**Pronunciation**

**Unstressed syllables**

1. After listening, get students to repeat the words.

<table>
<thead>
<tr>
<th>Verb</th>
<th>Adjective</th>
<th>Noun</th>
</tr>
</thead>
<tbody>
<tr>
<td>trans'mit</td>
<td>-</td>
<td>trans'mission</td>
</tr>
<tr>
<td>per'form</td>
<td>-</td>
<td>per'formance</td>
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<tr>
<td>pro'pel</td>
<td>-</td>
<td>pro'peller</td>
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<tr>
<td>-</td>
<td>e'lectrical</td>
<td>electricity</td>
</tr>
<tr>
<td>in'stall</td>
<td>-</td>
<td>in'stallation</td>
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<tr>
<td>'regulate</td>
<td>-</td>
<td>regu'lation</td>
</tr>
<tr>
<td>de'velop</td>
<td>-</td>
<td>de'velopment</td>
</tr>
<tr>
<td>main'tain</td>
<td>-</td>
<td>'maintenance</td>
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<tr>
<td>'specialize</td>
<td>-</td>
<td>'specialist</td>
</tr>
<tr>
<td>'qualify</td>
<td>-</td>
<td>qualifi'cation</td>
</tr>
<tr>
<td>-</td>
<td>'medical</td>
<td>'medicine</td>
</tr>
<tr>
<td>-</td>
<td>environ'mental</td>
<td>environ'ment</td>
</tr>
</tbody>
</table>

2. Get students to look for words which have the /a/ sound, underline them, and practise saying them.

**Make your point**

**Ordering a presentation**

1. Get students to read the advice and complete the exercise individually. Then allow them to compare their answers in pairs. Discuss any differences with the whole class.

<table>
<thead>
<tr>
<th>Possible answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 c 2 a 3 h 4 f 5 i 6 d 7 b 8 g 9 e</td>
</tr>
</tbody>
</table>

2. Allow students ten minutes to prepare a talk. Make sure students ask a question so that they pay full attention to the other speakers.

**Key words**

Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
12 Grammar test

1 Make polite requests to get the information in the sentences. There are three possible structures you can use.

**Example**

You want to know the height of the refrigerator

*I wonder if you could tell me / Could you tell me / I'd like to know the height of the refrigerator.*

1 You need a replacement thermostat for the refrigerator but don't know where to get it.

2 You want to know what type of hinges they use.

3 Someone should find you the name of a worktop supplier.

4 You need someone to explain to you how energy saving bulbs work.

5 You've just seen a Wattson but don't know what it is.

6 You want to find out if a guarantee for parts is included.

2 Underline and correct the mistake in each of the sentences.

1 Could you sending me the latest catalogue, please?
2 I wonder if you could tell me can cardboard be used to make furniture?
3 I like to know if the glass has been toughened.
4 Would you mind to confirm the measurements by return?
5 I'd like you work in the machining department next week.
6 I wondering if you could find a replacement screen.

3 Complete the dialogues by writing the questions.

A I've bought a new microwave oven. It's very useful but how does it work?
B Well, microwaves make the water molecules in food rotate, which generates heat.

A Aren't microwaves dangerous? Can ____________________________1?
B No, they can't escape. The oven is very well insulated to prevent that.

A Why ____________________________2?
B The plate turns to make sure the food cooks evenly.

A What ____________________________3?
B The fan allows cold air to circulate inside the oven.

C Inside the toaster the wires glow red hot.

C What ____________________________4?
D They're made of a special mixture of metal, often nichrome.

C Why ____________________________5?
D They glow red hot because this special metal slows down the movement of electrons and as a result the metal becomes hot.

C How ____________________________6?
D It contains a small timer which stops the toaster toasting.
12 Communication

Customer cards

You need a table and a set of twelve new chairs for the company boardroom. The Directors of the company meet regularly, and Managers use the room for group meetings, too.

You need some new tables and chairs for the company coffee room. It's a busy place where people chat, often about work issues.

You need some new furniture for the visitors’ room at the company headquarters. Visitors use this room while they are waiting for their appointment.

You need some new furniture for the reception area of your company. This area provides a first impression of the company, but people don’t wait here for long.

Manufacturer cards

You manufacture furniture in glass. Think of all the advantages of using glass. It can be toughened to prevent it breaking.

You manufacture furniture in cardboard. Think of all the advantages of using cardboard. It can be coated and printed.

You manufacture furniture in wood. Think of all the advantages of using wood.

You manufacture furniture in metal (aluminium and steel). Think of all the advantages of using metal.
13 Grammar test

1 Complete the sentences with the prepositions of place or movement from the box. Use each one once only.

<table>
<thead>
<tr>
<th>in</th>
<th>past</th>
<th>along</th>
<th>near</th>
<th>to</th>
<th>outside</th>
<th>at</th>
<th>below</th>
<th>on</th>
</tr>
</thead>
</table>

1. They didn't want to walk ________ the road where they'd be easily seen.
2. The ship's crew are leaving today. They're going ________ South America.
3. There were a large number of people demonstrating ________ the police station.
4. The tank was so well camouflaged that several people walked ________ without noticing it.
5. The satellite station has been built ________ top of the hill.
6. They detected the submarine ________ the coast. It was only a few metres away.
7. They're working ________ difficult conditions. The temperature has fallen ________ zero.
8. Riot police fired water cannon ________ the protesters in the city centre.

2 Complete the text with prepositions of time. If no preposition is required, write –.

The incident took place ________ last Friday 16 September. The local police received a phone call ________ 20.00. The caller said that a group of men had been standing at the corner of the road ________ two hours. They'd been there ________ 18.00. The police attended the scene ________ ten minutes later. ________ that time, the group had increased in size. The group became violent towards the police, so they called for reinforcements. A full-scale riot broke out and ________ 20.30 and 22.30, a number of people were hurt. The police decided to use rubber bullets and shortly ________, the crowd began to move away. The police waited ________ everyone had gone ________ returning to the police station.

3 Look at the picture and complete the sentence with the correct prepositions.

He was standing ________ the hallway, ________ the foot of the stairs, ________ the lift, ________ the main entrance door, ________ the clock, ________ 15.00 ________ Saturday 20 April ________ 2007.
13 Communication

Devices

**Implantable Radio Frequency Identification Tag**
This device is known as an RFID tag. RFID tags are used in supermarkets to tag expensive items. A miniature transmitter sends out a sequence of radio frequency pulses that represent a unique number, usually 10–16 digits long. It consists of a microchip and a metal coil, which acts as an antenna. When the coil is near an RFID reader, a voltage is created. It has no battery and requires no maintenance. This one is about the size of a grain of rice and can be implanted under the skin.

**ASENDRO**
ASENDRO is a modular robot that can be adapted for use in a variety of situations. It can be equipped with a manipulator arm and various sensors. These sensors relay signals to the mission control centre. ASENDRO is relatively light and small so can fit into the boot of a car. It is 40 cm wide, 60 cm long, and weighs 45 kg.

ASENDRO can detect and defuse bombs and, due to its high top speed – 10 km/h – it can also be used for military reconnaissance.

**Entomopter**
This is a micro air vehicle. It can fly, crawl, and swim. Its length and wing span are both about 15 cm. It weighs 50g. A chemical energy source makes the wings beat automatically like an insect. This is called Reciprocating Chemical Muscle (RCM). RCM produces small amounts of electricity to power the flight controls and the on-board sensor. It can enter a building through an open window and take photographs.

**Keystroke Logger**
This small device, about 5 cm long, can be plugged into the back of any PC. It records every keystroke made by the user. Normal antivirus software won’t detect it because it is hardware. It is simple and effective and can be used to record criminal internet activity.

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>What it does</td>
<td></td>
</tr>
<tr>
<td>One use</td>
<td></td>
</tr>
<tr>
<td>Other uses</td>
<td></td>
</tr>
</tbody>
</table>
14 Grammar test

1 Complete the text with who, which, when, or if.

Jack Kilby, ________¹ was born in 1923, worked for Texas Instruments in America. He discovered how to make more than one transistor in a material ________² was called germanium. He found he could connect transistors without wires ________³ he ‘grew’ them together at the same time. Robert Noyce, ________⁴ was working for Fairchild Semiconductors at the same time, made a similar microchip from silicon, ________⁵ became the standard material for making microchips. The first microprocessor chip, ________⁶ had 2300 transistors, was small, but chips ________⁷ are made today can have more than 30 million.

People ________⁸ make and test microchips have to work in dust-free rooms. Air contains impurities, ________⁹ could damage the microchip, so microchips are made in a vacuum. ________¹⁰ the microchip works when it is tested, it can be soldered onto a circuit board.

2 Join each of the two sentences into one complex sentence. Use the clue in brackets to help you.

EXAMPLE  Alessandro Volta developed the first chemical battery. Volta’s battery was made of zinc and silver. (relative clause)
Alessandro Volta developed the first chemical battery, which was made of zinc and silver.

1 Resistors are sometimes made of a length of nichrome wire. Resistors can be used to reduce the current in a circuit. (relative clause)
2 Potentiometers are used in radios as volume controls and tone controls. Potentiometers are often circular. (relative clause)
3 More current flows. The thermistor gets hotter. (time)
4 A lamp is marked 60W. This means it is converting electricity to heat and light at the rate of 60 joules per second. (condition)
5 X-rays were discovered by Röntgen in 1895. X-rays can be used in industry to inspect metal castings. (relative clause)
6 Radios and computers could be damaged. The power supply is connected the wrong way round. (condition)
7 Special diodes called LEDs give out light. Current passes through LEDs. (condition)
8 LEDs are often used as indicator lamps. LEDs are small, reliable, and need only a small current. (relative clause)
9 Light shines on a semi-conductor. A semi-conductor conducts electricity more easily. (time)
10 A reed switch is often used in electronic circuits. It consists of a glass tube with two iron reeds sealed in it. (relative clause)
14 Communication

**Buzzer**
- A mechanical device which holds electrical wires securely in place.
- An electrical device that produces a sound.
- A ________ device which ________.

**Galvanometer**
- An instrument which is used for measuring small amounts of electrical current.
- An instrument which is used for measuring the resistance of a metal.
- An instrument which is used for measuring ________.

**Jack**
- A device which is used to lift heavy objects off the ground.
- A machine which is used to cut circular pieces of wood or metal.
- A ________ which is used to ________.

**Orbiter**
- Part of a motor that is designed to spin round and generate electric current.
- A spacecraft that is designed to travel round a planet or moon.
- A tool that is designed to ________ round ________.

**A bogie**
- The wheels under a railway carriage are attached to the bogie. It lets the train travel round bends more easily.
- You wear a bogie on your head if you want to play a game in the virtual world. It’s a headset.
- In electronics, ________.

**Ergonomics**
- When you study Ergonomics, you study the surface of the Earth, e.g. hills, valleys, rivers, lakes, etc.
- When you study Ergonomics, you study working conditions to find the most effective way for people to work.
- When you study Ergonomics, you study ________.

**Theodolite**
An instrument that is used by surveyors. It’s used to measure angles between different points.

**Aperture**
An opening which allows light to reach a lens, e.g. in a camera.

**Dyke**
A barrier which is designed to stop or control the flow of water, e.g. to stop a river flooding.

**Throttle**
A pedal that allows more fuel to flow into an internal combustion engine (= accelerator).

**Ripsaw**
A saw which is used to cut wood across the grain.

**Denominator**
The number which appears below the line in a fraction, e.g. 4 in ¾.
15 Grammar test

1 Complete the dialogues with the Present Continuous or will form of the verbs in brackets.

1  A Here's an interesting job advertised in this magazine. It's for a Mechanical Engineer.
   B Oh, yes! I've got the right qualifications. I think I _________ (apply) for it.

2  A Did you do anything about that job we read about last week?
   B Yes, I sent off the application form on Monday and I hope to hear from them soon. They _________ (carry) out the interviews in London at the end of the month. If I get invited, I _________ (have to) stay in London for two nights.

3  A Have you seen this new spacecraft for taking tourists into space?
   B Yes, but I've heard that flights _________ (probably cost) $200,000. I'm sure there _________ (be) some people who _________ (pay) the price, but I don't think I _________ (ever go).

4  A Congratulations on the new job! When do you start?
   B Thanks. The job begins in three weeks' time and I've been given a plan for the first month. During the first three weeks, I _________ (work) in the packing department. Then the Technical Director _________ (take) me to the trade fair in Paris. I'm really excited. I know it _________ (be) hard work, but I'm sure it _________ (be) interesting.

2 Write sentences to describe future arrangements with the Present Continuous form of the verbs in brackets.

**EXAMPLE**

Marc has got a new job at Times Engineering, beginning on Monday morning. (start)

Marc is starting a new job at Times Engineering on Monday morning.

1 The Manager has invited Claire to an interview at 2 p.m. (interview)
2 Bernard has arranged to see his team leader at 9 a.m. tomorrow. (meet)
3 Gail has just bought a flight ticket to Moscow dated 10 September. (fly)
4 The timetable for the conference in Rome shows Anna’s presentation is at 11.45. (give)
5 Tom is on his way to the railway station. The President’s train is due to arrive at 10.30 a.m. (meet)
6 John’s final day at college is Thursday next week. (leave)

3 Underline and correct the mistake in each of the sentences.

1 I'm going to Berlin on business next week, but there not be any time for shopping.
2 I've promised to help Rosie with the report, but I not write it for her.
3 Mr Karkalas has cancelled the meeting, so I shall not go to London on Monday.
4 I feel tired. I go to get a cup of coffee.
5 I've got the interview tomorrow. What do they ask me?
15 Communication

What will the world be like in 2050? Find out what people think.

1 Food production
Farmers are responsible for producing the food we eat. How much of a farmer’s work will be done by robots and computers?
- all of it
- most of it
- some of it
What jobs will robots do?

2 Materials used to make clothes

3 Sources of energy

4 Building materials

5 Air travel

6 Inside our homes

7 City transport

8 Protection of the environment
Unit 1
1  to leave, do
2  doing, to study
3  wasting
4  to apply
5  checking
6  to reduce
7  finding
8  to include

2 1 designing
2  to send an application form
3  to do / doing the course in Music technology
4  managing the project
5  to get a qualification / earning money
6  studying Aeronautical engineering
7  learning / to learn French in September
8  visiting Ralph Construction

Unit 2
1  have been harvesting, have been working
2  has produced, has used
3  have been trying, have developed
4  have been used, have been
5  have been using, have been sold
2 2 have grown grew
3  have became became
4  come came
5  has have lived
6  have done did
7  have been being have been
8  I just completed I have just completed
9  had been working have been working
10  was become have become

Unit 3
1  Many thousands of years ago simple log bridges were built across streams.
2  The first long bridges were made by joining logs together to make beams.
3  Bridges had to be made of stone to last a long time.
4  Stone arch bridges were built by the Romans 2,000 years ago.
5  Iron was first used to build bridges by Engineers at the beginning of the 19th century.
6  By the end of the 19th century large beam bridges could be created because steel could be used.
7  Today, most bridges are built of concrete and steel.
8  Concrete is used because it can be poured into moulds and set into shapes.
9  In the future lighter and stronger materials will have to be used to build longer bridges.
10  Carbon fibre and Kevlar will probably be used for the deck and cables.

2 1 were transported 5 was completed
2  was taken 6 are made
3  was decided 7 are made
4  began 8 crossed

3 1 needn’t to be paid needn’t be paid
2  must be wearing must be worn
3  can obtained can be obtained
4  may be entered may enter
5  should be return should be returned

Unit 4
1  couldn’t to repair couldn’t repair
2  Are scientists able manufacture Are scientists able to manufacture
3  can’t make couldn’t make
4  we’ll can make we’ll be able to make
5  can be able to mould can be moulded
6  is able can be coloured could be coloured
7  can to be used to make can be used to make
8  can be made can make
Unit 5
1 was visiting, saw
2 destroyed, were running
3 were developing, were continuing / continued
4 began, began
5 were building, came
6 were developed, were looking
7 was building, planted
8 was developing, were invited
2 arrived / landed
2 waiting
3 was
4 blowing
5 generating / producing
6 spoke
7 was
8 passed / drove / went
2 couldn’t
6 aren’t able / weren’t able
2 weren’t able
7 can’t
3 won’t be able
8 will be able
4 could
9 Can
5 couldn’t
10 will be able

Unit 6
1 h If designers use a blended wing design, it will produce less turbulent airflow.
3 b If there’s a course in Aeronautical engineering at the local university, I’ll apply.
4 f If the new A380 lands at this airport, they’ll have to make airport alterations.
5 a If a pilot loses his / her way, he / she has to ask the Air Traffic Controller for help.
6 g If there isn’t enough interest in the new aircraft, they won’t build it.
7 e If there’s a problem with the fuel lines, the aircraft cannot take off.
8 d If the film studio hires a blimp, they’ll be able to film from the air.
2 1 when
4 before
2 As soon as
5 If
3 unless
3 could
5 didn’t follow
2 will increase
6 is published
3 would be
7 would be
4 doesn’t fail
8 will not be carried out

Unit 7
1 a 2 b 3 b 4 b 5 a 6 b 7 a 8 a
1 have to
2 Do I have to
3 don’t have to
4 have to
5 mustn’t
6 Do I have to
7 don’t have to
8 have to
9 mustn’t
10 have to

Unit 8
1 more fuel efficient
2 the longest
3 more affordable
4 the most convenient
5 more popular
6 emptier, shorter
7 the biggest
8 slower, quieter
2 Suggested corrections
1 F You can see that air travel produces a great deal more pollution than other forms of transport.
2 T
3 F There’s a small difference in the amount of hydrocarbons released by trucks and ships.
4 F Cargo ships produce a little fewer nitrogen oxides than trucks.
5 T
6 F Cargo ships account for the smallest amounts of carbon monoxide, but road transport accounts for the highest amounts of particulates.
Engineers have been helping farmers to improve agriculture for centuries by developing and improving equipment for each stage in the farming year from ploughing to harvesting to get work done faster, with less labour, and at less cost. They have helped to make farmers less dependent on fine weather and physical strength. Mechanization means that an arable farm of 200 hectares can be worked by just two people.

The tractor is one of the most important contributions to farming equipment because without it none of the agricultural implements in common use would have been developed to the capacity and efficiency required today. In addition to pulling ploughs, trailers, and other equipment, they provide hydraulic power to operate pumps, crop sprayers, hay balers, and many other devices. The introduction of IT to farming equipment has allowed precision agriculture to develop. An example is the use of satellite positioning along with soil analysis and aerial surveys to enable farmers to apply fertilizers to their fields in the exact amounts at the places where it is needed.

Harvesting a crop at just the right time and in the best condition to ensure good prices is also helped by technology. Machines have been developed to harvest and freeze delicate crops, such as peas, within two hours. Laser and optical technologies check the ripeness and quality of fruit before it is packed for shipment. Consumers demand fruit that not only is ripe but looks ripe so technologists have developed methods where citrus fruits can be stored and treated to emerge with the correct colour. Bananas can be picked green and ripened in transit to markets overseas.

Once harvested, food must be preserved from decay. Canning and freezing preserve food, as well as being convenient for storage, and so are vital to the health of the public. Older methods such as salting and drying (dehydration) are still in use. Most canned and bottled foods contain preservatives. Pasteurizing is a technique for destroying harmful bacteria in milk and other foodstuffs.

All agriculture is totally dependent on the availability of water. Low-tech innovations such as the foot-operated treadle pump are vital tools to farmers in developing countries with limited access to electricity or fuel.

Additional activity
(stronger students)
Get students to write a paragraph saying which of the inventions they consider to be the most significant and explaining why.

Additional activity
(weaker students)
Get students to identify five words from the texts which are new to them and to use these words in sentences of their own.

Additional activity
(all levels)
Get students to work in pairs to find out more about the inventions. What is their significance? How have they shaped the way we do things today? Which do you think was the most important and why?

These sites may help:
www.inventors.about.com
www.ideafinder.com

Switch on
1 Get students to work in small groups. Get groups to present their ideas to the rest of the class.

   1 D (1873)   2 C (1831)   3 A (1701)   4 B (1793)

2 Get students to do this exercise individually.

   1 cotton gin   2 barbed wire   3 seed drill   4 reaper

Language spot
Past Simple v Present Perfect

Ask students what they can remember about the Past Simple, the Present Perfect, and the Present Perfect Continuous tenses. Check that they know how to form these tenses, including the active and passive.

Refer to the Grammar reference on p.114.

1 Get students to do this exercise individually.
Unit 9
1 1 ‘re waiting
2 use
3 ‘re erecting, ‘re hoping / hope
4 is working
5 believe, ’s, are drilled, is found
6 understands, are enforced
2 1 They’re working hard to fix the Kelly before the end of their shift.
2 They bring food and water, which are essential.
3 These workers will stay on the rig for ten weeks.
4 He’s looking forward to going back to his land-based job.
5 He’s applied for a new job.
6 They also check the pipelines for any corrosion or damage.
7 They’ll have to stop if the wind increases.

Unit 10
1 1 the water treatment works would be completed in three months’ time
2 the water supply had been contaminated by agricultural chemicals
3 he hoped to get involved in projects in rural areas of India
4 he was working on an environmental assessment report for a bridge to the island
5 they were looking forward to completing the sustainability report by the end of that week
6 Paul and John had inspected the site the previous day
2 1 Why are you applying for the job?
2 Why do you think you are the right person for the job?
3 When did you join the company?
4 What do you like about it?
5 What do you know about industrial processes?
6 Have you ever been in a plastics factory?
7 Are you interested in doing a degree at university?
8 Will you be able to cope with the extra workload?

Unit 11
1 1 develop developing
2 distinguish to distinguish
3 to wasting wasting
4 to work from working
5 to convert convert
6 gaining to gain
2 1 prevents the driver (from) falling asleep
2 causes an ice warning to appear
3 letting the driver know
4 enabling the driver to see
5 makes the car slow down
6 stops the engine working
7 allowing the driver to see
8 preventing the car (from) starting

Unit 12
1 I wonder if you could tell me / Could you tell me / I’d like to know ..
1 ... where to get a replacement thermostat for the refrigerator.
2 ... the type of hinges you use.
3 ... the name of a worktop supplier.
4 ... how energy saving bulbs work.
5 ... what a Wattson is.
6 ... if a guarantee for parts is included.
2 1 Could you send / Could you send
2 could you tell me can cardboard be used could tell me if cardboard can be used
3 I like to know / I’d like to know
4 to confirm confirming
5 I’d like you work / I’d like you to work
6 I wondering I wonder
3 1 ... they escape from the oven?
2 ... does the plate inside the oven turn?
3 does the fan do?
4 ... are they made of?
5 ... do they glow red hot?
6 ... does the toaster stop toasting?
Unit 13

1  along  5  on
2  to  6  near
3  outside  7  in, below
4  past  8  at

2  1  –  6  By
   2  at  7  between
   3  for  8  after
   4  since  9  until
   5  –  10  before

3  1  in  5  below
   2  at  6  at
   3  beside / near  7  on
   4  opposite  8  in

6  Radios and computers could be damaged if the power supply is connected the wrong way round.
7  Special diodes called LEDs give out light if current passes through them.
8  LEDs, which are often used as indicator lamps, are small, reliable, and need onlyting a small current.
   Or
   LEDs, which are small, reliable, and need only a small current, are often used as indicator lamps.
9  When light shines on a semi-conductor, it conducts electricity more easily.
10  A reed switch, which is often used in electronic circuits, consists of a glass tube with two iron reeds sealed in it.
    Or
    A reed switch, which consists of a glass tube with two iron reeds sealed in it, is often used in electronic circuits.

Unit 14

1  1  who  6  which
   2  which  7  which
   3  when  8  who
   4  who  9  which
   5  which  10  if

2  1  Resistors, which are sometimes made of a length of nichrome wire, can be used to reduce the current in a circuit.
   Or
   Resistors, which can be used to reduce the current in a circuit, are sometimes made of a length of nichrome wire.
2  Potentiometers, which are used in radios as volume controls and tone controls, are often circular.
   Or
   Potentiometers, which are often circular, are used in radios as volume controls and tone controls.
3  When / As more current flows, the thermistor gets hotter.
4  If a lamp is marked 60W, it means it is converting electricity to heat and light at the rate of 60 joules per second.
5  X-rays, which were discovered by Röntgen in 1895, can be used in industry to inspect metal castings.
   Or
   X-rays, which can be used in industry to inspect metal castings, were discovered by Röntgen in 1895.

Unit 15

1  1  'll / will apply
   2  're / are carrying, 'll / will have to stay
   3  will probably cost, will be, will pay, 'll / will ever go
   4  'm / am working, 's / is taking, will be, will be

2  1  The manager is interviewing Claire at 2 p.m.
   2  Bernard is meeting his team leader at 9 a.m. tomorrow.
   3  Gail is flying to Moscow on 10 September.
   4  Anna is giving a presentation at the conference in Rome at 11.45.
   5  Tom is meeting the President at 10.30 a.m.
   6  John is leaving college on Thursday next week.

3  1  there not be any time there won't be any time
   2  I not write it I'm not going to write it
   3  I shall not go I'm not going
   4  I go to get I'm going to get
   5  What do they ask me? What are they going to ask me?
Tip
Encourage students to use their knowledge and the context to guess the meaning of unknown words. When necessary, encourage them to use English-English dictionaries to check meanings.

Tip
Try to designate an area on the classroom board where new vocabulary can be listed during each lesson. Before the end of each lesson, check that students can remember the meanings and that they have noted the words in their vocabulary books or files.

Additional activity
Get students to think of activities which they are working on at the moment, e.g., projects, essays, research, etc. They should write down at least three. Then in small groups, they should interview each other, asking:
What are you working on at the moment?
How long have you been ...ing?
When did you start?
How much have you done/finished?
Get students to write two paragraphs about two other people in the group.

Listening
Precision agriculture
1 Get students to discuss the term.
2 After listening get students to briefly explain.

Possible answer
Precision agriculture is using computers to analyze data which is then used to control agricultural equipment allowing the exact amount of chemicals or seed to be applied.

Give students a few moments to read the questions silently before playing the CD again.

1 Weed cover, a need for fertilizer
2 it's a waste of resources (chemicals).
3 Using satellite technology / planes or sensors on the farm vehicles
4 50% decrease in the amount of herbicide used

Allow students to listen a third time before getting them to make notes about the advantages and disadvantages.

* Tip
Weed killer and herbicide have the same meaning - a substance that is applied to kill unwanted weeds
Fertilizer - a substance that is added to the soil to make plants grow more successfully

<table>
<thead>
<tr>
<th></th>
<th>1 have been used</th>
<th>5 began</th>
<th>9 have made</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>were drawn</td>
<td>6 was</td>
<td>10 has increased</td>
</tr>
<tr>
<td>3</td>
<td>began</td>
<td>7 have been</td>
<td>11 was</td>
</tr>
<tr>
<td>4</td>
<td>pulled</td>
<td>8 have been</td>
<td>12 has risen</td>
</tr>
</tbody>
</table>
Top margin
Ask students if they have heard the expression it's the best thing since sliced bread. Get students to speculate about why sliced bread was such an instant and lasting success.

* Tip
Nouns formed from short adjectives may end in -ness, e.g. sweetness, firmness. Ask students if they can think of any more: dryness, wetness, juiciness, softness.

+ Additional activity
(stronger students)
Get students to answer the following questions.
1 What are the problems with destructive testing?
2 Can you think of any other types of non-destructive testing used in industry?
3 Why do fruit growers want oranges to have a strong orange colour and no blemishes on the skin?

* Tip
Refrigerated food in the supermarket is often referred to as chilled food. Canned food may also be called tinned. Dehydrated food is normally called dried food.
Chemical preservation includes the use of antioxidants, acids, sulphur dioxide, sugar, and nitrates. Get students to look at food packaging and find the names of some of the chemicals used.

Pairwork
1 Before reading, ask students if they can think of ways that technology can be used in fruit production. Allow students who have read the same text to compare their answers.
2 After making notes, get students who read the same original text to compare notes before reading to check.

<table>
<thead>
<tr>
<th>Student A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to make oranges more orange and to check the quality of the oranges</td>
</tr>
<tr>
<td>2 ethylene gas, digital camera, and computer</td>
</tr>
<tr>
<td>3 size, colour, shape, and any marks</td>
</tr>
<tr>
<td>4 made it easier to sort oranges according to quality and to increase the standard of quality</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Student B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to test apples, peaches, and apricots for sweetness and firmness</td>
</tr>
<tr>
<td>2 laser beams, an optical detector, an imaging spectrograph, a digital camera, and a computer</td>
</tr>
<tr>
<td>3 the amount of light absorbed by the fruit and the amount bounced back</td>
</tr>
<tr>
<td>4 no fruit is lost in the testing process and every single fruit is tested</td>
</tr>
</tbody>
</table>

Problem-solving
Ask students if they can name or describe methods of preserving food that they know. Ask them why food preservation is necessary.
1 Get students to do this exercise individually. Help with any unknown vocabulary.

| 1 activity 2 disease 3 destroyed 4 conditions |

2 In pairs, get students to match the pictures to the methods. Referring to the principle in 1, discuss with the class how each of these methods works in preserving food.

| 1C 2E 3A 4B 5F 6D 7G |

3 In pairs, get students to match to the methods in 2.

| 1d 2e 3g 4c 5f 6b 7a |

Make your point
Beginning a presentation
Ask students what they can remember about making a presentation from Unit 1. Get them to suggest what a speaker needs to think about before planning a presentation.
1 In pairs, get students to do the activity.
Additional activity
(all levels)
Brainstorm with students what they have read in the last 24 hours in any language. Make a list on the board. Include novels, dictionaries, signs, textbooks, emails, webpages, magazines, exercises, specialized materials, e.g. course notes, advertisements, forms, tickets, diagrams, etc. Then ask students why they read.
Elicit: 1 pleasure and 2 information. Then ask students how they read. Do they read every word? When? Do they read more than once? Is it necessary to understand every word?
On the board write:
Skimming—quick read to get the general meaning (gist)
Scanning—quickly looking through the text for a specific piece of information
Extensive reading—longer texts usually for pleasure
Intensive reading—reading shorter texts accurately for detail
Get students to put each of the articles, etc. they listed into one of these four categories.

Writing bank
Reports see p.64 exercises 1 and 2.

Gadget box

Students should discuss the advantages and disadvantages of using corks and screwtops and then identify the advantages of Vino-Lok.

It’s more attractive, it’s easy to reseal a bottle once it has been opened, more environmentally friendly (can be recycled), etc.

Reading

Scanning

1 Encourage students to use their own knowledge and experience to guess what this text will be about. Ask them what they expect to read about in the article.

2 Explain that this is a scanning exercise where they will be required to find specific information. Get them to look at the exercise and to suggest possible answers before reading. Allow them four minutes to find the answers.

<table>
<thead>
<tr>
<th>Cost</th>
<th>US$12–$35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight and leg muscle up to seven metres</td>
<td>3,500 – 5,000 litres per hour up to 0.5 hectare none</td>
</tr>
</tbody>
</table>

3 Students complete the task as quickly as possible. (maximum 5 minutes)

Key words

Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
3 Bridges and tunnels

Bridges are some of the most famous structures in the world. There are many different types of bridges. There are fixed bridges such as arch bridges and movable bridges which can pivot, fold, tilt, or swing. The Reading texts describe four important types of bridge: truss, arch, suspension, and cable-stayed. A truss bridge rests on a support, such as a pier, at each end and is held up by a truss superstructure, a network of members linked to each other to resist the forces acting on the bridge. A suspension bridge is supported by cables draped over towers. The cables are fixed to secure anchorages at each end of the bridge. The deck of the bridge is linked to the cables by vertical hangers. In a cable-stayed bridge, the deck is supported directly to cables which are fixed at an angle to towers. Arch bridges transfer their weight to either end.

There are two important forces that every bridge must deal with: compression and tension. The illustrations in the text show those forces acting in different types of bridges. Compression is a force that acts to compress or shorten the thing it is acting on. Tension is a force that acts to expand or lengthen the thing it is acting on.

The site of a bridge must be carefully selected, not just to interface with the existing road or rail system but to ensure that solid foundations can be provided to support the structure. Bridges must withstand stresses and strains from the traffic they carry and from the extremes of the weather they will be subjected to. They must remain safe, despite the corrosive effects of rainwater, sea spray, and road salt and possible collision damage inflicted by passing ships or trucks.

Tunnels, like bridges, are important links in the transport network. Sometimes a tunnel is the only option. Sometimes the choice between a bridge and a tunnel must be made. Tunneling can be simpler and cheaper than bridge building but this decision can only be made when a geological survey has revealed whether the tunnel will pass through clay, rock, or gravel and how simple or complex the tunneling will be.

Engineers will use a tunnel boring machine (TBM) rather than drilling and blasting, whenever possible. There are difficulties in tunneling in urban surroundings when the ground surface must not be disturbed. TBMs do not disturb the surrounding soil or rock making them ideal for use under built-up areas. They produce a smooth tunnel which is easy to line with concrete if this is required.

Additional activity
(all levels)
Get students to name and identify bridges in their country. For homework, ask them to find photographs of bridges they have seen. These will be useful in later exercises.

* Tip
A labelled sketch or simple diagram can help us remember words about a particular topic.

Switch on
1 Get students to work in pairs to answer the question. Then, discuss the answers as a class.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Golden Gate Bridge, San Francisco</td>
<td>D</td>
<td>Bahrain Causeway</td>
</tr>
<tr>
<td>B</td>
<td>Sydney Harbour Bridge</td>
<td>E</td>
<td>Charles Bridge, Prague</td>
</tr>
<tr>
<td>C</td>
<td>Forth Rail Bridge, Scotland</td>
<td>F</td>
<td>Grand Viaduc Du Millau, France</td>
</tr>
</tbody>
</table>

2 Discuss this question as a class. Encourage students to describe the bridges. Encourage students to consider how these bridges vary in style and construction and why.

Reading
Bridge types
1 Get students to work in pairs to complete the exercise.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>A</td>
<td>2</td>
<td>arch</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>1</td>
<td>truss</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>4</td>
<td>cable stay</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>3</td>
<td>suspension</td>
</tr>
</tbody>
</table>
Additional activity
(weaker students)
Get students to use any photographs that have been brought to the classroom and to decide what sort of bridges they are.

Tip
cofferdam = a cylinder or box casing that is sunk into a river bed.

Additional activity
(all levels)
Get students to work in pairs or small groups. Give each group a large sheet of paper and ask them to design and draw some signs which give warnings. These could be signs in common use or students could invent a few new ones. Get two groups to work together. Students should guess what each sign means, using the Passive. These could be written as follow-up.

Additional activity
(stronger students)
Get students to prepare and give a short presentation on how the tunnel-boring machine works. If necessary, allow them to note down key words but do not allow them to read the sentences they have written in the exercise.

2 Get students to work individually. Check the answer and check that students understand the vocabulary.

- truss

3 Get students to work in groups of three. Give each student in the group a number 1, 2, or 3 and get them to read the appropriate text.

- 1 arch 2 cable stay 3 suspension

4 Get students to work in their groups to complete the exercise. The blue arrows represent tension and the red arrows represent compression.

Language spot
The Passive
Get students to look at the diagram and read the example sentences. Discuss why we use the Passive in process descriptions (because the action is more important than the person doing it). Get students to read the rules and check that they know how to form the Passive in different tenses and with modal verbs.

1 Get students to work individually to complete the exercise.

- 1 Each deck section is made from steel.
- 2 The sections are floated into position below the bridge by barges.
- 3 The sections are hoisted by cranes.
- 4 Each section is hung from the cables.
- 5 Each section is welded into place.

2 Get students to work individually to complete the exercise.

- 1 were built 4 were needed 7 was used
- 2 have been used 5 were used 8 has led
- 3 were built 6 were constructed

3 Get students to work individually or in pairs to complete the exercise.

- 1 Mobile phones must not be used.
- 2 Eye protection must be worn.
- 3 This extinguisher must not be removed.
- 4 This machine must be switched off before servicing.
- 5 Spillages must be cleaned up.
- 6 Vehicles must not be unloaded here.

4 Students should work in pairs to discuss how a tunnel-boring machine works. Encourage the use of the Passive.

5 Get students to work in pairs to identify which sentences contain a new agent and then ask them to complete the exercise individually or for homework.

- 1 A number of methods to make tunnels are used by Construction Engineers.
- 2 A simple cut-and-cover method is used for shallow tunnels.
- 3 Explosives are used for tunnels in very hard rock.
Additional activity
(all levels)
Get students to use the sentences they have written in 5 to now write questions using the Passive. 1 How many methods are used to build tunnels? 2 What method is used for shallow tunnels?  Students should practise asking and answering the questions in pairs.

Top margin
Get students to discuss in small groups which statistic surprises them most and why they think the decision to build a tunnel was taken.

4 A tunnel-boring machine (TBM) is used to make deep tunnels in soft rock.
5 The workers and the machinery are protected by the TBM.
6 The rock is cut by a rotating cutterhead at the front.
7 The refuse is removed by machinery at the rear.
8 The TBM is pushed forward by hydraulic jacks.
9 A new tunnel ring is built every 1.5–2 metres by the segment erector.
10 Concrete segments are placed in the right position to form the ring.

It’s my job
1 Get students to discuss the questions in pairs.
2 Get students to work individually and then in pairs to check their answers.

O-T
1 A fast rail link from London to Paris
2 They are laser-guided.
3 Pumps running 24 hours a day to drain the water away
4 More building foundations, underground railway (tube) tunnels, sewers
5 A truck fire destroyed the concrete lining in one section.
6 Because it was a major project which will last for a long time and because it improves communications between London and Paris.

Problem-solving
1 Ask groups to explain what the common feature is. Encourage them to explain how each of the bridges operates.

O-T
They all open to allow ships to pass.

2 Get students to discuss and then choose one bridge to explain to the others. Encourage students to help each other if necessary.

O-T
A It swings. It’s a swing bridge.
B It lifts. It’s a lifting bridge.
C The roadway is in two sections. Each pivot at the base of one of the two towers. The centre rises.
D It tilts on a horizontal axis.

3 Once students have reached a decision, get one or two groups to present their ideas to the class. Encourage discussion.

* Tip
Rise (rose, risen) is used without an object. When people or objects rise, they move from a lower to a higher position.
Raise (raised) is a verb that must have an object. When a person raises something, they move it from a lower to a higher position.

Top margin
Get students to research more bridge and tunnel records. Encourage them to use superlatives when discussing them.
### Additional activity

(All levels)

Get students to write a short description of one of the bridges they have studied. They should try to use as much vocabulary from the unit as possible.

### Additional activity

(All levels)

There are many competitions for technology students to build a model bridge which will support a particular weight. On these websites you can find details of competitions to build bridges. Your students needn’t enter the competitions but they could try to build a model bridge to the specifications listed.

http://www.balsabridge.com/
http://pbskids.org/zoom/activities/sci/strawbridge.html

### Webquest

Get students to complete the table in class time or for homework. Choose a few students to describe what they have found to the rest of the class. If others do not agree or have additional information to give, ask them to wait until the speaker has finished.

<table>
<thead>
<tr>
<th></th>
<th>Type</th>
<th>Function</th>
<th>Location</th>
<th>Designer</th>
<th>Year completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>cable-stay</td>
<td>cable-stayed</td>
<td>road</td>
<td>Bilbao, Spain, over the Nervion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arenas &amp; Asociados Ingeniería de Diseño.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>in planning</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>lift</td>
<td>rail</td>
<td>Bourne, Massachusetts, USA</td>
<td>Public Works Administration</td>
<td>1935</td>
</tr>
<tr>
<td>C</td>
<td>bascule</td>
<td>road</td>
<td>London, England</td>
<td>Sir Horace Jones</td>
<td>1894</td>
</tr>
<tr>
<td>D</td>
<td>arch bascule</td>
<td>bicycle and pedestrian</td>
<td>Newcastle, UK</td>
<td>Wilkinson Eyre</td>
<td>2001</td>
</tr>
</tbody>
</table>

### Tip

This listening exercise focuses on listening for detail. If students have difficulty noting down the information while listening, ask them to raise their hands at the points where the figures are given, so you can pause the recording and give them time to write.

### Additional activity

(Weaker students)

Dictate some figures to students – a date, a time, a measurement (height, length, width), a fraction, a telephone number, a quantity, a price. Check students’ answers by asking them to dictate them back to you. Then get students to write down their own figures. In pairs they practise dictating these figures to one another. They can check their answers in pairs.

### Listening

**The Great Belt East Bridge**

1. Get students to discuss in pairs. then ask one pair to give their answers to the class and to explain their choices.

<table>
<thead>
<tr>
<th></th>
<th>A cable stay</th>
<th>B suspension</th>
<th>C box girder</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Play the recording more than once if necessary. Allow students to compare their answers. See below for correct order.

3. As students listen, they should make notes. Get them to check their answers in pairs.

   |   | 1 box girder (1965), 2 x 400m spans |
   |   | 2 cable-stay (1973), central span of 780m |
   |   | 3 suspension (1993), 1600m span, 2 towers of 254m, deck depth 4m |

### Key words

Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
Plastics have replaced wood, paper, glass, steel, and aluminium as the materials of choice for many common objects used today. They usually have inferior mechanical properties such as stiffness, strength, and temperature resistance to the materials they have replaced. However, plastics succeed because of their low density, toughness, and design flexibility. Much of this design flexibility is due to the manufacturing processes that have been developed to shape them into simple and complex forms that would be costly or even impossible to produce with traditional materials.

Moulding processes have been around for a long time and are particularly suited to making plastic parts. Most of the processes can efficiently produce plastic parts in high numbers, but even where low numbers are involved, the complexity of the required shape may justify the cost of moulding a part in plastic over machining a part from metal.

Plastics production really started in the mid-20th century. Today there are hundreds of different plastics available, each one developed to have specific characteristics to meet the requirements of different users. Think, for example, of the plastic bottle containing a fizzy drink and the plastic packaging used to protect a piece of electronic equipment during shipment.

Plastics can be given additional characteristics such as fire retardancy to allow them to be used in aircraft parts. Injection-moulded parts can include glass or carbon fibres for strength. Plastics can be moulded with a foaming agent which will reduce the density and hence the weight of the final component and reduce the material required so reducing the cost.

The list of plastics appears to be endless but they fall into two categories, thermoplastics and thermosets. Thermoplastics can be melted and recycled into new parts. Thermoset plastics are stronger than thermoplastics but cannot be recycled into new parts and have to be disposed of in other ways. Because plastics are not naturally biodegradable and not all plastics can be recycled, there is a real problem in disposing of plastic waste.

To help answer this concern, bioplastics are being developed from plant materials. It is possible to produce a mouldable ‘plastic’ with ground-up natural cellulose, other materials, and water. Drug capsules are made from starch-based bioplastics.

### Additional activity (stronger students)
Students should imagine they work for a plastics company. They should prepare a presentation to convince people of the qualities and range of uses of plastics. Allow each student to speak for one minute only. The rest of the class should decide on the most convincing sales person.

### Additional activity (all levels)
Students should write a paragraph about why plastic has been used in the production of a chosen product. They should give at least one reason why another material would not have been suitable.

### Switch on
Get students to look around them and identify and name products made of plastic.

1. Get students to name the products in the pictures. Encourage students to consider why plastic is so widely used. In pairs they should discuss each item in turn and gradually build up a list of properties.

2. Get students to compile a list of properties on the board.

### Possible answer
Plastics are:
- **versatile**: they can be shaped easily into a wide range of forms.
- **lightweight**: compared to other materials they are very light which reduces costs in, for example, transport.
- **safe**: hygienic properties allow them to be used in food wrapping and containers in medical applications.
- **durable**: plastics have a long life compared to many other products and they retain their shape and strength.
- **cost-efficient**: taken over their lifetime, plastics are cost effective.
- **resistant** to chemicals, water, and impact.
Listening
The history and properties of plastics

1 Get students to work in pairs to discuss the questions.

2 Get students to take notes while they listen. If necessary play the recording more than once. Check answers and provide spelling if necessary.

- 1 celluloid
- 2 petroleum, natural gas
- 3 bioplastics

3 Students should try to make simple notes while listening. Allow students to compare answers in pairs.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 replaced scarce materials such as ivory</td>
<td>explosive, standards of quality</td>
</tr>
<tr>
<td>2 versatile, wide range of cheap household and industrial products</td>
<td>waste, world running out of oil</td>
</tr>
<tr>
<td>3 biodegradable (can be broken down easily)</td>
<td>expensive, new technology required</td>
</tr>
<tr>
<td>4 reduces waste</td>
<td>collection systems</td>
</tr>
</tbody>
</table>

Language spot
Ability and inability

Introduce the language point by asking students what scientists were able to do with the first plastics. Ask them about the properties of plastics we use today and what other raw materials we will be able to use in the future. Get students to read the grammar rules and then find examples of sentences expressing ability and inability in the Listening script on p.125.

1 Get students to work individually to complete the exercise.

- 1 e 2 d 3 a 4 f 5 c 6 b
2 Look at the example with the students to make sure they understand what is required. Get students to do the exercise individually.

- Manufacturers can / are able to mould modern plastics into complex shapes.
- Manufacturers were able to / could colour casein, which was made from milk.
- Manufacturers are not able to / can’t / will be able to make cars completely from plastics.
- Manufacturers are able to / can use plastics to help designers reduce weight in aircraft.
- Manufacturers can / are able to replace metal components in engines with plastic.
- Manufacturers can / are able to recycle waste thermoplastics.
- Manufacturers are unable to / cannot / are not able to recycle waste thermoset plastics.
- Manufacturers were not able to / couldn’t produce nylon in 1900.

Problem-solving

1 Students should work in pairs to do as much of the exercise as possible. They can then go to the websites in 2 for help.

- 1 e 2 g 3 d 4 i 5 b 6 j 7 h 8 c 9 f 10 a

2 Get students to use the websites to check their answers to 1 and then find at least four other plastics.

Webquest

1 Ask students if they know where they would find these symbols. Discuss what they know about them. Get students to look at any plastic products they have with them (e.g. drinks bottles, food containers) to see if they can find these symbols.

- These symbols can often be found on the base of plastic products indicating the type of plastic they are made of. This information is useful when plastics are recycled but does not mean that the product will necessarily be recycled.

2 Get students to research these symbols and find out when they were developed and why.

- These are the internationally agreed recycling codes for plastics. They identify the type of plastic used in the item but this does not mean that the plastic should or will be recycled. A full list of the plastics in each group and possible uses of the recycled plastic can be found on the suggested websites.
**Make your point**

**Describing a pie chart**

1. Ask students what types of products are made of plastic and to try to suggest what the different sectors might be. Get students to work in pairs to discuss which sectors are represented by the segments of the pie chart.

2. Play the recording and get students to complete as much as possible. Play it again to find any missing information and to check the answers. Get students to compare answers.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>35%</td>
</tr>
<tr>
<td>Building and Construction</td>
<td>23%</td>
</tr>
<tr>
<td>Electrical and Electronics</td>
<td>8%</td>
</tr>
<tr>
<td>Furniture / Housewares</td>
<td>8%</td>
</tr>
<tr>
<td>Transport</td>
<td>8%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>7%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
</tr>
<tr>
<td>Toys / Sport</td>
<td>8%</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>2%</td>
</tr>
<tr>
<td>Medical</td>
<td>2%</td>
</tr>
</tbody>
</table>

3. Get students to read the *Useful language* and then listen to the presentation.

Lee does not say:

This pie chart represents ...  
I'd like to draw your attention to ...

4. Get students to work in pairs. Check that the pie charts correctly represent the information. Encourage students to use the names of the plastics rather than their codes and to use some of Lee's *Useful language*. In pairs, get students to give their short presentation and give helpful feedback.

**Gadget box**

Get students to read the paragraph and discuss. Ask them if they can imagine other applications for this resin.

**Pronunciation**

**Disappearing sounds and word linking**

Get students to read the introduction.

1. Allow students to listen several times if necessary. Once they have completed the exercise, play each sentence in turn and get students to repeat them.

You hear the letter in bold in:

1 B 2 A 3 B 4 B 5 B

2. Get students to work in pairs to complete the exercise.

a. Light stabilizers prevent light damage.  
b. Plasticizers are used to make plastics softer.  
c. Even the street lights are made of plastic.  
d. Plasitics production was really able to take off.  
e. Polyester fibres are used a great deal in clothing.
Top margin
Discuss the fact. Get students to research the rise in plastic consumption and represent it in graph form.

* Tip
* * high-precision = very accurate
* * filament = a very thin piece like a thread
* * durables = products that have an expected life of more than three years.
* * non-durables = products that have a life expectancy of three years or less.

Additional activity
(stronger students)
Get students to find other collocations with the words in column A. Allow them to use an English-English dictionary. Ask them to build their own sentences with these new collocations.

Additional activity
(all levels)
Students should design an advertisement for a supermarket which has decided to change to a new type of packaging. It could be a poster advert or a TV commercial which they could act out.

Additional activity
(all levels)
Divide the class into three groups. Give each group a role – environmentalists, plastics producers, consumers – and ask them to discuss the question from their point of view. Allow them ten minutes to brainstorm ideas. Ask each group to nominate a scribe to make notes and a spokesperson. Have a class debate on the subject, asking each group in turn to state their position. Encourage discussion.

3. Check that the students have marked the sentences correctly before they practise saying them.

Vocabulary
Collocations in plastics
1. Get students to complete the exercise individually. Allow them to check their answers in pairs.

<table>
<thead>
<tr>
<th></th>
<th>1 materials</th>
<th>2 process</th>
<th>3 appliances</th>
<th>4 industry</th>
<th>5 components</th>
<th>6 moulding</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Get students to work individually to complete the exercise.

<table>
<thead>
<tr>
<th></th>
<th>1 man-made polymer</th>
<th>2 textile fibres</th>
<th>3 chemical properties</th>
<th>4 expected life</th>
<th>5 medical devices</th>
<th>6 food containers</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reading
Packaging technology
Get students to focus on the pictures and title and to guess what the text will be about.

1. Discuss the question before students look at the text. Students should read quickly to check their answers.

<table>
<thead>
<tr>
<th>O</th>
<th>Customers can see the state of the food inside; it prevents contamination from air.</th>
</tr>
</thead>
</table>

2. Get students to read individually. Explain that they are reading for general meaning.

3. Get students to complete the table individually and then compare their answers with a partner. Remind them not to write sentences, just notes (key words).

<table>
<thead>
<tr>
<th>O</th>
<th>Packaging technology</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bioplastics</td>
<td>can be easily broken down so a reduction in waste provides information for the customer provides the best conditions for the food</td>
</tr>
<tr>
<td></td>
<td>active packaging</td>
<td></td>
</tr>
<tr>
<td></td>
<td>membrane wrapper</td>
<td></td>
</tr>
</tbody>
</table>

4. Get students to discuss the effects of the new technologies as a class.

Key words
Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
The knowledge that reserves of oil, gas, and coal are finite has forced governments and companies to commission Scientists and Technologists to find alternative sources of energy from renewable resources. There is also concern that burning fossil fuels releases CO₂ into the atmosphere, contributing to global warming.

People have used wind and water power, the sun, and geothermal energy for centuries. Wave and tidal power are being harnessed by different inventions such as wave energy converters, which convert this power into electricity. The benefit of using natural sources of power is that they are free at source and constant, but converting them to useful energy and transmitting that to centres of population can be expensive and commercially unviable.

Wind turbines are designed to be efficient and look attractive. They must present a smooth streamlined surface to the wind so the turbine and controls are housed in a nacelle compartment. They operate most efficiently when the rotors are facing the wind so they can be rotated to face the wind direction. To minimize the forces on the blades and allow the turbine to operate in winds of different strengths, the pitch, or angle the blade presents to the wind, can be varied. Brakes are provided to stop the rotor if required. There is some controversy surrounding where to site wind turbines. As they have to be built high up on hills or mountains some people feel they ruin the landscape. To avoid this problem some wind farms are being built offshore, although this often increases the distance the electricity has to travel and increases maintenance costs.

Microgeneration is an important part of decentralizing energy generation. This means that energy is generated at or near the point of use and is not wasted by being transported to the end-user. Decentralized energy can draw upon a variety of alternative energy sources such as geothermal, solar, hydroelectric, and wind. Cogeneration plants can be fired by renewable fuels like biogas and biomass. These types of plants capture the heat produced from burning fuels when generating electricity and use it to heat homes and offices. Trigeneration plants additionally produce cold water for refrigeration and air conditioning.

Additional activity
(all levels)
Get students to discuss in pairs which sources of energy are most appropriate for their country. They should either prepare a short presentation or write a paragraph explaining their choices.

Switch on
Discuss the problems related to the use of oil, gas, and coal for energy production. Get students to identify alternative sources of energy from the pictures and explain how they work.

- A sun – solar energy for cooking, heating water, conversion to electricity by solar cells
- B wind – can produce electricity through wind turbines
- C wave power – can generate electricity by rotating floating generators
- D rape seed / canola – biofuel as a diesel substitute
- E geothermal power – heat from the earth’s core can be used to provide domestic heating
- F waterfall – hydropower, falling water turns turbines to generate electricity
- G tidal power – tidal water trapped behind a barrage can be used to rotate generators and produce electricity
Listening

Wave Energy Innovator

1 Allow students to discuss the questions in small groups for five minutes.

Possible answers
1 A wave energy converter
2 Sea conditions can be very rough, getting the power generated on shore.
3 A collection of wave converters in one area
4 Carbon dioxide (and particulates) produced by burning fossil fuels
5 It will recover its costs and generate a profit.

2 Get students to read the questions before listening.

Wave energy converters
2 22.5 megawatts
3 Edinburgh University
4 Frog, Duck
5 It’s a sea snake which swims only on the surface like his wave converter, which floats on the surface of the sea.
6 He used Google.

3 Get students to read the questions before listening. Play the recording again but pause after the answer to the questions so students have time to write down the answer.

The grandfather of wave energy
2 going on about
3 put your money where your mouth is
4 They have to have an application in the modern world.
5 Come up with an energy that reduces carbon emissions.

Language spot

Past Continuous v Past Simple

Get students to read the rules.

1 Do the first sentence with the students to make sure they understand. Ask Which phrase a to f goes with phrase 1? Then ask Which part should be in the Past Continuous tense and which in the Past Simple? Why? Ask them to write it down and continue with the exercise. Once they have finished, they should check their answers in pairs.

were digging, collapsed
was working, split
happened, were sleeping
was coming in, crashed
was studying, met
were constructing, had
**Additional activity (weaker students)**
If students are struggling with the concept of the Past Continuous, use a picture which shows a number of people involved in a range of activities, e.g. at a railway station, in a street, etc. Say *This was the situation yesterday at 9.30. Describe it.* Students should use the Past Continuous to describe the various activities. Then explain that something happened to disturb this situation – a fire alarm, a thunder storm, a loud explosion. Ask students *What happened next to these people?* They reply in the Past Simple. Get students to write two paragraphs, one in the Past Continuous and one in the Past Simple.

**Additional activity (all levels)**
Get students to close their books. Explain that you are going to read the text aloud and when you pause, they should supply the next word. As you read, pause about ten or twelve times before important vocabulary. If it is a small class, allow students to call out the word but with a large class indicate a specific student to give the answer. If they are unable to give the answer, move quickly to someone else.

2 Get students to complete the sentences in class or for homework.

| 1 did, found | 6 wasn’t wearing, happened |
| 2 was working, was | 7 was running, removed |
| 3 heard, decided | 8 was, was using, happened |
| 4 was going on, were able to | 9 was running, developed |
| 5 used, thought | 10 were building, damaged |

**Reading**

**Making inferences**
Introduce the topic by discussing wind power, its advantages, and disadvantages. Discuss the use / possible use in students’ countries.

1 Get students to work in pairs to complete the exercise.

2 Get students to read the text individually to check their answers. In pairs they should quickly compare answers.

3 Get students to complete the exercise individually and then to check their answers in pairs.

**Making inferences**
Get students to read the notes.

4 Get students to work in pairs to discuss the answers to the questions. They should make notes, writing only key words. When they have all finished, ask some groups to explain their answers to the whole class. Encourage discussion. Get students to write clear answers, this time in sentences. Ask one person in each pair to write answers to the even number questions and the other to the odd numbers. This could be set for homework.

| 1 To harvest the strong winds offshore. Because they are less visible there. |
| 2 To make the most effective use of a windy site. It’s cheaper to link a number of turbines in one place to the grid and to maintain them than a lot of individual turbines in different locations. |
| 3 The technician is protected inside the tower. Open towers, such as lattice towers (like electricity pylons) offer less protection. |
| 4 Approximately 54 metres (twice the length of one blade). |
| 5 1500 r.p.m. (50 times 30). |
| 6 High speeds are needed to make the generator operate efficiently. |
| 7 3000kW, 3MW |
| 8 The anemometer measures wind speed; the wind vane determines wind direction. |
| 9 This is the most effective position to catch the wind. |
| 10 90 km/h |
Gadget box

Get students to discuss the question. If necessary, they should investigate the amount of power needed to power an average home for homework, and then work out the area required.

Project

1. Get students to work in pairs and discuss. Once everyone has completed the activity, ask one pair to present their ideas to the rest of the class. Allow other students to add to the points.

2. Encourage students to use technical or monolingual dictionaries if possible. Google has a functionality for giving definitions which can also be useful.

3. Get students to work in pairs. Check answers with the whole class.

4. Get students to discuss in pairs, making notes. Once they have finished, ask one or two stronger students to present their pair’s ideas to the rest of the class. Allow class discussion on any points arising.

Tip

The prefix co- means with or together. Tri- means three. Before students do 2 ask them if they can give you words with these prefixes and to say what they mean.

Additional activity

Get students to use the notes they made in 4 and any additional points that were put forward in the presentations to write a short report on how their community could be more self-sufficient in energy.
Webquest

Get students to work in small groups. Ask each group to first decide how they are going to share the work and to make sure that everyone has something to contribute. You could set some of this for homework, but allow class time for each group to share their information. Once they have finished, allocate one topic to each group and ask them to present their findings to the rest of the class in a short presentation. As follow-up, get students to write about one of the topics.

Vocabulary

Grouping words

Get students to read the introduction.

1 Get students to work individually to complete the exercise. Tell them that all verbs are used in the Present Simple tense, but have to be put in the correct form, singular or plural. Allow students to compare their answers in pairs.

<table>
<thead>
<tr>
<th></th>
<th>1. transfer / transmit</th>
<th>2. transfers / transmits</th>
<th>3. increase / decrease</th>
<th>4. turns / rotates</th>
<th>5. turns / rotates</th>
<th>6. stop</th>
<th>7. start</th>
<th>8. drives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 Get students to write the word energy in the centre of the page and then list the words which go before on the left-hand side and the words that go after on the right-hand side. Students should work in pairs to check their answers.

Key words

Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
6 Aeronautics

Aircraft designers must produce an aeroplane that will fly and can be controlled. An aerodynamic shape is required to minimize the resistance force of the air, known as drag. The wings must provide enough lift to overcome the weight of the aircraft and the engines enough thrust to overcome the drag and power the plane through the air. Control surfaces are provided to keep the plane flying smoothly. They act by controlling the yawing, pitching, and rolling movements of the aircraft. Yaw motion is the movement of the nose of the aircraft from side to side. Pitch motion is the movement of the nose up and down. Rolling is the movement of the wingtips up and down.

Air Traffic Controllers have different responsibilities depending on which stage of the flight the plane is at. Some control planes on the ground and others during take off and landing. There are also Area Controllers, like Alan Bueno in the unit, who handle the plane during the flight. Aircraft must meet strict noise limits and the drive is on to reduce the amount of fuel required. The SAX-40 is an experimental concept aircraft. It has not been built, which incorporates novel solutions to these problems. It has a blended wing-body design meaning that wings and body are one structure – there is no sharp distinction between the two.

Helicopters are rotary wing aircraft where the main rotor provides both lift and thrust. They are used for many tasks that would be impossible for fixed wing aircraft. They do not require a prepared runway and can hover over a fixed position, making them invaluable for many tasks such as rescue operations.

Giders work in a similar way to powered airplanes but the initial thrust is supplied by a winch or by being towed by a plane. During flight thrust is then generated by reducing altitude. Gliders are generally used for recreational purposes.

Most large commercial and military planes are powered by jet engines. Jet engines work by fans sucking in air at the front. A compressor raises the pressure of the air. The compressed air is then sprayed with fuel and the mixture is lit by an electric spark. The burning gases expand and blast out through the back of the engine. As the jets of gas shoot backward, the nozzle releases the air and gas mixture and the engine and the aircraft are thrust forward.

* Tip

Rolling is controlled by the ailerons. The plane rotates around the longitudinal axis, the wing tips move up and down. Pitching is controlled by the elevators. The plane rotates around the lateral axis, the nose moves up and down. Yawing is controlled by the rudder. The plane rotates around the vertical axis, the nose moves side to side.

Switch on

1. Ask students which forces act on a plane. Supply vocabulary as required. Students should work in pairs to label the diagrams.

   - [Image with labels: A drag, B lift, C thrust, D weight]

2. Discuss together as a class.

   - [Image with labels: A rolling, B pitching, C yawing]

3. Get students to work in pairs to match the parts. Get students to suggest the function of each part.

   - [Image with numbers 1 d 2 g 3 e 4 f 5 a 6 b 7 c]

It's my job

Ask students what they know about air traffic control.

1. Discuss as a class.

2. Get students to quickly read the text, underlining the different jobs in the text. In pairs, get students to complete the list of responsibilities.
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Background, teaching notes, tips, and additional activities

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2 Food and agriculture  p.11
3 Bridges and tunnels  p.15
4 Plastics  p.19
5 Alternative energy  p.24
6 Aeronautics  p.29
7 Future homes  p.33
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Grammar tests and communication activities

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15 Career development  p.106

Grammar tests key  p.108
Additional activity (stronger students)
Get students to work in pairs and think about these questions:
Why is a visual control tower needed at an airport? Technical aids provide assistance to visual control, but cannot totally replace it. Not all airports have ground control supported by radar and not even the most sophisticated systems can see when the cabin door is actually closed and the stairs removed.
What sort of special conditions would the pilot need to know about? Weather info, runway conditions, info about any aids or lights that are out of service. Ask students to explain their answers to the rest of the class.

3 Get students to read individually and then check their answers with a partner.

1 Computers, radar, and radio equipment
2 Weather, special conditions
3 Give them their exact position and guide them to safety
4 He applied when he was nineteen, spent twelve months at college and two years as a trainee.

4 Get students to work individually in class or set for homework.

Problem-solving
1 Get students to work in pairs. Get them to consider overall shape, wing shape, and position of engines.
2 Get students to work in pairs to complete the table.

Gadget box
Get students to discuss in small groups. Ask them to consider the problems associated with a vehicle of this sort. Ask a spokesperson for each group to report back to the class.

Advantages over ... Car: It does not need roads and can fly over obstacles.
Helicopter: It is cheaper and much easier to fly.
Plane: It can land almost anywhere and is easier to fly.

Language spot
First and Second Conditionals
Get students to read the examples and rules.

1 Get students to work individually and then check answers with a partner.
**Additional activity**
*(all levels)*
Get students to write a short description of the SAX-40, using the notes.

**Additional activity**
*(all levels)*
Superstitions tend to be culturally specific but there are some that are universal. Ask students if they believe any of these superstitions. Ask them if there is any scientific basis to them. Get students to think of superstitions in their culture and to consider where they originated from.

*If you walk under a ladder, you will have bad luck.*
*If you scratch your left hand, you will give money away.*
*If you put red and white flowers together in a vase, they will bring bad luck.*

---

**Pairwork**

1. Get students to work in pairs, A and B. Explain that they have to cooperate to complete their diagrams. Get them to look at their diagram individually and think of the questions they will need to ask. Then get them to read their text quickly. In pairs they should ask each other questions.

<table>
<thead>
<tr>
<th>Helicopter:</th>
<th>Glider:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 main rotor</td>
<td>thermals, hill / ridge</td>
</tr>
<tr>
<td>2 tail boom</td>
<td>lift, wave lift</td>
</tr>
<tr>
<td>3 tail rotor</td>
<td>no parts - thrust is</td>
</tr>
<tr>
<td>4 engine</td>
<td>created by reducing</td>
</tr>
<tr>
<td></td>
<td>altitude</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Helicopter:</th>
<th>Glider:</th>
</tr>
</thead>
<tbody>
<tr>
<td>main rotor</td>
<td>rudder</td>
</tr>
<tr>
<td></td>
<td>changes to the angle of</td>
</tr>
<tr>
<td></td>
<td>the main rotor blades</td>
</tr>
<tr>
<td></td>
<td>90th blades, engine and</td>
</tr>
<tr>
<td></td>
<td>tail rotor blades</td>
</tr>
</tbody>
</table>

2. Get students to work in pairs to complete the table.

<table>
<thead>
<tr>
<th>How is lift achieved?</th>
<th>Helicopter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>main rotor</td>
</tr>
<tr>
<td></td>
<td>rotor blades, engine and</td>
</tr>
<tr>
<td></td>
<td>tail rotor blades</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Which parts provide thrust?</th>
<th>Glider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>thermals, hill / ridge</td>
</tr>
<tr>
<td></td>
<td>lift, wave lift</td>
</tr>
<tr>
<td></td>
<td>no parts - thrust is</td>
</tr>
<tr>
<td></td>
<td>created by reducing</td>
</tr>
<tr>
<td></td>
<td>altitude</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How does the pilot achieve yawing?</th>
<th>Helicopter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>main rotor</td>
</tr>
<tr>
<td></td>
<td>rotor blades, engine and</td>
</tr>
<tr>
<td></td>
<td>tail rotor blades</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How does the pilot achieve pitching?</th>
<th>Glider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>thermals, hill / ridge</td>
</tr>
<tr>
<td></td>
<td>lift, wave lift</td>
</tr>
<tr>
<td></td>
<td>no parts - thrust is</td>
</tr>
<tr>
<td></td>
<td>created by reducing</td>
</tr>
<tr>
<td></td>
<td>altitude</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What provides stability?</th>
<th>Helicopter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>main rotor</td>
</tr>
<tr>
<td></td>
<td>rotor blades, engine and</td>
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</tbody>
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<tr>
<th></th>
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<tr>
<td></td>
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<tr>
<td></td>
<td>changes to the angle of</td>
</tr>
<tr>
<td></td>
<td>the main rotor blades</td>
</tr>
</tbody>
</table>

3. Get students to discuss in pairs and make notes. Ask some pairs to explain their ideas to the rest of the class.
Webquest
Jet engines

1 Get students to work in pairs to research different parts of a jet engine.

<table>
<thead>
<tr>
<th>Engine part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>fan</td>
<td>sucks in air</td>
</tr>
<tr>
<td>compressor</td>
<td>compresses air and so increases pressure</td>
</tr>
<tr>
<td>combustor</td>
<td>ignites the fuel</td>
</tr>
<tr>
<td>turbine</td>
<td>drives blades in compressor and fan</td>
</tr>
<tr>
<td>nozzle</td>
<td>produces thrust for the plane</td>
</tr>
</tbody>
</table>

2 Get students to work in groups of up to five people and each research one of the engines. If possible, students could print out the picture of the engine and use it in their presentation.

Make your point
Making telephone calls

1 🗣 Get students to look at the message before listening. Play the recording and get students to underline the mistakes in the message. If necessary, play again. Get students to check their answers in pairs.

Frank Hall, Francis Ball
MD-11, MD-11F
freighter, passenger plane
out after 4, out till 4
011... 001...

2 After discussing in pairs get students to discuss as a class.

By checking details, repeating information, and asking for clarification

3 🗣 Play the recording once. Get students to discuss.

Asks for repetition, checks details
He’s going to phone Ivor Teslenko to give him the details.

4 Get students to read Lee’s advice. Ask them to read their cards on p.110 and p.112, then practice exchanging information.

Key words
Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
The work of house builders is to construct attractive homes within budget. Planning permission must be obtained first and the homes must meet building regulations. Their work is becoming more difficult because of a shortage of suitable building land in many countries. In addition, they have to build houses which take into account global warming, drought and flood risks, and future fuel crises. This unit covers some of the ways future homes will adapt to these circumstances and will make use of new technologies. Householders will expect their homes to produce much of the energy their family needs so wind turbines, solar panels, and geothermal energy systems will be included. Homes will be adapted to collect and store rainwater and to recycle water. New systems of cooling will be developed to cope with rising temperatures.

Earth homes maintain a stable temperature all-year round so heating and air-conditioning costs are much lower. They can be built into hillsides or built on level ground with a living roof garden to make them less noticeable. Those built into hillsides or partially underground must be built with proper drainage and be waterproof, not just from rain water but also ground water. The building must be strong enough to support the soil on the roof and resist the pressure of the soil on the rear and side walls within the hillside.

In the Netherlands, where building land is very expensive, floating homes have been built on barges which rise and fall due to tidal action or river level changes. The technology developed there could be applied more widely as sea levels rise around the world.

Land shortages and ageing populations will intensify the demand for modular homes that can be adapted to meet the changing needs of a family. Interior walls can be moved or taken away. Furniture will be more adaptable and smart technology will make life more comfortable and safer. For example, refrigerators will read bar codes on food and suggest menus as well as warn when food is no longer safe to eat. Newspapers may be downloaded on to electronic paper. This is a display technology designed to mimic the appearance of ink on paper. It reflects light like ordinary paper and can hold text and images indefinitely.

Additional activity

Get students to choose one of the points 1 to 10 and write a paragraph giving and justifying their opinions on when and why they think it will happen.

* Tip

Building styles vary around the world, mainly because of climatic conditions. Try to find photographs of homes from different countries to encourage discussion. If students are from different parts of the world, invite them to describe homes in their country.

Switch on

With the class, briefly discuss changes in homes in the students’ countries within the last 100 years. Encourage students to explain why these changes have taken place.

Students should look at the predictions and discuss in pairs. Students should be able to justify their choices. Students should refer back to Unit 4 when discussing point 5 and to Unit 5 when discussing points 9 and 10. Ask groups to present their ideas to the rest of the class, giving reasons for their choices.
Additional activity
(weaker students)
Ask students the following questions:
In which direction do earth homes face in the northern hemisphere? Why?
Are earth houses cold and damp? Why not?
Do earth houses have a cellar?
How do earth houses make less impact on the environment?
Why do the roof and walls of an earth house have to be especially strong?
What is the purpose of roof panels?
What building features help control the temperature?

*Tip
Have to expresses external rules and regulations laid down by others while must indicates an internal/personal obligation to do something.

Additional activity
(all levels)
Get students to list some of the things which they have to/mustn’t/don’t have to do to complete their course. Ask them what things they feel they must do to complete the course satisfactorily.

Writing bank
Reports see pp.64-5. Get students to use the notes they have made in project to write a report on their research. This will give the students an opportunity to lay out a report.

Listening
Earth homes
Get students to read the list of advantages before listening. Get students to explain why these are advantages of earth homes. Play the recording. Get students to compare answers in pairs. Play the recording again so students can check their answers.

Language spot
Obligation and necessity
Get students to read the rules. Go through the Grammar reference or set it for homework.

1 Students should work in pairs to complete the exercise.

2 Students should work individually to complete the exercise or set for homework.

3 Get students to discuss and then write individually.

Gadget Box
Get students to discuss in pairs. They should be able to explain their ideas. Choose one pair to present their ideas to the rest of the class. Encourage discussion.

For short-stay living for students, business people, and weekenders.
**Tip**
Some other adjectives formed from verbs and ending in -able include changeable, advisable, acceptable, suitable, adjustable, breakable, dependable.
Some adjectives ending in -able are formed from nouns. In these words, the suffix, -able does not indicate the ability to do something, it indicates that something has these qualities. These include: comfortable, profitable, valuable, knowledgeable.

**Vocabulary**

**Adjectives with -able and -ible**

1. Get students to work individually, then in pairs to check their answers. Point out that many of the adjectives are formed from the verb, but not all.

   ![See below]

2. Play the recording and get students to listen for the stressed syllable. Play again, if necessary stopping at any word which is causing difficulties.

   ![convertible, predictable, variable]

**Reading**

**Inside the future home**

1. Get students to close their books, then read the question to them. Ask them to think about the size, building materials, internal design, furniture, electronic devices, energy, etc. Allow a maximum of 5 minutes.

2. Get students to read individually and then compare their list with the text.

3. Get students to do this exercise individually and then compare answers with a partner.

   ![See answer below]

4. Students should work in pairs to complete the missing reasons in the table.

<table>
<thead>
<tr>
<th>Prediction</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houses will be smaller.</td>
<td>because of the increase in population and shortage of building land</td>
</tr>
<tr>
<td>Interior walls will run on tracks.</td>
<td>so rooms can be used in different ways to allow privacy</td>
</tr>
<tr>
<td>Some partitions will be made of glass which becomes opaque when a current is passed through it.</td>
<td>because it saves space when folded</td>
</tr>
<tr>
<td>There will be convertible furniture.</td>
<td>because they take up less space</td>
</tr>
<tr>
<td>Wall-mounted flat screens will replace TVs.</td>
<td>as water becomes scarce</td>
</tr>
<tr>
<td>Ultrasound cleaners may replace washing machines and dishwashers.</td>
<td>because this saves work and time by humans</td>
</tr>
<tr>
<td>Robots will carry out tasks such as carpet cleaning and dusting.</td>
<td>to make sure we don’t eat dangerously old food</td>
</tr>
<tr>
<td>Fridges will monitor the ‘best before’ dates on foodstuffs.</td>
<td>to save costs and provide the most up-to-date news</td>
</tr>
<tr>
<td>Newspapers will be downloaded onto electronic paper.</td>
<td></td>
</tr>
</tbody>
</table>
Top margin
Discuss the quote. Discuss the problems associated with living on water and with a house that goes up and down.

* Tip
If students studied Technology 1, ask them how much they can remember about the structure of skyscrapers - the building requirements and materials.

Medicine containers will monitor your use.
Enough power for domestic use will be generated by wind or solar energy, or a combination of both.

Problem-solving
Ask students what they can remember about the requirements for an earth home wall, e.g. it would have to be water-tight and strong enough to hold back the pressure of earth around it.

1 Students should work in pairs to discuss the diagram.
2 Students should work individually and then compare their answers in pairs.

Project
1 Divide students into groups A, B, and C. Get students to discuss the pictures in their groups. Ask chosen groups to report their ideas to the rest of the class. Encourage class discussion.
2 Ask each group to research one of the buildings. Encourage them to make notes by writing down key words only rather than copying chunks of text.
3 Ask each student to get together with two other students from the other groups. Encourage students to ask each other questions as well as giving information.

Key words
Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
Most governments want to ensure that all parts of the country develop, not just the capital city. Modernizing the rail network and introducing new trains is one of the best ways of providing the fast, reliable transport links required for development. Trains are safe, energy-efficient, and have a low carbon footprint. The Pendolino tilting train, the Bullet train, and the Maglev train are examples of different approaches to fast rail travel. The Pendolino tilts when it goes round curves. The Shinkansen is the rail network in Japan developed to carry high-speed electric and diesel trains called Bullet trains. Maglev (magnetic levitation) trains have no wheels and run on a fixed guideway. The trains levitate above the guideway and are steered along it by electromagnetic cushions. They are propelled and braked by variable electric current passing through the linear motor. Maglev trains are fast and can run on elevated guideways built above existing motorways. They use very little land compared to roads. For every metre, a motorway uses up to 96 m² of land. A Maglev elevated guideway uses 2.1 m². At present the only large commercial system in operation is between Shanghai city and its airport.

Engineers test models of trains in wind tunnels to determine the optimum shape, both to minimize the energy required to power the train and to make the trains safer. Understanding the aerodynamic effects that trains are subjected to when passing each other, when in tunnels, and when subjected to high cross winds is important in the design of high speed trains.

The Airbus 380 is the largest aircraft Airbus has produced. The wingspan, or distance from wingtip to wingtip, is 79.8 metres. Many new materials and manufacturing techniques are being used in building this aircraft. Airbus is a European company with companies from different European countries participating in the project. These companies all provide parts for the planes, which is why inventive solutions were needed to transport sometimes huge parts from different locations. The Airbus A380 wings are placed in a jig, a special tool made to locate or hold a component during a production process, to be transported to Toulouse.

90% of the world’s trade by volume is transported by ship. The Emma Maersk, the world’s largest merchant ship, carries a cargo of 13,000 containers a month between China and Europe. Cruise ships are becoming an increasingly popular holiday choice for people who want to explore the world while at the same time living in luxurious surroundings.
Top margin
Ask students if they can guess what type of aircraft flies this inter-island flight. Explain that the plane lands on a grass field. (a small eight-seater Islander aircraft).

Additional activity
(all levels)
Get students to find words in the text which mean the following:
A device to hold a part or component in position (jig)
A control panel (console)
Goods or products for transport (cargo)
The rear part of a ship (stern)
What a ship does when it arrives in port (berths)
Where a ship ties up (berth / dock)
Boat for river transport (barge)

Tip
Most compound adjectives are written with a hyphen, but a good dictionary can be used to check.
Nouns joined together to form compound nouns are sometimes written with a hyphen, as one word, or two separate words. Use a good dictionary if you are not sure.

Additional activity
(all levels)
Get students to use the compound adjectives in 2 and combine them with a suitable noun to make sentences. It's more comfortable to work in an air-conditioned office.

Additional activity
(all levels)
Get students to write their own sentences for the compound nouns not used in the exercise and the following:
ballast tank, mass-production, satellite navigation, website, air pollution. They could write sentences with blanks as in the exercise and then ask a partner to write in the missing words.

Possible answer

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Perhaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>how the parts of the A380 are transported</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>how the A380 is manufactured</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>where the parts are made</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>about the French town of Toulouse</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>about problems with moving the wing</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>details about a ship</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>about different forms of transport used to transport A380 parts</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>about German manufacturers</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>about cities in Europe</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

3 Give students only two minutes to read the text. Ask them to check their answers from 2.

4 Get students to cover the text and work in pairs.

1 Six (airbus, MPV, river craft, Ville de Bordeaux, barges, lorries)
2 France, Wales, the UK, Germany
3 Because the parts are very big and have to travel long distances

Vocabulary
Compound adjectives and nouns
Get students to read the introduction.

1 Students should complete individually.

2 Get students to work individually and then check answers in pairs. Then, ask them to add a suitable noun after each compound adjective. Allow students to use a dictionary if they wish.

3 Students should work individually in class or set for homework.

Pairwork
1 Get students to discuss briefly in pairs. Ask them to consider speed, comfort, efficiency, cost, convenience, safety, and technology. Ask them to compare train travel with other forms of transport.

2 Ask students if they can identify either of these trains. Ask students if they have had any experience of seeing or travelling in these trains and their opinion of them. Students should read their respective texts and enter the
details in the table. They should then compare information to complete the second column.

<table>
<thead>
<tr>
<th>Country</th>
<th>Maglev trains</th>
<th>Bullet trains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max speed</td>
<td>431 km/h</td>
<td>300 km/h</td>
</tr>
<tr>
<td>Technology</td>
<td>magnetic levitation</td>
<td>existing rail technology</td>
</tr>
<tr>
<td>Fuel</td>
<td>electricity for magnets</td>
<td>electric or diesel engines</td>
</tr>
<tr>
<td>Track</td>
<td>elevated guideways</td>
<td>purpose-built track</td>
</tr>
<tr>
<td>Efficiency</td>
<td>more efficient than conventional rail transport</td>
<td>environmentally efficient</td>
</tr>
</tbody>
</table>

3. Students should work in the same pairs. Ask one or two stronger students to summarise what they have discussed for the rest of the class.

**Language spot**

**Comparative and superlative review**

1. Explain to students that this is really revision. Ask them to complete the exercise without looking anything up. Allow them to check their answers in pairs.

<table>
<thead>
<tr>
<th></th>
<th>1 quicker</th>
<th>2 more dangerous</th>
<th>3 happier</th>
<th>4 fastest</th>
<th>5 the most efficient</th>
<th>6 The cheapest, best</th>
</tr>
</thead>
</table>

Get students to explain the rules to you.

2. Allow students to work in pairs to complete.

<table>
<thead>
<tr>
<th></th>
<th>much, considerably, a good deal, a lot less, much more, a great deal, a lot, far</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>informal: a lot, far</td>
</tr>
</tbody>
</table>

3. Get students to complete in class or set for homework.

**Possible answer**

Travelling by car is the most expensive form of transport. It is much cheaper to use the bus, but walking is the cheapest. Cars are the most polluting form of transport. They are a good deal dirtier than buses and far dirtier than walking, which is the cleanest form of transport. Travelling by car is the most convenient form of transport. It is a lot more convenient than travelling by bus. Walking is slightly less convenient than travelling by bus and considerably less convenient than using the car. Travelling by bus is a bit slower than travelling by car, and a little deal faster than walking.

Top margin

Ask students if they can imagine the vision Henry Ford had in 1940. Ask students whether they think such a vehicle is a viable proposition today. What would it look like and how would it operate? Hold a class competition for the best car/plane. The Moller Volantor in Unit 6 is an example, the same inventor has also built a car/plane.
Technology is aimed at preparing students who intend to get a job in technology. It presents them with English from a wide variety of technological fields and situations, develops their communication skills, and provides them with background in major technological concepts.

Switch on
This is designed as a warm-up activity to the unit. It usually consists of a number of pictures and often introduces key vocabulary or concepts. It should be used to get students to focus on the topic.

It’s my job
These occur regularly, either as a reading or listening exercise. They are all based on authentic interviews and sources and are designed to be of interest to the students as they stand with only minimal tasks. Students will read about or listen to a variety of people in different technology environments and gain insight into the skills required.

General focus questions for It’s my job are: What do you think his / her job involves? What skills and experience does he / she need? Would you like to do it?

As an ongoing project, encourage the class to build up a portfolio of other ‘it’s my job’ features. For example, if students know someone who works in technology, they can write their own ‘it’s my job’ article or interview, with photos.

Make your point
This feature is introduced by Lee Avatar, a fictional communications guru. His aim is to help students with specific areas of communication, particularly giving presentations, as well as telephoning and interview skills. This feature takes the students one step on from the Customer Care feature in Technology 1 by practising communication not only with customers but also with other non-technical people, such as a group of town planners.

Problem-solving
This encourages students to work together to solve a problem — a key skill in technology. It is designed to stimulate discussion and often involves ranking exercises or evaluating the practicality of a variety of solutions to a particular problem.

Top margin
This top part of the page contains facts, statistics, and quotes. These are optional extras and can be used to add variety and interest to your lessons, or provide additional material for strong students who are ‘fast finishers’. Ways of exploitation include asking whether your students are surprised by the facts and statistics, or whether they agree, disagree, or can identify with the quotes.

It also contains Gadget box: interesting, often quirky, technological innovations related to the unit topic. Each Gadget box has an associated question, and allows you to take time out from the flow of the lesson in order to promote a more open-ended discussion.

There are also definitions for difficult words or phrases which are important to understand a text which appears on the same page. (Words or phrases in the text are highlighted in bold.)

Vocabulary
Students meet a large amount of vocabulary during the course. It is important to encourage good learning skills from the start, for example:
- organizing vocabulary into word sets and word groups rather than simple alphabetical lists
- understanding the context of vocabulary and whether it is a key word needed for production or for comprehension
- checking and learning the pronunciation of a word or phrase.

Language spot
This focuses on the grammar that is generated by the topic of the unit and concentrates on its practical application.

If your students need revision after completing the Language spot, direct them to the Grammar reference, which provides a handy check.

There is also one photocopiable Grammar test for each unit in this Teacher’s Resource Book.
**Tip**
We use very with base adjectives, but not with strong adjectives. It’s very cold. It’s really/absolutely (not very) freezing. We can use really with both base and strong adjectives. It’s very / really interesting.

**Pronunciation**

**Showing enthusiasm**

1. Play the recording and get students to repeat the sentences. Don’t be afraid to exaggerate the stress at this stage.

2. Students should work in pairs. Move around the class checking that students are using the correct stress.

<table>
<thead>
<tr>
<th>Opposite</th>
<th>Yes. It’s really/ absolutely ... Except 8 which starts No ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. fascinating.</td>
<td>3. unbelievable.</td>
</tr>
<tr>
<td>2. enormous.</td>
<td>4. marvellous.</td>
</tr>
<tr>
<td>5. essential.</td>
<td>6. luxurious.</td>
</tr>
<tr>
<td>7. delighted.</td>
<td>8. terrified.</td>
</tr>
</tbody>
</table>

**It’s my job**

1. Before listening, get students to read the questions. Explain to students that they should simply number the questions as they hear them. Play the recording once only. Get students to check their answers with a partner.

2. Play the recording again. This time get students to note the answers Matt gives. Remind them to write key words only.

3. Get students to discuss the questions in pairs briefly and then develop into a class discussion.

**Make your point**

**Persuasion**

1. Get students to study Lee’s checklist.

2. Play the recording once. Get students to work in pairs to evaluate the presentation. They should go through Lee’s list and consider how well Jo did. Play the recording again so students can check.

3. Get students to work in groups of four. Allow them some time to research their topic, if possible, and then give them time to prepare their presentation. Explain that in this exercise they must be persuasive. Encourage feedback.

**Key words**

Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
Finding crude oil is not easy. When trying to find oil, geologists try to identify possible locations with a combination of different types of rock: source rock, which was once the sea bed and may generate oil, porous rock, which forms a reservoir for the oil like a sponge holds water, and cap rock, which traps the oil. If the pressure and temperature are right in these formations, there may also be gas above the oil.

Oil wells can be located on land or offshore. Offshore drilling platforms differ from those used on land because they must be able to house the workers and machinery needed to drill and then produce the oil or natural gas found.

There are different designs of offshore platforms to allow wells to be drilled in relatively shallow to very deep water. Some platforms have legs resting on the sea bed while others float, fixed in position by anchors and cables. Some platforms store the oil that is extracted until it is collected by a tanker and others pump the oil through subsea pipe lines straight to shore.

Oil is usually found at a considerable depth or distance from a drilling platform. Therefore the drill bit, which rotates to cut the hole through the rock has to be driven further and further away. The bit is driven by a long set of pipes called the drill string. As the hole gets deeper another pipe is connected at the derrick, which is the tower-like structure on the platform. The drill bit is diamond-toothed to enable it to cut through solid rock.

The terms Roustabout and Roughneck, used to describe an unskilled labourer and someone with practical skills on an oil platform, have been adopted from the oil industry in the USA. Because the work on the rig can be dangerous, it is not a good environment for training. Drilling schools exist where special job skills and survival skills can be taught. Drill floor simulators are used to give the trainee driller experience in the type of problems they will encounter in the course of their work.

Crude oil is converted into a wide range of products at a refinery. Oil is heated, then cooled in tall distillation columns. The lightest fractions rise to the top of the tower where they cool and condense. These include petroleum. Diesel and kerosene condense in the middle of the column. The heaviest fractions settle at the bottom. Heavy fractions are processed further to produce more high-value products such as petroleum. Around half the standard unit of quantity in the oil industry, the 42 gallon (US) barrel, can be converted into petroleum.

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**Switch on**

1 Students should work in pairs or small groups to discuss. Ask them to identify the material of any items they feel are not made from oil. The items featured include plastic, nylon, petrol, asphalt, antiseptic, fertilizer, floor polish, paint, crayons, tyres, volleyball, liquid detergent, guitar strings. Ask one group to give its answers and check others agree.

- car tyres (made of rubber)

2 Give the same groups three minutes to discuss. List products on the board. If there is disagreement, get students to check for homework.

- Possible answers
  - bubble gum, roller-skate wheels, aviation fuel

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**It's my job**

1 🎧 Get students to work in pairs. Play the recording once and allow students to check their answers.
2 Get students to study the CV. Before listening, ask them what they are listening for in each space. Tell them to make simple notes, perhaps only the first one or two letters of a word while listening and that you will give them time to complete the notes at the end. Play the recording again. Give students a few moments to write the missing words.

3 Get students to read the questions quietly. Ask them to make only notes while listening. Play the recording without stopping, but give students time at the end to complete their notes. Get students to work in pairs to compare answers. Go over the answers at class level. If there are any disagreements, play the recording once more, stopping at appropriate points for students to recall the answer.

Additional activity (weaker students)
Get students to find the listed components in the text and to underline them. To help them complete the labelling, ask them these questions:
What is a drill string?
What do you do if you suspend something?
What does swivel mean?
Where is the bit?

Additional activity (stronger students)
Get students to work in groups. One stronger student should explain how a rotary derrick works using only the diagram. Other students can ask questions about the function or position.
2 Students should work individually in class or set for homework.

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit</td>
<td>cuts the borehole</td>
</tr>
<tr>
<td>draw works</td>
<td>lift sections of pipe into and out of the borehole</td>
</tr>
<tr>
<td>kelly</td>
<td>transmits torque from the turntable to the drill</td>
</tr>
<tr>
<td>mud pumps</td>
<td>pump mud down the drill pipe</td>
</tr>
<tr>
<td>power plant</td>
<td>provides power for the draw works</td>
</tr>
<tr>
<td>swivel</td>
<td>allows the pipe to rotate freely</td>
</tr>
<tr>
<td>travelling block</td>
<td>lets you raise and lower the pipe</td>
</tr>
</tbody>
</table>

3 Remind students to use the correct ending on the verbs while they are doing this exercise (present tenses will be practised in Language spot).

**Vocabulary**

**Collocations in petroleum technology**

1 Get students to work individually and write down the pairs. Allow students to check their answers with a partner.

| O×π | see below |

2 Get students to complete individually in class or set for homework.

| O×π | 1 mud pump   | 3 Assistant Driller | 5 power plant   |
|     | 2 drill string | 4 fossil fuel       |

**Language spot**

**Present tense review**

Get students to read the introduction. Ask students what they can remember about the rules of when to use each of these tenses and how to form them.

1 Get students to work individually and then in pairs to check their answers.

| O×π | 1 PS  | 2 PC  | 3 PS  | 4 PS  | 5 PC  | 6 PS |

2 Get students to read the rules and complete the exercise individually.

| O×π | 1 live | 3 'm studying | 5 'm playing |
|     | 2 'm living | 4 study      |

3 Get students to complete individually in class or set for homework.

| O×π | 1 I'm seeing | 3 I'm thinking | 5 I'm hearing |
|     | 2 I see     | 4 What do you think | 6 I hear |

**Pronunciation**

**be with the Present Continuous**

1 Play the recording, stopping after each one to allow students to repeat. Make sure they are not stressing the short form.
Tip
It's important for the student to understand that contractions are used in speech and in informal writing, but are not used in formal writing.

Additional activity (weaker students)
Ask students the following questions:
Which two elements combine to form hydrocarbons?
What process produces useful products from crude oil?
What happens when oil is heated?
How are fractions separated?
Which fractions are produced at the bottom of the column?

Additional activity (all levels)
Get students to find out about the chemical processing which follows distillation. They should find the name of the process, briefly describe what is done, and list the products obtained. The following website may be helpful: www.chervon.com/products/learning_center/refinery/
Get students to write an essay on what they have found or ask them to prepare a short presentation.

2 Get students to complete the sentences.

3 Play the recording, stopping after each sentence to allow students to repeat.

Pairwork
1 Get students to read the introduction.
2 Get students to read the instructions and then look at their diagrams. They should share the information by asking and answering questions. Once students have finished, they can check their answers by looking at their partner's diagram.

Problem-solving
Ask students what special difficulties there are in extracting oil from under the sea. Ask them what they know about oil platforms and how they are held in position.

1 Get students to work in small groups. Get them to decide as a group how they are going to do the exercise. They may choose to each read one description and find the respective diagram. In groups they should discuss the final choice, explaining why.

2 Get students to complete the table in pairs.

Key words
Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
Environmental Engineers have the important tasks of ensuring we have clean air to breathe and clean water to drink and that waste is disposed of without damaging the environment. In addition to treating water from reservoirs to ensure it is safe to drink, technologists can convert sea water into fresh drinking water. This is important in countries in the Middle East. Desalination plants separate the sea water into fresh water and dissolved salts. Sewage treatment is also essential to public health. Sludge is the solid organic matter that remains after the sewage treatment process. After any disease-causing agent, or pathogen, is destroyed, it can be used as a fertilizer or converted into pellets and used as fuel in power stations.

Environmental technology can help prevent pollution. The air from the chimneys of factories and power stations after combustion consists of water vapour and gases, such as carbon dioxide and sulphur dioxide, which are harmful to the environment. **Flue gas treatment** is a way of removing the poisonous gases.

**Remediation** is the process of cleaning up polluted ground and returning it to use. With land values increasing, remediation is more and more important to allow ‘brown field’ sites to be reclaimed for housing and recreational use. Land prices and environmental considerations make it increasingly difficult to find places to dispose of solid waste. Good **solid waste management** is important to make sure that as much waste as possible is recycled and that as little as possible is buried in land-fill sites.

Industrial processes such as spray painting can be harmful to the environment. Technology can provide a solution. Droplets of paint are caught in a ‘curtain’ of flowing water and washed into settling tanks where the paint eventually settles out and can be safely disposed of.

Environmental engineers can also protect the environment by helping to prevent harmful developments. When a new development like an airport or a holiday resort is considered, an environmental impact assessment should be carried out. The purpose of the assessment is to ensure that decision-makers consider environmental impacts, such as the effects of a development on the habitats and ecology of the area and its visual impact, before deciding to proceed.

The eco-city planned for Chongming Island, China, is on a large scale, but smaller developments built along the same principles are becoming more and more prevalent. The UK government plans to build ten eco-towns by 2020. These towns will be carbon-neutral with energy coming from renewable sources similar to the community described in Unit 5.

### * Tip*
- **Recycling** = reusing materials and objects rather than throwing them away as waste
- **Alternative energy** = energy from sources other than nuclear or fossil fuels
- **Flue gas treatment** = the removal of pollutants from gas emissions from factories
- **Solid waste management** = the removal and disposal of household and factory rubbish
- **Water purification** = the removal of contaminants from raw water to produce drinking water
- **Remediation** = action to clean up an environmentally contaminated site
- **Sewage treatment** = a process to purify human and other domestic waste

### Switch on
1. Get students to suggest answers. They may include ideas other than those shown.
   - **Possible answers**
     - aircraft emissions from burning fuel, discharge of oil on the sea,
     - traffic exhausts, untreated effluent into a river or sea, smoke from factory chimneys, agricultural chemicals going into the watercourse, waste in landfill

2. Students should work in pairs to match. Quickly check answers with the whole class. Get students to suggest what each topic is involved with and why it is important.
**Language spot**

**Reported speech**

Get students to read the introduction.

1 Students should work individually to complete the rules and then compare answers in pairs.

Go through the *Grammar reference* in class or set for homework.

2 Get students to work individually in class or set for homework.

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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Past Simple</td>
<td>had to</td>
</tr>
<tr>
<td>2</td>
<td>Past Perfect</td>
<td>the day before / the previous day</td>
</tr>
<tr>
<td>3</td>
<td>Past Perfect</td>
<td>that week</td>
</tr>
<tr>
<td>4</td>
<td>could</td>
<td>the following month</td>
</tr>
</tbody>
</table>

3 Get students to work individually in class or set for homework.

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<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>do you apply</td>
<td>removed</td>
</tr>
<tr>
<td>2</td>
<td>spray the paint</td>
<td>are absorbed</td>
</tr>
<tr>
<td>3</td>
<td>actually reaches</td>
<td>is stored</td>
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<td>4</td>
<td></td>
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<tr>
<td>8</td>
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</tbody>
</table>

**Vocabulary**

**Reporting verbs**

1 Get students to read the email before they listen. Play the recording as often as necessary and give students time to complete their notes.

2 Get students to compare what is reported with the actual words spoken. Check students understand the verbs listed. To help with the meaning of some of the verbs, get students to perform them, e.g. Ivor, apologize to Frank, Mary, promise to do your homework.

3 Remind students that the verbs have to be put into the correct tense (Past Simple). Students should work individually in class or set for homework.

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</thead>
<tbody>
<tr>
<td>a</td>
<td>asked</td>
<td>agreed</td>
</tr>
<tr>
<td>b</td>
<td>apologized</td>
<td>offered</td>
</tr>
<tr>
<td>c</td>
<td>questioned</td>
<td>complained</td>
</tr>
<tr>
<td>d</td>
<td>reminded</td>
<td>recommended / advised / proposed / suggested</td>
</tr>
</tbody>
</table>
Pronunciation

Showing disbelief

1 Play the recording more than once if necessary.
   O:\textit{D}, because there is a heavy stress on \textit{said} and the intonation goes down.

2 Get students to read the sentences. Explain to students that it doesn’t matter which they choose.

3 Students can have lots of fun doing this exercise. Remind students that it’s the job of the speaker to make their meaning clear in the stress and intonation. Allow students to change partners and try their sentences again.

It’s my job

1 Students should discuss possible answers. Explain that the work Environmental Engineers do is wide-ranging.

2 Get students to read the text quietly and then write the answers.

   1 Yes, he studied Civil engineering and then Environmental science.
   2 It did previously but no longer.
   3 He doesn’t mention it, but it would probably help as the job is quite international.
   4 Yes
   5 He doesn’t say, but probably.
   6 Lutz says he’s really interested in the environment. He feels he can make a difference.

3 Get students to work individually and write the answers in class or set for homework.

   1 Environmental assessments, strategic assessments, contamination assessments and waste management
   2 A large engineering company
   3 He’s really interested in the environment and enjoys feeling he can make a difference. He likes working with people who have similar feelings.

Gadget box

Ask students why researchers would want to develop such a product and which countries in the world would find such a product useful. Explain that the Aerated Showerhead was developed in Australia, a country facing ever increasing water shortages.

This product will not solve major water shortages but it will help save water and in a country such as Australia every little helps. It also helps raise people’s awareness of the importance of saving water.

Pairwork

1 Discuss with the class what they understand by the term fully-sustainable eco-city (a city which does not need to buy in power, water, materials, etc. from
Additional activity
(all levels)
Get students to discuss whether such a city would be possible in their country / region. Ask them to decide on a suitable location, giving reasons. Ask them to write a letter / email to local officials to make their suggestion and offering to come and talk to them.

* Tip
Further information about Dongtan can be found on the web by typing in Dongtan in a search engine such as Google.

other places because it is able to meet the needs of the city in a sustainable way itself. There are similarities with the Project in Unit 5. Divide students into pairs to discuss. At class level, ask individual students to explain what they have discussed.

Possible answers
Public transport: must use zero-carbon fuels
Water supply: methods of capturing water, recycling, reducing quantity required
Food supplies: should be located locally to reduce transport costs
Waste: should be prevented or recycled, rather than disposed of,
organic waste can be composted and used as fertilizer
Buildings: use local materials, well-insulated, low-energy use
Energy: should be renewable and not produce carbon

2 Before reading, get students to look at the picture and suggest some of the information they expect to read about in their texts. Students should share information to complete the table in pairs.

Transport
Cycling, walking, trams and buses using hydrogen-fuel technology or battery power, solar-powered water taxis

Food supply
Grown locally. Fish caught locally

Building construction
Buildings highly energy-efficient. Angled to maximize sun’s heat in winter and ventilation in summer. Local materials, traditional and modern design technology

Water supply
Rain water collected and recycled. Devices used to channel and use water in water features

Waste
Organic waste composted and used as fertilizer. Sewage treated and used as fertilizer. No landfill sites, materials recycled

Energy
Produced fully by renewable energy – biomass, wind, and solar

3 Remind students that in reading skills they have to use both the information in the text and their own knowledge in order to answer some questions.

Possible answers
1 Soil washed down by the river carries rich mineral deposits which provide rich alluvial deposits for fertile farm land.
2 It is self-contained. It won’t grow beyond the limits of the island, at least not for a long time. Wind can be easily captured for power generation, and the river provides fish.
3 Advantages: attracts tourists for income and employment. Provides green space.
Disadvantages: it may be disturbed by development and increase in population.
4 A lot of waste can be recycled or composted but there will still be problems with electrical goods, some plastics, etc.
5 To capture maximum effect of the wind and to reduce noise in the city.
6 The surrounding agricultural area can grow enough biomass and the rice industry produces large quantities of rice residue, which would otherwise have to be disposed of.
Listening

Cleaning water

1. Ask students what they know about the water that comes out of the tap in their home/school. Ask Where does it come from? How is it treated? Get students to look at the diagram while you play the recording the first time. Play the recording again so students can label the diagram. Give students time at the end to complete the labels. If necessary, play again. Get students to check their answers in pairs.

<table>
<thead>
<tr>
<th>1 microstrainer</th>
<th>4 sedimentation tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 aerator</td>
<td>5 rapid sand filter</td>
</tr>
<tr>
<td>3 flash mixers</td>
<td>6 disinfection tanks</td>
</tr>
</tbody>
</table>

2. Play the recording again. Encourage students to note as much information as possible, including what the equipment does. Allow students to check their answers with a partner.

| 1 removes rubbish, such as twigs and plastic bags |
| 2 provides good oxygen balance, releases trapped gases |
| 3 adds coagulants – alum, aluminium sulphate – which cause particles to stick together |
| 4 large particles settle to bottom, removed and treated |
| 5 removes remaining organic compounds by passing water through carbon or coal and layers of sand |
| 6 adds chemicals – chlorine or ozone – to disinfect water by killing pathogens |

3. Get students to research this for homework.

Key words

Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
Listening, Reading

These activities give realistic and communicative practice of language skills needed in technology. In Technology 2, more emphasis is given to the micro-skills, such as predicting, scanning and skimming, listening for gist, and listening for specific information.

- In the Listening activities students are exposed to situations related to technology, including dialogues, technical explanations, and interviews. They also hear a variety of English accents, both native speaker and non-native speaker.
- In the Reading sections students meet a variety of technology-based texts.

Speaking / Pairwork

In the Speaking and Pairwork sections, try to ensure use of English during activities, particularly those involving some discussion. Encourage this by teaching or revising any functional language students may need. There is also one photocopyable Communication activity for each unit in this Teacher's Resource Book.

Pronunciation

This practises aspects of pronunciation which are of maximum importance for intelligibility.

You can repeat the recordings in the Pronunciation as often as you like, until you and your students feel confident they have mastered a particular sound or feature.

Project / Webquest

These encourage students to take an active role in the learning process, both in terms of their English language work and the subject of technology itself.

Projects can be set as homework assignments, but it is worth spending time in class preparing students for the task. Students are usually required to use search engines such as www.google.com to find information, as well as websites dedicated to technological issues. Help can also be given by brainstorming some standard places where they can gather information.

Checklist

This allows students to check their own progress. You may want to get students to grade or assess how well they can perform each of the 'Can do' statements, e.g. 'easily', 'with difficulty', or 'not at all'. They can also test each other in pairs, by giving examples from the unit of each of the 'Can do' statements.

Key words

These are the main items of technology vocabulary introduced in the unit. A definition of each of these words appears in the Glossary. You should certainly check students' pronunciation, including the stress, of words likely to be used orally.

This section also provides students with the opportunity to look back through the unit and note anything about how English is used in technology that is new to them. In addition to encouraging students to build their own personal vocabulary, this activity encourages them to reflect.

Writing bank

This is in the middle of the book and gives skills practice in writing. There are seven sections, each devoted to a specific area of writing useful for students of technology. These include emails, instructions, and reports. Students are given an example that serves as a model. This is followed by intensive questions to guide comprehension and highlight specific areas of the writing style. Finally, students are asked to compose a piece of writing based on the model they have seen. These models also serve as useful extra reading practice.

Pairwork activities

This section contains one or more parts of the information gap activities from the main units (see Speaking / Pairwork).

Grammar reference

This can be used together with the Language spot, as a handy check or revision. It shows the form of a particular grammar point, briefly explains its use, and provides example sentences. It also indicates likely student errors.

Listening scripts

This is a complete transcript of all the recordings. Direct students to it for checking answers after they have completed a Listening task, or allow weaker students to read it as they listen to a particular recording, perhaps for a final time.

Glossary

This is an alphabetical list of all the Key words. Each word is followed by the pronunciation in phonetic script, the part of speech, and a definition in English.

The section begins with a phonetic chart, with an example word from technology to illustrate each of the sounds.
Robots are increasingly found in the workplace, the home, outer space, and even the battlefield. They are no longer seen as replacements for human workers. They are still used for routine tasks but they can now perform tasks impossible for humans. Some of the robots in *Switch on* provide good examples of the components of a variety of robots and their capabilities.

The *snake-arm robot* is used for assembly and inspection tasks and can penetrate difficult-to-reach places. It can be programmed to perform those tasks without continuous human guidance.

*ASIMO* is a humanoid robot which is capable of intelligent behavior. It can recognize objects and gestures, calculate distances and the direction of movement of several objects. *ASIMO* has advanced engineering and control systems to allow it to walk naturally and translate visual information into actions.

The *Mars Rover* must navigate over complex terrains, thinking several steps ahead. It has to be able to work independently from ground control because communication delays and interruptions in space are unavoidable.

The *robotic mower* may look simple but it has a guidance system that keeps it within the lawn and makes sure it cuts in perfectly straight lines.

Engineers working on the design of robots must have advanced knowledge of Mechanical, Electrical, and Electronic engineering. They must understand how computers can be used to control movements using electric motors, pneumatics, and hydraulics. All robots have a sensory system which replicates some or all of the human senses such as sight, smell, and touch. They have a processor to interpret those signals and make a decision to act autonomously or feed back the signals to a remote human controller.

Bomb and mine disposal are dangerous jobs that require expertise and involve considerable risk to anyone involved. The solution is to send in machinery. *Comet III* is an example of a robot specifically designed for a single task.

There are many robotics competitions that challenge entrants to devise a robot to overcome a variety of problems. Some of these are purely for entertainment such as the *Robot Wars* that was shown on television. Others have a more serious scientific or educational side such as the one run by Dean Kamen, the inventor of the *Segway*, an innovative two-wheeled, self-balancing human transporter. Others, like the robot car race, will generate research with an immediate commercial use.

### Switch on

Students should first work in small groups to discuss. Then ask two pairs to work together to compare answers. Remind students that they should provide reasons. Ask individual students to present their group’s ideas to the rest of the class.

<table>
<thead>
<tr>
<th>Possible answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  exploring other planets</td>
</tr>
<tr>
<td>B  handling radioactive materials</td>
</tr>
<tr>
<td>C  demonstrations and entertainment</td>
</tr>
<tr>
<td>D  domestic help</td>
</tr>
<tr>
<td>E  producing large quantities of medicines</td>
</tr>
<tr>
<td>F  reaching into tight spaces</td>
</tr>
<tr>
<td>G  mowing lawns</td>
</tr>
</tbody>
</table>

Discuss with the class the importance of these robots, asking students to justify their ideas.
**Tip**

Writers use paragraphs to divide text into manageable chunks. Each paragraph introduces one main idea. This idea is given in the topic (key) sentence and further sentences in the paragraph provide supporting details. The topic sentence often appears at the beginning of the paragraph. One way of skimming through a text is to look at the beginning of each paragraph in order to identify the topic sentence, which usually sums up the main idea (gist) of the paragraph.

**Additional activity**

(All levels)

Cut out two short articles from a magazine or newspaper. Give one article to each student. Get students to underline the topic sentence in each paragraph which gives the main idea and to copy out the topic sentences as in **Reading**. Get students to give this to a partner to predict the content. Students can then compare their answers with the original text.

---

**Reading**

**How robots work**

Ask students *Why are texts divided into paragraphs?* (to make text manageable) *What should each paragraph introduce?* (one main idea)

1. Explain to students that by reading only the first sentence in each paragraph they should have a general idea about the topic of each paragraph. Get students to work in pairs to anticipate what the paragraph will cover.

<table>
<thead>
<tr>
<th>First sentence</th>
<th>Possible topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Robots have five basic components: a movable structure, a motor, a power source, a sensory system, and a processor.</td>
<td>One or more of these components.</td>
</tr>
<tr>
<td>2. The motor provides the physical power to move the structure.</td>
<td>How robots move. OR Types of robot motors.</td>
</tr>
<tr>
<td>3. In the same way that humans depend on sight, hearing, taste, smell, and touch to make sense of the world, robots require a sensory system in order to function.</td>
<td>The sensory system. OR Types of sensors.</td>
</tr>
<tr>
<td>4. Heat sensors may be important for robots working in extreme conditions.</td>
<td>Heat sensors and possibly other specialist sensors.</td>
</tr>
<tr>
<td>5. The brain of a robot is the processor.</td>
<td>What the processor does.</td>
</tr>
</tbody>
</table>

2. Explain that students need to use their anticipation skills here. Using the key sentences in 1 and their own knowledge, they should try to work out the answers. Get students to work individually and then in small groups to compare their answers.

| 1. legs, wheels, or caterpillar tracks – some robots move only one part, such as an arm | 1 |
| 2. electric, pneumatic, heat engine                                              | 2 |
| 3. battery, compressed air, possibly biological fuel in future                  | 3 |
| 4. feeds information to the processor                                            | 4 |
| 5. controls the operation of the robot                                           | 5 |

3. Get students to read the text individually and then check their predictions and answers. Once they have finished, discuss the reading skills that they have used in this exercise. Explain that when they have to read textbooks or newspaper articles, it is important to be able to skim a text in order to locate relevant information or find an article of interest.

**Problem-solving**

1. Students should work in pairs to discuss. If necessary refer students back to the reading text to identify some sorts of sensors.

    | dimension sensors, object sensors, cliff sensors, wall sensors, dirt sensors | 1 |
2 ○ Get students to listen for just one sensor. Ask stronger students to listen for the dirt sensor which is more difficult. It may be necessary to play the recording more than once.

3 Get students to work in groups of five so they can share the information and complete the table.

4 ○ Play the recording again so students can check their answers.

### Additional activity

Get students to use their notes to write a paragraph about one of the sensors.

<table>
<thead>
<tr>
<th>Sensors</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>dimension sensors</td>
<td>Determine size of room. Walls reflect infrared signals. Processor calculates room dimensions.</td>
</tr>
<tr>
<td>object sensors</td>
<td>Bumper pressed in on impact with object.</td>
</tr>
<tr>
<td>cliff sensors</td>
<td>Infrared signals project downwards. Sudden change causes robot to move away.</td>
</tr>
<tr>
<td>wall sensors</td>
<td>Cleaner follows closely but not touching.</td>
</tr>
<tr>
<td>dirt sensors</td>
<td>Dirt hits acoustic impact plate causing vibrations. Processor makes cleaner clean area again.</td>
</tr>
</tbody>
</table>

### Gadget box

Discuss the milking system.

More free time. It’s very difficult for dairy farmers to leave the farm for very long as the cows have to be milked up to three times a day. It also provides the farmer with accurate data.

### Language spot

**Causing, preventing, and enabling links:** *cause to, make,*  
*prevent, stop, allow to, enable to, let*

Get students to read the rules. Go through the Grammar reference or set it for homework.

1 Remind students that some of the verbs will require *-ing* or *-s* endings. Students should work individually.

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</thead>
<tbody>
<tr>
<td>O-W</td>
<td>1 Prevent / stop</td>
<td>5 Enable / allow</td>
<td>9 Make</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Letting</td>
<td>6 Lets</td>
<td>10 Prevents / stops</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Enabling / allowing</td>
<td>7 Enabling / allowing</td>
<td>11 Let</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Prevent / stop</td>
<td>8 Causes</td>
<td>12 Allow / enable</td>
<td></td>
</tr>
</tbody>
</table>

2 Get students to write the sentences in class or for homework.

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</thead>
<tbody>
<tr>
<td>O-W</td>
<td>Possible answers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 The power sensor reports low battery current to the processor, which prevents the robot from moving.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>2 The bumper is pressed in, which makes the object sensor report an obstacle to the processor.</td>
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<td></td>
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<tr>
<td></td>
<td>3 The sensors detect a cliff, causing the robot to reverse.</td>
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</tr>
<tr>
<td></td>
<td>4 Infrared signals from the robot are reflected by a wall, which causes the robot to change direction and move parallel to the wall.</td>
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<td></td>
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<tr>
<td></td>
<td>5 Dirt hits the acoustic impact sensor plates, making the plates vibrate.</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>6 The sensors detect the vibration and pass a signal to the processor, which makes the robot clean the area again.</td>
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</tbody>
</table>
Tip

Contamination = process whereby substances make things impure, unclean, or dangerous
Diabetics = people suffering from a medical condition caused by a lack of insulin, which leads to high levels of glucose (sugar) in the blood
R&D (research and development) = the department in a company responsible for improving existing products and developing new products

Additional activity
(all levels)
Get students to find out about Henry Ford's assembly lines and car production lines today. They should write a short essay comparing the changes in technology.

It's my job

1 Students should discuss questions in pairs then discuss briefly with the whole class.
2 Play the recording once. Students should check their answers in pairs. If there are any difficulties, play the recording again.
   1 Developing all new processes and process automation for manufacturing his company's products
   2 A sensor which involves a living substance — in this case enzymes
   3 Mechanization is using machines to speed up production. Automation is using machines with intelligence.
3 Get students to read the questions before they listen again. Encourage students to note only key words while listening.
   1 Mechanical engineering with one year of Electrical and electronic engineering
   2 Because production increased enormously — went 'through the roof'
   3 Measures sugar in the blood
   4 Only machines can do it without the risk of contamination, with absolute accuracy, and at the speed required to produce huge volumes.

Speaking

Assessing explanations

Explain that students will all have an opportunity to present information but that they are going to work in small groups.

1 Students should read their text then prepare a set of notes which they can use during their presentation. Stress the importance of noting key words only. Help students with any problems with vocabulary.

2 While student A is making his/her presentation, student B must try to take notes. B may need to interrupt in order to clarify a point or ask for repetition. Remind students of how to do this politely. Excuse me, could you repeat that, please? Excuse me, could you repeat the number, please? Excuse me! Did you say ... I'm sorry, I didn't understand that.

3 Students should now change roles.

4 Allow the students time to reflect on the activity and discuss how they could improve. Draw the class together and ask groups to make comments on what they found easy/difficult.

Webquest

Students should do the research in class time or for homework. Depending on the size of the class, you may decide to ask each group to investigate a different competition and then present their findings to the rest of the class or ask groups to investigate every competition. Ask them to make notes so they can explain what they have found out to the rest of the class. For homework, ask them to write a short essay describing one of the competitions.
Top margin
Get students to discuss the statement and to discuss what human level intelligence really means.

**Make your point**

**Parts of a presentation**

1. Students should work in pairs to order the phrases. Allow them to practise saying them, making sure they are using the reduced forms effectively.

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<th></th>
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</thead>
<tbody>
<tr>
<td>h</td>
<td>a/l</td>
<td>m/f</td>
<td>e/j</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>a/l</td>
<td>m/f</td>
<td>e/j</td>
</tr>
</tbody>
</table>

2. Students should choose a topic which interests them. Allow them ten minutes to prepare what they want to say and then ask them to work in small groups. Students who are listening to a presentation should listen carefully to see how many of the phrases given have been used correctly. Ask one or two of the stronger students to make their presentation to the whole class.

**Project**

1. In their groups, get students to decide first which robot they would like to design and spend some time discussing the questions posed.

2. Each group should plan their presentation and be able to explain why they have made certain decisions. Explain that they will have to convince the others that they have come up with the best solution. Encourage them to use each person in the group to make the presentation. Remind them to use the phrases from *Make your point*. Encourage other students to ask questions.

3. Allow each group time to discuss the other proposals and to consider which they think is the best and why. Ask them to consider using different parts from different solutions to find the perfect answer. Explain that they are not competing against each other but working as a team to find the best solution. Then discuss as a class.

**Key words**

Go through the list of words to check students’ pronunciation and understanding. Refer them to the *Glossary* if necessary.
Kitchen furniture usually comes in flat packs for assembly by the purchaser. It is produced in high volumes from resin-bonded wood chip material finished with a plastic coating, or MDF (medium density fibre board), an artificial material used instead of wood. The pieces are cut to size using the latest CNC (computer numerically controlled) machinery. Resin-bonded materials, unlike wood, are very stable, so they can be assembled easily into a well-finished product.

The customer is given the choice of different finishes and designs for the visible parts of the furniture such as doors. Those items may be manufactured from real wood, such as oak, or from a low cost material with an expensive veneer or paint finish. Because MDF is made up of fine particles it can be painted to produce a smooth surface. It can be cut, drilled, machined, and filed without damaging the surface. Paints, varnishes, veneers, and laminates may be used to finish MDF.

The carcasses, the basic boxes which form wall cupboards or support the work tops, are hidden behind the doors and under work tops so can be made from white melamine covered chipboard. They are common through a range of kitchen designs so can be produced at low cost due to their high volumes. Work tops, the surface where food is prepared, need to be easily cleaned and resistant to scratching and damage from knife cuts and dropped kitchen utensils.

Fridges and other common household appliances often have a lot of technology inside. Fridges use compression and evaporation in order to change the temperature of the refrigerant and cool the inside of the fridge. Air conditioning systems use the same technique to cool larger areas.

The Kitchen Designer describes some of the innovations that she includes in her kitchen designs. These innovations include not only newer versions of existing appliances, but also entertainment systems and smart appliances.

Energy-saving devices for the home are increasingly popular. The Pairwork texts include: a water-powered calculator using completely recyclable H₂O batteries, energy-saving light bulbs, the Wattson device to show energy consumption, and the ECO kettle, which only boils the exact amount of water required.

The Wattson uses electroluminescence to produce colours to indicate power used. Electroluminescence is an optical and electrical phenomenon where a material emits light in response to an electric current passed through it.

* Tip

Household appliance – a machine or piece of equipment designed to do a particular job in the home

Switch on

1 Treat this as a quiz. Get students to work in pairs and write down as many appliances as they can in two minutes. Each pair in turn should show their list to the other groups. Students should defend their choice of items but the teacher must decide if entries are correct. The group with the longest list of correct items is the winner.

Possible answers
- microwave oven, oven, fridge, telephone, iron, washing machine, hairdryer, electric kettle, food processor, vacuum cleaner, air conditioning unit, television, coffee maker, toaster, dishwasher

2 Get students to work individually to complete the task. Ask them which words helped them make their choice.

1 refrigerator (fridge)  3 microwave oven  5 vacuum cleaner
2 iron  4 electric kettle  6 hairdryer
Reading
Making kitchens

1 Students should discuss in pairs.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>1 worktop</td>
</tr>
<tr>
<td></td>
<td>2 handle</td>
</tr>
<tr>
<td></td>
<td>3 hinge</td>
</tr>
<tr>
<td></td>
<td>4 knob</td>
</tr>
</tbody>
</table>

2 This is an exercise in looking for specific information in the text. Explain to students that they should not try to read every word or study the text. They should try allowing their eye to run over the text searching for the words given. Once they find them, they should read around the word to find the name of the material used.

<table>
<thead>
<tr>
<th></th>
<th>Component</th>
<th>Materials used</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>carcass</td>
<td>melamine-faced chipboard</td>
</tr>
<tr>
<td></td>
<td>doors</td>
<td>solid wood, board material, MDF</td>
</tr>
<tr>
<td></td>
<td>worktops</td>
<td>melamine coated chipboard, manmade materials, e.g. corian, stone (granite, slate, marble)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>CNC</td>
<td>computer numerical control</td>
</tr>
<tr>
<td></td>
<td>MDF</td>
<td>medium density fibreboard</td>
</tr>
</tbody>
</table>

3 Explain that students now have an opportunity to read the text in more detail in order to complete the flow-chart.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>1 slab</td>
</tr>
<tr>
<td></td>
<td>2 edgebanding</td>
</tr>
<tr>
<td></td>
<td>3 carving</td>
</tr>
<tr>
<td></td>
<td>4 acrylic-coating / vinyl-wrapping / lacquering</td>
</tr>
<tr>
<td></td>
<td>9 drying</td>
</tr>
</tbody>
</table>

Language spot
Question review

1 Get students to give you an example of a yes / no question. Write it on the board and ask them if they can explain how we construct this type of question. Students should do the exercise individually and then check their answers in pairs.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>1 How many boxes of screws have you ordered?</td>
</tr>
<tr>
<td></td>
<td>2 Did you see the edgebander working?</td>
</tr>
<tr>
<td></td>
<td>3 Have they got any computerized machines?</td>
</tr>
<tr>
<td></td>
<td>4 What (material) do they use?</td>
</tr>
<tr>
<td></td>
<td>5 Where did he study?</td>
</tr>
</tbody>
</table>

2 In pairs, get students to practise the questions. Get students to read the sample sentences.

3 Students should complete the task individually or set for homework.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>A variety of answers are possible. Teachers should encourage students to try to ask each question in a different way.</td>
</tr>
</tbody>
</table>
Additional activity
(all levels)
Get students to work in pairs and look at the Massachusetts Institute of Technology website (www.mediate.mit.edu/ai/). Get students to find a research project that interests them. They should prepare a short presentation or write about it for homework. The class should then discuss the future of these inventions and suggest other inventions which could be developed for use in the kitchen. Entering MIT kitchen technology into a search engine such as Google will bring up other sites that discuss the technology.

It’s my job

1 🎧 Get students to work in pairs and make a list of all the different parts of a kitchen which a Designer would have to think about, e.g. appliances, units, worktop, flooring. Look at the headings and ask students what they expect to hear. Play the recording and get students to make notes.

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Cabinet making, graduate in Wood technology and Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job title</td>
<td>Managing Director</td>
</tr>
<tr>
<td>Ovens</td>
<td>Self-cleaning; catalytic converter changes food residue and fat into water and carbon dioxide</td>
</tr>
<tr>
<td>Hobs</td>
<td>Magnetic induction hobs heat metal pot base, saving electricity, safer and quicker to heat food, only work with steel pots</td>
</tr>
<tr>
<td>Flat screens</td>
<td>flip-down screens for TV, Internet access, watching security cameras</td>
</tr>
</tbody>
</table>

2 Get students to practise asking and answering questions about Asma using the structures learned in Language spot.

Gadget box
Get students to read the text. Ask how many have seen or own a device like this. Get students to discuss the question in groups.

Photography is now far more democratic. People can afford to take a large number of photos and get better results than before.

Pronunciation

Polite requests

1 🎧 Play the recording more than once if necessary. Get students to repeat the two sentences.

<table>
<thead>
<tr>
<th>A Rude</th>
<th>B Polite</th>
</tr>
</thead>
</table>

2 🎧 Play the recording, several times if necessary.

| 1 P | 2 R | 3 P | 4 P | 5 R | 6 R | 7 P | 8 P |

Responding to requests
Practise saying this politely with the students.

3 🎧 Play the recording, stopping after each request to allow students to reply politely.

4 Get students to look at the Listening script on p.129. They should decide themselves whether to make the requests polite or not. They can extend the exercise to make up their own requests.
Tip

Global warming is also called climate change. Some people believe that this is a better term as not all areas of the globe will warm, some will get significantly colder.

Additional activity (weaker students)

Get students to look at all the texts and answer these questions:

Watson - What two pieces of equipment are needed to make it work? Where would you place the two components in the house?

CFLs - Which element inside the lightbulb is dangerous? How are the bulbs made?

Water-powered calculator - What is this made of? What must you do to keep sure these continue to work?

Eco-kettle - Why does this kettle have two chambers? Why will it reduce the amount of electricity we use?

Additional activity (all levels)

Write each of the phrases in 1 on separate cards (without the verb). Place these cards face down in the middle of the table and get students to take one. They have to say which verb to use with the phrase and then make a simple sentence with it. If they are successful they can keep the card, but if not, they must replace the phrase card somewhere in the pack. Continue until all the cards have been used up.

Pairwork

1 Give students five minutes to discuss. Then ask a few pairs to report what they have discussed to the rest of the class.

Global warming is the increase in the temperature of the earth’s atmosphere. This is caused by the increase in particular gases, especially carbon dioxide, which trap the heat of the sun. To combat global warming, people should try to reduce the amount of carbon dioxide they produce by using less electricity and fossil fuels, recycling, reducing the amount of waste produced, etc.

2 Students should discuss in pairs. Don’t give them answers at this stage.

3 Students should first read their articles and complete half of the table.

4 Students should share information in order to complete the table.

<table>
<thead>
<tr>
<th>Name of the product</th>
<th>What it’s used for</th>
<th>How it works</th>
<th>The conventional technology it replaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-powered calculator</td>
<td>To perform calculations</td>
<td>Water battery using special alloy electrodes that produce electricity in water.</td>
<td>Conventional batteries or electricity</td>
</tr>
<tr>
<td>Eco-kettle</td>
<td>Boiling water</td>
<td>There are two chambers – inner reservoir and outer boiling chamber. Only the required amount of water is released from reservoir into chamber to be boiled.</td>
<td>Conventional electric kettles</td>
</tr>
<tr>
<td>Wattson</td>
<td>Measure and display the amount of electricity being used in the house</td>
<td>Clip on the electricity cable transmits information wirefree to the device. Device glows blue (lot of energy being used), red (less energy being used).</td>
<td>Dial on the electricity meter</td>
</tr>
<tr>
<td>Compact fluorescent bulbs</td>
<td>Provide light</td>
<td>Electrical discharge through mercury vapour makes ultraviolet light. This makes coating on inside of tube glow brightly.</td>
<td>Incandescent light bulb</td>
</tr>
</tbody>
</table>

5 Get students to make a few notes. Get a few pairs to explain their ideas to the rest of the class and encourage a class discussion.

Vocabulary

Verbs make, do, have, and take

1 Students should work individually and then compare answers in pairs.
Tip
In order to understand the principle of the refrigerator, students need to understand these basic processes. If some students don’t know, ask the stronger students to explain and give examples.

Evaporate = this happens when water boils and changes to steam
Absorb = a towel absorbs water when you dry yourself
Compress = compressed air is squeezed into a smaller space so it is at a higher pressure
Condense = water vapour in the air cools as it rises and then condenses to form clouds in the sky

Additional activity
(all levels)
Get students to research another piece of equipment (vacuum cleaner, air conditioner, microwave oven) in pairs. As well as using books in their library, there are several websites which would be useful. Get students to make notes and then prepare a short presentation to explain to others.

Listening
Refrigerator
1 Ask students if they can simply explain the similarity.

- They both cool air by transferring heat from the inside to the outside.
- They use the principle of evaporating and condensing a refrigerant.

2 Get students to work in pairs. Check answers with the class.

- 1 b 2 c 3 d 4 a

3 Play the recording once without stopping. Then give students time to complete as much of the diagram as they can. Play the recording again. Get students to check their answers in pairs.

- 1 compressor
- 2 heat-exchange coils
- 3 expansion valve
- 4 heat-exchange pipes

4 Play the recording as often as necessary.

- Compressor - compresses refrigerant → increases temperature and pressure
- Heat exchange coils - heat lost → gas condenses to liquid
- Expansion valve - reduces pressure → refrigerant expands and evaporates
- Heat-exchange pipes - absorb heat → space feels cold
- Frost-free - heating coil beside freezer coils
- Timer → switches heater coil on
- Sensor → switches heater coil off

5 Students should work in pairs and practise explaining the process.

Key words
Go through the list of words to check students’ pronunciation and understanding. Refer them to the Glossary if necessary.
This unit covers three routes to a career in technology: apprenticeship, technical college, and university. In the UK, apprenticeships are normally open to 16- to 24-year-olds who are in employment. Sixteen is the earliest that a student can leave school. Finding an employer who is willing to take on apprentices can sometimes be difficult as apprentices, once qualified, often move on quickly to other employers or set up in business for themselves. For those who find suitable employment, an apprenticeship offers the advantages of earning money while gaining a qualification and practical skills. Apprenticeships combine on-the-job training at work with education at a local college, usually on a day-release basis.

There are further education college courses available for every aspect of technology. These lead to vocational qualifications at certificate and diploma level. Students enter from school at sixteen or eighteen with school leaving certificates but work experience may also be taken into account. Often courses are geared to the needs of local business and industry and are taught by lecturers who have work experience in their field. Students completing a college course can enter employment or, if their grades are good enough, move on to higher education. College courses last one or two years and are usually modular.

Universities offer both broad-based and specialist degrees in engineering. UK courses range from three to four years or longer if a work placement is included. One-year postgraduate MSc degrees in specialist fields are also common.

To maintain and improve our lifestyle, in this increasingly high-tech world, requires universities and learning institutions to produce Engineers, Technicians, and Technologists capable of adapting, for example, the latest discoveries in Physics and the Biological sciences, to practical solutions to benefit those in the developed and developing world.

Much work has been done to encourage students to stay at school and progress to some form of higher learning. Manufacturing and other societies of engineering professionals are active in encouraging school children to enter competitions which require technical knowledge and expertise to win.

School leavers entering industry are now more aware of the educational courses available and are encouraged by their employers to take advantage of those opportunities. Universities and colleges are prepared to recognize prior knowledge and work experience as entry qualifications.

Web technology plays an important part in enabling companies to conduct their business. They can stay in touch with customers and employees around the world. They can upload and download computer software, engineering designs, sales contracts, etc. Engineers can remotely monitor the performance of machines and provide solutions to problems as they arise to people on site, without the Engineer leaving the office.

Additional activity
(all levels)
Get students to choose one product and write a paragraph about which branches of technology would include it and why.

Additional activity
(all levels)
Get students to research one of the college courses listed to find out what subjects are included and some examples of the types of jobs available. They should use a search engine such as Google.

Switch on

1 Get students to name the products. Encourage them to discuss who uses the products, what they are used for, and their importance today.

<table>
<thead>
<tr>
<th></th>
<th>A tap</th>
<th>B CCTV camera</th>
<th>C electric motor</th>
<th>D synthesizer</th>
<th>E ultrasound machine</th>
<th>F processor chip</th>
</tr>
</thead>
</table>

2 Discuss each of the courses, making sure students understand the types of activities involved in each one. Get them to discuss the question in small groups.

|   | A Environmental technology | B Security technology | C Electrical engineering | D Music technology | E Medical technology | F Information technology |
13 Defence technology

The use of technology in the defence industry raises ethical questions. Many people believe that the power and influence of defence firms would be better used in non-military technologies which could address a variety of global problems. However, many technological developments for the military have been adapted to peaceful purposes and the opposite is equally true.

Stealth is the name given to the technology developed to make planes and ships difficult to detect and, if detected, to present a signal that will confuse the enemy into thinking they are something that they are not. Visby is a stealth warship incorporating the latest technological advances to prevent detection by as many defensive measures as possible. It should be in action before, or even without, being detected. Visby is fitted with bow thrusters for manoeuvrability particularly when docking. Bow thrusters allow the captain to turn the ship to port or starboard without using the ships main propulsion unit which requires some forward momentum to be effective.

Modern weapons such as bombs and missiles are very expensive to produce and military commanders want to be certain that they hit their target. Smart weapons technology involves embedding high-performance computing inside traditional weapons such as missiles, bombs, and torpedoes. These weapons are equipped with sensors. The computing unit in the weapon processes the sensor input for targeting and control, which can be from command centres many miles away from the target. The accuracy of the targeting allows it to minimize collateral damage, which can be the killing of non-combatants and destruction of their property or the accidental killing of friendly forces.

In future battle situations information on the enemy will be gathered by robotic sensors and robots, such as Talon, capable of carrying out reconnaissance, or attack operations in the most adverse conditions. Defence Analysts wonder if the military computer network will be able to cope with the amount of information received from such appliances. The transfer rate of 100 Megabytes per second required is equivalent to the information contained in one metre of shelved books being transferred per second.

A wide range of non-lethal weapons have been developed for situations where the user may wish to defend themselves, stop aggressors, or protect assets. These range from low tech rubber bullets to high-tech systems using microwave energy to cause skin burning and laser light to cause temporary blindness.

Additional activity
(all levels)
Write these words on the board, then get students to use an English-English dictionary to check the meanings.

stealth, detect, detection, crew, aerial, reconnaissance, sonar, temporary, amphibious

Get students to write a sentence to describe the items in 3, using these words.

Stealth planes have been designed to avoid radar detection.

Tip

Stealth = designed in a way that makes it difficult to be detected by radar

Amphibious = suitable for use on land or water

Switch on

1 Get students to suggest answers. Allow discussion of suggestions.

   Om  All developed for military purposes or for use in conflict situations.

2 Students should work in pairs for no more than three minutes. Discuss any ideas as a class.

   Om  Possible answers

   radar, the jet engine, blood banks

3 Students should work individually and then in pairs. Discuss as a class.

   Om  A stealth plane
   Om  B uncrewed aerial vehicle
   Om  C amphibious craft
   Om  D movable bridge
Reading

Visby: a stealth warship

1 Students should work in pairs to compare the two ships. Ask selected individuals to explain their ideas to the rest of the class.

   | cleaner, lower outline, no visible gun, nothing above deck |

2 Get students to make a list of the methods of detection and then discuss ways of preventing this.

3 Get students to work in groups of three and to decide who is A, B, and C before reading. They should then complete as much of the diagram as they can.

4 Students should share information in order to complete the diagram.

   | 57 mm multi-purpose gun | Combat Information Centre |
   | Carbon fibre reinforced plastic (CFRP) |

5 Remind students that they must use their reading skills. This means using information from different parts of the text, as well as their own knowledge to anticipate the answer. Being a skilled reader also means being able to decide quickly that the information sought is not in the text. Information on radio transmissions is not included in the text.

   | Ways of detecting ships | Countermeasures |
   | optical (by sight) | smooth outline, camouflage paint |
   | infrared (by heat emissions) | exhausts close to water level |
   | acoustic (by sound above and below water) | soundproofed engines |
   | magnetically – from any ferrous metals | carbon-fibre reinforced plastic hull |
   | radar | shaped to produce low radar reflection |
   | radio transmissions | not included |
   | pressure on the water | light-weight |

Listening

The future of defence

1 Allow students five minutes to discuss in pairs. Then invite some students to tell the rest of the class what they have thought of.

2 How will this be recorded? Students should work with two sets of listening equipment if possible – a group of A students and a group of B students. As they listen they should make notes writing down only key words. They may need to listen more than once. Allow all students to compare notes so the stronger students can help the weaker ones.

   | A Francis Hodges |
   | military strength dependent on computer networks |
   | information fed in from robots and sensors |
   | combat troops and command linked to the network |
Top margin
Ask students if they are surprised by this number. Ask them what effect this will have on the US military.

Additional activity
(stronger students)
Ask stronger students to prepare a short presentation of their views on future defence technology. Try to get two or three students to support each argument. Carry out a class debate by inviting these students to put their points of view and then encourage a class debate on the issues.

Additional activity
(all levels)
Tell the students you have hidden an imaginary object somewhere and they have to guess where. They must use Yes/No questions:
Is it near the door?
Is it in a drawer?
You can extend this to locations outside the classroom and allow students to play in small groups.
Is it in town?

Additional activity
(all levels)
Collect some pictures of simple scenes. Students should work in pairs. Give one student a copy of a picture and ask him/her to describe it to his/her partner. The partner should not see the picture but try to draw it from the description given. Explain that this is not an art test but rather an opportunity to locate things on a page using prepositional phrases.

Hardware smaller and lighter
unmanned vehicles
camouflage paint which can change its colour
smart programmed weapons
less collateral damage

Giles Wigg-Smith
high-tech systems have problems
very complex electronics can fail
transfer rate is greater than anything available
networks are vulnerable to hackers and viruses
no protection against low-tech weapons
many conflicts today are policing operations
can’t fight together as a unified force if systems not shared but
countries won’t share technical secrets

3 Students should work in their original A/B pairs to share ideas then discuss the viewpoints of the two analysts. Get students to decide which analyst they agree with.

Language spot
Prepositions review
Get students to read the example sentences and decide on the type of prepositions being used. Ask them to read the table of prepositions and complete the table. Go through the Grammar reference or set it for homework.

<table>
<thead>
<tr>
<th>Time</th>
<th>Place</th>
<th>Movement</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>before, until</td>
<td>between, on the back of, above</td>
<td>into</td>
<td>without</td>
</tr>
</tbody>
</table>

1 Get students to fill in the blanks individually and then compare their answers with a partner. Explain to them that this exercise uses prepositions of place.

<table>
<thead>
<tr>
<th>at the front</th>
<th>Above</th>
<th>at the top</th>
<th>on</th>
<th>beside</th>
</tr>
</thead>
<tbody>
<tr>
<td>at the end</td>
<td>at the back</td>
<td>at the side</td>
<td>Next to</td>
<td>below</td>
</tr>
</tbody>
</table>

2 Students should complete the exercise individually in class or for homework.

<table>
<thead>
<tr>
<th>through</th>
<th>into</th>
<th>along</th>
<th>between</th>
<th>at</th>
</tr>
</thead>
<tbody>
<tr>
<td>between</td>
<td>out of</td>
<td>past</td>
<td>at</td>
<td>onto</td>
</tr>
<tr>
<td>outside</td>
<td>at</td>
<td>up</td>
<td>down</td>
<td>at</td>
</tr>
<tr>
<td>for</td>
<td>across</td>
<td>over</td>
<td>to</td>
<td></td>
</tr>
</tbody>
</table>

Gadget box
Get students to read and discuss the question.

The round head and ears are intended to be reassuring for the wounded soldiers.
**Pairwork**

1. Get students to discuss in pairs and make a list. Ask different pairs to quickly give their ideas to the rest of the class. Ask the class in which situations this technology is most effective.

   - lasers, high-decibel sound (LRAD—long range acoustic device),
   - microwave, water cannon, rubber bullets, chemical sprays, stun guns,
   - non-lethal landmines

2. Students should read and make notes by writing down key words.

3. Get students to close their books and use only their notes when describing their weapon. They should discuss and be prepared to present their ideas to the rest of the class. Choose a few pairs to do this.

**Problem-solving**

Explain to the students that a lot of the technology we use in everyday life was originally developed for military use. Ask students as a class to look at 1. Get students to give you one example of civilian use and discuss in the class. Get students to work in small groups to discuss one of the categories given. Ask each group in turn to tell their ideas to the rest of the class.

**Possible answers**

1. **unmanned vehicles and aircraft**
   - Police already use UAVs for surveillance and searching for lost children. Archaeologists could use them for low cost aerial photography of sites. Fire services could use them to spot forest fires. Unmanned vehicle technology in future could be used for public transport.

2. **stealth technology**
   - to reduce noise levels in aircraft and ships, to camouflage ugly structures, to streamline vehicles, for police surveillance

3. **weapons guidance systems**
   - to improve automatic landing for planes

4. **robot soldiers**
   - rescue robots like Bear, robots which can work in dangerous environments

5. **sonar devices**
   - sonar devices for fishing boats to detect fish and show the depth of water below the boat

**Webquest**

Explain to students that they will need the information they find for *Make your point*.

1. Get students to choose a topic that interests them. This may be a topic they have studied or something they know nothing about but would like to find out about. Ideally, students should work individually, but if you feel weaker students would benefit from working together with another student, they could work in pairs.
2 Allow students sufficient time to research their chosen topic. Some of the research could be done for homework. Get students to bring notes, pictures, etc. to the lesson.

* Tip
This activity provides an excellent opportunity for students to practise speaking English in a realistic context. Explaining their poster is motivating and by repeating it several times they get fluency practice.

**Make your point**

**Giving a poster presentation**
Students should read the ideas from Lee Avatar. Ask students about the purpose of a poster (it’s a large notice to advertise something in a public place). Ask them to summarize to you how they can make their poster most effective.

1 Students can work in pairs or small groups, but be aware of weaker students not participating. Insist that everyone contributes. This stage is similar to the preparation for a presentation – they must decide on the content.

2 Students should now work on their posters.

3 Divide the class into two groups. One group should stand beside their posters and be prepared to explain them while the others walk round viewing. Then groups should change. When all the posters have been viewed, discuss with the class which posters have been the most successful and why.

**Key words**
Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
Electronics is at the heart of twenty-first century technology. Without electronics there would be no computers, televisions, radios, mp3 players, mobile phones, cinemas, video games, and almost all domestic appliances. Cars would not start, hospital equipment would not work, and planes would not fly. Most electronic circuits use low voltage and low current so tiny portable entertainment devices are now commonplace.

All electronics depends on the movement of electrons round a circuit. Circuits diagrams are drawn using standard symbols. Switch on presents the symbols for some of the most common electronic components. In addition to symbols, electronic components are labelled using abbreviations such as Sw for a switch, R for a resistor, and C for a capacitor. The value of each component is also shown using standard abbreviations, for example pF is picoFarads.

Relays are electromagnetic switches. They consist of an iron core with a copper coil wound round it. When current flows through the coil, the core becomes a magnet and pulls a movable contact arm towards it. This can make or break circuits just like a switch.

Transformers can step up or step down an ac (alternating current) voltage. They consist of thin metal plates with copper coils wound round them. When a voltage flows through the primary coil it induces a voltage in the secondary coil. Whether the induced voltage is higher or lower depends on the number of turns in the coil.

Potentiometers, variable resistors, are used to change the resistance in a circuit easily. They are used in volume controls, light dimmers, and other applications.

Fixed resistors have standard values. Thermistors vary in resistance according to temperature.

Capacitors store electrical energy. They can be charged and discharged very quickly. They are particularly important in high frequency devices such as radios. Electrolytic capacitors are usually larger. They can be connected in one way only and are used to store electricity and to smooth out pulsating signals, for example in power supplies.

Diodes allow current to flow through in one direction only. A light emitting diode (LED) produces light when a current flows through it.

Transistors contain tiny chips of semiconductor materials. They can be used as switches, as amplifiers, and as oscillators.

Logic gates are integrated circuits which provide the basic logic functions used in computers and other devices which use digital electronics. Signals in digital circuits are either on (1) or off (0). Basic logic gates include AND, OR, NAND, and NOR.

### Additional activity
(stronger students)
Ask the stronger students in the class to explain what the different symbols mean to the others.

### Additional activity
(all levels)
In order to practise the pronunciation of the terms in this exercise. Get students to cover the answers and to practise testing each other on the symbols.

What is symbol 1?
It's a potentiometer.
Which is the symbol for a diode?
It's number 8.

#### Switch on
Get students to work in pairs. Check the answers with the whole class.

0 1 2 3 4 5 6 7 8 9 10

#### Reading
Electronic alarm circuits

1 Get students to think of as many examples of electronic alarms as they can.
Additional activity (weaker students)
To help students locate the necessary information, ask them these questions:
When is the alarm triggered? What is the main component? When does the resistance of R1 rise? What is UA741? What does it do? When does current flow through the collector-emitter circuit? What is the result of this?

Additional activity (stronger students)
Using only the diagram on p.98, get students to explain how the frost alarm works to the rest of the class.

Possible answers

<table>
<thead>
<tr>
<th>Component</th>
<th>Type</th>
<th>Value / reference number</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>thermistor</td>
<td>15k / FX22Y</td>
</tr>
<tr>
<td>R2</td>
<td>potentiometer</td>
<td>10k</td>
</tr>
<tr>
<td>R3</td>
<td>fixed resistor</td>
<td>10k</td>
</tr>
<tr>
<td>R4</td>
<td>fixed resistor</td>
<td>10k</td>
</tr>
<tr>
<td>R5</td>
<td>fixed resistor</td>
<td>270k</td>
</tr>
<tr>
<td>R6</td>
<td>fixed resistor</td>
<td>4.7k</td>
</tr>
<tr>
<td>R7</td>
<td>fixed resistor</td>
<td>1k</td>
</tr>
<tr>
<td>D1</td>
<td>diode</td>
<td>IN4148</td>
</tr>
<tr>
<td>Q1</td>
<td>npn transistor</td>
<td>BC107B</td>
</tr>
<tr>
<td>SW1</td>
<td>single-pole single-throw switch</td>
<td>–</td>
</tr>
</tbody>
</table>

Students should work in pairs to complete the table.

Students should read the text and complete the exercise individually and then check their answers with a partner.

* Tip
Encourage students to use complex sentences when writing. When you mark their written work, highlight simple sentences which could be formed into more complex sentences and ask them to rewrite these parts.

Language spot

Complex sentence review

Explain to students that when we join two or more short sentences together to form a longer sentence, we have to use some sort of linking device. The newly-formed longer sentence is known as a complex sentence. A complex sentence is made up of two or more clauses. Ask students if they can suggest ways of forming complex sentences.

Get students to read the sample sentences. Go through the Grammar reference or set for homework.

Go through the example with students. Ask them to notice what has changed in making a complex sentence (the subject It has been removed and replaced by which, and commas have been used to separate the relative clause). Make sure students understand that the relative pronoun which or who (or that) must follow the noun it refers to. Get students to work individually.

1 Digital electronics, which is used in everything from watches to computers, is concerned with electrical systems made up of a series of switches.
2 Walter Brattain, who worked at Bell Laboratories, was one of three inventors of the transistor.
3 A bit, which is short for binary digit, is a single unit of information.
4 Lithium batteries, which are often used in cameras, can provide a higher current than ordinary batteries.
5 LEDs, which means light-emitting diodes, are used in watches and many electronic displays.
6 Ohm, Volta, and Ampère, who were pioneers in the study of electricity, are remembered in the basic units of electricity.

2 Get students to work individually in class or set for homework.

1 A milliammeter is a device which measures very small currents.
2 A residual current device trips when an excess current passes through a circuit.
3 Light strikes the solar cell, generating a voltage.
4 If an electrolytic capacitor is connected wrongly, it will be damaged.
5 Before you touch memory chips, make sure you are earthed.
6 D-type connectors, which are widely used for linking devices to computers, come in a variety of sizes.
7 A relay is an electro-mechanical switch which uses an electromagnet.
8 If the input signal to an inverter is 1, the output signal will be 0.
9 After a signal is detected, it is amplified.
10 A logic probe is a test instrument which provides an easy way of checking simple logic circuits.

Additional activity
(all levels)
Discuss what makes a good interview. Divide the class into two groups. One group should try to note down a few points of best practice for interviewers while the other group should write helpful hints for interviewees. Ask each group to present their ideas to the other group. In pairs students should try interviewing each other.

It's my job
1 Get students to work in pairs to answer the questions. Then discuss the different possible answers with the whole class.

1 Possible answers
DC and AC circuits, Solid state devices, Digital electronics, Applied maths, Computer programming, Linear electronics
2 Possible answers
Installation and maintenance of electronic equipment, Sound Technician, assembly and testing of electronic devices, Telecommunications Technician
3 Automated lighthouses contain equipment which is monitored electronically.

2 Get students to read the questions and to guess what the answers could be. Explain to students that while they are listening, they should only note down key words. Play the recording once and give students a minute afterwards to complete their notes from the listening. If any answers are missing, play the recording again. Quickly check the answers.

1 He was in an electronics club at school and he made transmitters and receivers for radio-controlled model aircraft.
2 He liked the practical side of his course.
3 The price of electronic goods fell so it was cheaper to buy new than to repair.
4 Global Differential Positioning System, combines GPS and land-based signals to provide very accurate information on a ship's location. It is important in busy shipping lanes.
5 To repair electronic equipment in automated lighthouses.
6 He likes his job too much to move.
3  🎧 Play the recording again stopping after each question to allow the students to write it down.

4  Encourage students to work together to get the questions correct. In pairs they should practise the interview and then swap roles and repeat. Ask one or two strong pairs to act out their interview for the whole class.

5  🎧 Play the recording again. Discuss any differences with the students.

**Gadget box**

Get students to read the text and discuss the question.

*The batteries could be used in smart credit cards, medical equipment, or to power digital paper.*

**Pronunciation**

**Reading component values**

1  Get students to work in pairs and identify the components.

```

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>ten microfarad electrolytic capacitor</td>
</tr>
<tr>
<td></td>
<td>a five hundred picofarad variable capacitor</td>
</tr>
<tr>
<td>a</td>
<td>ten kilohm variable resistor</td>
</tr>
<tr>
<td>a</td>
<td>nine volt battery</td>
</tr>
<tr>
<td>a</td>
<td>one milliamp milliammeter</td>
</tr>
<tr>
<td>a</td>
<td>sixty microhensaries inductor</td>
</tr>
<tr>
<td>a</td>
<td>six volt sixty milliamp bulb</td>
</tr>
</tbody>
</table>
```

2  🎧 In pairs, students should listen to the recording and note the values. The answers are above.

3  Get students to practise saying the component values.

4  🎧 Play the recording again, this time stopping after each value so students can repeat. Allow students to practise reading the values in pairs again.

**Problem-solving**

1  Divide the class into two, A and B students. If it is a large class make several A and B groups. Tell the A group(s) to study circuit A and the B group(s), circuit B. In their groups students should work out what the circuit is used for and the details of how it works. See 3 for answers.

2  One A and one B student should pair up and explain their circuits to each other.

3  Check that students understand the words listed. Get students to complete the texts individually.

```

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>thermistor</td>
</tr>
<tr>
<td>2</td>
<td>temperature</td>
</tr>
<tr>
<td>4</td>
<td>on</td>
</tr>
<tr>
<td>7</td>
<td>collector</td>
</tr>
<tr>
<td>10</td>
<td>rises</td>
</tr>
<tr>
<td>12</td>
<td>off</td>
</tr>
<tr>
<td>4</td>
<td>battery</td>
</tr>
<tr>
<td>6</td>
<td>If</td>
</tr>
<tr>
<td>8</td>
<td>flow</td>
</tr>
<tr>
<td>10</td>
<td>buzzer</td>
</tr>
</tbody>
</table>
```

**Additional activity**

(*all levels*)

In pairs, get students to test each other on the words listed at the beginning of 3 by asking questions, e.g. *What word means to start something working? (activate)* *What do you call a device which stores energy? (battery)* *What word do we use to describe the movement of electricity? (flow)*
Vocabulary

Collocations in electronics

1 Get students to work individually and then check their answers in pairs. Explain that the nouns can be used more than once and that some of the verbs collocate with more than one noun.

- actuate a relay
- adjust a control
- amplify a signal / a voltage
- boost a signal
- change frequency
- charge a capacitor
- complete a circuit
- detect a signal
- discharge a capacitor
- energize a relay
- generate a current / a signal / a frequency / a voltage
- induce a voltage
- modulate a signal / a frequency
- produce an output / a signal / a voltage
- step down / up a voltage

2 Get students to work individually in class or set for homework.

<table>
<thead>
<tr>
<th></th>
<th>1 steps down</th>
<th>2 adjust</th>
<th>4 discharges</th>
<th>5 induces</th>
<th>6 change</th>
<th>7 completes</th>
<th>8 energized</th>
<th>9 detects</th>
<th>10 amplified</th>
</tr>
</thead>
</table>

Make your point

Evaluating a presentation

Quickly brainstorm the elements of a good presentation with the students. This is now revision as they have covered presentations in several units in the book.

1 Get students to read Lee's checklist. Discuss any ideas students have.

2 Give students time to prepare their presentations, perhaps for homework. Remind them of the need to organize their ideas carefully. Ask them to look back through the Student's Book and remind themselves of appropriate language for presentations.

Encourage students to be positive in their comments of each other's presentations and constructive in any criticism. Also, encourage students to notice good practice in other's presentations which they could incorporate into their presentations in the future.

Key words

Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
Pairwork

Students should first work alone to identify the four courses they have. Help with any unknown vocabulary. In pairs, by revealing the components one by one, they can play a guessing game.

<table>
<thead>
<tr>
<th></th>
<th>1 Automotive engineering</th>
<th>5 Aircraft maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Communications engineering</td>
<td>6 Marine technology</td>
</tr>
<tr>
<td></td>
<td>3 Computer-aided draughting</td>
<td>7 Defence technology</td>
</tr>
<tr>
<td></td>
<td>4 Electrical engineering</td>
<td>8 Music technology</td>
</tr>
</tbody>
</table>

Webquest

Members of each group should first decide which courses they would like to research. Allow students time to share their results. Get them to choose what they consider to be the best course(s) and why.

Reading

Studying technology

1 In groups of three, get each student to choose one text A, B, or C.

<table>
<thead>
<tr>
<th></th>
<th>A 1 Studying at university</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 She wants the best choice of career and she's interested in doing research in digital communications.</td>
</tr>
<tr>
<td></td>
<td>3 Broad-based to start, for example Electrical engineering, but specialized in later years, in Cristina's case in digital communications. Cristina is also taking German.</td>
</tr>
<tr>
<td></td>
<td>4 Three years, but some take up to five if work experience is included.</td>
</tr>
<tr>
<td></td>
<td>5 Jobs in design, production, quality assurance, and other fields. Some work in marketing or management. Cristina hopes to become a Research Engineer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>B 1 Studying at technical college</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 He wanted to get a qualification before he started work and have more time to decide on a career.</td>
</tr>
<tr>
<td></td>
<td>3 Courses leading to vocational qualifications. These combine applied science, practical skills, and technical know-how. Students also study communication skills for work and dealing with the public.</td>
</tr>
<tr>
<td></td>
<td>4 A year for a certificate, two years for a diploma</td>
</tr>
<tr>
<td></td>
<td>5 Technician</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>C 1 Apprenticeship</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 He wanted to leave school and start working and earning money as soon as possible.</td>
</tr>
<tr>
<td></td>
<td>3 Courses leading to vocational qualifications and entrance qualifications for higher-level studies</td>
</tr>
<tr>
<td></td>
<td>4 Two years</td>
</tr>
<tr>
<td></td>
<td>5 Aircraft Fitter or Aeronautical Engineer if he completes higher studies.</td>
</tr>
</tbody>
</table>

2 In groups of three, get students to discuss what they have read using their answers to the questions in 1 as a guide.

Gadget box

Discuss the benefits of Moodle with the class. Discuss the question.
Technology is the key to so many enterprises that there are innumerable career paths available. We live in a global society competing on innovation, clever thinking, and creativity. There is a challenging career in technology for the brightest people.

Sami Hassan is a good example of someone who started his career at a fairly low level but was identified as a potential talent and was given support and training. This allowed him to rise up through his company until he got a job as a Project Manager. With technology playing such an important part in any company, staff with backgrounds in technology are increasingly being promoted to senior positions.

Companies seeking to recruit new graduates frequently take part in the "Milk round." This means they visit universities and colleges, invite students to attend presentations, and conduct interviews with those who are interested in employment. There is competition to recruit the most able students. The "virtual milk round" is where this system of recruitment is carried out over the Internet.

Your curriculum vitae (CV) is one of the most important documents presented to a potential employer. It lists academic achievements and work experience along with relevant personal information. It must be clear and well-written to hold the employer's attention and provide the essential information. Employers often ask applicants to supply a covering letter along with their CV. This allows the applicant to go into more detail as to why they are suitable for the job and they have the opportunity to address the employer on a more personal level.

Short-listed candidates for a post will be interviewed. Interviews are about selling yourself and presentation skills are most important. Practising these skills and preparing before attending an interview can improve one's chance of getting the job. Second interviews often ask candidates to carry out more practical tasks so that the interviewers can really assess how a candidate performs under pressure.

In a highly competitive job market it is important to gain the necessary qualifications and take opportunities to acquire additional work experience such as participating in exchange programmes organized by colleges, universities, and employers. Two examples of UK technical qualifications are NVQs (National Vocational Qualifications) and BTECs (The Business and Technology Education Council). NVQs are vocational awards achieved through assessment and training. They are practical qualifications based on being able to do the job. There are five levels from Level 1, which focuses on basic work activities, to Level 5 for senior management. BTECs are vocational qualifications to prepare students both for employment and for progression to higher education.

---

### Additional activity

(All levels)

Get students to write a paragraph about their career path so far and their hopes for the future. Provide them with the following sentence starters. You may have to vary these to suit your students' circumstances. Remind students to use the appropriate tense.

1. I left school when...
2. Following that, I...
3. When I was 19 years old, I...
4. At the age of ________, I started...
5. By the end of ________, I hope to...
6. Eventually, I would like to...

### Switch on

Get students to work in pairs.

- A doing school exams (Maths / Physics)
- B climbing telegraph poles
- C working in a telephone exchange
- D designing networks on the computer and studying
- E graduating from university
- F giving a presentation to a large audience

### Listening

**Interview with a Network Designer**

1. Play the recording once. Get students to note key words only. Play the recording again to allow students to check their answers and add any missing information. Allow them to check their answers in pairs.
Additional activity
(all levels)
Students should write a simple list of the things they have done in their lives, then in pairs interview each other. Then ask them to write a short summary of the person they have interviewed.

* Tip
When a sentence has two parts, we use the Present Simple tense after when, before, if, after, as soon as, until and will or be going to in the other part.
Ann's going to complete the form as soon as she receives it.
The Present Simple tense can also be used with a time phrase to express the future when we are talking about a timetable, usually a public timetable.
The train leaves at 8 o'clock.

Language spot
Future review
1 Get students to read the example sentences and identify the three different forms used to express the future. Students should work individually then read the Grammar reference on p.123.

2 Get students to work individually in class or set for homework.

3 This exercise practises the Present Continuous tense and the going to form. Explain to students that they must make their sentences realistic or their partner will know instantly when they are lying.

4 Allow students to move round the room and read their sentences to different students.

5 This exercise practises will. Get students to choose two or three topics to discuss. Set a time limit of five minutes and then ask selected students to tell the rest of the class what they have discussed. Encourage discussion from other students.
Additional activity
(all levels)
Get students to work in pairs and make a list of the things which give job satisfaction. After a few minutes, draw the class together and compile a list on the board. Then, again in pairs, ask the students to choose the three most important things for them. Ask a few stronger students to tell the class their three points and to explain why.

Vocabulary
Key skills
With the class, brainstorm the qualities an employer looks for in an employee and the skills that they should have.

1 Students should work individually to complete the task.

| O | A \n|---|---|
| O | a good attendance \n| O | technical \n| O | good communication \n| O | an industry \n| O | a good team \n| O | a good decision \n| O | well \n| O | good at \n| O | promotion \n| O | work \n| O | job \n| O | flexible |
|---|---|
| O | B \n| O | record \n| O | ability \n| O | skills \n| O | background \n| O | worker \n| O | maker \n| O | organized \n| O | multitasking \n| O | opportunities \n| O | experience \n| O | satisfaction \n| O | working hours |

2 Get students to think of people who could be described using the phrases. They should write at least eight sentences. This could be set for homework.

Tip
You may decide to get students to work in groups of three. Two students take turns at asking the questions, while a third is the interviewee. This tends to put more pressure on the interviewee and therefore creates a more realistic situation.

Make your point
Preparing for an interview
1 Get students to close their books. Read the question to them. Encourage them to think of preparing mentally as well as physically.

2 Get students to compare their lists with Lee Avatar’s.

3 Discuss any additional points made by students which are not included in Lee’s list.

4 Get students to work individually. They should note down a few key points to each question.

5 Get students to move their chairs so that they are facing each other before beginning. Remind them of good body language and eye contact as well as answering the questions well.

Additional activity
(weaker students)
Ask students these questions:
Is Anglo Telecom a British company?
If you apply, will you replace someone who is leaving the company?
What will you have to do in the job?
Which personal skills are necessary?
Must the candidate have experience of working with people from other cultures?

Reading
Job ad and covering letter
Get students to read the introduction. Quickly discuss where they would be likely to find advertisements for the type of job they would like to do.

1 Students should work individually and then compare answers in pairs.

| O | 1 Network Engineer for 21st-century development project \n| O | 2 People with a university qualification in Telecommunications engineering or similar and experience in switching and transmission. Also someone with good communication skills and a good team worker |
Ask students why companies are interested in doing this. Ask if any of the students have experienced this, and if so, how they feel about it.

* Tip
The covering letter should be no longer than a page. A Human Resources Manager in a company may receive hundreds of applications and cannot spend time reading long letters. The letter should focus on the most relevant points for the job in question.

Writing bank
* Writing a CV see p. 57.

* Tip
When correcting the students' letters, focus on the relevance of the content first of all. Once students have got that right, you can underline grammar and vocabulary problems and encourage students to correct these themselves.

Webquest
Allow students to use phrases from the covering letter in Reading. They could write the letter in class or for homework.

Speaking
Second interview task
Get students to read the introduction.

1 Provide each student with a large piece of paper (approx. 80 x 60 cm), some pencils, erasers, coloured pens, crayons, or pencils. Students should make a poster of an ironing board. Students should not carry out any research but should draw it from their own experience.

2 Explain to students that this task tests their personal skills as well as their technical skills. They should try to use everything they have learned about giving presentations and about communication skills.

3 Choose one or two stronger students. Discuss the elements of the presentations which make them successful.

Technology Game
The game works best if students can work in pairs. Try to pair a strong student with a weak student. Three pairs should work together using one board (book). Supply each group of six with a dice (die) and three counters. Get students to read the rules. Help clarify any points students are unclear about. Make sure the students understand the rules before they start.

Key words
Go through the list of words to check students' pronunciation and understanding. Refer them to the Glossary if necessary.
Instructions for communication activities

**Unit 1**

1. Make one photocopy per student.
2. Explain that the students have to find someone to answer each of the questions. If possible, they should find a different student for each question. They must write down the person’s name and the information required.
3. Explain that they need to think of how to form the questions. You could do the first one as an example. Did you study Business studies at school? Ask different students until you get a positive answer and then write their name. Then ask, Why did you study Business studies? and note the answer below.
4. Tell students to move round the room and interview each other. Set a time limit of fifteen minutes.
5. Once students have returned to their seats, go over the questions as a class. Follow up by carrying out a class survey by asking how many students studied Business studies, etc. Present the results as a graph.

**Unit 2**

**Stronger students**

1. Divide the class into pairs. Photocopy the sheet and cut it in half so that each pair has two copies of Crossword A or two copies of Crossword B. Do not give stronger students the Clues.
2. In pairs, students discuss and write clues for all the words in their crossword.
3. When they have finished, tell students with Crossword A to work with students with Crossword B.
4. They shouldn’t show each other their crosswords. In their new pairs, students should take turns asking each other the clues for the missing words in their crosswords. B What’s 1 down? A The noun from long. If they have problems thinking of the answer, their partner should help by giving more clues.
5. When they have finished, students should look at each other’s crosswords to check their answers.

**Weaker students**

Give groups A and B the Clues.

**Unit 3**

1. Make one copy of the Questions on the left-hand side of the page for each student and one Answer card for each student.
2. Tell students to work individually and match their answers with the correct question. Then pair students so that they are working with a student with a different Answer card and, working together, to match their partner’s answers with their questions.
3. When they have done all they can, they should then move around the classroom, asking other students the questions and trying to find the correct answers. They should write down the answer.
4. When all the students have finished, go over the questions and check that the answers are correct.

**Extension activity**

Ask students to work in pairs to write another question. They should write the question and answer on two separate pieces of paper. Divide the class into two groups A and B. Give A’s questions to B and B’s questions to A. Each group should lay the questions out on a table or stick them to the board. Give each group the answers and ask them to match them with the appropriate questions. The first group to finish is the winner.

**Unit 4**

1. Divide the class into pairs. Photocopy the sheet and cut it in half so that each pair has two copies of Card A or two copies of Card B.
2. In pairs students discuss their roles. Allow them to use a dictionary for any words they are not sure of. Check they understand their roles.
3. When they have finished tell students with Card A to work with students with Card B to carry out the role-play. At the end, you may wish to ask the best pair to perform in front of the class if they are willing.

**Unit 5**

1. Divide the class into pairs. Photocopy the sheet and cut it in half so that each pair has two copies of Card A or two copies of Card B.
2. Explain that students have to prepare a presentation of their project in order to obtain funding. They should work together to consider the main advantages and also consider the disadvantages of their project so that they can answer any questions and reassure possible investors. Remind students that these are examples of alternative energy and they should think of the overall advantages of alternative energy too. They have to persuade investors that this is the future.
3. Two pairs should now sit together. One pair should listen while the other gives their presentation. The listeners should ask questions. Then the other pair should give their presentations.
4. Once all the students have finished, encourage a class discussion on which project should obtain funding.
Extension activity
Ask students to prepare sketches or pictures and to be prepared to explain them during their presentations.
If students have access to PCs they could prepare slides for their presentations. Students may access websites for additional information:
www.awsocan.com
www.oceanpowertechnologies.com

Unit 6
1 Make a copy of the table for each student. Copy the Data cards so there is one for each student.
2 If necessary, revise the language for checking details covered in Make your point.
3 Introduce the subject of satellites. Ask students what they know about satellites, their function, the way they move, what they look like, etc. Make sure students understand the words orbit and launch. Tell students that not all the cards have the same set of information.
4 Give each student a table and distribute the Data cards. Ask students to complete the table with information from their Data card. They should then make telephone calls to other students to ask for data on other satellites. If possible, place students back-to-back to make the phone calls so that they can’t see each others’ cards. They should use appropriate language for checking details.
5 Once all the tables have been completed, ask students to check with one another that the data they have written down is correct.

Unit 7
1 Divide the class into groups of three, four, or five. Make one copy of the sheet for each group and cut up the People cards. Lay the Object board in the centre of the table.
2 To introduce the game to the whole class, point to the picture of the raft and ask students who would use one of these and why. Ask them what material it is made of and why that material has been used for this purpose. Ask them if they can think of any other uses it could be put to other than floating on water, e.g. carrying an injured person, upside down as protection in a rain storm, can be pulled like a sledge on snow, etc. Students should be creative.
3 Lay the People cards in a pile face down beside the Object board. Students should take turns to turn over the top card. They should lay it on the table face up and tell the others what it says. They should then choose an object to give to that person. They must explain to the others in the group why this person would be able to use the object. The others can ask questions or disagree. The group must decide if the explanation is convincing. If they are convinced, the student can lay the people card beside her/him and cross out the object on the board. The crossed out objects cannot be used again. If the group decide that the explanation is not good enough, the card is placed at the bottom of the pile and the next student continues. Play continues until all the cards have been used up. The winner is the person with the most cards.

Unit 8
1 Make one copy of the sheet for each student.
2 Ask the class why each of these points may be a requirement for a mass transportation system.
   EXAMPLE
   Why should transport systems be fuel efficient?
   To reduce pollution and also reduce costs and to stop wasting valuable resources.
   Why should they be cheap to construct?
   That way more transport systems can be built and fewer people will use their cars.
3 Ask students to work in pairs. Tell them to choose what they think are the ten most important features from the list and to put them in rank order 1–10. One person should write them down. Set a time limit of fifteen minutes.
4 Ask each pair to get together with another pair and compare their list. As a group of four, they should now compile a new list of the ten most important features, again in rank order. Set a time limit of ten minutes.
5 Ask each group to appoint a presenter. The presenters should come to the board, write their group’s list and explain their list, to the rest of the class explaining why they have chosen the features in that specific order. Others in the class may ask questions.

Unit 9
1 Ask students to look back through Unit 9 in the Student’s Book and remind themselves of the vocabulary they learned there. Ask them to come to the board in turns and write one or two words. Quickly ask the class what these words mean. Explain they’re going to play a game where they will have to explain the meaning of some of these words. Remove the words from the board.
2 Copy the sheet and cut up into individual cards. There are two different games students can play with these cards.
Game A

Divide the class into groups. Each group should have about six members. Give each group a pile of cards placed face down on the table. Explain to the students that this is a race. In turns, they have to lift a card and explain the meaning to the others in the group without using the word on the card. The others must try to guess what is written on the card.

Give an example. This material is found below the earth’s surface. It is extracted and refined and used to make fuel and other products which we use every day. Petroleum. If necessary you will have to continue the explanation until someone guesses correctly.

If a student doesn’t know the word, he/she should place it somewhere in the pile and take the next one. As soon as a correct guess is made, the next student picks up the next card and the game continues. The winning group is the group which finishes first.

Game B

Mix the cards. Ask one student to choose one card at random and to read it to himself/herself. The other students in the group can now ask 20 questions to find out what the word is on the card. They can only ask yes/no questions. The person who guesses correctly gets the card and is allowed to choose the next card. The game continues until all the cards are used up. The winner is the student with the most cards.

Unit 10

1. Copy the diagram and the paragraph strips. You will need one diagram for each student and one set of paragraph strips per four students. Cut up the paragraph strips and mix them in sets.

2. Introduce the topic of sewage treatment by asking students to tell you about water treatment which they learned about in the Student’s Book.

3. Provide each student with a copy of the diagram of a sewage treatment works. Explain that this is where waste water is treated and ask them what they know about this process.

4. Divide the class into groups of four. Give each student two paragraph strips.

5. Students should work together to work out the process by putting their strips into the correct order (A, H, E, B, F, C, I, G, D, I).

6. Once they have the process in order, as a group students should label the diagram.

Suggested labels
1. sewers
2. metal grids
3. digester tanks
4. aeration tanks
5. sand beds
6. disinfectant

Unit 11

1. Explain to the students that this is a game but that first they have to write the questions for the game.

2. Introduce students to different types of questions they could ask. For example:
   - What is the opposite of (expensive)?
   - Give the noun/adj/verb from (detect).
   - What’s the past simple of (rise)?
   - What is the word for a (device) which detects heat/movement/pressure?
   - Say the word (parallelogram).
   - Put the word (prevent) in a sentence.
   - Name 2 different types of (sensors).
   - Give a definition of (__________).

3. Introduce yourself/Greet your audience/Invite questions.

4. Provide cut up slips of paper or card for them to write their questions, one on each card. Allow students to work in pairs to write questions. Insist that they write different types of questions and that they should be based on classwork over the last few weeks. Each pair should write about 8-10 cards.

5. You will need a copy of the game board and a die (dice) for each group of three or six students and a counter or coin for each student. Collect the cards and mix them before laying them in a pile face down on the table. If it is a large class, divide the students into two or more groups, giving each group the cards from a different group.

6. The first student should lift the top card, read the question aloud and answer it. If the others agree that the answer is satisfactory, the first student should throw the die and move the set number of spaces. If they cannot answer, they must put the card to the bottom of the pile and miss their turn. If they land at the beginning or end of an arrow, they should follow the arrow up or down to its end. The next student can now take a card. The game continues. The winner is the first person to reach the finish.

Unit 12

1. Make enough copies of the sheet so that each student has a Customer card or a Manufacturer card.

2. On the board write glass, cardboard, wood, steel and underneath write flexible, can be coloured/patterned, biodegradable, hygienic, versatile, durable, expensive/cheap, flame retardant, strong, waterproof, can be recycled, lightweight/heavy, attractive appearance, interesting and ask the students to describe pieces of furniture made from the materials using the words.
3 Explain that some of the students are manufacturers who make tables and chairs in these materials, while others are customers who want to buy tables and chairs. Give out the cards. Students can work in pairs if there are more than eight students. If there are fewer than eight, remove one customer and one manufacturer card.

4 Customers should think about the qualities they require, while the manufacturers should think about the qualities of their materials. Set a time limit of two minutes.

5 Customers now have a meeting with each of the manufacturers to discuss their needs. The manufacturers must try to sell their products. Set a time limit of three minutes for each meeting and then tell customers to move round so that each customer meets each manufacturer.

6 Tell customers to decide who they will buy from and to shake their hands.

7 Discuss who has won the most contracts and why.

Unit 13

1 Make one copy of the table for each student and enough copies of the Devices so each student has one. Explain they are at a trade fair for security devices and should collect information about four devices. They should read about their device and enter the information in the first column of the table. Tell them to leave the final line empty for the moment. Then they should move around asking others for information about other devices and entering the information in the table. As they do, tell them to discuss other possible uses, military or civilian, with others and to enter ideas in the final line.

2 Once they have gathered all the information, ask students to discuss which one they like best and why. Discuss the different uses they have suggested and decide which is the most interesting.

Unit 14

Copy the sheet and cut into cards. Explain to the students that they have to guess the true definition of a word from three possible ones. This is the only occasion where you want them to lie!

Put the word skip on the board. Then give the following three explanations for the word. Try to explain them as fully as possible, without reading the words. Repeat if necessary.

a It’s an electrical switch which cuts an electrical circuit when it is overloaded. Nowadays, most houses have these to prevent electrical fires.

b It’s a large open container which is used for putting building waste and rubbish in. When it’s full it’s taken away on a truck and emptied.

c It’s a small water channel which carries away excess water after heavy rain. You can see these along the sides of fields.

1 Students should work in groups of three to discuss the three options. Set a time limit of two minutes. Explain that if they guess correctly, they get 10 points, but if they guess incorrectly, you get 20 points.

2 Ask each group in turn to tell you their chosen definition. Count the different choices on the board but don’t tell them which is correct until they have all given their answers. Then, tell them the correct answer (in bold) and add up the points on the board.

3 Give each group one of the first six words. Explain that the definition in bold is the correct answer. One other false definition is given and they must think of a third false definition. Allow them to use dictionaries if they wish but explain that they mustn’t read their definitions or the others will quickly guess which is correct. They are not allowed to read when they present their definition.

4 Ask each group in turn to write their word on the board and each member of the group to present one definition. Proceed as before.

5 Continue the game, using the other words where only the correct definition is given. They should design two false definitions. They should be prepared to explain all three meanings in their own words.

Unit 15

1 Make one copy of the questionnaire for each student. Ask students to work in pairs. Students are going to write questions to try to find out what people think about the future. I has been done as an example. Each pair should write a question under each heading giving three possible answers (a, b, or c) to choose from and a follow-up, open-ended question.

2 Once they have finished writing the questions, ask students to work individually. They should find four different people in the class (if possible) to answer their questionnaire. They should read their questions and make a note of the responses.

3 Ask students to compare their answers with their original partner. Do most people agree about the future or are there big differences?

4 Draw the class together. Compare some of the questions students wrote and ask them to report on their findings. Ask some students to report on the most interesting findings.

5 You could ask students to write a report on attitudes to the future.
1 Grammar test

1 Complete the sentences with the to infinitive or -ing form of the verbs in brackets.

1 Last year he decided ________ (leave) school and ________ (do) an apprenticeship in Electrical engineering.

2 At school, Aaron enjoyed ________ (do) technical drawings so he chose ________ (study) Computer-aided draughting at college.

3 We must avoid ________ (waste) valuable raw materials.

4 They worked hard at night school because they wanted ________ (apply) for a Civil engineering course at university.

5 He's responsible for ________ (check) all the safety systems before the aircraft is allowed to take off.

6 This new project aims ________ (reduce) design time in the aerospace industry.

7 During the course, students will study ways of ________ (find) faults in equipment.

8 When you apply for a course, remember ________ (include) your qualifications in English!

2 Complete the second sentences so that they have similar meanings to the first.

EXAMPLE ‘I went to university but first I completed a two-year apprenticeship.’

Roger said he went to university after completing a two-year apprenticeship.

1 ‘Kalik is a good designer.’

John says Kalik is good at __________________________ .

2 ‘I'll send an application form.’

The administrator promised __________________________ .

3 ‘I've applied to do the course in Music technology.’

Naomi intends __________________________ .

4 ‘Ian has done very well as Manager of the project so he should continue.’

The boss says that Ian should keep on __________________________ .

5 ‘It would be good to earn money but I think it's better to get a qualification first.’

Amy would prefer __________________________ before __________________________ .

6 ‘I'd like to study Aeronautical engineering.’

The student is interested in __________________________ .

7 ‘I'm interested in learning another language. I think I'll start French in September.’

Tea would like to start __________________________ .

8 ‘If you are interested in working in Engineering, it would be a good idea to visit Ralph Construction.’

His tutor suggested __________________________ .
1 Communication

Find someone who...

1. studied Business studies at school.
   Why:______________________________
   Name:__________________________

2. wants to become an Electrical Engineer.
   Why:______________________________
   Name:__________________________

3. knows what a Civil Engineer does.
   Answer:__________________________
   Name:__________________________

4. has done some work-based learning.
   What:______________________________
   Name:__________________________

5. can speak two foreign languages.
   Languages:__________________________
   Name:__________________________

6. knows which branch of technology a Ship Designer would study.
   Which:______________________________
   Name:__________________________

7. knows which syllable is unstressed in *photography* and *photographic*.
   Answer:______________________________
   Name:__________________________

8. would like to work in another country.
   Where:______________________________
   Name:__________________________

9. has an unusual hobby.
   What:______________________________
   Name:__________________________

10. has started or is going to start an apprenticeship.
    Where:______________________________
    Name:__________________________

11. would like a job where they had to work shifts.
    Why:______________________________
    Name:__________________________

12. would like to do research.
    Why:______________________________
    Name:__________________________
Problem-solving

1. In pairs, students should quickly brainstorm the sorts of questions they would ask.

2. Get students to read the first paragraph of the text. Get them to answer the questions in the example at the beginning of the paragraph. Then, get students to continue with the rest of the text and write appropriate questions.

   - Possible answers
   2. What will I study? / What subjects will I study? / What subjects are included?
   3. How will I learn? / How is it taught?
   4. What are the entry requirements? / What qualifications do I need to take this course?
   5. How long does the course last?
   6. When will I be expected to be in College? / How intensive is the course?
   7. How will I be assessed?
   8. What can I do with this qualification?

3. Students should not use dictionaries. Get them to work in pairs and try to work out what the terms mean. Discuss the ideas with the whole class.

   - with a practical focus on getting a job
   2. formal qualifications like school examination certificates
   3. learning and training in the workplace
   4. knowledge acquired through work or study before you do a course
   5. assessment during regular teaching unlike formal examinations at the end of a period of study
   6. regular development over a period of time

Tip

When noting new vocabulary, encourage students to write the part of speech beside the word(s) – v, n, adj, adv. Try to expand their knowledge of vocabulary by asking them to think of other parts of speech which come from the same stem, e.g., combination (n), combine (v).

Tip

Before listening, it is important for students to anticipate what they are going to hear. By reading the questions, they will be able to guess the situation and they will know what to concentrate on while listening.

It’s my job

1. Ask students what they can remember about an apprenticeship. Discuss the questions.

   - Predictable from Text C:
   1. working, taking part in on-the-job training, attending college part-time
   2. one to three years
   3. practical skills

2. After listening, discuss students’ answers.

   - After listening add:
   1. studying
   2. three years
   3. team work, problem-solving, communication skills, using new technologies

3. Before listening get students to read the questions and note any answers they can already give. Listen again to check and complete.
2 Grammar test

1. Complete the sentences with the Present Perfect Continuous or Present Perfect Simple, Active or Passive, form of the verbs in brackets.

1. They ________ (harvest) grapes. They ________ (work) since early this morning.

2. He ________ (produce) a soil map of the field. This is the first time he ________ (use) this equipment.

3. Scientists ________ (try) to develop plants which will survive well in dry parts of the world. They ________ (develop) a number of species successfully.

4. Mechanical harvesting machines ________ (use) since Cyrus McCormick invented the reaper in 1831. Although the principle is the same, there ________ (be) many changes in the technology.

5. People in Bangladesh ________ (use) the treadle pump to lift water since it was introduced in the early 1980s. Over one million pumps ________ (sell).

2. Underline and correct the ten mistakes in the job application letter. The first one has been done as an example.

Dear Mr Pandya,

I am writing to apply for the job of Agricultural Technician which has been advertised in the Farmers Weekly on 16th March.

I was born and brought up on my parents’ farm in Poland where we have grown mainly vegetable crops. At that time I have become interested in farming technology, especially planting and harvesting fruit and vegetables. In 2007, I come to Britain and has lived here ever since. At first I have done mainly seasonal work on a farm in the South-East, working in the hop gardens and in the apple and pear orchards. For the last two years I have been being a student at Writtle Agricultural College. I just completed a two-year foundation degree in Agriculture. During these two years, I have gained important practical experience working on a number of farms in the area.

I speak fluent Polish and German and I had been working hard to improve my English since coming to Britain. In my free time I enjoy playing the guitar and I was become a member of the local football team.

I hope you will consider my application favourably.

Yours sincerely,

Bazyli Rutecki

3. Complete the sentences with the Present Perfect Simple or Past Simple form of the verbs in brackets.

1. We ________ (build) a new dairy last year but we ________ (not be) able to use it yet.

2. Before modern farming equipment was invented, farmers ________ (use) horses to pull implements.

3. In 1930 General Motors together with DuPont ________ (invent) Freon, a refrigerant, and soon millions of households ________ (have) a refrigerator.

4. What ________ George Washington Carver (1864–1943) ________ (do)?

5. We ________ (introduce) computer technology to produce soil maps in 2005 and since then crop yields ________ (increase) significantly.
2 Communication

Food and agriculture crossword

Student A
Across
4  a method of preserving food by removing water
6  this device detects conditions on the ground and transmits it to a computer
11  a machine used on farms to pull implements
13  a substance applied to fields to make plants grow better

Down
1  the noun from long
8  these organisms can cause disease
9  the adjective from expense

Student B
Across
2  a system of supplying water to farmlands
8  a type of wire
12  plants that farmers and gardeners don't want growing on their land

Down
3  a plant grown in Egypt or India, for example, and used to make cloth
4  the noun from destroy
5  the amount collected from the fields
7  ripe fruit tastes _________
10  to cut and collect the crops when they are ripe
3 Grammar test

1 Rewrite the sentences using the Passive. Only use the agent if necessary.

**Example**
Bridges must be designed to carry heavy loads.

1 Many thousands of years ago people built simple log bridges across streams.
2 People made the first long bridges by joining logs together to make beams.
3 People had to make bridges out of stone to last a long time.
4 The Romans built stone arch bridges 2,000 years ago.
5 Engineers first used iron to build bridges at the beginning of the 19th century.
6 By the end of the 19th century Engineers could create large beam bridges because they could use steel.
7 Today, Engineers build most bridges of concrete and steel.
8 Builders use concrete because they can pour it into moulds and set it into shapes.
9 In the future Engineers will have to use lighter and stronger materials to build longer bridges.
10 Engineers will probably use carbon fibre and Kevlar for the deck and cables.

2 Complete the information about The Great Belt East Bridge with the correct form of the verbs in the box, Active or Passive, Past or Present.

<table>
<thead>
<tr>
<th>complete</th>
<th>decide</th>
<th>begin</th>
<th>cross</th>
<th>transport</th>
<th>make (×2)</th>
<th>take</th>
</tr>
</thead>
</table>

For more than 100 years, people and vehicles ________1 across the Great Belt in Denmark by ferries, but in 1986 the decision to construct the Great Belt East Bridge ________2. It ________3 to construct a gravity-anchored suspension bridge. Work ________4 in 1991 and the bridge ________5 in 1998. The cables and deck ________6 of steel while the pylons ________7 of reinforced concrete. In 2006, 27,600 cars ________8 the bridge each day.

3 Underline and correct the mistake in each of the sentences.

1 Parking fees needn’t to be paid if drivers show an official visitor’s card.
2 Hard hats must be wearing on site.
3 Ear protectors can obtained from the Foreman.
4 Visitors may be entered this area only if accompanied by a member of staff.
5 All drawings should be return to the office.
3 Communication

Find the correct answer

Questions

Why do we build bridges?

What do you call the distance between bridge supports?

How long is the longest bridge span (Akashi Kaikyo Bridge)?

What is the name for a temporary dam which stops water flowing in during construction?

What is the name of the part of a bridge on which traffic travels?

What is the simplest bridge design?

What do we call concrete that is strengthened with steel?

Which type of bridge is suspended from cables that are supported by tall towers?

What is the first stage in constructing a bridge?

What is the word for the vertical support half way along a bridge?

Why must steel bridges be painted regularly?

On a pontoon bridge, what are pontoons?

What is an aqueduct?

The George Washington bridge is the busiest bridge. How many vehicles use it every day?

What is the name for the structure that spreads the weight of the bridge and the traffic on it into the ground?

How long is the longest trans-oceanic bridge (Hangzhou Bay Bridge in China)?

Answers A

To make transport more efficient

Beam bridge

1,991 metres

36 km

Answers B

The deck

The span

Flat-bottomed boats

Suspension bridge

Answers C

A bridge that carries a water channel, e.g. a canal

Pier

To stop corrosion

Reinforced

Answers D

Holes for the foundations

100,000,000

Foundations

Cofferdam
4 Grammar test

1. Underline and correct the mistake in each of the sentences.
   1. They were at the plant all day but the Engineers couldn't to repair the machine.
   2. Are Scientists able manufacture plastics that decompose?
   3. Manufacturers can't make plastics to a high standard of quality before they started to use oil.
   4. Soon we’ll can make plastics from any kind of plant material.
   5. Plastics can be able to mould more easily if plasticizers are added.
   6. Casein became one of the first leading materials for making items such as buttons and buckles because it is able can be coloured.
   7. Plastics can to be used to make medical devices for surgery.
   8. By using light-emitting plastic film, manufacturers can be made wall coverings that light up.

2. Complete the conversation with the correct form of can or able (to), positive or negative.

   Boris: Hello, Ben. How are you? I’m sorry I ______ 1 come to the meeting yesterday.
   Ben: Don’t worry. We ______ 2 to complete the report because we ______ 3 to get the test results until next Tuesday.
   Boris: Right! I was working on the new machinery. We had some problems with the injection moulding machine. We thought we ______ 4 fix it ourselves but we ______ 5, so we called the engineers. They found the fault but they ______ 6 to get spare parts. We still ______ 7 use the machine but I hope we ______ 8 to get back into production tomorrow.
   Ben: ______ 9 you come to the meeting on Tuesday next week?
   Boris: Yes, I ______ 10 to come then.

3. Complete the sentences to express ability to do things in the past, present, or future.

   EXAMPLE: By applying thermal insulation coatings to window glazing, energy can be saved (save).

   1. Hard discs have thin magnetic coatings so they ______ (store) large amounts of data.
   2. Soon we ______ (use) new light-emitting plastic film to make wall coverings that light up.
   3. Ten years ago, drivers ______ (not prevent) car windows icing up in cold weather.
   4. In the 1950s, manufacturers ______ (apply) thin coatings of PTFE to cooking pots to prevent food from sticking.
   5. Light-emitting plastic film ______ (use) in safety applications.
   6. In the future it ______ (save) money and increase efficiency by using smart coatings on manufacturing components.
4 Communication

Card A
You are a Project Leader working in a specialist packaging company producing EPS mouldings. You have a meeting with a potential customer who wants your company to produce mouldings to cushion a product in shipment. Find out what the customer wants and use the flow diagram to explain to the customer how you would proceed.

The time scale:
- Design and prototype mouldings in six weeks
- Manufacture in twenty weeks

Quantity: 500 sets per month delivered on a just-in-time basis.

Card B
You are a Product Engineer working on the design of a new medical ultrasound scanner. You require packaging to allow you to ship the product safely. The first customer shipment is in 26 weeks. You have arranged a meeting with the Project Leader at a company specializing in the design and manufacture of EPS mouldings to discuss how the project would proceed. Ask the project manager to explain each step. You require a set of mouldings to cushion and protect a delicate piece of medical ultrasound equipment.

- The external surfaces of the equipment are irregular and the cushions will have to be shaped to protect it.
- The equipment weighs 18 kg and measures 30 x 40 x 20 cms.
- The mouldings must provide protection from a vertical drop of one metre and from the shock and vibrations associated with road, rail, and air transport.
- The mouldings should be anti-static and flame retardant.
- The mouldings should be carefully designed to meet the requirements of packaging waste regulations.
5 Grammar test

1 Complete the sentences with the Past Simple or Past Continuous, Active or Passive, form of the verbs in brackets.

1 While Andrew ________ (visit) the island, he ________ (see) construction workers erecting wind turbines.

2 A large wave ________ (destroy) the gully wave generator when Engineers ________ (run) tests.

3 While some companies ________ (develop) alternative energy, others ________ (continue) to use fossil fuels.

4 As soon as oil prices ________ (begin) to rise, Scientists ________ (begin) to develop alternative fuel for cars.

5 While they ________ (build) the dam, a number of problems ________ (come) up.

6 Solar cells ________ (develop) when American Space Scientists ________ (look) for ways to power satellites and space probes.

7 In 1990 when a Dutch company ________ (build) a new coal power station, they ________ (plant) trees in Indonesia to help reduce the amount of CO₂ produced.

8 While the company ________ (develop) new solar technology, students ________ (invite) to suggest new uses for the new solar cells.

2 Complete Frank's diary with one appropriate word in each space.

My plane ________ 1 at the airport at 8:45 in the morning. Mr Bahjef was ________ 2 for me. Outside, the sun ________ 3 shining and a light wind was ________ 4 . Our first visit was to the hydroelectric power station. Three giant turbines were ________ 5 electricity. We ________ 6 to the Chief Engineer, who ________ 7 sitting in his office.

As we ________ 8 through town, we stopped at a housing development site. Engineers were ________ 9 solar panels on the roofs and builders ________ 10 connecting the rain water collection system. However, we ________ 11 have much time so ________ 12 stay long.

When we ________ 13 to the wind farm overlooking the town, the wind was ________ 14 strongly and the blades on the turbines were ________ 15 quickly. But three turbines ________ 16 not working.
5 Communication

Card A

AWS Ocean Energy  Wave energy converter

Technology: cylinder shaped buoy fixed to the seabed. Cylinders are compressed by the weight of the wave and then released by the lower pressure of the trough. Movement converted to electricity using a hydraulic system and motor generator. Power taken on shore via underwater power cables. 50 megawatt farm will cover 2.5 km² of sea bed and supply electricity for 25,000 homes.

Location:
- where ocean swells greatest – west coasts of Europe
- 40–100 metres depth of water (away from shipping lanes)
- secure electricity grid on shore
- seabed suitable for power cables to shore

Maintenance: using remote operation vehicles (ROVs) which can operate in rough weather

Advantages:
- below sea surface, so avoids storm damage
- simple – only one moving part
- visual impact is zero
- environmental impact negligible
- low maintenance so low cost of energy production

Card B

Ocean Power Technologies  Powerbuoy

Technology: buoy moves freely up and down on the waves. Mechanical stroking is converted to drive an electrical generator. Power taken on shore via underwater power cables. 10 megawatt OPT farm will cover 0.125 km² of sea bed, enough for 5,000 homes. Sensors monitor equipment and ocean conditions. In storm, system automatically ceases production.

Location:
- off coasts
- 30–50 metres water depth
- secure electricity grid on shore
- seabed suitable for power cables to shore

Maintenance: existing marine vessels

Advantages:
- strong simple steel construction
- no environmental impact – no pollution, noise, exhaust, fuel
- minimal visual impact – much smaller than wind turbines, hardly visible from shore
- minimal impact on seabed – act as reefs for sea life
6 Grammar test

1 Match a sentence in A with a sentence in B and make sentences starting with if.

Example: If they build the SAX-40, it won’t make commercial flights until 2030.

A

1 They may build the SAX-40.
2 Designers might use a blended wing design.
3 Perhaps there’s a course in Aeronautical engineering at the local university.
4 The new A380 may land at this airport.
5 It can happen that a pilot loses his / her way.
6 There may not be enough interest in the new aircraft.
7 There might be a problem with the fuel lines.
8 The film studio is thinking of hiring a blimp.

B

a Then, he / she has to ask the Air Traffic Controller for help.
b In that case I’ll apply.
c It won’t make commercial flights until 2030.
d Then they’ll be able to film from the air.
e The aircraft cannot take off.
f In that case, they’ll have to make airport alterations.
g They won’t build it.
h Blended wings produce less turbulent airflow.

2 Complete the sentences with if, unless, as soon as, before, or when. Use each word once only.

1 There’s a green light and a red light. You can operate the machine __________ the green light is illuminated.
2 This is the emergency warning bell. __________ it sounds, everyone must leave the building.
3 We won’t be able to complete the project __________ we get more funding.
4 The alarms must be activated. The last person to leave should check they’re all switched on __________ they lock the doors and leave the building.
5 __________ the inventor can get permission to fly, he will put his M200G flying car on sale.

3 Decide if the sentences should be First or Second Conditional and complete them with the correct form of the verb in brackets. Questions 6 and 8 are Passive!

1 More people would be able to afford to travel into space if we __________ (can) lower the cost.
2 If forecasts about the number of British air passengers in the future are correct, the number __________ (increase) to 465 million by 2030.
3 If oil were spilled on the runway, it __________ (be) a major hazard to landing aircraft.
4 He’ll go to university as long as he __________ (not fail) his exams.
5 If the technicians __________ (not follow) the instructions carefully, it could lead to serious technical problems.
6 When the report __________ (publish), we’ll study it very carefully.
7 If the manufacturers used carbon-fibre reinforced plastic, the whole aircraft __________ (be) lighter.
8 Tests __________ (not carry out) unless safety procedures are improved.
6 Communication

Data cards

**Weather and Climate Satellite**

- **Name**: Orbiting Carbon Observatory
- **Date of launch**: 2008
- **Orbit level**: 700 kilometres above the Earth
- **Movement**: covers most of the Earth’s surface at least once every 16 days
- **Equipment**: atmospheric infrared sounder instrument
- **Function**: to measure atmospheric carbon dioxide, to track retreating polar ice, to monitor winds and rainfall

**Emergency communications satellites**

- **Name**: Iridium group of 66 satellites
- **Date of launch**: 1998
- **Orbit level**: 800 kilometres above the Earth
- **Movement**: orbit from pole to pole once every 100 minutes
- **Function**: worldwide voice and data communication

**Space exploration**

- **Name**: James Webb space telescope
- **Date of launch**: 2013
- **Orbit level**: 1.6 million kilometres above the Earth
- **Equipment**: infra-red technology; 6m mirror
- **Function**: to search for the first galaxies that formed after the Big Bang

**Earth observation**

- **Name**: TopSat
- **Date of launch**: 2006
- **Orbit level**: 700 kilometres above the Earth
- **Movement**: circles the Earth once every hour and 38.5 minutes
- **Function**: takes and stores high definition photographs of the Earth

---

You need information about four different satellites in orbit around the earth. Complete the first column with information about your satellite. Then phone your friends to ask for data on the others.

<table>
<thead>
<tr>
<th>Type of satellite</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of launch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orbit level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tip
Some verbs can be followed by either the -ing form or the to infinitive. See Grammar reference p.114 for verbs where there is little difference in meaning. Notice the difference in the following:
I remembered to lock the door.
(= I remembered that I had to lock the door.)
I remember locking the door. (= I can now remember that I locked the door.)
I tried to close the valve but the pressure was too high. (= I made an attempt to close the valve.)
I tried closing the valve but oil continued to leak out. (= I tested to see if closing the valve would solve the problem.)

Additional activity
(all levels)
Get students to close their books. On a piece of paper, students should write -ing and to at the top of two columns. Dictate the verbs listed, mixing them up, and students should decide which column they belong in. In pairs students can quickly compare answers.

Additional activity
(all levels)
Get students to choose four rows of words from the table and to write sentences using each word in the row to show the difference in the way the different parts of speech are used.

Language spot
-ing form and to infinitive
Get students to look at the example sentences then to quickly form short sentences using the verbs listed below, e.g. You must avoid wasting time. I can’t afford to go out tonight.

1 Get students to do this exercise individually.

<table>
<thead>
<tr>
<th></th>
<th>1 studying</th>
<th>3 to repair</th>
<th>5 to start</th>
<th>2 working</th>
<th>4 taking</th>
<th>6 to apply</th>
</tr>
</thead>
</table>

2 Get students to do this exercise individually.

|   | 1 repairing, maintaining | 6 to measure | 2 designing, making | 7 to manufacture | 3 doing | 8 cutting | 4 connecting | 9 to transfer | 5 to turn | 10 to become |

Vocabulary
Word families
Allow students to use dictionaries if necessary to complete the table. The completed table can be used to focus students’ attention on word suffixes -al for adjectives and -ion, -ance, -ment for nouns. Encourage students to think of other examples of adjectives and nouns which end in the same suffix.

See table in Pronunciation on p.10.
7 Grammar test

1 Choose the best sentence to describe the signs.

1 a You mustn’t enter the site.
   b You don’t have to enter the site.

   ![Danger Construction site]
   ![Keep out]

2 a You have to drink the water.
   b You don’t have to drink the water but you can.

   ![Drinking water]

3 a You mustn’t wear a hat or boots or work here.
   b You must wear a hat and boots to work here.

   ![NO HATS NO BOOTS NO JOB!]

4 a If there is a fire you don’t have to use the stairs.
   b If there is a fire, you mustn’t use the lift.

   ![In case of fire]
   ![DO NOT use lift]
   ![Use the stairs]

5 a The public mustn’t park here.
   b You have to park private cars here.

   ![Private Car Park]

6 a You mustn’t wash your hands here.
   b You mustn’t use this area for washing dishes.

   ![Hand wash only]

7 a This door has to be kept shut.
   b This door doesn’t have to be opened.

   ![Fire door Keep shut]

8 a You mustn’t run.
   b You don’t have to run.

   ![No running]

2 Complete the dialogue between a Building Control Officer (BCO) and a house builder (HB) with the correct form of have to, don’t have to, or mustn’t.

BCO Well, first of all you ________1 investigate the site. Are there any trees nearby?

HB Yes, there are. ________2 I ________3 cut them down?

BCO No, you ________4 cut them down, but you ________5 calculate the depth of the foundations carefully. Remember that you ________6 cut down large trees without permission. Who is going to draw your plans?

HB I’d like to do them myself. ________7 I ________8 get an architect to do them?

BCO No, you ________9 use an architect, but you ________10 prepare a location plan, a block plan, cross-sections, and elevations.

HB When can I start building?

BCO You ________11 start building before you get permission. Once you get permission, you ________12 remember to inform the Building Control Officer at various stages of the work.
# Communication

## People

<table>
<thead>
<tr>
<th>A friend who often goes hill walking</th>
<th>A colleague who is going to work in rural Africa for two years</th>
</tr>
</thead>
<tbody>
<tr>
<td>A person who lives in a dry desert area</td>
<td>A friend who is going on a study tour of Antarctica</td>
</tr>
<tr>
<td>Someone who is working on a six-month project in Spain</td>
<td>A friend who has decided to emigrate to Australia</td>
</tr>
<tr>
<td>A friend who enjoys travelling to remote regions of the world</td>
<td>A friend who loves gadgets</td>
</tr>
<tr>
<td>A friend who is building a new house</td>
<td>A colleague who is very traditional and doesn’t like change</td>
</tr>
<tr>
<td>A friend who works on an off-shore oil rig</td>
<td>A teacher who is taking a group of students to London</td>
</tr>
<tr>
<td>A colleague who is going to work in New York</td>
<td>A grandparent</td>
</tr>
<tr>
<td>Someone who uses a wheelchair</td>
<td>A friend who drives a transport lorry across Europe</td>
</tr>
<tr>
<td>A friend who enjoys sailing</td>
<td>A friend who has a long journey to work</td>
</tr>
<tr>
<td>A friend who wants to be rich</td>
<td>A friend who never wants to spend money</td>
</tr>
</tbody>
</table>
8 Grammar test

1 Complete the sentences with the comparative or the superlative form of the adjectives in the box.

<table>
<thead>
<tr>
<th>affordable</th>
<th>slow</th>
<th>long</th>
<th>environmentally friendly</th>
</tr>
</thead>
<tbody>
<tr>
<td>empty</td>
<td>fast</td>
<td>popular</td>
<td>quiet</td>
</tr>
<tr>
<td>short</td>
<td>convenient</td>
<td>fuel efficient</td>
<td>big</td>
</tr>
</tbody>
</table>

**Example** Engineers dream of an aircraft that will be faster and more environmentally friendly.

1 Ships with new combined gas and steam turbine electric engines are _________ than those with conventional engines.

2 At 59.39m, the Airbus A340-200 is _________ plane in the Airbus range.

3 Prices have fallen, so for most people, air travel has become _________ and they can enjoy holidays abroad.

4 For many people in the city, buses are _________ form of transport.

5 Gas powered buses have become _________ in recent years because of their low emissions.

6 On American roads, car sharing lanes for cars with two or more people are _________ than other lanes. So, people have _________ journey times.

7 Most people believe that of all forms of transport, roads have _________ impact on the environment.

8 Moving goods on canal boats is _________ than by road or rail, but people and wildlife benefit because it is also _________.

---

2 Look at the graph and decide if the sentences below are true or false. Correct the false ones.

**Example** Road transport is responsible for slightly less carbon monoxide than air travel.

*Road transport is responsible for a great deal less carbon monoxide than air travel.*

1 You can see that air travel produces far less pollution than other forms of transport.

2 Trucks produce slightly less sulphur dioxide than cargo ships.

3 There’s a large difference in the amount of hydrocarbons released by trucks and ships.

4 Cargo ships produce a good deal more nitrogen oxides than trucks.

5 Overall, cargo ships release far fewer exhaust gases than other forms of transport.

6 Road transport accounts for the smallest amounts of carbon monoxide but the highest amounts of particulates.
8 Communication

What are the most important features for future mass transportation systems in towns and cities?

Mass transportation systems for the future should
be fuel efficient.
be cheap to construct.
be cheap to maintain.
be comfortable.
be safe.
cause no pollution.
use alternative fuels.
operate only on demand.
look attractive.
be affordable for everyone.
be fast.
be quiet.
provide private personal space (individual / small group compartments).
be lightweight.
be powered by electricity.
have a low impact on the environment (take up little space).
be aerodynamic.
be automated (no driver).
travel on a dedicated network (own rails or road or corridor).
use only human body power.
9 Grammar test

1 Complete the sentences with the Present Simple or Present Continuous, Active or Passive, form of the verbs in brackets.

1 We can’t continue drilling. We _______ (wait) for the results to come back from the last core sample.

2 Geologists _______ (use) the readings from seismic surveys to make charts showing where oil or gas may be found.

3 We _______ (erect) the derrick at the moment and we _______ (hope) to start drilling in the morning if everything goes well.

4 Lou _______ (work) as a Roughneck until he has earned enough money to start his own business.

5 We all _______ (believe) there _______ (be) oil here, but sometimes as many as ten test wells _______ (drill) before any oil _______ (find).

6 Everyone on the rig _______ (understand) how dangerous it can be. Safety precautions _______ (enforced) strictly at all times.

2 Choose the best sentences from the box to follow on from sentences 1–7 below.

These workers will stay on the rig for ten weeks.
They also check the pipelines for any corrosion or damage.
They bring food and water, which are essential.
He’s looking forward to going back to his land-based job.
They’ll have to stop if the wind increases.
He’s applied for a new job.
Other workers on the oil rig prepare food.
They’re working hard to fix the kelly before the end of their shift.

Example

The crew operate the machinery which controls the flow of gas and oil.

Other workers on the oil rig prepare food.

1 The crew are working on the drilling equipment.

2 Helicopters transport personnel and provisions to the rig.

3 The helicopter is transporting the new crew.

4 Tony isn’t enjoying working off-shore.

5 Mark doesn’t enjoy working on the rigs.

6 Roustabouts have to regularly remove rust and repaint the rig.

7 Roustabouts are removing rust from one of the legs.
# 9 Communication

<table>
<thead>
<tr>
<th>tyre</th>
<th>crude oil</th>
<th>borehole</th>
</tr>
</thead>
<tbody>
<tr>
<td>mud</td>
<td>bit</td>
<td>kelly</td>
</tr>
<tr>
<td>helicopter</td>
<td>offshore</td>
<td>paint</td>
</tr>
<tr>
<td>refine</td>
<td>oil well</td>
<td>platform leg</td>
</tr>
<tr>
<td>gasoline</td>
<td>lubricants</td>
<td>bitumen</td>
</tr>
<tr>
<td>sea bed</td>
<td>aviation fuel</td>
<td>pipeline</td>
</tr>
<tr>
<td>derrick</td>
<td>Roughneck</td>
<td>blowout</td>
</tr>
<tr>
<td>hydrocarbons</td>
<td>chemicals</td>
<td>plastics</td>
</tr>
<tr>
<td>Geologist</td>
<td>Roustabout</td>
<td>rig</td>
</tr>
</tbody>
</table>
10 Grammar test

1 Use reported speech to complete what the people said.

**Example**

'We have increased waste recycling by 5% over the last year.'

_The Engineer explained that they had increased waste recycling by 5% over the previous year._

1 'The water treatment works will be completed in three months' time.'
_The Site Manager assured us that___________________________.

2 'The water supply has been contaminated by agricultural chemicals.'
_The Water Engineer warned the public that___________________________.

3 'I hope to get involved in projects in rural areas of India.'
_The Environmental Scientist told us that___________________________.

4 'I'm working on an environmental assessment report for a bridge to the island.'
_The Engineer mentioned that___________________________.

5 'We're looking forward to completing the sustainability report by the end of this week.'
_The Engineer said that___________________________.

6 'Paul and John inspected the site yesterday.'
_The Foreman reported that___________________________.

2 Read the description of an interview for a new position in a company.

First of all he asked me why I was applying for the job. Then he wanted to know why I thought I was the right person for the job. He asked me when I had joined the company and what I liked about it. Then he asked me what I knew about industrial processes and if I had ever been in a plastics factory. He asked if I was interested in doing a degree at university and if I could cope with the extra workload.

Now complete the interviewer's questions.

1 How did you become interested in this industry?

2 How do you think your previous experience was relevant to this job?

3 Can you tell me about a time when you had to work under pressure?

4 How do you think your skills will contribute to our company?

5 What are your strengths?

6 What do you like about working with people?

7 Do you think you have the necessary qualifications for this job?

8 What do you see as your biggest challenge in this role?
A. Sewage is water that is flushed from our toilets and sinks. It contains solids (such as paper, plastic, dirt and soil), chemicals (for example detergents and bleaches from washing up and cleaning), and disease carrying pathogens. Sewage is collected in a network of pipes called sewers and drained into the sewage treatment works.

B. The waste water is then pumped into large sedimentation tanks where solid organic matter sinks to the bottom to form a thick sludge.

C. From here, the sludge is moved to digester tanks where it is thickened and bacteria break down the organic matter further.

D. The treated water enters a final filtration in large circular sand beds.

E. Grit and sand settle out as water flows along deep, wide channels. This material is taken to landfill sites.

F. The thick sludge is sprinkled onto large circular beds about 2 meters deep that are filled with stones or clinker. Through a process known as biological filtration, bacteria break down the waste into carbon dioxide, water, and nitrogen-containing compounds.

G. Meanwhile, the waste water containing dissolved organic matter is taken from the top of the sedimentation tanks to aeration tanks. As organic matter decays, it uses up oxygen and aeration replenishes this oxygen.

H. On arrival, large metal grids screen it for large objects such as wood, cans, and plastic.

I. Disinfectant may be added to kill any remaining germs before the water is discharged into a nearby river.

J. The sludge is taken by tankers to be used as a fertilizer on fields or burnt to produce energy.
11 Grammar test

1. Underline and correct the six mistakes in this report on a robot designed for agricultural purposes.

Unwanted plants or weeds absorb many of the nutrients in the soil, preventing crops from develop fully. Now, an experimental solar-powered robot has been developed at the University of Illinois. An on-board computer enables the robot to distinguish between plants and weeds. The robot can place chemicals directly on the stems of the weeds and this stops farmers to wasting weed killers.

To begin with, scientists used a battery to power the robot but it had to be changed every two hours which prevented the robot to work for long periods of time. Now, they have built a curved solar panel over the robot which lets it to convert the heat of the sun into energy.

In the future, scientists intend to use different sensors and cameras on the robotic arms to allow them gaining information about soil properties and plant conditions.

2. Complete the sentences with the correct form of the words in brackets. Add prepositions or articles where necessary.

**EXAMPLE**

The oil pressure sensor detects low oil pressure which **causes a red light to shine / causing a red light to shine (cause / red light / shine)** on the instrument panel.

1. The driver-condition-detection sensor shakes the driver's seat, which ________________ (prevent / driver / fall / asleep).

2. The road-surface sensor detects the road is icy, which ________________ (cause / an ice warning / appear) on the instrument panel.

3. When the pneumatic sensor notices the air pressure in a tyre has fallen, a red light appears, ________________ (let / driver / know) which tyre has a problem.

4. The distance-to-vehicle-ahead sensor creates an audible warning sound ________________ (enable / the driver / see) if he / she is getting too close to another vehicle.

5. If the speed sensor detects the car is travelling faster than 250 km/h, the fuel supply to the engine is reduced, which ________________ (make / the car / slow down).

6. If the fuel sensor detects the fuel is contaminated, the supply to the engine is cut, which ________________ (stop / the engine / work).

7. If the door sensor detects a door is not closed properly, a light appears on the display panel ________________ (allow / the driver / see) which door it is.

8. The seatbelt sensor detects the driver has not fastened his / her seatbelt, ________________ (prevent / the car / start).
11 Communication

Start → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27 → 28 → 29 → 30 → 31 → 32 → 33 → 34 → 35 → 36 → 37 → 38 → 39 → 40 → 41 → 42 → 43 → 44 → 45 → 46 → 47 → Finish