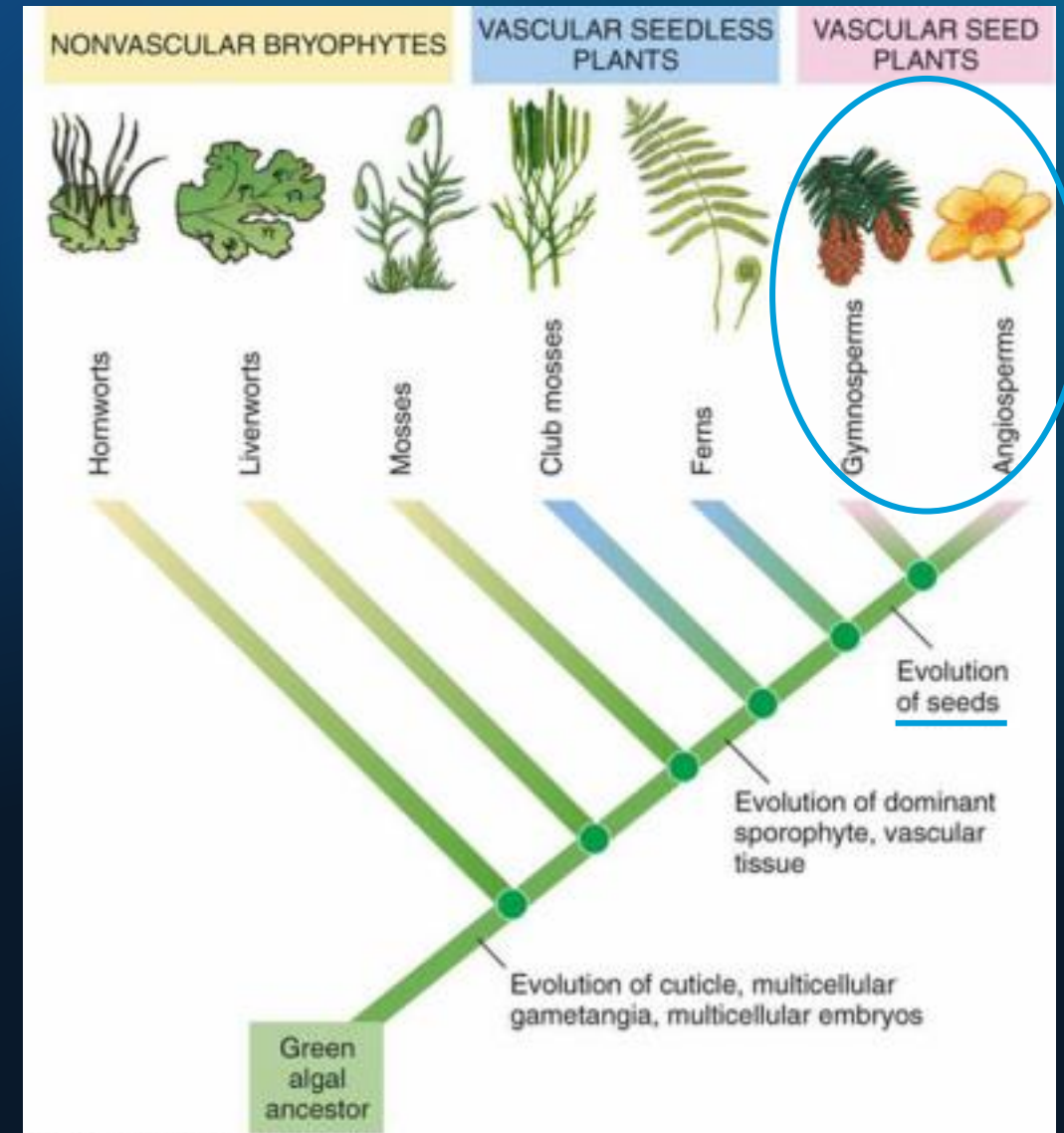
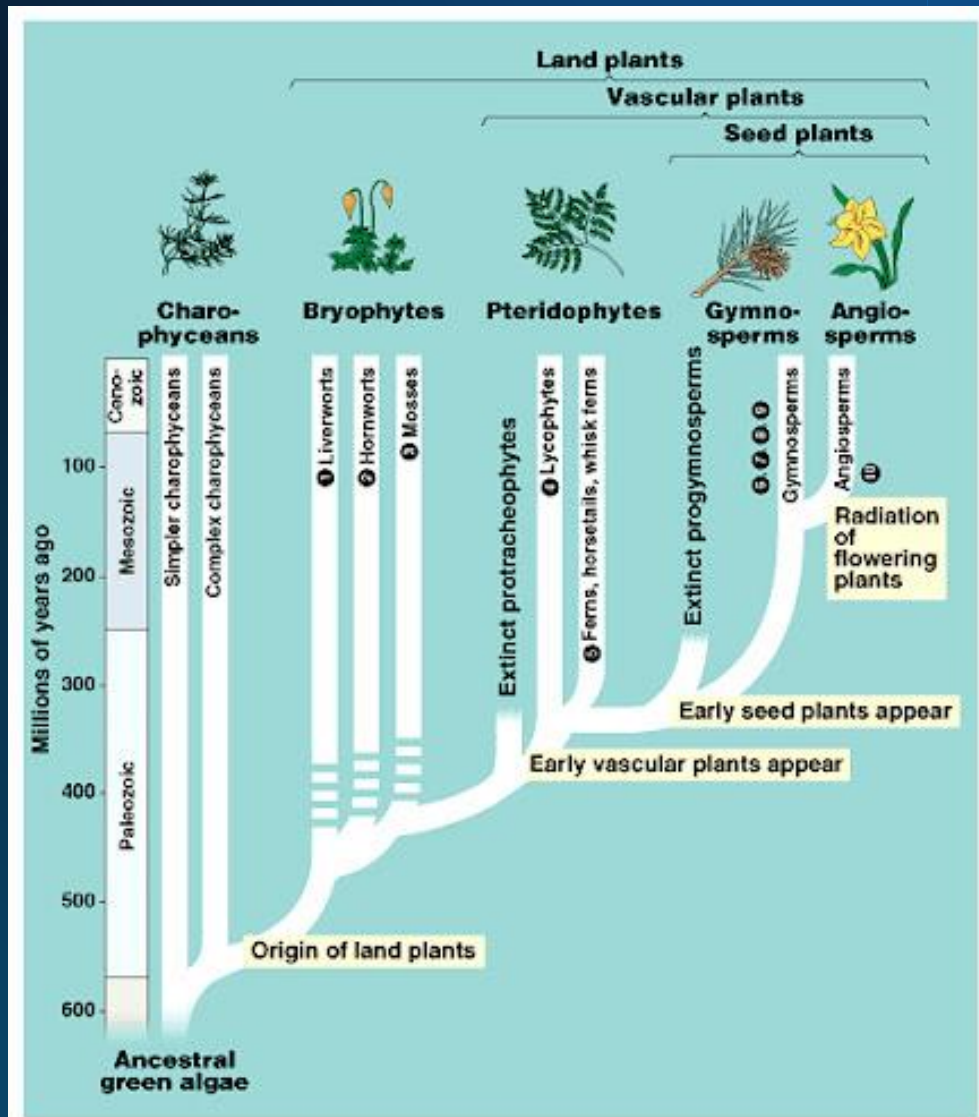


# Reproduction in Seed Plants (chapter 25)

# Cones and Flowers as Reproductive Organs (25-1)

# A HISTORY LESSON

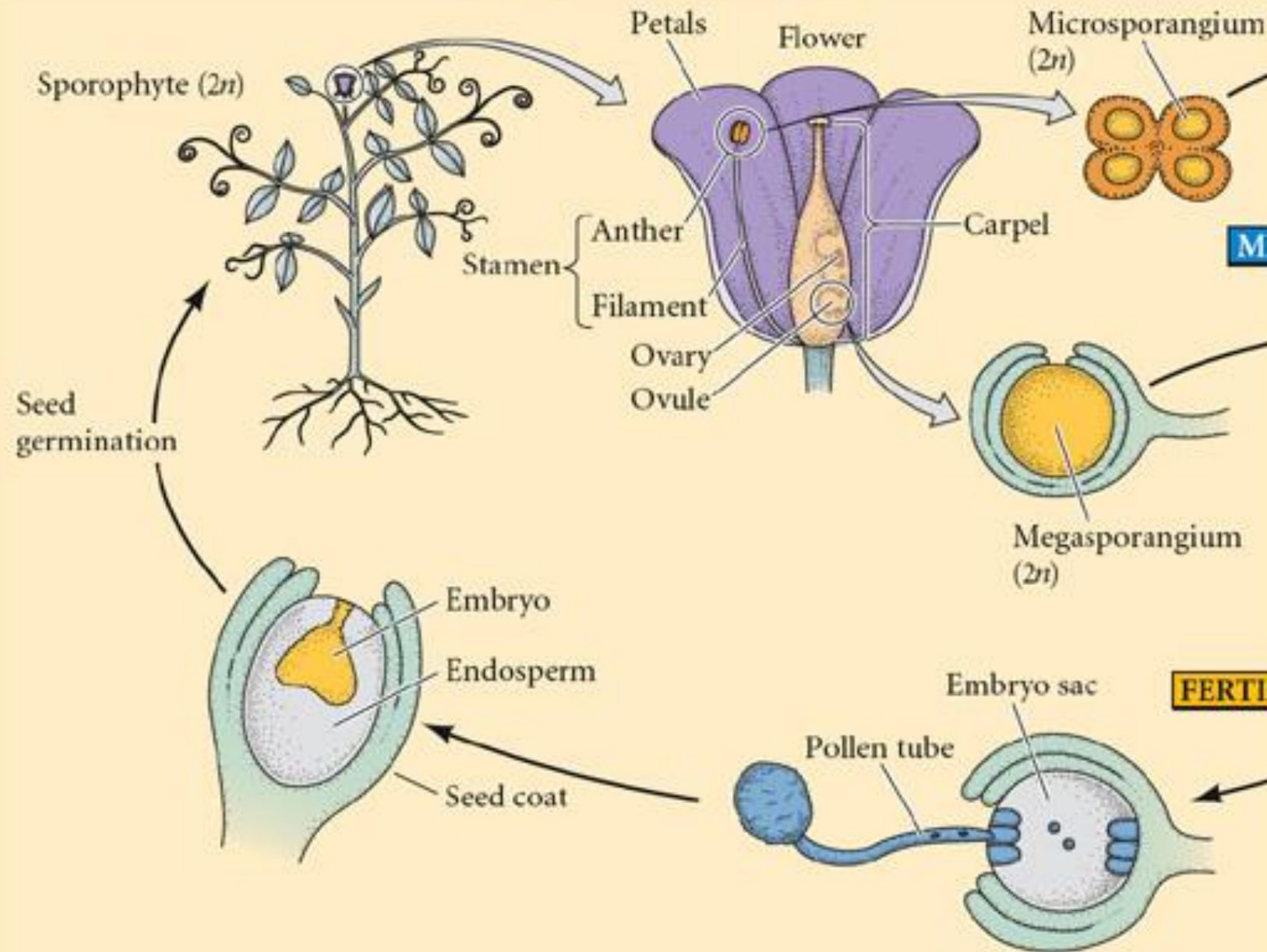


# THE SECRET SEX LIVES OF PLANTS

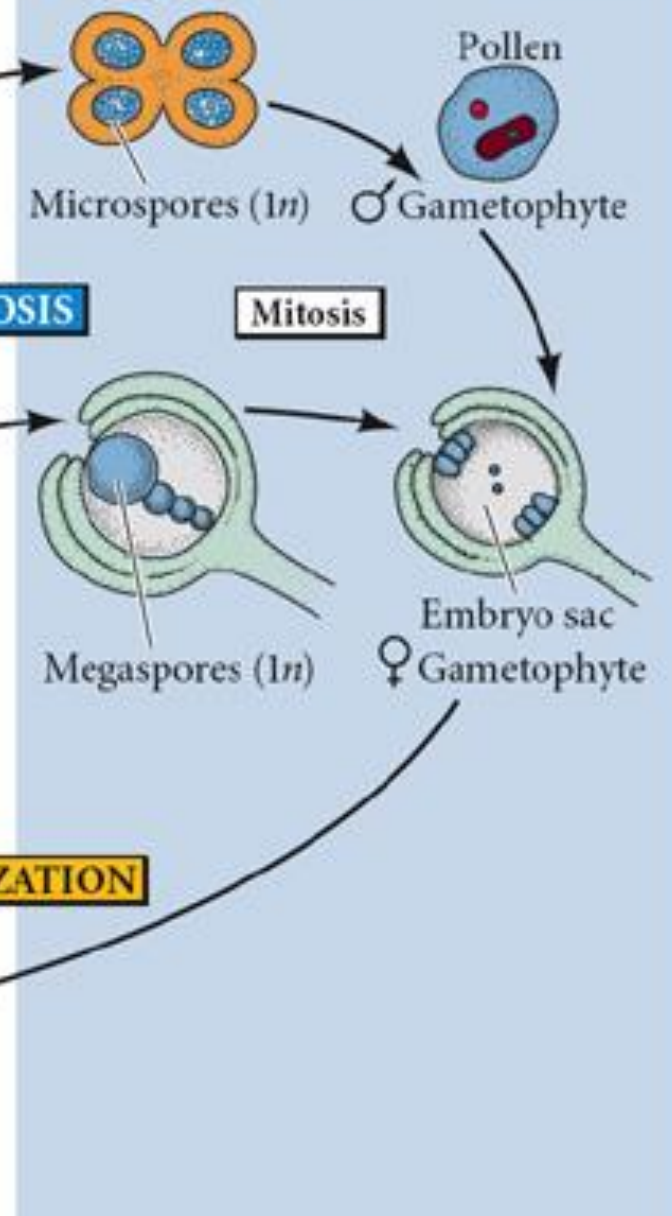
- Gymnosperm **cones** and angiosperm **flowers**:
  - *Sexual organs* for the purpose of reproduction
  - Seed plants not reliant on water for reproduction



## Diploid sporophyte generation



## Haploid gametophyte generation



# THE SECRET SEX LIVES OF PLANTS

Alternation of generations (gymnosperms and angiosperms):

- Sporophyte is dominant
- Gametophyte is tiny and only made of a few cells; completely dependent on sporophyte for nutrients
- Male gametophyte is **pollen** and produces **sperm**
- Female gametophyte develops inside an **ovule** and produces **eggs**

# Gymnosperms (Plants with Naked Seeds)



# GYMNOSPERMS

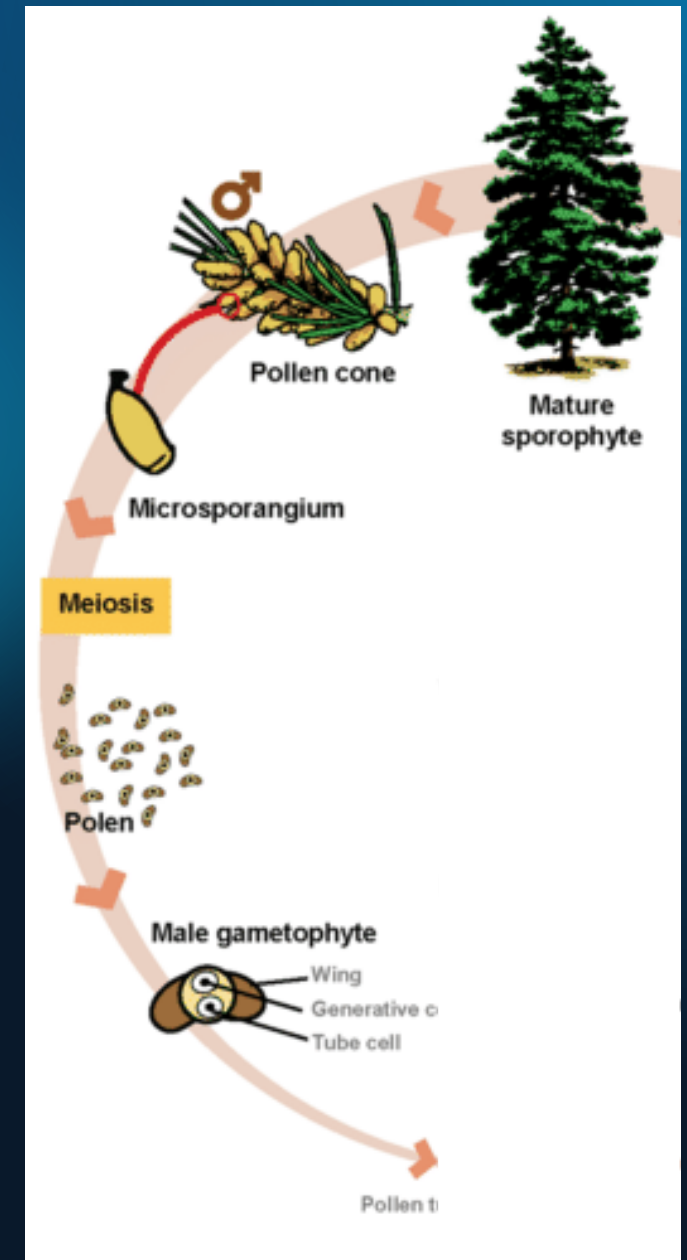
- “gymno” = naked; “sperm” = seed
- (Ovules do **not** develop within an ovary, unlike angiosperms)
- Use **male and female cones** as reproductive structures
- Are **monoecious**: a single individual produces both male **and** female cones
- Examples: pine tree, cypress tree, ginkgo tree, cycads



# GYMNOSPERMS: CONES

## Male 'pollen cones'

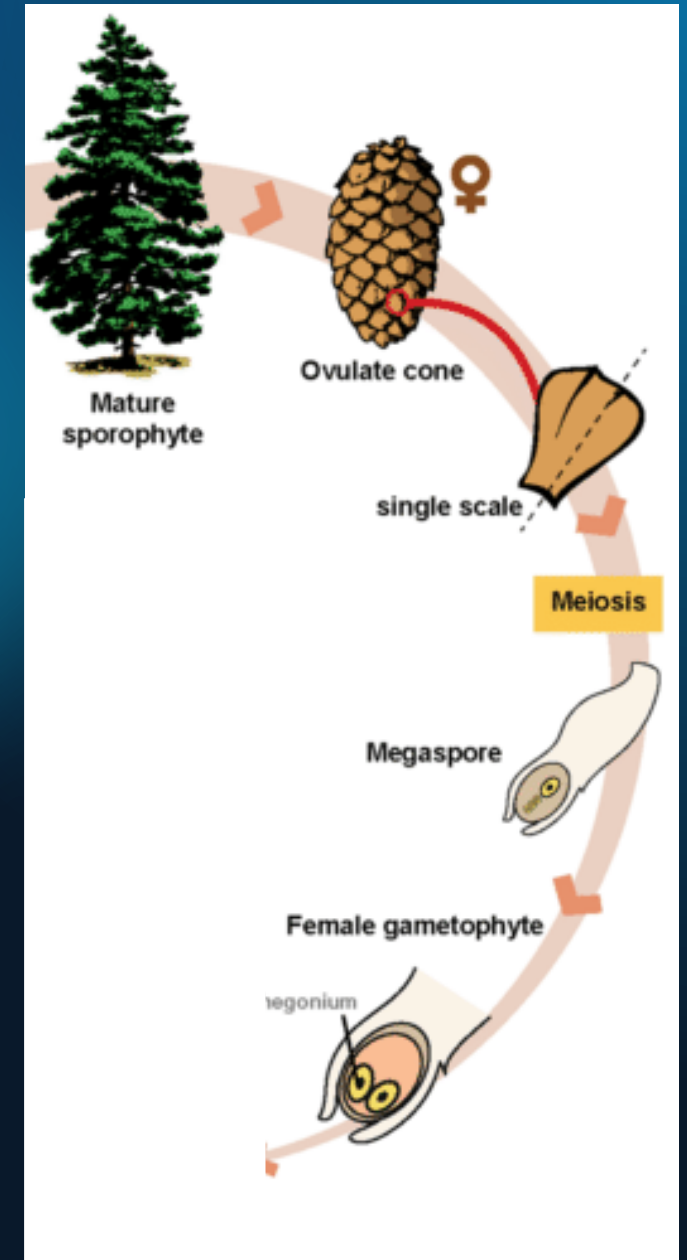
- Small cones
- Contains pollen-producing structures
- (Review: **pollen** is the male gametophyte and produces sperm)

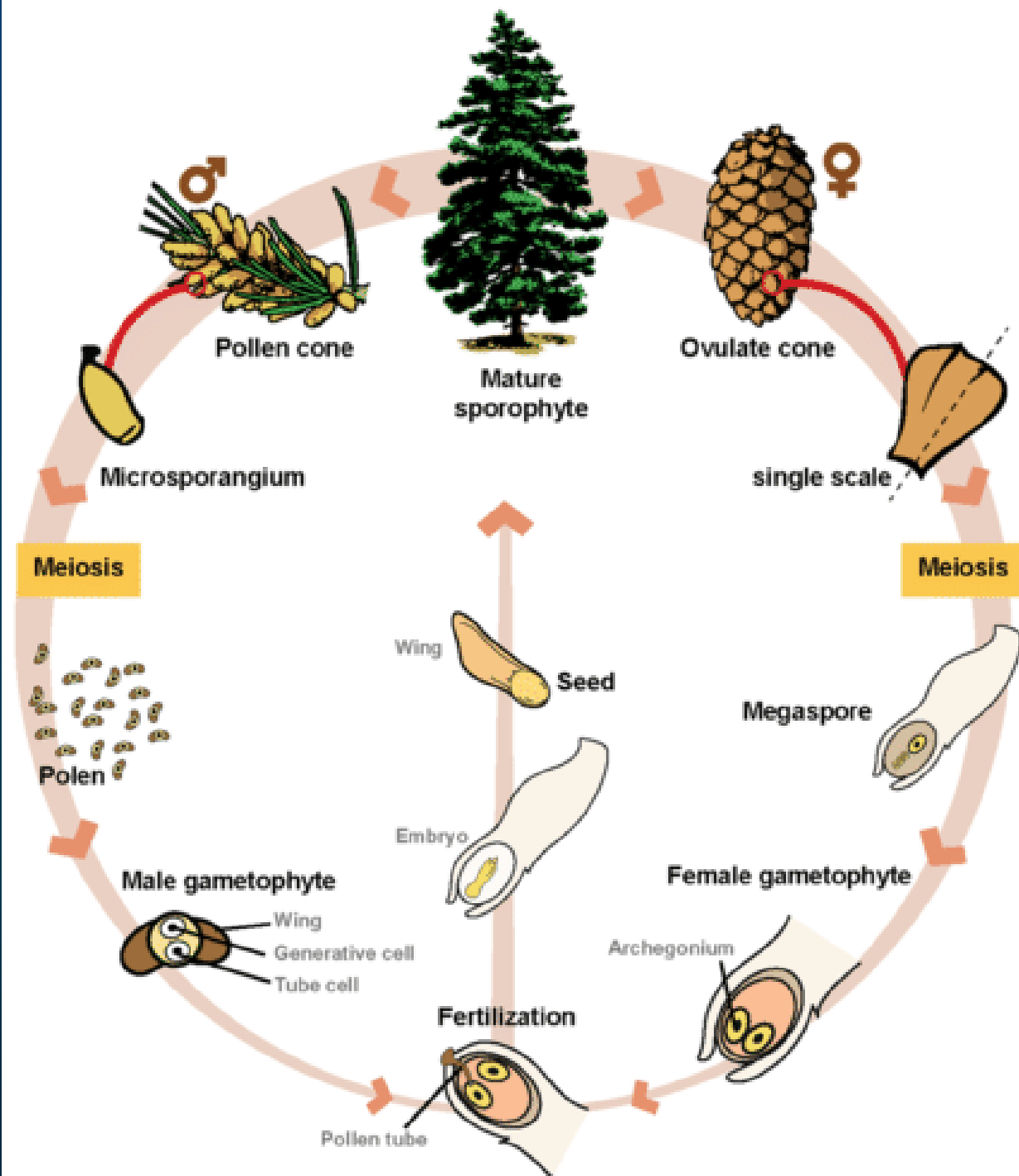


# GYMNOSPERMS: CONES

## Female 'seed cones':

- Large cones
- Contains ovules, which produce female gametophytes
- (Review: Female gametophyte develops inside an ovule and produces eggs)





# GYMNOSPERMS: WIND-POLLINATION

- Pollen is carried by the **wind** to female cones.
- **Hay fever** is an allergic reaction to pollen; symptoms are worse in the spring when most wind-pollinated plants\* tend to release their pollen to the air

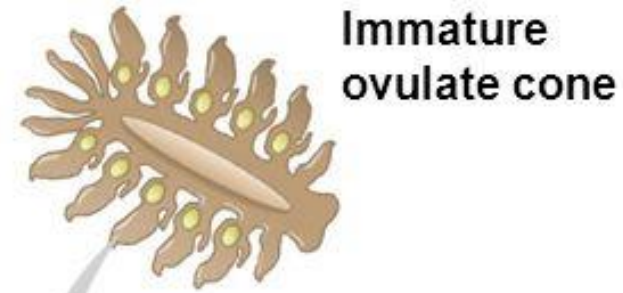
\* includes both gymnosperms and angiosperms



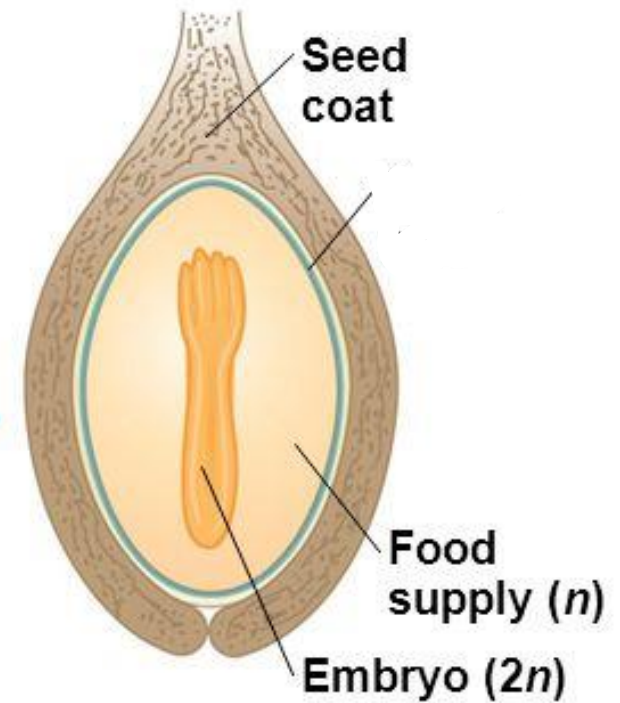
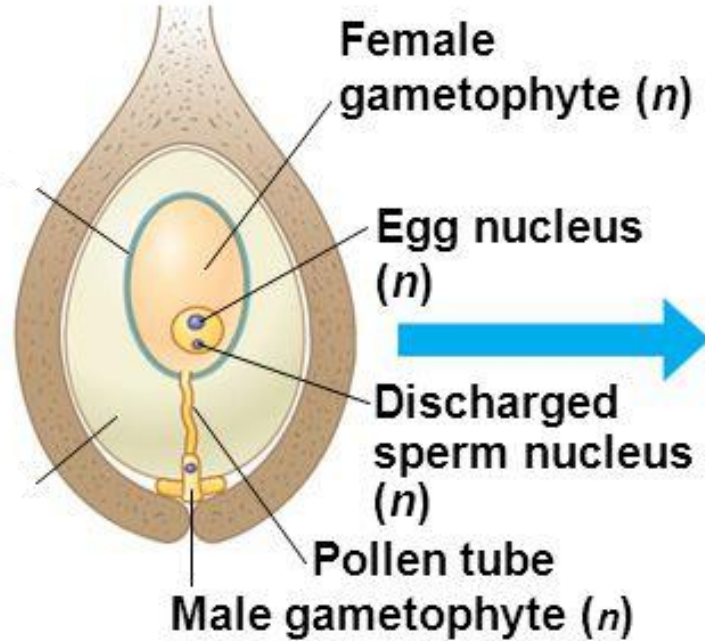
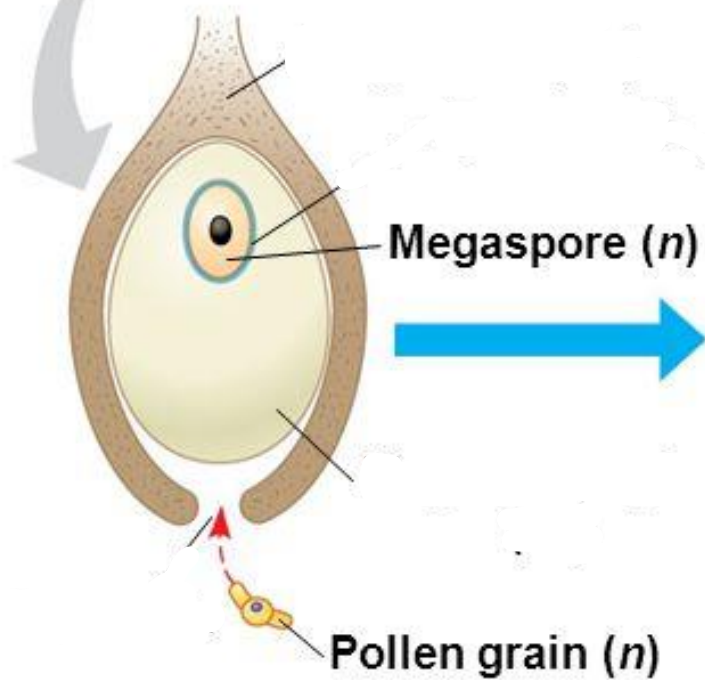
# GYMNOSPERMS: FERTILIZATION

- After pollen lands on a female cone, a **pollen tube** grows towards egg
- Sperm travels down the pollen tube towards the ovule and fertilizes it to form a diploid zygote

# GYMNOSPERMS: FERTILIZATION



Note: this diagram is for illustrative purposes only, to show how the pollen tube grows and an embryo is formed. Do not memorize any new vocabulary.



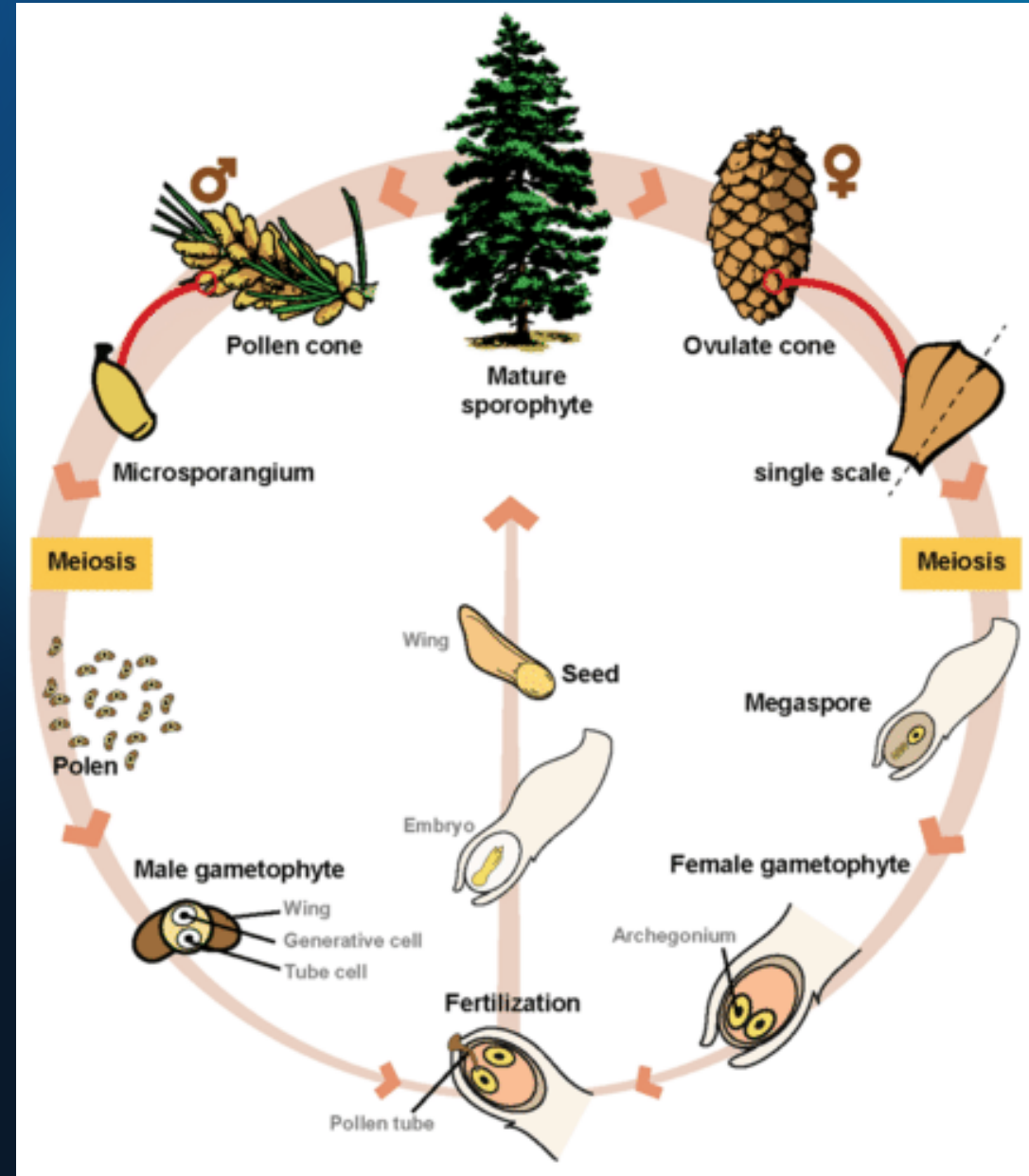
(a) Unfertilized ovule

(b) Fertilized ovule

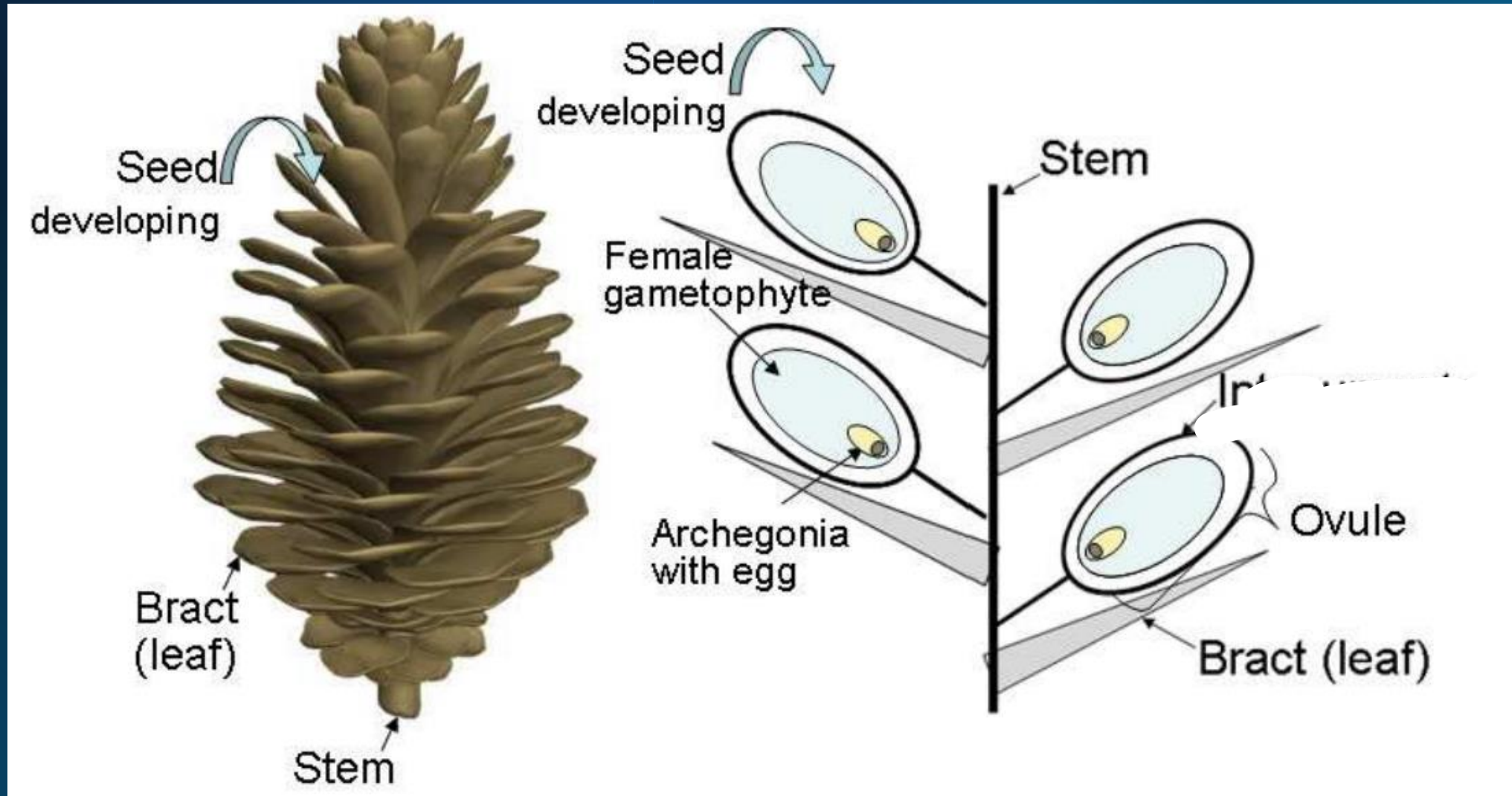
(c) Gymnosperm seed

# GYMNOSPERMS: SEED

- After fertilization, diploid zygote grows into an embryo.
- Each seed contains:
  - One embryo
  - Supply of food for developing embryo when it germinates into diploid sporophyte



# GYMNOSPERMS: SEED



Note: this diagram is mostly for illustrative purposes. Important vocabulary: egg, female gametophyte, ovule, seed.



# GYMNOSPERM REVIEW QUESTIONS

- 1) Why are gymnosperms referred to as “naked seed” plants?
- 2) Compare and contrast female cones and male cones.
- 3) Describe the life cycle of a gymnosperm.
- 4) How do gymnosperms and angiosperms differ from other tracheophytes (e.g. ferns)?

# Angiosperms (Flowering Plants)

DIVERSE LIFE CYCLES AND LIFE  
STRATEGIES

MANY HAVE EVOLVED INTIMATE SYMBIOTIC  
RELATIONSHIPS WITH POLLINATORS



# ANGIOSPERM LIFE CYCLE

- “Angio” = container, vessel; “sperm” = seed
- Use **flowers** as their reproductive organs
- Ovules and seeds develop within **ovary** (unlike gymnosperms) to produce **fruit**
- Most are monoecious, though a small percent are dioecious
  - **Dioecious:** a single plant will only produce sperm or egg
- Diverse life cycles and strategies, including symbiotic relationships with pollinators

# FLOWER OVERVIEW

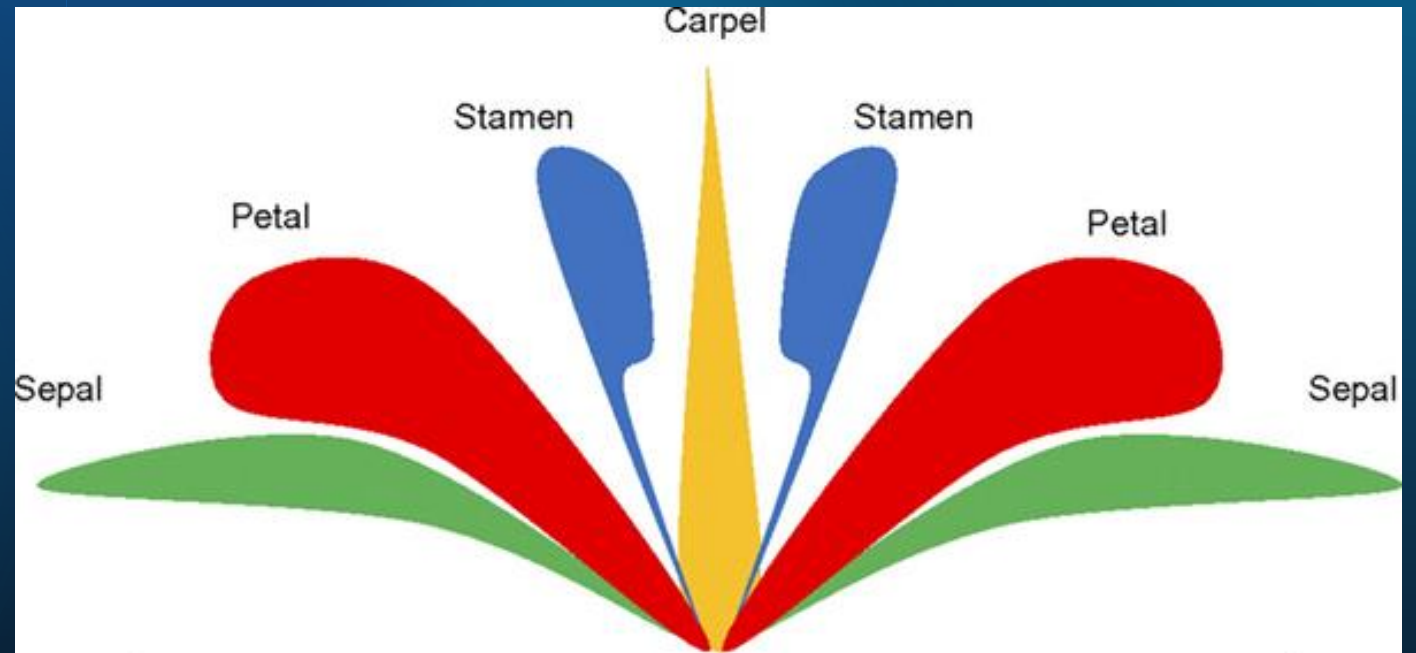
- **Flowers** are stems with modified and highly specialized leaves for the purpose of reproduction
  - The specialized leaves can be **fertile** (produce gametes) or **sterile** (does not produce gametes)
- Each flower contains both male and female gametes\*
- Flowers tend to contain the same structures in the same order\*

\*Because angiosperms are such a diverse group, exceptions exist.

# FLOWER STRUCTURE

The 'leaves' in a flower are arranged in **whorls** (rings):

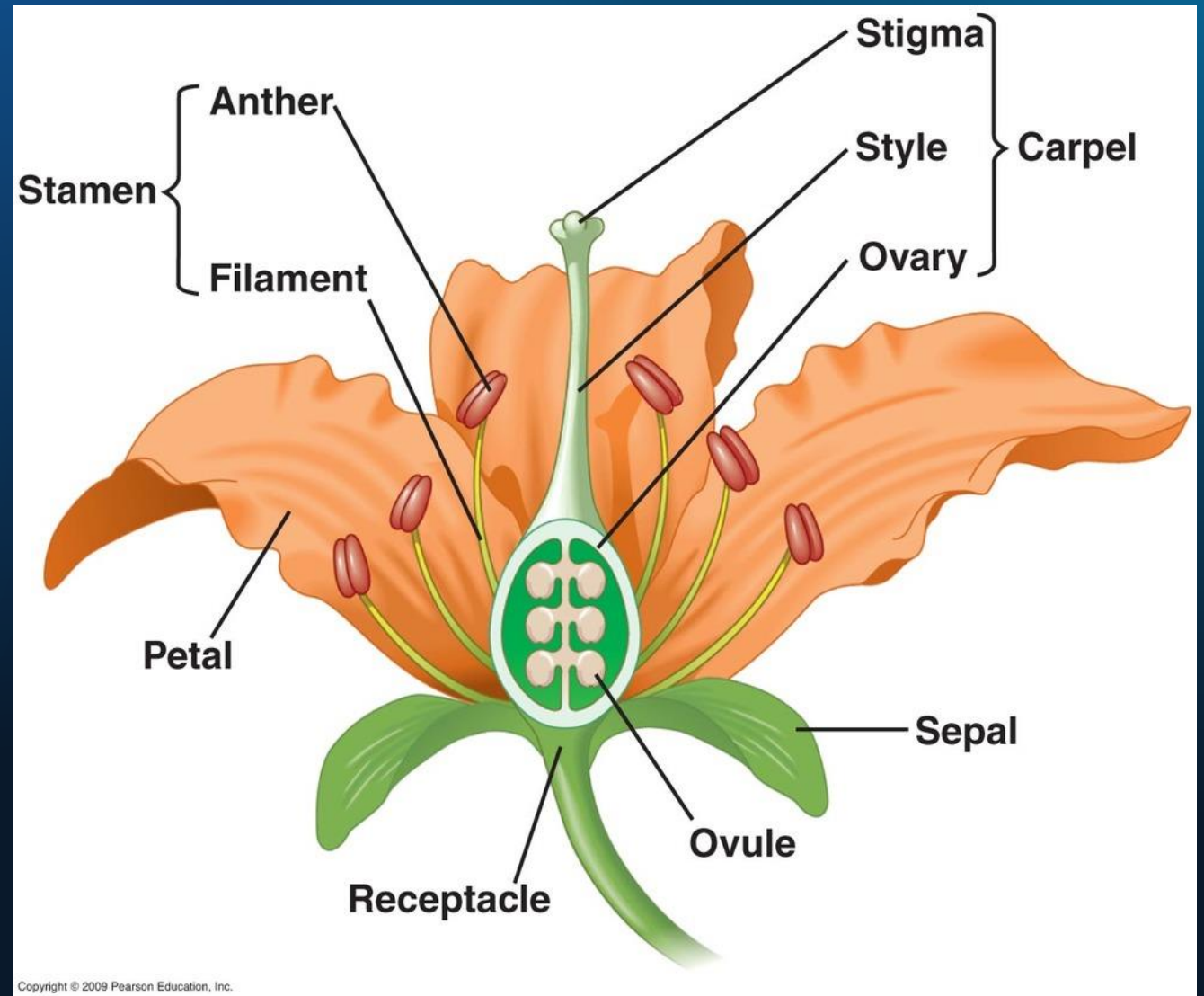
- **Sepals**
- **Petals**
- **Stamens**
- **Carpels**



# FLOWER STRUCTURE

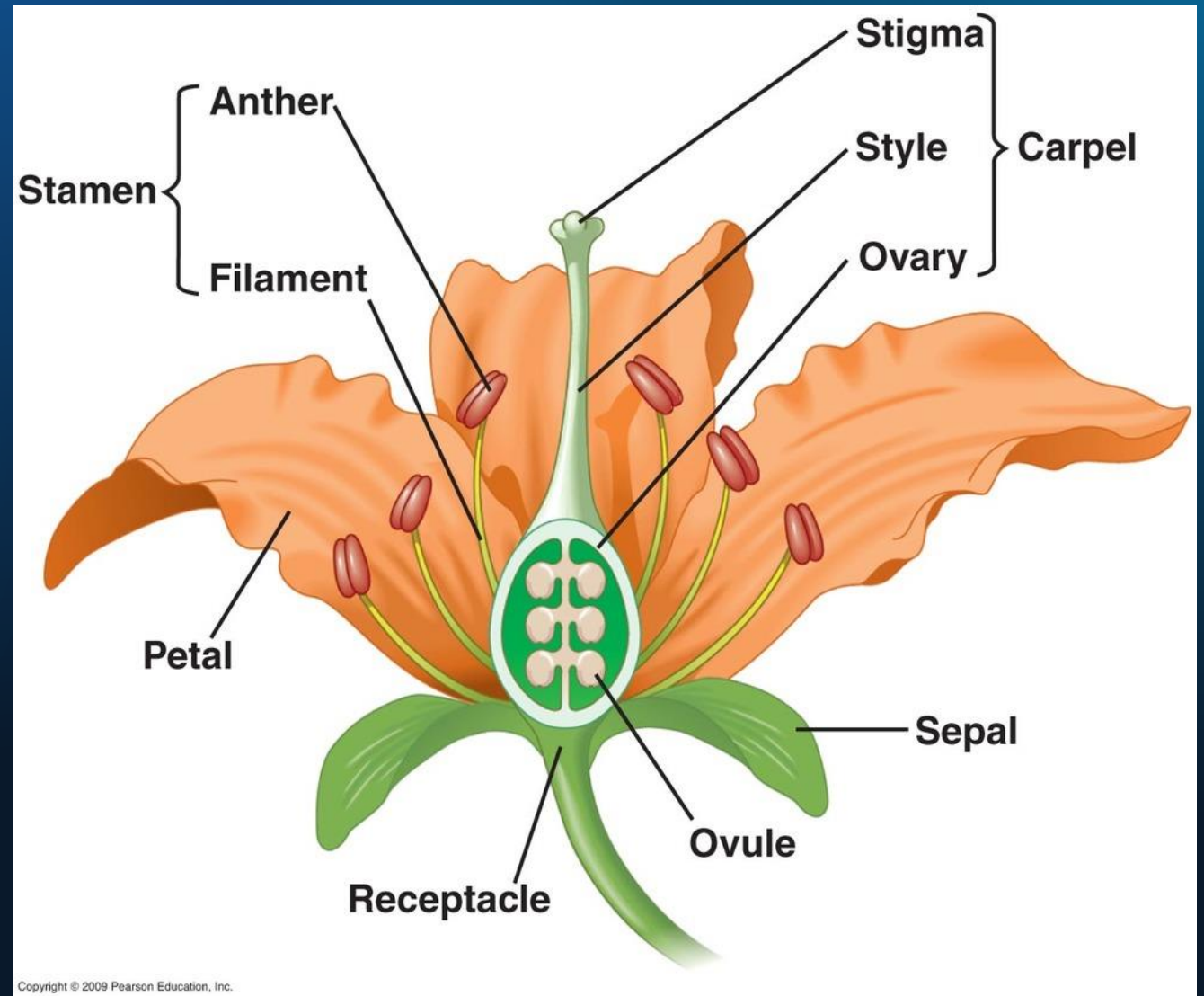
The 'leaves' in a flower are arranged in **whorls** (rings):

- **Sepals**
- **Petals**
- **Stamens**
- **Carpels**



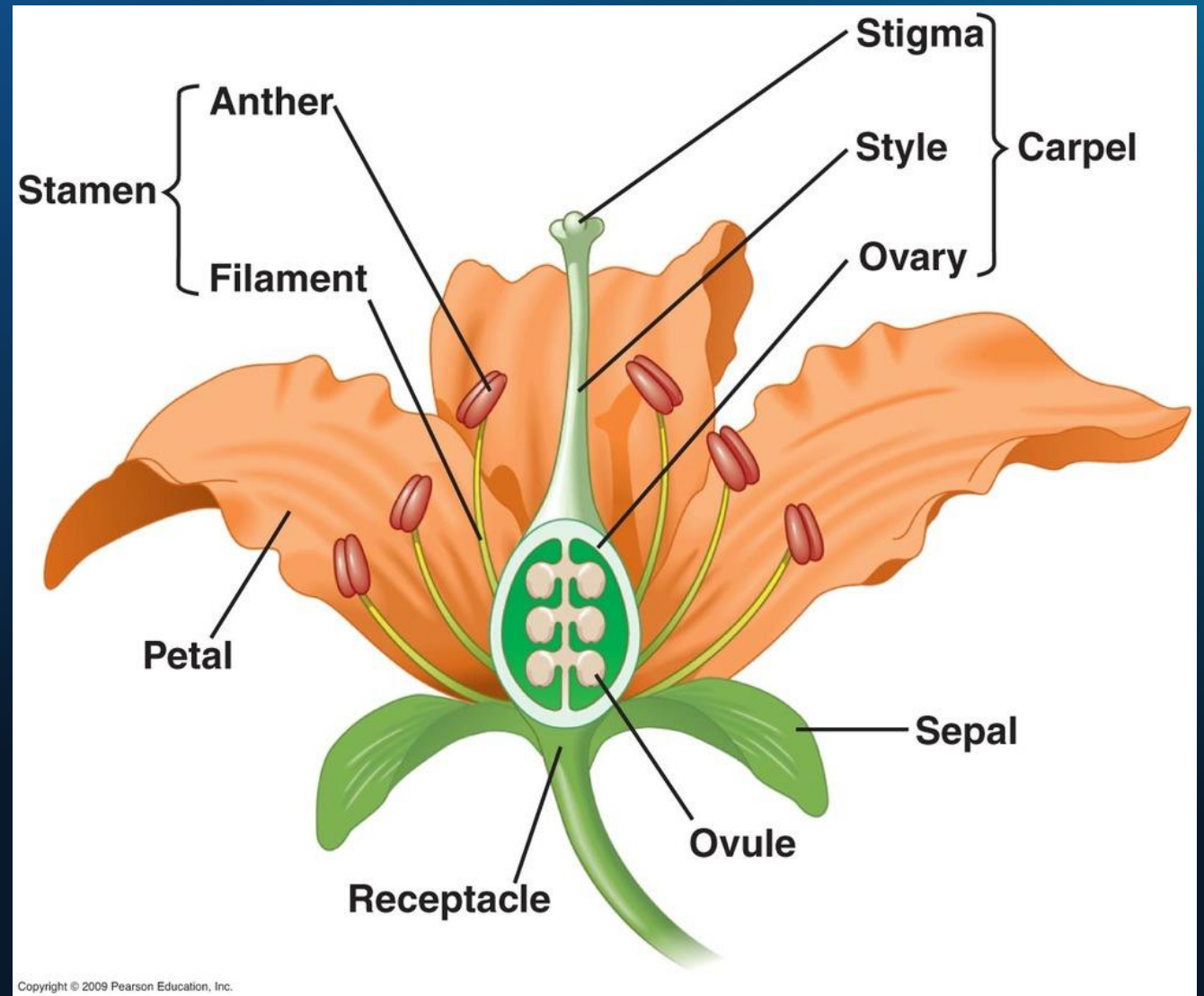
# SEPALS

- **Sepals:** sterile leaves that make up the outermost flower whorl
- The most 'leaf-like' of the whorls; often green but can also resemble petals
- Enclose and protect the developing flower bud



# PETALS

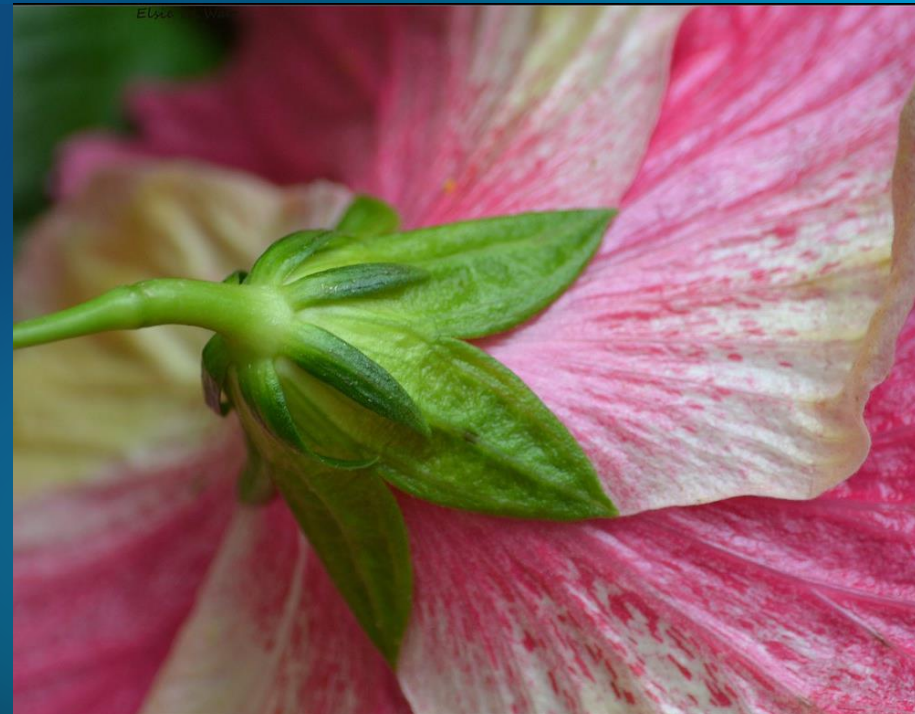
- **Petals:** sterile leaves between sepals and stamens
- Usually brightly coloured to attract pollinators





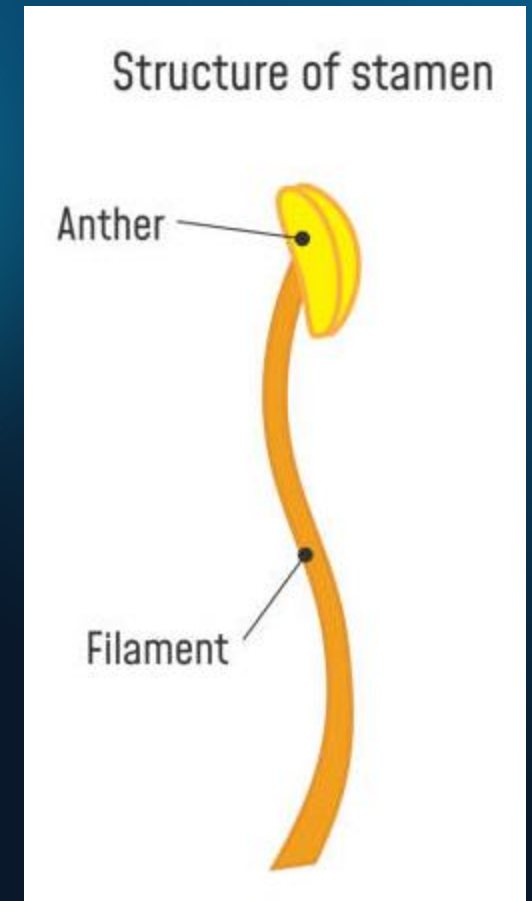


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# STAMENS

- **Stamens:** fertile male leaves between petals and carpels
- Each stamen has two parts:
  - **Filament:** the 'stalk' supporting the anther
  - **Anther:** produce male gametophytes (pollen), which produce sperm



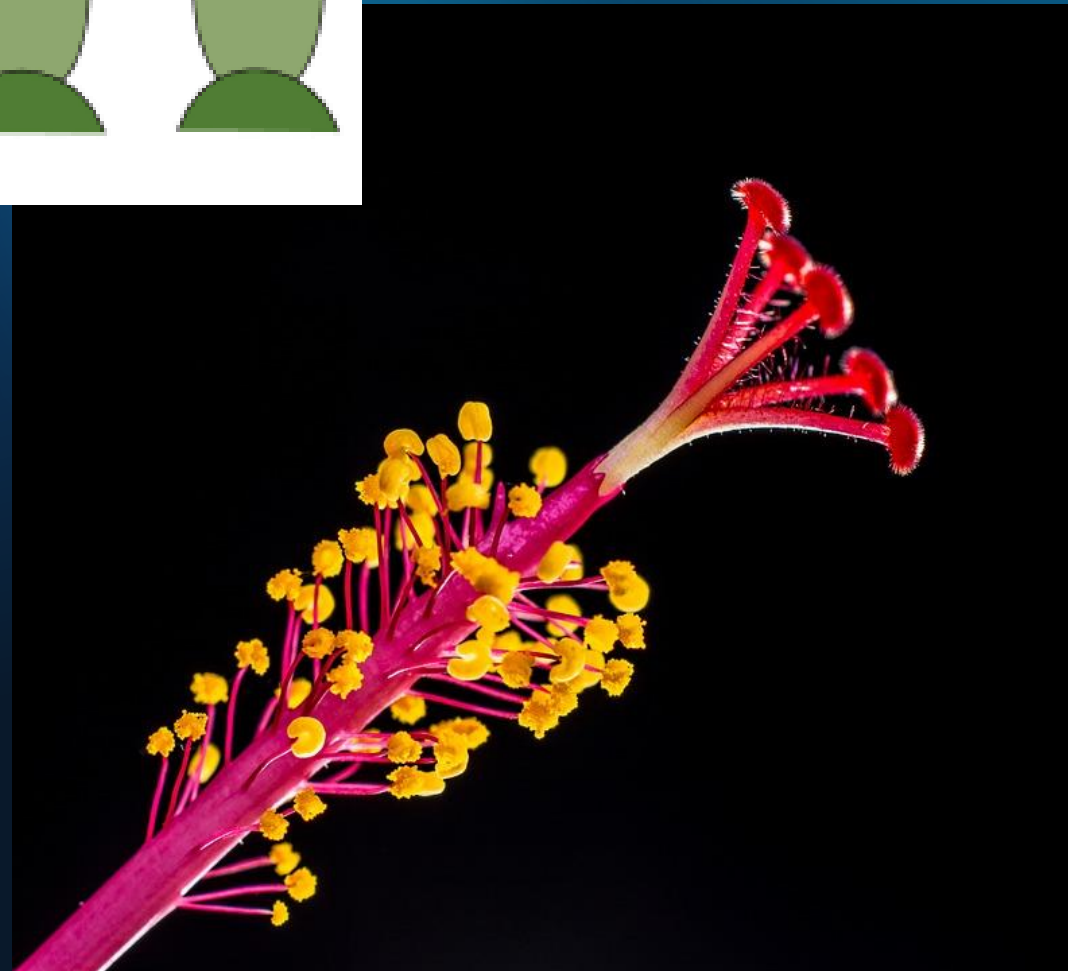
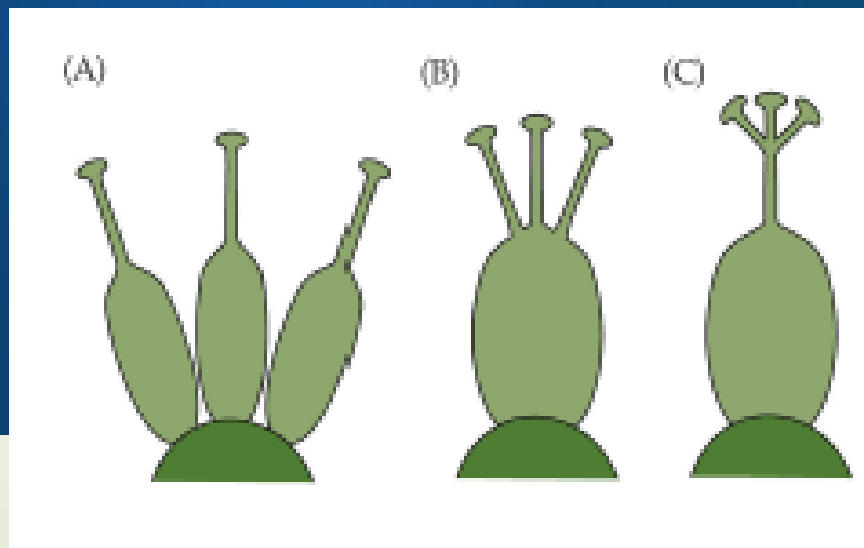
# CARPELS

- **Carpels:** fertile female leaves that make up the innermost flower whorl
- Each flower has one or more carpels

\*Note: when studying, you may encounter the term 'pistil'. They are not exactly the same, but we will not learn the difference in this course.

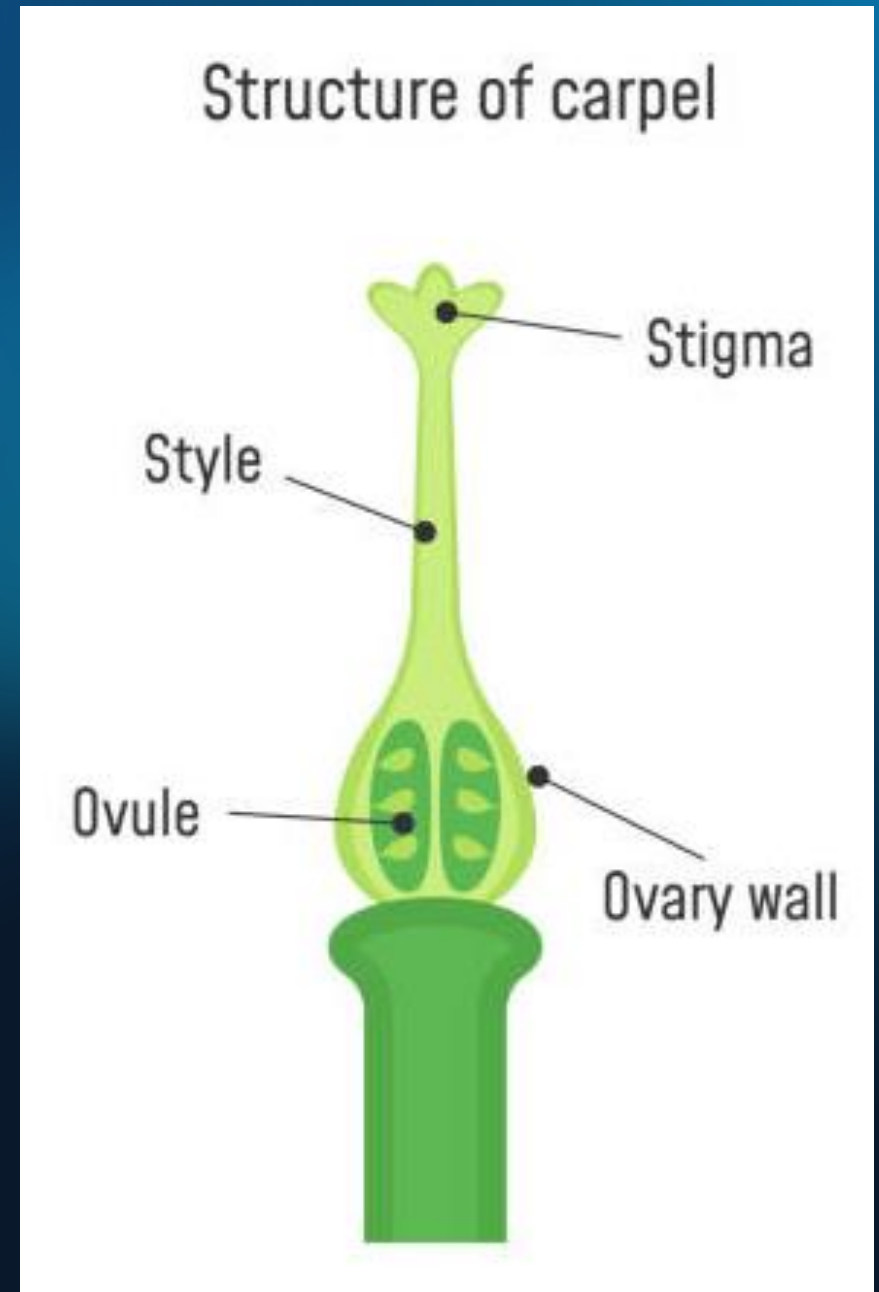


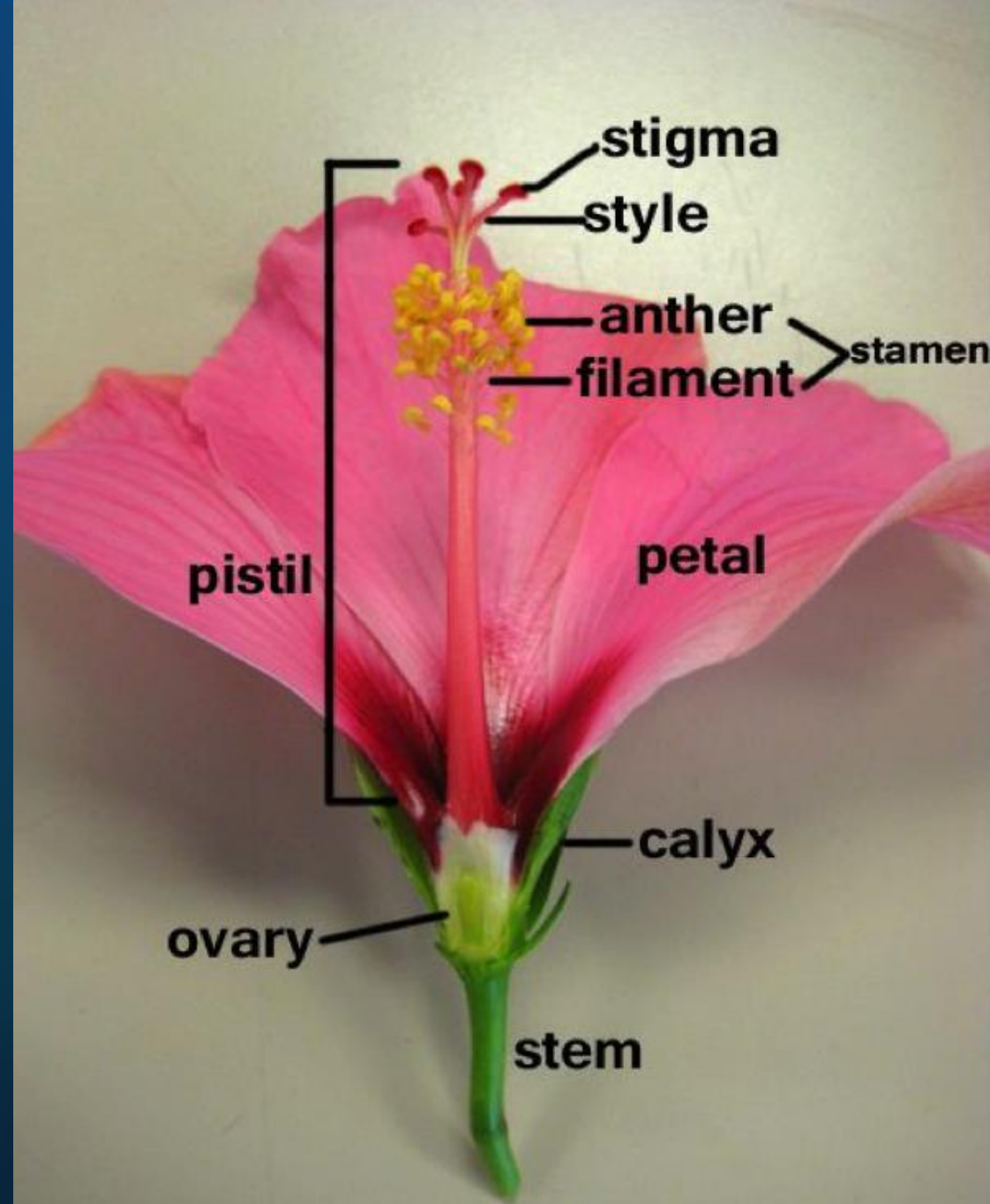
# CARPELS

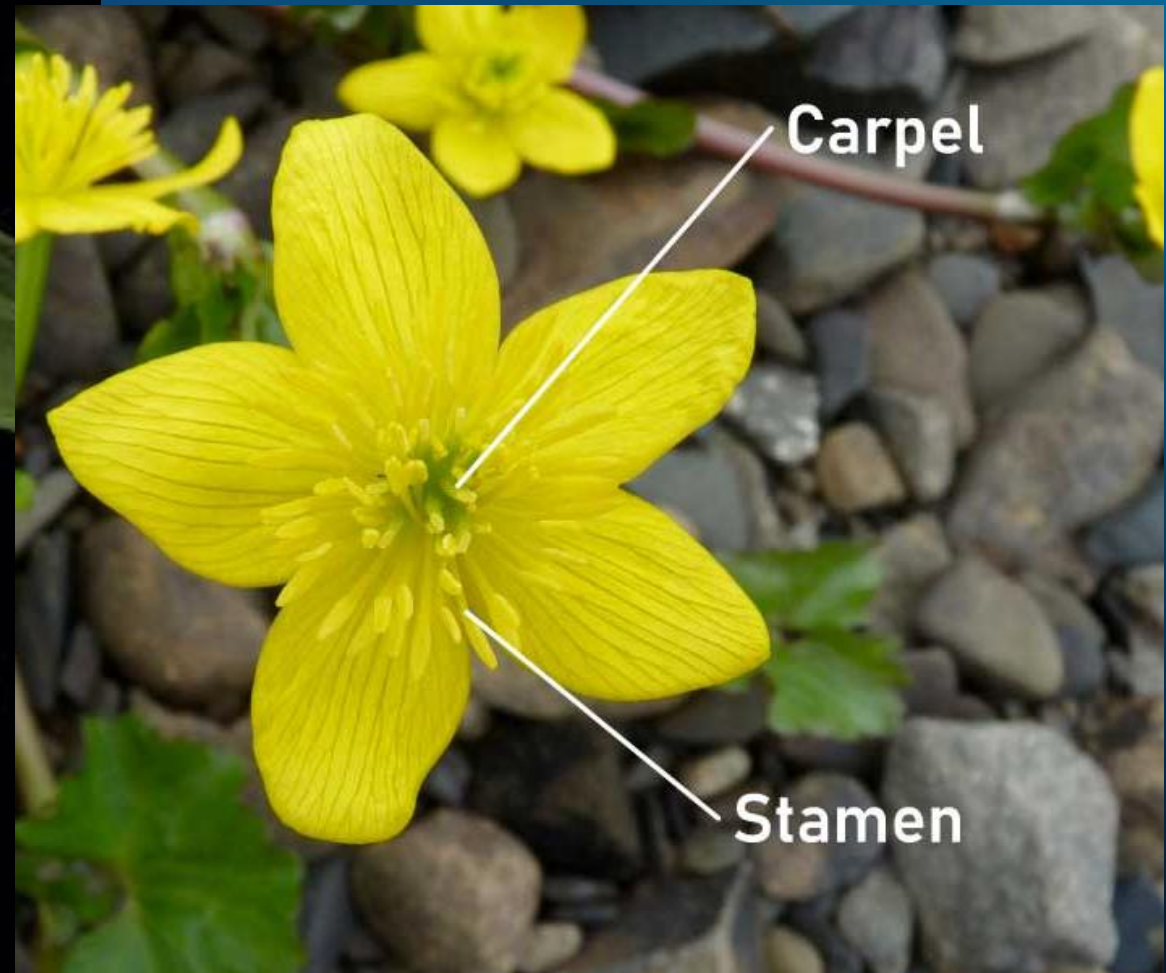
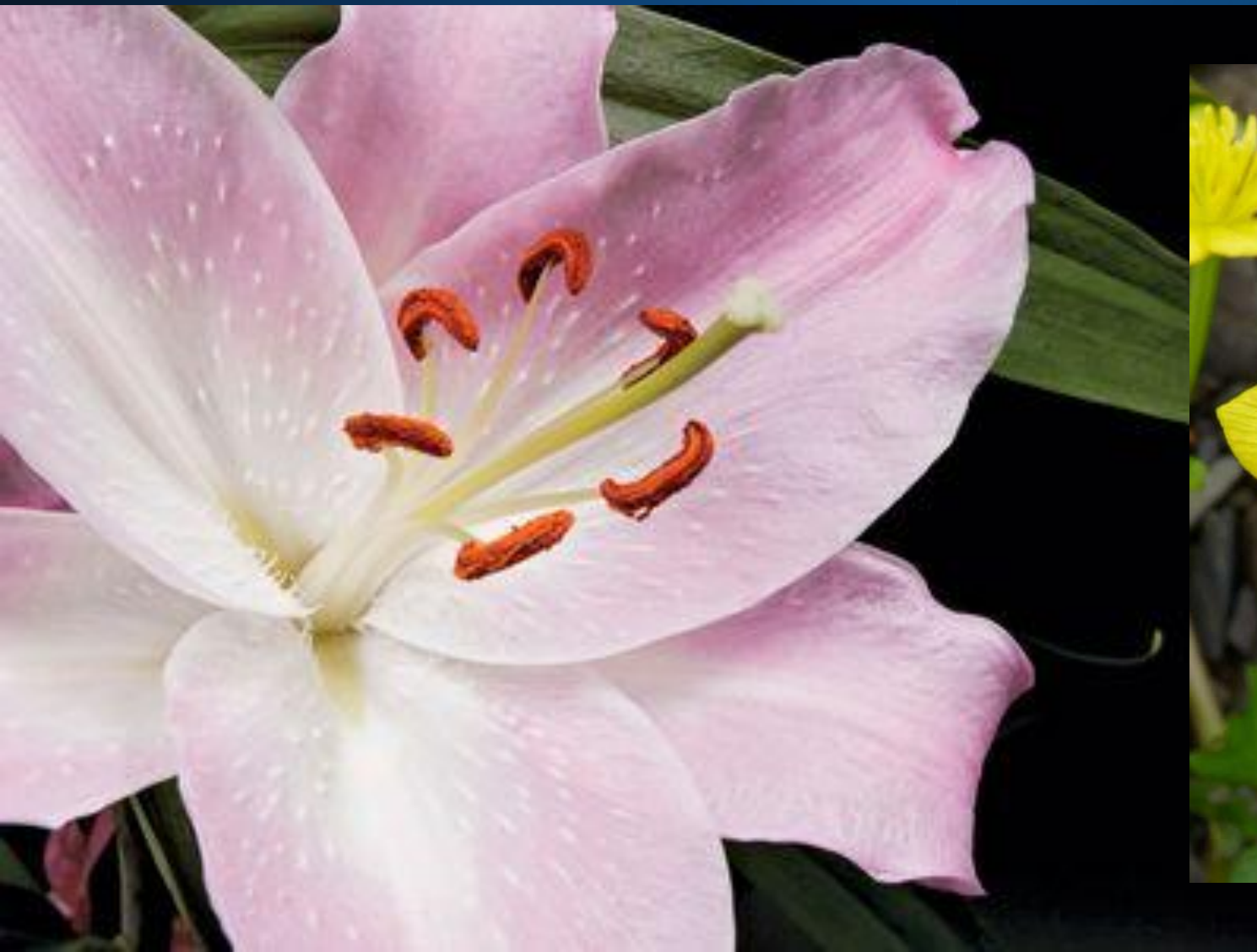


# CARPELS

- Each carpel consists of:
  - **Stigma:** sticky surface where pollen is deposited
  - **Style:** connects stigma to ovary
  - **Ovary:** contains ovules, which produce female gametophyte, which produces eggs







# MONOCOT VS DICOT COMPARISON

- **Monocots** have flower parts in multiples of 3, while **dicots** usually have flower parts in multiples of 4 or 5



**Monocots**  
Parts in 3s



**Dicots**  
Parts in 4s or 5s



# PRACTICE

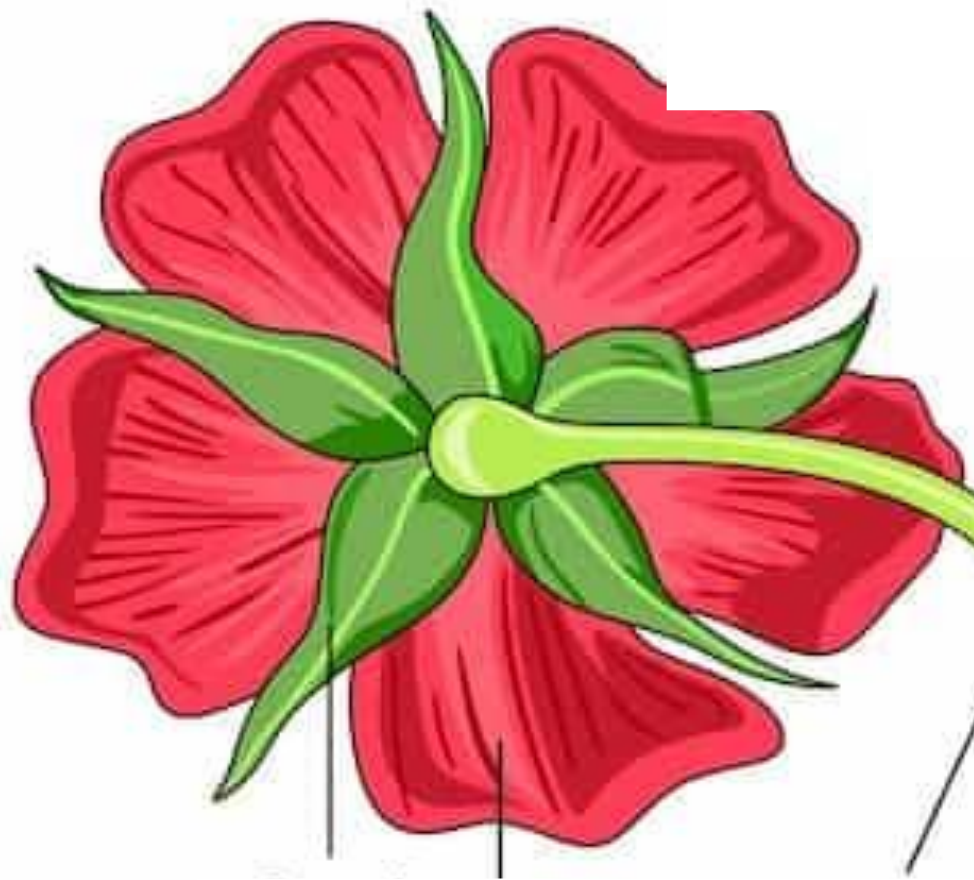
- 1) Review the locations and functions of the following: sepals, stamens, carpels, petals.
- 2) What are the parts of a stamen? What purpose does each part serve?
- 3) What are the parts of a carpel? What purpose does each part serve?

# PRACTICE

4) For each of the following:

a) Identify if it is a monocot or dicot.

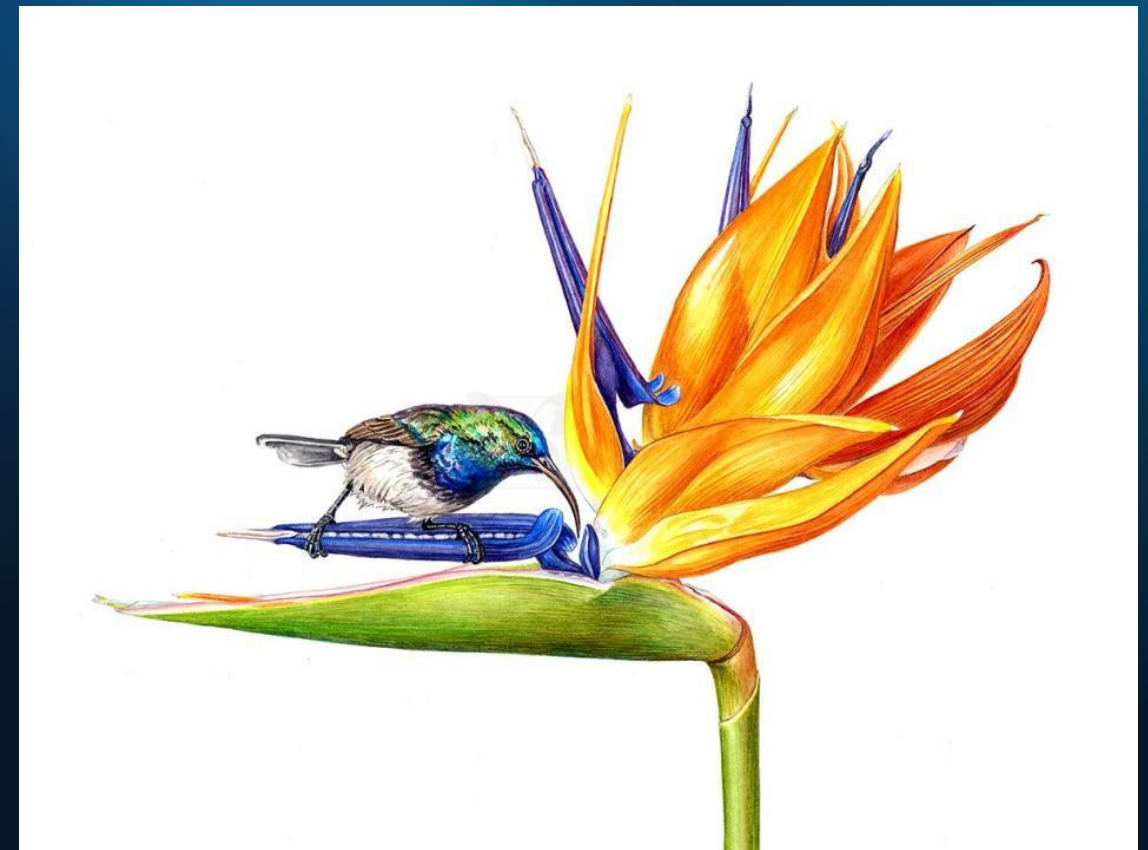
b) Identify and count the numbers of sepals, petals, stamens, and carpels in each (if possible).





# WEIRD AND WACKY FLOWERS

‘Bird of paradise’ flowers expose their anthers when a bird steps on the blue petal.



# WEIRD AND WACKY FLOWERS

*Salvia* flowers have a unique lever mechanism for pollination.

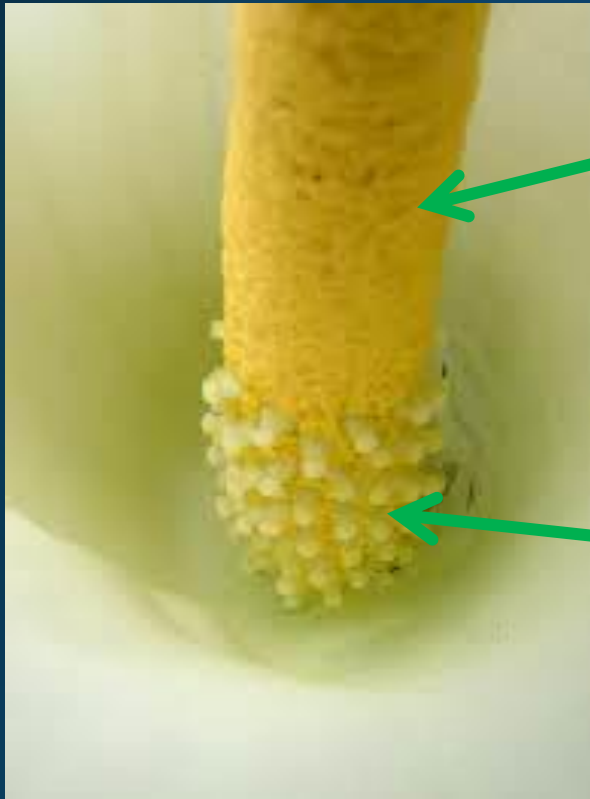


You won't be asked to label the flower parts of this flower, but you should know that *Salvia* has a lever mechanism for pollination.

[https://www.youtube.com/watch?v=UoB1xv4qEMc&ab\\_channel=MarkusJerominek](https://www.youtube.com/watch?v=UoB1xv4qEMc&ab_channel=MarkusJerominek)

# WEIRD AND WACKY FLOWERS

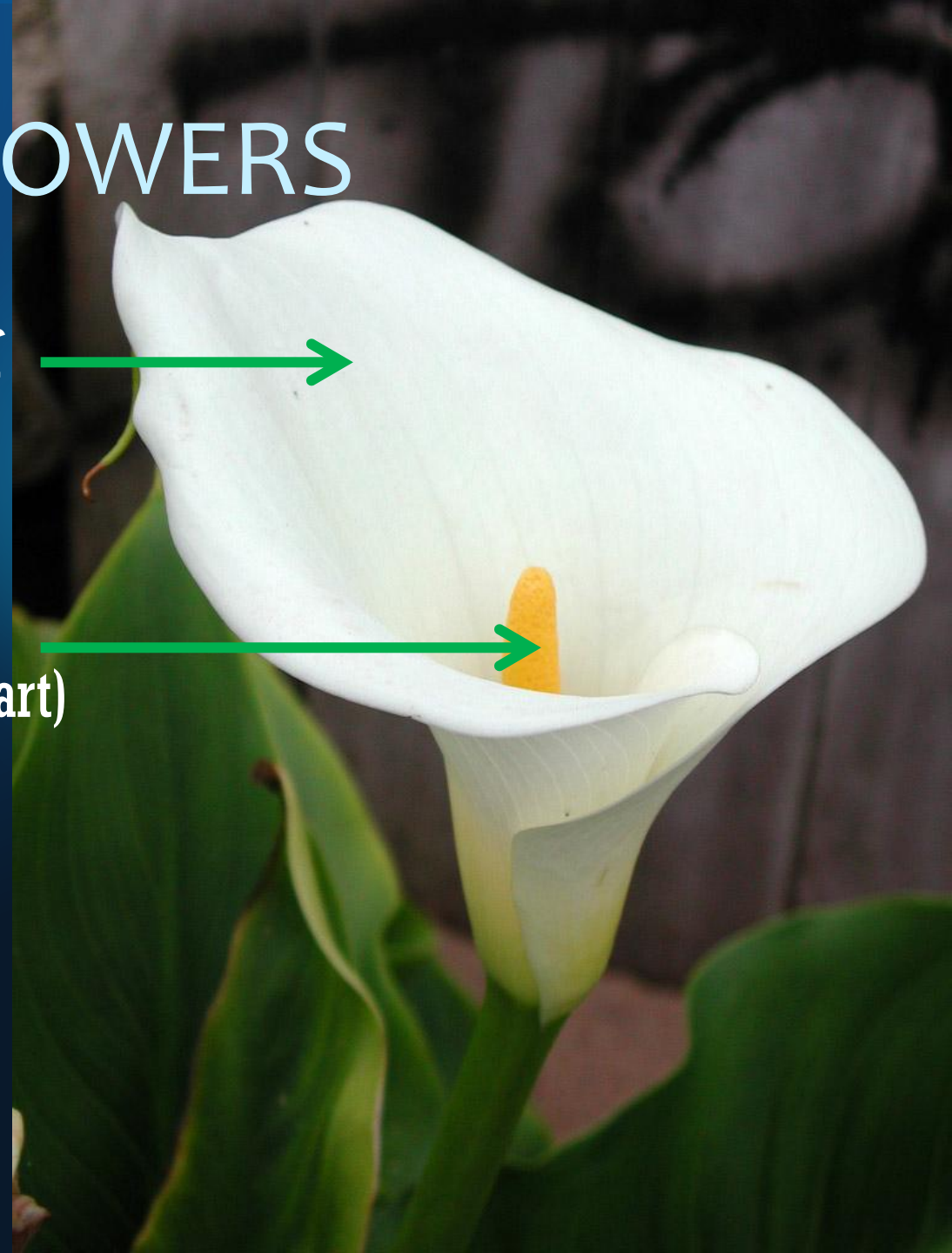
The Calla lily 'flower'  
is not a flower...



modified leaf  
(white part)

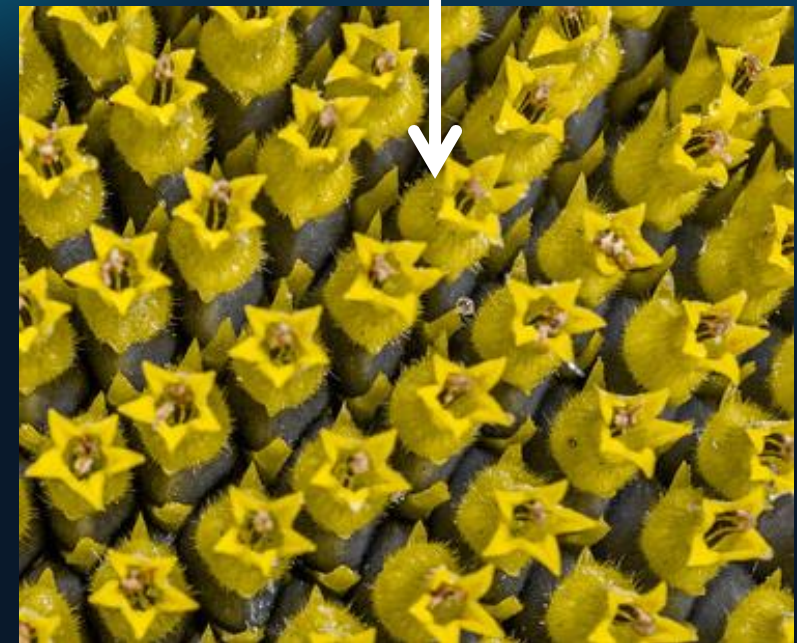
male flowers  
(upper yellow part)

female flowers  
(bumps)



# WEIRD AND WACKY FLOWERS

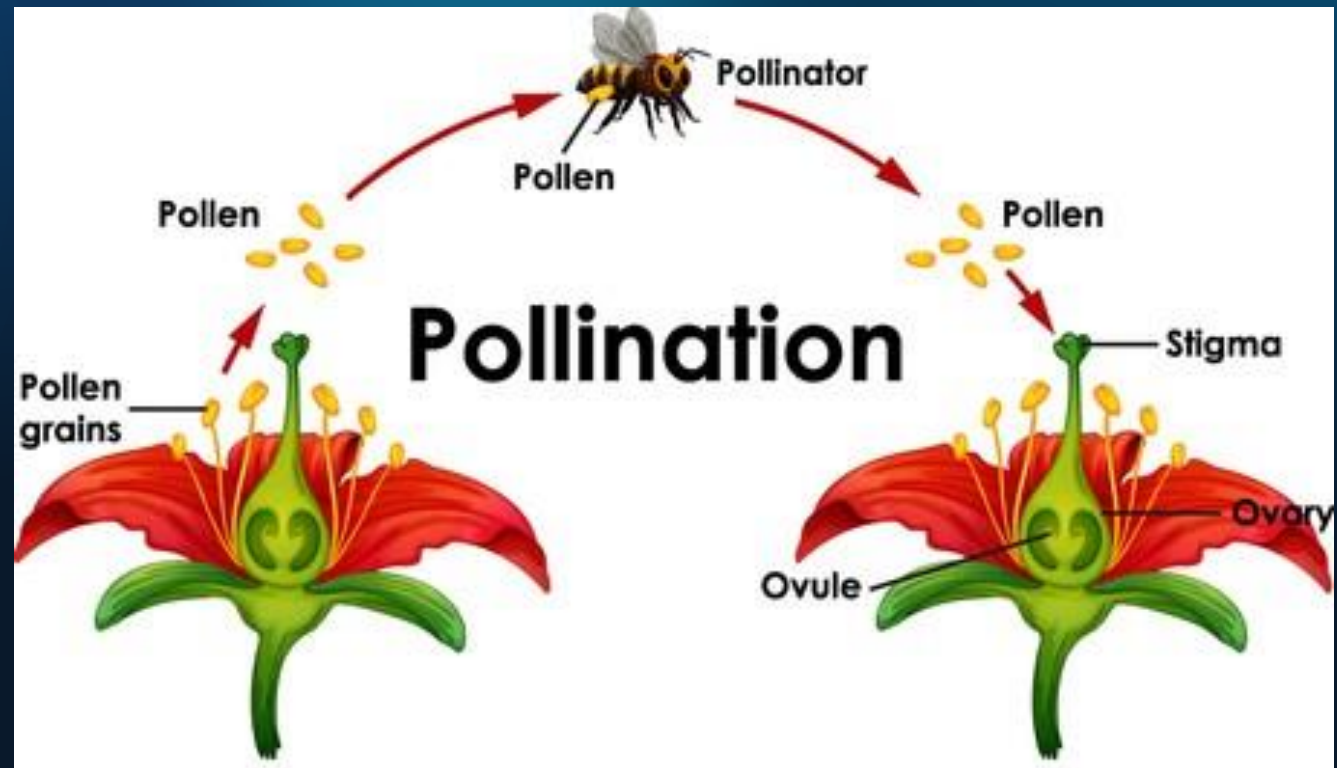
Sunflowers and other members of the family Asteraceae are not flowers: they are *clusters* of flowers.





# POLLINATION

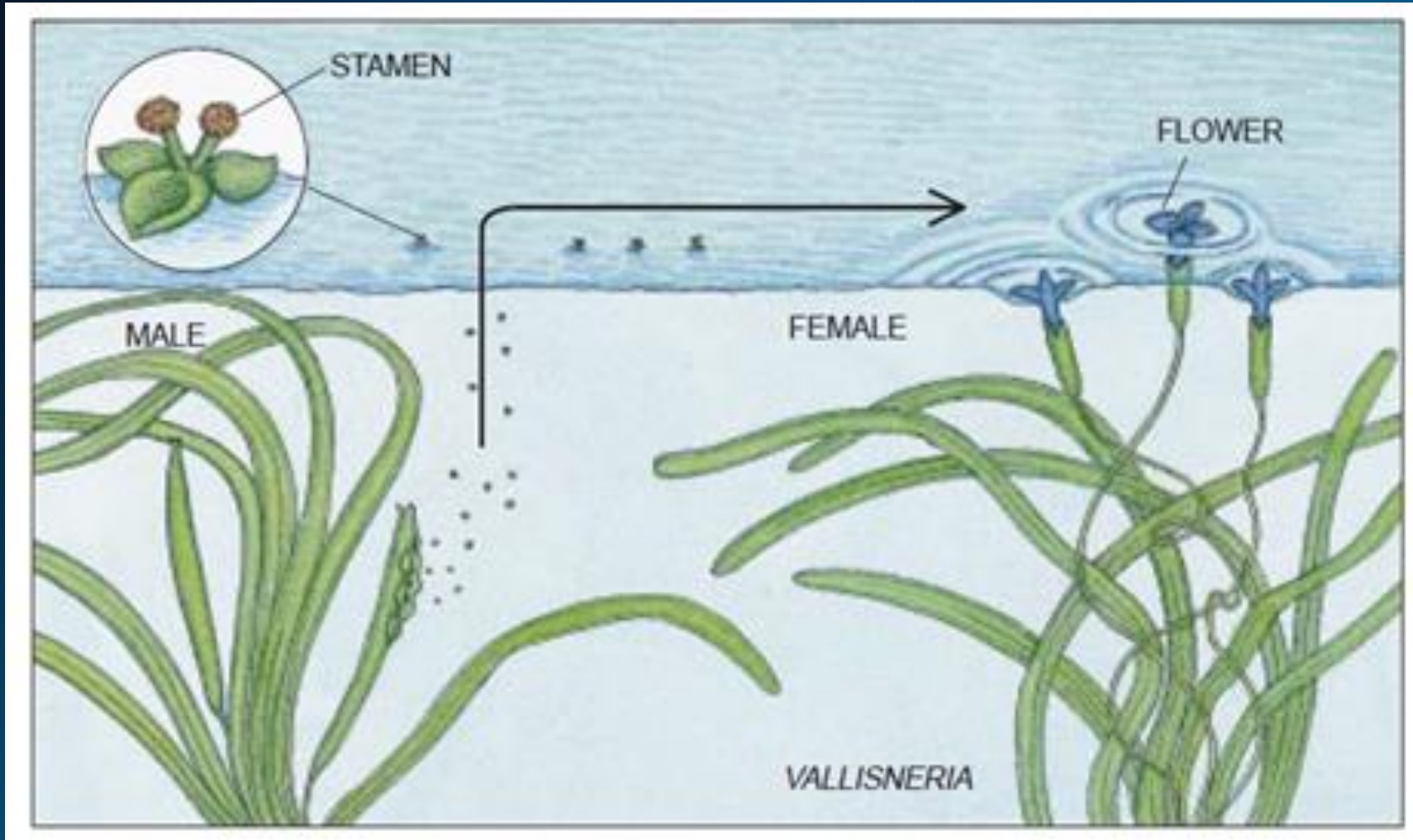
- **Pollination** in angiosperms involves the transfer of pollen from **anthers (stamens)** to **stigma (carpel)**.
- Many strategies for pollination:
  - Wind
  - Water
  - Animal (bird, beetle, bee, moth, butterfly, rodent)



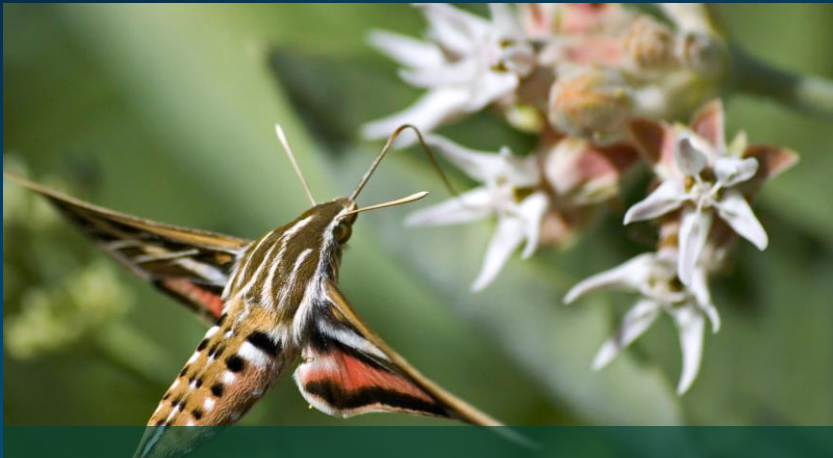
# POLLINATION - WIND



# POLLINATION - WATER



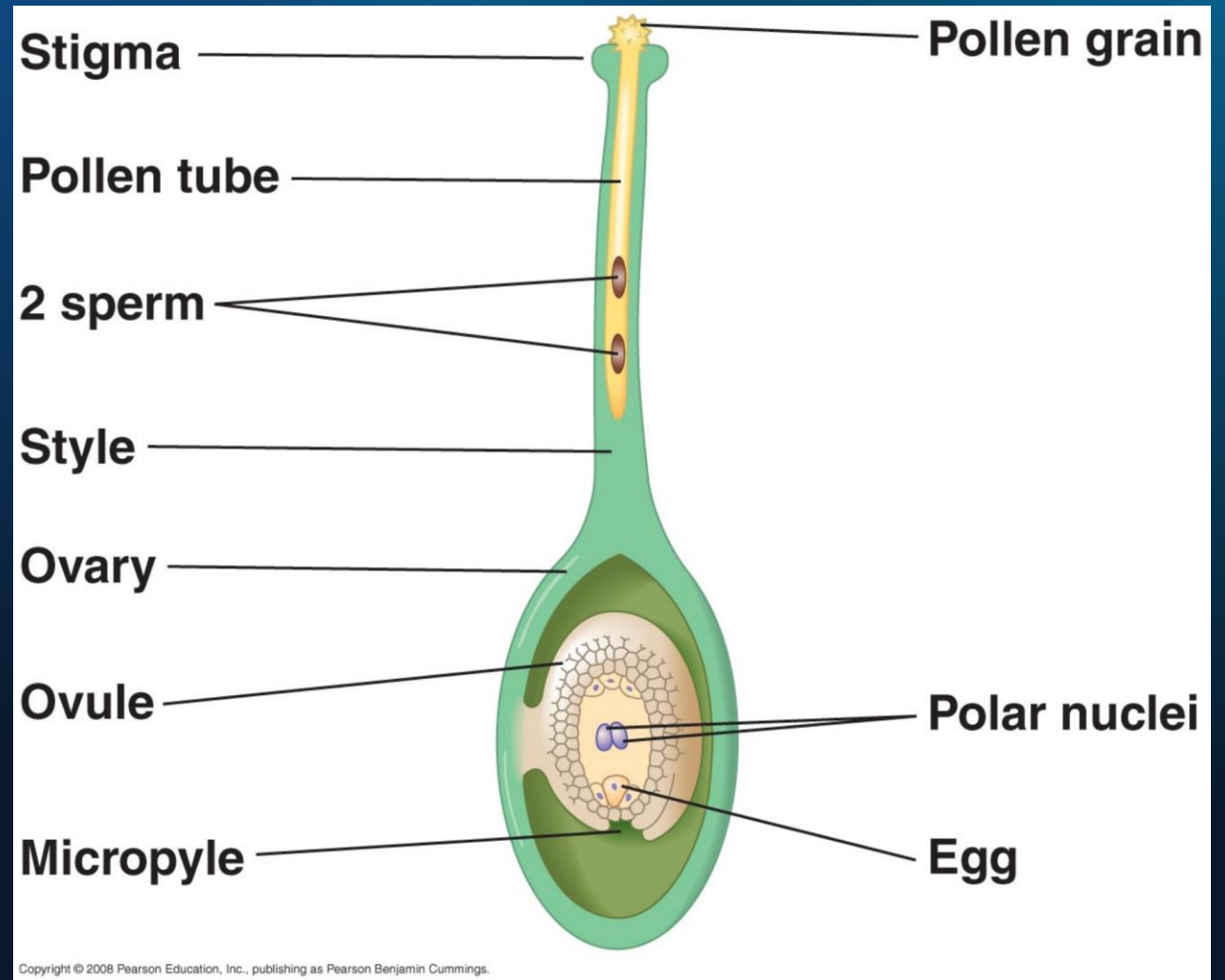
# POLLINATION - ANIMALS



Flowers offer rewards (usually food) in exchange for animals' pollination services.

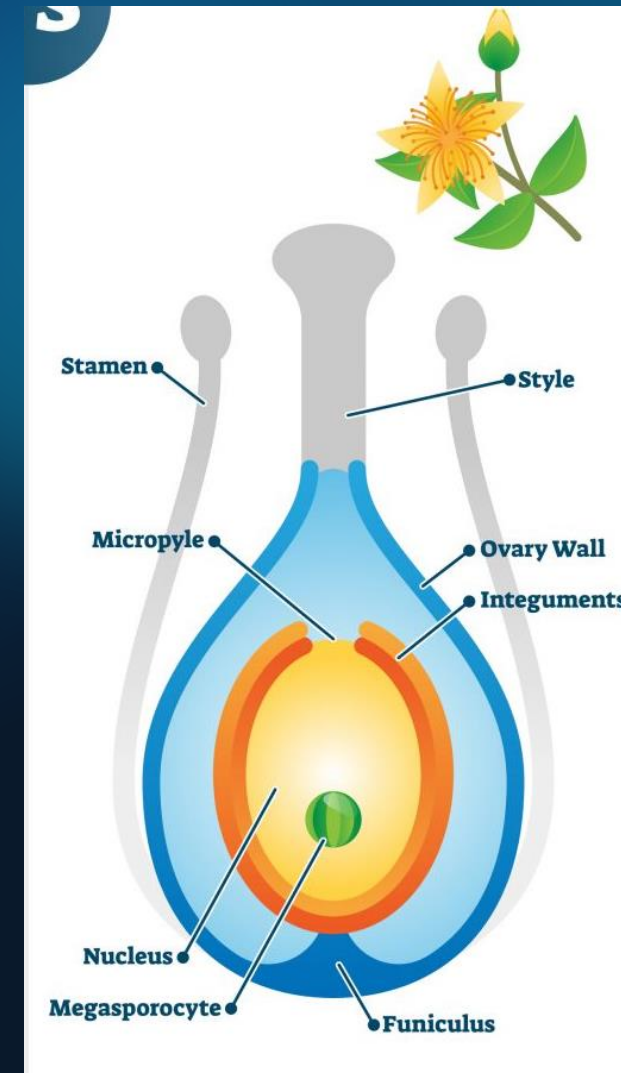
# ANGIOSPERM: FERTILIZATION

- Pollen grain lands on stigma, grows a pollen tube towards the ovule
- Sperm travels down the pollen tube towards the egg



# ANGIOSPERM: SEEDS AND FRUIT

- After fertilization:
  - Ovule hardens to form a seed
  - Rest of flower may mature to form a **fruit** to hold the seeds

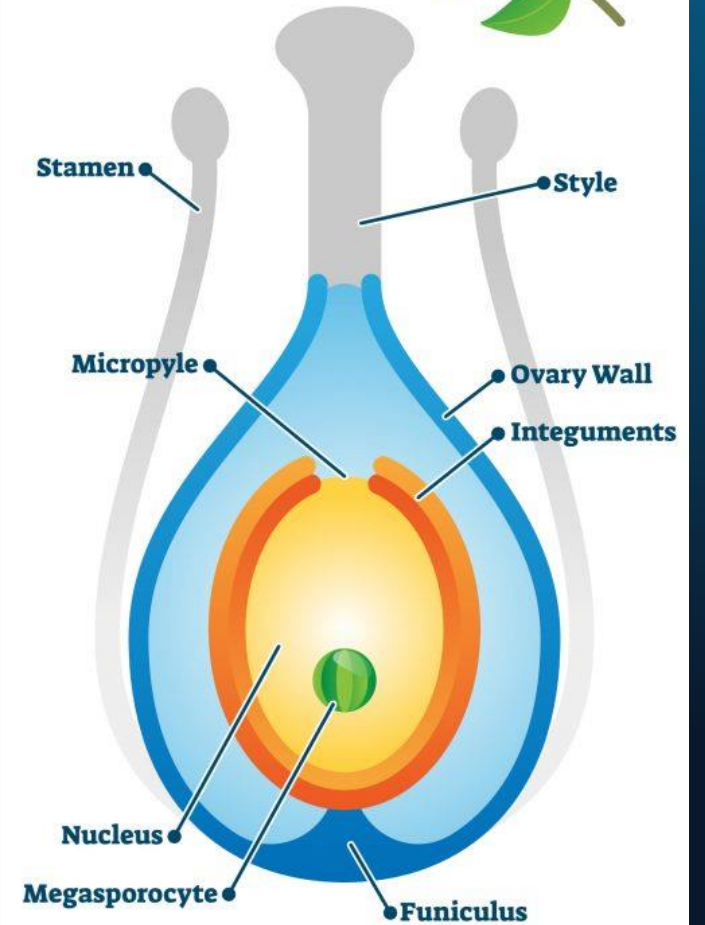
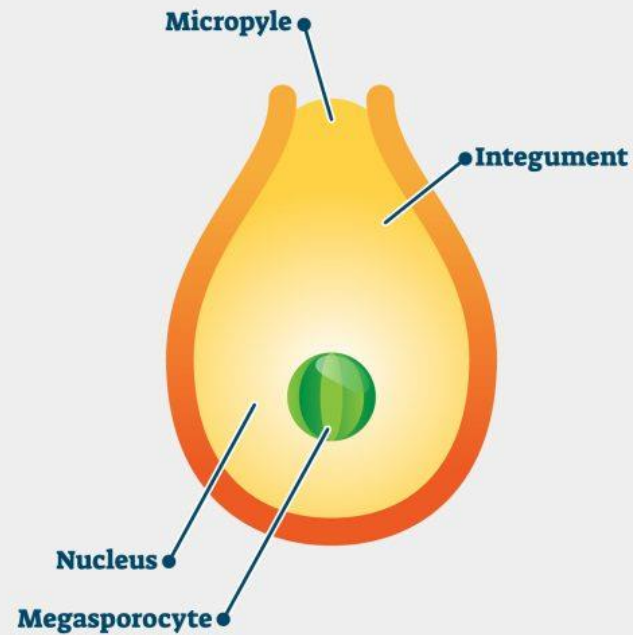
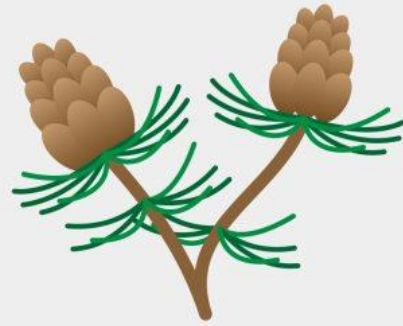


# SEED COMPARISON

**GYMNOSPERM**

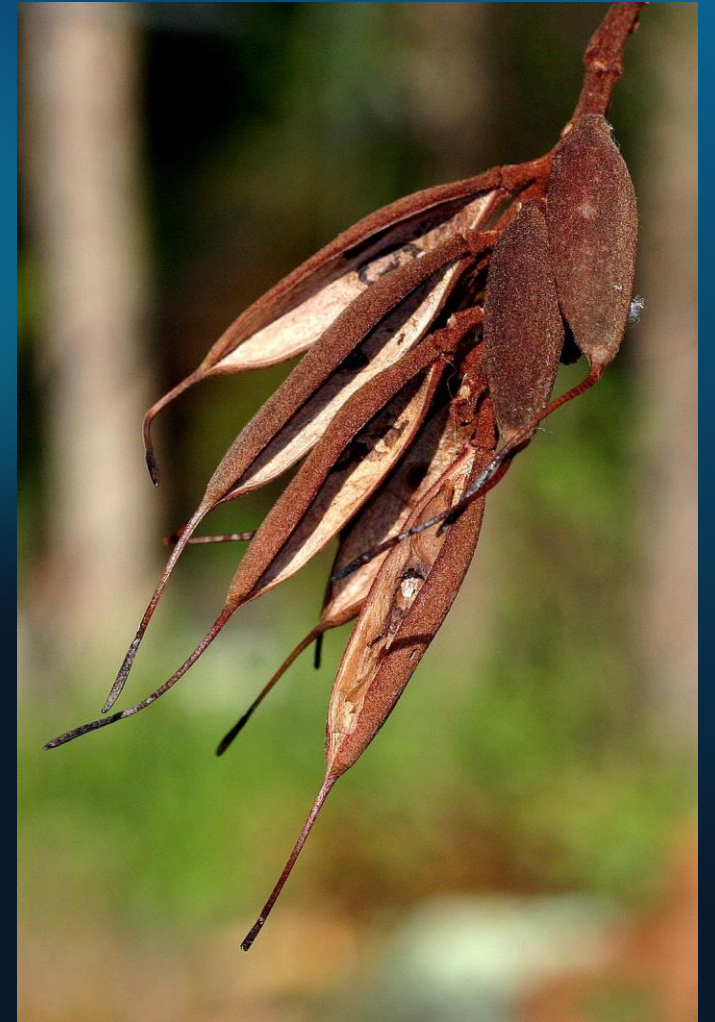
**VS**

**ANGIOSPERM**



# ANGIOSPERM: SEEDS AND FRUIT

- A **fruit** is a mature **ovary** that contains **seeds**
- Fruits are involved in **seed dispersal** in angiosperms. Examples:
  - Split open when seeds are mature
  - Wind dispersal
  - Eaten (and transported) by animals
  - Prickly fruits that get stuck to animals





# ANGIOSPERM - FRUIT

Wind dispersal



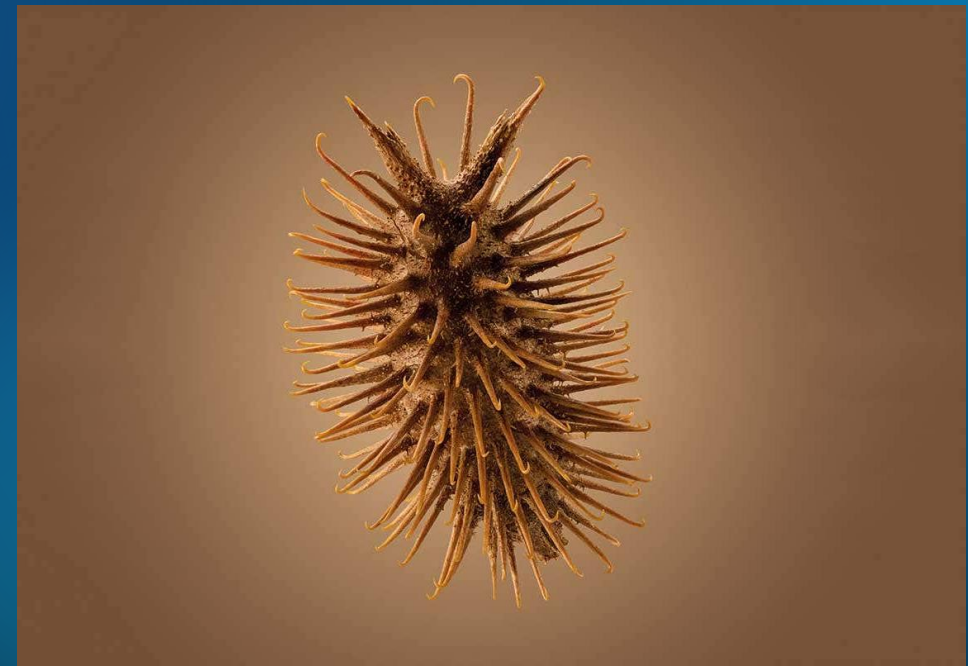
# ANGIOSPERM - FRUIT

Eaten (and transported) by animals



# ANGIOSPERM - FRUIT

Prickly fruits that get stuck to animals



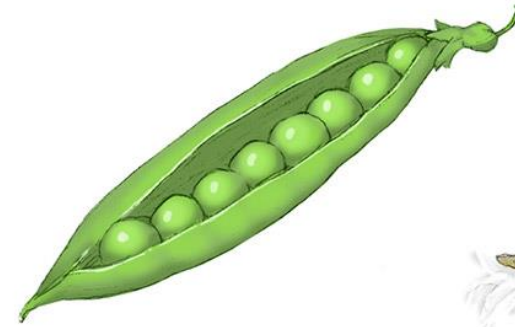
# TYPES OF FRUIT (NOT TESTABLE)

Dry fruit

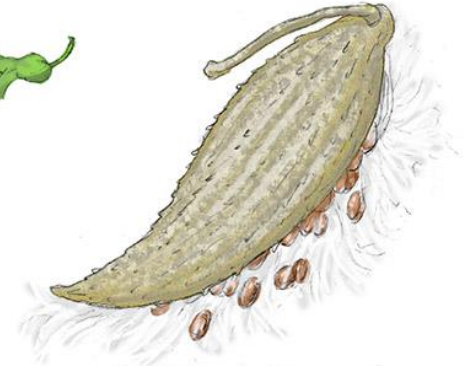
## A. Dehiscent fruit



Capsule (iris)



Legume (pea)

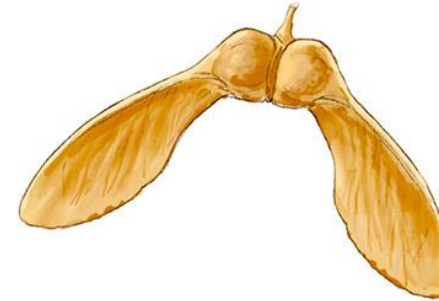


Follicle (milkweed)

## B. Indehiscent fruit



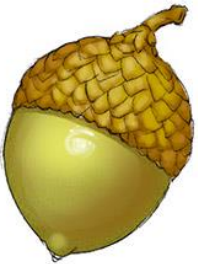
Achene (dandelion)



Samara (maple)



Grain (corn)



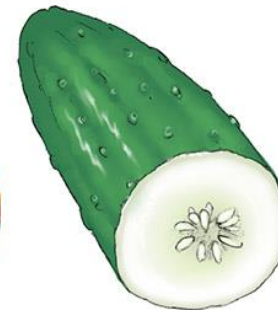
Nut (acorn)

©DaveCarlson

## C. Fleshy fruit



Berry (tomato)



Pepo (cucumber)



Drupe (cherry)



Hesperidium (orange)



Pome (apple)

## Simple fruit

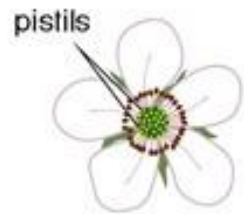


pistil



pistil

## Aggregate fruit



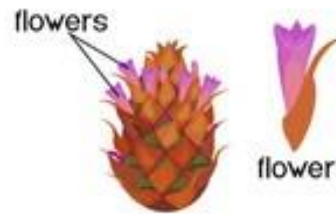
pistils



pistils

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## Multiple fruit



flowers

flower



fruits

# DISCUSSION: TYPES OF FRUIT

Blackberry is an 'aggregate fruit': made of *multiple fruits in a cluster*.

If you were to dissect a blackberry, what would you expect to find inside each of the round structures?



You do not need to know the term 'aggregate fruit'.

# DISCUSSION: TYPES OF FRUIT

A strawberry is considered a “false fruit”.

Why is this the case?

Where is the actual ‘fruit’ found on the strawberry?



You do not need to know the term ‘false fruit’.

# WHY SO BERRY COMPLICATED?

<https://www.livescience.com/57477-why-are-bananas-considered-berries.html> <- not testable, fyi only

# ACTIVITY: PRESSING HERBARIUM SPECIMENS