

## Secondary Science

### 13 What is soil?

**Aim:** To understand that soils have a variety of properties because of their different constituents and structures.

Students conduct the following practical soil activities:

- Visual inspection for components

Look closely at a soil sample and identify as many 'bits' as you can. A magnifying glass or microscope will be useful.

- Identifying soil types

Use the flow chart (see Appendix 4, page 35) to assess and categorise soil types.

- Water content

Weigh a soil sample and leave to dry overnight on some paper, in a desiccator or oven set on low. Reweigh. Alternatively, heat a soil sample in a test-tube. Moisture condenses on the neck of the tube.

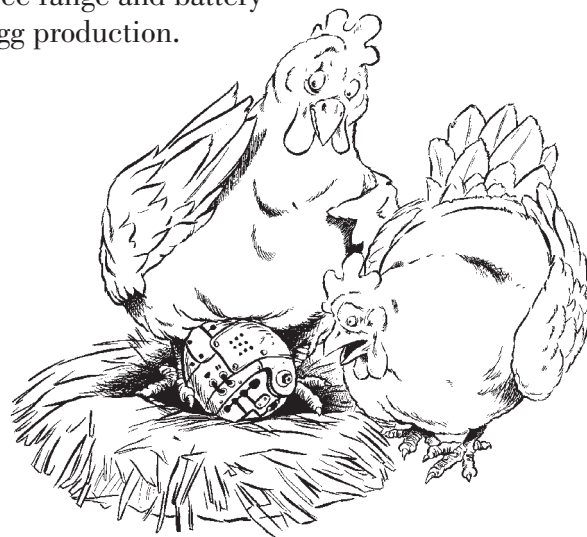
(See also Activities 17 and 18 on pages 16 and 17 for more soil identification ideas.)

### Discussion

Crops and pasture require specific properties from soils. Understanding and assessing soils is integral to the development and maintenance of a sustainable farm. Soil should be considered as a living integrated system and as such should not be treated as if each part were independent.

### 14 An industrial egg

**Aim:** To explore the processes involved in the production and distribution of food by comparing, as an example, backyard, free range and battery egg production.



Egg production illustrates a wide range of processes and environmental considerations. For example, any kind of battery production involving animals requires extensive inputs to keep the animals highly productive and healthy in artificial environments.

Students:

- Brainstorm the needs and products of a chicken. Items may include: grains, greens, protein, calcium (for shells), grit, water, shelter, heat, pest control, manure, eggs, feathers, meat, noise.
- Discuss how these needs are met in battery and free range farms and backyards and what happens to the products.
- Follow inputs such as 'food pellets' back to their source including associated industries and activities such as transport, buildings (mining and forestry) and energy production. For example, chicken pellets are made from low-grade fish products, caught in remote fisheries, processed and taken to the pellet mill. Finally, the pellets are transported to the farm.
- Prepare a concept map, flow diagram or poster describing how a battery, free range or backyard egg is produced and ends up on the kitchen table.

At each stage of the concept map, students should show where the energy comes from to transform the food into something different. If the energy comes from the sun, then this is sustainable. If the energy comes from coal or oil, then this energy input is unsustainable. The manufacture of highly processed foods uses up much more energy than they supply our bodies. In fact, the less processed a food is, the more sustainable it is.

### Examples of pairs

teabag	diffuser
heater	jumper
foam cup	ceramic mug
reused paper notepad	bought notepad
plastic garden tie	string
locally made product	imported product
processed food	unprocessed food
excess packaging	minimal packaging
aerosol	pump-pack
fountain pen	biro
bottle juice	tetrapak
hand beater	electric mixer

### 15 Environmental pairs

**Aim:** Students to explore their ideas of sustainability in terms of their own lifestyle choices and the availability of resources in the community.

Collect pairs of objects so that there is at least one pair per student. See the table on the bottom left hand side of this page for examples.

Mix the pairs up and lay out in the centre of the room with students in a circle around the objects. Students 'pick a pair'.

Each student explains:

- why the objects chosen are a pair
- which one is the more 'environmentally friendly' and why
- which one they would actually use and why.



There are no correct answers. The purpose of this activity is to raise issues for discussion, in particular how people view the products they use and why they choose them.

## 16 Lifestyle environmental audit

**Aim:** To investigate personal lifestyle choices and promote changes that are more environmentally sustainable.

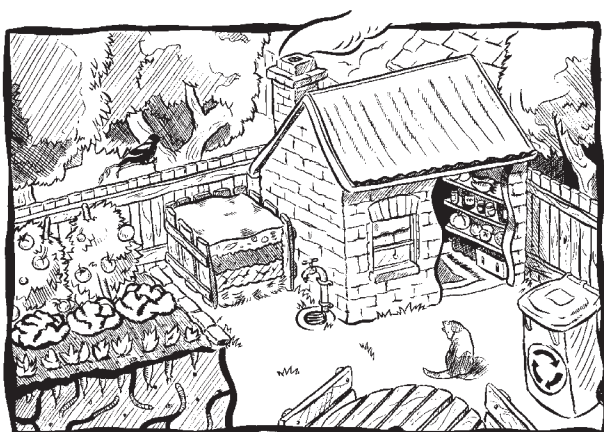
Students:

- use the Lifestyle Environmental Audit checklist (Appendix 3 on pages 32 to 34) to rate practices used in the home.
- discuss benefits of those which are used and the reasons why others are not.

See Activity 4, page 8, for details of how to carry out a school or community based project.

### Discussion point

Students could consider the effect of extending the savings in one household to all the households in a region, state or country. For example, if each home in Victoria reduces their water use, this might mean one less reservoir. Planting trees especially in rural areas, will attract native animals and provide shelter for stock, help lower ground water levels and reduce salinity problems.



## 17 What is in soil?

**Aim:** To demonstrate that soils have a variety of constituents.

Students conduct practical soil activities such as the following:

- **Organic content**

Weigh a crucible, add dry soil and reweigh. Heat over a Bunsen burner and allow the sample to char. Allow to cool and weigh again.

- **Soluble mineral content**

Mix 5 spoons of soil with 20 mL water in a beaker and stir. Filter and collect the filtrate into a preweighed evaporating dish. Heat until dry. Allow to cool and weigh again.

- **Ion content**

Add soil to water and stir. Allow to settle and use a calibrated pH and/or conductivity meter to measure ion content.

- **Specific minerals**

There are numerous chemical tests that can be conducted on soils using specific tester kits.

See Activity 13, page 14 for other soil experiments.

### Discussion

Crops and pasture require specific properties from soils. Testing soils can assist in the running of a farm.

## 18 Hydrologic properties of soil

**Aim:** To investigate the water holding and infiltration capacities of soil.

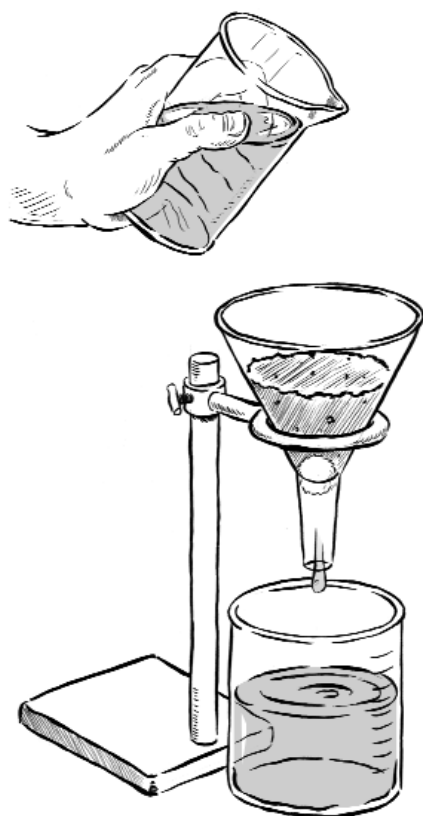
Students conduct the following practical activities.

- Water infiltration

Sink a large tin (open at both ends) into the soil to a depth of 2 cm. Place a ruler in the tin to record water depth. Pour water into the tin until it is three-quarters full. Record water depth every 30 seconds for 5 minutes. Repeat at several locations. Use graphs of 'infiltration vs time' to compare soils.

- Water-holding capacity

Plug a funnel with some cotton wool and half fill with soil. Tap down lightly and support the funnel over a beaker. Pour 50 mL water slowly into the funnel and record the time it takes to stop dripping. Record the amount of water that drips out and calculate how much was retained. Mix the soil sample with sand and repeat. Try again with humus added instead of sand. Discuss results and implications.



## Discussion

Soil needs to have an open structure to effectively hold and release water. When soils are compacted, water and plant roots have difficulty penetrating the surface. Soils can be compacted by people walking, cycling or driving, by cattle around dams and even by some ploughing methods which may create a 'hardpan' beneath the surface of the soil.

## 19 Transpiration of water

**Aim:** To understand that plants transfer ground water to the atmosphere.

(See also to Activity 7, page 10 for preliminary work on the capillary action of plants.)

Students:

- Place a plastic freezer bag over the end of a branch so that there are a number of leaves inside the bag. Adding a small pebble in the bag helps to pool the water that is collected.
- Tie on and seal the bag.
- Remove the bag after 24 hours and measure the amount of water transpired.
- Estimate the amount transpired by:
  - the whole tree in a day
  - one hectare of forest (assume 70 trees/ha) in a day
  - a forest in one year.

## Discussion

- What would be the effect on the soil's water table of clearing large areas of forest?
- A rising water table carries salts to the surface. How might salinity problems be addressed by extensive tree planting?

## 20 Extracting essential oils from plants

**Aim:** To investigate and produce essential oils from plants.

Many plants, for example, eucalypts and herbs, contain essential oils. These volatile oils are called essential because they contain the distinguishing fragrance and many of the characteristic chemicals of the plant.

Students:

- Extract oils by mixing the plant material with water and then distilling or steam distilling the mixture. Science or Chemistry texts should be consulted for details of equipment and procedures.
- Place distillate in mystery bottles (label with a code) which other students identify by smell.
- Research for a presentation on the medicinal and other uses for the oils. The presentation could include a component in which volunteers from the audience attempt to identify oils by 'scratching and sniffing' pieces of paper impregnated with oils.

### Extension

Plants are a source of a large variety of chemicals useful to society, ranging from flavours and oils to medicines and dyes.

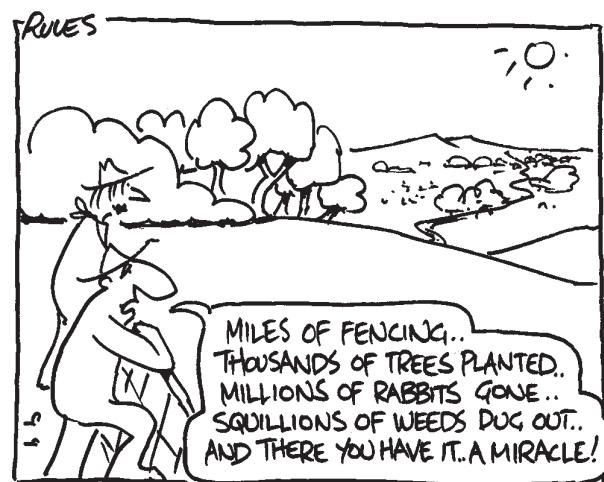
Students could watch the movie *Medicine Man* in which actor Sean Connery searches the Amazon Jungle for a plant which contains a chemical that could be a cure for cancer.

## 21 Future harvesting

**Aim:** To research sustainable farming techniques.

Students research and prepare a poster, display or class presentation focusing on a technique used by farmers to make their farm more sustainable. For example:

- tree planting
- water management
- erosion control
- crop diversity—moving away from monoculture
- minimising the use of fertilisers and insecticides
- using/recycling wastes.



The case study summaries on the *Future Harvest* website would be a good starting point for this research.

## 22 Needs analysis

**Aim:** To explore relationships between systems and observe how the outputs of one can be used as inputs for another.

Conducting a needs analysis is a very useful process for the planning of a wide variety of activities by business and industry. This activity utilises a simplified version of this process.

Divide the class into three groups: 'chicken', 'garden/orchard' and 'household'. Each group works together to brainstorm and record a list of needs and one of products on a large sheet of butcher paper. (See diagram.)

CHICKEN	
NEEDS	PRODUCTS

Encourage the students to include anything that might be relevant on their lists. For example; chickens need grit, protein (worms, meat, seeds), shelter and the presence of other chickens. Chickens produce eggs, manure, feathers, noise and heat. Chickens also spend a lot of time scratching the ground or floor. Students might need to carry out research at this stage.

After the lists are complete, ask group representatives to explain their lists to the rest of the class. The class may have a few additions.

Pin each list up and ask the students questions such as:

- What does a chicken need that can be provided by the household?
- What does a chicken produce that satisfies a need of the garden or the household?

Use questions such as these to make links between the needs and products of the three lists.

### Discussion

Systems depend on each other. Creative ways to integrate them can result in resource savings as well as waste reduction. Taking account of the needs and products of a system is an important step towards ensuring its sustainability.

## 23 Build and maintain a 'no-dig' garden

**Aim:** To design and build a 'no-dig' vegetable garden.

See Appendix 6, pages 37 to 38 for details of this activity.

## 24 Worms at work

**Aim:** To investigate the action of worms in the soil.

Students:

- Build a wormery using either a tall glass jar or two framed sheets of glass similar to an 'ant farm'.
- Fill with alternate layers of sand, compost and soil.
- Add worms and food (for example, vegetable scraps, paper). Water should be added so the mixture is damp but not soaking.
- Place a removable cover around the outside to stop light entering.
- Observe changes after a few days.

### Extension

A larger wormery could be established in a series of stacked trays or boxes and integrated with other recycling/composting programs at the school. Commercial tubs for worm farms are available from many councils and hardware stores.

See Activity 11, page 12 for ideas on how to set up a composting/worm farm project at your school.

### Discussion

The conditions in a wormery need to suit the living requirements of the worms.

Worms lay eggs without shells and have moist skin. The wormery must be kept moist. If too wet, worms will suffocate, if too dry, they dehydrate. The wormery should be kept cool and dark to simulate the conditions of normal soil.

Worms will eat most food scraps and papers but do not like too much acid so avoid too many citrus scraps. Worms produce waste called 'castings' which is a very concentrated source of nutrients for many plants. The liquid that drains from a wormery is also a good fertiliser.

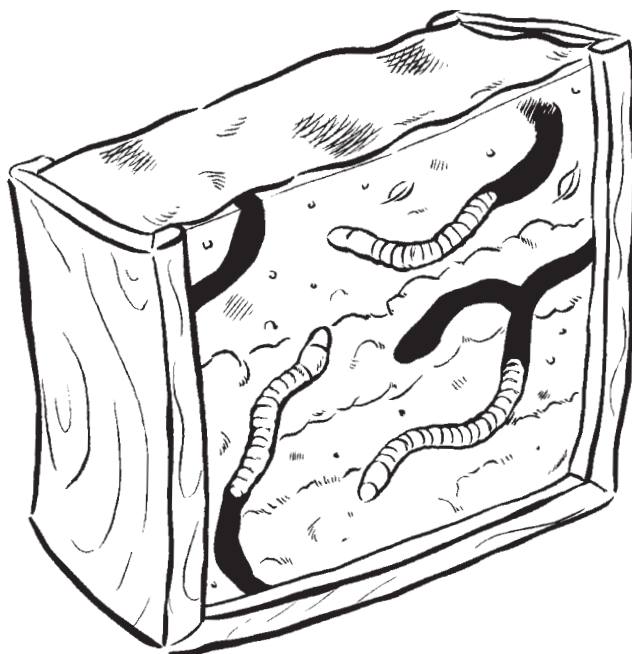
Worms improve soils in other ways too.

Worm holes create spaces for air and water to pass through the soil and help give the soil an open structure which is more easily penetrated by plant roots. Also, the tunnelling process mixes the soil and helps organic materials to decay.

Like all animals and plants, there are many species of worms. In general, worms fall into two groups:

- Worms that live in the top layers of the soil and prefer to eat organic material. These 'composting' worms are the best ones to use in a domestic wormery to break down compost. Commonly available species include red, blue and tiger worms.
- Worms that live deeper in the soil and prefer to forage for minerals in the subsoil. These worms are very useful in bringing nutrients up to the topsoil as well as providing tunnels that improve the drainage of water through the soil.

Common garden worms can be one or other of these types of worms or, more probably, a crossbreed of a number of species.



## Secondary SOSE

### 25 Landscapes

**Aim:** To observe local examples of weathering and erosion and relate these to wider issues of human impact on the environment.

Students and teachers:

- Walk around the school yard to observe erosion and weathering, for example, in places where students walk across a lawn area, where there is water run-off or where paint has bubbled and cracked.
- Discuss what caused the effects observed.
- Use pictures/posters portraying a variety of landscapes to stimulate large and/or small group discussions on the natural forces which have shaped these landscapes and the effects of human activity. Both positive (such as part of a well-managed farm) and negative images should be included.

### 26 Food for all seasons

**Aim:** To conduct taste tests and investigate the seasonal nature of foods.

Obtain several varieties of a particular fruit, for example, apples. Slice the fruit so that each student has a piece of each variety.

Students:

- Score each variety according to taste. Criteria for taste could include juiciness, texture, crispness, sweetness and aroma. Students tasting the fruit should be blindfolded to ensure that results are not biased by appearance.
- Record the results in a chart.
- Discuss why taste does not appear to be the main factor that determines which varieties are grown and sold. (Consider factors such as appearance, size, shelf life, resistance to disease, yield, suitability of soil and climate, harvest season and local growing conditions.)
- Research when particular fruits and vegetables are in season in their region.
- Present their findings as a poster.



## 27 Defining sustainability

**Aim:** To explore various viewpoints about sustainability.

Students:

- Brainstorm their ideas about sustainability.
- Each ask five people (parents, relatives, friends, teachers, shopkeepers) for their ideas/definitions of sustainability.
- Display all responses on individual pieces of paper in appropriate groupings.
- Discuss the significance of the results obtained.

### Further discussion

Appendix 1, Page 29 lists some ways of stimulating further discussion. Focus of discussion might include sustainable and non-sustainable practices, food production techniques, efficiency of food distribution methods, the impact of population growth and global economies.

## 28 Act locally... think globally

**Aim:** To investigate and become involved in local land management issues.

Teachers:

- Contact local authorities to develop a list of current land management issues.

Students:

- Add local environmental issues of their own.
- Discuss in groups and prepare preliminary reports on possible solutions for these issues.

### Further discussion

Teachers, in collaboration with students:

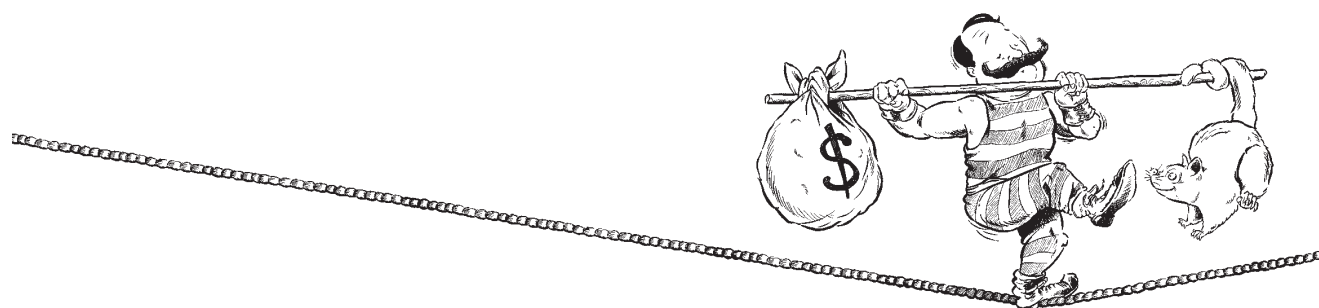
- Invite speakers to talk about how a local group may be formed to address local issues identified in preliminary reports.
- Invite speakers to talk on local issues.

Students:

- Become more actively involved through the organisation of a group or campaign. As an alternative, the class may consider working with, for example, a local Landcare, Parks Conservation group or farmer for a day to do some tree planting.

### Thinking globally discussion

- Many people consider that sustainability can be achieved through technological innovation without any change in lifestyle.
- In a market-driven world, advertising tries to appeal to our wants and encourages people to consume rather than consider environmental impacts.
- Governments try to follow what they think 'most' people want, tend to think short term and respond to issues when the groundswell is big enough to cost votes.
- It is important that people are in a position to make informed decisions, learn how to cooperate with others and become active in the community. Many significant changes occur at a local level first.



## 29 Advertisements

**Aim:** To promote community awareness of environmental and resource issues.

Students:

- Design and prepare information ads (posters, newspaper radio and/or TV ads), that will inform farmers and the general public about how they can tackle an environmental and/or resource issue, for example, salinity, water tables and tree planting; monoculture and companion planting; and waste recycling.

For some detailed instructions on how to produce your own advertisement, the Media Foundation has an Internet site at:  
<http://www.adbusters.org/main2.html>

## 30 River catchments

**Aim:** To investigate a river catchment.

Students:

- Undertake a field investigation of a local river or stream, dividing it into appropriate sections.
- Focus on the physical characteristics of the catchment in each section.
- Carry out more detailed observations through the use of transects and quadrats.
- Prepare a field report as a product of their studies.

If a field study is not practical, then students could analyse and interpret information from maps, photographic and numerical data. Features to be addressed could include depth, quality, meanderings, flood plain size, bank height, areas suffering from salinity, irrigation channels and land use patterns. This could take the form of a description and analysis of rainfall patterns, numbers of tributaries, volume of water flow, number, type and placement of trees. Discussion could include issues such as salinity, erosion control or the various uses of water, and the potential for conflict between water users in river systems.



## 29 Picnic time!

**Aim:** To discover different types of food and where they come from.

Organise a picnic with your class. Groups (or individuals) could be set the challenge of putting together platters of food each on a specific theme, for example:

- in season now
- locally grown
- grown in Victoria
- Australian produced
- family/cultural/traditional foods
- 'bush tucker'
- low environmental impact.



As a follow-up, students could bring along seeds, seedlings and home-made produce to swap with others.

## 32 Towards sustainability

**Aim:** To investigate how local industry is responding to the challenge of sustainability.

Contact farmers, representatives of local industry or retail stores regarding their willingness to be interviewed by students about processes, techniques and sustainable practices.

Supervise the arrangement of these interviews to ensure that no person is interviewed more than once.

Information could also be researched and obtained from groups such as Agriculture Victoria and the Wheat Board. For contact details, see *Future Harvest* website [www.museum.vic.gov.au/futureharvest/gcplinks.html](http://www.museum.vic.gov.au/futureharvest/gcplinks.html)

Students could then prepare a poster and/or oral report to the class.

### 33 Developing a proposal

**Aim:** To model the development of an environmental strategy proposal.

Students:

- develop proposals using agreed criteria.

The class brainstorms a set of funding criteria that the 'Government' will use to decide which proposal(s) to implement. Factors could include total budget and a list of preferred outcomes. Funding is limited and only the most suitable projects will be able to get financial support.

The class should agree that it is the teacher who will assess each proposal using the agreed criteria.

Arrange students into groups to deal with a specific environmental problem. Each group prepares a proposal.

Each group presents their proposal to the class. After class discussion, each group hands their proposal to the teacher for assessment.

#### Discussion

How far does this process really reflect the real world?

### 34 Past, present and future environments

**Aim:**

- To explore the history of a local area.
- To research planning in the area.

Students:

- Study a range of resources such as maps, aerial photographs and descriptions of their local area.
- Interview parents, grandparents, or residents of a local elderly citizens home about changes to the local area over their lifetime.
- Research government and council planning documents.
- Share their findings with the class and discuss the changes.

Teachers could invite guest speakers to speak to the class, for example, a local community identity, historian, councillor, environment officer, developers and activists.

#### Extension

Divide students into groups focusing on particular decades. Using the resources listed above, the groups construct a timeline which describes changes within their local area. The various decade groups could then join their timelines together to form a larger display.

### 35 Food from where?

**Aim:** To investigate where our food is produced.

Each student:

- Is given a list of food groups—proteins, starches and sugars, fruit and vegetables, dairy, fats and oils, with examples of each.
- Lists 10 food products found in their home; two from each food group.
- Finds out where each product is produced (locally, in Victoria, interstate, overseas). For fresh food such as fruit or meat, students may have to get information from their supplier.

Divide the class into five groups and assign each group a collation task:

- **Group 1:** Chart the percentage of products produced locally, in Victoria, interstate, and overseas.
- **Group 2:** List products produced locally.
- **Group 3:** List the major products produced in Victoria.
- **Group 4:** List the major products produced interstate.
- **Group 5:** List the major products produced overseas.

Each group transfers the relevant information from each student's food list, marks it as read after being processed and passes the list onto the next group.

Groups present their findings to the class.

#### Discussion

Discuss findings. In general, fresh, locally produced foods have the least environmental impact since production and transport costs are less. From the foods surveyed, are there any foods that could be substituted with others that have less environmental impact?

#### Extension

The class could develop charts and maps of the area in which their chosen foods are grown.

The climate and soils in these regions could be researched and compared to the requirements of the crop grown there. Are there other regions with similar conditions that would also suit the crop? These regions could be highlighted on the maps as possible future market opportunities. This kind of study was conducted in the wine making industry for new sites for vineyards.

### 36 Bin sort

**Aim:** To identify and sort garbage items into groups according to their future use or destination.

Fill a clean garbage bin with clean mixed garbage such as: wrappers, bottles, paper, cartons, orange peel, an old shirt, etc. Empty the contents onto the floor and ask a few students to sort the garbage into eight groups—recycling (paper, aluminium, steel, plastic and glass), reuse, composting and waste.

#### Discussion

What items were placed in the various groups? Why did students consider an item to be recyclable or non-recyclable? How do the students manage garbage sorting on a day-to-day basis at home?



**Reduce**

**Reuse**

**Recycle**

**Rethink**