Ecosystems
Interdependence *and* Plant reproduction

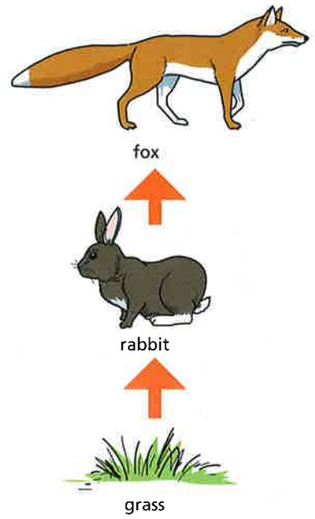
9.0

Ideas you have met before

The environment

All living things depend on one another to survive.

A food chain shows how each living thing gets food for energy.



Reproduction in plants

The roots, stems, leaves and flowers of a plant each have a specific purpose.

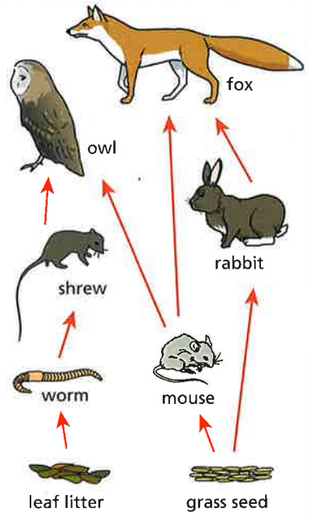
Flowers enable reproduction in plants, through pollination and seed dispersal.

Plants have evolved different ways of carrying out these processes.

In this chapter you will find out

Relationships in the environment

- In any environment there are many interlinked food chains. These can be disrupted by factors such as toxins entering the food chain, or disease.
- Food chains usually start with a plant or plant material, called a producer.
- Animals that eat plants and other animals are consumers and these are found at different levels of a food chain.
- The availability of food is crucial, and insects can play an important role in food security.



How plants are adapted to reproduce

- Flowers are adapted in many ways to attract pollinators or use the wind to help pollination.
- A pollen grain contains the male sex cell in plant reproduction and the ovule is the female sex cell; fertilisation is the meeting of these two cells.
- Plants have evolved different mechanisms to disperse their seeds, increasing their chances of survival.
- We can use models to investigate the efficiency of seed dispersal.

Understanding food webs

We are learning how to:

- Describe how food webs are made up of a number of food chains.
- Make predictions about factors affecting plant and animal populations.
- Analyse and evaluate changes in a food web.

Food chains show the feeding relationships between living organisms. If something happens to disrupt part of the chain, it can have serious knock-on effects through the whole chain.

The ups and downs of food chains

The organisms in a **food chain** are dependent on each other. For example, in Figure 1.9.1a, grass is eaten by rabbits, which in turn are hunted and eaten by foxes. The grass captures the energy from sunlight to photosynthesise and make glucose. The glucose provides energy for the plant to grow. When a rabbit eats grass, some of the energy left in the grass is transferred to the rabbit. The rabbit uses some of this energy to move and grow. When a fox eats a rabbit, the remaining energy in the rabbit is transferred to the fox.

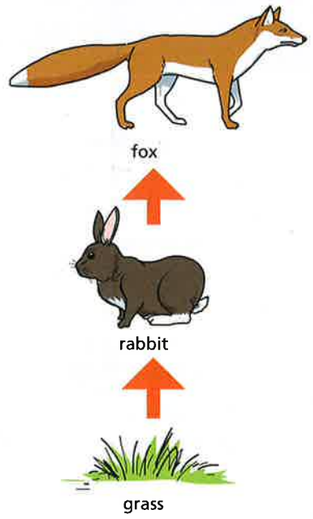


FIGURE 1.9.1a: A simple food chain.

Changes in the number of one organism in an area – its **population** – affect other organisms in the same food chain.

- The number of plants in an area can be affected by the amount of rain, sunlight, minerals and space available to grow.
- The number of animals can be affected by the availability of food, habitats, mates and water, and by disease.

Look at Figure 1.9.1a again and then answer these questions.

1. What would happen to the numbers of rabbits and foxes if all the grass died out?
2. What would happen to the amount of grass and foxes if all the rabbits died out?
3. Why is it a good idea for an organism to have different sources of food?

Food webs and trophic levels

Most animals eat many different things and are involved in many different food chains. These food chains can be linked together in a **food web**, which shows how the food chains are connected. Food webs can be complex.

Did you know...?

Fungi, such as mushrooms, are very important as decomposers in food webs. Each fungus has chemicals, called enzymes, that decompose only a small number of specific materials. Some fungi can even decompose jet fuel!

FIGURE 1.9.1b: Shaggy ink cap fungus (*Coprinus comatus*).

In a food web:

- **producers** make their own food;
- **consumers** eat other organisms, either plants, animals or both;
- **decomposers** break down dead plant and animal material; the nutrients released are recycled in soil or water.

These rankings are called **trophic levels**. The trophic level of an organism is the position it occupies in a food chain.

4. Identify a consumer in the food web in Figure 1.9.1c. What does this consumer eat?
5. Describe the role of a decomposer and give an example from the food web in Figure 1.9.1c.
6. If all the mice died, what could happen to the rabbits in the food web?

Knock-on effects

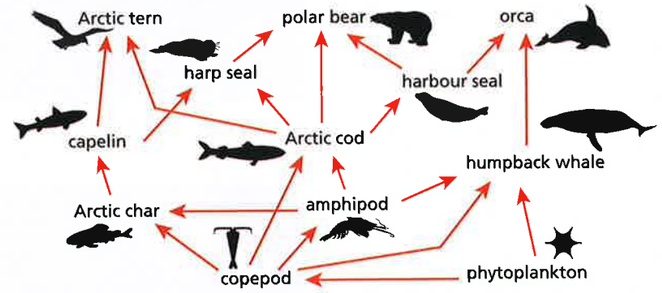


FIGURE 1.9.1d: An Arctic food web.

Look at Figure 1.9.1d. Harbour seals, harp seals and Arctic terns all feed on Arctic cod. If the Arctic cod catch a disease and die, the Arctic terns and harp seals will eat more of their other prey. The harbour seal only eats Arctic cod, so they will die too. There will be no cod to eat amphipods and copepods, so there will be more food for the humpback whale and Arctic char, and their populations will increase.

7. Harp seal populations are controlled by killing them – this is called 'culling'. Analyse and evaluate the impact of culling the majority of harp seals.
8. Explain how this food web shows that energy is transferred from the copepod to the Arctic tern.

9.1

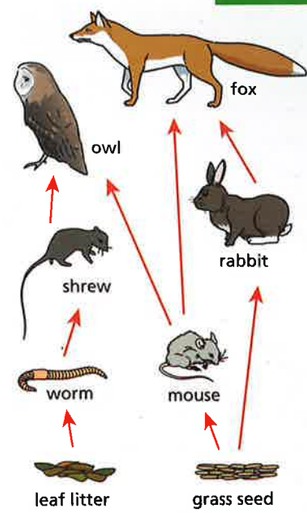


FIGURE 1.9.1c: A simple food web. What do the arrows in the food web mean?

Know this vocabulary

food chain
population
food web
producer
consumer
decomposer
trophic level

Understanding the effects of toxins in the environment

We are learning how to:

- Describe how toxins pass along the food chain.
- Explain how toxins enter and accumulate in food chains.
- Evaluate the advantages and disadvantages of using pesticides.

Otters nearly became extinct in the south of England in the 1960s. What caused this? Why were otters more affected than other animals? Why do we use chemicals in agriculture?

Why are chemicals used in agriculture?

In recent times, the global human population has increased dramatically. Food needs to be grown more quickly to feed the growing number of people. Soils are quickly depleted of the nutrients needed to grow healthy crops. Nowadays, farmers rarely mix keeping animals with growing crops, so they do not have the supplies of cattle manure to replace the nutrients naturally. Instead, artificial **fertilisers** and nutrients are used to replenish the soil.

Insecticides and **pesticides** are chemicals used to kill insect pests and other small creatures that damage crops.

1. Why do farmers use chemicals in agriculture?
2. Why do most modern farms not use manure on their fields?

FIGURE 1.9.2a: Why is the farmer adding artificial fertiliser, not manure?

Chemicals entering the food chain

Toxins can enter the food chain in several ways.

- Fertilisers dissolve in water and are washed off the fields by rain into rivers and reservoirs.
- Chemicals used by farmers to kill weeds or insects contaminate small creatures that are eaten, or the chemicals are washed or blown into waterways.
- Water runs off urban streets into waterways.
- Soft mud acts like a sponge that slowly soaks up the toxins. Plants absorb these through their roots.
- Some chemicals fall from the air, such as mercury released by coal-burning power plants.

FIGURE 1.9.2b: Insects covered in insecticide are eaten by other animals.

A consumer may eat the plants containing the toxins; other (secondary) consumers eat that (primary) consumer; and so on up the food chain.

3. Give examples of a primary consumer and a secondary consumer that could be affected by pesticides used on farmland.
4. Explain how toxins enter the food chain.

Accumulation of toxins in the food chain

Organisms at the start of a food chain can take up small amounts of toxins. The higher up the organism is in the food chain, the more concentrated the toxin will become – eventually it is so concentrated that it can kill the top predator.

A pesticide called DDT was used in the 1960s. It killed insects that were damaging crops, but it ran off into rivers and contaminated plants. The small animals and fish further up the food chain collected more and more of the toxin because it stayed in their bodies. This process is called **bioaccumulation**.

Otters that ate the fish were killed and almost became extinct in the south of England.

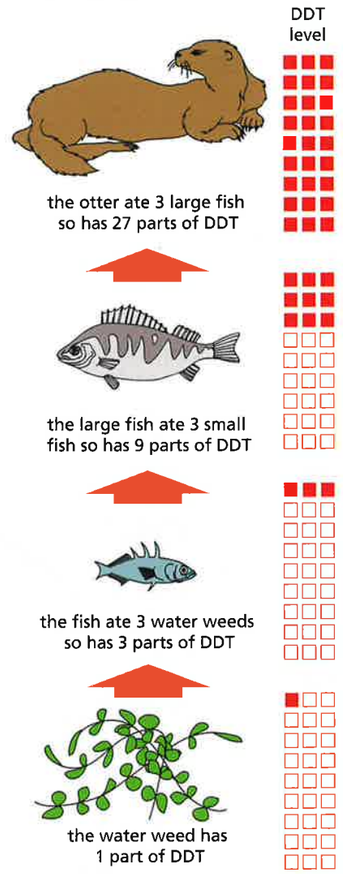


FIGURE 1.9.2d: Bioaccumulation of DDT in a food chain.

5. Explain why otters were in danger of extinction because of DDT.
6. If the otter population declined, how would this affect the river ecosystem?

9.2

FIGURE 1.9.2c: How does mercury released into the air get from here into an organism?

Did you know...?

DDT was banned worldwide in 2001. The only remaining legal use of DDT is to control malaria-carrying mosquitoes. Modern insecticides do not accumulate in food chains.

Know this vocabulary

fertiliser
insecticide
pesticide
toxin
bioaccumulation

Exploring the importance of insects

We are learning how to:

- Describe the role of pollination in crop production.
- Explain why artificial pollination is used for some crops.
- Evaluate the risks of monoculture on world food security.

Food security refers to the availability of food and the ability to obtain it. What is the role of bees and other insects in our food security? How does agricultural practice impact on food security?

Fruit production and bees

Bees are vital in pollinating fruit crops. **Pollination** is successful when flowers receive healthy pollen at the best time. The better the pollination of apples and pears, the more numerous and larger the fruits.

Anything that interferes with bee activity, such as disease or adverse weather, will reduce pollination. Bee colony numbers in Britain have fallen dramatically. The reduced pollination has lowered fruit yields and hence the earnings of fruit growers – the apple harvest in 2012 was 50% lower than expected. This resulted in a higher cost of apples in the shops.

Recent research has found that the fall in wild bee populations, caused by habitat destruction, is having a greater impact than the fall in honeybee numbers. This is because wild bees are twice as effective as honeybees in pollinating orchards.

1. Why do fruit growers put beehives in their orchards?
2. How can we help wild bee colonies to survive and grow?

Ensuring pollination

In south-west China, wild bees have become extinct because of overuse of pesticides and the destruction of their natural habitats. Apple and pear farmers now hand-pollinate their trees, using pots of pollen and paintbrushes to pollinate each flower individually.

Crops of cucumbers, tomatoes and peppers are also often hand-pollinated. Date palms have male and female plants; natural pollination therefore requires trees of both types.

FIGURE 1.9.3a: Honeybee hives are placed in orchards to ensure pollination.

FIGURE 1.9.3b: These women are hand-pollinating blossom on pepper plants.

By using hand-pollination, date farmers need only grow female trees and so avoid wasting space by growing male plants.

There are not enough humans in the world to pollinate all of our crops by hand. In addition, hand-pollinated fruits are often smaller than those pollinated by bees. Scientists are trying to develop a robotic bee that could be used to pollinate plants artificially and support the work of real bees.

3. Why is artificial pollination vital to fruit growers in China?
4. What are the advantages and disadvantages of artificial pollination?

Tackling food security

Evidence from around the world shows that yields of insect-pollinated crops are falling and are becoming ever more unpredictable. This is especially true in the areas with the most intensive farming. Where single crops are grown in vast fields – a practice called **monoculture** – there are not enough insects to go around.

Almond orchards cover hundreds of square miles in California. Bees cannot survive naturally in these areas because the flowering time is too short and there are no other plants for them to feed on.

FIGURE 1.9.3c: Monoculture is a modern agricultural practice that destroys the pollinators' natural habitats.

Some poor countries use monoculture to grow huge quantities of crops that they sell to richer countries, such as coffee, cocoa and bananas. Little fertile land is left to grow food crops for the local people, who then suffer food insecurity.

5. Evaluate the practice of monoculture in agriculture.
6. Suggest how farmers can ensure pollination in monocultural systems.

Did you know...?

It has been suggested that 'travel stress' caused by bees being shipped from pollination site to pollination site is partly to blame for disorders in bee colonies that hugely reduce their population.

Know this vocabulary

food security
pollination
monoculture

Exploring ecological balance

We are learning how to:

- Describe ways in which organisms affect their environment.
- Explain why prey populations affect predator populations.
- Evaluate a model of predator–prey populations.

Organisms are not isolated in their environment. They interact with other individuals of their own species, with other species and with their physical environment. The study of the interactions between organisms and their environment is called ecology. In what ways do organisms interact? How does one organism affect others?

FIGURE 1.9.4a: How can cows affect grass when they graze?

How organisms affect the environment

All organisms cause changes in the **environment** where they live. An organism's behaviour depends on the nature of its environment. This includes factors such as:

- the types and numbers of other organisms present;
- the availability of food and resources;
- physical characteristics of the environment.

The living and non-living things in an area make up the **ecosystem**. Cattle that stay in one place for a long time will overgraze and destroy the plant life. Without plants to hold it, topsoil runs off into streams and lakes, causing habitat loss for organisms living in the fields. Soil fills the bottom of the streams and lakes and absorbs water, causing a drop in the water volume. This can affect the range and number of plants and animals living in the water. This then affects the range and number of organisms that can feed from plants and animals in the streams and lakes. This reliance of organisms on one another is known as **interdependence**.

1. What is 'ecology'?
2. Describe examples of how organisms affect their environment.

Competition

Competition is an example of interdependence. Organisms in an ecosystem are continually competing for the same limited resources. For example, if there is only a small number of fruit trees and one animal is taller and, therefore, better at reaching the fruit than a shorter animal, then the shorter animal is less likely to feed and may starve.

Did you know...?

Big cats are examples of predators adapted for efficient hunting. One of the cheetah's best hunting skills is its ability to run at high speed. It can run faster than any other land animal, accelerating from 0 to 100 km/h (62 mph) in about three seconds.

FIGURE 1.9.4b: A cheetah.

Some organisms co-exist by specialising – for example, different plant roots may access water at different depths in the soil.

3. Explain how specialisation can help to reduce competition.

Predators and prey

The relationship between **predator** and **prey** is probably the most important form of interdependence. Predators need to be adapted for efficient hunting to catch enough food to survive. Prey species must be well adapted to escape their predators to ensure their survival. If the prey population grows, predator numbers will respond to the increased food supply and grow too. Increased predator numbers will reduce the food supply so that it can no longer supply the predator population. The resulting pattern of prey and predator numbers is shown in Figure 1.9.4c.

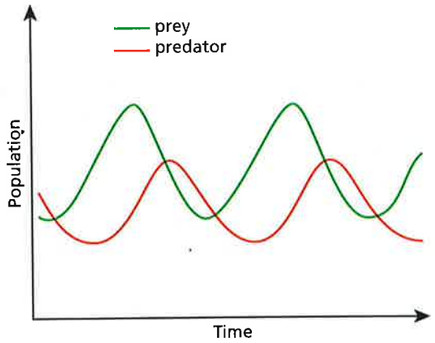


FIGURE 1.9.4c: The relationship between predator and prey numbers.

The effects of predator and prey, such as lion and antelope, on each other can be explored using a model. Make cards labelled 'lion' or 'antelope'. You will toss these on the table, which acts as the habitat of the animals. When a lion card lands on an antelope card, this models the lion catching and eating the antelope. The antelope 'dies' (and is removed from the game). When the lion card does not land on *three* antelope cards, this models the lion having insufficient food and it 'dies' (and is removed from the game).

Start by tossing three antelope cards and one lion card. Remove any cards of animals that would die. Record the outcome for this generation (1). Next, double the number of remaining antelope to model them reproducing, and repeat using one lion. Again, record the outcome (generation 2). Continue doubling the number of antelope left at the end of each generation. If a lion survives (by catching at least three antelope), it then reproduces so introduce a second lion in the next generation. Continue for approximately 16 generations and record the outcome of each.

FIGURE 1.9.4d: Ladybirds are used to control aphid populations.

4. Draw a graph to show predator and prey numbers at each generation of your model.
5. Predict the shape of the graph for generations 17 to 25.
6. Is this a good model? Explain your answer.
7. What variables affect the numbers of predators and prey in a population?
8. Explain how prey populations affect predator populations.

Know this vocabulary

ecology
environment
ecosystem
interdependence
competition
predator
prey

Exploring flowering plants

We are learning how to:

- Identify parts of flowering plants.
- Describe the function of the parts of flowering plants and link structure with function.
- Evaluate the differences between wind-pollinated plants and insect-pollinated plants.

The first plants on Earth were mosses. These relied on moisture and touch to transfer pollen. The first flowering plants, using wind and insects to transfer pollen, are thought to have evolved about 200 million years ago. Nowadays about 70 per cent of plant species use insects, birds or mammals to transport pollen.

Flowers as reproductive organs

Most flowers have male and female parts. The male part is the **stamen**, consisting of an **anther** and a **filament**. The anther produces **pollen**, which contains the male sex cell.

The female part is the **carpel**. This consists of an **ovary** (with the female sex cells in the ovules), the **style** and the **stigma**, which has a sticky top.

The purpose of the flower is to produce pollen in the anther and transfer it to the stigma of a different flower. This process of transferring pollen is called **pollination** and is mainly achieved using wind, insects, birds or bats.

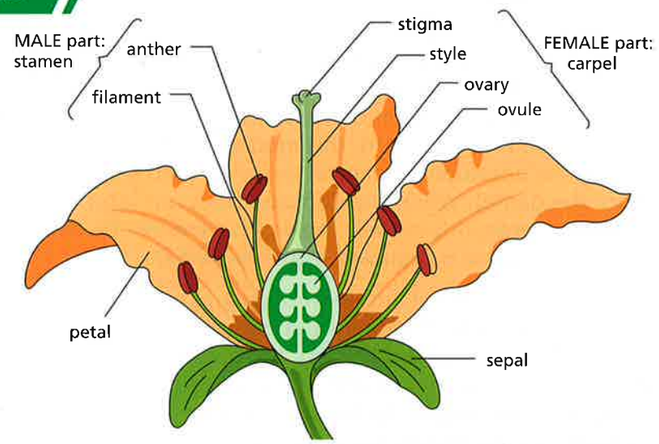


FIGURE 1.9.5a: Male and female parts of a flower.

FIGURE 1.9.5b: A flowering Tulip.

1. Identify the following parts of the flower in Figure 1.9.5b: anther, filament, stamen, stigma, style, ovary.
2. What differences can you see between the two flowers in Figure 1.9.5d?

Attracting insects

Most insect-pollinated plants produce brightly coloured flowers with sweet smells to attract insects. Many also produce nectar deep inside the flower. This is a sugary fluid that encourages insects into the flower. Pollinators such as bees collect the pollen and nectar as food sources. Plants produce a lot of pollen to increase the chances of successful pollination.

3. Describe different ways plants encourage insects to visit them.
4. Why do plants use such a diverse range of methods of attracting pollinators?

FIGURE 1.9.5c: This orchid mimics the appearance of a female wasp. The male wasp visits the flower and becomes covered in pollen.

Wind or insect pollination?

There is no guarantee that the wind will successfully transfer the pollen from one plant to the stigma of another plant, so wind-pollinated plants produce millions of pollen grains to improve their chance of success. Some stigmas evolved to become large and feathery so as to capture pollen floating on the wind. Even so, there is no guarantee that the pollen from the same species will land on the plants.

Insect-pollinated plants produce far less pollen than wind-pollinated plants, but use other mechanisms to attract insects. However, some insects eat parts of the flower and plant, so flowers have developed mechanisms to avoid this, such as producing toxins and growing spikes.

FIGURE 1.9.5d: Which flower is wind pollinated and which is insect pollinated?

5. Discuss the advantages and disadvantages of wind pollination and insect pollination.

Did you know...?

The oldest known pollen grains were found on the bodies of tiny insects encased in amber. The pollen was thought to be over 200 million years old. Fossilised pollen has provided evidence of how plant life on Earth has evolved.

Know this vocabulary

stamen
anther
filament
pollen
carpel
ovary
style
stigma
pollination

Exploring fertilisation

We are learning how to:

- Describe the process of fertilisation in plants.
- Describe the role of pollen tubes.
- Explain how seeds are formed.

The world's chocolate supply depends on midges. These tiny flies are the only insects that can pollinate the cacao plant. Once fertilised, the plant produces seeds, which are used to make chocolate.

FIGURE 1.9.6a: Seed pods on a cacao plant.

From pollination to fertilisation

Pollination ends when pollen from one flower reaches the stigma of another flower. A pollen grain contains the male sex cell. The female sex cell, the ovule, is found in the ovary. For **fertilisation** to occur, the ovule and the pollen cell must meet.

- As the pollen sits on the stigma, a **pollen tube** grows out of the pollen grain through the stigma and style and down into the ovary.
- The nucleus of the pollen cell travels down the tube into the ovary.
- The nucleus of the pollen cell meets the nucleus of the ovule; this is fertilisation.
- This fertilised ovule will eventually develop into a new plant.

1. Describe how pollination and fertilisation differ.

Pollen tubes

When a stigma is ripe for fertilisation, it secretes a sugary fluid onto its surface. It is this sugar that stimulates the growth of pollen tubes. The sugar provides the energy needed for the tubes to grow.

The concentration of sugar affects how well pollen tubes grow. This can be investigated by adding sugar solutions of different concentrations to the stigmas of plants and measuring the pollen tubes. Some results are shown in Table 1.9.6.

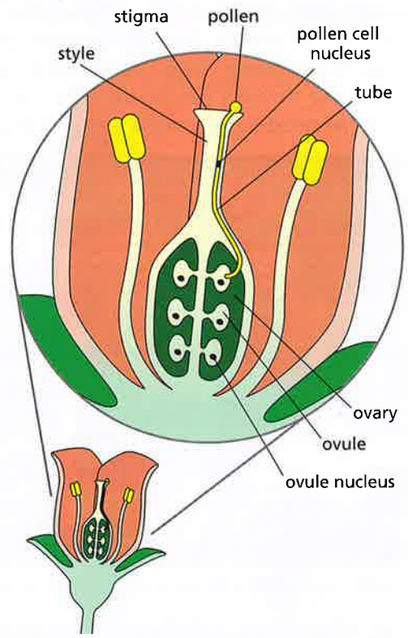


FIGURE 1.9.6b: How do you think a pollen tube is formed – from one cell or many?

TABLE 1.9.6: The effect of sugar on the growth of pollen tubes.

Sugar concentration (%)	5	10	15	20
Growth of pollen tubes (micrometres, μm)	250	350	450	200

2. Plot a graph of the data in Table 1.9.6.

3. Describe the pattern shown by the data.

4. Suggest what you would need to control if you were investigating how sugar concentration affects the growth of pollen tubes.

Development of seeds

Following fertilisation, many of the parts of the flower fall off because they are no longer needed. This includes the petals, sepals and stamens. Each fertilised ovule then becomes a **seed**. The outer layer of the seed becomes hard and the seed dries out (imagine an apple seed and how it feels). The ovary develops into a **fruit**. The fruit protects the seeds until they are ripe and ready to form a new plant.

In science, a fruit is defined as an ovary after fertilisation, containing seeds.

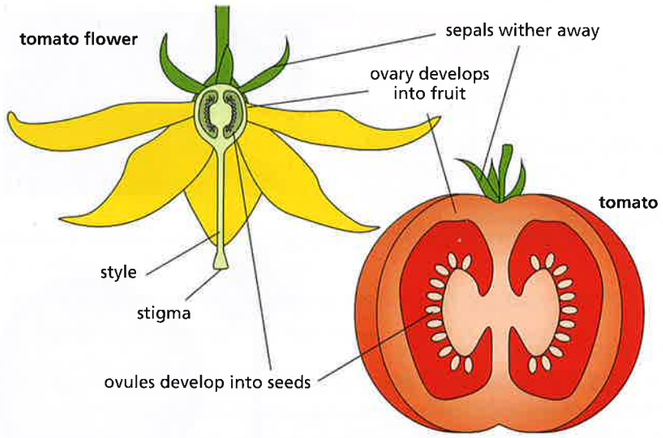


FIGURE 1.9.6c: How a flower develops into a fruit.

5. Make a table and record what happens to the petals, stamen, ovule and ovary following fertilisation.

6. Suggest why pea pods are fruits although they are often called and classed as a vegetable.

Did you know...?

Pollen that does not land on a stigma remains in the environment. It is the primary cause of hay fever and allergies. Pollen counts are made by counting how much pollen lands on a greasy spinning rod over a 24-hour period.

Know this vocabulary

fertilisation
pollen tube
seed
fruit

Understanding how seeds are dispersed

We are learning how to:

- Recognise the variety of different structures of different seeds.
- Describe the need for plants to disperse their seed.
- Plan an investigation into seed dispersal by wind.

The largest seed in the world is 50 cm in diameter. It comes from the palm tree called Coco de Mer, found only in the Seychelles islands in the Indian Ocean. Another large seed is the coconut – it can be carried by the sea and germinate in a new place. Plants have developed many ingenious ways to be dispersed and to colonise new areas.

FIGURE 1.9.7a: Coco de Mer seed – the largest on the planet.

The challenge of moving seeds

Plants colonise new areas by moving their seeds in a process called **dispersal**. Seeds can be dispersed by:

- wind;
- water;
- exploding pods that release seeds on touch or with moisture;
- being carried inside animals that eat the fruit;
- hooking onto the fur or skin of passing animals.

1. Look at Figure 1.9.7b, and identify how each of the three seeds is dispersed.
2. Give reasons for all of your answers to question 1.

FIGURE 1.9.7b: Why have plants developed such variety in types of seed?

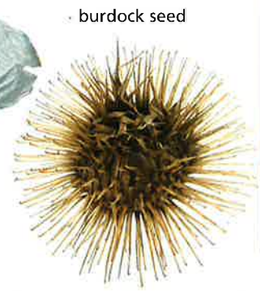
Ways of travelling

Seeds dispersed by wind have many shapes and sizes. The dandelion has parachute-like seeds, and the sycamore has seeds like helicopters. Peas and pansies have pods that explode when they have dried out or are touched by an animal, causing the seeds to fly out. Some plants produce fruits that animals eat but cannot digest. These pass through the animals, allowing the seed to begin **germination** in another place, using nutrients from the animals' dung. Burdock seeds have tiny hooks that catch on the fur of passing animals.

9.7

Seeds need to be dispersed as far away from the parent plant as possible, where there could be more light, nutrients and water – thereby increasing the chance of successful growth. Seeds are packed with nutrients to help the germinating plant to grow. Smaller seeds have fewer nutrients but may travel further. Larger seeds have bigger stores of food and can last much longer.

Alsomitra vine seed



burdock seed

witch hazel seeds

sycamore seeds

FIGURE 1.9.7c: How are these seeds dispersed?

3. Why are the seeds from trees in forests most likely to be dispersed by the wind?
4. What are the advantages and disadvantages of a seed growing near the parent plant?
5. Suggest why the coconut seed is carried by water rather than by air.

Investigating models of seed dispersal

The sycamore seeds shown in Figure 1.9.7c are often described as travelling like mini helicopters. Their small size and aerodynamic features allow them to be dispersed over large areas. We can model this seed and investigate what affects its dispersal.

Make a model seed from paper, like that in Figure 1.9.7d. Consider:

- How can you measure how well it can be dispersed?
- What factors might affect how well it is dispersed?

6. Plan an investigation into a factor that affects how well this model seed works. Consider the **independent**, **dependent** and **control variables**. Plan what you will measure and how you will record your results.
7. Draw a conclusion based on your investigation. If possible, compare your model to real sycamore seeds.
8. Describe the most successful seed, based on your modelling. Could you design other seeds that would be successfully dispersed?

Did you know...?

The seeds of the *Alsomitra* vine tree were the inspiration in the development of the first gliders and aeroplanes. With a wing span of up to 13 cm, they are the largest wind-pollinated seeds in the world.

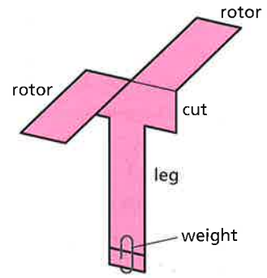


FIGURE 1.9.7d: A model of a paper mini helicopter.

Know this vocabulary

dispersal
germination
independent variable
dependent variable
control variable

Understanding how fruits disperse seeds

We are learning how to:

- Describe how fruits are used in seed dispersal.
- Compare evidence about seed dispersal by wind and fruit formation.
- Use data to evaluate different seed dispersal mechanisms.

Without animals to disperse their seeds, some plants would become extinct. The seeds of the *Astrocaryum* palm used to be dispersed by dinosaurs. Now, small rodents called agoutis disperse the seeds. Agoutis steal each other's seeds, increasing the distance of dispersal.

Plants exploiting animals

Plants may develop edible fruits to disperse seeds. A **fruit** is the ovary of a plant after fertilisation. The fruit is a nutritious treat surrounding the seed or seeds, mainly made of sugars and tasty nutrients to attract animals. Examples include some nuts, tomatoes and cucumbers. Some seeds cannot be digested, so pass through the intestines and out with the faeces. Some seeds, such as mango seeds, are too large to be eaten. When they are discarded on soil, they can germinate to make new plants.

Fruit contains lots of energy, which is transferred to the animals that eat the fruit. Plants that disperse seeds by fruit do not need to produce as many seeds, as most are carried away from the parent plant and end up in soil that is nutrient-rich from dung.

1. What is a 'fruit'?
2. Which of the items in Figure 1.9.8a is not a fruit?
3. What is the main advantage of fruits dispersing seeds?

FIGURE 1.9.8a: Where are the seeds in these plant products?

Surveying and sampling seeds

Botanists carry out surveys to try to find out how seeds are dispersed and how successful different plants are at germinating the seeds they make. They might do this by sampling many plants of the same species in a particular habitat. First they count the number of seeds made. Then, after the seeds have dispersed, they sample the habitat again to make an estimate of the number of seedlings that have germinated. By comparing the number of seeds that have germinated with the number of seeds made originally, they can judge how successful the seed dispersal mechanism is.

4. What is the independent variable in this survey?
5. Which variables need to be controlled in such a survey?
6. How would you ensure the evidence collected was **reliable**?
7. Why might it be important to find out how successful plants are at dispersing and germinating seeds?

How efficient are different methods of seed dispersal?

TABLE 1.9.8: Different methods of seed dispersal.

Name of plant	Type of dispersal mechanism	Approximate number of seeds made per plant	Average dispersal distance
ragwort	parachute	10 000	over 100 m
ash tree	helicopter	1000	over 100 m
Alsomitra vine tree	glider	40 000	1–2 km
witch hazel	exploding pod	100	10 m
pea	exploding pod	100	a few metres
blackcurrant	fruit	300	variable
melon	fruit	500	variable
coconut	water	50	hundreds of miles

Table 1.9.8 summarises the types of seed dispersal mechanisms used by a variety of plants.

8. If you were a plant, which dispersal mechanism would you prefer and why?
9. What can you say about the different dispersal mechanisms from the data?
10. Show the data from the table in a graphical form. Choose a good way to represent the data so that the different mechanisms can be evaluated.

Did you know...?

Avocados are thought to be the most nutritious fruit, with over 25 essential nutrients, including vitamin C, iron, magnesium and potassium. The demand for avocados has led to the destruction of some of Mexico's pine forests as farmers make space to grow as many avocados as possible.

Know this vocabulary

fruit

Checking your progress

To make good progress in understanding science you need to focus on these ideas and skills.

- Describe an example of a simple food web.
- Define producers, consumers and decomposers and give examples of each in different food webs.
- Describe how changes in the population of one organism can influence other organisms in the food web.
- Describe the role of insects in fruit crop production.
- Explain why artificial pollination is used for some crops.
- Explain what is meant by 'food security' and explain the risks posed by monoculture on food security.
- Recall ways in which organisms can affect their environment.
- Explain how changes in predator and prey populations affect each other.
- Use data and models to predict changes to predator and prey populations based on their interdependence.
- Give examples of toxins and describe how toxins pass along a food chain.
- Explain how toxins accumulate in food chains.
- Evaluate the advantages and disadvantages of using pesticides

- Describe the roles of different parts of a flowering plant in reproduction.
- Explain the differences in wind-pollinated and insect-pollinated plants.
- Discuss the strengths and weaknesses of wind pollination and insect pollination.
- Recognise that pollination and fertilisation are both part of plant reproduction but are two different processes.
- Describe the stages of fertilisation in plants, including the role of the pollen tube.
- Describe the fate of flower structures following fertilisation and the formation of seeds and fruit.
- Recognise different seed-dispersal methods and relate these to the structures of the seeds.
- Identify key variables that need to be controlled when investigating the effect of seed design on seed dispersal.
- Explain the advantages and disadvantages of different seed-dispersal mechanisms.

Questions

KNOW. Questions 1–6

See how well you have understood the ideas in this chapter.

1. What is the name for an animal that eats other animals or plants? [1]

a) Producer **b)** Decomposer **c)** Consumer **d)** Prey

2. Why does preying on more than one animal help populations to survive? [1]

a) Toxins are less likely to get into the food chain.

b) It allows animals to have a more varied diet.

c) If the population of one prey decreases, there is still a food source for the predator.

d) It allows the predator to move higher up the food chain.

3. Describe why bee numbers have decreased and explain the effect of reduced numbers of bees on crop production. [3]

4. Which structure is not directly linked to fertilisation? [1]

a) Ovule **b)** Ovary **c)** Stigma **d)** Pollen grain

5. The male parts of a flowering plant as a whole are called: [1]

a) Carpel **b)** Stigma **c)** Stamen **d)** Pollen

6. Describe the events that take place after pollination, leading to a fruit being formed. [4]

APPLY. Questions 7–12

See how well you can apply the ideas in this chapter to new situations.

7. Harmful algal blooms (HABs) produce toxins in the sea. Oysters are animals that filter food particles like plankton from the water. How could dining on oysters during a HAB affect a person's health? [1]

8. Look at this simple food web in a rainforest. What will happen to the number of red-eyed tree frogs if all the chimpanzees die from a disease? [1]

a) They stay the same.

b) They go up.

c) They go down.

d) They will die out too.

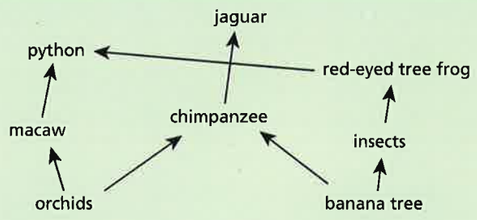


FIGURE 1.9.10a

9. Look at the food web in Figure 1.9.10a. The jaguar and the python are predators. What will happen if both of these predators die out? [4]

10. Some plants live in areas of high density of other plants. Choose **two** ways that plants may compete with others to attract pollinating insects. [2]

a) They have brightly coloured flowers.

b) They have high levels of chlorophyll in their leaves.

c) They produce huge numbers of light, feathery pollen grains.

d) They produce large amounts of nectar.

11. Seeds are dispersed by a variety of mechanisms. Some are shown in Figure 1.9.10b. Which type of seed is likely to be dispersed by: [2]

a) water?

b) being carried on the fur of an animal?

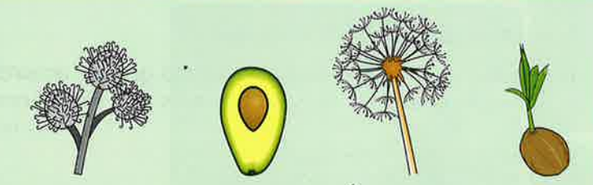


FIGURE 1.9.10b

12. A rare fruit and its seeds are analysed and are found to contain large amounts of energy compared to several other fruits. Suggest **two** reasons why containing lots of energy supports the growth of a new fruit plant. [2]

EXTEND. Questions 13–14

See how well you can understand and explain new ideas and evidence.

13. Figure 1.9.10c shows how the populations of lynx and hares changed over time. Analyse and evaluate the data to explain why the populations rise and fall when they do. Do you think this pattern is still happening today? Explain your answer. [4]

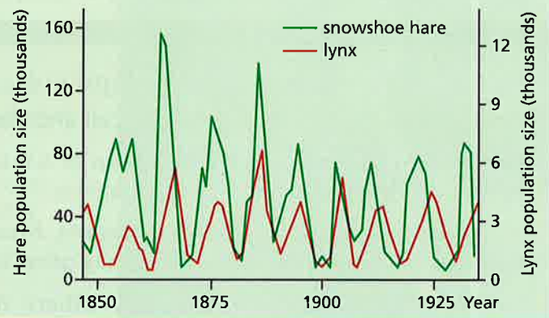


FIGURE 1.9.10c: Lynx and hare population data.

14. Using the average data in Table 1.9.10, describe the effect of sugar concentration on growth of pollen tubes. Suggest which one result the students ignored when calculating the averages. [3]

TABLE 1.9.10: The growth of pollen tubes in different sugar concentrations.

Sugar concentration (%)	5	10	15	20
Growth of pollen tubes (micrometres) – experiment 1	225	345	200	213
Growth of pollen tubes (micrometres) – experiment 2	250	350	450	207
Growth of pollen tubes (micrometres) – experiment 3	275	355	450	250
Average growth of pollen tubes	250	350	300	233