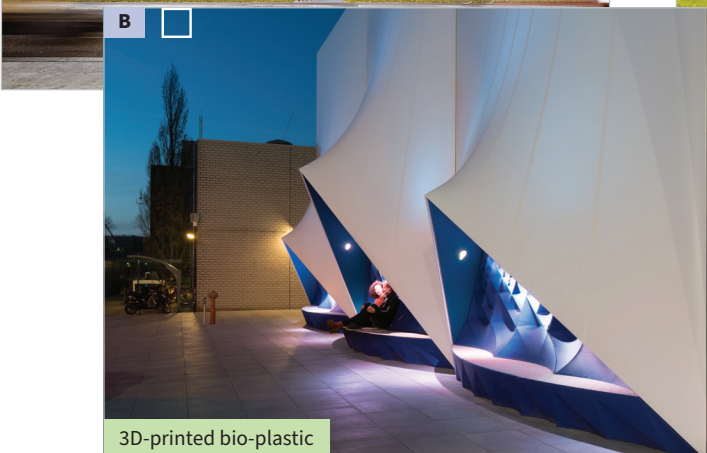


1 Future shapes

START HERE » 1 Work in pairs. Look at the photos and read their captions. Discuss these questions.

- 1 What do these mean: *composite, bio-, recycled, fibre, 3D-printed*?
- 2 What are the car/buildings/plane made of? Where do the materials come from?



LISTENING » 2 2.1 Listen to the news reports. Write the report numbers (1–4) on the photos.

3 Listen again.

- 1 Make notes in the chart using information from the news reports.
- 2 Compare your notes with a partner.

	Europe House	Airbus	Luca	Cube
Material	<i>bio-plastic</i>	<i>CFRP</i>		
Source	<i>a plant</i>			
Method	<i>3D printing</i>	<i>carbon fibres in plastic resin</i>		
Prediction	<i>will be more common</i>			
Advantages	<i>can recycle</i>			

READING » 4 Read the article and write the letters of the paragraphs A–G which deal with these types of prediction about the future.

- 1 certainty A ___ ___
- 2 possibility ___ ___ ___
- 3 probability ___ ___ ___

The future of plastic composites in the design of cars, planes and buildings

- A** The world will definitely be very different in 20 years' time. There's no doubt that plastic composites will play an increasingly important role.
- B** In aerospace, for example, engineers will probably be able to construct practically the whole aircraft entirely from plastic composites.
- C** It is even possible that all the plastics used in a plane will be bio-composites, made from renewable natural materials, instead of composites made from petroleum.
- D** In the automotive industry, experts are certain that electric vehicles (EVs) will be manufactured almost entirely from recycled plastics.
- E** However, it is unlikely that every part in an EV traction motor will be made of plastic composites.
- F** Car designers in the future certainly won't waste time trying to make plastic internal combustion engines (ICEs).
- G** As for the construction industry, architects are likely to design larger and more complex buildings made almost entirely from plastic composites using 3D printers.

5 Tick the predictions below which are the same as the ones in the article in 4. Write the letter of the paragraph which includes the prediction.

- 1 They'll possibly use bio-composites for all the plastic parts in a plane. ___
- 2 It's likely that they'll make almost a complete plane from plastic composites. ___
- 3 They'll probably make EV motors 100 percent from plastic composites. ___
- 4 They definitely won't attempt to make a plastic engine for petrol cars. ___
- 5 They'll probably make large buildings entirely from plastic composites. ___
- 6 They'll definitely make EVs almost completely from recycled plastics. ___

LANGUAGE »

It's certain that they will They will certainly/definitely	make recycled plastic cars not make plastic petrol engines.
It's probable/likely that they will They will probably	make all-plastic planes. not make all-plastic motors.
It's possible that they will They will possibly	make planes from bio-composites. not make planes from petroleum composites.

6 Say each of the predictions in 5 in a different way with the same meaning.

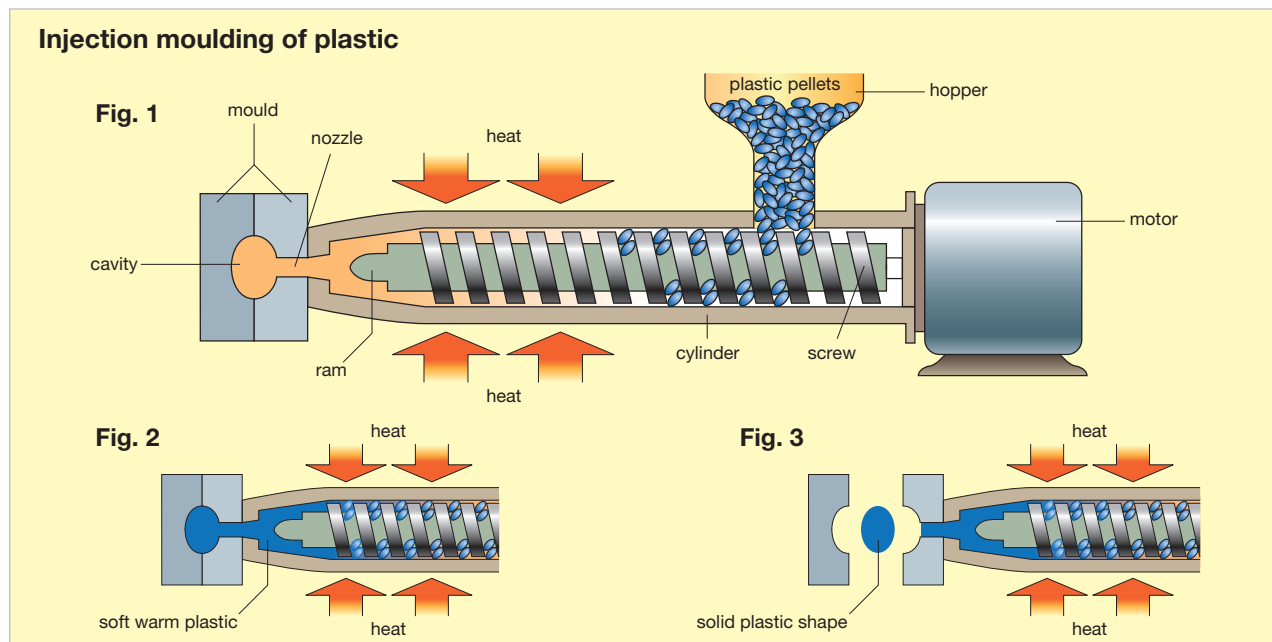
Example: 1 *It's possible that they'll use bio-composites for all the plastic parts in a plane.*

SPEAKING » 7 Go round the class making predictions. Express either *certainty, probability or possibility* about each one.

Example: *I think that we will probably find some life on Mars, but it's unlikely that we'll find any life on Saturn or Jupiter.*

2 Solid shapes

START HERE » 1 In pairs, discuss the process illustrated in the diagrams and answer the questions.



- 1 Why is heat used?
- 2 What is the function of the screw?
- 3 Which of the following items do you think are shaped using this process?



READING » 2 Rearrange these sentences into the correct order according to the diagrams in 1.

- a) The mould opens and the cold, hard, solid plastic shape is ejected.
- b) The screw stops rotating and then a ram in front of the screw moves straight forward.
- c) Small pieces (or pellets) of plastic are fed from the hopper into a cylinder.
- d) The soft, warm plastic is pushed towards a nozzle by the ram.
- e) The pellets are pushed along the cylinder by a rotating screw and heated.
- f) Inside the cavity, the plastic is cooled by the mould and becomes hard.
- g) The soft plastic is injected through the nozzle into a shaped cavity between the two halves of a mould.

3 Check your answers to the three questions in 1.

VOCABULARY » 4 Find two words in 2 which contain the letters 'ject'. Which one means *thrown out* and which one means *pushed in*?

LANGUAGE » With an *active verb*, the *subject* = the *agent*. The subject carries out the action.

subject = agent	active verb	object
A rotating screw	pushes	the plastic pellets.

With a *passive verb*, the *subject* ≠ the *agent*. The subject does not carry out the action. The agent does the action to the subject.

subject	passive verb		agent
	be	past participle	
The plastic pellets	are	pushed	by a rotating screw.

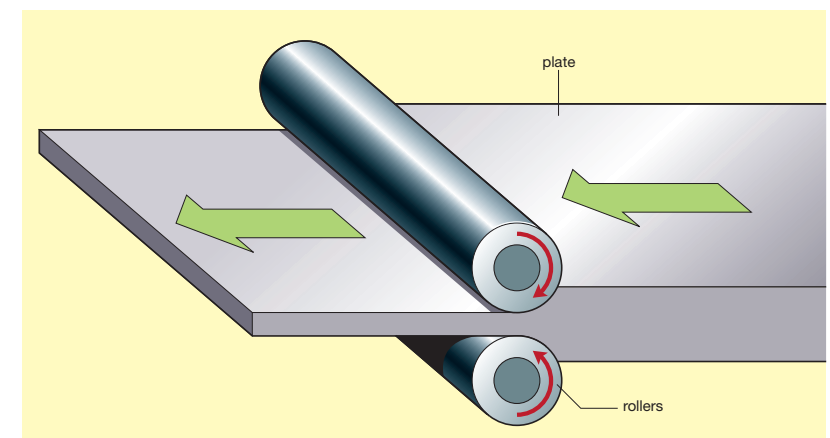
5 Look at the diagram in 1 again and complete these sentences, using the active or passive forms of the verbs in brackets, as appropriate.

- 1 Plastic pellets _____ (store) in a hopper at the top of the machine.
- 2 The pieces of plastic _____ (transfer) from the hopper into a cylinder.
- 3 The plastic _____ (propel) along the cylinder by a rotating screw.
- 4 The heaters around the cylinder _____ (raise) the temperature of the plastic.
- 5 As a result, the soft, warm plastic softens and _____ (flow) more easily.
- 6 The plastic _____ (force) under pressure through a small nozzle.

WRITING » 6 Rewrite the paragraph below. Improve it by changing some (but not all) of the verbs to the passive form. Where appropriate, delete the agent. Make any other necessary changes. Begin some sentences with *First*, *Next*, *Now* and *Finally* as appropriate.

The metal-rolling process

Someone adjusts the gap between the rollers to the correct width. Someone switches on the motor and the heavy rollers begin to rotate in opposite directions. A worker heats the metal plate. Then something pushes the hot metal plate through the gap between the rollers. As the hot metal moves between the rollers, the rollers compress it to a thinner shape. The metal comes out from the rollers in the form of a metal sheet. Someone then cools the metal sheet.



SCANNING » 7 Practise your speed reading. Look for the information you need on the **SPEED SEARCH** pages (115–117). Try to be first to answer these questions.

Which plastic is used for making:

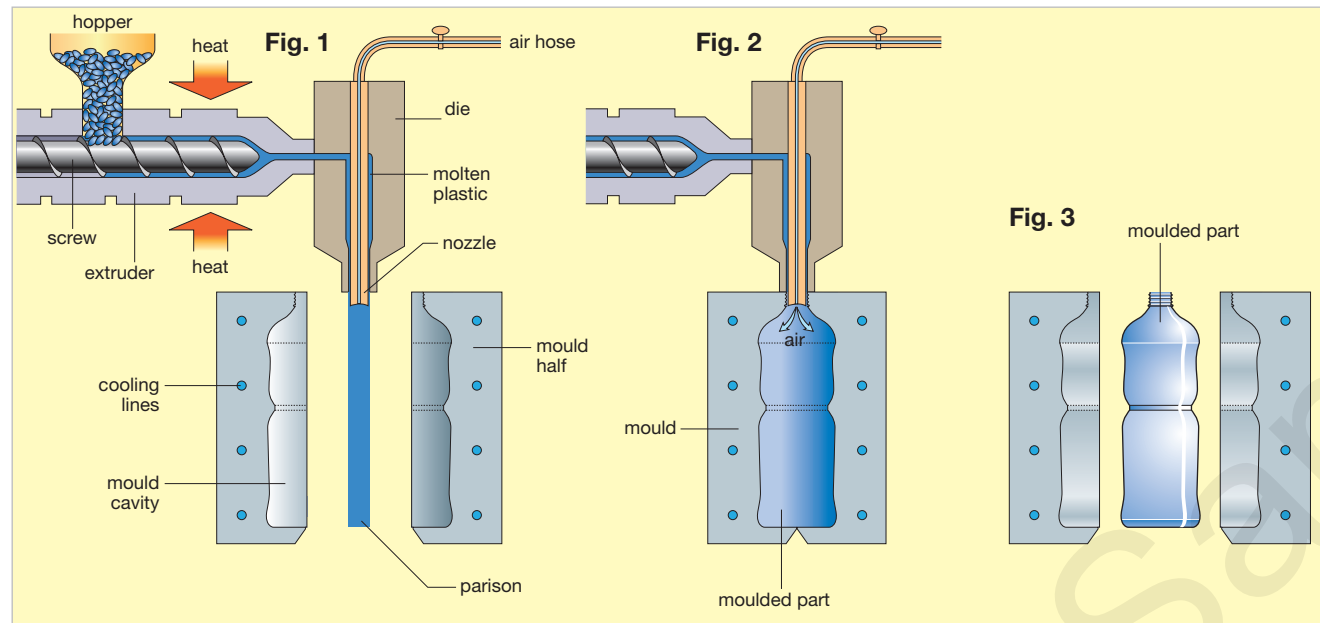
- 1 goggles _____ ?
- 2 oars _____ ?
- 3 volleyball nets _____ ?

3 Hollow shapes

START HERE » 1 Work in pairs. How do you think the plastic items in the main picture were shaped? There's a clue in the two smaller photos.



LISTENING » 2 With your partner, study the illustrations and then rearrange the notes below into the best order for a talk on extrusion blow moulding.



The extrusion process (See Fig. 1)

- movement of warm, soft molten polymer along cylinder
- extrusion of molten polymer into mould
- heating and melting of polymer pellets
- transfer of polymer pellets from hopper to cylinder of extruder
- movement of cold polymer pellets along cylinder
- rotation of screw

polymer = plastic
molten = melted

The blow moulding process (See Figs. 2 and 3)

- cooling of plastic bottle shape
- expansion of polymer to fit shape of mould
- blowing of compressed air into molten polymer
- ejection of plastic bottle from open mould
- inflation of molten polymer by compressed air
- closure of two halves of mould with molten polymer inside

3 **2.2** Listen to this talk and check the order of your notes.

4 Listen again and fill in the gaps with these phrases.

illustrates shows can be seen is shown is illustrated can see

- 1 As you _____ in Figure 1, there is an extruder at the top left ...
- 2 As _____ in Figure 1, there is a ninety-degree angle ...
- 3 As Figure 1 _____, the hot, soft plastic is extruded down ...
- 4 Then, as Figure 2 _____, the two halves of the mould close.
- 5 The second stage _____ in Figure 2.
- 6 The third and final stage _____ in Figure 3.

VOCABULARY » 5 Make a list like the one below. Write the first word from each note in 2 above in the noun column and write the related verb in the verb column.

noun	verb
movement	move

LANGUAGE » 6 Change the notes in 2 into full sentences, using the verbs from 5. Write them in the correct order. Use either active or passive verbs, as needed.

Examples:

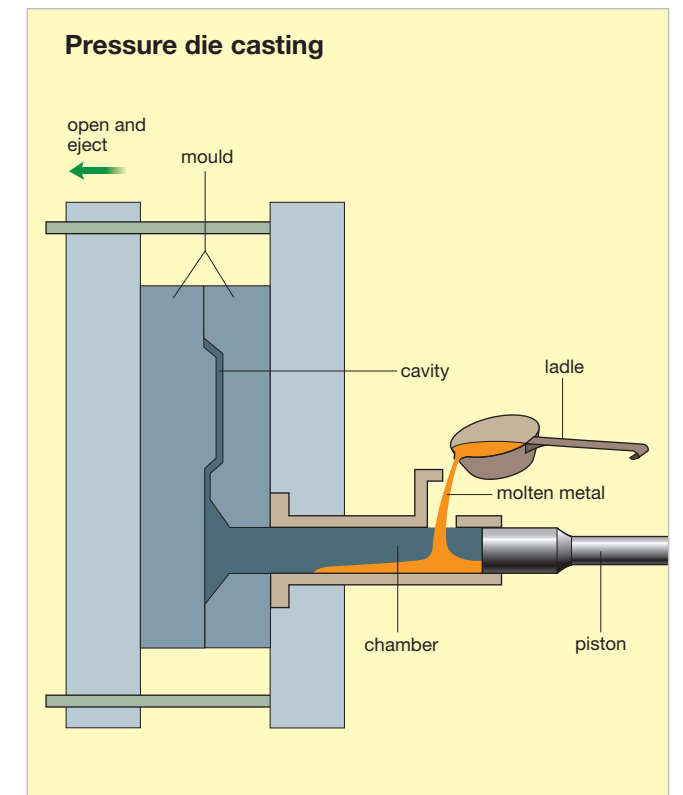
- 1 The polymer pellets are transferred from the hopper to the cylinder of the extruder.
- 2 The screw rotates.

WRITING » 7 Study the diagram and the notes below and write an explanation of the process of pressure die casting. Use *First*, *Then*, *Next* and *Finally*, and the passive where appropriate.

Begin: *First, some metal is heated until it melts. Next, the molten metal ...*

Pressure die casting

- heat metal until it melts
- pour molten metal into chamber
- piston moves along chamber
- piston pushes molten metal under pressure into cavity
- cavity is between two halves of mould
- molten metal fills cavity
- metal cools and becomes solid
- open mould
- eject solid metal component from mould



SPEAKING » 8 Explain the process in 7 to the class or to a partner. Do not look at your writing. Refer to the diagram where appropriate, using phrases from 4.

Example: *Next, as you can see in the diagram, the molten metal ...*