

- 1 Work with a partner. Discuss what you know about the stock market crash in 1929.
- 2 Read the text. Complete the gaps 1–5 with the headings A–E.
 - A The Crash
 - B Investors and speculators
 - C The Great Depression
 - D Recovery
 - E The boom years in the 1920s

- 3 Read the text again. Answer the questions.
 - 1 Why were the 1920s an exciting time in America?
 - 2 Why did people invest a lot of money in shares?
 - 3 Which industries started to fail after 1929?
 - 4 What happened on Black Tuesday?
 - 5 Why did the US stock market crash affect the rest of the world?
 - 6 How many American people were unemployed in 1933?
 - 7 What did people who did not have enough money to buy food do?
 - 8 How did President Roosevelt try to solve the problems?

1 _____

The 1920s were exciting times in America. War had ended, the economy was doing well and there was a feeling of social liberation. In 1928, America was an economic success. The Republican president Herbert Hoover was confident about the country's prospects. During this decade the US stock market expanded rapidly, reaching a peak in August 1929.

2 _____

The 1920s were a period of speculation where people had invested lots of money in shares. People who had never bought stocks and shares invested in the stock market because they thought it was possible to get rich quickly. As more people invested, prices rose. By 1928, the stock market was doing so well that ordinary people had started borrowing money in order to invest. Companies and banks were investing their customers' money, without their knowledge. No-one thought of the dangers involved in this sort of speculation.

3 _____

However, in September and early October 1929, stock prices began to fall. Around this time many industries started to decline. Demand for steel began decreasing; fewer cars were selling, so the car industry declined; and fewer people could pay for new houses and buildings, so construction slowed down. On October 24th, share prices fell dramatically and people began to panic. Many people tried to sell their shares, but they couldn't, and they lost all the money they had. A record 12,894,650 shares were traded. The day became known as 'Black Thursday'. A few days later, on October 29th, 'Black Tuesday' became the worst day in the history of the stock market. Everyone was trying to sell their shares but no one was buying, so prices collapsed completely. Billions of dollars were lost and thousands of people became bankrupt.

4 _____

Over the next two years, many companies which had lost money in their investments had to close. This created high unemployment. Thousands of people lost everything, and weren't able to find work. In the 1920s, America had lent money to other countries, and now they had to ask for this money back. This extended the crisis around the world. America and the rest of the world began a period known as the Great Depression, which lasted ten years (1929–39). By 1932, stocks were only worth 20% of their 1929 value. By 1933, nearly half of America's banks had failed and unemployment was around 15 million. People had to queue for food in bread lines and soup kitchens, in towns and cities all over America. Farmers couldn't afford to harvest their crops and had to let them die in the fields even though people in cities were hungry.

5 _____

When President Franklin D. Roosevelt came to power in March 1933, he immediately put in measures to help create jobs and stimulate the economy. He tried to reform the banks and the stock market to prevent another stock market crash. However, the US economy did not fully recover until after the beginning of the Second World War (1939–45), which helped stimulate the American economy and take it out of economic recession.



- 4 Read the text on p1 again. Find the underlined words in the text and match them to their definitions.
- a _____ a difficult time for the economy when there is less trade and no jobs
 - b _____ the number of people who don't have jobs
 - c _____ the place where the buying and selling of shares in companies takes place
 - d _____ without money to pay what you owe
 - e _____ the way that companies can offer a financial participation to investors

- 5 Read the text *The Dust Bowl*. Complete the gaps 1–5 with the sentences A–F. There is one extra sentence that you do not need to use. **F**
- A The crops failed and farms were abandoned.
 - B However, this was not the case, and the majority of people failed to get employment or buy land.
 - C Over the years, the land had become worn away by droughts, overplanted with unsuitable crops, and over-grazed by sheep and cattle.
 - D This had an important cultural and historical impact, and is widely read in American literature courses today.
 - E It was directed by John Ford and starred Henry Fonda.
 - F During these years, land in the agricultural states such as Kansas, Oklahoma, and Texas was badly affected.

What do you think?

- Do you think ordinary American people helped create the stock market crash of 1929, or was it only the fault of bankers and stock market traders?
- How could you protect yourself from the effects of a future economic depression?

PROJECT

Use the Internet to research the ways in which the Great Depression has been represented in American literature and Hollywood films. Think about representations of realism or escapism. Write about a work of your own choice or choose from the list below. Write 200–250 words.

- *Modern Times*, with Charlie Chaplin
- *The Grapes of Wrath*, by John Steinbeck
- *Duck Soup*, by The Marx Brothers
- *King Kong*, with Fay Wray



During the years of the Great Depression, the situation was made worse as a severe drought hit the southern Midwest of America between 1930 and 1936. (1) ____ The Dust Bowl was a huge area of land where the rich topsoil turned to dust and blew away in the wind. (2) ____ This led to the soil drying up and becoming thin and infertile. As the soil dried up and blew away, large clouds of grey dust were seen across the Great Plains. In 1932, there were 14 dust storms and in 1933, there were 38. More than one million acres of land were affected during this time. Nothing would grow. (3) ____ Thousands of farmers lost their property and their livelihood.

During the period known as the Dust Bowl, 200,000 people became economic migrants and travelled to California, where they believed they could find work and buy cheap land. (4) ____ They had to live in shanty towns in the California valleys with no work and no money. The lives of these migrant workers was represented in the book *The Grapes of Wrath* by John Steinbeck, published in 1939. (5) ____ The book was made into a film in 1940, which today is considered a Hollywood classic.



- 1 Work with a partner. Choose the correct options to complete these facts about the United Nations. Then read *The United Nations* and check your answers.
- 1 The United Nations was created in 1919 / 1945 / 1946.
 - 2 There were originally 50 / 51 / 52 Member States.
 - 3 The last country to sign the charter was *Russia / the US / Poland*.
- 2 Read the text again and complete the gaps 1–5 with sentences A–F. There is one extra sentence that you do not need to use. **F**
- A In Ethiopia and Malawi the UN has set up programmes that help keep girls in education.
 - B If disagreement did descend into war, the UN could intervene.
 - C The US, the UK, and the Soviet Union were represented by Franklin Roosevelt, Winston Churchill, and Joseph Stalin.
 - D It has provided jobs for more than 300,000 Haitian people.
 - E The aim of The League of Nations was ‘to promote international cooperation and to achieve peace and security.’
 - F Where possible, the UN helps refugees return to their countries.



The United Nations

The United Nations is an international organization which was created in 1945 after the end of the Second World War. Fifty-one countries agreed to work together to maintain international peace and security, develop friendly relationships between nations, and promote social progress, better living standards and human rights.

The model for the United Nations was based upon The League of Nations, an organization which was created in 1919 after the First World War. (1) ____ However, the League ended in 1946, because it failed to prevent the Second World War.

In 1942, 26 nations met to sign the Declaration by United Nations. In the charter the nations agreed to continue fighting together against the Axis Powers (Germany, Italy, and Japan). At the end of the Second World War on April 25th 1945, the principles of the United Nations Charter were created when representatives of 50 countries met

at the San Francisco Conference in the US. (2) ____ The charter was signed on June 26th 1945 by representatives of the 50 countries. Poland signed at a later date and was included as one of the original 51 Member States.

The United Nations provides an organization for its Member States to express their views on world events and global crises. While it is well known for peacekeeping and conflict prevention, the UN is also well known for giving humanitarian assistance around the world. The UN provides protection, shelter, medicine, and other help for refugees who have been affected by war or environmental disaster. (3) ____ If this is impossible, it helps them find homes in a new country. Since 1950, the UN has helped about 50 million refugees. Where communities are affected by environmental disaster, the UN provides support not only for the refugees but for the communities that remain.

Following the earthquake in Haiti in 2010, the UN has helped the people of Haiti rebuild their communities by providing food, medicine, and water; and donating solar lights and emergency shelters. (4) ____

In addition to providing humanitarian assistance, the UN works to promote democracy, human rights, and gender equality. (5) ____ In India the UN works to provide better working conditions for farm workers, many of whom are women. It also supports sustainable development as in Mali and Senegal in Africa, where the UN has provided money for poor farmers who don't have enough money to buy farming equipment. One of the UN's environmental projects in Tanzania helps provide solar energy to 8,400 families in isolated areas.

The work of the UN is wide and varied and has changed since 1945, but its fundamental principles of promoting peace, equality, and human rights remain the same.

3 Answer the questions.

- 1 When was The League of Nations created?
- 2 Why did The League of Nations end in 1946?
- 3 What did 26 nations agree to do when they signed the Declaration by United Nations in 1942?
- 4 Who represented the US, the UK, and the Soviet Union at the San Francisco Conference in 1945?
- 5 How many refugees has the UN helped since 1950?
- 6 In which country has the UN helped farm workers, many of whom are women?

4 Match the underlined words or phrases from the text with their meaning.

- 1 a period of fighting or war between two countries

- 2 equality between men and women

- 3 helping to reduce suffering and improve people's lives

- 4 a written statement describing the rights that a group of people should have

- 5 a system of government where individuals vote for their political representatives

- 6 development that does not harm the environment

5 Read the text *Saving children from disease*. What disease is the UN hoping to remove from the Earth?

6 Read the text again. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- 1 The UN is involved in international health programmes.
- 2 The UN vaccinates 2.5% of the world's children.
- 3 Polio is a disease which kills animals.
- 4 About 1,000 children were paralyzed by polio in the 1980s every day.
- 5 The UN has helped save one million children and adults from polio.
- 6 Polio remains in only three countries in the world.



As one of its fundamental aims, the UN works with other global organizations such as the World Health Organization (WHO) and UNICEF to promote health programmes around the world. Women and children around the world die every day from diseases which can be prevented. The UN and its partners vaccinate 57% of the world's children and save 2.5 million lives every year.

Polio, a disease which causes paralysis, can be prevented with a cheap vaccine that is available in Europe and the western world to all children. And yet, in the 1980s, about 1,000 children around the world were paralyzed by polio every day.

Today, five million children and adults have been saved from paralysis caused by polio, because of programmes organized by the UN and its partners. In the past, polio affected people in 125 countries around the world. Today, polio is present in only three countries: Pakistan, Afghanistan, and Nigeria. Perhaps one day it will be removed from the Earth in the same way that other diseases have been removed.

What do you think?

- What do you think is the most important aspect of the UN's work: promoting peace, humanitarian assistance, or gender equality? Give your reasons.

PROJECT

Use the Internet to find an example of where the UN has helped resolve a problematic situation somewhere in the world. Choose a topic between peace keeping, humanitarian assistance, and health programmes. Write a short presentation of 200–250 words. Think about these questions:

- What measures did the UN take to help the situation?
- What were the lasting positive effects?

- 1 Work with a partner. Choose the correct options to complete these facts about Indian independence.
- 1 Britain started gaining political power in India in the *sixteenth* / *seventeenth* / *eighteenth* century.
 - 2 *Mohandas Gandhi* / *Jawaharlal Nehru* / *Mohammed Ali Jinnah* was a leader of the Indian National Congress in the 1920s.
 - 3 India gained independence in *1917* / *1919* / *1947*.
- 2 Read the text *Indian independence* and check your answers. Read the text again. Complete the gaps 1–5 with sentences A–F. There is one extra sentence that you do not need to use. **F**
- A This campaign of non-cooperation became popular and very influential.
 - B The Spanish and the French were the first Europeans to explore North America.
 - C However, the transition from British rule to Indian rule was not easy.
 - D Other European countries including Spain, France, and Portugal had colonies in Africa, Asia, and Latin America.
 - E The aim was to end religious conflict.
 - F By the end of the eighteenth century, most of India was ruled by the British.



Indian independence

The first overseas colonies were established by the British in the sixteenth century, in North America and the West Indies. Two hundred years later, when the British were defeated in the American War of Independence (1775–83), British rule in America ended. However, in the eighteenth and nineteenth centuries Britain went on to establish colonies in Africa, Asia, and India. (1) ____ By the early twentieth century, the British Empire covered a fifth of the land in the world.

During the first half of the eighteenth century, Britain had started trading in India. The East India Company set up by the British established important trading links in products such as sugar, indigo, silk, and spices. In the second half of the century, Britain wanted to gain political power, and used its army to gain control. As the Indian 'Mughal' empires collapsed, the British Empire became stronger.

(2) ____

At the beginning of the twentieth century, India was the largest colonial territory in the world and it had been ruled by Britain since 1858. During the First World War, millions of Indian

soldiers fought in Europe for the British army, and thousands died. Feelings of resentment started to grow. From 1917 onwards, the National Congress (an Indian political party) began to campaign for self-rule. However, Britain regarded India as the 'jewel in the crown' of its empire and did not want to give India independence. In 1919, when a large crowd gathered at Amritsar to protest, the army killed 380 people and injured 1,200. This damaged the relationship between Britain and India for many years.

The campaign for independence grew, and in 1920, Mohandas Gandhi (1869–1948), a leader of the Indian National Congress, started a peaceful campaign of non-cooperation with British laws, and a boycott of British goods and institutions.

(3) ____ Throughout the 1920s and 30s, calls for independence grew, although the British resisted them.

By 1945, Britain had suffered financially, and was much weaker as a result of the war. Britain had promised to give India independence once the war was over. As violence and unrest grew, the British finally agreed to give India self-rule as they couldn't afford to sustain an empire,

now that her economy was so weak.

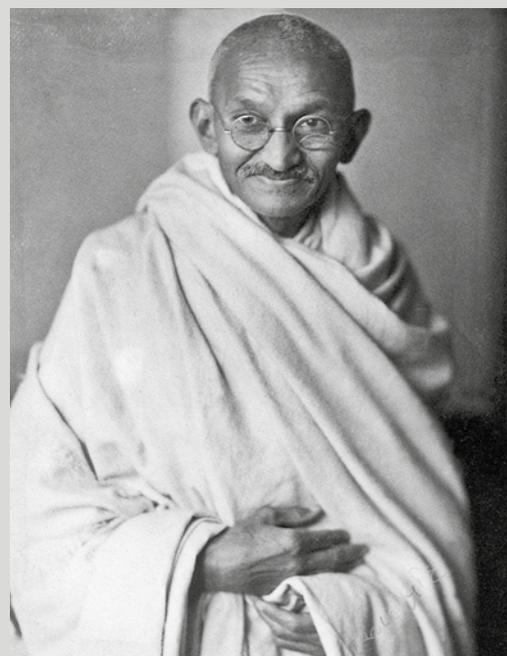
(4) ____ The main problem of independence was religion. The majority of Indians were Hindus, but there were also a large number of Muslims who did not want to live under Hindu rule. Many issues were unresolved when power was transferred from Britain to India.

At independence India was divided into two separate countries during a process called partition. On August 14th 1947, the northwest became the independent country of Pakistan, with a Muslim majority and governed by Mohammed Ali Jinnah. On August 15th, Jawaharlal Nehru became prime minister of an independent India, with a Hindu majority. (5) ____ However, religious tensions remained during partition, and there was more rioting and fighting. Millions of people became separated from their families and found themselves in the 'wrong' country. This led to mass migration, and more violence, and during this time thousands of people were killed.

Mohandas Gandhi (1869–1948)

Mohandas Gandhi was the leader of the Indian nationalist movement against British rule. He was born into a privileged family in Gujarat, and studied law in Bombay and London before working for an Indian law firm in South Africa. Gandhi's political beliefs were formed in South Africa, where he opposed the system of racial segregation there called apartheid. He spent 20 years living in South Africa and was sent to prison many times for trying to gain rights for Indian workers. Influenced by Hinduism and Christianity, he developed his own form of non-violent peaceful protest as a way to fight injustice.

When he returned to India in 1916, Gandhi decided to practise non-violent disobedience to protest against British rule. He became known as 'Mahatma', which means 'Great Soul'. By the 1920s, he had become an important figure in the Indian National Congress, and led many programmes of peaceful protests, strikes, and boycotts of British goods involving thousands of people. At the time of independence, Gandhi didn't support partition and tried to improve relations between Hindus and Muslims. When rioting broke out in Delhi and Calcutta he brought peace by refusing to eat until the fighting stopped. Gandhi survived six assassination attempts during his life. However, in 1948 he was assassinated in Delhi by a Hindu fanatic who disagreed with his ideals of religious tolerance.



'You must not lose faith in humanity. Humanity is an ocean; if a few drops of the ocean are dirty, the ocean does not become dirty.'

3 Find the words in **A** in the text on p1 and underline them. Match them with their correct meaning in **B**.

A	B
1 ____ colonies	a to refuse to buy, use, or take part in something as a way of protesting
2 ____ boycott	b countries or areas governed by people from another, more powerful country
3 ____ unrest	c the division of a country into separate parts
4 ____ self-rule	d the governing of a country or area by its own people
5 ____ partition	e a political situation in which people are angry and likely to protest or fight

4 Read *Mohandas Gandhi*. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- Gandhi was a supporter of British rule in India.
- Gandhi studied law in India and Britain before working in South Africa.
- He believed that violent protest was the only way to fight injustice.
- In the 1920s, Gandhi was working in the Indian National Congress.
- Gandhi thought partition was a good solution to the problems facing the Indian people.
- Gandhi was assassinated in 1947 by British soldiers.

What do you think?

- Do you think Gandhi's system of peaceful protest was successful? Why (not)?

PROJECT

Use the Internet to research the colonization of a country by Britain, France, Germany, or Italy during the nineteenth or twentieth century. Think about:

- how the country changed during colonization
- what effects colonization had on the people there
- how self-rule was established

- 1 Work with a partner. Choose the correct options to complete these facts about globalization. Then read the text *Globalization today* and check your answers.
 - 1 Globalization is a process where businesses can operate *nationally / internationally*.
 - 2 Cheaper and better *products have / transport has* enabled companies to trade more easily.
- 2 Read the text again. For questions 1–4, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**
 - 1 How has the Internet transformed business and trade?
 - a It has helped to create more national and regional businesses.
 - b It has made it easier for people to work in Peru and India.
 - c It has replaced landline telephone systems with mobile technology.
 - d It has created international marketing and sales opportunities.
 - 2 Why do companies want to operate in different countries?
 - a Sometimes cheaper raw materials and cheaper labour are available.
 - b They can set up a clothing business.
 - c They don't have to look after the environment.
 - d Their workers can go to fast food restaurants if they want to.
 - 3 What effect has the growth in the soya, beef, and palm oil industry had?
 - a It has reduced pollution.
 - b It has contributed to the deforestation of the rainforests.
 - c It has promoted sustainable development.
 - d It has caused people to eat less fast food.
 - 4 What advantage could a multinational corporation bring to a country?
 - a It could help educate people.
 - b It could save money on education, health, and infrastructure.
 - c It could stop deforestation and pollution.
 - d It could bring new ideas to a community.

Globalization today

Globalization is the process of increased interconnectedness among countries, in the areas of economics, politics, and culture. A McDonald's restaurant in China, a French clothes store in the US, and an iPhone store in Scotland represent globalization.



Globalization allows businesses and organizations to operate on an international scale, largely because of deregulation and improved communications, giving access to goods, products, and information to a wider population than ever before. These new markets provide opportunities for new business and more profits.

There are many key factors that have influenced the process of globalization. Improvements in transport mean that goods can be transported faster and more cheaply than in the past. Improvements in telecommunications and computer technology help people access information more easily and more quickly than in the past. The Internet has transformed business and trade, creating new ways for businesses to advertise and sell their products. Today, businesses use computers, smartphones, text messages, and Skype to conduct business. Social networking sites, Twitter, and apps are changing the way people do business, as well as changing the way they

use and share information for personal and social reasons. Combined with free trade agreements between countries, these developments have affected every area of the economy. Whether a business is in India, Peru, or the US, it is possible to exchange information and products in ways that were impossible 20 years ago.

Companies that operate in several countries are called multinational corporations. Companies sometimes want to operate in developing countries because they can take advantage of cheap raw materials, cheap labour, and easier employment laws. The clothing industry has taken advantage of cheap labour in Asia and India for decades. One of the problems of globalization and increased consumerism is the exploitation of the world's natural resources and the world's poor. As well as causing social problems by exploiting cheap labour, globalization can have a negative impact on the environment. For example, the link between the deforestation of rainforests for soya, palm oil, and beef can be directly linked to the growth of the fast food industry. Another problem with globalization is that while different cultures around the world interact, cultural differences can be lost in the process. The presence of the same multinational corporations in every city around the world means that the cities begin

to lose their unique identity. This can make the world a much less interesting place.

While there are some aspects of globalization that are negative, there are also many positive aspects to be found. As more money is invested in developing countries, there is a greater chance for the people to benefit from investment in education, health, and infrastructure. This helps raise the standard of living for everyone. Globalization also brings greater access to knowledge which can inform people around the world about global issues such as pollution, deforestation, and the need for sustainable development. There is also greater access to foreign cultures in the form of music, films, food, clothing, and ideas. This can help break down the barriers between cultures and improve relations. Globalization can be seen as both a positive and a negative process, with arguments in favour of and against it. However, most would agree that it is an inevitable process that is changing the world and the way we live in it.



- 3 Match the underlined words in the text on p1 with the correct definitions a–e.
- a financial gains _____
 - b a computer program which operates on smartphones, tablets, and other mobile devices _____
 - c the systems and services that are necessary for a country, for example, buildings, transport, and water and power supplies _____
 - d the technology of sending information by satellite, telephone, radio, and television systems _____
 - e the people who work or are available for work in a country or a company _____
- 4 Work with a partner. Look at the photo and discuss these questions.
- Where do these men come from?
 - How do you think they make their living?
 - Do you think they use any kind of technology in their lives? If so, what?
- 5 Read the text. Are these sentences true (✓) or false (✗)? Correct the false sentences.
- 1 Mobile phone technology is popular in Kenya because it is cheaper to install than landline systems.
 - 2 Increasing numbers of people in Kenya are using apps on their mobile phone.
 - 3 The iCow app teaches farmers how to look after their dairy cows.
 - 4 The mFarm app helps farmers find and buy cheaper farms.
 - 5 Mobile phones are too expensive for most Maasai people.

What do you think?

- What do you think are the advantages and disadvantages of globalization?

PROJECT

Use the Internet to research how life has changed in your country over the last 30 years in terms of globalization. Think about changes related to the following things:

- access to international travel
- food
- cultural identity
- the environment

Write a description of these changes and give your opinion about whether they are largely positive or negative. Write 200–250 words.

The information revolution in the developing world

One of the greatest revolutions to occur in the late twentieth and early twenty-first centuries has been the revolution in communication. The speed that information can travel around the world has meant that cultural, political, social, and economic information can be exchanged in seconds. Information Technology (IT) is one of the most important factors in the creation of the global economy and the process of globalization.

While globalization is often blamed for the problems caused by rapid progress and mass consumerism, such as the exploitation of resources and people, it can be argued that it has also brought opportunities to people, particularly in the developing world. And in many cases it is IT that supports this process.

In some places in Kenya, for example, landline telephone systems have been replaced by mobile phone technology. One reason for this change is that mobile technology is better for some sections of the population like the nomadic Maasai, who often live long distances from towns and cities. The opportunity to use mobile phone services helps people who live in remote areas control their money. This technology allows Kenyans to transfer money, view accounts, pay bills, and open micro-credits using their mobile phones, which they are able to recharge using solar panels.

In recent years, Kenya has seen a rapid increase in app technology, with numerous apps created for the cheaper smartphones that many Kenyans use. For those who live on small farms with only a few cattle, iCow is a free veterinary advice service that advises farmers how to look after their dairy cows, avoid illness, and improve milk production. A second popular app is mFarm, which helps farmers get the right price for their produce, find buyers, and sell their products.

For the same price as a goat, mobile phones have become an affordable way for the Maasai and other nomadic peoples to take advantage of modern technology without losing their traditional way of life. In this way, IT has helped protect rather than destroy cultural diversity, which so often is the victim of globalization.



1 How much do you know about the history of Russia? Choose the correct option in each sentence.

- 1 Russia was ruled by *an elected government / an aristocratic family* before the First World War.
- 2 Russia *sent / didn't send* a lot of soldiers to fight in the First World War.
- 3 Lenin was a Russian *politician / revolutionary*.
- 4 The Bolsheviks represented *working people / the upper classes*.

2 Read about the Russian Revolution. Complete the gaps 1–5 with the headings A–F. There is one extra heading that you do not need to use. **F**

- A Lenin makes reforms
- B The Bolsheviks
- C Trotsky
- D Background to revolution
- E The Bolsheviks seize power
- F Lenin

Revolution in Russia

1 _____

The Bolshevik party was part of the Russian Social-Democratic Workers' Party, which followed communist ideology. Led by Vladimir Lenin, it was a disciplined revolutionary party. The Bolshevik army was called the Red Army.

2 _____

In the early 1900s, Lenin was in exile in Europe, where he was an important figure in the international revolutionary movement. The Germans helped him return to Russia, hoping he would cause problems and weaken Russia's place in the war.

3 _____

Russia's involvement in the First World War brought the country to a crisis. By 1917, there were nine million dead or wounded soldiers. There was no food. Fifteen million men had gone to fight, so there weren't enough farm workers. The railways were used by military transport, so food couldn't be taken to cities. The government didn't try to improve the situation. In March 1917, Russia suffered military defeats in the First World War, and there were riots across Petrograd. The army joined the rioters and on March 15th, Tsar Nicholas II abdicated from power, and a Provisional Government was established.



4 _____

From the start, there were problems with the Provisional Government. It shared power with the Petrograd Soviet, a council of soldiers and workers which controlled large parts of the army and navy, who often disagreed with the Provisional Government. When Lenin returned to Russia from exile in April 1917, he began to organize opposition to the Provisional Government. On the night of November 6th, the Bolsheviks took power in St Petersburg (this is called the October Revolution because in Russia at that time, they used a different calendar). The Red Army took control of bridges, railways, and telephone lines, and isolated Petrograd from the rest of Russia. On the evening of November 7th, they captured the Winter Palace, which was the headquarters of the Provisional Government. By morning, the Bolsheviks were in power.

5 _____

Following the October Revolution, life changed for Russian people. Lenin signed a contract which ended Russian involvement in the war. The new government led by Lenin divided the estates owned by the aristocracy and gave the land to the peasants. The workers took control of the factories and the government improved workers' rights and pay. The government took control of the banks. But under Lenin's rule, Russia quickly became a communist dictatorship, and it was forbidden to question the theories and practices of communism. Tensions grew, and in 1918 there was civil war between the Red Army led by Lenin and the anti-communist White Army. Eventually, however, the Bolsheviks took control. The Bolsheviks went on to establish more control by capturing parts of the former Russian Empire. These lands were organized into socialist republics governed by a soviet. In 1922, these soviets were brought together and organized into the Union of Soviet Socialist Republics (USSR), a single communist state, which lasted until 1991.

- 3 Read the text on p1 again. Put these events in the order that they happened.
- a The Tsar abdicates from power.
 - b The Bolsheviks take control of St Petersburg.
 - c A Provisional Government is established.
 - d The Russian army suffered defeats in the First World War.
 - e Lenin returned to Russia and began to organize opposition.
 - f There is civil war in 1918, and the Bolsheviks take control.

- 4 Find the words in **A** in the text and underline them. Match them with their correct meaning in **B**.

A	B
1 ____ riots	a a Russian word meaning an elected council, district, or national council
2 ____ abdicated	b living in another country that is not your own, for political reasons
3 ____ soviet	c when a king, queen, or member of the ruling aristocracy resigned their position
4 ____ exile	d a country governed by one person who has complete power
5 ____ dictatorship	e a violent public protest

- 5 Read the text about Lenin. What did Lenin want when he returned to Russia?
- 6 Read the text about Lenin again. Are these sentences true (✓) or false (✗)? Correct the false sentences.
- 1 Lenin's real name was Vladimir Ilich Ulyanov.
 - 2 Lenin was a revolutionary who wanted political reform in Russia.
 - 3 In 1897 he spent time working as a lawyer in Siberia.
 - 4 Lenin led the Bolshevik party to power in 1919.
 - 5 During the revolution Lenin was a fair and popular leader.

What do you think?

- What do you think Tsar Nicholas II could have done to help prevent revolution in Russia?

Lenin

Vladimir Ilich Ulyanov was born in 1870 into a well-educated family. He studied law and moved to St Petersburg, where he became involved in revolutionary political activities. In 1897 he was exiled to Siberia for his extreme political views. When he returned to Russia under the new name of Lenin, he wanted major reforms in the way Russia was governed.

When Lenin led the Bolsheviks to power in 1917 he was an idealist who wanted to redistribute wealth from the aristocracy to the poor. However, during the revolution, Lenin became a cruel dictator. He crushed all opposition in an extreme and cruel way. Lenin's secret police force arrested, tortured, and killed people who protested against him. In 1918, he was seriously wounded in an assassination attempt. He never really recovered and he died in 1924.



PROJECT

Use the Internet and reference books to find out more about one of the following topics:

- the October Revolution, when Bolsheviks took control of the Winter Palace
- the final years of the Tsar and his family
- the life of Lenin

Prepare a presentation with photographs or illustrations to show the class. Write 200–250 words.

- 1 Can you name three countries that were in the communist Eastern Bloc in the second half of the twentieth century?
- 2 Read the text *The Cold War*. Find the words in **A** in the text and underline them. Match them with their correct meaning in **B**.

A	B
1 ____ NATO	a the alliance between the Soviet Union and Eastern European communist states
2 ____ Warsaw Pact	b the boundary line that separated Eastern and Western Europe
3 ____ Eastern Bloc	c reforms which were introduced by Mikhail Gorbachev
4 ____ iron curtain	d East Germany, Poland, Czechoslovakia, Hungary, Romania, Bulgaria, and the Soviet Union
5 ____ perestroika	e the alliance between the US, Canada, and several Western European countries

The Cold War

The Cold War is the name for a period of political and military tension between the West (the US and its NATO allies) and the East (the Soviet Union and its Warsaw Pact allies). The period began around 1947 after the end of the Second World War, and continued until after the fall of communism in the Soviet Empire and Eastern Europe in the early 1990s.

After the Second World War, the Soviet Union and the United States became the world's dominant superpowers.

(1) ____ At the end of the Second World War, the Soviet Union set up communist governments in the Eastern European countries that had been liberated by the Russians during the war. In response, the US gave financial and military support to the remaining countries in Western Europe and created NATO, an alliance between several Western European countries, Canada, and the US.

So, the Soviet Union set up the Warsaw Pact, an alliance of the Eastern communist states with the Soviet Union. (2) ____ The border between Eastern and Western Europe was named the 'iron curtain' by Sir Winston

Churchill. Those countries which formed the 'Eastern Bloc' – East Germany, Poland, Czechoslovakia, Hungary, Romania, Bulgaria, and the Soviet Union – were considered 'behind the iron curtain'.

There wasn't a direct conflict between the two superpowers, but there were conflicts in countries across the world as a result of the struggle between the two ideologies. (3) ____ One of the first conflicts of the Cold War was the blockade of West Berlin in 1948, after which Germany was divided into East and West. In the next 40 years there were a number of wars and conflicts around the world, including the Korean War, 1950–53, the Hungarian Revolution of 1956, the Suez Crisis in 1956, the Cuban Missile Crisis of 1962, and the Vietnam War of the 1960s and 70s. (4) ____ It was during the Cold War that nuclear war became a possibility.



Nuclear technology was very important for both the US and the Soviets as they became involved in a race for power. The launch of Sputnik, the first satellite by the Soviet Union, worried the US, because Sputnik indicated that the Soviets had nuclear technology. Both the US and the Soviets wanted to discover what each other was doing, and they used spies to find out their secrets. It was a dangerous time when some British MI5 agents and Russian KGB agents acted as 'double agents' and secretly worked for their opposing governments. In the 1970s, MI5 discovered that 120 Soviet spies were working in Britain.

The Cold War gradually came to an end over a period of years, beginning in the 1980s following reforms in the Soviet Union made by the Soviet president Mikhail Gorbachev known as 'perestroika'. (5) ____ Following this, the Eastern European nations wanted independence and democracy, beginning with Poland and spreading throughout the Eastern Bloc. The collapse of the communist party in the Soviet Union in 1991 resulted in the break-up of the USSR, the break-up of the Eastern Bloc, and the US becoming the world's only superpower.



3 Read the text on p1 again. Complete the gaps 1–5 with the sentences A–F. There is one extra sentence that you do not need to use. **F**

- A During this time, both sides began developing and collecting nuclear weapons.
- B After the Cold War ended, the world's economy started to grow.
- C These reforms marked the beginning of the end of communism.
- D During this time, Europe was divided into two halves and free travel between the two halves was almost impossible.
- E These conflicts were supported by the two superpowers.
- F However, even though they fought together during the Second World War, they became enemies because of conflict between communism and capitalism.

4 Read *The Cuban Missile Crisis*. Answer the questions.

- 1 When was the Cuban Missile Crisis?
- 2 How long did the crisis last?
- 3 What were the names of the US and Soviet presidents involved in the crisis?
- 4 Why did the US react badly when it discovered the Soviet Union's plans?
- 5 What did the crisis nearly cause to happen?

5 Read the text again. Put these events in the order that they happened.

- A The Soviet Union organized their army.
- B The Soviet Union started building nuclear weapon sites in Cuba.
- C Khrushchev agreed to remove the Soviet Union's nuclear weapons in Cuba.
- D The US discovered that the Soviet Union had already started preparing to place nuclear rockets in Cuba.
- E Khrushchev and J.F. Kennedy made a secret agreement.
- F The US threatened to invade Cuba.

What do you think?

- Do you think nuclear war is a threat today? Why (not)?
- Which countries do you think are the world's superpowers today? Give your reasons.

The Cuban Missile Crisis

In 1962, major tension arose between the two superpowers in a situation that became known as the Cuban Missile Crisis. When the US discovered that the Soviet Union had secretly started preparations to place nuclear rockets in Cuba, the US felt threatened. The US government announced that it would use its navy to block the delivery of the weapons to Cuba. It demanded that the Soviet Union remove the weapons from Cuba and return them to the Soviet Union. The US threatened to invade Cuba. The Soviet Union saw this as an act of aggression and organized their army for war. The US responded by putting US nuclear bombers into the air. It became a conflict between two presidents: Khrushchev and J.F. Kennedy. The confrontation lasted 13 days and the two superpowers came close to nuclear war. It ended when both presidents made a secret agreement. Khrushchev publicly agreed to remove the Soviet Union's nuclear weapons from Cuba. It is considered to be one of the most dangerous times of the Cold War.



PROJECT

Choose one of the conflicts that occurred during the Cold War and use the Internet and reference books to find out more about it.

- Korean War (1950-53)
- Hungarian Revolution (1956)
- Suez Crisis (1956)

Prepare a presentation with photographs or illustrations to show the class. Write 200–250 words.

- 1 Can you name an approach used in psychology that was developed by Sigmund Freud? Read the text and check your answer.

Sigmund Freud

Sigmund Freud was born on May 6th 1856 in Freiberg, Moravia, now Pribor in the Czech Republic. The family moved when Freud was four years old and settled in Vienna, where Freud was educated. He studied medicine in Vienna and went on to become a neurologist, physiologist, and psychologist. He is regarded as one of the most influential thinkers of the twentieth century and he is most famous for developing a method of psychological treatment known as psychoanalysis.

After graduating in medicine in 1881, he worked in a general hospital and then studied neurology in Paris in 1886. When he returned to Vienna, Freud began a private medical practice and developed the theory that some neuroses are caused by painful experiences from the past, especially from childhood. He argued that the memories of these experiences have been forgotten, and are hidden from consciousness in the unconscious mind. He first published his ideas in 1899 in *The Interpretation of Dreams*, and subsequently he worked with Jose Breuer and developed the method of conversational 'free association' as a way to 'unlock' the painful memories in the unconscious. This was the beginning of psychoanalysis; the study of the effects of the unconscious mind on behaviour.

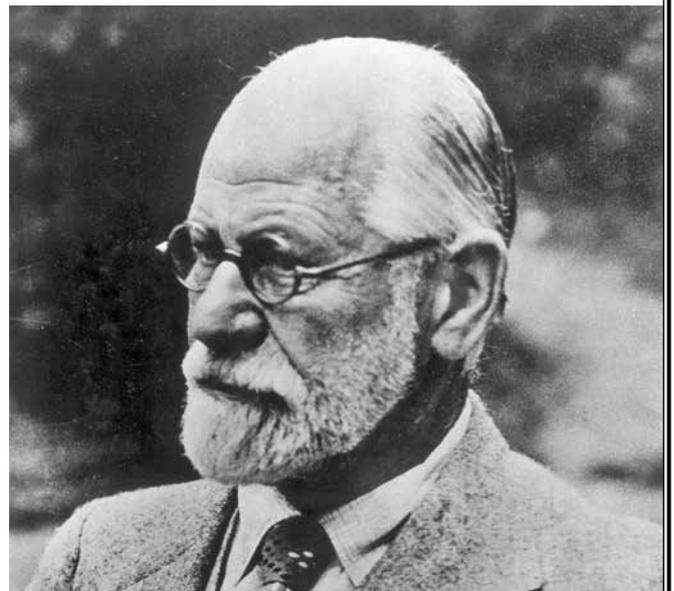
In 1902, Freud was appointed Professor of Neuropathology at the University of Vienna, where he studied psychological and psychopathological behaviour and the role of sexuality in the unconscious. Despite the fact that many people consider his work controversial, his theories of psychosexual development, the unconscious, and dream symbolism remain influential today. Freud formed a close working relationship with Carl Jung, another leading psychologist of the time.

Freud and Jung's work on dream analysis was to become a cornerstone of psychoanalysis. However, over time their theories began to differ and their relationship broke down. Jung felt that Freud focused too much on sexuality and he also felt that his concept of the unconscious was limited and negative. In contrast to Freud, Jung saw the unconscious

as a place of creativity and possibility, not simply neurosis. Eventually, they went on to pursue different careers in this area with Jung forming his own influential school of analytical psychology.

In 1923, Freud published *The Ego and the Id*, which suggested a new structural model of personality, divided into the id, the ego, and the superego. In later years, Freud spent less time working in clinical observation and concentrated on the application of his theories to history, art, literature, and anthropology.

Freud's work helped shape our view of childhood, the mind, sexuality, memory, and therapy. His ideas have become part of our vocabulary with the introduction of the concepts of repression, denial, ego, and the Freudian slip. His work introduced the concept that not all mental illnesses have physiological causes, and he provided evidence that cultural differences have an impact on psychology and behaviour. While some of his theories have caused disagreement, it is accepted that his work has left a legacy which forms the foundation of modern psychology. Many of his theories of personality are still influential today.



2 Read the profile of Sigmund Freud. For questions 1–6, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**

- 1 Where was Sigmund Freud educated?
 - a the Czech Republic
 - b Vienna
 - c Paris
 - d Leipzig
- 2 What does psychoanalysis examine?
 - a the conscious
 - b neurology
 - c the unconscious
 - d psychology
- 3 What is Freud's theory about neuroses?
 - a They can be caused by forgotten experiences from the past.
 - b They are caused by the conscious mind.
 - c They are made worse using conversational free association.
 - d They are usually neurological.
- 4 What was the main focus of Freud's work *The Ego and the Id*?
 - a clinical observation
 - b the development of personality
 - c dreams and sex
 - d a new model of the unconscious
- 5 Why did Freud and Jung's working relationship break down?
 - a Jung felt Freud's work wasn't creative enough.
 - b Freud didn't agree with Jung's school of analytical psychology.
 - c Jung didn't think that the unconscious was a place of creativity.
 - d Jung thought Freud's understanding of the unconscious was negative and too focused on sexuality.
- 6 What does Freud's work teach us about mental illness?
 - a It isn't always caused by physical problems.
 - b It can be caused by denial.
 - c It is always caused by physical problems.
 - d It is the subject of disagreement.

3 Match the underlined words in the text with the definitions.

- a the study of mental or behavioural disorders

- b the mental aspect of the sexual impulse

- c the study of the development of human behaviour and society

- d without conscious control or thought

- e the study of the physical body

- f mental illnesses involving fear and anxiety

Defence mechanisms

In order to deal with anxiety and emotional pain, Freud believed that we create various defence mechanisms. These defence mechanisms protect us from internal conflicts created by the id, the ego, and the superego. Repression and denial are two well-known defence mechanisms.

Repression works by keeping information out of the conscious and locked in the unconscious. Unfortunately, this information continues to influence behaviour. For example, a person who has repressed memories of being kicked by a horse as a child may develop a fear of horses in adulthood.

In most cases, repression occurs unconsciously, but in some cases the information can be suppressed as a conscious act.

Denial occurs when people are unable or refuse to admit an obvious truth. Denial protects the ego from the truth because it may be too painful or difficult to admit. Drug addicts or alcoholics may often deny that they have a problem, while victims of a painful event may deny that the event occurred.

4 Read the text *Defence mechanisms*. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- 1 Defence mechanisms are an attempt to avoid emotional pain.
- 2 Defence mechanisms are a form of repression.
- 3 Repression keeps information 'locked' in the unconscious.
- 4 Repression is always a conscious act.
- 5 Denial is when a person will not accept that they have a problem.
- 6 Denial helps people admit the truth.

What do you think?

- Do you agree that dreams are meaningful and can reveal fundamental worries or anxieties? Why (not)?

PROJECT

Either:

- write a synopsis of Freud's interpretation of the id, ego, and superego as a model of personality, or;
- find out about another approach to psychology and write a brief description.

Use the Internet and reference books to find the information you need. Write 200–250 words.

- 1 Do you know the names of any publications by Karl Marx? Read the text and check your answers.

Karl Marx

Karl Marx was a highly influential revolutionary thinker and philosopher born in Germany on May 5th 1818. His political and social-economic theories became known as Marxism, an ideology which criticizes capitalism and the exploitation of the working class, in favour of communism and a more equal society based on a redistribution of wealth.

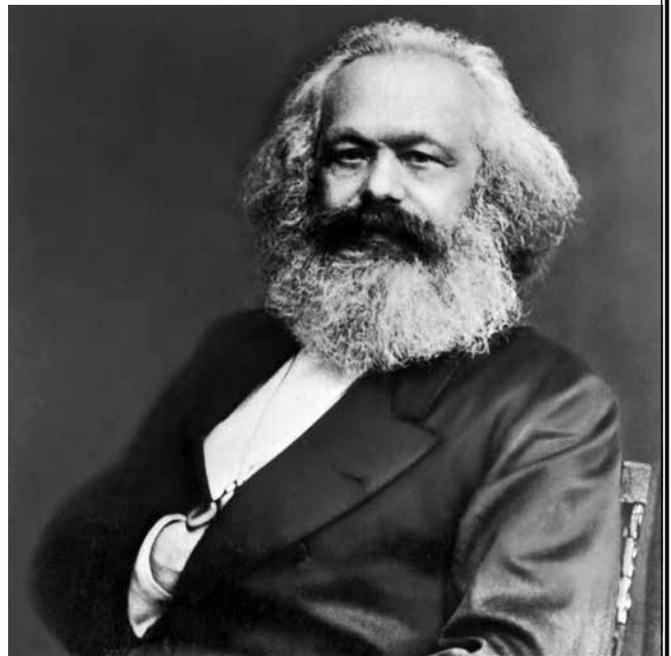
Marx studied law in Bonn and Berlin, during which time he was introduced to the ideas of Hegel and Feuerbach. He went on to study philosophy at the University of Jena. In 1843, he and his wife moved to Paris. It was here that Marx met the German philosopher Friedrich Engels, who would become a lifelong friend and collaborator. Marx was exiled from Paris at the end of 1844, and together with Engels moved to Brussels, where he remained for the next three years. In 1848, Marx and Engels published *The Communist Manifesto*, which laid the foundation for socialism and communism.

The theory that forms the basis of Marxism is that social life is based upon a 'conflict of interest'. The most fundamental of these conflicts is between those who own and control the means of production in a capitalist society (the bourgeoisie) and those who provide the labour (the proletariat). Class struggle, which arises out of this conflict of interest between the bourgeoisie and the proletariat, is the main force for social change. Marx saw an end to class struggle through social revolution in favour of a classless society under communism.

1848 was a time of enormous political change and conflict in many European countries. Marx had returned to Paris and then moved back to Cologne in Germany, where he edited a newspaper. However, the newspaper was suppressed by the authorities because they thought it was too radical. So in 1849, Marx and his family moved to London, where he spent the rest of his life. For a number of years, the family

was very poor and Marx had to rely on Engels for some financial support. Nevertheless, Marx continued to work on his writing and published what was to become his most influential work: *Das Kapital*. It was a comprehensive analysis of capitalism which was published in three volumes over a number of years. The first volume was published in 1867 and became the 'bible of the working class'. The following two volumes were published after his death by his loyal friend Engels (1885, 1894). In these works, Marx predicted the failure of the capitalist system and the international revolutions which would happen as a result. Marx died on March 14th 1883 and was buried at Highgate Cemetery in London.

Marx did not live to see his ideas carried out in his lifetime. However, it was Marxism that fuelled the most significant political and social revolutions of the twentieth century, resulting in the creation of the communist states of the Soviet Union and the People's Republic of China.



2 Read the text on p1 again. For questions 1–6, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**

- 1 Who was Karl Marx?
 - a a capitalist
 - b a philosopher
 - c a politician
 - d a priest
- 2 Which two philosophers influenced Marx's early work?
 - a Hegel and Engels
 - b Engels and Feuerbach
 - c Feuerbach and Schopenhauer
 - d Hegel and Feuerbach
- 3 What is the 'conflict of interest' that Marxism refers to?
 - a the struggle between politics and economics
 - b the struggle between the bourgeoisie and the proletariat
 - c the struggle for social revolution
 - d the struggle between capitalism and communism
- 4 Which political system does Marxism criticize in *Das Kapital*?
 - a Marxism
 - b communism
 - c capitalism
 - d socialism
- 5 What did Marx predict would happen in *Das Kapital*?
 - a the failure of capitalism and international revolutions
 - b the rise of nationalism and fascism
 - c the collapse of the bourgeoisie and the middle class
 - d the end of the working class and poverty
- 6 Why did Marx come to England in 1849?
 - a He was a refugee and didn't have any money.
 - b The newspaper he was editing was too radical and so he had to leave Germany.
 - c His book had been published and he wanted to leave.
 - d He was very poor and needed to borrow money from his friend Engels.

A

'The worker becomes all the poorer the more wealth he produces, the more his production increases in power and range. The worker becomes an ever cheaper commodity the more commodities he creates. With the increasing value of the world of things proceeds in direct proportion the devaluation of the world of men. Labour produces not only commodities; it produces itself and the worker as a commodity, and does so in the proportion in which it produces commodities generally.'

Marx, Economic and Philosophic Manuscripts

B

'The ideas of the ruling class are in every epoch the ruling ideas, i.e. the class which is the ruling material force of society, is at the same time its ruling intellectual force. The class which has the means of material production at its disposal, has control at the same time over the means of mental production, so that thereby, generally speaking, the ideas of those who lack the means of mental production are subject to it. The ruling ideas are nothing more than the ideal expression of the dominant material relationships, the dominant material relationships grasped as ideas.'

Marx, The German Ideology

- 3 Read quotations A and B by Karl Marx. Match them to these topics.
 - 1 the way people in power control the ideas of society _____
 - 2 the exploitation of the proletariat _____
- 4 Read the quotations again. Match the underlined words with their definitions.
 - a a reduction in value _____
 - b a period of time in history _____
 - c a part or share of a whole _____
 - d understood something completely _____
 - e a product that can be bought or sold _____
 - f availability for use _____
- 5 Read the quotations again. Are these sentences true (✓) or false (✗)? Correct the false sentences.
 - 1 The more workers produce, the richer they become.
 - 2 Workers become like the commodities they produce.
 - 3 The more we value what we produce, the more we value the workers who have produced it.
 - 4 The class with economic power has control over ideas and education.
 - 5 Those who have no intellectual power are made powerless by having no intellectual power.

What do you think?

- Marx felt that the unequal distribution of wealth in a capitalist society is unfair. Do you agree with him? Why (not)?

PROJECT

Either:

- find out more about the relationship between Marx and Engels – write about the influence they had on each other's work – or;
- find out more about a communist country and write about the effect of Marx's ideas on the development of the country.

Use the Internet and reference books to find the information. Write 200–250 words.

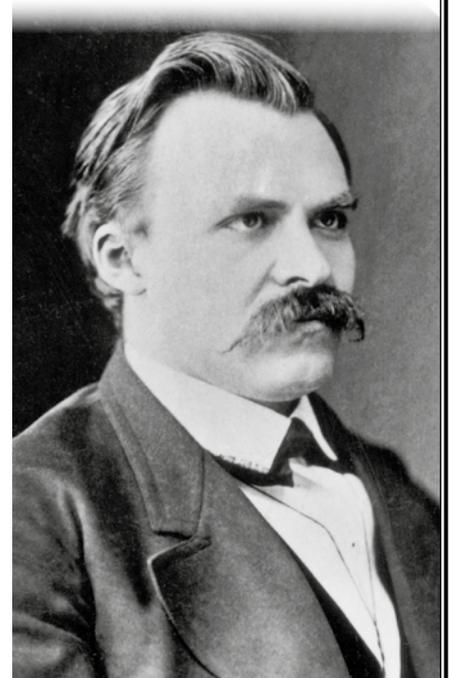
- 1 Work with a partner. Discuss what you know about Friedrich Nietzsche.
- 2 Read the text. Which of the things you discussed in question 1 are included here?

Friedrich Nietzsche

Friedrich Nietzsche (1844–1900) was a thinker who was very much a product of his time. He challenged the foundations of Christianity and yet was also acutely aware of how potentially destabilizing the removal of traditional belief systems could be, both for individuals and for society in general. He was born in a small town called Röcken, near Leipzig, in the province of Saxony, then part of the Kingdom of Prussia. His father died in 1849, and his younger brother Ludwig died the following year. Friedrich, his mother, and his older sister Elisabeth went to live in Naumberg with extended family. He was talented at school, and in 1858 he started at the internationally renowned Schulpforta, where, among other subjects, he studied Greek, Latin, Hebrew, and French. This was important later, as it allowed him to read ancient philosophical and religious texts in their original forms, and offer new interpretations of them. In 1864 he started at the University of Bonn, studying theology and classical philology, but after the first term he stopped studying theology, and appears to have lost his faith in Christianity. This caused a rift between him and his mother and sister. However, he continued his studies in philology, and the following year he began to study the philosopher Schopenhauer, and was greatly influenced by his ideas.

This was an interesting historical period, as all around, ideas were changing. Charles Darwin had put forward the theory of evolution, which offered an alternative to the view of creation as described in the Bible. Across Europe, there was a growing awareness of the philosophy of materialism, which suggests that the physical world is all there is, and that all our thought, experience, and emotion arises from physical matter. There were also arguments against this, notably from Immanuel Kant (1724–1804), who stressed the importance of rationalism and empiricism. Scientific progress was also accelerating and having more of an impact on daily life. Against this background, Nietzsche felt that there was no longer a place for God, and he saw this era as facing a crisis in values. Science had replaced God, yet science doesn't offer any moral guidance – people would be left without meaning or value in their lives. Alongside this, there was increasing confidence in the idea of the German state, and Nietzsche feared that this nationalism would replace Christianity, but bring hatred and aggression instead. While Nietzsche didn't propose a return to established Christianity, he wanted to suggest a way of finding meaning and value in life. He believed in the strength of the individual, what he called 'the will to power', as the

driving force behind life and human activity. This means the will to achieve something, to find a higher meaning by controlling oneself and realizing one's ambitions, without relying on anything beyond this life, in the form of God or a soul. Furthermore, Nietzsche refuted the idea of a fixed individual self, preferring instead the notion that reality is constantly changing, and that what we see as a human soul or being is instead in a state of constant conflict between different wills and desires. This also applies to the concept of truth. Nietzsche felt that to propose a single truth was to demonstrate an inflexible mind, and that a healthy, enquiring mind should see questions from many points of view.



3 Read the text on p1 again. For questions 1–6, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**

- 1 Who did Nietzsche grow up with?
 - a his close family
 - b his mother and sister
 - c his mother and brother
 - d his mother, sister, and other family members
- 2 Why were his studies in languages important?
 - a He travelled a lot.
 - b He enjoyed reading books in foreign languages.
 - c He could read the original versions of important texts.
 - d He could interpret ancient stories.
- 3 Why did Nietzsche have an argument with his mother and sister?
 - a They wanted him to continue studying theology.
 - b They didn't want him to study philology.
 - c He stopped studying after one term.
 - d They lost their faith in Christianity.
- 4 What was significant about this historical period?
 - a There were new interpretations of the Bible.
 - b Scientific progress was becoming important, and having an impact on daily life.
 - c It was an age of revolution.
 - d Immanuel Kant was writing about materialism.
- 5 What was Nietzsche's view on the problem of this era?
 - a He worried that without God, people had no alternative moral guidance.
 - b He didn't think science could explain everything.
 - c He wanted the German state to support Christianity.
 - d He thought science brought hatred and aggression.
- 6 What is 'the will to power'?
 - a the strength of the family
 - b the importance of being ambitious in work
 - c the need for individuals to achieve and to develop
 - d the importance of human activity

- 4 Match the underlined words in the text on p1 to their definitions.
- a a serious disagreement _____
 - b the belief that behaviour should be based on reason rather than emotions or religious beliefs _____
 - c the scientific study of the development of language _____
 - d the gradual development of plants and animals over many years _____
 - e a belief in the need for experiments and experience as the basis for ideas _____
 - f the belief that only material things exist _____

- 5 Read the text *Publications and ill health*. Answer the questions.
- 1 What problems did Nietzsche have while he was teaching?
 - 2 Was his first book successful?
 - 3 Why did he need someone to write his notes for him?
 - 4 Why did his sister change some of his work?

Publications and ill health

In 1869, at the age of 24, Nietzsche became a professor of Greek language and literature at the University of Basel in Switzerland. This was soon interrupted by national service as a hospital attendant in the Franco-Prussian war (1870–71). During this time he suffered from ill-health. Illness was something which troubled him throughout his life and eventually forced him to retire from his university position in 1879.

Although he had published his first book, *The Birth of Tragedy*, in 1872, it had not been very successful. His main writing was completed in the ten years after leaving the University of Basel. During this time, he led a nomadic existence and travelled between Germany, Switzerland, France, and Italy, never staying more than a few months in each place, but nevertheless producing many books, including *Thus Spoke Zarathustra* (1883) and *Beyond Good and Evil* (1886).

His eyesight deteriorated to the point where he needed someone to write his notes for him, and then, in 1889, Nietzsche suffered a complete mental collapse, from which he never recovered. It is now thought he had a form of brain cancer. He spent the rest of his life in a state of semi-awareness, and had to be cared for first by his mother, and after her death, by his sister. His sister had very different political views from his own, and as his work became better known, she shaped some of his notes and unpublished work to fit her own nationalistic and anti-semitic ideals. He died in 1900, unaware that his work was becoming better known.

What do you think?

- Do you think that scientific progress has replaced religious belief in today's world?

PROJECT

Either:

- find out about one of Nietzsche's publications and write about some of the ideas expressed in it, or;
- find out more about Nietzsche's close friendship with the composer Richard Wagner and write about it.

Use the Internet and reference books to find the information. Write 200–250 words.

- 1 Are the following statements about Kierkegaard true (✓) or false (✗)? Read the text and check your answers.
- a He had a strong Christian faith.
 - b He was critical of the German philosopher Hegel.
 - c His philosophy formed the basis of a political movement.

- 2 Read the text again. Find the words in **A** and underline them. Match them with their definitions in **B**.

A	B
1 ____ existentialism	a the study of religion and beliefs
2 ____ theology	b moral principles that control or influence a person's behaviour
3 ____ pseudonym	c a piece of writing, music, or acting that deliberately copies the style of somebody or something in order to be amusing
4 ____ ethics	d a name used by someone, especially a writer, instead of their real name
5 ____ satire	e a theory which states that the individual is free and responsible to determine their own development
6 ____ parody	f a way of criticizing a person, an idea, or institution by using humour to show their faults or weaknesses

Søren Kierkegaard

Søren Kierkegaard was a nineteenth century Danish philosopher, social critic, and theologian. He wrote widely on the subjects of philosophy, religion, psychology, ethics, and morality. One of the main principles of his work is the issue of individualism and the importance of personal choice and subjective experience. It is believed by many academics that he was the father of existentialism and modern psychology.

Kierkegaard was born on May 5th 1813 into a wealthy family in Copenhagen. In 1830 he enrolled at Copenhagen University, where he studied theology. At university Kierkegaard had a reputation as someone who was amusing and sociable, but privately he suffered from severe depression, a condition which influenced his life and much of his work.

Kierkegaard published his first major book, *Either/Or: A*

Fragment of Life, in 1843, and his last, *The Changelessness of God*, in 1855, the year of his death. Between these two books, he wrote more than 30 volumes of philosophy, theology, and criticism. He was a very productive writer. He often published his works under different pseudonyms, as a way to present different viewpoints on a subject. He did this to make his readers think as they read his work. He also used satire, parody, and irony as a way of challenging his readers and provoking different reactions in them. He did this because he wanted to make readers think about the issues he raised and arrive at their own opinions.

Kierkegaard strongly criticized Hegelian philosophy, which was the most popular philosophy of the time. Hegel, a German philosopher, wanted to create a philosophical model based on objective

logic and reason that would lead to an understanding of life, existence, and God. Kierkegaard, on the other hand, didn't think that an understanding of reality or of God could be reached entirely through logic. He believed that reality was a personal and subjective experience, not one that could always be rationalized. He believed that each individual has to create a personal relationship with God without help from the church or the government. He also believed that the way to reach truth was through faith, rather than logical explanations, as expressed in this quotation from his writing:

'The highest and most beautiful things in life are not to be heard about, nor read about, nor seen, but, if one will, are to be lived.'

Some of Kierkegaard's ideas later became associated with existentialism.

Much of Kierkegaard's work, including *Fear and Trembling* (1843), *The Concept of Dread* (1844), and *Purity of Heart is to Will One Thing* (1847), expressed a deep interest in religious issues. He criticized the dogma of the Church of Denmark and he examined religious themes such as faith in God, the institution of the Christian Church, Christian ethics, and theology. His work discusses the individual's subjective relationship with God, which came through faith, not logic. Kierkegaard died on November 11th 1855.



- 3** Read the text on p1 again. For questions 1–8, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**
- What issue does Kierkegaard focus on in much of his work?
 - the principles of Danish Christianity
 - logic and reason as a way of understanding existence
 - the right to choose your own religion
 - the individual and the importance of subjective experience
 - How did Kierkegaard appear to his friends while he was at university?
 - quiet and shy
 - depressed and sad
 - friendly and sociable
 - noisy and arrogant
 - How productive was Kierkegaard as a writer?
 - He wrote very few books.
 - He wrote two books.
 - He wrote a lot of books.
 - He didn't write as many books as he wanted to.
 - Why did he use satire and parody in his writing?
 - He wanted to make fun of his readers.
 - He wanted his readers to think about the issues he raised and arrive at their own opinions.
 - He wanted his readers to believe him and no-one else.
 - He wanted to confuse and trick his readers.
 - Which word describes the quality Hegel valued in the study of philosophy?
 - objective
 - existential
 - satirical
 - irrational
 - Which word describes the quality Kierkegaard valued in the study of philosophy?
 - comic
 - subjective
 - religious
 - logical
 - How did Kierkegaard believe that man could best form a relationship with God?
 - with the help of the Church
 - by applying logic and reason
 - through his own personal and subjective experiences
 - with the help of the government
 - How would you describe Kierkegaard's attitude to religion?
 - He didn't believe in God.
 - He wanted more people to join the Church.
 - He wasn't interested in religion.
 - He didn't trust organized religions and he criticized the Church.

'If I were to wish for anything, I should not wish for wealth and power, but for the passionate sense of the potential, for the eye which, ever young and ardent, sees the possible. Pleasure disappoints, possibility never. And what wine is so sparkling, what so fragrant, what so intoxicating, as possibility!'

Either / Or: A Fragment of Life

- 4** Read the extract by Kierkegaard. Are these sentences true (✓) or false (✗)? Correct the false sentences.
- Kierkegaard's greatest wish is to have wealth and power.
 - He talks about the wonderful feeling you have when you are excited about something that could happen in the future.
 - He believes that reality is always exciting, but the 'idea' or possibility of something is never exciting.
 - He compares the excitement of possibility to a delicious sparkling wine.
- 5** Read the extract again. Match the underlined words to their definitions.
- making you feel so excited that you can't think clearly _____
 - a possibility _____
 - having a pleasant smell _____
 - very enthusiastic and showing strong feeling about something _____

What do you think?

In much of his work, Kierkegaard agreed that we can learn about the outer world through observation and the application of logic, but that it's only possible to understand the inner, spiritual world as a subjective experience.

- Do you think Kierkegaard is right? Why (not)?

PROJECT

Either:

- find out more about people who were influenced by Kierkegaard and write about what they found interesting in his work, or;
- find out more about Hegel and describe his ideas.

Use the Internet and reference books to find the information. Write 200–250 words.

1 In pairs, discuss what you know about Ludwig Wittgenstein, then read the text.

Ludwig Wittgenstein

Ludwig Wittgenstein was one of the most influential philosophers of the twentieth century, although he only published one book in his lifetime. The basis of his ideas was that philosophical problems arise from misunderstanding the logic of language.

He was born into an extremely wealthy family in Austria and his father, Karl, was one of the most successful businessmen in the Austro-Hungarian Empire, having made his fortune in the steel industry. The family participated in the rich cultural life of Vienna and Ludwig was the youngest of nine children who grew up in a house often visited by famous artists, such as Gustav Klimt, and musicians, such as Johannes Brahms and Gustav Mahler. The boys were first educated at home, but Ludwig went to school in 1903, when he was 14.

Later, he studied mechanical engineering in Berlin, and in 1908 he moved to the University of Manchester in England, to do a doctorate in aeronautics. During his research, he became interested in the foundations of mathematics and logic, and this overtook his interest in aeronautics. In 1911, he went to Cambridge University to study the philosophy of mathematics. His tutor, Bertrand Russell, was a leading philosopher, logician, and

mathematician. Wittgenstein was an intense and passionate student, and Russell considered him one of his best pupils.

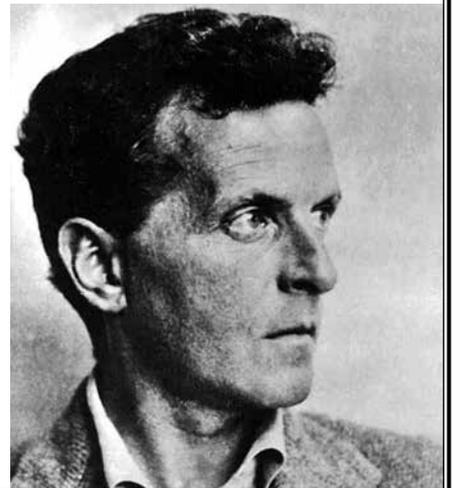
In 1913, Wittgenstein inherited a fortune when his father died. He gave away a lot of it to struggling artists, and retreated to an isolated village in Norway. There he began writing *Tractatus Logico-Philosophicus*. When the First World War started in 1914, he signed up to serve in the Austro-Hungarian army. He won many medals for his bravery, and was respected as an officer.

The war shaped his philosophical views, and he kept philosophical and personal notebooks during this period. In 1918, he took leave from the army and returned to Vienna. In August he completed the *Tractatus*, although at first it was rejected by publishers. A series of personal tragedies – the deaths of his uncle and his close friend, and his brother's suicide – left him emotionally wounded. When he returned to the war, he was captured by Allied forces and spent nine months as a prisoner.

On his return to Vienna in 1919, he was depressed and exhausted. He gave his fortune to his sisters and his brother, Paul, and he trained as a teacher. In 1920, he began working as a teacher in a small Austrian village. It was during

his teaching career that *Tractatus Logico-Philosophicus* was published, first in German in 1921, then in English in 1922. The central idea showed the relationship between language and the environment. Language is a way of representing objects, it is a picture of reality. It argues that while language is of central importance for communication, it is not suited to putting meaning to philosophical concepts such as truth or knowledge. Abstract concepts can't always be described in linguistic terms. In *Tractatus*, logic determines the structure of language and reality.

When Wittgenstein finished the *Tractatus*, he initially felt that he had solved all the philosophical questions which had concerned him, and he didn't return to these for some years.



2 Read the text on p1 again. Find the words in **A** and underline them. Match them with their definitions in **B**.

A	B
1 ____ influential	a the science of thinking about or explaining the reason for something using formal methods
2 ____ logic	b based on general ideas, not a particular thing
3 ____ isolated	c having an important role in shaping events and ideas
4 ____ represent	d an idea or principle about events or behaviour
5 ____ concept	e physically separated from other people or places
6 ____ abstract	f to show something

3 Read the text again. Answer the questions.

- 1 What kind of people did Wittgenstein meet as he was growing up?
- 2 How did his studies change when he was at university?
- 3 What was Bertrand Russell's opinion of Wittgenstein?
- 4 What did Wittgenstein do with the money he inherited?
- 5 Was his first book successful immediately?
- 6 Why did Wittgenstein stop writing after he finished the *Tractatus*?

4 Read about Wittgenstein's later life in *Later work*. Complete the gaps 1–4 with the sentences A–E. There is one extra sentence that you do not need to use. **F**

- A he now considered that the way language is used is its most important role.
- B Abstract concepts can't be described in language.
- C Gradually his ideas began to change.
- D we make oversimplifications in order to create general concepts which do not exist.
- E However, he decided not to publish it in his lifetime.

5 Read the text again. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- 1 Wittgenstein's ideas had changed when he returned to philosophical study.
- 2 He wanted to publish *Philosophical Investigations*, but he died before he could.
- 3 He didn't think language games were useful.
- 4 Wittgenstein believed that you can't study philosophy in the same way you study science.
- 5 He believed that theories are good because they are based on rational ideas.

Later work

In 1929, Wittgenstein returned to Cambridge and began studying philosophical enquiry again. (1) ____ His later work is quite different from his early publication. Through lecture notes, letters, and recorded conversations, he recorded these changes, and he prepared the manuscript for his final work, *Philosophical Investigations*. (2) ____ It was only published after he died.

When *Philosophical Investigations* is read in relation to his earlier work, it offers new perspectives on his thoughts on language, truth, and philosophy. While he accepts that language represents ideas, (3) ____ He uses language games to show different interpretations of meaning, which is characteristic of language. He claims that philosophy as a subject has no ability to reveal truths about human behaviour. As a discipline, it takes too much from the scientific approach to learning which aims to give concrete answers and universal truths. When we apply this approach to philosophical investigations, (4) ____ In his view, the correct approach to philosophical problems is to reveal the irrational assumptions on which theories are based.

What do you think?

- Do you think that it is useful to analyse ideas such as 'truth' and 'knowledge' in a philosophical way? Why (not)?

PROJECT

Either:

- find out more about one of Wittgenstein's language games and describe the ideas it illustrates, or;
- find out more about the cultural and artistic life of Vienna at the end of the nineteenth century and write about it.

Use the Internet and reference books to find the information. Write 200–250 words.

- 1 Work with a partner. Can you think of an example of a mathematical model?
- 2 Read the text. Who might use a mathematical model?

Mathematical modelling

Mathematical modelling is the technique of creating an abstract model which uses mathematical language in order to describe or predict how a system will work. It is widely used in physics, engineering, computer science, and economics, (1) ____ It is an activity which enables a mathematician to solve problems that he or she might face as an ecologist, an economist, a chemist, or a physicist. Instead of carrying out experiments in the real world, a mathematical model is an abstract experiment with mathematical representations of the real world.

At its most simple form, we can use a mathematical model to find out how much space is inside a cardboard box: volume = height x width x length, or $v = h \times w \times l$. At a more complex level, we can alter the formula to find out more detailed information. (2) ____ This can then be applied in the real world in terms of the needs of an online delivery company. They could adapt and extend this model, using different variables such as amending the size of the box, or the thickness of the cardboard, in order to find the most economical size of box to use.

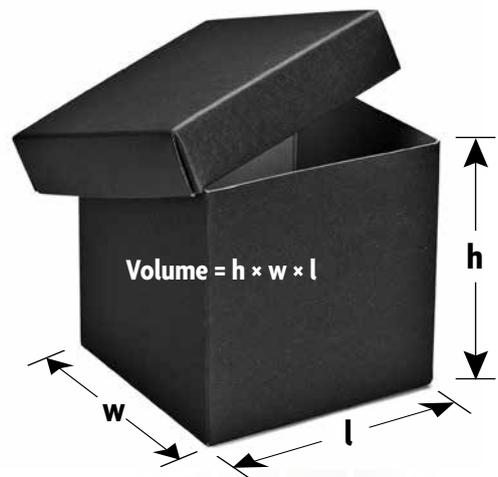
Mathematical modelling is an important area of mathematics as it has so many real-world applications. For instance, an engineer could enter known information into a mathematical model, and then alter different measurements. (3) ____

Mathematical modelling uses mathematics to explain things that happen in the real world and to research important questions about the world around us. It can also be used to test ideas; for example, how much steel we would need to buy if we were going to extend a railway by 3,000 miles. Furthermore, it can be used to allow us to make predictions about the real world. (4) ____

- Step 1** Take data from the real world.
- Step 2** Enter this information into the formula to create the model.
- Step 3** Analyse the data and draw mathematical conclusions.
- Step 4** Interpret the results to make predictions or explanations.

Mathematical models are often very complicated, so computers are used. (5) ____ For example, something on this scale would be economic models to predict changes in house prices or inflation, or weather forecasting.

The aim is to produce the simplest model which incorporates all the important features of the phenomenon being researched.



- 3** Read the text on p1 again. Complete the gaps 1–5 with sentences A–F. There is one extra sentence that you do not need to use. **F**
- A We could then discover how much money can be saved on delivery charges by using different sizes of boxes.
- B If we add different information to the model, we can see what might happen and use this as a basis for predictions.
- C The mathematical rules get written into computer programs to make a computer model.
- D as well as in biology, electrical engineering, sociology, sports, ecology, and political science.
- E Sports experts can use mathematical models to see how quickly athletes can run races.
- F This could show how large structures such as bridges or skyscrapers behave under varying amounts of stress.
- 4** Find the words in **A** in the text on p1 and underline them. Match them with their definitions in **B**.

A	B
1 ____ abstract	a not spending more money than is necessary
2 ____ formula	b a fact or event in the real world
3 ____ economical	c based on ideas, not existing in the real world
4 ____ application	d a statement that says what you think will happen
5 ____ prediction	e a series of letters, numbers, or symbols that represent a rule or law
6 ____ phenomenon	f a practical use

Variations within models

There are many forms of mathematical models, including dynamical systems, statistical models, differential equations, or game-theoretic models. The types of models can overlap, so any given model could have a variety of abstract structures.

There are six groups of variables within a model: decision variables, input variables, state variables, exogenous variables, random variables, and output variables. There can be many variables of each type, and the variables are generally represented by vectors.

Problems being examined through mathematical modelling are often classified into black box or white box models, according to how much initial information is available. A black box model is a system for which there is no initial information available.

A white box model is a system where all necessary information is available.

- 5** Read *Variations within models*. Are these sentences true (✓) or false (✗)? Correct the false sentences.
- There are four different forms of mathematical models.
 - A model can have a variety of abstract structures.
 - Within a model, there are six groups of variables.
 - The variables are represented as formulas.
 - A model is black box or white box depending on how beneficial the outcome is.
 - A white box model doesn't have complete information.

What do you think?

- Can you think of any situations in which it would be useful to analyse options using a mathematical model? Discuss your ideas in groups.

PROJECT

Do further research on mathematical modelling on the Internet. Find a simple problem that can be examined through a mathematical model. Can you enter data to the model and analyse the findings?

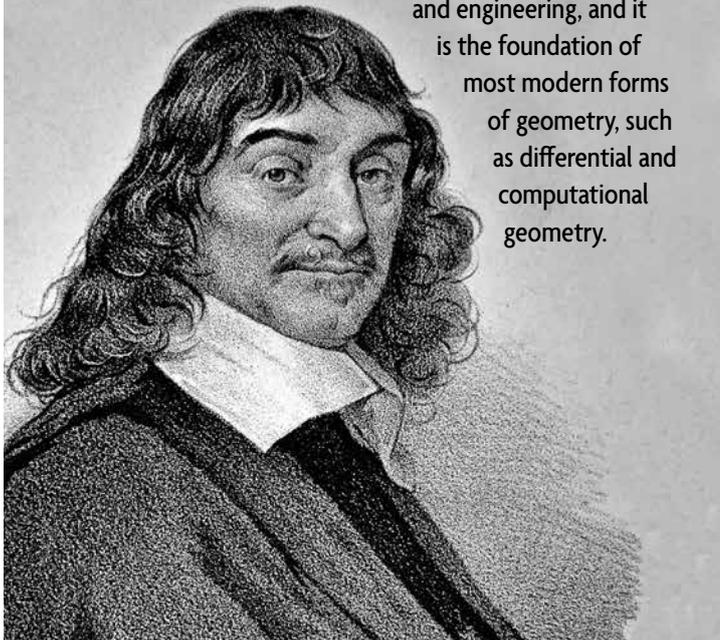
- 1 Work with a partner. Ask and answer these questions.
 - How much time a week do you spend studying maths?
 - Which area of maths do you prefer: algebra or geometry? Why?
- 2 Read the text *Analytic geometry* and answer the questions.
 - 1 What is analytic geometry?
 - 2 What system did René Descartes devise in *Discourse on Method*?
 - 3 What did analytic geometry mark the beginning of?
 - 4 In what areas of study is analytic geometry used?

Analytic geometry

Analytic geometry is the study of geometry using algebra to manipulate equations for planes, straight lines, curves, and circles, often in two or three dimensions of measurement on a coordinate plane. The most common coordinate system used is the Cartesian coordinate system, named after René Descartes, the seventeenth century mathematician and philosopher.

René Descartes introduced the foundation for analytic geometry in 1637 in his work commonly referred to as *Discourse on Method*, its full title being *Discourse on the Method of Rightly Conducting One's Reason in the Search for Truth in the Sciences*. This work and its philosophical principles provided the foundation for calculus later introduced by Sir Isaac Newton and Gottfried Wilhelm Leibniz. It is accepted that the introduction of analytic geometry was the beginning of modern mathematics. Analytic geometry is used in physics, astronomy,

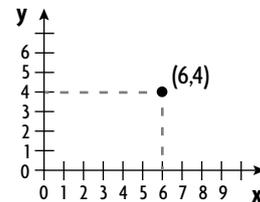
and engineering, and it is the foundation of most modern forms of geometry, such as differential and computational geometry.



Cartesian coordinate system

Lines and planes

In the Cartesian coordinate system, each point has an x coordinate which represents its horizontal position, and a y coordinate which represents its vertical position. These are written as an ordered pair (x, y). This means that the horizontal distance (x) is always written first, and then the vertical distance (y). Each reference line is called a coordinate axis and the point where they meet is its origin (0,0).



In this example, point (6,4) is 6 units in the horizontal position (x), and 4 units in the vertical position (y).

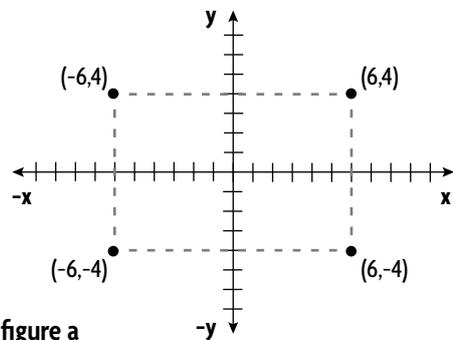


figure a

For negative values, negative (x) travels left on the horizontal position and negative (y) travels down the vertical position.

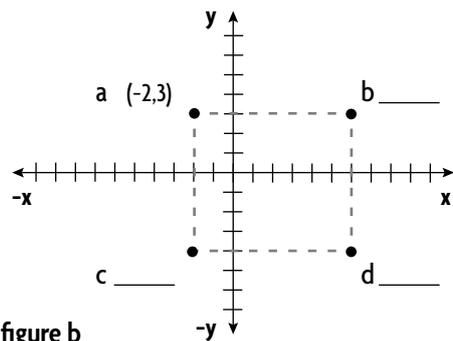
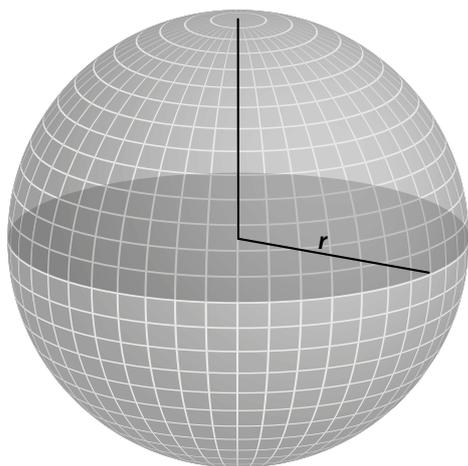


figure b

Sphere

A sphere is defined mathematically as the set of all points in three-dimensional Euclidean space \mathbf{R}^3 that are located at a distance r (the 'radius') from a given point (the 'centre'). The diameter of a sphere is twice the radius. A sphere relates only to the two-dimensional closed surface, whereas a ball includes the interior dimensions of the sphere.



Using Cartesian coordinates, the equation of a sphere of radius R is:

$$x^2 + y^2 + z^2 = R^2$$

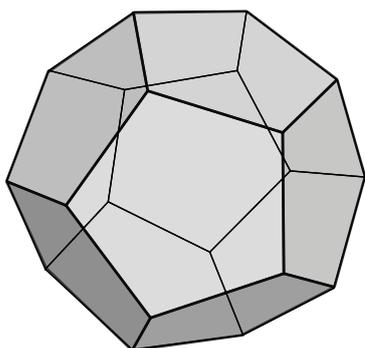
In analytic geometry, a sphere with centre (x, y, z) and radius r is:

$$(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = r^2$$

Polyhedron

In geometry, a polyhedron is a three-dimensional solid which consists of a collection of polygons, usually joined at their edges. The plural of polyhedron is 'polyhedra'.

In algebraic geometry, a polyhedron is defined as a space that can be built from 'building blocks' such as line segments, triangles, and tetrahedra.



- 3 Read the text *Lines and planes* and complete the definitions.
 - 1 x represents _____
 - 2 y represents _____
 - 3 In an ordered pair, _____ is written first, and _____ is written next.
 - 4 Each reference line is called a _____.
 - 5 The point where each reference line meets is the _____ or _____.
 - 6 Negatives values: $(-x)$ travels _____ on the horizontal position and $(-y)$ travels _____ the vertical position.
- 4 Look at figure b on p1. Write the coordinates for points **b**, **c**, and **d**.
- 5 Read the texts *Sphere* and *Polyhedron*. Find the words in **A** in the text and underline them. Match them with their definitions in **B**.

A	B
1 _____ polygon	a a mathematical statement showing that two amounts or values are equal
2 _____ diameter	b a flat shape with three or more sides and angles, often five sides and more
3 _____ radius	c solid shapes with four flat sides that are triangles
4 _____ equation	d a straight line between the centre of a circle and a point on its outer edge
5 _____ tetrahedra	e a straight line going from one side of a circle to the other

What do you think?

- In what professions do you think analytic geometry is used today?

PROJECT

Find out about how analytic geometry is used in modern physics, astronomy, or engineering. Use the Internet and an encyclopaedia to collate information about a particular example that interests you.

The Earth's atmosphere

The atmosphere is divided into four different layers, marked by major changes in temperature. The structure of the atmosphere affects weather patterns near the Earth's surface.

The layer that we live in, immediately surrounding the earth, is the troposphere, which extends to a (1) _____ of around 12 kilometres. The height varies depending on location – it is lower over cold areas and higher over warm areas. This is the layer where weather occurs. As height increases, the temperature drops, by about 6.5°C per kilometre. The reason it is (2) _____ at the surface of the Earth is because a lot of the sun's energy is absorbed by the ground, which then releases this as heat in infrared radiation, so this layer is heated from the ground upwards. As the warm air rises, the molecules move apart and lose energy, which causes the temperature to drop.

At the top of the troposphere is the tropopause, a layer which separates the troposphere from the next layer, the stratosphere. This is where the jet stream is found – strong (3) _____ that blow east – and it is the highest point where weather can occur.

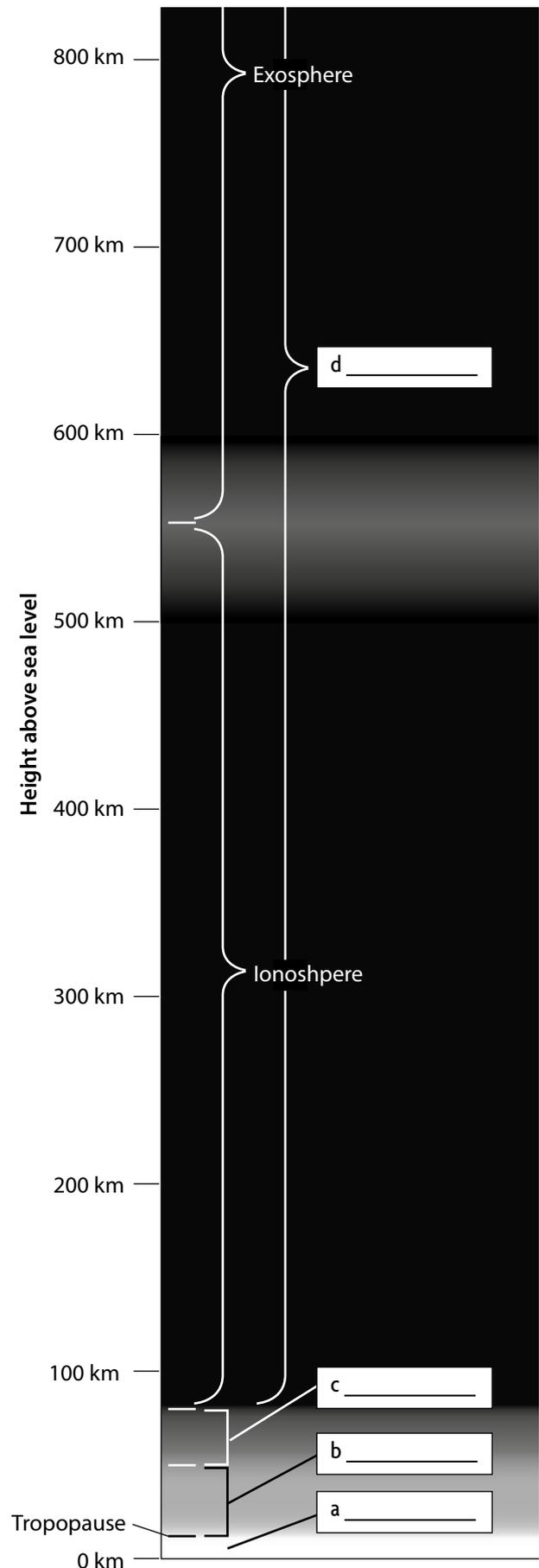
The stratosphere is from 12–50 km above Earth. In the lower part, the temperature starts at around -60°C, but here, the temperature increases with height, because of the ozone layer. Ozone protects the Earth's surface from ultraviolet radiation from the (4) _____ as it absorbs the ultraviolet light. This causes an increase in temperature in the upper part of the stratosphere, above the ozone layer.

Above the stratosphere is the mesosphere, which is around 50–80 km high. This is the (5) _____ part of the atmosphere, at -100°C, and the temperature decreases with height. This layer protects the Earth from meteoroids, as they burn up here.

From 80 km upwards is the thin air of the thermosphere. Thermo means 'heat', and the temperature here is very high because it is heated directly by the sun. Within the thermosphere there are two separate (6) _____. The first is the ionosphere, from 80–550 km. This is where radio waves reflect waves back to Earth. Gas particles in the thermosphere absorb UV and X-ray radiation from the sun, and the particles of gas become electrically charged ions. Radio waves bounce off these ions. Solar flares in this layer can increase the number of ions and interfere with the transmission of some radio waves.

The exosphere is the upper part of the thermosphere, from about 550 km to thousands of kilometres from the Earth. This is where satellites orbit the Earth, and the air is very thin.

The changes in atmosphere are caused by different strengths of air pressure, which is a measure of the weight of the air molecules above you. The molecules in the atmosphere are pulled down towards the (7) _____ of the Earth by gravity. The atmosphere is concentrated at the surface and gets thinner with height. As you move up, there are fewer molecules above you, so air pressure decreases, and the amount of oxygen reduces. This is why it is hard to (8) _____ at the top of a mountain.



- 1 There are over 1,000 man-made satellites orbiting the Earth. With a partner, discuss how far away from Earth you think they are.
- 2 Read the text *The Earth's atmosphere* on p1. Check your answer to exercise 1.
- 3 Read the text again. Complete the gaps 1–8 with the words in the box.

winds layers breathe height coldest sun
surface warmer

- 4 Using information from the text, label the diagram with the names of the layers in the Earth's atmosphere.
- 5 Put the descriptions of layers in order, from the closest to the Earth's surface to the furthest away.
 - A In the stratosphere, it is hotter at the top than at the bottom.
 - B The thermosphere is heated directly by the sun.
 - C Satellites orbit the earth in the exosphere.
 - D Weather occurs in the troposphere, the area surrounding the Earth.
 - E The mesosphere is the coldest part of the atmosphere.
 - F Above the troposphere is the tropopause, where the jet stream is found.
- 6 Read the text again. Answer the questions.
 - 1 Why is it hotter on the surface of the Earth than it is at the top of the troposphere?
 - 2 Why does air get cooler as it rises?
 - 3 What is the jet stream?
 - 4 Why does the temperature change through the stratosphere?
 - 5 How does the mesosphere protect the Earth from meteoroids?
 - 6 What effect can solar flares have on the ionosphere?
- 7 Work with a partner. Student A, look at photos 1 and 2. Student B, look at photos 3 and 4. Take turns to do the following tasks. **F**

Step 1

Talk about your photographs for about a minute. They show different parts of the atmosphere. Compare and contrast the photos. Describe in what way the temperature and air pressure vary between the two photos and explain why they vary.

Step 2

With your partner, discuss what changes you would experience if you floated up in a hot air balloon.



What do you think?

- Why does the jet stream sometimes affect long-distance aeroplanes?

PROJECT

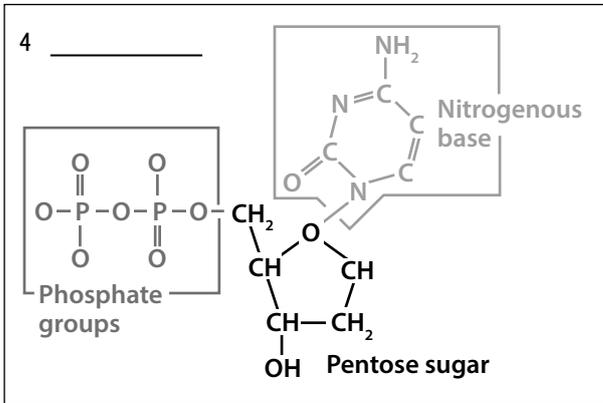
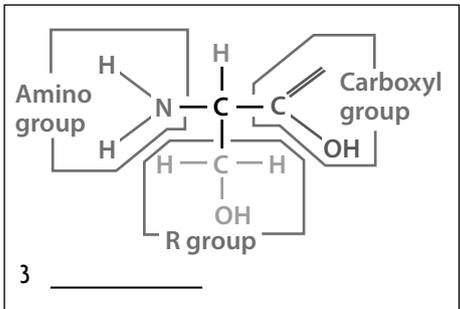
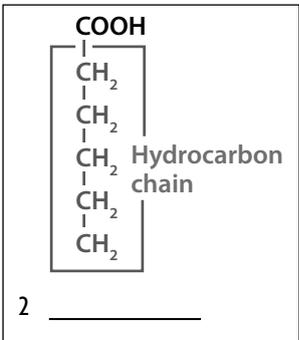
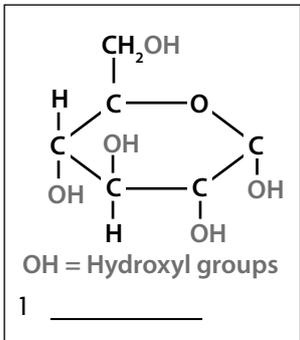
Use the Internet to find out more about the different layers of the atmosphere.

Write 250–300 words about how changes to the atmosphere – to the ozone layer, for example – can affect the Earth's climate and lead to global warming.

- 1 Which of these is not a biomolecule? Why?
- a protein
 - b nylon
 - c carbohydrate

- 2 Read the text *Important biomolecules*. Complete the sentences with the missing numbers.
- 1 There are ____ main types of biomolecules.
 - 2 Disaccharides contain ____ monosaccharide molecules.
 - 3 There are ____ different amino acids in proteins.
 - 4 Amino acids have ____ groups attached to a central carbon.
 - 5 There are ____ kinds of nucleotides in nucleic acids in cells.
- 3 Read the text again. Match the biomolecules in the box to the diagrams 1–4.

lipid nucleic acid carbohydrate protein



Important biomolecules

Biomolecules occur naturally in living organisms. They are compounds that consist mainly of carbon and hydrogen, with nitrogen, oxygen, sulphur, and phosphorous. The four major classes of biomolecules are carbohydrates, proteins, lipids, and nucleic acids.

Carbohydrates

Carbohydrates are a source of energy for the cell. The simplest unit of a carbohydrate is a monosaccharide. Monosaccharide molecules are simple sugars that are made up of between three and seven carbon atoms. Disaccharides are made up of two monosaccharides. Disaccharides and monosaccharides are sweet, crystalline, and they dissolve in water. Polysaccharides are long chains of monosaccharides, for example, a long chain of sugars. They aren't crystalline and they don't dissolve in water, for example, starch.

Proteins

Proteins are composed of units called amino acids and are responsible for the structure and function of the cell. There are 20 different amino acids. Amino acids are composed of four groups bound to a central carbon atom: a carboxyl group, an amino group, a hydrogen atom, and a variable 'R' group. The R group gives the amino acid special properties that determine its particular function. A polypeptide is a long chain of amino acids.

Lipids

Lipids are composed of long hydrocarbon chains and make up the building blocks of the structure and function of cells. There are several classes of lipids. The main ones are glycolipids, phospholipids, and sterols. Cholesterol and other sterols are lipids and are necessary components of cell membranes. Examples of lipids include fats, oils, waxes, non-soluble vitamins, and the non-protein membrane of cells.

Nucleic acids

Nucleic acids are composed of a polymer of nucleotides. They are responsible for all genetic information and are the building blocks for DeoxyriboNucleic Acid (DNA) and RiboNucleic Acid (RNA). There are five different types of nucleotides in the cell: adenine, thymine, guanine, cytosine, and uracil. Each nucleotide is composed of a nitrogenous base, a 5-carbon sugar, and a 3-phosphate group.

- 4 Read *Functions of biomolecules*. Match the name of the biomolecule with the function 1–4 which best describes it.

Functions of biomolecules

- 1 These molecules provide fuel and energy for the body. They are essential for the function of all the major organs and systems: the brain, heart, nervous, digestive, and immune systems. Deficiency causes fatigue and poor mental function.
- 2 These molecules have a variety of different functions. Some are responsible for the structure of the cell, some help in the function of the cell, and some provide defence against infections. They can exist as antibodies, hormones, or enzymes.
- 3 These molecules store energy in the body. They also comprise the structural component of cell membranes and control the flow of material in and out of the cell.
- 4 The sequence of these molecules carries the genetic information in the cell. They are the building blocks for DNA and RNA and are essential in protein synthesis.

- 5 Read *Amino acids and diet*. Are these sentences true (✓) or false (✗)? Correct the false sentences.
- 1 Protein molecules fold in different ways to make different proteins.
 - 2 Eleven amino acids are made by our bodies.
 - 3 Serotol is an essential amino acid.
 - 4 Lysine is contained in fish and red meat.
 - 5 Lysine is used in the body to produce potassium.
 - 6 Tryptophan helps the body produce serotonin.

Amino acids and diet

Amino acids are bound together in long chains to make up protein molecules. The long chains of amino acids fold in different ways to give each type of protein molecule a particular shape. Proteins can have different functions. They can be structural components of tissue, such as muscle; hormones, such as oestrogen; antibodies; or enzymes. There are 20 different amino acids which occur naturally. There are nine essential amino acids that humans must get from food, and 11 amino acids which can be produced in our bodies. The nine essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Lysine and tryptophan are two essential acids which don't occur in a lot of plant proteins. Some vegetarians and vegans may find it difficult to get enough of these amino acids if they don't eat well. Lysine, which is present in spinach, fish, and red meat, is used to build muscles and collagen. It helps the body absorb calcium, and it helps produce enzymes and hormones. Tryptophan, which is present in nuts, seeds, eggs, meat, and dairy products, helps the body produce serotonin, which is necessary for good brain function, and melatonin, which aids sleep.

- 6 Work with a partner. Student A, look at photos 1 and 2. Student B, look at photos 3 and 4. **F**

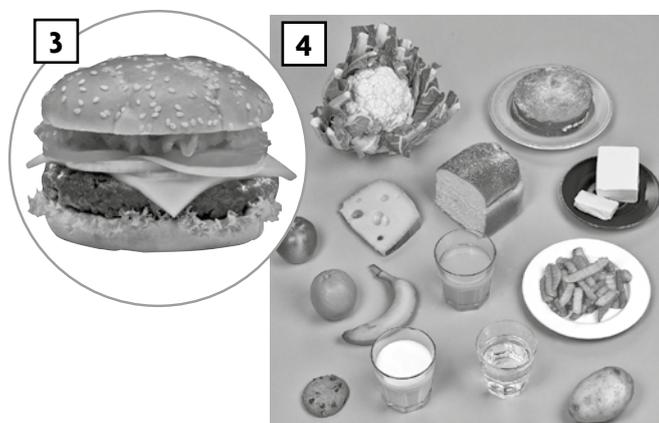
Take turns to do the following tasks.

Step 1

Talk about your photographs for about a minute. They show different kinds of food. Compare and contrast the photos and say what nutrients are available from these foods and what kind of contribution they can make to a balanced diet.

Step 2

With your partner, discuss whether you have a balanced diet and what you might improve about your diet.



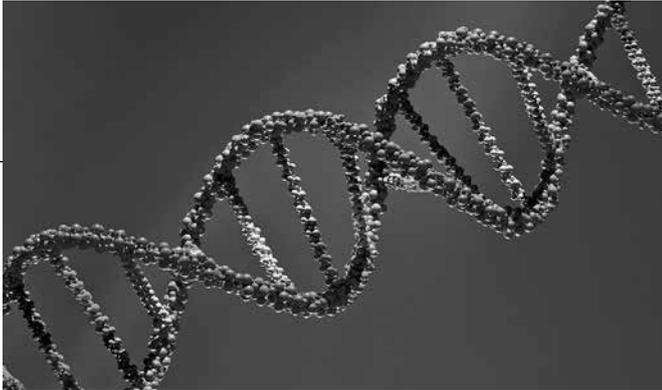
What do you think?

- What different carbohydrates can you think of? Discuss your ideas in pairs or small groups.

PROJECT

Choose one of the five different types of nucleotides: adenine, thymine, guanine, cytosine, and uracil. Use the Internet and your science books to find more information. Write about its composition and function. Draw and label a diagram.

- 1 Work with a partner and discuss these questions.
 - What do you know about the Human Genome Project?
 - Can you name any practical applications for genetic engineering?
 - What do you know about gene therapy?
- 2 Read the text *Genetics, gene therapy, and genetic engineering* and check your answers.



Genetics, gene therapy, and genetic engineering

Genetics is the study of heredity. Heredity is the process by which genes are passed to the next generation of organisms through reproduction. The DNA in the cell of living organisms contains all the genetic information, or the complete genome, for that organism. (1) ____ Genes provide the specific information for an enormous variety of functions. Variations in a gene (an allele) will result in physical characteristics such as eye and hair colour, but also some diseases. In recent years, scientists have made enormous advances in identifying genes and their functions.

The Human Genome Project, which started in 1990, aimed to identify the estimated 20,000 to 25,000 genes in human DNA. The project was officially completed in April 2003. (2) ____ Since scientists began to understand the structure of genes, they have tried to apply this knowledge in medical research. It is now possible to help or cure some diseases and genetic disorders using gene therapy.

In plants and animals, genes control all the physical features, and by altering genetic information those features can be changed. For example, the colour or size of a plant can be changed by changing the genes which carry that information. This process happens naturally during reproduction when the

- 3 Read the text again. Complete the gaps 1–5 with sentences A–F. There is one extra sentence that you do not need to use. **F**
 - A Since then, approximately 12,800 genes have been identified.
 - B Some GM plants have been created so that they are resistant to disease or harmful insects.
 - C Small parts of DNA are called genes.
 - D The body’s immune system recognizes and destroys harmful things.
 - E Then the insulin is taken from the bacteria and can be used.
 - F It does this by introducing genes into the target DNA.

genetic information from parents mixes and results in a new organism with slightly different DNA.

Genetic engineering can manipulate specific changes artificially in the DNA of organisms. (3) ____ These newly introduced genes will alter the genetic information. Once the specific properties and identities of different genes are isolated, all kinds of practical applications may become possible. This is why genetic engineering has been growing in importance.

Practical applications of genetic engineering have been made in areas including agriculture, medicine, and research. One application of genetic engineering is in the area of genetically modified (GM) plants. (4) ____ Some have been modified to tolerate toxic pesticides. Many people believe that GM food represents a danger to the environment because not enough is known about the long-term effects on bees and insects, biodiversity, and human health. GM foods such as maize, corn, tomatoes, and papaya have been grown in America since 1994.

Another important application of genetic engineering is in the area of health care. Some diseases are inherited and are the result of genetic disorders. By providing a healthy gene to replace the unhealthy gene, it is possible to treat some diseases and prevent others. This approach is used in some cases of cancer treatment.

A further example of the practical use of genetics in health care is where large quantities of organic substances are needed, which cannot easily be manufactured. For example, large amounts of insulin are needed for the treatment of diabetes. The insulin gene is introduced into bacteria, which is grown in sterile conditions. (5) ____ This process became available commercially in 1982, whereas previously, insulin had been obtained from cows and pigs, which is both difficult and expensive. It is hoped that in the future gene therapy may be used to prevent diabetes.

4 Find the words in **A** in the text and underline them. Match them with their definitions in **B**.

A	B
1 _____ genome	a a section of DNA which controls a particular characteristic in a living organism
2 _____ gene	b a living thing
3 _____ organism	c a chemical that controls the level of sugar in the blood
4 _____ pesticides	d a medical condition
5 _____ insulin	e a chemical used for killing insects
6 _____ diabetes	f the complete set of genes in a cell or a living thing

5 Read the text on p1 again. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- Variations in a gene (an allele) mean that everyone has the same coloured eyes and hair.
- The Human Genome Project aimed to identify all the genes in human DNA.
- Genetic engineering has been used in the area of genetically modified (GM) plants.
- GM food is considered safe because there are no long-term effects on the environment.
- Genetic engineering has found a cure for cancer.
- Genetic engineering is applied in the production of insulin.

6 Read the text *Progress in research*. Why are viruses used as carriers?

7 Read the text again. For questions 1–4, choose the answer (a, b, c, or d) which you think fits best according to the text.

- What stage is this biological therapy at?
 - It is widely available.
 - It isn't available yet.
 - It is making good progress.
 - The experimental stage is finished.
- Will the virus make the patient ill?
 - It may make a patient slightly ill.
 - No, not at all.
 - There's a chance it could make a patient very ill.
 - Yes, definitely.
- What are scientists trying to ensure in their ongoing research?
 - They are trying to make cells live longer.
 - They need to be sure that the benefits don't disappear when the cells divide.
 - They need to stabilize cell division.
 - They need to establish the health benefits before the cells divide.
- What is one disadvantage to this therapy?
 - The immune system usually rejects it.
 - It attacks the immune system.
 - All the drugs cost over \$1 million.
 - It is extremely expensive.

Progress in research

Since scientists began to understand the structure of genes, they have tried to apply this knowledge in medical research. It is now possible to help or cure some diseases and genetic disorders using gene therapy. Gene therapy is still in an experimental stage, and progress has been quite slow. It isn't available as a standard cancer treatment yet.

One of the difficult parts of the therapy is getting the genes into the cancer cells. It is usually done using a carrier, such as a virus. Viruses are used because they can go into cells with genetic information. The virus may cause mild symptoms, but it won't cause serious disease. Researchers are engineering viruses which target and destroy cancer cells, not healthy cells.

Research is still ongoing. Scientists need to ensure that any changes to the genes are stable and can survive a long time. It is in the nature of cells to divide and replicate, so it is important that the health benefits remain when the cells divide. There can also be problems with the body's immune system, which is programmed to attack any foreign object in human tissue. This can reduce the effectiveness of the therapy. In addition, it is a very expensive process – one drug, used for this type of therapy, was reported to have cost \$1.6 million per patient in 2013!

What do you think?

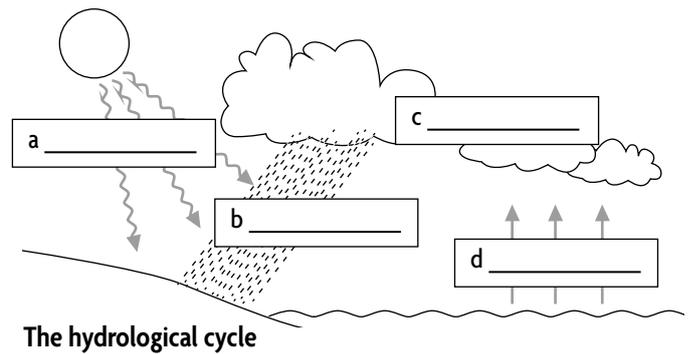
- Do you think it will be possible to get rid of cancer using genetic engineering? Why (not)?

PROJECT

Find out how genetic engineering has been used to produce genetically modified (GM) food. Use the Internet and reference books to find the information. Write 200–250 words.

- 1 Work with a partner. What is the climate like in your country? Discuss the different weather in each season.
- 2 What do you know about the hydrologic cycle? Label the diagram with these words. Read the text *Weather processes* and check your answers.

evaporation precipitation condensation insolation



Weather processes

The terms ‘weather’ and ‘climate’ are sometimes confused. Weather relates to hourly or daily atmospheric conditions such as precipitation, sunshine, cloud cover, temperature, and humidity. Weather describes processes over a short period of time, whereas climate describes the average weather conditions taken over a long period of time. Climate gives a general picture, whereas weather can vary from day to day or hour to hour.

Energy from the sun passes through the atmosphere to Earth in the form of short wave radiation or insolation, and is responsible for weather and different climates. Once insolation has reached the Earth it is converted into heat energy. As the ground warms, it heats the atmosphere above. However, as energy passes through the atmosphere on its way to the Earth, most of it is lost via the following processes:

- absorption: as ozone, dust, clouds, and carbon dioxide absorb the energy
- scattering: as gas diverts incoming radiation
- reflection: as clouds, snow, land, and water surfaces reflect energy back into space (a green forest reflects 3–10% of the energy that reaches it, and fresh snow reflects 80–90%)

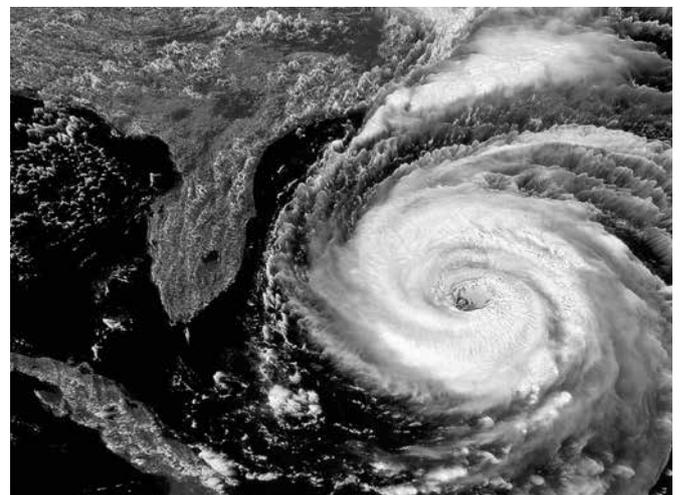
The remaining energy that reaches the Earth is absorbed through a process called transmission.

Weather processes such as air temperature, wind, clouds, and precipitation (rain and snow) are the result of the atmosphere responding to the uneven heating of the Earth by the sun. The atmosphere is composed of distinct air masses that have different temperatures, different amounts of moisture, and different atmospheric pressures.

Wind is caused by air moving from high pressure areas to low pressure areas in the lower levels of the atmosphere. The rotation of the Earth causes air masses to rotate. This can be seen in weather satellite photographs. When the rotation becomes a tight, rapidly spinning circle, the air mass is called a cyclone.

Clouds form when water vapour in the air condenses into tiny, visible water droplets or ice crystals when the air cools. This process of condensation occurs when the water vapour collides and joins with tiny particles of salt and dust which are present in the atmosphere. As the droplets continue colliding, they stick together. The droplets aren’t big enough to fall as rain, and gather together as clouds in the lower atmosphere. Clouds are composed of ice or water droplets depending on the height of the cloud and the temperature of the surrounding air.

Precipitation refers to moisture that falls to Earth as rain, sleet, hail, snow, frost, or dew. Rain occurs when the tiny droplets contained within clouds become heavy enough to fall. The droplets enlarge, first by moisture from the air condensing with them, and then by colliding and joining together with other raindrops as they fall. This process is called coalescence. Raindrops can vary in size from 0.5mm to as much as 6mm during a heavy thunderstorm. As they fall, evaporation takes place, and if the air is warm and dry, the cloud is very high, and the raindrops very small, they may evaporate completely before they reach the surface of the Earth. There are three main types of rainfall: frontal rain, orographic rain, and convective rain.



- 3 Read the text on p1 again. Answer the questions.
- 1 How is weather different to climate?
 - 2 What happens to solar radiation once it reaches the Earth's surface?
 - 3 Name the three ways energy is lost as it travels from the sun to the Earth.
 - 4 Name four weather processes.
 - 5 What is the process of condensation?
 - 6 When do clouds form?
 - 7 How does rain form?
- 4 Find the words in A in the text on p1 and underline them. Match them with their correct meaning in B.

A	B
1 ____ rotation	a not having the same quality in all parts
2 ____ uneven	b change from a gas into a liquid
3 ____ pressure	c force of the atmosphere on the Earth's surface
4 ____ moisture	d action of moving in a circle around a fixed point
5 ____ condense	e very small drops of water that are present in the air

- 5 Read the text *Seasonal winds*. Complete the gaps 1–6 with sentences A–G. There is one extra sentence that you do not need to use. **F**
- A It usually carries red sand from the Sahara.
 - B The friction of the moving air across the water sets ocean currents in motion.
 - C The Santa Ana winds are north or northeast winds that blow from the deserts.
 - D In the southern hemisphere they blow from the southeast.
 - E It comes out of the deserts of North Africa and Saudi Arabia.
 - F Historically, trade winds helped merchant ships sail across the oceans.
 - G The north wind brings snow.

Seasonal winds

Many winds around the world are seasonal and are identified by name. Trade winds are strong, steady winds whose name originates from the time of sailing ships. (1) ____ In the northern hemisphere these winds blow from the northeast. (2) ____ Trade winds push on the ocean water as they blow across the surface. (3) ____ The friction keeps the currents moving in the direction of the wind.

The Sirocco is a hot, dry wind that blows from the south. (4) ____ In southeast Spain the Sirocco is called the Leveche. (5) ____ The wind is strong and lasts about four days. It sometimes brings fierce storms. In coastal southern California, Santa Ana winds are hot and dry and feature in late summer.

(6) ____ The Santa Ana winds blow through the mountains and across the California coastal plain. In Europe, the dry, cold, northerly Mistral blows down the Rhone valley in France.



What do you think?

- What extreme weather has been making the news recently? What caused it?

PROJECT

Choose one of these seasonal winds and write about it. Use the Internet to find more information. Write a short description of 250–300 words, including information about temperature and wind direction.

- the Bolon or Tamboen of Sumatra
- the Tehuantepecer of Mexico
- the Knik of Alaska
- the Kona or Mauka of Hawaii

- 1 Work with a partner. What do you know about the scientists Michael Faraday and James Clerk Maxwell?
- 2 Match the underlined words in the text with the definitions.
- a large empty space _____
 - to have an effect on another object _____
 - the force that attracts objects in space towards each other, and on earth pulls objects to the centre of the planet _____
 - a mathematical statement _____
 - a very small piece of matter _____
- 3 Read the text again. For questions 1–6, choose the answer (a, b, c, or d) which you think fits best according to the text.
- Which definition best describes electromagnetism?
 - It is one of many natural forces.
 - It is a natural event.
 - It is a mixture of electrostatic and magnetic force.
 - It is a mixture of gravity and magnetic force.
 - What are the sources of electromagnetic fields?
 - charged particles – negative electrons and positive protons
 - charged particles – positive electrons and negative protons
 - stationary charges
 - gravity
 - What does ‘action at a distance’ mean?
 - One object can move another one a long way.
 - Objects which aren’t touching can have an effect on each other.
 - Objects can touch each other in space.
 - Objects which aren’t touching don’t make each other move.
 - What did Michael Faraday do?
 - He looked at different ways to explain action at a distance.
 - He developed other people’s ideas.
 - He developed a theory in 1849.
 - He used a Newtonian model of gravity.
 - What happens when a magnet is moved near a wire?
 - It creates a magnetic field.
 - The magnet moves.
 - It lets a current flow.
 - The wire moves.
 - How important was Maxwell’s work?
 - It wasn’t important at the time.
 - It was very important at the time, but it isn’t now.
 - It wasn’t important then, but it is now.
 - It was important at the time, and it is now, too.

Action at a distance

The electromagnetic force, electromagnetism, is a combination of the electrostatic force and the magnetic force.

Electromagnetic interaction is one of the four fundamental forces of nature, along with gravitation, weak interaction, and strong interaction. It is the combination of an electric field, produced by stationary charges, or voltage, and a magnetic field, produced by moving charges, or currents. The sources of electromagnetic fields are charged particles: either electrons, which have a negative charge, or protons, which have a positive charge.

The phrase ‘action at a distance’ describes the concept that an object can be moved or changed without being physically touched by another object. Objects which are physically separate can still interact on some level. In early theories of gravity and electromagnetism, the term was used to describe how an object is affected by the influence of distant objects. As scientists researched this field, they made significant discoveries in physics.

Early theories of electricity and magnetism used a Newtonian model of gravity. This suggested that isolated objects moving in a void can exert forces on each other at a distance, without needing physical contact. Michael Faraday approached the idea from a different point of view. He introduced the idea of forces being exerted through a type of field which was present throughout all of space.

The relationship between electricity and magnetism is based on electrical charge and its motion. When a wire has an electrical current flowing through it, a magnetic field is generated. When a magnet is moved near a wire, it allows a current to flow. James Clerk Maxwell built on Faraday’s work and described this idea as one theory, electromagnetism.



He produced five fundamental equations to describe this law, accounting for all electromagnetic interactions, as well as light. This theory shows the electromagnetic force as waves of energy moving through space.

In 1875, Maxwell published *Treatise on Electricity and Magnetism*, which was very influential at the time and still is today. In this ‘field theory’, the field is a physical thing. It carries energy across space, and allows action at a distance, which is the visible effect of charges interacting with their surrounding field. The electrostatic interaction between charged particles is due to the fact that charges produce an electric field around themselves. This field allows interactions between currents and charges across empty space.

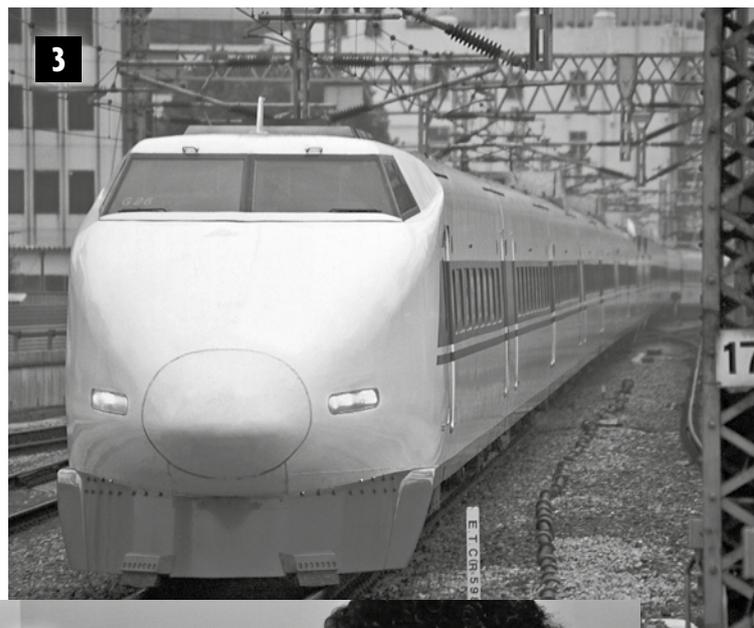
4 Work with a partner. Student A, look at photos 1 and 2. Student B, look at photos 3 and 4. Take turns to do the following tasks. **F**

Step 1

Talk about your photographs for about a minute. They show different forces at work. Compare and contrast the photos and describe the forces.

Step 2

With your partner, discuss what you know about the link between electromagnetism and any household objects.



PROJECT

‘Electromagnetic interaction is one of the four fundamental forces of nature, along with gravitation, weak interaction, and strong interaction.’

Use the Internet to research another one of the four fundamental forces of nature. Find out how it works and what effect it has. Write 200–250 words.

1 Work with a partner. Which of these things do you think has an electric field?



2 Read the text *Electric and magnetic fields*. Complete the statements with the correct words.

- 1 Natural electric fields occur in the atmosphere, in _____, and anywhere electricity is used.
- 2 Electric fields are produced by charged particles whether stationary or _____.
- 3 Electric fields are _____ closest to their source.
- 4 It is the movement of the _____ which creates the magnetic field.
- 5 The magnetic field is normally focused along _____ poles.
- 6 The magnetic field which surrounds the Earth is called the _____.

Electric and magnetic fields

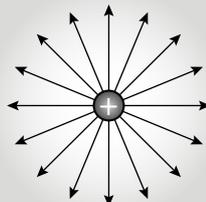
Electric and magnetic fields (EMFs) are invisible areas of energy that occur naturally, and also in connection with the use of electrical power. Electric and magnetic fields are found everywhere that electricity is used, e.g. computers, TVs, and household appliances. While electric fields can be blocked, magnetic fields pass through most objects.

Electric fields

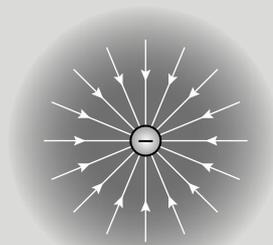
Electric fields occur in the atmosphere and also in living organisms in association with nerve and muscle activity. An electric field is produced by electrically-charged electrons and protons, either stationary or in motion. All charged objects create an invisible electric field that extends outwards. The strength of the electric field depends upon the amount of charge and the distance from the charge. Electric fields are strongest closest to their source.

What does an electric field look like?

An electric field can be represented visually by drawing lines of force. Lines of force, also known as field lines, indicate the size and strength of the field. Field lines start on positive charges and end on negative charges. If a positive charge is placed on the field line, the force will travel in the same direction as the field; if it is negative the force will be opposite to the field.



The electric field from an isolated positive charge



The electric field from an isolated negative charge

Magnetic fields

A magnetic field occurs as the result of the movement of charged particles, and displays a magnetic force. It is the movement of the charged particles which creates the magnetic field. Electricity and magnetism are always linked, and there needs to be an electric field to create a magnetic field. The magnetic field is normally focused along two poles. Most magnetic objects are composed of many small fields called domains. A magnetic field cannot be divided and will always have two poles. If you divide a magnet you will get a smaller magnet with the same two poles, but its strength will reduce. The magnetic field which surrounds the Earth is called the magnetosphere. It exists because the iron (Fe) in the Earth's core is liquid (molten) and it moves like a huge river. As the molten iron flows, it creates an electric current. That current in turn results in the formation of the magnetic field that surrounds the planet. The magnetic field has the effect of making a compass point north, and also helps protect the Earth from space radiation and the solar winds.

3 Read the text again. For questions 1–6, choose the answer (a, b, c, or d) which you think fits best according to the text. **F**

- 1 What are electric and magnetic fields?
 - a an electrical current
 - b invisible areas of energy
 - c electrical power
 - d natural electricity
- 2 What determines the strength of an electric field?
 - a the amount of charge and the distance from its source
 - b the amount of electrons and protons
 - c the level of electric charge
 - d the temperature of the atmosphere
- 3 What does a 'field line' indicate?
 - a a negative or positive charge
 - b the colour of the energy field
 - c the direction of the energy field
 - d the size and strength of the energy field
- 4 What direction does a positive charge travel on the field line?
 - a the opposite direction
 - b the same direction
 - c both directions
 - d It doesn't travel in any direction.
- 5 What creates a magnetic field?
 - a two poles
 - b an electric current
 - c a magnet
 - d electrons and protons
- 6 What creates the magnetic field around the Earth?
 - a the flowing molten iron in the Earth's core, which creates a current
 - b the magnetosphere
 - c a river which is at the Earth's core
 - d space radiation and the effects of solar winds

4 Read the text *Bumblebees sense electric fields in flowers*. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- 1 Until recently, insects haven't been able to sense electric fields.
- 2 Flowers have an electric field.
- 3 Bumblebees create a positive electrical charge when they fly.
- 4 When bumblebees land on a flower, the flower's electric field disappears.
- 5 Bumblebees use the information they get from the flowers' electric fields to know where they are.
- 6 By sensing changes in the electric fields of flowers, bumblebees can save time when looking for food.



Until recently, it wasn't known that insects could sense electric fields. However, scientific research conducted by Professor Daniel Roberts at Bristol University, in the UK, has shown that bumblebees can sense electric fields in flowers. We know that flowers attract pollinators using bright colours, patterns, and fragrance, but this study shows that electrostatic information is also important.

As they fly, bumblebees build up a positive electrical charge. The electric charge helps pollen stick to their hair when they land on flowers. While the bee is on the flower, there is an electrical interaction between the flower and the bee, and the flower becomes more positively charged. By sensing changes in the electric field, bumblebees know if the flower has recently been visited by other bumblebees and is therefore a good flower to visit. The bumblebees use this information to decide which flowers to visit, and therefore to be more efficient at finding food.

What do you think?

- Think of more examples of where electric and magnetic fields occur in the natural world.
- Make a list of your own possessions that create electric fields.

PROJECT

There have been fears that EMFs in computers and mobile phones can be harmful to health. Use the Internet to find out more information about the latest research. Write a presentation for the class. Give evidence to support what you have found.

- 1 Work with a partner. Look at the photos. Which one do you think would be affected more badly by a fall?



- 2 Read the text. Were your ideas correct?
- 3 Read the text again. Complete gaps 1–8 with the words in the box.

world jug flies safe
Italian size smaller fridge

Laws of scaling

Have you ever wondered why spiders and (1) _____ can walk up walls, while it would be impossible for humans to do this? Or why smaller animals aren't hurt when they fall from a great height? If a person fell from a relative distance in proportion to their size, they would have a terrible injury.

The reason for this was discovered by Galileo Galilei, an (2) _____ physicist, philosopher, and astronomer, whose work is extremely influential in modern science. He discovered that there is a fundamental ratio of scale underpinning objects in the natural (3) _____. The ratio is that as the width of an object is doubled, the surface area is squared, and the volume is cubed. So if an object is made ten times wider, it will have 100 times the surface area, and 1,000 times the volume. The mass of the object – the amount of material it contains – increases in proportion to this scale.

The important factor is the ratio of surface area to volume. This is the amount of surface area per unit of volume in an object. Essentially, the larger the object is, the smaller the surface area to volume ratio. A large object with a small surface area to volume ratio will be more affected by a fall than a (4) _____ object with a high surface area to volume ratio.

But how can this law be shown in a laboratory experiment?

- First, make two jelly balls. You will need two different-sized bowls to use as moulds for the jelly, two measuring jugs, and 200g of gelatine powder.
- Pour 900 ml of hot water into one (5) _____, and add 100g of gelatine powder. Repeat with the second jug. Stir the mixture in both jugs carefully and put the jugs in the fridge for three hours.
- After three hours, boil some water, and pour it into a large bowl or bucket. Take the jugs out of the (6) _____, and place them one at a time in the hot water. Stir

the mixture in the jug carefully, until the gelatine turns to liquid completely.

- Take the two different-sized bowls, and wipe the insides gently with oil to stop the gelatine sticking to them. Carefully pour 450 ml of liquid gelatine into the small bowl, and 1,350 ml into the larger bowl. Put both bowls in the fridge for 12 hours. When you take them out of the fridge, they should be elastic but firm.

- Tip both jellies out of the bowls.

Now you can take your lab activity outdoors! Take the jellies to a safe, high area that has a hard surface below. Check that the area is clear and (7) _____ below you, then drop the jellies. The small jelly will stay whole, and the larger jelly will be damaged. The damage increases depending on the (8) _____ of the jelly – the bigger the jelly, the more it will be damaged. This is because a small jelly has a larger surface area to volume ratio, and a larger jelly has a smaller surface area to volume ratio.

4 Read the text on p1 again. Are these sentences true (✓) or false (✗)? Correct the false sentences.

- 1 Galileo's work isn't considered influential in modern science.
- 2 As the width of an object is doubled, the surface area is cubed.
- 3 The mass of an object increases in proportion to the ratio of scale.
- 4 The larger an object is, the larger the surface area to volume ratio it will have.
- 5 The jelly needs to be completely firm to touch before the experiment.
- 6 The small jelly should not be damaged by the fall.

5 Find the words in **A** in the text and underline them. Match them with their correct meaning in **B**.

A	B
1 ___ gravity	a the action of one object or surface moving against another
2 ___ friction	b the property of liquids by which they form a layer at their surface, and which makes sure that this surface covers as small an area as possible
3 ___ adhesion	c to spread something out equally
4 ___ surface tension	d the force that pulls things on Earth to the centre of the planet
5 ___ meniscus	e the ability to stick or become attached to something
6 ___ distribute	f a layer formed at the surface of liquids

6 Answer the questions.

- 1 Why do objects fall to the ground?
- 2 Why are humans affected by gravitational forces?
- 3 What forces affect smaller animals?
- 4 Why can insects walk up walls?
- 5 Why is weight important to an insect's ability to walk on water?
- 6 How does an insect distribute its weight?
- 7 In the experiment, why does the paper clip sink when it is vertical?
- 8 What supports the paper clip when it is horizontal?

Walking on walls, walking on water



Gravity is the force which pulls objects on earth to the centre of the planet, so things fall to the ground when they are dropped. As humans, our surface area is relatively small compared to our volume. This means that we are affected by gravitational forces. Smaller animals have a much larger surface area to volume ratio, and gravity has less of an effect on them. Smaller animals are more affected by surface forces such as friction – the resistance between one surface and another – and adhesion – the ability to stick or become attached to something. This explains why many insects can walk up walls!

Some insects have the apparently amazing ability to walk on water, such as the pond skater. This is because of the ratio of their weight to the surface tension of water. At the surface of water, the molecules group together to form a layer called a meniscus. When an insect is very light, the meniscus can support it. If you look at one of these insects, you will often see that it spreads its weight out over its six long, thin legs, to distribute the weight evenly.

You can try out a simple experiment to test the surface tension of water:

- You will need a glass, some water, and some paper clips.
- Fill the glass with water.
- Drop a paper clip into the water vertically. It will sink to the bottom of the beaker, as the point of the paper clip breaks the surface of the water.
- Now try lying a paper clip horizontally, so it is flat on the water surface.



Because the paper clip is very light, and its weight is spread out, it can float on the meniscus of the water – just like the pond skater!

What do you think?

- Do you enjoy doing activities in a science lab to find out how things work? Why (not)?

PROJECT

Choose a topic you have learnt about in a physics class. Use the Internet and reference books to find a simple science experiment to carry out. Describe the following information:

- the materials you need for the experiment
- the steps you need to follow
- the results of the experiment

Write 200–250 words.

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