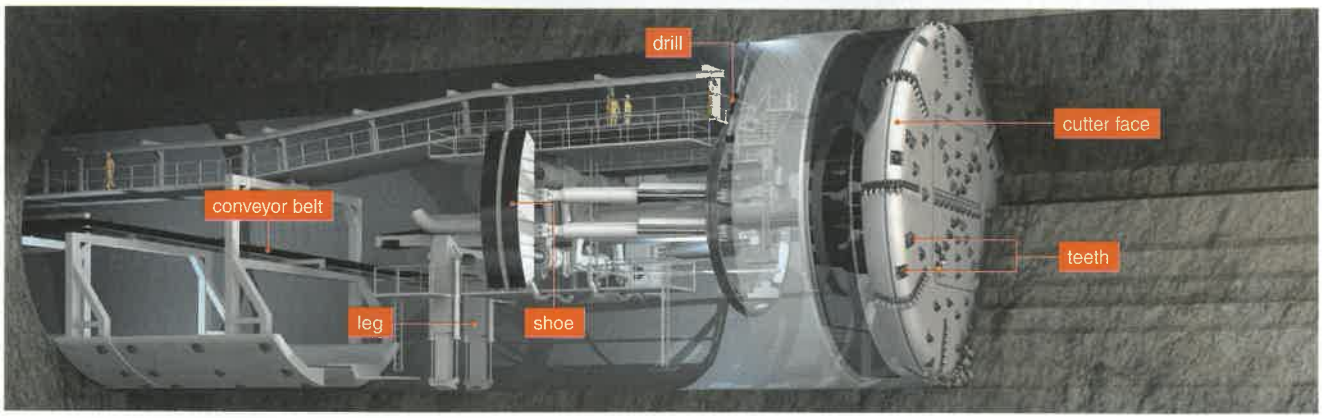
4 Processes

1 Infrastructure



Start here **1** What is this? What does it do? How does it work? Discuss with your partner.

Listening **2** 12 Listen and complete the specifications chart.

MB471/316 Tunnel Drill Specifications	
Length	
Diameter	
Speed	
Manpower needed	
Cost	

Reading **3** Read this article and put these headings in the correct place.

Collecting the rocks Controlling the movement Moving the cutter
Cutting the rock surface Strengthening the roof Supplying the electricity

THE MB471-316 TUNNEL DRILL – one of the largest hard-rock drills in the world

1 _____
The face of the cutter has 85 teeth. Each tooth is 60 cm long. The cutter face rotates about seven times a minute. When it rotates, the teeth cut large circles into the surface of the rock.

2 _____
Pieces of rock fall to the ground. They are collected by large scoops. They are then dropped into chutes. When the cutter face rotates upwards, the rocks fall onto conveyor belts. They are then carried to the rear of the machine.

3 _____
Hydraulic cylinders push the body of the cutter slowly forwards. As it moves forwards, steel shoes move outwards and grip the tunnel walls. At the same time, two legs push down and lift the machine off the floor.

4 _____
Fifteen electric motors supply the machine with 6,375 horsepower. The power is connected to the cutters by means of a 13,800-volt cable.

5 _____
There are two drills attached to steel arms. These are located immediately behind the cutters. When the machine moves forwards, holes are drilled into the roof of the tunnel. Then the holes are filled with bolts and cement. This strengthens the roof.

6 _____
The machine operator sits in a cabin at the heart of the machine. Here he/she controls its speed and direction. Video cameras monitor the cutter and the tunnel.

Vocabulary **4** Make a list of all the names of parts of the body and clothing in the text in 3.

5 List other technical contexts where the items in 4 are used.

Example: 'teeth' are also found on gears.

Language In an active sentence, the subject = the agent. The subject does the action.

Subject = agent	Active verb	Object
Hydraulic cylinders	push	the cutter.
Large scoops	collect	the rocks.

In a passive sentence, the subject is NOT the same as the agent. The subject does not do the action. The agent does the action to the subject.

Subject	Passive verb		Agent
	be	Past participle	
The cutter	is	pushed	by hydraulic cylinders.
The rocks	are	collected	by large scoops.

6 Change this set of instructions into a description of a process, using the passive and the words in the box.

finally first next now then

How to change the oil in a car

1	Run the engine for a few minutes.	5	Put the oil drain plug on
2	Switch off the engine.	6	Take off the oil filler cap.
3	Take off the oil drain plug.	7	Pour in the new oil.
4	Empty the old oil into a container.	8	Put the oil filler cap back on.

Begin: First the engine is run for a few minutes. Then it is switched off. Now the …

7 Make a set of instructions about a process you know about. Then rewrite it as a process description in the passive.

Examples of processes: food manufacture, steel making, canning, assembling computer components, manufacturing a CD, dairy processing.

8 Fill in the gaps, using the correct form of the verbs in brackets.

1 Large drills _____ (make) holes in the roof of the tunnel. Then the holes _____ (fill) with bolts and cement.
2 A large propeller _____ (push) the hovercraft forwards. The propeller _____ (drive) by a powerful engine.
3 Hot water _____ (flow) from the engine into the radiator. Here it _____ (cool) by the fan.
4 The robot _____ (monitor) by a computer. This computer also _____ (control) all the other robots in the building.
5 First, the rusty machine parts _____ (bring) into the factory. Then they _____ (clean). Then the rust _____ (remove). Next the parts _____ (paint). Finally, they _____ (take) out of the factory again.

9 Make a list of headings for the main stages of a process you know about. Make each heading begin with a verb ending in ***-ing***, like the ones in 3.

Example: Moulding and shaping steel – 1 Melting the steel; 2 Casting; 3 Cooling; 4 Rolling the steel; 5 Straightening; 6 Cutting.

10 Give a short talk to the class explaining your process. Use your headings.

PEARSON

2 Technological change

Start here

1 Work in pairs. What are the 10 most important tools in the history of mankind? Make a list and put them in order of importance.

Note: the tools must be *hand-held* or *easily portable*. Do not include *simple machines* (such as levers or pulleys), *heavy machine tools* (like hydraulic jacks) or *complex, self-running machines* (such as cars, windmills or computers).

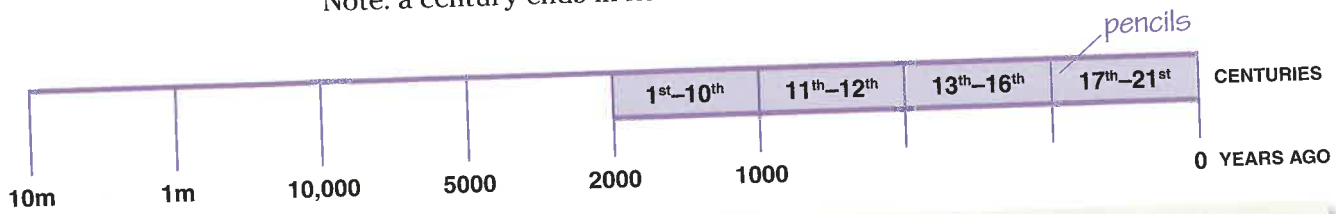
2 Explain your list to the class. Give reasons for your group's choice.

3 Compare your list with the results of a survey on page 111. Do you agree with their list? Give reasons.

Reading

4 Read this magazine article and mark the inventions on the timeline.

Note: a century ends in its own number. The 14th century is 1301–1400.



Tools through the ages

THE FIRST KNIVES were made about two and a half million years ago. They were crafted by early ancestors of modern humans. At first, sharp pieces of stone were broken off a rock, but in later times they were sharpened and straightened into blades.

The abacus is one of the first mechanical counting devices, an ancestor of today's computers. It consisted of a frame containing beads on wires. The modern abacus was designed by the Chinese around the year 1200.

The compass allowed sailors to navigate across oceans and discover new worlds. The compass was invented by the Chinese about 2200 years ago. A spoon-shaped piece of magnetic rock was balanced on a flat surface. Since it was magnetic, the handle rotated to align itself with the Earth's magnetic poles.

The first mass-produced pencils were made in Germany in 1662, which helped writing and education to develop.

The harness lets people control horses and attach them to carts. It was probably invented about 6000 years ago, when horses were first tamed and kept.

The scythe allows people to cut grass and harvest crops from the field. It consists of a long wooden shaft with handles on the end and in the middle, and a long curved blade on the other end. The blade is sharp on the inside. It was first used in Europe in the 12th century.

Glasses (or spectacles) make workers more productive and accurate, and allow people to work into old age. Mathematical calculations for a spherical lens were first made by Arab scientists in the 11th century. The first spectacles were manufactured by Italian craftsmen in the 13th century.

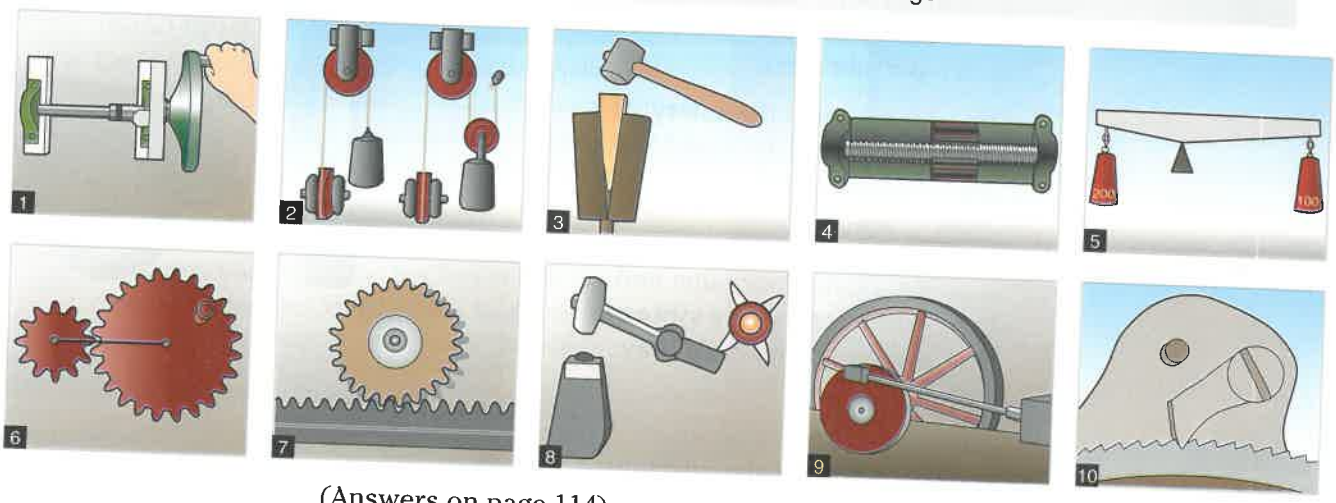
Saws were first used by the Egyptians more than 5000 years ago to cut both wood and stone. They were made of copper.

The first balance scales were seen in southern Mesopotamia about 9000 years ago. They consisted of two weighing pans attached to either end of a beam, which was balanced on a central pivot. They allowed merchants to calculate the exact weight of goods.

The chisel consists of a long, narrow, sharpened edge attached to a handle. It's different from a knife or axe, because it is driven by a sharp blow from a hammer or mallet. The earliest chisels were made from flint (a kind of stone) 10,000 years ago. Later, they were used by the Egyptians to carve stone for the pyramids.

Vocabulary **5** Do you know these simple machines? Match the pictures with the words and phrases in the box.

cam and follower | crank and rod | gear | lever | pulley and belt | rack and pinion | ratchet and pawl | screw | wheel and axle | wedge



(Answers on page 114)

6 Which of these simple machines are used in your industry or technical field? How are they used? Explain to the class.

Language **7** Complete this article about the history of oil drilling. Use the correct form (present or past, active or passive) of the verbs in brackets.

Drilling for oil – past and present

Long ago, wells (1) were dug (dig) in the ground using percussion drilling. A heavy wooden cutting tool (2) _____ (suspend) by a rope from a pulley on a wooden tripod. The tool (3) _____ (pull up) by hand or steam engine, and then it (4) _____ (drop) into the hole. The rock (5) _____ (break) by the weight of the tool. The maximum depth was only about 70 metres.

Nowadays, much deeper oil wells of 700 m (6) _____ (dig) using a method called rotary drilling. A sharp drill bit (7) _____ (suspend) by a drill string from a pulley on a steel derrick. The drill bit (8) _____ (rotate) in the hole by a powerful engine. The rock (9) _____ (break) by the rotation of the drill bit.

Now there is also a new method of drilling which (10) cuts (cut) the rock using lasers. No cutting tool or drill bit (11) _____ (use). Instead, the rock (12) _____ (split) by beams of high-energy light. A fibre-optic cable (13) _____ (carry) the light from the lasers on the surface down the hole to a set of lenses. The lenses then (14) _____ (focus) the light to a sharp point on the rock face, which (15) _____ (cut) almost 100 times faster than by a drill bit. As a result, the cost of drilling (16) _____ (reduce), and drilling jobs (17) _____ (complete) much more quickly.

Task **8** Work in small groups.

- Choose an industry or work process which you know something about. *Examples: building, heavy lifting, fishing, mining, road-building, communications, sea or land travel, heating, lighting, pumping, irrigation*
- How was the work done in the past? How is it done now? Make notes showing the contrast between past and present.
- Explain your group's ideas to the class.

2 Sensors

Start here

1 Which of the following is ***not*** a sensor? Why not?

2 What other sensors can you think of?

3 With a partner, write a definition of a sensor. Use these or other words.

sensor, device, detect, change (n), environment, convert, data

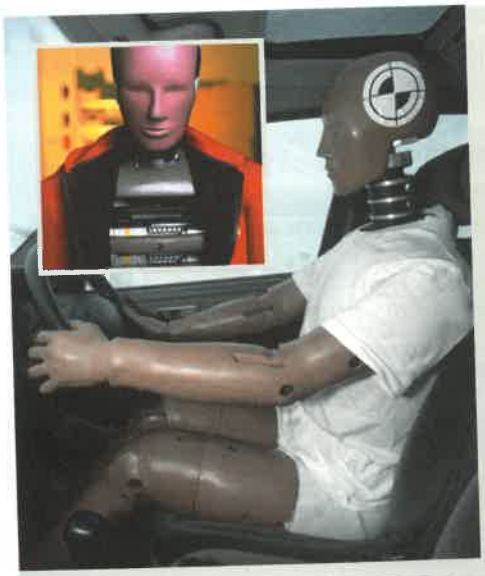
Begin: A sensor is …

Reading

4 Discuss with your partner.

- What's happening here?
- What are the engineers trying to measure?
- What kind of sensors are used?

5 Read this article and complete the statements below using these words: ***acceleration***, ***load***, ***motion***.



Two different crash test dummies are used in standard European vehicle crash tests. The first dummy is used for front impact crashes, and the second one is a side impact crash dummy. The dummies, which are made of steel, aluminium and rubber, contain many sensors.

Three types of sensing equipment are used: *acceleration sensors*, *load sensors* and *motion sensors*. The dummy heads contain three accelerometers (single direction acceleration sensors) which are set at right angles (forward–backward, up–down, and left–right). The dummy necks contain load sensors to detect the bending forces, shear forces and tension forces, which put pressure on the neck in a crash. The dummy legs contain load sensors, which measure the bending, shear, compression and tension forces on the leg.

In addition, a front impact crash test dummy has steel ribs fitted with motion sensors which record front rib movement. A side impact dummy has motion sensors which record side chest deflection (or inward movement), and load sensors to measure compression forces on the chest.

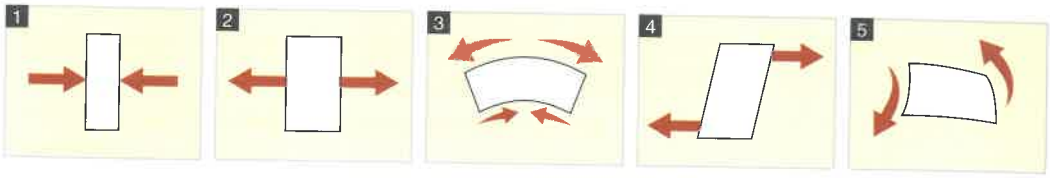
Three types of sensors are used in crash test dummies:

1 _____ sensors measure deflection (inward movement) of a body part during a crash.

2 _____ sensors measure how much a body part increases or decreases speed during a crash.

3 _____ sensors measure the force or pressure on different body parts during a crash.

Vocabulary **6** Match the diagrams with (a) the names of the forces and (b) their descriptions.



(a) bending, compression, shear, tension, torsion
(b) squeezing or pressing together; sliding in opposite directions; stretching or pulling apart; twisting; squeezing one side + stretching the other side

Language Noun + noun combinations are very common in technical English.

Examples: acceleration sensors (= sensors which measure acceleration); *vehicle crash tests* (= tests which crash a vehicle to measure its safety); *a side impact crash dummy* (= a dummy which measures the impact from the side in a crash).


gas flow meter


engine speed dial


tyre pressure gauge


bass volume indicator

7 Find phrases in the article in 5 which mean the same as these. All the words in the phrases must be nouns.

1 forces which pull something apart
2 sensors which detect movement or motion
3 deflection of the side of the chest
4 crashes which are caused by an impact from the front
5 a dummy which is used for testing the impact of a crash from the front

8 Expand these phrases. You can change words and add information.

1 a gas flow meter = *a meter which measures/for measuring the flow of gas (along a pipe)*
2 an engine speed dial = _____
3 a tyre pressure gauge = _____
4 a bass volume indicator = _____
_____
5 an air pressure sensor = _____
_____
6 a fuel intake port = _____

9 Make full sentence definitions from 8.

Example: 1 A gas flow meter is a meter which measures the flow of gas along a pipe.

Task **10** List some sensors used in your industry. Complete a table like this one. If possible, work in small groups with others from the same industry.

Industry: civil engineering and construction		
Name of sensor	**Function/Use**	**Application**
strain gauge	to measure deformation of structures	high-rise buildings, bridges, roads

11 Explain to the class about the sensors you have listed in your table.

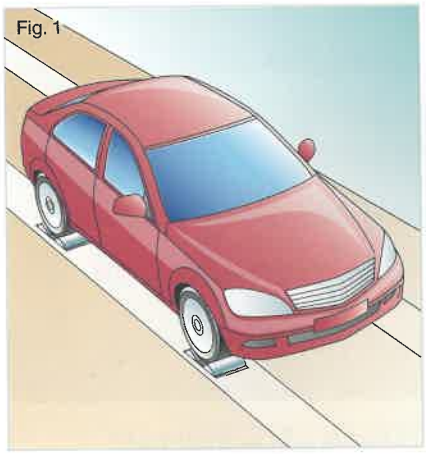
In the field of civil engineering and construction, strain gauges are used for measuring the deformation of structures. They're used in high-rise buildings, bridges and roads, for example.

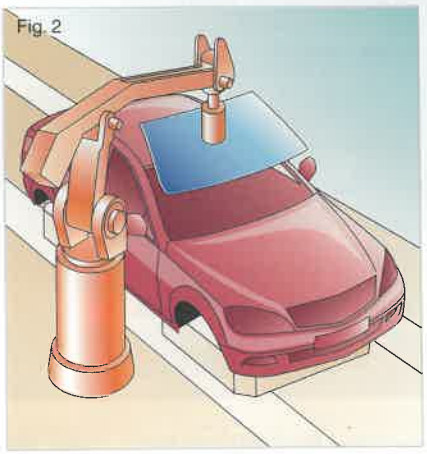
2 Manufacturing

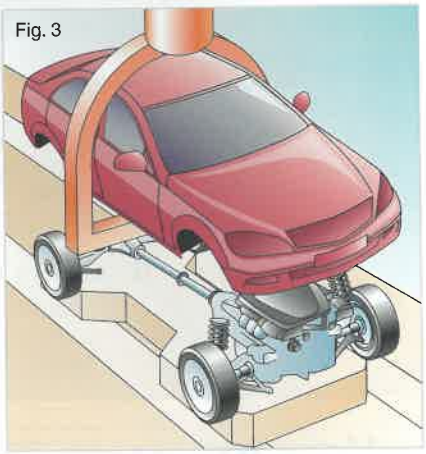
Start here

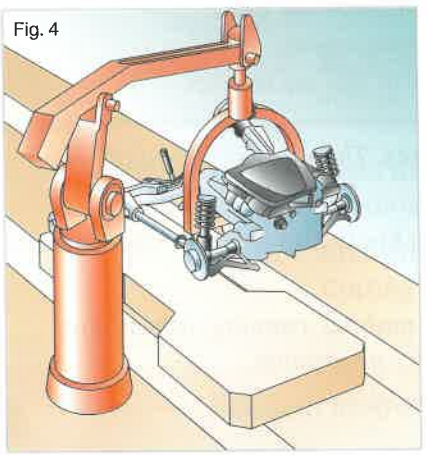
1 What do you know about cars? Discuss with a partner the location and function of these parts: *body*, *chassis*, *drive shaft*, *axle*, *transmission*.

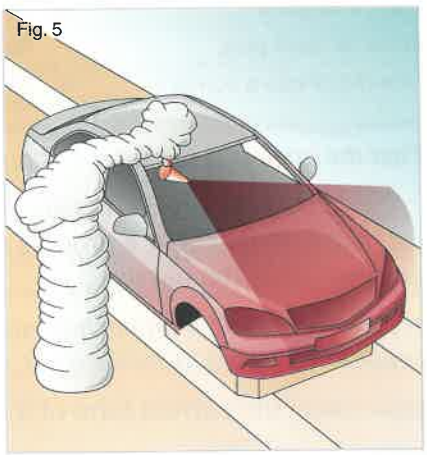
2 The photos show the main stages in assembling a car, but they are in the wrong order. Write the figure numbers in the correct boxes in the flow chart.

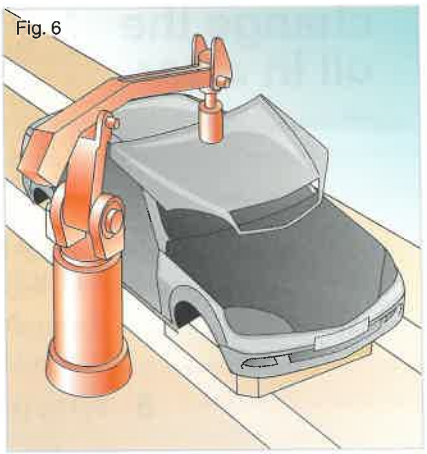


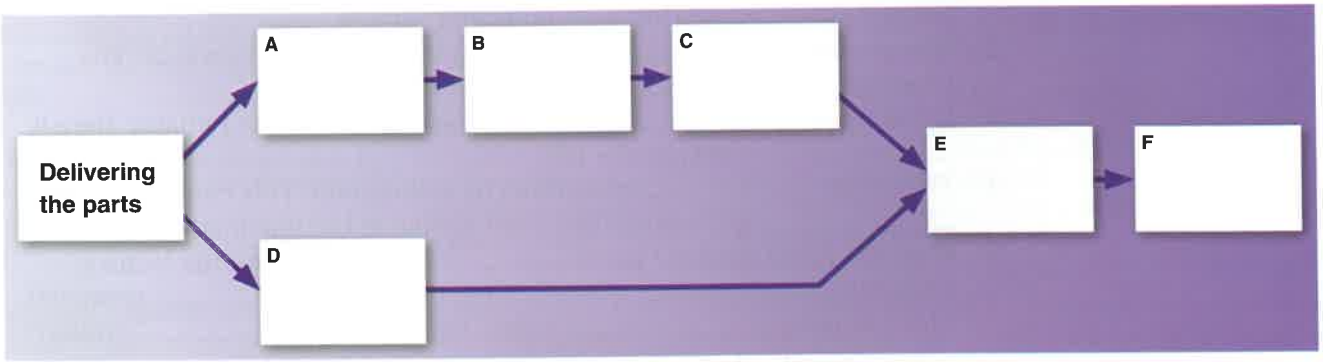












3 Make captions for the six photos with the verbs and nouns in the box. Use verbs ending in ***-ing***.

add	attach	install	paint	test	weld	body	chassis	finished car	parts

Example: Fig 6. Welding the body panels to the body frame.

Reading **4** Read this website of a car company and check your answers to 2 and 3.

Assembling a car

First, the parts are delivered by truck or rail to the *delivery area* of the car assembly plant. From here, some parts are taken to the body shop, and other parts are transported to the chassis line. The parts are carried around the plant by forklift trucks or conveyor belts.

In the *body shop*, the panels are welded to the frame to form the body of the car. This is done by more than 400 robots.

Then the body is taken to the *paint shop*. Here it is cleaned and painted by robots. Special clothing is worn by the robots to protect the paint. After this, the body is checked by human workers to look for faults.

Next, the painted body moves along a conveyor belt to the *trim line* and many parts are added to it. For example, the instrument panel, the air conditioning system, the heating system and the electrical wiring are all installed here. The windscreen is inserted by robots using laser guides.

Meanwhile, in the *chassis line*, components are added to the chassis. First, the chassis is turned upside down, to make the work easier. Then the fuel system, the transmission, the suspension, the exhaust system, the axles and the drive shaft are all installed. Next the chassis is turned over (rightside up). The engine is lowered into the chassis and connected to it.

Now the chassis and the body move simultaneously to the *final assembly line*. Here the body is attached to the chassis, and all the final parts are added. The tyres and the radiator are added here. The hoses are connected, and the radiator and air conditioner are filled with fluid. The car's central computer is also installed here.

Lastly, the finished car and all electrical systems are tested. The car is filled with fuel and the engine is started for the first time. The car is put on special rollers to test the engine and the wheels. If it passes the test, the car is finally driven out of the assembly plant.

Language *to* + verb is used to talk or write about the purpose of an action.

Why do you paint the car body? To protect it from rust.
The car body is painted to protect it from rust.

Speaking **5** Match actions with their purposes. Refer to the text in 4.

	action		purpose of action
1	workers weld thin metal sheets to a frame	a)	to check the movement of the wheels
2	they turn the chassis upside down	b)	to make the car body
3	the robots wear special clothes	c)	to inspect it for faults in the paint
4	they turn the chassis rightside up	d)	to protect the wet paint from dust
5	workers put the finished car on rollers	e)	to install the fuel system easily
6	workers check the car body by hand	f)	to lower the engine into it

6 In pairs, ask and answer the questions in 5. Use the passive form in the question.

A: Why are thin metal sheets welded to a frame?
B: To make the car body.

7 Ask questions to get these answers. Refer to the text in 4.

1 They're delivered by truck or rail.
2 They're welded together in the body shop.
3 They're carried by forklift trucks or conveyor belts.
4 To look for faults in the paint.
5 It's done by human workers.
6 It's done using laser guides.

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