Biodiversity of plants

Scope

Topic	Breakdown of topic
Biodiversity of pants	Grouping of Bryophytes and Pteridophytes Grouping of Gymnosperms and Angiosperms Use simple diagrams to identify an example of each group and a comparative table to demonstrate the presence/absence of following in the four groups: - vascular tissue (xylem and phloem) - true leaves and roots - seeds or spores fruit. - decreasing dependence on water for reproduction from Bryophytes to Angiosperm Asexual and sexual reproduction, name advantages and disadvantages of each. Flowers as reproductive structures Adaptations for pollination through (different pollinators) wind, insects and birds (South African examples only) differences and similarities

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Biodiversity of plants

Notes

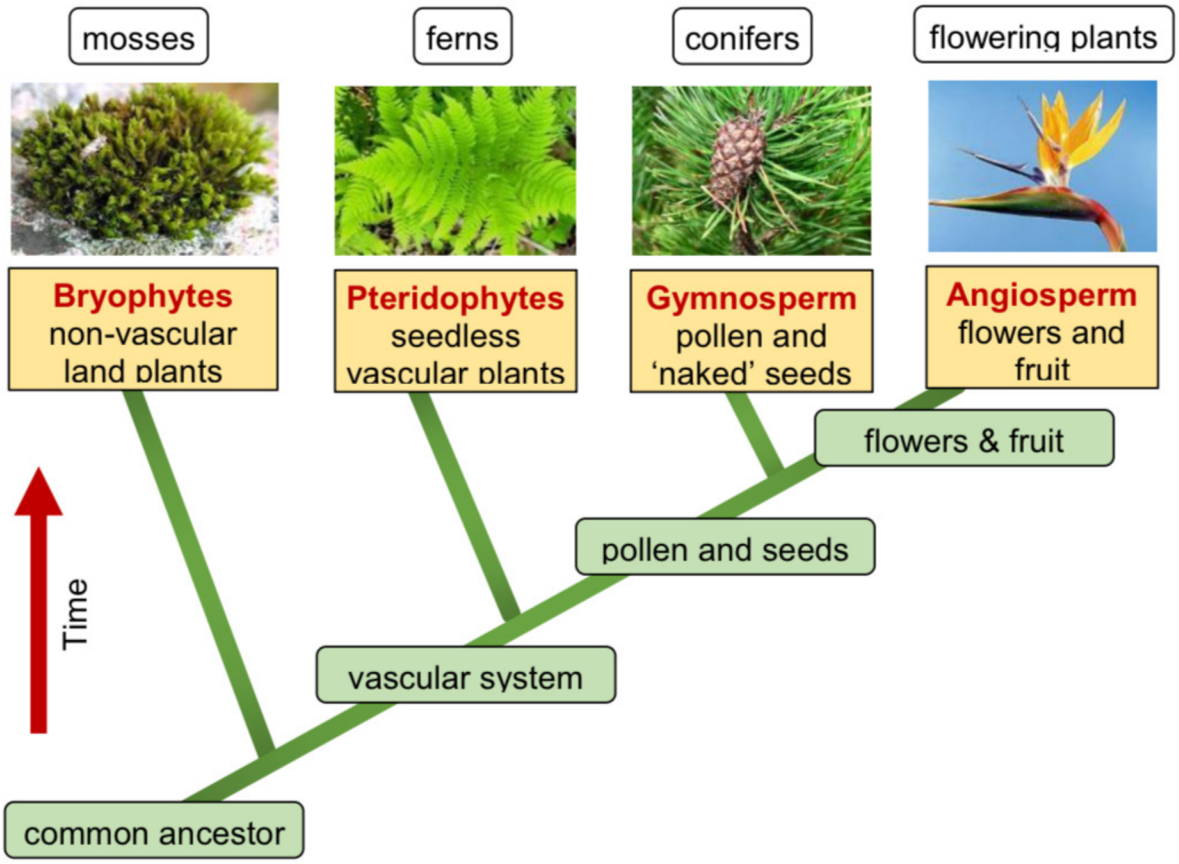
Biodiversity refers to the wide variety of plants, animals and micro-organisms on Earth.

All plants are thought to have evolved from simple unicellular algae.

Four major plant groups exist namely:

- Division Bryophyta.
- Division Pteridophyta.
- Division Gymnospermae (Gymnosperms)
- Division Angiospermae (Angiosperms)

A cladogram illustrating the relationship between these divisions is illustrated



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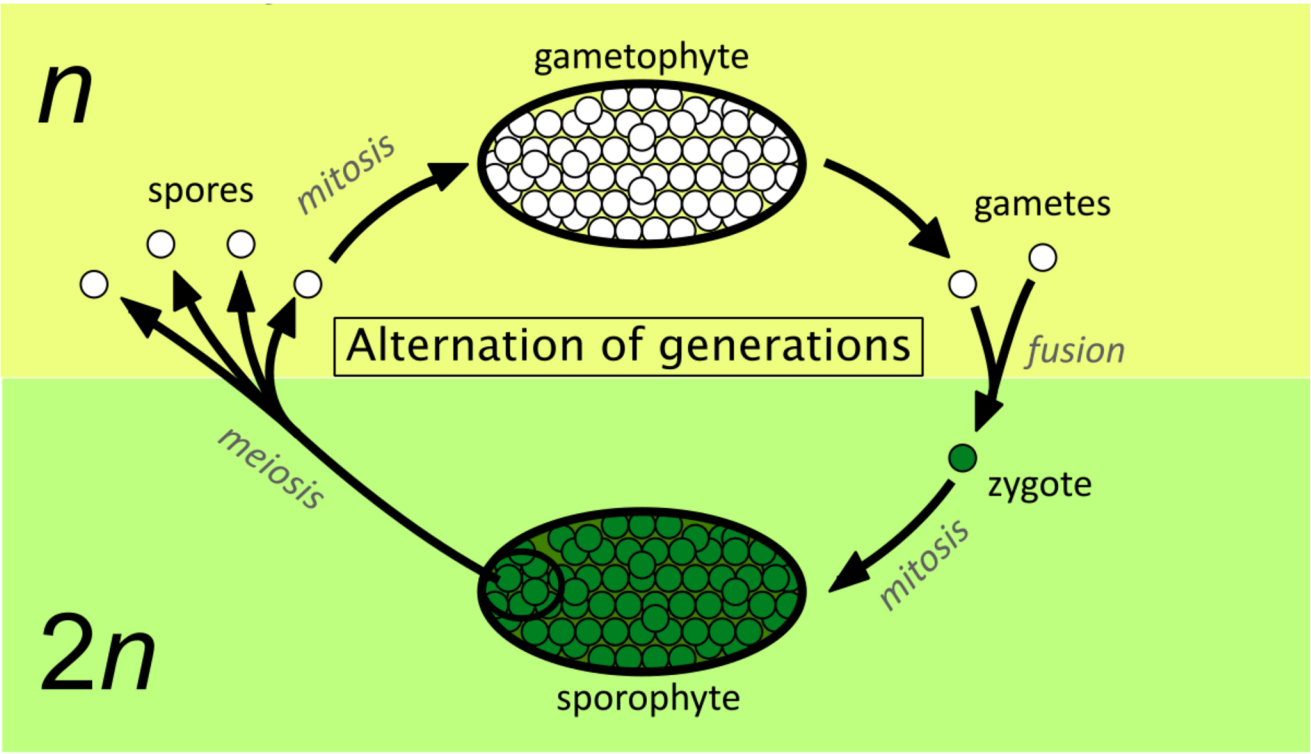
The four groups (divisions) of plants belong to the Kingdom Plantae.
They have the
following in common:
- multicellular
- eukaryotic (cells have a membrane bound nucleus)
- cell walls are made of cellulose
- most are autotrophic and have chloroplasts for photosynthesis
- a life cycle involving two generations: a diploid, spore producing generation called a sporophyte and a haploid, gamete producing generation called a gametophyte – referred to as an **alternation of generation**



The characteristics used to place a plant into one of the four groups depends on:
- the presence or absence of true conducting tissues such as xylem and phloem
- the presence or absence of true, roots, stems and leaves
- the type of reproduction and reproductive structures formed
- the degree of dependence on water for reproduction

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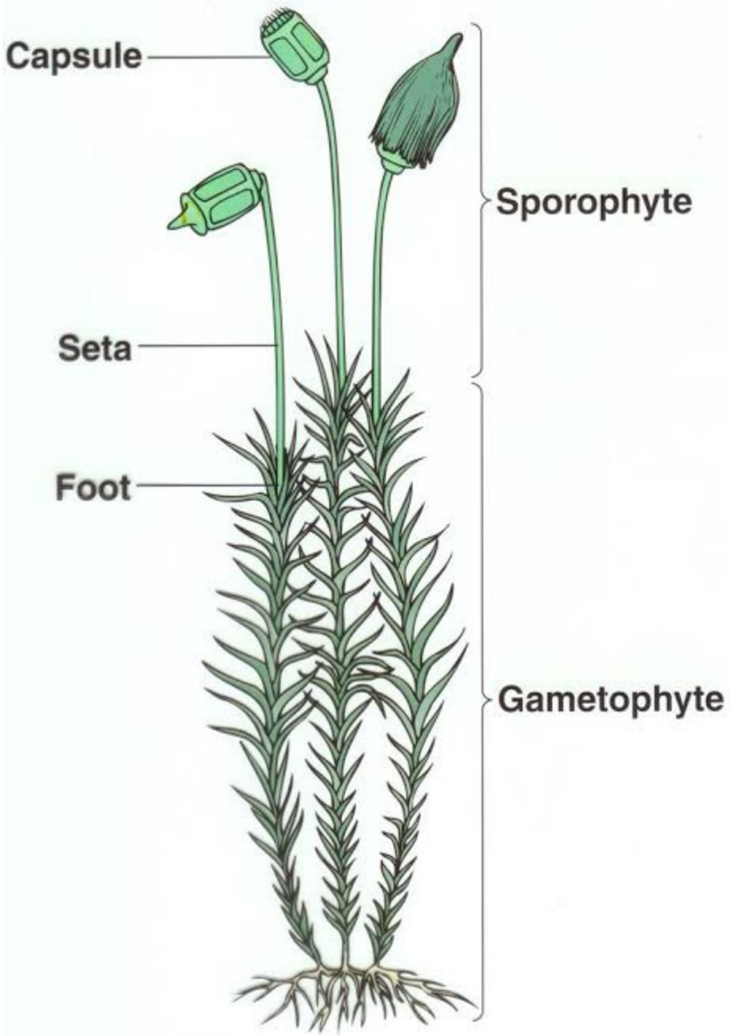
Bryophyte

Bryophytes are the most primitive terrestrial plants. The division Bryophyta includes mosses, liverworts and hornworts. **Mosses** are commonly found in damp shady areas

Characteristics

Mosses are generally small (< 20 cm).

- They do not have true roots, stems or leaves (referred to as a thallus)
- The leaves are not true leaves and are often referred to as 'leaflets'.
- The size of mosses is limited because they do not have any conducting tissues i.e. no xylem or phloem (vascular tissue) is present.
- Rhizoids at the base of the plant are responsible for anchoring the plant to substrate.
- Bryophytes can reproduce either asexually or sexually.
- The gametophyte generation is the dominant generation and consists of a green leafy plant, capable of photosynthesis.
- No fruits or seeds produced



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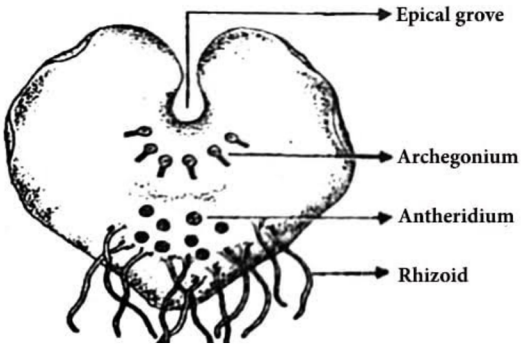
Pteridophyte

The division **Pteridophyta** includes all **ferns**. There are approximately 12 000 different species of ferns. They range in size from tiny plants of only 1 cm in height to tree ferns which can grow to 25 m in height. Most ferns require a warm, damp, shady habitat

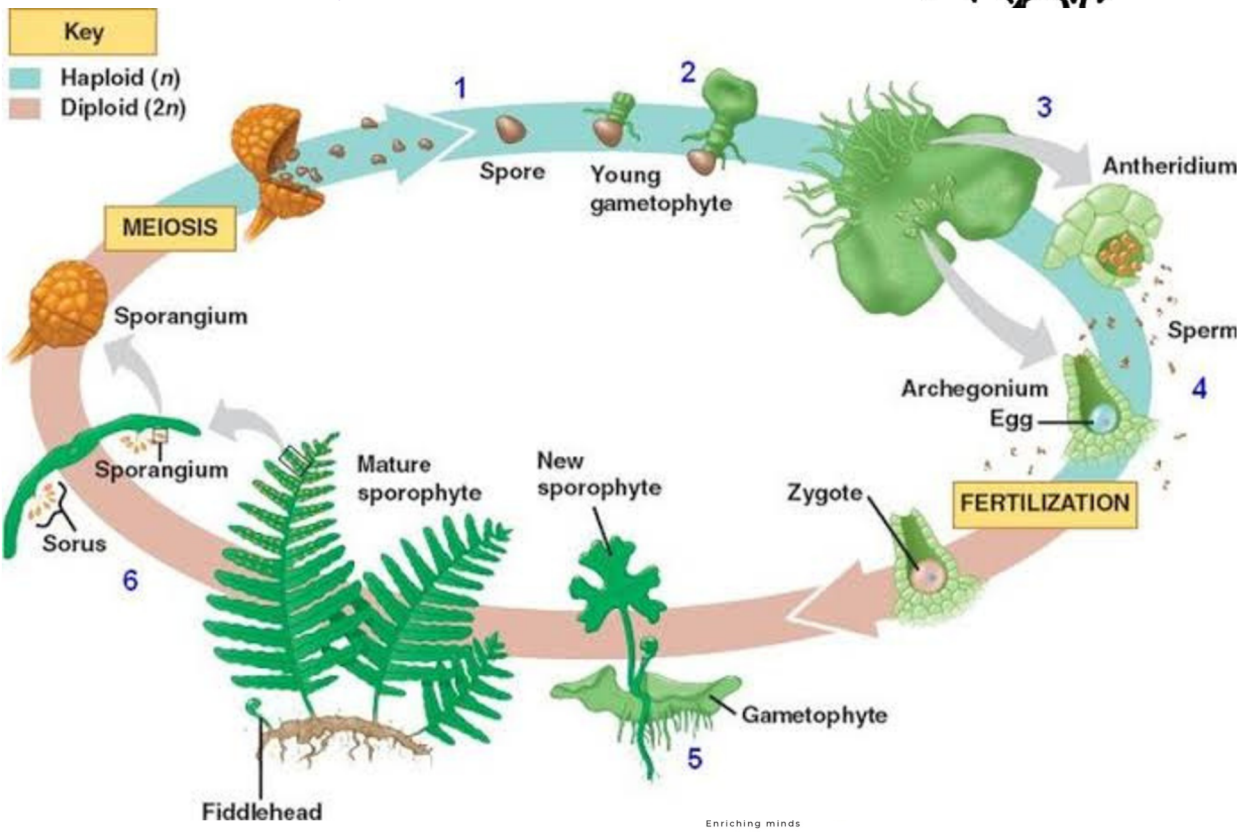
Characteristics

- Ferns have true leaves, roots and stems.
- The presence of vascular tissues allows ferns to grow taller than mosses.
- They have both xylem and phloem which transport water and photosynthetic products respectively.
- The stems of most ferns grow horizontally and are called rhizomes.
- Ferns reproduce both sexually and asexually. The **dominant** generation in ferns is the **sporophyte** generation. Spores are produced in sporangia arranged in **sori** under the leaf
- No fruit or seeds are produced.

Prothallus



Life cycle of a fern



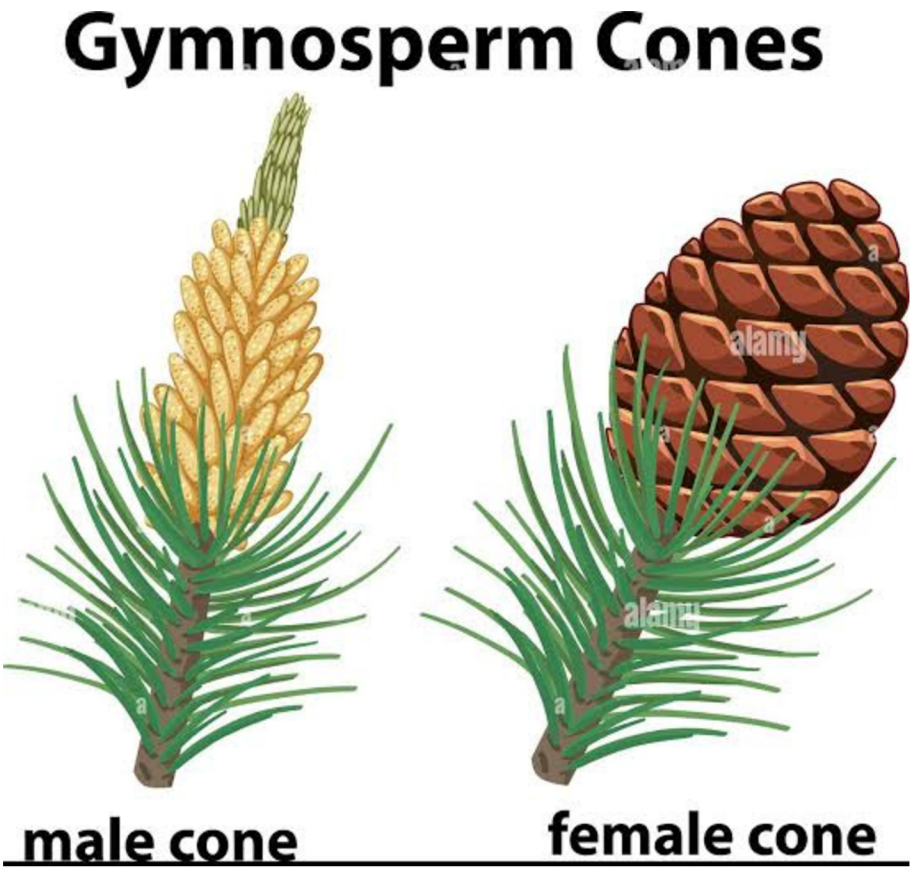
Biodiversity of plants

Gymnosperm

The division **Gymnosperms** includes cycads, Gingko biloba, Welwitschia and pine trees. Gymnosperms all produce seeds which develop into cones.

Characteristics

- **Gymnosperms** have true roots, stems and leaves.
- Vascular tissues, namely xylem and phloem are present.
- Gymnosperms do not produce flowers. They form both male and female cones. *It is important to note that fertilization is not dependent on water.*
- Pollen is carried by the wind from a male cone to the female cone.
- The seeds of the pine are said to be "naked" because they are not protected by a fruit.
- In gymnosperms the sporophyte generation is dominant and the most visible e.g. the pine tree.



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Angiosperm

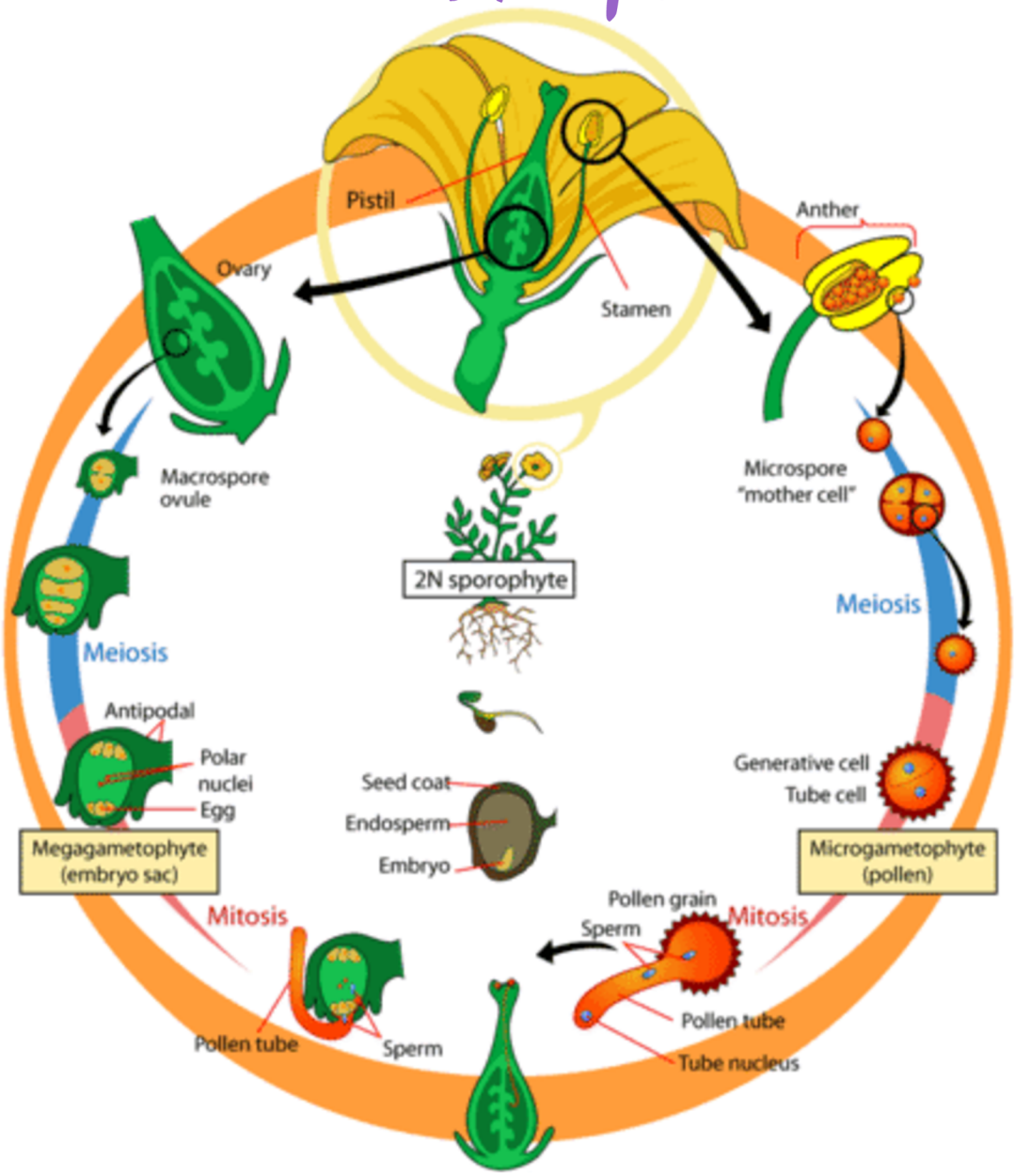
Angiosperms are commonly referred to as "flowering plants" and are the most varied and **successful** group of plants. Most angiosperms are autotrophic, but some are parasitic, while others are saprophytes. Angiosperms typically produce seeds which are found inside fruits

Characteristics

- It consists of true roots, stems and leaves.
- Xylem and phloem are responsible for transporting water and photosynthetic products, respectively.
- Angiosperms produce seeds protected by fruit.
- The sporophyte generation is the dominant generation in angiosperms

The *Pertunia* is an example:

Life cycle



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Dependency on water

As plants have increased in size over millions of years, they have become progressively less dependent on water for their survival and for the completion of their life cycles.

Bryophytes

Of the four groups studied, the **bryophytes** are the least adapted to surviving dry conditions for the following reasons:

- they have no cuticle, no supporting tissues and no vascular tissues
- plant body is a thallus because there are no true roots, stems or leaves
- the gametophyte is the dominant generation
- the sporophyte is totally dependent on the gametophyte for both food and water
- the male gametes are motile (capable of motion) and require water to swim to the female gamete

Pteridophytes

The **pteridophytes** are more evolved than the bryophytes but are still dependent on water for fertilization. have the following adaptations which enable them to grow larger than bryophytes:

- leaves with a cuticle to prevent desiccation (drying out)
- vascular tissue to transport food and water
- the sporophyte is the dominant generation and is not dependent on the gametophyte for water and food once mature

Gymnosperms and Angiosperms

Both the **gymnosperms** and **angiosperms** are well adapted to life on land.
As plants have increased in size over millions of years, they have become progressively less dependent on water for their survival and for the completion of their life cycles.

Adaptations include:

- leaves with a cuticle
- true roots, stems and leaves
- an embryo enclosed in a seed to prevent drying out
- pollen grains to protect and transfer the sperm cells i.e. water is not needed for fertilization

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Sexual and asexual reproduction

Both animals and plants are capable of asexual and sexual reproduction.

Asexual reproduction

Reproduction that does not involve gametes(sex cells).
In asexual reproduction only one parent is required, and the new organism is produced by mitosis.

Advantages

- Only one parent is required.
- Asexual reproduction is **quicker** because the parent does not need to find a mate.
- All the offspring are identical and if conditions are favourable, they can crowd out any **competition**.
- Asexual reproduction **does not rely on pollinators** or dispersion agents.

Disadvantages

- All the offspring are **genetically identical**. If conditions become unfavourable, they will all die.
- **Poor characteristics** in the parents will be passed on to the offspring.
- **Rapid multiplication** by asexual reproduction may lead to overcrowding.

Sexual reproduction

Reproduction that involves the fusion of gametes(sex cells).
In sexual reproduction a haploid sperm cell fuses with a haploid egg cell to produce a diploid zygote. The zygote divides by mitosis to form an embryo and later, a new organism.

Advantages

- The offspring are **genetically different** and are able to withstand a variety of conditions.
- Farmers can **select** organisms with **desirable characteristics** and **cross-breed** with them.

Disadvantages

- **Two parents** are required.
- Plants that reproduce sexually rely on **pollinating agents** and **dispersal agents** to spread their seeds.

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Flowers as reproductive structures

Flowers have the following functions:

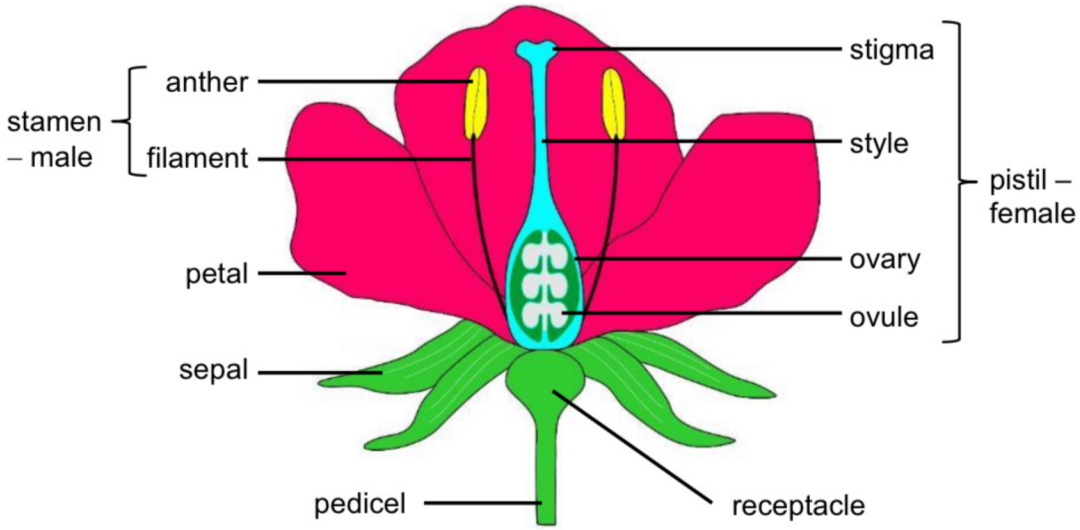
- contain and protect the reproductive organs
- attract pollinators

All the parts of a flower are actually modified leaves arranged in whorls (circles around a central point). Each whorl is specialized to perform a specific function.

The four whorls are the:

- calyx
- corolla
- androecium
- gynoecium

the outermost whorl is called the calyx and consists of a number of green sepals. All the floral parts are attached to a receptacle. The corolla is made up of coloured petals to attract pollinators. The calyx and corolla are known collectively as the perianth.



The stamens (male part) of the flower. Each stamen consists of a filament and a bi-lobed anther with four pollen sacs . Pollen grains are haploid and produced by meiosis.
The pistil(female part) of the flower usually consists of carpels fused together. Each pistil consists of a stigma, style and ovary.
Ovules are formed inside the ovary by meiosis.
When a pollen grain lands on the stigma, it germinates by growing down the style towards the ovule carrying the male gametes to fertilize the ovule.
The fertilized ovule forms a seed and the ovary wall thickens to become a fruit.
In general, fruit do not develop without fertilisation.

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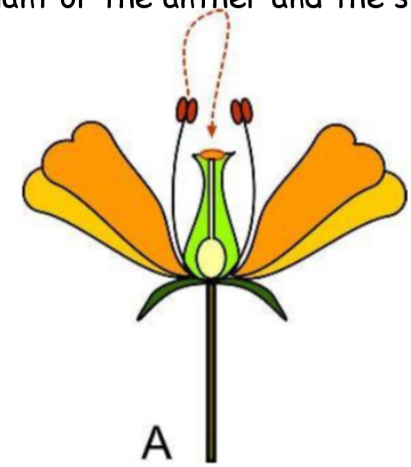
Pollination

Pollination can be defined as the transfer of pollen from an anther to the stigma of the same or the stigma of a different flower of the same species.

Self pollination

Self-pollination occurs when pollen is transferred between flowers of the same plant or the anther and the stigma of the same flower

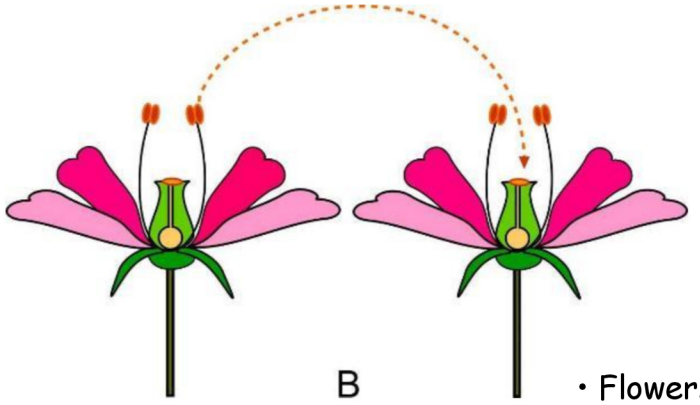


How self pollination may be prevented

- The pollen may ripen before the stigma.
- The pollen will then be dispersed before the stigma is mature.
- The stigma is mature before the anthers mature and receives pollen from other plants of the same species.
- Some flowers are adapted to be incompatible with their own pollen.

Cross pollination

Cross-pollination occurs when pollen is transfer from the flower of one plant to the flower of another plant of the same species



Importance

It creates **genetic diversity**. This means that the offspring are genetically different to the parent. Genetic diversity ensures that a species has a better chance of surviving unfavourable conditions.

Adaptations to pollinators

Bird

- Flowers Larger than insects
- little or no scent
- Dilute nectar
- often red(seen by birds)

Wind

- small flowers
- large anther
- no scent or nectar
- long feathery stigma
- large amount of pollen

Table: The difference between pollinator and wind pollinated flowers.

Feature	Pollination by a pollinator	Wind pollinated
Flower	colourful	small and inconspicuous
Stigma	held inside the flower	protrude from the flower
Stamens	inside the flower	protrude from the flower
Pollen	sticky pollen	large amounts of dry pollen
Scent	strongly scented	no scent
Energy spent	energy spent making nectar and pollen	large amount of energy wasted on producing pollen

Insect

- Large bright petals
- Sweet scent
- Produce nectar
- sticky pollen
- produce many pollen

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plant diversity

Terminology

multicellular	an organism made up of many cells.
eukaryotic	any single or multicellular group of organisms that have a **membrane-bound nucleus** containing genetic material
autotrophic	organisms which can synthesize their own food e.g. green plants, algae and some bacteria.
phylogenetic diagram/ cladogram	a diagram which shows the evolutionary relationship between organisms
thallus	a plant body that is not differentiated into stem and leaves and lacks true roots and a vascular system; thalli are typical of algae, fungi, lichens, and some liverworts
rhizoids	a filamentous outgrowth or root hair on the underside of the thallus in some lower plants, especially mosses and liverworts, serving both to anchor the plant and (in terrestrial forms) to conduct water
gametophyte	the gamete-producing generation
sporophyte	the spore-producing generation
sporangium	spore producing structure
zygote	formed by the union of the sperm cell and the egg cell
haploid	haploid is the term used when a cell has half the usual number of chromosomes
diploid	having two sets of chromosomes or double the haploid number of chromosomes in the germ cell

frond	the leaf of a fern usually with many divisions
rhizome	a stem which grows horizontally
adventitious roots	roots which arise at the nodes of stems
sori	a cluster of sporangia found on the underside of fern leaves

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plant diversity

Terminology

calyx	formed by the green structures around the petals (the sepals) together; serves to protect the flower and its reproductive organs
corolla	all the petals of a flower together form the corolla
receptacle	the thickened part of a stem from which the flower organs grow
perianth	the non-reproductive part of the flower; the calyx and corolla that form a protective envelope surrounding the sexual organs
stamen	male part of the flower consisting of a filament and pollen producing anthers
pistil	female part of the flower consisting of a stigma, style and an ovary where ovules are produced
fruit	a fleshy, often sweet layer, formed around the seeds in angiosperms following fertilization
fibrous/ adventitious root system	formed by many thin, moderately branching roots growing from the stem – common in monocotyledons
tap root system	characterized by a main root or primary root system, growing vertically downward – common in dicotyledonous plants
nectar	a sugar-rich liquid produced by plants in glands called nectaries to attract pollinators

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