TECHNOLOGY

Grade 7

Book 2

CAPS

Learner Book

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Contributors:
Graham Barlow, Louis Botha, John de Klerk, Jacqui Greenop, Chris Human, Piet Human, Riekie Human, Xenia Kyriacou, Morne Labuschagne, John Laurie, Ezekiel Makwana, Rallai Maleka, Mafahle Mashegoana, Themba Mavuso, Peter Middleton, Lebogang Modisakwena, Peter Moodie, Neil Murtough, Sarah Niss, Humphrey Nkgogo, Phillip Radingoane, Jan Randewijk, Margot Roebert, Marlene Rousseau, Marcus Taba, Yvonne Thiebaut, Cecile Turley, Louis van Aswegen, Karen van Niekerk, Elene van Sandwyk, Hettie Vos, Magdaleen Snyman

Illustrations and graphics:
Astrid Blumer (Happy Artworks Studio), Ian Greenop, Chris Human, Piet Human, Peter Middleton, Peter Moodie, Melany Pietersen (Happy Artworks Studio), Theo Sandrock, Lisa Steyn Illustration, Heine van As (Happy Artworks Studio), Leonora van Staden, Geoff Walton

Cover illustration: Leonora van Staden

Photographs:
Lenni de Koker, Ian Greenop, Chris Human, Tessa Olivier, Elsa Retief (GalleryProductions)

Text design: Mike Schramm

Layout and typesetting: Lebone Publishing Services

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Chapter 1
Magnetism

In this chapter, you will learn all about magnetism. You will investigate magnetic fields, and you will experiment to see which kinds of materials are magnetic.

Figure 1: The back of a speaker can be used to pick up certain items!

1.1 What is magnetism?

Some people use fridge magnets to keep notes or lists on the fridge's door. You even get magnets in the shape of words or letters that you can put on a fridge door to play with. The magnets make the letters stick to the metal of the fridge door.

Can you think of other ways in which magnets can help us in our daily lives?

In this chapter, you will learn about different types of magnets and how we use them in everyday life.

Magnetism is a force that can attract (bring closer) or repel (push away) objects that have a magnetic material like iron inside them.

Thousands of years ago, humans discovered that a certain type of rock could attract iron. This rock was called lodestone. People believed that it had magical powers! Pieces of lodestone would also push or pull other pieces of lodestone.

The ability to attract iron is called **magnetism**.

We now know that lodestone contains a material called magnetite, which is a kind of iron oxide. Iron oxides are chemical compounds of iron and oxygen. "Lodestone" is a natural magnet.

All magnets are able to attract other magnets or magnetic objects. Magnetic objects consist of iron or some other metals.

Experiment with a magnet to pick up paperclips. You will notice that if you hold the magnet far away, nothing happens. If you move the magnet closer to the paperclips, the paperclips will suddenly stick to the magnet.

Figure 2: Lodestone attracts pieces of iron.

Think about these questions:

- What is it about a magnet that attracts these particular objects?

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- Does a magnet have to touch a magnetic object to attract it?

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To find out more about magnetism, do the following investigation.

Action research

You need the following for this activity:

- a ruler,
- a paperclip, and
- at least three different kinds of magnets.

Put the ruler flat on your desk. Place a paperclip so that it is in line with the zero mark of the ruler. Put one magnet at the other end of the ruler. Slowly push the magnet toward the paperclip, as shown in the picture. The moment the paperclip moves towards the magnet, stop moving it.

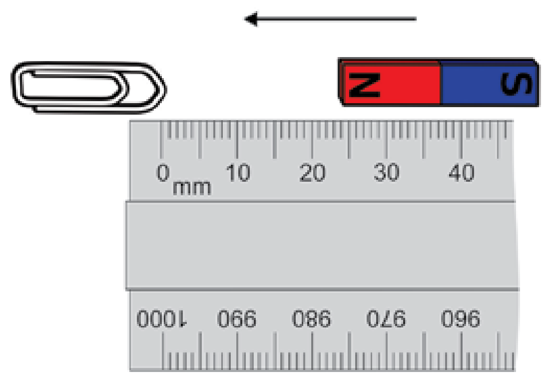

Figure 3

Look at the measurement on the ruler to see how far apart the magnet and paperclip were when they came together.

Do this again with all of your magnets.

1. Fill in the table to show the distance at which each magnet attracted the paperclip.

	Distance from paperclip
Magnet 1	
Magnet 2	
Magnet 3	
Magnet 4	

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2. Which magnet is the strongest?

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3. Which magnet is the weakest?

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What does this show us?

A magnet has an invisible magnetic field around it. The field is stronger close to the magnet, and weaker further away. The magnet does not affect the paperclip until the paperclip is close enough to be within this field.

Stronger magnets can attract magnetic materials from further away than weaker magnets can. This is because a stronger magnet has a larger magnetic field.

A few questions to answer

1. Name three situations in which you have seen or used magnets.

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2. How would you find out if an object is magnetic or not?

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3. You have two magnets, one is magnet A, which can attract a paperclip from 10 cm away. The other magnet, magnet B, can attract a paperclip from 12 cm away. Which magnet is stronger? Explain your answer.

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4. Why can a magnet have an effect on a paperclip from a distance? Explain it in your own words.

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1.2 Permanent magnets and the magnetic fields

You have learnt that magnets can pull certain objects towards them because the objects have a magnetic field around them. An object that a magnet moves becomes a “temporary” magnet. A temporary magnet is not a magnet all the time. When you move the paperclip within the magnetic field of the magnet, the paperclip also becomes a magnet. The paperclip loses its magnetic field quickly.

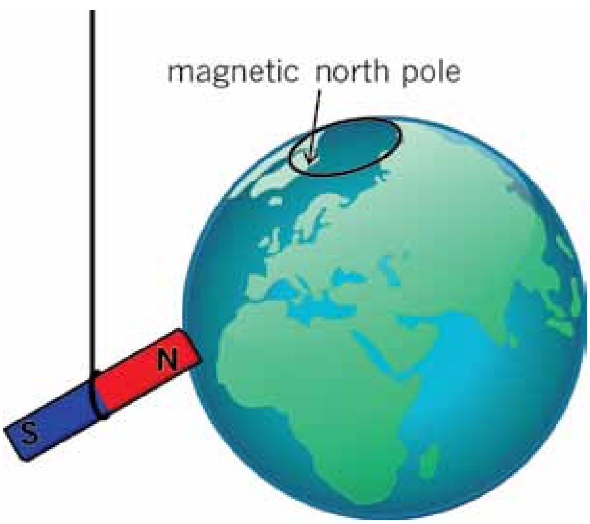

Figure 4: The north pole of a magnet points to the Earth’s magnetic north pole.

The north pole of a magnet points to the Earth’s magnetic north pole if it is allowed to swing freely on a thread.

A permanent magnet keeps its magnetic properties for a long time. A temporary magnet acts as a magnet only as long as it is in the magnetic field of a permanent magnet.

A lodestone is a natural permanent magnet. You investigate permanent magnets that have been made artificially. These magnets have a north end and a south end, but they can come in different shapes. There are two basic shapes of magnets that you will use: bar magnets and horseshoe magnets.

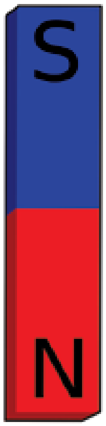

Figure 5: Bar magnet

Figure 6: Horseshoe magnet

Bar magnets are rectangular, with a north pole on one end of the bar and a south pole on the opposite end of the bar. This means that the poles are far apart.

Horseshoe magnets also have a north and a south pole, but the bar has been bent into a curved shape. This bend brings the north and south poles closer together than they would be in a bar magnet.

Let us investigate what the north and south poles of the magnet mean.

Investigating magnet poles

For this investigation, you will need two bar magnets, with the north and south poles marked. Work in small groups.

1. Hold a bar magnet in one hand and put another bar magnet on your desk. Bring the north end of the magnet in your hand close to the north end of the magnet on the desk. Write down what happens when you bring the north poles of the two bar magnets closer together.

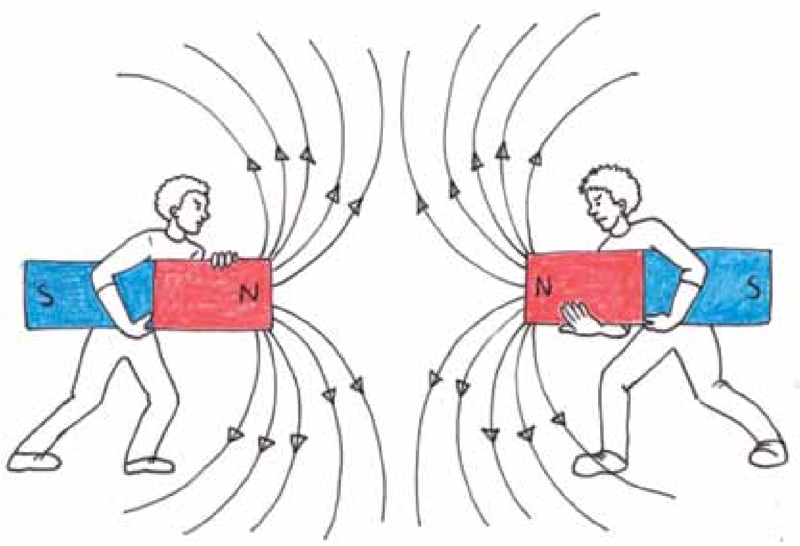

Figure 7

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2. Now bring the south pole of one of the bar magnets close to the south pole of the other bar magnet. Write down what happens when you bring the south poles of the two bar magnets closer together.

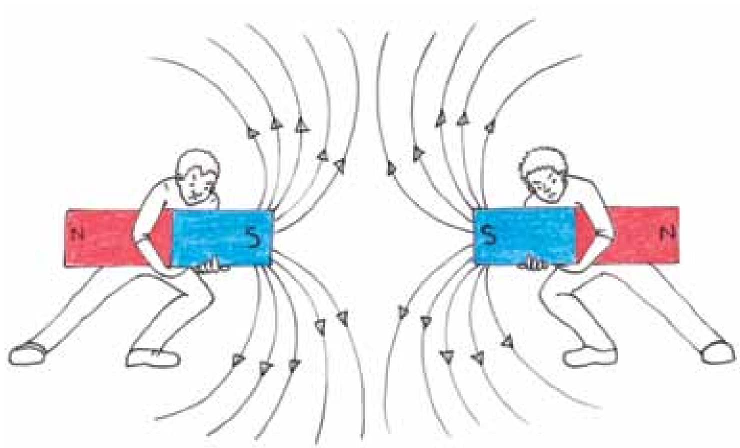

Figure 8

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3. Now bring the north end of one bar magnet close to the south pole of the other bar magnet. Write down what happens when you bring the north pole close to the south pole.

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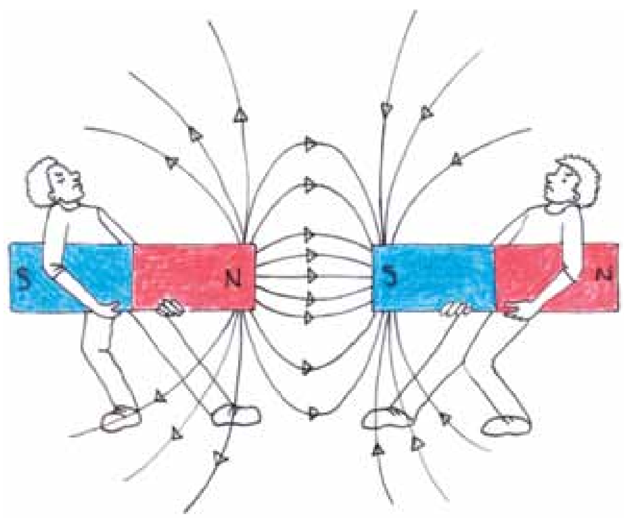

Figure 9

You should have noticed that as the north poles were brought together, there was a "resistance" to getting too close. This is why you found it difficult to get the north or south poles to touch each other. However, when you bring the north pole close to the south pole, they pull towards each other.

When the poles are the same, the force pushes them apart, but when the poles are different, the force pulls them together. So a north pole and a south pole attract each other, while a north and a north pole or a south and a south pole repel each other.

The magnetic field around each magnet has direction.

We say that unlike poles of a magnet attract each other and like poles repel each other.

Visualising magnetic fields (extension)

Although we cannot see magnetic fields, we can detect them using iron filings. Work in small groups to do this investigation.

You will need the following for this activity:

- two bar magnets,
- a piece of firm white paper, just bigger than the magnets, and
- iron filings.

Iron filings are tiny pieces of iron that look like a fine powder. Be careful – the filings will stick to the magnets, so you must make sure that you keep a piece of paper between the magnets and the filings at all times.

1. Put one of the bar magnets on the table in front of you.
2. Put the piece of white paper over the magnet.
3. Lightly draw the outline of the bar magnet on the paper, and mark the positions of the north and south poles.
4. Carefully sprinkle the iron filings onto the paper in the area of the magnet.

   You should see the iron filings making a pattern around the magnet. Gently spread the iron filings around the magnet so that you can see the whole pattern. Notice the places where there are lots of iron filings very close together and the places where the iron filings are more spread out.
5. Use the space below to draw the pattern that the iron filings make.

The iron filings show you the pattern of the magnetic field. Each tiny piece of iron behaves like a magnet and lines up with the magnetic field around the bar magnet.

If you are not able to see the magnetic field pattern for yourself, here is a photograph of iron filings around one bar magnet:

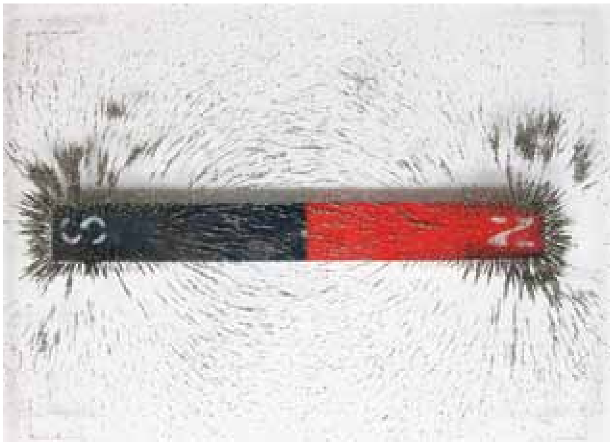

Figure 10

To draw a magnetic field around a magnet, you use lines to represent the path of the iron filings. Figure 10 shows the lines. These are called magnetic field lines. The lines always have arrows that point from the north pole to the south pole.

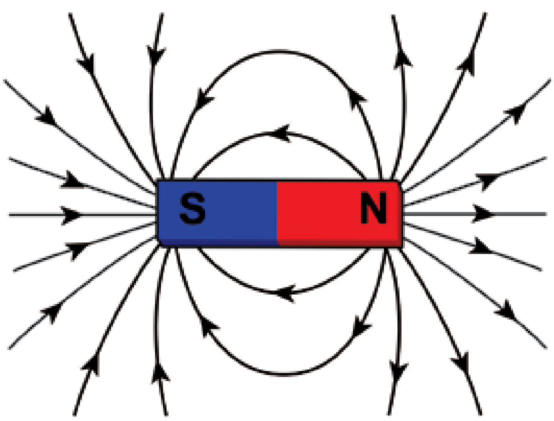

Figure 11

Notice the following about the magnetic field lines in Figure 11:

- The field lines have arrows on them.
- The field lines come from the north pole and go to the south pole.
- The field lines are closer together at the poles.
- The magnetic field is stronger in the places where the lines are closer together.
- Further away from the magnet the lines get further and further apart, showing that the field is much weaker.

Now repeat the steps using two bar magnets with the north and south poles labelled. Put the north pole of one magnet close to the south pole of the other magnet. Put the paper over the magnets and sprinkle the iron filings on top of the paper.

6. Use field lines to draw the pattern you see. Draw the lines closer together where there are many iron filings and further apart where there are fewer.

Do your field lines look like those in Figure 9, where the magnets attract each other?

7. Now repeat the steps using the north pole of one magnet close to the north pole of the other magnet. Put the paper over the magnets and sprinkle the iron filings on top. Draw the pattern you see.

Do your field lines look like those in Figures 7 and 8, where the magnets repel each other?

1.3 Which substances will stick to a magnet?

Practical Investigation

For this investigation, you will need the following:

- a bar magnet or a horseshoe magnet,
- pins,
- ceramic, such as a mug,
- iron nails,
- wood,
- plastic,
- copper,
- paper, and
- coins.

You will now find out which materials are attracted to magnets, and which materials are not.

1. Hold a magnet close to each of the objects in turn. The material will either be attracted to the magnet, or not. Put a tick in the column that matches what you see:

Material	Attracted to magnet	Not attracted to magnet
pins		
ceramic		
iron nails		
wood		
plastic		
copper		
paper		
coins		

2. List the items that stuck to the magnet.

. . . .

3. What do you notice about all of the items that did stick to the magnet?

....

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4. Are all metals attracted to magnets?

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Did you see that the materials that do not contain metal did not stick to the magnets? That means that non-metals are not highly magnetic substances. We say that they are not magnetic.

Did you see that the only things that were attracted to the magnet were metals? Does that mean that all metals are magnetic? You will investigate this further in the next chapter.

All substances are magnetic in some way. However, many substances have very weak forms of magnetism, so that there is not enough attraction to make them move towards a magnet. Strongly magnetic substances will stick to a magnet.

Next week

In the next chapter, you will learn how people use the property of magnetism in the recycling industry.

Chapter 2
Investigation: Metals and magnetism

In Chapter 1 you learnt about magnets and magnetism. Now you will investigate which metals are attracted to magnets and which are not. You will also learn why it is good to recycle scrap metal and how this important work is done.

We can also recycle materials other than metal. Plastic, paper, cardboard and other materials that are often thrown away could be recycled instead. Since we are running out of basic resources, we need to reuse or recycle as much as we can instead of simply throwing things away.

You will start work on a recycling plan for your school by recording the waste produced by your school and how much of it could have been recycled. Many factories use waste materials, so you can develop a plan to raise funds for your school by recycling waste.

Figure 1: Metals used in the home

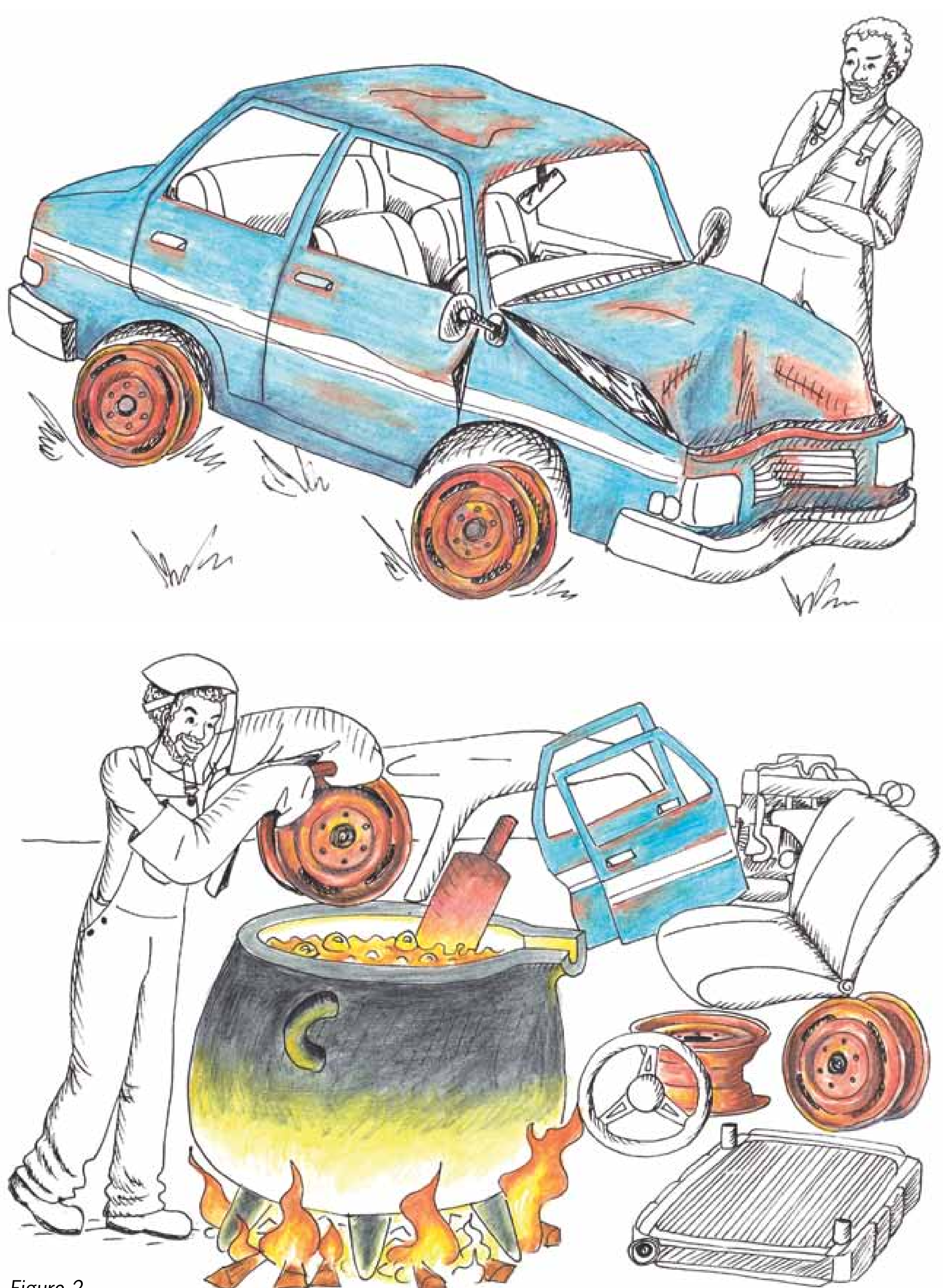


Figure 2

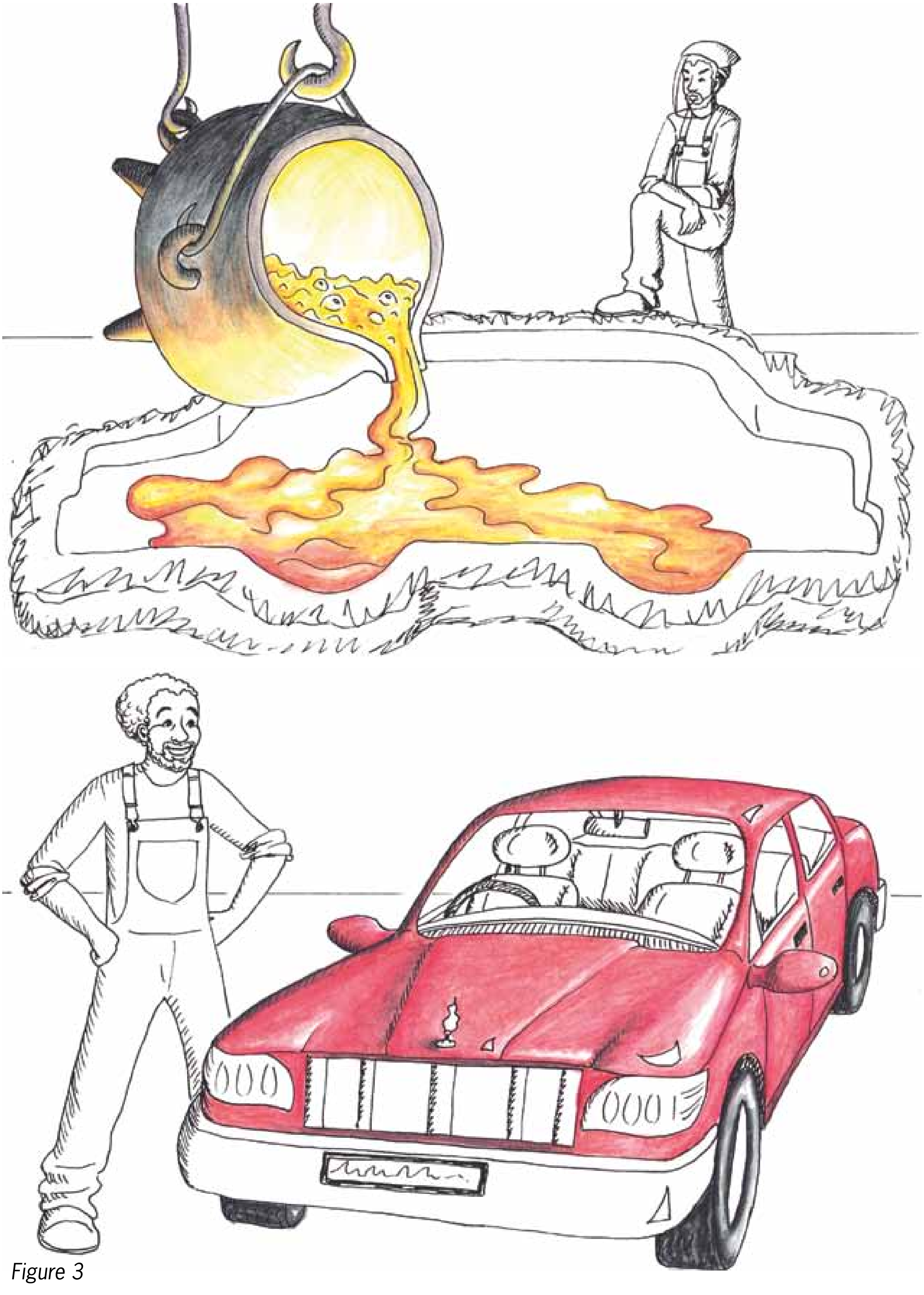


Figure 3

2.1 Magnetic and non-magnetic materials

You learnt about magnetism and magnets in Chapter 1. You learnt that non-metals do not stick to magnets, while other metals do stick to magnets. We say that these metals are magnetic.

Look at the objects made of different metals in Figure 4:

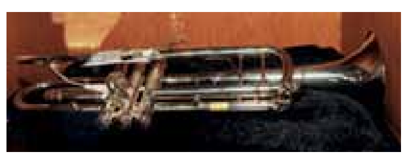
Steel electricity pylons

Cast-iron stove

Lead solder

Copper beading

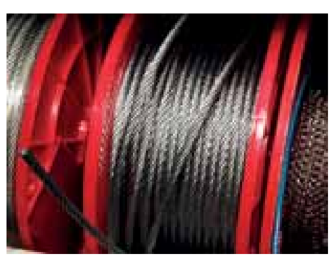
Brass horn. Brass is a mixture of copper and zinc.



Silver trumpet

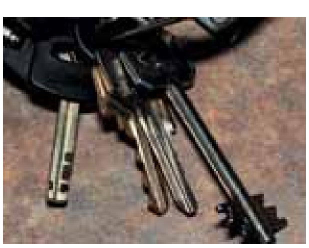
Gold earrings

Nickel cupboard fittings



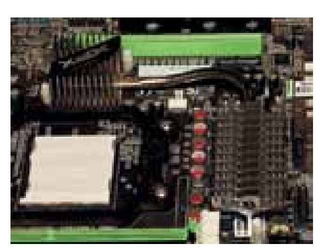
Steel cable

Bronze pot. Bronze is copper mixed with tin.



Steel keys

Tin can



Aluminium computer parts

Figure 4: Some different types of metal

1. Which of the objects are made of magnetic metals? Fill in the table below:

Material	**Is the material magnetic?**	
	Yes	**No**
Steel pylon		
Cast-iron pot		
Silver trumpet		
Copper beading		
Brass horn		
Lead solder		
Gold earrings		
Nickel fittings		
Steel cable		
Aluminium computer parts		
Bronze pot		
Tin can		
Keys		

How many of the metals are magnetic? If you said only three, then you are correct. They are steel, iron and nickel, and they all contain iron and are magnetic. Any metal containing iron and that is magnetic, is called a **ferrous metal**.

Many people think that tin is magnetic, but it is not. The tins that you buy food and other household goods in are actually made of very thin steel and are covered with another thin layer of tin to stop them from corroding. Steel is a mixture of iron and carbon. When you place a magnet next to a tin can, it is attracted to the iron in the steel, not the tin.

Often, you will see iron that has rusted. This is called corrosion. Rusty iron is still magnetic.

Ferrous metals are metals that contain iron.

When a metal is in contact with oxygen, it forms rust over time.

Rust is also magnetic.

Tin and zinc don't rust, so we use them to protect iron and steel.

Figure 5: The coating of zinc has worn off this corrugated steel roof.

Investigation: Test which metals are magnetic

Common metal objects.

In your daily life you see many useful metal objects around you. Some are very big, such as cars and buses. Some are very small, such as paperclips.

1. In the first column, list 15 metal items that you use or often see around you.
2. In the second column, write down what metal each object is made of. If an object consists of more than one metal, write down which metal makes up the biggest part. For example: cars are mainly made of steel.
3. Test the items to see whether they are magnetic or not. Write down your results in the last column.

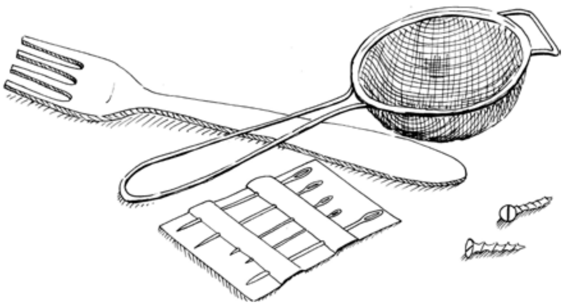


Figure 6: Things you find around the house: a fork, a strainer, needles and screws.

Object	Metal	Magnetic: Yes/No

2.2 Case study: Recycling scrap metals

Are you surprised that so many things we use every day are made of metal? We use different metals to help us with almost everything we do. This means that factories need a constant supply of metal so that they can keep manufacturing all these items. We use millions of tons of steel, aluminium and other metals every year. But the earth's supply of metal will eventually run out. Can you think of the problems this will lead to?

Recycling is to use something over and over again. It may be in a different form, but we use the basic materials again and again.

The answer is to **recycle** the scrap metal. Everything that is made of metal can be broken up and sorted into its basic parts and used again. This will help to save the country millions of rand each year and will also stop us from using up all the planet's resources.

Figure 7: Steel recycling bales

Metal is ideal for recycling as it can be melted down and reused without losing its strength.

Collecting scrap metal

The process of collecting scrap metal for recycling starts when people learn to not throw metal objects away. Everything made of metal can be recycled and everyone has to make sure that nothing that can be reused is thrown away.

At home, make sure that all small metal objects, such as empty tins, are collected separately and sent to recycling centres. Bigger objects such as old household appliances will be collected by scrap metal dealers. Scrap metal dealers sort the different types of metals they collect into piles and send these to the factories. The factories then melt down the metal objects so that the metal can be used again.

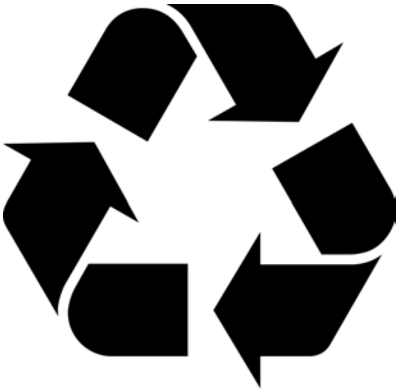


Figure 8: The international recycling symbol. When you see this sign, it means that the materials used to make the product can be recycled.

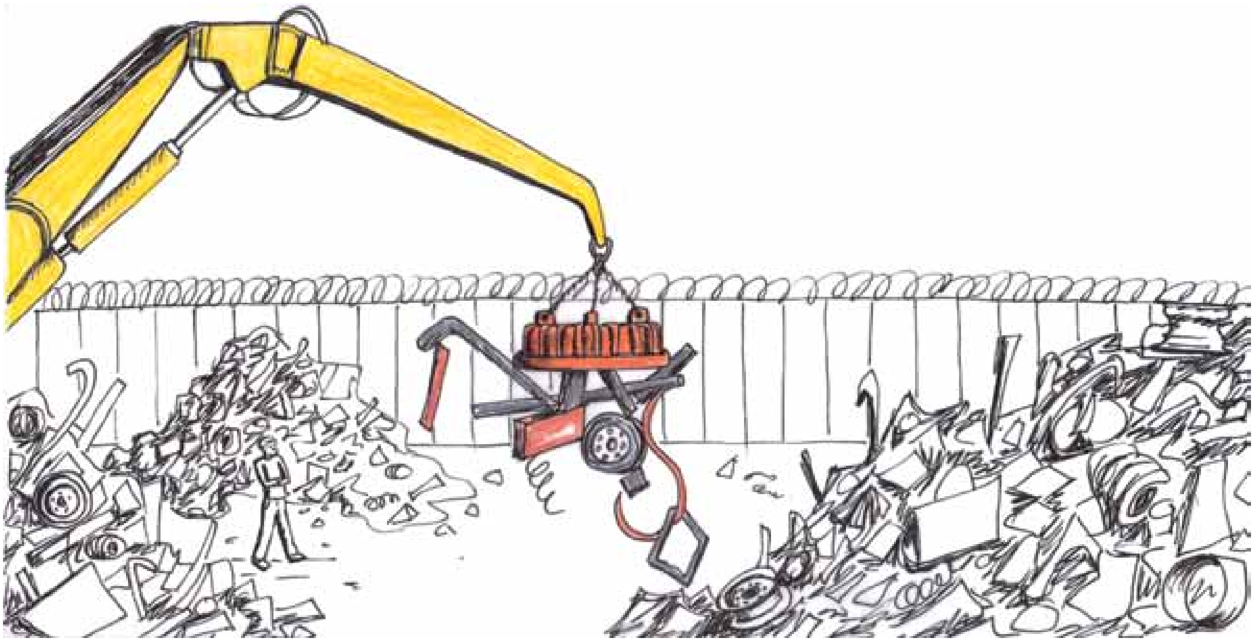


Figure 9: Scrap metal yards use magnets to sort piles of scrap metal.

Can you see how a magnet can be used to help sort piles of metal? Scrap dealers use large magnets to pull out the magnetic metals from the piles. This speeds up the process.

Making money from recycling

To encourage people not to waste valuable materials that can be recycled, scrap metal dealers will pay for scrap metal. They usually pay by mass, so it doesn't really matter what shape or form the metal comes in, it is the mass that counts.

But this can create problems too. Some people steal metal objects such as steel manhole covers and copper wire from telephone and electricity cables, to try and make money. Stealing these articles is not only dishonest, but it also puts other people in danger. If manhole covers are stolen, then there are holes in the roads that people can drive or fall into. Stolen electricity cables can cause loss of power.

Collecting scrap metal honestly

1. Do you think there are metal items that scrap metal dealers should not accept from people trying to sell them? Discuss your ideas with another learner. Write down the items you think scrap metal dealers should not buy.

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2. List a few scrap metal objects that people can collect to sell to scrap metal dealers.

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3. If you were collecting scrap metal to sell to a scrap metal dealer, how would you show that you had gathered the items legally? Here is an example: "I would get the owner of the house to give me a letter saying that she gave me the items." Write down any other steps you could take.

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Identifying recyclable materials

Scrap metal is not the only recyclable material. Most waste can be recycled. There are companies that specialise in collecting all forms of recyclable waste, and this serves the community in many ways.

In the last section of this chapter, you are going to investigate what a recycling scheme for your school will achieve. Before you start collecting materials, discuss in the class which waste materials the school produces could be recycled. Remember that it is not only your classroom, but the whole school.

Get one learner to write these items on the board, with a few examples of the materials you are likely to find at school.

For example:

Plastic: milk bottles, cold drink bottles.

Cardboard: food cartons, boxes.

How much recyclable waste is produced by the school?

- For the next week, keep a record of the amount of waste that the school produces.
- It would be helpful if the rest of the school knows that you are collecting recyclable waste. Ask your principal if you can have a special waste bin or small area where learners can bring their recyclable waste. If your school has extra waste bins, you could put them next to the normal bins and put recycling labels on them.

Safety

When you are collecting waste materials, always wear gloves. Wash your hands thoroughly after you have finished sorting the material.

- Collect the recyclable material and sort it into piles. Put this recyclable material into black bags. Tie each bag when it is full and mark them clearly. Get advice from your teacher on where to store the material while you are collecting it.
- Find out if there are scrap dealers near you or your school who will collect the waste, and ask them how much they will pay for the various types of material.

2.3 Recycling plan for your school

Making money from recycling

You have been collecting and storing recyclable waste for one week. Now do the following exercises as a class:

- Gather all the waste you have collected and make sure it is correctly sorted: one pile for paper, one pile for cardboard, one pile for plastic.
- Place the piles into bags and mark them carefully according to what is in the bag.
- Weigh the various types of material. Work out the total amount of each material that you have.
- Multiply the weight of the material by the value the scrap dealer said he or she would pay for that material.
  For example:
  3 kg aluminium tins at R3,50 per kg: R3,50 × 3 = R10,50
- Total all the amounts for all of the materials.
- Discuss ways you could improve the collecting system.
- Discuss ways to make sure the whole school is involved and interested in this project.

Write an individual report on the value of recycling for your school

You have worked as a class to see how much recyclable material can be collected over a week from the school, and how much money could be made for school projects. Each of you must now write a report on the process.

You need to include the following topics:

1. Which materials could the school recycle?
2. What amounts of each material could be collected each week on average?
3. Who will collect the waste each day?
4. Where will you store the waste material safely and hygienically?
5. What scrap dealer or recycling company will collect the material, and how much will they pay for it?
6. Should you bring extra material from home or other collection points to add to the piles each week to make more money?
7. Should you involve the whole school in the project?
8. Write down new ideas about how to make the process of recycling more efficient while raising extra money.

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Next week

In the next lesson, you will learn about simple electrical circuits, how to draw circuit diagrams, and how to make an electromagnet.

Chapter 3
Simple electric circuits

In this chapter, you will learn what an electric circuit is and how to connect all the parts of an electric circuit. You will learn how to draw circuit diagrams. You will also learn how electromagnets work and how to make a simple electromagnet.

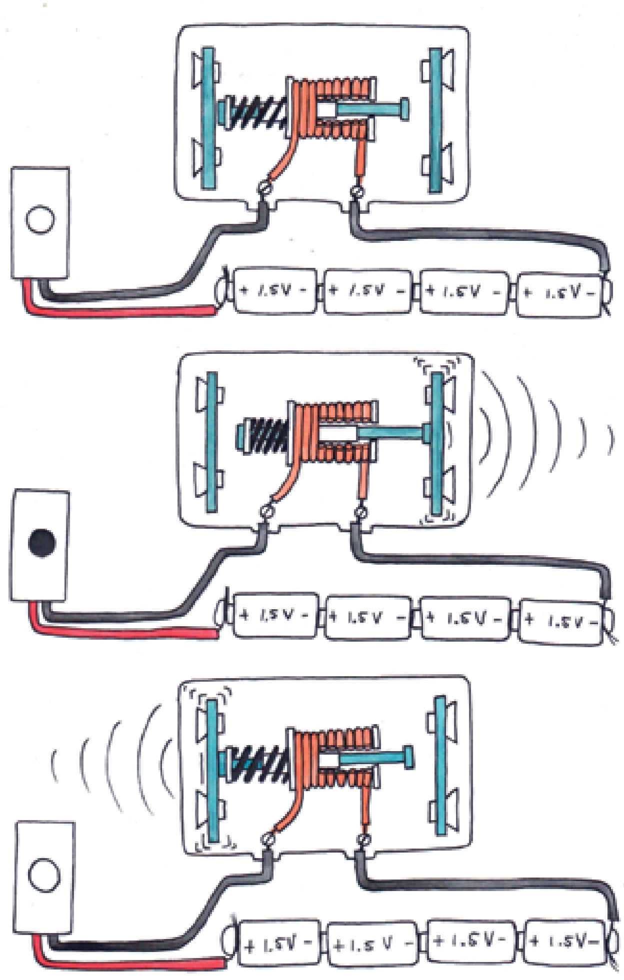


Figure 1: A bulb can form part of an electric circuit. The filament in the bulb forms part of the circuit.

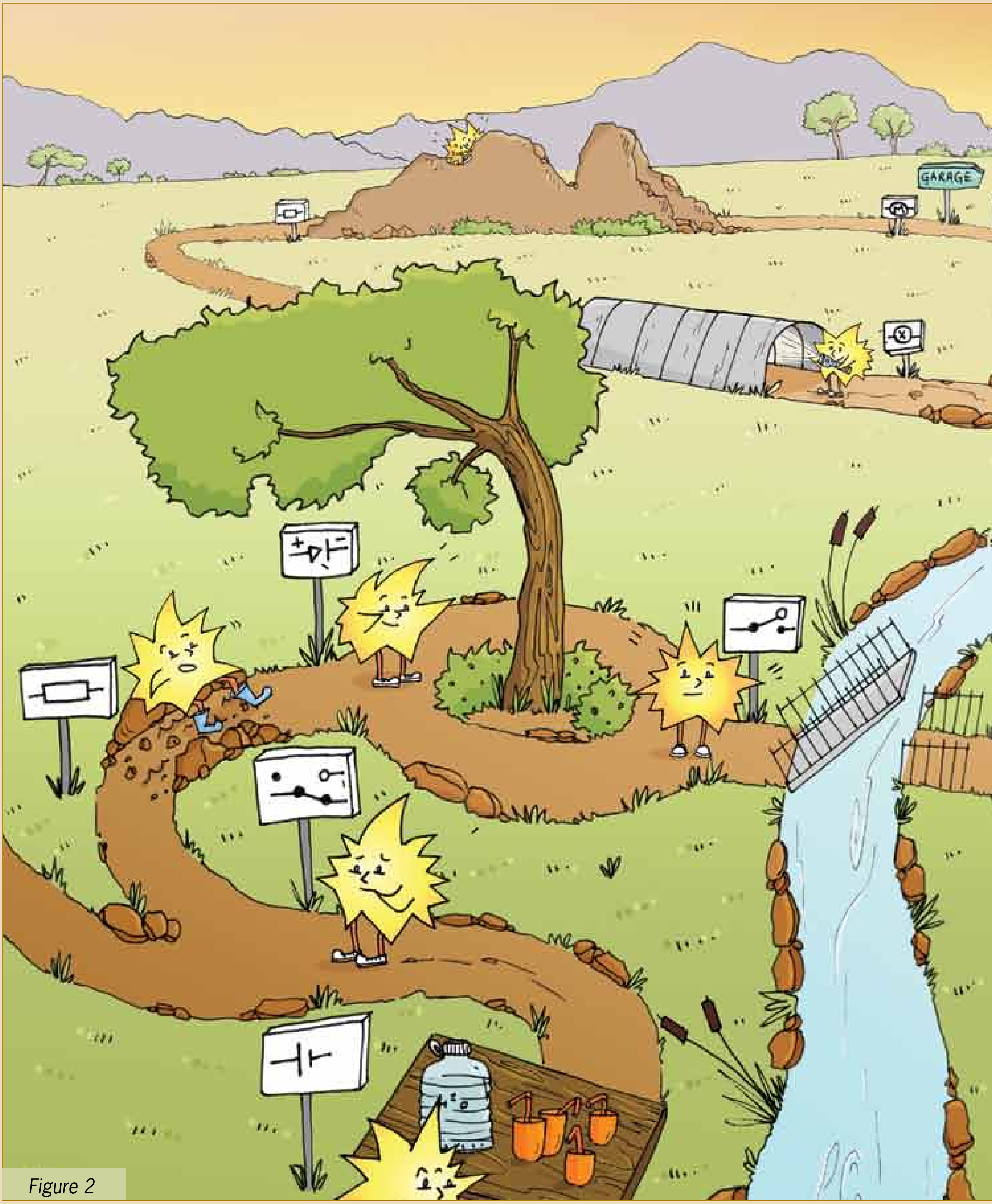
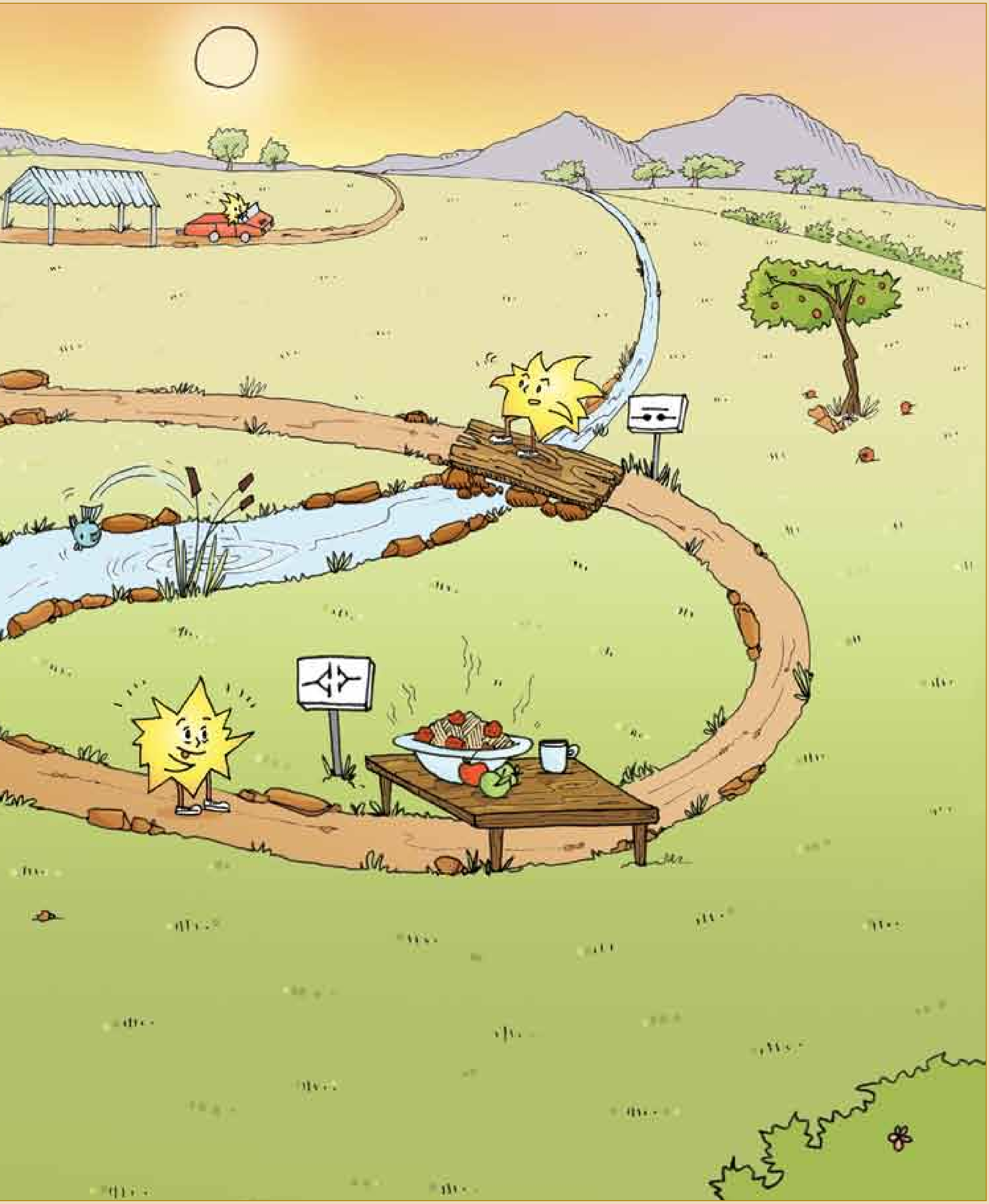


Figure 2



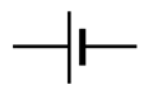
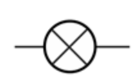
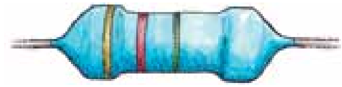
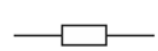
3.1 Circuits and components

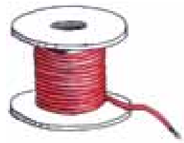
An electric circuit needs three basic things to work:

1. An energy source. This can be a cell or a stronger power source.
2. A complete circuit. There has to be an unbroken pathway of conducting materials through which the electrical current can flow.
3. A load. There has to be some form of resistance in the circuit. This could be in the form of a light bulb, a resistor, a motor or other electrical components.

To show how an electric circuit should be connected, we draw circuit diagrams with symbols that show each **component**. This is a simple way to represent the electric circuit. This table shows the symbol we use for each component:

A **component** is one part of a whole system.

Name	Picture	Symbol
electrochemical cell or cell		
batteries in series, which means they are next to each other		
switch		
light bulb		
resistor		
buzzer		

Name	Picture	Symbol
conducting wires		

The following is an example of a simple electric circuit. This circuit consists of a cell, a switch, and a light bulb that have been connected by insulated copper conducting wires.

Circuit diagrams are shown as rectangular boxes, even though the real circuit looks quite different.

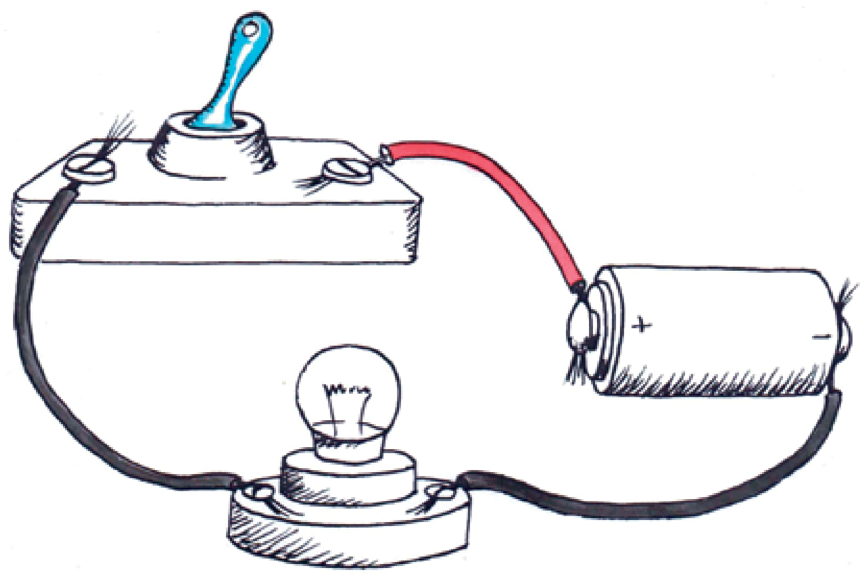


Figure 3

Questions to answer

1. What are the three things that you need to make an electric circuit?

   ....

2. How do you think you can see if the circuit in the picture at the top of this page is working?

   ....

3. If you made a mistake while putting the circuit together and the connections were not complete, what do you think would happen?

   ....

3.2 Building your own electrical circuit

Build simple circuits

For this practical exercise, you will need the following objects:

- several 1,5 V cells or one 9 V cell,
- insulated copper wires,
- a switch, and
- a light bulb.

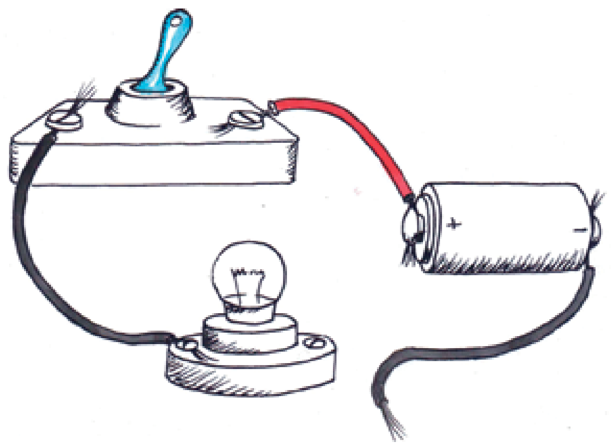


Figure 4

1. Divide into groups of three or four.
2. Connect the components as shown in the diagram in Figure 4.
   (a) Does the light bulb light up?

   ....

   (b) Why does the light bulb not light up?

   ....

3. Now try this circuit:
   (a) Does the light bulb light up?

   ....

   (b) Why does the light bulb light up?

   ....
   ....
   ....

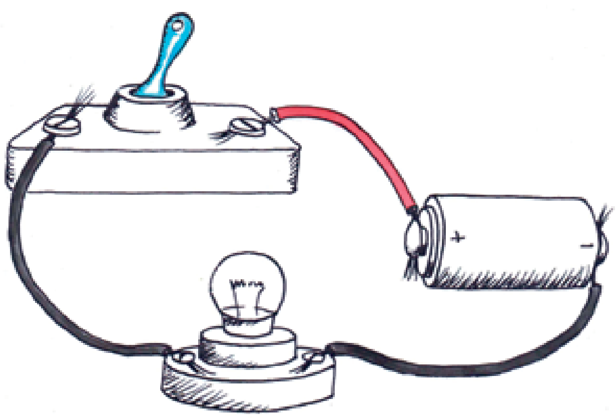


Figure 5

4. Draw a circuit diagram to show how you connected the components in your circuit. Remember to use a ruler.

5. Which of the components in your circuit is the energy source?

....

6. Which of the components in your circuit is the load?

....

3.3 Electromagnets

Now we are going to look at a very interesting phenomenon, which is the relationship between electricity and magnetism.

Electromagnets are magnets that are created using electricity. They are not permanent magnets. They are only magnets when electricity flows through them. When the electricity is switched off, they lose their magnetism.

Electromagnets are very useful for separating scrap material. Scrap material in waste dumps is usually a mixture of metals and non-metals. The ferrous metals, which are those that contain iron, are still valuable. It takes a lot of time to sort waste material by hand.

As you learnt last week, ferrous metals are attracted to magnets. An electromagnet is passed through the waste material and all the ferrous metals stick to it. The electromagnet is then moved over a collection bin. When the electromagnet is switched off, the ferrous metals are no longer attracted to it and they fall into the bin.

Figure 6: An electromagnet is used to sort metal in a scrap metal yard.

Apart from being useful to sort scrap metal, electromagnets are often used as components in other electrical devices. Some examples include:

- in motors: to rotate the motor.
- in loudspeakers: an electromagnet responds to the sound signals and amplifies them.
- in computer hard drives: electromagnetism is used to write and store data.
- in electric bells: electromagnets attract and release the hammer of the bell.
- in a magnetic door switch: electromagnets are useful to close and open doors.

In all of these applications, the fact that the magnetic force can be controlled by switching the electric circuit on and off is the property that makes the electromagnet so useful.

Now let us look at a simple electromagnet in the classroom. Your teacher can do this experiment as a demonstration.

Make a simple electromagnet

For this activity, you will need the following objects:

- a long iron nail, about 15 cm long. If you don't have a long nail, you can make a bundle of several pieces of iron wire,
- 3 m of insulated copper wire,
- a D-cell cell,
- wire stripper, and
- metal paperclips.

1. Use the wire stripper to strip a small piece of the insulation from both ends of the insulated copper wire.
2. Neatly wrap the iron nail with the insulated wire. Make sure that you keep the wire turning in the same direction. Keep the coils close together.

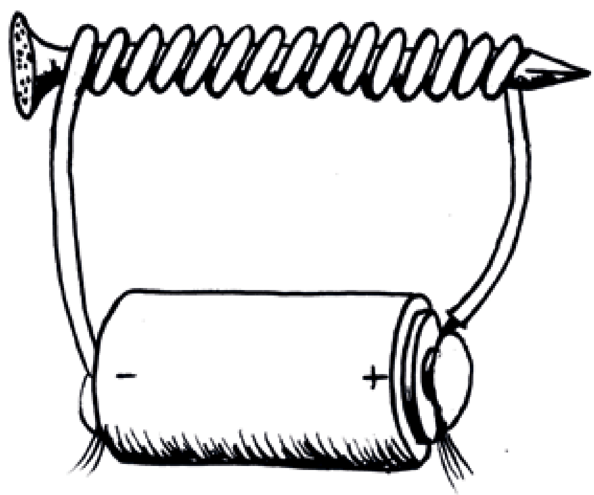


Figure 7: A simple electromagnet

3. Now wrap one of the stripped ends of the wire around the positive terminal of your cell.
4. Wrap the other stripped end around the negative terminal of your cell.
5. To test if your electromagnet is working, see whether it can pick up paperclips. If the paperclips are attracted to the iron rod, then your electromagnet is working!

Safety note:
The iron nail can become quite hot, so be careful not to burn your hands!

....

....

6. Once you have tested your electromagnet, disconnect the wire from one terminal of the cell. Now try to pick up the paperclips. Are the paperclips attracted to the iron rod?

....

....

7. How can you use the electromagnet to pick up paperclips from one place and then put them in a different place?

....

....

How does an electromagnet work?

There is a strong relationship between electricity and magnetism. The electricity in the wire coils creates a magnetic field. The iron nail is right in the middle of this magnetic field. Because the iron nail is a ferromagnetic material, it becomes magnetised by the field. The magnetic field from the electric current is made much larger, or amplified, by the magnetic field in the iron nail. Without the iron core, the magnetic field would be very weak. When the electric current is switched off, the iron nail loses its magnetism.

Next week

Next week you will revise mechanical systems and frame structures in preparation for this term's mini-PAT.

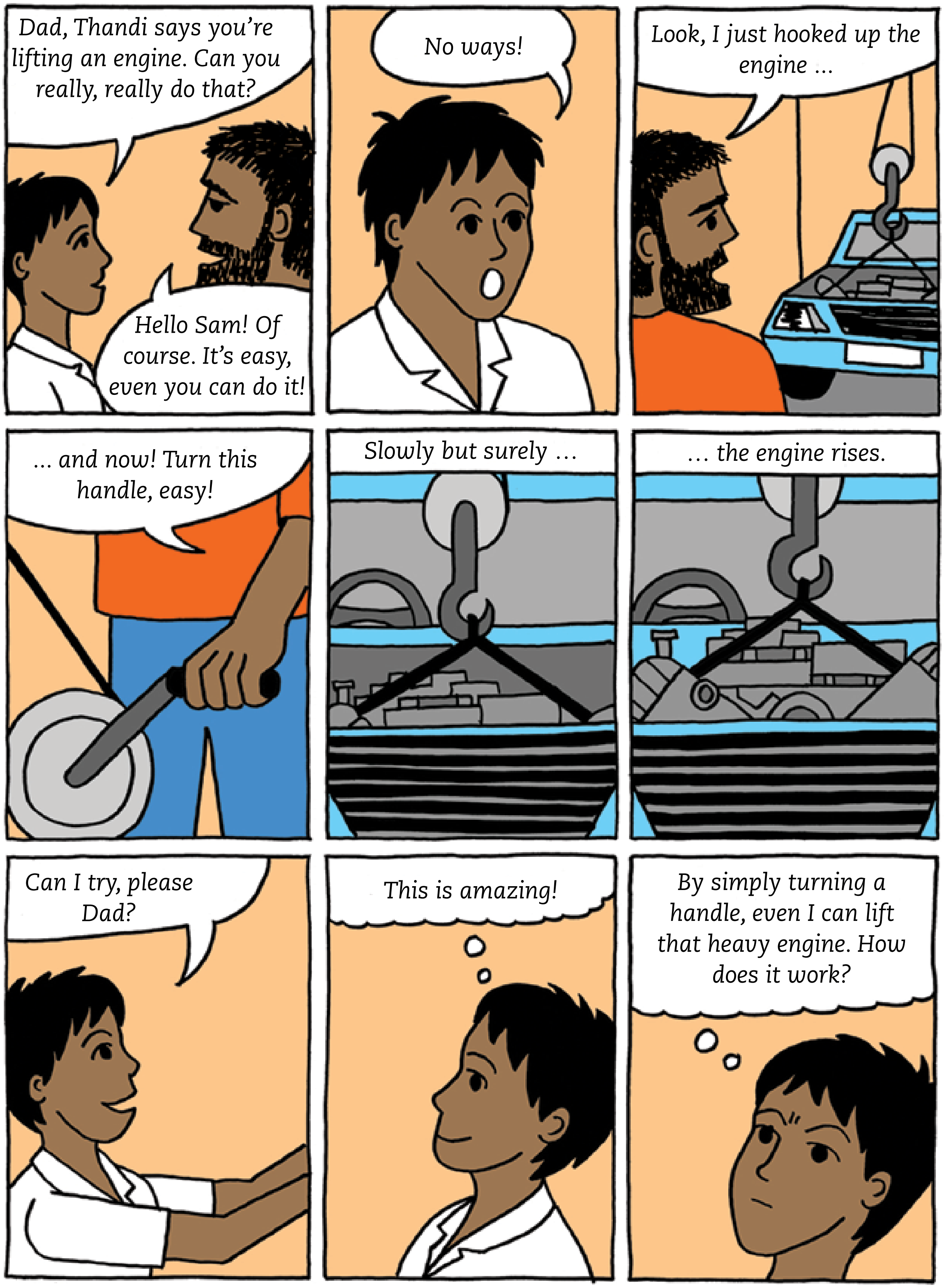
Chapter 4
Simple mechanisms combined

In this chapter, you will learn how simple mechanisms can be combined to make complex machines that are useful. You will learn about a mechanism called a pulley, which is often part of a crane. Then you will learn how a crank handle can be used to make a winder. A crank and winder mechanism allows a rope to wind up easily.

Figure 1: Cranes use pulleys and levers.


Sam goes past his Dad's workshop on his way home from school.
RECEPTION
WORKSHOP
Hello Thandi. What's Dad doing?
Hi Sam! He's lifting an engine out of a car.
What!?! Seriously? He can't be that strong!
Why don't you go help him?
That's impossible!

Figure 2



Dad, Thandi says you're lifting an engine. Can you really, really do that?
Hello Sam! Of course. It's easy, even you can do it!
No ways!
Look, I just hooked up the engine ...
... and now! Turn this handle, easy!
Slowly but surely ...
... the engine rises.
Can I try, please Dad?
This is amazing!
By simply turning a handle, even I can lift that heavy engine. How does it work?

4.1 Machines combine simple mechanisms

Do you remember what a mechanism is? Mechanisms are the parts that make up a machine. Machines are usually made of many simple mechanisms connected together.

Why are mechanisms useful? They help us to move things further, faster or more easily. We can put together simple mechanisms to design a machine that will give us mechanical advantage.

Remember:

- Mechanical advantage reduces the input or effort force so that loads are easier to move.
- First-class levers have the fulcrum positioned between the effort and the load.
- Second-class levers have the fulcrum positioned at one end of the lever and the effort at the other end. The load is always between the effort and the fulcrum.
- Third-class levers have the fulcrum and the load positioned on opposite ends of the lever. The effort is in the middle.

Figure 3 on the opposite page shows a "tower crane". These cranes are used to help us build high buildings.

Tower cranes are tall, straight cranes that use ropes, pulleys and winches to help people to lift very heavy things, such as bricks and cement. They are made of simple mechanisms all working together.

Use the picture of the tower crane on the opposite page to answer the questions.

1. What do you think the main purpose of the crane is?

   ....

   ....

2. What do the pulleys do?

   ....

   ....

   ....

   ....

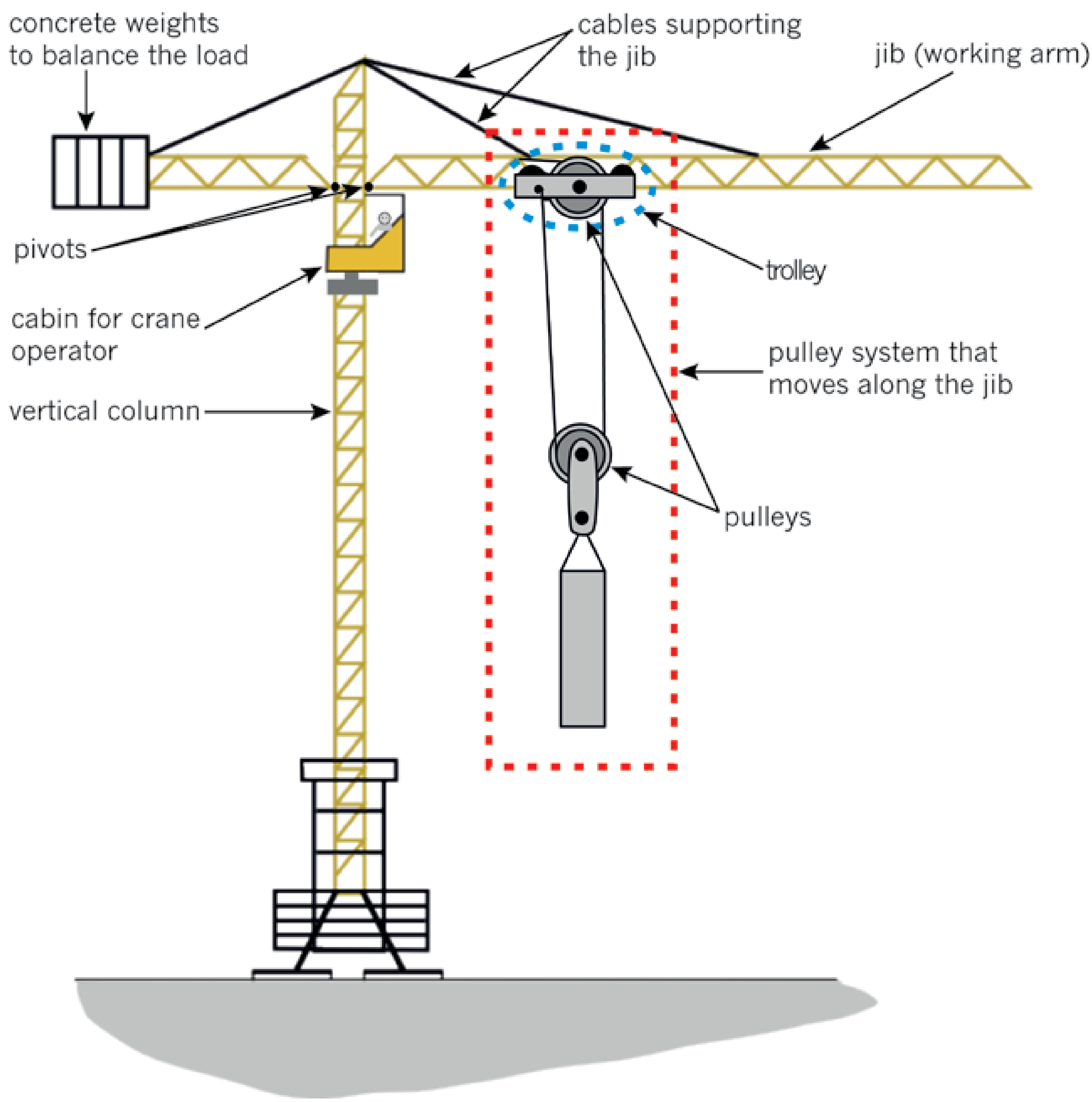


Figure 3: A tower crane uses many different mechanisms.

3. The crane needs to lift heavy things from different places on the ground. How does the trolley help people to lift things from different places on the ground?

....

....

4. Why does the crane need to **rotate**?

Rotate means to turn around an axis or centre point.

....

....

5. The jib has a fulcrum on top of the vertical column. It has an input force or effort from the diagonal cables right at the top of the crane pulling the jib up, and a load pulling the jib down. How do you know that the **jib** is actually a lever?

6. Is the jib a first-class, second-class or third-class lever? How do you know?

7. What stops the crane from falling over when it lifts something?

8. Make a list of all of the mechanisms on this crane that help it to lift loads.

9. Now make a list of all the parts that hold the crane up, and keep it balanced, so that it can lift things safely.

4.2 Pulleys – mechanical advantage from ropes and cables

Look at Figure 4. A man is lifting a heavy bag. He is using a rope wrapped around a pulley so that he can pull down to lift the bag, instead of lifting the bag up. The pulley makes it possible for the rope to change the direction in which the rope pulls. When he pulls down on the rope, he can lean with his weight on the rope to make it easier to pull the bag up. But there is no mechanical advantage in this situation.

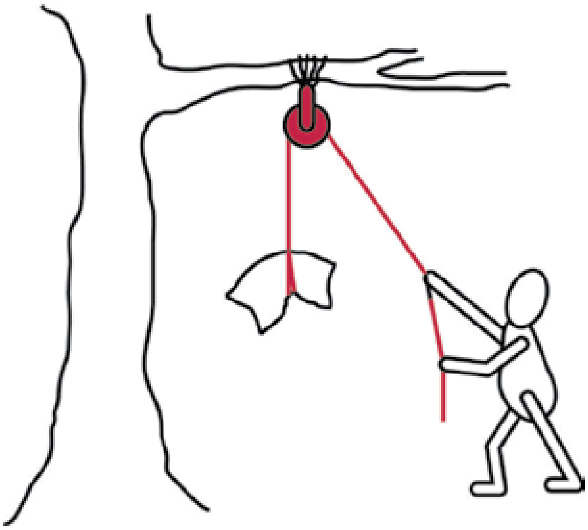


Figure 4: A man is using a rope and a pulley wheel to lift a heavy bag.

Look at Figure 5. A person uses two pulleys to lift a weight. One pulley wheel is connected to the roof. The second pulley wheel hangs on a loop of rope. The two pulleys and the way the rope is wrapped around both pulleys, forms a pulley system. The pulley system makes it easier to lift a load. Here is how it works:

- At the effort end, you pull on one piece of rope.
- Two pieces of rope lift the load.
- Two pulleys connected to a single piece of rope, as shown in Figure 5, give a mechanical advantage.

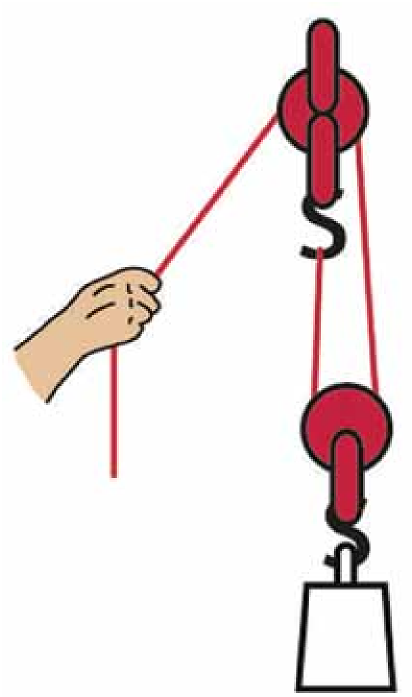


Figure 5: If you connect two pulleys to a piece of rope like this, you get a mechanical advantage.

Make your own pulley system

You need the following things for this activity:

- two plastic curtain sliders to act as pulleys,
- 500 mm of string or cotton,
- a few weights, like steel nuts or washers,
- a flat piece of corrugated cardboard, about A4 sized,
- paper clips, and
- three pins.

Study the picture in Figure 6 to help you make your own pulley system. The instructions are below.

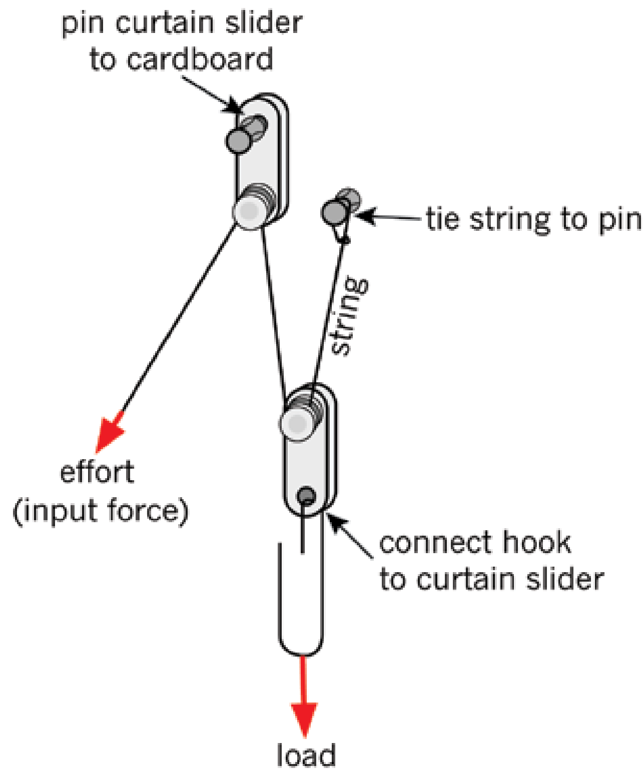


Figure 6: You can make a pulley system out of curtain sliders.

Making your own pulley system

- Use a pin to attach a curtain slider about 30 cm from the top of the corrugated card. This will be the fixed pulley.
- Make a hook from the third paper clip and attach it to the bottom hole of the other curtain slider. This will be the moving pulley.
- Use a pin to fix one end of the string to the cardboard somewhere close to the fixed pulley
- Thread the string around the moving pulley, and then back up and over the fixed pulley.
- Attach your load to the hook at the bottom.
- Hang the pulley board onto a wall, or lean it against a wall.

1. Pull the string downwards. What happens to the load?

   ....

2. How many parts of the string pull up the load on the output or load side of the system?

   ....

3. How many parts of string are pulled down on the input or effort side of the system?

....

4. Pull the end of the string at the input or effort side down by exactly 100 mm. Then measure how far the load lifts up. Write your answer below.

....

5. Try to lift the load without the pulley system. How does it compare to lifting the load with the pulley system? Does the pulley system make it easier?

....

An even easier pulley system

Do this activity for homework to add to your understanding of pulley systems. Add two more curtain sliders to your pulley system. Look at the picture below to help you. Test the system by lifting the same load as before.

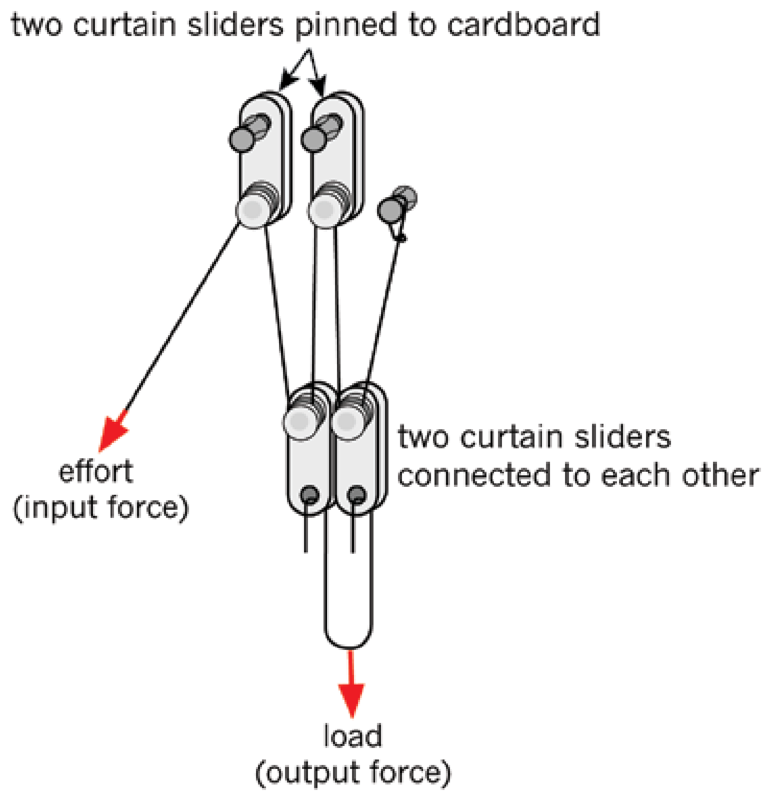


Figure 7: You will increase the mechanical advantage if you use more pulleys. There will be more lengths of string to lift the load.

1. What distance does the load lift when you pull the string down by 100 cm?

....

2. Describe what a pulley mechanism does.

....

....

....

....

....

....

3. What do you think pulley systems are mostly used for?

....

4. Real pulley systems use wheels instead of curtain sliders. Why do you think this is? **Hint:** Think how you can make it easy to slide an object over a rough surface.

....

....

4.3 Combining mechanisms

Make a lifting system

In this activity, you will combine mechanisms to make a machine that can lift things. Remember that machines make it easier for us to move, lift, push or pull things.

Look at the model of the lifting system shown in Figure 8. You will have a chance to make this lifting system in the activities that follow. But first answer the questions below.

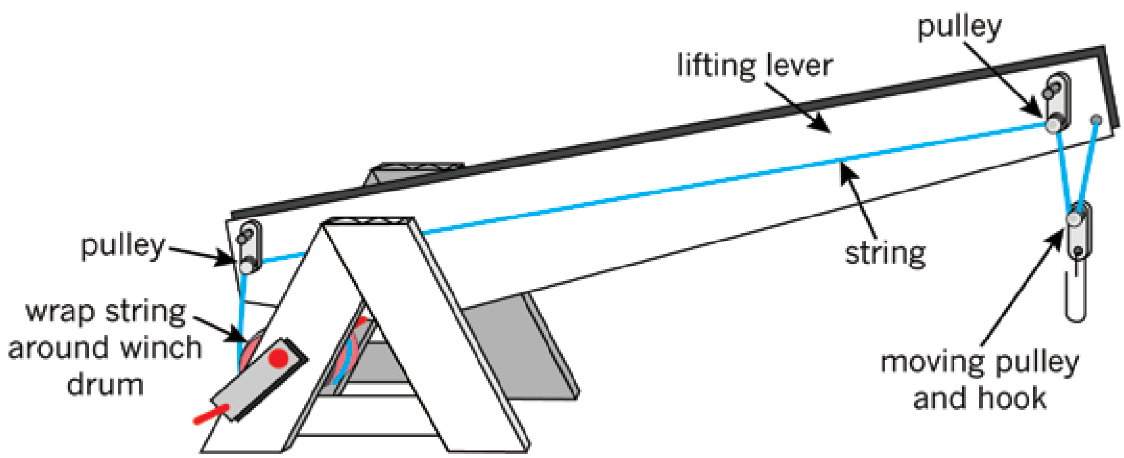


Figure 8: A lifting system that you can make

1. How does the pulley system help to lift things?

....

....

2. What does the lever do in this system?

....

3. Explain how you could use this system to lift a load?

....

....

Make an A-frame for a fulcrum

Trace the shapes in Figure 9 below. Then cut out the shapes and paste them onto a piece of corrugated cardboard. Cut out the cardboard shapes.

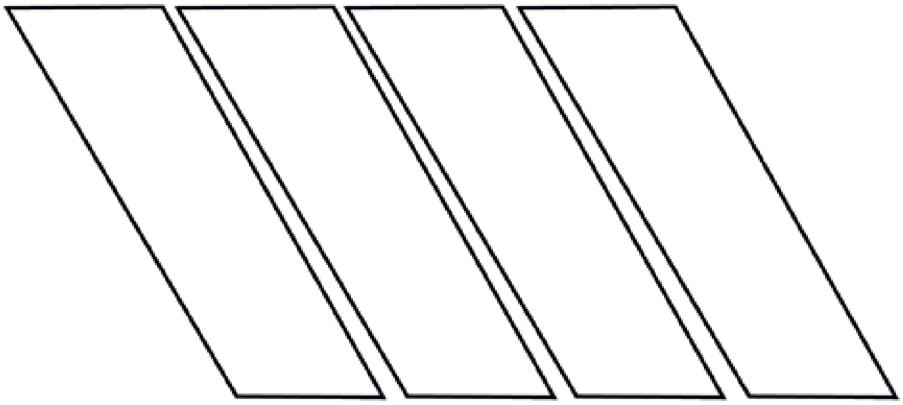


Figure 9: Use these four shapes to make an A-frame.

- Use these shapes to make two A-frames.
- Glue two shapes together at the top.
- Add parcel tape to the bottom to make the A shape.

Look at Figure 10 to see how to do this.

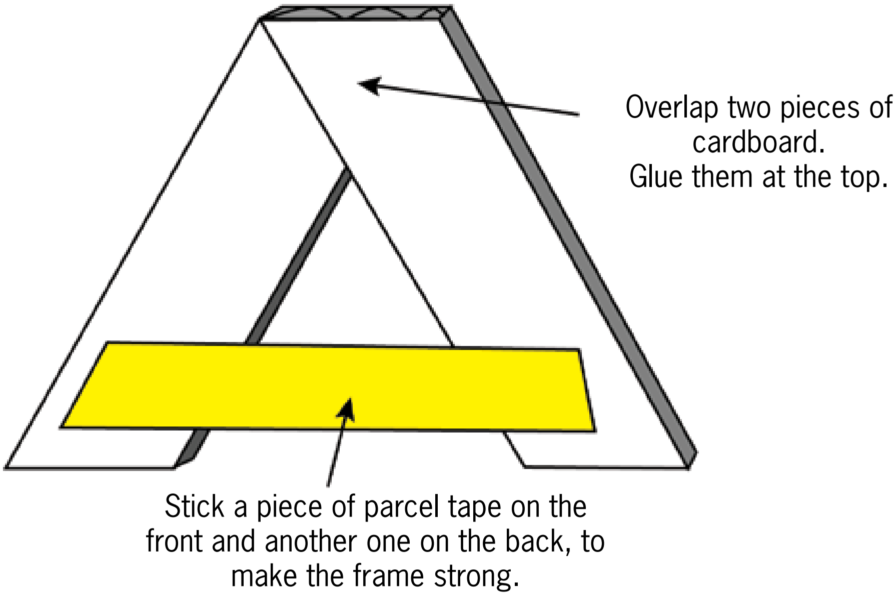


Figure 10: How to make an A-frame

Make a hand-driven winch

A winch is a mechanism that is the combination of:

- a **winch drum** that is a cylinder around which rope or cable is rolled up,
- an **axle** that allows the drum to rotate, and
- a **crank** that is a lever or "arm" with which the drum is turned.

You need the following things for this activity:

- two milk-bottle tops,
- sticky tape,
- a long nail,
- stiff cardboard 15 mm wide and 40 mm long, and
- a small nail.

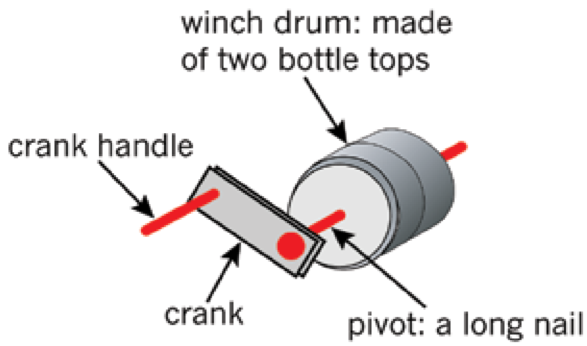


Figure 11: You can make a hand-driven winch drum by joining two milk-bottle tops together.

- Tape the two milk-bottle tops together.
- Make two small holes in the centres of the bottle tops. The **axle** of your winch will go through these holes.
- Cut a piece of stiff cardboard for your crank. It should be about 15 mm wide and 40 mm long.
- Push the long nail through one side of the crank. Then push the nail through the centre of the drum, and out through the other side of the drum.

An **axle** is the straight bar around which something like a wheel or a winch drum rotates. In other words: it is the fulcrum around which something turns.

Note: The crank lever and the drum must fit tightly onto the nail. When the crank turns, the drum should also turn.

- Make a crank handle by pushing a smaller nail through the other side of the crank lever.

Attach the winch to the A frame

- Make a hole through each of the two A frames, in the one "leg" of the A frame, about 45 mm from the base.

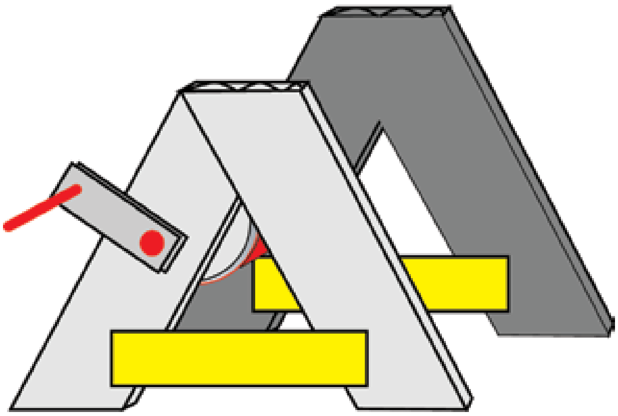


Figure 12: Put your crank and winder into your A frame.

- Carefully take the winch apart and set the drum aside. Then push the axle with the crank attached to it through the hole on the A frame at the front.
- Put the drum between the A frames at the front and the back, and then push the axle through the drum again.
- Keep pushing the axle until it goes through the hole in the A-frame at the back.

1. What does the hand-driven winch do?

   ....

Make a lifting lever

Now trace this shape and use it to make a corrugated cardboard lifting lever, exactly the same size as the one below in Figure 13.

Figure 13: You can use this shape to make a lifting lever.

Follow these steps:

- Make a hole in both A frames, about 10 mm down from the top.
- Make a hole on the lifting lever, 10 mm up from the bottom of the V-shape.
- Use a nail as the fulcrum and join the lifting lever to the two A frames to make a second-class lever.
- Push another nail through the right legs of the A frames to hold the lever up. Look at Figure 14 to help you.

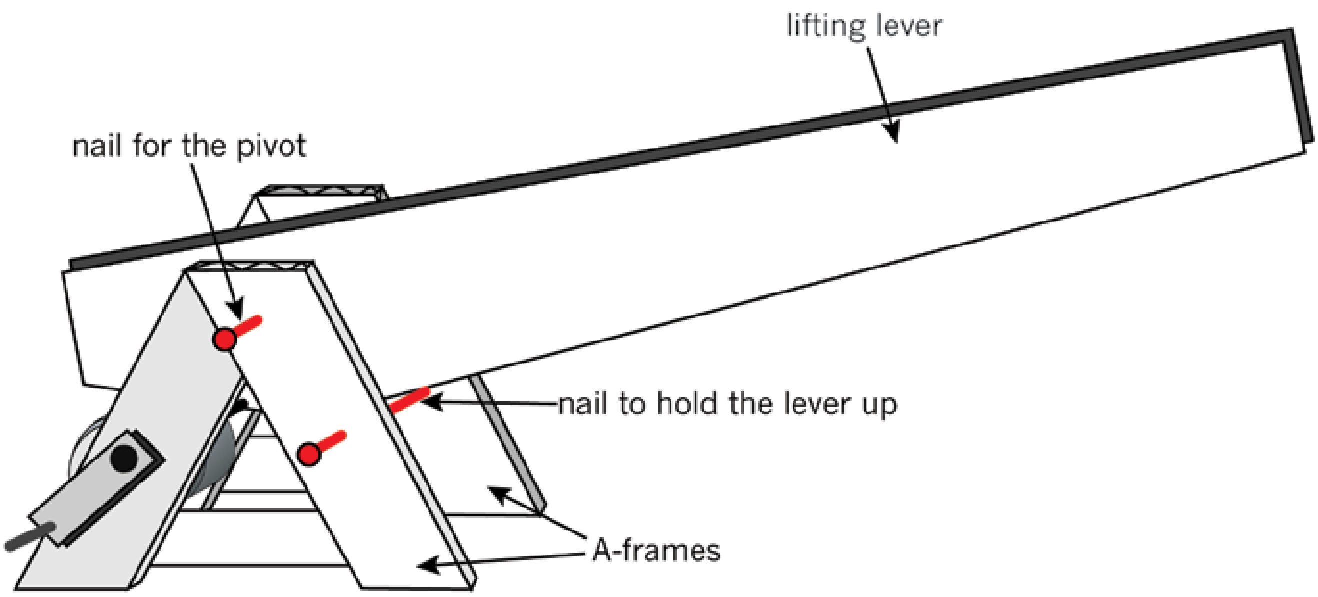


Figure 14: How to connect your lifting lever to your A frames

Add a pulley system

Follow this method:

- Pin two curtain sliders onto your lifting lever, one on the right and another one on the left. These sliders will guide your lifting rope.

- Add a pin, or make a hole on the right-hand side of the lifting lever. Tie a piece of cotton thread or thin string to the pin, or make a knot through the hole.
- Make a hook from a paper clip and hook it onto another curtain slider.
- Thread the string around the pulley with the hook on, over the pulley on the right side of the lifting lever, and then over the pulley of left side of the lifting lever.
- Pull the loose end of the string down to the winch, and wrap it around the drum a few times. Then stick it onto the drum.
- Turn the crank until the hook hangs in the air.

Look at Figure 15 to help you, and answer the questions.

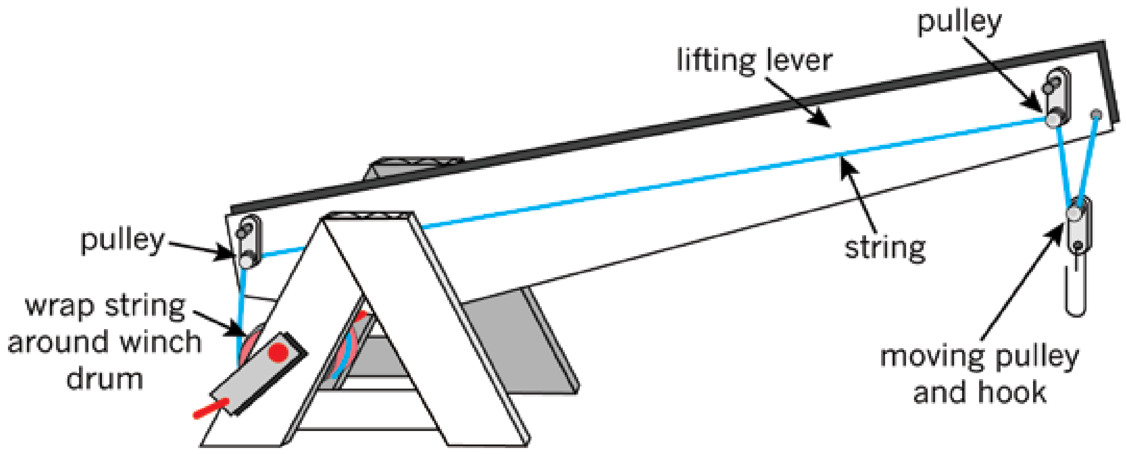


Figure 15: Add a pulley system to your lifting lever.

Questions

1. How do you use this system to lift things?

   ....

   ....

2. What shape do you think makes the A frames on this system strong?

   ....

   ....

   ....

   ....

3. As it is at the moment, the lifting lever of your model crane does not move. Could you change or add something so that you can make the lifting lever move up and down? Explain how you could do this. **Hint:** You can have two winches on a crane.

   ....

   ....

4. Name the mechanisms that have been combined to make this system.

....

5. Does the winch give you a mechanical advantage? Explain your answer.

....

....

6. Does the pulley system give you a distance advantage? Explain your answer.

....

....

Remember: A mechanical advantage makes the output force (on the load) bigger than the input force (effort).

A distance advantage makes the load move further than the effort moves.

What have you learnt?

1. Which mechanisms can you combine to make a crane? Explain your answer.

....

....

....

2. Give an example of a machine that uses a crank.

....

3. Give an example of a machine that uses pulleys.

....

4. How does a pulley system give a mechanical advantage?

....

....

Next week

Next week, you will start your mini-PAT for Term 3. You will design and make a machine to help a scrap-metal dealer sort the magnetic from the non-magnetic metals in the scrap yard.

Chapter 5
Build a model crane

For this term's mini-PAT, you will work on your own and as part of a group to build a crane that can be used to pick up pieces of metal. You will work through all the stages of the design process while you build a model crane with an electromagnet. Your teacher will assess you on all the stages of the design process.

Assessment

Design process:	Investigate: identify cranks and pulleys	[10]
Design:	Write a design brief with specifications and constraints	[15]
	Sketch your ideas	[10]
Make:	Draw a flow chart	[5]
	Draw a circuit diagram	[8]
	Model crane with electromagnet	[12]
Evaluate:	Develop an evaluation sheet	[5]
Communicate:	Oral presentation	[5]

[Total marks 70]

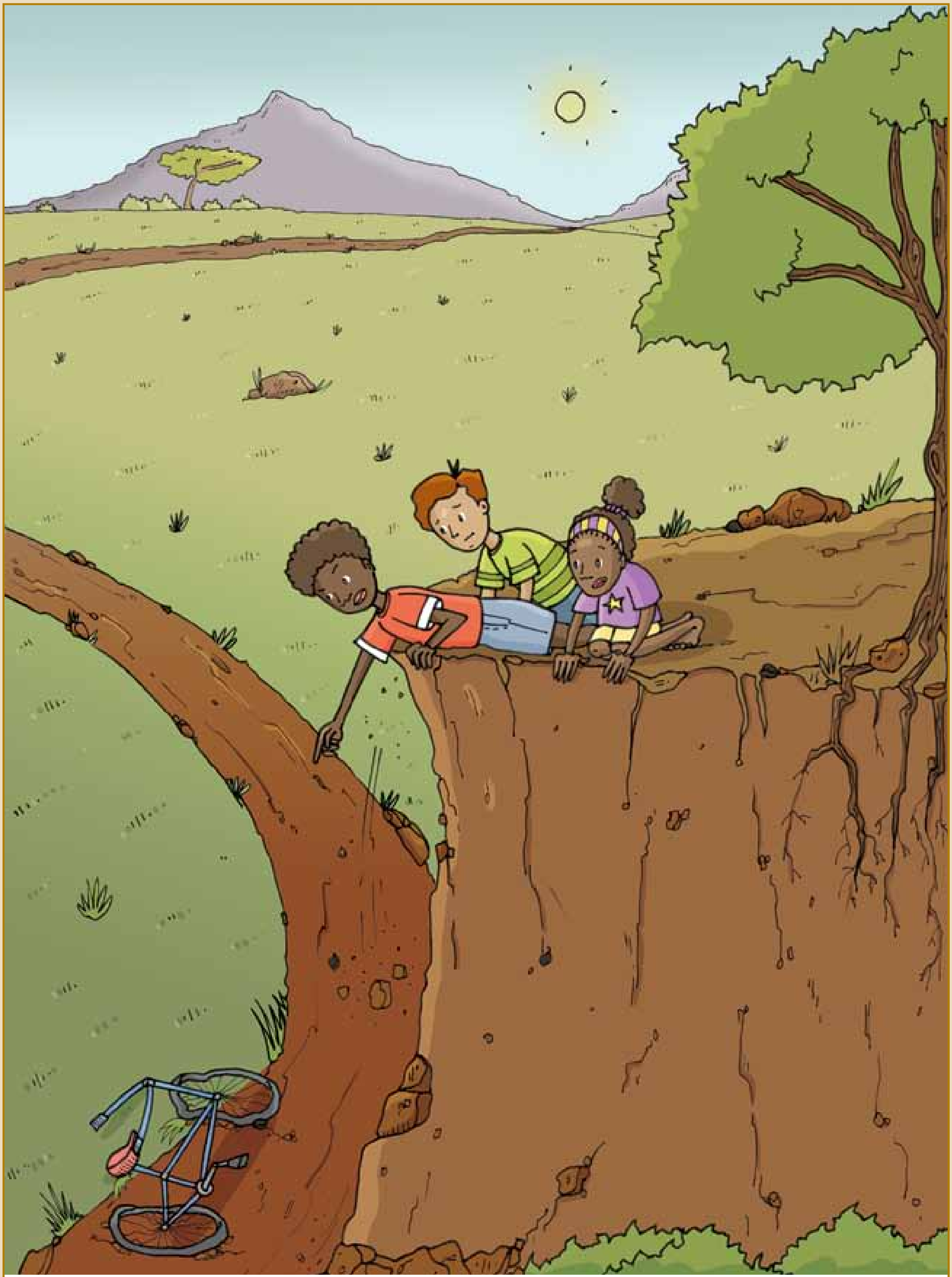


Figure 1

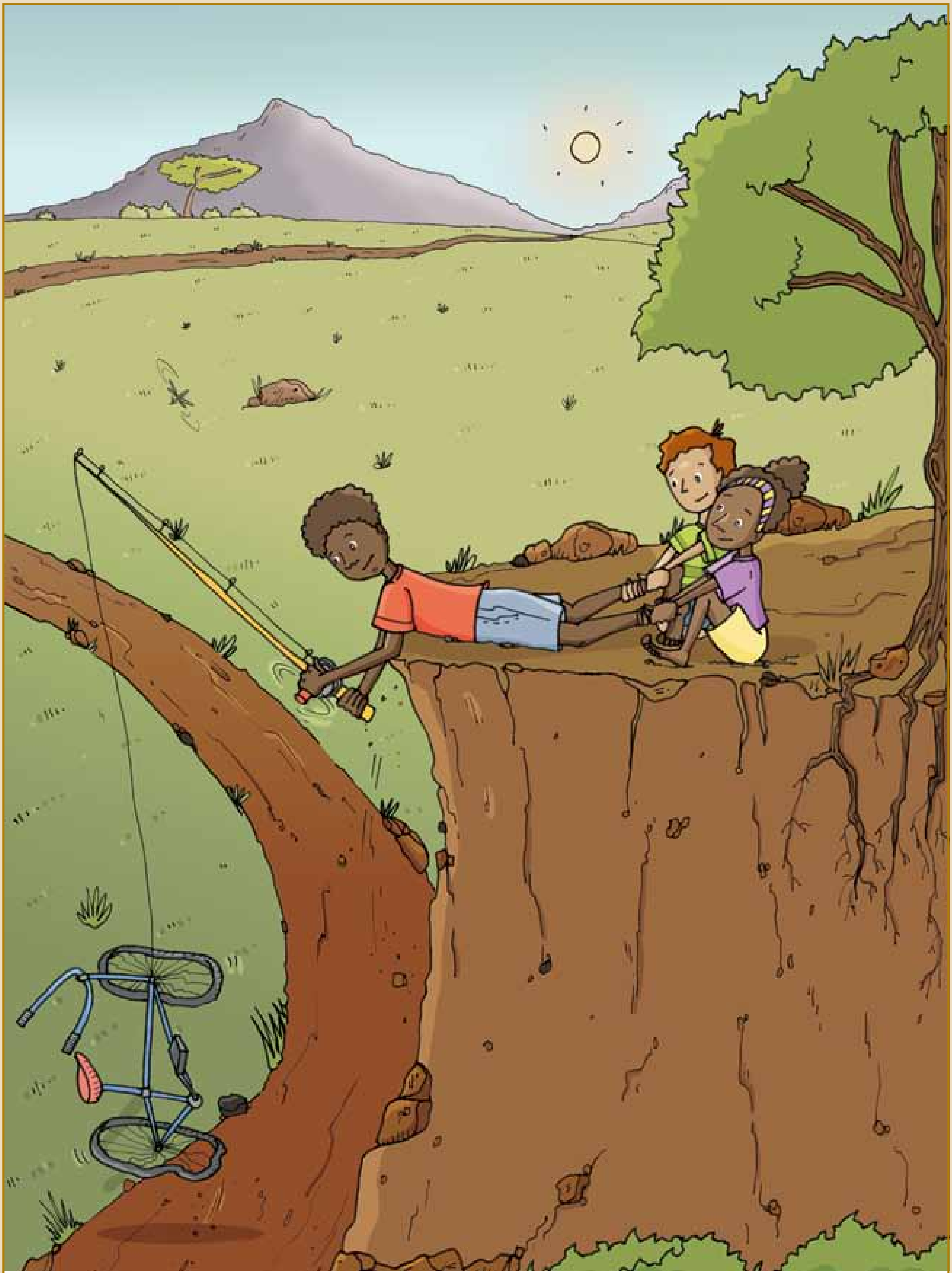


Figure 2

Week 1

Design Part 1 (30 minutes)

A scrap metal dealer sorts magnetic and non-magnetic metals into separate piles for recycling. They use a crane with a magnet, but find it difficult to remove the metal pieces from the magnet. They need a magnet that can be switched on and off to help with this.

The company wants you to design and build a model crane that:
- should be a simple frame structure,
- should be made strong, stiff and reinforced through triangulation,
- should work with a pulley and a crank mechanism,
- should pivot, or it should raise and lower its arm, and
- is made from any materials. Some can be bought, while others can be simple materials, such as paper dowels or elephant grass.

The crane should have an electromagnet attached to its arm. The electromagnet:
- should have a soft iron core made from a bundle of short lengths of iron wire,
- must have a switch so that it can be switched on and off;
- must be strong enough to pick up several steel paperclips, nails or coins.

Design brief with specifications and constraints

Work on your own. This task will be assessed. Read through the information given under "Design Part 1" before completing the three sets of questions.

Ask yourself:
- What is the problem?
- Who is the solution for? Or, in other words, who will benefit from it?
- What should the solution do?
- Will it benefit or harm the community?

1. Now write the design brief. Use the answers of the questions you have just answered to help you.

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.... (3)

2. Identify the specifications.
   (a) List the specifications for the model crane.

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.... (7)

   (b) List the specifications for the electromagnet.

....

....

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.... (4)

3. Identify constraints, if there are any.

....

....

.... (1)

[Total 15]

Investigate cranes (30 minutes)

Identify cranks and pulleys

Work on your own. This task will be assessed.

1. Study all four images of cranes on the following pages. All the cranes have a crank and a pulley system. Some cranes have more than one pulley.
2. Look at where the cranks are placed. Mark each crank with the letter C.
3. Look at where the pulleys are placed. Mark each pulley with the letter P.
4. Which of the cranes have pulley systems with three or more pulleys?

.... [10]

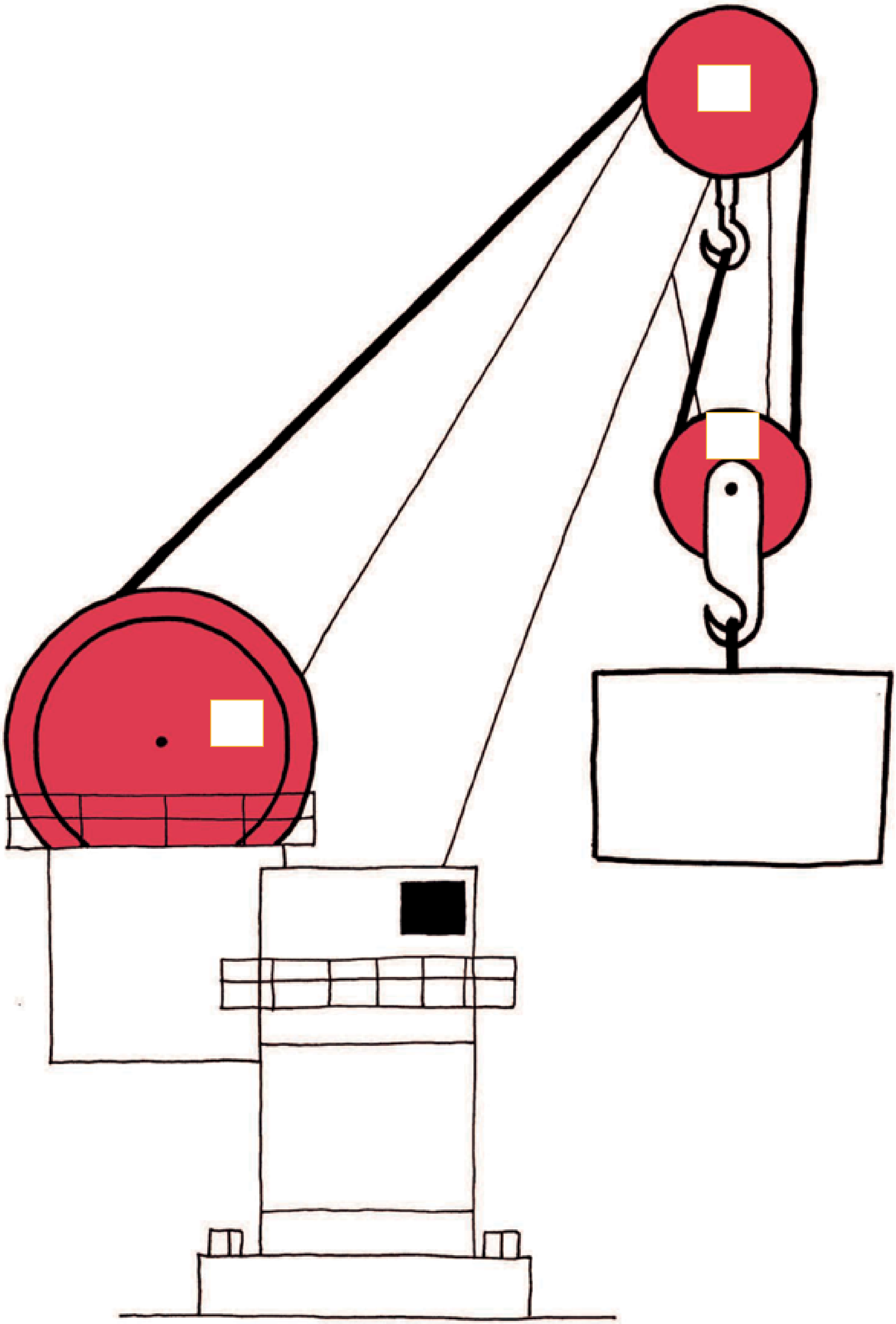

Figure 3: Crane in harbour

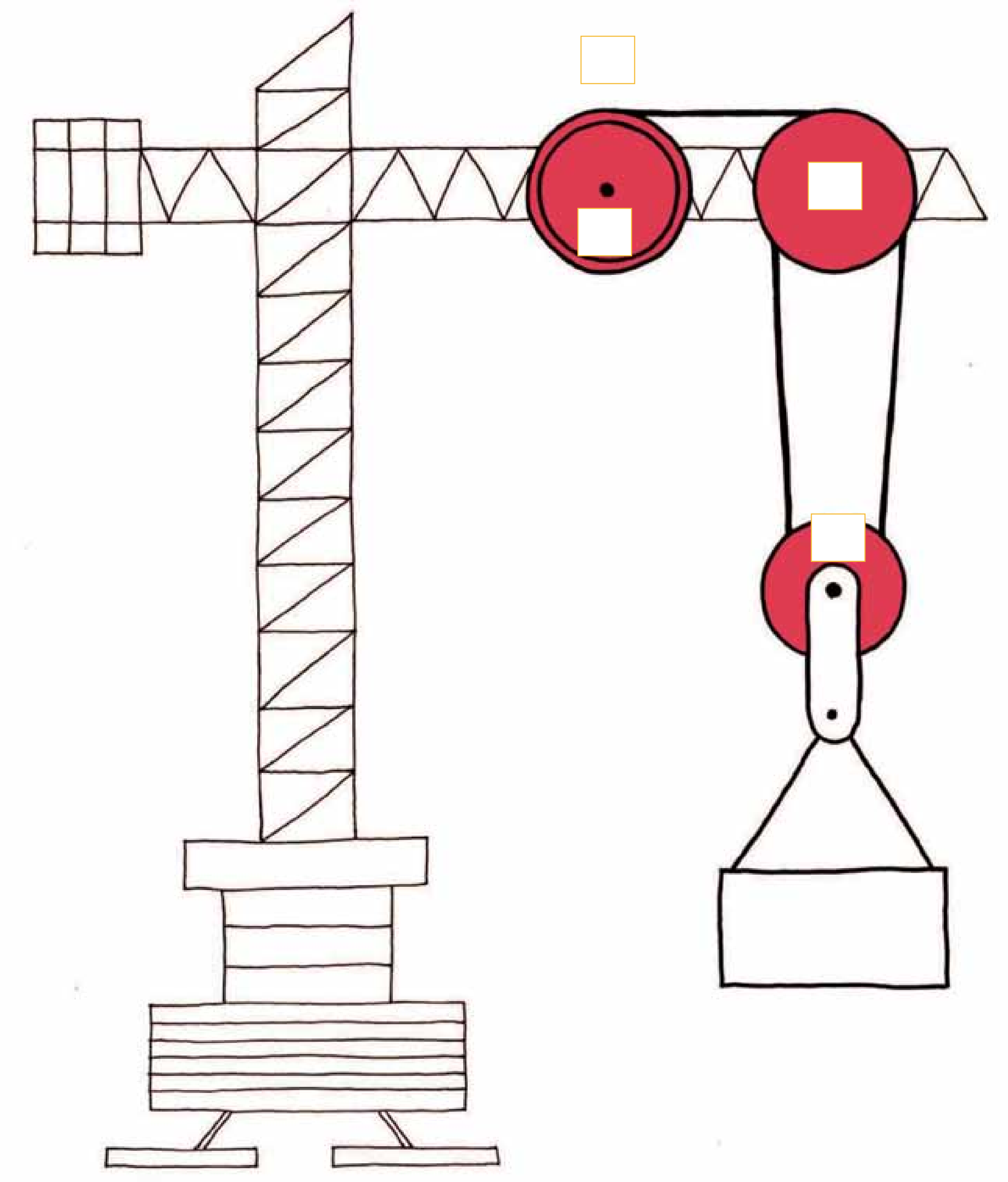

Figure 4: Tall builder's crane

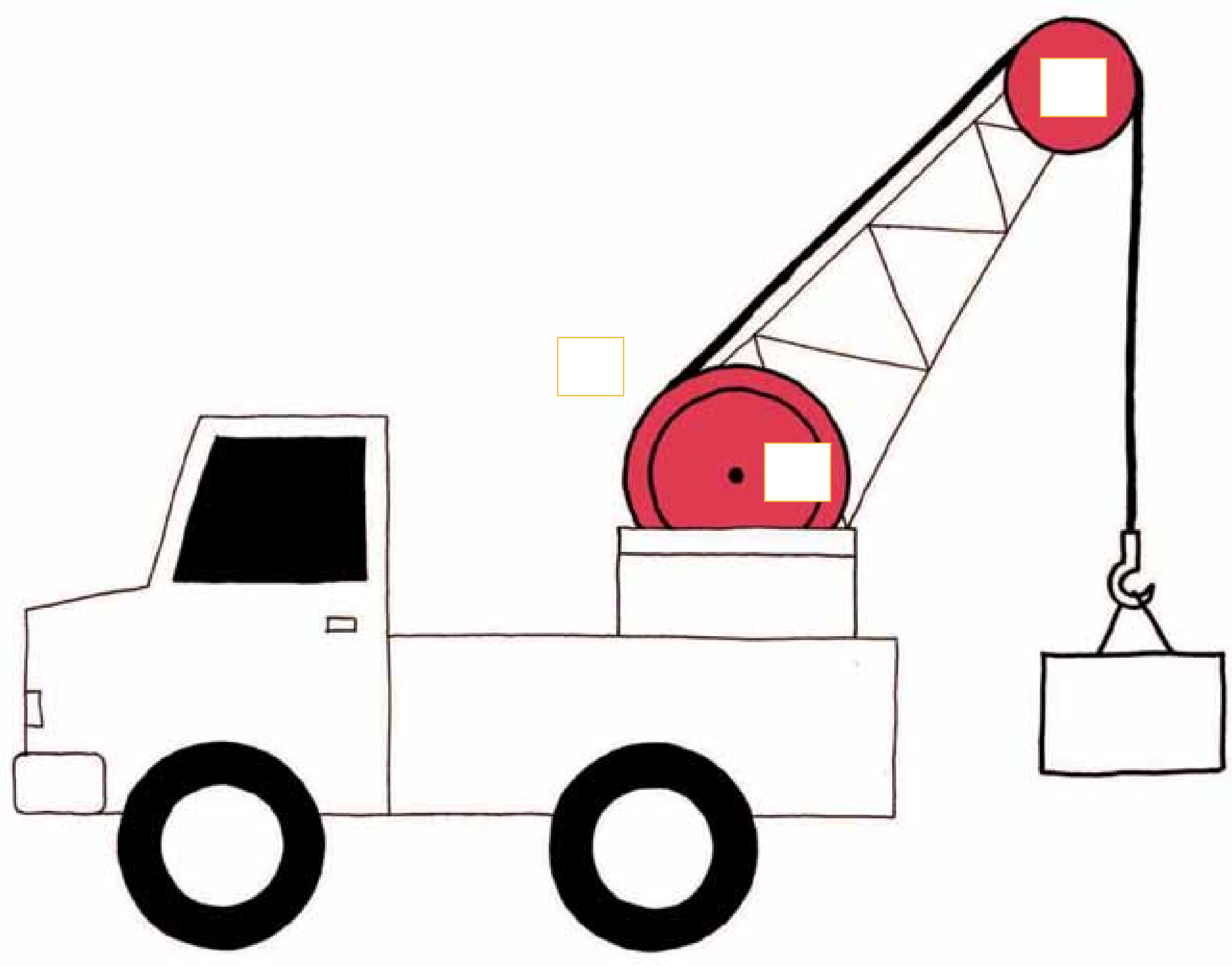

Figure 5: Crane on a truck

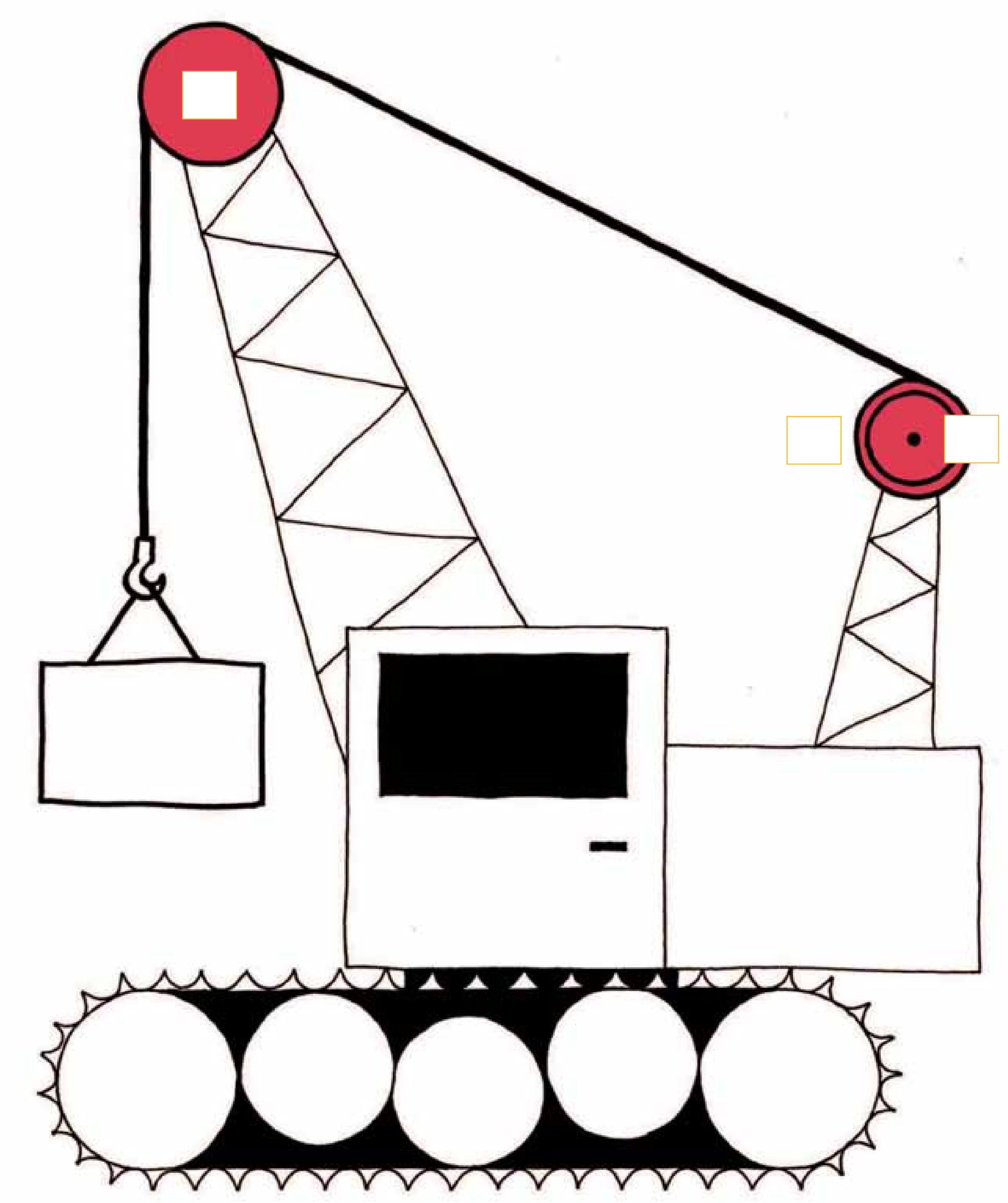

Figure 6: Crane on caterpillar tractor

Look at this model crane

Work in pairs. Look at the photographs on the next few pages, showing the steps to make a model crane. Answer the questions after the series of photographs.

Figure 7

Figure 8

Figure 9

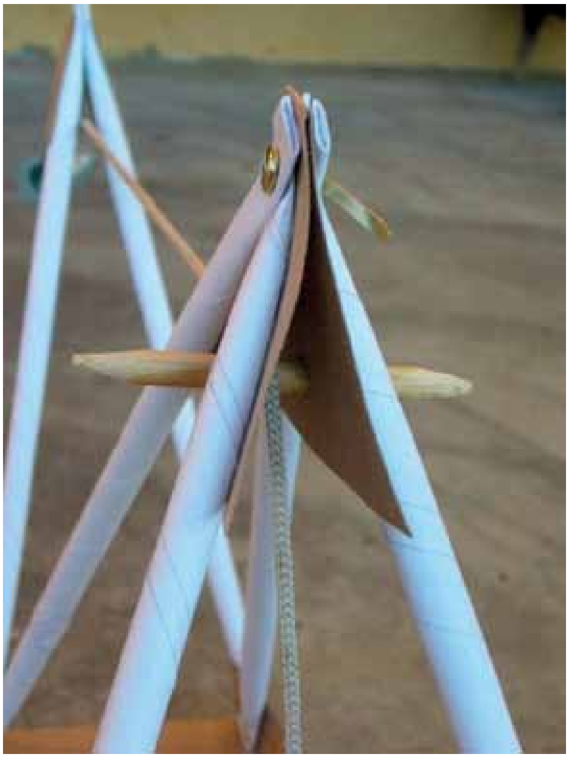

Figure 10

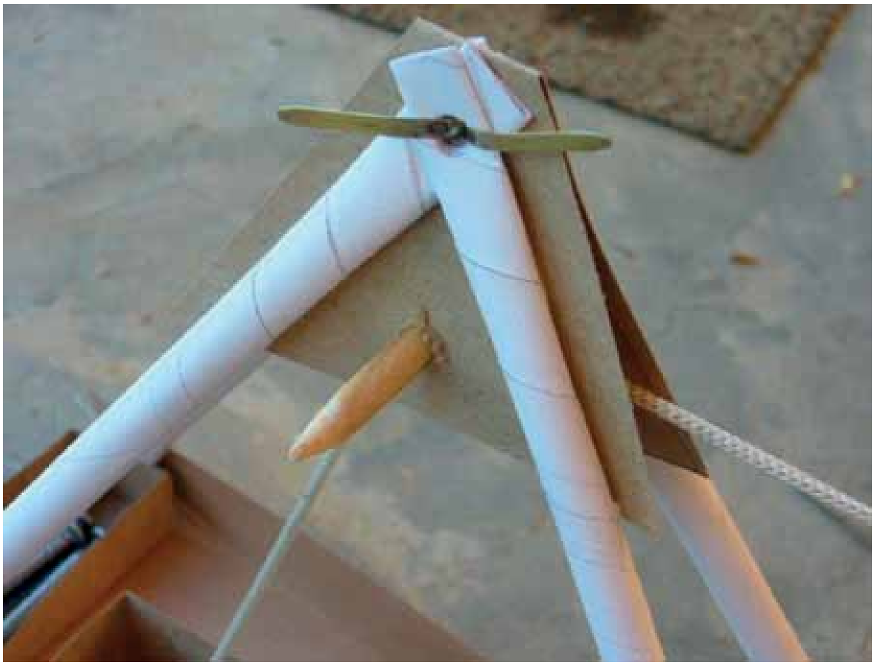

Figure 11

Figure 12

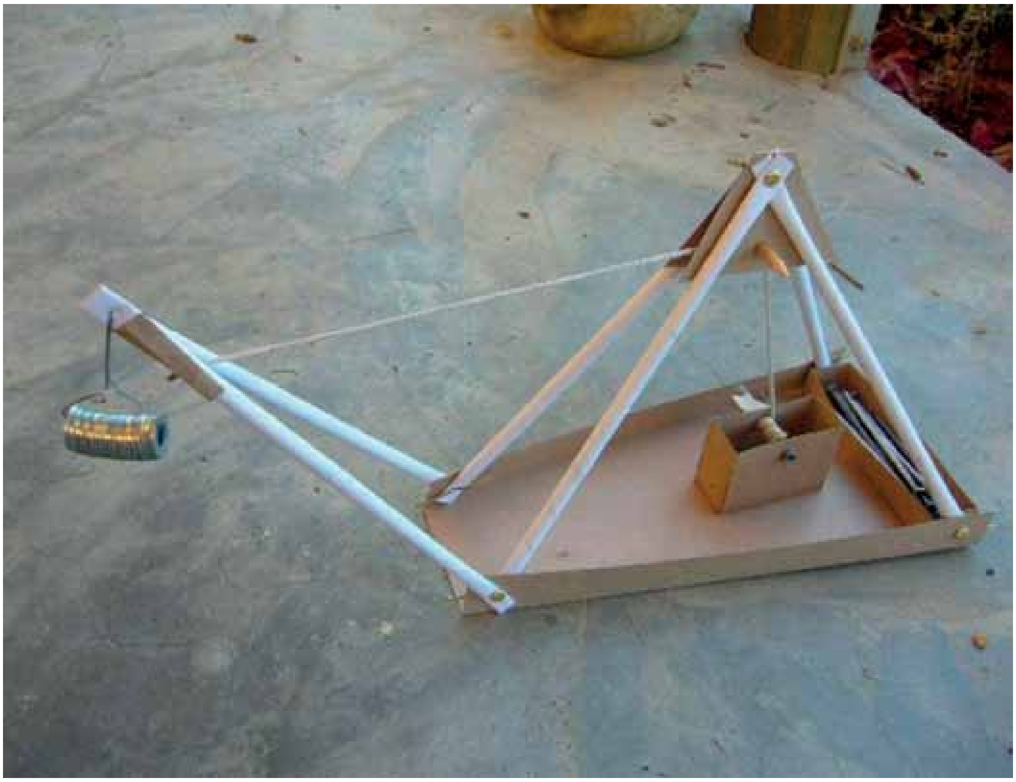

Figure 13

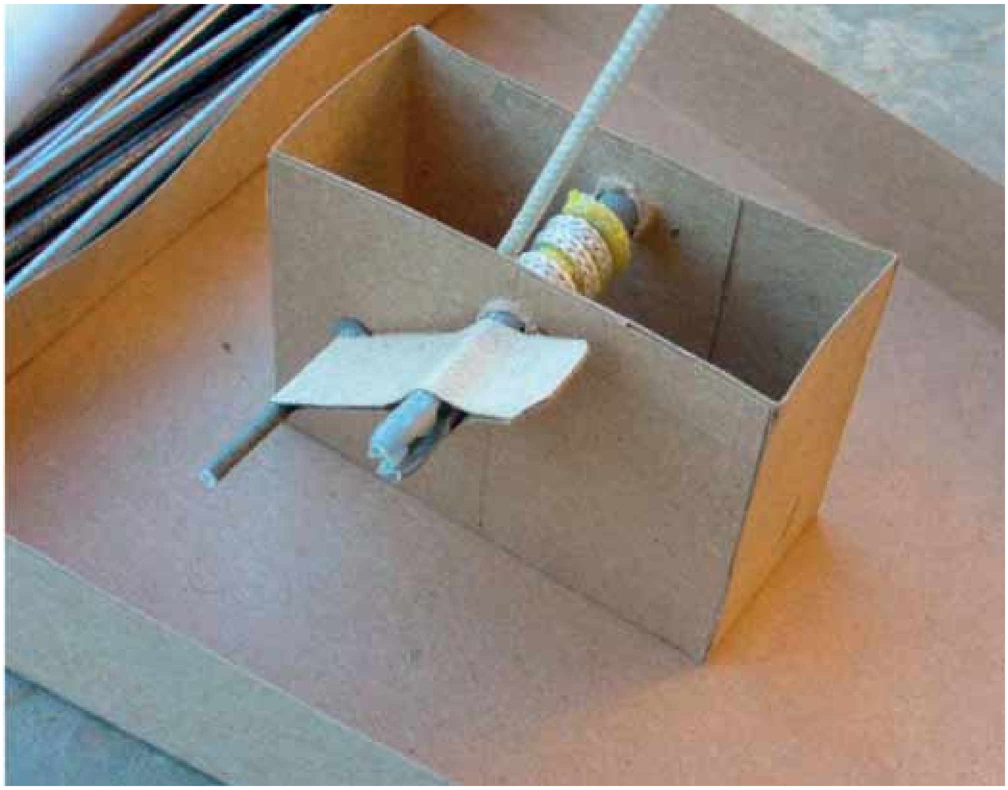

Figure 14

Figure 15

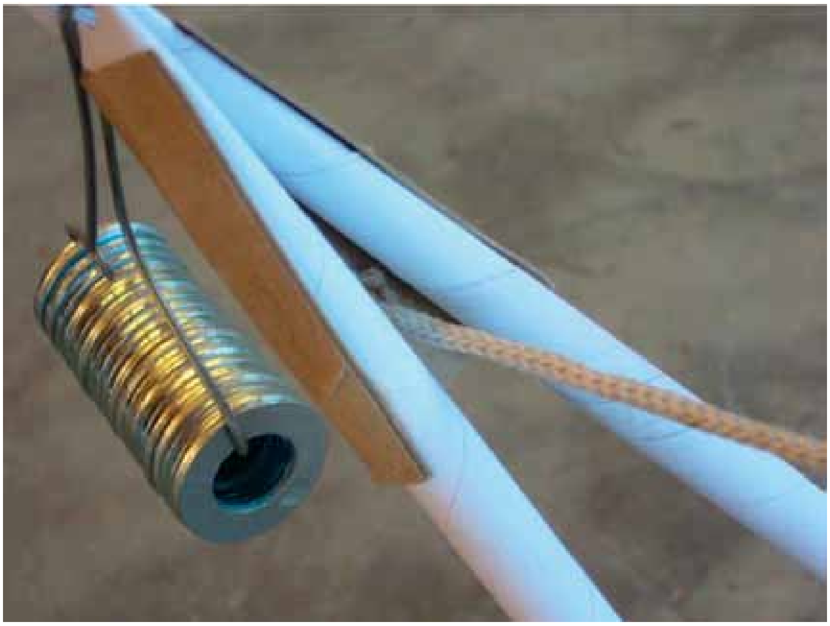

Figure 16

1. The frame of the model crane in the photographs is built from paper tubes made into triangles (see Figure 8). How many triangles were used?

....

....

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2. Mark the triangles on Figure 9. Number them from 1 onwards.

....

3. List the materials used to build this model.

....

....

4. Identify the materials and the method used for the joints on this model.

....

5. Look at Figures 11, 12, 13 and 14. Look at how the pulley is made. List the materials used for the pulley.

....

6. Look at Figure 14. Look at how the crank is made. List the materials used for the crank.

....

7. Note where and how the weight has been attached to the end of the pulley. Explain what you see.

....

8. What is the purpose of the box of nails at the back of the crane?

....

....

Sketching and perspective drawing (60 minutes)

Sketch your ideas

1. Read the specifications for your model crane again. Remember that you have to use materials suitable to build a frame structure.
2. Think of two different designs.
3. Sketch one of your designs on the next page. Add labels to show the parts of the crane and the materials you will be using. This sketch will be assessed.

   Use this checklist to make sure that you have included everything.

Things to look at	
Does your drawing have a heading?	
Did you label the different parts?	
Did you indicate the materials you will use?	

   Your teacher will assess your sketch using a scale from 3 to 1:
   3: Good work, **2:** Satisfactory work, **1:** Poor work

4. Draw your other design in single vanishing point perspective. Your drawing doesn't have to be drawn to scale. Use this check list to see if you have included everything. This drawing will not be assessed.

Things to look at	
Does your drawing have a heading?	
Did you mark the vanishing point?	
Did you draw the face of the crane that shows the most detail?	
Did you draw feint guidelines from the corners of the shape of the crane to the vanishing point?	
Did you draw horizontal and vertical lines to show the back of the crane?	
Did you darken the feint lines that show the outline of the crane?	

....

....

Sketch one of your designs here:

[5]

Sketch your other design here:

[5]

Week 2

Planning to make the crane (30 minutes)

Now it is time to prepare for the actual building of the model crane. Work in a group of three or four. You will build the model together as a team.

Decide what you will do and how

Work as a team for the first task. Work on your own for tasks 2, 3 and 4. These tasks will be assessed.

1. Look at all the designs. Each member will have two designs to offer. Discuss all the designs. Decide which design the team will build. Your group can also develop a completely new design. Remember what you learnt about reaching an agreement last term when deciding this. If you develop a new design, one person has to make a design sketch of the new design. Use the space below for this drawing.

2. Make a list of all the materials you plan to use to build your model.

....

....

3. Make a list of the tools you will use to build the model, for example the tools that you will use to measure and cut with.

....

4. Think about your own safety when you use tools. Some tools can be dangerous if used incorrectly. Write down one safety rule for one of the tools you will use.

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Order of work

You are going to present the steps you will follow to build the model as a "flowchart". Flowcharts are sometimes called flow diagrams.

- Flowcharts are designed to make information easier to understand.
- They are fun to use, because you can use colours and pictures instead of just words.
- You will make a process flowchart. A process flowchart shows the method or process of making something from start to finish. There are other types of flowcharts too.

How to make a flowchart

- The first shape identifies the topic or the first step of the process.
- Arrows show the direction of the process from the first step to the end. Follow the steps to read the process in the correct order. They can run horizontally or vertically.
- The last shape is used for the last step in the process.

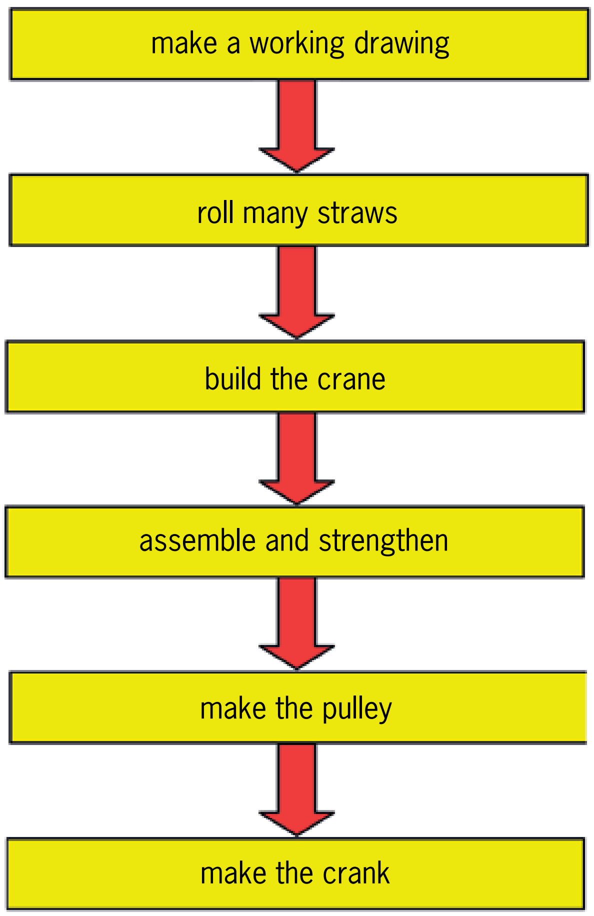

Figure 17: A flow diagram for building a model of a crane

Plan to make an electromagnet (30 minutes)

You made an electromagnet in Chapter 3. An electromagnet is made up of:

- a core that can be an iron bolt for a hard core, or a bundle of short pieces of iron wire for a soft core;
- a long length of insulated wire to wrap around the core, and
- insulation tape to hold the components together.

The circuit for the electromagnet is made up of:

- a battery. You can use four 1,5 V D-cells. We use D-cells instead of 1,5 V AA-cells (penlight batteries), because the D-cells contain more material and therefore last longer.
- a battery holder. The cells must be connected in series, one behind the other for them to provide 6 V of power. You can use insulation tape to tape them together.
- a switch. Use a switch that will stay on until you want to switch it off. You can make your own or buy a switch.
- wire to connect the different components.

Plan to make an electromagnet

1. List the materials you will use for the electromagnet.

   ....

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   ....

You can use thin telephone wire instead of insulated copper wire. Because this wire is thin, you get more turns when you wrap it around the nail. More turns will make the magnet stronger.

2. List the equipment you will use to build the electromagnet and its circuit. Make sure you use the correct tools. Don't cut wire with scissors.

   ....

3. Write at least one safety rule to follow while making the electromagnet.

   ....

   ....

   ....

4. Draw a flowchart of the method you will follow to build the electromagnet and its circuit. This task will be assessed.

[5]

Draw a circuit diagram (30 minutes)

Your teacher will assess this task. We draw working drawings before we start making a model. When you plan to make a circuit, you first draw a circuit diagram.

Draw a circuit diagram for the electromagnet

Indicate on your circuit diagram:

1. The heading. That will be what the diagram is for.
2. The positive and negative poles on the battery.
3. The direction of the flow of current. Use an arrow to show the direction the current will flow in.
4. The correct symbols for the different components. Use the symbol for an electromagnet as shown below. [8]

Figure 18: Circuit symbol for an electromagnet

Draw your circuit diagram here:

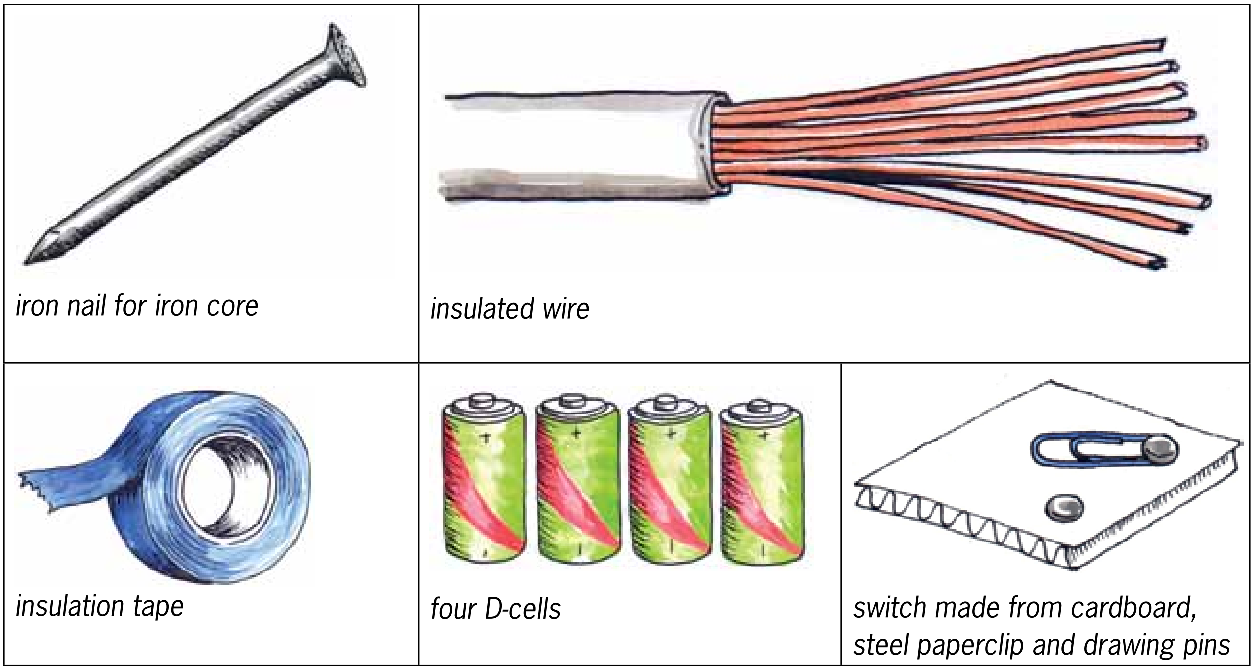

Figure 19: Materials used to make an electromagnet

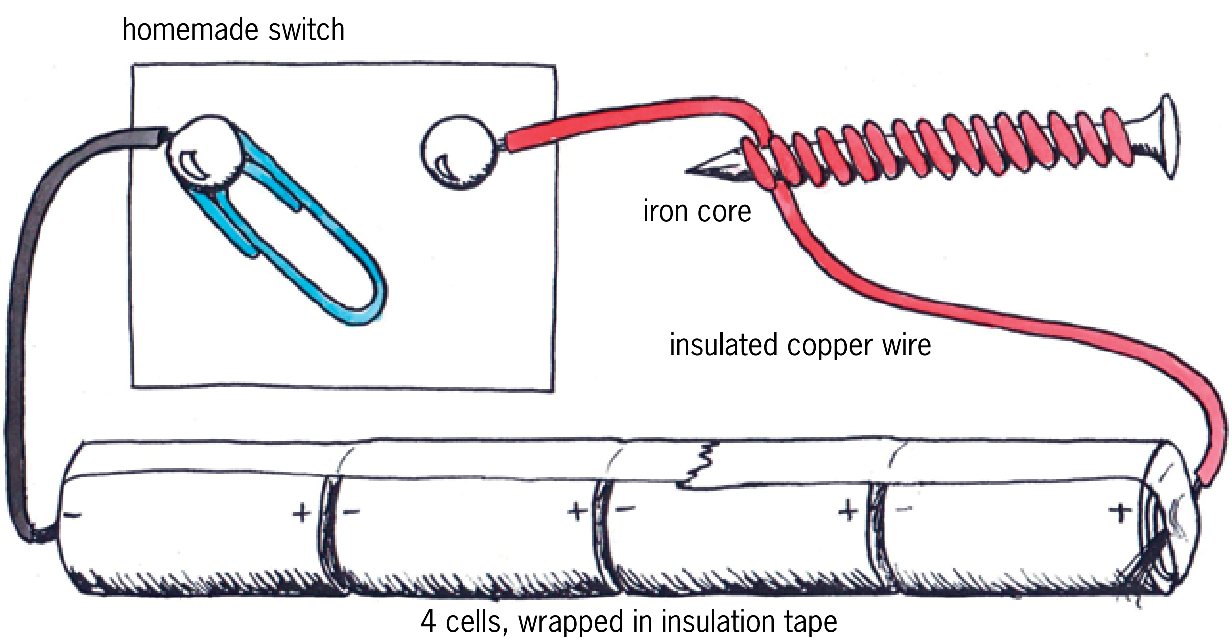

Figure 20: Electromagnet

Start to build the crane and electromagnet (30 minutes)

Make sure that you finish building the model crane and the electromagnet in the time given. Pay special attention to the time allocated for each of the tasks. You may not have more time.

Remember to work safely and neatly. Remember to give each person a task or a part of the model to make. Each person has to work equally hard to build the model. Pack away your model and its parts at the end of each lesson in a box with your names on it.

Sometimes a design does not work out. You may make changes and add things to your model so that it will work.

- You have 180 minutes (6 × 30 minute lessons) to put the crane together and to build the electromagnet.
- The time indicated below is a guide for you to follow.
- Remember to evaluate as you go along.
- Your group's model with its electromagnet will be assessed. [12]

Prepare to build

1. Gather all your materials and tools.
2. Roll as many straws as you think you will need, as well as a few extra ones.
3. Start making the crane and the box it will be mounted on.
4. Start wrapping the iron pieces with the insulated wire.

Week 3

Build the crane (30 × 4 = 120 minutes)

Build the frame of the crane (30 minutes)
- Make sure that the joints are well made and strong.

Join the frame to the base (30 minutes)
- Measure the structural members accurately. This will contribute to a stable crane that balances properly.

Build the crank and pulley (30 minutes)
- Make the crank and insert it in its mounting.
- Make the pulley.

Attach the pulley to the frame (30 minutes)
- Make sure that the frame is strong and firm enough where the pulley will be attached to the frame.
- Attach the pulley to the crane.

Practise measuring

Use a good-quality, firm ruler. Make sure the ruler is marked in millimetres.

Start measuring from the zero (0), not the edge of the ruler.

Use the correct tools

Use a sharp pair of scissors or a craft knife to cut string, paper or card.

Use a sharp nail or an awl to make a hole.

[12]

Week 4

Build the electromagnet (30 × 2 = 60 minutes)

Make the electromagnet (30 minutes)
- Attach the pulley to the crane.
- Complete the electromagnet.

Build and assemble the electrical circuit (30 minutes)
- Assemble the electrical circuit for the electromagnet.
- Attach the circuit to the crane model.
- Add the counterweight materials to the crane so that it will balance and not fall over.
- Evaluate and make any changes you think are necessary.

Revise and draw: Oblique drawing (30 minutes)

Oblique drawing:

- Draw the lines for length and height straight up and straight across, exactly like the front view of a box in a 2D drawing.
- Oblique drawings should be scale drawings. For the front view of an oblique drawing, use true scale measurements. So if the length of the object is 600 mm and the scale is 1:10, you draw the length as 60 mm. Indicate the scale below your drawing.
- Corners are projected at a 45° angle and the depth measurement must be half the true scale measurement. So if the depth is 300 mm and the scale is 1:10, you must draw the breadth line to 15 mm.

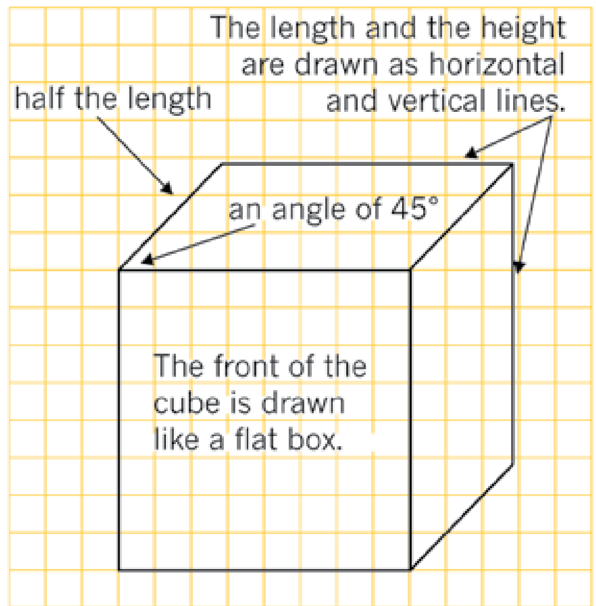

Figure 21: How to draw an oblique drawing

- Make sure that you have given your drawing a heading.

Scale:

- We often draw objects smaller than they really are so that the drawing can fit on a page.
- A scale drawing of 1:4 is four times smaller than the real object. If the object is 400 mm wide, we draw its width as 40 mm.

Make an oblique drawing

Work on your own.

1. Choose one part of your model to draw in oblique view.
2. You should draw the part to scale. You can draw it larger than it is on the model. If you draw it twice the real size, show the scale as 2:1.
3. Draw the part on the grid paper on the opposite page.
4. Use the space below to make a rough drawing first.

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Develop an evaluation sheet (30 minutes)

Your crane with its electromagnet is finished. Now you have to develop a checklist to judge your crane and how well you met your specifications.

- Does it meet the criteria you identified as specifications?
- Does the electromagnet work well?

To judge the cranes, you will develop an evaluation sheet. Remember you developed an evaluation sheet to evaluate your tower last term.

Develop an evaluation sheet

1. Work on your own. This task is for assessment. Make a list of the features the crane model must have. Use your list of specifications to help you. [5]

Here is an example:

The crane needs to work properly.		
The crane needs to lift metal objects.		

2. Work as a team.
   (a) Combine your individual sheets into one joint evaluation sheet.
   (b) Include a three-point scale. 3: Good, 2: Just all right, 1: Poor.

This evaluation sheet will be used to evaluate your own model and the models that the other groups have built.

3. Use the evaluation sheet to evaluate your own model.

Week 5

Evaluate the other models (30 minutes)

When you evaluate work, you have to do your best to be **objective** and fair. This means that you must not give high marks to your friends unless they really deserve it. You have to give them the marks they deserve for the work they have done, and you should be able to explain and support the mark you gave. This means that your comments have to be valid.

To be **objective** means to judge something for what it is without being emotional or personal.

Evaluate the models of other groups

1. Work as a team.
2. Copy your evaluation sheet three or four times.
3. Evaluate the models of three or four teams. Remember to write down the names of the teams you are evaluating.

Prepare your presentation (30 minutes)

Each team should prepare an oral presentation of their plans and functioning model to the class.

The presentation should be longer than five minutes but shorter than seven minutes. The class will have three lessons (90 minutes) to do all the presentations.

1. Plan your presentation.

- All the members of your group should be part of the presentation.
- Decide what each person will do.
- Each person should talk about the work they did and the role they played.
- One learner should show and explain the design sketch.
- Another learner should explain the circuit diagram and draw it on the board.
- One learner should show how the crane with the electromagnet works.
- Another learner should talk about the problems the group experienced.

Hints for presenting your work:

Stand up straight and look at the class while you speak.

Do not read your presentation.

Speak clearly. Do not mumble or whisper. Everyone should be able to hear you.

Know when it is your turn to speak.

Keep to the time limit.

- Include the following information in your presentation:
  - how an electromagnet works,
  - how to make an electromagnet stronger,
  - why it is important to sort metals.
- Make an artistic drawing of your model crane with its electromagnet.
- Decide who will start and who will talk next. Know when it is your turn.

2. Use the rest of this lesson to practise your presentation. You might also need to spend some time at home for this. You have lots of time to practise as you will be doing self-reflection in the next lesson.

Reflection and evaluation (30 minutes)

To reflect means to look back. Looking back at what you did and how you completed a task is an important learning activity. It gives you the opportunity to identify the mistakes you made, as well as what you did well. From this, you learn not to make the same mistakes again, and how to improve on what you do well.

Reflect and evaluate your own work and contribution

Work on your own. This task is for assessment.

1. Write down at least five activities that you want to reflect on. Choose at least:
   - one practical activity,
   - one drawing activity,
   - one activity where you had to answer questions, and
   - one group activity.
2. Tick a face to show how you felt about each activity. [5]

Description of the activity	☺	😐	☹
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Deliver your presentations (30 minutes)

It is important that everyone takes part as you will all be assessed by your teacher. You will have three lessons (90 minutes) to complete the presentations.

Oral presentation

1. Each person's oral presentation will be assessed separately.
2. Your teacher will use an evaluation sheet like the one below to assess you.

Criteria	Good	Satisfactory	Poor
The learner speaks clearly so that everyone can hear.			
The learner speaks confidently, knows the work and what he or she wants to say.			
The learner makes eye contact with learners sitting in the front and in the back of the class.			
The learner explains his or her own role in the project.			
The learner shows and demonstrates the model/ drawing/diagram.			

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Week 6

Presentations continued (30 × 2 = 60 minutes)

All the presentations must be finished by the end of this week.

Chapter 6
Emergency situations

In this chapter, you will learn about emergency situations and the effects they have on people. People are sometimes forced to leave their homes because of emergencies. They then become refugees. You will learn how sheltered, safe areas are created for refugees and how aid workers provide food and water.

Figure 1: This family of refugees were forced to leave their home and now need a safe place to live until they can return.

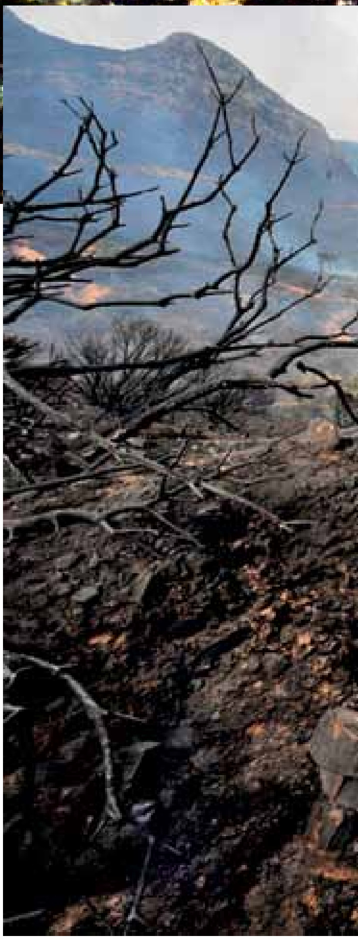

Figure 2: Devastating fires are just one form of emergency situation that communities might have to face.

6.1 Situations that cause people to become refugees

Emergency situations can cause large numbers of people to be forced from their homes. Emergencies not only affect people in areas where a disaster took place, but also the people in the area where the **refugees** are moved to. People need shelter, water and food. A refugee camp has to be set up, and the camp needs to be very well planned.

Refugees: People who are forced to leave their homes during a disaster or in an emergency situation. Sometimes, refugees move to a safe area that is close by, and at other times, they have to travel to another country.

In emergencies, plans to help refugees need to be made very quickly to prevent further suffering. Two types of emergency situations that force people to leave their homes are war and natural disasters.

In this lesson, you will learn about emergency situations and investigate ways to help refugees.

War

Since the beginning of time, there have been wars between people all over the world. And while armies fight battles, people are forced to flee from their towns and villages. Over the centuries, many people have ended up as refugees. Even today, there are more than 3,8 million refugees all over Africa. These people have been chased from their homes because of wars.

Figure 3: This refugee camp was set up for Rwandans during the war in their country in 1994.

Natural disasters

Natural disasters are caused by nature and not by people. Floods, wildfires, earthquakes, and volcanic eruptions are all natural disasters. All of them can force people to leave their homes.

Natural disasters usually happen with no warning. They can create emergencies very quickly, which means that people have to move to safer areas immediately.

In 2000, a terrible flood hit Mozambique and destroyed huge areas of farming land. Thousands of people lost their farms and were forced to flee to dry ground. Refugee camps were set up in other parts of Mozambique and also in South Africa.

Compare the pictures on the right. These pictures were taken from a satellite in space. They show the same area in Mozambique before and during the flood, and how much land was flooded.

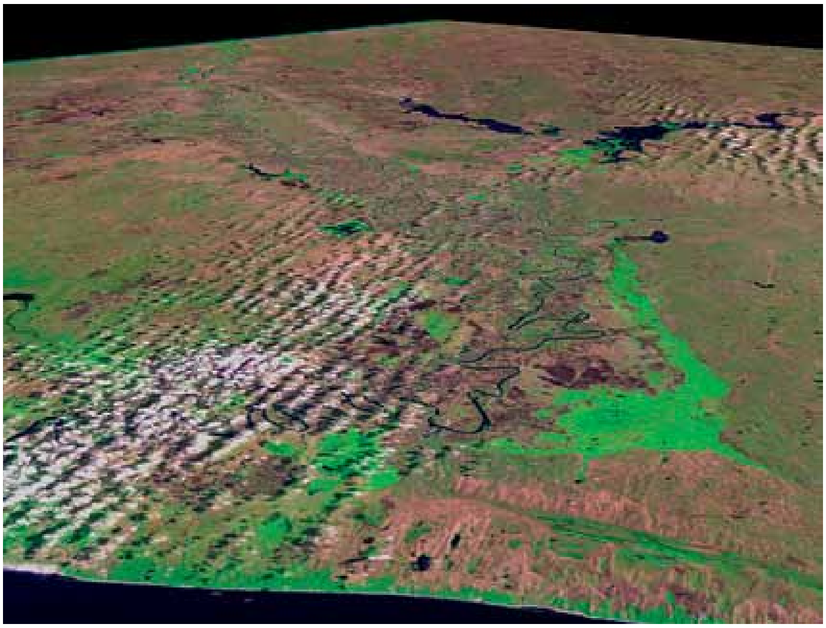

Figure 4: This satellite picture of the disaster area in Mozambique was taken before the flood.

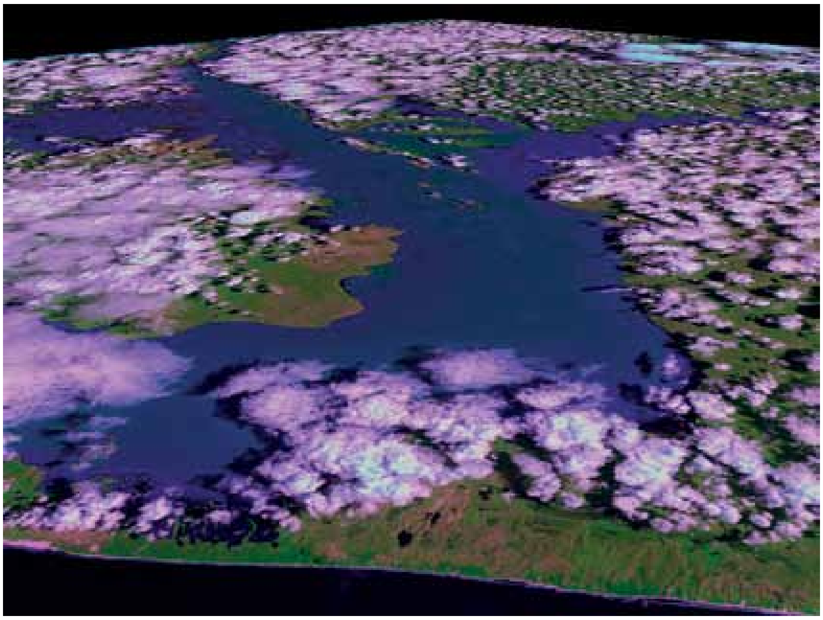

Figure 5: This satellite picture of the disaster area in Mozambique was taken during the flood.

A natural disaster can also happen over a longer period of time. In Africa, we rely on rain to water our crops. But this continent often has droughts. Droughts can create emergencies for farmers. During long droughts, large groups of people can be forced to leave their homes and their farms. These people then look for food, water and shelter, and they become refugees.

Figure 6: Droughts in Africa cause the destruction of habitats and the death of wildlife.

6.2 Initial problems facing refugees

Disasters such as floods and wars happen suddenly, which means that people have to leave their homes quickly. These refugees will not have a lot of food and water with them. They will also not have tools or materials to build shelters.

Emergencies that happen more slowly over longer periods of time include droughts, or long wars. Refugees in situations like these have a bit more time to pack up their possessions and plan their journey.

The type of emergency situation influences the **mix of people** in a refugee camp. Sometimes, there will be more men than women. Other times, there will be many babies who are not able to walk yet and small children. And at other times, there will be many elderly people who need special help and care.

Mix of people: The different types of people in a group, such as the young and the old, male and female and disabled people.

For example, during a war, there are usually fewer men at home, because the men will be fighting. And during a drought, babies and elderly people may die since they are more vulnerable.

Different people have different needs for food, water and shelter. Children become dehydrated more quickly than adults and they also need more high-energy foods. Old people need more warmth and blankets.

Questions for you to answer

1. Which emergencies happen suddenly, without warning?

   ....

2. How will these sudden emergencies affect each of the following:

   (a) the mix of people in the group?

   ....

   ....

   (b) the amount of food and water refugees have with them?

   ....

   ....

   ....

   (c) the ability of refugees to build their own shelters?

   ....

   ....

....

....

3. Which emergencies happen slowly, over a longer period of time?

....

4. How will these slower emergencies affect:
   (a) The mix of refugees in the group?

....

....

....

....

   (b) how much food and water will they have with them?

....

....

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....

   (c) whether they can build their own shelters or not?

....

....

....

5. Which emergencies are the most difficult to plan for? Explain why you say so.

....

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6. Which emergencies are easier to plan for? Explain why you say so.

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6.3 Refugees in a foreign land

When refugees arrive at a refugee camp, they need many things, such as food, clean water and shelter. These basic needs have to be supplied by the rescue workers who are setting up the refugee camp.

In the following exercise, you will look at the experiences of people on either side of a refugee situation: refugees and the rescue and aid workers who are helping them.

Situation: Refugees in a foreign land

Discuss the situation below in groups of three or four before answering the questions yourself. Your answers should be short paragraphs.

> A sudden war has broken out between two small countries in central Africa and a large number of people had to flee to a neighbouring country.
> Imagine what it must be like to be one of the refugees, and also what the situation would be like for the **host** nation.

Host: A person who gives food, water and shelter to another person. A host nation is a country that helps refugees from another country.

1. What do you think the mix of people in the group is like? Remember this is a war situation, and people had to flee from their country. Think about the ages of the refugees and write down which groups will need the most care and attention.

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   ....

2. What are their needs for shelter? Remember that they have not brought many possessions with them. Who will provide the shelters or the materials needed to build them?

   ....

   ....

   ....

3. What food and supplies do the refugees need? Remember that the refugees have been travelling on foot for long periods of time. Think about the ages of the people. Will some of them need more food and water than others, and if so, why? Will some people have special needs, and if so, why?

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Next week

One of the biggest problems facing refugee camps is to provide enough nutritious food. Nutritious food provides all the nutrients your body needs to stay healthy.

Think about these questions to prepare for next week's lesson:

- Which foods are the easiest to find in your area?
- Which foods are the cheapest to buy in your area?
- Which foods would you choose to feed a large camp of refugees?

Chapter 7
Processing food for emergency situations

In the previous chapter, you learnt about refugees and why large numbers of people can be forced to leave their homes and their countries. Usually, refugees have little or no possessions. They can also not carry enough food for a long period of time. In this chapter, you will learn how to process food for emergency situations. Processed foods last much longer than fresh foods and are ideal for refugee camps. You will write a design brief and plan an emergency meal that is nutritious and tasty. It should be possible to make this emergency meal in a refugee camp.

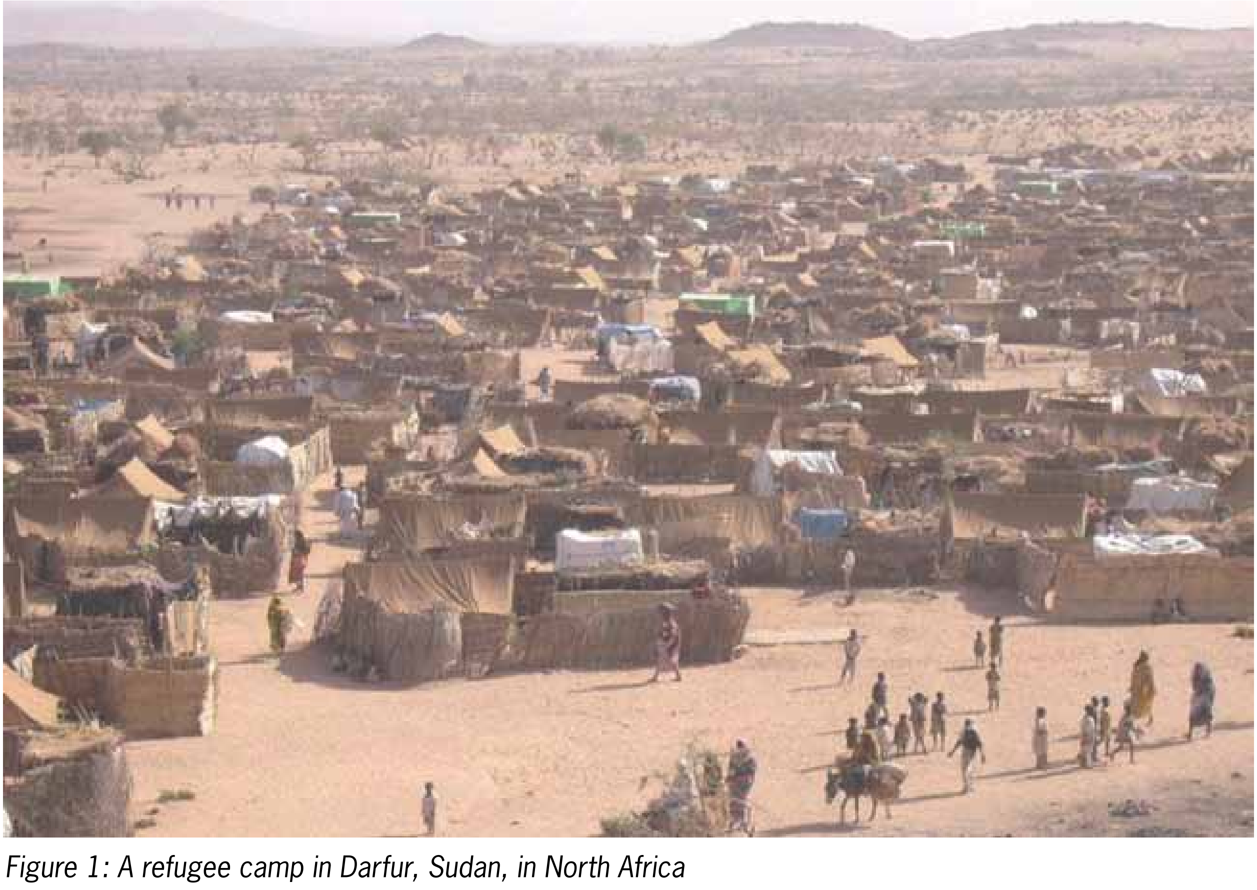

Figure 1: A refugee camp in Darfur, Sudan, in North Africa

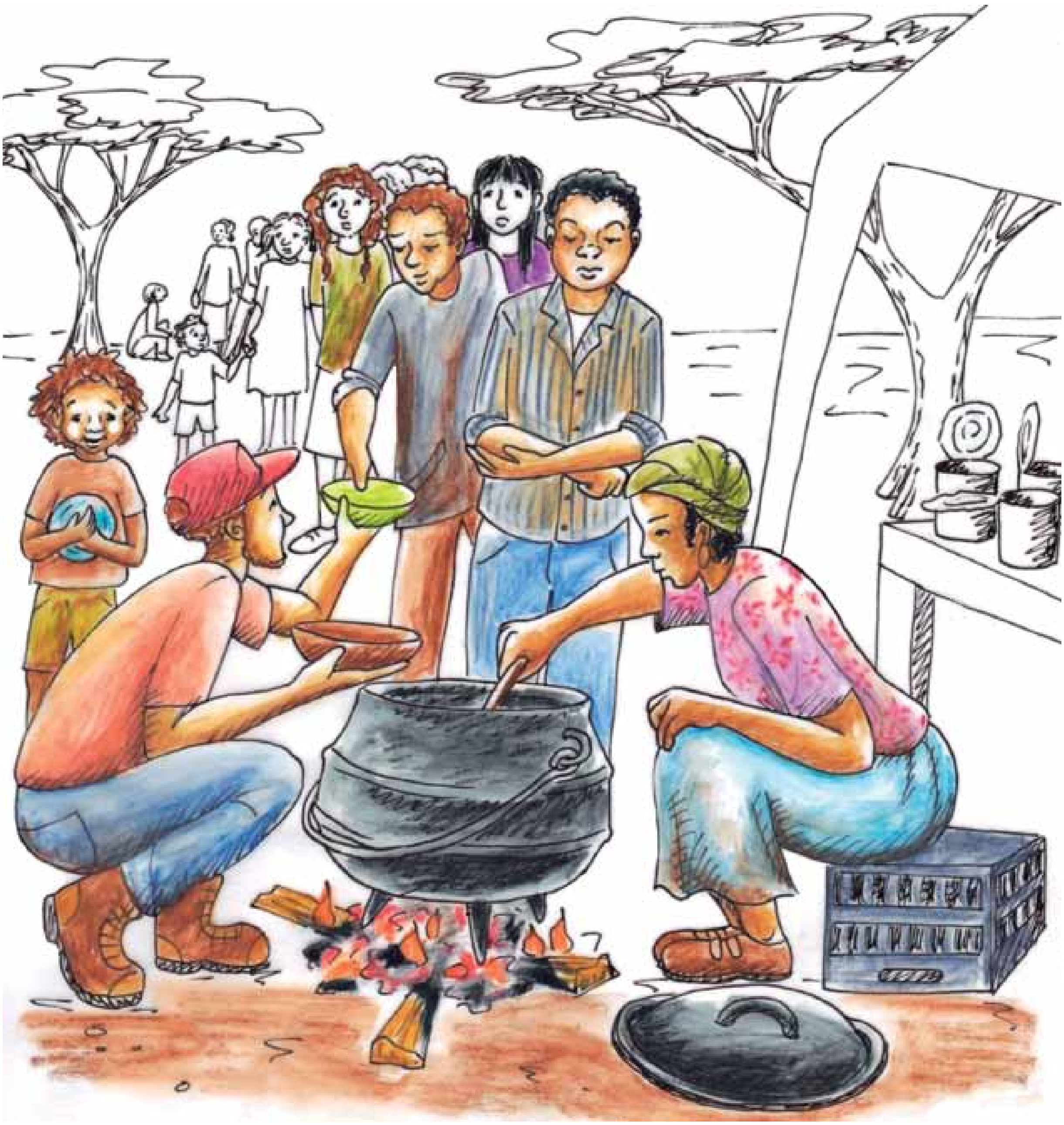

Figure 2

Figure 3

7.1 Investigate types of food

When refugees travel to a host country, the people in the host country usually take care of them.

In the previous chapter, you looked at the mix of people and how this mix would change, depending on whether the emergency was caused by a natural disaster or a war.

The type of food refugees eat depends on the mix of the group. Children need more protein than older people, babies need special milk formulas, and old people need lots of vegetables to protect them from disease.

For homework, you had to think about types of food that are available in South Africa and that can feed a large group of people. The food had to be cheap, easy to find and nutritious.

Refugees do not expect expensive food, just enough healthy food. Bad nutrition can lead to problems like illness and disease. If refugees get weak or sick, they will not be able to look after themselves and the situation in the refugee camp will become worse.

Nutritious food

To remain healthy, the human body needs different types of food known as food groups. Meals that contain the right combination of the different food groups are called balanced meals. A balanced meal includes the following food groups:

- Carbohydrates: These provide energy and are found in starchy foods like potatoes, mealie meal, rice and bread.
- Protein: These build muscle and give us strength. Protein-rich foods include meat, fish, chicken, eggs, beans, cheese and milk.
- Fats and oils: These provide energy and help to protect our internal organs. They also help our bodies to fight disease. Foods in this food group include cheese, butter, margarine and oils such as sunflower or canola oil.
- Vitamins and minerals: These are found in all foods, but especially in fresh fruit and vegetables. They are very important for good health, strong bones and teeth, and to keep your brain working well. Vitamins also help to prevent disease. For example, Vitamin C, which is found in oranges and lemons, fights colds and flu.

Balanced diets

Have a look at the drawing below and see if you can tell which foods are high in carbohydrates, protein, fats and oils, and vitamins and minerals. Notice that similar types of foods are grouped together. Also notice that the groups are of similar size or “proportion”. The drawing shows that we need to eat similar proportions of food from all of the five food groups every day to stay healthy.

You can think of nutrition as a wheel where each type of food is an important part.

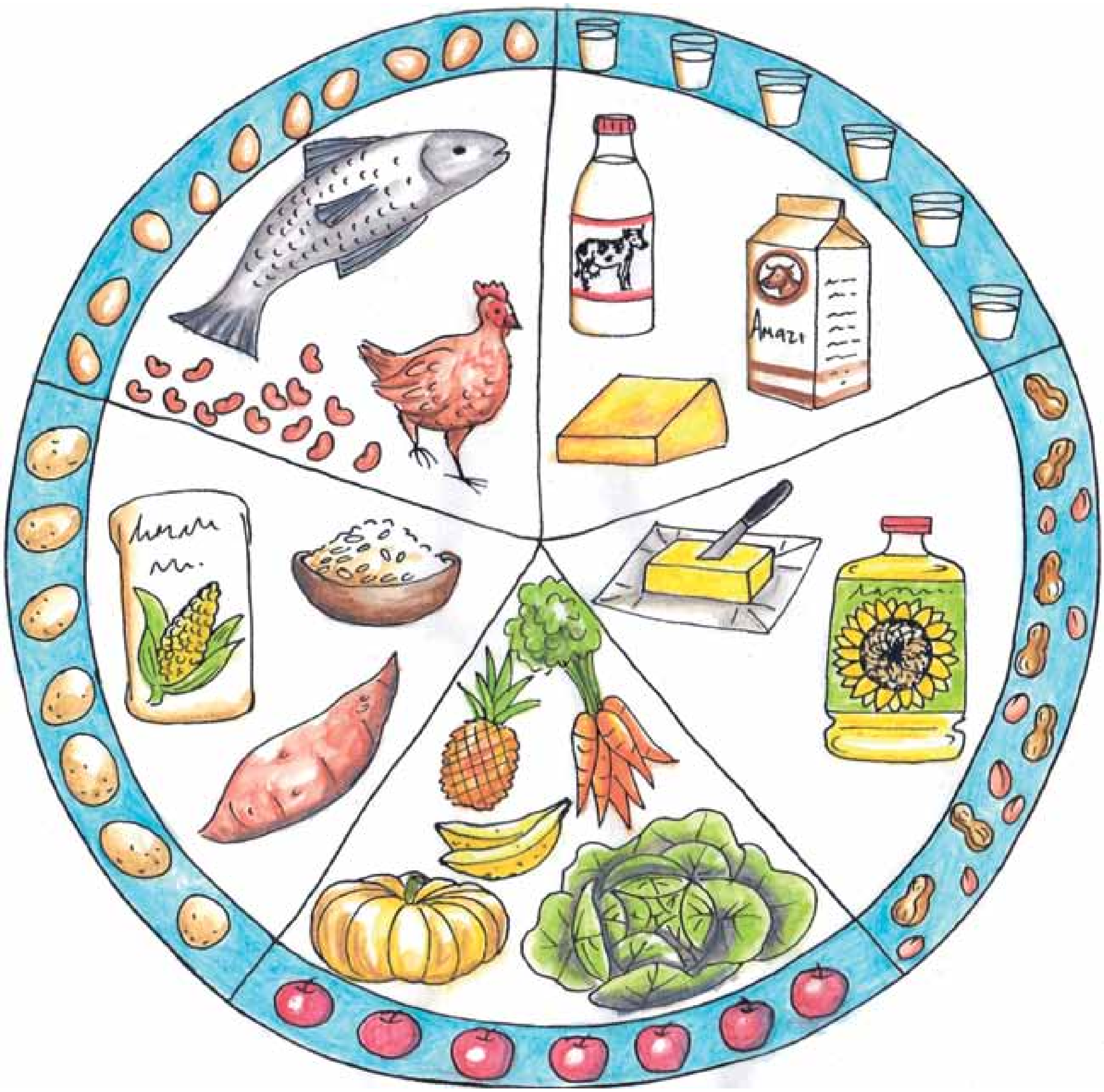

Figure 4: A balanced diet consists of food from all five food groups every day.

Also remember that your body needs fresh, clean water to keep working and to digest and absorb the food you eat.

Figure 5: Drinking fresh, clean water is very important for your health.

For your homework in the previous chapter, you were asked to think about foods that are cheap and easy to find, and that are nutritious and easy to prepare.

- Work in pairs and compare your homework notes.
- Explain the reasons for your choices to each other. The main things to consider are the cost of the food, how easy it is to find, and how nutritious it is.
- Make a joint decision on what you would feed the refugees. If both of you have good ideas, you can suggest a combination of your dishes.

Figure 6: Bananas are very nutritious and they are cheap and plentiful in summer.

Figure 7: Oranges have lots of Vitamin C to help prevent colds and flu. They are cheap and widely available in winter.

Figure 8: Wheat is very nutritious.

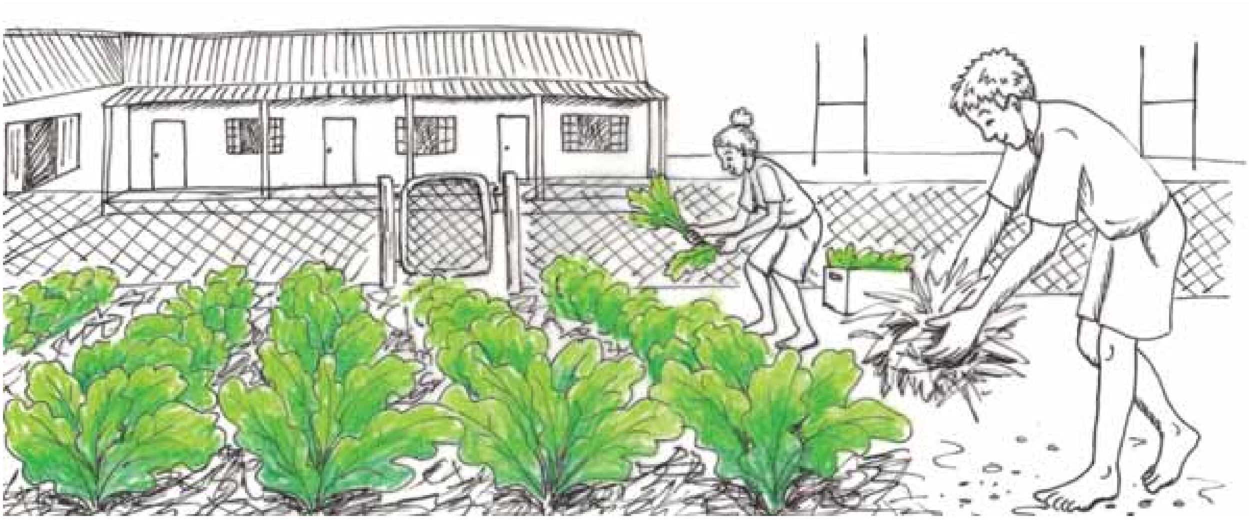

Figure 9: Spinach grows quickly and is high in vitamins and minerals.

Questions about your investigation

1. What type of food did you choose? Write down why you chose it.

   ....

   ....

   ....

   ....

2. Did you think about the different age groups of the people in the camp? If you have chosen different foods for different age groups, explain why you did that.

   ....

   ....

   ....

3. Is there a lot of this food available to feed a large group? Write down why it should be easy to get enough of it for the camp.

   ....

   ....

   ....

4. Is the food nutritious? Write down why you think the food you have chosen will keep the refugees healthy.

   ....

   ....

5. Is it easy to prepare? Write down the reasons for your answer.

   ....

   ....

   ....

7.2 Investigate your refugee camp

A group of 100 refugees have settled near your community. You have been asked to feed them. Before you draw up your plans, the whole class has to make decisions about the issues below.

- What is the mix of the group? Divide them into four categories: babies, children, adults and old people. Complete the table below to help you with the next task.

The number of people of different ages in your group of 100 refugees

Age group	Number of people in this age group
Babies (1–5 years old)	
Children (6–15 years old)	
Adults (15–65 years old)	
Old people (older than 65 years)	

- Your group has not brought any food with them. Decide where you will find food to feed the people. How will you transport the food? How will you cook it?
- Is there a supply of clean water nearby? Why is water important for cleaning and cooking food? Discuss your answers with each other?
- Will the food be nutritious? Can you feed the people the same food every day until they can be resettled? Discuss your answers with each other.

Write down your decisions as you make them. Use the space below.

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7.3 Write a design brief to feed your refugee camp

Before you can work out how much food you need for 100 people, work out how much food you need for one meal. The food needs to be nutritious, tasty and easy to find. It should include as many of the food groups as possible.

For each age group, list the ingredients and amounts you will need for one person. Use the tables below. One example has been done for you.

Amount of each ingredient needed to feed one baby

Ingredient	Amount
Samp	One third of a cup (100 grams)

Amount of each ingredient needed to feed one child

Ingredient	Amount
Samp	Two thirds of a cup (200 grams)

Amount of each ingredient needed to feed one adult

Ingredient	Amount
Samp	1 cup (300 grams)

Amount of each ingredient needed to feed one old person

Ingredient	Amount
Samp	Half a cup (150 grams)

Design a meal for 100 refugees

Once you have completed the tables above, each of you have to write a design brief to feed the 100 refugees. Your design brief should list your specifications. Specifications are the ingredients that you will need to make the meal.

You need to work out how much of each ingredient you need to make one nutritious meal for each age group. For example, this is how you would do the calculations.

For each ingredient, add the amount needed for each of the age groups:

- One baby needs 100 grams of samp for one meal. Now multiply 100 grams by the number of babies in your group.
- One child needs 200 grams of samp for one meal. Now multiply 200 grams by the number of children in your group.
- One adult needs 300 grams of samp for one meal. Now multiply 300 grams by the number of adults in your group.
- One old person needs 150 grams of samp for one meal. Now multiply 150 grams by the number of old people in your group.

Example:

If there are 20 babies in your group, multiply 100 grams by 20. This gives you 2 000 grams, or 2 kilograms, of samp needed for all the babies for one meal.

If there are 30 children in your group, multiply 200 grams by 30. This gives you 6 000 grams, or 6 kilograms, of samp needed for all the children for one meal.

If there are 40 adults in your group, multiply 300 grams by 40. This gives you 12 000 grams, or 12 kilograms, of samp needed for all the adults for one meal.

If there are 10 old people in your group, multiply 150 grams by 10. This gives you 1 500 grams, or 1,5 kilograms, of samp needed for all the elderly people for one meal.

Now write the specifications for your design brief on the next page. Make two lists. In the first list, write all the ingredients that you need to make one nutritious meal for 100 refugees of different ages. In the second list, write the amounts of each ingredient you need.

Writing your design brief

Name of ingredient	Amount of the ingredient needed
....	....
....	....
....	....
....	....
....	....

Next week

Next week, you will prepare a meal according to your design brief. It will have to be tasty, nutritious, easy to find and easy to make in the refugee camp. You will taste and evaluate the meal yourselves, so think carefully about what you are going to prepare!

Chapter 8
Making and evaluating emergency meals

In the previous chapter, you investigated the types and amount of food refugees need to stay healthy while they are in an emergency situation. You learnt about nutrition and about the food groups that should be in every meal. You also wrote a design brief to feed a refugee camp of 100 people. In this chapter, you will investigate how to make your own meal, prepare the meal and then evaluate it:

Figure 1

Figure 2: Ingredients for an easy-to-cook, healthy meal.

8.1 Method for preparing part of a meal

Choose one item of food from your emergency meal. Remember that it should be:

- nutritious,
- easy to find,
- easy to cook, and
- tasty.

Before you prepare the food, write down the steps you have to follow to make it. Write the steps in the correct order, from start to finish. Think carefully about what you need to do first, and then what you need to do after that. To list your steps in this way can be called writing your steps in sequence. Write the steps one underneath the other in a table.

But first, write down how or why you will do each step. How you will do a step is called an instruction. Why you will do a step is called a reason. Write the instruction and reason for each step next to the particular step. Look at the drawing below to see what Linda has done.

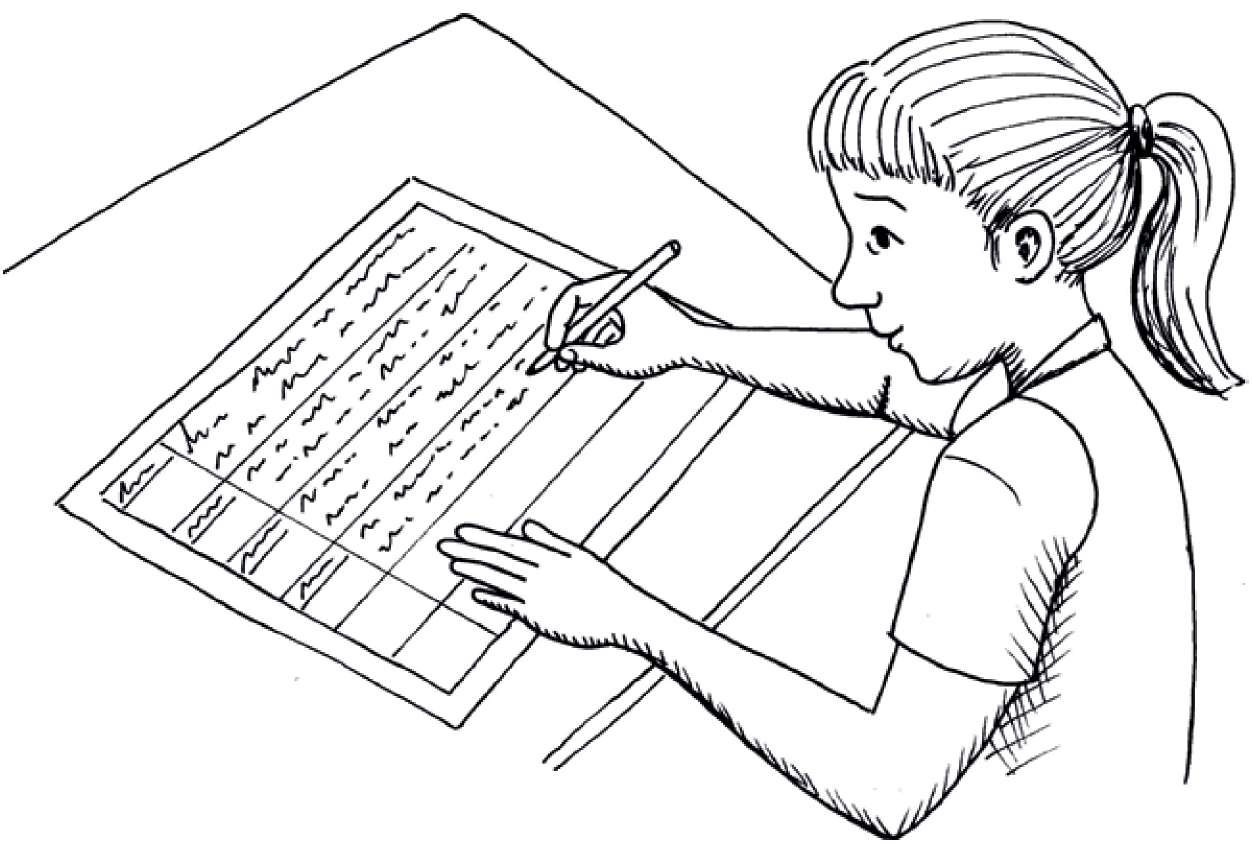

Figure 3: Draw a table that shows what you need to do to prepare the food from start to finish. Write the instruction and reason for each step in the column next to each step.

You have to plan carefully, and then set out your plan using the following guidelines:

- Say whether the food you will cook is for breakfast, lunch or dinner. Explain why you decided to cook it for that meal. Here is an example of how to write your answer in the table:

Example

Breakfast	It is the most important meal of the day and will give the refugees a lot of the energy they need.

- Which item of food did you choose? Explain why. Does it mainly consist of carbohydrates or protein? Look back at the food groups you learnt about in Chapter 7.

Example

Samp	It is high in carbohydrates for lots of energy.

- Estimate how much of each ingredient you will need to make your item of food for one adult. To do this, look back at your design brief in Chapter 7.

Example

Samp	300 grams

- Write down how you are going to prepare your item of food. Write down each step in the process.

Example

Measure	Measure out 300 grams of samp. Measure out 1 litre of water.

- How are you going to cook the food? For this activity, you have to write down the process that you will follow at home, not what you would do at a refugee camp.

Example

Choose a pot	Select a pot that will be suitable for cooking the food.
Mix the ingredients	Place samp, water and salt in the pot.

- How long do you think the preparation and cooking will take? Divide it into steps. Add up all the steps and put in the total time at the end.

Example

Measure ingredients	5 minutes
Mix ingredients	2 minutes
Cook ingredients	30 minutes
Total time	37 minutes

- Ask an adult at home to help you. Write down in your plan who this person will be.

Figure 4: Get an adult to help you with the ingredients and the cooking.

When you have completed your plan, take it to school. Discuss your plan with another learner. This is an important part of the planning before you cook the meal. If either of you missed an important step, you will have to rewrite your plan. Remember, the steps in your plan are your guide to cooking the food.

8.2 Prepare the food

In this lesson, you will follow your plan and prepare an item of food at home. It will only be enough for one person, not for 100 people! You will then bring your food to school and the class will evaluate it.

You need to do this part of the activity at home.

- Find all the ingredients before you start.
- Read the plan you wrote to help you. Follow the steps closely.
- If you change one of the steps, write down how you changed it. Also write down why you changed it. You will use this information when you evaluate your making sequence.

Very important!

You must get permission from an adult when you use equipment at home to cook, or if you are taking ingredients from the cupboard.

Also ask an adult to help you cook.

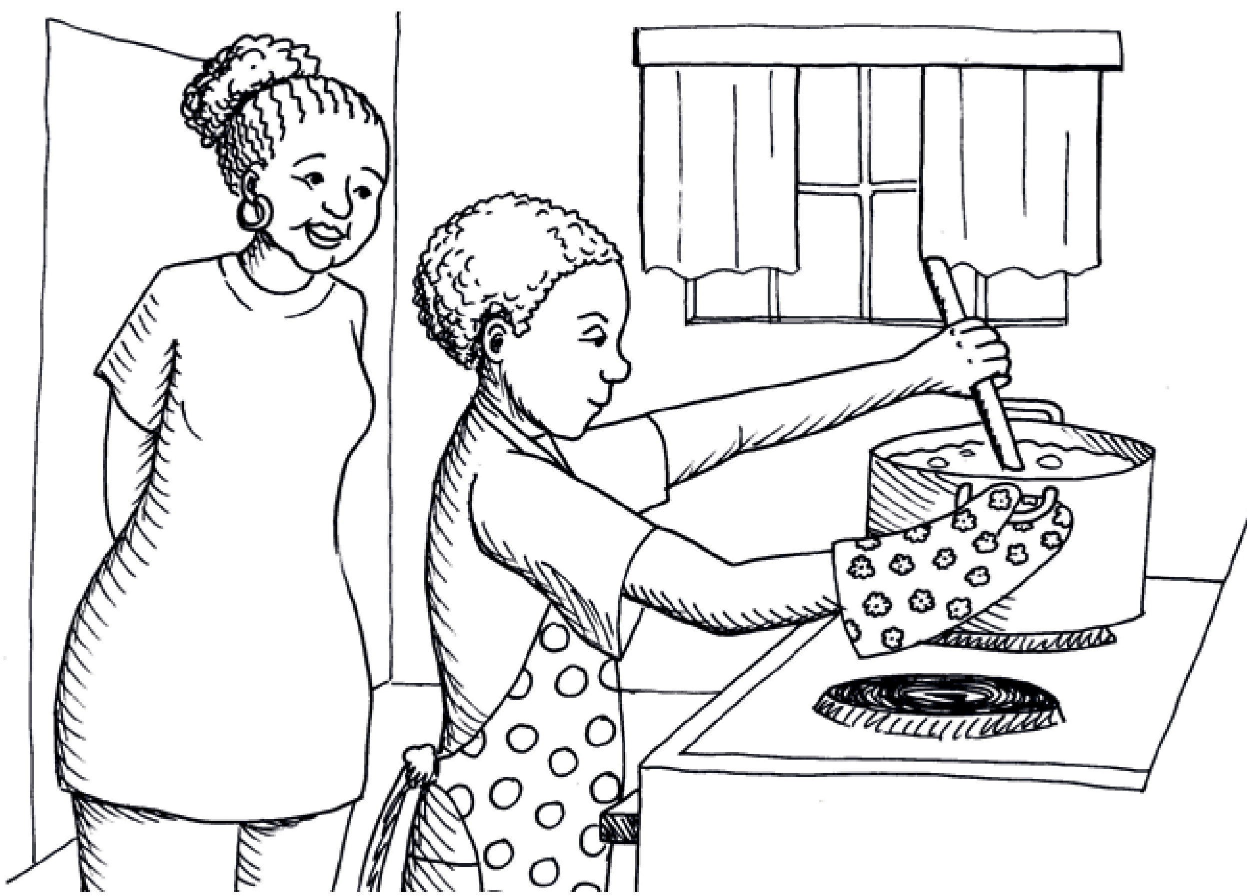

Figure 5: Ask an adult to help you with the ingredients and the cooking.

Write down any changes you made to the method or the ingredients here:

....

After cooking the meal, taste it to check that it tastes good. This is called evaluating the flavour of the meal. If you have cooked the meal for the right length of time, it should be easy to chew and swallow. This is called evaluating the texture of the meal. You will present the meal for evaluation, so it should taste good and be healthy. A healthy meal will have the correct nutritional value. You learnt about nutrition in Chapter 7.

Describe your evaluation of the food here:

....

....

Safety warning

If you use an open fire to cook on, remember that open fires can be dangerous. Always make sure safety measures are in place.

1. Make sure the fire is completely out when you have finished your cooking.
2. Put something around the fire to ensure it does not spread.
3. Keep small children away from the fire.

Store the meal in a plastic container with a seal that will keep the air out. If you don't have a special container, use an empty, clean margarine container.

Keep the container in the fridge overnight. Bring your item of food to school the next day for evaluation.

8.3 Evaluate the food

Bring your prepared meal to school for evaluation. Divide into groups of four. Use plastic spoons and taste each other's meals.

After trying out all the food that the other learners have brought to school, write an evaluation of their food and of your own food.

Hygiene warning

Bring your own spoon to school. If you share a spoon, wash it with soap and water before you use it.

Evaluate each food item. Use the checklist below. Tick "yes" or "no" for each question.

	Yes	No
Flavour: Is the food tasty?		
Texture: Does the food taste as if it is properly cooked?		
Nutritional value: Is the food healthy?		
Comments:		

When you have all tasted each other's meals and listed your comments, give each other feedback. Do not be rude about other learners' food. Make positive suggestions. Say how you think they can improve the taste, texture or nutritional value of their food.

Now write an evaluation of your own meal based on the feedback you received.

Write your evaluation in paragraph form.

For example:

I found this to be a very interesting task. At first, it was difficult to work out how to make sure there was enough protein and carbohydrates, so I used the food groups to guide me. I chose samp as it is a very nutritious grain which is cheap and easy to find. I checked on cooking times for the samp to make sure it was properly cooked and that the texture was right. I added salt and butter to make it tasty.

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....

Now write a second paragraph about everything that you learnt in this chapter. At the end, write down how you would do it differently next time.

For example:

In this chapter, I learnt about planning. I also learnt how to prepare and cook an item of food. If I had to do this lesson again, I would add spinach to my samp, because spinach has vitamins that are not found in samp. Spinach would have made my food more nutritious.

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Next week

In the next lesson, you will investigate materials that can be used in rescue operations. Choose two emergency services that support the community, for example the fire department and the National Sea Rescue Institute.

Chapter 9
Protective clothing

In the previous three chapters, you investigated situations that can cause people to become refugees. You also investigated how food is processed. You then wrote a design brief for a meal for 100 refugees, and you designed, made and evaluated food that is nutritious as well as tasty. In this chapter, you will investigate the special clothing worn by people who work in emergency situations. For example, these rescue workers could be from the fire department or the National Sea Rescue Institute (NSRI).

Figure 1: Fire fighters have to wear special clothes to protect them from fires.

Figure 2: Sea rescue workers also wear specifically designed protective clothing.


YAMAHA

9.1 Emergency services

Dangerous situations such as fires, floods and accidents usually happen unexpectedly. People need to take immediate action to save the lives of the people involved. This type of situation is called an emergency.

Emergencies don't always mean that many people are forced away from their homes. An emergency may affect only one family, or even just one person.

For example, a house fire or a wildfire can threaten a group of houses. Other examples of emergencies are when swimmers get into difficulty out at sea, or when fishermen are in trouble on a sinking boat.

People who work in emergency services are called emergency workers. They are specially trained to respond to emergencies and they must be ready to respond quickly to a call for help. Emergency services include the fire department, police, ambulances and sea-rescue services.

Emergency workers go into dangerous situations, so they need to wear protective clothing.

> Emergency workers wear clothes that are designed to protect them from danger. These clothes are known as personal protective equipment, or PPE.
>
> Experts study the dangers caused by emergencies and design and make clothes, shoes, helmets and other items that will protect emergency workers during these situations.

Emergency services

1. Think about emergency situations that can happen in your community, and list them below.

   ....

   ....

2. List the emergency services that can be called to help in an emergency.

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   ....

3. Think about other communities. Are there emergencies that could affect them, but not affect your community? Think about the environment where these

communities live. Are there rivers or beaches nearby? Are they in cities, the country, forests or grass fields? List all the emergencies that could happen in these places. Then list the emergency services that can be called in to help them.

Emergencies	Emergency services
....	....
....	....
....	....

9.2 Clothing for emergency workers

Emergency personnel wear protective clothing that is specially designed to protect them from the dangers they could face in an emergency.

For example, fire fighters need protection from flames and heat, and sea-rescue workers need protection from water, rain, the wind and cold.

The materials that we use to make any kind of clothing are called textiles.

The materials we use to make any kind of clothing are called textiles. Special textiles are used to make protective clothing. These textiles are made from woven or knitted materials, that can have chemicals added to them to give them special qualities, such as waterproofing or fire resistance.

Figure 3: A fire on a mountain. Fire fighters monitor the situation to make sure that the nearby community is safe.

A firefighter's protective clothing

Fire fighters' jackets are made from fire-resistant textiles, and are lined with reflective tape so that fire fighters can be seen in the smoke.

Fire fighters' boots are made of strong leather, with thick soles to protect their feet from flames.

A sea rescuer's protective clothing

Sea rescuers' jackets are designed to keep sea rescuers dry and warm, even in heavy storms. They are made of thick plastic or rubber.

*Waterproof boots, or **wellingtons**, are made of thick rubber. They keep a sea rescuer's legs and feet dry and warm. The rubber sole also prevents slipping on wet decks.*

Figure 4

Clothing for emergency workers

Now that you have learnt about some of the protective clothes used by emergency workers, you can design some protective clothes of your own.

Fire fighters and sea rescuers wear the specific clothes mentioned on the previous few pages. Think about the other emergency services that you listed in the exercise "Emergency services".

Wellington boots were named after a Duke of Wellington in England. He was a famous soldier who wore them into battle.

1. Write down at least three emergency situations that they may be called to deal with.

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2. Write a list of special protective clothes you think they should wear in each situation.

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3. Write down the textiles their clothes should be made of.

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4. Draw a picture of one type of protective clothing that you have written about.

....

....

9.3 Investigate protective clothing and emergency equipment

In this section, you will investigate the kinds of protective clothing and emergency equipment used by fire fighters and sea rescuers.

Work together in groups of four.

Choose one of the emergency professions you have learnt about: fire fighting or sea rescue.

Discuss the special clothes that these emergency workers wear to help protect them in their duties. Use the information in this chapter, but also try to find extra information from people you know. For example, maybe you know someone who works at the fire department and can talk to them. The pictures below will give you more information.

Sea rescuers always wear life jackets when they are at sea. Life jackets help them to float if they fall into the sea, so that they do not drown. A life jacket is made from thick plastic or rubber and has air inside so that it can float.

Figure 5

Protective equipment or emergency equipment used by emergency workers includes life jackets for sea rescuers and oxygen tanks for firefighters.

Fire fighters carry oxygen with them to help them breathe when there is a lot of smoke from a fire. An oxygen tank is an example of the type of **protective equipment** used by emergency workers.

The tank is made of thick metal to keep the oxygen from exploding. The pipes are made from rubber so that they are waterproof.

The dials are covered by glass or see-through plastic, which are both waterproof.

Figure 6: Fire fighters use oxygen tanks.

Protective clothing and emergency equipment

After you have done your investigation and you have all the information, fill in the table below.

In the first column, write down an item of clothing or equipment that you have learnt about. Then answer the questions in the other columns. You should say what the item of clothing or equipment is made from, and also say why it is made from that material. There are two examples to get you started.

	Firefighters	**Sea-rescue workers**		
	Made from	**Why?**	**Made from**	**Why?**
jacket	fire-resistant textile	cannot catch fire	thick plastic	can withstand bad weather and keep the rescue worker dry
boots	leather	strong enough to protect fire fighters' legs and feet from flames	rubber	waterproof

After you have completed the table, answer the following questions on your own:

1. Why is it important that protective textiles are used to make clothes for emergency workers?

 ....

 ....

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2. What clothes should fire fighters wear, and what equipment should they carry when they respond to a call?

 ....

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 ....

 ....

3. In what other emergency situations should special clothing or equipment be used? Think about the refugees you learnt about in Chapter 6. What kind of emergencies could happen in their camp?

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Next week

Next week, you will begin your mini-PAT for this term. In this mini-PAT, you will investigate a natural disaster and design emergency shelters for victims of the disaster. You will also sketch a design idea and make a model of an emergency

Chapter 10
Mini-PAT: Shelters for refugees

shelter.

For the next three weeks, you will investigate building techniques: past and present, making fabric waterproof and the burning characteristics of textiles. Then you will design and build a model emergency shelter. You will work on your own and your teacher will assess your work.

Assessment

Design:

Design brief and specifications .... [12]

Design sketch .... [20]

Make:

Waterproof fabric .... [10]

Model emergency shelter .... [28]

[Total marks 70]

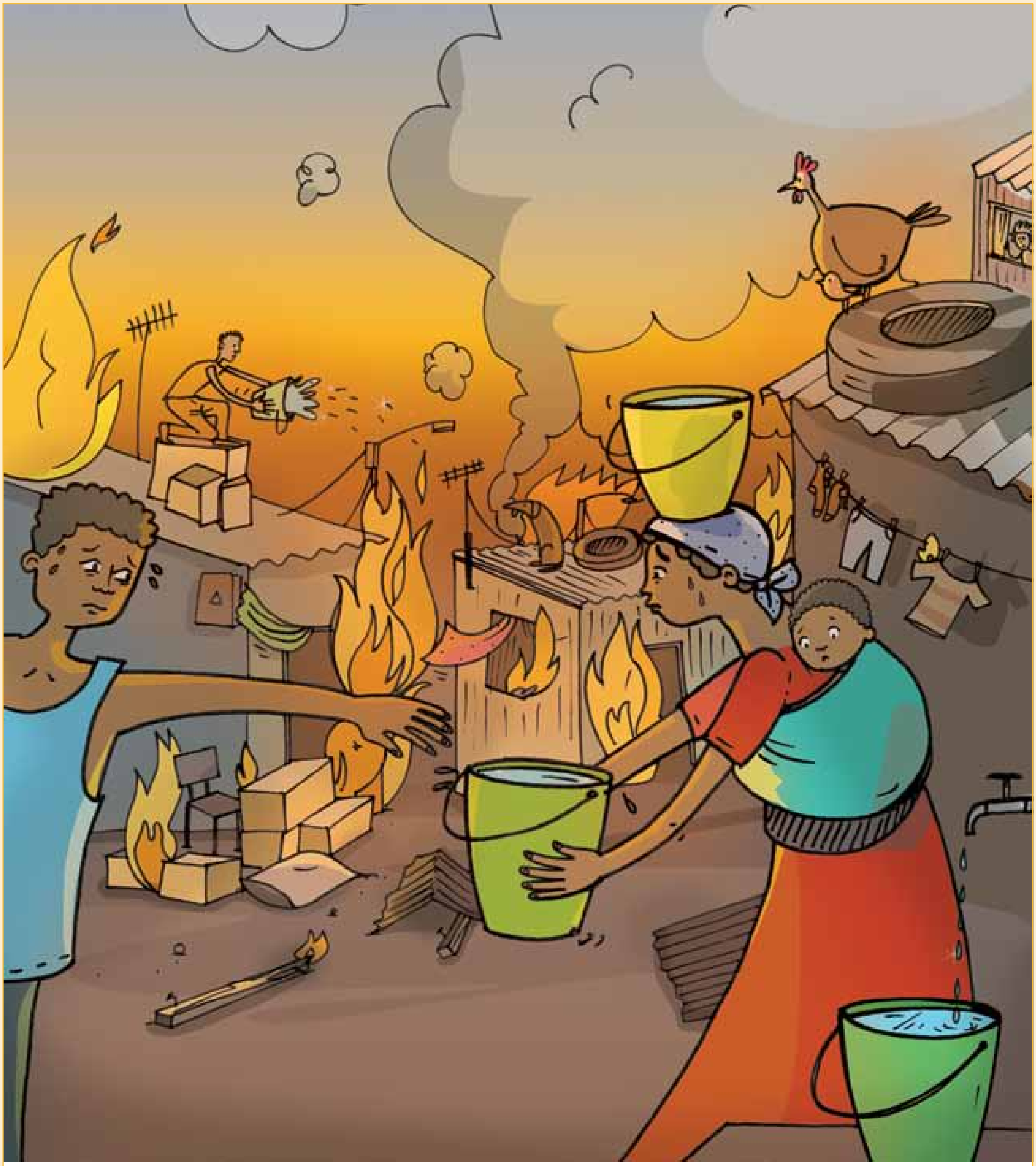

Figure 1: An informal settlement during a fire

Shack dwellers face many problems. Fires are particularly dangerous. Shack fires kill many people every year. People in shacks use open fires and candles for heat and light. When a candle falls over or an open fire is not dampened down to kill all the flames, a fire starts. These fires spread very quickly because shacks are built too close to each other. There are also no proper roads in between the shacks. This makes it difficult for fire fighters to reach the fires in order to put the fires out.

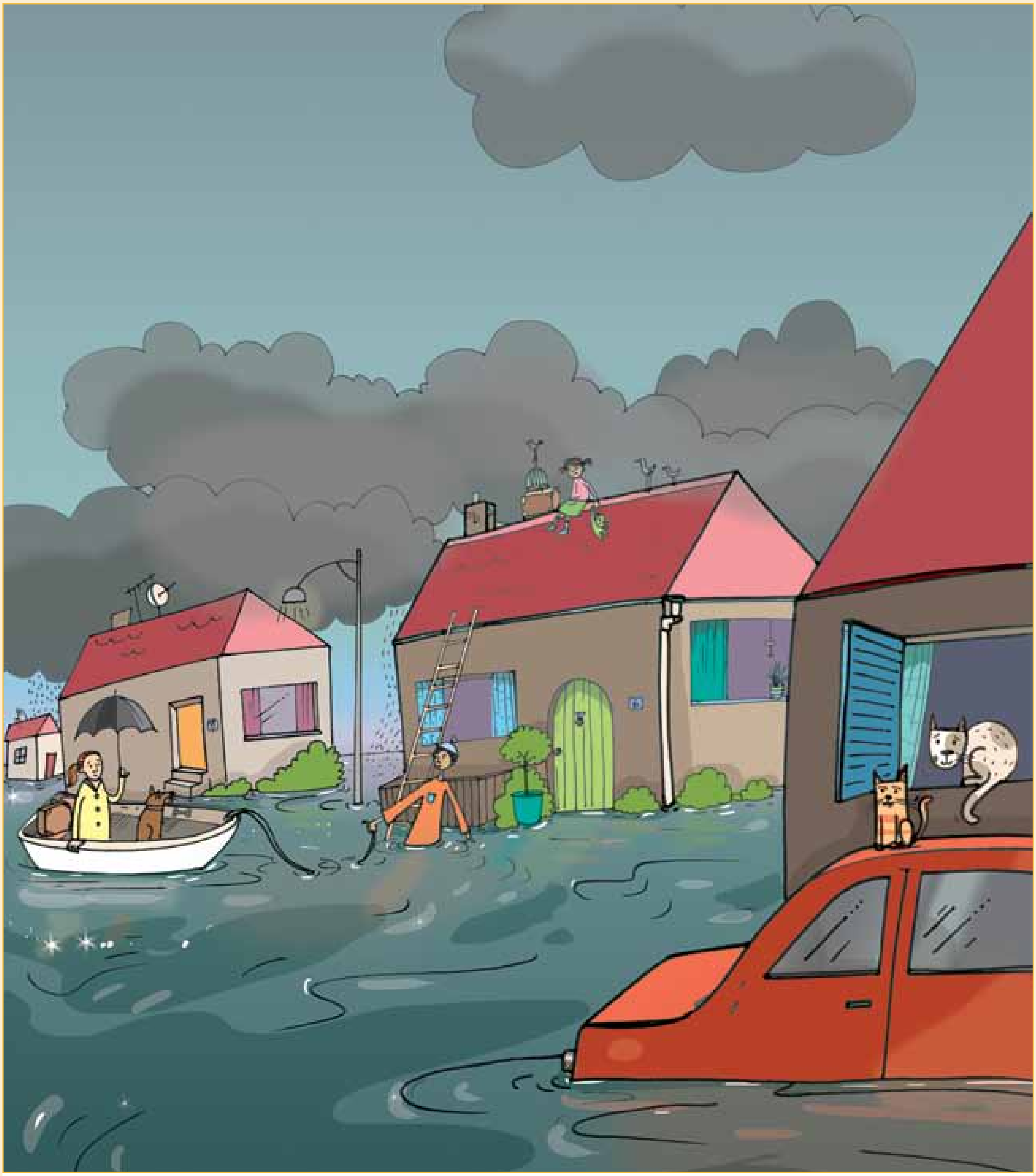

Figure 2: A town flooded after very heavy rainfall

People sometimes build houses on an open piece of land without thinking if it is a good place to live. Sometimes the land is low lying and there is nowhere for the storm water to go when it rains heavily. The area becomes flooded and the water runs through their homes. This causes a lot of damage to the few possessions they have. Often people don't want to leave their flooded shacks because they are scared that their possessions will be stolen while they are living in temporary housing.

Week 1

Investigate part 1

Let us look how our ancestors lived (30 minutes)

The Khoi (Khoikhoi or KhoeKhoe), which means "people people", and the San (Bushmen or Sho), which means "men without domestic livestock", were the first people to live in southern Africa. They were the earliest inhabitants of our country and have been living here for thousands of years.

Both groups were nomadic. Nomads do not live in one place for a long time. They move from a place in search of food for themselves and their animals. The Khoi people owned livestock. They moved in search of good grazing for their cattle and goats. The San people were hunter-gatherers. They did not have livestock. The men tracked and hunted wild animals. The women collected mainly eggs, roots and bulbs.

Both groups built dome-shaped huts made from green sticks tied together at the top. These frame structures were covered with reeds and grasses which grew around them. Some of the Khoi wove grass into mats, which they used to cover the frames. The grasses or reeds made the huts windproof and waterproof. When they moved on they left the huts behind, so their huts were not made to last a long time. These were not permanent dwellings.

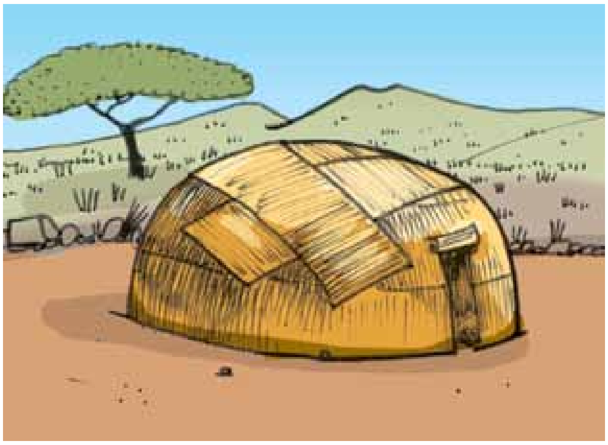

Figure 3: Khoi hut

Figure 4: San hut

Look at the homes of the Khoi and the San people

Work in pairs.

1. What materials did the Khoi and the San use to build their homes?

   ....

2. Where did they find the materials they used?

   ....

3. Were the building materials suitable for the environment where the Khoi and San lived? Explain your answer.

   ....

   ....

4. What happened to the huts and materials they left behind once they moved on to another place?

   ....

   ....

5. Do you think that any of the materials would have harmed the surrounding environment where they were used? Give a reason for your answer.

   ....

   ....

6. Why did the Khoi and the San people need their structures to be temporary?

   ....

   ....

Investigate part 2

Permanent homes of our indigenous people (30 minutes)

About 2000 years ago, people slowly **migrated** from northern Africa to the south. Four main groups ended up in the area that is now South Africa: Nguni, Sotho, Venda and Tsonga.

These are the forefathers of most of our **indigenous** cultures. They grew crops, mainly grains like maize for food. They kept cattle for meat and milk. So they needed to live close to rivers or streams and in areas where the land was fertile.

Migrate: to permanently move from one place in a country to another place or another country.

Indigenous: people originating in a particular country.

Because they lived in one place, they built permanent homes.

Some people built dome-shaped huts. They did this by:

- making a framework with upright branches,
- using thin green saplings to make a fine mesh between the upright branches, which makes a strong framework. This makes a strong framework that lasts for a long time, and
- covering the framework with thatch and then with plaited grass mats. The two layers of covering insulate the huts against extreme temperatures and keep the people warm and dry.

Figure 5: The framework is covered with grass.

Figure 6: Completed dome-shaped hut

Other people built round "rondavel" homes.

- Saplings were used for the straight upright walls.
- Gaps between the saplings were filled with clay.
- The walls were plastered on the inside and outside with clay.
- A cone-shaped roof was made from a framework of wooden sticks covered with grass, reeds or thatch.

Figure 7: Rondavel hut

Ndebele people came into contact with **immigrants** from Europe. They started to build rectangular homes.

- The walls were built with mud bricks and plastered with mud.
- The outside walls were decorated with brightly coloured designs. This makes these homes **distinctive** and attractive.

Immigrant: a person who moves to another country permanently

Something is **distinctive** if it has a special property or quality that makes it stand out from other similar things.

Figure 8: Rectangular Ndebele hut

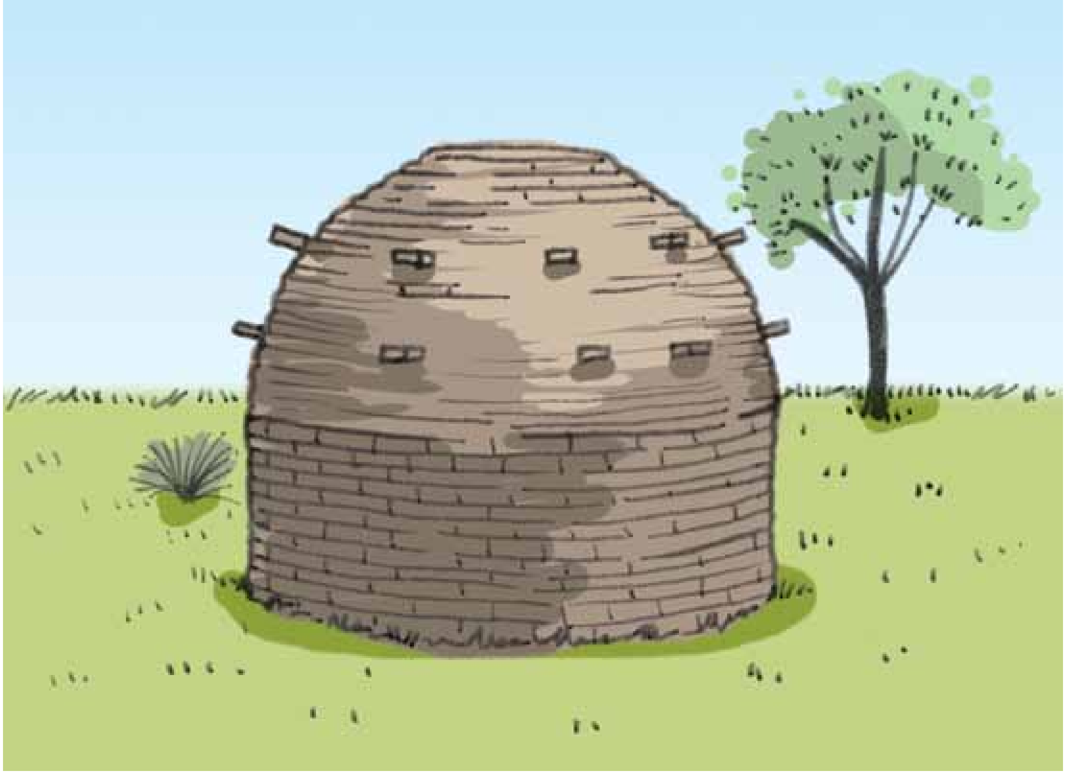

Figure 9: Corbelled hut

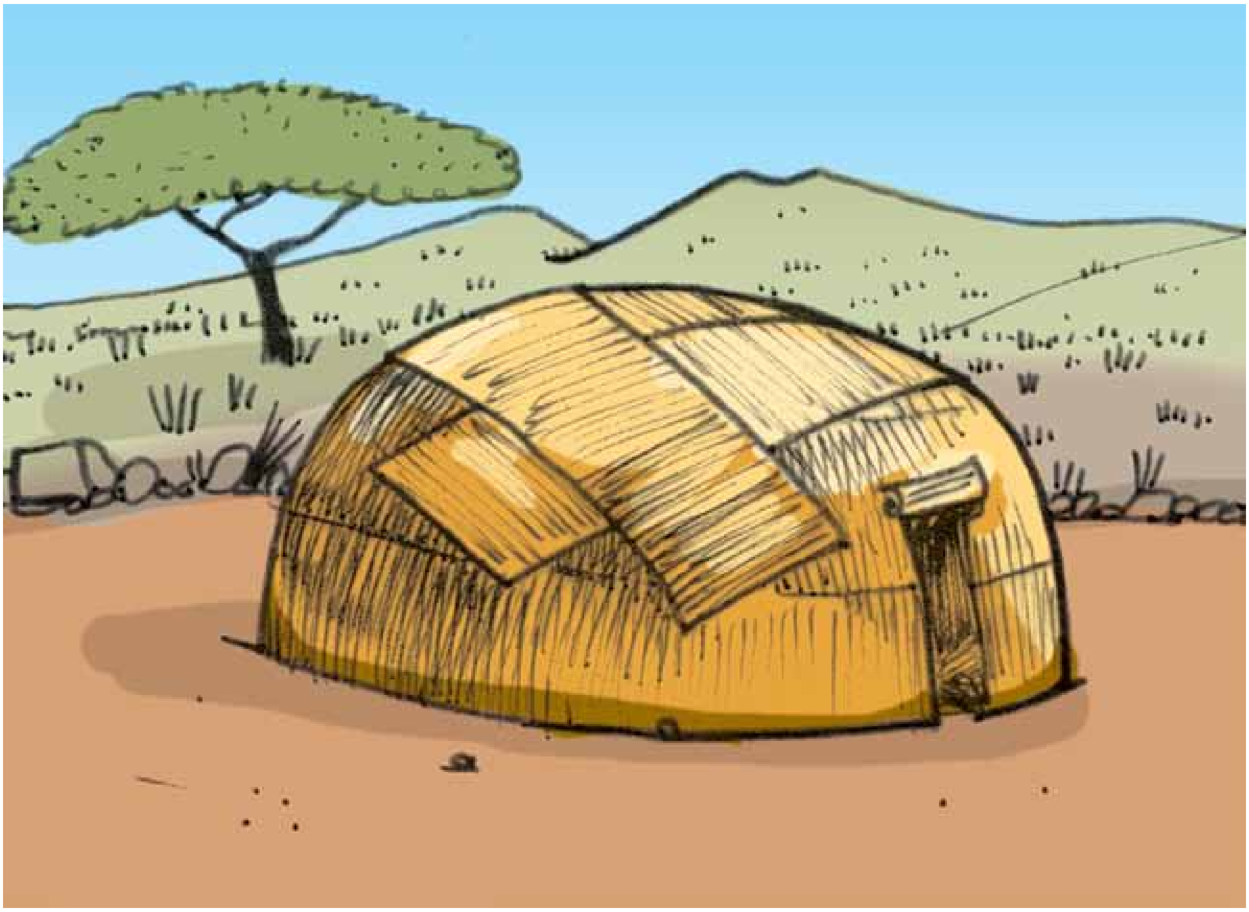

Figure 10: Matjieshut

Matjiehuts were temporary houses built by the Nama people of the Richtersveld. These were also built by white farming families when they needed temporary houses.

Nomadic farmers in the northern Cape built corbelled houses from flat stones, with a minimum amount of mud-clay to bond them. The style is more than 4000 years old, and comes from the Mediterranean countryside.

Look at the huts built by our indigenous people

1. Why did these people build permanent homes?

....

2. What makes their dome-shaped huts better than those that the Khoi and the San people built?

....

....

3. Why do the people that build 'rondavel' huts choose to use mud as building material?

....

....

4. What is the advantage of using thatch as a building material?

....

....

5. What is special about the homes of the Ndebele people?

....

....

6. Are the materials used to build these homes suitable for building homes? Explain your answer.

....

....

7. Would any of the building materials they use harm the environment? Explain your answer.

....

....

....

8. Do you think the early people who moved from North Africa were immigrants like the people from Europe that came much later? Explain your answer.

....

Investigate part 3

Dwellings in informal settlements (30 × 2 = 60 minutes)

Many people migrate from rural areas to large towns and cities looking for a better life. They arrive with no money and no place to live. They build temporary places to live on open pieces of land near the towns. As more people arrive, more houses are built until there is a whole group of houses close to each other. We call this group of houses an informal settlement.

These informal settlements have no roads, no water supply, no toilet facilities and no waste removal. These temporary houses are commonly called shacks.

People use materials that they find in scrap yards and what they can afford to buy. Some examples are: cardboard, plastic sheeting, wooden planks, old tyres, pieces of polystyrene foam and sheets of corrugated iron.

WARNING

Asbestos is very harmful to people. The fine fibres irritate the lungs and can cause lung disease and cancer.

Its only advantage is that it is heat and fire resistant, but this does not make up for its health hazard.

These materials have many disadvantages:

- Polystyrene foam and cardboard catch fire and burn easily.
- Dry wood burns quickly too.
- When tyres get old and deteriorate, they give off unhealthy fumes.
- Plastic and tyres give off black fumes when they burn. The fumes are very unhealthy to breathe in.
- Old sheets of material made of asbestos are sometimes taken from demolished buildings and used to make walls and ceilings. Asbestos is very harmful to humans and should be avoided as a building material.

Figure 11

Look at the matetrials used to build shacks

1. Look at the photographs of shacks and informal settlements on the previous page. Complete the table about the different materials. Do not use the example that has been completed for you.

Material	What is the material used for?	Is it suitable or not suitable for what it is being used?
Bricks	To hold down a roof	Bricks are not heavy enough to hold down a roof during a strong wind.

2. Do you think the materials used by the Khoi and San people and the indigenous people are better or worse than those used to build shacks? Give reasons for your answer.

....

....

....

Week 2

Let us help the disaster management team (30 minutes)

The scenario

The disaster management team wants to be better prepared for emergency situations. They need emergency shelters that can be moved easily to disaster areas. The shelters will be stored until there is a need for them. They must be set up and packed away quickly and easily.

The health of the disaster victims who will be housed in the shelters is important. The shelters have to be sturdy and windproof and waterproof. They must be safe and large enough for six people to live in for up to a month.

They have asked for help with a design. The specifications are:

- design a shelter,
- build a model of the design,
- the structure must be covered with fabric, that you have made waterproof, and
- the shelter should keep people safe and healthy.

The first task is to find out how to make fabric waterproof. The second task will be to find ways of making fabric fireproof. Your teacher did some research and found the following information.

Different ways to make fabric waterproof

- Spray fabric with a commercial silicone spray.
- Rub candle wax or petroleum jelly (Vaseline) on the fabric.
- Paint fabric with any PVA paint.
- Cover fabric with transparent plastic contact sheeting. This plastic sheeting has a smooth front and a sticky back. You can also call it sticky-backed plastic.
- Mix ½ cup cooking oil and ¼ cup turpentine in a spray bottle. Spray the fabric a few times with the mixture.

Different ways to make fabric less likely to catch fire and burn

- Mix 2 tablespoons borax with 1 cup hot water in a spray bottle. Spray fabric a few times until soaked. Leave to dry and spray again.
- Mix 2 tablespoons borax and 1 tablespoon boric acid with 1 cup hot water in a spray bottle. Spray the fabric, leave to dry and spray again. Repeat a few times.
- Paint fabric with PVA paint and cover the fabric with sand on both sides while the paint is still wet.

Something that you add to make fabric or something else difficult to burn is called a "fire retardant".

Get ready to conduct water and fire retardant experiments in your next lesson

1. You will work in groups. Some groups will conduct the waterproof experiments and other groups the fire retardant experiments. Work in groups of eight. Each group will split up into four pairs. Get your groups and pairs together.
2. Use identical pieces of cotton fabric for all the experiments. Scrap pieces of canvas or denim will be ideal. Each pair will need a piece of fabric more or less 10 cm × 10 cm.
3. You will need lots of old newspapers or magazines to work on.

To compare the different ways of treating fabric in a fair way, you need to use the same type of materials for each treatment.

Figure 12: Some materials for waterproofing tests

Figure 13: Some materials for fire retardant tests

Waterproofing and fireproofing (30 minutes)

In this lesson, you will prepare the samples for testing later.

Groups that will waterproof fabric:

- Pair A: You will need three pieces of fabric. Apply candle wax to the first piece, petroleum jelly to the second piece, and PVA paint to the third piece.
- Pair B: Apply sticky-backed plastic to a piece of fabric.
- Pair C: Apply cooking oil and turpentine to a piece of fabric.

Leave the samples to dry on newspaper. Write the method you applied on your sample on the newspaper. That way you will know which method was applied to each piece of fabric.

Groups that will make fabric fire retardant:

- Pair D: Apply borax solution to a piece of fabric.
- Pair E: Apply borax and boric acid solution to a piece of fabric.
- Pair F: Apply PVA paint and sand to a piece of fabric.

Leave the samples to dry on newspaper. Write the method you applied on your sample on the newspaper. That way you will know which method was applied to each piece of fabric.

Investigate part 4

In this lesson, you will test your samples to find out how well the different methods worked. Use one piece of fabric that was *not treated by any method* to help compare the effectiveness of the treatments. We call this the control sample.

Appoint one pair to do the testing. The other group members have to record what they observe.

Testing samples (30 minutes)

Test waterproofed samples

Use a spray bottle filled with water. Spray the samples until they are wet on top. Lift up the sample and observe the newspaper underneath. What do you see?

Method applied	Paper stays dry	Paper slightly wet	Paper very wet
Control sample (untreated fabric)			
Candle wax			
Petroleum jelly			
PVA paint			
Sticky-backed plastic			
Cooking oil and turpentine			

1. The most effective method is:

....

2. The least effective method is:

....

....

....

....

....

....

Test fire retardant samples

You cannot set alight the whole sample. That would be too dangerous. Cut a thin strip from each sample. The strip of fabric must be less than 1 cm wide.

Some of the samples may burn. Wear safety goggles to protect your eyes and oven gloves to protect your hands.

You will need:

- a metal sheet, enamel plate or piece of wood to work on. Do not work on newspaper, since paper burns easily.
- a candle and matches.
- a pair of tongs or a wooden clothes peg to hold the sample over the flame.

Hold the sample over the flame for a few seconds. Observe how it reacts while in the flame and once removed from the flame.

Method applied	**Reaction while in the flame**	**Reaction once removed from the flame**
Control sample (untreated fabric)		
Borax solution		
Borax and boric acid solution		
PVA paint and sand		

1. The most effective method is:

   ....

2. The least effective method is:

   ....

How do different textiles burn?

For this experiment, you need the same equipment that you used to test your fire retardant samples. A few fibres of different textiles, for example woollen cloth or knitting yarn, cotton fabric, and synthetic fabric such as nylon or polyester will be useful.

One person will conduct the experiment while the rest of the class will observe and record their observations in the table on the next page.

Follow the same safety rules as you did when you tested your fire retardant samples.

Sample	Approaching the flame	In the flame	When removed from the flame	Smell	Remains after burning
Sample 1					
Sample 2					
Sample 3					

Compare your observations with the information below. Now you will know what textiles your samples were made of. Fill in the textiles in your observation table.

Sample	Approaching the flame	In the flame	When removed from the flame	Smell	Remains after burning
Animal fibres such as wool	Shrinks away	Burns slowly	Smoulders and then the flame dies	Burning hair	Dark bead that turns to powder when touched
Plant fibres such as cotton	Pulls towards the flame	Burns quickly	Continues to burn	Paper burning	Grey, feathery ash
Synthetic fibres such as nylon and polyester	Tip starts to melt	Burns and melts	Continues to melt	Acid	Hard bead of plastic

1. Which of the textiles is the least flammable?

....

In the next lesson, you will waterproof a piece of fabric that you will use to cover your model. You will need a piece of fabric at least 50 cm × 50 cm in size.

Make part 1

Waterproof the fabric for the model (30 minutes)

You have to make fabric waterproof, so that it is ready to be used to cover your model emergency shelter. Use a piece of cotton fabric at least 50 cm × 50 cm. The fabric need not be one piece. You may sew pieces together to create the right-sized square. Take care to make strong joints that you can waterproof well. [10]

Week 3

Design part 1

Design and sketch the model shelter (30 minutes)

Write a design brief and specifications

Go back to the situation and read through it carefully. Also make a note what the disaster management teams expect from you. Remember that you are building a model, so you must consider the scale of the model to the shelter you will be designing. If you are using your cloth of 50 cm × 50 cm, and you use a scale of 10:1, the actual shelter would be 5 m × 5 m. Would this be big enough for six people?

1. Write a design brief.

....

....

....

....

....

.... (3)

2. Identify and list the specifications you have been given.

....

....

....

....

....

....

....

....

....

.... (9)

Total [12]

Design part 2

Design sketch (30 minutes)

Make a sketch of your design

1. Make a rough pencil sketch of a possible solution on this page.
2. Label your drawing to show the different parts of the model shelter.
3. Identify the materials you will use. [20]

Make Part 2

Construct the model (30 minutes × 2 = 60 minutes)

Build your model

1. Collect all the materials and equipment you need for your model.
2. Decide how you are going to go about building the model.
3. Think about any safety measures you have to consider.
4. Only now can you start building the model.
5. Once the model is finished, check that you have met all the specifications. The specifications become the features of the model emergency shelter.
6. Make sure that you considered the health and safety of the disaster victims.
7. Make adjustments if needed.

Your teacher will look at the following

- Can the model be transported easily?
- Can it be set up and packed away quickly and easily?
- Can six people live in it comfortably for a month?
- Is it windproof and waterproof?
- Is the waterproofing effective? (Consider the health of the victims.)
- Is it safe? (Consider the dangers of fire.)
- Is it well built and sturdy?

Good luck and do your best! [28]