

## INTRODUCTION

A basic knowledge of how plants work is fundamental to an understanding of their importance to the entire ecosystem. The current set of notes is designed to familiarise you with the anatomical parts of the plant, how each structure is related to its function and the processes which it carries out.

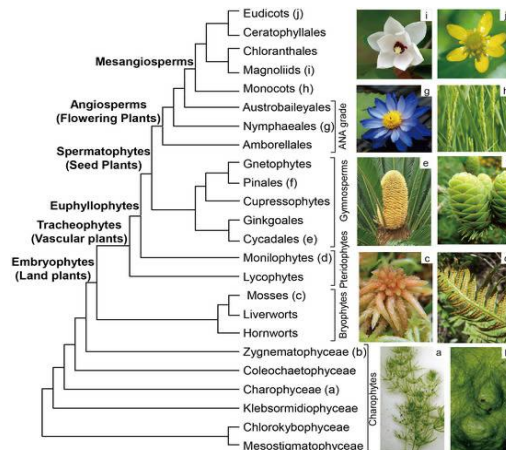
## MODERN TAXONOMY

Taxonomy is an ever-changing science. Traditionally classification used structure and reproductive strategies but in more recent years molecular information such as DNA and RNA, have been used. This shows the closeness of organisms and allows them to be placed according to evolutionary descendants going back to their common ancestor.

Terms you may come across are clade, cladistics, cladogram, phylogeny but these will not be considered in this course.



█ = Adenine  
█ = Thymine  
█ = Cytosine  
█ = Guanine  
█ = Phosphate backbone



## CLASSIFICATION OF LIVING THINGS

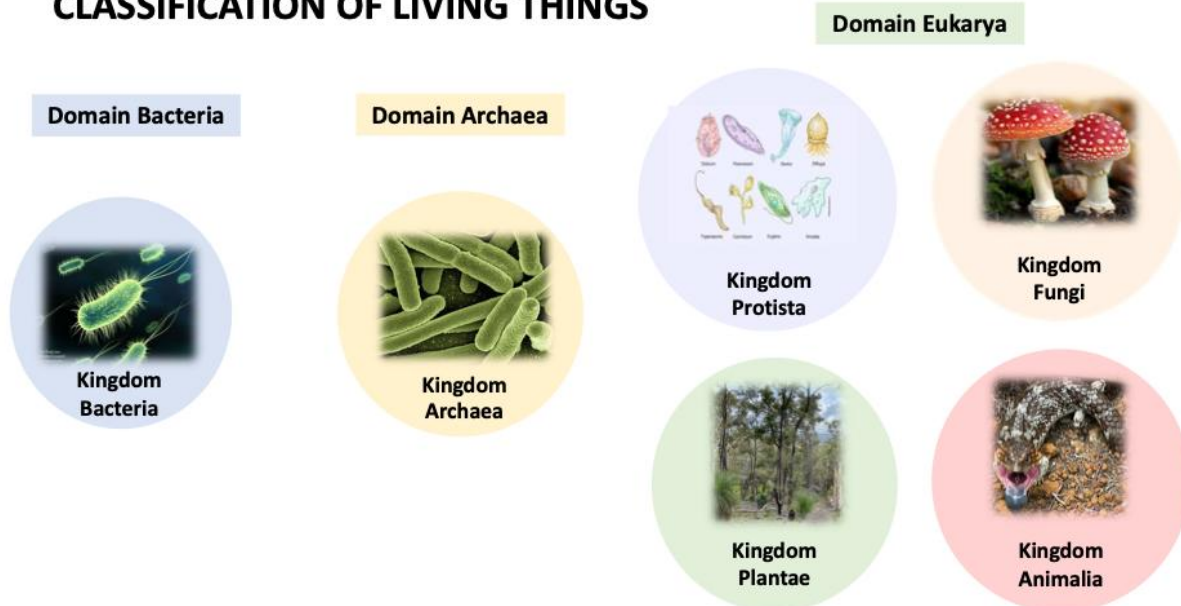


Diagram showing the 3 domains and 6 kingdoms system.

**BACTERIA AND ARCHAEA** – previously in the Kingdom Monera. Both are prokaryotes (no nucleus), and unicellular (single-celled). Archaea are ancient forms of bacteria that can live in extreme environments.

**PROTISTA** - Eukaryotes (nucleus in cell); mostly unicellular, or collections of very similar cells. May have plant, fungus, or animal characteristics.

**ANIMALIA** -Eukaryotes; multicellular; must obtain complex food molecules from external source, broken down and absorbed internally. Usually capable of movement.

**FUNGI** - Eukaryotes; almost all multicellular; must obtain complex food molecules from external source, absorbed through external surface. Almost never capable of movement.

# CHARACTERISTICS OF KINGDOM PLANTAE



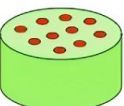



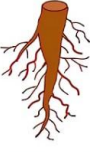
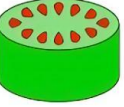


All plants are multicellular and are eukaryotic, that is they have a membrane that surrounds the nucleus. They are capable of producing their own food through photosynthesis.

## GROUPS OF PLANTS

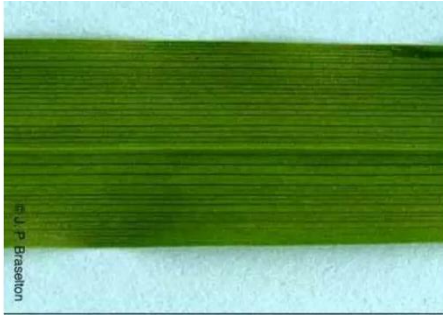
There are 4 main plant groups.

1. **LIVERWORTS and MOSSES:** These are mostly terrestrial, common on tree trunks. They are small green plants with no real roots and they develop from spores. They have a 2 phase lifecycle.
2. **FERNS:** Typically, the large leaves called fronds are the visible part, the stems being underground with simple roots along their length. Spores, in clusters, rows or sheets, develop on the under surface of the frond. They have a 2-phase lifecycle – the leafy plant (the sporophyte) produces the spores. The spores travel through moisture and develop into a tiny heart shaped plant (the gametophyte). The gametophyte produces the gametes which unite and develop into the sporophyte. Examples are maidenhair, fishbone and staghorns.
3. **GYMNOSPERMS:** These plants have what are called naked seeds because ovule (where the seed is produce) is not protected. The plants develop male cones which produce pollen, whereas the larger female cones produce the ovules. Typically, the 'pollen' from the male cone to the female cone is wind transfers but in some it is by insects eg in our Macrozamia. The pollen is trapped by a sticky fluid. The seed develops after fertilisation. Two groups of gymnosperms are:
  - **Cycads:** These are a very primitive type of plant which have been thought to date back to the days of the dinosaurs. The male plant is separate from the female plant (dioecious). The only cycads native to the South-West are *Macrozamia riedlei* in the jarrah forests and *M. fraseri* on the coastal plain. They have compound leaves and are palm-like.
  - **Conifers:** Most conifers are evergreens occurring in temperate and subarctic regions. The group in the Northern Hemisphere include the true pines with needles such as the Monterey Pine (*Pinus radiata*) and the Stone Pine (*P. pinea*). In the Southern Hemisphere there are 3 major families all of which have scale leaves instead of needles. The Araucariaceae are loosely referred to as pines but do not belong to the genus *Pinus*. This includes the Wollemi Pine (*Wollemi nobilis*), the Bunya Pine (*Araucaria bidwillii*). The family Cupressaceae includes Rottneest Island Pine (*Callitris preissii*) and Podocarpaceae includes the Emu plum (*Podocarpus drouynianus*).
4. **ANGIOSPERMS – THE FLOWERING PLANTS:** These plants have roots, stems, leaves and importantly they have flowers which develop into fruits and enclose the seeds. There are two main groups of flowering plants –
  - the **monocotyledons** which have one seed leaf or cotyledon and include the grasses, bamboos, palms, orchids and the lilies,
  - the **dicotyledons** which have two seed leaves or cotyledons and include the Banksias, Eucalypts, Jacksonias and Melaleucas.

## DIFFERENCES BETWEEN MONOCOTS AND DICOTS

	Seed	Root	Vascular	Leaf	Flower
<b>Monocot</b>					
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
<b>Dicot</b>					
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

## LEAVES

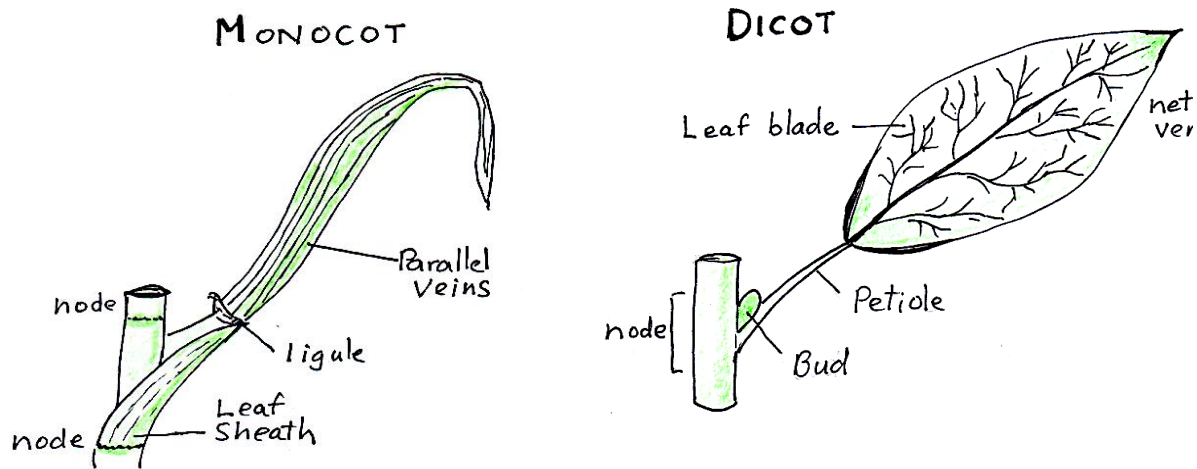


Monocot leaf



Dicot leaf

The **monocot leaf** usually has **parallel veins**. In grasses the leaf appears to come from the stem one node higher than where it is attached. This forms a **sheath** which wraps around the stem. To prevent water running down from the blade into the sheath and causing rotting there is often a flap or **ligule** to deflect the water.



The **dicot leaf** typically has a **network of veins** and there are a wide variety of shapes and leaf margins. The leaf has a **blade** or **lamina** and usually a stalk or **petiole**. If there is no petiole the leaf is **sessile**. The angle where the leaf joins the stem is the **axil** and shoots and flowers develop from here. Leaves branch off at **nodes** and the part of the stem between nodes is an **internode**.

## ROOTS

Roots have three functions.

1. They anchor the plant,
2. absorb water and mineral salts from the surroundings and
3. provide a network of tubes to carry the liquid up to the rest of the plant.

Monocots typically have roots of about equal size and no tap roots. This is called a **fibrous root** system.

Dicots often have a main root or **tap root** with smaller roots (secondary roots) branching off them. These have microscopic root hairs which take in water.



## STEMS

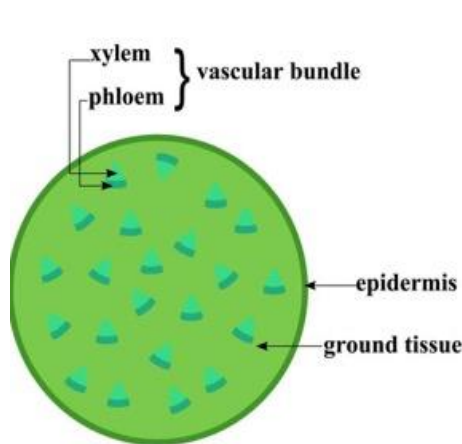
Stems support the leaves and flowers, provide channels for raw materials to go up to the leaves and manufactured materials to go down to the roots.

### Monocot stems

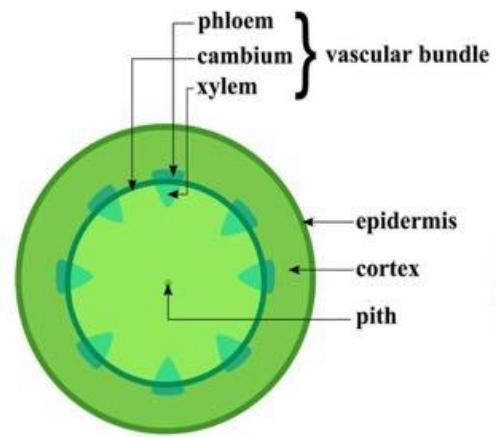
- **Vascular Bundles:** have the bundles of phloem and xylem vessels that are arranged irregularly throughout the stem and contain little cambium.
- **Cambium:** limited amount and irregular distribution which results in less growth in girth and support of the plant.

### Dicot stems

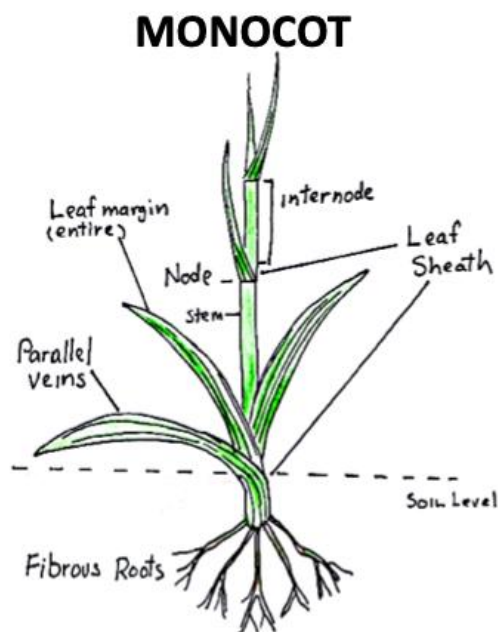
- **Vascular Bundles:** conducting vessels arranged regularly in bundles just below the outer skin of the stem. These vascular bundles contain cells which can divide to form new tissue, and in the case of trees increase the girth as the tree ages. The outer set of tubes is called the **phloem** while the inner set is called the **xylem**. Manufactured materials flow down in the phloem and raw materials flow up in the xylem.
- **Cambium:** The growth cells or cambium between these two sets divide producing new xylem (secondary xylem) to replace the old xylem which becomes wood. This growth on the inner side of the cambium forces the cambium further out from the centre giving a thickening of the stem. The vascular bundles move out so that they are always near the surface. This seasonal growth outwards at different rates gives growth rings in some plants.



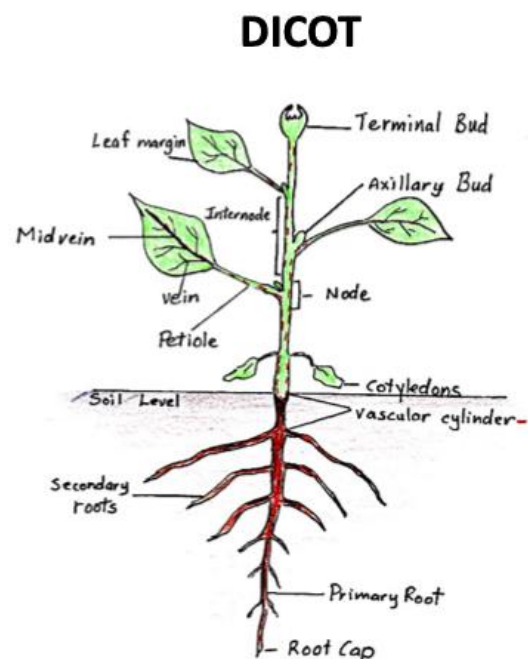
**Monocot**



**Dicot**



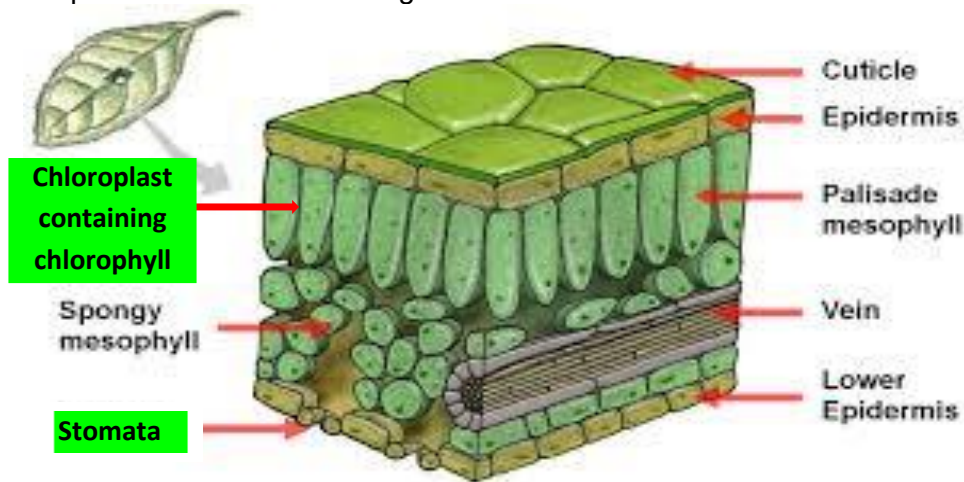
**MONOCOT**



**DICOT**

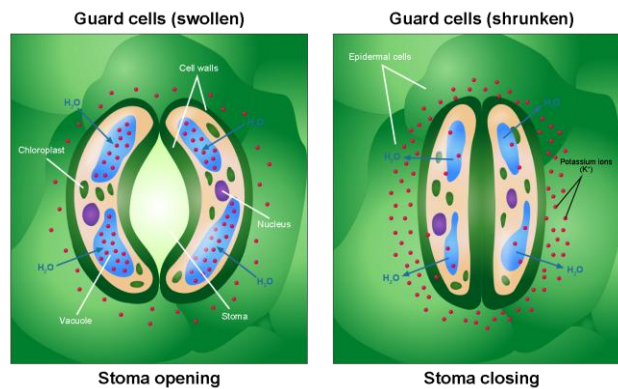
# LEAF FUNCTION AND STRUCTURE

Leaves trap the sunlight for photosynthesis and allow the exchange of gases for photosynthesis and respiration. Transpiration also occurs through the leaf.



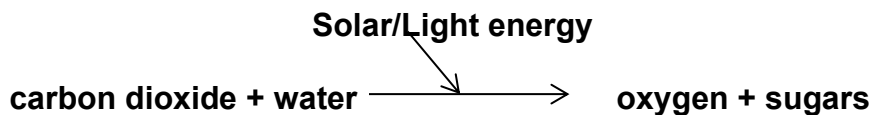
## STOMATA

Stomata are openings in the leaf that open and close to allow for the exchange of gases and for transpiration (water loss) to occur.



## PHOTOSYNTHESIS

Photosynthesis (photo – light, synthesis – build up) is a set of chemical reactions that occur primarily in the chloroplast (organelles containing the green pigment chlorophyll) in the leaves during the day.

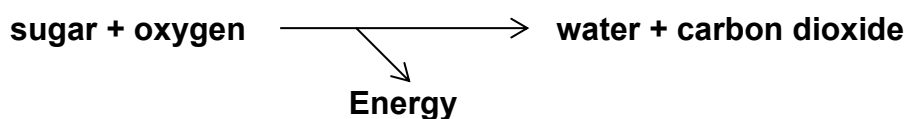


Carbon dioxide from the air is taken in through the stomata. The water and minerals are taken up from the soil, via the roots. Chemical reactions take place with oxygen, which is released via the leaves, and used sugars being produced. The sugars are used for energy or build up tissues and storage organs.

## RESPIRATION

Respiration is a series of reactions that breaks down the sugar releasing the chemical energy for use by the plant. Carbon dioxide is also produced and released through the stomata.

It can be represented by the following equation.



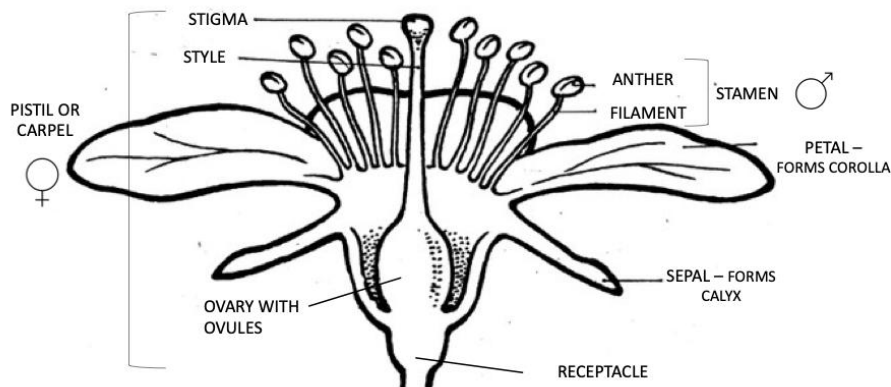
## TRANSPIRATION

Transpiration is the process of losing water vapour from the plant, usually the leaves, through small openings called stomata.

# FLOWERS

Flowers are the sexual reproductive part of a flowering plant. They attract pollinators and produce seeds from which new plants may grow.

## TYPICAL FLOWER STRUCTURE



Flowers are a very important tool in identification and it is important to understand the basic structure and the modifications which may be encountered.

- **Petals:** collectively called the **corolla** and are usually coloured to attract insect or birds which pollinate the flower. Generally, Insects are attracted to yellow, white and blue whereas birds notice red and orange. Unlike other parts of the world Australia has many bird and some mammal pollinators. The secretion of aromatic substances and nectar also help to attract various pollinators. In some plants the petals are joined to form a tube or **corolla tube**. Some flowers have petals with distinctive markings on them which guide an insect to the reproductive parts of the flower (Eremophila, Hemiandra).
- **Sepals:** occur outside the whorl of petals, forming the **calyx**. They are usually green and protect the developing bud. The sepals also occur as multiples of four and five in dicots or three in monocots.
- **Pistil or Carpel:** the female parts of the flower, the gynoecium, and is in the centre. The **pistil (carpel)** consists of a **stigma** which is a platform on which the pollen will collect and the stalk or **style** connecting the stigma to the **ovary** at the base of the flower. The ovary contains the **ovule**. The ovary becomes the fruit and each ovule will contain a seed. There may be one or a number of carpels in a flower.
- **Stamens:** the male parts of the flower, the androecium. They surround the carpel. Each stamen consists of an **anther**, which produces **pollen**, and is supported by a stalk or **filament**. Pollen is transferred to the female part of the flower in the process called **pollination**.
- **Receptacle:** the swollen stalk which supports the flower.

Flowers can be '**PERFECT**' and contain both male and female structures. '**IMPERFECT**' flowers contain either male or female structures.



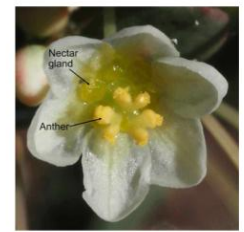
*Perfect flower of Chamelaucium 'white diamond'*



Separate male and female flowers on the same plant



Female flower



Male flower

*Imperfect flower of Lysiandra calycina (formerly Phyllanthus calycinus)*

Plants with both male and female reproductive structures on the same plant are **monoecious**. **Dioecious** plants have male and female male and female flowers on separate plants.

## SEXUAL REPRODUCTION

There are 2 steps to sexual reproduction in angiosperm, pollination and fertilisation.

**Pollination** is the transfer of the pollen from the anther to the sticky stigma. Transfer is usually cross pollination, that is, to a different flower. This is to maintain genetic diversity. Many plants have the male and female parts maturing on the same flower but the male and female parts develop at different times or they can be different heights so a flower cannot pollinate itself. Pollination may be carried out by

- **animals** such as insects, birds and small mammals and man (kangaroo paws, orchids)
- **wind** in the case of the sheoak which is dioecious
- **water** where a splash of rain carries the pollen to a receptive stigma (clematis)

## INSECT POLLINATORS



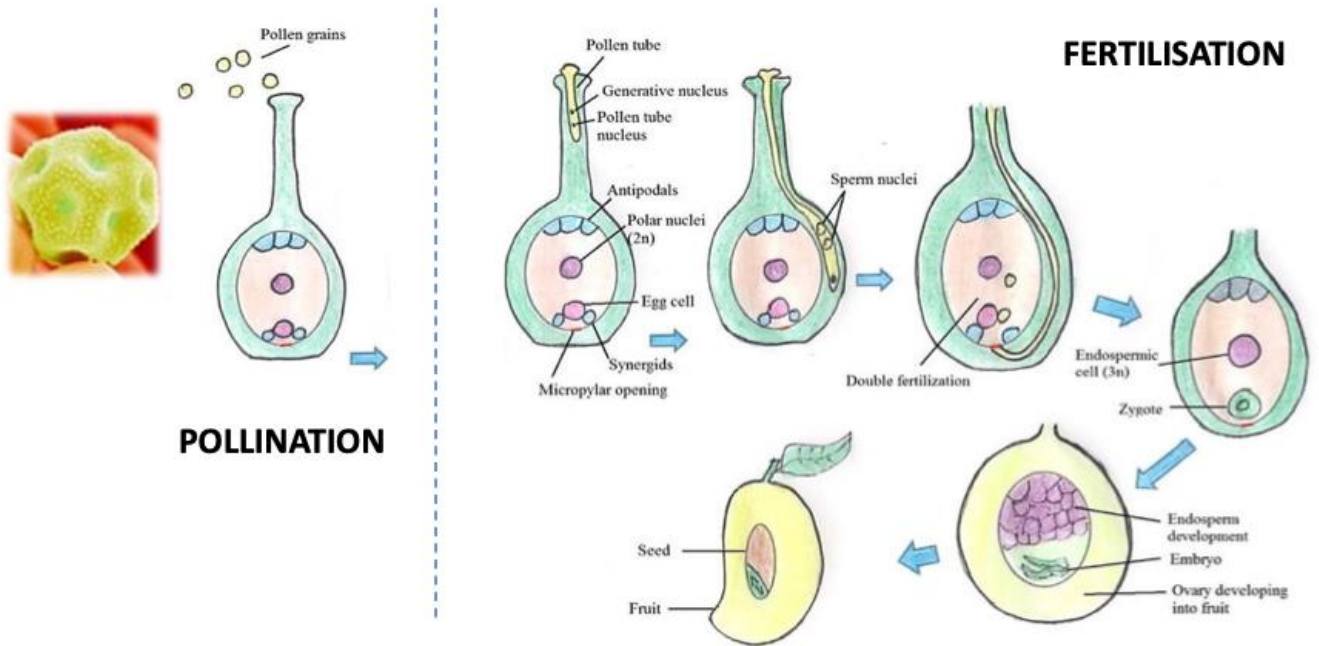
## BIRD AND MAMMAL POLLINATORS



In the South West floristic region 15% of plants are bird and/or mammal pollinated, the highest percentage in the world.

**Fertilisation** occurs when the male nucleus grows down through the style to fuse with a female nucleus in the ovule. The fertilised ovule develops into a seed which has an embryo, a food store and a protective coat. Each seed is produced by the action of one pollen grain so a fruit such as a tomato and Thomasia with hundreds of seeds must have had hundreds of pollen tubes reaching hundreds of ovules at about the same time.

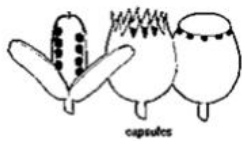
# POLLINATION AND FERTILISATION



## FRUITS

These are the seed-bearing structures developed from the ovary after fertilisation. These can be dry or fleshy. Fleshy fruits are relatively infrequent amongst West Australian plants.

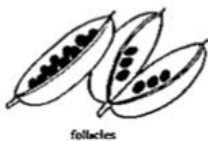
### Dry Dehiscent



**Capsule** – cap drops off to disperse the seeds eg Eucalyptus, Melaleuca



**Pod** - splits open along 2 sides eg Acacia, Chorizema



**Follicle** - splits down one side only eg Grevilleas, Hakea



**Dry Indehiscent** – do not split open at all and usually one seed.



Calytrix



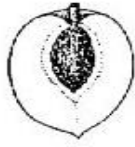
Eremophila



Adenanthos

## Fleshy fruits

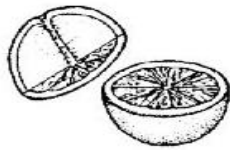
A **drupe**, for example, develops from a single ovule in which the protective coats enlarge. The inner layer hardens to enclose the seed in a woody shell in the case of the Quandong



Stone or drupe  
of peach



A **hesperidium** is a berry like fruit with a leathery rind eg finger lime.



Hesperidium  
of orange



There are many other fleshy fruit types such as -

A **pome** has seeds embedded in fleshy tissue which has developed from a swollen receptacle, such as the apple.

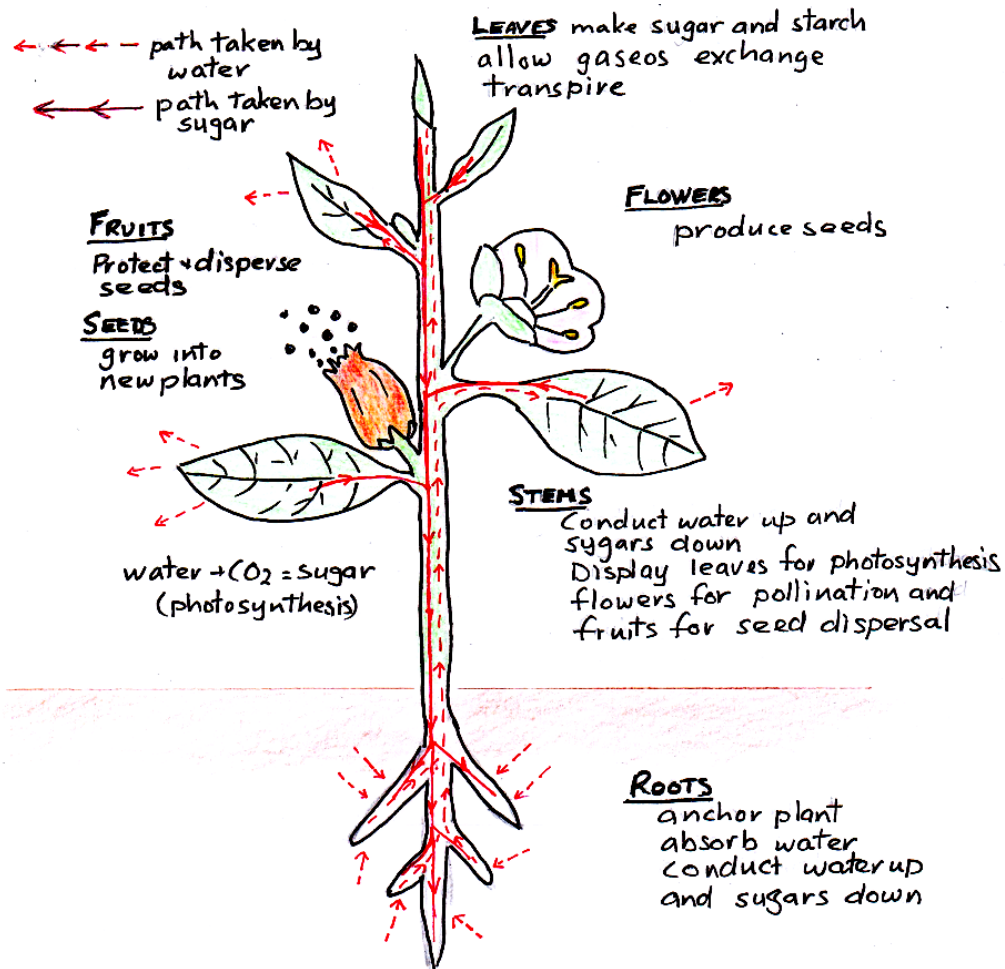
A **berry** has developed from a single flower and does not break open when mature. Examples are grape, tomato, banana and date.

## SEEDS

The seeds contain the infant plant, a food supply to support its development until it can manufacture its own food, and a protective coat.



**Asexual** or vegetative reproduction occurs without the fusion of male and female sex cells. For example new plants form when a rhizome divides to form two plants. A new corm can develop on an old corm. Cuttings are another way of forming new plants.



**Diagram Showing Functions Of Flowering Plants**

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