

# Changing the environment

## Learning objectives:

- recall causes of environmental change
- describe the impact of environmental change
- explain the impact of an environmental change.

## KEY WORDS

dredging  
environmental  
change  
global warming

**Human life is dependent on a rich biodiversity for survival. Our actions are decreasing biodiversity, and are doing so at an alarming rate.**

HIGHER TIER ONLY

## Thinking about environmental changes

Environmental changes can be:

- natural, caused by
  - › seasonal changes
  - › geographic location
- caused by humans.

Environmental changes affect the distribution and behaviour of organisms found there. Changes may be short lived or long lasting.

These changes may cause migration, enable the survival of some well-adapted organisms or lead to the death of organisms.

Environmental changes include temperature changes, or the availability of water and atmospheric gases.



- 1 What causes environmental change?
- 2 Suggest how organisms react to environmental change.

## Environmental changes and impact

Examples of changes include:

- seasonal changes
  - › low temperatures and food shortages cause some animals to migrate, hibernate or have a dormant stage
  - › hot seasons may cause drought; rainy seasons may cause flooding
  - › hot temperatures reduce the available oxygen in water
- Geographic changes
  - › land bridges sinking and stopping animals from moving between continents, for example, hairy mammoths
  - › with **global warming**, mountainous regions are becoming warmer; mountain species are having to compete with lowland species whose habitats are extending upwards

Figure 8.39 What caused these environmental changes?

- › with global warming, the seas are becoming more acidic (and warmer), which means that the shells of calcareous organisms (such as bivalve molluscs) are dissolving and becoming thinner
- › erosion by rivers and tides may gradually destroy habitats.

Examples of environmental change caused by humans include:

- burning fossil fuels, which causes global warming. Higher sea temperatures are associated with lower dissolved oxygen levels.
- intensive farming, causing desert regions.
- dredging sea beds for building has endangered some marine ecosystems.

**3** Describe the impact of some natural environmental changes.

**4** Describe the impact of some environmental changes caused by humans.

## The impact of rising sea temperatures

Coral reefs have a rich biodiversity. They cover 1% of the Earth's surface but are home to 25% of all marine fish species. They form from coral polyp colonies that have a hard exoskeleton of calcium carbonate. Coral reefs develop near the shores of tropical oceans, where sea temperatures are 24°C to 26°C. They can only grow in water that is less than 25m deep. Corals feed on algae.

Global warming is increasing sea temperatures. This causes bleaching of corals, which means that algae living in them cannot survive. Warmer seas are also endangering some marine species which are unable to adapt to the increased temperatures. Around 20% of coral reefs have been destroyed in just 50 years.

### REMEMBER!

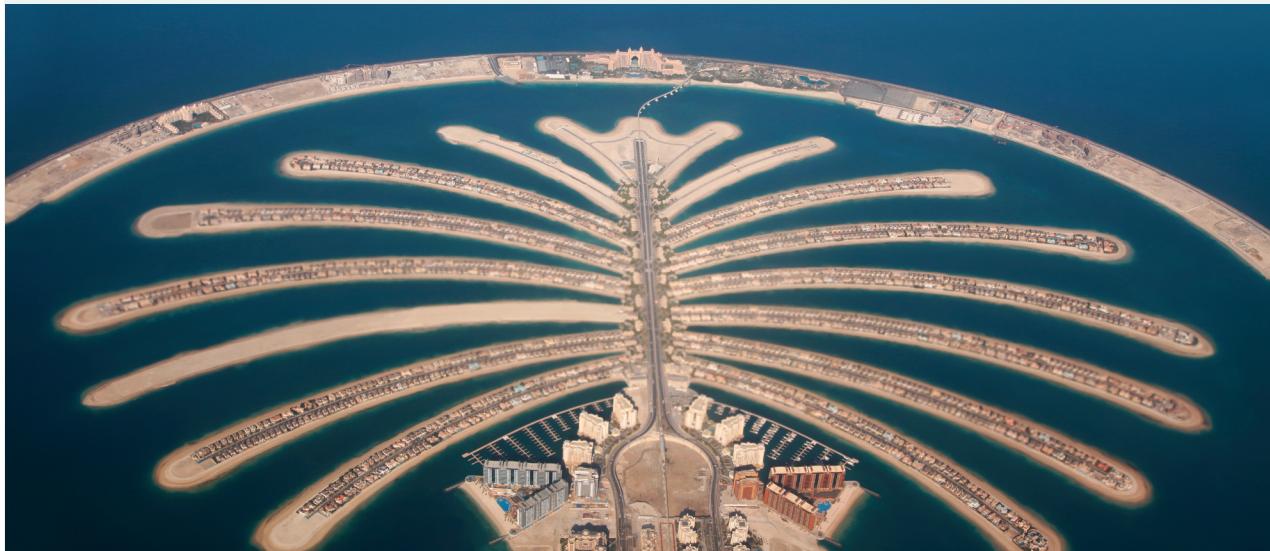
Evaluate the impact of changes. Explain the intended changes, unintended changes and short- and long-term impacts.

### DID YOU KNOW?

Volcanic eruptions can cause land masses to appear (for example, the Hawaiian Islands). The lava makes mineral-rich soils for successful plant growth.

**5** Evaluate the impact of rising sea temperatures on biodiversity.

Figure 8.40 Dredging sand for building has changed the marine ecosystem



# Learning about land use

## KEY WORDS

eutrophication  
run-off

### Learning objectives:

- identify why land use has changed
- describe the effects of changing land use
- evaluate a change in land use.

**Scientists agree that human activity has changed environments and that we need to protect the Earth's biodiversity.**

### Human population growth

The world's population has increased rapidly, from 1 billion (1000 million) in 1880 to about 7 billion in 2012. People use increasing amounts of the Earth's resources, resulting in a decrease in the land available for other organisms.

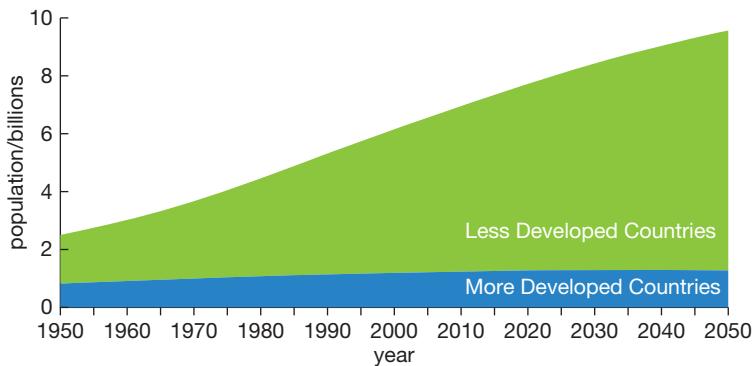


Figure 8.41 Why do less developed countries have a greater population increase?

Humans are using more land for:

- farming
- building
- quarrying
- dumping waste.

Sudden increases in the populations of animals and plants are usually controlled by predators, food availability, disease or toxic waste products. Humans have no predators, grow large amounts of food and have the ability to cure or prevent disease.



Figure 8.42 Intensive farming using fertilisers produces large crops

- 1 How do humans change the use of land?
- 2 Why do farmers use fertilisers?

## Using the land

As our population increases, biodiversity decreases:

- More land is needed for homes, shops, factories and roads. Building sites destroy habitats. Roads divide habitats making it harder for organisms to find food and mates.
- New quarries are mined to provide stone, slate and metal ores for building materials. Habitats are destroyed.
- More farmland is needed and fertilisers are used. Many farms grow one crop over huge areas. This affects food availability for insect pollinators. There are fewer available nesting sites for birds.
- More waste is sent to landfill, and more sewage and industrial waste are produced. This can pollute the land.

Human population is growing exponentially. This means that the increase in any year is greater than in the previous year because the birth rate is greater than the death rate.

- 3 Suggest the impact if human populations keep rising.
- 4 Describe the impact of two land-use changes.

## Polluting water



Figure 8.44 Why are there no fish in this water?

If water contains a lot of fertilisers (caused by **run-off** from farmers' fields) or sewage, the nitrates and phosphates in the water increase and so then algal growth increases. Algae cover the water surface and prevent light from reaching water plants. The plants and algae die. Bacteria respire as they break down dead plants and use up oxygen in the water. The other living organisms in the water die. This is called **eutrophication**.

- 5 Explain the impact of fertiliser run-off.
- 6 Evaluate a change in land use.
- 7 Why do we need to maintain local and global biodiversity?



Figure 8.43 An abandoned quarry

### REMEMBER!

Humans reduce land availability for other organisms by building, farming, quarrying and dumping waste.

### DID YOU KNOW?

When landfill sites are closed, the waste is left to degrade and stabilise. The land is re-used for parks, golf courses and even airports.

# Changing the landscape

## Learning objectives:

- identify the reasons for deforestation
- describe the impact of peat bog destruction and deforestation
- evaluate the destruction of peat bogs and forests.

## KEY WORDS

deforestation  
peatlands

Many species in tropical forests and peatlands are struggling to survive as their habitat is destroyed.

## Why are landscapes changing?

Huge areas of tropical forest are being destroyed. This **deforestation** is happening to:

- provide land for cattle and rice fields
- grow crops, for example, oil palm and sugar cane to make biofuels. Biofuel crops are sometimes grown at the expense of food crops.

Cleared forests are often used to grow a monoculture (one crop) over huge areas.



Figure 8.45 Peat cut to be used for fuel

Peat bogs form over thousands of years in marshy areas. Decomposers cannot completely break down plant material in acidic conditions with little oxygen, so peat forms. Peat stores carbon.

Peat is used as a fuel and as cheap compost by gardeners. Compost improves soil quality to increase food production.

- 1 Why are forests cut down?
- 2 What is peat and how is it used?

## The impact of changing landscapes

Forests are often destroyed by burning. Mass destruction of trees has:

- increased the release of carbon dioxide into the atmosphere (due to burning and the respiration of microorganisms that are decaying the remaining plant material)
- reduced the rate that carbon dioxide is removed from the atmosphere (by photosynthesis)
- reduced biodiversity; some of the lost plants and animals may have been useful in the future
- increased methane in the atmosphere because cleared land is used to grow rice in swamp-like fields.



Figure 8.46 How will forest fires affect the atmosphere?

Insufficient trees are being replaced. Peat is being destroyed faster than it is being made. Peat and trees are both important carbon 'stores' that are being lost. The loss of peat bogs reduces the variety of different plants, animals and microorganisms that live there. Monocultures also reduce biodiversity.

- 3** Describe and explain the impact of deforestation.
- 4** How can woodland habitats be preserved?

### Balancing act

There is a massive conflict between:

- the need for deforestation to increase land available for food production
- the use of peat as cheap compost to increase food production
- the need to conserve forests and peatlands as habitats for biodiversity
- the need to reduce carbon dioxide emissions from using peat as a fuel and from burning forests.

- 5** Evaluate the destruction of peatlands.

### REMEMBER!

Trees and plants in peatlands all use carbon dioxide to photosynthesise. Carbon is then stored in these plants.



Figure 8.47 Orangutans are losing their food sources

### DID YOU KNOW?

About 13 million hectares of forest have been cleared or lost through natural disasters. By 2030, there may only be 10% of our forests left.

# Thinking about global warming

KEY WORD

global warming

## Learning objectives:

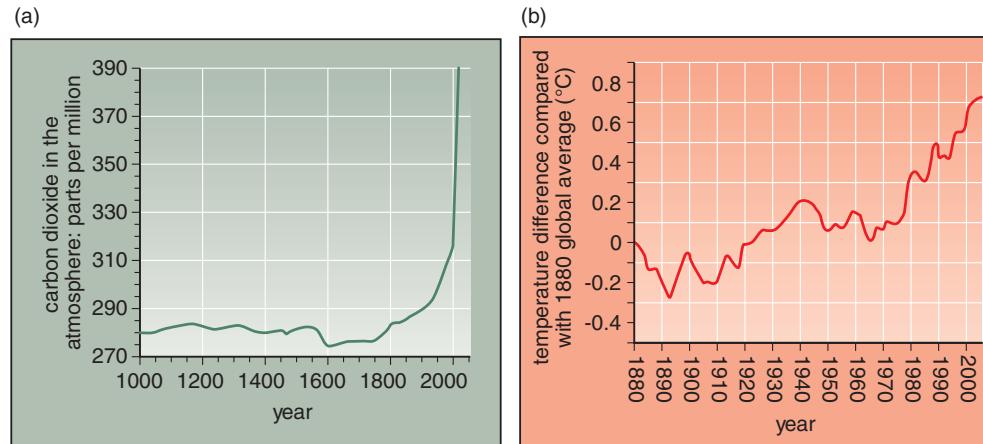
- recall what global warming is
- describe the causes of global warming
- explain how global warming impacts on biodiversity.

The future of the human species on Earth relies on us maintaining a good level of biodiversity, yet we are threatening it by our actions.

## What is global warming?

The average global temperature of the Earth and its atmosphere is increasing. This is **global warming**. It is caused by increasing atmospheric levels of:

- carbon dioxide
- methane.



**Figure 8.48** (a) CO<sub>2</sub> in the atmosphere 1000–2012; (b) temperature difference from 1880 global average temperature, 1880–2012. What do these graphs tell you?

These gases occur naturally in the atmosphere, but levels have increased over the last 150 years because:

- power plants burn fossil fuels
- petrol is used as fuel in vehicles
- rice crops and cattle farming are increasing
- deforestation and destruction of peatlands are increasing.

As the human population increases more pollution is produced from fossil fuels, particularly by relatively small populations in developed countries.

- What is global warming?
- What causes global warming?

## Impact on ecosystems

Scientists think that global warming is changing the climate. The average world temperature rise is small (about 0.8°C since 1880), but some species such as coral reefs are sensitive to this.

- 3** How do human actions affect global warming?
- 4** Explain how global warming might affect biodiversity.

### Case studies

The white lemuroid possum is the first mammal in Australia to have become almost extinct due to global warming. There are just four known adults left. The white possum's habitat spans cooler areas of high-altitude rainforest. Possums are vulnerable to increases in environmental temperature because they cannot maintain their body temperature.

Little terns are vulnerable to high tides and storms. These are happening more often because of global warming. Little terns migrate to the UK each spring and make their colonies just above the high tide line. Their nests are vulnerable to flooding by stormy seas.

Coastal mangrove forests grow in equatorial regions. Increasing numbers of storms and typhoons are undermining the fine sediment that the mangroves grow in. Seedlings cannot root and essential nutrients for the mangrove ecosystems are washed away.



Figure 8.49 Penguins are losing their habitats. Where else can they survive?

#### REMEMBER!

Learn three ways that global warming affects biodiversity.



Figure 8.50 How does global warming affect little terns?

- 5** Explain how global warming affects biodiversity.

#### DID YOU KNOW?

If sea levels rose by 1 m, half of the world's important coastal wetlands would be threatened.

# Looking at waste management

## Learning objectives:

- describe how waste production is linked to human population growth
- describe the impact of waste on ecosystems
- explain how waste impacts on biodiversity.

KEY WORD

.....  
sewage

As our population keeps increasing, so our impact on the environment and biodiversity is also increasing.

## Pollution

Human population growth and living standards are increasing, particularly in developed countries. We use more resources.

As living standards increase, the demand for agriculture, manufacturing and industry increase, producing more waste.

Domestic and industrial waste must be handled correctly to avoid causing more pollution.

Waste substances include:

- sewage
- smoke and toxic gases
- herbicides, pesticides and fertilisers
- lead
- paper and cardboard
- plastic products.

Waste can kill plants and animals and reduce biodiversity.



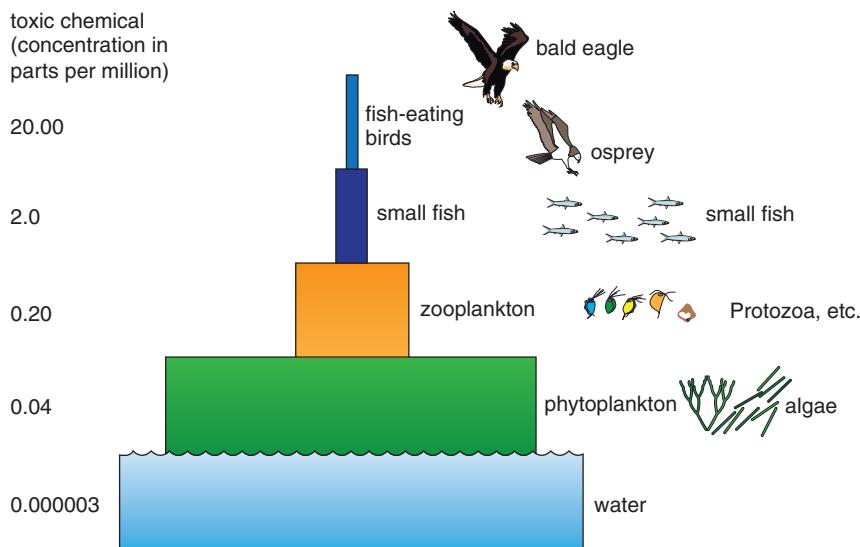
**Figure 8.51** Waste tips reduce biodiversity. They are home to decomposers and some birds

- 1 Why is the amount of waste we produce increasing?
- 2 Name three types of waste produced by people.

## Waste and ecosystems

Causes of pollution include:

- Fertilisers. These can enter waterways, causing eutrophication.
- Toxic chemicals from household and industrial waste. If taken to landfill sites, they can spread into soil and enter waterways. Pesticides and herbicides are also washed into waterways. Toxins build up in food chains, kill organisms and affect feeding relationships.



**Figure 8.52** Dangerous levels of toxic chemicals can build up through trophic levels

- Sewage. If untreated, chemicals and parasites can enter waterways. Microorganisms that decompose sewage use dissolved oxygen, causing aquatic organisms to die.
- Smoke and gases. Soot in smoke covers and damages trees; organisms may find breathing difficult.

### 3 How do human actions affect water quality?

### 4 Suggest how soot damages trees.

#### REMEMBER!

Learn how and where pollution is produced.  
Remember: pollution reduces biodiversity.

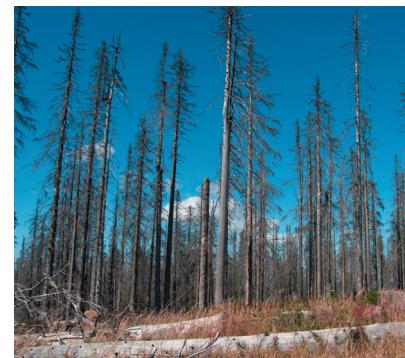
## Acid rain

Acidic gases are produced when fossil fuels burn. They dissolve in water vapour to make acid (about pH 4). Acid rain:

- damages leaves and roots of plants
- washes mineral ions out of soil, causing mineral deficiencies in plants
- washes aluminium ions from soil into lakes, which affects gills in fish and they cannot survive
- acidifies waterways, so aquatic organisms cannot survive
- can travel in air; acid rain produced in the UK has affected trees and fjords in Norway.

Pollution reduces the available space for other organisms; some species cannot survive. We need to balance our development while sustaining the environment for future generations. Many countries (including the UK) have legislation that controls the use of toxic chemicals, use of landfill sites and treatment of sewage.

### 5 Explain how dangerous levels of toxic chemicals can build up through trophic levels.



**Figure 8.53** How does acid rain affect trees?

#### DID YOU KNOW?

The Mbeubeuss waste tip in Senegal is one of the world's largest waste tips, receiving 475 000 tonnes of rubbish a year. It covers about 175 hectares (around 266 football pitches).

# Investigating pollution

## Learning objectives:

- identify pollution levels using indicator species
- explain how indicator species measure pollution
- compare different methods of measuring pollution.

## KEY WORD

**indicator species**

**Scientists monitor environmental change to understand how it affects living organisms.**

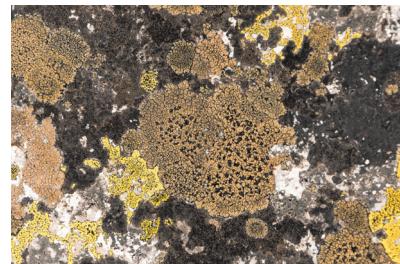
## What is an indicator species?

Living organisms are sensitive to different abiotic conditions. If conditions change – for example, through pollution – the distribution of organisms can also change. Some organisms are used to measure environmental change. They are called **indicator species**.

Lichens grow on trees, roofs and rocks. They are rarely found growing in cities because they cannot survive in polluted air. The sampling of numbers and types of lichens informs scientists about pollution levels.

Lichens are sensitive to sulfur dioxide concentrations in the air.

Very few types and numbers of lichens grow near power stations. The further away they are, the greater the number and different species that are found.



**Figure 8.54** The cleaner the air, the leafier the lichens that grow. (a) Leafy lichen; (b) crusty lichen.

## 1 How does pollution affect living organisms?

## 2 What is an indicator species?

## More indicators

Pollution also affects the distribution and numbers of animals. Aquatic invertebrates are used as indicators of pollution and dissolved oxygen in water, as shown in the following table.

- Sludge worms can live in polluted water. This is because they are adapted to cope with the low oxygen levels in polluted water.
- Mayfly larvae can live in slightly polluted water. There is sufficient oxygen for their needs.
- Alderfly larvae cannot live in polluted water. They cannot survive when oxygen levels are low.



**Figure 8.55** Power stations produce sulfur dioxide

Animal	Sensitivity to pollution
stonefly larva	sensitive
water snipe fly larva	sensitive
alderfly larva	sensitive
mayfly larva	semi-sensitive
freshwater mussel	semi-sensitive
damselfly larva	semi-sensitive
bloodworm	tolerates pollution
rat-tailed maggot	tolerates pollution
sludgeworm	tolerates pollution

Pollution affects the distribution of aquatic invertebrates

Water containing lots of different species is a healthy environment.

Pollution levels are also measured directly using:

- probes attached to computers to measure precise conditions, for example, pH, temperature, oxygen and carbon dioxide
- special tests to indicate levels of different chemicals, for example, nitrates.

- 3 A water sample from a river contained sludgeworms but no stonefly larvae. Is the water polluted? Explain your answer.  
 4 Suggest two methods to measure the pH of a stream.

## Using indicator species

The animals in three different aquatic habitats near a town were sampled and identified. Unfortunately, the names of the habitats came off the sample jars. The samples were taken from a polluted pond, a stagnant pool near a water outlet and a fast-running stream.

Sample	Animals found
A	stonefly larva, mayfly larva, damselfly larva, alderfly larva, water snipe fly larva
B	rat-tailed maggot, sludgeworm, bloodworm
C	sludgeworm, damselfly larva, freshwater mussel

- 5 Which sample came from which habitat?  
 6 Which sample contained the least dissolved oxygen? Explain your answer.  
 7 Suggest one advantage and one disadvantage of using chemical tests instead of indicator species to test for pollution.

### DID YOU KNOW?

Coral reefs are water quality indicators because they only tolerate narrow ranges of temperature, salinity and water clarity.

### REMEMBER!

Pollution alters the numbers and distribution of plant and animal species.