Propagation

Poster 4

Lesson Notes
Notes for the Educator

Congratulations on obtaining your Water Wise education notes from Rand Water. The following notes explain the concepts displayed in the poster, and include activities that can be done in the classroom.

The pack is aimed particularly at intermediate phase learners, and is appropriate to the Natural Sciences Learning Area, grade 9 and 10. However, the notes can be adapted to various grades by expanding on the content for more advanced groups, or condensing the content for groups that need only the basic concepts.

The facilitator should first determine the group’s needs, desired learning outcomes and the resources available. They can then decide how best to use the poster and notes. The notes include suggested activities that tie in with the outcomes-based curriculum. The content and activities also touch on the critical and development outcomes found in our constitution, in line with the Revised National Curriculum Statements.

The poster and notes may also be adapted for the training of gardeners.

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Plants produce and recycle the oxygen on which animal life depends. They capture the energy of the sun and convert it into forms that can be used by humans and animals. Plants (including algae) are the only living organisms capable of manufacturing their own food. Plants need to reproduce or multiply so that new generations of plants are produced. Plants reproduce in two ways, namely sexual (when seeds are produced) and asexual (vegetative) reproduction.

If only one plant existed on the entire earth, it would surely rank as the foremost wonder of the world. Plants are oxygen and food factories, and humans and animals cannot exist without them.
What is a food chain?
A food chain always starts with plants and ends with animals. Each link in this chain is food for the next link. A simple food chain starts with trees & shrubs ➔ Giraffes (eat trees & shrubs) ➔ lions (eat the giraffes) ➔ beetles and worms (break down the lion’s body when it dies). The final stage of the food chain is decomposition where nutrients are returned to the soil and taken up by the plants. The food chain is part of the complex balance of life. If one animal’s source of food disappears, such as from unsustainable fishing or habitat destruction, other animals higher in the food chain are impacted and may die.

ACTIVITY
1. Where do you feature in a food chain in comparison to plants? Discuss why the existence of plants is essential to your survival on earth.

REPRODUCTION VS PROPAGATION
What is the difference between reproduction and propagation?
When organisms multiply to produce new generations, the process is termed reproduction. Plants reproduce in two ways: sexual or asexual (vegetative) reproduction. When reproduction is deliberately controlled and manipulated by people to produce more of a plant that they want, it is called propagation. Both sexual and asexual reproduction techniques can be used to propagate plants.

Why do we need to propagate plants?
Nurseries need to propagate flowering plants to sell to people to plant in their gardens. Farmers need to propagate food plants so they have vegetables to sell for us to eat.

Plants need light, air, water, soil and nutrients to grow, and they also need these to reproduce or multiply.
Sexual reproduction involves the fertilisation of a female cell by a male cell. In flowering plants, the female reproductive cells are called ovules and are found in the ovaries, inside the flowers. The male reproductive cells are called pollen grains and they are borne on the anthers of the flowers. When a pollen grain fertilises an ovule of the same species, an embryo is formed.

The embryo develops into a seed, and the ovary surrounding the seeds develops into the fruit. The seeds are dispersed and, under the right conditions, they germinate and develop into adult plants. The adult plant produces flowers, which in turn produce seed. Coniferous plants like pine trees produce male and female cones instead of flowers. The pollen from the male cones fertilises the ovules in the female cones to form seeds.

**What are hybrids?**

The new plant that develops from a seed is unique as it contains characteristics from both the parent plants. Plant breeders sometimes crossbreed different types of plants, e.g. two types of lilies, to create a hybrid that combines the best of both parents. This is how we get many of the interesting shapes and colours of flowers. This technique is also used by farmers, e.g. to breed a strain of drought-tolerant maize plants that produce good quality cobs. A drought-tolerant strain with poor cobs is crossed with one that produces good cobs but needs a lot of water. Some of the offspring (hybrids) will have both desirable characteristics: good cobs and drought-tolerant. The rest of the offspring will have a mix of desirable and undesirable characteristics like the parents, e.g. drought-tolerant but poor cobs, or good cobs but need a lot of water. The farmer will then take those hybrids that are drought-tolerant with good cobs, and farm with these.
Good cobs but needs a lot of water

Drought-tolerant but has small cobs

Some of the offspring (hybrids) will have both desirable characteristics: good cobs and drought-tolerant
Function of flowers

A flower's only purpose, from nature's perspective, is to produce seeds. Colours, markings, fragrance, shape - all the things we love and admire are there purely to attract animals like insects, birds, bats and mice to probe into the flower in search of nectar or pollen, and in so doing fertilise it. The pollen grains stick to the legs or fur of these animals and are carried to the next flower, where they are transferred to the sticky stigma (female part) of that flower. These animals are known as pollinators. Wind can also act as a pollinator, with seeds and pollen being transported by a gust of wind.

Where a pollinator transfers pollen between flowers of different plants, this is called cross-pollination. Some plants self-pollinate, meaning that pollen moves to the stigma of the same flower, or to another flower on the same plant, by means of a pollinator. Certain plants take this a step further, and the flowers pollinate themselves without the aid of a pollinator, e.g. the stamens grow until they come in contact with the pistil.

Refer to the poster: The Black-collared Barbet has been attracted to the berries (fruits). The seeds are inside the berries and are ingested by the bird. They pass through the bird's digestive system unharmed and are then deposited on the ground in the bird's droppings. The seeds will then germinate and develop into new plants.

ACTIVITY

1. In small groups, collect examples of different flowers from a garden. Make a list of the characteristics of the plants - colour, size, scented or not, shape, and presence of nectar. Write down next to each characteristic how you think this feature aids pollination. Take a guess at what you think the pollinator would be.

The colour, shape and size of flowers are related to how they are pollinated:
- Insect-pollinated flowers usually have large, showy, colourful corollas (petals) that attract insects visually and act as landing platforms. They are usually scented and often contain nectar.
- Birds are usually attracted to red or yellow tubular-shaped flowers.
- Flowers pollinated by butterflies are frequently red, yellow, orange or pink.
- Those pollinated by moths are often white.
- Flowers that attract birds and bats often need to have large petals or strong stems for landing.
- Wind-pollinated flowers are designed differently. They are often missing the calyx and corolla and have no nectar. Their stigmas are frequently large and feathery.
**Pollinators**

**Beetle-pollinated flowers**
Beetles can see better than they can smell. Flowers that attract beetles are usually dull or white in colour, but have a strong smell. The smells of the flowers are usually fruity, spicy or like the smell of fermentation. These scents mimic the smell of the beetle’s main food sources, such as fruit, dung or rotting meat. Examples of these plants include *Sparaxis grandiflora* (Cape buttercup) and the *Ixia viridiflora* (green ixia).

**Fly-pollinated flowers**
Carrion flies are attracted to flowers that smell, look and feel like rotting meat. These flowers are reddish brown in colour and some have hairs on their petals. (Not true for all fly pollinated flowers). Examples of these plants include members of the genus *Stapelia* and *Cussonia*.

**Bat-pollinated flowers**
Flowers that attract bats are large in order to support the weight of the bat. As fruit bats feed at night, these flowers are usually dull in colour and only open at night. Fruit bat-pollinated flowers have strong fermenting or fruit-like smells, because bats rely mainly on their sense of smell. A good example of a bat-pollinated plant is the Baobab tree and *Adansonia*.

**Bird-pollinated flowers**
Birds can see colour well, but do not have a good sense of smell. Flowers that attract birds therefore have little scent but are extremely colourful (red and yellow). The flowers or stem are usually also large enough to support the weight of a bird. They hold a lot of watery nectar as a reward for their large pollinators. Examples of these plants include the *Strelitzia* and *Leonotus*. 
**Moth and butterfly-pollinated flowers**

Moths and butterflies are attracted by sight and smell. The typical moth-pollinated flower is white or pale in colour so it shows up well at night. It releases a heavy, sweet scent after sunset when most moths are active.

Butterfly-pollinated flowers can be red, yellow, orange or pink. The nectar of moth and butterfly-pollinated flowers is usually found at the base of a long, thin corolla tube, accessible only by the long tube-like proboscis (mouthparts) of moths and butterflies. Such plants are: *Turraea obtusifolia* (small honey suckle tree) and many *Satyrium* species.

**Bee-pollinated flowers**

Bees are responsible for pollinating more species of plants than any other animal group. Bees live on nectar (a nutritious, sugary liquid produced by flowers). The workers also collect pollen to feed to the larvae (only the queen bee lays eggs). Bees can see ultra-violet light, and quickly learn to recognise the colours, smells and outlines of the best flowers to visit.

Bee-pollinated flowers have big, brightly coloured petals (usually blue or yellow). Bees recognize patterns such as *nectar guides* - special markings on the flower that show the bee where to find the nectar, e.g. *Crassula rupestris* (kebab bush). Some flowers have markings that only show up under ultra-violet light, so the bees can see them, but we cannot.

The flowers also have a “landing platform”, where the bee can land and access the nectar. The bee’s mouthparts are suited to accessing the nectar at the base of the corolla tube. Bees pollinate many agricultural crops, such as the sunflower. An example of a bee pollinated plant is the *Coleonema calycinum* (confetti bush).
**Wind-pollinated flowers**

Plants that use wind for pollination do not need to waste energy on producing colourful scented flowers with nectar. Wind-pollinated flowers are dull, odourless, do not produce nectar and their petals are small or absent. These flowers usually have their stamens well exposed, so that the pollen can be easily caught up by the wind. Pollen is produced in large quantities to ensure that at least some of it reaches another flower. The stigmas are also exposed, and may have branches or feathery outgrowths for “catching” the pollen as it floats by on the wind. Typical wind-pollinated flowers are found in most grass species, including corn and maize plants. *Passerina ericoides* and *Restio dispers* are wind pollinated flowers and conifers.

**Activity**

1. Use the flowers collected previously if still fresh, and have learners dissect and draw a cross-section of the flower. Learners must include the following labels on their drawing: sepal; stamens; petals; filament; anther; pistil; ovary; stigma; and style. The learner can research each label and determine its function. Include a brief description of the function for each label.

**Parts of a flower**

Flowers are composed of distinct parts:

The sepals are usually green and protect the flower bud.

The petals are normally brightly coloured and are sometimes scented to attract pollinators.

The stamens are the male parts of the flower. They consist of a filament with an anther at the end. Pollen grains are produced within pollen sacs found in the anther.

The pistil is the female reproductive organ. The ovary contains the ovules which will become seeds if they are fertilized, and the whole ovary will become the fruit. The style is attached to the ovary and has a sticky stigma at the tip. The pollen grains stick onto the stigma.
SEED DISPERSAL

Wind-dispersed fruits and seeds
Some seeds that are dispersed by wind are very small and light, like dust. Others have wings or plumes or hairs that allow them to be blown around easily, like Combretum seeds.

In tumble weeds, for example, the whole plant is blown around by the wind, and in so doing scatters seeds. A South African example is the Boophane where the flower head breaks off and rolls around, scattering seed, whilst the bulb remains firmly in the ground.

Water-dispersed fruits and seeds
These are adapted for floating. Either some air is trapped inside the fruit or seed, or the fruit or seed has special large air spaces in its tissues. The coconut is an example of a waterborne fruit. A South African example is the fruit of mangrove trees.

Pollination
When pollen is released from an anther, some of it may land on the stigma, which is sticky. Each grain of pollen contains two cells. One of these cells forms the hollow pollen tube that grows down the style and into a tiny hole in the ovule, and the other divides to become two sperm cells. The sperm cells travel through the pollen tube and into the ovule, where one sperm cell unites with the egg. The other sperm cell joins with another ovule and becomes a food store to nourish the germinating seed. The ovary, which encloses the seeds, becomes the fruit.
Animal-dispersed fruit and seeds
Fruits and seeds that are dispersed by animals have two basic types of adaptations. Firstly, they may have bright, fleshy, sweet fruits that animals eat. When animals eat the fruit, the seeds pass unharmed through the digestive tract, or are regurgitated (when swallowed food is brought back up to the mouth and chewed again) some distance from the parent plant. A tomato is a good example of this type of seed. Secondly, the fruit or seeds may have hooks, spines, hairs, or sticky coverings. These enable them to stick to the fur or feathers of animals. In this way they “hitch a ride” and can be transported for great distances. Blackjacks are typical hitch-hikers of the plant world.

ACTIVITY

1. As a concluding exercise, all the learners can take a walk around the garden and look for examples of pollination or seed dispersal in action. Learners must walk around silently recording their observations and where they took place. They must then report back to the group and have a discussion. This walk is best taken during the summer months. Note that it is not always possible to see both pollination and seed dispersal on the same day.

Notes
GROWING SEEDLINGS

This is the most common form of plant propagation. Seeds can be collected or bought from a nursery. The quality of the seeds will be a determining factor in your success.

Seedlings are similar to babies, in that they need extra special attention and protection. Seedlings need to be protected from the harsh conditions in a garden, and the soil, light, water, food, air and temperature the seed receives needs to be controlled. Germinating seedlings need more protection as any drying out or disturbance during this early vulnerable stage can cause the seedling to die.

Some seeds need to be cleaned and prepared to encourage germination. One of the techniques is to scratch the seed coat lightly to allow for easier water penetration. Seeds with thick and tough seed coats may need to be soaked, or go through a process called scarification. Scarification usually happens when a bird swallows a seed that then passes through the digestive system. Acid there eats through the tough seed coat. When the bird passes the seed it is ready to germinate. You can replicate this process by scratching the seed with sandpaper. Stratification is a process where seeds are chilled for a period before planting; this is done to imitate cooler climates and conditions.

Seeds should be planted in small containers or seed trays. Each plant prefers a certain soil mix, so you should try and match the soil mix (sand and compost) to the plant’s needs. Use more sand for plants that grow in dry places and more compost for plants that prefer moist soil. If you are uncertain, use a mixture of two-thirds compost to one-third sand.
Seeds do not need to be buried deeply - many of them can be scattered on the surface of the soil mixture. For annuals with small seeds, gently sprinkle the seeds evenly over the top of the soil and press in. Cover large seeds with a 5 mm layer of soil or compost. A general rule is that seeds should be planted no deeper than two thirds of their broadest side.

Seeds need to be kept moist in order to germinate. The seed tray should be covered with a clear plastic cover and placed in a warm area, thus creating a moist microclimate that will encourage germination and growth. The air must not be too warm and there must be some air circulation.

A microclimate is a small part of a larger area whose climate differs to that of the large area, eg. A shady spot under a plant where the rest of the garden is sunny. The microclimate can differ in terms of temperature, humidity, pH and air movement. By placing a bottle over your seedling you are creating a microclimate which differs from the climate outside the bottle.

Old cool drink bottles or clear cake covers can be used, or the seed tray can be placed inside a clear plastic bag that has been blown up and tied off with elastic. To reduce the problem of fungus attacking and destroying the seedlings, it is best to sterilise the soil and container before using it. This can be done by rinsing the container out with boiling water, and pouring boiling water over the soil and allowing it to drain through (always have a responsible adult around when working with boiling water).

Compost forms naturally nearly everywhere!!! Leaves drop from trees. Grass clippings are left after mowing the lawn. Plants and animals die. Over time, these organic materials break down or decompose. The rich, dark-brown, crumbly, soil-like material that results is called compost.
The seed propagation technique

1. Fresh seeds are always best to use. If you are buying seeds in a packet check the expiry dates. (Alternatively, collect seeds from the garden. Clean away any fruit flesh or dried parts from the seeds.) It is best to use easily germinating seed that is large in size, such as beans, pumpkins and maize.

2. Select the appropriate soil mixture for the plant type.

3. Fill the seed trays or plastic containers with the soil mixture and press down until the soil is 1 cm below the edge of the tray/container.

4. Dampen the soil before sowing the seeds.

5. Sow seeds evenly in the tray.

6. Cover the seeds with soil and a light layer of mulch. Some seeds can be sown directly onto the ground, eg. carrots.

7. Water the seeds gently with a fine rose-head watering can.

8. Label the container and cover it with a clear plastic bag, secured with an elastic band. Place in a warm sheltered spot such as a window sill that has a lot of natural light.

9. When the first greenery (cotyledons) appears, remove the plastic bag. The seedlings can now be placed in a spot that is lighter, but not in direct sun.

10. When the first true leaves appear the seedlings need to be transplanted. (The facilitator must bring examples of seedlings at this stage so the demonstration can continue; beans are a good example, as they grew quite easily). A new container has to be filled with potting mix and firmed down. The seedling will be transplanted into it.

11. Once the seedlings are transplanted they need to be watered.

12. Place the seedlings in a shaded place and after a few days start gradually exposing them to the open air and light for short periods of time until they are able to withstand the conditions outside all day.

13. Young plants should be planted in the garden. Plant when the soil is moist. Water the soil the day before planting. Remember to space the plants correctly to allow for their adult size.

14. Thereafter, water regularly and feed the plants with liquid fertiliser every 2-3 weeks to keep them healthy.
Germination
Germination is the process whereby a plant grows from a seed after a period of dormancy. Germination is the sprouting of a seedling from a seed, when the first greenery becomes visible (cotyledons). The leaves to follow are the first true leaves.

Transplanting:
1.Seedlings will first develop a pair of cotyledons (rounded leaves) and after that the true leaves will form. Once the true leaves are formed transplanting may take place.

2.Use a pencil to make holes in the compost approximately 4 to 5 cm apart in all directions.

3. Remove the seedlings from their tray, using a knife, by carefully levering under the soil. Lift the seedlings 2/3 at a time. Hold them by their leaves and gently shake them apart.

4. Place each seedling into a hole. Press the compost down gently around the seedlings. Place the seedling into the new hole at the same depth that it was before it was transplanted.

5. Water the seedlings gently with a fine rose-head watering can.

Transplanting a seedling involves digging a hole large enough to fit all the roots in and to allow the stem of the plant to be level with the soil surface once the hole is filled in. The seedling needs to watered regularly (every few days) and fed organic fertiliser every 2 to 3 weeks to keep them growing well.

1. Loosely sown seed has germinated.
2. Prepare a new tray with compost & make holes using a pencil.
3. Once first time leaves have appeared, remove 2/3 seedlings at a time, lifting them with a knife and gently separating the new seedlings from one another.
4. Place each seedling in the new holes which are evenly spaced.
5. Finally, press the soil down gently around each seedling and water.
ASEXUAL REPRODUCTION

Most plants reproduce naturally by seed, but this is by no means the only way. New plantlets can develop from pieces of the parent plant - this is called vegetative reproduction. When plants reproduce asexually, the young plants are genetically identical to the parent plant (clone). Vegetative reproduction can be very useful to farmers and gardeners because it means that they can multiply a plant that has attractive flowers or tasty fruit. Each new plant will have the exact characteristics of their parent plant. Skilled gardeners use a number of propagation techniques to increase the number of plants of a species.

Asexual or vegetative reproduction does not involve the fusing of a male cell with a female cell. Vegetative reproduction relies on the ability of certain non-sexual parts of the plant to form a whole new plant by cell division. For example, if the root of a Dandelion is broken, each root fragment can give rise to a new plant.

Strawberries reproduce asexually by means of runners, which are thin stems that grow along the ground. A whole new strawberry plant can grow from the nodes of the runner stem. Potatoes reproduce by mean of “eyes” or small buds that develop into new potato plants.

Different plants reproduce vegetatively in different ways; therefore you need to learn how your plant reproduces in order to successfully propagate it.

PROPAGATION TECHNIQUES

Propagation is the process of reproducing or multiplying plants by natural or artificial methods. Techniques for making cuttings (hardwood, soft tip, heel), and planting from a bag are discussed in the following sections.

The key to successful propagation lies in understanding how plants grow, and providing the best balance of essential factors for plant growth. You will recall that plants require certain factors (air, light, water, soil and food). They need the right balance of each of these factors for healthy and efficient growth. This is especially important during the early stages of development of the young plant, as it is most vulnerable to adverse or harmful conditions then. Find out what conditions are best for your plant before you try to propagate it.
Cuttings
Most fruit trees and shrubs are propagated from cuttings. This technique involves taking small sections (called cuttings) from an adult plant and encouraging them to grow into a whole new plant, producing a new plant identical to the parent. Cuttings can be taken from different parts of the parent plant. The base of the cutting can be dipped in a rooting hormone and then put into a soil mix. These hormones stimulate root growth so that the cutting produces its own root system. Remember to keep the cuttings the right way up, as the cutting will not take root if you put it into the soil mix upside down!

<table>
<thead>
<tr>
<th>Hardwood cuttings</th>
<th>Soft tip cuttings</th>
<th>Heel cutting</th>
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<tbody>
<tr>
<td>Plumbago</td>
<td>Gazania</td>
<td>Fir</td>
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<tr>
<td>Freylinia</td>
<td>Scabiosa</td>
<td>Coleonema (confetti bush)</td>
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<tr>
<td>Tecoma (Cape honeysuckle)</td>
<td>Pelargonium</td>
<td>Most conifers</td>
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<tr>
<td>Rhus lancea</td>
<td>Plectranthus</td>
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Hardwood cuttings
Hardwood cuttings are bare pieces of woody stem cut in wintertime while the plant is dormant and leafless. The cutting is 20-25 cm in length and must be cut so that it includes a bud at both ends.

Soft tip cuttings
In this method, the soft, immature shoot tips are cut from the adult plant in summertime. The cutting should be firm but not hard, and must have 4-5 pairs of leaves. The lower pair of leaves is removed and the remaining leaves are cut in half to reduce water loss due to transpiration.

Heel cuttings
A heel cutting is made by pulling a shoot off the parent stem so that a small piece of the parent plant’s stem remains attached to the cutting. This bit of stem is called a heel, and it promotes root growth in the cutting.
Take a cutting of between 20 and 25 cm in length. Cut cleanly below a bud at the base and just above a bud at the top end. Your cutting can be planted in a mixture of two parts coarse sand to one part peat moss or sterilised compost. This mixture produces a soil that drains well. To sterilise compost, place the compost in a microwave oven for 10 minutes. Cuttings can also be planted in open ground in a sheltered and semi-shaded position. An optional extra is to dip the bases of the cuttings into a hormone powder (hardwood rooting compound) before planting them to improve root development. Use a pencil to make holes in the compost, approximately half the length of the cuttings. Place the cutting facing up the same way as they were growing. An upside down cutting will not grow. Keep the soil moist but not wet. After 6 to 8 weeks most cuttings will have grown roots (this also depends on the type of plant). Gently tug the stem to see if there is any resistance. If there is carefully remove the cutting from the pot. If roots are 1 to 2 cm in length, transplant (same procedure as seedlings) the cuttings into individual pots. Plant the pots in the garden bed for the winter months to protect them. Mulch the young plants, leaving a 2 cm gap around the stem to prevent rot.

**ACTIVITY**

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**Notes**
Planting from a bag

Nurseries supply young trees and shrubs that have been propagated in plastic bags. This allows you to plant trees and shrubs in the garden if you haven’t got time to wait for seeds or cuttings to grow. When planting from a bag you need to choose a well-drained spot.

How to plant a tree the Water Wise way

1. Dig a hole larger than the bag. Digging a square hole rather than a round one allows roots to find weak spots in the corners and push out into the surrounding soil, instead of going round and round inside the hole. This helps the plant to form a wide and extensive root system. Loosen the soil at the bottom of the hole, this will make it easier for the roots to penetrate downwards and will help with drainage.

2. Put the topsoil (top 20cm) that you have dug out of the hole to one side. Mix two-parts of this soil with one-part compost and wet it. The remaining subsoil is nutrient-poor - mix it into your compost heap or use it on pathways.

3. Check that the hole is deep enough for that the entire plant bag to fit into the hole.

4. Remove the bag and unwind and loosen any roots that have become tangled (do not remove the soil around the plant as this supports the roots; also, you will remove the fine root hairs if you remove the soil, and the plant needs these to take up water and nutrients). Use your hands to do this.

5. Place the plant into the hole, so that the level of the soil from the bag is the same as that of the surrounding soil. Place a wide piece of pipe down to the roots so that it just sticks out above the hole. This allows you to water directly to the roots.

6. Cover the root ball and pipe with the soil and compost mixture to ground level. The soil should be added in stages and firmed down to avoid air pockets.

7. Create a water bowl on the surface with a radius of one spade length.

8. Water the plant and mulch the surrounding weed free area (the mulch must not touch the base of the plant as this can lead to rotting).

Hint

Mulch will keep the soil moist and keep the plants roots cool in summer and warm in winter. Continue to water the plant on a regular basis to ensure good growth. Remember to also add fertiliser and compost to keep your soil fertile.
**Splitting**

Splitting or dividing is the simplest way to propagate plants with fibrous or tuberous roots, and plants with rhizomes or bulbs. Splitting involves dividing the plant up into smaller parts. This can be done by hand in fleshy and bulbous species. In fibrous or rhizomatous species, it will require strong garden forks to pull the plants apart, and a knife to cut through stubborn roots. You need to try to do as little damage as possible to the plant and especially the roots (the crown, growing point) when you split them. Shake and wash the soil off the roots to ensure an easy separation, whereby both parts are left with good growth buds. Splitting helps to rejuvenate the old plant.

**ACTIVITY**

**Splitting plants with rhizomes**

1. Dig up the entire rhizome of the plant you want to divide, trying not to damage the root system.

2. Examine the roots. Divisions will reestablish best if they have at least two growth buds with leaves growing from them as well as roots.

3. Clean away all the soil from around the roots so that the main old rhizomes, and the new underground stems coming out from it, are exposed.

4. Select side growths (new stems) that have strong buds or vigorous young shoots and healthy roots. Each new shoot selected should be 5-10 cm long.

5. Separate the side growths with a sharp knife.

6. Use a sharp knife to cut the division. A blunt knife can bruise tissue.

7. Trim away any dead or rotting parts. Also cut back the leaves so that the plant is not stressed by having to provide water for a large leaf area.

8. Replant immediately. Plant the rhizome horizontally with the root cluster facing downwards. Plant to the same depth as the original rhizome to make sure it is firmly anchored in the soil, but not too deep.

9. Mulch the plant and water regularly.
Learners are to make a mind map showing the value of trees in their daily lives.

Discussion:
- What are some of the functions of trees?
- Why do we need to plant more trees?

| Splitting | Early Spring to Autumn | Chrysanthemums, Lamb's ear
|-----------|------------------------|------------------------|
| Fibrous root system | Early spring to autumn | Elephant ear, Christmas fern
| Rhizomes | Early spring to autumn | Asparagus fern, Dahlia |
| Tubers | Autumn or before replanting in spring | |

| Cuttings | Early Summer to Mid Summer | Daphne, Hydrangea
|-----------|-----------------------------|-----------------------------|
| Softwood | Early summer to mid summer | Daphne, Hydrangea
| Hardwood | Late autumn or early winter, after the plant is dormant | Juniper, Roses, Lavender, Cotton |
| Leaf | Any season | African violet, Sedum |

**Genetically Modified Food**
Genetically modified (GM) foods are foods produced from genetically modified organisms (GMO) that have had their DNA altered through genetic engineering. GM foods were first put on the market in the early 1990s. The most common modified foods are derived from plants: soybean, corn, canola, cottonseed oil, and wheat. Controversies surrounding GM foods and crops commonly focus on human and environmental safety, labeling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation.

Genetically modified organisms have been the subject of a raging debate for several years, with scientists divided over how safe they are to consume.

**Activity**
Divide learners into two groups. Have the first group research what genetically modified food. Have them report back to the rest of the class. Divide the second group into two; have them list the pros and cons of genetically modified food. Have them report back to the class. Finally end the lesson with a class debate of those who are for and those against GM food.
For information and ideas on Water Wise gardening call the Rand Water customer service centre on 0860 10 10 60, or visit the home and garden section of their website at www.randwater.co.za