# Chapter 2 **Landscape**

## The Earth is moving . . .

The solid surface we are all standing on is moving, albeit very slowly, as giant **tectonic** plates move over the planet. Where these plates part and collide, earthquakes, volcanoes, and mountain building occur, all contributing to the formation of new landscapes.

The plates are floating on a layer called the **mantle**. Rocks in the mantle act rather like plastic and under the high temperatures and intense pressures, and at plate rifts and collisions, molten rock pockets rise to the surface. These pockets can flow as lava from volcanoes or intrude into existing rock before cooling and solidifying. They may then be folded and uplifted to form mountains. This is where you can witness the structures formed by tectonic movement, and erosion can begin to play its part.

**Erosion** of rocks by water cutting into them, ice scouring over them or by the action of windblown particles, has shaped the landscape we see around us. This erosion has also been responsible for soil formation as base rock is broken down by *three* processes:

- ☞ **Physical erosion** such as the impact of rain dislodging and washing particles down a slope.
- ☞ **Chemical processes** such as the action of acids in rain dissolving rocks on buildings.
- ☞ **Biological processes** such as the formation of leaf litter that can 'glue' a soil together and form a protective layer against rain impact.

Soil is the eventual product of the interaction of all these processes. The rock is broken down into particles which can be moved around and bound together by organic matter derived from plant and animal waste or decay. The presence of this dead organic 'glue' also provides nutrients for plants.

As water percolates down through a column of soil, the particles can be differentiated into bands forming a **soil profile**. Within each band of the profile there will be different proportions of sand, clay, and organic matter. The mix of these ingredients creates soil texture and determines the drainage properties of the soil.

## Moving the Earth

All of these processes are taking place now as they have done for millions of years. Human interference has, however, accelerated the process of change. One obvious visible effect is our interference with the landscape to obtain stone, metals and fuels. Not content with removing mountains we are also making new ones by dumping enormous quantities of waste. It is becoming increasingly important to **reuse** and **recycle** materials (as nature does) in order to reduce the need for so many precious resources to be dug out of the ground. Such processes would also save energy. Most of the activities on re-use and recycling are contained in the chapter on positive action.

The way we use or misuse soil also has wide-ranging implications. Intense crop production and overgrazing are destroying the protective vegetation cover in many areas and the excessive use of artificial fertilisers produces soils with no 'organic glue' (and consequent breakdown of the soil structure). The resulting degraded soil is easily **eroded.** In mountainous areas the wholesale felling of trees on slopes deprives the soil of the 'binding properties' of plants and leads to erosion and instability which frequently results in landslides.

The following section outlines ideas for the investigation of rock formation, erosion, and the properties of soil. Hopefully your findings locally will encourage you to take action to address the wider issues outlined above.

**Landscape**

## Basic concepts and issues

Rock formation and tectonics

Change

Soil texture and profile

Soil fertility

Erosion

Recycling

## Activities

2.1 Custard tectonics

2.2 What's a rock?

2.3 Cardboard clinometer

2.4 Timescales

2.5 Soil sorter

2.6 Bottled worms

2.7 Tullgren funnel

2.8 Compost corner

2.9 Soil glue-o-scope and impact indicator

# 2.1 Custard tectonics

## Concept

*Giant tectonic plates are important in the formation of mountains, new land areas and earthquakes. Movements of the Earth also result in folds and faults in the rocks. It is difficult to imagine how these huge plates move along on the planet's surface.*

## Context

*A simple way to introduce the idea of giant plates of rock moving over the surface of the planet is to make some custard! Custard acts like the hot layer (the mantle) beneath the crustal plates. As it is heated the hot semi-liquid rises and cooler custard takes its place setting up a convection current. It is on this current that the custard skin (representing the tectonic plates) moves. At the points where the plates collide or part, mountain chains are formed.*

## Equipment

1. ***Custard tectonics:*** *saucepan - milk - custard powder - cooker - jug*

2. ***Models of rock:*** *2 cups of water - 2 cups of flour - 2 cups of salt - 2 tablespoons of oil - 2 teaspoons of cream of tartar - food colouring*

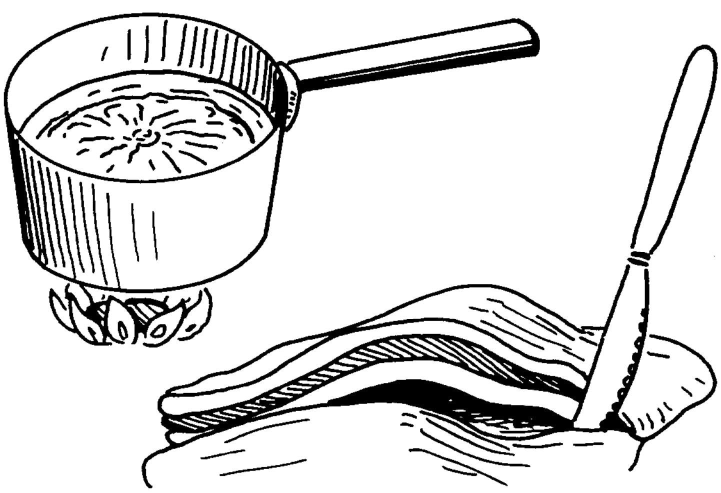
## Making it

1. ***For custard tectonics***

*Heat the milk until it is boiling. Then pour the boiling milk onto the custard powder, stirring vigorously. Return the custard to the saucepan and leave it to cool and form a skin.*

2. ***For the models of rock***

*Make the dough by mixing all the ingredients together and add one food colouring. Place the mixture over a heat source and 'cook' until a dough is formed. Repeat this sequence until you have enough balls of coloured dough. Placing the dough in sealed plastic bags or airtight containers keeps it fresh and malleable.*



## Using it

*When a skin has formed, reheat the custard gently to set up convection currents. The plate, or custard skin, will move slowly and split. You can try varying the rate at which your custard heats up. What happens if you only heat up one side of the saucepan?*

*You can then model geological features in the landscape in the following way:*

1. *Start with a board and roll out slabs of dough. Then pile them up in strata. Mimic the earth movement seen in the field by folding or cutting to make faults.*

2. *You may wish to model landscape features that are to be found around you.*

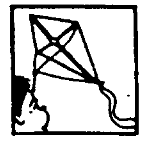
3. *Try making another dough without using oil and cream of tartar. Does this behave any differently?*

4. *Plasticine can be used instead of dough.*

## Adapting it

*Use this activity in association with a world map. Try to find out about places where volcanoes and earthquakes are known to occur (California, Iceland, Sicily etc). Locate them on the world map and try to relate them to mountain ranges or rift valleys. This should help you locate the edges of the tectonic plates on the surface.*

# 2.2 What's a rock?



## Concept

*It can often be difficult to grasp the difference between the building blocks of rocks (minerals) and rocks themselves.*

## Context

*This activity uses a 'guessing game' to explore the nature of rocks and their derivatives. Many people are surprised how many useful objects or man-made structures are made from rocks, minerals or their products.*

## Equipment

*Milk cartons (as they are waterproof) or plastic containers - selection of items which may include talcum powder, tea leaves, sand, mud, toothpaste, nails and mayonnaise - a blindfold*

## Making it

*1. Put a selection of the items in the bottom of the cartons.*

*2. Blindfold the participant and lead them to the table with the cartons on. (Be careful if you take the carton to the participant as they tend to use the sounds of objects moving as a clue).*

*3. Guide their hand into each carton in turn and ask them to identify the object inside. Is it rock?*

## Using it

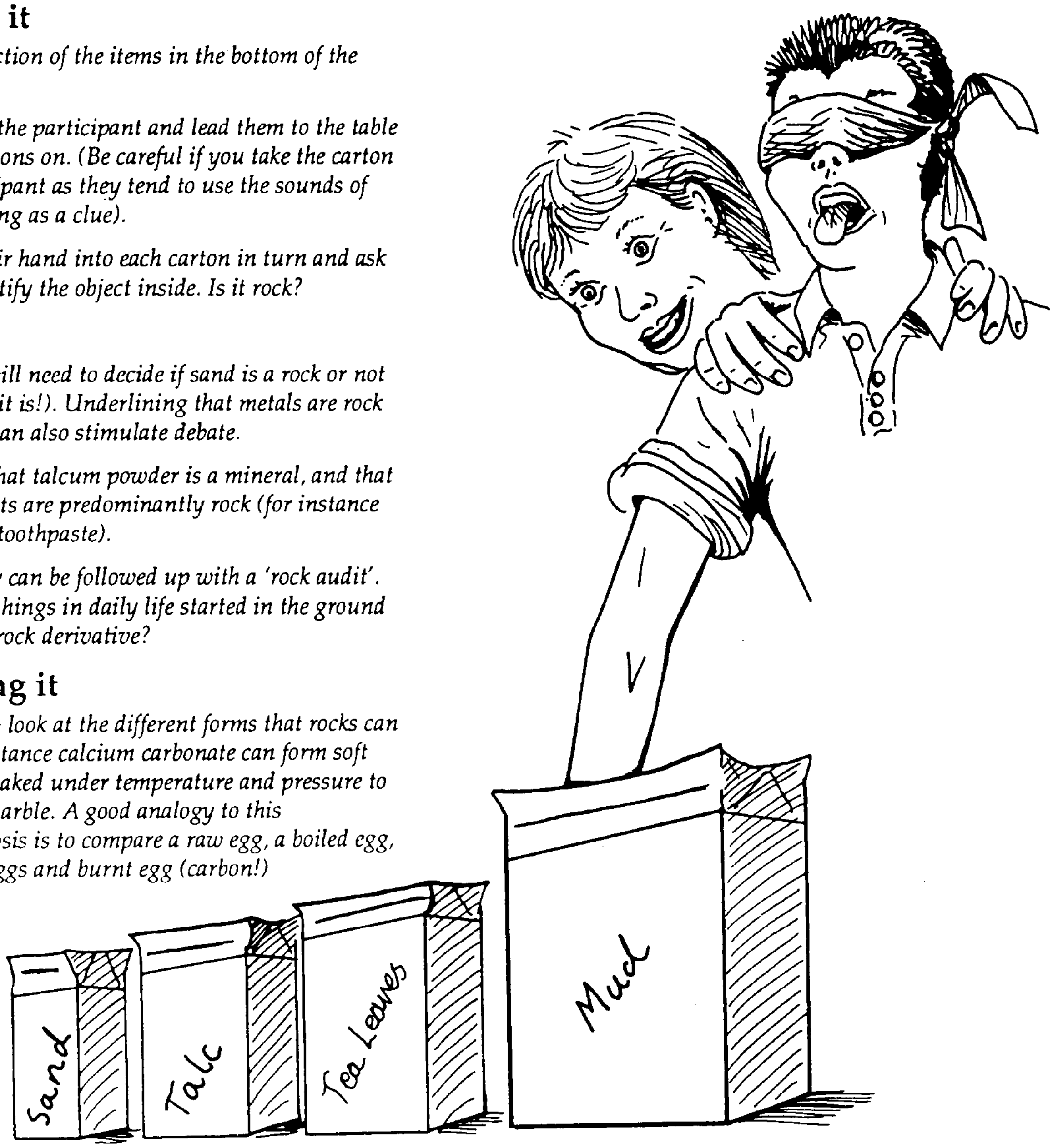
*The group will need to decide if sand is a rock or not (technically it is!). Underlining that metals are rock derivatives can also stimulate debate.*

*Remember that talcum powder is a mineral, and that some products are predominantly rock (for instance the chalk in toothpaste).*

*This activity can be followed up with a 'rock audit'. How many things in daily life started in the ground as a rock or rock derivative?*

## Adapting it

*You can also look at the different forms that rocks can take. For instance calcium carbonate can form soft chalk or be baked under temperature and pressure to form hard marble. A good analogy to this metamorphosis is to compare a raw egg, a boiled egg, scrambled eggs and burnt egg (carbon!)*



# 2.3 Cardboard clinometer

## Concept

*Faults are caused by rocks splitting along a line of weakness, although some rocks can be plastic and bend into folds instead of splitting. The physical manifestation of ground movements and earth movements is shown in rock bedding planes and the results of these movements can be observed in particular features of the landscape.*

## Context

*This activity involves measuring the angles of slope on weathered surfaces or at different points on a hillside.*

## Equipment

*Rectangular piece of strong card - protractor - paper clip - cotton - tape*

## Making it

*1. Carefully cut the card so that its edges are straight and square.*

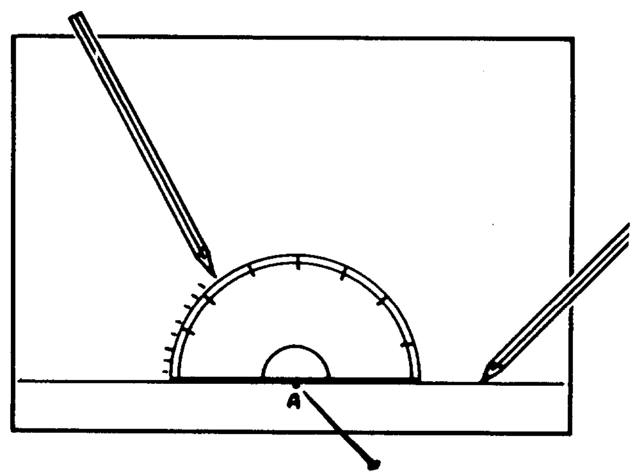
*2. Draw a line 1cm from the long edge of the card (and running parallel to it). Then mark the mid point of the line you have drawn.*

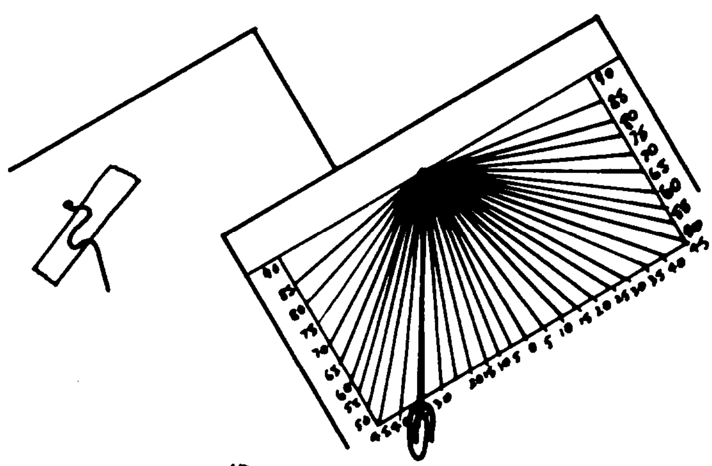
*3. Place the protractor on the line (centred at the mid point). Draw around the protractor and make marks at 5 degree intervals.*

*4. Draw in the radius lines (extending them outwards if necessary).*

*5. Make a hole with a needle at point A on the diagram and then thread a piece of cotton through the hole. Fix the cotton on the unmarked side of the card.*

*6. Ensure the cotton is tied securely and attach a small weight (paper clip) to the other end of the cotton. The length of the cotton should be the same as the radius of the protractor scale.*



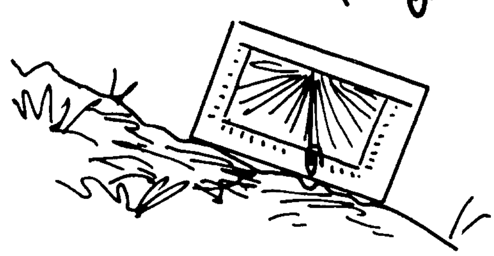



## Using it

*1. Place the long edge of the clinometer on a suitable weathered slope or rock face. You can then read off the angle of the dip from the position of the paper clip pendulum (a piece of sellotape wrapped around the clip may make it swing more smoothly).*

## Adapting it

*If you have a spare protractor attach it to a piece of white card or a piece of wood painted white. Then make an appropriate sized groove around the edge of the protractor and glue a piece of clear plastic tubing into the groove. Place a small ball bearing in the tubing to record the angle of dip.*



# 2.4 Time scales

## Concept

*Geological time scales are often difficult to get a 'feel' for. They contrast strongly with the rapid pace of change resulting from current human activities and help put across the idea that these processes are still happening.*

## Context

*This activity uses a piece of string to demonstrate how rapidly we have caused change.*

## Equipment

*Pen - paper - old year planners or timetables - old photographs - string - models or cut outs*

## Making it

*Measure out a piece of string (or make a line) 46 metres long to represent the age of the Earth (1cm along your string will roughly equal 1 million years). Using this as a guideline mark off the geological timescale.*

## Using it

*1. Draw relevant pictures such as prehistoric fish, trilobites, dinosaurs etc onto pieces of card (or make photocopies and cut them out). Then get the group to guess where they think mammals (and man!) first appear.*

*2. The model can be used in conjunction with old photographs of the area you are working in. It allows comparison of the speed of change which has taken place in recent times to the long periods of the geological record.*

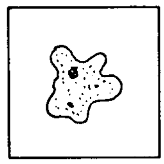
*3. You can follow this up by sketching views of local scenes from old photographs, and then making sketches of what you think might happen to them in future.*

## Adapting it

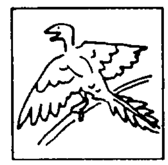
*1. You can create a* ***'Planet Earth Year Planner'*** *which condenses the geological timescale into a 12 month calendar.*

*2. An* ***'Appointments Diary'*** *for a day can also be created to condense the time-scale even further.*

*3.* ***Wall hangings*** *can be created using a straight stick and some string (each 1mm of string representing 1 million years). Measure out lengths of string to represent the period of time from the start of each major geological era to the present day. Then attach the different length pieces of string to the stick and attach pictures of the plants or animals associated with each era to the ends of the string.*



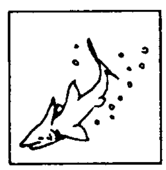
*simple life forms*
*2000 million years ago*



*first bird*
*170 million years ago*

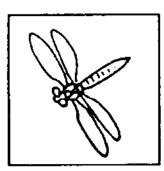
*first land plants*
*440 million years ago*

*first modern mammal*
*65 million years ago*

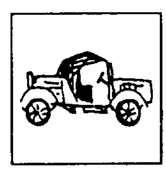


*first bony fish*
*400 million years ago*

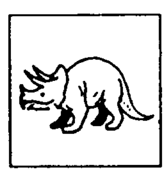
*first man*
*1 million years ago*



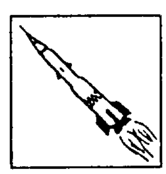
*first winged insects*
*350 million years ago*



*first car*
*100 years ago*



*first dinosaurs*
*250 million years ago*



*first space craft*
*30 years ago*

# 2.5 Soil sorter

## Concept

*Soil is made up of a number of ingredients including both inorganic and organic materials. Soil formation begins with the erosion and transportation of rocks and it is the proportions of these ingredients that create different soil textures. The basic material thus formed then interacts with dead organic matter and living plants and animals. The different layers in the soil can often be observed as a soil profile.*

## Context

*The ingredients in the various layers of a soil profile can be investigated using a soil sorter which is readily made from very simple materials.*

### Equipment

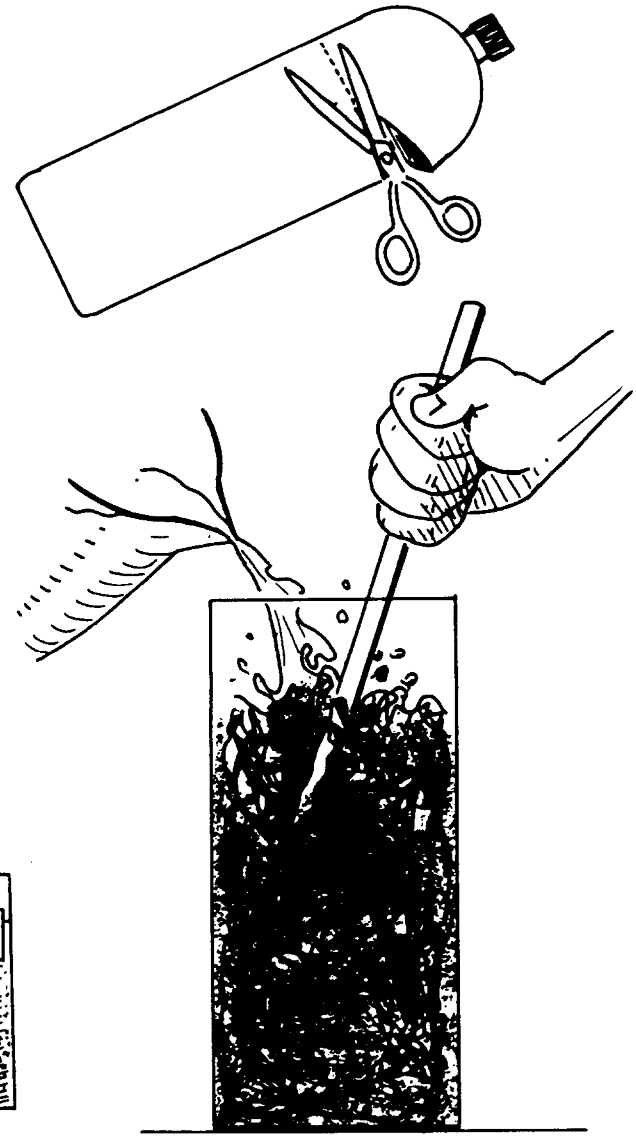
*Plastic bottle - knife - soil*

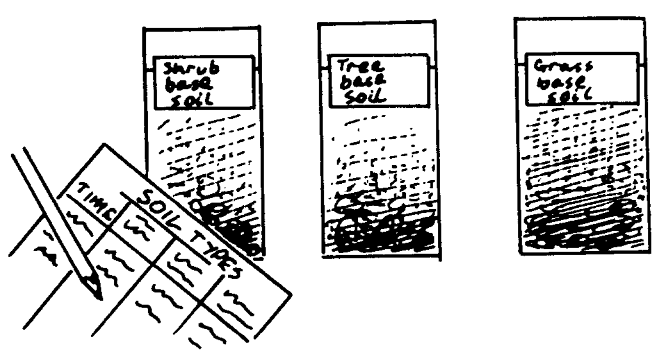
### Making it

1. *Cut the funnel shape top from a clear plastic bottle.*
2. *Place enough soil to half fill the bottle.*
3. *Cover the soil sample with water and stir vigorously with a stick.*
4. *Leave the mixture to settle and observe the different layers.*

### Using it

1. *Identical bottles/jars can be used to compare different kinds of soil, as long as the same amount of soil is used in each. (Note glass jars can be heavy to carry).*
2. *Feel the soil sample between your fingers (it is sometimes easier to wet the soil first) and describe the texture eg. gritty, silky, sandy. Compare the description to the soil sorter results. Try rubbing the samples onto paper for variations in colour markings which could reflect different origins and textures.*
3. *Compare samples taken from under different vegetation and from different depths in the soil profile.*





# 2.6 **Bottled worms**

## Concept
*The integration and breakdown of dead organic matter into soil is vital for soil fertility (as well as the prevention of the build-up of dead bodies!). Animals, especially earthworms, mix the soil material together ensuring that essential nutrients are available for uptake by the roots of plants. The decomposition of leaves and other organic material also increases the surface area available for fungal and bacterial decay.*

## Context
*The importance of animals in the formation of soil can readily be demonstrated by making a simple 'wormery'.*

## Equipment
*Plastic bottle - card/newspaper - leaves - earthworms - sand, silt and soil samples - plastic bags - elastic bands*

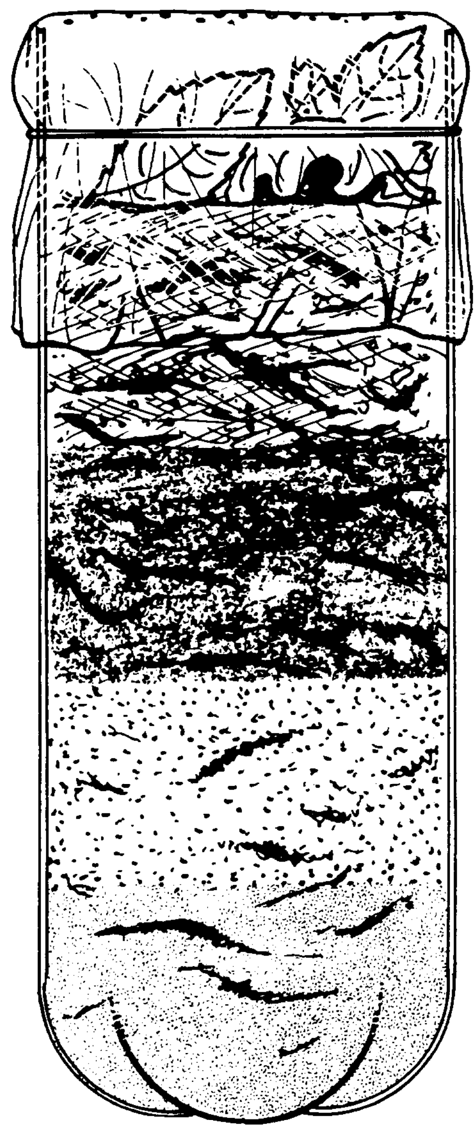
## Making it
*1. Cut the funnel shaped top off a plastic bottle.*

*2. Fill the bottle up with layers from different soils (avoiding stones and hard, lumpy soils).*

*3. Keep the soils in the bottle moist but not wet. Then place 3 or 4 leaves (preferably ones which have started to decay) on the surface and introduce a few earthworms.*

*4. Cover the bottle with a lid made from the plastic bag and puncture it with a series of holes to allow it to 'breathe'.*

*5. Keep your wormery in a cool dark place; a tube of newspaper wrapped around the wormery will encourage the worms to burrow near the edge.*



## Using it
*1. After a week or so check the surface of the soil by sliding up the tube of newspaper. What has happened to the leaves? Are the layers still visible? Are there any worm casts? If so, what are they made up of?*

*2. Air is introduced into the soil by this mixing and burrowing which is analogous to digging. Try digging a hole in the ground, placing all the soil on a plastic sheet. Then carefully replace the soil. Will it all go back in? What takes up the extra room? Why is it important?*

## Adapting it
*Soils vary considerably. You can collect different coloured soils and sands and place them in plastic bottles or jars. Then label the location and date found on the side of each container.*

# 2.7 Tullgren funnel

## Concept

*Soil, leaf litter and compost are often rich in different types of 'minibeast' many of which are invisible to the naked eye. These organisms are vital in the manufacture of soil and its fertility and the cycling of the nutrients used by plants.*

## Context

*'Minibeasts' can be collected and then sorted using a Tullgren funnel.*

## Equipment

*Empty flexible plastic bottle - knife - meshes of different sizes - lamp*

## Making it

*1. Cut the plastic bottle two-thirds down from the top to make a long 'funnel' and a short 'container'.*

*2. Ensure the cap has been removed and then place the funnel section (narrow section downwards) into the container.*

*3. Cut a piece of small wire mesh the same diameter as the top of your funnel (ie. so that it fits inside) and then push it as far down as it will go. If you can't find suitable wire mesh then put the soil or leaf litter in a piece of net curtain and place this in the top of the upturned 'funnel' bottle.*

*4. Fill the funnel with your soil sample and then shine a lamp above the funnel.*

## Using it

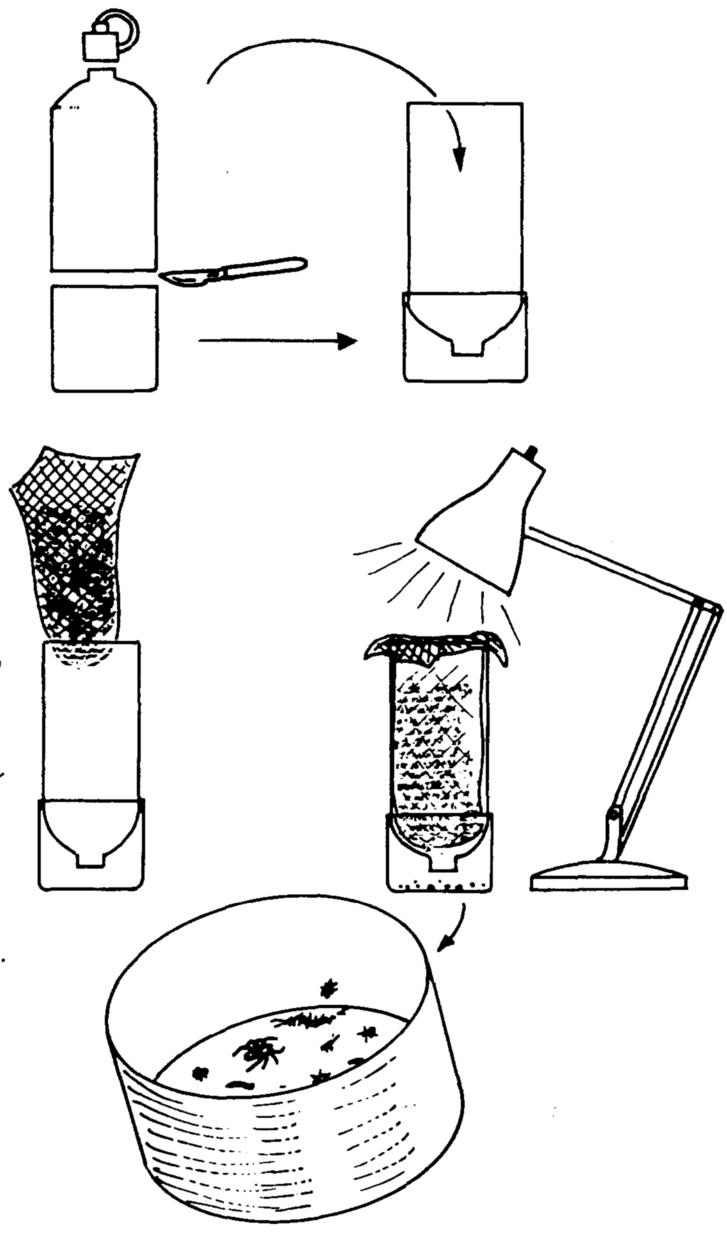
*1. Be careful when positioning the lamp; if it is too close to the sample the organisms are killed before they can escape to the bottom. It is also a good idea to place some dampened paper in the collector to keep the minibeasts alive.*

*2. Different sized meshes can be made by folding over (doubling or trebling) the chicken wire. This will allow a basic sorting of animals according to their size.*

*3. If you cannot find any wire try using leaf litter which is coarse enough not to fall through the funnel.*

## Adapting it

*Try comparing animals from different points in the soil profile, or from different parts of a compost heap.*



# 2.8 Compost corner

## Concept

*The breakdown of leaves on a forest floor is a 'recycling' process which results in the formation of an organic 'glue' which helps to hold the soil together and provides essential plant nutrients.*

## Context

*The breakdown of vegetable waste involves the same principles and the resulting compost can be used as an organic fertiliser.*

## Equipment

*3 plastic bottles with crinkled bases - 1 plastic bottle with a coloured base - kitchen food waste and organic rubbish - modelling knife and knitting needle*

## Making it

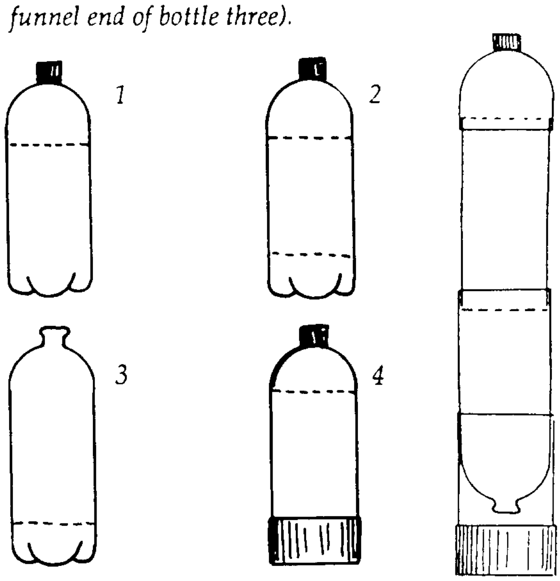
*1. Take one crinkle-bottomed plastic bottle and cut off the top section just below the widest point. This will make a funnel which will slide on and off the bottle trunk as a lid. Now cut off the base of the bottle and discard it.*

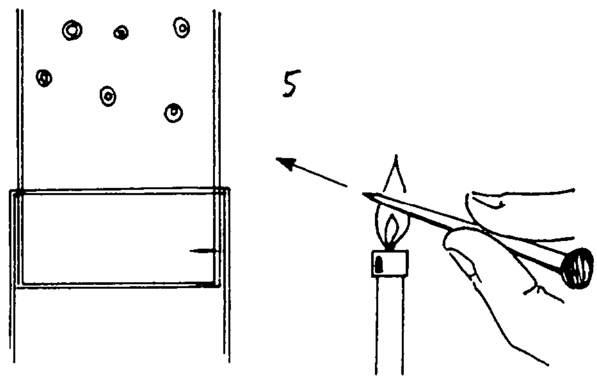
*2. Repeat the process with a second bottle, discarding the top and bottom to leave a tube. Now use this to make an extension to bottle one.*

*3. Remove the cap from the third bottle, cut off the bottom at its widest point and discard cap and base. Invert the remaining section and push the combined bottle one and two into it.*

*4. Remove the funnel end from the bottle with the coloured base and discard. Use the coloured bottom section to support the plastic column you have made.*

*5. Heat the point of the knitting needle and use this to melt some holes into the structure (except for the funnel end of bottle three).*




*6. Fill the column with kitchen waste and garden plant refuse.*

## Using it

*1. The holes are critical as they encourage the growth of aerobic bacteria which breakdown the waste. If you have enough bottles try making a second unit and see what happens if you keep the lid on the funnel of bottle 3 or leave out the holes!*

*2. On a larger scale, a compost heap made from old loading pallets in a corner of the school grounds can provide a useful comparison. Ensure the waste pile is above the ground to facilitate air flow. This can also be used to recycle waste to make garden compost.*

*3. Liquid that collects in the base of the column can be used as a liquid fertiliser (see 1.8). Try comparing growth of plants watered with different dilutions of your liquid compost.*

## Adapting it

*It is also possible to compare the decomposition of the waste in the classroom to that taking place in a compost heap outside. What factors may be responsible for any differences?*

# 2.9 Soil glue-o-scope and impact indicator

## Concept
*The overuse of non-organic fertilisers and overcropping rob soils of their important humus content. Rain water easily washes away soils that are not 'glued together' by organic matter or bound by the root systems of plants.*

## Context
*This activity investigates the effect of the impact of rain on a variety of samples under various conditions.*

## Equipment
*1. **Soil glue-o-scope:** jars - wire netting - sponge - organic rich soil - compost - clay - sand*

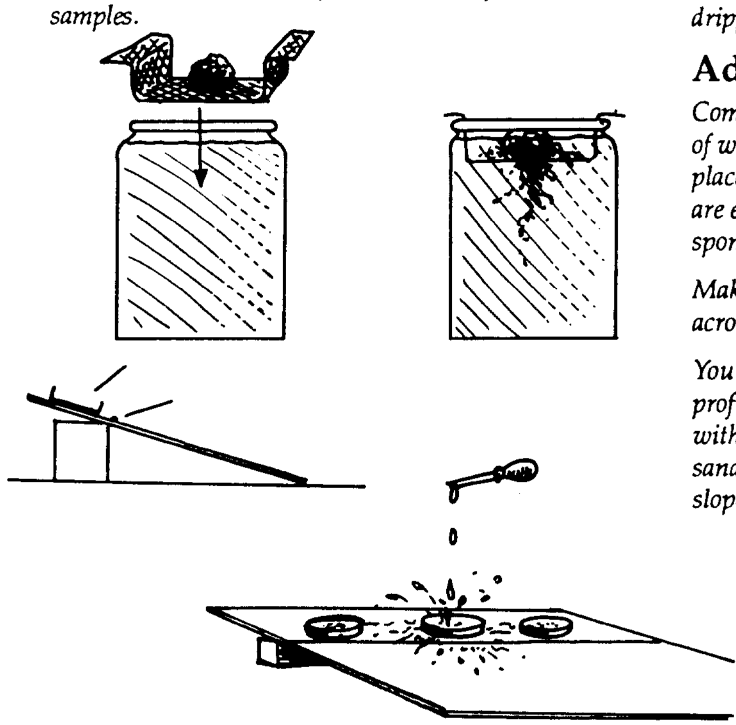
*2. **Impact indicator:** jar lids - sheet of wood painted white - sand, soil and silt*

## Making it
***1. For a glue-o -scope***

*Take a jar and make a ''U' shaped cradle from the wire netting or mesh that can be lifted easily in and out of the jar. Make a series of soil substance balls from samples taken from the field or made up artificially from sand, clay and vegetable cuttings.*

***2. The impact indicator***

*This is easy to make. Draw a line one -third of the way in from the longest side of the wooden board. Glue the jar lid onto the board and fill it with one of the soil samples.*



## Using it
*1. Place the balls of material into the 'U 'shaped cradle in turn. Lower them into the jar which you filled with water. Watch how quickly /how much of the ball breaks up (those with the highest organic content should crumble less).*

*2. You can now investigate the effect of the impact of rain on your soil samples. Start with the indicator flat on the ground. Drip water onto the first sample. Measure the distance the sand or silt is splashed out. Raise the board at one end to form a slope. Now look at the pattern of the soil movement when water is dripped onto it.*

## Adapting it
*Compare these results with a constant drip or stream of water on to the different samples that have been placed on tilted trays. Try protecting the soils that are easily eroded with artificial humus such as sponge or plasticine.*

*Make artificial terraces by putting strips of wood across the board to collect the soil.*

*You can also compare materials from down the soil profile. Try making plasticine hillsides with and without terraces. See where the water collects, or if sand is washed away as water is poured down the slope.*