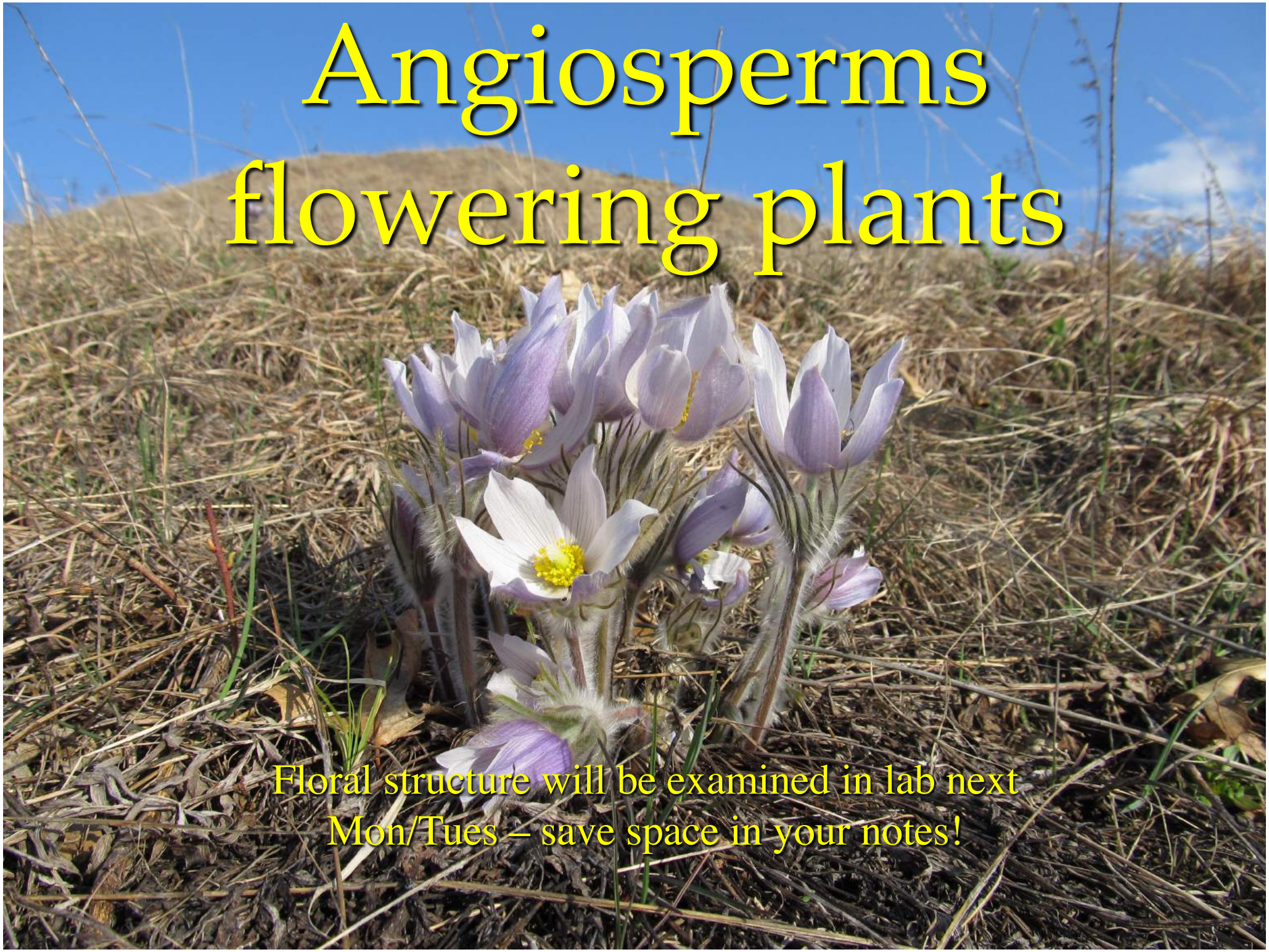
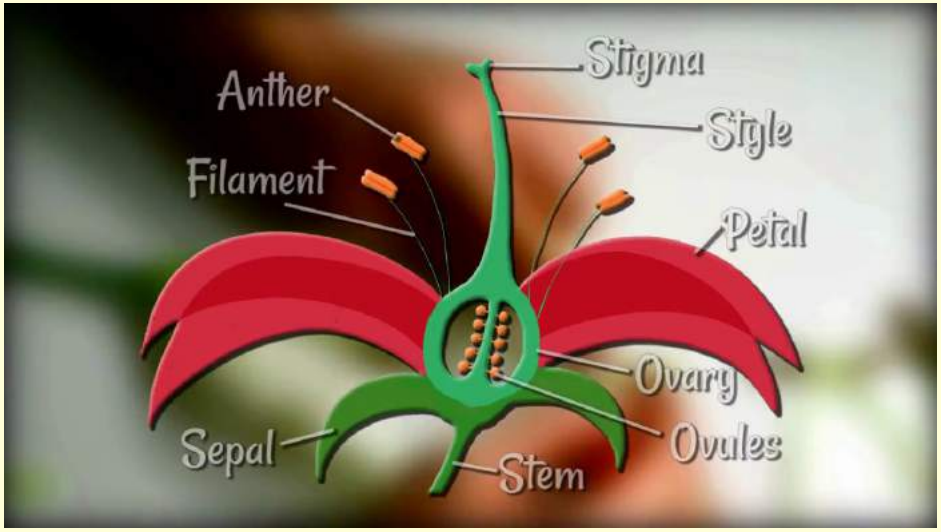


Angiosperms flowering plants

Floral structure will be examined in lab next Mon/Tues – save space in your notes!

Magnoliophyta - Flowering Plants



violet flower & fruit

Introduction to Angiosperms

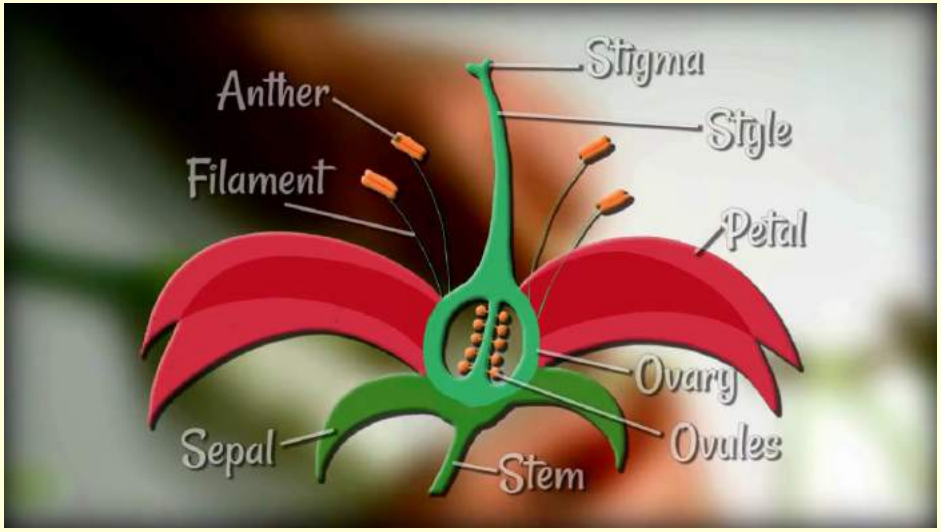
- "angio-" = vessel; so "**angiosperm**" means "**vessel for the seed**" [seed encased in ovary and later fruit]

- Dominant group of land plants and arose about 140 million years ago – Jurassic/Cretaceous

- 275,000+ species – diverse!

- Co-evolved with animals and fungi

Magnoliophyta - Flowering Plants



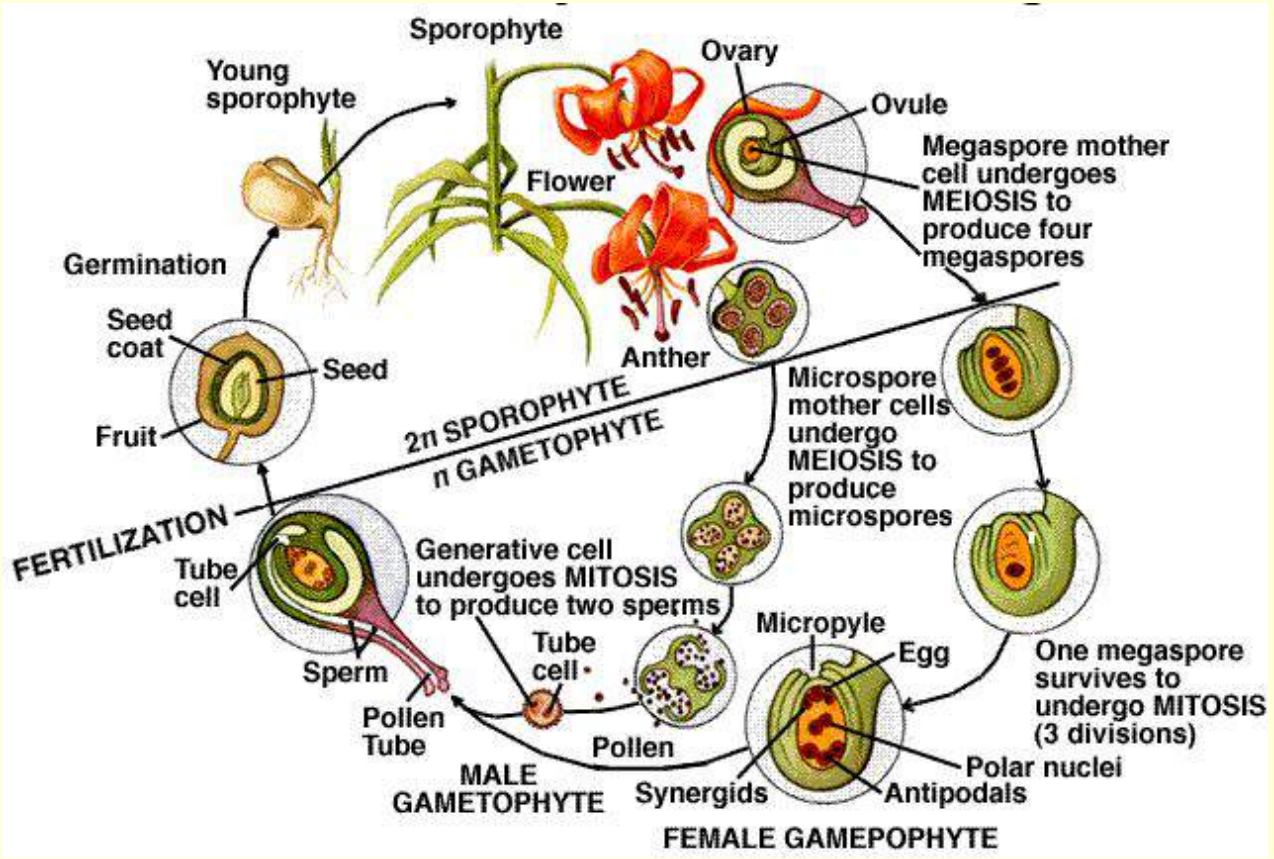
4 Features Define Angiosperms

1. Possession of **flowers** – with stamens and ovaries – ovary(ies) becomes a **fruit**

violet flower & fruit

Magnoliophyta - Flowering Plants

2. Further reduction of the gametophyte stages - **embryo sac** and **pollen grain**

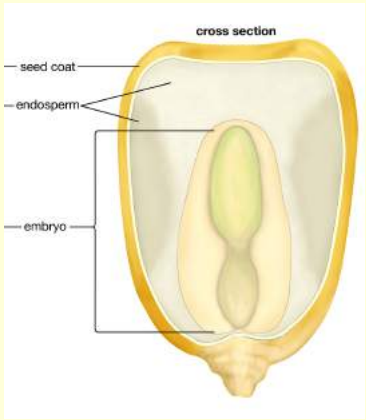


Magnoliophyta - Flowering Plants

2. Further reduction of the gametophyte stages - **embryo sac** and **pollen grain**

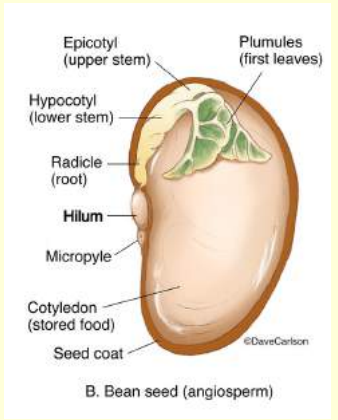
3. **Double fertilization**: the sperm cell has two nuclei – **zygote** and **endosperm**;

pink lady-slipper seeds with NO endosperm



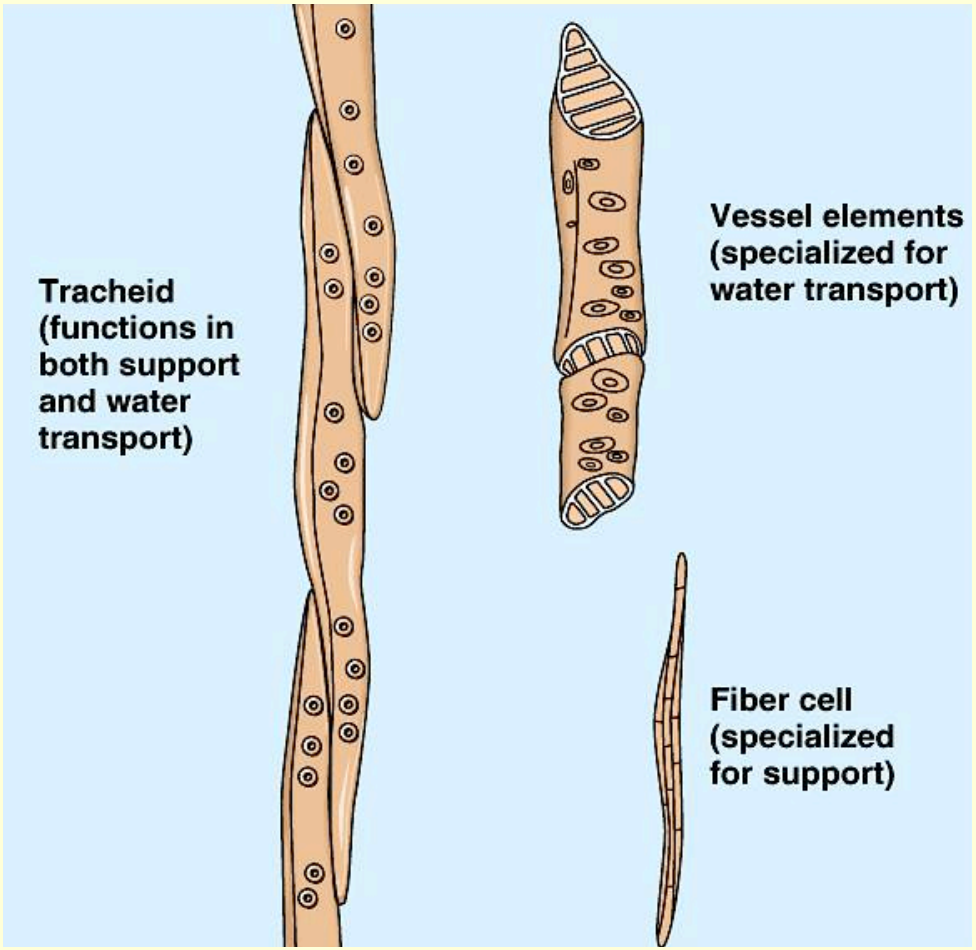
corn seed
endosperm

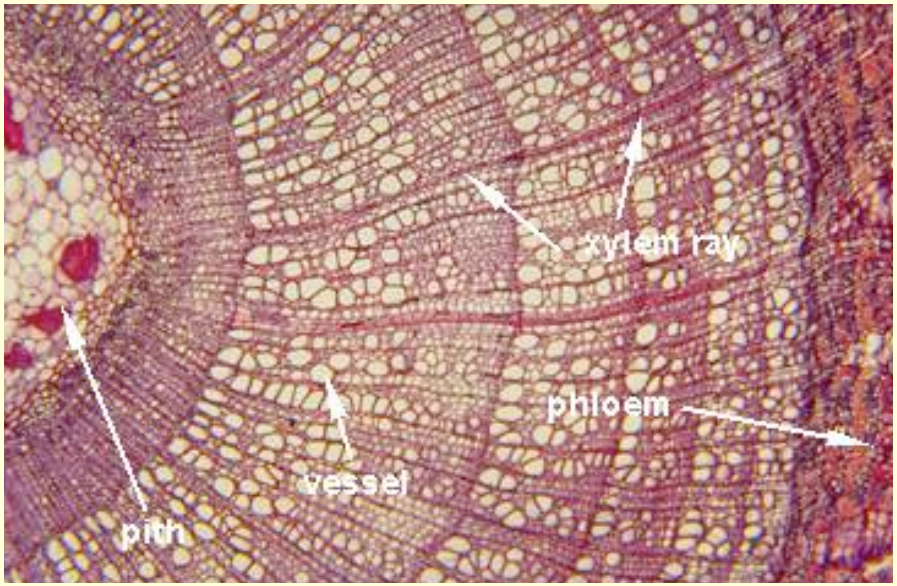
bean seed
cotyldeons-
endosperm



Magnoliophyta - Flowering Plants

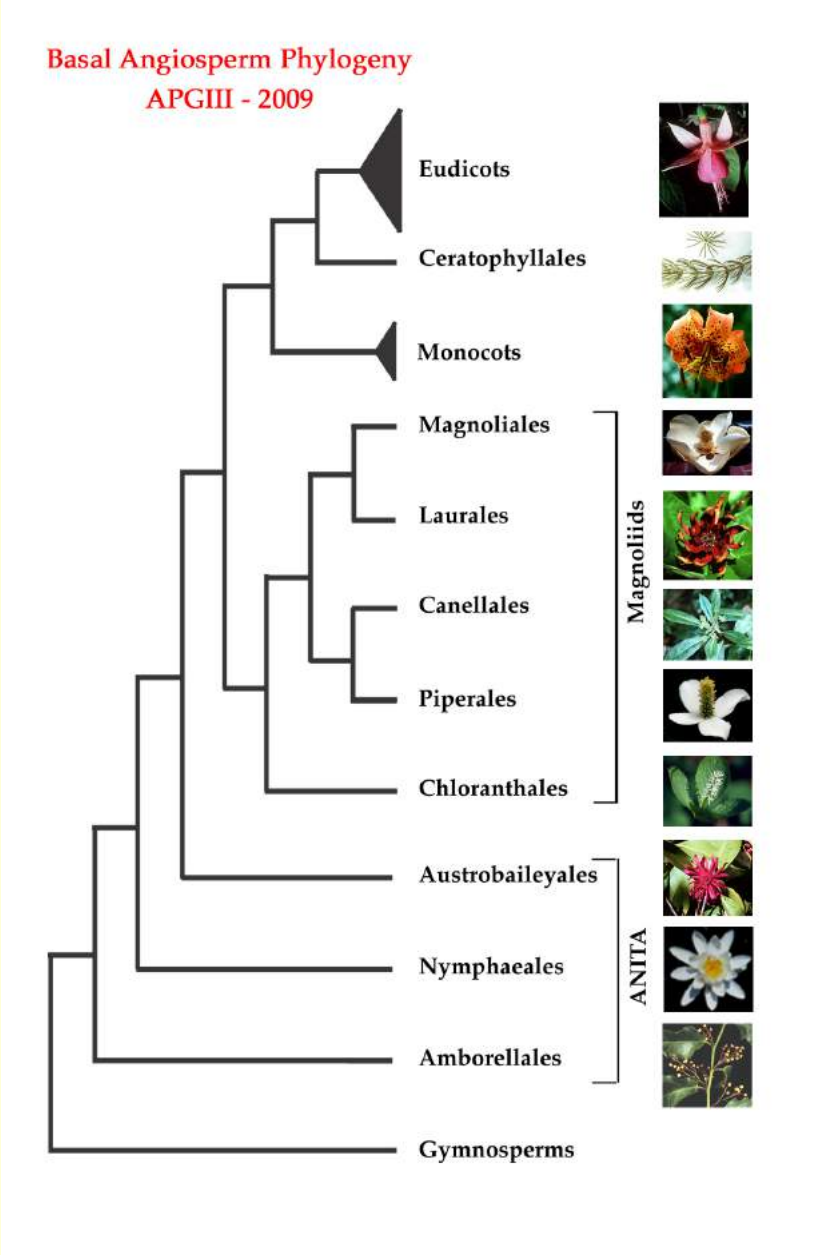
4. **Vessel elements** in xylem - efficient water conducting cells





Cross section of young American basswood

Magnoliophyta - Flowering Plants



Classification of Angiosperms

Relationships of flowering plants are now well known based on DNA sequence evidence - **APG** (Angiosperm Phylogeny Group) classification system is standard.

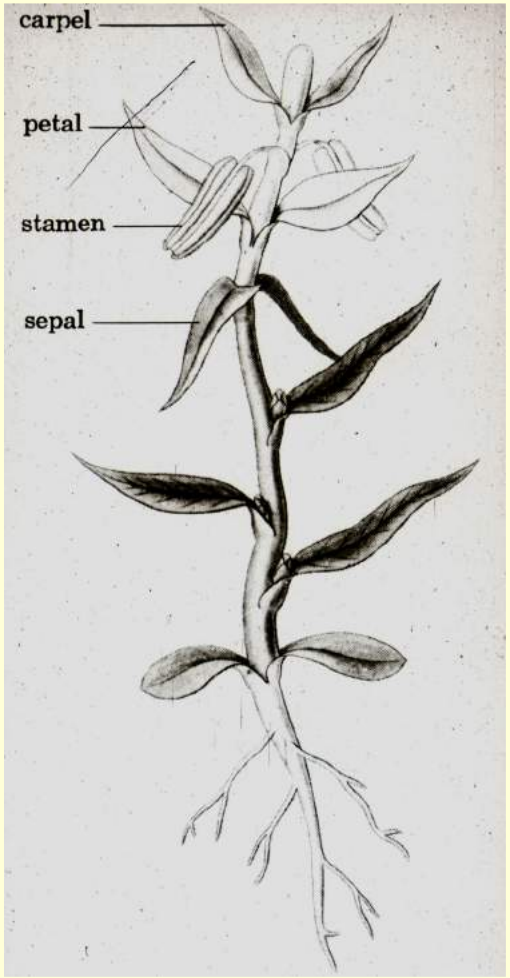
Changes in families (names and genera) have been common in recent years!

Field Manual of Michigan Flora has most up-to-date (generally)

The Flower

- The outstanding and most significant feature of the flowering plants is the **flower**

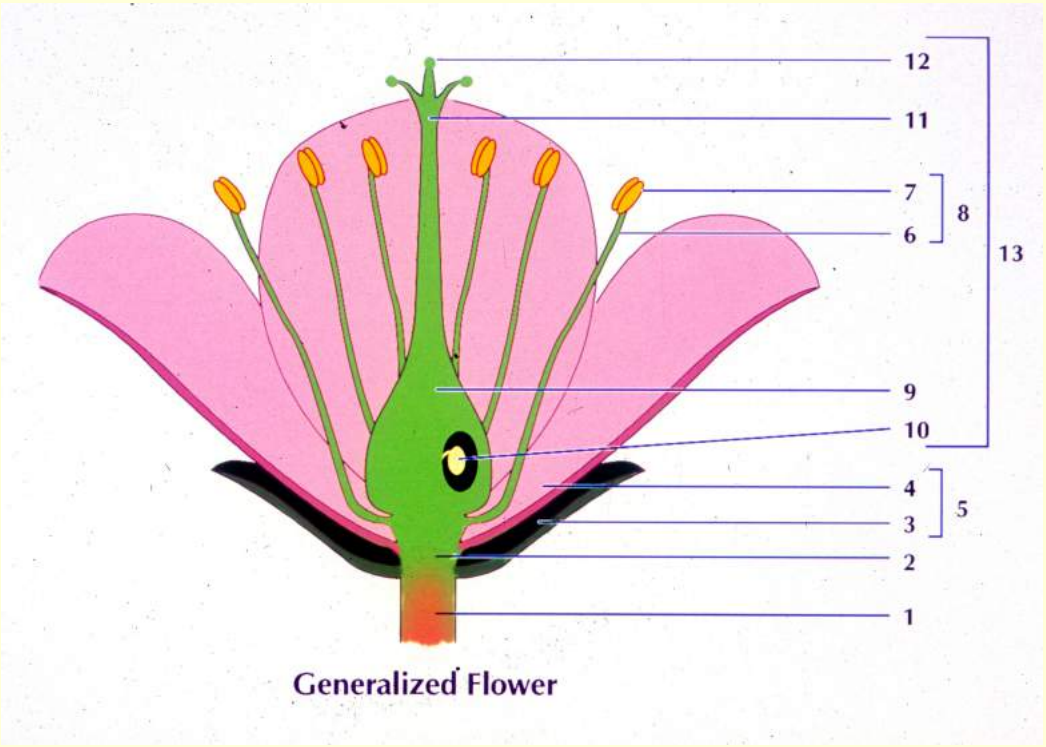
- Understanding floral structure and names of the parts is important in recognizing, keying, and classifying species, genera, families.



from Schleiden 1855

Flower: highy **specialized shoot = stem + leaves**

The Flower

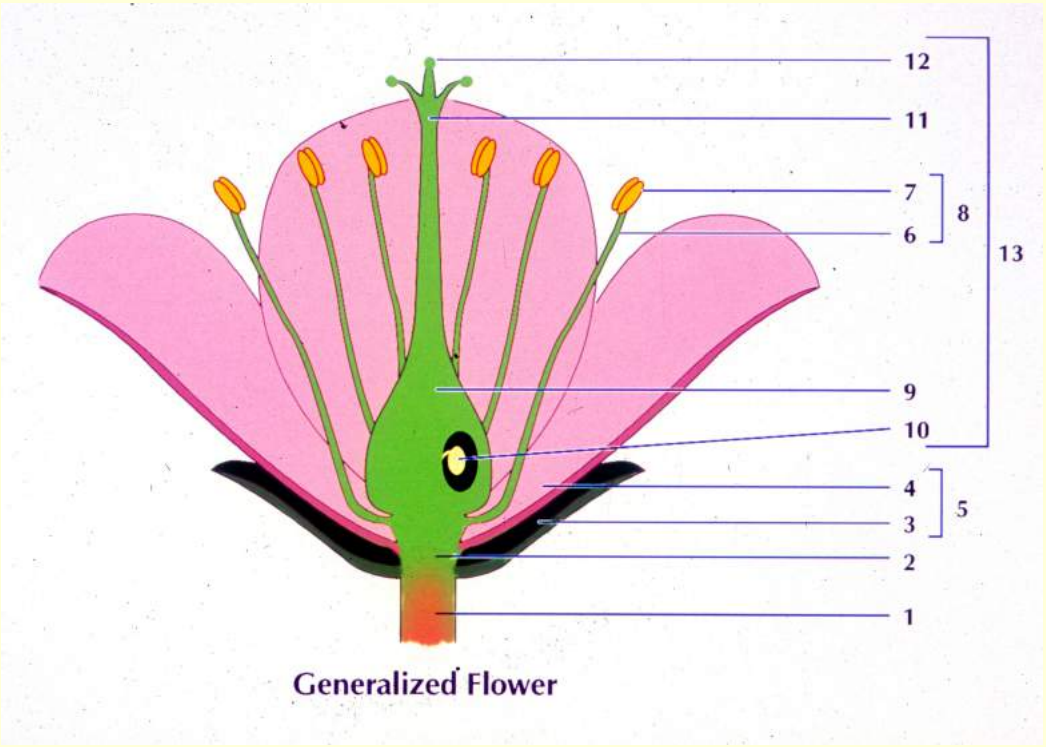


1. **Peduncle**: floral stalk, the stem supporting the flower; sometimes referred to as the **pedicel**

2. **Receptacle**: modified floral stem or axis from which arise the floral appendages or modified leaves

3. **Sepal**: the outer most whorl of leaves, typically green and protect the inner floral parts in buds; collectively all sepals are called the **calyx [CA]**

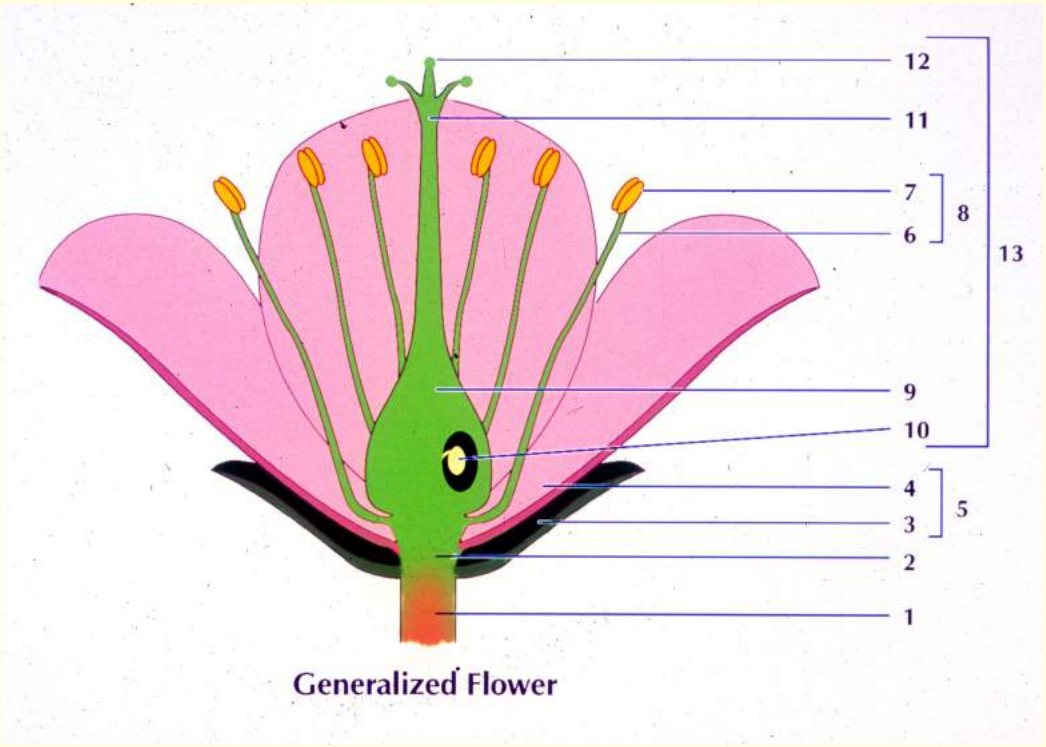
The Flower



4. **Petal**: the second whorl of leaves, typically brightly colored and and assist in attracting pollinators, collectively called the **corolla [CO]**

5. **Perianth**: collective term for sepals and petals **[P]**; if perianth parts cannot be differentiated into sepals and petals, that is, they look so much alike, then they are called **tepals**

The Flower

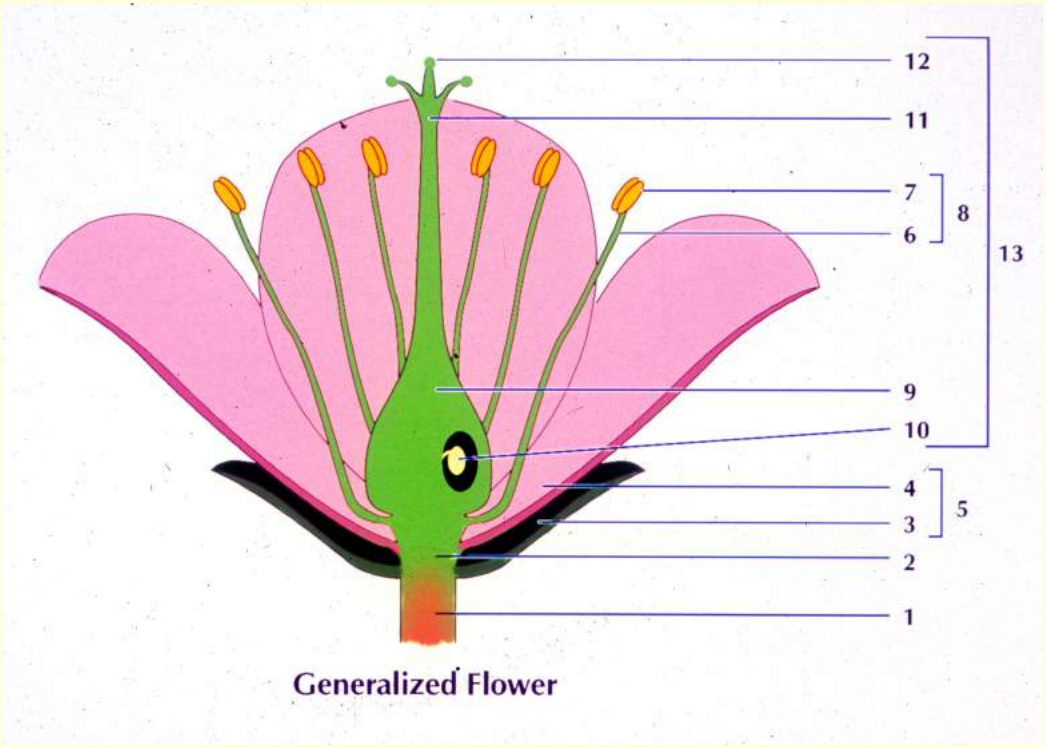


6. **Filament**: slender stalk of the stamen supporting the anther; permits exsertion of pollen out of flower

7. **Anther**: fertile portion of stamen that dehisces to release **pollen grains**; composed of **anther sacs**

8. **Stamen**: the male structure of flower comprising filament and anther; collectively, all the stamens are referred to as the **androecium** (= 'house of males') **[A]**

The Flower

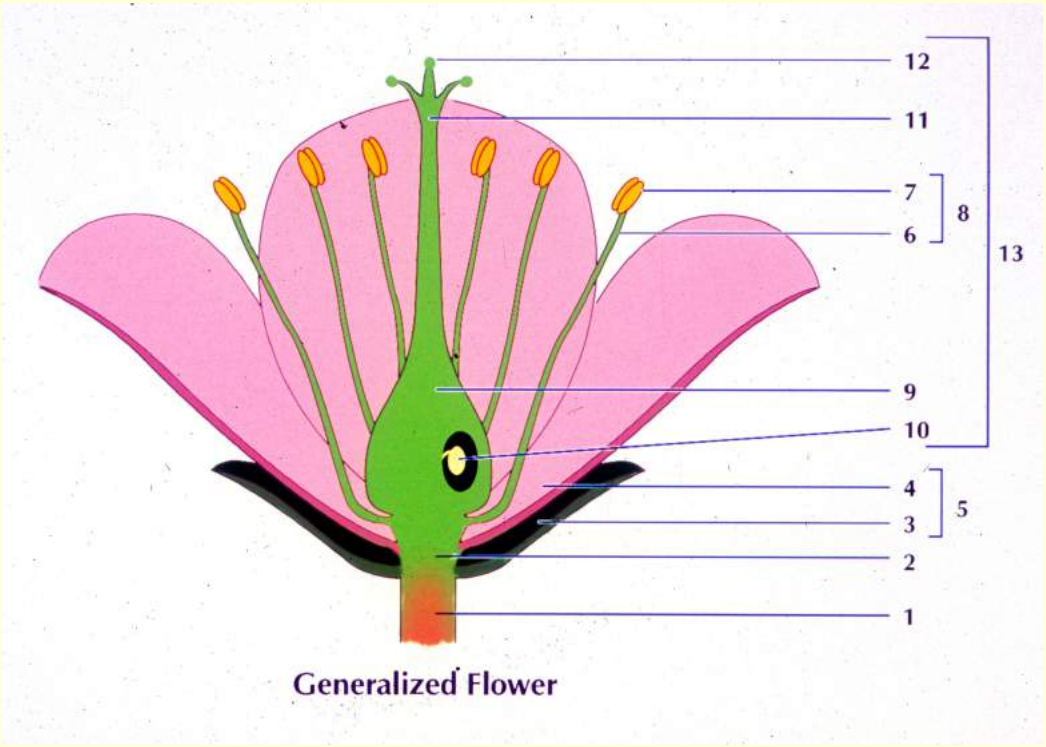


9. **Ovary**: basal portion of pistil that contains ovules; at maturity becomes fruit with seeds

10. **Ovules**: fertile portions of pistil that contain female gametophyte (embryo sac); develop into seeds after fertilization

13. **Pistil**: flask-shaped, female structure comprising three main parts; often referred to as **carpel**(s); all pistils (1 or more) are referred to as the **gynoecium** (= 'house of females') **[G]**

The Flower

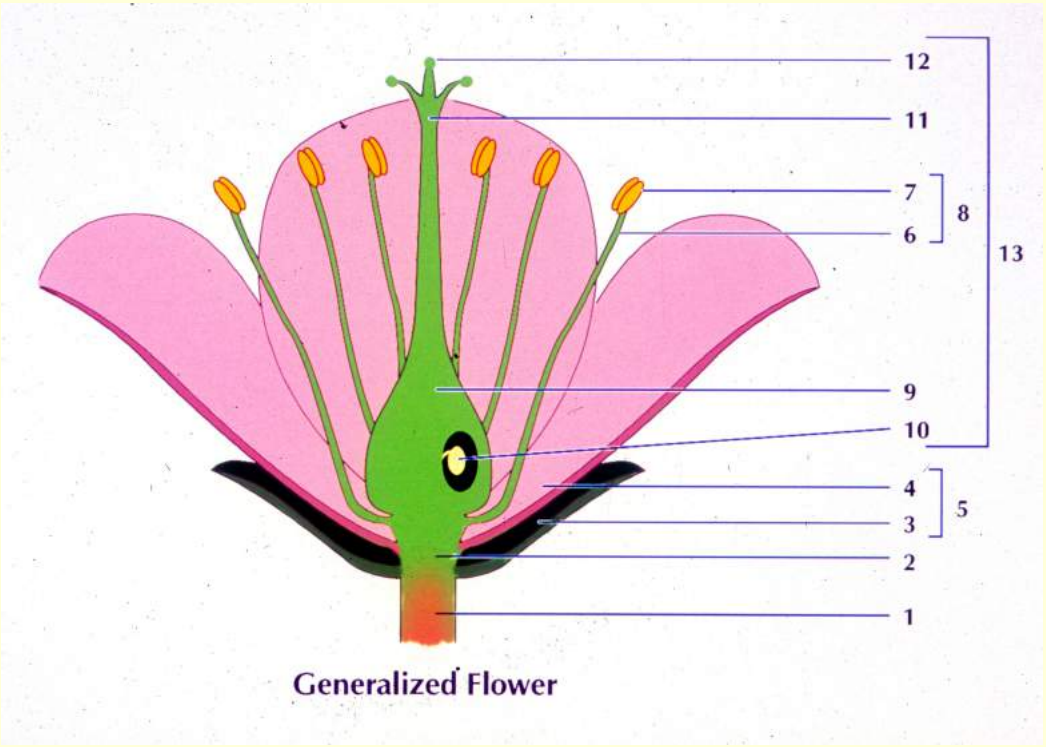


11. **Style**: slender stalk of pistil above ovary that the pollen tubes must pass through to reach eggs in ovules

12. **Stigma**: receptive portion at top of style that receives and recognizes pollen

13. **Pistil**: flask-shaped, female structure comprising three main parts; often referred to as **carpel**(s); all pistils (1 or more) are referred to as the **gynoecium** (= 'house of females') **[G]**

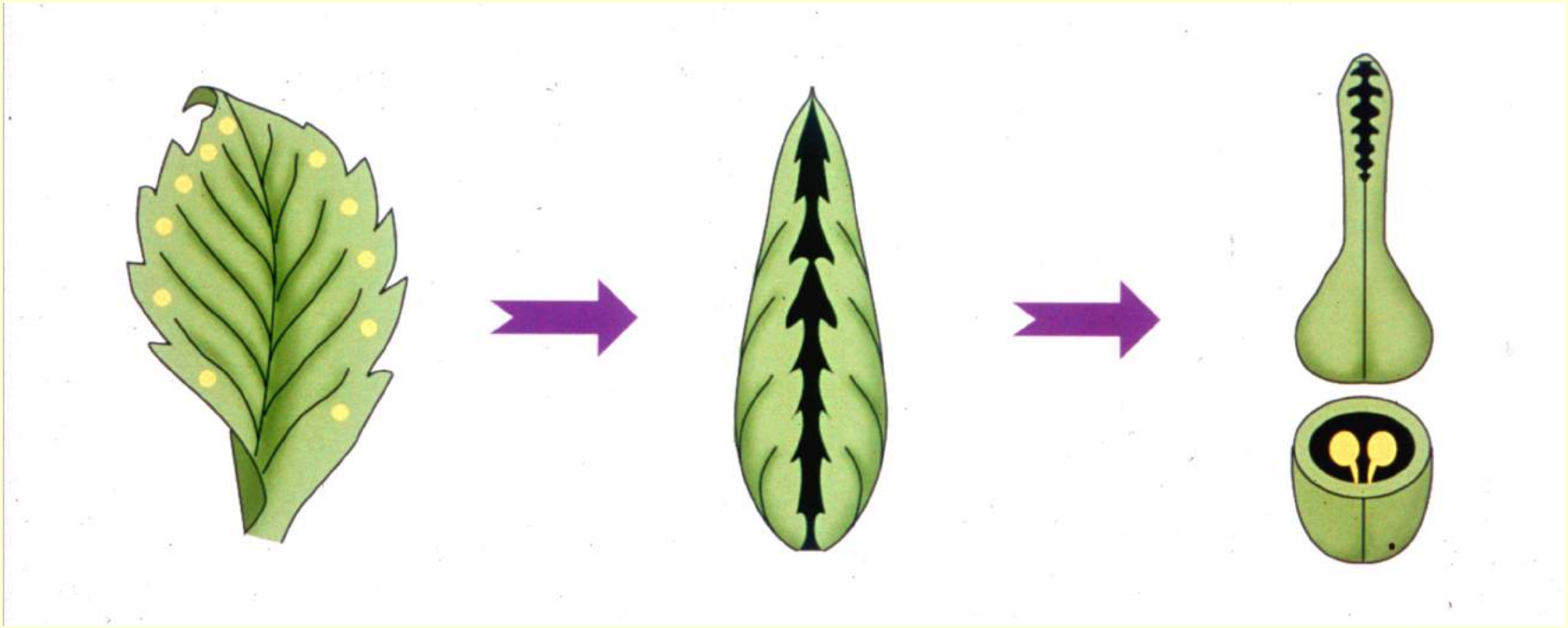
The Flower



What is the difference between the pistil and the carpel?

13. **Pistil**: flask-shaped, female structure comprising three main parts; often referred to as **carpel**(s); all pistils (1 or more) are referred to as the **gynoecium** (= 'house of females') **[G]**

The Flower



1 floral ‘leaf’ in gynoecium

Folded ‘leaf’

1 carpel = 1 pistil

This gynoecium is
monocarpic
(one carpel)

The Flower

- If 2 'leaves' in one flower each **separately** form carpels,

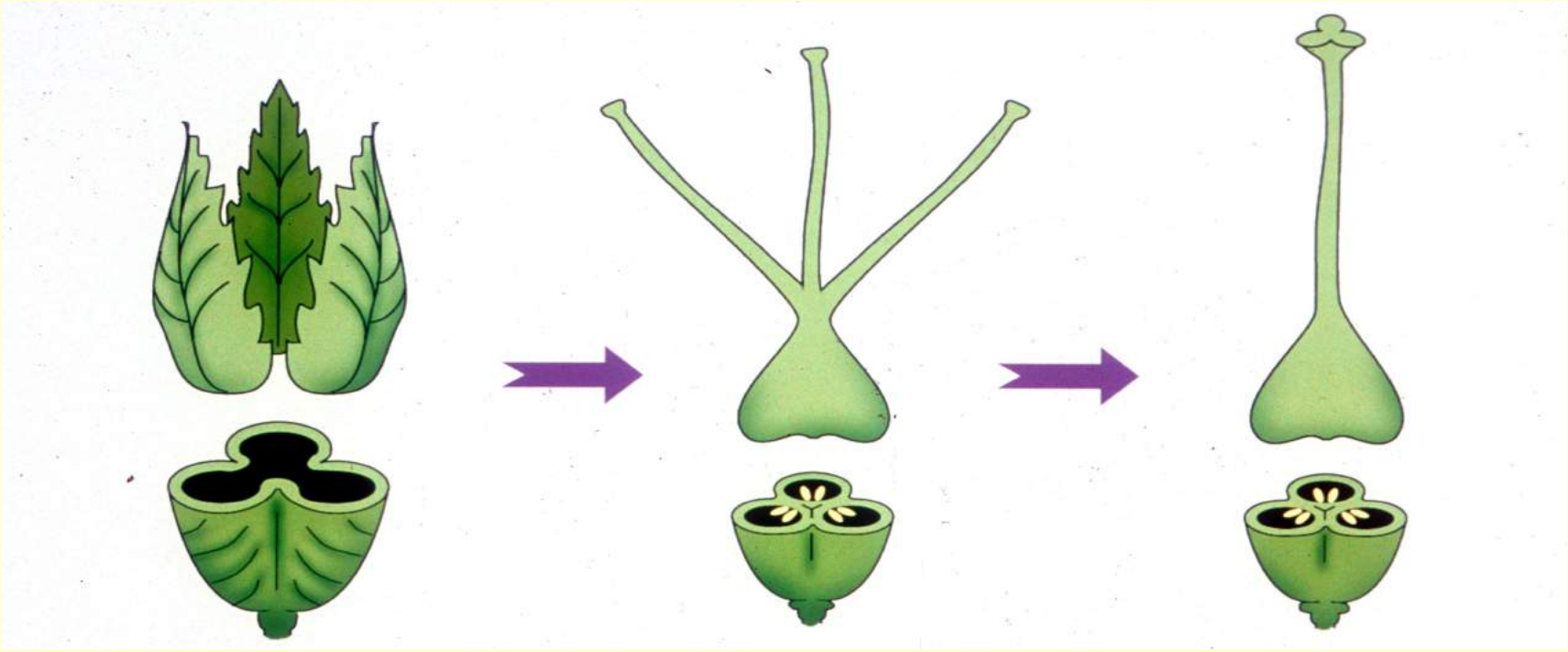
- then the flower has 2 carpels and 2 pistils,

- gynoecium is **apocarpic (separate carpels)**

Caltha palustris - Marsh marigold

9 fruits (pistils) from 1 flower
Gynoecium is **apocarpic** with 9 carpels or 9 pistils

The Flower



3 floral ‘leaves’ in gynoecium **fuse**

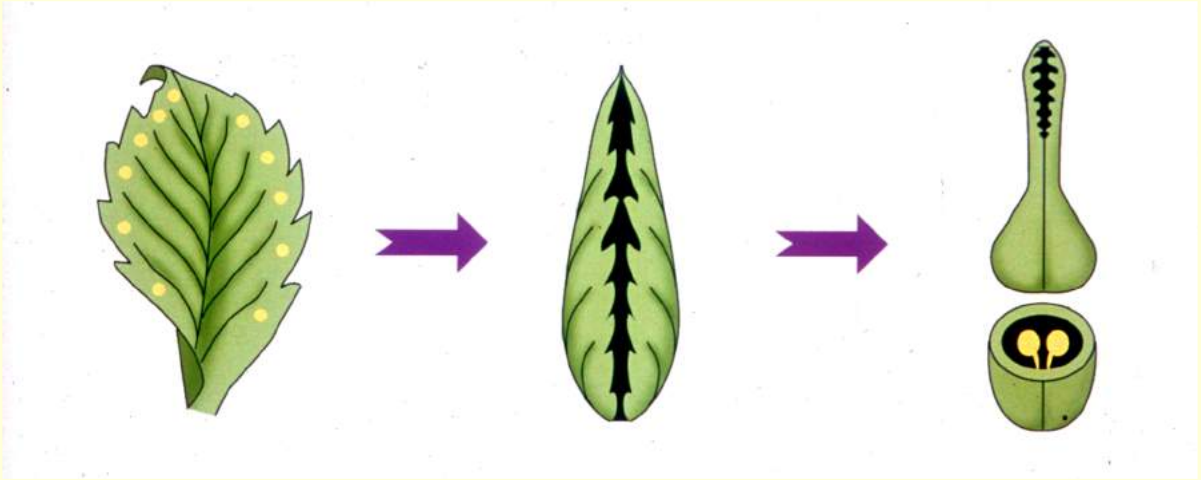
3 carpels = 1 pistil
3 styles

This gynoecium is **syncarpic**

3 carpels = 1 pistil
1 style

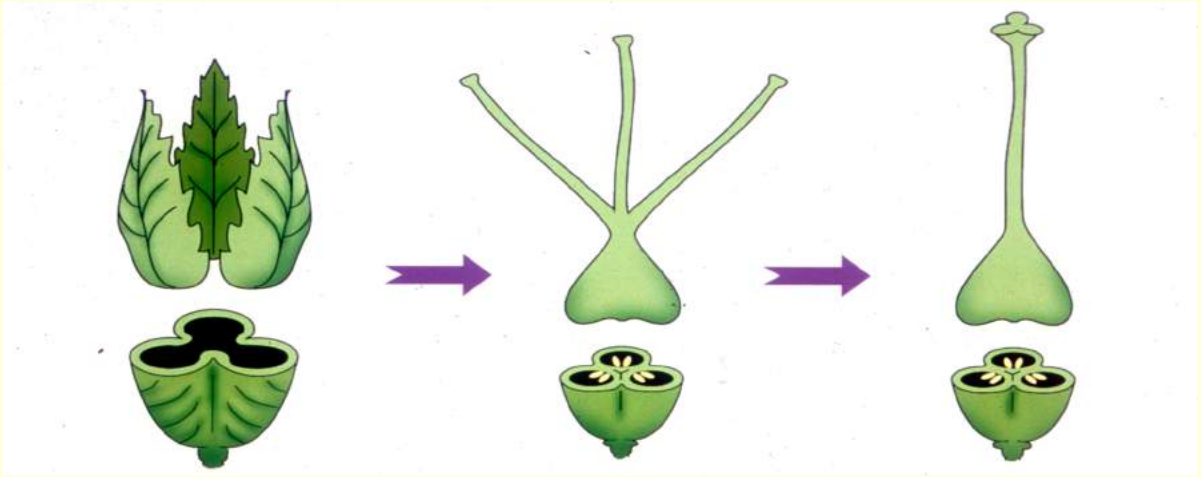
This gynoecium is **syncarpic**

The Flower



Placentation types- arrangement of ovules

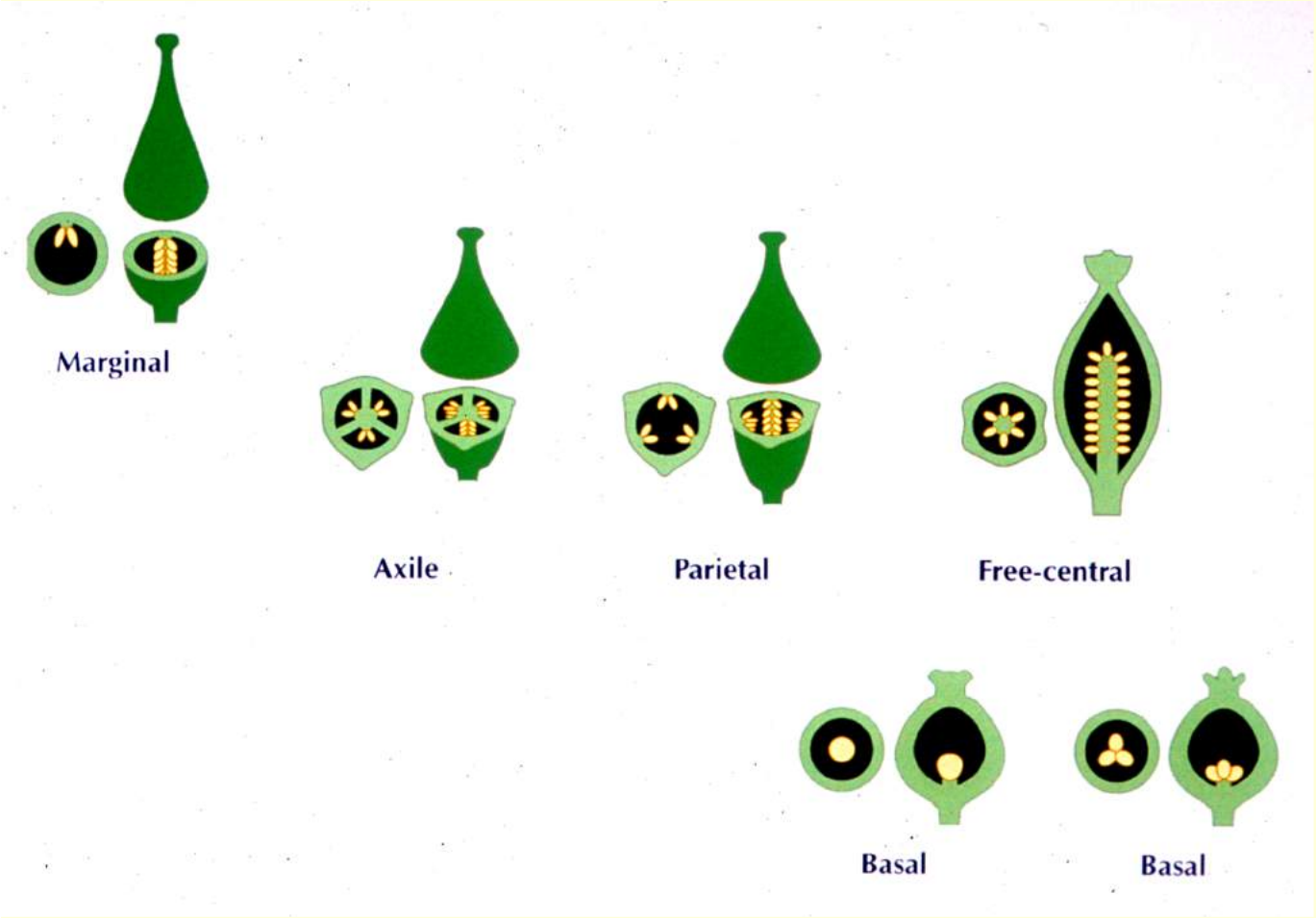
Marginal - found in all monocarpic or apocarpic pistils



Axile - found in many syncarpic pistils

The Flower

Placentation types- arrangement of ovules



Parietal - found in some syncarpic pistils

Free-central - found in a few syncarpic pistils

Basal - found in some monocarpic, apocarpic, or syncarpic pistils

The Flower

Numerical plan - usually referring to perianth

perianth spiralled

perianth 5-merous

perianth 4-merous

perianth 3-merous

The Flower

Symmetry

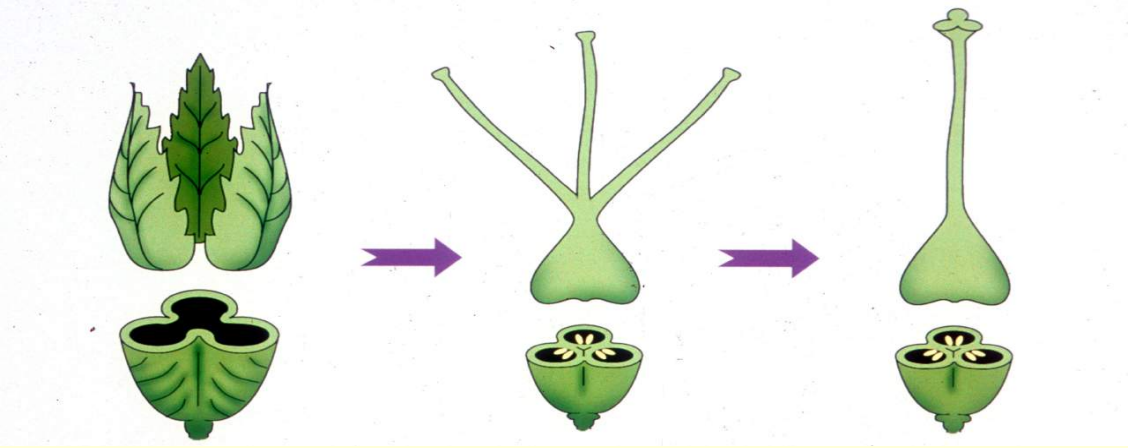
Flowers radially symmetrical

Flowers **actinomorphic**

Flowers bilaterally symmetrical

Flowers **zygomorphic**

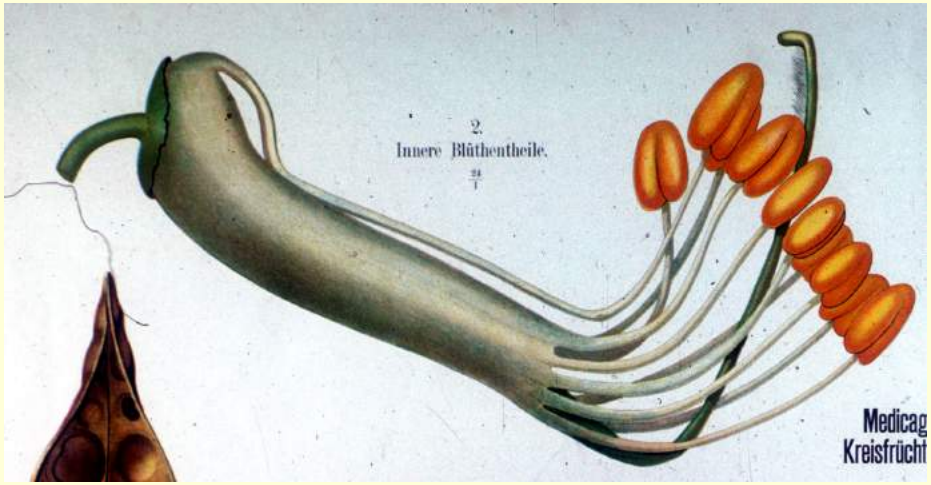
The Flower



Fusion of carpels ⟶ Syncarpic pistil

Fusion

1. Connation: fusion of floral parts from the same whorl



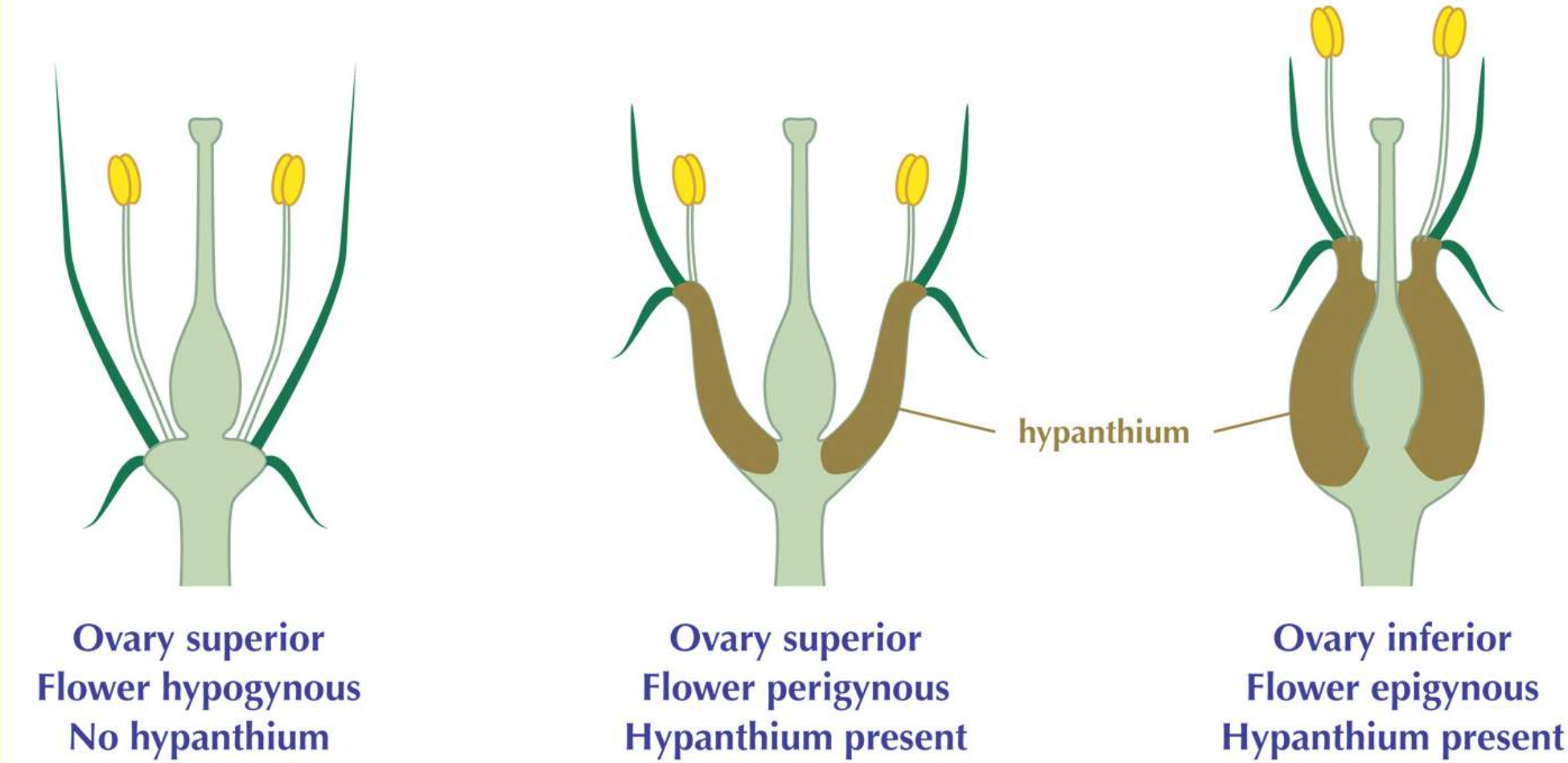
Fusion of stamens ⟶ Staminal tube

Fusion of petals ⟶ Corolla tube

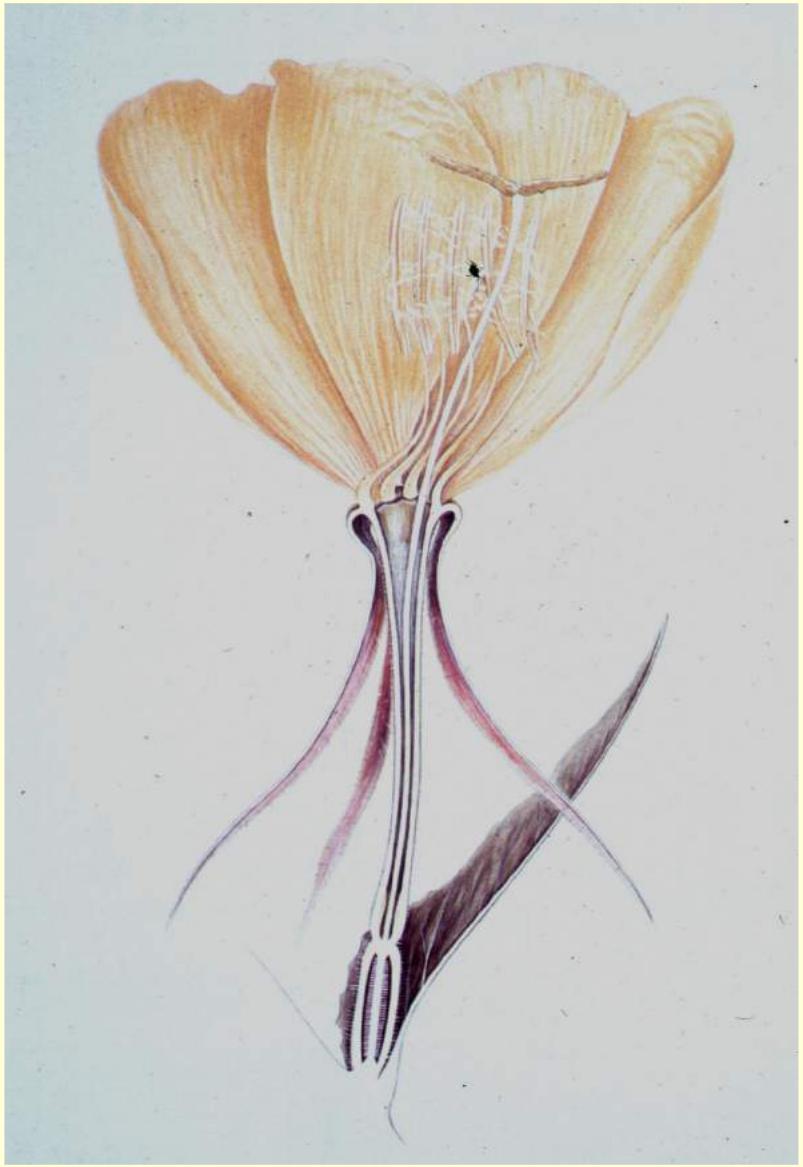
The Flower

2. Adnation: fusion of floral parts from different whorls

Fusion



The Flower



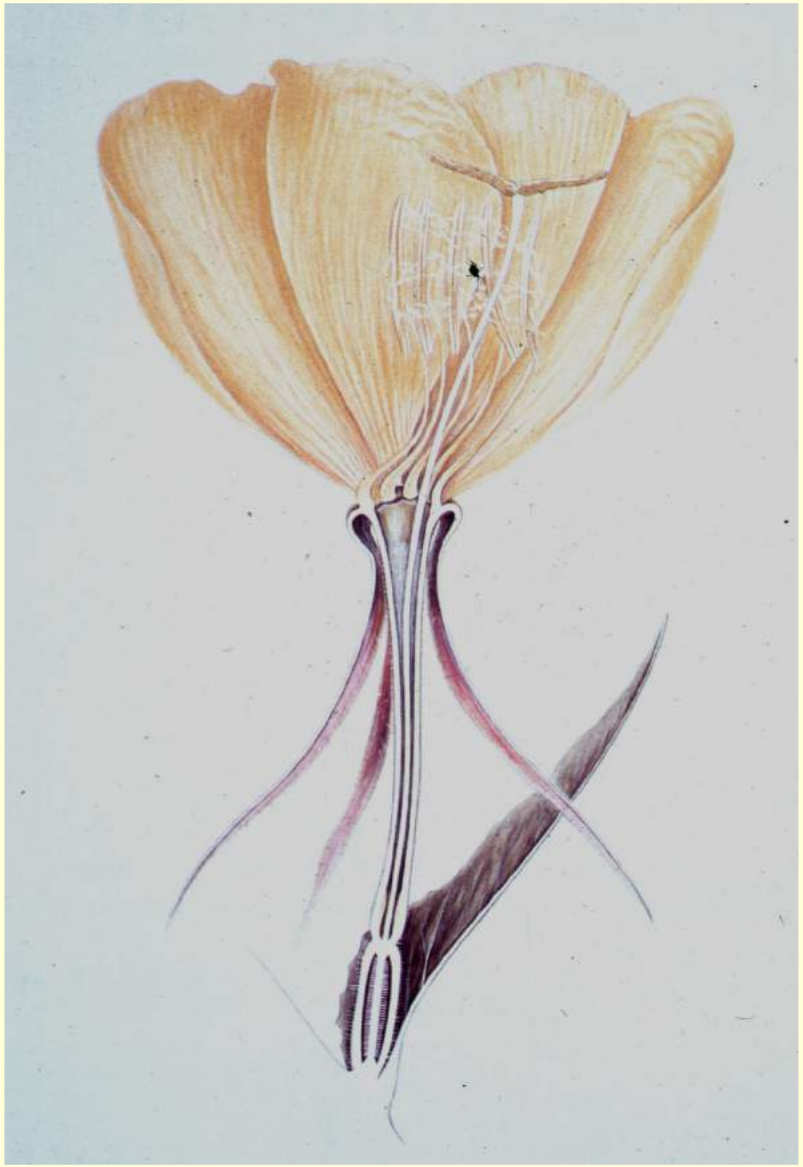
Floral formulas

$$CA^{4} \quad CO^{4} \quad A^{8} \quad G^{4}$$

4 sepals (**CA**lyx)
4 petals (**CO**rolla)
8 stamens (**A**ndroecium)
4 carpels (**G**ynoecium)

Oenothera biennis
Evening primrose

The Flower



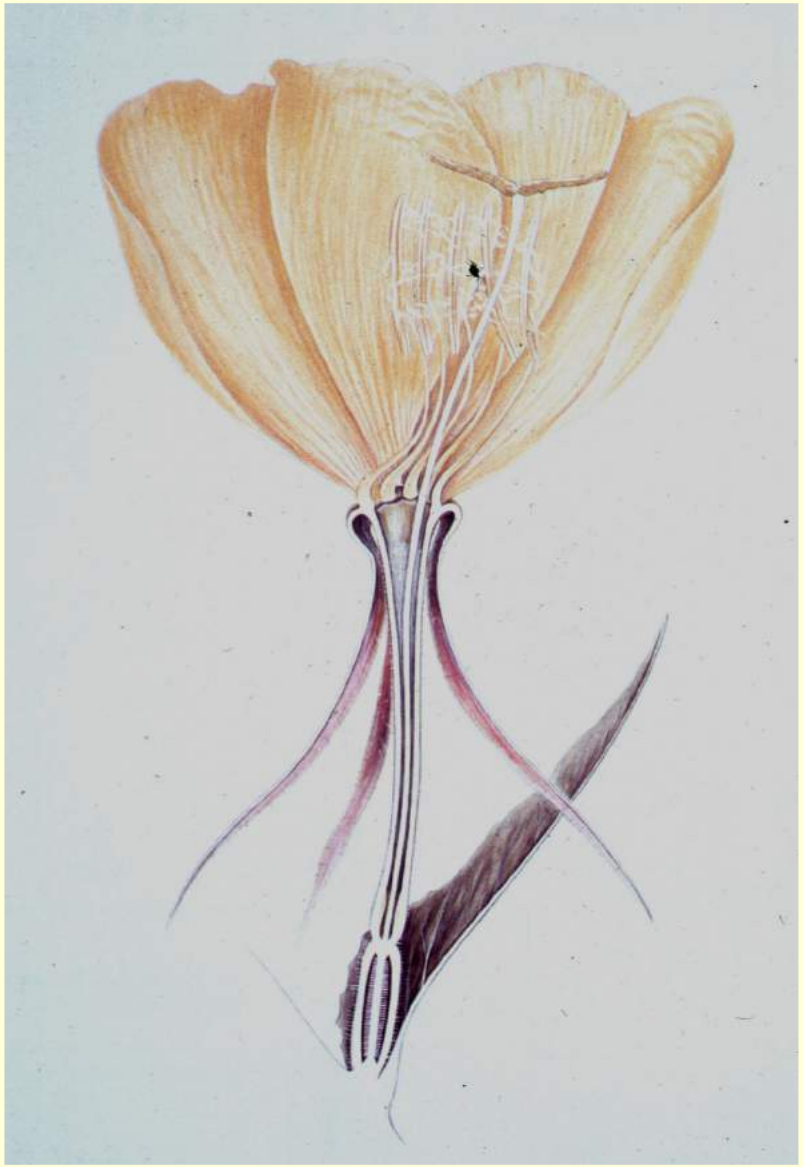
Floral formulas

$$CA^{4} \quad CO^{4} \quad A^{8} \quad G^{(4)}$$

4 sepals (**CA**lyx)
4 petals (**CO**rolla)
8 stamens (**A**ndroecium)
4 carpels (**G**ynoecium)
Carpels fused = 1 pistil

Oenothera biennis
Evening primrose

The Flower



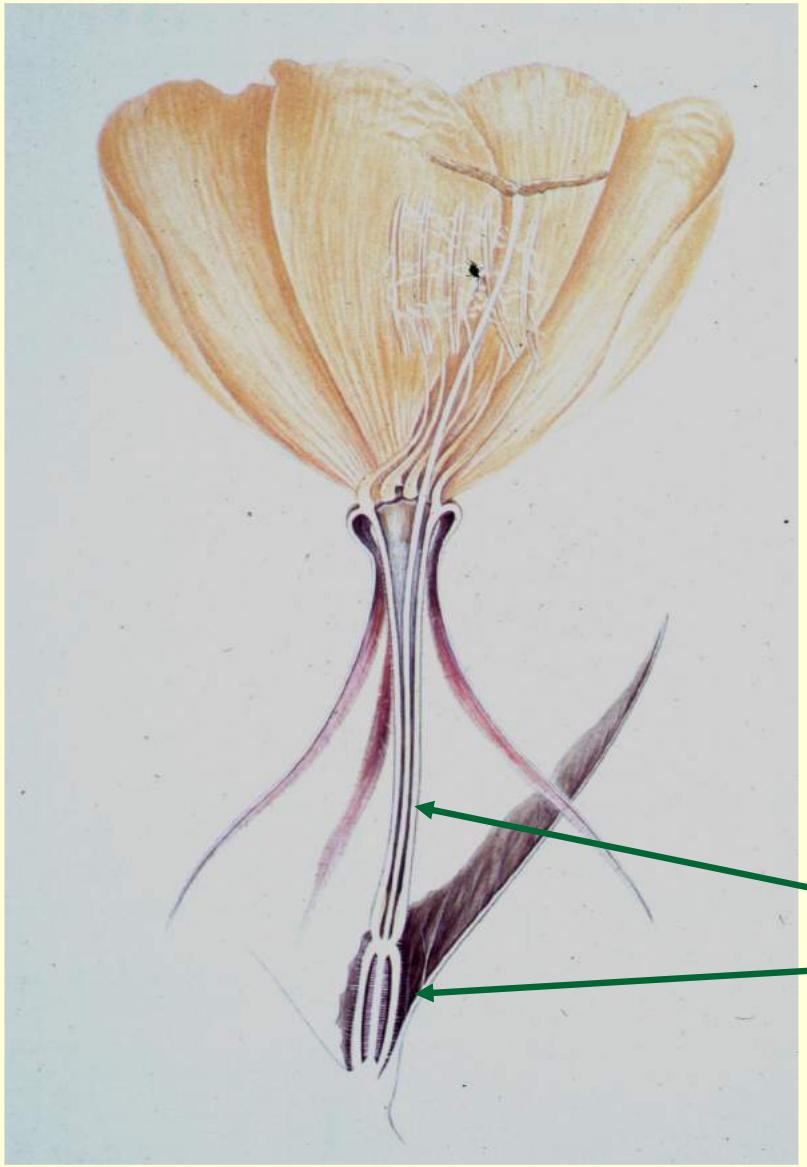
Floral formulas

$$CA^{4} \quad CO^{4} \quad A^{8} \quad \frac{}{G}\,④$$

4 sepals (**CA**lyx)
4 petals (**CO**rolla)
8 stamens (**A**ndroecium)
4 carpels (**G**ynoecium)
Carpels fused = 1 pistil
Ovary inferior

Oenothera biennis
Evening primrose

The Flower



Floral formulas

$$CA^{4} \quad CO^{4} \quad A^{8} \quad \underline{G}^{(4)}$$

4 sepals (**CA**lyx)
4 petals (**CO**rolla)
8 stamens (**A**ndroecium)
4 carpels (**G**ynoecium)
Carpels fused = 1 pistil
Ovary inferior
Hypanthium
(+ hypanthium tube)

Oenothera biennis
Evening primrose