

Main Plant Families

(Continuation)

Fabales

Fabaceae

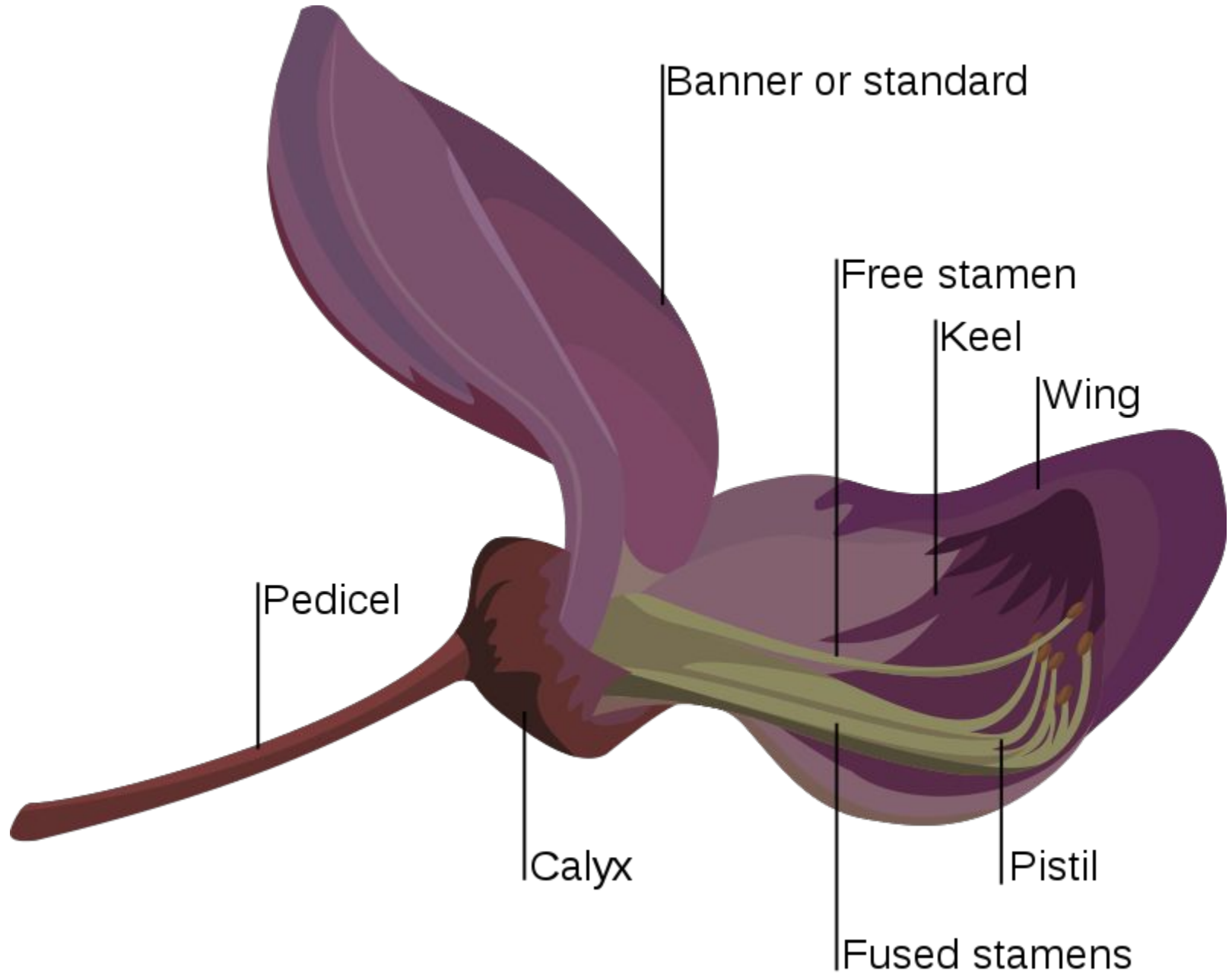
Fabaceae

- Fabaceae includes over about 751 genera and some 19,000 known species.
- **Distribution:** The family is widely distributed, being found everywhere except Antarctica and the high arctic. And it is the most common family found in tropical rainforests and in dry forests in the Americas and Africa.
- The five largest of the genera are Astragalus (over 3,000 species), Acacia (over 1000 species), Indigofera (around 700 species), Crotalaria (around 700 species) and Mimosa (around 400 species).
- According to most taxonomic systems, including the APG III system, the family includes six subfamilies: Cercidoideae, Detarioideae, Duparquetioideae, Dialioideae, Caesalpinioideae (incl. the former subfamily Mimosoideae), Faboideae

Typical features of Fabaceae

- **Life forms**: Trees, shrubs, perennial or annual herbaceous plants.
- **Flowers**: They are generally hermaphrodite (bisexual). The flowers are often (Caesalpinioideae) or always (Faboideae) zygomorphic or actinomorphic (Mimosoideae). Flowers are usually showy to attract pollinators.
- **Perianth**: include five generally fused sepals and five free petals.
- **Androecium**: The stamens are always ten in number, their filaments can be fused in various configurations, often in a group of nine stamens plus one separate stamen.
- **Gynoecium**: one elongated superior ovary, with a curved style.
- **Fruit**: The ovary most typically develops into a legume. A legume is a simple dry fruit that usually dehisces (opens along

Typical flower of Fabaceae (*Wisteria sinensis*)



Features of Fabaceae

- Fabaceae is the third-richest plant family, behind only the Orchidaceae and Asteraceae.
- Fabaceae plants are actors of biological nitrogen fixation due to the presence of root nodules containing nitrogen-fixing bacteria.
- Most species of temperate zone have a stable floral formula:

e.g., *Trifolium repens*: ♀♂↑K₅Co_{1,1,(2)}A_{(9),1}G₁, with modification in androecium (e.g., for *Genista tinctoria*, *Chamaecytissus ruthenicus*):

♀♂↑K₅Co_{1,1,(2)}A₍₁₀₎G₁



Trifolium repens

♀♂↑**K**₅**C**_{01,1,(2)}**A**_{(9),1}**G**₁



Astragalus cicer



♀ ♂ ↑ **K₅C₀_{1,1,(2)}A_{(9),1}G₁**



♀♂↑ $K_5C_01,1,(2)A_{(9),1}G_1$



Lotus corniculatus

♀♂↑**K₅C₀_{1,1,(2)}A_{(9),1}G₁**



Medicago sativa

Chamaecytisus ruthenicus

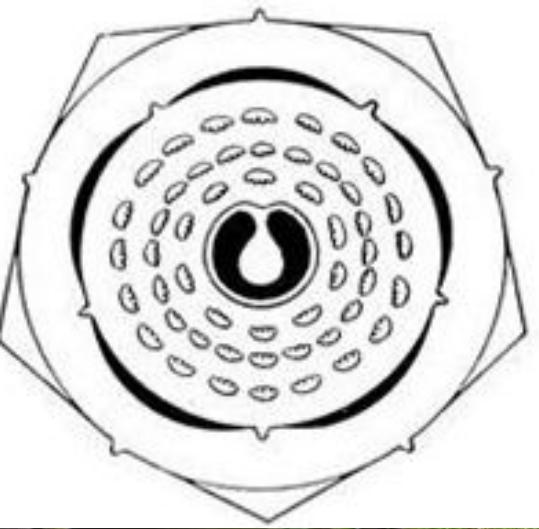


♀ ♂ ↑ $K_5 C_{01,1(2)} A_{(10)} G_1$



♀ ♂ ↑ **K₅C₀_{1,1,(2)}A₁₀G₁**

Sophora microphylla



Acacia nitelica



♀♂*K₍₅₎C₀(₅)A_∞G₁



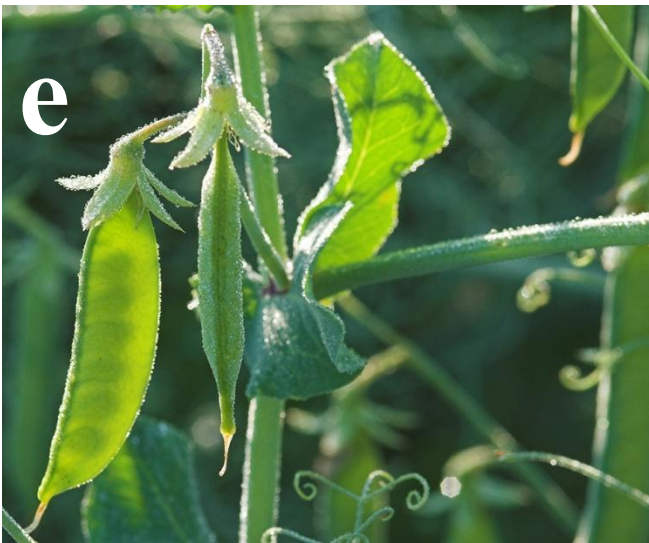
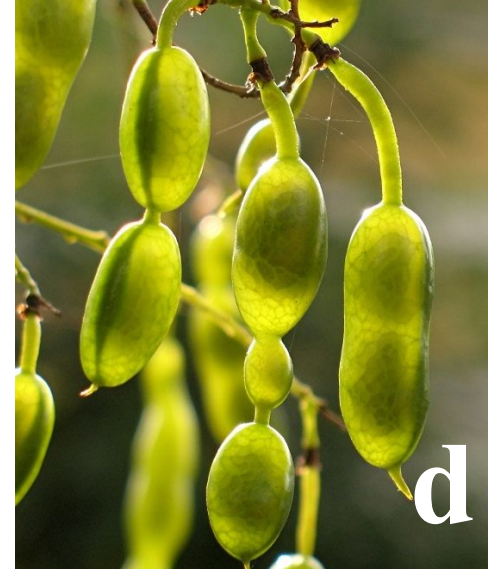
Cercis siliquastrum



♀ ♂ ↑ **K₍₅₎C₀₅A₁₀G₁**



Fruits



a: *Albizia julibrissin*; **b:** *Ceratonia siliqua*; **f:** *Lupinus polyphyllus*; **c:** *Sophora japonica*; **d:** *Pisum sativum*; **g:** *Medicago sativa*; **e:** *Glycine max*.

Brassicales

Brassicaceae

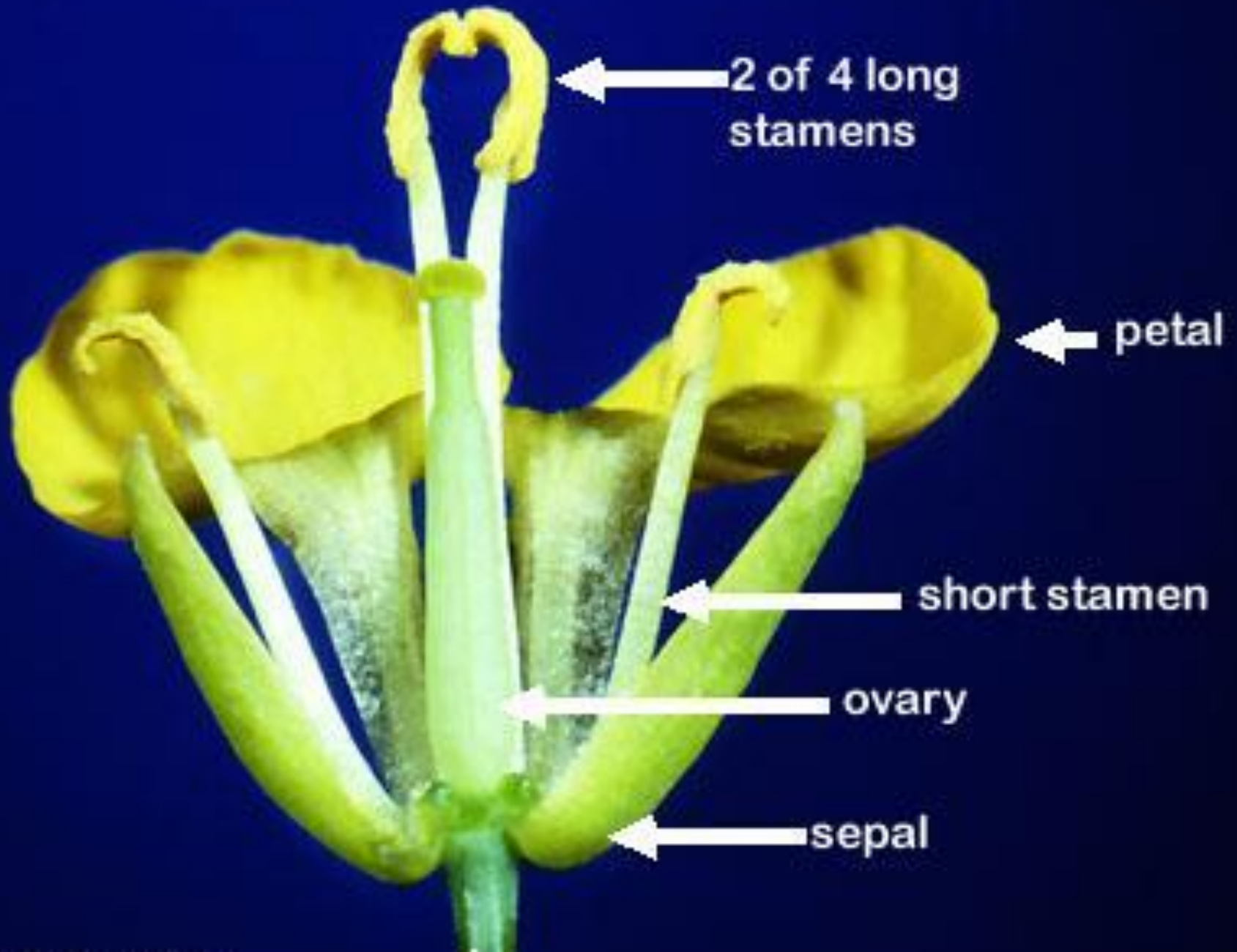
Brassicaceae

- Brassicaceae contains 372 genera and 4060 accepted species..
- **Distribution:** Brassicaceae can be found almost on the entire land surface of the planet, but it is absent from Antarctica, and in some areas in the tropics. The family is a medium-sized and economically important.
- The largest genera are *Draba* (440 species), *Erysimum* (261 species), *Lepidium* (234 species), *Cardamine* (233 species), and *Alyssum* (207 species).
- The area of origin of the family is possibly the Irano-Turanian Region, where approximately 900 species occur in 150 different genera (incl. about 530 endemics). Next in abundance comes the Mediterranean Region with around 630 species (290 of which are endemic) in 113 genera.

Typical features of Brassicaceae

- **Life forms**: Mostly annual, biennial, or perennial herbaceous plants, some are dwarf shrubs or shrubs, and very few vines.
- **Flowers**: May be arranged in racemes, panicles, or corymbs, and few species have individual flowers on stems.
- **Perianth**: Each flower has four sepals and four petals, set alternating with the sepals.
- **Androecium**: The mostly six stamens are set in two whorls: usually the two lateral, outer ones are shorter than the four inner stamens.
- **Gynoecium**: There is one superior pistil that consists of two carpels.
- **Fruit**: Fruits are capsules that open with two valves, usually towards the top. These are called silique if at least three times longer than wide, or silicle if the length is less than three times the width.

Typical flower of Brassicaceae

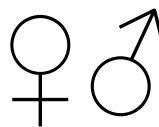


Features of Brassicaceae

- This family includes important agricultural crops: *Brassica oleracea*, *Brassica rapa*, *Eruca sativa*, *Lepidium sativum*, *Nasturtium officinale*, *Raphanus*.
- Garlic mustard, *Alliaria petiolata*, is one of the most aggressive and damaging invasive species in North America.
- The small Eurasian weed *Arabidopsis thaliana* is widely used as model organism in the study of the molecular biology of flowering plants
- Brassicaceae species have a stable floral formula:
 $\text{♀♂}^* \text{K}_{2+2} \text{C}_{0+2} \text{A}_{2+4} \text{G}_2$



*Brassica
olearacea*



* $\mathbf{K_{2+2}C_{0_{2+2}}A_{4+2}G_2}$



Raphanus sativus



♀ ♂ * $K_{2+2}C_0 2_{+2}A_{4+2}G_2$





Bunias orientalis



♀♂* $\mathbf{K_{2+2}C_0A_{4+2}G_2}$



Lepidium densiflorum



♀♂* $\mathbf{K_{2+2}C_0a_{2+2}A_{4+2}G_2}$

Fruits



Solanaceae



Lamiaceae

Solanales

Solanaceae

Solanaceae

- Solanaceae consists of about 98 genera and some 2700 species.
- **Distribution:** Solanaceae are found on all continents except Antarctica. The greatest variety of species are found in Central America and South America. Centers of diversity also occur in Australia and Africa. In general, plants in this family are of tropical and temperate distribution.
- The most economically important genus of the family is *Solanum*, that contains the potato (*S. tuberosum*), the tomato (*S. lycopersicum*), and the eggplant or aubergine (*S. melongena*). Another important genus, *Capsicum*, produces both chili peppers and bell peppers.
- The genus *Physalis* produces the so-called groundcherries, as well as the tomatillo (*Physalis philadelphica*). *Nicotiana* contains, among other species, tobacco.

Typical features of Solanaceae

- **Life forms**: The family ranges from annual and perennial herbs to vines, lianas, epiphytes, shrubs, and trees.
- **Flowers**: generally hermaphrodite. Pollination is entomophilous. The flowers can be solitary or grouped into terminal, cymose, or axillary inflorescences. The flowers are usually actinomorphic, slightly zygomorphic.
- **Perianth**: The both five sepals and five petals are fused, forming a tube with the (4)5(6) segments equal.
- **Androecium**: includes (2)(4)5(6) free fertile stamens, rarely they have staminodes. They alternate with the petals.
- **Gynoecium** is bicarpelar (rarely 3- or 5-locular) with two locules, which may be secondarily divided by false septa.
- **Fruit**: The fruit can be a berry (as in the case of the tomato or potato), or a dehiscent capsule (as in Datura).



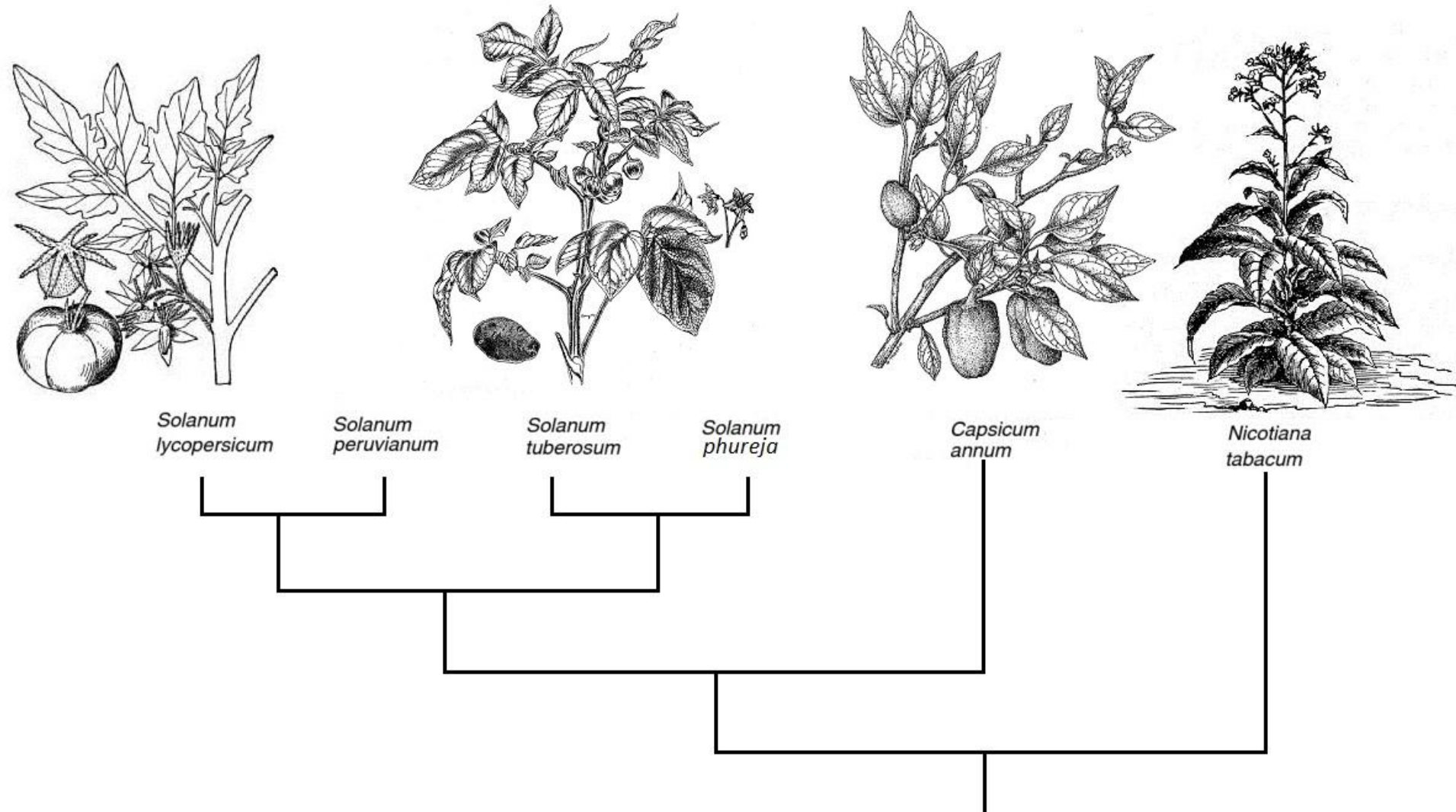
Typical flower of Solanaceae

Fruits



(1–3), *Solanum melongena*; (4), *Solanum pimpinellifolium*; (5–8), *Solanum lycopersicum*; (9–14), Variants of *Capsicum annuum*; (15), *Physalis alkekengi*; (16), *Physalis floridana*; (17–19), *Physalis philadelphica*. The Chinese lantern in *Physalis* spp. was opened to show the berry inside. Bar = 1 cm. (According to: Wang et al. (2015), DOI: 10.3389/fpls.2015.00248)

Cladogram showing the relationship between the three important genera of the family Solanaceae



Solanum dulcamara



♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Solanum dulcamara

Fruits



♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Solanum tuberosum



♀♂***K**₍₅₎**C****o**₍₅₎**A**₅**G**₍₂₎

Solanum lycopersicum



♀♂***K**₍₅₎**C****O**₍₅₎**A**₅**G**(2)

Solanum melongena



♀♂***K**₍₅₎**Co**₍₅₎**A**₅**G**₍₂₎

Solanum nigrum



♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Datura stramonium

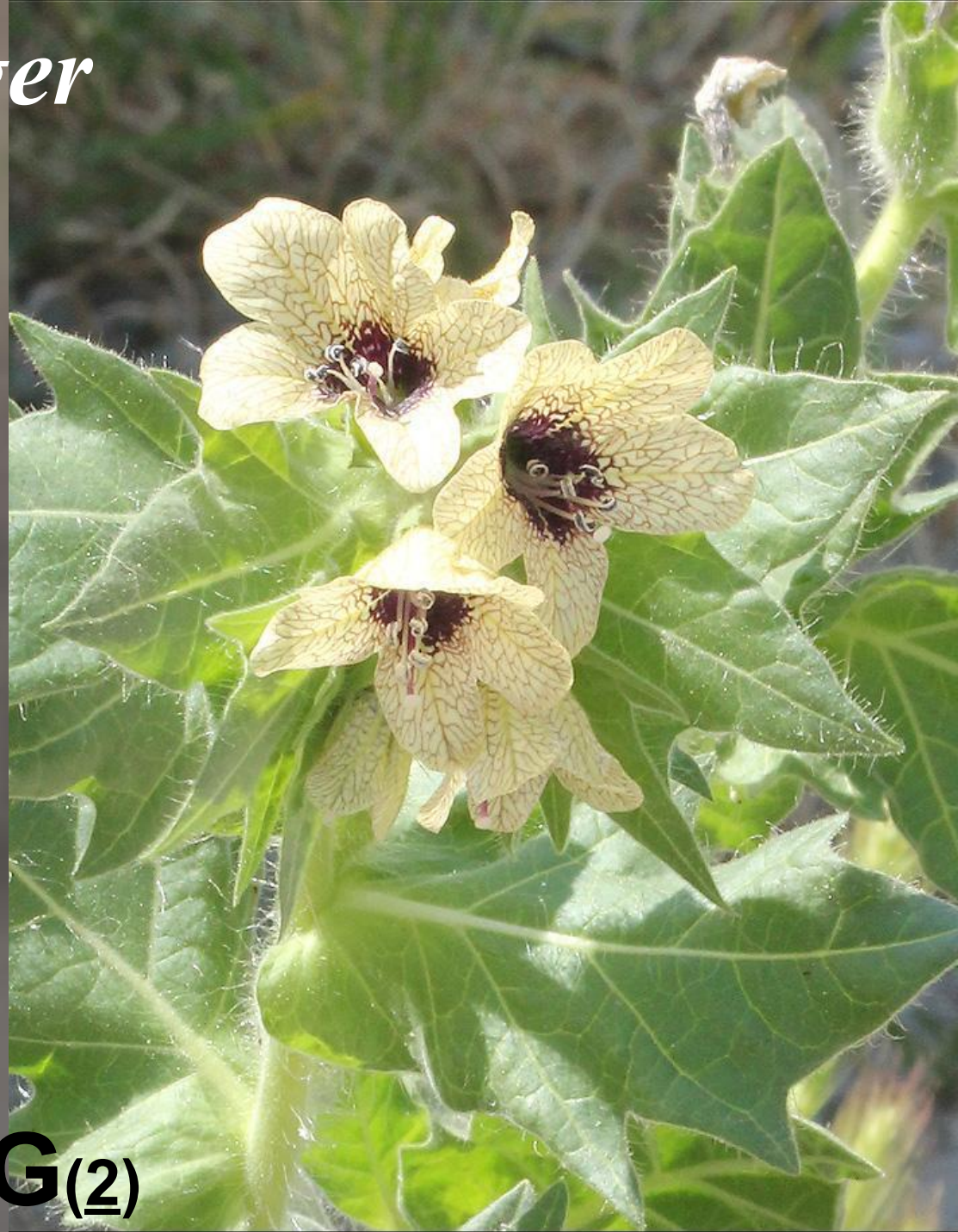


♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Physalis alkengi

♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Hyoscyamus niger



♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Physalis alkengi



♀♂***K₍₅₎Co₍₅₎A₅G₍₂₎**

Lamiales

Lamiaceae

Lamiaceae

- The enlarged Lamiaceae contain about 236 genera and have been stated to contain 6900 (Heywood et al., 2017) to 7200 (Harley et al., 2004) species, but the World Checklist lists 7534.
- **Distribution:** The family has a cosmopolitan distribution.
- The largest genera are Salvia (900), Scutellaria (360), Stachys (300), Plectranthus (300), Hyptis (280), Teucrium (250), Vitex (250), Thymus (220), and Nepeta (200).
- Many members of the family are widely cultivated.
- The distinctive features of the family Lamiaceae are: 1) tetrahedral stem, 2) opposite leaf arrangement, 3) pubescence of simple and glandular hairs, 4) the presence of essential oils. Most of Lamiaceae species have bilabiate corolla.

Typical features of Lamiaceae

- **Life forms**: annual and perennial herbaceous plants, some species are shrubs, trees, or, rarely, vines.
- **Flowers**: The flowers are bilaterally symmetrical (zygomorphic), usually bisexual and verticillastrate (a flower cluster that looks like a whorl of flowers, but actually consists of two crowded clusters).
- **Perianth**: includes five united petals and five united sepals, but corolla (usually similarly with calyx) is usually divided into two lobes: upper with two petals and lower with three petals.
- **Androecium**: includes 4 (but 2 in e.g. *Salvia*, *Rosmarinus*) free fertile stamens.
- **Gynoecium**: One pistil includes 2 united carpels. Ovary is 4-lobed with 2 locules separated inside by false septa.
- **Fruit**: The fruits are presented by 4 nutlets per a flower.

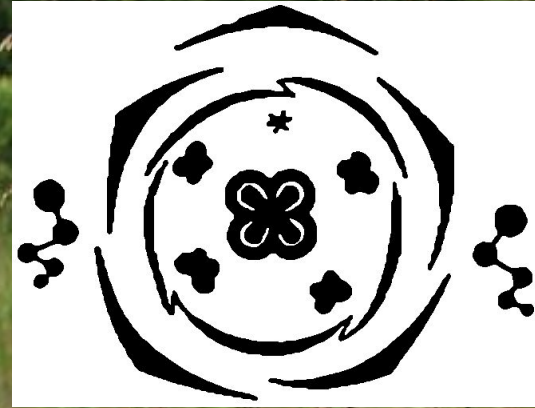


Lycopodium europaeus

♀ ♂ ↑ **K**₍₅₎ **C**0_(3,2) **A**₄ **G**(2)



Galeopsis speciosa



♀ ♂ ↑ **K**₍₅₎ **C**_{0(3,2)} **A**₄ **G**₍₂₎



Phlomis tuberosa



♀ ♂ ↑ **K**₍₅₎ **C**_{0(3,2)} **A**₄ **G**₍₂₎



♀ ♂ ↑ $\mathbf{K}_{(3,2)}\mathbf{C}0_{(3,2)}\mathbf{A}_2\mathbf{G}_{(2)}$ *Salvia stepposa*



Asterales

Asteraceae

Asteraceae

- The family Asteraceae currently has 24700 accepted species names, in 1623 genera (Christenhusz & Byng, 2016).
- **Distribution:** Asteraceae species have a cosmopolitan distribution, and are found everywhere except Antarctica and the extreme Arctic. They are especially numerous in tropical and subtropical regions.
- The typical inflorescence of Asteraceae species is a pseudanthium, also called a flower head or composite flower, surrounded by involucral bracts. It include numerous elemental flowers forming a certain type of pseudanthium.
- Seeds have certain dispersal devices, formed by the reduced calyx (pappus).

The different types of flowers of the Asteraceae family, belonging to the two most representative subfamilies:

Asteroideae and Cichorioideae:

- 1 - *Anthemis tinctoria* (Asteroideae),
- 2 - *Glebionis coronarium* (Asteroideae),
- 3 - *Coleostephus myconis* (Asteroideae),
- 4 - *Glebionis* sp. (Asteroideae),
- 5 - *Sonchus oleraceus* (Cichorioideae),
- 6 - *Cichorium intybus* (Cichorioideae),
- 7 - *Gazania rigens* (Cichorioideae),
- 8 - *Tithonia rotundifolia* (Asteroideae),
- 9 - *Calendula arvensis* (Asteroideae),
- 10 - *Leucanthemum vulgare* (Asteroideae),
- 11 - *Hieracium lachenalii* (Cichorioideae),
- 12 - *Osteospermum ecklonis* (Asteroideae)



Typical features of Asteraceae

- **Life forms**: mostly herbaceous plants, but some are shrubs, climbers and trees.
- **Flowers**: The flowers are arranged in anthodia (flower heads). Individual flowers are divided into five types, and may be actinomorphic or zygomorphic, bisexual or female or asexual.
- **Perianth**: includes 3-5 (depending of flower type) fused petals, while calyx is reduced until a **pappus**, that is represented by different forms.
- **Androecium**: There are usually five fused stamens..
- **Gynoecium**: The pistil consists of two connate carpels. The ovary is inferior and has only one ovule.
- **Fruit**: The fruit is achene-like, and is called a cypsela (plural cypselae), or exactly achene.

Four types of Asteraceae flowers

**Tubular flower
(also “disk flower”)**

♀ ♂* **K₀C₀(5)A₍₅₎G₍₂₎⁻⁻**

Ligulate flower

♀ ♂ ↑ **K₀C₀(5)A₍₅₎G₍₂₎⁻⁻**

Ray flower (common)

♀ ♂ ↑ **K₀C₀(3)A₀G₍₂₎⁻⁻**

Ray flower (sterile)

♀ ♂ ↑ **K₀C₀(3)A₀G₀**

Tubular flower

♀♂***K₀C₀(5)A₍₅₎G₍₂₎⁻**



Ligulate flower

♀ ♂ ↑ **K₀C₀(5)A₍₅₎G₍₂₎⁻**



Ray flower (common)

♀ ♂ ↑ **K₀C₀(₃)A₀G₍₂₎⁻**



Ray flower (sterile)

♀ ♂ ↑ **K₀C₀(₃)A₀G₀**



Main types of Asteraceae flower heads

- **Radiate head** has both ray and disc (tubular) flowers
- **Ligulate head** has all ligulate flowers.
- **Discoïd head** has only disc (tubular) flowers.

Radiate head



Ligulate head



Discoid head



Bidens cernua



Artemisia abrotanum



Scalesia pedunculata



Scalesia pedunculata



Mutisia decurrens



Centaurea marschalliana



Leucanthemum vulgare



Artemisia latifolia



Scabiosa ochroleuca





Erigeron acris

Bidens pilosa



Arctium tomentosum



Arctium tomentosum



Arctium lappa



Arctium lappa



Picris hieracioides



Anthémis tinctoria



Centaurea scabiosa



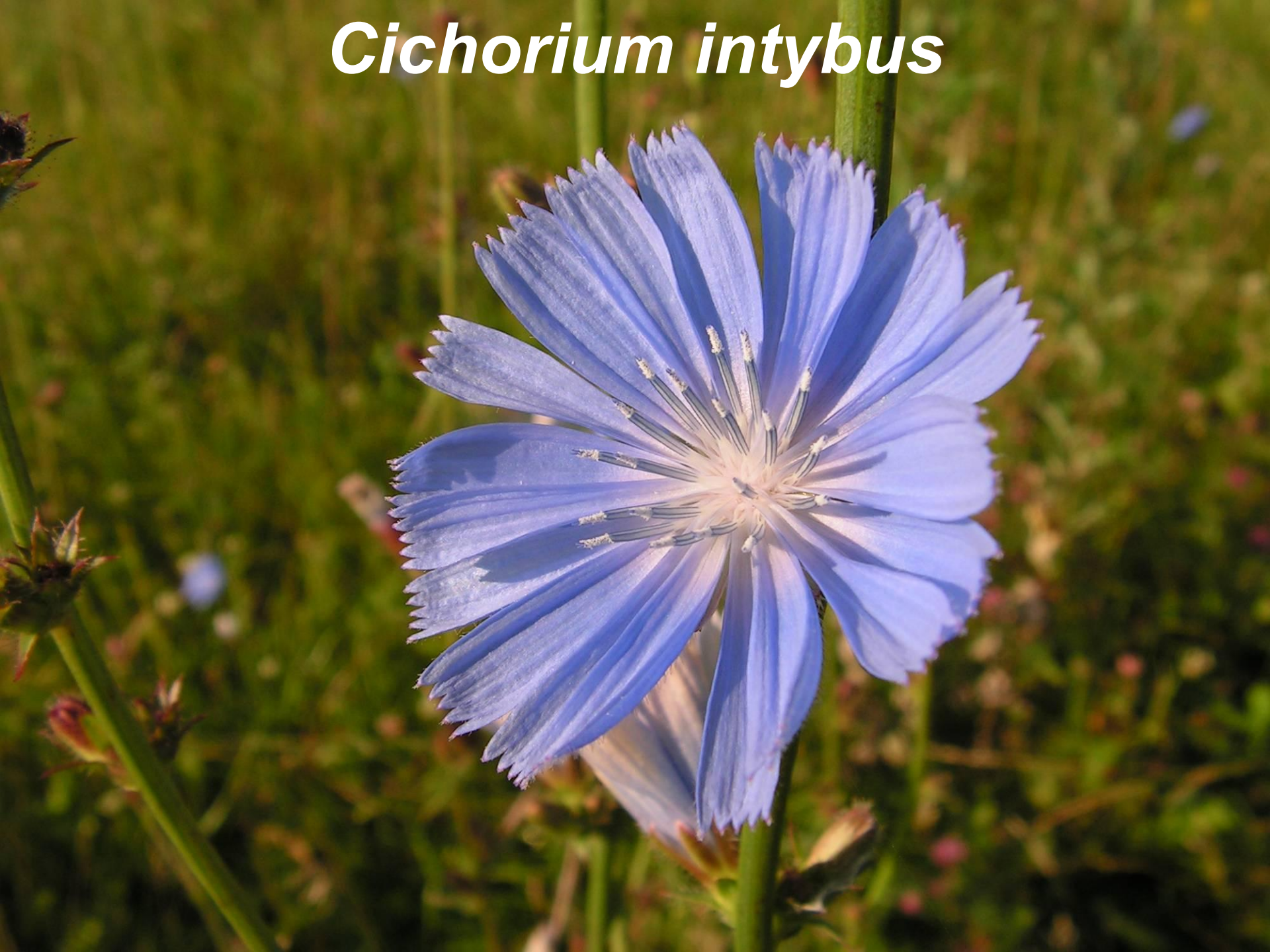
Centaurea ruthenica



Solidago virgaurea



Cichorium intybus



Cichorium intybus



Cirsium arvense



Ambrosia trifida



Erigeron annuus



Helianthus annuus



Monocots

Main families



Poales

Poaceae

Poaceae

- The Lamiaceae contains 780 genera and around 12,000 species.
- **Distribution:** The grass family is one of the most widely distributed and abundant groups of plants on Earth. Grasses are found on every continent, including Antarctica with the presence of *Deschampsia antarctica* on the Antarctic Peninsula.
- The largest genera are *Salvia* (900), *Scutellaria* (360), *Stachys* (300), *Plectranthus* (300), *Hyptis* (280), *Teucrium* (250), *Vitex* (250), *Thymus* (220), and *Nepeta* (200).
- Many members of the family are widely cultivated.
- The distinctive features of the family Lamiaceae are: 1) tetrahedral stem, 2) opposite leaf arrangement, 3) pubescence of simple and glandular hairs, 4) the presence of essential oils. Most of Lamiaceae species have bilabiate

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- **Gynoecium**: One pistil includes 2 united carpels. Ovary is 4-lobed with 2 locules separated inside by false septa.
- **Fruit**: The fruits are presented by 4 nutlets per a flower.

Злаки

- Общее число видов около 10000.
- Стебель - соломина
- Цветки мелкие, обычно обоеполые, собраны в элементарное соцветие **колосок**.
- Исходная модель цветка – трехмерная, но большинству свойственны:
- 2 колосковые чешуи
- тычинок 3, реже – 2 (цинна, душистый колосок), еще реже – 6 (рис).
- Число компонентов завязи – 2. Завязь нижняя.

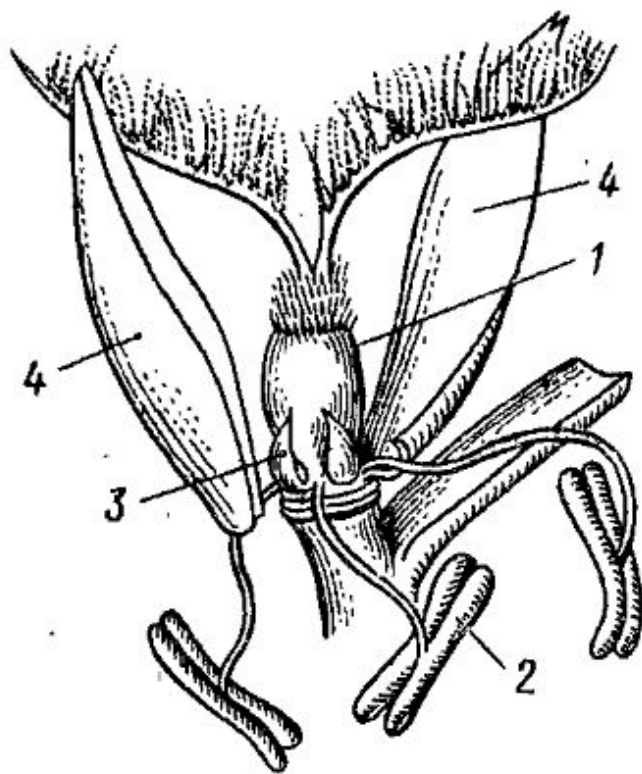
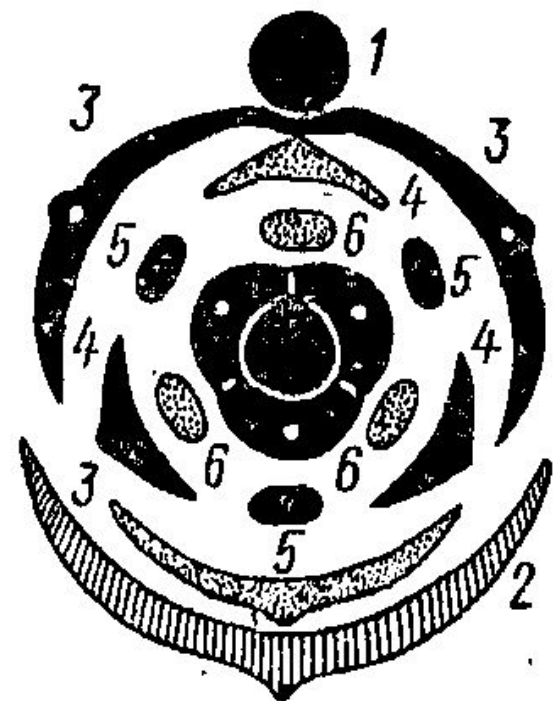


Рис. 143. Строение цветка злака:

1 — пестик (гинецей), 2 — тычинки (андроцей), 3 — цветковые пленки (лодикулы), 4 — цветковые чешуи



↑ ♀ $P_{1+(2)} A_3 G_{(2)}$

145. Теоретическая диаграмма цветка (редуцированные части показаны пунктиром):

1 — ось колоска, 2 — нижняя цветковая чешуя (palea inferior), 3 — верхние цветковые чешуи (palea superior) образуют внешний круг околоцветника, 4 — пленки (lodiculae) — листки внутреннего круга околоцветника, 5, 6 — тычинки наружного и внутреннего круга (по Шустеру)

Орхидные

- Общее число видов 25000-30000.
- Цветки крупные, необычной формы.
- Преимущественно тропические виды.
- Основная модель цветка – пятикруговой, зигоморфный, обоеполый, андроцей редуцирован до 1-2 тычинок:
- 3 чашелистика, 3 (2) лепестка (обычно принимаемых за листочки простого околоцветника)
- тычинок 1, реже – 2 или 3.
- 3 плодолистика. Завязь нижняя.

Диаграммы цветков орхидных

♀♂↑P₃₊₃A₂G₍₃₎—



венерин башмачок

♀♂↑P₃₊₃A₁G₍₃₎—



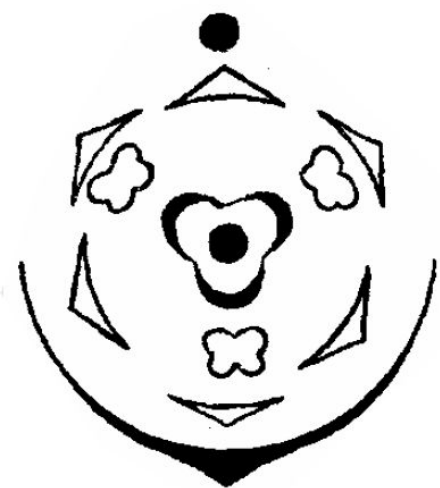
пальчатокоренник

Осоковые

- Общее число видов 5600, 120 родов.
- Стебли трехгранные, реже – цилиндрические
- Цветок актиноморфный.
- Околоцветник (при наличии) представлен 3 или 6 листочками.
- Тычинок 3
- Гинецей из 3 (реже 2) плодолистиков. Завязь верхняя.
- Женский цветок заключен в так называемый мешочек.

Варианты диаграмм осоковых

* ♂ ♀ $P_6 A_3 G_{(3)}$



Камыш
лесной



Пушица

* ♂ $P_0 A_3 G_0$; * ♀ $P_0 A_0 G_{(3)}$



Осока

Лилейные

- Общее число видов 3500-4000, 170-250 родов.
- Листья более или менее мясистые, очередные, сидячие.
- Вегетативные органы часто видоизменены в луковицы, корневища, клубни и т.д.
- Цветок актиноморфный, трехчленный, обоеполый.
- Околоцветник простой, венчиковидный, представлен обычно 6 листочками в 2 кругах.
- Тычинок 6, в 2 кругах.
- Гинецей из 3 плодолистиков. Завязь верхняя.
- Плод – коробочка или ягода.

Диаграммы лилейных



Гусиный лук

$$* \text{ } \overline{\text{P}}_{3+3} \text{ } \overline{\text{A}}_{3+3} \text{ } \underline{\text{G}}_{(3)}$$



Ландыш

$$* \text{ } \overline{\text{P}}_{(3+3)} \text{ } \overline{\text{A}}_{3+3} \text{ } \underline{\text{G}}_{(3)}$$

купена душистая (*Polygonatum odoratum*) — $* \text{ } \overline{\text{P}}_{(3+3)} \text{ } \overline{\text{A}}_6 \text{ } \underline{\text{G}}_{(3)}$

майник двулистный (*Maianthemum bifolium*) — $* \text{ } \overline{\text{P}}_{(2+2)} \text{ } \overline{\text{A}}_4 \text{ } \underline{\text{G}}_{(2)}$



Ирис желтый



Лилия саранка



А



Б



В



Г

Рис. 206. Диаграммы цветков злаков: А — бамбука; Б — риса; В — мятлика; Г — душистого колоска