

Part 7

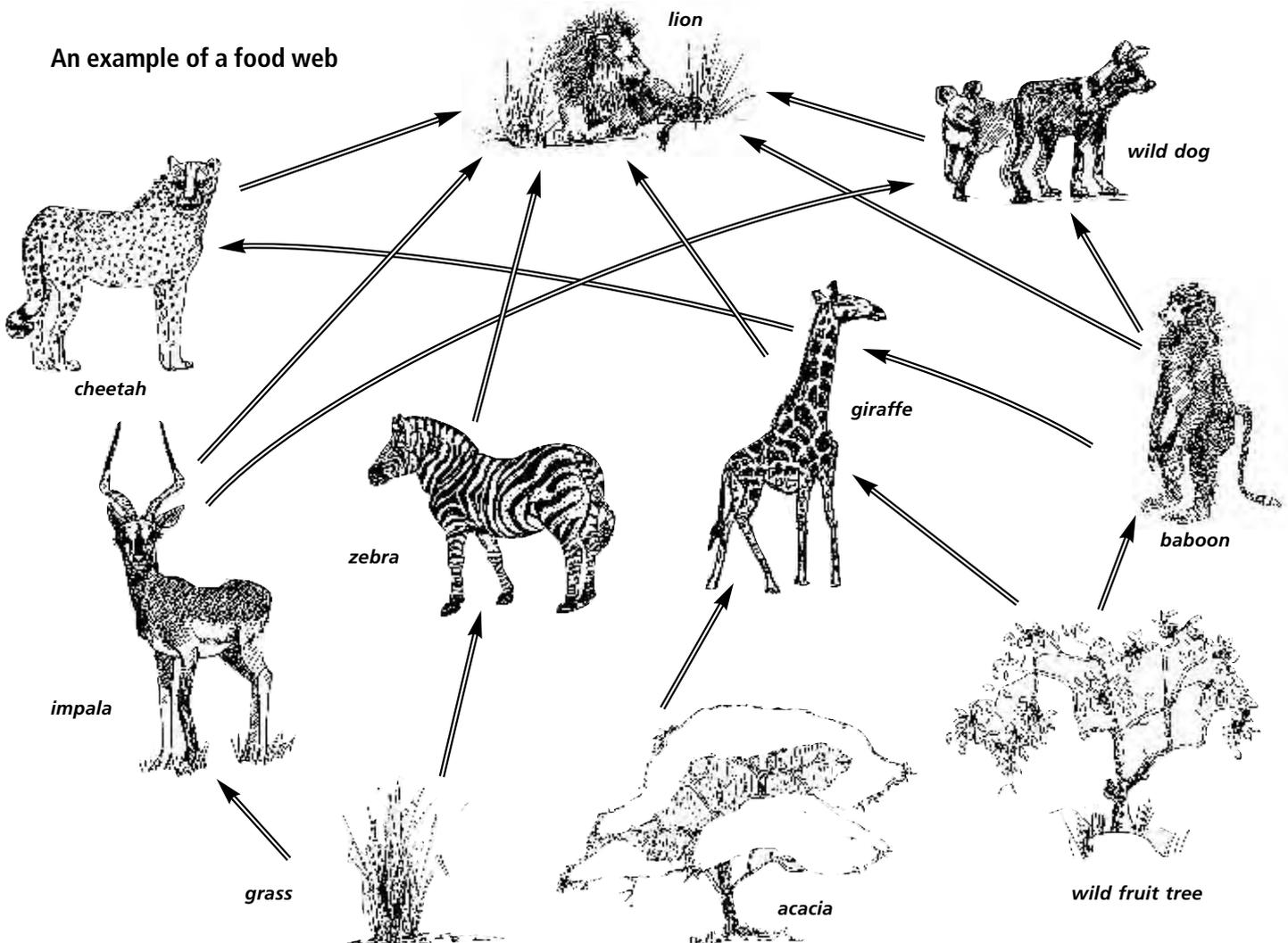
Ecosystems and guilds

worksheet 7.1

Working with ecosystems

In any area, the living things (plants, animals and micro-organisms such as fungi and bacteria) and the non-living things (soil, water, air, sunlight, rocks, climate) all interact together and depend on one another. This interaction forms a system called an ecosystem. Any ecosystem is made up of three groups: producers, consumers and decomposers.

Plants are the producers because they produce their own food by the process of photosynthesis. The consumers are animals. Decomposers, as you read above, are fungi, bacteria and soil animals that break down organic matter. This supplies mineral nutrients to the plants. There are many different producers, consumers and decomposers in an undisturbed ecosystem. These all act together to form a food web.



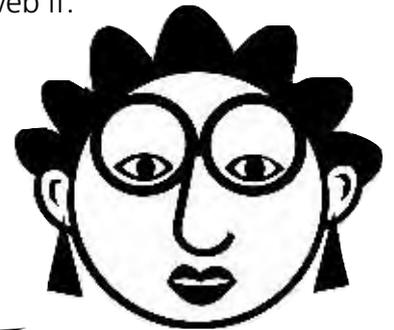
Activity 7.1



Pair work

Think about food webs

1. Describe the food web in the diagram by filling one of the words below into the gaps in the paragraph.
sun, grass, cheetahs, wild dogs, zebra, baboons, giraffe
The plants make food using the energy from the _____. The impala get their food by eating _____. The animals that eat impala are the _____, _____ and _____. Besides impala, the lions also eat _____, _____ and _____.
2. What do you think would happen to this food web if:
 - a) the number of lions decreased?
 - b) the number of lions increased?



The other important relationship between plants and animals is that of pollination – many flowering plants are pollinated by animals such as bees, birds and butterflies.

Succession

People often disturb ecosystems. They do this by causing big changes to the numbers of one or more type of animal or plant in a food web. This can cause the whole food web to change or to be destroyed. After a disturbance, ecosystems go through a process of change that is called succession.

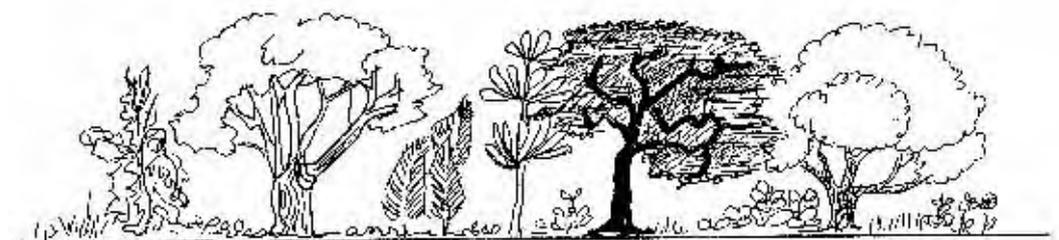
1. After a natural or human disturbance, such as ploughing, weeds and grasses begin to grow on the disturbed area. The first plants to grow in a disturbed area are called pioneers. They cover and protect the soil, bring in nutrients and make the environment less harsh for other types of plants.



2. Small bushes and tough herbs follow the pioneers in a few seasons and further improve growing conditions. Pioneers add diversity. Insects, birds and other animals arrive.



3. As the soil and growing conditions improve, more plants and trees are able to grow. The plant community stabilises. The ecosystem moves from a pioneer stage to a climax stage.



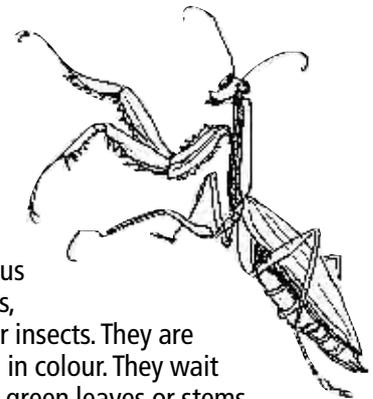
Pioneer plants	Climax plants
Can grow in difficult environments	Need stable environments
Large numbers of few different plants	Small numbers of many different plants
Simple food web	Complex food web
Plants are annuals – they live for less than one year	Plants are perennials – they live for many years

As your garden develops, you will see succession happening in front of your eyes!

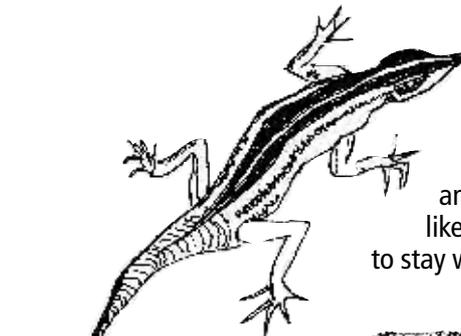


Habitats

Some kinds of animals can live almost anywhere in the world, but most animals are only able to live in a certain habitat. A habitat is a particular type of place where a particular plant or animal can survive.



Praying mantises are carnivorous insects, that is, they eat other insects. They are usually green in colour. They wait unmoving on green leaves or stems, ready to catch any insect that passes by.



The habitat of most South African lizards is a sunny, rocky spot. **Lizards** are cold-blooded animals, so they must like to be in sunny areas to stay warm.



Chameleons are known for their ability to change their color, their elongated, sticky tongue with which they catch their prey, and for their eyes which can be moved independently of each other. Most chameleon species live in trees where they take on the colour of the surrounding foliage as they wait for passing insects.

The **frog's** habitat is in or near ponds. This is because frogs lay their eggs in water. Tadpoles hatch from the eggs and remain in the water while they develop into frogs. They are then able to leave the water. The area round the pond provides plenty of slugs, flies and other insects for the frog to eat.



Can you describe the habitats of a few different animals?



Animals' habitats provide them with:

- 🌱 places where they can find their particular type of food
- 🌱 places where they can hide from animals that may feed on them
- 🌱 places where they can shelter their young until the young are old enough to survive alone
- 🌱 places where they can rest
- 🌱 materials to build their nests.

Plants provide the habitat for many animals. When people clear the plants off land for farming and building cities, they destroy the habitats of many animals. This causes the numbers of these animals to decrease.

Many animals are becoming extinct because people are destroying the plants on which they depend. We say that an animal is extinct when there is not a single one left on Earth. Many South African animals, such as the blue antelope and the quagga, a type of zebra, are already extinct.

Scientists say that 50 000 different types of animals will become extinct in the next 50 years unless people act quickly to protect them. To stop the extinction of animals we have to change our farms and cities in ways that protect the habitats of animals.

Biodiversity

Biodiversity is the diversity of life. People's interference in the environment has greatly decreased biodiversity mainly because of the loss of habitat. For example clearing natural forests with thousands of different plants and animals to plant pine trees for timber. Ecosystems cannot function properly if there is a loss of biodiversity. In Permaculture, we encourage biodiversity.

Activity 7.2



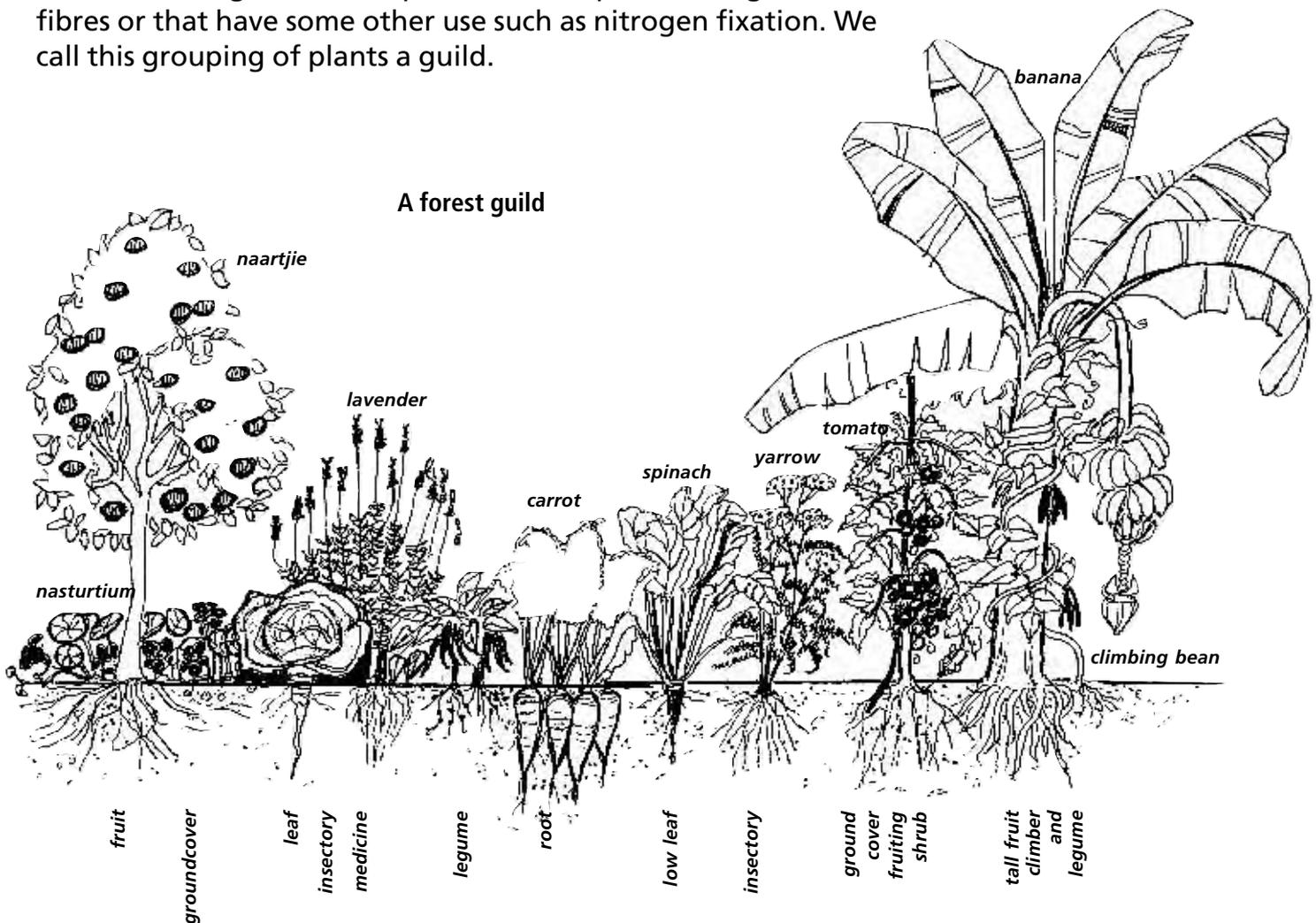
Homework

Explore animal habitats

1. Investigate and describe the habitat of three wild animals living near your home. These will probably be small animals such as rats, birds and spiders.
2. Choose three of the animals shown on the previous page. Describe what you think will happen to them if the plants on which they depend are cleared for farming.
3. People are one of very few kinds of animals that can live almost anywhere in the world. Why do you think this is so?
4. Speak to an old person who lives near your home. Ask him or her whether there are any animals that used to live in the area but that now can no longer be found there. Write down what he or she says.
5. Do you think the biodiversity of the area had increased or decreased? Give a reason for your answer.

Guilds and food forests

Permaculture gardens are based on natural forest systems. If you studied the plants growing in natural forests, you would notice that certain species of plants tend to grow together because they benefit one another. We use this idea in Permaculture gardens, but instead of using wild forest plants, we use plants that give us food, medicine or fibres or that have some other use such as nitrogen fixation. We call this grouping of plants a guild.



A forest guild can be planted over three years. First we plant the pioneers. Then the annual vegetables, and some perennial vegetables and herbs, and finally fodder and fruit trees and climbers and creepers that will grow on the trees.

You should include indigenous plants, that is, plants that originate in your area, as these are well suited to the area. Indigenous plants also provide a habitat and food for wild birds and other animals threatened by the loss of their natural habitats.

Guilds can include: creepers, groundcovers, annual and perennial herbs and vegetables, fruit trees, legume trees and groundcovers.



If I remember correctly, annuals are plants that grow, flower and set seed in less than one year while perennials live for many years, usually flowering and fruiting at the same time every year.

Activity 7.3



Pair work

Activity 7.3 Thinking about food forests

1. Which foods do you eat that come from trees?
2. What do you think 'food forest' means?

Choosing plants for a guild

Here are a three important principles we use when choosing plants for a guild: stacking, companion planting and usefulness. We will explore these three principles in the following sections.

Stacking

Stacking involves using all available space, including vertical space. For example:

- 🌿 climbers and creepers that grow over trees and trellises to make use of vertical space
- 🌿 shade-tolerant plants under trees
- 🌿 groundcover plants as living mulches, to fill in the spaces at ground level and cover and protect the soil.

Table 7.1: Climbing plants and groundcovers

Climbing plants – plants for vertical space	Groundcovers – plants for living mulch
<ol style="list-style-type: none"> 1. Legumes Common beans Four wing bean Lablab bean Velvet bean 2. Cucumber family Watermelon Melon Cucumber Pumpkin Loofah Shoo-shoo Oysternut 3. Grapes Wild grapes Mediterranean grapes 4. Malabar spinach 5. Granadillas Granadilla Bananadilla Giant granadilla 	<p>Bambara groundnut Cowpea Chickpea Desmodium Groundnuts Pigeon pea Sunnhemp Sweet potato</p>

Companion planting

Companion plants are plants that enhance each other's functions, repel insects from each other or simply improve their companion's flavour. Antagonists are plants that do not like one another. The table below lists the companions and antagonists of some common vegetables and herbs.

Table 7.2: Companion and antagonist plants

VEGETABLE	COMPANION	ANTAGONIST
Asparagus	Tomatoes, parsley, basil	
Beans	Potatoes, carrots, cucumbers, cauliflower, cabbage, summer savoury	Onions, garlic, gladiolus
Bush beans	Potatoes, cucumbers, corn, strawberries, celery, summer savoury	Onions
Pole beans	Corn, summer savoury	Onions, beets, kohlrabi, sunflowers
Beets	Onions, kohlrabi	Pole beans
Cabbage family (cabbage, cauliflower, kale, kohlrabi, broccoli)	Aromatic plants, potatoes, celery, dill, camomile, sage, peppermint, rosemary, beets, onions	Strawberries, tomatoes, pole beans
Carrots	Peas, leaf lettuce, chives, onions, eeks, rosemary, lsage, tomatoes	Dill
Celery	Leeks, tomatoes, bush beans, cauliflower, cabbage	
Chives	Carrots	Peas, beans
Corn	Potatoes, peas, beans, cucumbers, pumpkin, squash	
Cucumbers	Beans, corn, peas, radish, sunflowers	Potatoes, aromatic herbs
Eggplant	Beans	
Leeks	Onions, celery, carrots	
Lettuce	Carrots, radishes, strawberries, cucumbers	
Onions and garlic	Beets, strawberries, tomatoes, lettuce, summer savoury, (sparse) camomile	Peas, beans
Parsley	Tomatoes, asparagus	
Peas	Carrots, turnips, radishes, cucumber, corn, beans, most veg and herbs	Onions, garlic, gladiolus, potatoes
Potatoes	Beans, corn, cabbage, horseradish (planted at corners of patch), marigold, eggplant (lure for colorado beetle)	Pumpkins, squash, cucumbers, sunflowers, tomatoes, raspberries
Pumpkins	Corn	Potatoes
Radishes	Peas, nasturtiums, lettuce, cucumbers	
Soybeans	All	
Spinach	Strawberries	
Squash	Nasturtiums, corn	
Strawberries	Bush beans, spinach, borage, lettuce (as a border)	Cabbage
Sunflowers	Cucumbers	Potatoes
Tomatoes	Chives, onions, parsley, asparagus, marigolds, nasturtiums, carrots	Kohlrabi, potatoes, fennel, cabbage
Turnips	Peas	

Usefulness

There are thousands of plants that have specific uses for people. These uses include food, windbreaks, food for chickens or other animals, nitrogen-fixing, dynamic accumulators,

medicine, craft materials, erosion control, mulch and compost, truncheons for fences and other structures, firebreaks, plants for pest control.

Appendix 1 lists the characteristics, including uses, of about 140 plants.

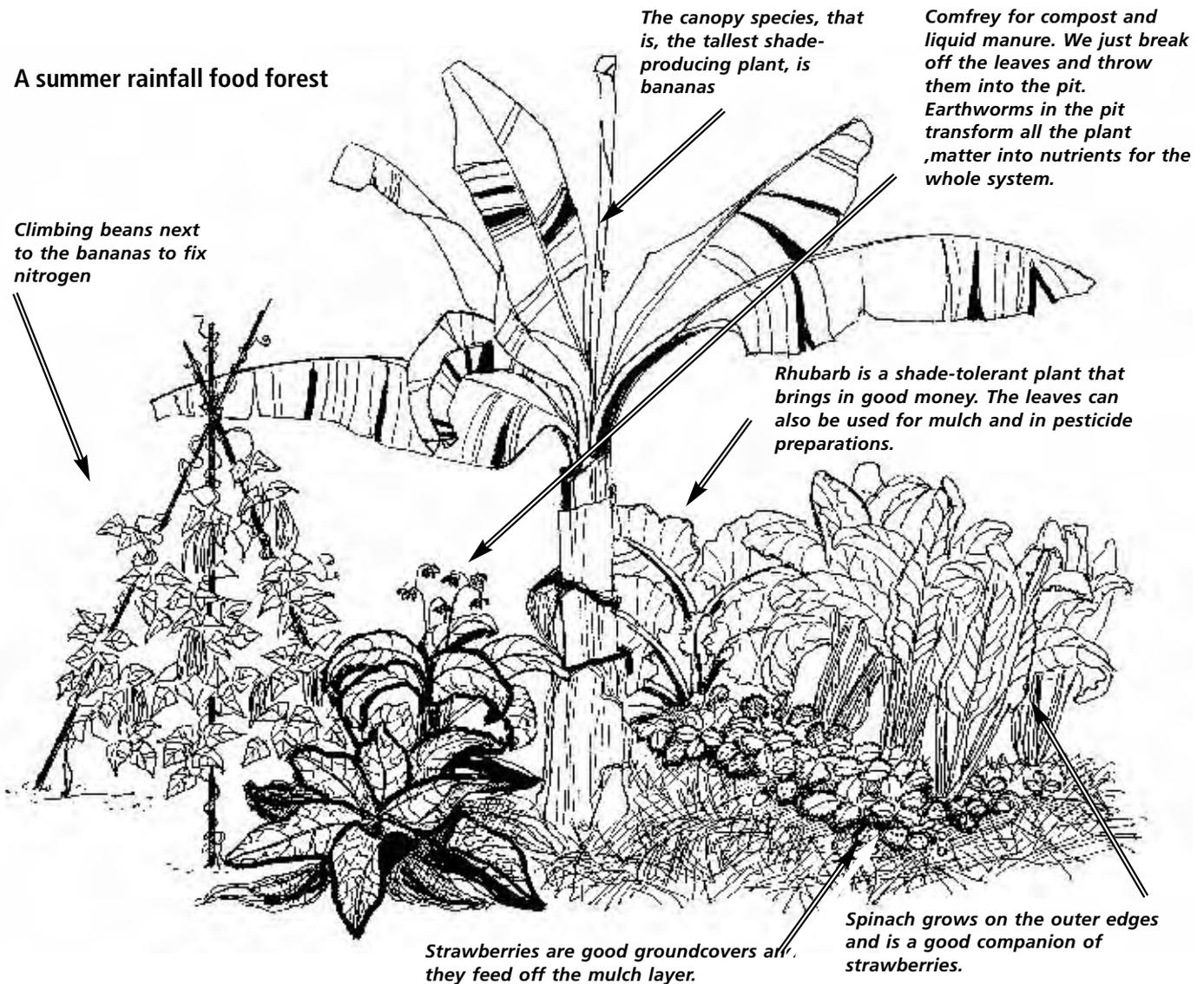
Here are some of the different uses we need in a food forest.

1. To encourage the growth of a food forest, we need:
 - ☞ plants that will provide shelter for food trees to grow
 - ☞ plants and trees that will enrich the soil (dynamic accumulators and nitrogen-fixing trees)
 - ☞ plants that we can cut back to create a layer of mulch on the 'forest floor' to protect the soil from drying out too much.

2. To fill in the spaces between all the plants in the food forest, we need:
 - ☞ fruit trees
 - ☞ ground covers
 - ☞ creepers.

Here are two examples of pit bed food forests, one for summer rainfall, and the other for winter rainfall.

A summer rainfall food forest



A winter rainfall food forest

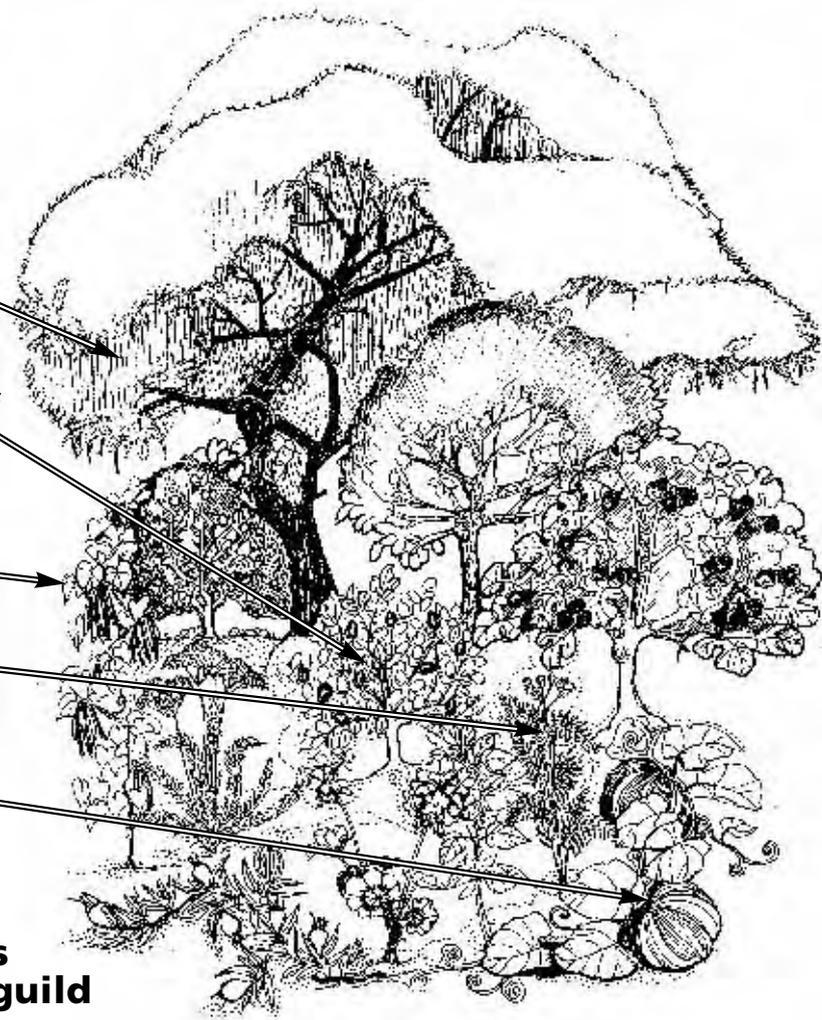
Legumes like acacia karoo and vigilia are used to establish microclimates for more delicate species

Hardy indigenous food trees like carissa, keiapple, sand olive, wild peach and wild figs are used as pioneer food species

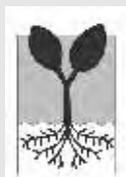
Climbers like beans, granadilla and shoo-shoo are used to add further abundance to the system

Mediterranean and soil conditioning herbs are used as an under storey. Tansy, rue, yarrow, perennial basil and geraniums

Indigenous medicinal groundcovers like vygies and pumpkins



Activity 7.4



Pair work

Choose plants for a pit bed guild

You will need

pencil, rubber

1. Imagine that you are going to plant a circular pit bed that is about 2 metres in diameter.
2. Select 10 different useful plants for the pit bed by thinking about stacking, companion planting and usefulness. Use the information in Tables 7.1 and 7.2 and Appendix 1 to help you select your 10 plants.
3. Write your selections in a table such as the one below. Work in pencil rather than pen so that you can change your selections if you want to.
 - ☞ Name of the plant can be in any language that you choose.
 - ☞ Use of plant can include food, windbreak, fodder for chickens or other animals, mulch, nitrogen-fixing, medicine, craft material, erosion control.
 - ☞ Plant type can include tree, shrub, vine or creeper, groundcover, annual vegetable or herb, perennial vegetable or herb.
 - ☞ Name of any companion plant is the names of any other of the 10 plants chosen that are companions of this plant.
 - ☞ Name of any antagonist plant is the names of any other of the 10 plants chosen that are antagonists of this plant.

Name of plant	Use of plant	Type of plant	Name of any companion plant	Name of any antagonist plant

Part 7: Ecosystems and guilds

worksheet 7.1 Working with ecosystems

Activity 7.1 Think about food webs

Pair work

1. The plants make food using the energy from the sun. The impala get their food by eating grass. The animals that eat impala are the cheetahs, lions and wild dogs. Besides impala, the lions also eat (any three of) cheetahs, wild dogs, baboons, zebra and giraffe.
2. a) In this food chain the lions are the tertiary consumers. They eat two secondary consumers, cheetahs and wild dogs, so these should both increase in number if there are no lions. Lions also eat impala and baboons, which are also eaten by the secondary consumers, so the numbers of impala and baboons will probably decrease.
b) An increase in the number of lions should lead to a decrease in all the animals on which lions feed.

Curriculum Links

Core content and knowledge

NS Life and Living

Ecosystems are self-contained areas where a wide variety of plant and animal species live and reproduce. They depend on each other and on the non-living environment. The life and reproduction of all the organisms in an ecosystem depend on the continuing growth and reproduction of plants.

Outcomes

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

Assessment

Assess the answers to the questions.

Activity 7.2 Explore animal habitats

Home activity

Introduce the concept of a habitat as a distinct place where a particular animal or plant can live. The aim is to get learners to realize that most animals have very narrow habitats and cannot survive away from them.

Answers to questions

1. These habitats are likely to be the soil and the garden plants including garden and neighbouring trees.
2. The answers for all these animals is likely to be extinction due to loss of habitat.
3. People are one of very few kinds of animals that can live almost anywhere in the world because they have been able to change their environment to make it more suitable for themselves. For example, they are able to build shelters, produce food, warm and cool their surroundings and find water under the ground.
4. This answer should be a description of what was learned from the interview of an old person.
5. This answer will depend on the answer to question 4. If there are no longer certain types of animals in the area, then the biodiversity will have decreased.

Curriculum Links

Core content and knowledge

NS Life and Living

Animals' habitats are the places where they feed, hide and produce and shelter their young. People are destroying the habitats of many types of animals. This is leading to the extinction of thousands of species of animals.

Outcomes

NS LO1: Learners conduct investigations, collect data, evaluate the data and report on their findings.

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

NS LO3: Learners understand the impact of technology – learners identify the negative effects of development on the environment.

Assessment

Assess the answers to the questions.

worksheet 7.2 Guilds and food forests

Activity 7.3 Thinking about food forests

Pair work

This activity gets learners to explore the idea of a food forest.

Answers to questions

1. Food from trees includes many fruits (apples, peach, pear, avocado, lemon, orange) and nuts (pecan, almonds, macadamias, cashews) as well as spices like cinnamon and pepper.
2. A food forest is a forest planted with trees and other plants that provide food.

Curriculum Links

see below for Activity 7.4

Activity 7.4 Choose plants for a pit bed guild

Pair work

This activity gives learners practice in selecting plants according to stacking, companion planting and usefulness with the use of the information in Tables 7.1 and 7.2 and Appendix 1.

Curriculum Links

Outcomes

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

CO2: Identify and solve problems and make decisions using critical and creative thinking.

CO7: Demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation.

Assessment

Assess the completed tables.

Part 8: Pest management

worksheet 8.1 Controlling pests and diseases

Activity 8.1 Think about ways to protect plants

Group work

Learners may not have done Activity 4.2 in which they look for food chains. In this case ignore Step 1 and begin the activity with Step 2. Tell learners that they are now going to see what food chains they can find in their school grounds. Divide learners into groups and assign each group an area in the school. Agree on how much time is needed to carry out this research. Then continue with Step 4 in the classroom.

In Steps 6, 7 and 8 of this activity the learners will explore their own knowledge and ideas about protecting plants from pests, diseases and weeds. There are no right or wrong answers in this activity. Encourage discussion and the sharing of ideas and knowledge. Listening to the discussions can inform you about the nature of the learners' understanding and you to identify and correct misconceptions.