10. A student investigates an exothermic reaction between calcium chloride and water. The table shows the mass values of calcium chloride that the student intends to use. Identify:

TABLE 2.6.10

Mass of calcium chloride (g)	Dependent variable
25	
40	
55	
70	
85	
100	

a) The range of values of the independent variable. [1]

b) The interval of values of the independent variable. [1]

c) Suggest what could be measured as the dependent variable, including a unit. [2]

11. The carbonates of metals X, Y and Z are decomposed. It is found that Z is easier to decompose than X, but harder to decompose than Y. What is the correct order of reactivity of the metals, with the most reactive first? [1]

a) Y, Z, X **b)** X, Y, Z **c)** X, Z, Y **d)** Z, X, Y

12. Magnesium reacts with oxygen to form magnesium oxide. The mass of the magnesium oxide at the end of the experiment is greater than the mass of magnesium at the start because: [1]

a) It burns with a bright light.

b) It gives off carbon dioxide.

c) Magnesium is not very dense.

d) The oxygen has added to the mass of the magnesium.

13. A student weighed a crucible containing steel wool. He then burned the steel wool and reweighed the crucible. The mass after burning would be: [1]

a) less than before **b)** more than before

c) the same as before **d)** zero.

14. A carbon monoxide detector picks up higher levels of carbon monoxide in the lounge of a house than in the dining room. What does this suggest about the type of combustion taking place in each of the room's fires? Explain your answer. [2]

EXTEND. Question 15

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

15. Hydrogen peroxide decomposes to make oxygen and water. The graph in Figure 2.6.10b shows the effect of a catalyst on the reaction. Sketch a graph to show the effect of a better catalyst. What is similar about the two graphs? [3]

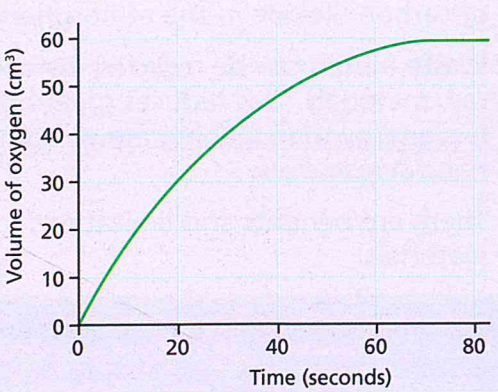


FIGURE 2.6.10b: Graph showing the rate of decomposition of hydrogen peroxide with a catalyst.

Earth
Climate *and* Earth resources

Ideas you have met before

Combustion reactions

When substances react with oxygen to release energy it is called combustion.

The products of combustion depend on the substance reacting with oxygen.

Most fuels release carbon dioxide and water during combustion.

Changing Earth

There are cycles in nature. The water cycle, for example, is the continuous movement of water on, above and below the surface of the Earth.

The Earth's resources are limited and can be damaged by human activities.

Using and re-using the Earth's resources

The Earth has many useful resources, such as metal ores.

The extraction process can damage the environment by, for example, digging mines, pollution caused by waste and subsidence of land.

Some metals are extracted from their ores using carbon, which leads to increased levels of carbon dioxide in the atmosphere.

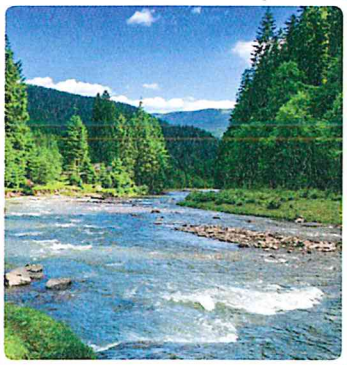
Waste metals can be recycled instead of extracting new raw materials. This reduces greenhouse gas emissions, uses less energy than making metal from its ore and conserves natural resources.

There are benefits and limitations to the recycling of materials.

In this chapter you will find out

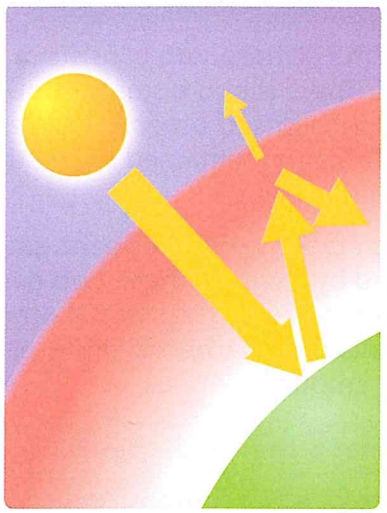
7.0

Carbon is re-used in a variety of ways



- Nature constantly recycles materials – for example, carbon in the carbon cycle.
- Carbon is recycled through natural processes in the atmosphere, ecosystems (such as photosynthesis and respiration), oceans and the Earth's crust.
- It is also used and changed in human activities (such as burning fuels).

Changing Earth



- The Earth's atmosphere has changed over time and is still changing now.
- Some human activities are thought to affect the rate at which the atmosphere is changing.
- Greenhouse gases reduce the amount of energy lost from the Earth through radiation and therefore the temperature has been rising as the concentration of those gases has risen.
- Scientists have evidence that global warming caused by human activity is causing changes in climate.

Using and re-using the earth's resources

- There is only a certain quantity of any resource on Earth, so the faster it is extracted, the sooner it will run out. Recycling reduces the need to extract resources.
- The need to use land for homes, industry and farming must be balanced against the impact on the Earth's resources.
- Most metals are found combined with other elements, as a compound, in ores.
- The more reactive a metal, the more difficult it is to separate it from its compound.
- Carbon displaces less reactive metals, while electrolysis is needed for more reactive metals.

Understanding our atmosphere

We are learning how to:

- Describe the composition of the atmosphere.
- Identify which gases are greenhouse gases.
- Explain how carbon dioxide is released from the burning of fossil fuels.

Our atmosphere consists of the gases around the Earth and is unlike that of any other body in the Solar System. What gases are in our atmosphere? How are they changing?

What is in the atmosphere?

The Earth's **atmosphere** consists mainly of nitrogen and oxygen. There is also a small amount of argon and even smaller amounts of other gases (see Table 2.7.1). Our atmosphere has remained about the same for the past 200 million years.

Nitrogen is the most abundant gas in the atmosphere, followed by oxygen. These two gases make up about 99 per cent of the gases in the atmosphere. The remaining gases, including carbon dioxide, are found in much smaller amounts.

1. What is the atmosphere?
2. Describe the composition of the Earth's atmosphere.

TABLE 2.7.1: Percentages of the main gases in the Earth's atmosphere.

Gas	Percentage
nitrogen	78
oxygen	21
argon	0.9
carbon dioxide	0.04
water vapour	variable
other gases	trace

Fossil fuels

Fossil fuels have an important role to play in affecting the atmosphere. Fossil fuels include gas, oil, coal and peat. They are formed from the remains of living things from millions of years ago, that have been changed by chemical processes deep under the surface of the Earth. They are a useful source of energy and for years people have been extracting them and burning them. This releases large amounts of thermal energy, which can be very useful.

However, the **combustion** of fossil fuels also releases gases, usually including carbon dioxide. Huge amounts of fossil fuels have been, and continue to be, burned and this is altering the make-up of the atmosphere. Later in this chapter we'll be finding out about the greenhouse effect, which involves gases in the atmosphere changing temperatures with potentially catastrophic consequences.

Did you know...?

There is no clear defining line between the Earth's atmosphere and outer space, but most figures estimate that space starts between 80 and 120 km above the surface of the Earth.

FIGURE 2.7.1a: Burning gas releases carbon dioxide.

3. State three examples of processes that involve the burning of fossil fuels.
4. Suggest why fossil fuels are so widely used.

Methane and carbon dioxide

The amount of each type of gas in the atmosphere isn't fixed. Sometimes it alters because of human activities. It might be that gases produced or removed have negative effects.

As well as carbon dioxide, methane is an important gas and also contributes to the greenhouse effect. It is released from many processes, including natural ones but man-made effects include farm animals, rice production and decomposing waste in landfill sites. It is also released from water treatment processes and burning plant material.

FIGURE 2.7.1b: Cattle numbers have increased and this has added to the amount of methane released into the atmosphere.

5. Explain why an increasing world population can cause increased levels of methane in the atmosphere.
6. Explain why recycling more waste and throwing away less material would reduce the amount of methane released.

Know this vocabulary

atmosphere
combustion

Understanding how carbon is recycled

We are learning how to:

- Describe the carbon cycle.

Carbon is found in all living organisms. Most of the chemicals that make up our tissues and organs contain carbon. Where does the carbon come from? What happens to it when we die?

Natural recycling

Living organisms have been recycling materials for millions of years. Decomposers such as bacteria and fungi break down waste along with dead and decaying organisms. They release the chemical elements they contain, including carbon, available again for living organisms to use for growth. Carbohydrates, proteins and fats all contain carbon.

The main way that carbon enters food chains is as carbon dioxide from the air. All producers in the oceans and on land use carbon dioxide to make carbohydrates such as glucose. The carbon is then passed on to the next organism in the food chain.

1. Explain how carbon gets into the food chain.
2. What is the role of decomposers in the **carbon cycle**?

FIGURE 2.7.2a: These are phytoplankton – microscopic plants. Why are plants so important in the carbon cycle?

Explaining the carbon cycle

Carbon, in carbon dioxide, is released by respiration and combustion into the atmosphere. Green plants remove carbon dioxide from the air when they photosynthesise. They trap the carbon in compounds such as glucose. The carbon then passes from organism to organism along food chains. Each organism returns carbon dioxide to the air during respiration.

Decomposers return carbon dioxide to the air when they feed on dead and decaying matter. In certain conditions, decomposition cannot happen and the carbon in dead organisms is trapped in the Earth. Over millions of years this trapped carbon is changed into fossil fuels. Combustion (burning) then returns carbon dioxide to the atmosphere.

FIGURE 2.7.2b: Green plants convert carbon dioxide to carbohydrates by photosynthesis.

These processes form the carbon cycle, summarised in Figure 2.7.2c.

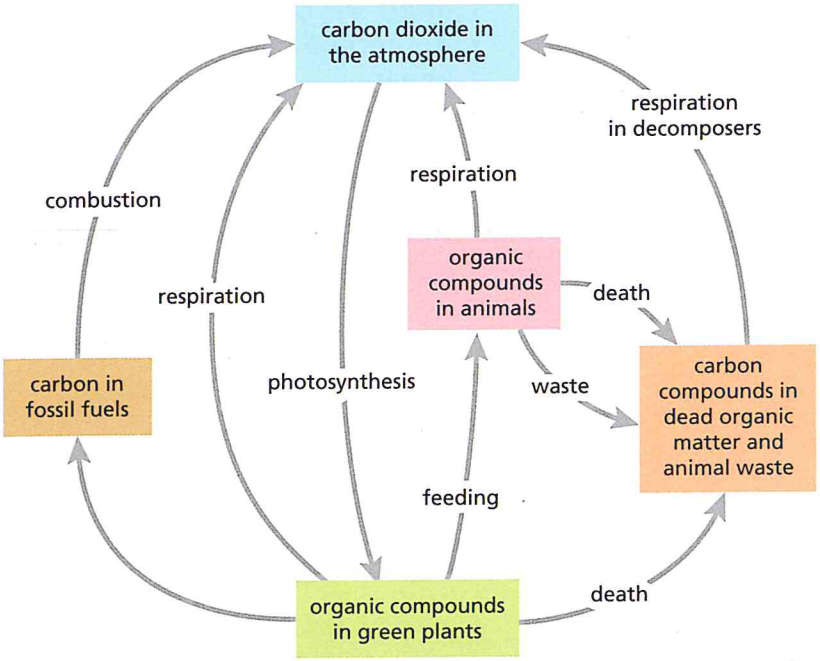


FIGURE 2.7.2c: A simple summary of the carbon cycle.

3. Name four sources of the carbon dioxide in the atmosphere.

4. How is carbon removed from the atmosphere?

Carbon sinks

The amount of carbon in the Earth and the surrounding atmosphere is fixed. What matters is the form in which this carbon exists. The more of it that is in the form of carbon dioxide, the more problems it causes as this is a greenhouse gas and adds to the effects of global warming. Some carbon is in other forms, such as in the oceans, as fossil fuels and in the soil. This doesn't add to the amount of greenhouse gas.

Ways of storing carbon so it isn't in the atmosphere are known as **carbon sinks** (or carbon stores). These are natural, but some scientists are interested in ways of increasing carbon storage. Some ways of doing this involve enhancing natural processes, such as planting more forests and changing the way land is farmed. Other ways, however, involve ideas such as injecting sea water with carbon dioxide, storing it underground or combining it chemically with **minerals**.

5. What is a carbon sink?

6. Why is there interest in removing carbon from the atmosphere?

7. Why do forests and woodlands reduce the amount of carbon dioxide in the atmosphere?

Did you know...?

The oceans and some rocks can store carbon for many years and are known as carbon 'sinks'.

Know this vocabulary

carbon cycle
carbon sink
minerals

Exploring how humans affect the carbon cycle

We are learning how to:

- Understand that human activitie affect the carbon cycle.
- Appreciate the scale of this impact.
- Explain how the impact relates to carbon stores as well as carbo dioxide producers.

We don't just live on the Earth – we change it. The Earth is a different place because of humans. We have changed the atmosphere, the seas and the surface of the land in many places. Thanks to us, some animals are much less common and others much more so. One of the things we have changed is the way that carbon is cycled.

Humans make a difference

If we were to do something fairly common, such as go to the garage, fill our car up with fuel and use it to go for a day out, we have affected the carbon cycle. The fuel that we put in the car was made using oil, a **fossil fuel**. By using this we have reduced the amount of oil left.

Driving the car involved burning the fuel. It used the process of **combustion**. This added to the amount of carbon dioxide in the atmosphere.

In fact, simply by eating and breathing, we have moved carbon around its cycle. We have eaten food (which grew, or which ate something that grew). This decreased the number of plants and we breathed out carbon dioxide.

FIGURE 2.7.3a: Filling up the car – how does this affect the carbon cycle

1. Would it have made any difference to the carbon cycle if our day out had been:
   - **a)** by bus?
   - **b)** by electric train?
2. Why does it matter if there's more carbon dioxide in the atmosphere?
3. How do farm animals affect the carbon cycle?

Ve make a big difference

The carbon cycle existed long before humans did of course, and there have been animals (and plants) respiring for millions of years before humans first walked on the surface of the Earth. In fact, for many years, people didn't affect the movement of carbon much. All that has changed in the last few hundred years.

We have used up a huge amount of the available fossil fuels through burning them and this has released large volumes of carbon dioxide into the atmosphere. These fuels have been used to provide transport, generate electricity and power factories to make things.

We have also changed the way that we use land. Large areas have been cleared of natural **vegetation**. The dense growth that has been removed stored much more carbon than the crops planted in their place.

4. Why have most of these changes only happened within the last few hundred years?
5. Why have we cleared large amounts of land over the years?
6. How has population growth affected land usage?

ncreased sources – and reduced stores

Not only have we added to the processes that produce carbon dioxide, but also we have reduced the ways that it is removed. Looking at the carbon cycle, the way that carbon dioxide is removed from the atmosphere is by **photosynthesis**. Plants use carbon dioxide in the process of releasing energy from sunlight. If we grow, or allow to grow, fewer plants or smaller plants, their need for carbon dioxide is less.

7. Why is photosynthesis crucial to the carbon cycle?
8. How have humans affected the way that nature removes carbon dioxide from the atmosphere?
9. Why is this something we should be concerned about?

FIGURE 2.7.3b: Palm oil plants growing in areas where rain forest has been cleared.

Did you know...?

Burning one litre of petrol (such as in a car engine) produces 2.4 kg of carbon dioxide. This amount of fuel will enable a small modern car to travel about 20 km.

Know this vocabulary

fossil fuel
combustion
vegetation
photosynthesis

Understanding global warming

We are learning how to:

- Describe the effects of global warming.
- Explain the consequences of global warming for living things.
- Evaluate the arguments for human activity impacting global warming.

The greenhouse effect is a natural phenomenon that allows the Earth to be warm enough to support life. Without it the average temperature of the Earth would be –18 °C. What causes the greenhouse effect and how does human activity affect it?

What is global warming?

The Sun's radiation passes through the atmosphere, is absorbed by the Earth's surface and is re-radiated as heat. Some of this heat is absorbed or reflected by greenhouse gases in the air instead of escaping into space, causing the atmosphere to warm up.

Human activities have caused higher **concentrations** of greenhouse gases in the atmosphere. Scientists think that this increase has thrown the natural **greenhouse effect** out of balance. The atmosphere is trapping too much heat and causing the temperature of the Earth to rise. This is known as the 'enhanced greenhouse effect' or **global warming**.

1. What is the natural greenhouse effect and why is it important for life on Earth?
2. Name three greenhouse gases and identify where they come from.

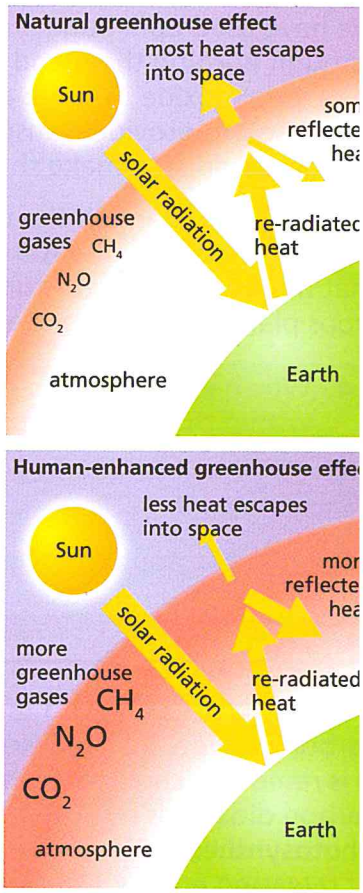


FIGURE 2.7.4a: Comparing natural and human-induced greenhouse effects, including the role of carbon dioxide (CO_2), nitrogen oxides (N_2O) and methane (CH_4).

The impact of global warming

A rise in the global mean temperature will cause climate change, which may result in:

- polar ice sheets melting, causing sea levels to rise, low-lying areas of the world becoming submerged and habitat loss for many species
- some areas having less available water, causing food shortages, drought and desertification of land
- longer growing seasons in temperate regions and faster growth for some crop species due to increased carbon dioxide concentrations

- agricultural pests thriving in warmer environments
- tropical diseases, for example malaria, affecting a larger area
- an increase in severe weather events.

Scientists agree that the Earth's temperature has risen over the last century and that carbon dioxide is one of the greenhouse gases that cause global warming. Some disagree over whether global climate change is part of a normal cycle or not, and about how big a problem it could become.

3. Explain how global warming might affect polar bears, penguins and mosquitoes.

4. Suggest how global warming might affect global food security.

FIGURE 2.7.4b: If the polar ice caps melt, will the wildlife survive?

Are we to blame?

The Earth's average temperature increased by about 0.5 °C over the last century. It is projected to rise between 1.4 °C and 5.8 °C in the next 100 years. The Earth's climate has changed naturally throughout its history, but the current rate of change has not been seen in the last 10 000 years.

Most research shows that human activities are accelerating global warming.

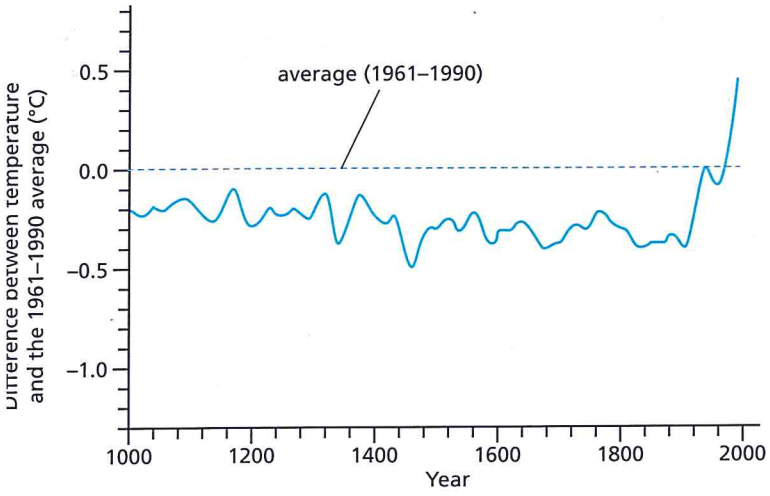


FIGURE 2.7.4c: A graph showing climate change using data from The Intergovernmental Panel on Climate Change (IPCC).

5. Explain why scientists believe that global warming is happening.

6. Look at the data in the graph in Figure 2.7.4c. Describe what the graph shows. What conclusions can you draw about global warming from the data?

Did you know...?

The United Nations Sustainable Development Goals are an internationally agreed set of goals focused on making better and fairer use of the Earth's resources by 2030.

They include Goal 17: Take urgent action to combat climate change and its impacts.

Know this vocabulary

concentration
greenhouse effect
global warming

Exploring damage to the Earth's resources

We are learning how to:

- Describe resources that the Earth provides.
- Explain how human activity limits these resources.
- Justify decisions about making changes to the environment.

The Earth has limited resources that we rely on for survival. How have our activities affected these resources? How can we protect them for the future?

The Earth's vital resources

The Sun's energy, the wind, the tides and geothermal heat are some of the Earth's **natural resources** that you have already studied. The Earth provides many other resources, from the air we breathe and the wood and rocks used for building, to the minerals that we refine into metals. Life as we know it would not be possible without these precious resources, but as we process them, pollution is produced.

Other natural resources that are vital to our survival include:

- biological resources (plants and animals)
- land
- fossil fuels
- metal ores
- water.

FIGURE 2.7.5a: Which natural resources can be seen here?

Natural resources are often classified as **renewable** or **non-renewable resources**.

1. Choose six natural resources. Describe why we need each one and how we use it.
2. Classify each of the resources identified in question 1 as renewable or non-renewable.

Did you know...?

Water is abundant on the Earth, but 97 per cent of the water is salt water in the oceans. Only 3 per cent is in fresh water lakes and rivers.

Damaging the planet

As the human population increases, so do pollution and environmental damage. Developed countries use the majority of the world's resources. About 25 per cent of the world's population are causing 75 per cent of the damage to the environment. Areas that are most vulnerable to damage are those that are easily accessible and supply natural resources that are in high demand.

Mining provides precious gems, coal for making electricity, and ores from which metals are extracted. It also causes pollution and leaves scars on the landscape. This environmental impact means that the mining is not **sustainable**. Other examples of unsustainable activities are oil extraction, deforestation, over-fishing the seas and intensive farming (producing more food from the same area of land). To get the most out of their land, farmers who use intensive farming sometimes cut down hedgerows, which results in habitat loss and affects food chains. They also use chemicals – for example, pesticides and fertilisers, which pollute the land and waterways, killing organisms and disrupting food chains.

3. Why are some natural resources more vulnerable to human activities than others?

4. Look at Figure 2.7.5b. How has this damage occurred?

Making sustainable decisions

Deforestation in the Amazon rainforest is becoming a major issue. Huge areas of the rainforest are cleared annually to:

- increase the land available for farming soya and cattle
- allow mining
- flood the land for use in hydro electric power stations
- sell the timber.

However, once the trees have been cut down, the soil quickly becomes less fertile, making farming difficult. Wildlife is lost and local tribespeople are forced off the land and lose their traditional cultures. Global impacts include loss of biodiversity (including valuable medicinal or crop plants) and increased carbon dioxide levels in the atmosphere.

5. Explain why there has been a loss of biodiversity in the Amazon.

6. Suggest how we could manage the Amazon's resources in a more sustainable way.

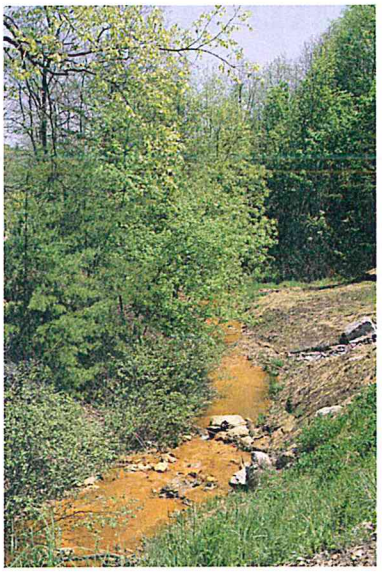


FIGURE 2.7.5b: Drainage from surface coal mines can pollute nearby streams.

FIGURE 2.7.5c: The lush biodiversity of the Amazon rainforests is being destroyed.

Know this vocabulary

natural resource
renewable
non-renewable
sustainable

Considering the importance of recycling

We are learning how to:

- Describe examples of recycling.
- Explain the benefits and limitations of recycling schemes.
- Compare the efficiency of recycling methods.

Recycling is the collection and processing of waste materials to make new products. What materials can be recycled and why do we recycle?

Why recycle?

UK households produce about 82 000 tonnes of rubbish every day. Each week, a typical family in England or Wales uses an average of:

- 7 glass bottles or jars
- 14 food or drinks cans
- 8 plastic bottles
- 4 kilograms of paper.

Continuing to burn or dump this amount of rubbish is unsustainable – **recycling** is a sustainable alternative. It reduces the demand for natural resources, including fossil fuels. It also causes less pollution and release of greenhouse gases, and less waste is sent to **landfill**.

Many materials can be recycled, including batteries, mobile phones, clothes and wood. Currently we recycle about 43 per cent of our household waste, though this varies across the country.

1. Name ten materials that can be recycled.
2. Use Table 2.7.6a to draw a bar chart showing the time taken for different materials to decompose.
3. Suggest why paper milk cartons take so long to decompose.

The limitations of recycling

Disadvantages of recycling are that recycling sites can produce pollution and they may be unsafe and unhygienic. The initial costs of recycling plants can be very high and some processes use a lot of energy. The separation of useful

FIGURE 2.7.6a: How do landfill sites damage the environment?

TABLE 2.7.6a: Some materials take hundreds of years to decompose.

Material	Time taken to decompose
paper	2–4 weeks
paper milk cartons	5 years
plastic bags	1020 years
cans	100 years
plastic bottles	450 years
glass bottles	500 years
rubber	80–2000 years

material from waste can be difficult and recycled products are often not high quality (for example, paper) or durable (for example, textiles). Finally, many of the resources saved are not that rare.

4. Why is reducing the demand for natural resources an advantage of recycling?
5. Suggest why recycling sites may be unsafe and unhygienic.

Making sustainable decisions

There is much debate over the efficiency of recycling. Experts have conducted detailed life cycle analysis of recycled goods, estimating the energy used from collecting to processing. The efficiency compared to using new raw materials varies dramatically depending on the material. However, in most cases the energy needed to extract and process natural resources is much higher than that used to recycle the same material. Recycling therefore reduces the negative impact on the environment.

Recycling materials like metals and glass is fairly efficient. However, some materials have to be **'down-cycled'** into products that cannot themselves be recycled. For example, soft-drink bottles made from PET (a plastic) end up as polyester fibres in clothes or carpets.

There is no economic incentive for people to recycle – the cost is zero for the consumer whether they throw their rubbish away or recycle it. The industry has therefore struggled for consistent amounts of materials to recycle. China now imports vast amounts of waste in order to recycle things like paper.

TABLE 2.7.6b: How much more efficient is aluminium recycling compared to glass recycling?

Material	Reduction in energy needed to recycle rather than use raw material (%)
aluminium	96
glass	21
plastic	76
newsprint	45

6. Explain why it is efficient to recycle aluminium.
7. Suggest why China imports waste paper to recycle.

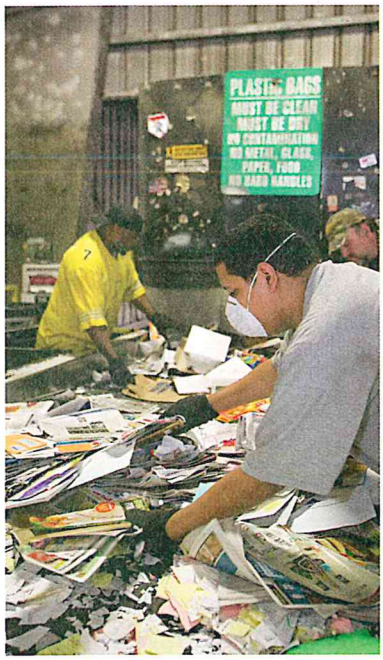


FIGURE 2.7.6b: Why is this worker at a recycling plant wearing a mask?

Did you know...?

In Brazil old car tyres are cut up to make the soles for beach sandals. The rubber is hard wearing, waterproof and gives a good grip.

Know this vocabulary

recycling
landfill
down-cycle

How to extract metals

We are learning how to:

- Understand that most metals are found as ores.
- Understand how less reactive metals can be extracted.
- Understand how more reactive metals can be extracted.

That are lots of different metals and they vary a great deal in terms of how reactive they are. For example, gold is extremely unreactive and is mined as a pure metal. However, potassium is far more reactive; if a fresh face is cut it will rapidly oxidise.

FIGURE 2.7.7a: The gold in this mask is so unreactive that it is still shiny over 3000 years after being made.

Getting the metals we need

Most metals found in the ground have reacted with other elements, often oxygen, sulfur or carbon. They have formed compounds. If we want the pure metal, we have to find a way of getting rid of the other chemicals that had joined with it. Sometimes it's fairly easy to do that and sometimes it's harder. We call this separation process '**extraction**' and if it is more difficult, the price will be pushed up. The more **reactive** the metal, the harder it is to extract it.

Tin, for example, is used to coat steel cans for food storage. The steel is strong but would rust, so it's coated with tin. Tin is extracted from tin **ore**, which is known as cassiterite which is an impure tin oxide.

1. Which elements are present in tin oxide?
2. What does pure tin look like?

FIGURE 2.7.7b: Tin cans are actually made out of steel but coated with tin to prevent them from rusting.

Extracting less reactive metals

If the ore is an oxide, a fairly easy way of extracting the metal is to heat the ore with something more reactive. With some ores, carbon works well. For example, iron ore (which is iron oxide) mixed with coke (a good source of carbon) and heated will react. The carbon will react with the oxygen and leave the iron behind. The temperature needs to be high and the equipment has to be able to cope with molten iron, but it works effectively.

'his process produces iron and we have used it for many 'ears to produce the metal, either to use as it is, or to then :overt into steel. Iron has been used to build bridges and nake gates, and steel is used for car bodies and cutlery.

IGURE 2.7.7c: Making iron involves heating the ore strongly with coke. Other ıgredients, such as limestone, are added to remove impurities from the iron. Air is lasted in and the temperatures are well over 1000 °C.

3. In this reaction, which is more reactive – the carbon or the iron?
4. When the carbon reacts with the oxygen, what does it form?
5. What will determine which other metal ores you could extract the metal from in the same way?

xtracting more reactive metals

f the metal is more reactive than carbon, roasting it with oke won't work. Aluminium, for example, is more reactive han carbon, so a different method has to be found. In this ase **electrolysis** is used. The ore is turned into a molten orm and electricity passed through it.

'his is a more expensive process; it needs a high emperature and electrolysis uses a lot of energy. Aluminium ; useful though; it is lighter than steel and won't rust. 'his means that recycling is important; melting down used luminium takes less energy than making it from the ore.

6. Why bother with aluminium if it is more expensive to make than iron?
7. Why does the recycling of aluminium make a lot of sense?
8. Apart from reduced energy requirements, why else might it be a good idea to make aluminium from recycled material rather than from ore?

Did you know...?

Tin cans were first used for food storage over 200 years ago. However, as each can had to be handmade and the food took six hours to prepare, the cost was far in excess of what most people could afford. Tin cans were used in expeditions by the Navy.

Know this vocabulary

extraction
reactive
ore
electrolysis

Checking your progress

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

☐ Name the main gases in the atmosphere and describe the composition of the atmosphere.	☐ Describe how the gases in the atmosphere, and their relative proportions, have changed over time.	☐ Explain how plants and then animals have changed the atmosphere over time using different processes.
☐ Identify natural resources that the Earth provides.	☐ Explain how human activities limit or damage resources.	☐ Compare the advantages and disadvantages of a human activity in terms of its impact on the environment and suggest whether or not it should be allowed.
☐ Explain how global warming affects living organisms.	☐ Suggest why scientists have different opinions about global warming and its effects.	☐ Evaluate the arguments for and against human activities enhancing the global warming effect.
☐ State examples of natural activities that involve reactions with carbon.	☐ Describe the carbon cycle as natural recycling and name the different ways that carbon enters and leaves the atmosphere.	☐ Explain how each stage of the carbon cycle affects the amount of carbon in the atmosphere.

- State examples of human activities that involve reactions with carbon.
- Explain how human activities that involve reactions with carbon may damage the environment.
- Evaluate ways of reducing the negative impact of human activities on the environment.
- Identify greenhouse gases.
- Explain the effect of greenhouse gases on the environment.
- Suggest the various impacts of reducing greenhouse gas emissions.
- State examples of metals that need to be extracted from ores.
- Explain how metals can be extracted from their ores.
- Evaluate the case for recycling particular metals.
- Name some materials that can be recycled.
- Describe the benefits of recycling.
- Identify limitations of recycling.

Questions

KNOW. Questions 1–5

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

1. Which of these statements is incorrect? [1]

- **a)** Methane is a greenhouse gas
- **b)** 21 per cent of the Earth's atmosphere is oxygen
- **c)** The soil is a carbon sink; it absorbs and stores carbon
- **d)** An ore is a rock that contains minerals.

2. What caused the amount of oxygen in the Earth's early atmosphere to increase? [1]

- **a)** respiration
- **b)** volcanic activity
- **c)** photosynthesis
- **d)** earthquakes and uplift.

3. What was the major cause of the decrease in carbon dioxide levels in the Earth's early atmosphere? [1]

- **a)** it was locked up in fossil fuels and sedimentary rocks
- **b)** volcanic activity
- **c)** it formed the oceans with condensed water vapour
- **d)** photosynthesis.

4. Which one of these does not add to the amount of carbon compounds in the atmosphere? [1]

- **a)** photosynthesis
- **b)** decaying animal remains
- **c)** burning fossil fuels
- **d)** respiring animals.

5. Explain why carbon can be used to extract iron from iron ore but not aluminium from aluminium ore. [2]

APPLY. Questions 6–7

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

6. If aluminium is made from aluminium ore, it requires a temperature of around 900 °C whereas scrap aluminium melts at around 650 °C. Suggest two reasons why recycling aluminium is a good idea. [2]

7. Rory says that he doesn't know what all the fuss is about burning fossil fuels and releasing carbon dioxide into the atmosphere. After all, he says, we're not adding to the total amount of carbon in the carbon cycle – that's fixed. All we're doing is recycling it. Explain why he is right about the amount of carbon but wrong that burning fossil fuels doesn't matter. [2]

EXTEND. Question 8

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

8. Some organisations encourage people to (in this order): 'Reduce, re-use, recycle' in order to make use of resources. Suggest why these words are used and why in this order. [3]

Organisms
Breathing *and* Digestion

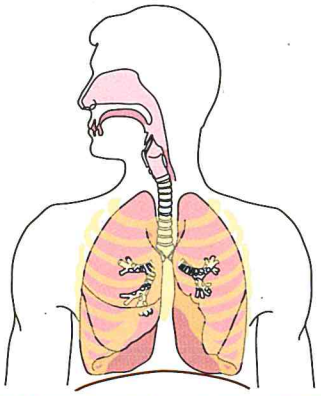
Ideas you have met before

Breathing and gas exchange

Animals, including humans, need air to survive.

Breathing is taking air in and out of our lungs.

The air around us contains oxygen.



Diet and nutrition

Animals cannot make their own food and must eat plants or other animals for energy.

Humans must eat a balanced diet containing the correct types of food to stay healthy.

Digestion

We have different types of teeth and each type has a different role in breaking down food.

Several parts of the body help us to digest food – such as teeth, stomach and intestines.

Each part of our digestive system has a different job to do.

Nutrients from digestion are transported round the body in the blood.