Fundamentals of the morphology of generative organs.

The structure and functions of the flower.

Inflorescences.
Part 1

Plan.

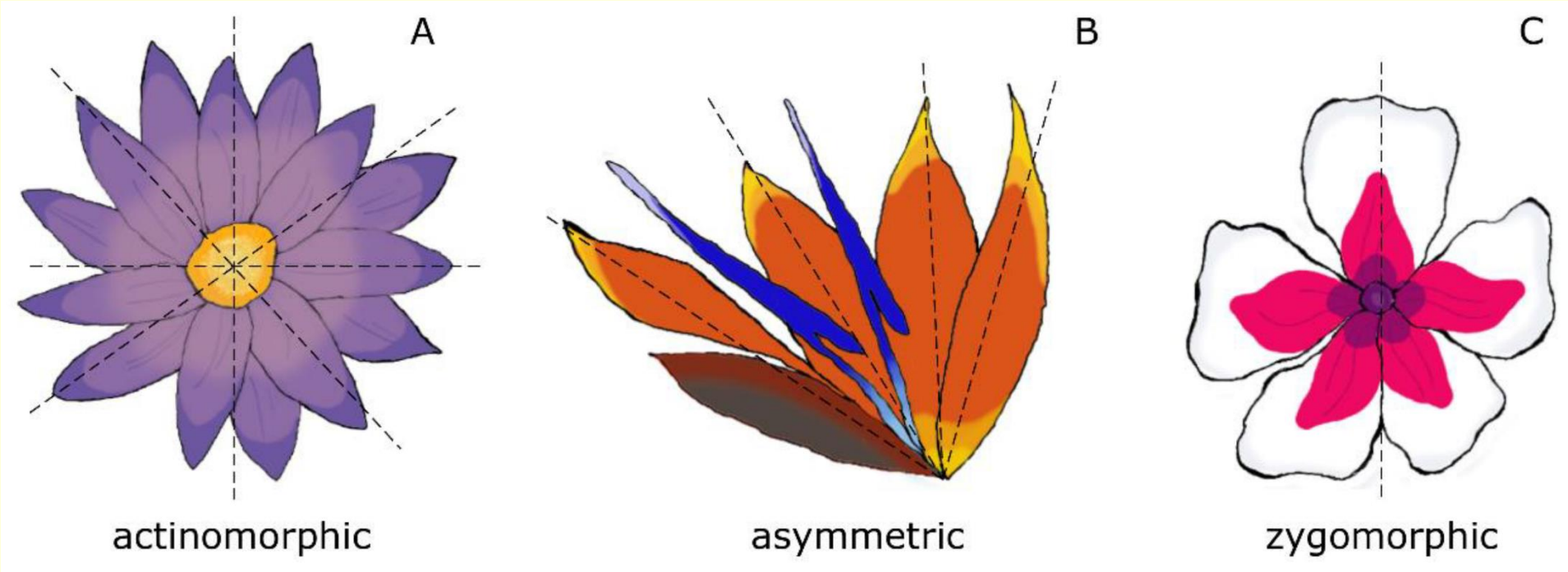
- **Angiosperms division. Their origin.**
- **Flower. Concept and functions. Flower Parts**
- **Flower formula and diagram**
- **Inflorescence. Classification of inflorescences**
- **Biology of Angiosperm reproduction.**
- **Microsporogenesis and male gametophyte**
- **Megasporogenesis and female gametophyte**
- **Flowering and pollination of plants**
- **Seed development**

Reproductive (generative) organs are intended for sexual or asexual reproduction itself. The reproductive organs of plants include sporangia and organs of sexual reproduction: archegonia and antheridia. In angiosperms, the reproductive organs include a flower and its derivatives - a seed and a fruit.

The flower is a modified shortened shoot adapted to produce spores for asexual reproduction us well us gametes for the sexual process that results in seeds and fruit.

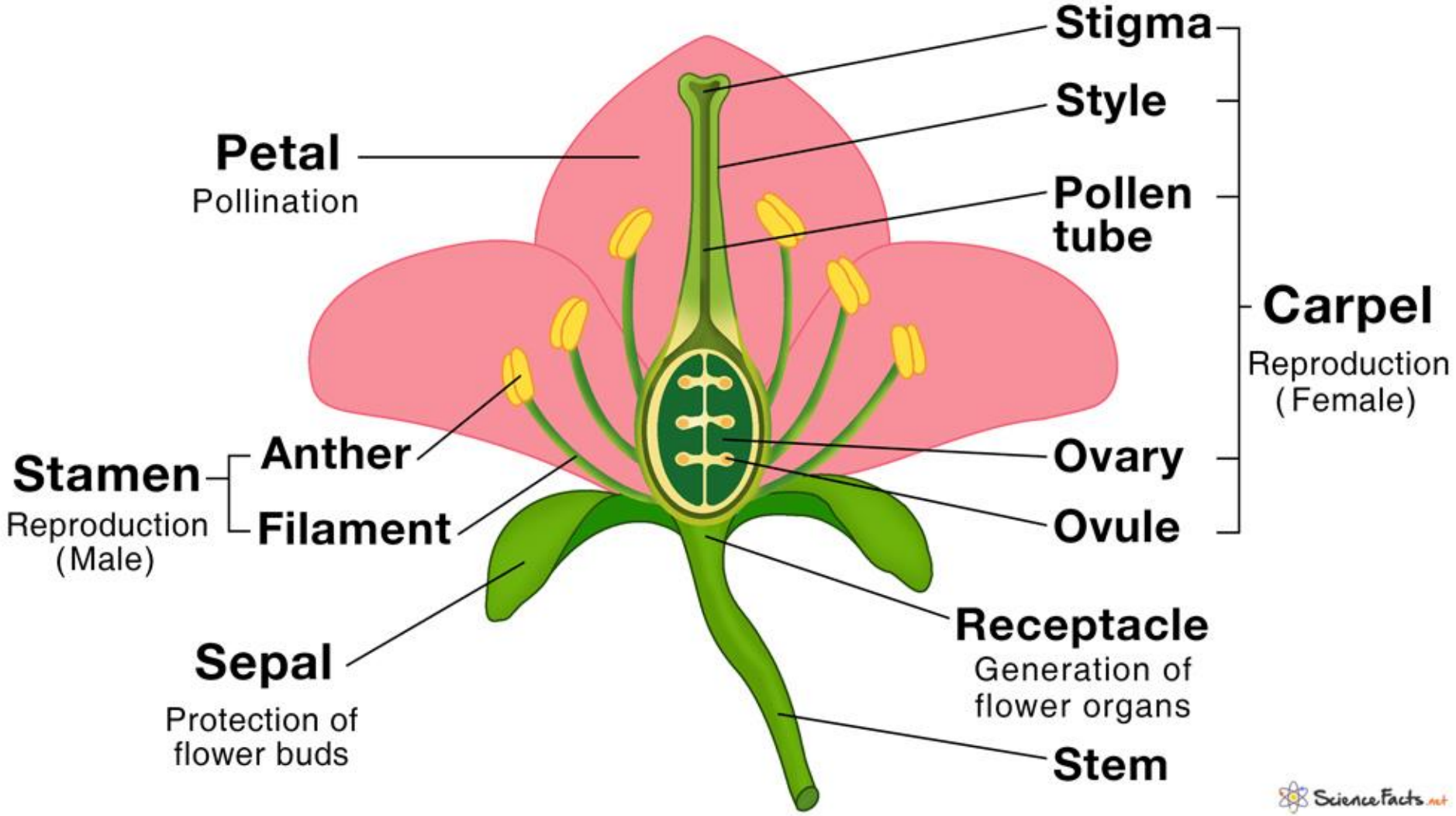
Sporogenesis, gametogenesis and the sexual process take place in the flower. After pollination and fertilization, the flowers turn into fruits and the ovules into seeds. The fruit cannot arise independently of the flower, but is always formed from it.

Symmetry of flowers




PicToday.ru

Parts of a Flower



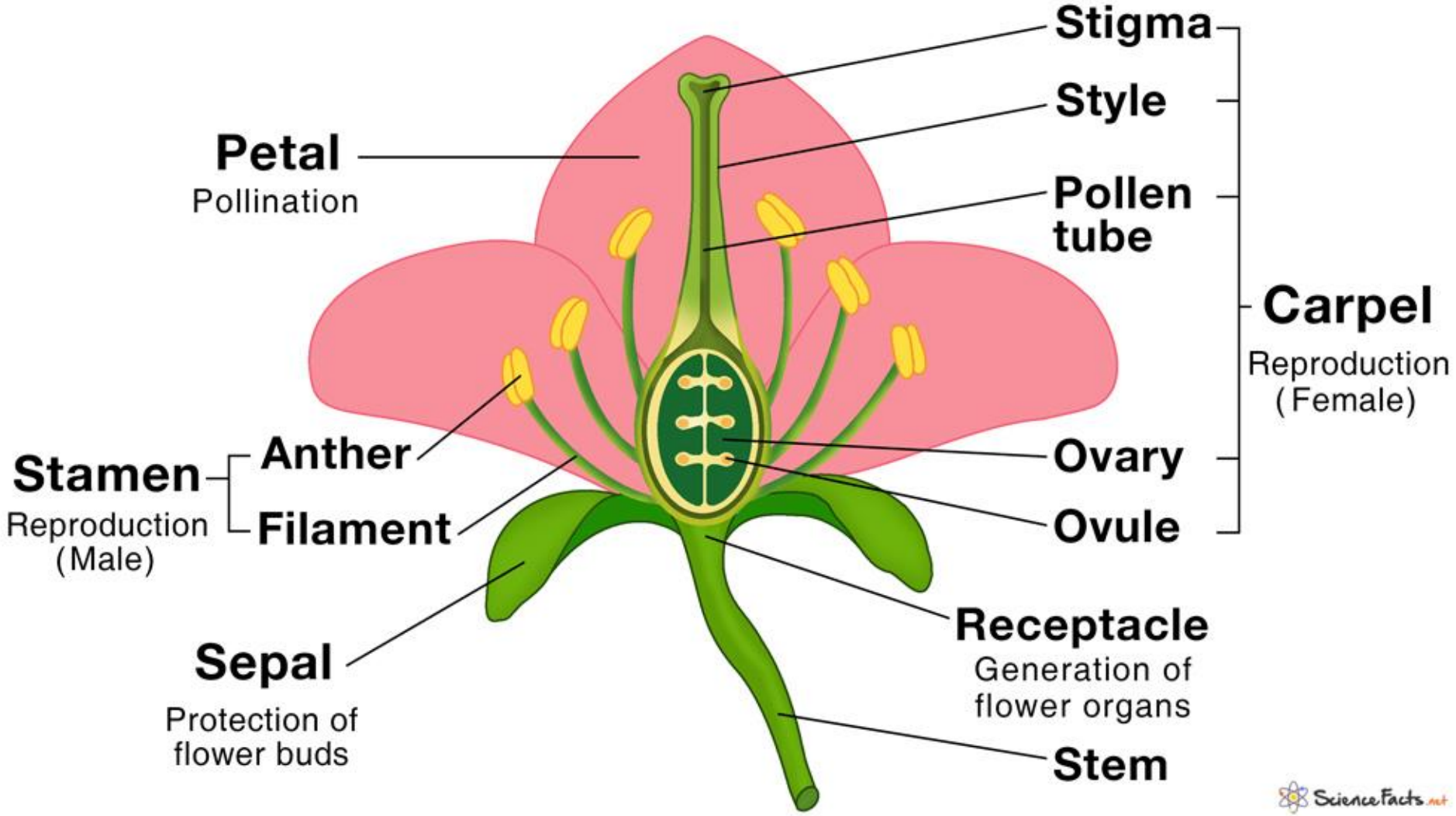
ARRANGEMENT OF FLORAL ORGANS

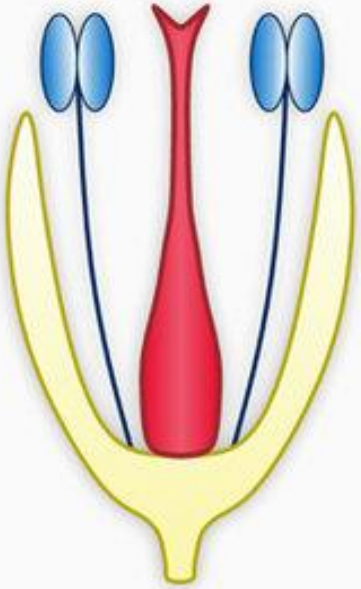
CYCLIC

ACYCLIC

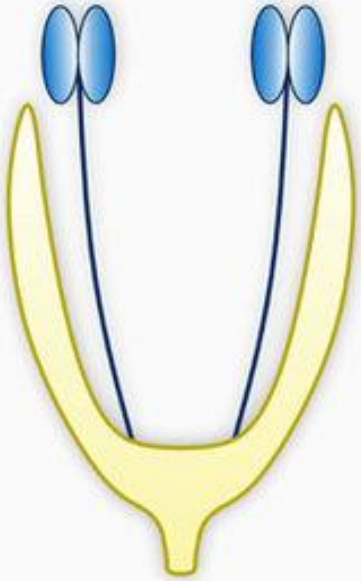
SPIRO CYCLIC

Parts of a Flower





Bisexual flower



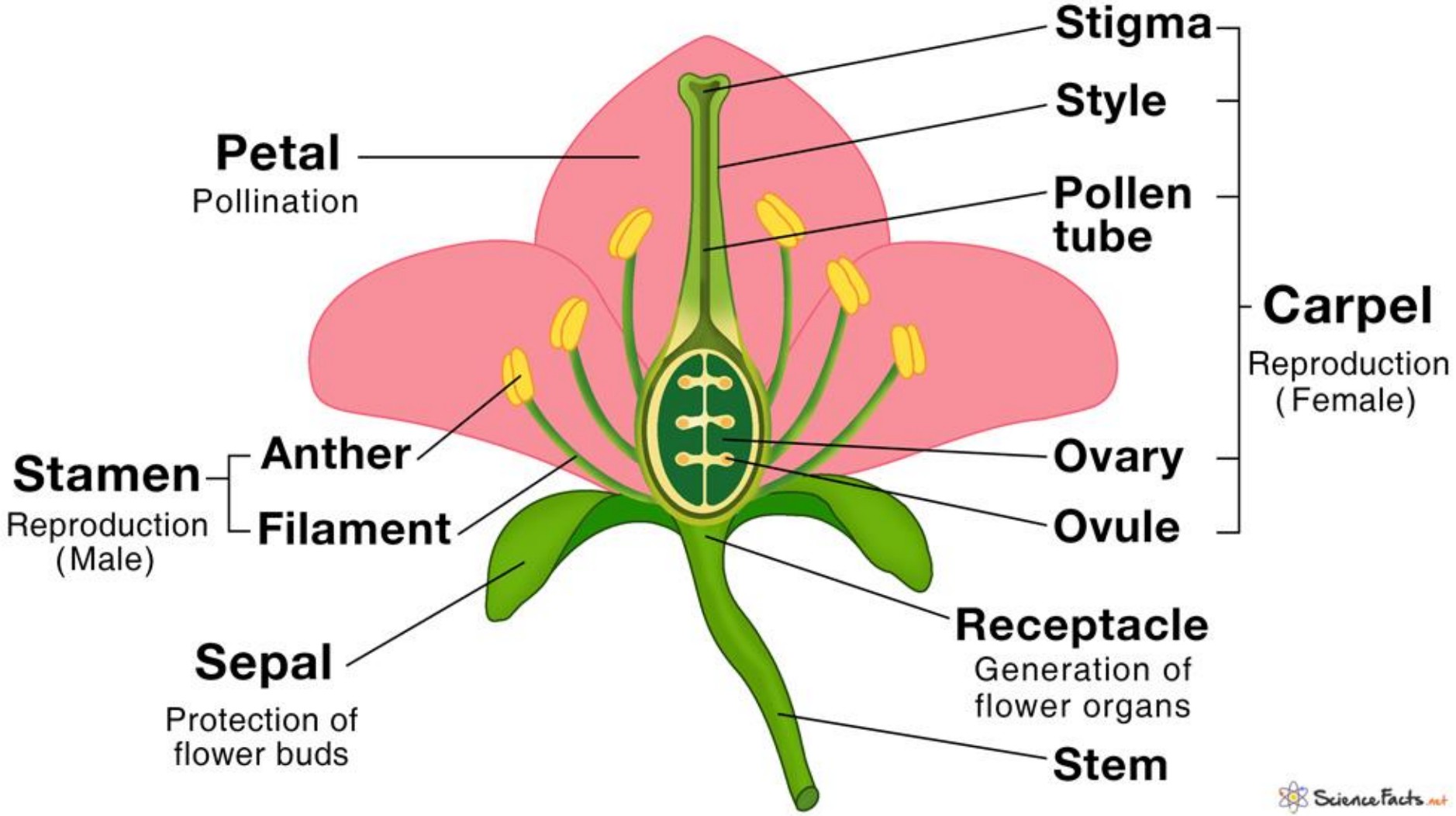
Staminate flower

Pistillate flower

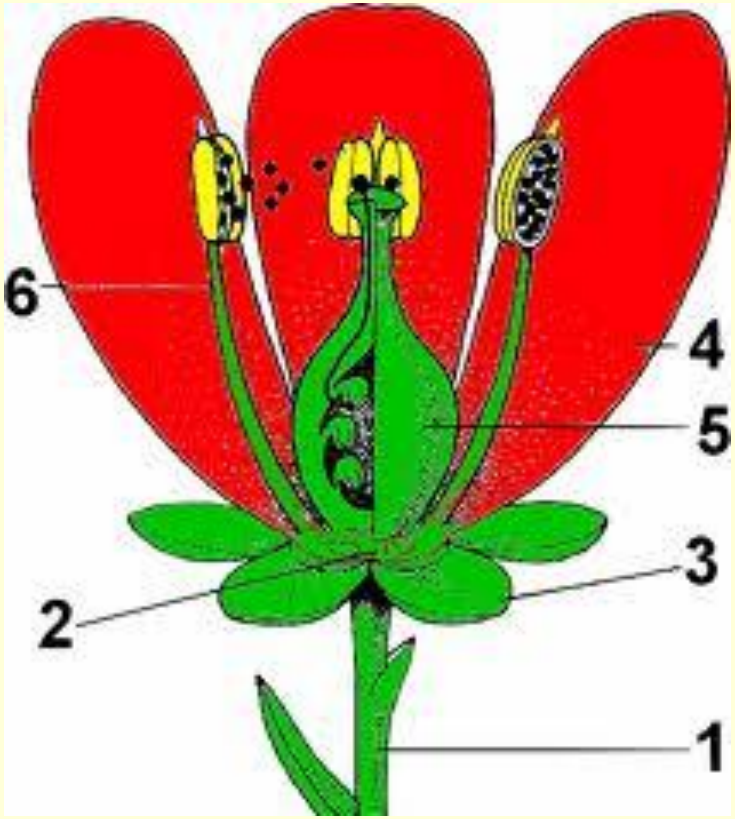
Bisexual flowers

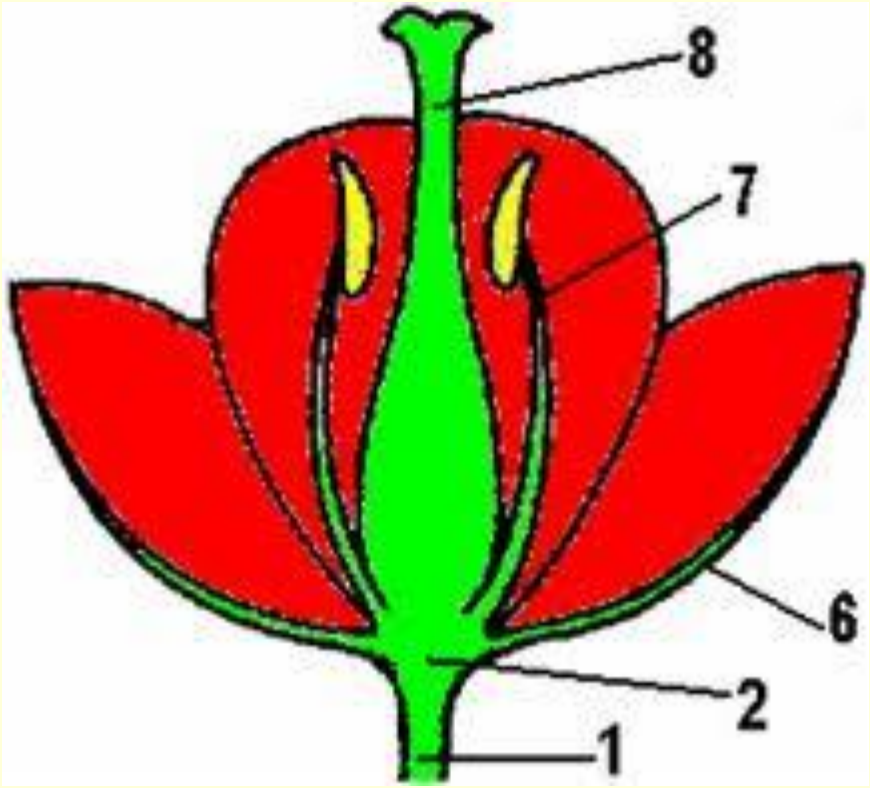
Unisexual flower

Parts of a Flower

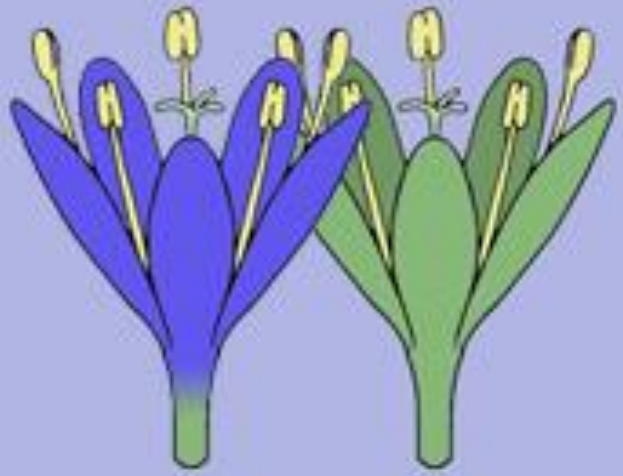


The perianth can be differentiated into a calyx and a corolla, in this case it is called double, or consist only of a calyx or only of a corolla and is called simple.





With a distinct calyx and corolla



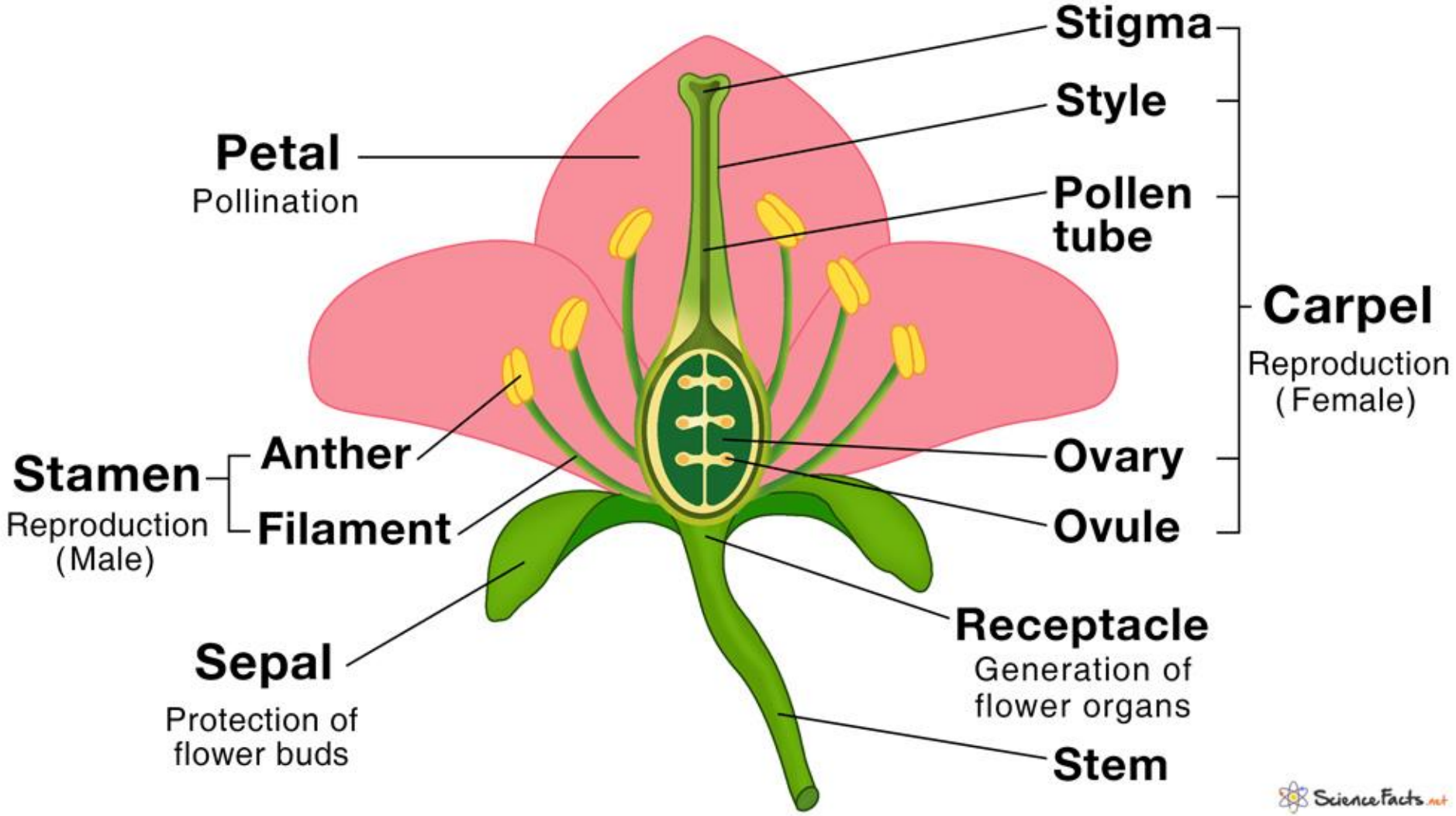
Perianth not resolvable into calyx and corolla (e.g. petal- or sepal-like parts only)

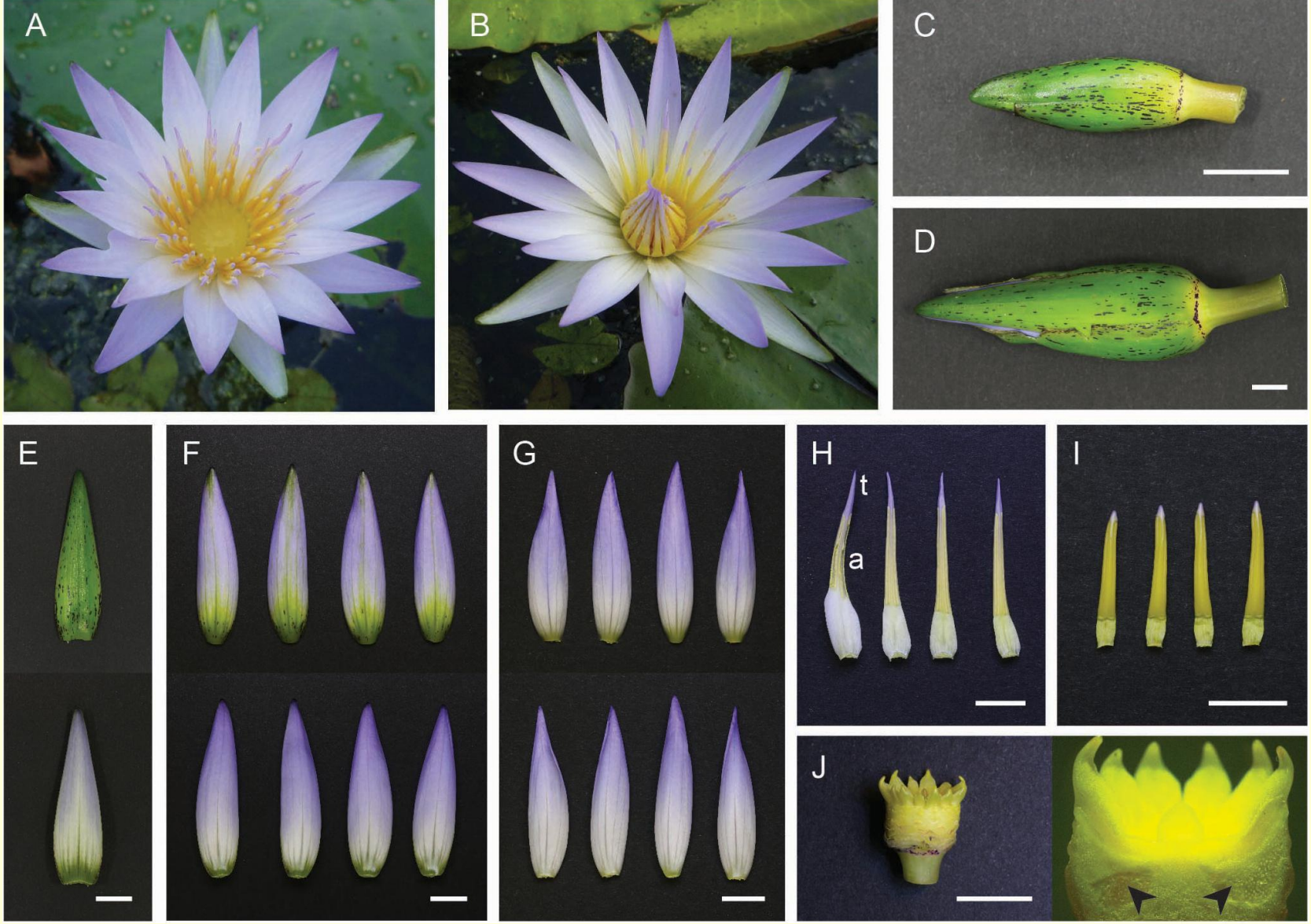
Perianth vestigial (much reduced) or absent

Double perianth

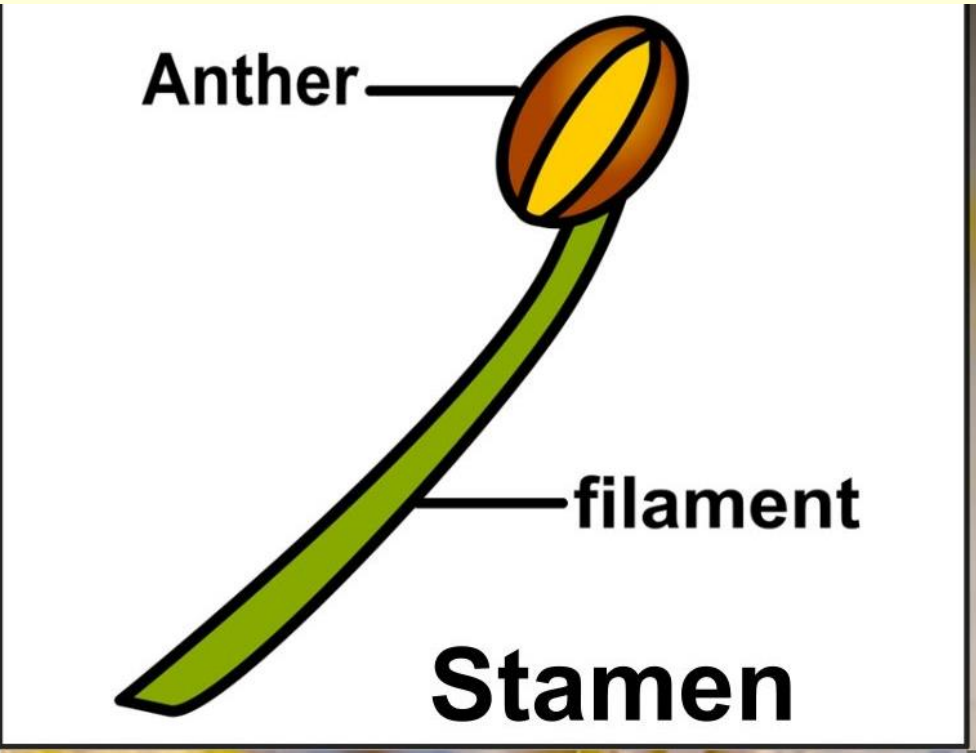
Simple perianth

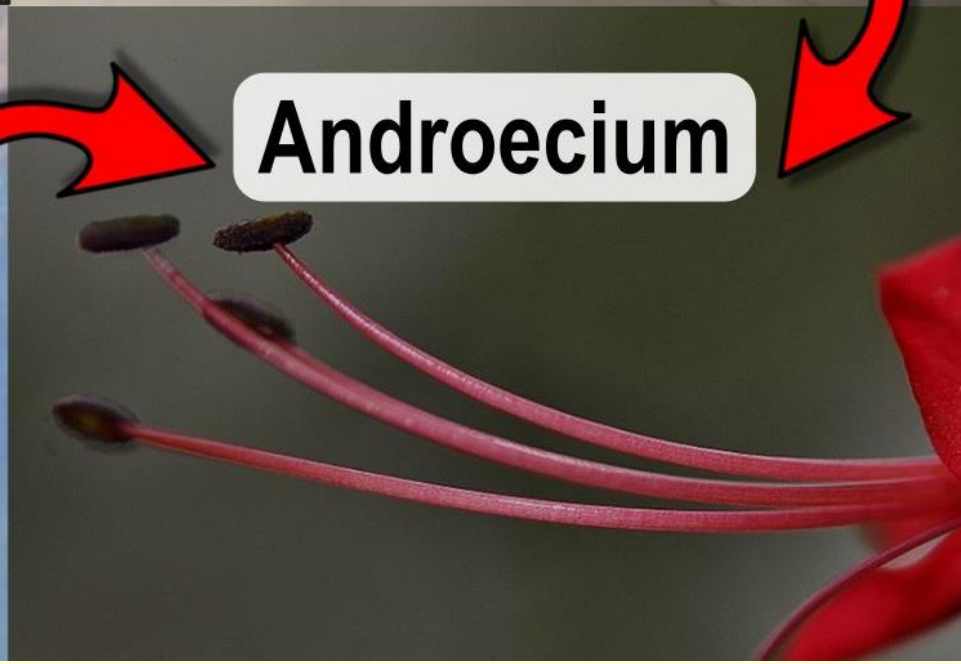
Parts of a Flower

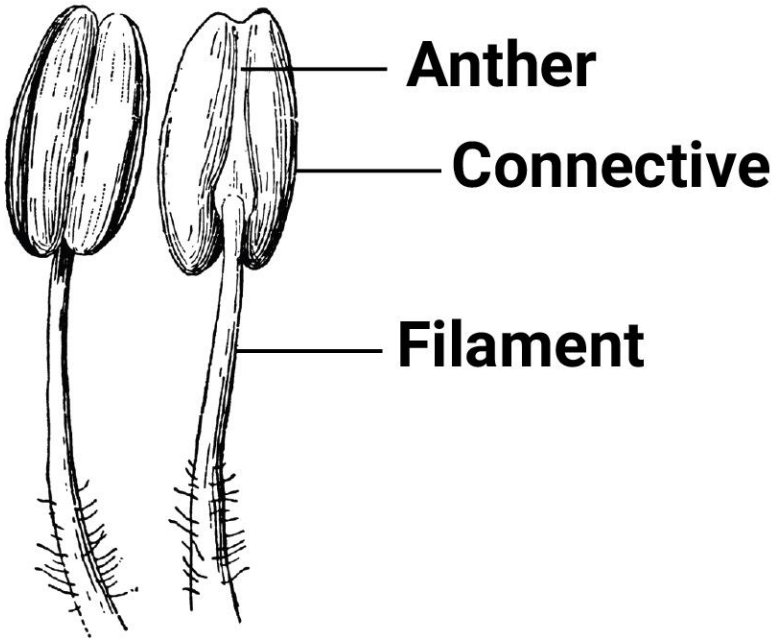


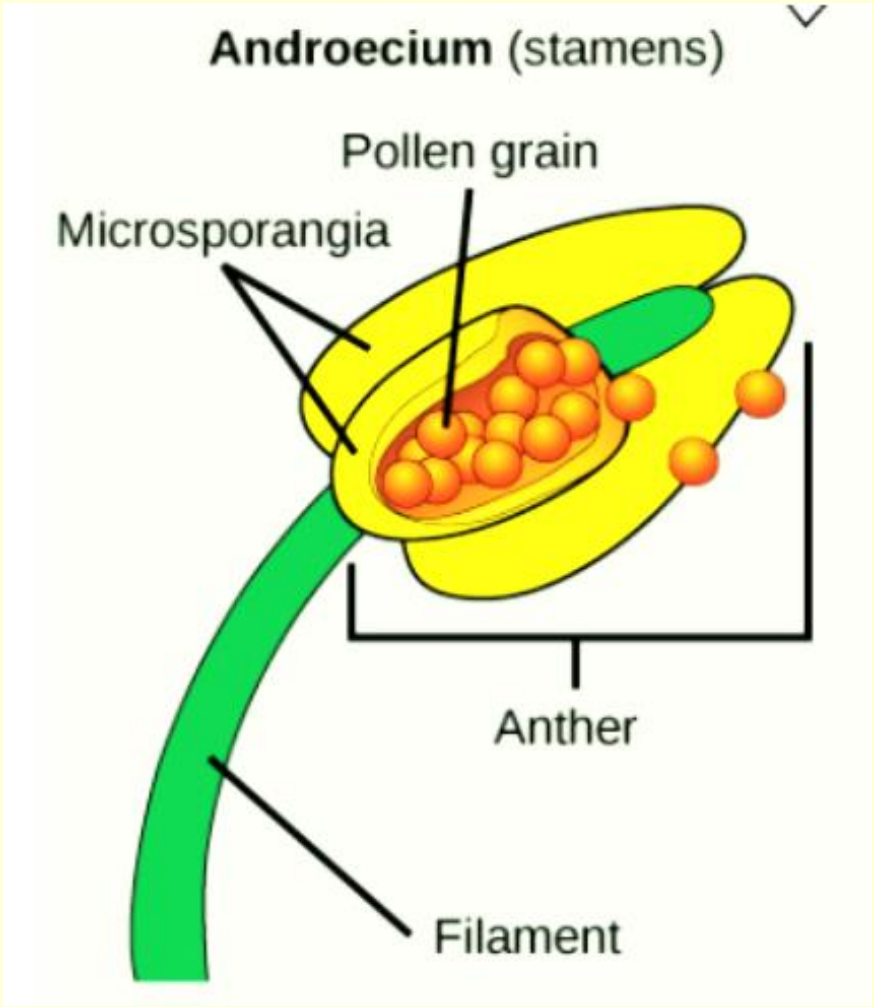


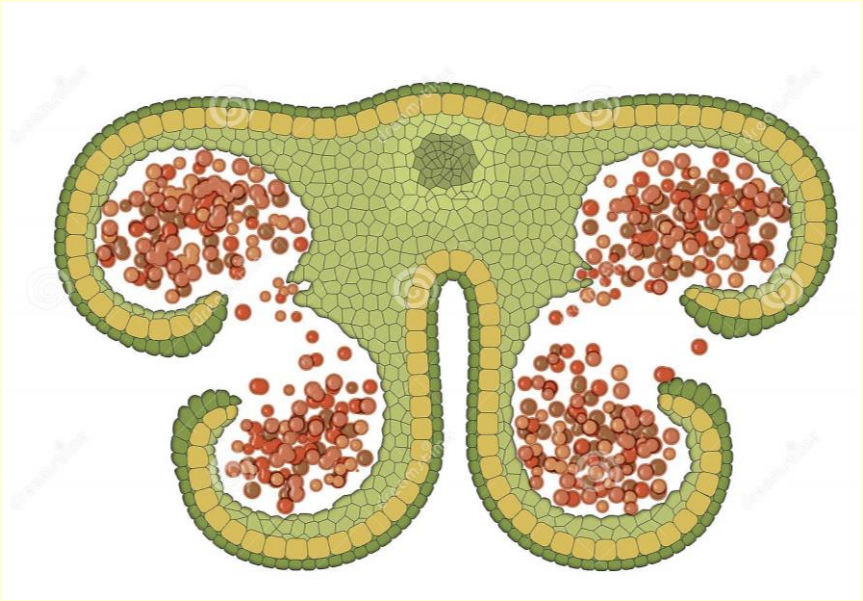
Nymphaea caerulea floral components. **(A)** Flower at first day of anthesis; **(B)** flower at second day of anthesis. **(C)** A total of 2.5 cm long floral bud; **(D)** 5.5 cm long floral bud. **(E)** Green abaxial surface (top) and whitish adaxial surface (bottom) of a sepal. **(F)** Abaxial surface (top) and adaxial surface (bottom) of outer petals. **(G)** Abaxial surface (top) and adaxial surface (bottom) of inner petals. **(H)** Petaloid stamens, “t” indicates the cerulean tip and “a” indicates the anther portion. **(I)** Inner stamens. **(J)** Pluricarpellate pistil. Arrowheads indicate ovules within carpels. Scale bar, 1 cm.

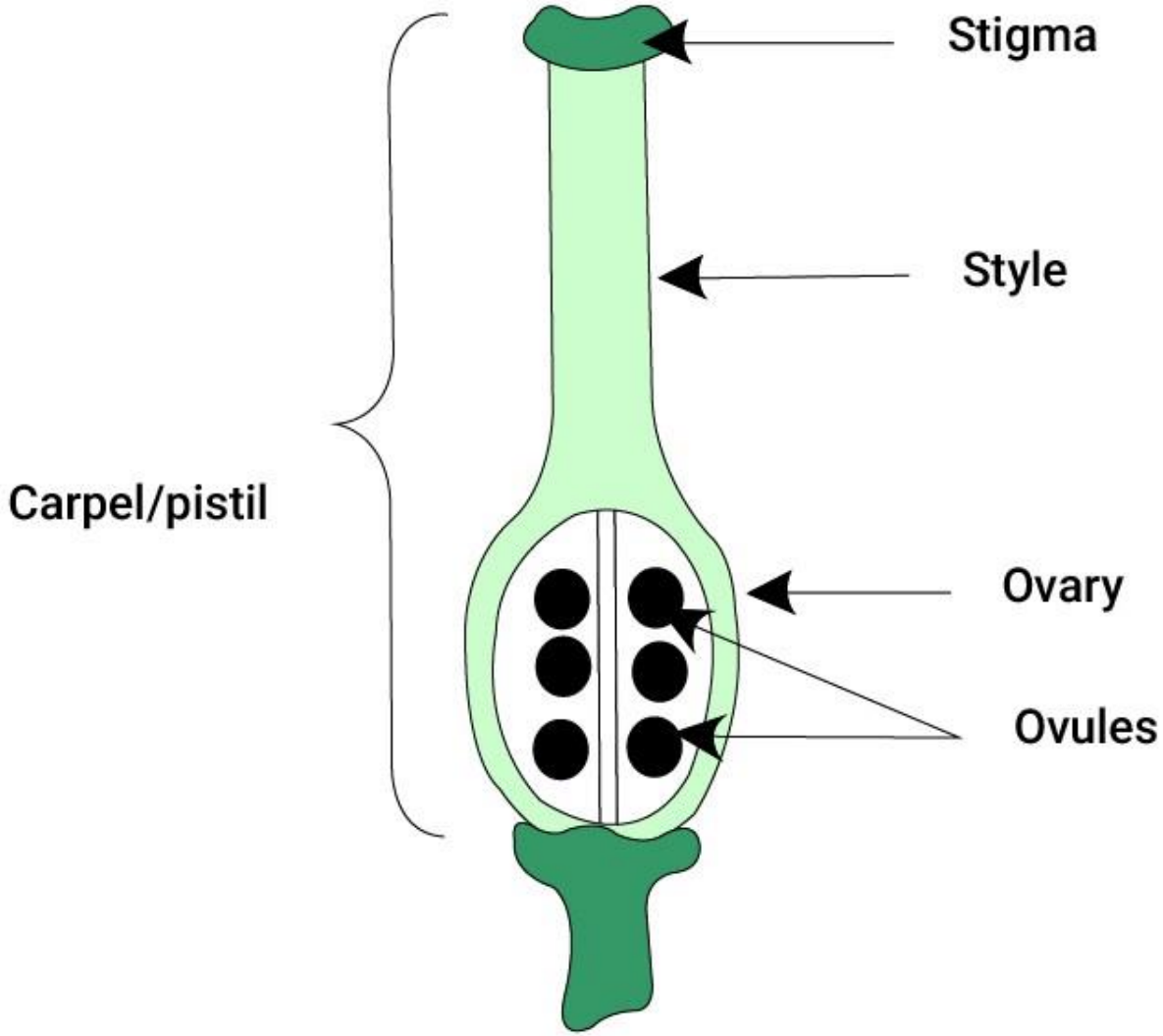

Anther
filament
Stamen


Androecium


Anther
Connective
Filament


Androecium (stamens)
Pollen grain
Microsporangia
Anther
Filament



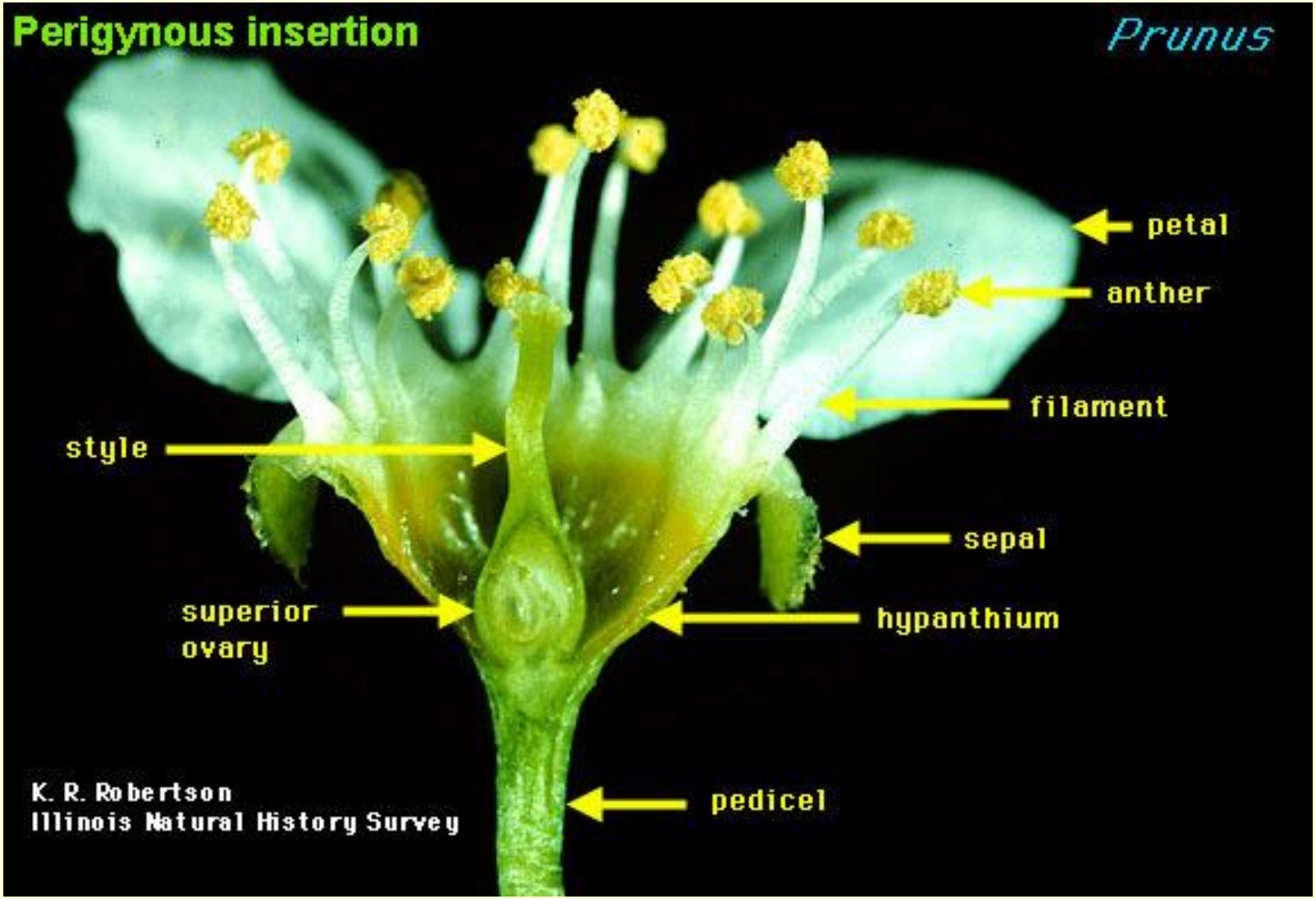

Stigma
Style
Carpel/pistil
Ovary
Ovules

Classification of Flower Based on Position of Ovary

Hypogynous
(Ovary Superior)

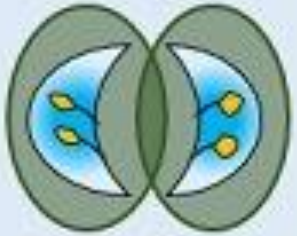
Perigynous
(Ovary Half-inferior)

Epigynous
(Ovary Inferior)


Perigynous insertion
Prunus
petal
anther
filament
style
sepal
superior
ovary
hypanthium
pedicel
K. R. Robertson
Illinois Natural History Survey

TYPES OF OVARY BASED ON LOCULES

UNILOCULAR



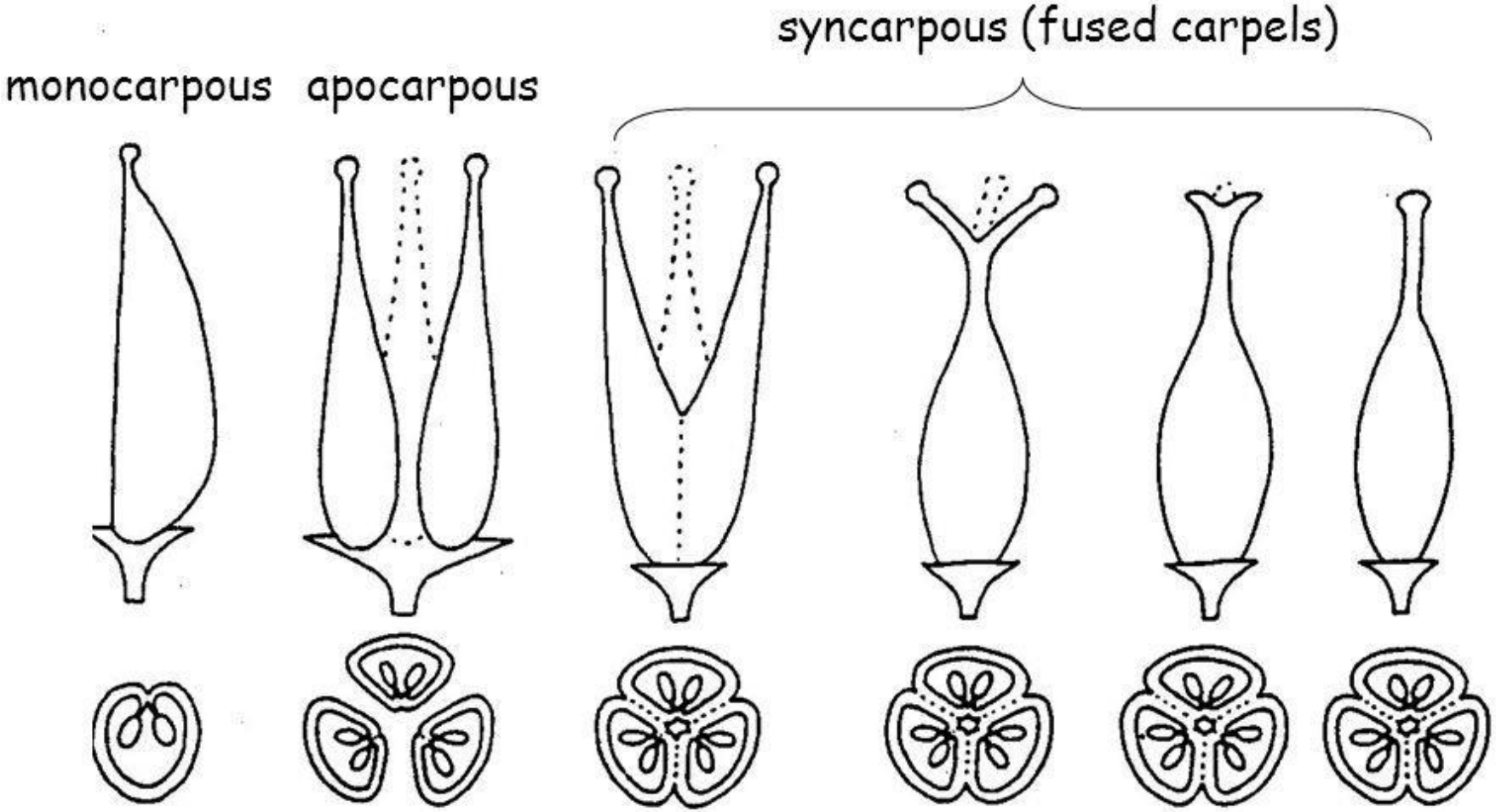
BILOCULAR

TRILOCULAR

TETRALOCULAR

PENTALOCULAR

Fusion of the gynoecium



$\overline{(5)}$

A floral formula consists of five symbols indicating from left to right:

Floral Symmetry: * - Actinomorphic; ↑- zygomorphic; ϟ – Asymmetry flower

Number of Tepal – P
Number of Sepals - Ca
Number of Petals - Co
Number of Stamens – A
Number of Carpels – G

$\uparrow Ca_{(5)}Co_{(2+1+2)}A_{10}\underline{G_1}$

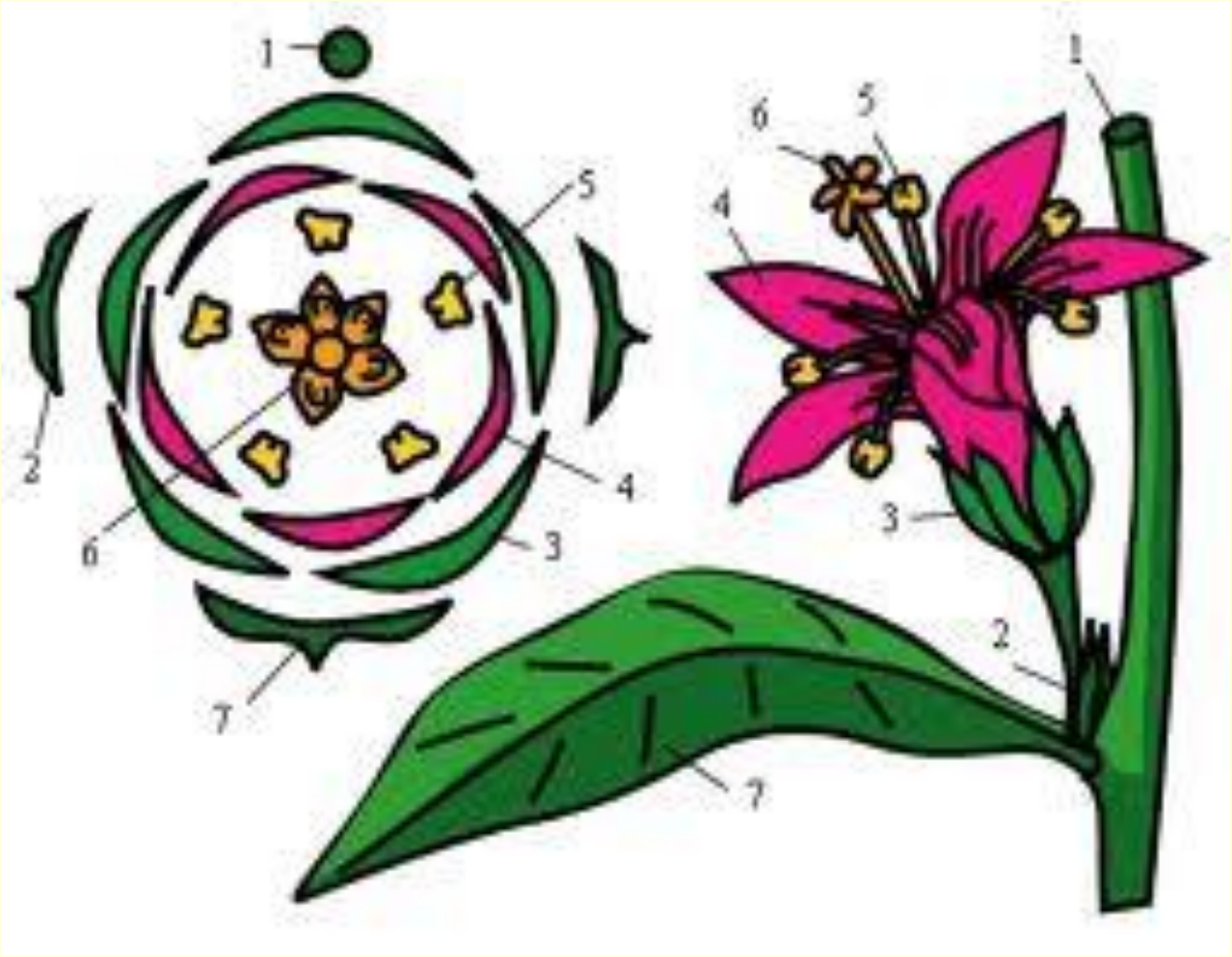
$*Ca_{(5)}Co_5A_\infty G_{(3)}$ –

$*Ca_{(5)}Co_5A_\infty \underline{G_\infty}$

The number of members of each part of the flower is indicated by numbers in the subscript. The parts of the flower are described according to their arrangement from the outside to the inside of the flower. If an organ type is arranged in more whorls, the outermost is denoted first, and the whorls are separated by "+". If the organ number is large or fluctuating, is denoted as "∞". In the case of fusion of parts of the flower, the fused parts are taken in parentheses.

When describing the gynoecium, the formula should reflect the number of carpels that formed it, as well as the position of the ovary. The position of the ova-ry is indicated by a line above the numerical index of the gynoecium if it is lower, under the numerical index - if it is upper.

It sometimes becomes very lucid if the ground plan of a flower be represented in the form of a floral diagram, in a floral diagram the position of the inflorescence axis or stem is shown by a dot or a small circle while the sepals, petals and stamens are put in concentric circles (or spirals when the floral phyllotaxy is spiral), the gynoecium being put at the centre.



Inflorescence.

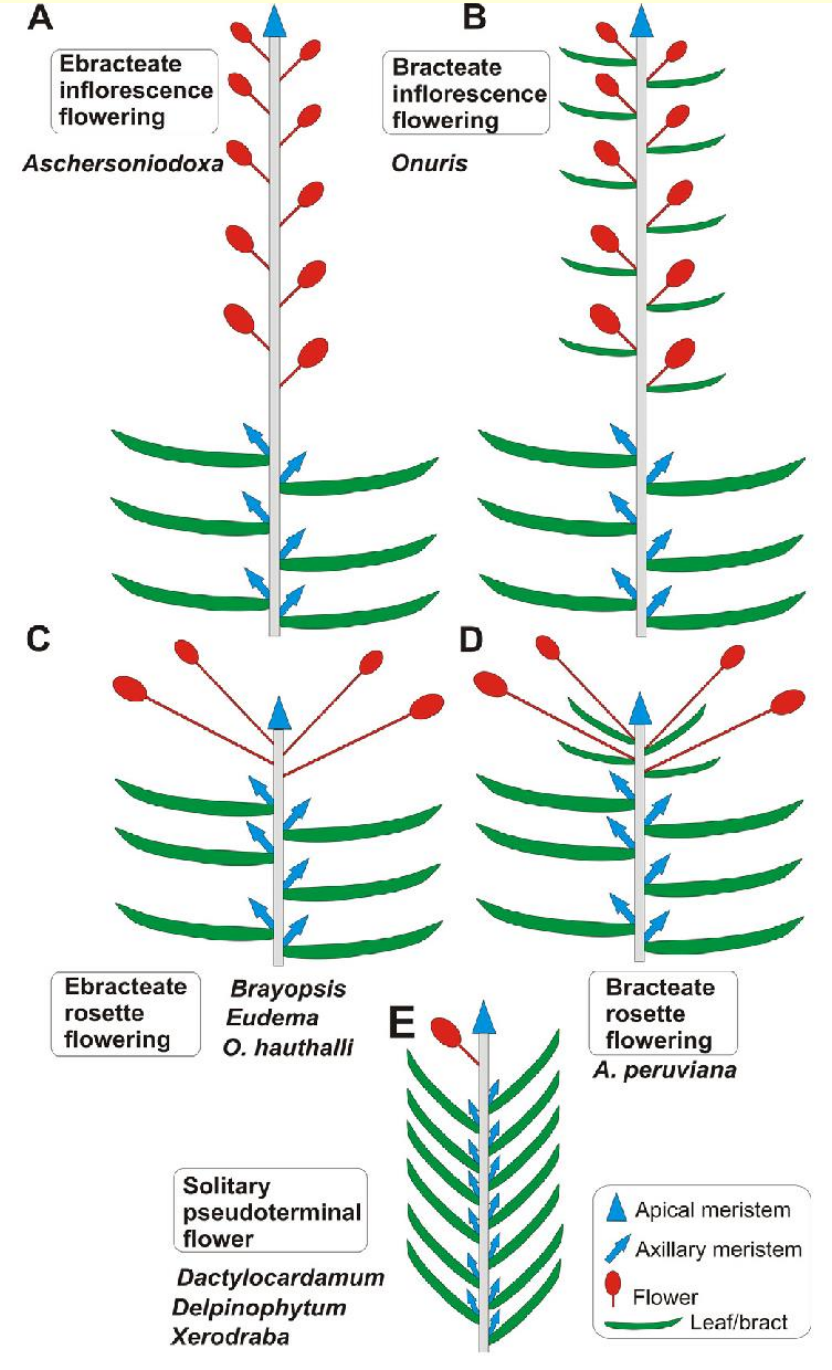
An inflorescence is a shoot or a system of shoots bearing flowers. At the nodes of the inflorescence axes there are leaves called bracts.

The biological advantage of inflorescences over single flowers is to increase the guarantee of pollination, to reduce the likelihood of flowers being damaged by adverse environmental factors due to their gradual blooming. Inflorescences have most plants.

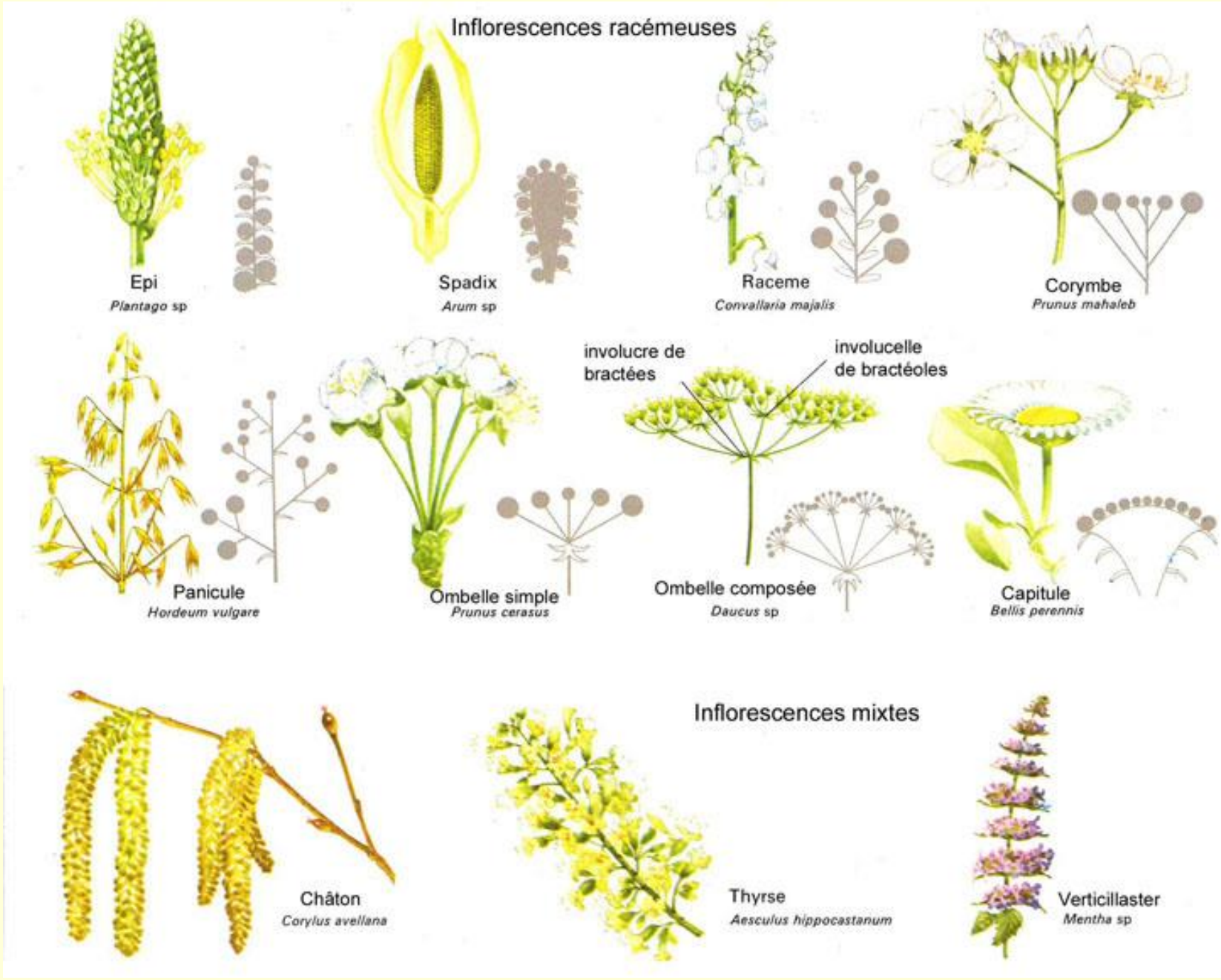
Inflorescences may be simple (single) or complex (panicle). The rachis may be one of several types, including single, composite, umbel, spike or raceme.

Complex inflorescences – when the flowers are located on the branches of the main axis. Simple inflorescences - directly on the main axis.

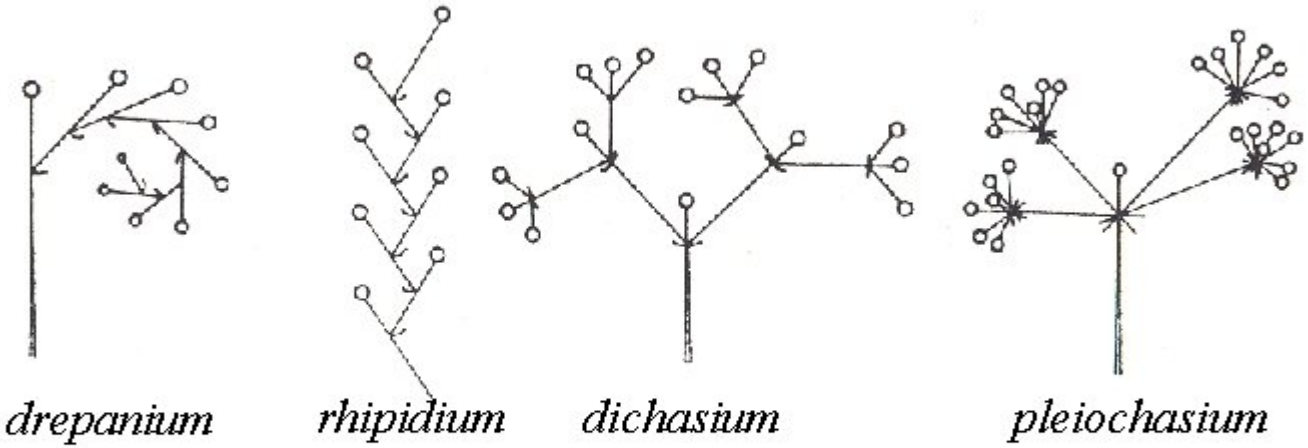
If the inflorescence ends with a flower, it is called determined. If the inflorescence ends with the bud is called indetermined.



Leafy inflorescences


Inflorescences racémeuses
Epi
Plantago sp
Spadix
Arum sp
Raceme
Convallaria majalis
Corymbe
Prunus mahaleb
Panicule
Hordeum vulgare
Ombelle simple
Prunus cerasus
involucre de bractées
involucelle de bractéoles
Ombelle composée
Daucus sp
Capitule
Bellis perennis
Inflorescences mixtes
Châton
Corylus avellana
Thyrse
Aesculus hippocastanum
Verticillaster
Mentha sp

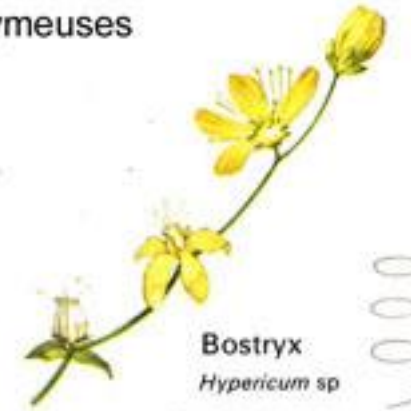
INFLORESCENTIAE CYMOSAE –



drepanium *rhipidium* *dichasium* *pleiochasium*

Inflorescences cymeuses

Simple
Iris sp



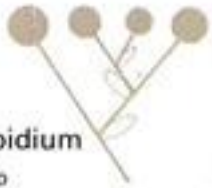
Bostryx
Hypericum sp

MONOCHASIA

Drepanium
Juncus bufonius

Cincinnus
Strelitzia reginae

Rhipidium
Iris sp



DICHASIA

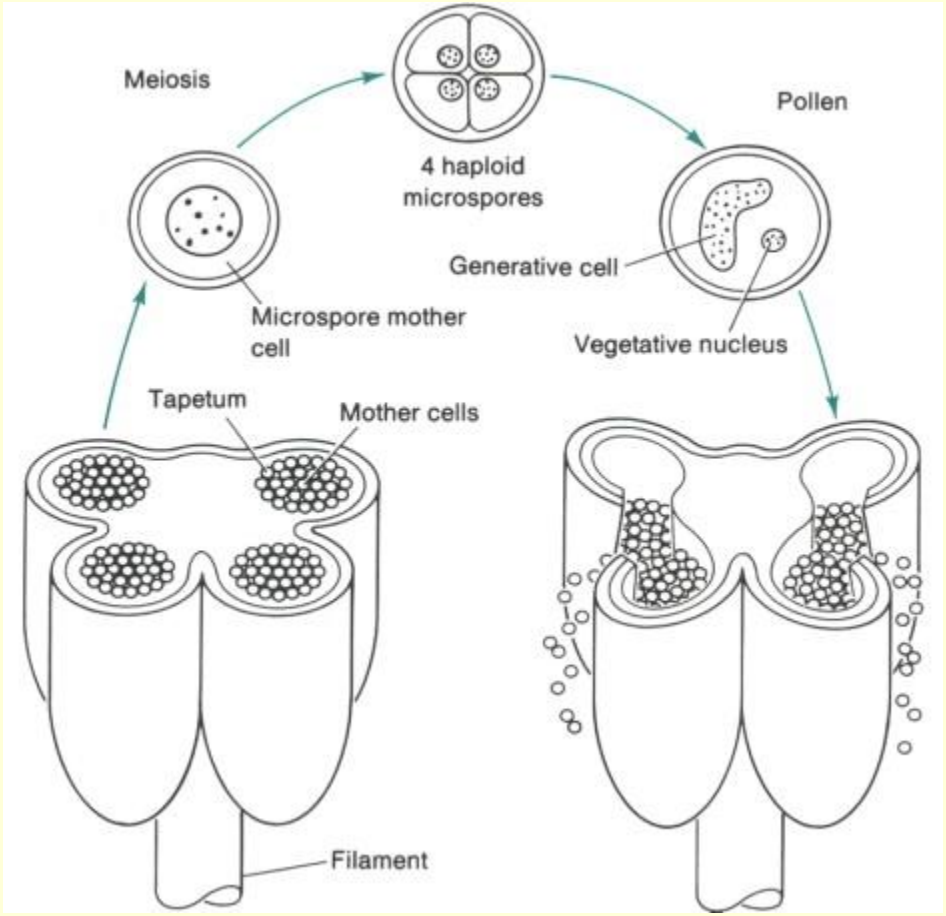
pédicelle
bractée
pédoncule

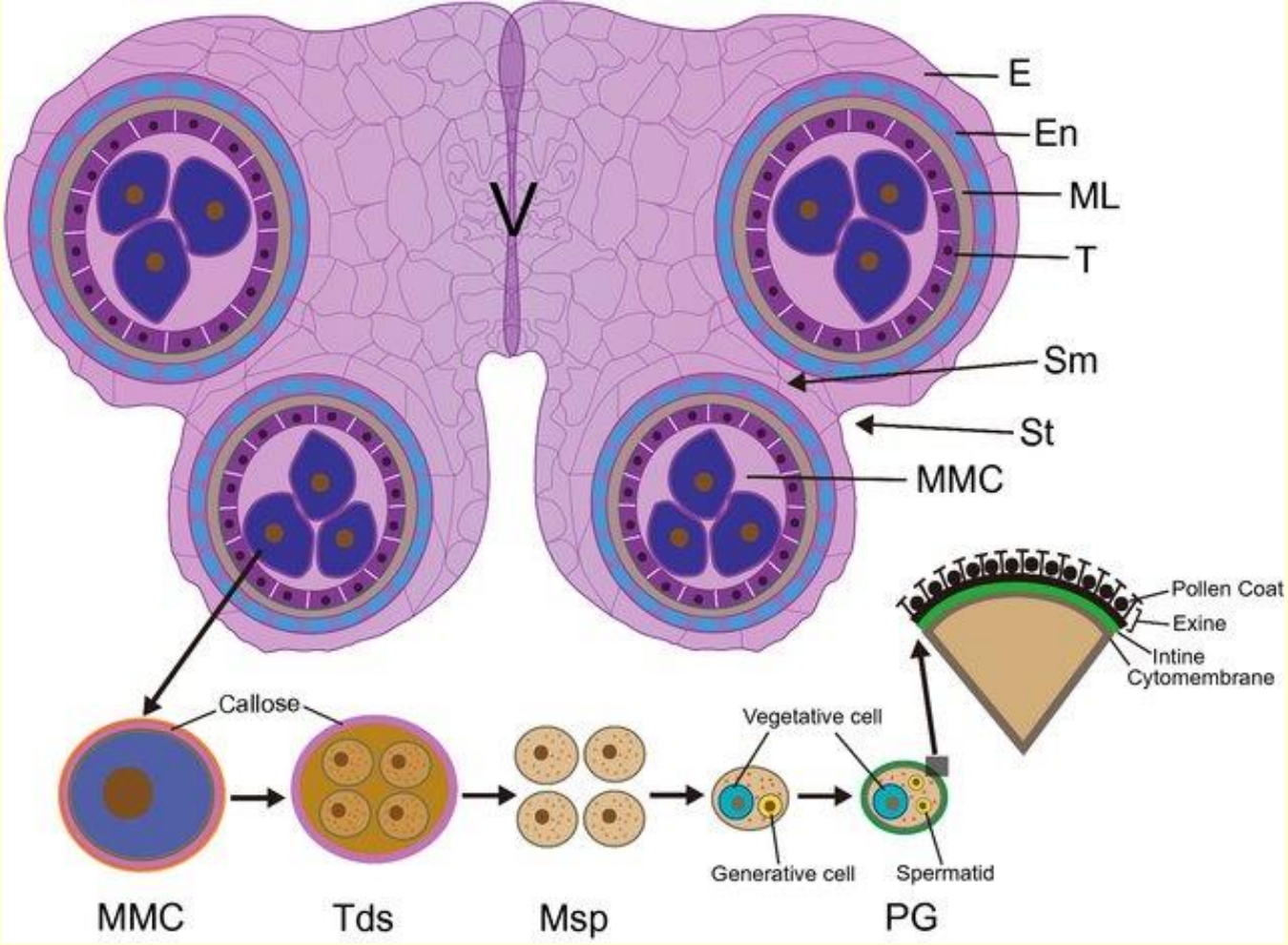
Simple
Cerastium arvense

Composé
Stellaria holostea

Biology of Angiosperm reproduction. Double fertilization.

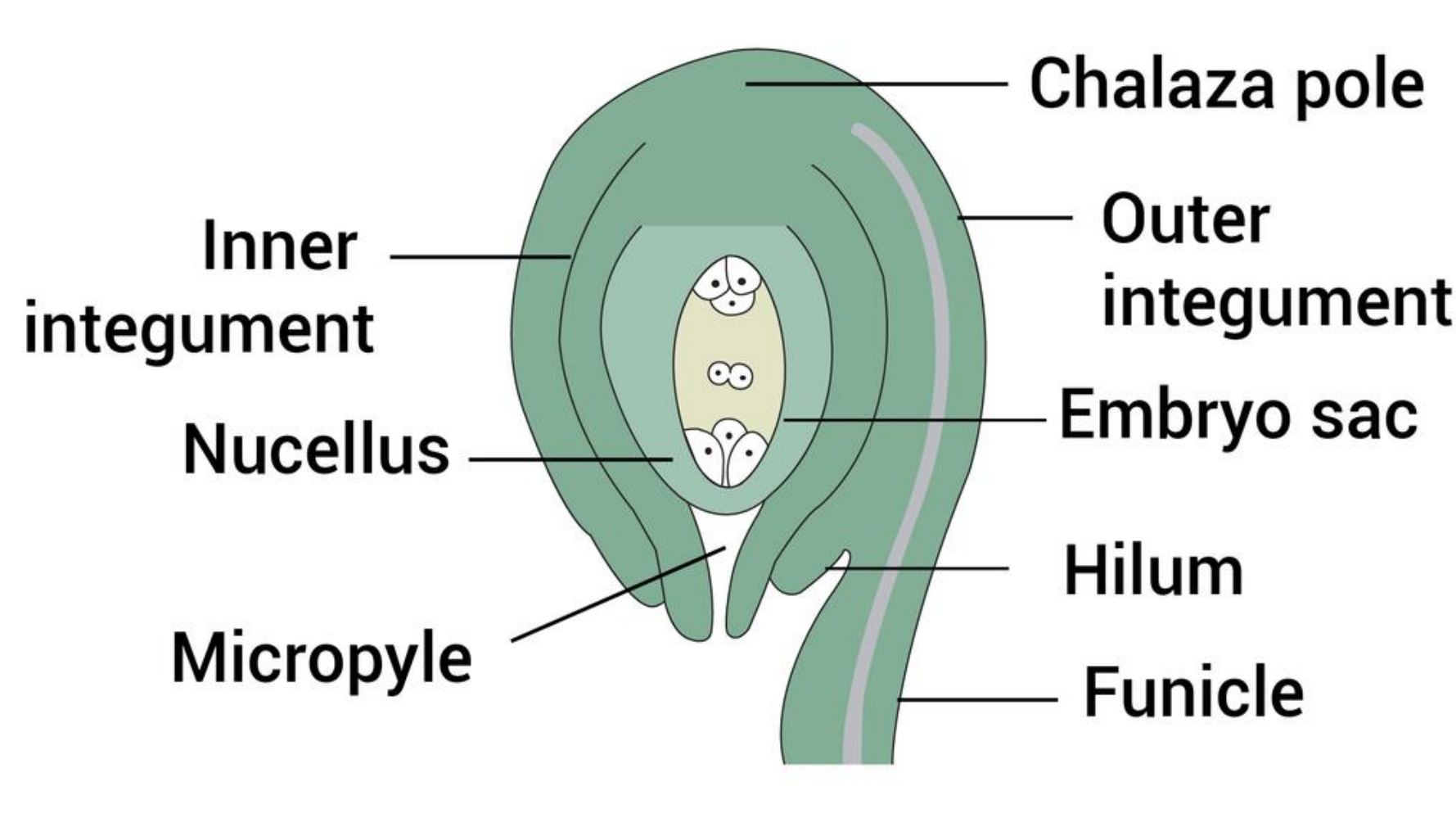
MICROSPOROGENESIS AND MALE GAMETOPHYTE

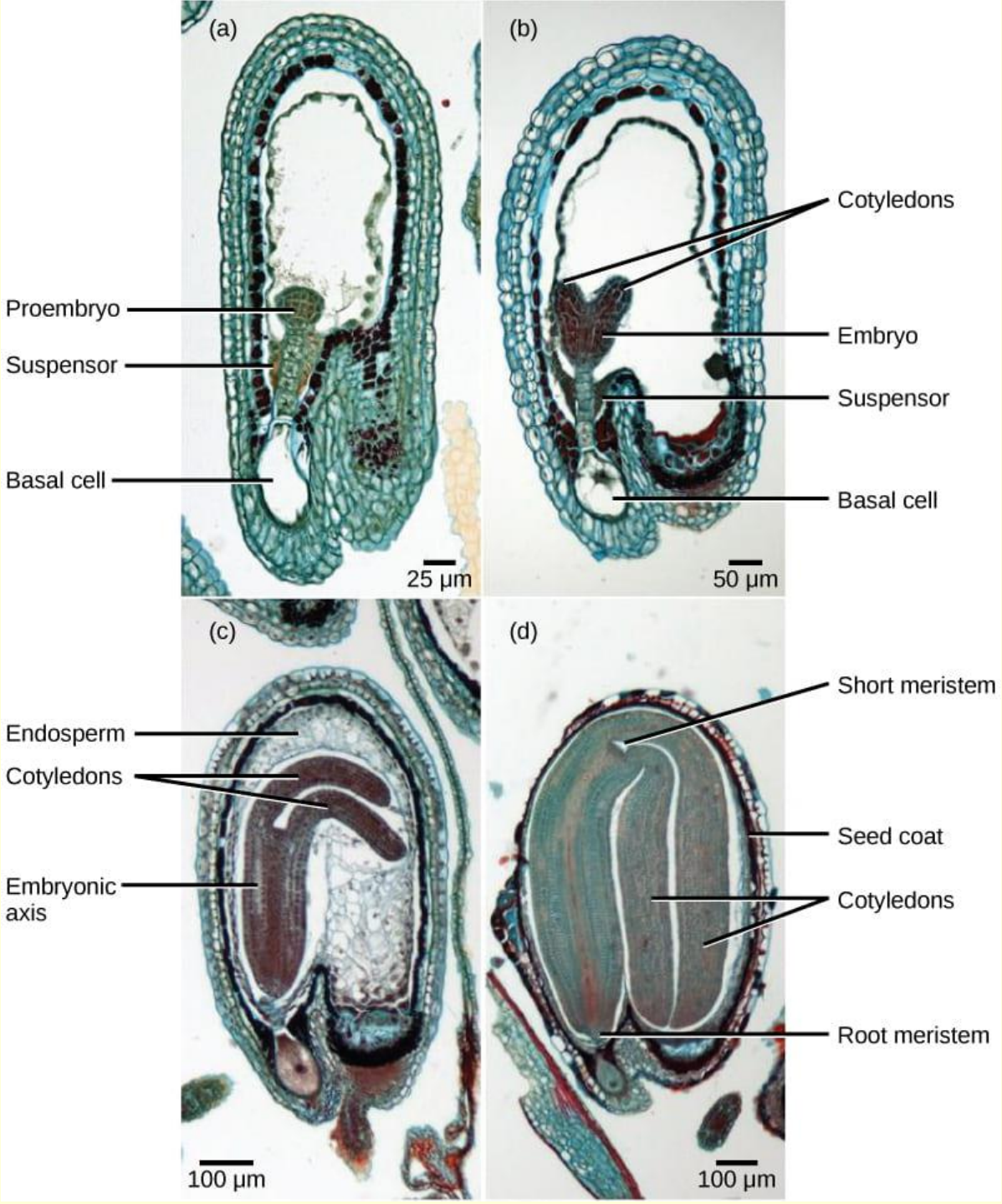




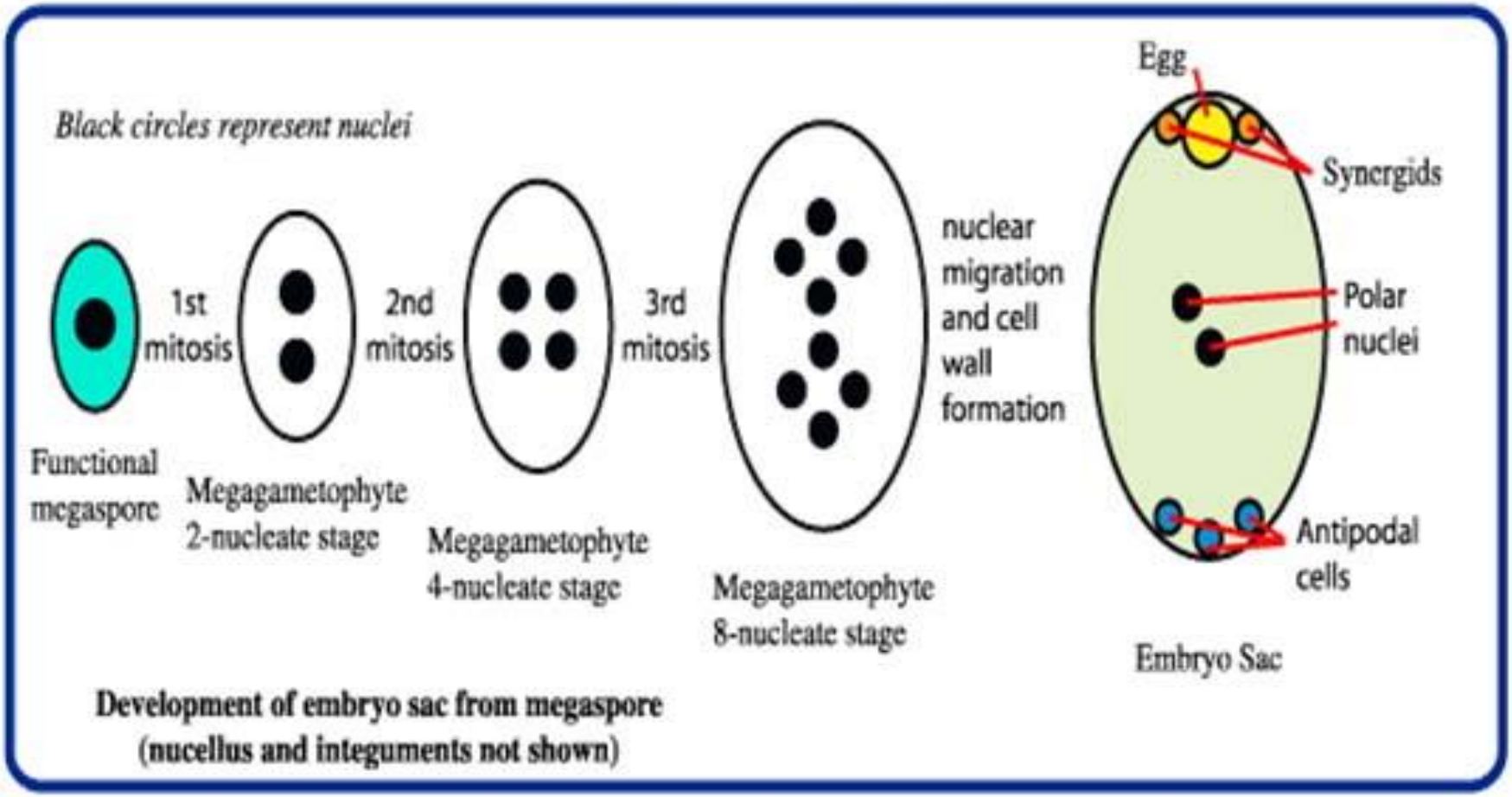
Anther morphology and key events of anther development. One anther includes four pollen sacs, and each pollen sac consists of epidermis, endothecium, middle layer, tapetum and reproductive cell layer. The pollen mother cells undergo meiosis to form tetrads wrapped by callose, and microspores were released after callose degradation by the callase secreted by tapetum. Each microspore undergoes two mitosis to produce mature pollen grains containing two generative cell and one vegetative cell, meanwhile tapetum transports nutrient to synthesize pollen wall. In the later stage of anther development, septum and stomium successively dehisce to release pollen grains. V, vascular bundle; E, epidermis; En, endothecium; ML, middle layer; T, tapetum; Sm, septum; St, stomium; MMC, microspore mother cells; Ms, microsporocytes; Tds, tetrads; Msp, microspores; PG, pollen grain

Structure of Ovule

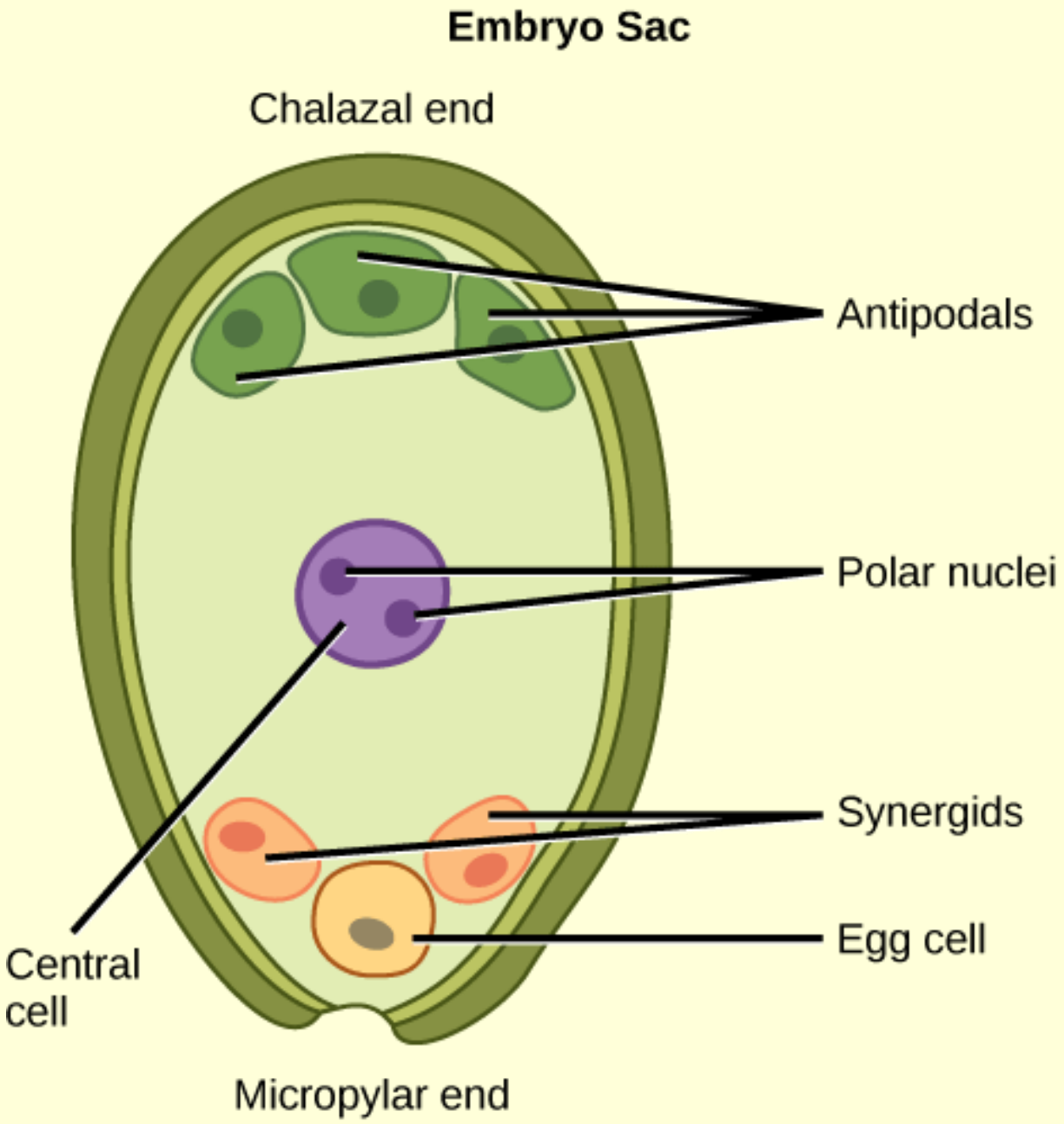



(a)
Proembryo
Suspensor
Basal cell
25 µm
(b)
Cotyledons
Embryo
Suspensor
Basal cell
50 µm
(c)
Endosperm
Cotyledons
Embryonic axis
100 µm
(d)
Short meristem
Seed coat
Cotyledons
Root meristem
100 µm

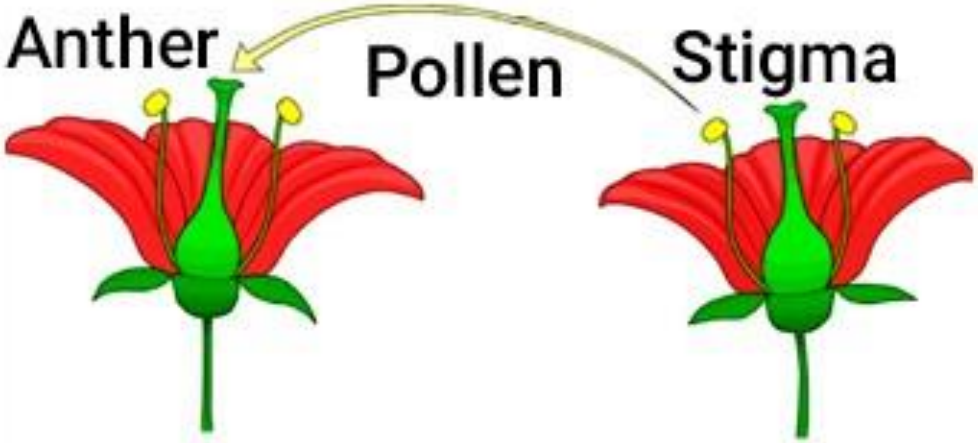
Angiosperm Ovule/Seed Development



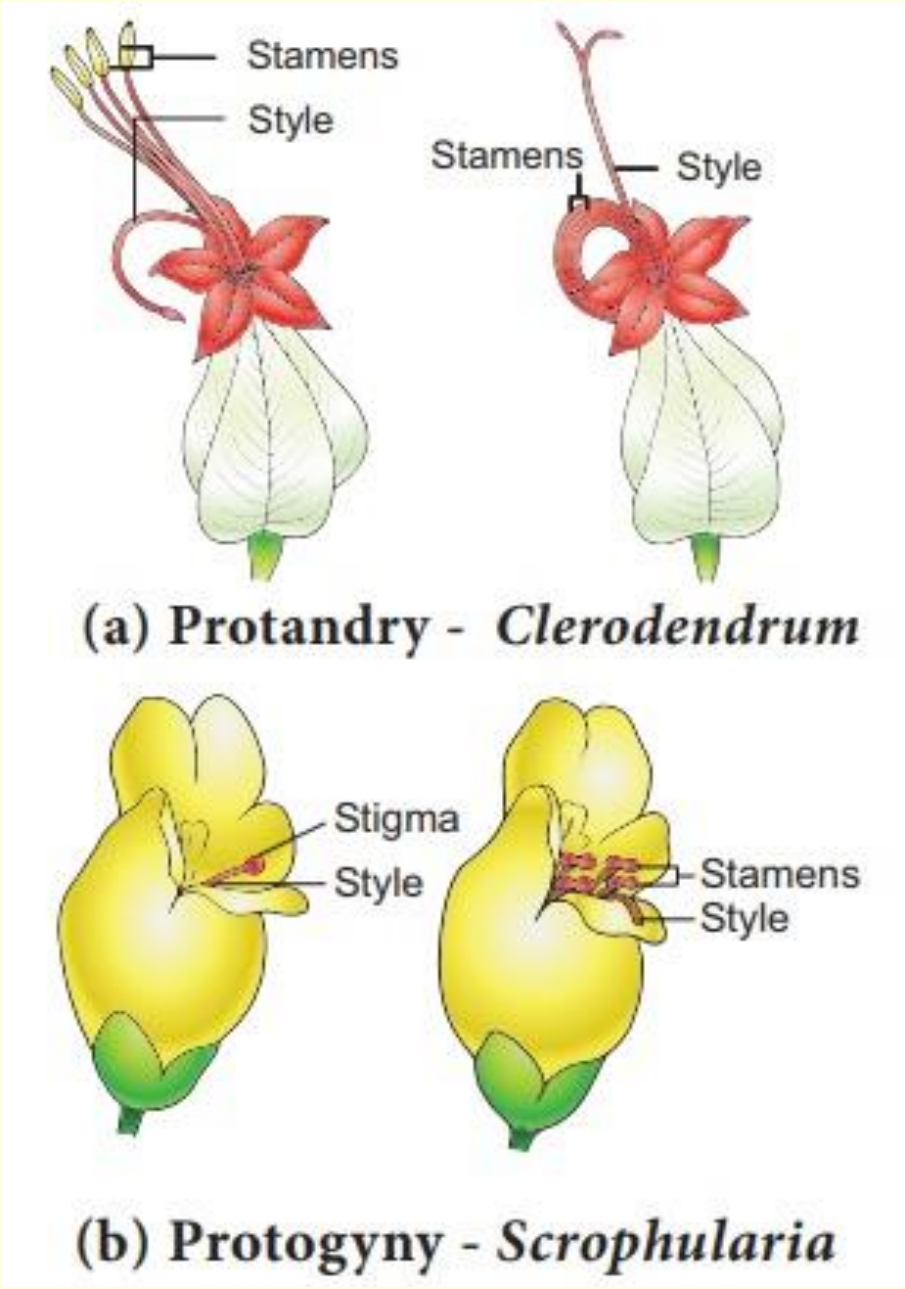
Development of embryo sac from megaspore
(nucellus and integuments not shown)

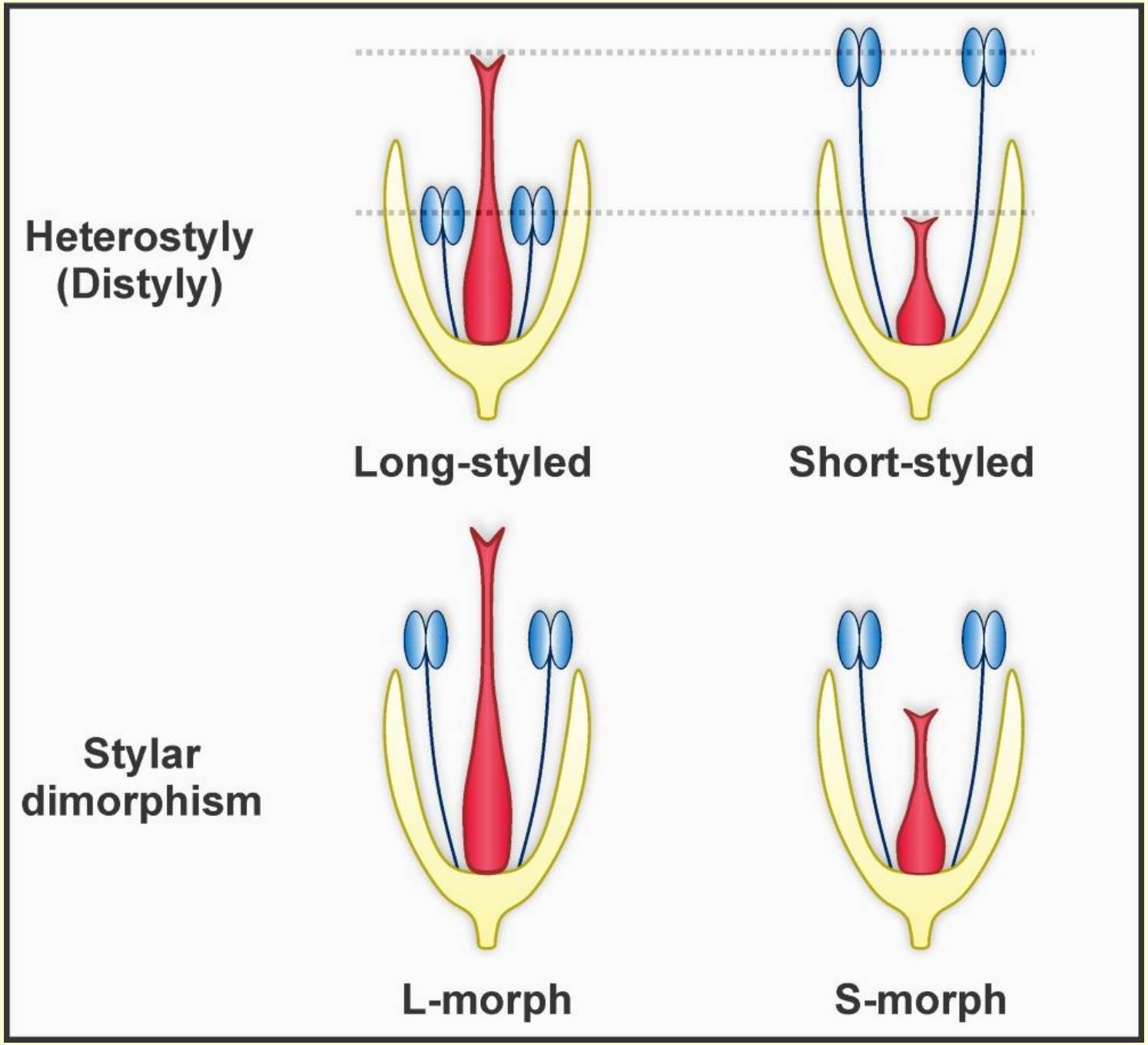

Embryo Sac
Chalazal end
Antipodals
Polar nuclei
Synergids
Egg cell
Central cell
Micropylar end

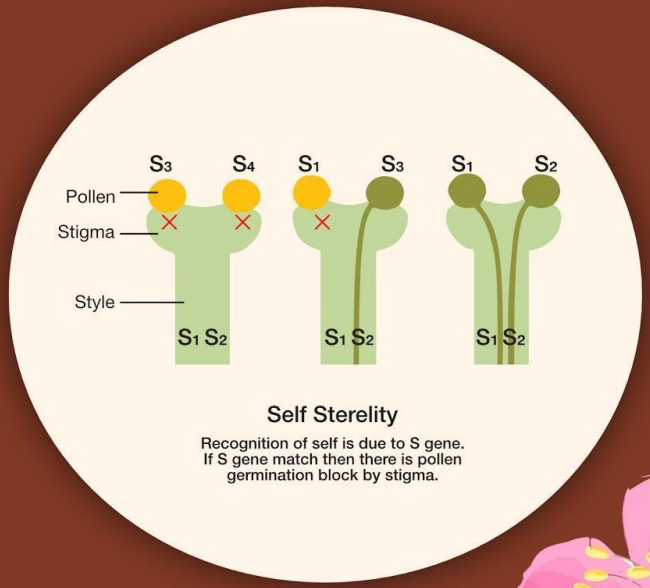
Cross Pollination



Self-Pollination

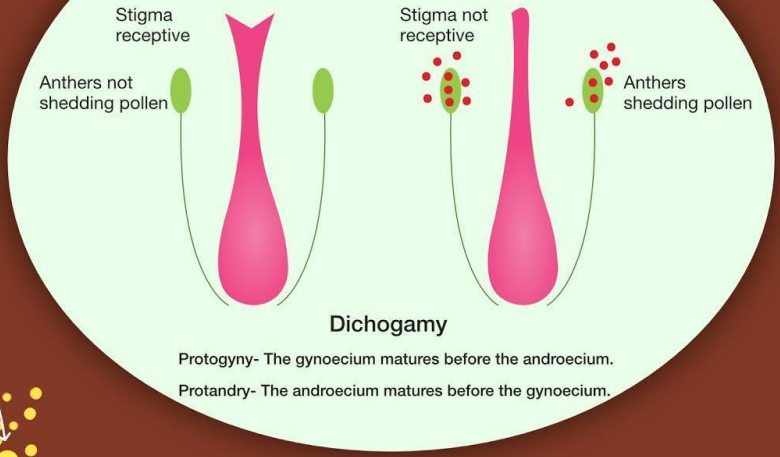

Stamens
Style
Stamens
Style
(a) Protandry - Clerodendrum
Stigma
Style
Stamens
Style
(b) Protogyny - Scrophularia


Heterostyly
(Distyly)
Long-styled
Short-styled
Stylar
dimorphism
L-morph
S-morph



Self Sterelity

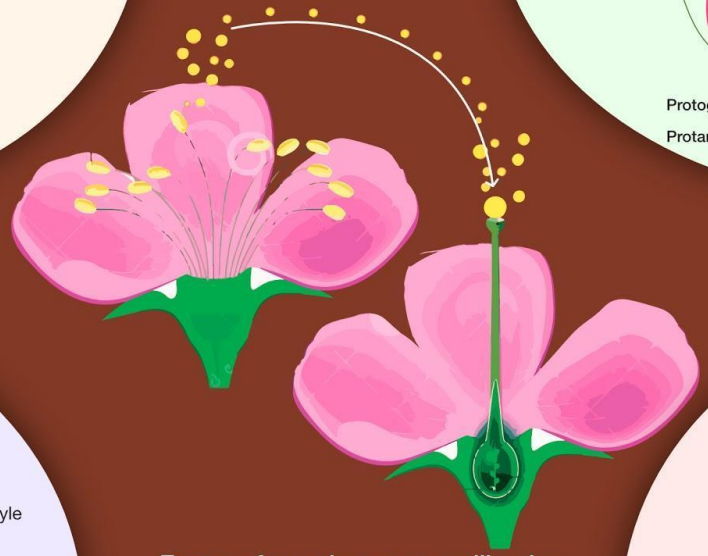
Recognition of self is due to S gene. If S gene match then there is pollen germination block by stigma.



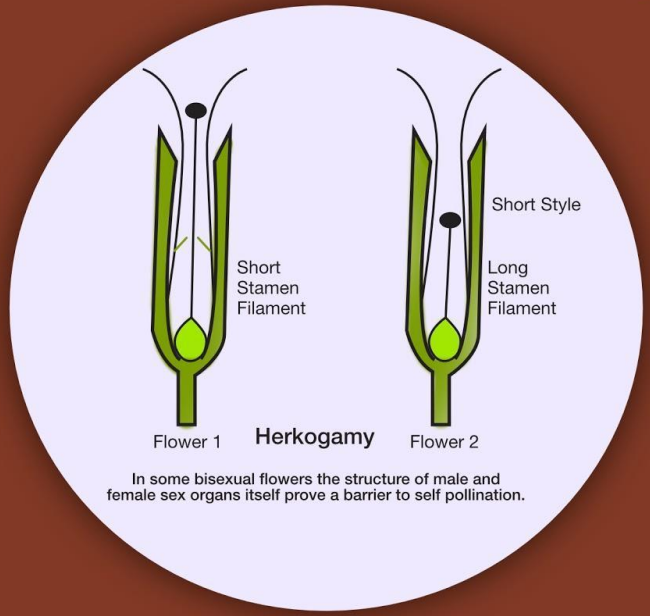
Dichogamy

Protogyny- The gynoecium matures before the androecium.

Protandry- The androecium matures before the gynoecium.

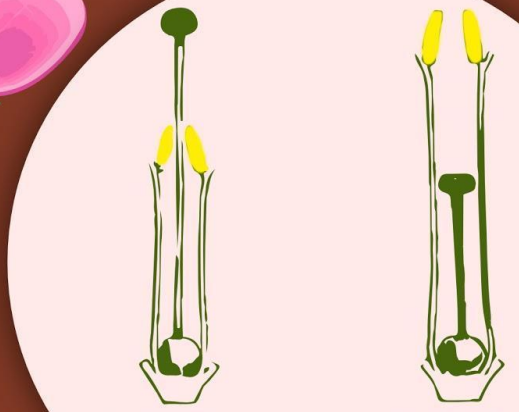


Factors favouring cross pollination



Herkogamy

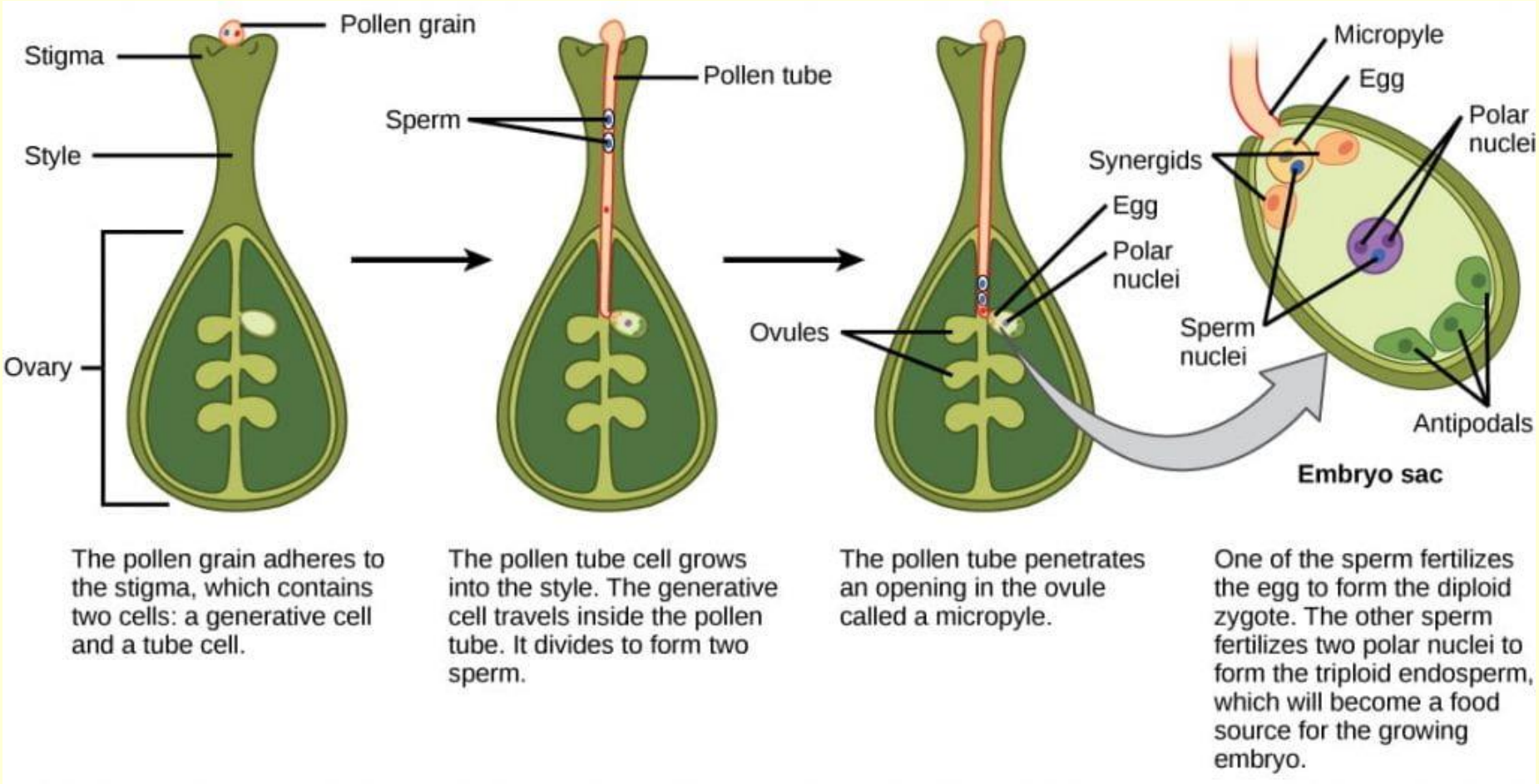
In some bisexual flowers the structure of male and female sex organs itself prove a barrier to self pollination.



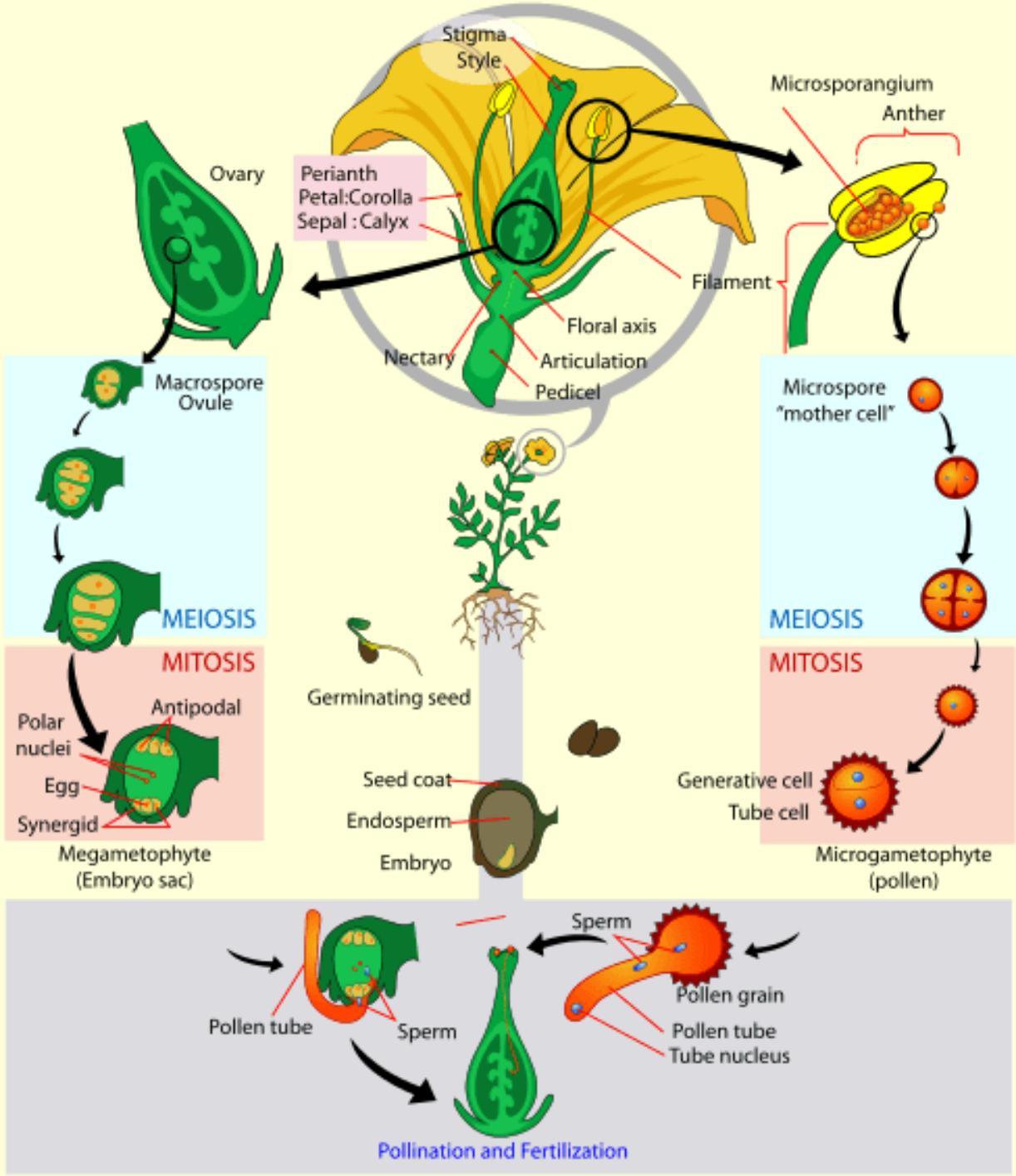
Heterostyl

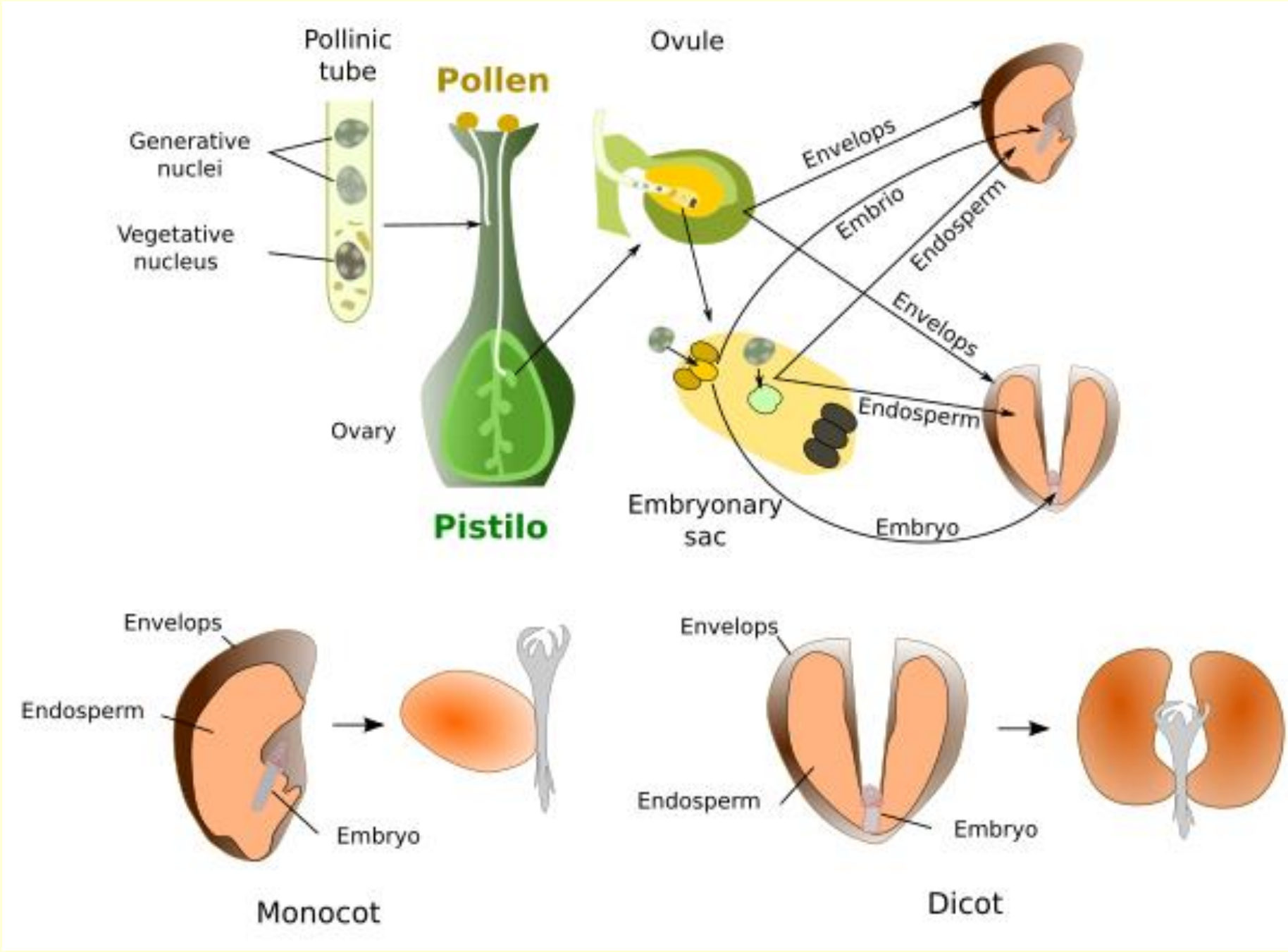
Flower have different types of height of styles and stamens.

FERTILIZATION AND DEVELOPMENT OF THE SEED

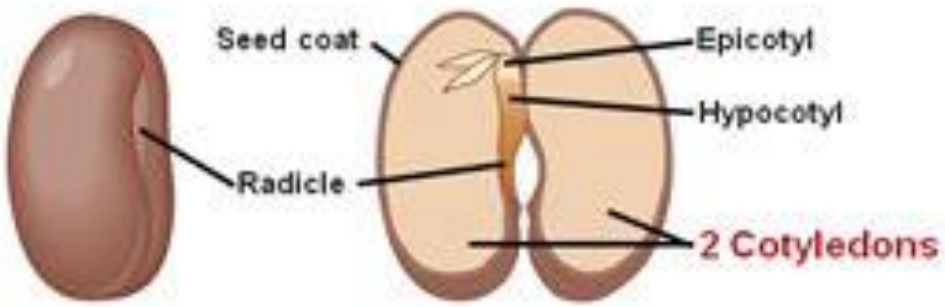


https://www.youtube.com/watch?v=AykzPemLs7Q
https://www.youtube.com/watch?v=l5dEgwTdBok
https://www.youtube.com/watch?v=0UEpq1W9C_E

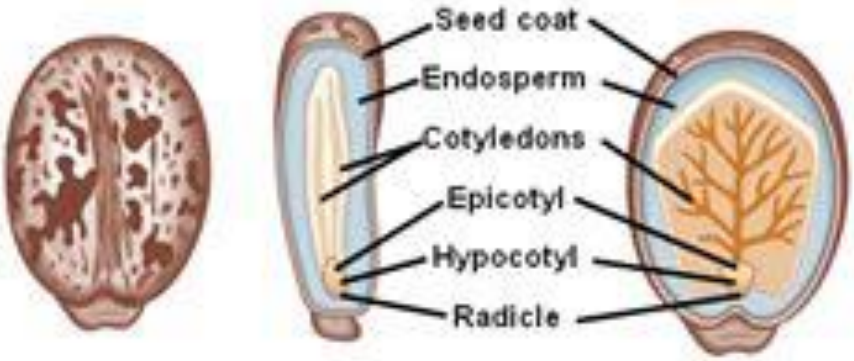

Stigma
Style
Microsporangium
Anther
Ovary
Perianth
Petal:Corolla
Sepal :Calyx
Filament
Floral axis
Nectary
Articulation
Pedicel
Macrospore
Ovule
Microspore
"mother cell"
MEIOSIS
MEIOSIS
MITOSIS
MITOSIS
Antipodal
Polar
nuclei
Egg
Synergid
Germinating seed
Seed coat
Endosperm
Embryo
Generative cell
Tube cell
Megametophyte
(Embryo sac)
Microgametophyte
(pollen)
Sperm
Pollen grain
Pollen tube
Tube nucleus
Pollen tube
Sperm
Pollination and Fertilization


Pollinic tube
Pollen
Ovule
Generative nuclei
Vegetative nucleus
Envelops
Embrio
Endosperm
Envelops
Endosperm
Ovary
Pistilo
Embryonary sac
Embryo
Envelops
Endosperm
Embryo
Monocot
Envelops
Endosperm
Embryo
Dicot

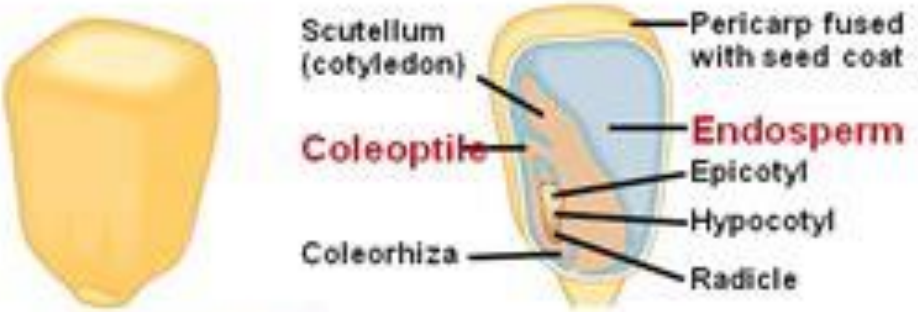
Seed Structure



(a) Common garden bean, a eudicot with thick cotyledons



(b) Castor bean, a eudicot with thin cotyledons



(c) Maize, a monocot