Unit 9:
Plants

Think and answer?

a. What can you see in the photograph?

b. What vital function are they related to?

c. No all the members of this Kingdom have this type of organ. Can you put an example of them?

d. How do these living beings perform nutrition function?

UNIT OBJECTIVES

In this unit you will learn:

- To recognise the main characteristics of plants
- To classify plants into groups
- To describe plant ways of nutrition
- To describe plant ways of interaction
- To describe plant

1. Characteristics of plants.

Organisms of **Plant Kingdom** are **multicellular** living beings, made up of **eukaryotic plant cells** and **autotrophs (photosynthetic)**.

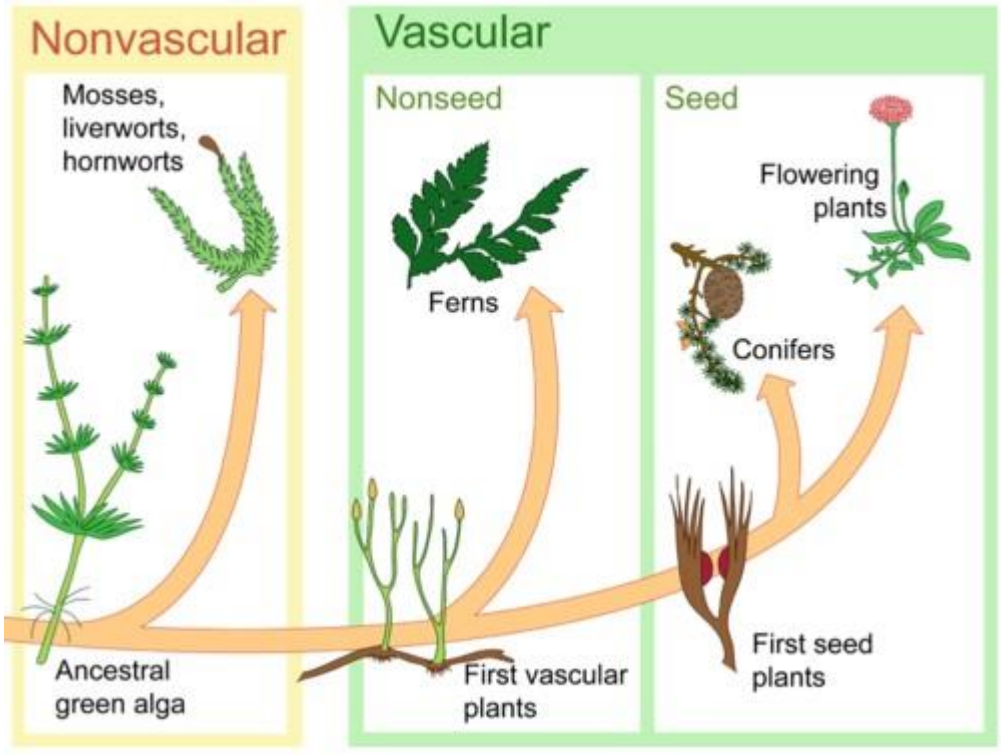
First terrestrial living beings were plants. They evolved from green algae, about 500 million years ago.

They have **tissues** and **organs** (leaves, roots, stems and flowers) but they do not have **systems**.

Most part of plants is adapted to live in land, attached to the ground. Although they cannot displace, however they are able to make some movements. For example they grow towards the light, or close their flowers during the night.

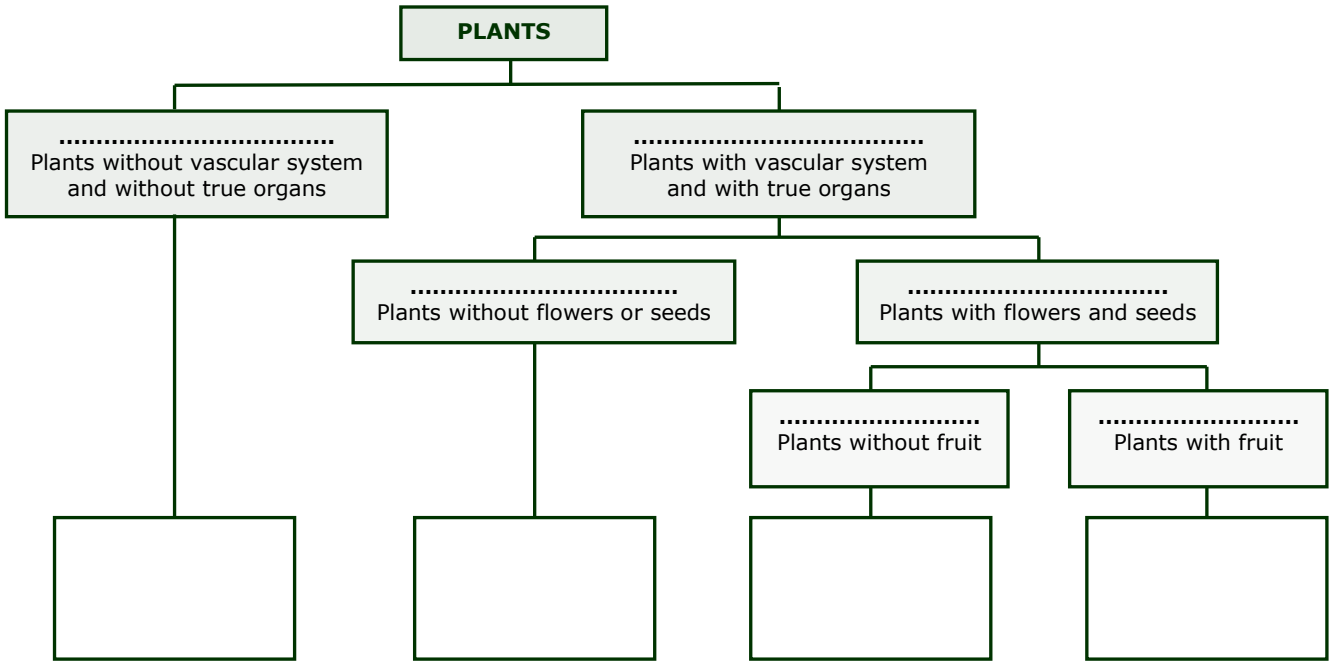
Traditionally the Plant Kingdom is divided into two groups, according to the way they reproduce:

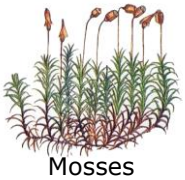
- **Non-seed plants.** They are the simplest plants that do not form flowers.
  - **Bryophytes** (Mosses). They don't have conductor vessels (Non-vascular plants) and non-true organs.
  - **Pteridophytes** (Ferns). They have conductor vessels (Vascular plants) and true organs (leaves, root and stem)
- **Seed plants (Spermatophytes).** They are the most complex plants. They form seeds.
  - **Gymnosperms** (Conifers). They are vascular and they form seeds but not fruits.
  - **Angiosperms** (Flowering plants). They are vascular too and they form seeds and fruits.



READING ACTIVITIES

1. 1. Complete the sketch. Then, classify the following plants in their correspond group.




Mosses


Pines


Horsetails


Poppies


Liverworts



Ferns


Holm oak


Cypresses

1.2. Relate these two columns (put the correspondent letter in the point line

a. They don't have true roots, stems or leaves.
b. They don't have a vascular system.
c. They have stems, roots and leaves (true organs).
d. They depend on water for reproduction.
e. They make spores, not seeds.
f. They have xylem and phloem (conductive vessels).
g. They have very simple flowers.
h. They produce seeds inside cones (no fruits).
i. They have flowers.
j. They produce fruits with seeds inside.


Bryophytes.....


Pteridophytes.....


Gymnosperms .....


Angiosperms.....

2. Classification of Plants

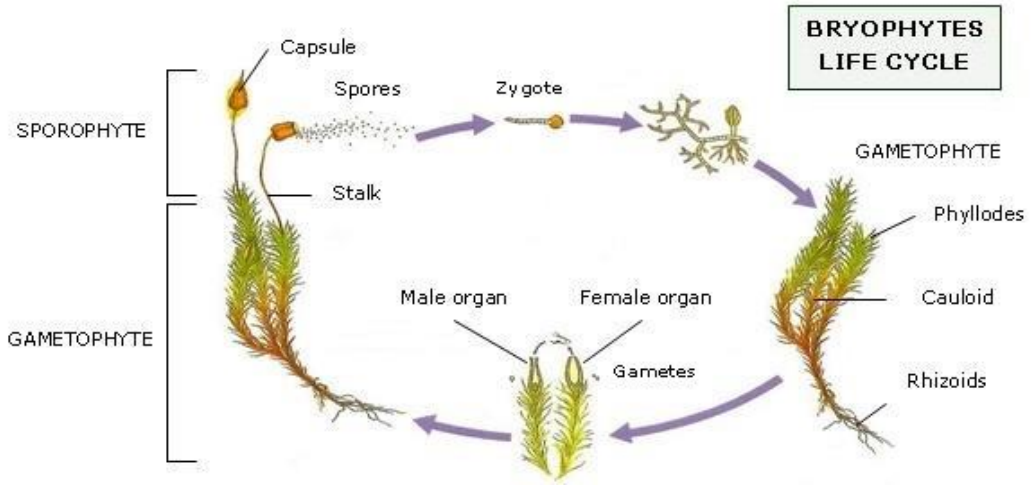
2.1. Non-seed plants.

This group includes *mosses* and *ferns*. They do not form flowers or seeds. They have a complex life cycle with **alternation of generations**. That is there are a sexual stage (*gametophyte*, which produce *gametes*) and an asexual stage (*sporophyte*, which produce *spores)*.

They only grow in damp, shady places, because they depend on the water to reproduce.

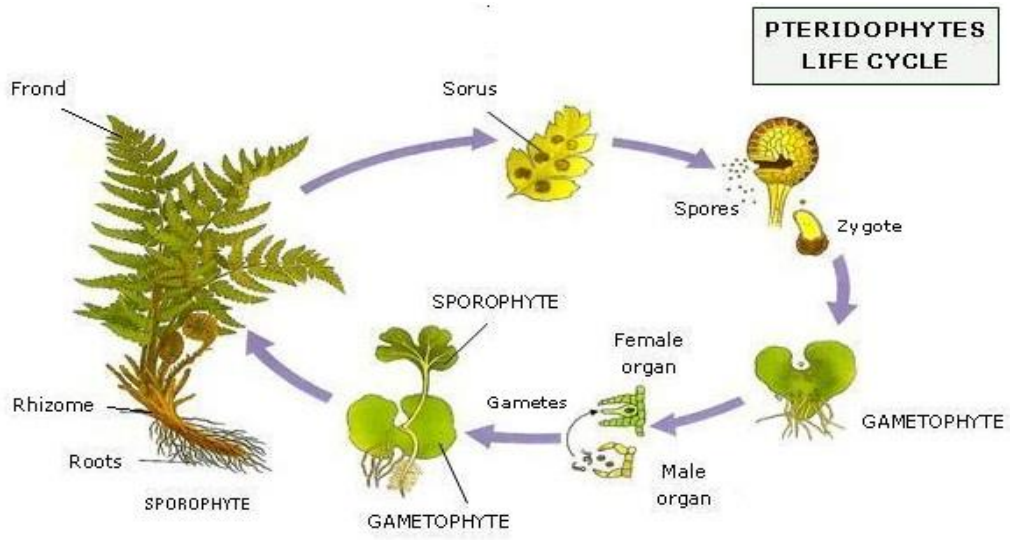
a) Bryophytes (mosses)

They are the most primitive plants on the Earth.
They are very small plants that only grow at ground level.
They do not have conductive vessels. They are **non-vascular** plants.
Mosses have false organs. These structures are similar to true leaves, stems and roots, but they do not make the same functions.
They obtain water and nutrients through their whole surface.
Mosses reproduce by **spores** which are formed in a **sporangium** called **capsule**.



b) Pteridophytes (ferns)

They are bigger than mosses, but they are usually shorter than 1.5 metres tall.
They have conductive vessels. They are **vascular** plants.
Ferns have true organs: **rhizome** (underground stem) with **roots** and **fronds** (leaves)
The **spores** are produced in **sporangia** called **sori** which are usually on the underside of fronds.



2.2. Seed plants: Spermatophytes

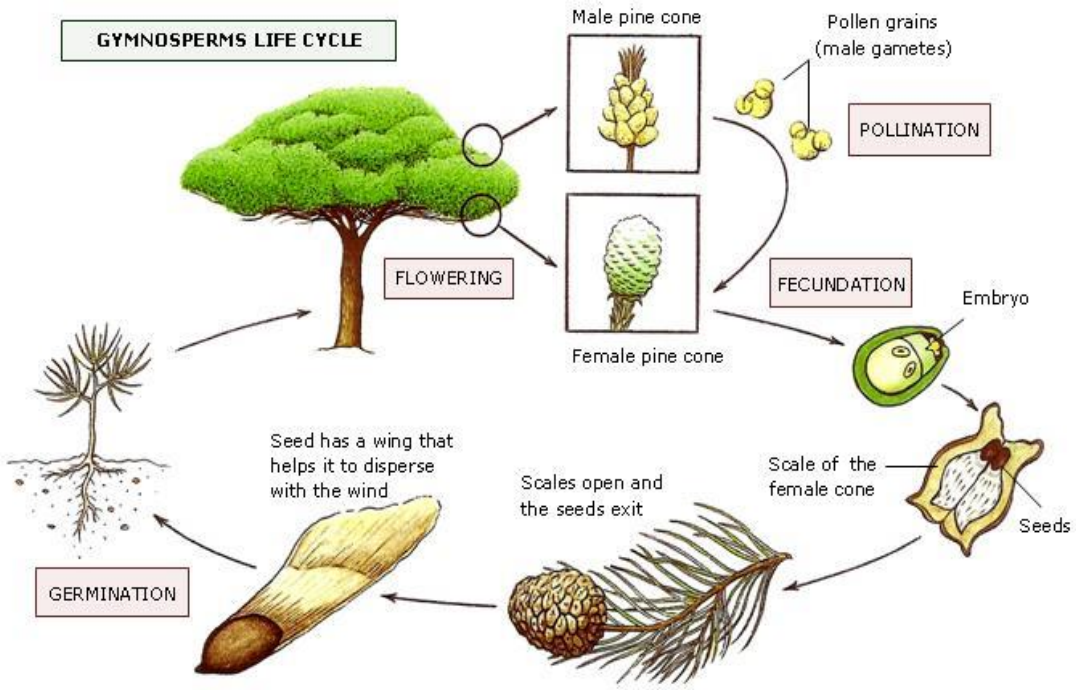
Spermatophytes are divided into two groups: **Gymnosperms** (*conifers*) and **Angiosperms** (*flowering plants*). Both reproduce by seeds but only Angiosperms make a fruit, which protect the seed inside itself.

a) Gymnosperms (conifers)

- They are **woody** plants, mainly trees.
- Most are **evergreen**. They have **perennial leaves**, which is they keep them all the year.
- Leaves can be **acicular** (needle like) or **scale-leaf** (scale like).
- Their flowers are little and without petals. They form inflorescences called **pine cones**.
- They are mainly **unisexual** and with separate sexes. There are male and females plants.
- They produce **naked seeds**, without a fruit.

In the past, gymnosperms were more widely distributed but today they are reduced to cold latitudes and mountains where they form forests.

Some examples of gymnosperms are firs, cedars, pines, cypresses and junipers.



b) Angiosperms (flowering plants)

- They are **woody** plants (trees and shrubs) and **herbaceous** plants (forbs and grasses).
- They have **deciduous leaves**, which is they lose them during part of the year.
- Leaves can have different shapes and sizes.
- Flowers can be large, fragrant and bright coloured or not. They can form inflorescences or be alone.
- They are mainly **hermaphrodites**, with both sexual organs in the same flower.
- They produce seeds which are inside a **fruit**.

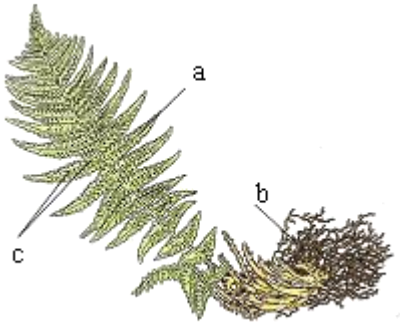
Nowadays they are the most important group of plants and they are distributed all around the world.

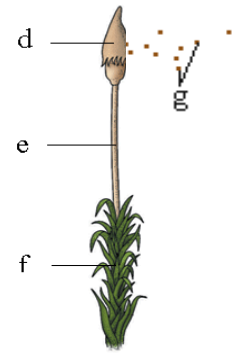
Some examples of angiosperms are almond tree, rosebush and corn.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:

2.1. Relate the letters with the names on the column. Indicate what represent every picture:





☐ Rhizome
☐ Spores
☐ False leaves
☐ Sorus
☐ Capsule
☐ Frond
☐ False stem

a. Why are moss leaves, roots and stems called "false"?
b. Why do Pteridophytes need a vascular system and Bryophytes don't?
c. Where do ferns produce spores? Where do mosses do it?
d. What does it mean that Pteridophytes and Bryophytes have "alternation of generations"?

2.2. Answer the following questions about seed plants (Spermatophytes):

a. What difference is there between evergreen plants and deciduous plants?
b. Which does it mean that Gymnosperms produce naked seeds?
c. How are Gymnosperms' inflorescences called?

2.3. Relate each sentence with the group of Spermatophytes that it belongs to:

a. Some of them are herbaceous plants, forbs or grasses……
b. They have deciduous leaves…….
c. They are mainly hermaphrodites…….
d. Their flowers are usually coloured and fragrant…….
e. They produce seed inside a fruit, that protect it……..

2.4. Listen and indicate what group of Spermatophytes is described:

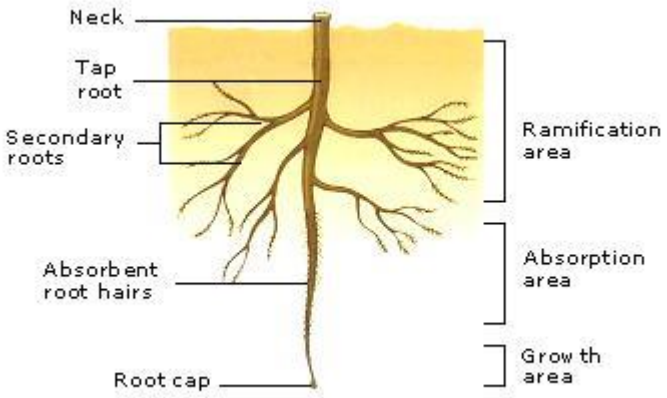
a. Gymnosperms
b. Angiosperms

3. Structure of Spermatophytes

All spermatophytes are divided in three basic parts: **root**, **stem** and **leaves**. These organs are responsible for the nutrition and interaction. **Flowers** are the organs responsible for reproduction.

3.1. Vegetative organs of Spermatophytes

a) The root



The root grows in the opposite direction to the stem and it is usually an underground organ.

The functions of the root are:

- To **attach** the plant to the ground.
- To **absorb** the water and the mineral salts.
- Sometimes, to **store** reserve substances

There is a **main root** (tap-root) which has several **secondary roots**.
All of them have **absorbent root hairs**.
Protecting the end of the roots there is a structure called **root cap**.

There are two types of root systems:

- **Primary** (one tap root and several secondary roots)
- **Fibrous** (many roots all of the same size)

b) The stem

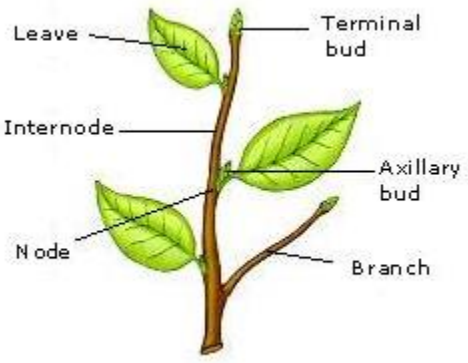
The stem is the axis of the plant. On it, there are **nodes** where branches and leaves grow and **internodes** which are the zones between two nodes. **Buds** are the shoots of the stem. **Terminal buds** are responsible for the longitudinal growth and **axillary buds** produce new branches, leaves and flowers.

The functions of the stem are:

- To **support** the leaves and the flowers.
- To **transport** substances between roots and leaves.

There are several ways to classify stems:

- How long they last (**annual** or **perennial**)
- How rigid they are (**woody** or **herbaceous**)
- Where they grow (**aerial**, **aquatic** or **underground**)

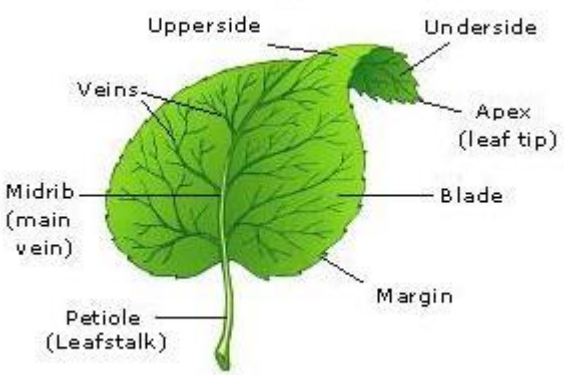


c) The leaf

Leaves are usually flat and green organs and grow from the trunk or the branches.

The functions of leaves are:
- To carry out **photosynthesis**
- To control the **gaseous exchange**.
- To regulate the **loss of water** (transpiration)

The **blade** is the flat wide part of the leaf.
It is crossed by **veins** (conductive vessels).
The **petiole** is the stalk that joins the leaf to the stem.



3.2. Reproductive organs of Spermatophytes

a) The flower

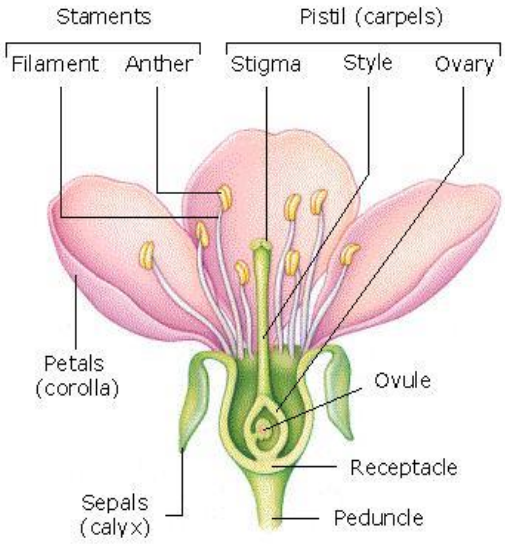
Flowers are the reproductive organs of Spermatophytes. They are formed by several groups of modified leaves join together in the **receptacle**.

- **Stamens** (male reproductive part)
  Everyone is formed by a **filament** and an **anther**.
  Anther contains the **pollen grains** (male gametes).

- **Pistil** (female reproductive part)
  It is formed by a group of fused leaves (**carpels**).
  It is divided into: **stigma**, **style** and **ovary.**
  Inside the ovary are the **ovules** (female gametes).

- **Petals**
  They are coloured leaves which function is to attract insects.
  Collectively they are called **corolla**.

- **Sepals**
  They are green leaves located below the petals which protect the flower.
  Collectively they are called **calyx**.



A flower that contains all these elements is a **complete flower**.
But some flowers do not have some elements (corolla or calyx). They are **incomplete flowers**.

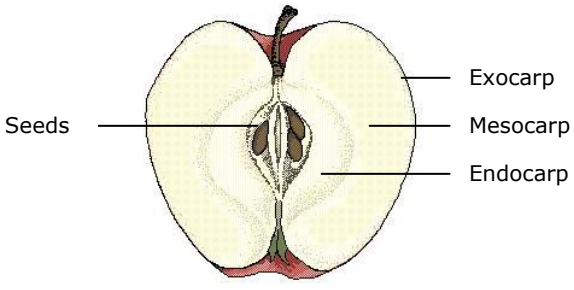
Flower can be **unisexual** (they only have stamens or carpels) or **hermaphrodites**.

Usually flowers are in groups called **inflorescences**.

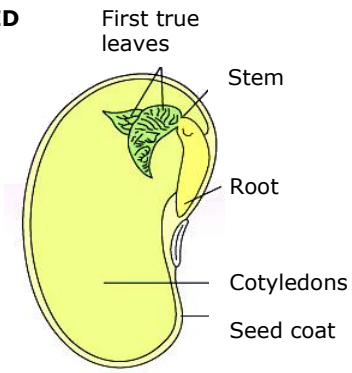
b) The seed and the fruit.

Angiosperms produce fruit: structures that come from the flower's ovary and that contain one or several seeds. The ovule of the flower changes into the seed and the walls of the ovary change into the fruit.

FRUIT

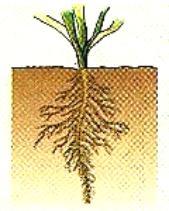


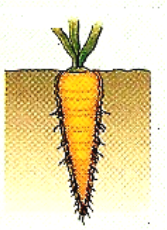
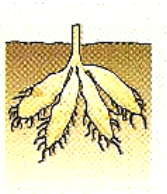
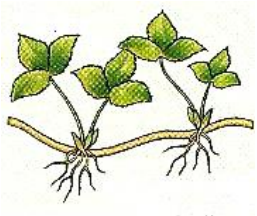
SEED



READING ACTIVITIES

3.1. Relate every type of root with their characteristics and with their picture.



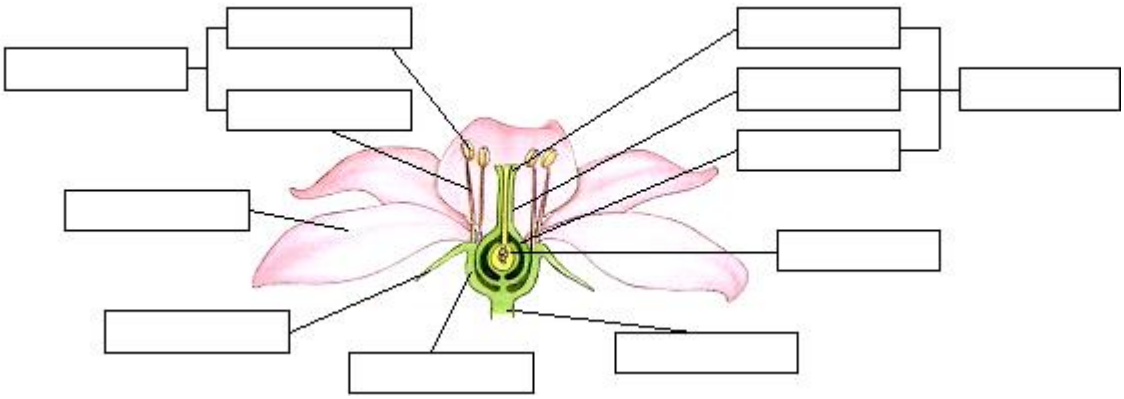
They are aerial and hold on to others plants, walls, etc	Secondary roots (lateral roots) accumulate nutrients.	There is not a main root; all the roots have the same size.	Primary root accumulates nutritive substances.	Primary root (taproot) grows more than secondary roots
Adventitious roots	**Taproot**	**Fibrous roots**	**Tuberous roots**	**Storage taproot**

3.2. Complete the sketch:

STEMS

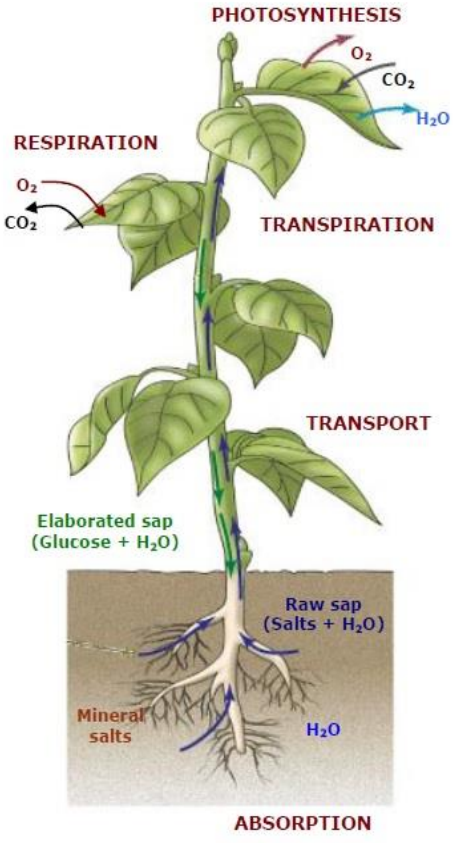
- By their consistence
  - ……. (Flexible and soft) E.g. *Poppies*
  - ……. (Rigid and hard) E.g. *Olive tree*
- By their way of grown
  - ……. (It grow erect, vertical) E.g. *Rosebush*
  - ……. (It grow creeping) E.g. *Strawberry*
  - ……. (It grow climbing) E.g. *Vine*
- By the environment
  - ……..(It grow on the ground) E.g. *Sunflower*
  - ……. (It grow under the ground) E.g. *Onion*

3.3. Label this diagram. What does it represent?
Then listen the descriptions and relate each one with the described part.



3. Nutrition in plants

We can differentiate several phases in plant nutrition:



a) Absorption:

Plants take *water* and *mineral salts* from the soil through their roots. The mixture of these substances is called **raw sap**.

b) Transport:

Raw sap ascends from roots to leaves through the conductive vessels of the **xylem**. Once transformed in **elaborate sap** is distributed to every cell through the conductive vessels of the **phloem**.

c) Transpiration:

The excess of water that plants absorb through their roots is expelled to atmosphere through the **stomata**, in a process called transpiration. This process helps raw sap to ascend.

d) Photosynthesis:

Plants use the energy from sunlight and inorganic matter (carbon dioxide and water) to produce organic matter (glucose) through this chemical process. All green parts of the plant perform photosynthesis.

This process is done within the **chloroplasts** that contain **chlorophyll**. This pigment can catch the energy of sunlight and transform it in chemical energy. Then this energy is used to make organic substances from the inorganic ones.

Raw sap provides water for the photosynthesis and carbon dioxide is absorbed by the stomas.

During the process, besides glucose, **oxygen** is produced and plants expel it to the atmosphere.

We can represent the reaction of photosynthesis as:

$$H_2O + CO_2 + \text{Sunlight} \rightarrow \text{Glucose} + O_2$$

In this way, raw sap is changed into **elaborated sap** that is a mixture of water and glucose.

e) Respiration:

As all living beings, plants need energy to carry out vital functions. To obtain it, every cell burns organic matter in their **mitochondria**. This process is called **cellular respiration** and produces water and carbon dioxide besides energy. To do it, the cell needs oxygen that is absorbed by the stomas.

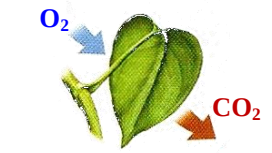
The reaction of respiration is:

$$\text{Glucose} + O_2 \rightarrow \text{Energy} + H_2O + CO_2$$

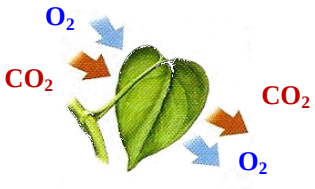
Plants perform respiration during the day and during the night, but only can perform photosynthesis while they have sunlight.

READING ACTIVITIES

4.1. The following pictures represent the gaseous exchange produced in a leaf in different moments of the day: dawn, noon and night. Which of them correspond to every one?



A. .....



B. .....

C. .....

a. Do plants perform *respiration* during the day? Do they do it during the night?

b. Do they perform *photosynthesis* during the day? Do they do it during the night?

4.2. Order the steps of plants nutrition. Copy them in the correct order:

d. Oxygen is expelled to the atmosphere.	c. Cells of leaves make photosynthesis	b. Raw sap is made, from water and mineral salts.	a. Raw sap goes up from the root to the leaves.
g. Glucose is produce and elaborated sap is made	h. Elaborate sap is carried to every cell.	f. Carbon dioxide goes into trough the stomas.	e. Root absorbs nutrients from soil.

4.3. Indicate the differences between:

a. Raw sap-Elaborate sap

b. Xylem –Phloem

c. Respiration - Photosynthesis

4.4. Listen and indicate what term is described:

a. Photosynthesis
b. Respiration
c. Xylem
d. Phloem
e. Raw sap
f. Elaborated sap
g. Chlorophyll
h. Stomata

5. Interaction in Plants

Interaction in plants is not easy to observe, as their reactions are often very slow and subtle. Despite this, we can see that plants react, in a coordinated way to stimuli such as light, humidity or temperature.

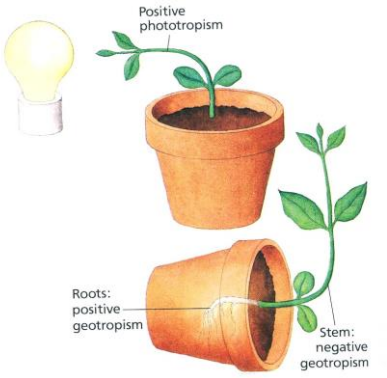
When a stimulus reaches a plant, some of its cells sense it and react or send a signal to other cells (for example, they produce a substance which is distributed around the organism) leading to a joint, coordinated response of part, or all of the plant.

The most frequent reactions of plants are tropisms, nastic movements and changes in their vital processes.

a) Tropisms

Tropisms are plant responses which consist of directing their growth towards, or away from stimulus.

- **Phototropism** is a response to **light**.
  For example, the shoots of a plant grow towards the light.
- **Geotropism** is a response to **gravity**.
  For example, roots grow towards the earth.
- **Hydrotropism** is a response to the presence of **water**.
  The roots grow towards water in the soil.
- **Thigmotropism** is a response to **contact**.
  It occurs in the shoots of creepers, which grow around the objects they touch.



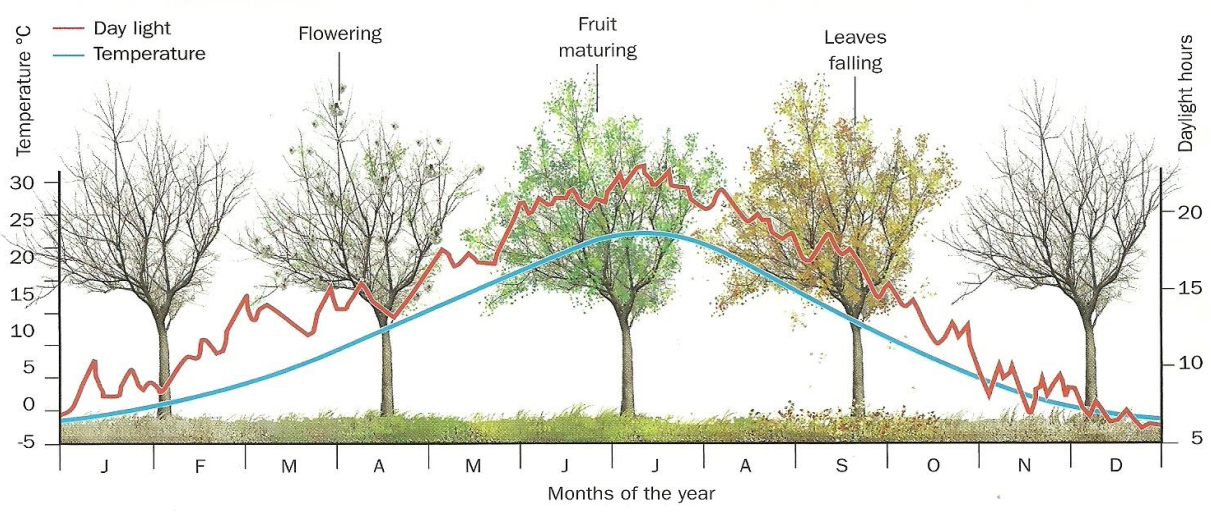
b) Nastic Movements

Nastic movements are plant responses which consist of **rapid** movements of some parts of the plant. They are usually **reversible** and **temporary**. For example:

- **Photonasty** is a response to **light**. Examples are the way leaves or flowers turn, following the sun; or the opening and closing of some flowers depending on whether it is day or night.
- **Thermonarty** is a response to **temperature**. For example, some flower close when temperature drops down too much, or some leaves fold when the temperature is too high.
- **Thigmonasty** is a response to **contact**. For example, the mimosa shrub folds its leaves when touched; the flytrap, a carnivorous plant, snaps its leaves shut when an insect brushes against it.

c) Changes in a plant's vital processes

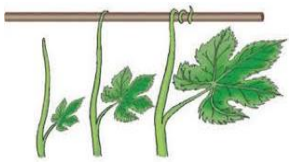
Some plants react to certain stimuli by modifying some of their vital processes. The most characteristic reactions of this type are the **seasonal changes** of many plants, like responses to temperature, the light or the length of the day and night. For example, flowering in spring, shedding leaves in autumn, fruits maturing in summer.



READING ACTIVITIES

5.1. What is the main difference between *nastic movements* and *tropisms*?

5.2. Vine tendrils (runners) wrap around other stems and nearby objects.



a. What type of response is it?

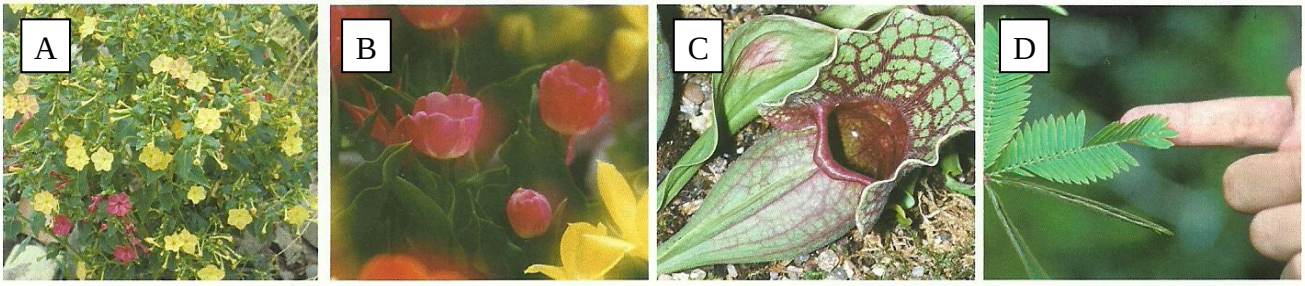
b. What type of stimulus provokes it?

c. Why is it useful for vines to have tendrils?

5.3. Answer the questions:

a. What type of plant response is shown in the photographs tropisms or nastic movements? Why?

b. Identify the type and the stimulus which act in each case.



These flowers open at dusk and close during the day.

Tulips open and close according to the temperature.

Carnivorous plants close their leaves when an insect lands on them.

Mimosa leaves retract when touched.

6. Reproduction in Plants.

6.1. Asexual reproduction in plants

Asexual reproduction is more common in plants than in animals. It involves the formation of new individuals from the cells of a single parent.

There are three main types:

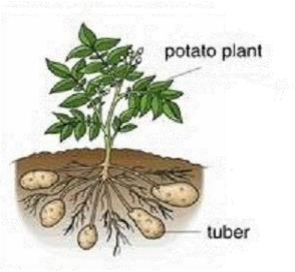
a) Spore formation:

It is typical of mosses and ferns.
A spore is a cell, surrounded by a hard protective covering.
When it falls on the ground, grows into a new individual.

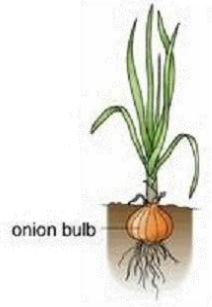
b) Vegetative reproduction:

New plants are formed from parts (buds) of the original plant. Plants can increase its distribution and when environmental cconditions are too hard to survive, they stay alive in latent form, until these conditions return to be good.

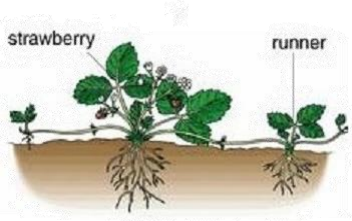
These vegetative structures can be:



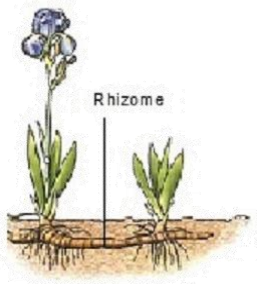
- **Tubers:**
They can be roots or undergrownd stems with a reserve of nutrients and buds. These tubers become new plants. E.g. Potato.



- **Bulbs**:
They are underground stems with thick leaves containing nutrients. These nutrients feed the shoot which will become a new plant. E.g. Onion.



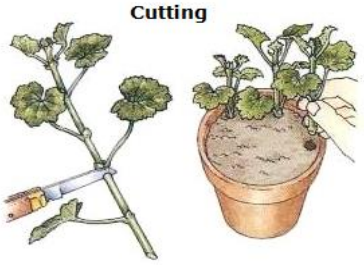
- **Stolons:**
They are aereal stems which root when they touch the ground. If stolons are separated from the mother plant they become new plants. E.g. Strawberry.



- **Rhizomes**:
They are undergrownd stems that grows horizontaly.
E.g. Iris

c) Fragmentation

The new plant is created
from a fragment of the mother plant.



3.2. Sexual reproduction in Plants

We can distinguish several phases in the life cycle of Spermatophytes:

a) Formation of gametes

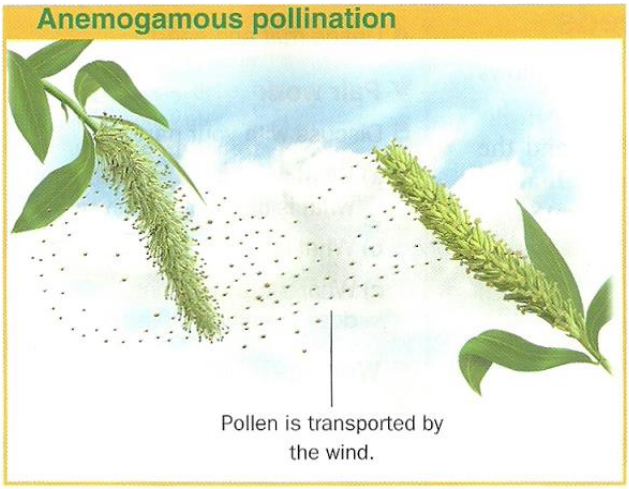
Gametes are formed in the flowers.
- The ovule of the pistil produces the **female gamete**
- The anther of staments produces pollen grains that produce **male gametes**.

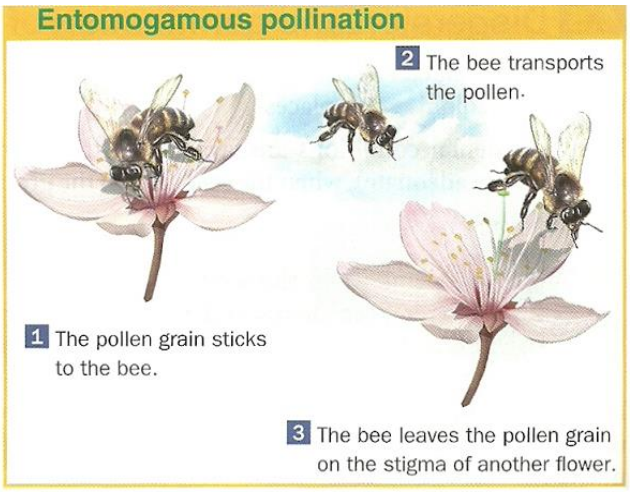
b) Pollination

Pollination is the transfer of pollen grains from the anthers of a flower to the pistil of other flower of the same plant (self-pollination) or of other one (cross-pollination).

Pollen grains can be transported in two different ways:

- By **wind**. These plants have incomplete and small flowers and they produce a lot of pollen, in order to make easier its release and to assure that at least a part reaches its objective.
- By **insects**. These plants have big, coloured and fragrant flowers and usually produce a sweet substance called nectar, in order to attract insects. They do not need to produce a great amount of pollen because insects carry it directly to other flower.



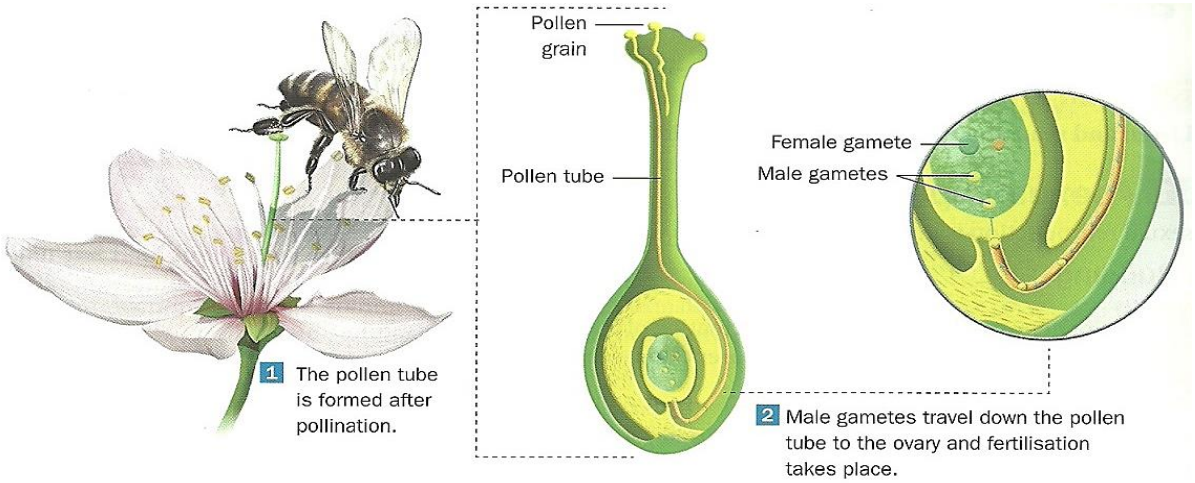


c) Fertilisation

Fertilisation consists of the union of the male gamete and the female gamete.

When the pollen grain reaches the stigma, it forms a pollen tube, which grows along the style until it reaches the ovary and the ovule inside.

The male gamete goes down inside its pollen tube. When it arrives to the ovule, join together with the female gamete and the zygote is formed.



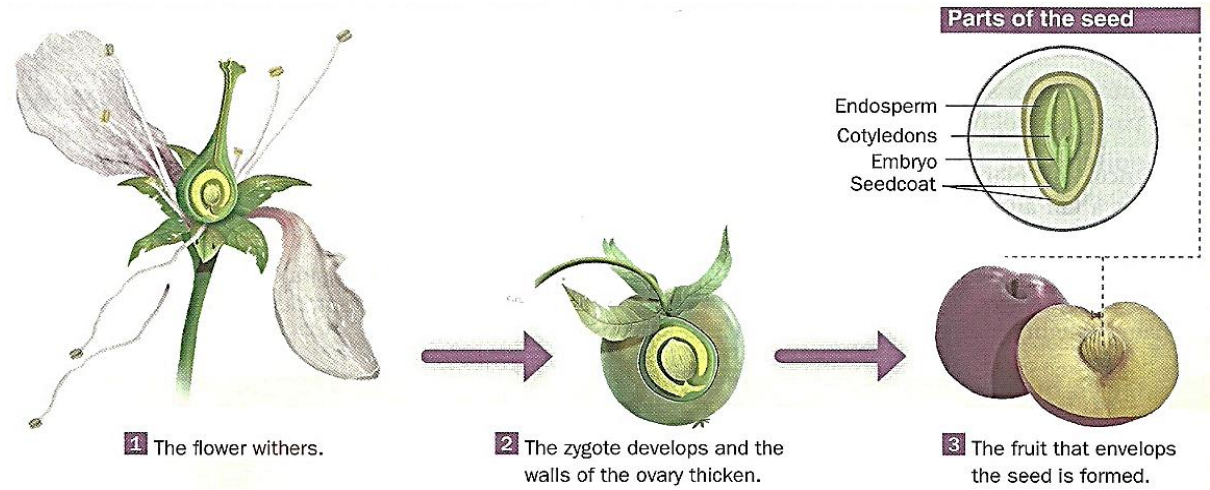
d) Formation of the seed and the fruit

The **seed** is formed from the ovule tissues. The seed is composed by three parts:

The **fruit** is formed from the ovary tissues in *Angiosperms*. After fertilisation, the flower loses the sepals, petals, stamens, the style and the stigma. The walls of the ovary grow and develop with the seed inside.

The fruit function is to protect the seed and help in its dispersion. There are two types of fruits:

- **Fleshy fruit**, such as tomatoes or peaches, where the part around the seed is a juicy pulp.
- **Dry fruit**, such as sunflower seeds or nuts, where the seed has a stony fruit wall.



e) Dispersion and germination

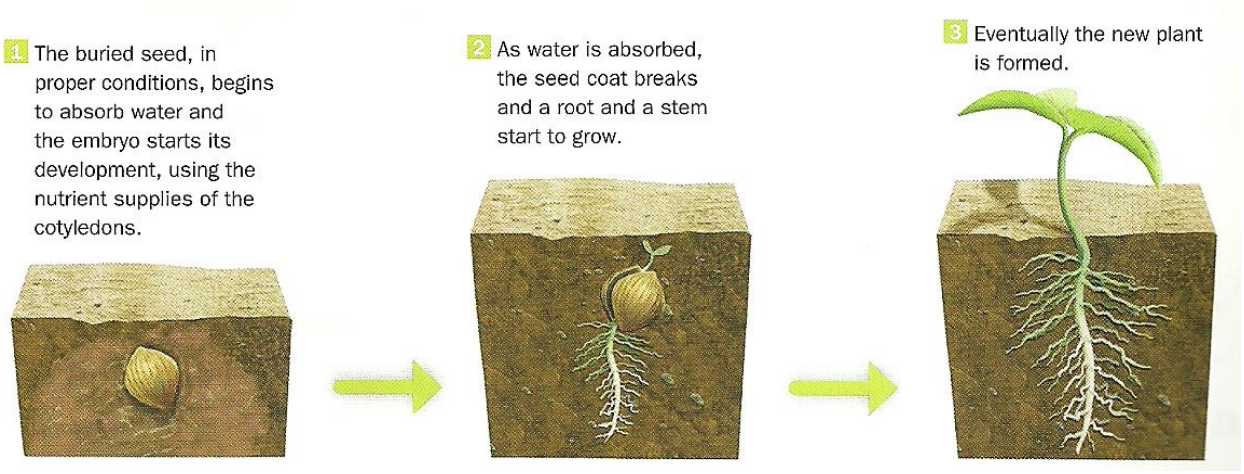
Dispersion of seeds and fruits can occur in the following ways:

- By **animals**:
  - Animals eat plants, but they can't digest the seeds. So these seeds are then released in the animal's faeces in different places.
  - Some fruits are not edible but they have hooks that stick to the fur of animals, so they are dispersed as animals move around.
- By **wind**: Some fruits and seeds are shaped like wings or windmills.
- By **water**: Some fruits and seeds have waterproof covers that allow them to float.

For germination to take place the seeds must disperse: they must land on suitable ground, at a distance from the mother plant and have enough space, light and nutrients.

Germination begins when the seed absorbs water, which causes its coat to break. The seed opens and the embryo begins to develop to create a new plant.

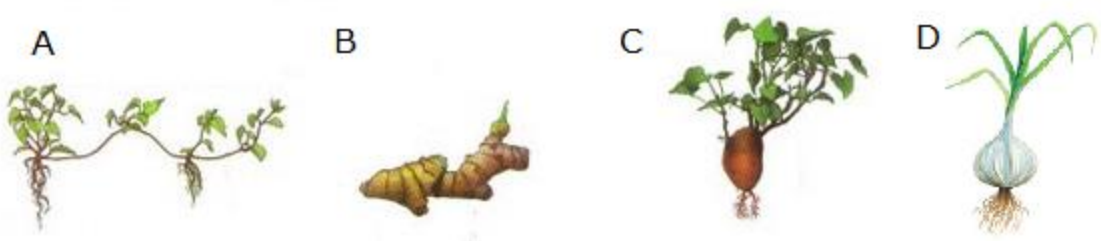
In the first stages the new plant feed on the supplies stored in the seed until it can carry out photosynthesis and begins to make its own nutrients.



READING ACTIVITIES

6.1. What advantages do plants obtain reproducing in a vegetative way?

6.2. Identify the vegetative structures that are represented in the pictures:



6.3. Listen and indicate if the following sentences are true or false.

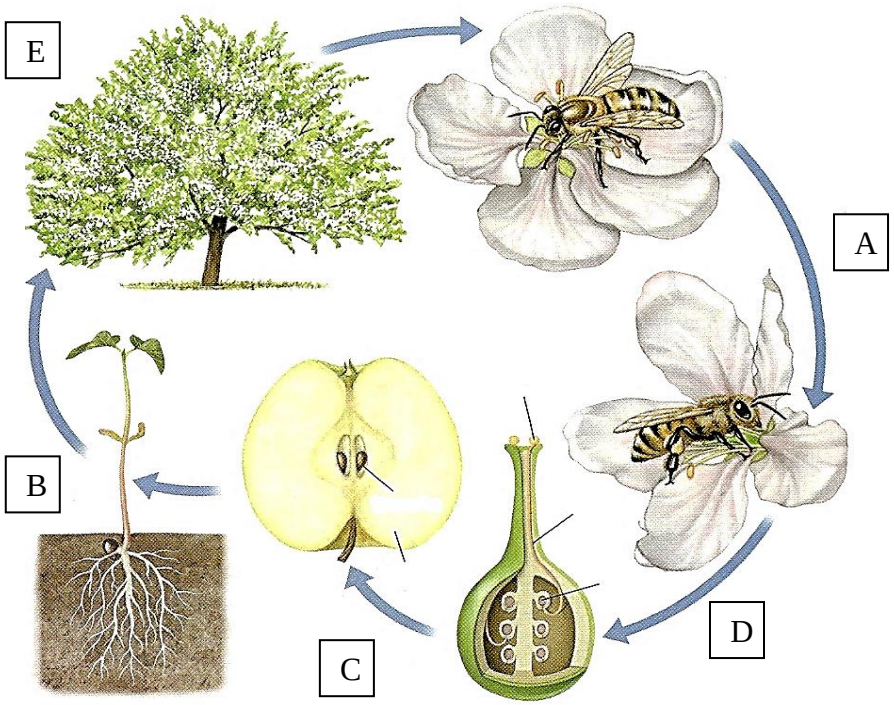
6.4. Indicate which of the following characteristics allow to plants pollinated by insects (I) and to plants pollinated by wind (W).

a. They produce a lot of pollen
b. They have flowers with coloured petals
c. They produce nectar
d. Their flowers have little or no scent at all
e. They have big and bright coloured flowers
f. They have very fragrant flowers
g. They produce little pollen
h. They don't produce nectar
i. Flowers usually grow at the end of the branches
j. Flowers are small and, often do not have petals

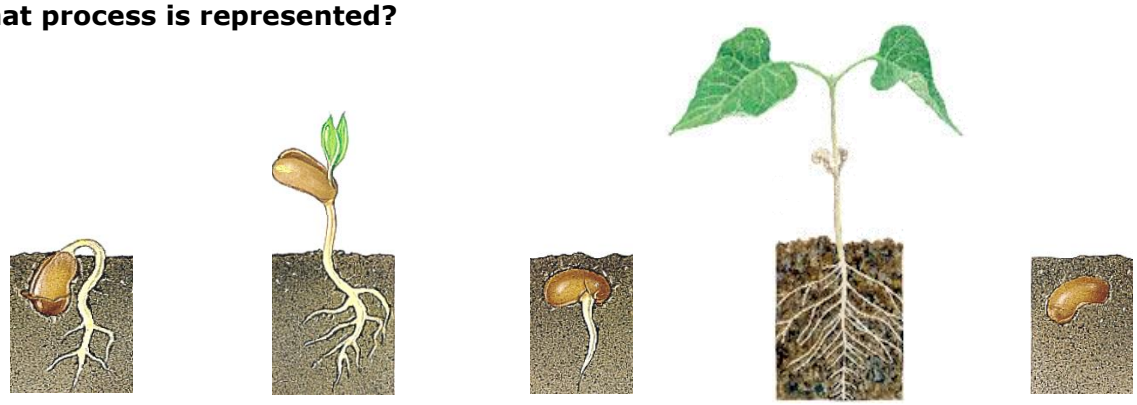
Now listen and indicate which characteristics correspond to each type of pollination:

a. Anemogamous pollination (by wind)
b. Entomogamous pollination (by insects)

6.5. Identify the phases of this Angiosperm's life cycle.



6.6. Cut out these pictures and glue them in the right order in your notebook. Complete the sentences and relate them with their correspondent image. What process is represented?



a. The …… waits for favourable conditions to ……..
b. The ……appears when there is enough moisture in the soil.
c. The seed ……..…….. falls and the young …….. come out of the soil.
d. The …… feed the plant while it hasn't got real leaves to perform ……
e. Finally, the first real …….. appear and the cotyledons fall down.