

Kingdom Plantae

Key words

feature	bryophytes	herbaceous	node
to release	pteridophytes	sporangium,	leaf (leaves)
damp	gymnosperms	vascular	apix
cluster	angiosperms	rhizome	sepal
shrub	tropism	fronds	calyx
to burst	nastic	sorus, -i	corolla
petal	stamen	filament	anther
carpel or pistal stigma	style	ovary, -ies	to fuse
ovule	gamete	zygote	fleshy
ripe			

1. What Is a Plant?

Plants or metaphytes are, autotrophic multicellular eukaryotes, with tissues.

- Plants are **multicellular**, they are made of many cells.
- They are **eukaryotes**; their cells have a defined nucleus in the cytoplasm.
- They have **tissues**; their cells are specialised into tissues, organs (such as leaves, roots or flowers) and systems.
- They are **autotrophs**; they make their own food by **photosynthesis**.

Besides these main characteristics, plants all have similar physical features that make them easily recognizable.

- They have **roots, stem and leaves**, even though their shape may vary from one species to another.
- They are **green** due to the presence of **chlorophyll**; a photosynthetic pigment.

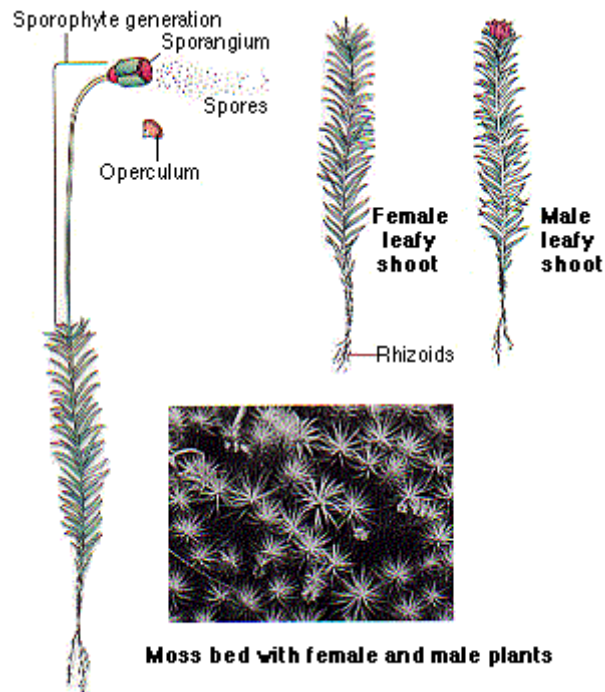
They are **non-motile**. They are rooted to the ground. However, they do move when they open their flowers, fruits

Classification of Plants

Plants are classified into 4 groups: bryophytes or mosses, pteridophytes or ferns, gymnosperms and angiosperms.

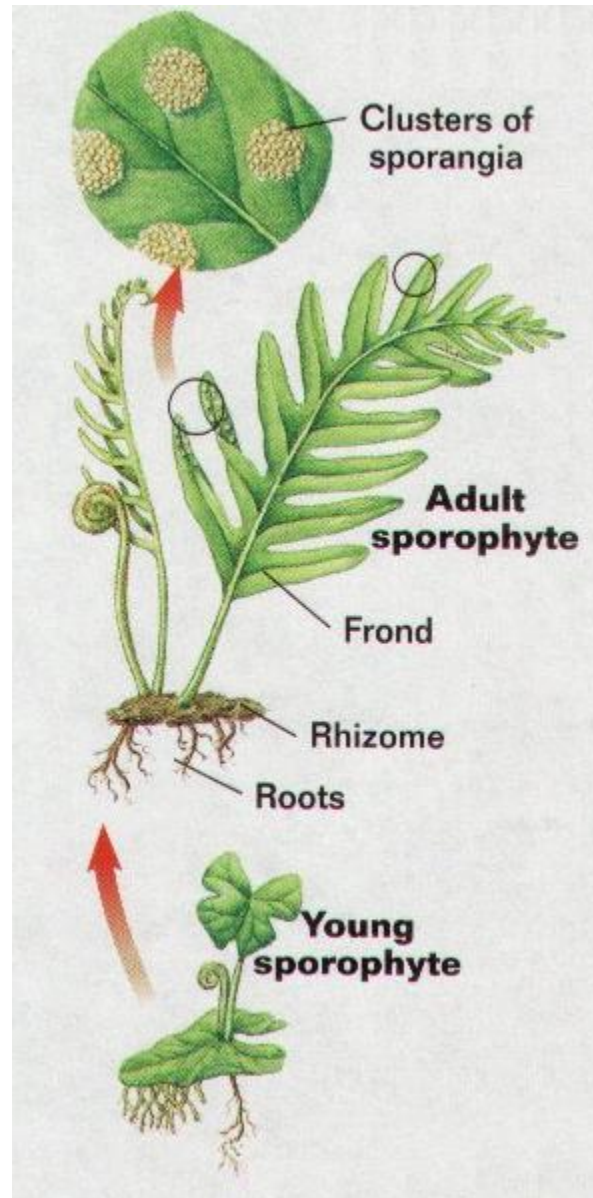
2.1 Mosses and liverworts (Bryophytes)

Mosses and liverworts (Bryophytes) are the simplest plants. They are small, with no true vascular tissues, flowers nor fruits.



2.2 Ferns (Pteridophytes)

Ferns (Pteridophytes) are medium sized plants with true vascular tissues. They don't have flowers nor fruits.



2.3 Gymnosperms

Gymnosperms or conifers are plants with vascular tissues, and flowers, but without fruits.

They are trees or shrubs, mostly evergreen and they grow in different climates. However most of the species are found in colder climates and at higher altitudes than other trees. The features of a conifer are the following:

- They have **softwoods**.
- They have **needle-like leaves** covered by a very thick cuticle which prevents water loss.

- The '**flowers**' of conifers are **small cone-shaped** and of dull colours, **refer to as cones**.
- The **seeds** are not enclosed in an ovary. Their seeds are 'naked', without protection from a fruit.

Conifers reproduce sexually. The male cones of conifers produce pollen. The pollen is distributed by wind reaching the female cones. Once fertilization takes place, the female cone develops into a pine cone. The fertilized pine (female) cones grow seeds (pine seeds) which will eventually give rise to new plants.

Angiosperms

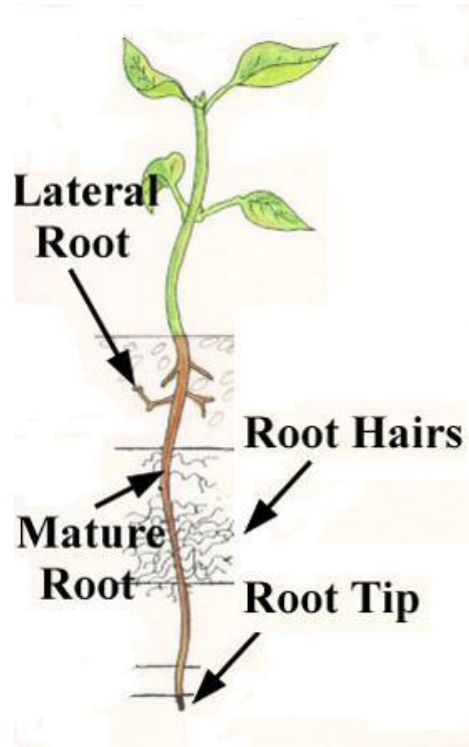
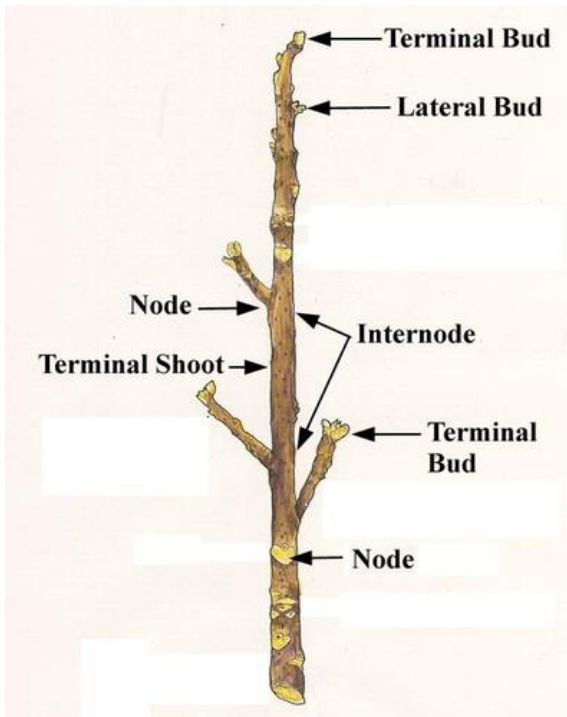
Angiosperms or flowering plants have vascular tissues, flowers and fruits.

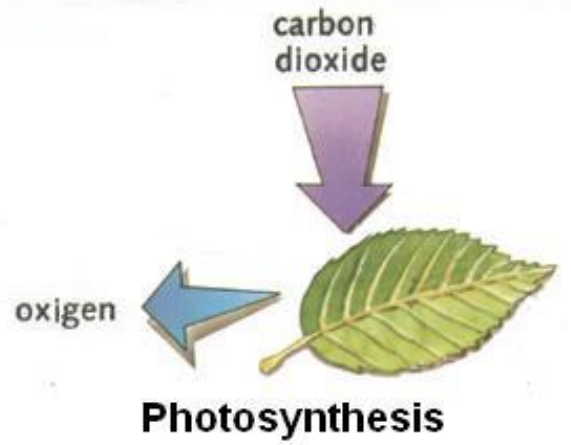
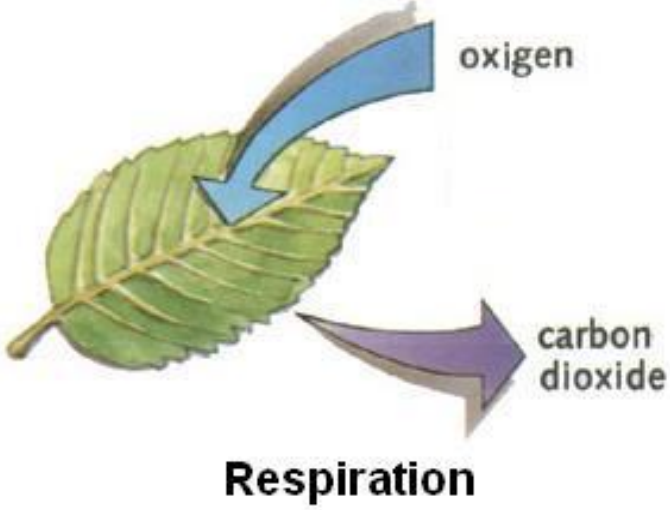
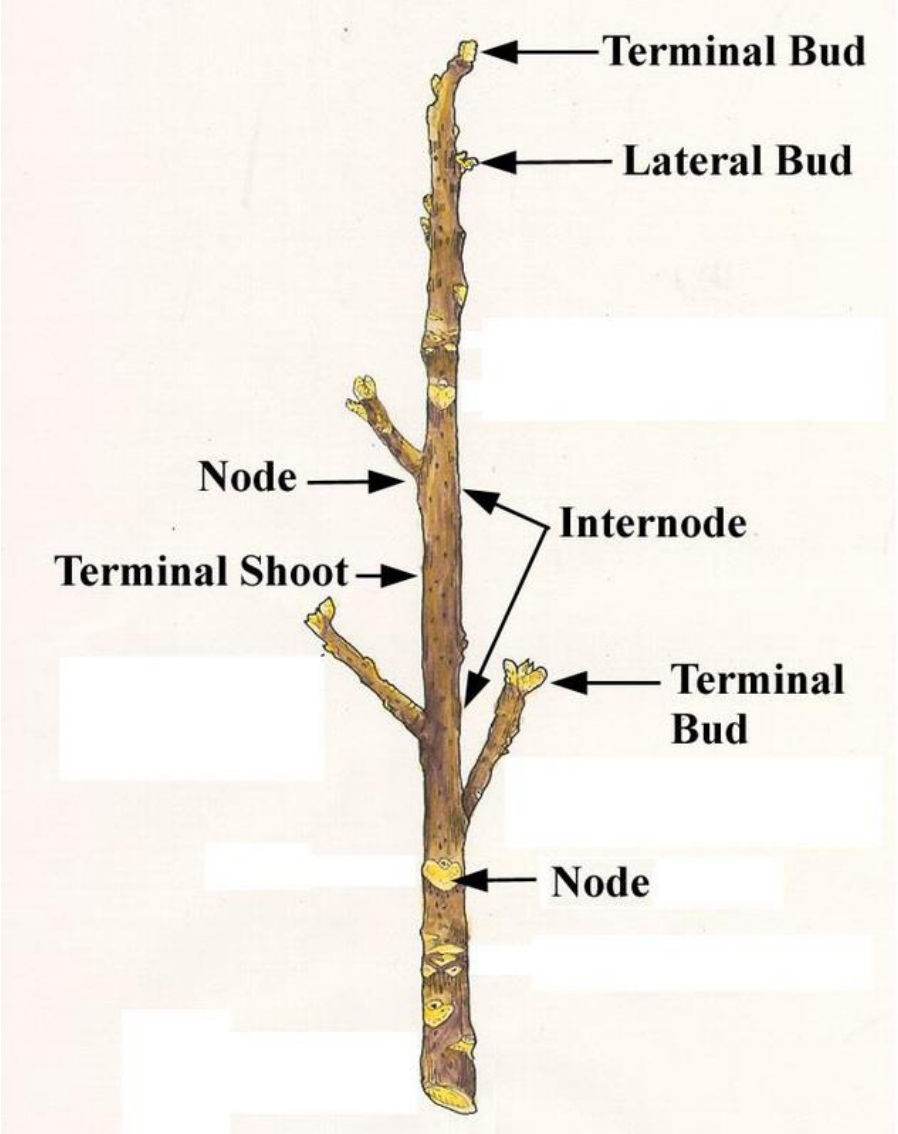
Angiosperms are the most successful of plants. We can find an enormous variety of them, and they are the largest group. They have evolved into many species and adapted to all habitats

Flowering plants share the following general characteristics:

- They have efficient, well developed **vascular tissues**.
- They have broad **leaves** well adapted for photosynthesis.
- They have bright colourful **flowers**.
- Their seeds are enclosed in a **fruit**.

Flowering plants also reproduce sexually. The pollen is transported by insects or distributed by the wind from flower to flower. After a flower is fertilized, the fruit is formed in which the seeds are enclosed.





3. More About Plants

3.1. Roots, stems and leaves

Roots: Subterranean organs. They anchor the plant, absorb water, mineral salts and other nutrients from the soil. They are also a reservoir for food.

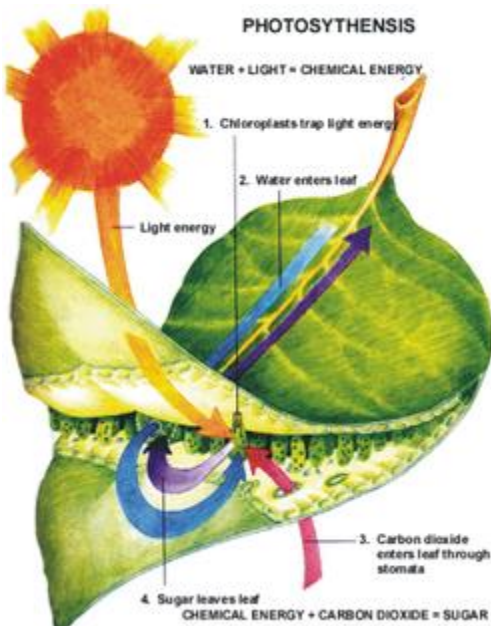
The stem: Aerial organ. It keeps the plant upright, and the different organs together. It also transports substances throughout the plant.

Stems (shoots) can be herbaceous, if they are soft, or woody if they are hard. (The stem divides into branches where we can see **nodes**; small bumps from which other branches, leaves, flowers or fruits can develop. The space between nodes is known as **internode**. At the nodes and apex of the stems there are **buds**. From buds new leaves and branches are formed).

Leaves: Laminated green organs where photosynthesis takes place and gas exchange occurs.

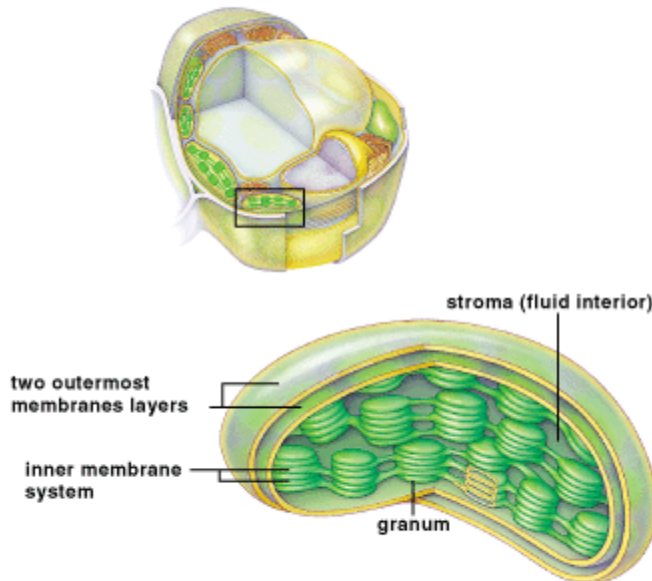
3.2. Photosynthesis and plant nutrition

Plants are autotrophs. They manufacture their own food by the process of photosynthesis. They take inorganic compounds from the soil and the air, and with the energy from sunlight transform them into organic substances (sugars)



- Plants take water and mineral salts from the soil through their **roots**. This mixture is called **raw sap**.
- Raw sap is transported **up the stem** to the leaves through vascular bundles
- The leaves take carbon dioxide from the air, and through the process of **photosynthesis**, using the energy from sunlight, they transform the raw sap into elaborated sap. This elaborated sap contains nutrients (sugars = glucids).
- The elaborated sap is transported to the rest of the plant also through vascular tissues, and to the roots for storage.

Photosynthesis: process by which plants elaborate organic substances from simple inorganic substances, like water, and carbon dioxide, using sunlight. The organic substances elaborated during this process are simple sugars like glucose. During the process of photosynthesis, oxygen (O₂) is released as a waste product.



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The simple sugars manufactured during photosynthesis will be used by the cells to make other substances.

3.4 Respiration in plants

Plants, just like any other living organism, also **respire**. During respiration, the gas exchange is exactly the opposite as in photosynthesis. Oxygen is taken in and carbon dioxide is expelled as a waste product. **Plants always respire.**

Plants carry out photosynthesis and respiration during day time, and only respiration at night time.

3.5 How plants interact and respond to their environment

Plants, like all living things, are sensitive to their environment. Since plants are non-motile, they respond to different stimuli by changing their growth patterns.

A **positive response** is when the plant moves towards the stimulus. And a **negative response** is when the plant moves away from the stimulus. Some of the responses to stimuli are temporary movements while others are definite changes.

Tropisms are permanent changes in a plant's growth: ex. when a plant grows towards or away from light it is phototropism. A positive geotropism is when the root tries to find soil.

Nastics are temporary changes that have nothing to do with their growth; such as plants that follow the sun, or open (up) during the day and close at night.

[Click here](#) to play a respiration game and [here to check your knowledge](#).

4. Plants Reproduction

Plants can reproduce **asexually or sexually**.

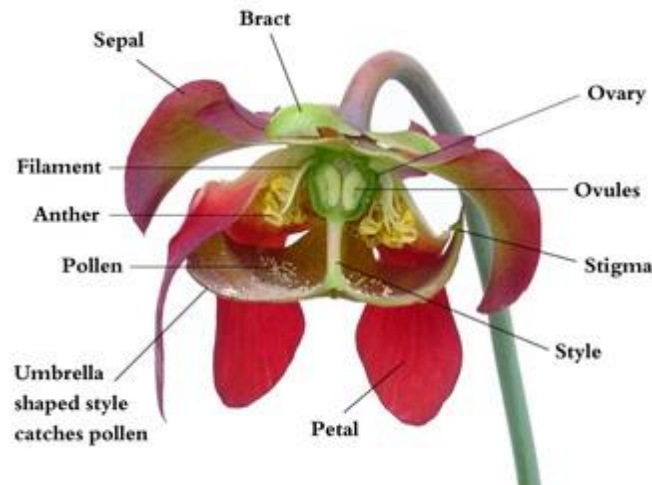
In **asexual reproduction** only one individual plant takes part. Asexual reproduction in plants is also known as vegetative propagation. Stem cuttings are a form of artificial propagation.

In **sexual reproduction** two sex cells of opposite sex (a female and a male sex cell) are involved. Inside the flower sex cells, called gametes, are produced. The male gametes are in the pollen of the flower, while the female gametes are in the ovary of the flower. After fertilization seeds develop, being able to grow into a new plant.

.1. The flower of an angiosperm ([LINK TO ANIMATION](#))

The flower is the reproductive organ system in angiosperms. The flower of an angiosperm is formed by the following parts:

- The **sepals** are green leaf-like structures at the base of the flower which protect the flower before it opens. The collection of the sepals makes up the **calyx**.
- The **corolla**, made up by the **petals**, protects the reproductive organs of the flower. The petals are brightly coloured leaves
- The **stamen** is the male reproductive organ of the flower. It consists of an elongated **filament** with an **anther** at its tip. Each anther contains four **pollensacs** filled with **pollen grains**. The male gametes are in the pollen grains.
- The **carpel or pistil** (gynaecium) is the female reproductive organ of the flower. Its shape resembles that of a small bottle with an elongate neck and it is at the centre of



the flower. The carpel consists of the **stigma, the style and the ovary**. The ovary contains the **ovules**, which contains the female gametes.

- **4.2. Pollination**

In order for sexual reproduction to take place, the male gametes and the female gametes must meet. This is done by a process known as pollination.

Pollination is the transfer of pollen grains, containing the male sex cells (gametes), to the female flower parts, containing the female sex cells (gametes)

We can differentiate between **self-pollination** and **cross-pollination**. In self-pollination, the transfer of gametes takes place within the same flower. However, if the transfer takes place between two different flowers (from one flower to another) of the same species, we call it cross pollination.

Pollination is carried out by the wind or animals (usually insects but also some birds species such as hummingbirds)

- **4.3. Fertilization**

Fertilization is the step that follows pollination. Once the grain of pollen has landed on the stigma of a flower, pollination is complete.

Now that the pollen grain is in the stigma of the flower, it grows a **pollen tube** that goes down the style. Eventually, the pollen tube will reach the ovary.

Once inside the ovary, the pollen tube opens up allowing the male sex cells move down and into the ovary where it will fuse with the female sex cell forming a **zygote**.

The zygote will turn into an **embryo**, which will be enclosed in a **seed**.

4.4 The formation of seed and fruit

After fertilization takes place, the flower undergoes a few changes.

- The sepals and petals dry up and usually fall off.
- The stamen, the stigma and the style also dry up (wither away), being left only the ovary, which grows and changes in colour. It has now become the fruit.
- If the fruit contains lots of water such as an apple, a peach, a cherry, a grape etc., it is called a **fleshy fruit**.
- However, if the fruit has little water and it becomes hardened such as peanuts, acorns, beans etc., it is called a **dry fruit**.

4.5 Germination of seeds

When the fruit is **ripe**, it falls to the ground eventually releasing the seeds. Shortly

after that, if the environmental conditions are good, the seed will germinate.

The seed needs the following to germinate: a water supply, oxygen and a suitable temperature.

During germination, the seed absorbs lots of water swelling up until bursting (splitting open) of the outer coat. Once the outer coat splits open the new plant begins to grow.