



*A cricketer wears face, body and leg protection against the impact of a very hard ball and fast bowling*

Sometimes it is necessary to provide the face and eyes with protection from other hazards. Swimmers and divers need to protect their eyes from the water, and so a different form of mask is required.

4



*An ice hockey player has face protection and padding for protection against the impact of the puck - and other players!*

**Q** Question

- 3 Look at these pictures. How have they tried to solve the problem of protection?
- 4 Why are the solutions different?
- 5 Why do you think that this form of face protection is more common nowadays than it used to be?

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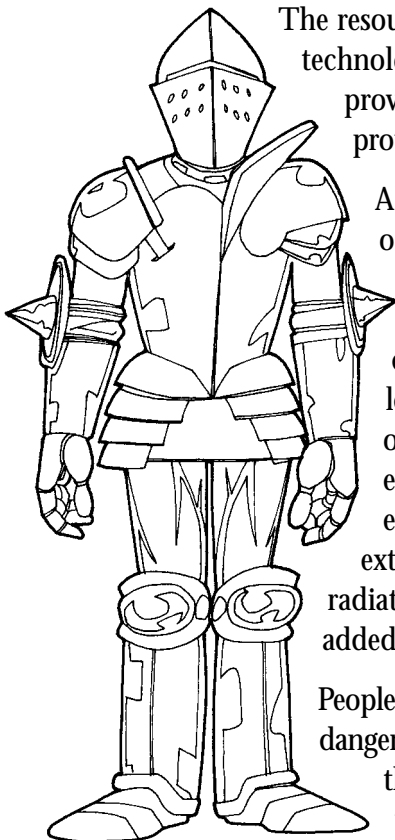
# Taking cover

# 1

The resources of design and technology have been used to provide better forms of protection for the head and face.

Although the human body offers its own defence against many forms of attack, there are numerous dangers that can prove harmful or even lethal. Our skin can protect our inner organs to some extent, but when faced, for example, with excess heat, extreme cold, flying objects, radiation or chemicals, we need added protection.

People have always recognised such dangers and have tried to protect themselves. In the past armour was used for protection in

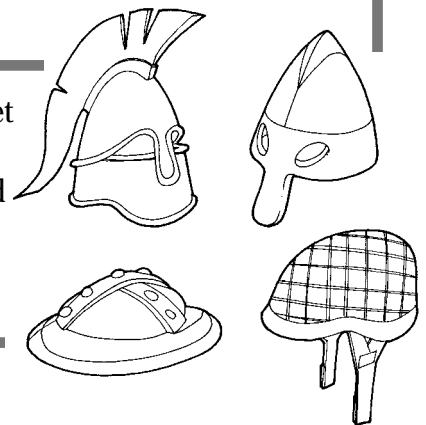


1

**Q** Question

- 1 Look at the suit of armour shown here. Why do you think it stopped being used?
- 2 What took its place?

warfare. From just a helmet and leg guards in Bronze Age Greece, this developed into full body armour in sixteenth century Europe.



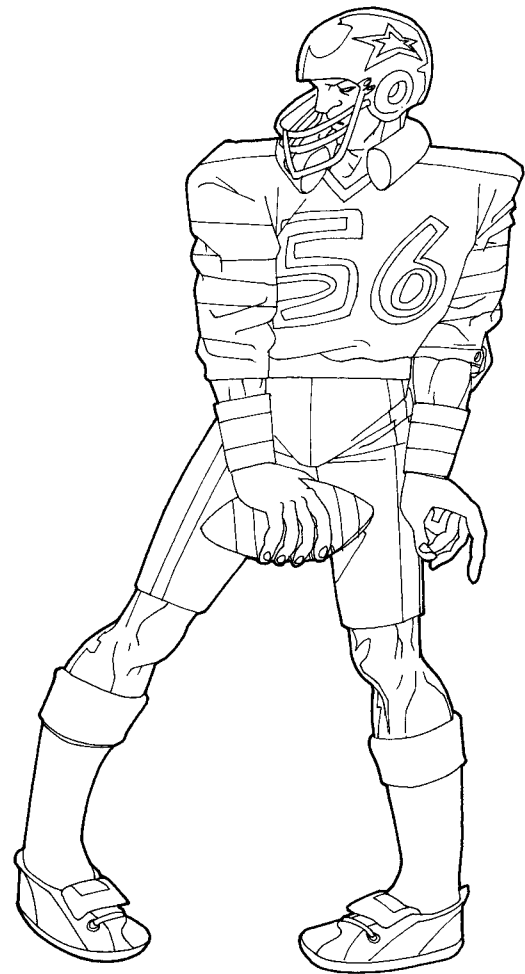
**R** Research

The pictures show examples of helmets from different periods in history. Find out how head protection has changed over the centuries. What are the differences in the materials used? Collect pictures to show the differences between periods.

The face is a specially sensitive area. We depend on our eyes, in particular, for information about our surroundings, so it is hardly surprising that much attention has been paid to protecting the face.

### ***Sporting lives***

Sport is sometimes described as a modern form of warfare. This certainly seems true judging by the protective clothing now worn in some sports! Protective headgear is becoming more and more common for people taking part in high-risk sports. New materials have been developed so that lighter but stronger headgear can be made. These improve the protection available to cricketers, hockey players and American footballers, among others. They are all designed to offer protection against fast-moving objects.

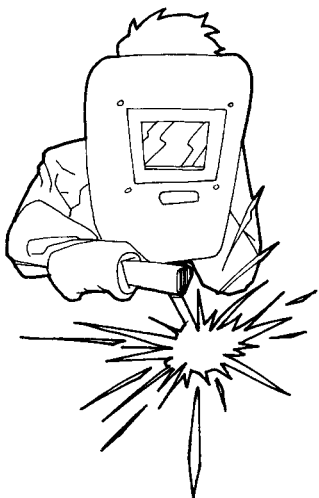


***An American football player wears padding and a crash helmet for protection against impact.***

2

### ***At work***

Safety at work is very important. Much stress has been placed on protecting our face and eyes from possible injury. Methods range from wearing a pair of goggles to protect eyes from flying debris to wearing a complete hood and ventilation system to protect from dangerous chemicals or gases.



***A full-face mask protects the face and eyes from hot flying sparks and the blinding flash of the welding***



***A mask and a respirator for a firefighter protect against debris, gas, heat and smoke.***



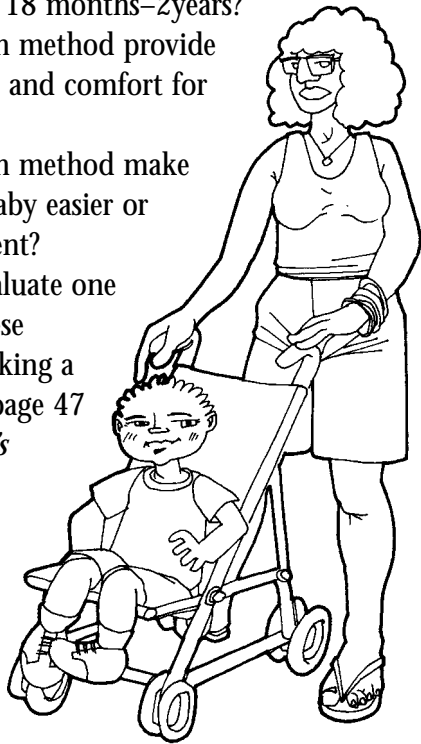
***A clear plastic visor gives good visibility and protects from flying debris.***

3

**Q Question**

3 Four ways of carrying babies are shown here.

- a Which method would you choose for each of these age ranges: 0–3 months, 3–6 months, 6–18 months, 18 months–2 years?
- b How does each method provide safety, warmth and comfort for the baby?
- c How does each method make carrying the baby easier or more convenient?
- d If you can, evaluate one or more of these methods by taking a user trip (see page 47 of the *Student's Book*).



4

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# Carrying

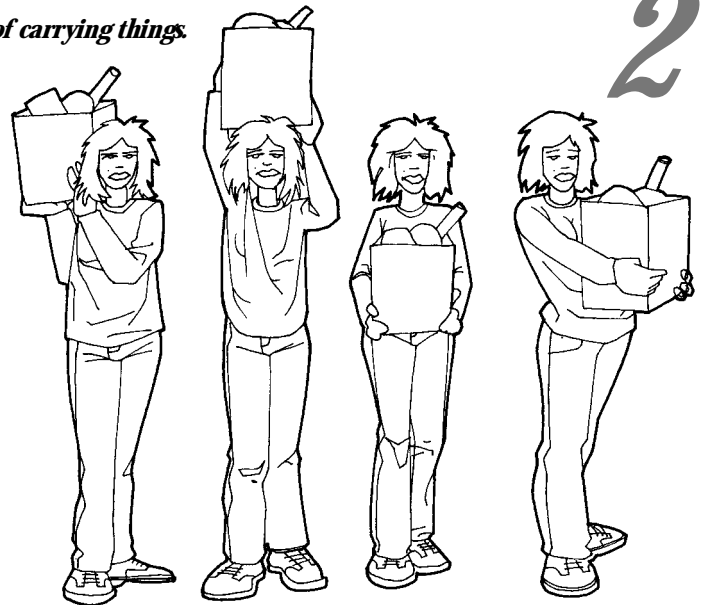
Four ways of carrying things.

## People carrying things

Loads people carry include water from the well, tools and equipment, crops, firewood, goods to and from market and personal possessions.

**Q Question**

- 1 Different ways of carrying loads are shown in these pictures. For each one, decide:
  - a which parts of the body are being used to lift the loads;
  - b which parts are being used to support and balance the loads;
  - c which parts may get tired or sore.



2

## Designing carriers

People design carriers to make carrying easy.

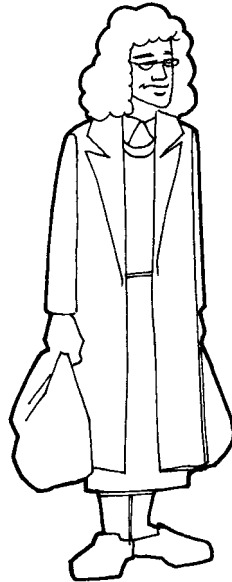
The design depends on:

1

- the load – how heavy it is, how bulky, how fragile, whether it is alive or dangerous;
- the people – how strong they are, their stamina, and what else they have to do whilst carrying;
- the method of carrying used;
- the materials available from which to make the carrier;
- how far the load has to be carried.

**Q Question**

- 2 Look at the carriers in the pictures.
- a What is likely to be carried in each?
  - b Is it heavy, bulky or fragile?
  - c What materials are the carriers made from?
  - d How will each carrier be used?
  - e Which are suitable for long journeys?



*Different designs of carriers.*

2

Straps and handles on carriers must be comfortable and not cut into our bodies. They should be made from hardwearing, soft and pliable materials.

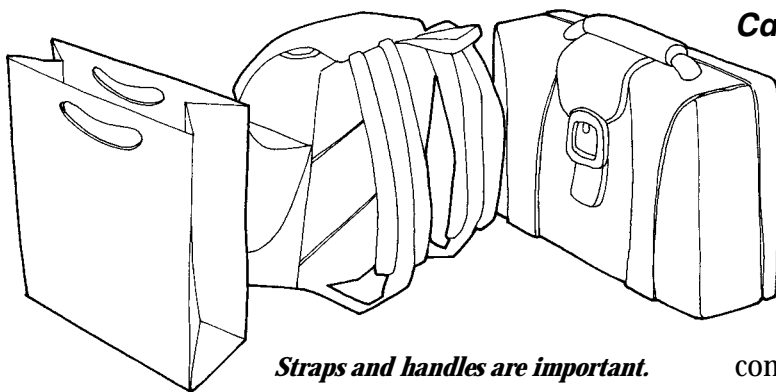
**R Research**

Look at a range of carriers to find out how comfortable they are to use. Record your findings.

**Carrying babies**

Babies need to be carried until they can walk on their own. People have designed many ways of carrying babies. Babies are precious, so special attention is paid to their safety, warmth and comfort.

*This baby is securely held by its father, but he will end up with aching arms and cannot do anything else at the same time.*



*Straps and handles are important.*

3



Some new products that were successful in 1999

Table 1 New food and drink products in the UK

Year	Number	%increase
1991	3233	10.2
1992	3823	18.2
1993	4525	18.4
1994	4815	6.4
1995	4596	-4.5
1996	4614	0.4
1997	6159	33.5
1998	7458	21.1

**R** Research

- 1 List the food products that your family buys in its weekly shopping.
- 2 Divide the list into three categories:
  - raw e.g. potatoes;
  - processed e.g. oven chips;
  - convenience e.g. crisps.
- 3 How do you think this list will differ from one made 10 years ago and one made ten years in the future?

4

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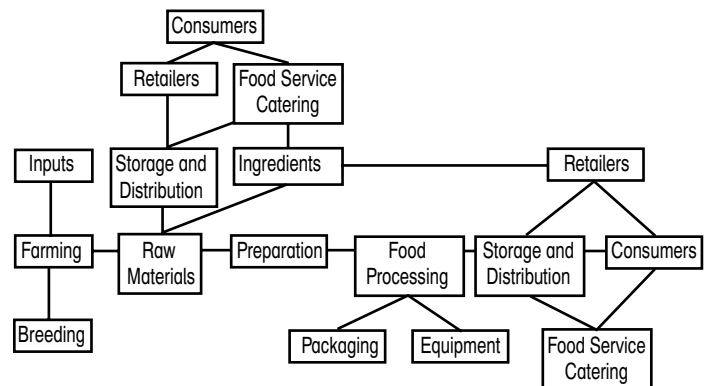
# Food across the world

# 3

Everybody in the world needs to eat. The world population is growing so the demand for food across the world is increasing. Whitney Macmillan, the chairman of a large food processing company said, '... ours is the business that wakes every morning with a quarter-million new potential customers, whether we do anything or not.' At the moment the world's population is about 6 billion, that's 6 000 000 000 000 people. Food crops are grown over about 6 million square miles of land. But only 60% of this food is consumed by humans. 40% is lost to disease, pests and weeds. It is the food industry that provides the food we eat.

The food industry is a complex mix of different activities. A summary diagram is shown in the panel below.

**What is the Food Industry**



Food industry summary diagram

**P** Pause for thought

Just how does the bread we eat get from the farm to our table?

What is the food industry?

1

At first sight it looks complicated but you can make sense of it by thinking what happens to something like wheat. Start at the left-hand side in the farming box. Farmers grow wheat using specially bred seeds and inputs such as fertilizers and weed killers. The resulting raw material, wheat, can then go along several routes. It can be milled to give flour (preparation) and then processed to form bread which needs to be stored and distributed to retailers or caterers before it reaches the consumer. Or it could be milled to give an ingredient (flour) which is sold to retailers who sell it to consumers. Whatever we eat starts by growing either on a farm of some sort or in the wild. It takes the food industry to turn it into the food products that we buy in the shops.

### Question

- 1 Using the food industry summary diagram discuss with a partner how each of the following raw materials becomes the food product listed:
  - from potatoes to chips at a fish and chip shop;
  - from chicken to chicken madras in an Indian restaurant;
  - from tomatoes to tomato soup in a factory canteen;
  - from cod to fish fingers in a large supermarket.

The food industry divides the global food industry into two main markets each with its own distinctive features. These are the developed market and the developing market. The developed market occurs in places which have high income economies such as the European Community, USA, Australia, New Zealand and Japan. The developing market occurs in places which have middle income economies such as parts of Africa, Asia, Central and Southern America.

In the developed markets the vast majority of the population is well fed and there are no food shortages.

2

The food industry has identified the following short term trends for these markets.

- Population growth will slow.
- There will be more elderly people, single person households and working couples.
- There will be fewer people of working age.
- There will be greater affluence which will lead to greater demand for choice.
- There will be an increased interest in 'healthy' convenience foods.

Those countries in the developing markets are moving to a position where more and more of the population are well fed. The food industry has identified the following short term trends for these markets.

- Population growth is unlikely to slow.
- Consumer buying power will strengthen.
- Eating habits will change and become more varied.
- Western eating styles may be adopted.
- New demand for innovative and convenience products.
- There will be a move away from dietary staples.

### Question

- 2 Discuss with a partner the differences between the developing and developed markets. Try to explain the reasons for the differences.

### **New products**

Across the world there has been a large increase in the number of new food and drink products over the past few years as shown in Table 1. In 1998 there were 7458 new food and drink products in the UK amounting to 143 new products per week. While some of these products are not commercially successful these figures are an indication of the activity taking place in the food industry.

3



	Pop Tart	Toast and jam	Jam tart
What does it look like?	A large pale biscuit	A brown square with shiny red stuff on it	Small, round and shiny in the middle
The smell	Fruit cake	Hot bread	No smell
In the mouth	Crispy and then squidgy	Crunchy and then soggy	Hard and then soft and sticky
The taste	Very sweet quickly	Sweet and buttery	Very sweet and fruity
How is It made?	In a factory, by machine. I toasted it.	I made it	In a factory and I don't think the jam is cooked
Is it a good snack?	Two Pop Tarts would be good for breakfast as they are quick.	Yes. if I was hungry	If you want a small snack
What else is good about it?	They keep a long time.	It is made from things you usually have in the cupboard	If you weren't really hungry.

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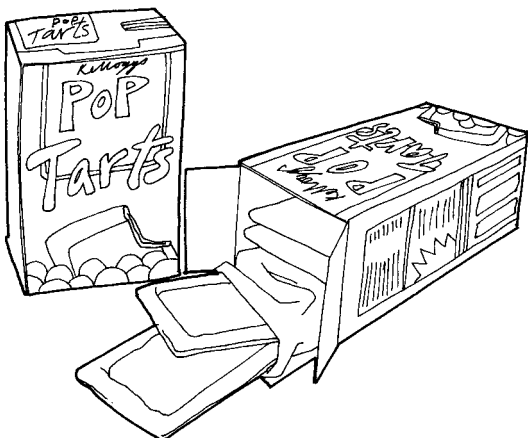
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# Pop Tarts

# 4

Pop Tarts are a sweet snack, sold in most supermarkets. They come wrapped in foil, six to a box. They are designed to be heated in a toaster and eaten warm. If you could cross toast and jam with a square jam tart, you might arrive at a Pop Tart

Do you enjoy snack foods? What do you like? Are they sweet or savoury? Do you prepare them or are they ready-made? When do you eat them? Do you buy them? How much do they cost?



## Question

- 1 Pop Tarts are a new idea in snacks. What do you think the manufacturers based this idea on?
- 2 Why are they wrapped in foil?
- 3 Is the name a good one? Why?



**Snack foods can be eaten instead of a traditional meal.**

1

## When is a snack not a snack?

How big or small does food have to be to still be a snack? Is it the way you eat it, for example with your fingers? Look at this table. It contains the nutritional information for one Pop Tart.

One Pop Tart contains	
Energy	210 Kcals
Protein	3 g
Carbohydrate	35 g
Fat	6 g
Fibre	0.7 g
Sodium	0.25 g
Plus vitamins	



### **P** Pause for thought

Do you ever have a snack meal? When and what is it?

### **R** Research

Find out the same information for a snack of your choice.

2

Pop Tarts are made of two layers of pastry sandwiched together with a fruit or chocolate filling. They are rectangular with sealed edges. They are advertised as a 'delicious, anytime snack'. Susie wrote this about them.

Pop Tarts could be described as a development of a toast and jam snack. Steven compared a Pop Tart with toast and a jam tart. He looked at appearance, feel in the mouth, aroma, flavour and how it was made.

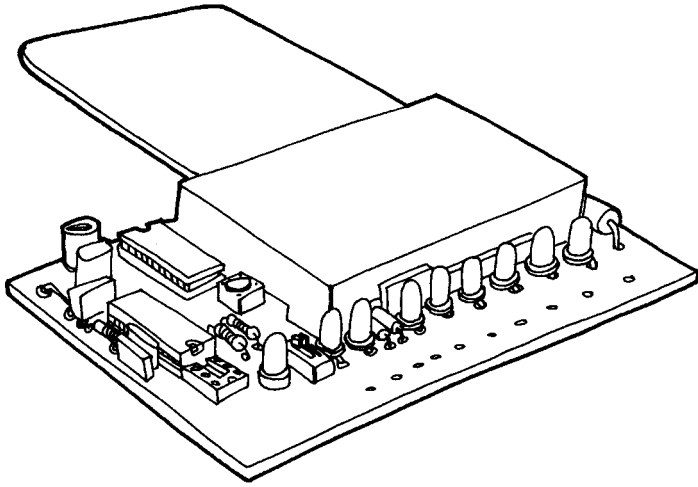


### **Q** Question

- Why are Pop Tarts made of pastry rather than bread?
- Do you agree with Steven's comments in the chart shown on page 4? Would you add anything to the chart, or change anything in it?

Do you agree with her?

3



***You can use this smart card controller in school***

It is important to understand that a single card could combine a selection of these uses. A smart card can contain simple computer system, which means that it can be programmed to do almost anything; for example a store loyalty card could also act as payment card.

**Q Question**

- 1 Now you know some of the things a smart card can do, think up some new uses for a smart card.
- 2 For each new use, list the possible winners and losers.

**R Research**

For more information on smart cards, look at the 'smart card cyber show':

<http://www.cardshow.com/>

This web site also includes the smart card museum, which gives a brief history of the use of smart cards:

<http://www.cardshow.com/museum/welcome.html>

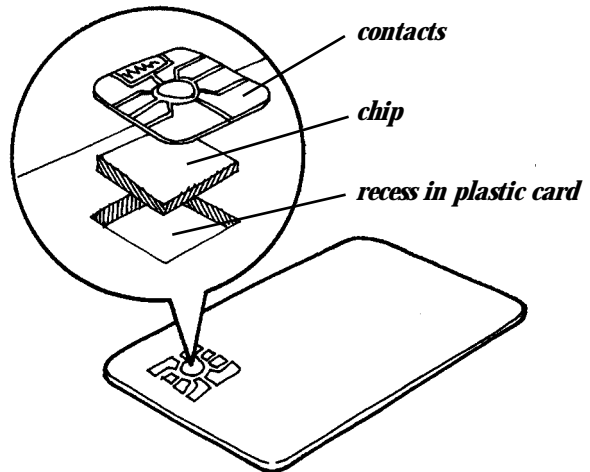
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# Smart cards

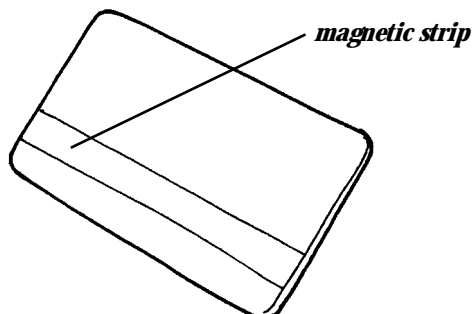
Smart cards have been in limited use since the middle of the 1980s. During the 1990s their use has increased enormously and in 1998 over 1 billion (1,000,000,000) were produced and circulated.

At first glance, a smart card looks just like a typical cheque or credit card. The difference is that instead of having a magnetic strip on its back, a smart card has a chip embedded into it.

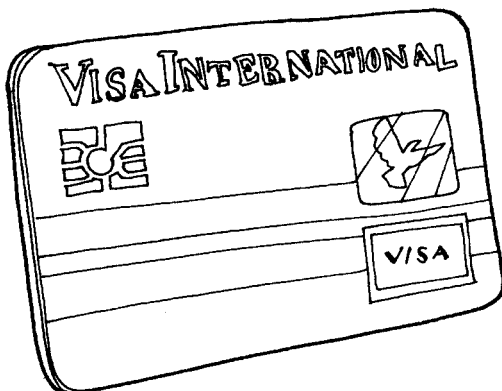


5

***Inside a smart card***



***A credit card***



***A typical smart card***

1

**P** *Pause for thought*

- 1 How many people do you know who use credit or cheque cards?
- 2 How about smart cards?

This may appear to be a small difference but it provides two large differences:

- memory – a smart card can have a memory chip in it that has more than 100 times the memory of a magnetic strip. This will increase as the capacity of memory chips improves;
- the chip in a smart card can be a computer processor – this allows the card to be programmed and used very flexibly.

Currently smart cards fall into six categories of use.

- 1 To store personal information.  
Information such as facts about who you are, personal information, health information or training records can be stored on the card and can be updated when they change. This can be very

2

- 3 To track the movement of people or property.  
A smart card can keep track of data such as when someone has entered a building and where they have been in it.
- 4 In loyalty programs.  
The loyalty cards that shops issue do not only give the shopper air miles or discounts. They are used to record people's shopping habits; stores are able to deduce a great deal about someone by analysing their shopping habits. Loyalty cards can also be used to allow cardholders low rates, for example in hotels or for air tickets.

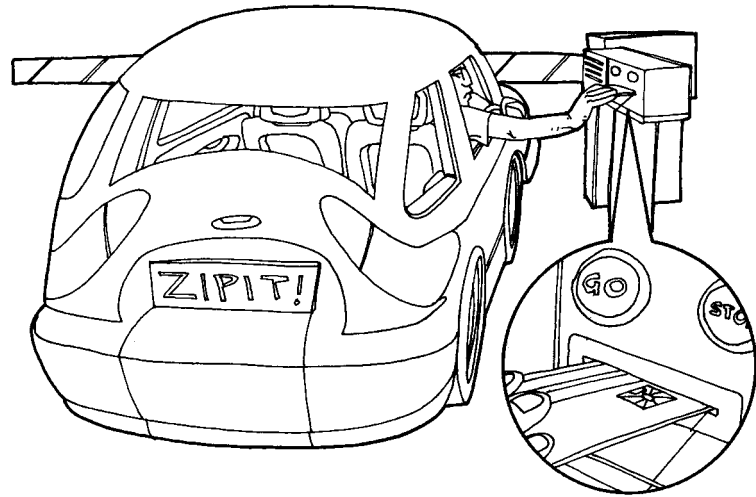
- 5 To pay for things.  
There are three ways that this can work:

- A fixed amount of 'money' can be stored on the card; when this is all spent the card is thrown away. Telephone cards usually work like this. In some payment systems the card can be topped up with more money rather than being thrown away.
- As a credit card; here you effectively borrow money as you spend and pay it back later.
- As a debit card that arranges for money to be

3

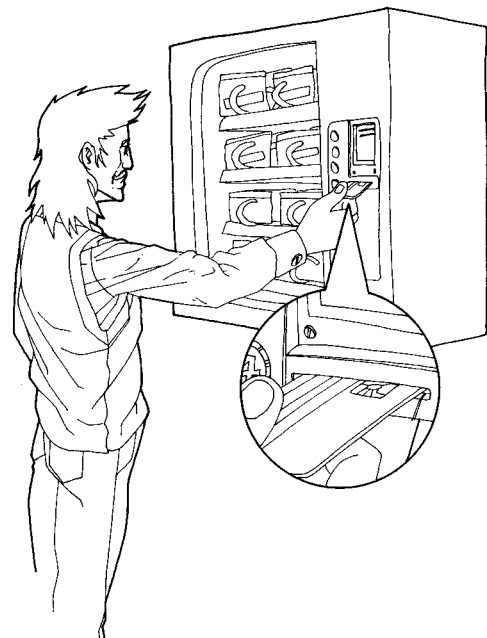
convenient, but there are concerns about keeping personal information confidential.

- 2 For security.  
Access to car parks, buildings or computer systems can, for example, be controlled in this way.



*A smart card entry system*

transferred from one account to another. A switch card works like this.



*A smart card vending machine*

- 6 Data collection and control. Smart cards can be programmed to control scientific experiments or industrial processes.

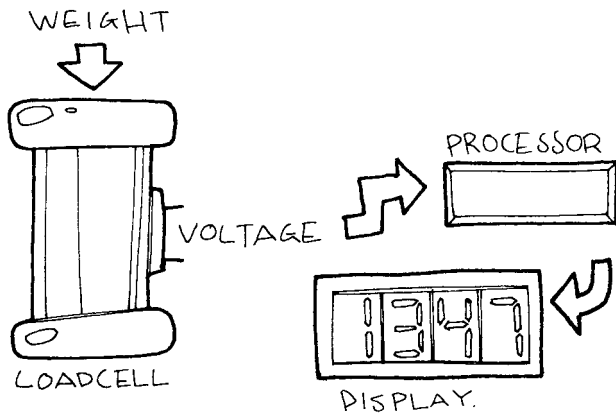
the display can be some distance apart, even in different rooms. The signal can even be sent to another electronic device such as an alarm system, printer or computer.

**Q Question**

7 The picture below shows a visit to a grocery shop one hundred years ago. How would it have differed from visiting a supermarket? List your ideas.

**P Pause for thought**

Why might it be useful to separate the object being weighed and the display? The electronic weighing machine can easily be used as part of a larger system in a factory, supermarket or airport check-in.



*The components of a modern electronic weighing machine*



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4

# Weighing

**Different solutions for different needs**

From spring balances to supermarket check-out scales, machines for measuring weight must be designed to suit their use

People have needed to weigh things ever since they first started to exchange goods with each other. The variety of things we need to weigh is enormous.



**Q Question**

- 1 Make a list of ten different things that need weighing.
- 2 Why do these things need weighing? Where are they weighed? Use a table like this to record your ideas.

What?	Why?	Where?
flour	cooking	kitchen

How did you do? You probably thought of weighing scales in the kitchen and bathroom, but how about weighing:

- newborn babies in hospitals to check their health?
- baggage at the airport to make sure that the plane is not overloaded?
- £5 notes at a bank to find out how many there are?

Each of these situations has different needs.

1

## The right choice

To design a weighing machine we need to think about:

- **Accuracy** – Drugs in a hospital may have to be weighed to the nearest thousandth of a gram. Vegetables can be weighed a lot less accurately.
- **Environment** – Is the machine being used indoors or outdoors? Is it in a clean or a dirty area? Is there a risk of dampness or overheating?
- **Range** – How much variation in weight is there in the things we are weighing?
- **Portability** – Does the machine need to be moved from place to place?
- **Reliability** – A spring could become overstretched, either by being tampered with or by overloading.
- **Ease of use** – Would we have to train someone to use the machine?
- **Servicing** – Is it easy to repair?
- **Running costs** – For example a portable electronic balance would need batteries.

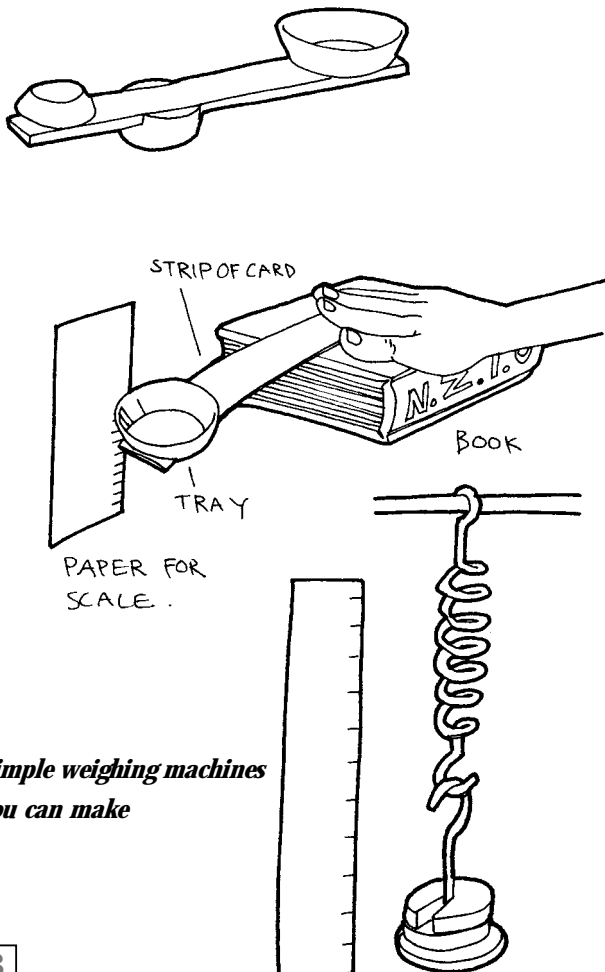
## Question

- 3 Look back at your table. For each situation write down the most important factors an engineer needs to think about when designing a weighing machine.

## Weighing machine

At the heart of every weighing machine is a component which responds to weight. It might be a spring which stretches, a lever arm which tips, or a piece of material which twists or stretches. Can you think of other possibilities?

2



*Simple weighing machines you can make*

3

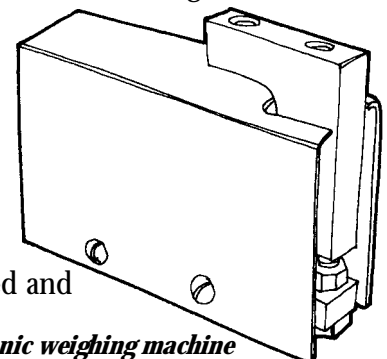
## Question

- 4 Look at the designs for weighing machines in the picture opposite. Choose one and make it.
- 5 Calibrate a scale for the weighing machine using 1 p coins as weights. Use your machine to weigh some small objects.
- 6 Evaluate your weighing machine. Describe how you made it, how easy it was to use and any improvements you could make.

## Electronic weighing machine

The heart of a modern electronic weighing machine is a **load cell**. This produces an electrical signal when it is squashed. The signal is processed by an electronic circuit which controls a display.

Electrical signals can be carried along wires, so the object being weighed and

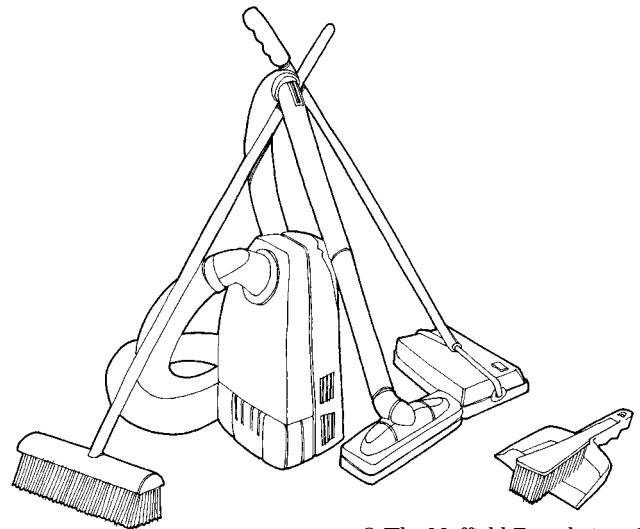


*A load cell from an electronic weighing machine*

It is possible to have different products for the same job. Consider cleaning. You could use a vacuum cleaner, a carpet sweeper, a dust pan and brush or a broom. Each of these will have different effects on our environment in terms of its manufacture and its use and eventual disposal. The broom made from natural and renewable materials has the least effect but is the most difficult to use and probably the least effective. The vacuum cleaner made from a wide range of non-renewable materials and manufactured components will have the most effect of the environment but is the least difficult to use and the most effective. There is a dilemma here – good for us but bad for the environment, or bad for us but good for the environment!

**Q Question**

- 2 Discuss the following questions with others in your class.
- What can be done to lessen the environmental impact of the vacuum cleaner?
  - Why do people buy and use products that are harmful to the environment?
  - What can be done to encourage people to buy products that do less damage to the environment?



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**R Research**

Compare the sustainability of a towel and a hair drier. Present your answers as bullet points in a table.

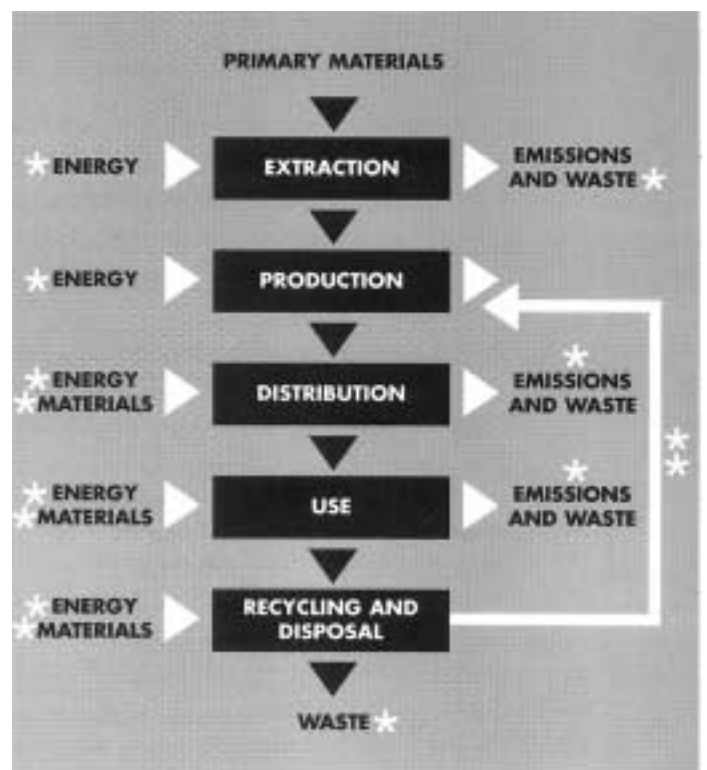
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# Product life cycle analysis

7

An important way of looking at the impact of a product on our environment is product life-cycle analysis (PLCA). PLCA is sometimes called 'cradle to grave analysis' because it tries to describe everything that is involved in the life of a product; from the impact of getting the raw materials used to make the product to what happens to the product after its useful life is over.

The life-cycle of a product is summarised in the diagram below. You can use each part of the diagram to ask questions about the impact of the product on our environment.



**P Pause for thought**

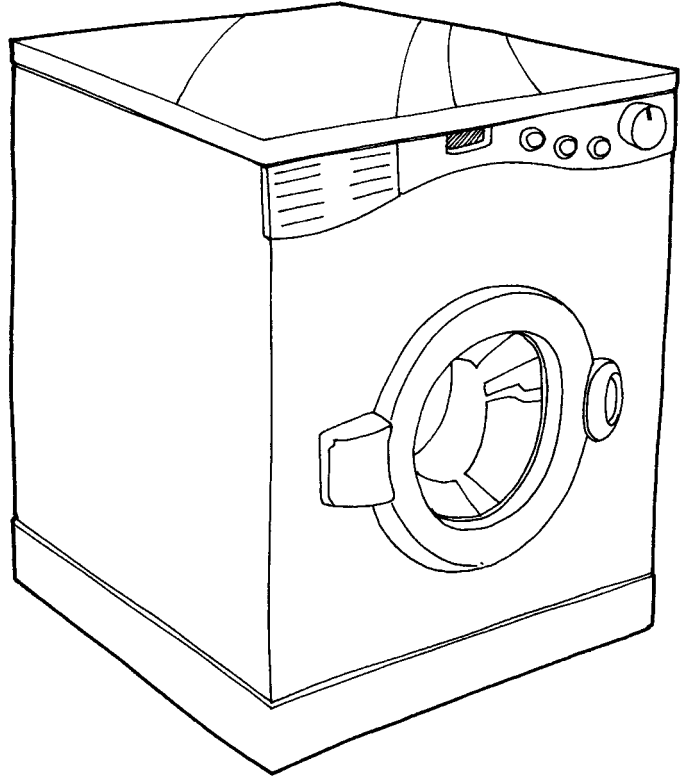
What effect will the size of the inputs and outputs labelled \* have on the environmental impact of a product?

Why is it important that the feedback loop labelled \*\* is maximised?

1

## Thinking about a washing machine

The case, chassis and working parts are made mainly from metal. This has to be extracted and refined. It is important that the amount of energy used for this is kept to a minimum. It is also important to keep emissions into the environment and waste products from these processes to a minimum. Once the metal is available it has to be turned into the various parts of the machine. Again the energy used and the emissions and waste should be kept to a minimum. Once the machines have been made they have to be distributed and sold. Again this will use energy and cause emissions and waste which should all be kept to a minimum. Then the machine is used. A washing machine might have a working life of 20 or more years during which time it will use energy and give out hot water contaminated with detergent. Finally the machine will come to the end of its useful working life. It is important that as much material as possible is recycled and that any disposal is as harmless as possible.

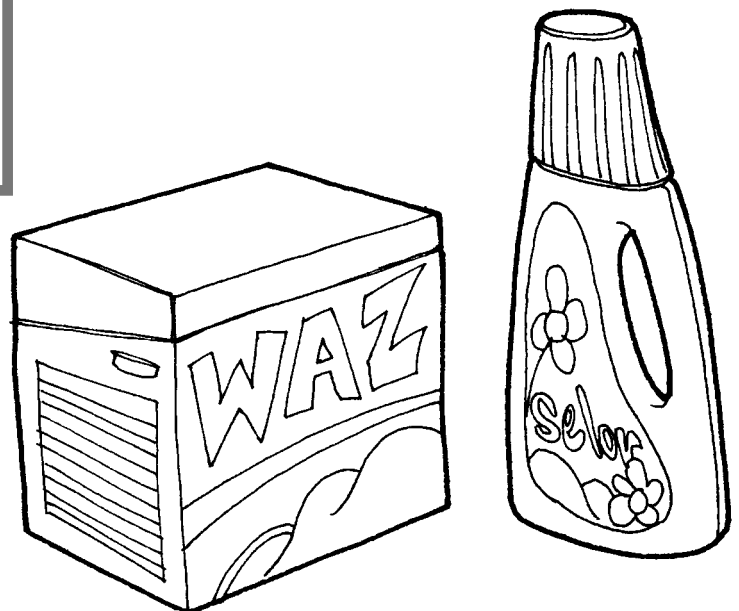


*What is the environmental cost of clean clothes?*

2

### Question

- 1 In the life of a washing machine, which input and output do you think are likely to cause the most environmental impact? Discuss your answers with others in your class. You can look on the web to get more information. This site from Australia gives useful information: <http://www.environment.gov.au/portfolio/esd/climate/gwci/contents.html>.



*How much of these materials will be used in the life of a washing machine?*

3