

Part 4

Nutrient cycles

worksheet 4.1

Plants get green suntans

Food contains nutrients. Nutrients are needed by the bodies of plants and animals to keep alive and healthy. In this section you will see how nutrients flow between the different parts of a system.

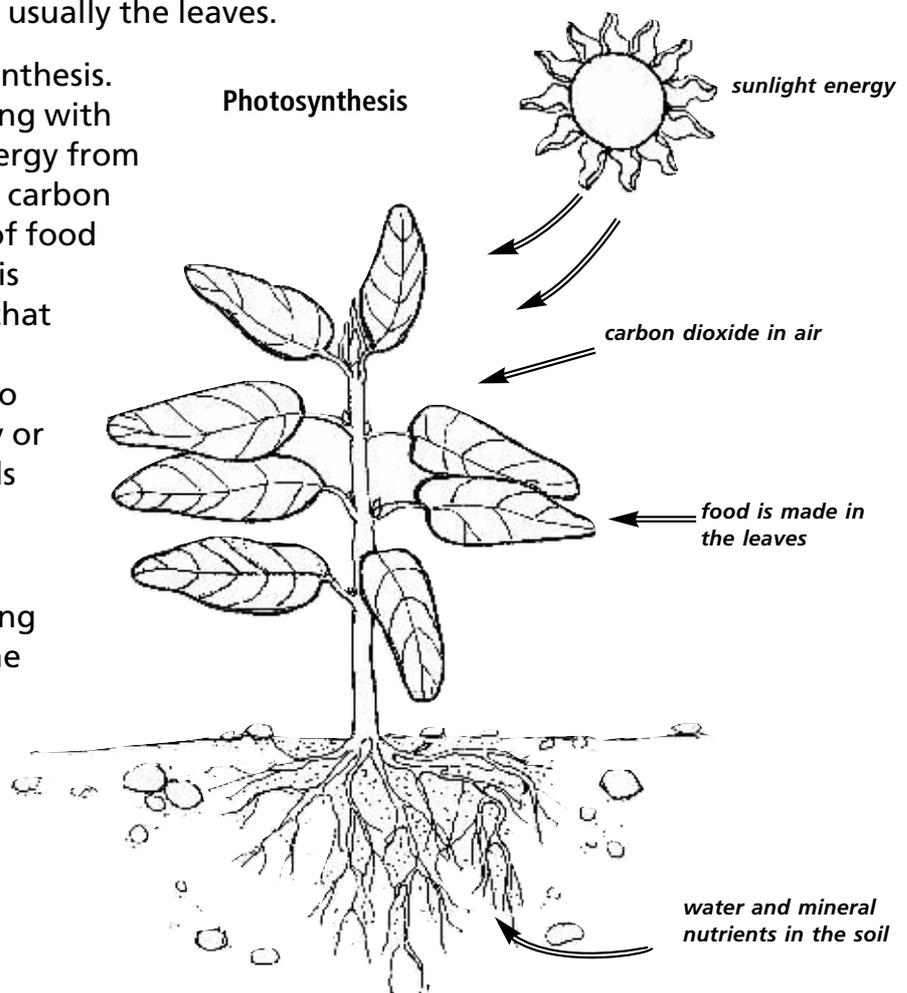
Plants have one very special feature. This is their green colour. The green colour is usually in the leaves but sometimes other parts of plants are green. Some plants are only green at certain times of the year, but all plants have green parts. These green parts of plants are important for the way that plants make food.

Plants produce starch

Look at the diagram below. Plants use the energy of sunlight, the gas carbon dioxide from the air and water and mineral nutrients from the soil to make their food. The food is made in the green parts, which are usually the leaves.

This process is called photosynthesis. Photosynthesis means "making with light". So plants use light energy from the sun to change water and carbon dioxide into food. The type of food produced by photosynthesis is starch. Plants use the starch that they make to grow and stay alive. Plants also store food to be able to grow after the dry or cold seasons or for their seeds to grow.

Besides starch, plants also produce the gas oxygen during photosynthesis. Oxygen is one of the gases in air. All living things need oxygen to live. If there were no photosynthesis, there would be no oxygen and therefore no life on Earth.



Plants need mineral nutrients

Soil contains mineral nutrients. Mineral nutrients dissolve in soil water which plants take up through their roots. Most plants need 14 different mineral nutrients. Plants use the minerals, together with the starch produced in photosynthesis, to live, grow, flower and produce fruit and seeds. If any one of these minerals is short then the plants do not grow properly.

Each mineral has a name and a symbol. The symbol is always written with a capital letter. If there are two letters in the symbol, the second is always a small letter. For example, nitrogen and calcium are two minerals. N is the symbol for nitrogen, Ca is the symbol for calcium.

Plants need different amounts of the different minerals:

- ☞ Nitrogen (N), phosphorous (P) and potassium (K) are needed in large amounts.
- ☞ Calcium (Ca), magnesium (Mg) and sulphur (S) are needed in smaller amounts than N, P and K.
- ☞ Other minerals, called trace elements, are needed in very small amounts. The trace elements are zinc (Zn), copper (Cu), manganese (Mn), boron (B), molybdenum (Mo), iron (Fe), cobalt (Co) and chlorine (Cl).

Sources of nutrients

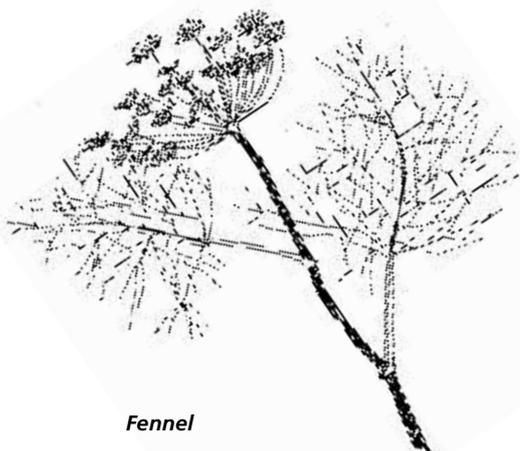
Nitrogen: good sources of nitrogen are compost, manure, guano, hoof and horn, legumes, urine, liquid manures, green leaves.

Phosphorous: good sources of phosphorous are compost, manure, bone-meal, rock phosphate, hoof and horn.

Potassium: good sources of potassium are compost, manure, seaweed (kelp) wood ash.

Dynamic accumulators

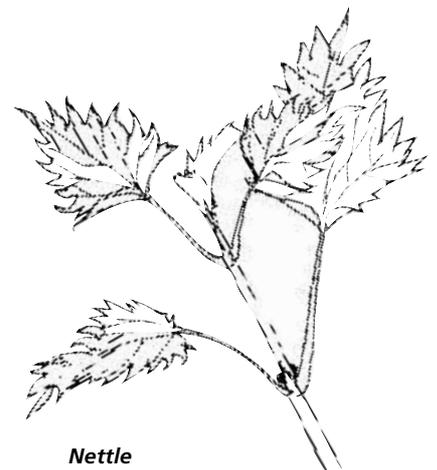
Dynamic accumulators are good sources of mineral nutrients. A dynamic accumulator is a plant that takes up one or more specific mineral nutrients from the soil. Dynamic accumulators sometimes 'mine' the soil of that mineral nutrient by sending roots down to soil layers rich in the specific mineral nutrient. When we use these plants as mulch or compost, the mineral elements that were accumulated are released into the topsoil and thus become available to other plants.



Fennel



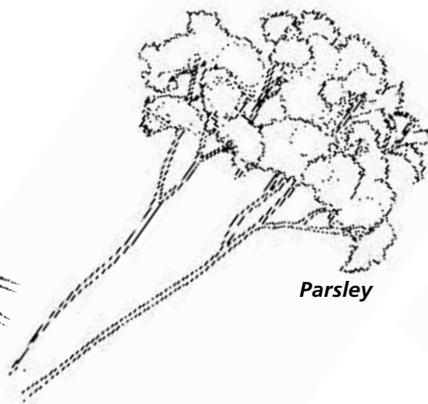
Comfrey



Nettle



Red clover



Parsley



Dandelion

The following table lists the main mineral nutrients and the plants that accumulate them.

Table 4.1: Dynamic accumulators

<p>Nitrogen Legumes Comfrey Seaweed Stinging nettle</p> <p>Magnesium Carrot leaves Comfrey Dandelion Seaweed Parsley Peppermint Willowbark Watercress</p> <p>Boron Beetroot Cardboard boxes</p>	<p>Potassium Borage Carrot leaves Chamomile Clovers Fennel Stinging nettle Parsley Yarrow</p> <p>Sulphur Fennel Garlic Mustard Stinging nettle Watercress Cabbage leaves Onions Plantain</p>	<p>Phosphate Barley Chamomile Clovers Lupins Garlic Marigolds Mustard Vetches Watercress</p> <p>Copper Plantain Dandelion Stinging nettle Yarrow</p>
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Activity 4.1



Group work

Think about plant food

- Green plants produce their own food. How do animals get food? Discuss this question with your group and write down your conclusions.
- Complete this sentence: Green plants use the energy of, carbon dioxide from the and and from the soil to produce their own..... This process is called The gas is also produced during photosynthesis.

Have you ever heard about the Gaia theory? It says that life gives rise to the special conditions needed by life. For example, all living things need oxygen yet it is living things that produce the oxygen. Our nearest planets, Mars and Venus, have no oxygen. It was the evolution of life on Earth, as microscopic plants in the early oceans, which began the production of oxygen that allowed other life forms to develop.



The nutrient cycle

Animals eat

When we feel hungry, our bodies are telling us that we need food. Unlike plants, animals cannot make their own food. Animals have to eat to get food.

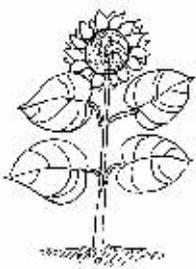
Some animals feed on plants. Plant eaters are called herbivores.

Some animals feed on other animals. Animal eaters are called carnivores.

Some animals feed on both plants and other animals. These animals are called omnivores.

All animals depend on green plants for their food. Even carnivores depend on green plants for food because they eat animals that eat plants. For example, lions eat zebra which eat grass.

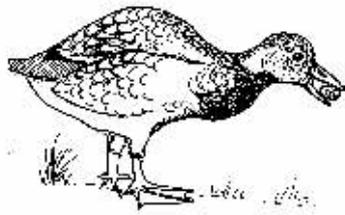
Food passes from one living thing to another. This is called a food chain. An example of a food chain is shown below.



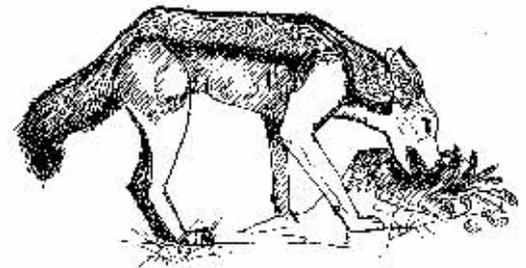
plant



snail eats plant



bird eats snail



jackal eats bird

Activity 4.2



Individual work

Think about animal food

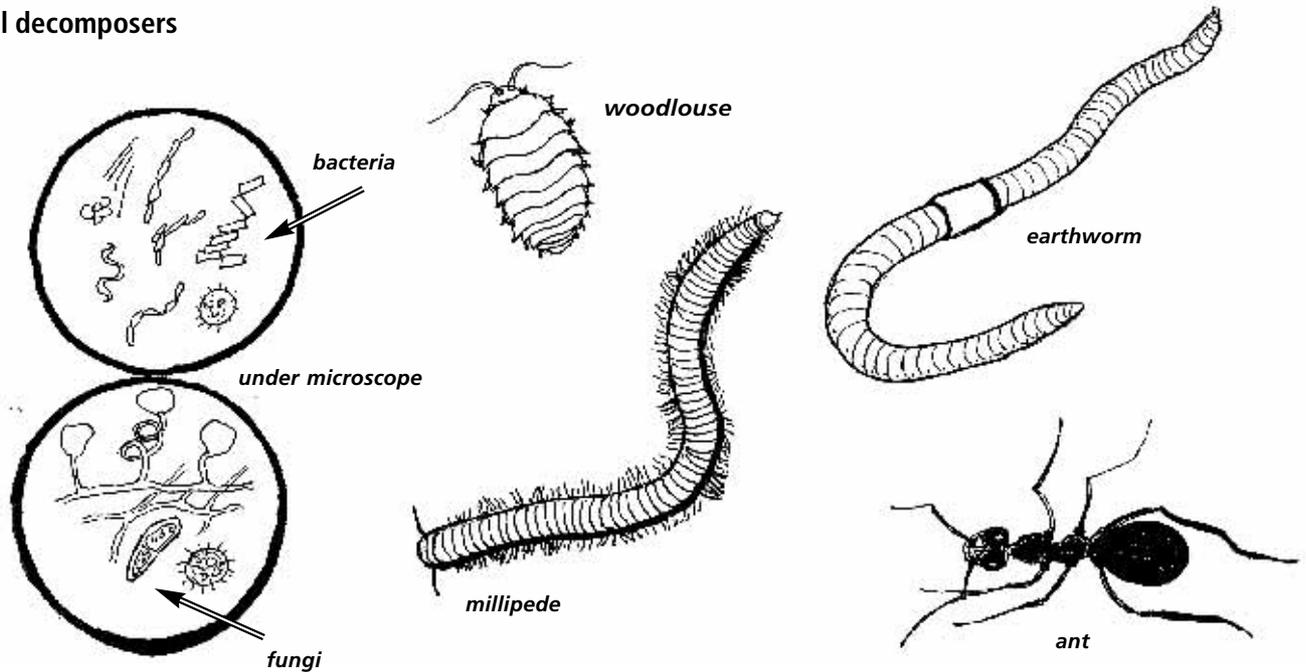
1. Research and then write down an example of a food chain in your school or home garden. To do this, it helps to first find one animal and then watch it to see what it eats and what may prey on it.
2. Write true (T) or false (F) for each of these statements.
 - a) Animals that eat other animals are called omnivores.
 - b) Plants are the only living things that can produce their own food.
 - c) Some types of animals can produce their own food.
 - d) Omnivores are animals that can produce their own food.
 - e) All animals depend on green plants for their food.
 - f) Some plants get their food from animals.

Decomposers recycle nutrients

Decomposers feed on organic matter. Organic matter is material that came from living things. Living plants produce organic matter when they drop their leaves, seeds or fruits. Living animals produce organic matter when they get rid of their solid wastes (faeces) and liquid wastes (urine).

When plants and animals die, their bodies form another source of organic matter. Most decomposers live in or on the soil. Soil decomposers range in size from bacteria and fungi – that we can only see if we enlarge them under a microscope – to larger animals like ants, millipedes, woodlice and earthworms.

Soil decomposers



Soil decomposers slowly break down, or decompose, organic matter into humus. Humus looks like black breadcrumbs. Soils rich in humus have a rich dark colour, a good smell and a soft, spongy feel. Humus acts like mineral nutrient bank, because its particles store large amounts of mineral nutrients. In breaking down organic matter, decomposers return mineral nutrients that were in the plant or animals bodies to the soil where they again become available to growing plants.

Besides supplying mineral nutrients, humus improves the soil in many other ways:

- ☞ Humus helps the soil to hold water. This is especially important for sandy soils which dry out quickly if they do not contain humus.
- ☞ Humus helps extra water to drain from the soil. This is especially important for clay soils which can become so full of water that there is no air left in the soil.
- ☞ Humus helps to cool the soil in summer and to warm it in winter.
- ☞ Humus stops the soil from becoming hard and compacted. It keeps the soil light and full of air so that roots can easily spread through the soil.
- ☞ Humus binds the soil so that it is not eroded by wind or water.

A soil's fertility largely depends on how much organic matter it has in it. Soil organic matter is usually found in the dark topsoil, not in the lighter coloured subsoil that lies beneath the topsoil. We can increase the fertility of any soil by adding lots of organic matter. This extra organic matter means more food for decomposers, which therefore grow and flourish, rapidly changing organic matter into humus. In the next few weeks we are going to be using a number of different methods to improve the soil of the school garden.

Activity 4.3



Group work

Investigate decomposition in the soil

Each group will need

a spade, sheets of newspaper, a magnifying glass if you have one

Look for moist soil beneath fallen leaves under a tree.

Scoop up the top layer of soil with a spade and put it on a sheet of newspaper.

Look closely at the soil and then answer these questions:

- Can you see any remains of living things like plant roots or leaves?
- Are these remains of living things whole or have they begun to break down?
- Can you see any soil animals such as earthworms, woodlice or millipedes?
- If your answer to c) was yes, describe what soil animals you can see. Draw them too.
- What do you think the soil animals feed on?
- What colour is the soil?
- Do you think the soil is rich in humus?
- Give a reason for your answer to g).

Legumes produce nitrogen

Nitrogen is a mineral nutrient that plants need in large amounts. If a soil is short of nitrogen, the plants growing in it are usually small and yellow in colour. Most of the air is made up of nitrogen gas, but plants need nitrogen in the form of nitrates or nitrites, so the nitrogen in the air is unavailable to plants.

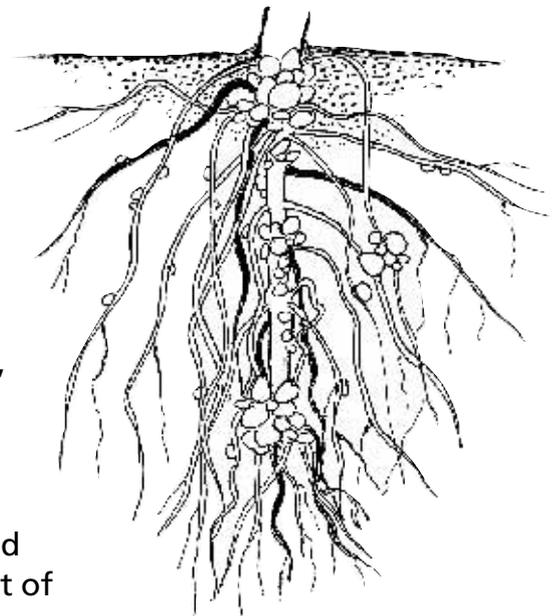
Legumes are a family of plants that have a special way of improving soil fertility. You can recognize legumes because they all produce their seeds in pods. Examples of legumes are all beans and peas as well as peanuts, cowpeas, lucerne (alfalfa) and trees such as acacias, honey locust and leuceana.



Legumes produce their seeds in pods

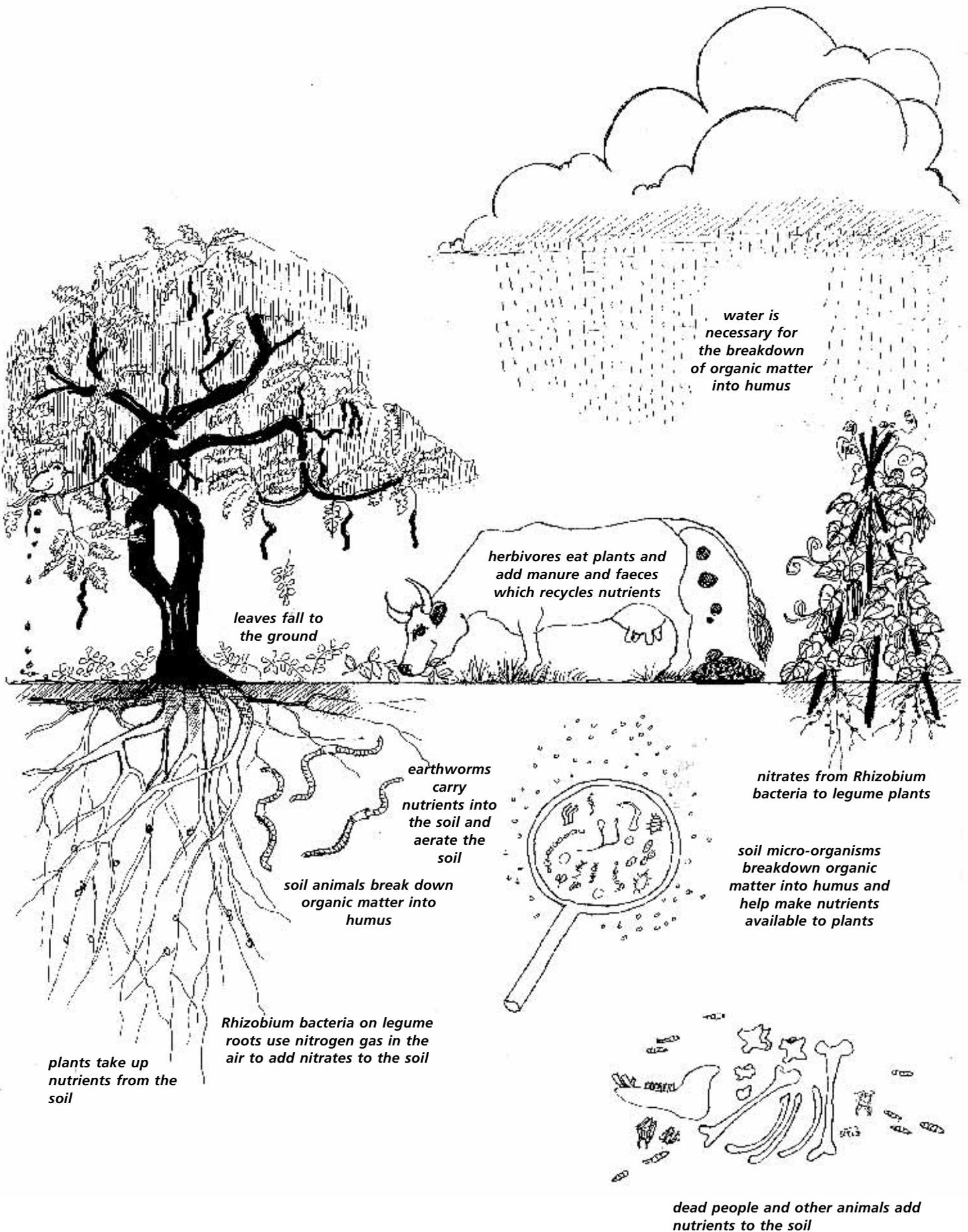
Legumes have little lumps, called nodules, on their roots which contain a type of bacteria called *Rhizobium*. These bacteria take nitrogen gas out of the air and change it into nitrates. The legume gets some of the nitrate while it is growing, and some it goes into the soil.

When we grow legumes, we can mix *Rhizobium* inoculant with the seeds before planting. An inoculant is a small amount of bacteria or other micro-organisms that you add to a substance where the micro-organisms are needed. You can buy *Rhizobium* from seed shops where you buy legume seed. Each different legume has its own species of *Rhizobium*.



Nodules of *Rhizobium* bacteria on legume roots

The nutrient cycle



Answers to questions

1. Animals get their food by eating either plants or other animals.
2. Green plants use the energy of sunlight, carbon dioxide from the air and water and mineral nutrients from the soil to produce their own food. This process is called photosynthesis. The gas oxygen is also produced during photosynthesis.

Curriculum links

(find below with activities 4.2 and 4.3)

worksheet 4.2 The nutrient cycle

Activity 4.2 Think about animal food

Individual work

Work through the theory before the activity first and then allow the learners to work individually to answer the questions. This is a good activity to give for homework as it encourages learners to look around their home or school gardens to find the answer to Question 1.

Answers to questions

1. There are many possible answers. For example, plant, aphid, ladybird beetle. The animal and plant names can be in the learners' home languages as the names may not be known in English.
2. a) F
b) T
c) F
d) F
e) T
f) F

Activity 4.3 Investigate soil decomposition

Group work

Each group will need

a spade, sheets of newspaper, a magnifying glass if they have one

Answers to questions

The answers are all descriptive according to what the learners see in the soil sample.

Curriculum links (Activities 4.1-4.3)

Core knowledge and content

NS Life and Living

- Green plants produce their own food and grow by using water and substances from the air and soil. Energy from light is needed to change these simple substances into food and plant material. Green plants are the only organisms that can produce food in their own bodies.
- Animals cannot make their own food, and so animals eat plants for food while some animals eat other animals. All animals ultimately depend on green plants for their food.
- Soil forms by natural processes from rock and from dead plants and animal material. Substances that plants take from the soil must be replaced to maintain the fertility of the soil.

Outcomes

NS LO2: Learners know, interpret and apply scientific knowledge.

Assessment

In all three activities, assess the correctness of the answers to the questions.