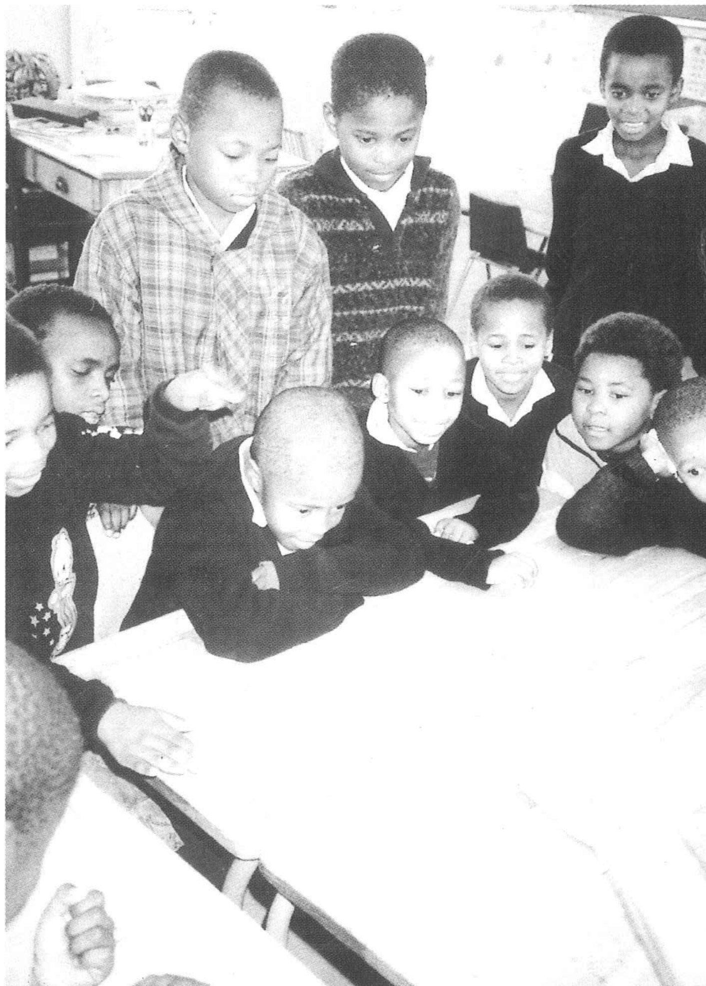
UNIVERSITY OF
FORT HARE

Eastern Cape Education
Department

Distance Education Project



Core Learning Areas Course

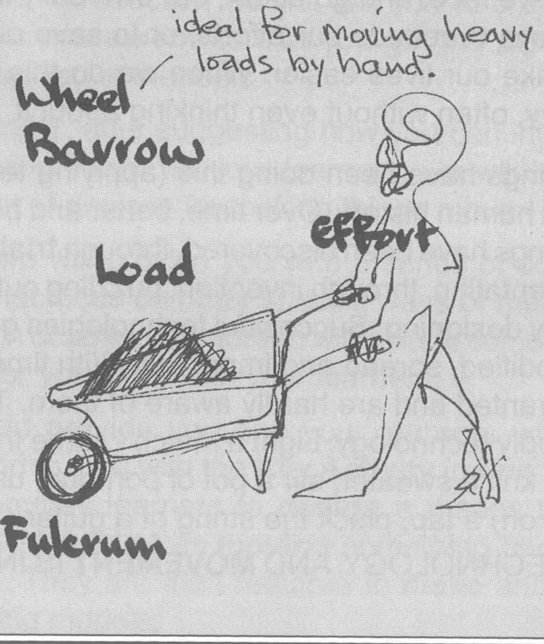
Technology Education

6th Umthamo

Making Moves

2nd Draft Edition
January 2002

Contents



ideal for moving heavy loads by hand.
Wheel Barrow
Effort
Load
Fulcrum

Introduction

> The world around us is never still. In the towns, cars and trucks move along the streets. Above the countryside, aircraft fly through the sky. Obviously, such machines are driven by their engines. Their engines are complex machines that produce a force - a push or a pull - to drive the vehicle along. But how do machines produce their power and how do forces produce movements? And what about the movements of natural objects and phenomena? Why do winds blow and rivers flow? Why do the Sun and the Moon move across the sky? Are all moving objects pulled or pushed along by forces? These questions have been asked for thousands of years....... (Lafferty, 1992:)

Stop for a moment and look out of the nearest window. Focus your attention on every possible movement that you can become aware of, and you might be both challenged and surprised. Noticing things, and wondering about them **(philosophy),** is a natural human activity that makes us sentient beings (living things capably of perceiving things through our senses). Sharing what we think with others **(language)** gives us our **culture.** And trying to explain what we see, and why things happen, can lead to **religion** or mythical beliefs **(literature).** Trying to understand what and how these things which we wonder about actually happen, is **science.** Finding ways to make *use* of these things to make life easier, is **technology!**

Understanding, and making use of our understanding of elements of **movement,** contributes to the ease or difficulty with which we face, and go about, our own daily lives. If we can find ways to reduce our efforts, or to save our energy, we can make our lives easier. When we do this we **apply technology,** often without even thinking about it.

Human beings have been doing this (applying technology) throughout human history. Over time, better and better ways of doing things have been discovered, through **trial** and **error** or experimentation, through invention, puzzling out and even deliberately designing. Successful technologies get shared, copied, modified, spread and improved. With time, we take them for granted and are hardly aware of them. Turn a key and you apply technology. Light a match - same thing. Move needles to knit a sweater, stir a pot of porridge, use an iron, open (turn on) a tap, pluck the string of a guitar.

IT'S ALL TECHNOLOGY, AND **MOVEMENT** IS INVOLVED.

So far in this strand of the Core Learning Areas course, you have been exposed and introduced to a range of aspects of **technology education.** Reference books about Technology Education vary in the way they break up and list the different aspects of technology. But, generally you will find the following included:

- **Design** - recording and communicating ideas and plans (Umthamo 15)
- **Structures** - building and constructing (Umthamo 7)
- **Materials** - properties, possible uses, joining and fastening (Umthamo 31)
- **Processes** - changing things and making things (Umthamo 23)
- **Systems** - planned ways to solve specific problems (Umthamo 39)
- **Mechanisms** - tools or machines to move and change things (Umthamo 47)

We cannot hope to cover every aspect of so broad a field as **technology.** But we hope that what this course has exposed you to will give you the confidence, as a *generalist class teacher,* to deal with **technology education** effectively, and to incorporate it, in a relevant and practical way, into your day-to-day general work with primary school learners (3 to 13 years). We hope that we've laid a reasonable foundation of understanding so that you can transfer what you have learned as you face possible new demands of changing curricula in the future.

> *Teach a teacher the content and she can teach it today. Teach a teacher **how to tackle** (approach) the content and she can teach anything for life.*

What is in this mthamo?

Later in this Introduction we will ask you to brainstorm the whole topic **movement** so that you get the *big picture* of what is involved in the topic.

Then in Unit 1, after suggesting how you can introduce the topic *'Moving things'* to your learners, we will look at one specific set of devices for making things move - **levers.**

In Unit 2 we will provide you with a series of double-page spreads that focus on other specific ways of making things move. Each double-page spread will include some suggested activities for you to try with your learners.

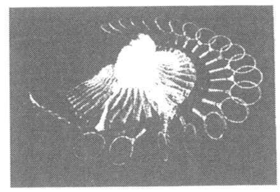
This should provide you and your learners with enough background to deal with the **Key Activity** in Unit 3. The Key Activity requires learners to **design** a means to **solve a problem** which involves **moving** something under certain conditions. They are then required to **make** and **appraise** their working models.

> *Note: A case-study report on your work on the Key Activity is a required hand-in Assignment for this Umthamo*

The fourth unit should really come earlier, because it is about assessment; and you know by now that assessment should be part and parcel of a good teacher's thinking at *every* stage of her work.

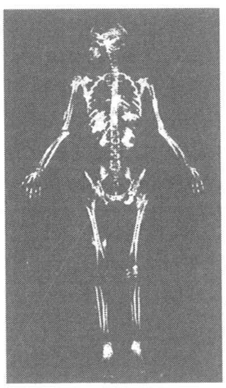
Originally we planned a fifth unit in which we would underline the relevance of this mthamo. We hoped to do this by suggesting ways that you might be able to link with the Department of Water Affairs and Forestry as you and your learners consider important aspects of water supply, both now and in the future. This has not been possible yet.

Now we want you to brainstorm the *big picture* of what is involved in making things move. You will carry out this activity at the face-to-face session where this mthamo is introduced.



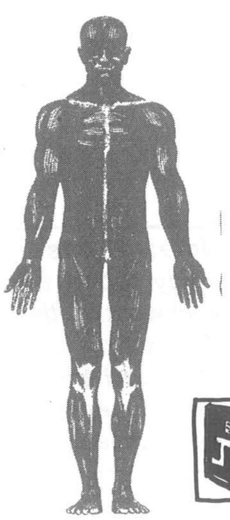
Activity 1 - What do we understand by *'movement'*?

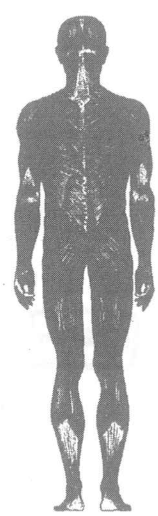
In your group, make a quick mind-map of all the words you associate with the word, ***movement.*** Record the words you think of in any language (some languages seem to express or describe certain ideas or feelings better than others!). Here are some questions which you may find useful as a guide for your discussion:



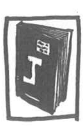
- What do you notice about this topic?
- To what extent is movement a part of your daily life? Why is this so?
- Do all things move in the same way? Why? Make a quick list of as many different ways as you can.
- In what ways do things people have made, move similarly to the ways we can move our bodies?
- In what ways do things people have made, move differently from the ways our bodies and limbs move?

As you make your mind-map, try to write similar ideas and/or words together. Then if somebody else looks at your mind-map, they will find a logic (reasoning) in the ways you have arranged the words. This will help them to make sense of this piece of work. When you share your ideas with the rest of the teacher-learners at your centre, you will find it easier to see which ideas you have in common, and which are different.





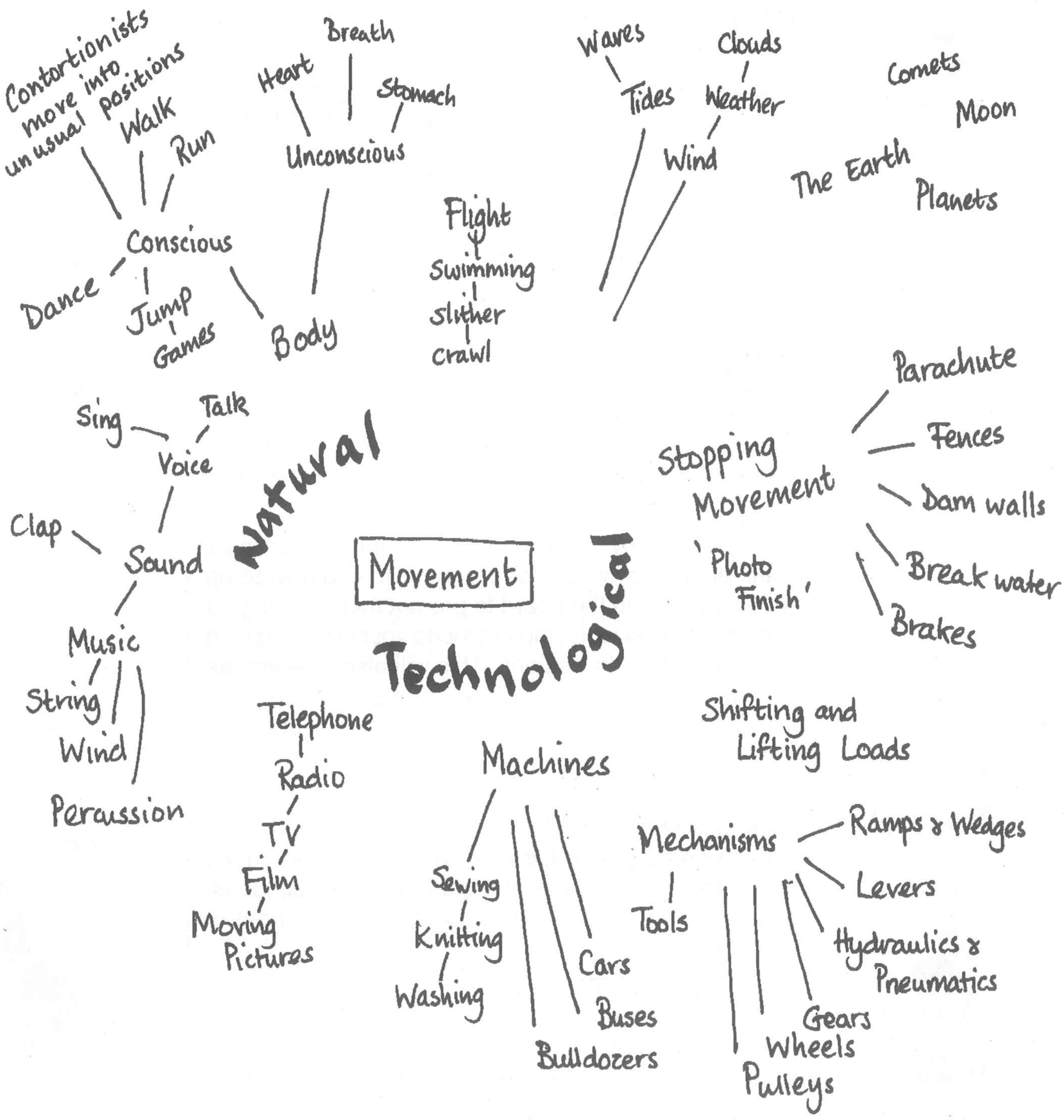
When all the groups of teacher-learners share their ideas, write in the additional points, which you have not thought of, on to your map in a **different** colour. Talk about your ideas. Ask your fellow teacher-learners for clarification if you are not clear about an idea or a word.



Now open your Journal and write as quickly as you can what you have learned about **movement** from this activity. What would you like to learn more about?

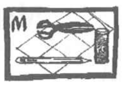
Outcomes

The outcomes should be implicit in the mthamo. As a developmental exercise for you, we would like you to think about, or work out, the likely outcomes for this mthamo for yourself. Then at the final face-to-face session you should come up with your own brief statements of outcomes for the mthamo that you have just worked through. You can first compare the outcomes you think of with those of your peers, before your umkhwezeli shows you the ***actual outcomes*** we had in mind. Will they be the same?



Unit 1 - Getting things moving

In this unit we will start with an activity in which you assess your learners' current understanding and interests with regard to the topic **movement.** This will help them start from an established base, as they explore how technology has influenced the way we **move** *ourselves*, the way we **move** *goods*, and the way we **move** *information*. The focus will be on the *technology* of **movement.** Again, as in Umthamo 7, we will need to make the distinction between movement that is **natural** and movement that involves **technologies.**



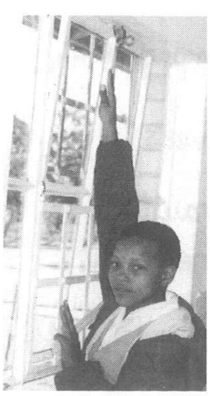
Activity 2 - What do your learners understand by *'movement'?*

If you work with younger learners, we suggest that you prepare a large sheet of paper for this discussion **before** you go to work with your class. In the middle of the sheet of paper write the word, ***movement*** (or *intshukumo*).

When you are with your learners, gather them around you. Then put up your large sheet of paper ready to record each person's ideas in the form of a mind-map.

If you work with older learners, you can ask them to work in a similar way to the way you yourself worked in Activity 1 on page 4. Make sure that you have enough A4 size paper for each group to make a group mind-map of their ideas, associations, and discussion. You will also need a large piece of newsprint to make a record of all the ideas from the groups.

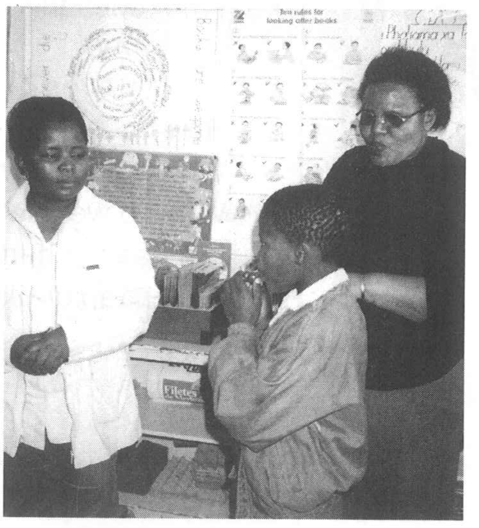
Set the task clearly. Explain that you want your learners to think about the word ***movement.*** You could write up some questions on the board to prompt their thinking, or as a guide. As they work, move around your class listening in to some of the discussions. This will also give you an opportunity to clarify the task, if any of your learners were not quite clear what you wanted them to think about and discuss.



After about 10 minutes of group discussion, stop the groups, and chair a whole class discussion. Make sure that each group gets a fair chance to share their ideas with the rest of the class. As the groups share their ideas, record these on a large mind-map on a large sheet of newsprint.

Whether you are working with younger learners, or older learners, think carefully about how you make the large mind-map. You will know from Activity 1 that it helps if the person recording the ideas arranges similar ideas together. If the ideas are written randomly , it is more difficult to make sense of what has been said and written. It is also more difficult to remember what was said. You will need to concentrate carefully as you record what each group of learners shares.

To finish off this activity, go over what you have written on the large class mind-map. Read out the different ideas and suggestions. Ask if anybody has any questions, and encourage the other learners to try to answer the questions of their peers. Then ask your learners what they would like to find out more about.



Thando shows us that the pea in this whistle ***moves*** *to make a better sound*

Later, on the same day, open your Journal, write the date, and write about what happened in this activity. How did you feel as you facilitated this task? What surprised you? Why? What did you learn about your learners? What did they want to find out more about? Why do you think this might be? How could you facilitate their finding out and learning about the aspects of this topic which really interest them?

Be prepared to share this with the other teacher-learners at your Centre at the next face-to-face session.

Activity 3 - Getting more specific - using pictures and real things

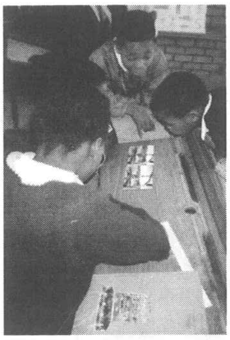
Before you start this activity, you will need to collect lots of suitable pictures from old magazines and newspapers. Look for pictures of people **moving** things (a wheelbarrow, a bicycle with a load or a person being lifted, a traditional African sled being pulled by oxen, or even a garden hose-pipe in use). You will also need to have some pictures of people **being moved** (a lift, a taxi, escalators, and even a donkey cart). Try to include pictures of things (or bring the actual items) that have something to do with **movement** (a corkscrew, a watch, a bottle opener, a broom, a pencil, a pneumatic drill, a bulldozer). Make sure that you also have some pictures that involve the **movement** of information such as envelopes, cellphones, a TV set or radio and a computer, etc.

Let the learners work in pairs to help sort the pictures into 4 categories:

- Technology used to move **people**
- Technology used to move **things**
- Technology used to move **goods**
- Technology used to move **information**

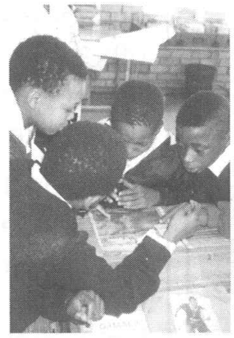
Goods are produce or products packaged specially for transport.

Things referred to anything else we might need to move.



Each pair should spend a little time with their pictures or items so that they are able to say a few things about each one by answering questions such as the following:

- What does this picture show us about **movement?** (category)
- What **moves?** (mechanism)
- How does it **move?** (force)
- Where does it **move** to or from? (direction)
- Why do we use it? (purpose or need)
- Is it easy or hard to **move?** (effort and energy)
- Is it cheap or expensive to **move?** (costs)

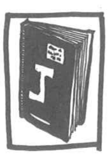


Younger learners will need more guidance. Older learners will be able to work more independently. You will need to make your own decisions as you are the expert when it comes to knowing what your learners are capable of, and what will challenge them without making them lose heart.

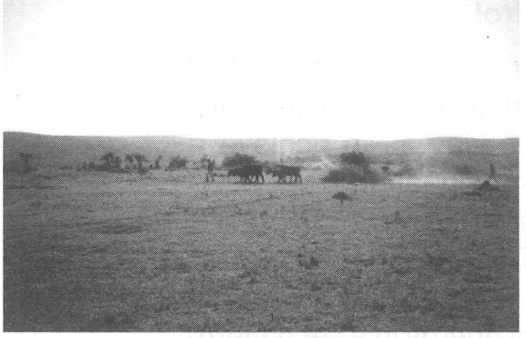
You will also need to make your own decisions of how the work of this activity will best be recorded. Will you make a display on a wall of the classroom? Will you paste the pictures in groups onto a chart? Will you use a scrap book (see Umthamo 31 - Joining and Fastening), and have a section for each of the four categories? Or will you ask your learners to make their own drawings and notes on four separate pages of their Science and Technology notebooks (intermediate phase), or their Life skills book (foundation phase)?

On the opposite page, you can see the pictures which we used, together the Mpongo learners' comments. Repeat the activity using actual items such as cork screws, clothes pegs, pliers, or screw drivers. Adapt the questions and transcribe your learners' answers.

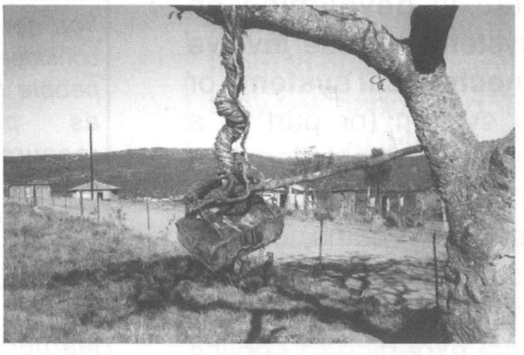
Journal write

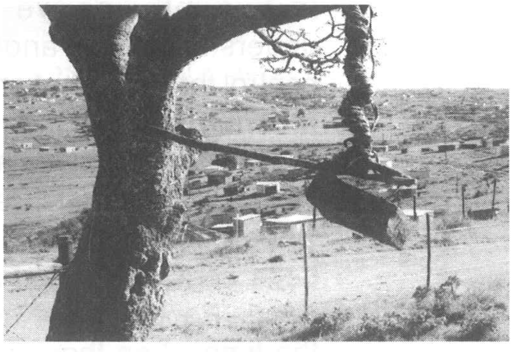


After completing these two activities, make sure that you do a careful summary in your Journal where you note down and comment on what the children seem to know and understand. Also comment on what they seemed interested to learn more about. How did your learners find the activity? Why do you think this was so? What problems did they have? What problems did you have? What responses did you not expect and why? How would you do this activity differently next time? Why? You may want to share some of your experiences with your learners. They may also have something to say about what they have learnt and how they feel about they way you chose to ask them to work.



Kuqhutywa inkomo zirhuqa isileyi. Kukho umntu ophethe induku - ubetha inkomo zihambe.





The strips of cowhide hung from a branch are being pulled down by the heavy stone. The strips are twisted tightly and the wooden rod, levered against the tree trunk, prevents them twisting.

The people make two chains of five people to lift water from a deep donga with steep sides. Their feet must hold tight in the wet clay. They use half-calabashes to hold the water. They pass them from person to person. It must be slow, hard work to give water to their goats.

Understanding systems that control movement

From the point of view of technology, the word '**system**' is used to describe an arrangement of things which are **connected,** or organised, in such a way as to achieve a specific purpose. Traffic lights (robots) in larger towns and cities would be an example of a system used to control the **movement** of cars and other traffic. This example of a system is an **electrical** one that involves timers and switches and conversion of electrical energy to light energy in a set pattern. Electrical systems are not the purpose of this mthamo.

In this mthamo we are interested in developing an understanding of another set of systems. These involve control through what are known as **mechanical systems** or ***mechanisms***. A **mechanism** is a system (or part of a system) that involves an arrangement, or organisation, that includes things such as inclined planes, wedges, screws, wheels, ball bearings, lubricants, pulleys, chains, cables, belts, cogs, axles, springs, levers, pistons, cams, cranks and gears. People called **mechanics,** work with these things all the time when they use their practical expertise to service and repair **mechanisms** and **machines. Mechanical** engineers are people who are trained to design and improve **mechanical systems** and **machines.**

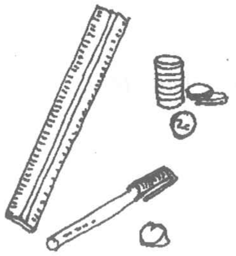
You need to be considering local people like this as possible resources to draw on to help with answers to unanswered questions you and your learners might have.

(Some practical evidence - ie children talking to a local informal sector mechanic in this regard - would be useful for version 2 of this mthamo, and we would welcome any interesting transcripts.)

A **machine** is something made up of several parts that is designed to apply **mechanical power** for a definite function. The function is often specified in its name. So you get a sewing **machine,** or a mincing **machine,** or a food processor, or a drill or even a harvest **machine**/harvester. You also get **simple machines** which consist of only one part such as a crowbar which is a kind of **lever.**

Lever systems

In the following activity we suggest a way that you can introduce the idea of **levers** to learners of any age. This activity helps them see that there is a **mechanical** advantage in setting up a simple lever system to make the work of lifting something a little easier. All you need is:



- a handful of 2c coins,
- a 30cm ruler,
- a pencil or pen that is round (rod shaped) and not • hexagonal (with six flat faces) and,
- a small amount of prestik.

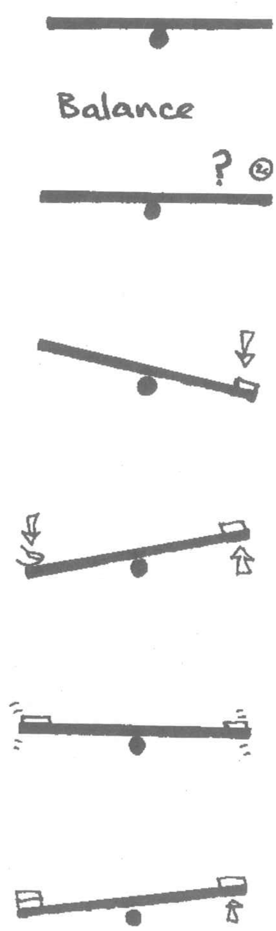
Activity 4 - A Coin See-saw

Plan to do this activity, group by group, with your learners when there is a time that the rest of the class is busy working independently and productively on something else. Make sure you have a means of recording what is said in the form of a pen and paper, or even your tape recorder, provided it can be used unobtrusively (without causing a distraction).

Gather the group around a suitable clear flat surface - it could be the teacher's desk. Tell the learners that you are going to show them something and that you want them to *observe* carefully, and *think* carefully about, what they see happening. Tell them that you will ask questions and explain things, as you go, and that they are also free to make comments and ask questions as well.

We found it useful to place a clean sheet of A4 paper on the table like a mat. Lay the round pen (or pencil) flat across the middle of the paper. Use the prestik to fasten it down so that it doesn't roll. Ask a learner to **balance** the ruler across the pen. Ask "*What do we have to do to get the ruler to balance?*" Expect answers like.... "*The middle of the ruler must be on the pen.*" or "*Both sides must be the same length.*" Ask them what this reminds them of. The combined Grade 1 and 2 learners we tried this with, called it *iqegu,* and the older learners said it was a balance.

'*Amahlandinyuka*'



Then ask, "*What will happen if I place the 2c coin I am holding on one end of the ruler?*" You are sure to get the answer, "*It will go down.*" Then demonstrate to confirm the rather obvious prediction. Now ask, "*What has happened?*" This time work to get a more specific observation such as, "*The heaviness of the coin has pushed down the one end of the ruler.*" (You want to try to get them to use the word **push,** of their own accord).

Next ask, "*How can we get the coin to move up?*" Some may say, "*We can use a finger to **push** down on the opposite end of the ruler.*" Others may suggest, "*You can put a two cent coin on the other end.*" Try it and see what happens. It may go down, it may remain the same. Or it may even oscillate (move up and down) for a while, and then settle, exactly balanced.

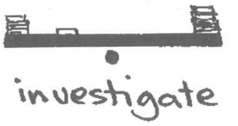
Experiment for a while. Then ask, "*What do we have to do if we want to use coins so that we can be sure that the first coin will be lifted up?*" We are sure you will find that someone will realise that two coins will do the trick.

Now start again. *This* time put the first coin **half-way** between the end of the ruler and the pen it's balancing on. The ruler should go down on that side. Ask your learners how many coins they think will be needed to make sure that the first coin is pushed up. You will probably get the answer, *"Two."* Say, *"OK, lets try."* and start by counting the first coin, *"One"* as you place it on the far end of the ruler. Watch your learners' reactions when the one coin easily moves the other coin up.

'Le uyisondelisile, wabhekelisa kule.' Mveliso

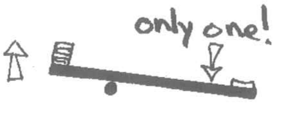
Now check to find out what your group of learners have to say to explain what they saw. Note their attempts to explain their observations. Do they comment on the different distances from the centre? You might want to use your fingers to demonstrate these different distances.

Allow the group to suggest and investigate other arrangements, where the number and position of coins varies. (Remember Natural Sciences Umthamo 35 - *Fair Tests,* where we talked about **variables?**) The variables in this instance are the **number** and **position** of coins.



Now change the variable and see whether you surprise the learners again. Explain that you are going to change the position of the resting place of the ruler. Move the ruler so that two-thirds is on one side of the pen (the 20cm mark should rest over the pen). Hold down the short side with 5 coins. Ask how many coins your learners think you will need to put on the far end, in order to lift the 10 cents worth at the short end. (We found that even older learners expected that you would need a lot of coins.) A single 2c coin should easily provide enough force to lift the 5 coins! This is quite a dramatic demonstration that a simple lever can be used to reduce effort.

'Imali eninzi - enye incinci. Ayizukuphakamisa'



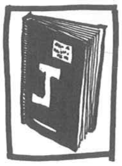
'Yhu! inamandla le 2 cents!' Asanda

This might be the time to focus on some of the technical aspects that make up the identifiable components of a **lever**. Ask learners to describe the essential elements as they see them.

You can expect your learners to come up with the following, in some form or other.

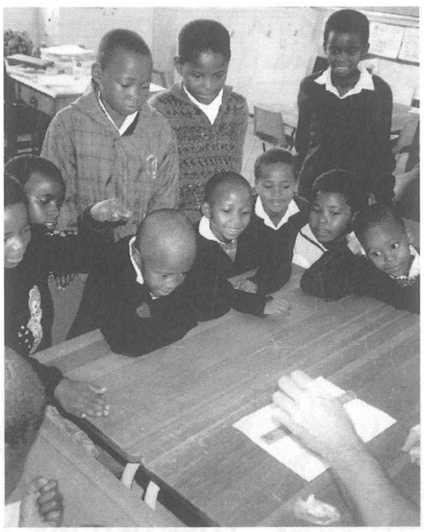
- There is a rod or rigid length.
- There is a support point, or centre of turning, where the lever rests (fulcrum).
- Then there are two other points. The one carries or holds the thing that needs to be moved (load). The other is the place where the force to make the movement happen is applied (effort).

Finish off by asking what factors (variables) affect the power of the lever. The **position** of the bar on the *fulcrum* is *one* variable, because the closer the load is to the fulcrum, the less effort is required to move it. The **size** of the load is *another* variable. There is a relationship between the distance of the **arc of effort** and the **height** to which the load is lifted. The direction of the effort is opposite to that of the load.



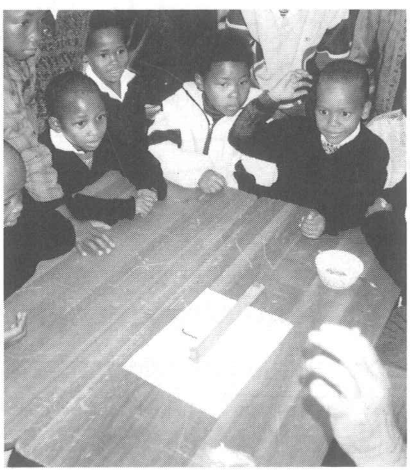
Don't forget to write up your findings after this activity in your Journal. Make sure that you **analyse** and **reflect** carefully on the ways your learners have tried to talk about and articulate, their thinking as a result of their experience with levers.

Remember that, at primary level, we are not trying to teach *precise* and *exact* use of technical terminology. We are trying to provide learners with ***rich experiences*** which they can engage with thoughtfully, as a basis for later more formal learning.

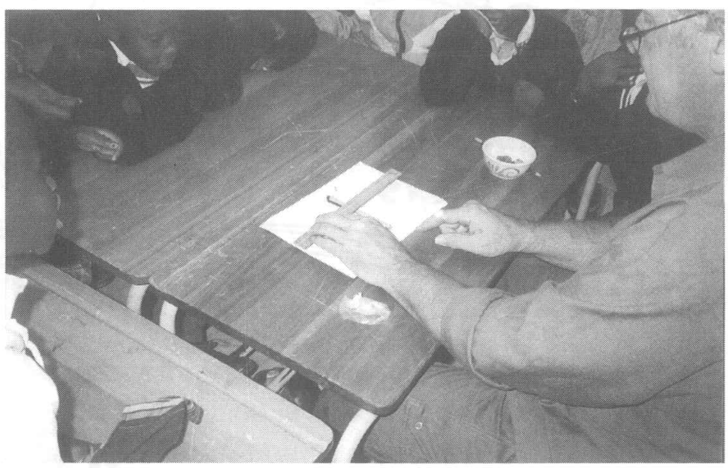


It will go up and down . . .

Iza kuhḷa inyuka . . .



Tyhini !

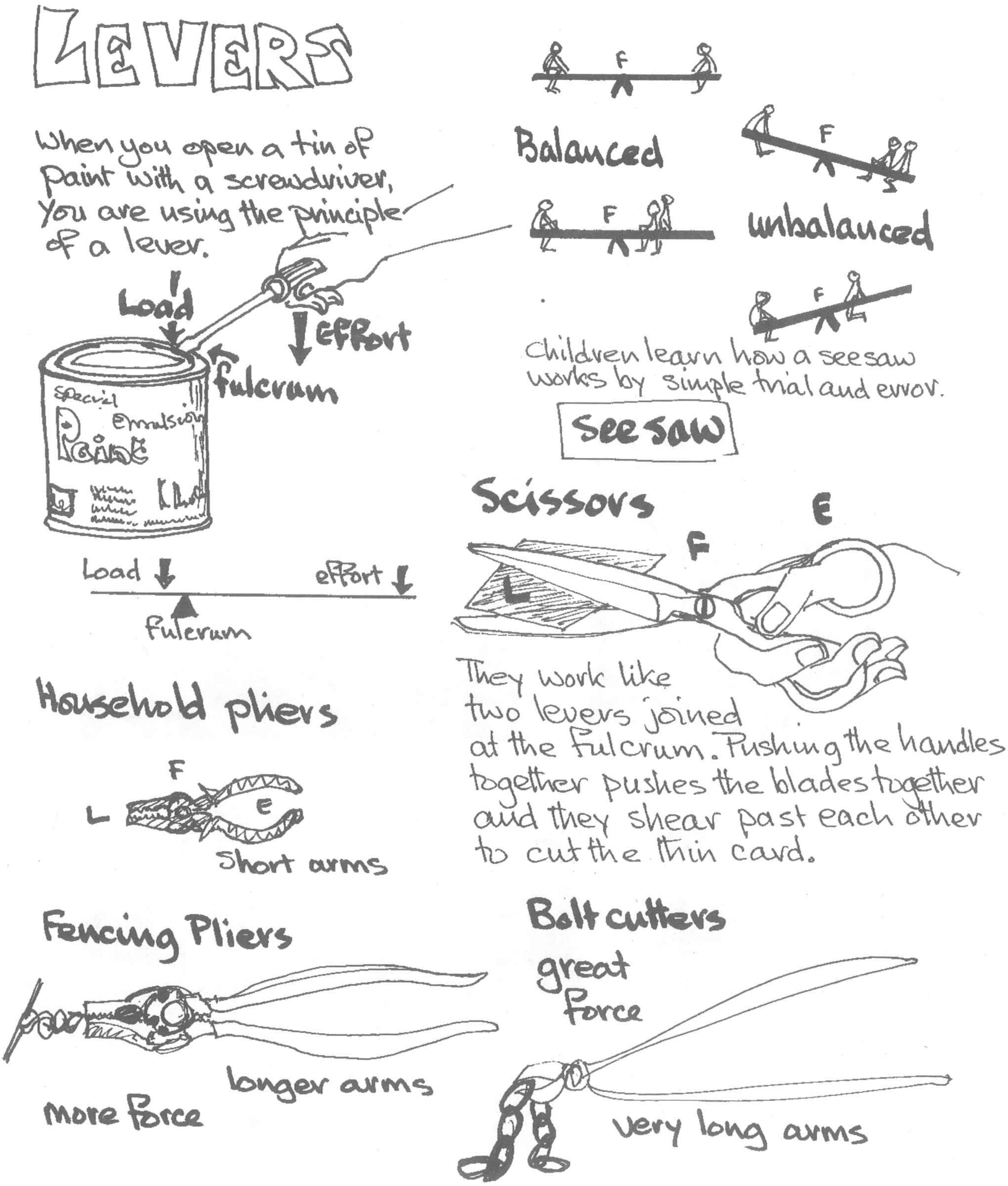


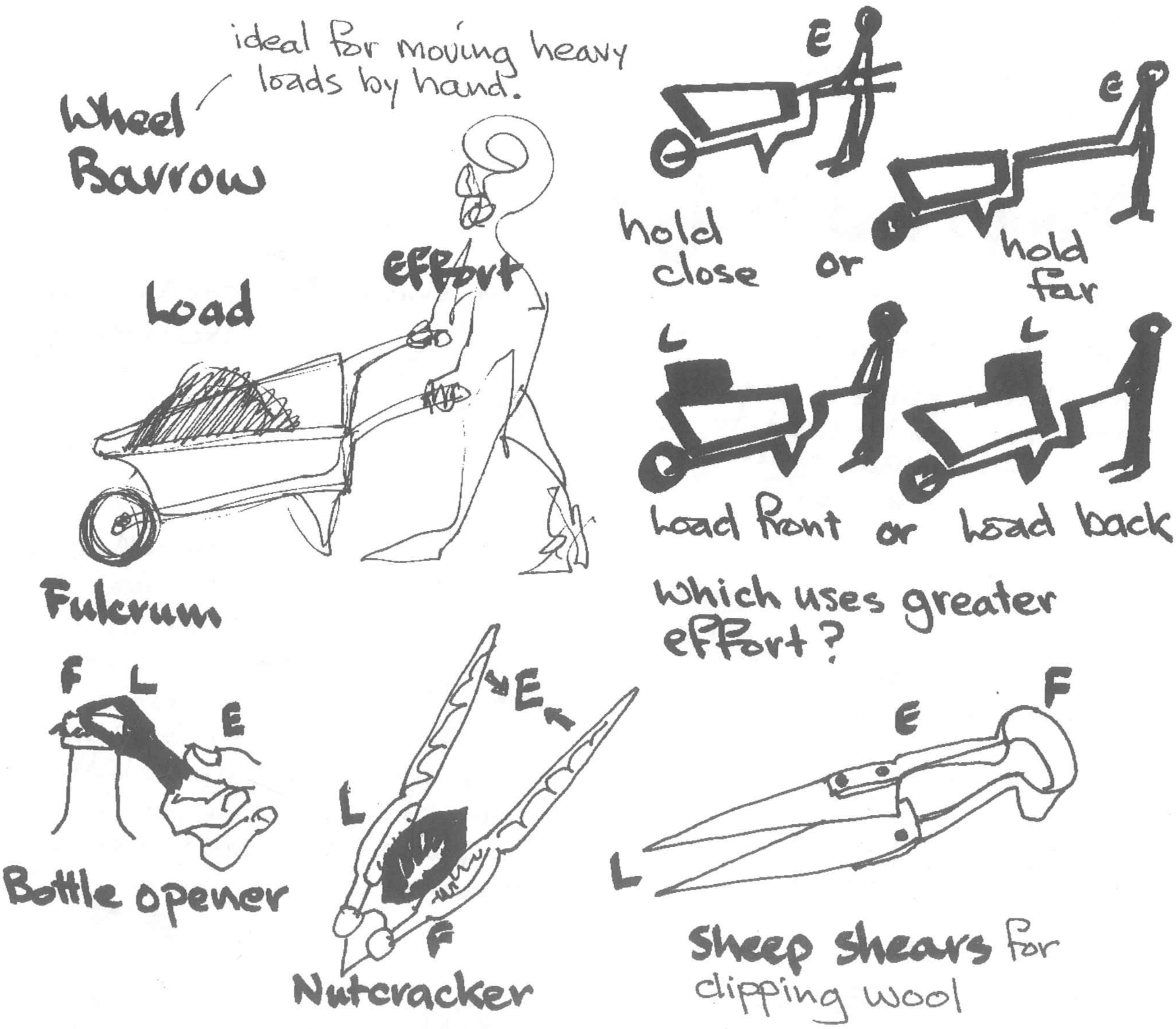
What will happen if . . . ?

Investigating other levers

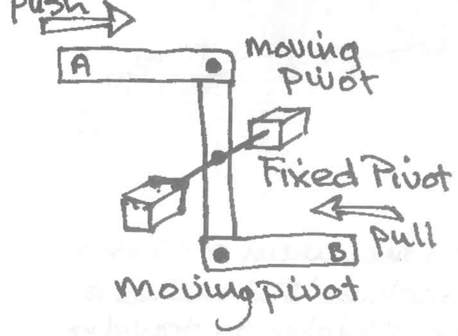
Now it is up to you to decide how you will take investigations into the workings of levers further. What makes a **wheelbarrow** a kind of lever? Where are the features like **load, effort** and **fulcrum** in a wheelbarrow? Does the length of the handles (arms) of the wheelbarrow make a difference to the effort? What about scissors, pliers, bolt cutters? How do they work?

This double page spread will help you with further background about levers, and some ideas about how to help learners investigate the principles involved in using levers.





LINKAGES - a way to transfer motion and force by connecting two or more levers together - with fixed or free (moving) pivot points



If you push A the result will be that B is pulled in the opposite direction

What to expect in Unit 2

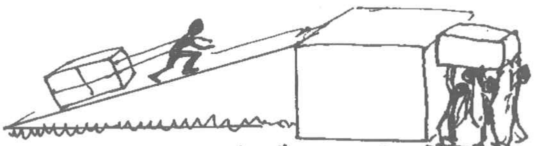
Unit 2 consists of a series of double page spreads that lay out other interesting mechanical systems in much the same way as the one in this unit on levers. You are encouraged to work through the unit carefully, as this replaces a Content Audit, since most of the information will be new to primary school teachers.

Here are some things for you to think about, and some ideas to try with you learners.

Ramps and Wedges

Inclined planes

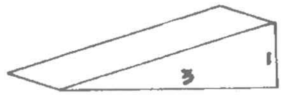
An inclined plane is a smooth slope that can be used to move heavy loads to a higher position with less effort.



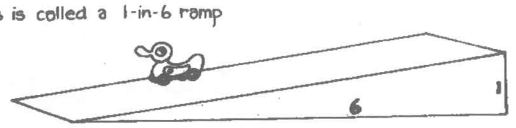
One man can do the work of four. A mechanical advantage of 4.

Up we go!
Nowadays, where we have to go from one level to another, for example, at sports stadiums, on road bridges and in subways, there are two methods in use: there are the usual steps but there are also *ramps*, or long slopes, so that prams, wheeled shopping baskets and invalid chairs can be moved about more easily.

this is called a 1-in-3 ramp

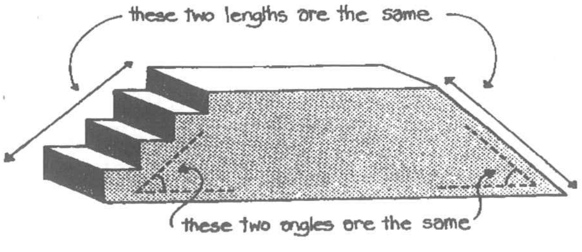


this is called a 1-in-6 ramp



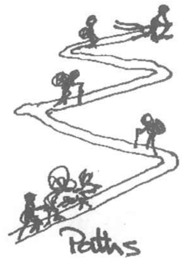
Do you think that even the 1-in-6 ramp is gentle enough for prams and invalid chairs?

If you make a drawing of a flight of stairs and a ramp, you will find that, to be sensible, you will have to make the *angles* at which they go up very different. In the drawing shown here, they rise at the same angle and you can see how impossible it would be to push a pram up the ramp! But if you make the ramp at a shallower angle, you lengthen the distance that has to be walked. The whole idea of the ramp is to make things *easier*. Perhaps if you draw a steps and ramp diagram, but give *your* ramp a *gentle* slope, you can measure the distance along the ramp and compare it with the distance walked up the stairs.

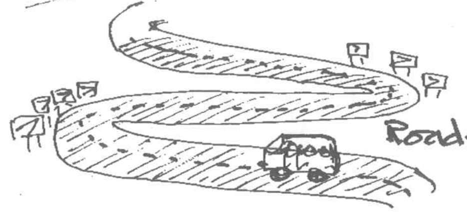


Tapered shapes that can be used to APPLY or Resist FORCES – Axe head – Door jamb

Have you ever noticed cattle browsing grazing on a mountainside. They never walk straight up or down, but follow a zig-zag path. The paths people make up a steep place are the same, winding their way up the hill. Roads on a mountain pass have 'hairpin' bends. Have you ever wondered why?

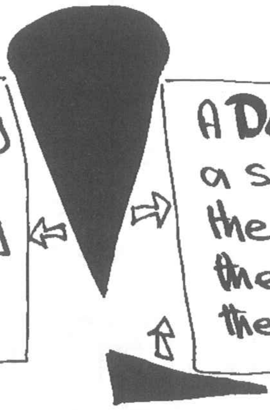


Paths



Roads

A winding mountain road is a 'simple machine' that makes it easier for vehicles to travel up the slope by turning back and forth across the mountainside. The ZIG-ZAG of linked inclined planes make the effort less, although the time and distance is greater.



with an **Axe** - a sharp strong metal wedge fitted to a handle - a small swinging force produces a strong cutting or splitting force

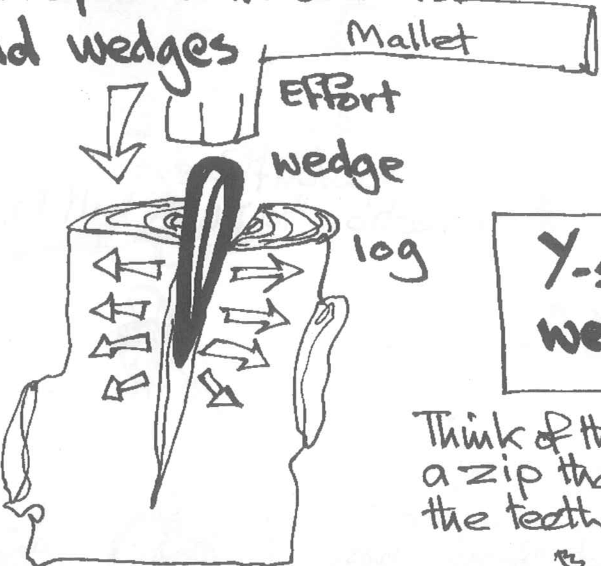
A **Door Wedge** works in a similar way. It forces the floor and the bottom of the door apart and jams the door in one position

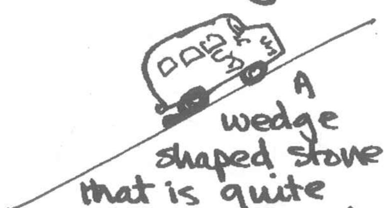
The cutting blades of many tools such as knives, scissors and chisels are also wedges, forcing apart or slicing into the material that is being cut. The smaller the angle between the two planes of the blade - the sharper the tool.

A wedge shaped blade is dragged through the ground to cut and turn the earth

The farmer's plough

Stones and large logs are split with chisels and wedges





A wedge shaped stone that is quite small can prevent a large vehicle from running back down a hill.

Y-shaped things work like wedges. So do V shapes

Think of the slide of a zip that forces the teeth together

Think of the traditional African wooden sled.

Downward motion produces sideways force splitting the wood of the log apart with increased force

NB - Bolts and Screws are disguised inclined planes Can you say why?

Pneumatics + Hydraulics

works with fluid matter that can flow

Liquids   Gases

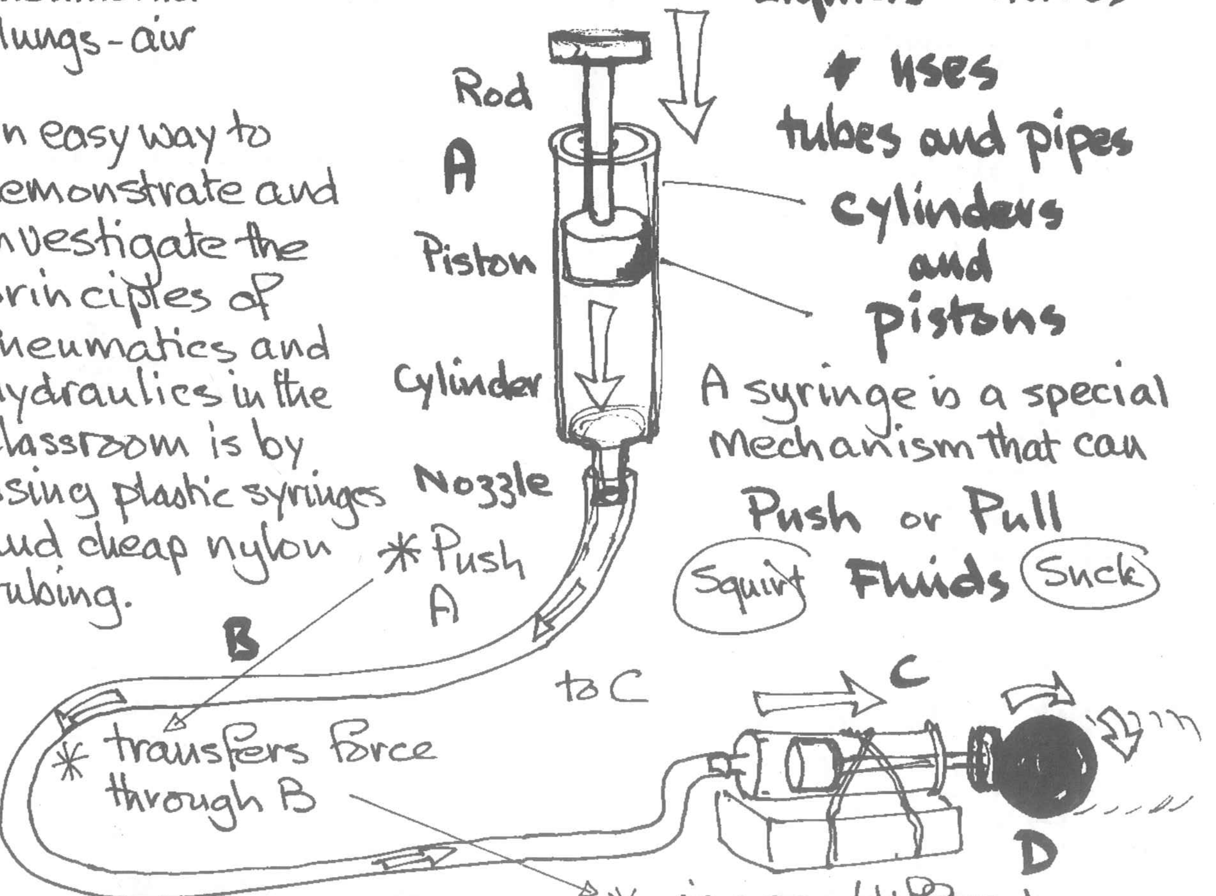
+ uses tubes and pipes

cylinders and pistons

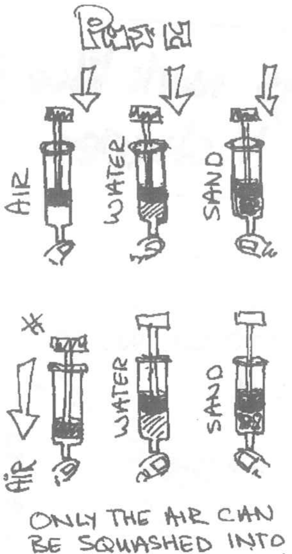
Pneumatics: To do with AIR - think pneumonia - lungs - air

Hydraulics: Think LIQUIDS Hydra - greek word for water

An easy way to demonstrate and investigate the principles of Pneumatics and Hydraulics in the classroom is by using plastic syringes and cheap nylon tubing.



A syringe is a special mechanism that can **Push** or **Pull** (Squirt) **Fluids** (Suck)



ONLY THE AIR CAN BE SQUASHED INTO A SMALLER SPACE!

Compressed

NB!

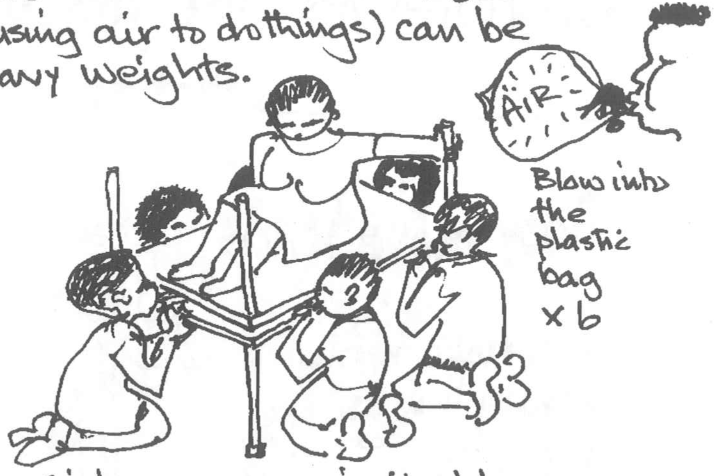
Compressed Air can be used to power tools such as a pneumatic road drill. A motor called a 'compressor' forces air at high pressure through a high pressure hose into the drill which is used to break up hard surfaces such as roads and concrete.

The hissing sound that the doors of certain buses and trains make indicate that they are operated pneumatically with compressed air.

Blow up the Teacher!

Here is an idea for a dramatic demonstration of just how powerful pneumatics (using air to do things) can be when it comes to lifting heavy weights.

You need two small flat school desks and six large supermarket plastic bags. Place the six plastic bags carefully on the first desk so that their openings hang over the edge. Then lay the second table upside-down on top of the first table. Then the teacher/or a learner sits carefully on the top of the upturned table.

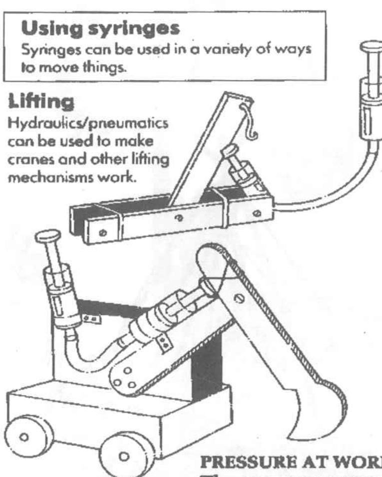


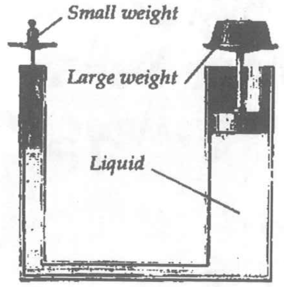
Six learners are invited to come forward and on a given command "Blow" they must blow air into the six plastic bags. What happens?

Hydraulics – Construction vehicles

- Bulldozers
- Tip Trucks
- Mechanical Diggers

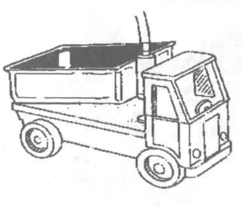
If there is road building or construction taking place near your school – take learners to observe (think safety!!!) Can they see Pistons? Cylinders? Tubes and Pipes? What liquid is used?



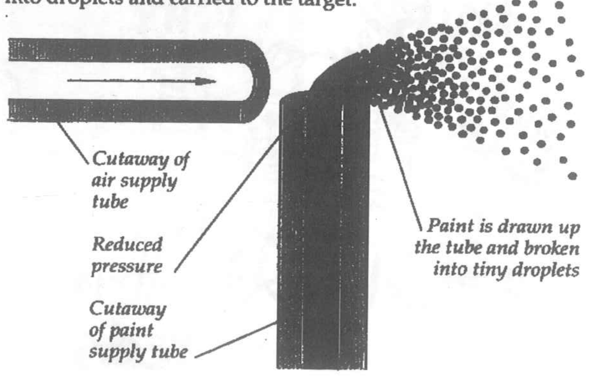


PASCAL'S PRINCIPLE
Pascal's Principle states that in a liquid or gas at rest, the pressure is transmitted equally in all directions. Many kinds of hydraulic device, such as the car jack, work on this principle. As this engraving shows, a small weight pressing on a narrow column of liquid is able to support a large weight on a wide column connected to it. The pressure in both columns is the same, but as the large column has a greater area it produces a larger total force.

The heart of a spray gun consists of two fine tubes. One leads up from a reservoir of paint and the other directs a flow of high-speed air across the top of the paint tube. In accordance with Bernoulli's principle, the fast flow of air creates low pressure above the paint tube, sucking paint upwards into the air stream. The paint is broken into droplets and carried to the target.

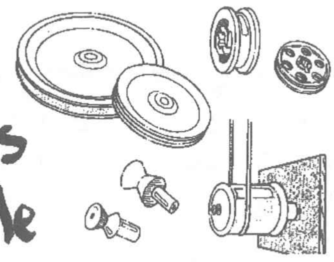


PRESSURE AT WORK
The spray gun was invented by Doctor De Vilbiss of Toledo, Ohio, USA in the early 1800s. He used it to blow medicine down infected throats. After a time the spray gun became more widely used, mainly for applying coatings such as paints, lacquers, and glazes. The gun relies on high pressure or compressed air for its power. The compressed air enters the gun from an inlet in the handle and passes through a valve controlled by a trigger. The air then travels through the gun to the paint nozzle, where it draws the paint out of its container by suction. The paint is atomized – broken up into tiny droplets – by the air stream, and a fine mist of paint spray is blown forwards on to the surface being painted. The airbrush, used in artwork and graphic design, operates on exactly the same principle.

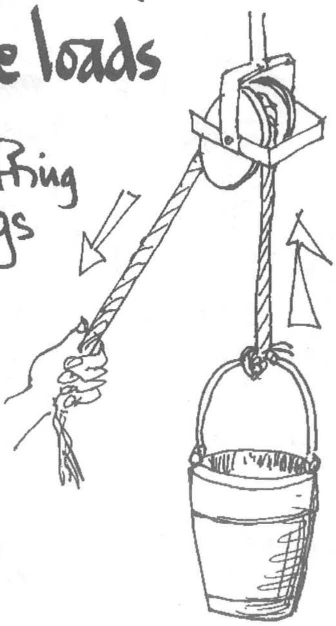


Pulleys

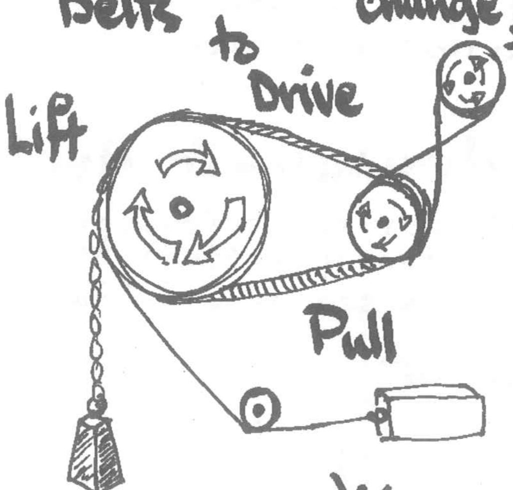
are grooved wheels that turn on an axle



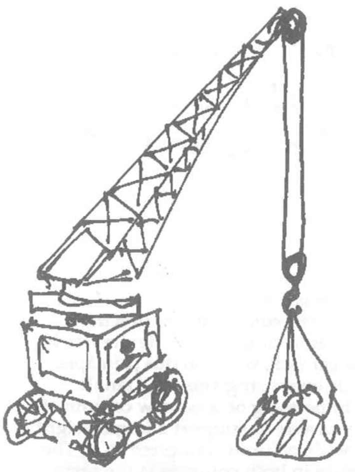
They move loads and make lifting heavy things easier to do



They change the direction of a FORCE and use Ropes, chains and belts to

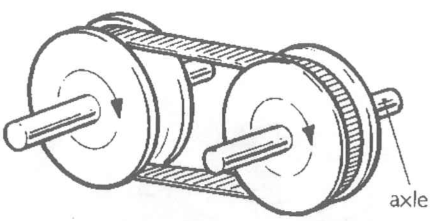


Most Machines that rotate have belts + pulleys.

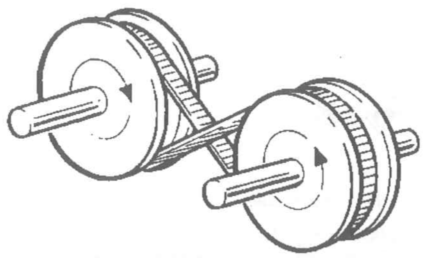


Cranes at harbours and building sites

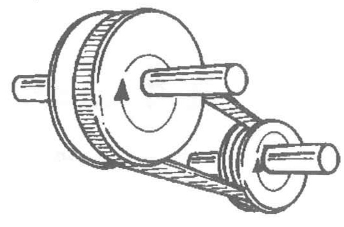
Block (Pulley) and Tackle (Chain) used by mechanics to lift a heavy engine from the bonnet of a car



2 pulley wheels, straight belt

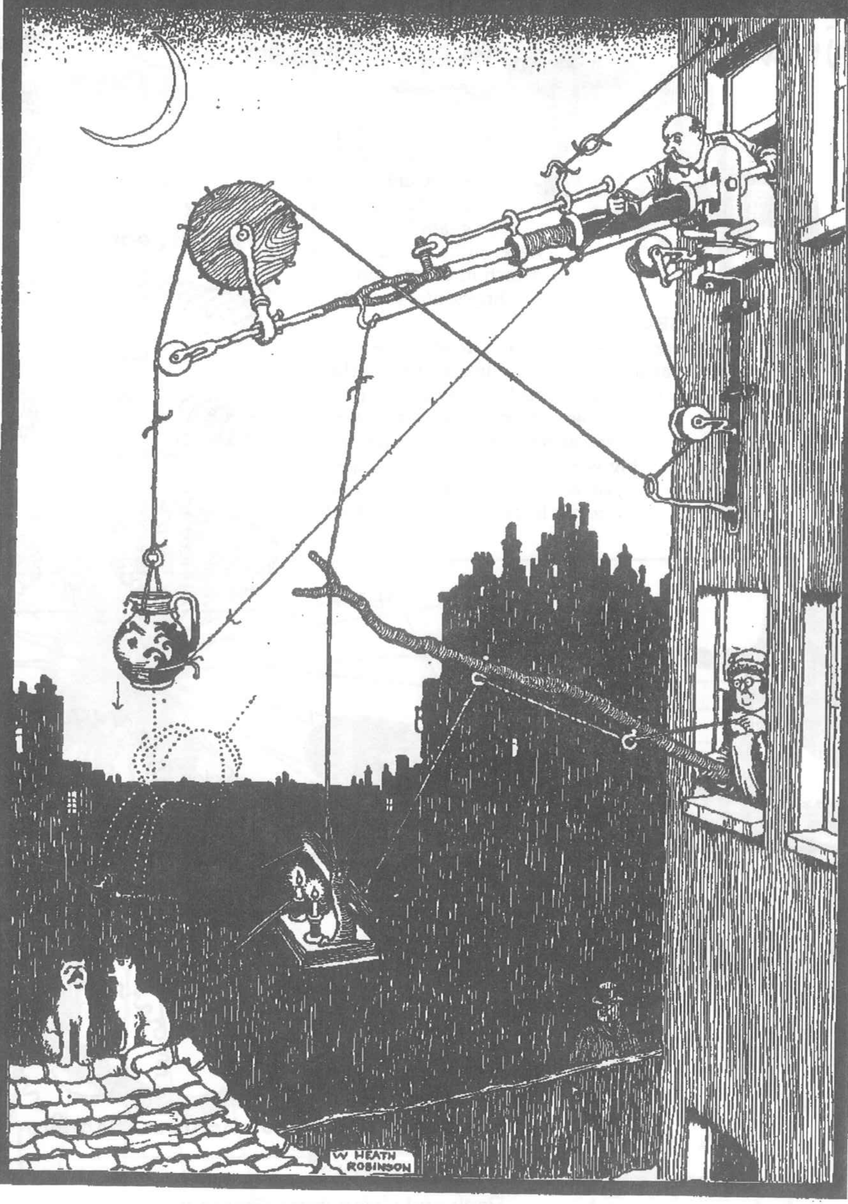


2 pulley wheels, crossed belt



Different size pulleys

This drawing is by Heath Robinson, who was famous for his funny drawings of very complicated machines to do simple jobs. See if you can draw, or even make, a complicated 'Heath Robinson' machine for cracking nuts. Heath Robinson liked complicated machines, but we all need some machines to help us.



When is it better to use gears and when is it better to use pulleys?

How does size and number of pulleys effect work?

What is a problem with pulleys?

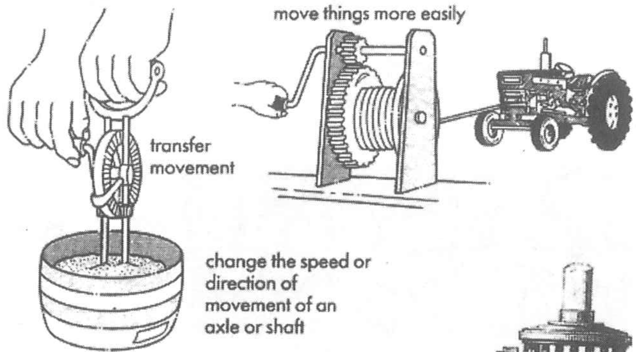
How can you prevent bands slipping?

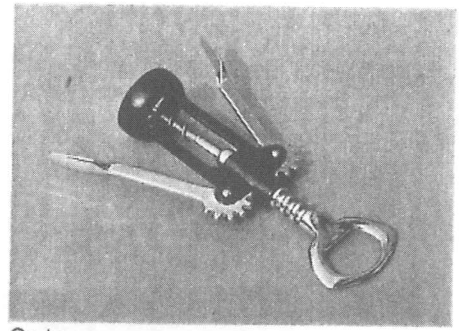
Why are some belts and bands toothed with ridges?

How many pulleys can you see?

GEARS

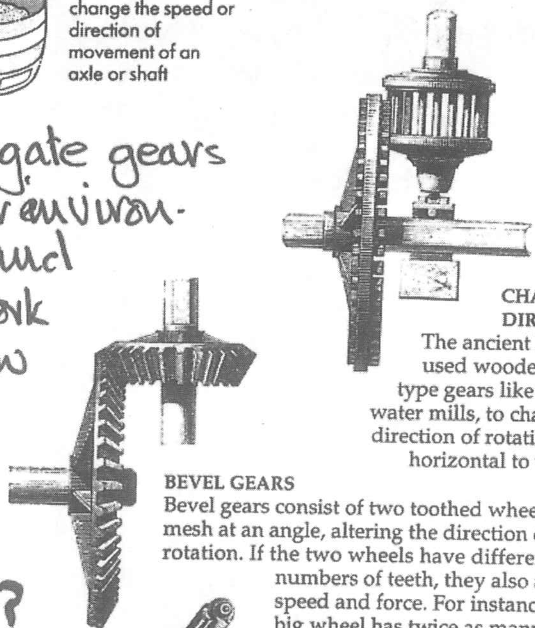
Gears can be used to:





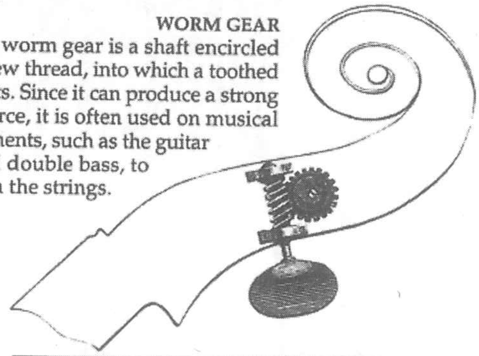
Corkscrew

Investigate gears in your environment and try to work out how they work



CHANGING DIRECTION
The ancient Romans used wooden bevel-type gears like these in water mills, to change the direction of rotation from horizontal to vertical.

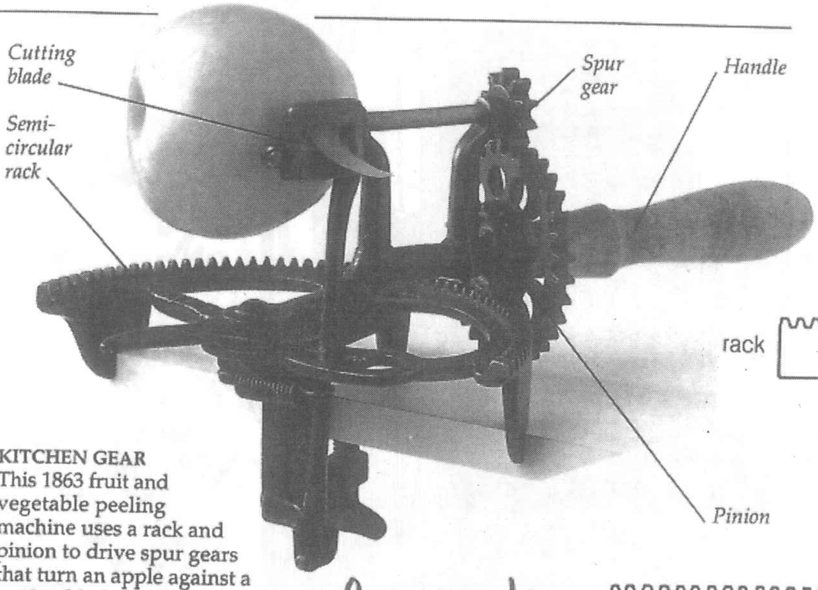
WORM GEAR
The worm gear is a shaft encircled by a screw thread, into which a toothed wheel fits. Since it can produce a strong force, it is often used on musical instruments, such as the guitar and double bass, to tighten the strings.



How does this work?

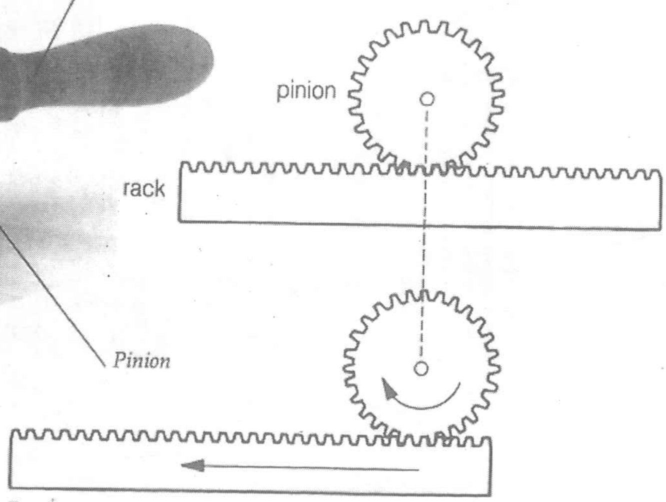
BEVEL GEARS
Bevel gears consist of two toothed wheels that mesh at an angle, altering the direction of the rotation. If the two wheels have different numbers of teeth, they also alter speed and force. For instance, if the big wheel has twice as many teeth, it rotates with half the speed and twice the force of the small wheel.

Types of gear



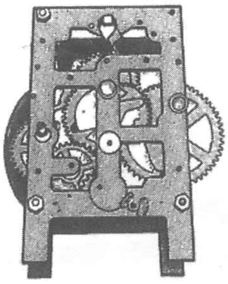
KITCHEN GEAR
This 1863 fruit and vegetable peeling machine uses a rack and pinion to drive spur gears that turn an apple against a cutting blade. As the handle is pushed round the semi-circular base, the peel is removed from the apple in a single sweep.

Can you also see the lever and the wedge?



Rack and pinion (rotary to linear motion)

Gears can be used to increase or decrease the speed of rotation.

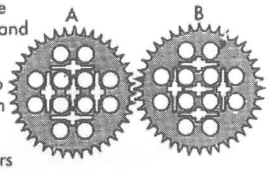


Driver – gear that starts movement.
Follower – gear that responds to this.

Same size follower and driver.

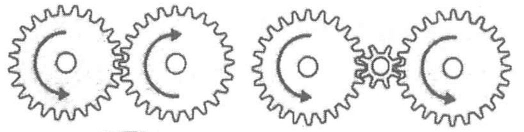
Result: no change in speed.

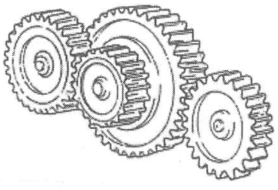
Both gears rotate at the same speed.



Gear train

Two or more gears that mesh together.

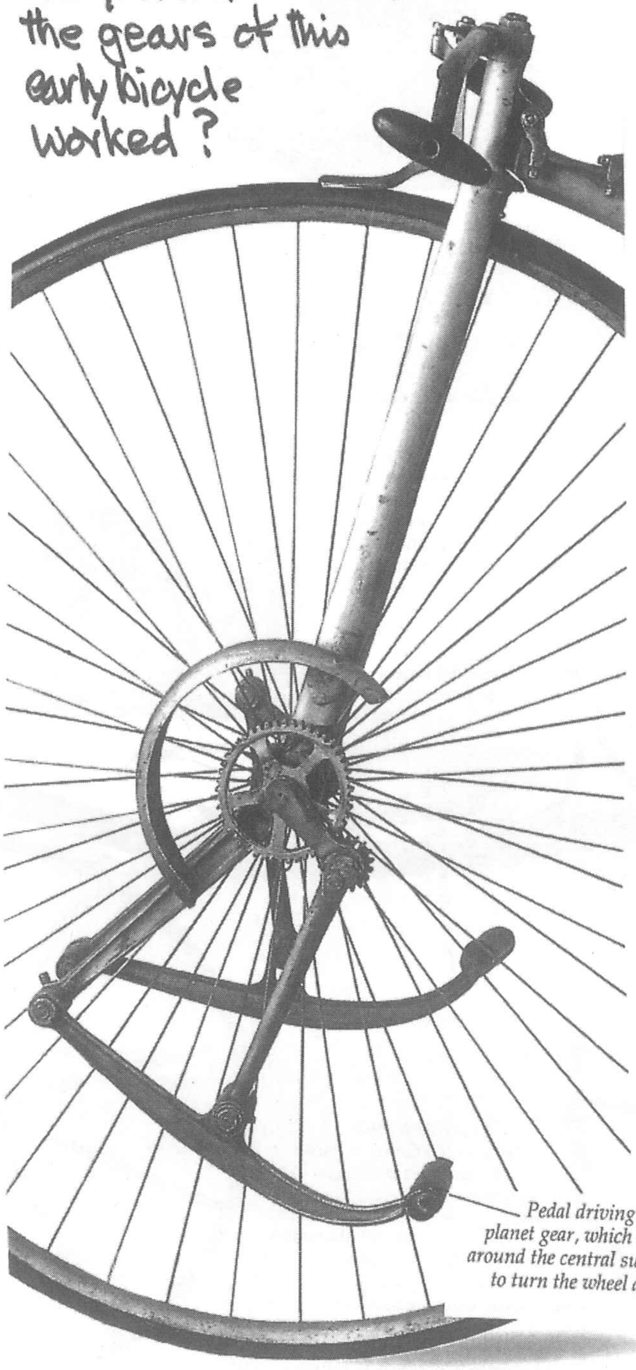




Compound system

A compound gearing system contains two or more pairs of meshing gears. This allows greater changes in speed or torque.

Can you work out how the gears of this early bicycle worked?



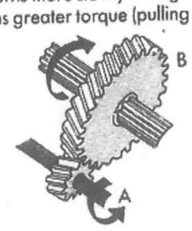
Pedal driving planet gear, which runs around the central sun gear to turn the wheel axle

Simple systems

Only one pair of gears.
If different sized gears are used the speed of rotation can be changed. This also changes the torque (or ability to move something).

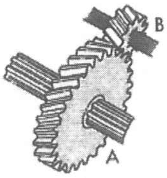
Gearing down

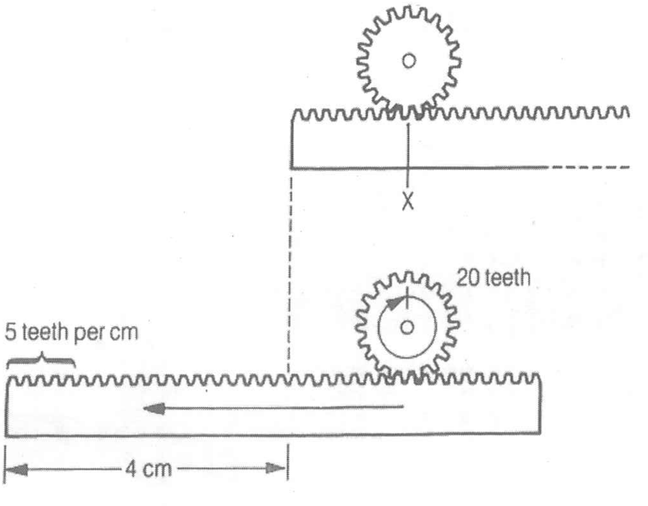
Small driver (A) Large follower (B)
Result: decrease in speed or gearing down.
Gear B turns more slowly than gear A and has greater torque (pulling ability).



Gearing up

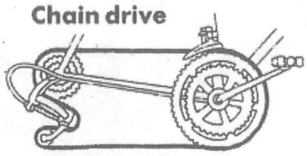
Large driver (A) Small follower (B)
Result: increase in speed or gearing up.
Gear B turns much faster than gear A but has less torque (pulling ability).





Rack movement during one revolution of the pinion

Chain drive



'Sprockets' linked by a chain are used on bicycles as a type of gearing mechanism.

Adjusting the chain on to different size sprockets can make pedalling up hills easier.

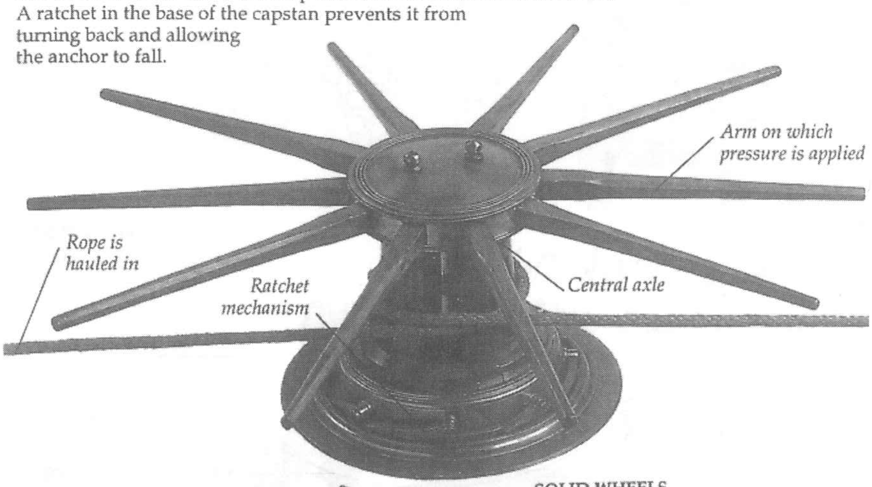
Investigate just how the chain and gears of a modern bycycle work.

Wheels and Axles

for Machines and to reduce friction

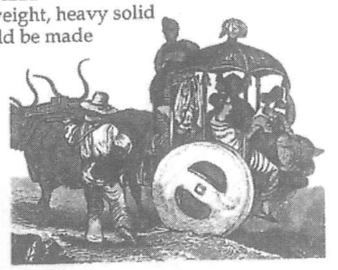
As a wheel rolls along, each point in turn touches the ground and then rises up off the ground and doesn't drag behind

HAUL AWAY
The capstan was used for many centuries to haul up the anchor of a ship. Turned by sailors pushing on the long arms, the capstan acts as a wheel and axle, magnifying the turning force. The anchor is lifted by a rope or chain winding around the central axle. The arms on this 1820 capstan can be removed so that it takes up less room on deck when not in use. A ratchet in the base of the capstan prevents it from turning back and allowing the anchor to fall.

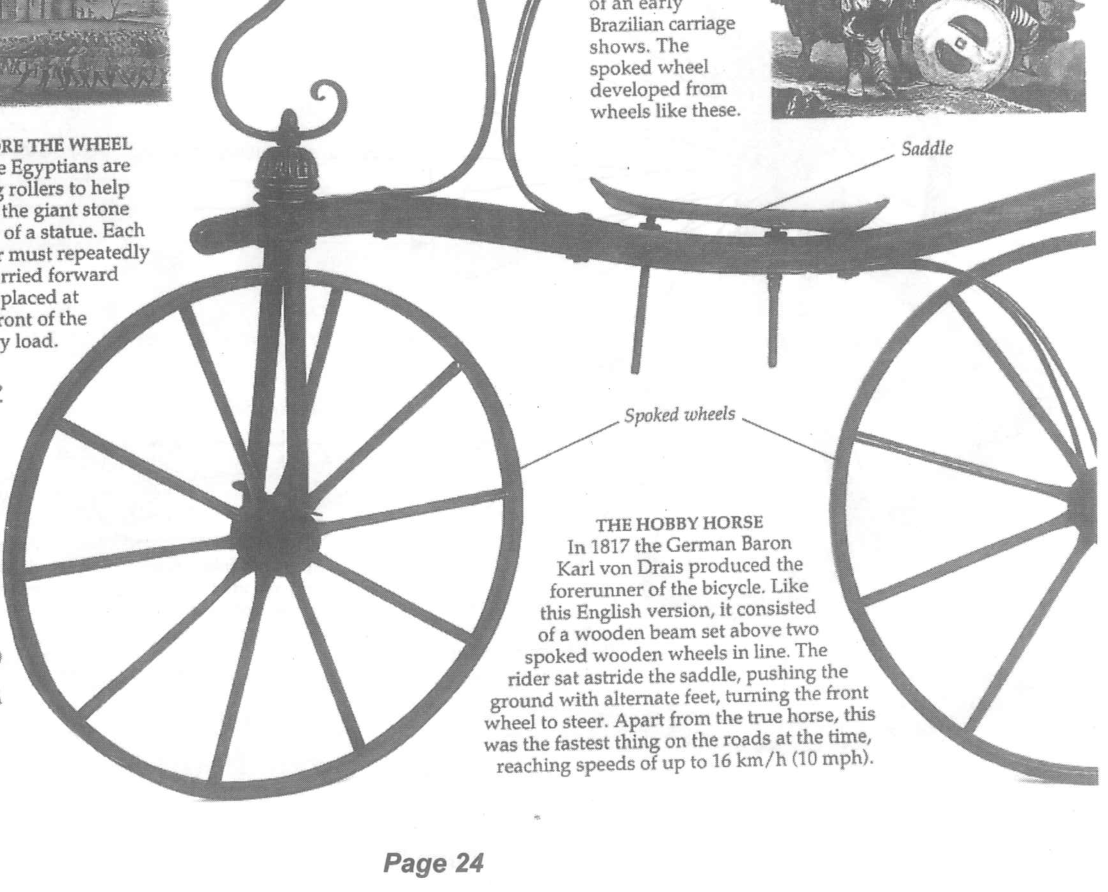


SOLID WHEELS
The wheels on this chariot from 2,500 BC, found painted on a stone in the tomb of the kings of Ur in Iraq, are clearly made from two separate planks joined together. Being mounted on axles, wheels remain in position under the load and they are therefore more convenient to use than rollers.

THE SEMI-SOLID WHEEL
In order to reduce weight, heavy solid wooden wheels could be made lighter by cutting out sections and leaving a cross-bar, as this picture of an early Brazilian carriage shows. The spoked wheel developed from wheels like these.



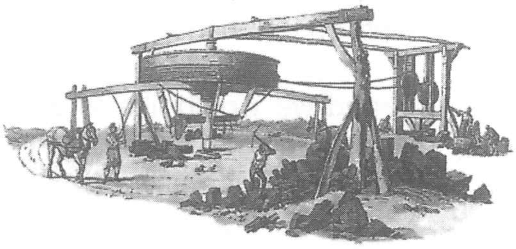
BEFORE THE WHEEL
These Egyptians are using rollers to help drag the giant stone head of a statue. Each roller must repeatedly be carried forward and placed at the front of the heavy load.



THE HOBBY HORSE
In 1817 the German Baron Karl von Drais produced the forerunner of the bicycle. Like this English version, it consisted of a wooden beam set above two spoked wooden wheels in line. The rider sat astride the saddle, pushing the ground with alternate feet, turning the front wheel to steer. Apart from the true horse, this was the fastest thing on the roads at the time, reaching speeds of up to 16 km/h (10 mph).

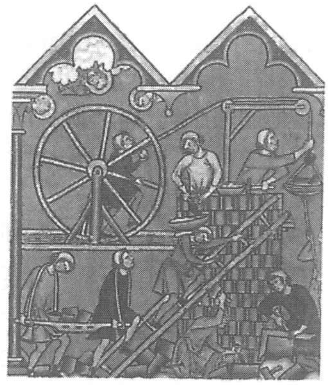
* You will see from the grade 1 + 2 designs on page 30 that the children know about the need for spokes.

Making work easier with wheels.

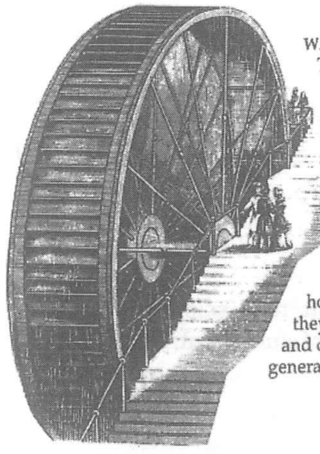


THE CAPSTAN ON LAND
The capstan, or windlass, can also be used to move loads on land. This 19th-century watercolour shows a horse-drawn windlass being used to haul up coal from an underground mine by means of ropes that run over pulleys (p.18) at the top of the shaft.

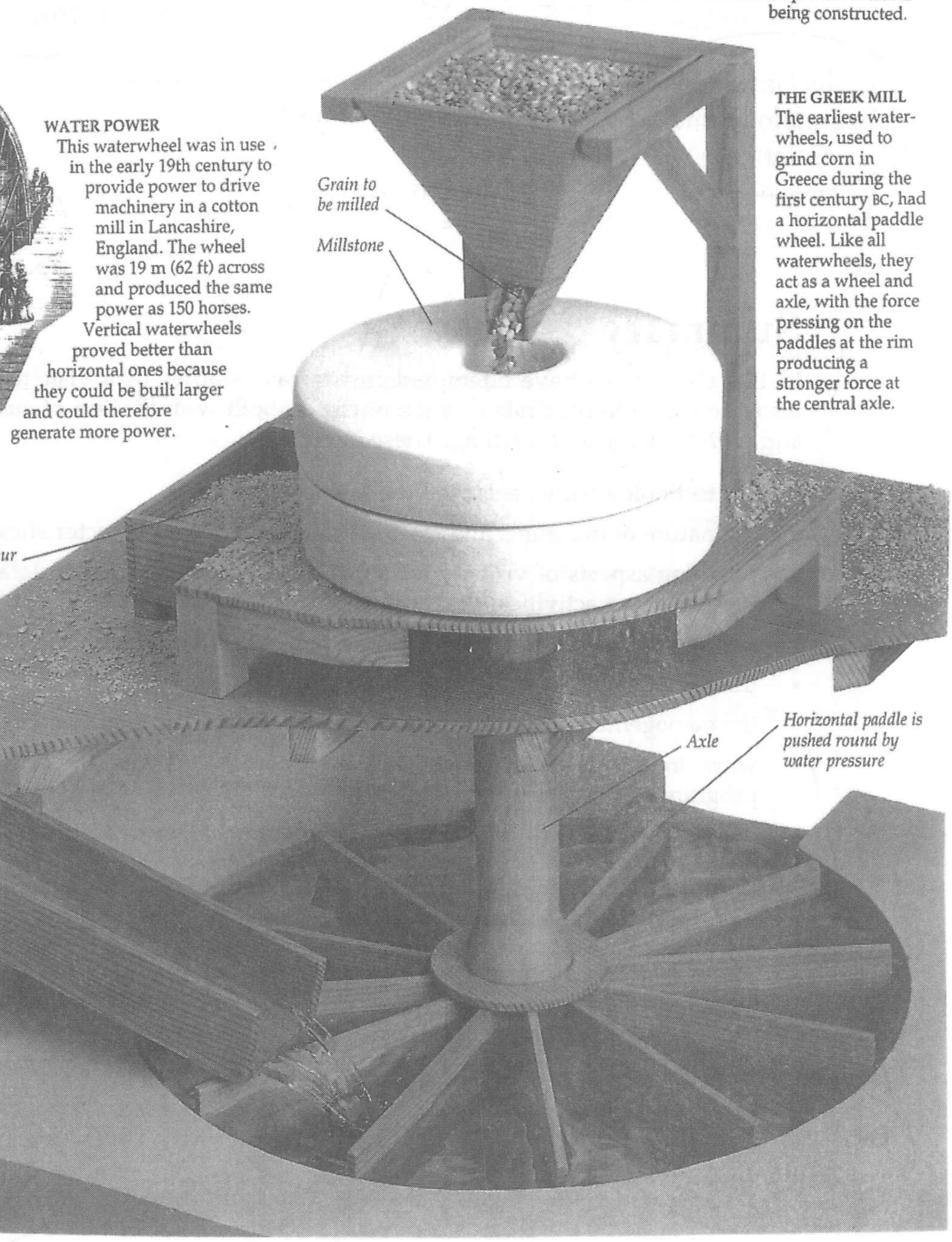
POTTER'S WHEEL
This 1822 picture shows an Indian potter pushing a wheel round with his foot to produce a turning force at the axle, where the clay is being worked.



HARD AT WORK
Early industry relied upon a few simple machines, such as levers, pulleys and wheels. This medieval painting shows a man-powered treadwheel being used to lift building materials up a tower that is being constructed.



WATER POWER
This waterwheel was in use in the early 19th century to provide power to drive machinery in a cotton mill in Lancashire, England. The wheel was 19 m (62 ft) across and produced the same power as 150 horses. Vertical waterwheels proved better than horizontal ones because they could be built larger and could therefore generate more power.



THE GREEK MILL
The earliest waterwheels, used to grind corn in Greece during the first century BC, had a horizontal paddle wheel. Like all waterwheels, they act as a wheel and axle, with the force pressing on the paddles at the rim producing a stronger force at the central axle.

Reading

When we were hunting for academic texts to support the ideas in this mthamo, we were very pressed for time. The Reading from Skamp's book (1998) was the only one we could find that we thought might be appropriate. But we had no time to test out its suitability. We are also concerned that the selected chapter might be rather long.

So we are not sure how relevant and accessible it is, and we would like to ask the teacher-learners who get this 'provisional draft copy' of the mthamo to work through the Reading of chapter 4 - *Studies of Motion* (Scamp 1998) carefully. Identify

- what is useful for you
- what was difficult, but still useful
- what was not helpful
- what was not relevant **and, be able to say *why*.**

Your considered feedback will be very valuable.

Do we have Resource Centres in the E.C.?

Links between Technology and Science!

Are these issues relevant here in South Africa?

Are these case-studies useful?

Summary

In this chapter we have attempted to use case studies of a visit to a science resource centre to illustrate a range of issues, both with the use of such centres and with teaching and learning. These include:

- the technology of wheels, and the science of motion;
- the nature of museums and their special educational characteristics;
- planning aspects of visits to informal learning centres, including a range of pre-excursion activities;
- the role of parents, and the features of adult–child discourse;
- the encouragement and use of children's questions;
- the management of, and the learning that arises out of, construction activities;
- ways in which an excursion can be incorporated into the wider school program;
- different ways in which assessment of learning can be carried out.

Within the broader Scienceworks-based programs, much valuable learning went on, particularly with regard to the technology of wheels. It seems likely there was also a good deal of learning concerning the non-conceptual aspects of science (such as attitudes, and knowledge of the link between science and technologies).

Tom Radford
Russell Tytler

Design, Make and Appraise

Assessment! What can I gain from this?

More about knowledge, skills and **attitudes**

Studies of motion associated with a science resource centre visit

INTRODUCTION

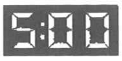
How, and why, do things move? How do we describe how they move? This chapter looks at P–4 (Preparatory to Year 4) programs on motion, based on a visit to a science resource centre. It deals with two major issues: firstly, ideas children have about motion and strategies for teaching about motion in the primary school program, and secondly, the issue of ways in which an excursion to a science resource centre can be effectively incorporated into the curriculum. The particular case study described concerns a science museum, but the issues and strategies discussed could also apply to resource centres such as zoos, environmental sanctuaries or even local industries.

BACKGROUND TO THE CHAPTER

Scienceworks is the science museum on the banks of Melbourne's Yarra river, on the site of the old pumping station that once handled Melbourne's waste water. The pumping station still exists, in fact, and is one of the attractions of Scienceworks. The main displays are contained within a new chrome and glass tent-like structure that sits back from the river, and which houses both permanent and special exhibitions.

Planning a program for the lower primary school based on the idea of energy presents a difficulty. What can one say about energy that would be useful for young children? Energy is one of the most abstract ideas in science, and one for which different scientists would have some trouble agreeing on a definition. Chapter 5 in this book deals in more detail with the concept of energy, and discusses the challenges presented by the idea.

In the event, it was decided to build the program (Peterson, Radford & Tytler 1994) around the travel exhibition, which had at that time many fine examples of vehicles, from a magnificent Cobb & Co. coach up to the first Holden, the quintessential Australian car. As one walked around the exhibit, the things that caught the eye were the different wheel designs, mechanisms for driving or stopping the carriages, and the developing sophistication of the materials used in the vehicles, from the wood and leather of the Cobb & Co. coach, to the metal, plastic and rubber of the Holden. The focus ideas thus became the forces and energy associated with motion, materials and their uses, and the design aspects of vehicles — in particular their wheels



Unit 3 - The Key Activities

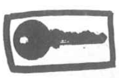
We have an important responsibility as teachers to help our learners to develop confidence as they progress through their schooling. The area of Technology Education is one in which we can encourage them to try out their ideas, and as they test these ideas to refine them. If learners have positive and successful experiences then their confidence will grow.

But we also need to **trust** our learners more. If we *trust* that they will be able to **design, make** and **appraise** their own solutions to solve problems, we will be surprised at what they can and will do. Don't feel that you need to tell even very young learners ***how*** to make something. Let them experiment, and find out for themselves by trial and error. We have found that even very young learners are extremely observant. They learn from observing and watching other people at work around them. And they learn from what they see. We just need to provide them with the 'space' and opportunities to try things out for themselves.

As you work through the **Key Activity** with your learners, you will feel more confident if you follow the steps carefully.

Note: A case-study report on your work on the Key Activity is a required hand-in Assignment for this Umthamo

The option for working with younger learners requires them to **design, make** and **appraise** something which will **roll** down an inclined plane and along a surface. The option for older learners requires them to **design, make** and **appraise** something which will move things **vertically** (lifting).



Key Activity

Option A - Working with younger learners

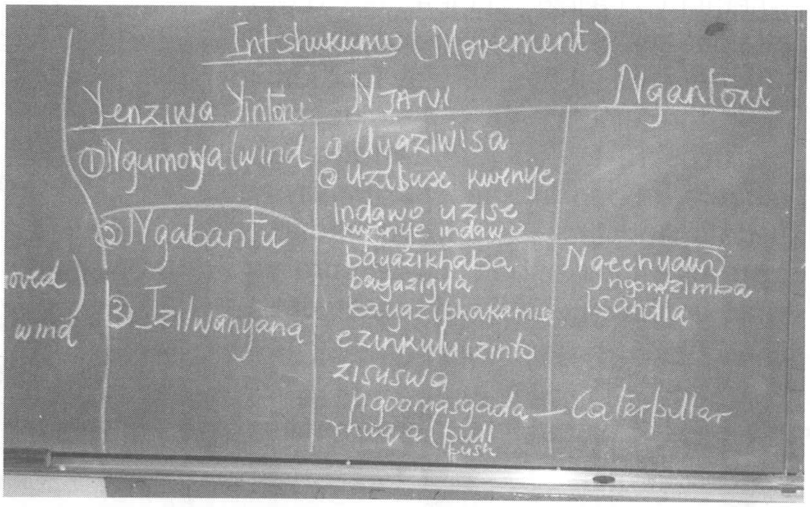
Before you go to your class to work with your learners we suggest you think of a story which will provide a scenario for your learners to think about the problem. This will give them a **context,** which they will try to solve through **designing** and **making** something.

Step 1 - Setting the scene

Gather your learners around you and begin your story. This is the story Namhla told to the Grade 1 and 2 learners.

Izolo phambi kokuba nidyokulala ndibeke phezu kwesitulo ekitshini, ibhola yam, iphepha ebendizakuzoba kulo kunye nepen yokubhala. Ndithe ndakuvuka kusasa, tyhini! Iphepha lam liphantsi, ibhola, itshone phantsi kwetafile ipen yona andiyiboni. Ingaba kwenzeke ntoni kwizinto zam, loo nto yenzeke njani . . .? Ndcedeni zitshomi zam.

When you have told your story, ask your learners what they think the problem is. Then ask them to think of some possible solutions. Give them some time to talk. Encourage them to give reasons for their answers. Do you remember one of the Readings we included with the first Science umthamo, Umthamo 3? It was called "Pulley" and came from a book called *Wally's Stories* by Vivian Gussin Paley. In that excerpt, Vivian Gussin Paley's pre-school learners suggest possible ways to solve a problem, and give reasons for their suggestions. So you see, even very young children can be expected to support their ideas.



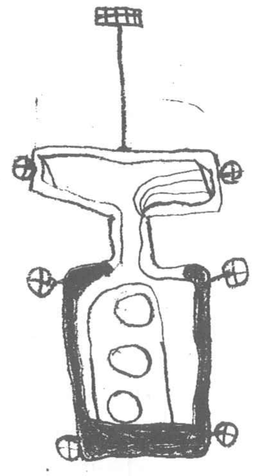
2 - Setting the task

We found that when we worked with the youngest of learners, some of them seemed to struggle to **design** a solution. They all enjoyed the opportunity to draw, and immediately began to draw vehicles. Some of the slightly older children in the class began to make drawings of vehicles to transport three stones, and drew pictures as though they were looking at the vehicle from above. But others made detailed drawings of cars with people riding in them from the side, and then included the three stones. We realised that for these very young children, it might have been more natural for them to **make** something *first,* and *then* **draw.**

This is an important point. Designers do not *always* make drawings first. Some designers prefer to make a small model first, before they make the actual thing. If we are serious about providing opportunities for our learners to *behave like designers,* then we need to allow them to **design** in ways they feel most comfortable. **Design** does not mean exactly the same thing as **draw!**

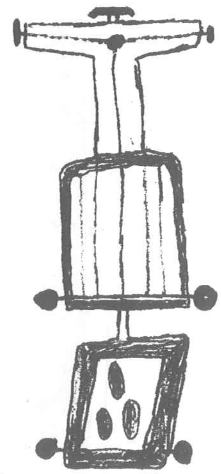
Note: Experience from the Sept. 2001 Portfolio Presentations convince us that there should not be a limit to the sort of materials learners choose to use. This is endorsed by Kathe Paige.

Explain to your learners that you want them to **design** a vehicle or device which can transport 3 stones down a ramp and along the floor. Provide them with card (cereal boxes, or packaging from various foods), straws, glue, sellotape and split pins and any other suitable safe material.

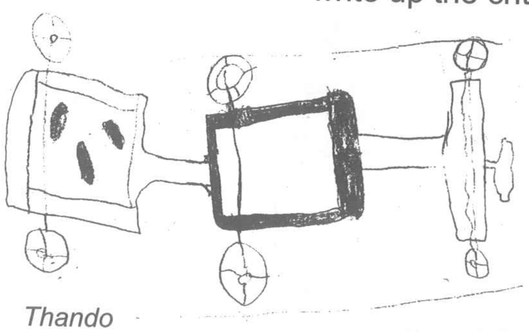


Siyamthanda

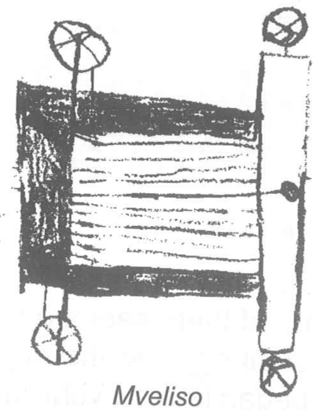
Before your learners start to work on their designs, discuss how you should **appraise** their efforts. Decide on criteria. Then give them time to **design** and **make** their solutions. You will need to decide whether you allow your learners to work straight away, or whether you set aside another time on another day for them to work carefully at turning their ideas into pictures (2-D representations) and models (3-D representations). Finally, set a date and time when you intend to **appraise** their efforts. Make sure you write up the criteria for assessement .



Xolelani



Thando



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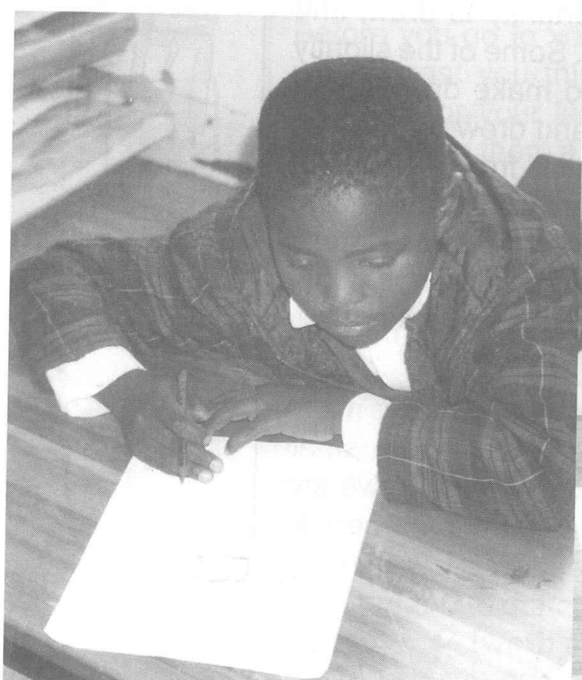
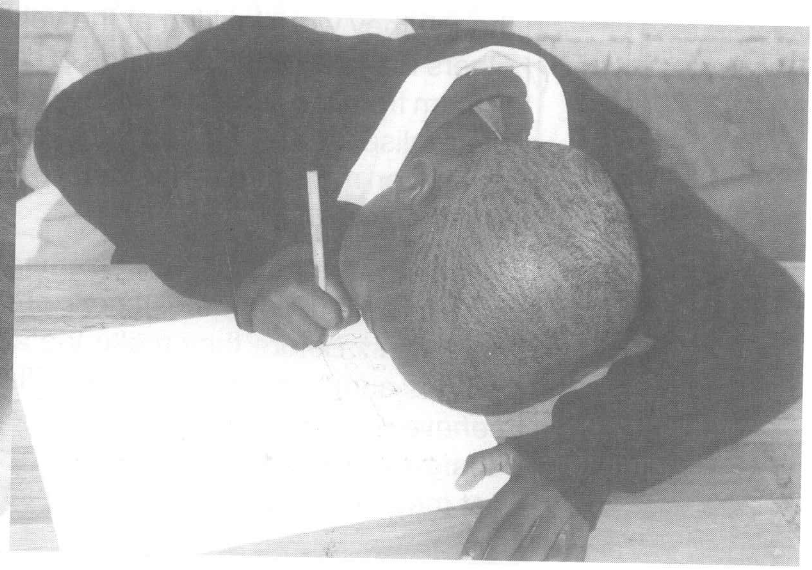
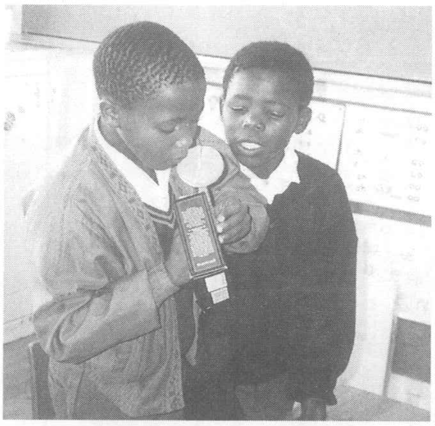
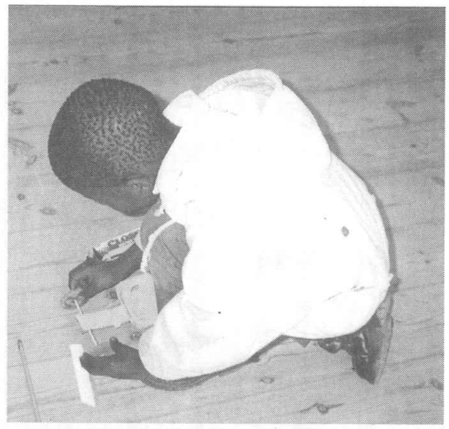


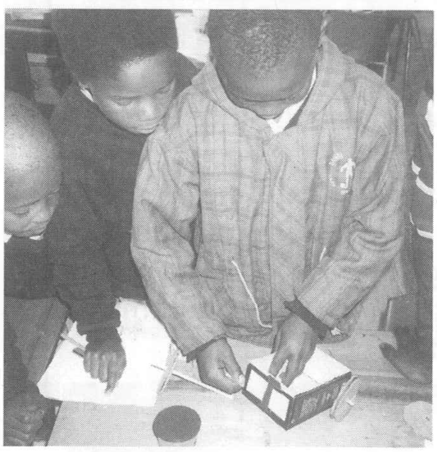


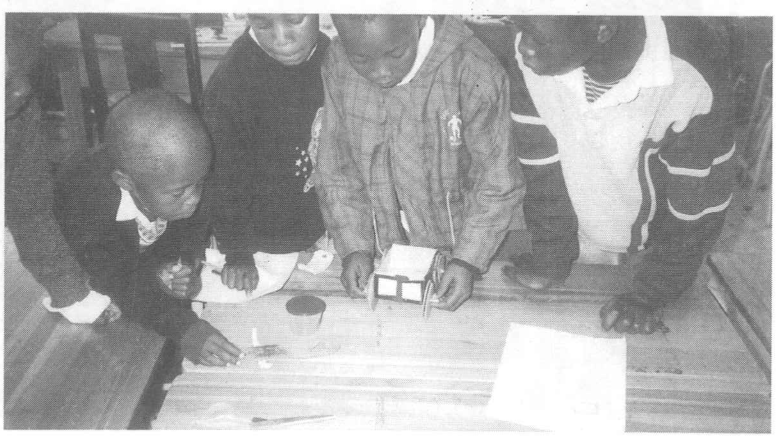
Step 3 - Monitoring the work

You will need to monitor what they are doing, and to check that everybody has completed their work by the set date. Make sure that any initial drawings and models are kept, as they are all part of the *process* of making something. You may have to discuss how these can be stored safely. We suggest that you look back to Umthamo 31 where you worked with learners on *Joining and Fastening.* Remind yourself of the way you worked with learners on that project by looking through that umthamo, and by re-reading what you wrote in your Journal at that time.









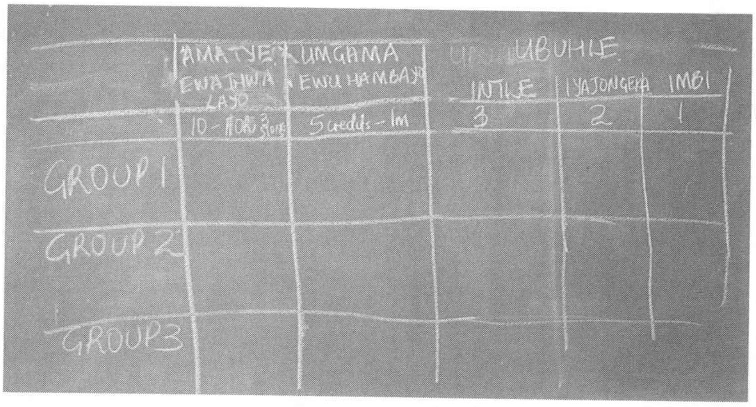
Step 4 - Appraisal

First of all, ask your learners to think about what will make a good design. How strong must the design be? Should it look good? Why? How will they test their designs? What would be a 'fair' test? Write the criteria your learners agree to on a large sheet of paper and put it up on the wall. This will act as a reminder of what will be expected at the Appraisal.

When your learners have completed their designs and the things which they have made, you are ready to appraise their work together. Remind them of the criteria which the class agreed on. Then let each group show their work.

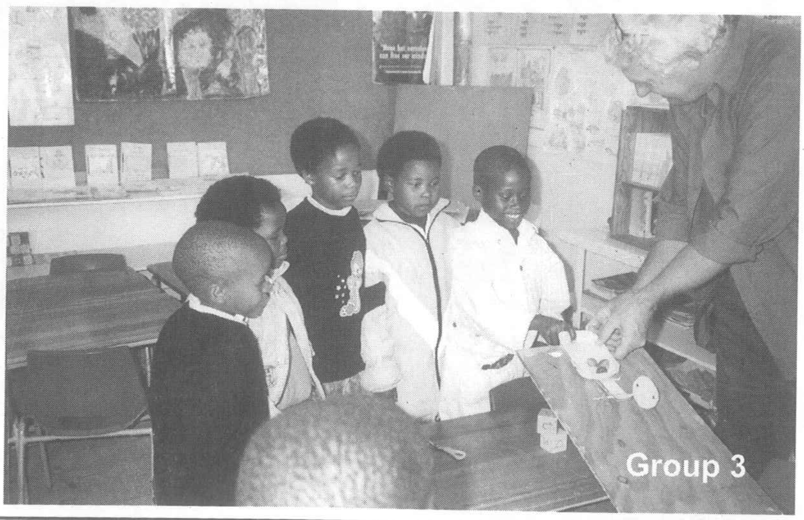
You can see our criteria in the photo of the chalk board.

We tested the designed models by letting them run down a ramp to see how far they would run with the load of three stones. (see page 30).

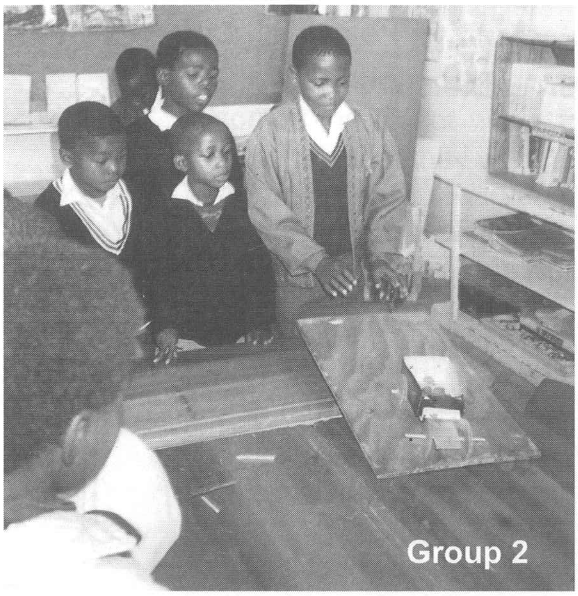


Criteria for assessment

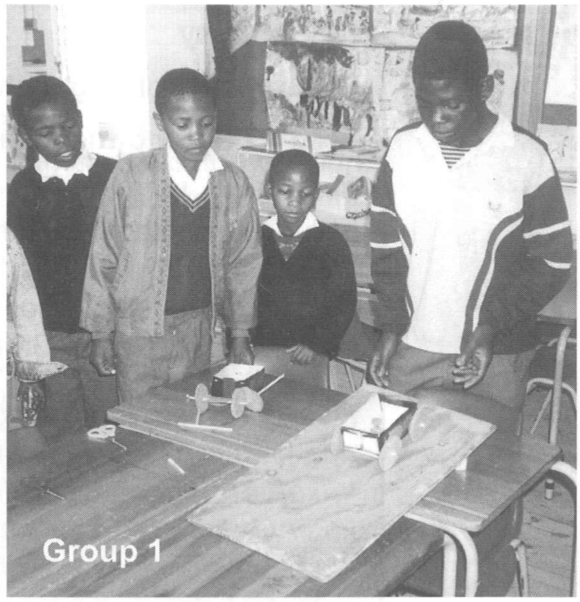
Chair this appraisal sensitively. Encourage the children to explain how they came up with their designs, and to support this by showing the drawings and models which they made, even the very first drawings. Encourage the rest of the class to ask questions. Model the kinds of questions that you want them to ask. Carry out the test for each design. Then encourage the learners to appraise each one. The 'designers' and the 'audience' should make an honest and fair evaluation for each group.



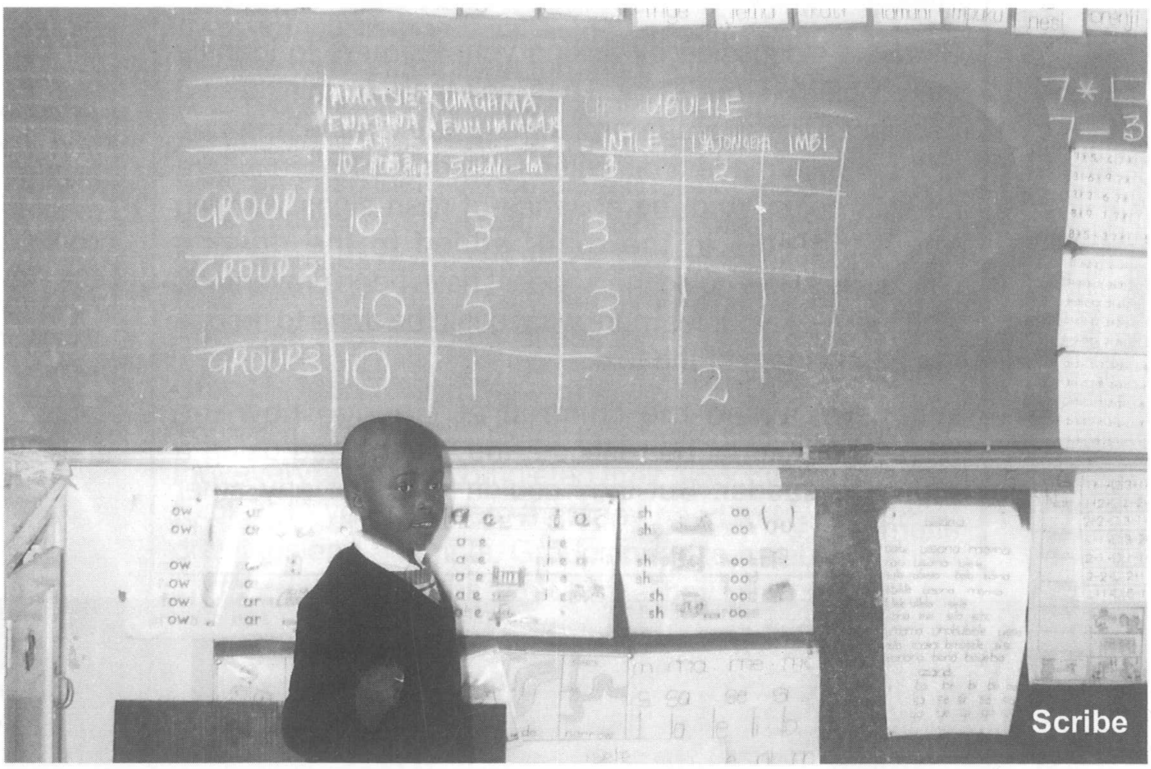
The following photos show the testing and apraising of the models that had been designed and made.



Group 2



Group 1



Scribe

Later, spend time thinking carefully about this work. If you have been making regular notes of your observations, you will remember how your learners have worked through the whole process of **designing, making** and **appraising** their vehicles. Open your Journal and write about what you have noticed as your learners have worked. Include examples to support your observations. How did your learners surprise you? Did any children struggle to **design** a vehicle or device? Why do you think this was the case? How did the same children cope when it came to **making** their vehicles? Why was this? What do you think you have learned from this experience? How will this influence you the next time you start a Technology Education project with your learners? What advice would you give colleagues who want to try something similar with their learners?

Key Activity

Option B - Working with older learners

Step 1 - Setting the scene

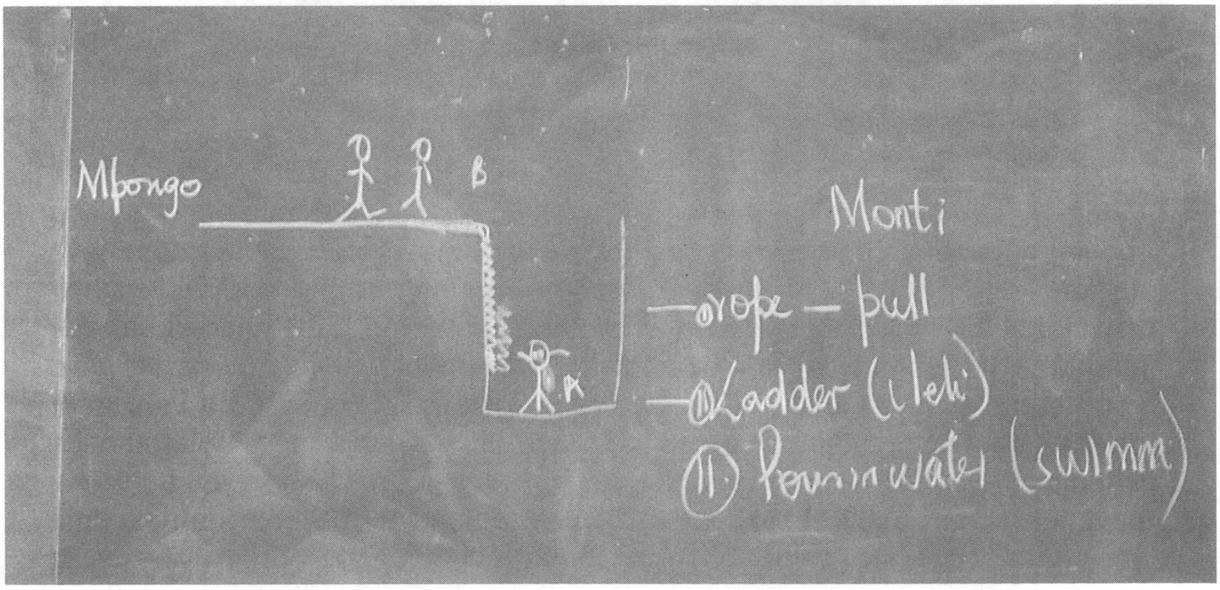
First of all, tell your learners a story. Your story must include a problem which requires **vertical movement** in the solution. You will need to allow some time after telling the story for a discussion with your learners. This is the story Namhla told the Grade 5 and 6 learners at Mpongo.

Izolo, bendisuka eMpongo ndisiya eMonti. Bekunetha ngamandla kukho nenkungu. Kubenzima ukuba ndibone kakuhle njengoko bendiqhuba ebusuku. Andazanga kutheni suka ndaya kweyela emngxunyeni. Ndizamile ukuphuma emotweni ngefestile, ndahlala phezu kwebhuti yemoto kuba ngenxa yodaka imoto ibivele ngebhuthi kuphela. Ndihleli kuloo mhadi ndikhwaza . . . . .

Start the discussion by asking your learners to identify the problem in the story. Then ask them to think about possible causes of the problem. (For example, the rain and the mist made it difficult for the driver to see where he was going. And the absence of road signs warning about the hole in the road, added to the driver's difficulties.) How could the accident have been prevented? And then ask your learners what could be done to rescue the passengers of the taxi.

Review of this option B and outcomes of the first affirmation lead us to suggest that you could broaden the topic and consider lifting things other than water.

When we asked the children at Mpongo how the passengers could be rescued, they suggested using a rope or a ladder. But they couldn't think of any other alternatives.



Step 2 - Setting the task

Tell your learners that you want them to **design** and **make** something to get water from a well. They can use any materials that they want to use. But whatever they design must be able to **lift** water from a lower source. Tell your learners that the constraints of their task are

- the object must be able to scoop at least half a cup of water and lift it up
- only one person will use the system to scoop water from a basin on the floor and lift it to the top of a table
- they have just 3 days to design and make a water-lifting 'machine'.

Before your learners start to work on the task, negotiate how their 'machines' will be appraised. Then give them time to design and make their solutions. You will need to decide whether to allow your learners to work straight away, or whether you set aside time on another day for them to work carefully at turning their ideas into pictures (2-D representations), and models (3-D representations). Alternatively, you could start your learners off with the task, and ask them to complete it for homework. But be sure to point out that you will expect them to also bring their drawings or models which they make as they design their machine. Set a date and time when you intend to **appraise** your learners' efforts.

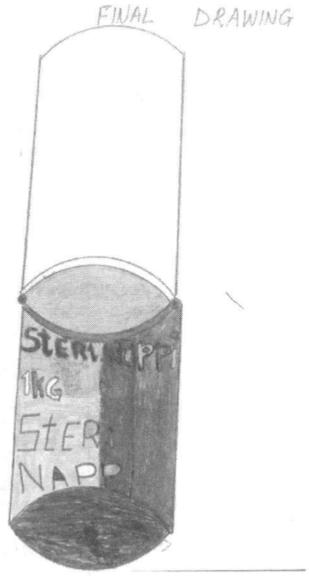
Step 3 - Monitoring the work

You will need to monitor what they are doing, and to check that everybody has completed their work by the set date. Explain to your learners that they need to keep **all** their drawings and attempts. Groups need to be able to show **all** the different ideas they had. They also need to be able to give reasons for their choice of the design they consider to be the most appropriate. These will provide them with important evidence of how they have worked. Make sure that any initial drawings and models are kept, as they are all part of the *process* of **making** something. You may have to discuss how this work can be stored safely.

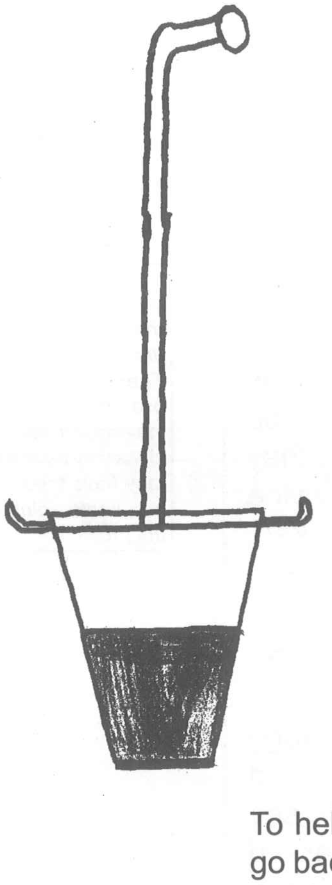
As you monitor your learners' work, ask them to label their drawings accurately. These drawings will provide important information about the ideas they have had as they have tried to find a suitable solution to the problem.

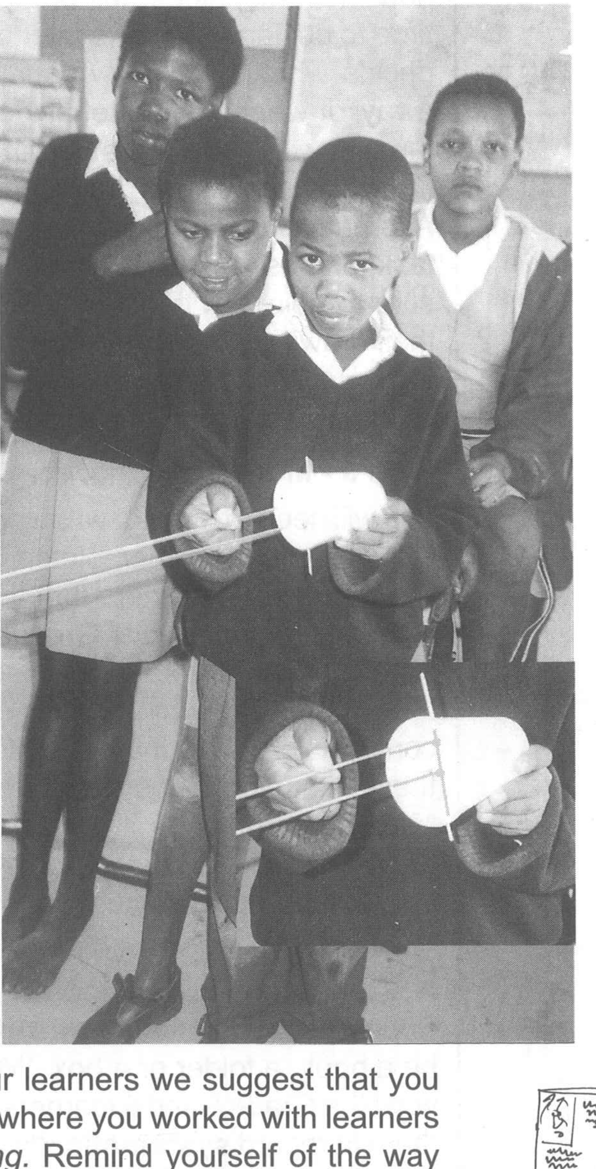
It is an accepted procedure for work in Technology Education to be kept in a **Project Portfolio.** This could be a book, a folder or a box. When we went back to see what the Grade 5 and 6 learners had done, Namhla asked them to record **systematically** all the steps of their work. They included their initial drawings, the final drawing, and then a report of the materials they used, and how they used them.

Sichole ibhakethe etiphini Salihlamba la. Coceka Saligqobhoza nge cingo eli shushu imqwungo emibini Safaka intambo Sasa Sathatha ibhakethe Salitywina nge peyinti latywineka Sangalela amanzi. Salinjonga ukuba aliyavuza nyani aliyavuza Sanjonga ukuba liyakwazi ukukha amanzi xa sifake intambo Ewe liyakwazi ukukha amanzi Sisiphe Sisiphelo & Sayo



FINAL DRAWING



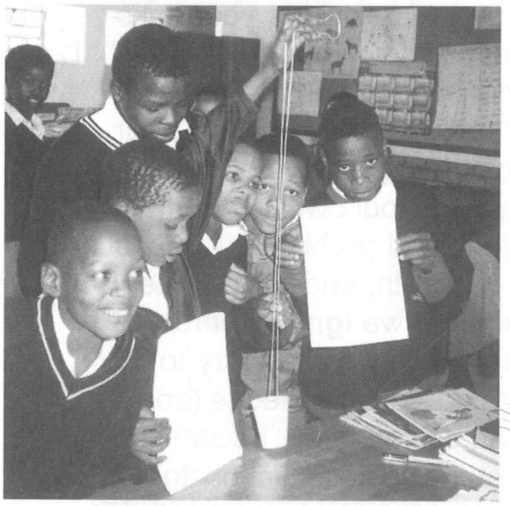


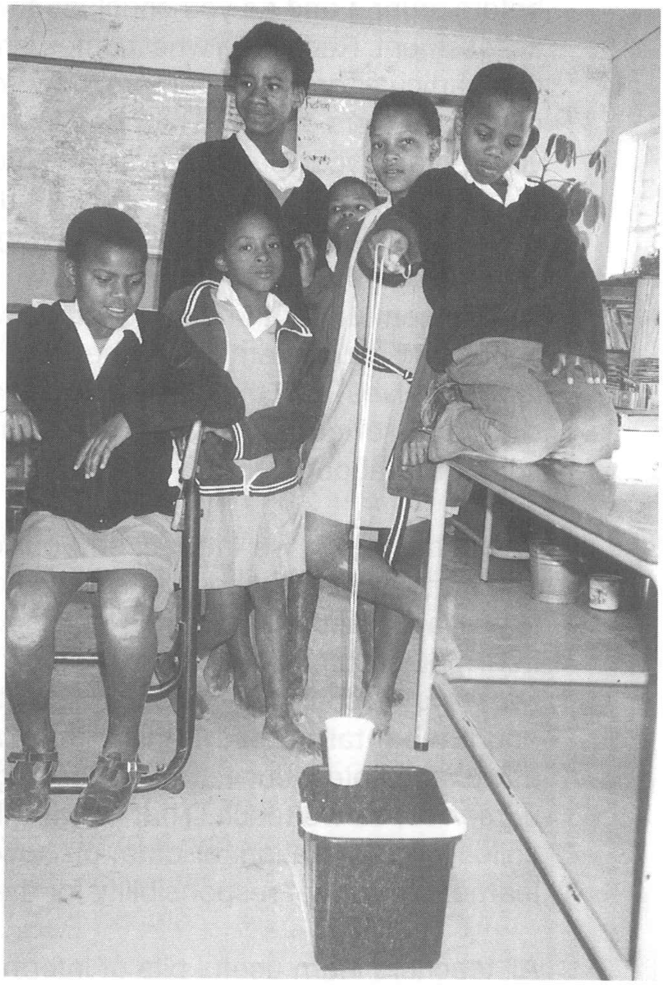
To help you support your learners we suggest that you go back to Umthamo 31 where you worked with learners on *Joining and Fastening.* Remind yourself of the way you worked with learners on that project by looking through that umthamo, and by re-reading what you wrote in your Journal at that time.

Step 4 - Appraisal

First of all, ask your learners to think about what will make a good design. How strong must the design be? Should it look good? Why? How will they test their designs? What would be a 'fair' test? Write the criteria your learners agree to on a large sheet of paper and put it up on the wall. This will act as a reminder of what will be expected at the Appraisal.

When your learners have completed their designs and the things which they have made, you are ready to appraise their work together. Remind them of the criteria which the class agreed on. Then let each group show their work.





On the day when your learners present their work, we suggest you follow the guidelines set out in Umthamo 31. Chair this appraisal sensitively. Encourage the children to explain how they came up with their **designs,** and to support this by showing the drawings and models that they **made,** even the first drawings. Encourage the rest of the class to ask questions. Model the kinds of questions that you want them to ask. Carry out the test for each **design.** Then encourage the learners to **appraise** each one. The 'designers' and the 'audience' should make an honest and fair evaluation for each group.

Later, open your Journal and write your reflections and feelings about the whole process of this activity. Write about both your learners', and your own, experiences. Critically analyse (ukuhlalutya) what occurred, and how you felt.

Unit 4 Self Assessment - Critical Teaching Moments

Have you often wondered what it would be like to be a fly on the wall, listening to and observing how a certain teacher teaches? Think how very much aware of your presence that teacher would be. Or have you thought about what someone else would feel observing you? How would they feel as they noticed all the actions and how you perform? What would they think about how you walk around your classroom, from learner to learner, group to group, and how you explain things and ask questions?

Making notes on the questions you ask, on the decisions you make before, during and as you conclude the lesson, is an important part of assessment. Recording what comes into your mind as you go and listen to a particular group of learners, how you respond to certain behaviour of your learners, how you respond to wrong and right answers and how you appraise your learners, is also a crucial part of your own assessment of your teaching. There are always questions and problem situations we, as teachers, find ourselves having to deal with, and how we deal with them has a big impact on how we teach. Do we **ignore** them and 'brush them under the carpet', or do we **confront** them and try to do something about them? A teacher who is willing to acknowledge (admit to themselves) that these are things that can be improved, becomes a **critically reflective teacher** when she starts to take action to do something about them.

In Umthamo 45, we introduced you to assessment as a process of gathering evidence about learners' knowledge of mathematics, ability to use, and disposition towards that knowledge and of making inferences from mathematics evidence for a variety of purposes. We also introduced two ways we could use to gather data about learners, namely the **rubric** and **anecdotal notes.** In this mthamo we explore further the idea of using anecdotes, but instead of looking at what *learners* do, we look at *ourselves,* as we teach. That is, we will introduce a systematic way of collecting information, or data, on how one engages and encourages learners to accept responsibility for their own learning.

All teachers learn useful bits of information about their learners every day. If you have a systematic plan of gathering this information while observing learners, at least two very valuable things happen. First, you will probably gather a lot more information. Information that may have gone unnoticed is all suddenly visible and important. Second, observation data gathered systematically can be added to other data and used in planning lessons, providing feedback to students, and so on.

Depending on what information you are trying to gather, a single observation scheme may require several days to two weeks before it has been observed. We imagine that we have a **mirror,** and all our decisions and actions are *reflected* in that mirror. The only thing we do is just look back at that mirror. We look for patterns. We try to interpret our actions. And then we take action on *how* we teach. But, how do we do that?

Before we go into that, let's look at how Mthunzi tried to deal with a problem he faced as a primary school teacher in Cape Town.

We were two colleagues, teaching Grade 7s at a school in New Cross Roads. I would prepare what I would regard as a good lesson. But every time I tried the lesson with the Grade 7 learners (who were then referred to as Standard 5s), they would hardly show any interest at all. My colleague wouldn't prepare any lessons. Instead he told the learners jokes and chatted throughout his lesson periods. The learners loved this, but it was really frustrating for me. I thought that I had gone to that particular school to learn, and to make a difference to the learners.

No matter how hard I tried, the learners were not bothered. I wrote pages and pages about this in my Journal. Remember, in those days teachers had an answer to this problem – to beat the kids. I realised that I had a number of options: I was teaching Grades 3s as well, so I could concentrate my efforts on my work with the Grade 3s as I had a good rapport with them. And then I would be less concerned about the Grade 7s, since they were disinterested ('sweep the problem under the carpet'). I could report the Grade 7s to the authorities. But I didn't want to do this in case I ended up having to watch them being punished with a stick. I could also confront the situation, but the question was how?

What I had at my disposal were **anecdotal notes.** *These notes were thick descriptions of similar incidents – learners showing no respect for one another, or for myself, as a new teacher. What I had to do was to think of an explanation and find meanings within the immediate context. I was very much aware that they knew I was not going to punish them physically, as he did not believe in corporal punishment. The easiest option would have been to conform. However, I held a position that says learners should be required to be more responsible for their behaviour.*
My responsibility as a teacher, and one of my only options was to make them aware of my frustrations. So, this third option was the only one to follow. I thought of using an "I – You message" which I had learnt in Educational Psychology at UCT. I told them that I had something serious to tell them. I told them how much I really cared about their future. I was honest with them about how I worked. I told them that when I got back home, I went to the University library to look for books to plan lessons for the following day, and that I usually got to sleep at around 2 in the morning. My experience was that no matter what I planned for a particular day, they didn't seem to appreciate it. I said, "if you do this … this is how I feel." I had with me evidence of what I did, what they did and how I felt about what they were doing. I had many examples of, "If you do… how I feel…?"

This worked like a miracle for this particular group of learners. Also, because I introduced them to journal writing, I got them to write about their own experiences and frustrations in the classrooms. Now they had enough evidence which they gathered themselves, that could back up my evidence. Remember, no single observation recording format will serve all purposes. Their experience was also reflected in their Journals. Interestingly, they felt that teachers don't have feelings, or if they do, they don't share their feelings with learners. They weren't aware that I spent so much time preparing for a lesson, while they were sleeping. They expressed a new desire and willingness to co-operate.

What I learned from this experience was that initially I had not made the learners aware that I was collecting data about the classroom, and what I intended to do with the data in the first place. So, I had my own secret, and the learners didn't know what was expected of them (or by whom). By bring things out into the open, both the Grade 7's and I were able to decide to take responsibility for improving the teaching-learning situation.

As teachers we are often confronted by a number of situations within our classrooms, and we have a responsibility to be the mature adult in those situations. For example, Mthunzi, as a result of a series of anecdotes and journal writes from learners, was able to confront his situation. It is a significant moment in his professional development as a teacher that he can still recall, even though it is a long time ago.

In your Journal, write down what you regard as a moment you would like to be changed or resolved as you attempt to adapt or adopt your Key Activity. It is important to take as a premise the assumption that what happens in your classroom is *not* because other people or your learners are responsible for it. The assumption should be that what takes place is a result of yourself (as a teacher) doing, or not doing, something. So, try not to blame somebody else. This should be a moment or an experience that stands out amongst the rest.

The moment may, for example, occur at the point where you introduce an activity, or at the moment when you approach a learner or group of learners to intervene in some way in what they are doing. Such moments, are usually characterised by a decision on the part of a teacher whether to speak, what to say, how to say it, and even when to finish speaking.

Next, you need to focus on *what* you do, and *how* you do things in your classroom. Then you need to spend *at least* five minutes, either during or immediately after a lesson, and write short notes in the form of a narrative. Collect these notes until you have completed your Key Activity. Remember these notes should be on *how* you do something, or on how you dealt with a certain situation. Your notes should not be about how others misbehave. For this mthamo, we will refer to these situations or moments as **Critical Teaching Moments.**

These *Critical Teaching Moments (CTMs)* have to be written **before** your energy and attention shift as you move on to another activity. This is mainly because memory quickly fades, or plays tricks on us. While the teacher is making a few notes of the *CTMs,* the learners can also be doing the same thing. These notes are just *accounts* of what happened. By this we mean *descriptions.* They should be free of judgement and justification - remember the metaphor of a **mirror?** It is about *what* happened at a particular moment in teaching, which you regard as **critical** and which influences what happens next in a learning event.
Some people find it challenging to give *an account* of an event without providing an explanation for it through justifying, explaining and judging. Remember that at first you are just intending to **describe** *what* happened, and *how* you *felt,* in an **open** and honest way. Resist the temptation to over-analyse. It may be useful to get a sympathetic reader to verify your account of the events.

You may be asking, so what is a *CTM* and how do I recognise one? The simplest answer to that is, *CTMs* are not things which exist without the observer, waiting to be discovered like gold! They are created *by* the observer. Read the following fictitious account of Mphuthumi looking for permission to sharpen his pencil. We think it will provide you with an example.

When Namhla was trialling this mthamo at a particular school (name of school withheld), Mphuthumi, one of the learners, raised his right hand. After about a minute Namhla noticed that he had been sitting there for a while with his hand up, and asked him what he wanted. Mphuthumi asked if he could sharpen his pencil. Namhla felt irritated.

This is a description of what was observed. It is not an explanation (account), because it does not say *why* this exchange took place. We can provide an account for it by adding to the description, explaining *why* Namhla felt irritated, and *why* Mphuthumi was doing what he was doing. *Namhla felt irritated because it seems as though Mphuthumi is not 'on task', and he is preventing her from doing what she is busy with. Mphuthumi wants to write neatly, but his pencil is blunt. He conforms to the classroom rule that says learners must get permission from the teacher before they leave their desks.* This explains the significance of the account, without justifying or judging.

The next task is to look for *common threads.* In other words, look for patterns of behaviour, or similar situations which you have noted. Look back over your accounts. Share your accumulated data with a sympathetic colleague. The task for your friend is to assist you to look for these *common threads* in your data. Which moments dominate over others? Often, what happens at this stage, is that you realise that what *you* thought was an important issue, is *not* what dominates your accounts of *Critical Teaching Moments.* Something else might be emerging as more deserving of your attention, if you are serious about your professional growth.

There is a back and forth process of keeping track of teaching moments, and looking for threads in those moments. Accounts provide data for detecting threads, and the threads which we detect tend to influence the subsequent moments that we notice. In this way, we become systematic in our reflection of our experiences.

It is important to share these experiences, as this process requires a supportive group of colleagues who work together in a collaborative manner, and who are interested in sharing each other's observations. By sharing your experiences you gain access to possible ways of dealing with similar situations if, and when, they occur in your classroom.

In this mthamo we are using the process of accounting for **teaching moments** to create data in the form of thick descriptions of *CTMs.* As we deal with, and reflect on, this rich data, we hope to change aspects of what we do, and become more professionally accountable as Primary Classroom practioners.

The process

First of all, **describe** the moment. Try to have at least two moments per day. The moments are not restricted to Technology Education as a learning area. You can develop these moments from other learning areas as well. Try to be more detailed in your description of the moments, including the date and time in your accounts.

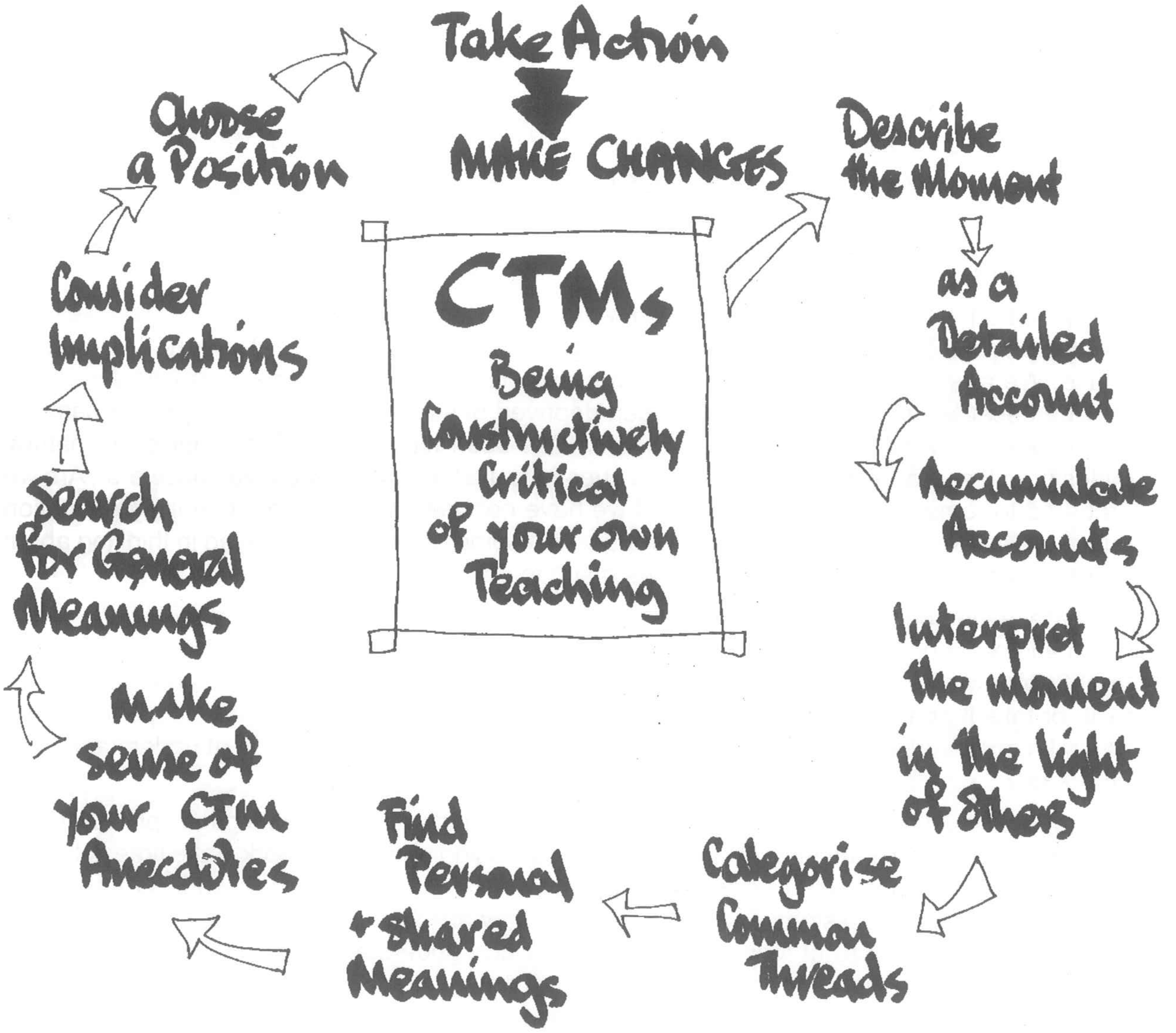
The second step is to try and **interpret** what you have written with the help of colleagues, and identify **categories,** or common threads.

The third step is to suggest what each category **means.** For example, Mphuthumi's actions were a result of the way the learners in his class were expected to ask permission before sharpening their pencils.

The fourth step is find a **more general meaning** or classify these moments into significant learning. In the case of Mphuthumi, this would be to say that what happened can be read as an example of teachers wanting complete control in their classrooms, and learners being denied opportunities to use their initiative and take responsibility in school.

Lastly, think about what your **position** is about this kind of behaviour as the teacher. What do you intend doing about it? What **actions** will you take? What **changes** will you make?

The process of creating, interpreting your teaching moments can be summarised in a cyclical model (although the order may not be as we have suggested).



Conclusion

The Hand-in Assignment

For this umthamo you are asked to hand in a careful **case study report** of your work on the option you chose for the **key activity**. There can be some confusion about what is meant by a case study. For the purposes of this assignment a case study means giving a detailed report of **all** the aspects of a specific event or series of related events in a certain setting. It is more than just a description of what happened.

In this case it includes how you planned and prepared for the activity (what were your thoughts as you did this?). And then, what happened when you worked on the activity in your classroom with your learners needs to be **described** and **analysed** based on careful **observations**. You need to **gather** and **select** supportive **evidence** from the work in the form of specific artifacts (samples of work and transcripts of talk), and show that you have given thought to **interpreting** the work you include as evidence by including comments. It should end with some **considered comment** on the value or worth of the event (this could include opinion collected from learners, colleagues or interested parents). Finally you could offer **suggestions** of how improvements could be made and make **recommendations** for the future.

Suggested Assessment Criteria

These should be discussed, understood and agreed upon at the second face-to-face for this umthamo.....

- Description: detailed, clear, honest, accurate. (1 - 5)
- Evidence: a good range, useful, relevant, choice justified. (1 - 5)
- Interpretation: valid, realistic, worthwhile comments. (1 - 5)
- Conclusions: logical, useful, meaningful. (1 - 5)

The Challenge of Technology Education

Evidence from the first phase of the implementation of this umthamo is that we as teachers are not challenging nor extending our learners enough. This is especially evident with the intermediate phase. We are not tapping into what they are experiencing or curious about themselves. This may be because we as teachers have been deprived of stimulation ourselves when it came to technology. Verwoed's Bantu Education policy has been too effective in stamping out natural curiosity with a school culture of "don't ask questions, just memorise the given answers". Are we prepared to remain victims of our past? If we have not been exposed to technology education ourselves and were not encouraged to grapple with some of the ideas involved in thinking about **mechanisms** and **machines,** what are we going to do about it?

Do we take the trouble to think about just how things like locks, keys, latches and other everyday mechanisms work? Do we wonder why the doors of certain busses hiss? Why do generators throb? Or do we ignore these questions? When something mechanical breaks down do we try to fix it, or take it apart to see how it works before we throw it away? What has happened to our natural human curiosity about how things work? Do we just accept blindly that understanding is not for us?

The writers would urge teachers to **explore** the ideas included in the double page spreads in unit 2 carefully, alongside their learners. Spend time discussing how things work. Take time to look at things and to take apart old or broken mechanisms to try to see how they work. What are the cogs, levers, rods and pistons and valves doing? How are they arranged? How do they work? Let's build a new culture of technological curiosity and understanding together in our primary schools, so that our learners have a collective technology consciousness that takes them into the future with confidence to continue to be curious.

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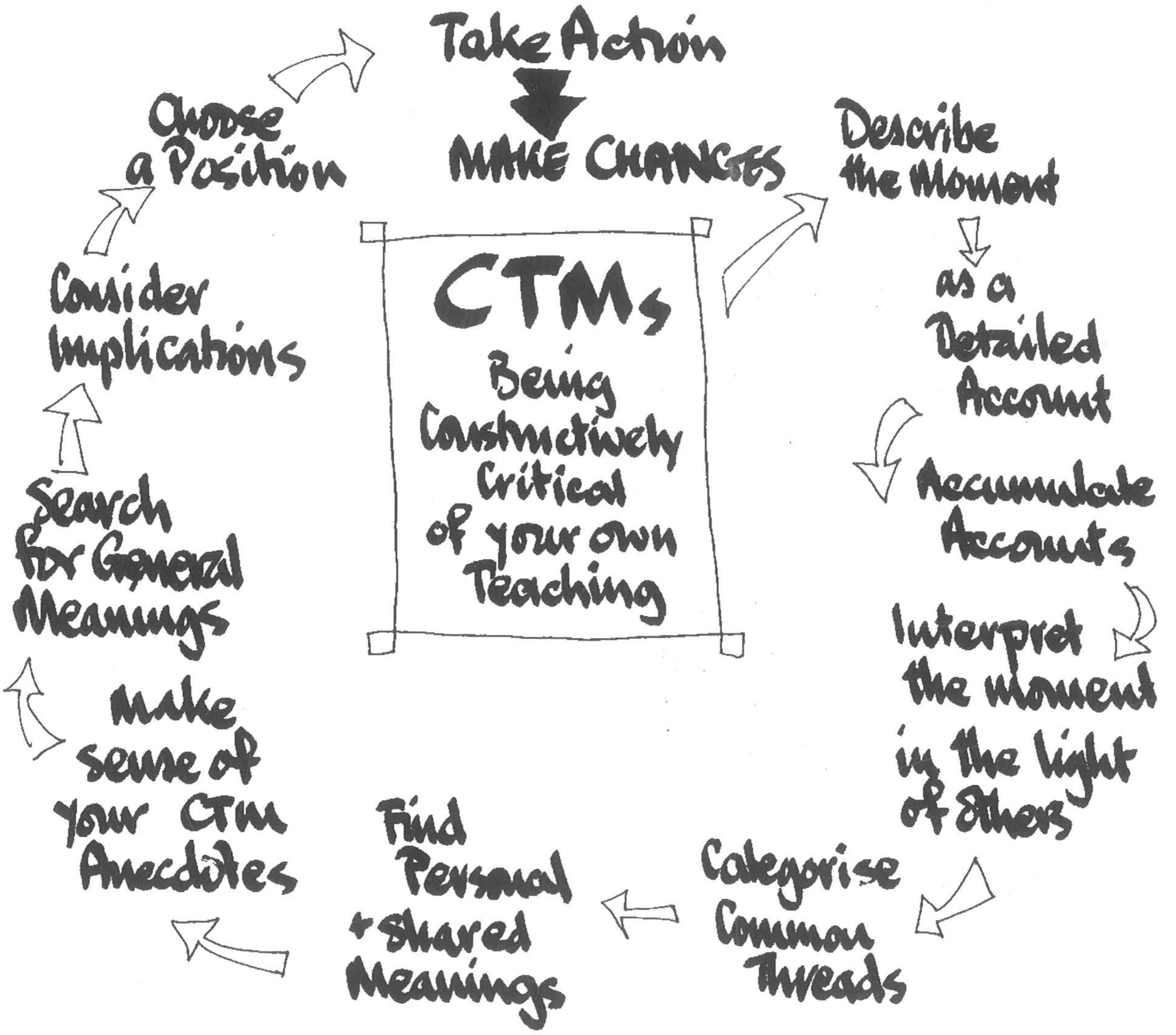

This book provides practical ways in which teachers can move from concern about their students and what they are learning, concern about their teaching, or even concern about other practices such as managing, conducting and participating in meetings, to doing something about it in a practical and disciplined manner. At the heart of all practice lies noticing: noticing an opportunity to act appropriately. To notice an opportunity to act requires three things: being present and sensitive in the moment, having a reason to act, and having a different act come to mind. Consequently one important aspect of being professional is noticing possible acts to try out in the future, whether gleaned from reading, from discussion, from watching others, or from personal reflection. A second important aspect is working on becoming more articulate and more precise about reasons for acting.

The mark of an expert is that they are sensitised to notice things which novices overlook. They have finer discernment. They make things look easy, because they have a refined sensitivity to professional situations and a rich collection of responses on which to draw. Among other things, experts are aware of their actions in ways that the novice is not, whether teaching, researching, attending meetings, administering, supporting colleagues, or preparing for any of these.

Mason J. 2002

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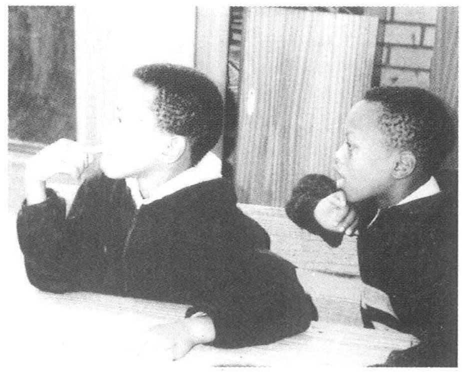

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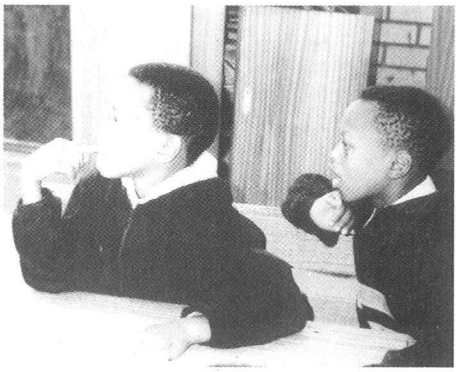

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