Humans and the Environment
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Pressure on ecosystems

- Pollution
- Deforestation
- Measuring change
- Summary activities
Ecosystem services

Ecosystems provide clean air, water, soil, minerals, plants, animals, etc. on which humans depend. These factors are called ecosystem services.

Sustainability is important to ensure that the needs of the present are met without affecting the ecosystem services for future generations.

However, the growth in population is putting more pressure on our natural resources. When plants, water, fuel, etc. are consumed more quickly than they are replaced, this leads to environmental degradation and a loss of biodiversity.
What is biodiversity?
What is biodiversity?

**Biodiversity** is the number and variety of organisms found in an area. This includes:

- the variety of different species – how many different types of birds, animals, fungi, bacteria, etc.

- genetic variation within species – inherited differences between members of the same species.

High levels of biodiversity makes an ecosystem more able to cope with environmental changes. However, as the human population rises, more land is needed for building, agriculture, landfill sites, etc. This leads to a loss in biodiversity.
Rate of population growth

How is the world's population changing?

Population (billions):
0 2 4 6 8 10 12

Year:
1750 1800 1850 1900 1950 2000 2050 2100 2150
What impact will population growth have on the

Some of the resources we use are finite, which means they will eventually run out. Brainstorm the impacts that population growth will have on the environment, then press on the buttons in this mind map to check your ideas.

Press **start** to begin.
Changing the balance of the ecosystem

Our use of natural resources is not always sustainable, for example over-fishing and deforestation.

Human activity can unbalance the **closed loop system** of ecosystems by altering the inputs and outputs.

For example, the formation of fossil fuels takes millions of years. Humans are using them at a much faster rate than their formation.

Fossil fuel emissions include carbon-based outputs that are not used up in an ecosystem at the same rate.
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What are pollutants?

Where do pollutants come from?

One of the biggest problems of a rising population is an increase in pollution. A pollutant is a substance that contaminates air, water or land. Press on each image to learn more. Press "start" to begin.

start
Land pollution

Land and soil can be polluted by two main types of substance:

- **solid waste** – such as plastic, metal, paper and other man-made substances
- **chemicals** – such as herbicides and pesticides, crude oil and waste from industrial processes.

Land pollution often leads to water pollution, as chemicals are washed into rivers and lakes.
Water pollution

Sewage, industrial waste, oil, pesticides and fertilizers all pollute water.

Fertilizers and sewage can easily be washed into rivers, streams and lakes. Nutrients in these substances, such as phosphates and nitrates, cause eutrophication.

Eutrophication is the accumulation of nutrients in water, which causes excessive algal growth. This leads to a reduction in oxygen levels and the death of aquatic life.
Eutrophication is a serious problem caused by water pollution.

Press "play" to find out more.
Stages of eutrophication

What is the order of stages in eutrophication?

1. Fertilizers and liquid nutrients wash into the water.
2. Fish and invertebrates die from lack of oxygen.
3. Algae starts to grow rapidly, blocking out the light.
4. Oxygen levels drop as microbes feed on dead plants.
5. Plants below the surface of the water die.
Types of water pollutants

Some pollutants can build up in food chains, causing harm to aquatic organisms. These chemicals tend to be very stable compounds that are not easily broken down in the natural environment.

- **PCBs** are chemicals used in coolants and insulating fluids in electrical equipment. Their use was banned in 1978.

- **DDT** is a chemical that was widely used as an insecticide, helping to control populations of disease carrying insects. It was banned in 1972.

It is thought that these chemicals can cause a variety of problems in animals higher up in food chains, affecting the immune system, growth and reproduction.
Bioaccumulation in food chains

How do pollutants accumulate in the food chain?

As a pollutant passes along food chains, it becomes more concentrated and more harmful at each stage. This is called bioaccumulation.

Press "start" to find out how it happens.
Human activity produces two main types of air pollutant:

- **noxious gases**, i.e. carbon dioxide ($CO_2$), sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$)
- **particulates**, which are tiny particles suspended in air.

Air pollution is increasing with population growth because:

- the burning of fossil fuels increases to provide more energy
- an increase in rice and cattle farming to supply more food generates methane, which is 7.5 times more effective as a **greenhouse gas** than carbon dioxide.
The cause and effect of air pollutants

Human activity is changing the composition of the atmosphere.

Press on the buttons below to find out more about the causes and effects of the major atmospheric pollutants.

- carbon dioxide
- carbon monoxide
- sulfur dioxide
- particulates
- nitric oxides
Global warming and greenhouse gases

One of the greatest threats caused by air pollution is **global warming**. Global warming is caused by a build-up of greenhouse gases, which leads to an increase in the Earth’s temperature.

A **greenhouse gas** is an atmospheric gas that absorbs infrared light.

Key greenhouse gases include:

- carbon dioxide (CO$_2$)
- methane (CH$_4$)
- water vapour (H$_2$O)
- nitrous oxide (N$_2$O).
The greenhouse effect

What is the greenhouse effect?

Certain gases in the Earth's atmosphere are **greenhouse gases**.

Press "play" to find out why they are called this.
Are temperature and CO₂ related?

The global average temperature has increased at the same time as the levels of carbon dioxide have risen. However, it is not correct to say that carbon dioxide levels have caused this temperature change, because there are other factors involved.
The effects of global warming

What are the possible effects of global warming?

Select a feature from the drop-down menu below to find out more about the effects of global warming.
**Peat** consists of partially decayed vegetable, organic matter.

Peat bogs can **absorb** a lot of carbon dioxide in our **atmosphere**. However, peat degrades and releases the stored carbon dioxide when it dries out, due to warmer temperatures, poor drainage and over-grazing.

**Peat-free compost** is encouraged to avoid extraction and degradation of peat. As it takes thousands of years to develop, the use of peat as compost is not sustainable.
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Deforestation

The removal of forest habitats to make use of the land is called **deforestation**. Harvesting the timber, and replacing vegetation with agricultural crops and livestock, can have damaging effects on the ecosystem.

- Burning timber releases carbon dioxide into the **atmosphere**.
- Forest habitats are lost, leading to a reduction in biodiversity.
- The level of photosynthesis is reduced, meaning less carbon dioxide is used up in this process.
Deforestation

The destruction of a woodland habitat may mean species are unable to find the resources they need to survive. They may become **endangered** or even extinct.

In Borneo, the orangutan population is slowly declining as forests are slowly being removed to make way for other crops.

In some areas, woodland is cleared to grow crops that can be used to produce **biofuels**.
What are biofuels?

**Biofuels** are renewable fuels produced from plant material, such as agricultural crops.

**Bioethanol** is produced by the natural fermentation of the sugars in certain plants, such as sugar cane or sugar beet.

It can be used in vehicles with conventional engines to decrease the demand for petrol and reduce the burning of non-renewable **fossil fuels**.
There are ethical, environmental and economic **advantages** and **disadvantages** to using alternative fuels, such as bioethanol, instead of fossil fuels.

Click on each tab to find out more.
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Using indicator species

**Indicator species** are organisms that are sensitive to pollutants and environmental changes. Their presence or absence can tell scientists about conditions in a habitat.

To monitor water pollution, scientists can identify and count the invertebrates and other organisms in the water.

To monitor air pollution, scientists can identify and count types of **lichen** on trees and fungi that are sensitive to pollutants in air.
Sampling aquatic indicator species

How to survey aquatic indicator species

To collect data on indicator species in a stream, scientists carry out a survey.

This must be done carefully to ensure the data is accurate.

Press "play" to find out more.
### Improving the survey

**How could the indicator species survey be improved?**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>accuracy</strong></td>
<td>Take a larger sample at each site and use clear keys to identify organisms.</td>
</tr>
<tr>
<td><strong>reliability</strong></td>
<td>Ensure that the indicator species you are looking for are native to that habitat.</td>
</tr>
<tr>
<td><strong>validity</strong></td>
<td>Repeat the survey a few days later or check the results against instrumental readings.</td>
</tr>
</tbody>
</table>
Evaluating indicator species

Are these benefits or drawbacks of using indicator species?

**benefits**

**drawbacks**

- Test for a range of environmental changes simultaneously
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Glossary of keywords: Humans and the Environment

alternative fuel – Fuel not derived from traditional methods; not a fossil fuel.

atmosphere – The layer of gases surrounding the Earth.

bioaccumulation – The accumulation of pollutants in a food chain.

biodiversity – The number and variety of organisms found in an area.

bioethanol – A fuel produced by the natural fermentation
Multiple-choice quiz

Can you manage this quiz about humans and the environment?

Press "start" to begin.