerals.

Changes in one population affects others.

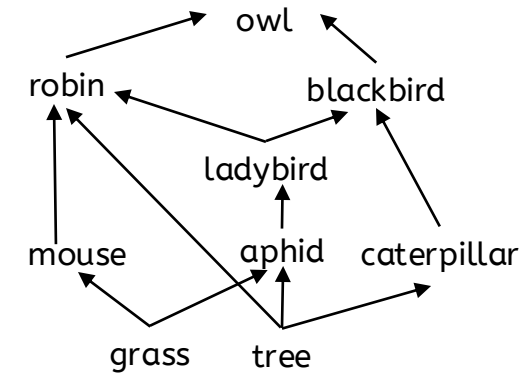
Feeding relationships are shown in food chain diagrams. The trophic level is the position of an organism in a **food chain**. Food chains always start with a **producer** and end with a **consumer**.

**Biomass** is the dry mass of one or more organisms. It is transferred through feeding relationships.

Arrows indicate the direction of energy (biomass) flow.



- **Predator and prey** populations are **interdependent**: more prey means predator numbers rise, but as predators increase, prey numbers fall, causing predator numbers to drop later.
- This cycle, with a time **lag between peaks**, helps maintain a **stable community** where populations stay relatively constant.



**Food webs** show interconnected food chains and energy transfer, giving a more realistic picture of feeding relationships. Changes in one population can have impacts throughout the food web, including indirect impacts through competition or shared resources. Human activities can also disrupt this balance.



# Interactions and Interdependence

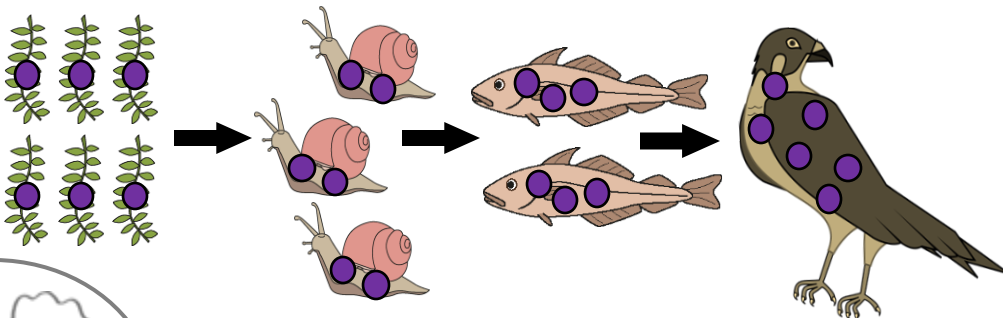


## Bioaccumulation

- **Fertilisers** supply minerals like nitrates and phosphates to help plants grow and boost food production.
- **Fertilisers** can reduce minerals in soils and pollute water, causing algae to overgrow on the top of the water and block sunlight. This kills producers and disrupts food chains.
- **Pesticides** kill pests to protect crops. **Herbicides** kill producer pests and **insecticides** kill consumer pests.
- Pesticides can also harm pollinators, beneficial insects, and other nearby plants. This reduces producers and pollinators, disrupting food chains and ecosystems, and can even lower crop production in the long term.

**Bioaccumulation** happens when **toxic substances**, like pesticides, build up in organisms because they cannot be broken down. These toxic substances pass along food chains and become more concentrated at each trophic level, which can harm or kill top predators.

● = toxic substance e.g. pesticide



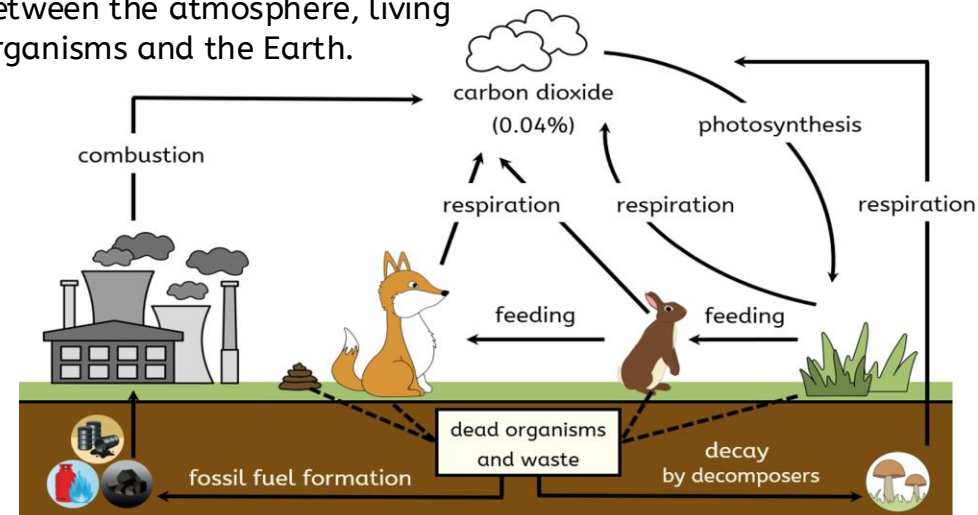
## Materials Cycling

- **Decay** is the breakdown of dead organisms and waste by **decomposers**.
- Decay recycles nutrients by releasing them back into the ground, so that it can be used for new plant growth and to support food chains.
- Decay also returns carbon dioxide to the atmosphere for photosynthesis, cleans the environment, and helps with fossil formation by breaking down the soft tissues of a dead organism and leaving behind hard parts.

The **ideal conditions** for decay are:

1. **Plenty of oxygen**, so that decomposers can respire.
2. **Warm temperatures** so that decomposers are more active.
3. **Moisture** to allow chemical reactions to take place.

The **carbon cycle** is a closed system that continuously recycles carbon between the atmosphere, living organisms and the Earth.



# Interactions and Interdependence



## Classification

- **Classification** is the sorting of items into groups based on shared characteristics. The scientific practice of classifying organisms is called **taxonomy**.
- Organisms can be classified based on observable physical features and microscopic characteristics such as cell structure.
- **Carl Linnaeus** developed the modern classification system. Organisms are grouped into kingdom, phylum, class, order, family, genus and species.
- **Kingdom** is the largest group, with many organisms.
- **Species** is the smallest group, with just one type of organism.
- Classification helps scientists identify and name organisms accurately, track species for conservation, predict characteristics, understand relationships and study evolution.



## Competition and Adaptation

- **Competition** is the struggle between organisms for the same limited resource. The more similar the needs, the more intense the competition.
- Animals compete for food, water, shelter and mates.
- Plants compete for sunlight, water, minerals, space, pollinators and seed dispersers.
- **Interspecific competition** occurs between different species and **intraspecific competition** occurs within the same species.

An **adaptation** is a characteristic that allows an organism to compete, survive and reproduce in its environment. Adaptations can be:

- **Structural** (physical features like thick fur, sharp claws and spines on plants)
- **Behavioural** (actions like migration, huddling for warmth and growing towards light)
- **Functional** (internal processes like producing venom, conserving water and slowing heart rate during hibernation).



Polar bear

White coat → camouflage  
 Large paws → spread weight over ice  
 Thick layer of fat → insulation to keep warm  
 Thick coat → insulation to keep warm  
 Small ears → small surface area  
 Small tail → small surface area  
 Sharp claws → kill prey and grip ice  
 Sharp teeth → kill and eat prey



Camel

Hump with fat → stay cool (fat in one place)  
 Sandy colour → camouflage  
 Large feet → spread weight over sand  
 Long eyelashes → keep sand out  
 Minimal sweat/ urine → conserve water

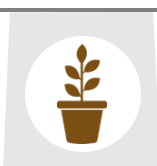


Cactus

Shallow long roots → absorb water quickly  
 Waxy skin → minimise water loss  
 Thick fleshy stems → store water  
 Spines instead of leaves → reduce water loss  
 Spines → protection from being eaten



# Interactions and Interdependence



## Natural Selection, Evolution and Extinction

Individuals within a species show genetic variation because offspring inherit a random mix of **genes** from their parents. This causes differences in **characteristics**, some of which give an **advantage in competition** and make individuals **better adapted to survive and reproduce**.

- **Natural selection** is a process by which organisms that are better adapted to their environment (due to genetic variation) are more likely to survive, reproduce and pass on their genes to their offspring.
- Over many generations, these beneficial characteristics become more common in the population.
- This idea was proposed by Charles Darwin.
- The process of natural selection involves the following steps:

|                 |  |
|-----------------|--|
| 1. Variation    | Individuals within a species have different characteristics due to random genetic variation.                               |
| 2. Advantage    | Some characteristics can give individuals an advantage.  |
| 3. Competition  | This advantage make them more likely to compete successfully.  |
| 4. Survival     | This makes them more likely to survive.  |
| 5. Reproduction | They are more likely to reproduce and have offspring.  |
| 6. Inheritance  | They are more likely to pass on their genes to their offspring. Over generations these characteristics become more common. |

- **Evolution** is the process in which the characteristics of species change over many generations, sometimes leading to new species.
- Darwin's theory of natural selection explains how evolution occurs : organisms better adapted to their environment survive, reproduce and pass on their genes.
- Over billions of years, life evolved from simple ancestors into more complex organisms.
- **Fossil evidence** supports this scientific theory, showing older rocks contain simple organisms and newer rocks contain more complex ones, despite gaps in the fossil record.
- **Extinction** is the complete loss of all members of a species because it could not adapt to its environment.
- Causes of extinction include climate change, habitat destruction, pollution, new diseases, new predators, new competitors and natural disasters.
- Human activities like deforestation, overhunting, introducing species and climate change make extinction more likely.
- Species at risk of extinction are called **endangered**.

### Datalogging and Technology in Science

Researchers use GPS and datalogging technology to monitor populations, studying predator-prey interactions, behaviour and habitats. This supports conservation efforts.

