

3. Subphylum: ANGIOSPERMATOPHYTINA – ANGIOSPERMS

Table 1. shows some of the main differences between two subphylums of seed plants: Coniferophytina (Gymnosperms) and Angiospermatophytina (Angiosperms) are compared based on the features of stem, vascular tissues, flower structure, pollination and seed development.

Table 1.

GYMNOSPERMS	ANGIOSPERMS
<u>stem</u> : woody	herbaceous and woody
<u>homoxylous wood</u> : only tracheids	<u>heteroxylous wood</u> : tracheas + tracheids
<u>phloem</u> : sieve cells	<u>phloem</u> : sieve tubes
<u>flowers</u> : separate male/staminate and female/pistillate flowers	<u>flowers</u> : usually bisexual (staminate and pistillate structures in 1 flower)
<u>perianth</u> : often reduced or missing	<u>perianth</u> : calyx + corolla or tepals
<u>pollination</u> : by wind	<u>pollination</u> : by insects (birds, bats etc.)
<u>pollen deposited</u> on ovule	<u>pollen deposited</u> on stigma
<u>nutritive tissue</u> : endosperm only	endosperm + cotyledons
<u>cotyledons</u> : variable (2-24)	<u>cotyledons</u> : 1 or 2

Angiosperms can be divided into two classes: Monocotyledonopsida and Dicotyledonopsida. Monocotyledonous plants (monocots) germinate with a single cotyledon, dicotyledonous plants (dicots) with two cotyledons, while gymnosperms have variable number (2-24) of cotyledons. Table 2. summarizes the main distinctions between monocots and dicots.

Table 2.

DICOTYLEDONOPSIDA		MONOCOTYLEDONOPSIDA
	<u>Germination</u>	
with 2 cotyledons		with 1 cotyledon
	<u>Root system</u>	
tap root system		fibrous root system
	Number of vascular bundles	
few (oligarch)		several (polyarch)
	<u>Stem: vascular bundles</u>	
in rings		scattered
collateral open		collateral closed
	Secondary thickening	
yes		no
	<u>Leaf</u>	
varied, divided		simple, undivided
	<u>Flower</u>	
whorls of 4 or 5		whorls of 3
calyx (sepals) + corolla (petals)		perigonium (tepals)

Classis: DICOTYLEDONOPSIDA

Subclassis: MAGNOLIIDAE

Ordo: Magnoliales

Familia: Magnoliaceae – Magnolia family

The Magnoliaceae consist of trees and shrubs, distributed in tropical to warm temperate regions, especially in the northern hemisphere. Flowers are large, bisexual, actinomorphic; the receptacle grows into an elongate axis, which bears the androecium and gynoecium. The **perianth** is **multiwhorled** or spiral; **stamens** are **numerous, spiral**, filaments are thickened to laminar; the gynoecium is apocarpous, with numerous, superior, **spirally arranged ovaries**/carpels. The fruit is an aggregate of follicles, berries or samaras. Economic importance includes ornamentals like *Liriodendron* and *Magnolia*. The tulip tree (*Liriodendron tulipifera*) received its name from the four-lobed, tulip-shaped leaves. The bark of this poisonous plant is used in homeopathy.

Familia: Annonaceae – Custard-apple family

The Annonaceae consist of trees, shrubs or woody vines (lianas), with mainly tropical distribution. The flowers are bisexual; with trimerous perianth. The stamens are numerous, usually spiral. The gynoecium consists of numerous carpels with superior ovaries. The fruit is typically an **aggregate of berries**. Resin canals are usually present. Several species are grown for their large, pulpy, **edible fruits**, e.g. custard-apple (*Annona reticulata*), cherimoya (*A. cherimola* / *A. cherimoya*), sweetsop (*A. squamosa*), atemoya (*A. cherimola* x *A. squamosa*) and pawpaw (*Asimina triloba*). The bark, leaves and fruits of some species are used in folk medicine. The so-called Annonaceae-acetogenins are intensively researched, due to their cytotoxic effect. A wide variety of products has been developed and is available for cancer treatment. Another economically important member of the family is **ylang-ylang** (*Cananga odorata*), whose essential oil is utilized in aromatherapy and the perfume industry.

Familia : Myristicaceae – Nutmeg family

The family comprises evergreen trees and shrubs with tropical distribution. The flowers are small and actinomorphic. The most important representative is the nutmeg tree (*Myristica fragrans*), whose egg-shaped, 20 to 30 mm long seed is known as **nutmeg**, while the dried, reddish-brown, “lacy” covering (aril) is known as **mace**, and they are both used as spices. It has to be noted, however, that the consumption of extreme amounts can be toxic and hallucinogenic, due to compounds like myristicin. The essential oil is used in the cosmetic and pharmaceutical industries, e.g. in toothpastes and cough syrups.

Familia: Illiciaceae – Star anise family

The Illiciaceae consist of trees and shrubs with essential (ethereal) oil cells. Its members are distributed in South-East Asia and South-East U.S. to the Caribbean. The leaves are simple and evergreen. The flowers are small, bisexual and actinomorphic. The perianth consists of numerous (7-33) distinct tepals, typically spirally arranged, the outer sepal-like parts grading into inner petal-like parts, which grade into central anther-like parts. The stamens are few to numerous (4-50), in one or more spiral series. The gynoecium is

apocarpous, with numerous (5-21), superior carpels in a single whorl. The fruit is an aggregate of follicles. The flowers are beetle-pollinated.

Star anise (*Illicium verum*) is used as a spice (e.g. in liqueur), and is medicinally important as an expectorant, due to the trans-anethol in its **essential oil**. The poisonous Japanese anise (*I. anisatum*) is used to kill fish and in religious rites.

Ordo: Laurales

Familia: Monimiaceae – Monimia family

The family is distributed in the southern hemisphere, with trees, shrubs and lianas in the tropical areas. **Boldo** (*Peumus boldus*) is native to Chile. Its hard leaves have a slightly bitter flavour and camphor-like aroma, and are used for culinary purposes in Latin America. Boldo leaves are also used as herbal medicine, to support the gallbladder. Its cholagogue effect is attributed to the **alkaloid boldine**.

Familia: Lauraceae – Laurel family

Its representatives are shrubs and trees with essential oil glands. The Lauraceae are distributed in tropical to warm temperate regions, especially in the Mediterranean, South-East Asia and tropical America. The leaves are evergreen, simple, undivided or lobed. Flowers are small, actinomorphic, the subtending receptacle often enlarging in fruit. The perianth is 1-3 whorled, usually consisting of 3 tepals in each whorl. Stamens are 3-12 or more, the gynoecium consists of a single superior ovary. The fruit is a berry or a drupe, which may serve as food, as in the case of **avocado** (*Persea americana*). The leaves of laurel/bay (*Laurus nobilis*) are used as spice, due to the cineole content of the **essential oil**. The members of the genus *Cinnamomum* live in Asia and Australia. The bark of cassia or Chinese cinnamon (*C. cassia*) and Ceylon cinnamon (*C. zeylanicum*) provide the valued spice “**cinnamon**”, with a high level of cinnamic aldehyde in their essential oil. Another important representative of the genus is the **camphor tree** or camphor laurel (*C. camphora*), the source of natural camphor.

Ordo: Piperales

Familia: Piperaceae – Pepper family

The Piperaceae consist of herbs, shrubs, vines or trees with a tropical distribution. The leaves are spirally arranged and simple. The inflorescence is a **spadix**, with very small, actinomorphic flowers densely packed around a fleshy stem; the **perianth is absent**. The fruit is a 1-seeded berry or a drupe; the seeds have a starchy perisperm as their main nourishing tissue, since the endosperm is scanty. The plants have spherical essential oil cells in the parenchyma.

The most important genus is *Piper* (pepper). **Black pepper** (*P. nigrum*) is native to Indonesia. The immature, briefly cooked and dried drupes are known as the spice black pepper, whose pungency is due to the alkaloid piperine. Green pepper is also made from unripe drupes, treated in a way that retains the green colour, such as freeze-drying. If the outer layers of the fruit wall, i.e. the pericarp and mesocarp, are removed, white pepper is obtained, which is essentially the seed with the remaining, innermost layer of the fruit wall (endocarp).

Other *Piper* species are used for flavouring and as medicinal plants or euphoric plants. **Cubeb** or tailed pepper (*P. cubeba*) is cultivated for its fruit and essential oil, mostly grown in

Java and Sumatra, hence sometimes called Java pepper. Cubebs consist of the unripe, dried berries, similar in appearance to black pepper, but with stalks attached (hence the name “tailed pepper”).

Kava or kava-kava (*P. methysticum*) is a crop of the western Pacific. The roots of the plant are used to produce a drink with mild sedative properties. Kava is sedating and is primarily consumed to relax without disrupting mental clarity. It is effective in treating anxiety, as analgesic (relieves pain) and muscle relaxant.

The **betel** plant (*P. betle*) is an evergreen and perennial creeper, with glossy, heart-shaped leaves. The betel leaf is cultivated in most of South and South East Asia. Betel leaves have been chewed as stimulants along with the betel nut or areca nut (*Areca catechu*, *Arecaceae*) since very ancient times. The active ingredients of betel oil, obtained from the leaves, are primarily a class of allylbenzene (chavibetol, chavicol, eugenol etc.), but several terpenes (e.g. p-cymene and terpinene) and terpenoids (e.g. eucalyptol and carvacrol) are also present in the essential oil. The betel leaves are wrapped around areca nut and mineral slaked lime (calcium hydroxide), and this package is chewed together. The lime acts to keep the active ingredient in its alkaline form, thus enabling it to enter the bloodstream. The areca nut contains the alkaloid arecoline, which promotes salivation (the saliva is stained red) and is itself a stimulant. In India, betel is used to cure worms. According to traditional Ayurvedic medicine, chewing areca nut and betel leaf is a remedy for bad breath.

Ordo: Aristolochiales

Familia: Aristolochiaceae – Birthwort family

The Aristolochiaceae consist of shrubs, vines or rhizomatous herbs, usually climbing. Members of the family have distributions in tropical and warm temperate regions, especially in the Americas. The leaves are simple and spirally arranged. Flowers are bisexual, **actinomorphic** (in *Asarum*) or **zygomorphic** (in *Aristolochia*). The perianth consists of a three-lobed, petal-like (petaloid) calyx; the corolla is absent or reduced to three minute petal-like structures (*Asarum*). Stamens are 6-40, often fused with the style, forming a gynostemium (also called a column). The gynoecium is syncarpous, with a mostly inferior ovary. The fruit is usually a capsule, the endosperm of the seed is oily to starchy.

Two species are native to Hungary: European birthwort (*Aristolochia clematitis*), with heart-shaped leaves and pale yellow, tubular flowers; and European wild ginger (*Asarum europaeum*), with kidney-shaped (reniform) leaves and purple flowers lying on the ground. *Aristolochia clematitis* was used earlier as an immune stimulant and diuretic, but recently some of its compounds were found to be carcinogenic and therefore its inner use is prohibited. In *Asarum europaeum* the proportion of phenylpropanes and sesquiterpenes in the essential oil varies to such a degree in various populations, that chemical varieties (**chemovarietas**) can be distinguished. It was formerly used as a spice, and medicinally as an emetic.

Ordo: Ranunculales

Familia: Menispermaceae – Moonseed family

The family comprises mostly climbing plants, and the great majority of the genera are tropical. The flowers are trimerous, the fruit is a drupe. Most family members contain **bitter** substances of **sesquiterpene or diterpene** character. A good example is the bitter Columba root (*Jateorhiza/Jathorhiza palmata*), whose roots (*Colombo radix*) are commercially available, and used for dysentery and diarrhoea, but also increase appetite and enhance

digestion. The other characteristic compounds of the family are the **bisbenzylisoquinoline alkaloids**, found in plants whose extracts have been used as arrow poisons by South American Indians since ancient times. **Tubo curare** (also known as tube or bamboo curare, because of its packing into hollow bamboo tubes) is derived from *Chondrodendron tomentosum*, a large tropical liana native to Central and South America. Its main alkaloid is d-tubocurarine, used as a general anaesthetic and muscle relaxant in various types of surgeries.

Familia: Berberidaceae – Barberry family

The Berberidaceae consist of perennial trees, shrubs or herbs, with a worldwide distribution, especially in the north-temperate regions. The leaves are mostly spiral, but may occur in whorls of three or as a leaf rosette on short internodes; and sometimes the leaves on the long internodes modify into spines. The flowers are bisexual, actinomorphic, hypogynous and trimerous. The perianth is 6-7-seriate, i.e. consists of 6-7 whorls, with 3 parts per whorl: the outer 2 whorls sepal-like (sepaloid), the inner 4-5 whorls petal-like (petaloid), the innermost 2-3 of these nectariferous. The 6 stamens are mostly grouped in two whorls. The gynoecium is unicarpellous, with a superior ovary. The fruit is a berry, or in some cases a follicle or an achene.

Some representatives, such as the common barberry and *Mahonia* species, are characterized by the presence of the greenish-yellow **alkaloid berberin**, along with other alkaloids. European or common barberry (*Berberis vulgaris*) is a deciduous shrub, native to central to southern Europe, northwest Africa and western Asia. The small oval leaves are borne in clusters of 2-5, subtended by a 3-branched spine. The bright yellow flowers are in panicles, the fruit is an oblong, red berry, which is edible, and rich in vitamin C, but very sour. Oregon-grape (*M. aquifolium*) is the type species of the genus *Mahonia*, which comprises evergreen species native to eastern Asia, the Himalaya, North and Central America. *Mahonia* typically have large, pinnate leaves with 5-15 leaflets, and flowers in racemes. Several species are popular garden shrubs, whose berries are edible and rich in vitamin C.

As opposed to the above genera, members of the *Podophyllum* genus lack alkaloids, but are rich in a resin-like compound, podophyllin, which is a strong laxative. **Podophyllotoxin** is a lignan-glycoside, which, due to its antimetabolic effect, is also used as a cytostatic and topically in the treatment of viral and genital warts. Mayapple (*P. peltatum*) is an herbaceous perennial plant, native to North America. The stems grow to 30-40 cm tall, with 2 or 3 palmately lobed leaves on reproductive individuals, or one peltate (umbrella-like) leaf on sterile individuals (hence another common name: umbrella plant). The white flower matures into a yellow-greenish fruit, which is edible only in moderate amounts. When consumed in large amounts, the fruit is poisonous, similarly to the rhizome, roots and foliage. The rhizome has been used for a variety of medicinal purposes, originally by native Americans, and later on by settlers.

Familia: Ranunculaceae – Buttercup family

The Ranunculaceae consist of terrestrial or aquatic, perennial or annual shrubs, herbs or lianas, distributed mainly in temperate and boreal regions. The leaves are spiral, simple to compound. The inflorescence is a cyme or a solitary flower. The flowers are mostly bisexual, actinomorphic or zygomorphic, hypogynous. The perianth is **heterochlamydeous**: the calyx consists of 5-8 (rarely 3), often petaloid sepals; the corolla is made up by few to numerous petals. The numerous stamens are arranged spirally. The gynoecium is apocarpous, usually of numerous pistils/carpels, with superior ovaries. Nectaries can often be found at the base of staminode-like petals. Floral formula: * $C_5C_0A_\infty G_{(\infty)}$ or * $P_{3+3} A_\infty G_{(\infty)}$. The fruit is an

aggregate of follicles, achenes or berries. The flowers are insect- or wind-pollinated. Characteristic active compounds are mostly toxic, and include various alkaloids and cardiac glycosides. **Protoanemonin**, a toxic lactone, is present in all species with achenes. When the plant is wounded, protoanemonin is released, causing itch, rashes or blistering on contact with the skin or mucosa. When drying the plant, the inactive, dimer anemonin is formed.

Buttercups (*Ranunculus*) are mostly herbaceous perennials with bright yellow or white flowers, usually with five glossy petals. All *Ranunculus* species are poisonous when eaten fresh. When buttercups are handled, naturally occurring ranunculin is broken down to form protoanemonin, which is known to cause contact dermatitis in humans. The toxins are degraded by drying (see above). Certain *Ranunculus* species are used in homeopathy.

Aconitum species, known as aconite, monk's hood, wolfsbane, devil's helmet, is a genus of herbaceous perennial plants, native chiefly to the mountainous parts of the northern hemisphere. The leaves are palmately divided. The inflorescence is a raceme of zygomorphic flowers with numerous stamens. They are distinguishable by having one of the five petaloid sepals in the form of a helmet (hence the vernacular names with "hood" or "helmet"). Most of the 2-10 petals are modified into nectaries. The fruit is a follicle. Aconites contain the highly poisonous triterpene alkaloid aconitin (already a few milligrams can be fatal). Several species of *Aconitum* have been used as arrow poisons. Currently they are utilised in homeopathic remedies. Some well-known species are common monkshood (*A. napellus*) and yellow monkshood (*A. anthora*).

Pheasant's eye (*Adonis vernalis*) is a perennial plant found in dry meadows and steppes in Eurasia. The plant is poisonous, containing cardenolide type cardiac glycosides, substances used to treat heart failure. In Hungary *A. vernalis* is protected, thus cannot be collected for medicinal purposes.

Commonly known as hellebores, members of the genus *Helleborus* comprise herbaceous perennial species, native to much of Europe. The flowers have five petaloid sepals, surrounding a ring of small, cup-like nectaries (petals modified to hold nectar). The plants are poisonous, due to the presence of bufadienolide type cardiac glycosides. The protected *H. odorus* grows wild in Mt. Mecsek and southern Transdanubia. Other hellebores native to Hungary include *H. dumetorum* and *H. purpurascens*. The rhizomes and roots of hellebores are traditionally used to support the immune system of cattle and sheep.

Several authors classify some of the above discussed genera into the family **Helleboraceae (hellebore family)** rather than the buttercup family. They are distinguished by follicles or berries as the typical fruit type, rather than achenes; and by the presence of bufadienolide type cardiac glycosides as the characteristic chemical compounds. According to the above distinction, hellebore (*Helleborus*), monk's hood (*Aconitum*), bane berry (*Actaea*), columbine (*Aquilegia*) and larkspur (*Consolida* and *Delphinium*) species are all members of the Helleboraceae.

Ordo: Papaverales

Familia: Papaveraceae – Poppy family

The Papaveraceae consist of annual or perennial herbs, shrubs or small trees, with milky latex from **articulated laticifers** in some taxa. The **latex** contains a mixture of **alkaloids** (benzyl-, phtalid-isoquinoline-, phenanthrene-type alkaloids), the exact composition characteristic to the given species. The leaves are usually divided; the flowers are bisexual and actinomorphic. The perianth is heterochlamydeous: the calyx consists of 2 (sometimes 3) sepals, which fall by the time of flower opening; the corolla is made up by two whorls of 2+2

(or 3+3) petals. The stamens are usually numerous, therefore the insect-pollinated flowers are often called “pollen flowers”. The gynoecium is paracarpous, with a superior ovary, 2 to several carpels and usually parietal placentation. Floral formula: * Ca₂Co₂₊₂A_∞G₍₂₋₂₅₎. The fruit is generally a **poricidal capsule**, the seed endosperm is rich in oils and proteins.

The genus *Papaver* is the most significant both pharmaceutically and culturally. Opium poppy (*P. somniferum*) is the leading representative. **Opium** (poppy tears), the dried latex obtained from poppy by scratching the immature fruits, was already recognized in ancient cultures. Opium contains the mixture of more than 50 alkaloids, the most important ones being morphine, codeine, narcotine and papaverine. Opium itself used to be applied as an excellent narcotic analgesic (painkiller) and spasmolytic (suppresses muscle spasms), even in surgery. At the meantime, however, the narcotic effect of opium became known. Even today, **morphine** is one of the best analgesics known; **codeine** and **narcotine** are chiefly used as cough suppressants (antitussives); while **papaverine** is valued for its antispasmodic effect. Sertürner, a German pharmacist investigated poppy alkaloids (1805-1817) and discovered morphine. The administration of morphine in itself (independently from opium) as an analgesic began at the time of the 1st World War. In the 1920s the Hungarian pharmacist, János Kabay and his wife devised a method for the production of morphine from the green, later on from the dried plant parts of poppy, and finally from the dry, seedless capsules. Morphine can be converted into **heroin** (diacetylmorphine), an analgesic and illegal recreational drug, whose frequent and regular administration can lead to addiction. Poppy breeding (developing new poppy cultivars with higher alkaloid content and a special alkaloid spectrum for pharmaceutical purposes, or with lower alkaloid level for food products) has had a long tradition in Hungary.

Another significant species is the Iranian poppy (*P. bracteatum*), with large red flowers and a black spot near the base of the petals. Besides being an ornamental, this species can be used for production of **thebaine**, which is converted to codeine and semi-synthetic opiates. The main advantage of *P. bracteatum* is that it does not contain morphine or other narcotic phenanthrene-type alkaloids. Oriental poppy (*P. orientale*), native to the Caucasus, northeastern Turkey and northern Iran, is also cultivated as an ornamental.

Corn poppy or field poppy (*P. rhoeas*) is an agricultural weed with bright red flowers, native to Europe. Red poppies are the symbol of fallen soldiers, and in Persian literature are considered the flower of love. The main alkaloid of corn poppy is rhoeadine, which can be used as cough suppressant. The petals have a mild antiphlogistic (reducing inflammation) effect.

Greater celandine (*Chelidonium majus*) is native to Europe and western Asia. The leaves are characteristically lobed, the flowers are yellow, the fruit is a long capsule. The sap is yellow to orange. The whole plant is toxic as it contains a range of isoquinoline and phenanthrene alkaloids (coptisine, berberine, chelidonine etc.), but there are numerous therapeutic uses when applied at the correct dosage. The fresh herb has a mild analgesic, cholagogic, spasmolytic and cytostatic effect. The latex contains proteolytic enzymes that could explain the topical use against warts and moles.

Familia: Fumariaceae – Fumitory family

Fumariaceae (fumitory, fumewort or bleeding-heart family; sometimes treated as subfamily Fumarioideae under family Papaveraceae) is a family of herbaceous plants native to the northern hemisphere and some parts of Africa. The family comprises both annuals and perennials (with tubers or rhizomes). Distinctive features from Papaveraceae are the **lack of latex**, and the **disymmetrical** (biradial) or **zygomorphic** (bilateral) **flowers**, the outer whorl of petals usually with a spur or sac. The fruit is a capsule or nutlet. Attached to the seeds,

elaiosomes (fleshy structures, rich in lipids and proteins, attracting ants that in turn help seed dispersal) can be observed in species with capsules. Similarly to Papaveraceae, the main active compounds are various alkaloids, which are secreted by special idioblasts.

The genus *Fumaria* comprises small, fragile plants that are weeds on arable lands. Common fumitory or earth smoke (*Fumaria officinalis*) is the most common species of the genus in Central and Western Europe. The annual plant contains alkaloids and tannins and is also a major source of fumaric acid. It is occasionally used as a mild laxative and cholagogue.

Corydalis is a genus of annual and perennial plants native to the temperate northern regions and the high mountains of tropical eastern Africa. *Corydalis cava* / *C. bulbosa* and some other tuberous species (e.g. *C. solida*) contain the alkaloids corydalin and bulbocapnine, which are occasionally used in medicine. *C. bulbosa* and *C. solida* are typical understory plants in our deciduous forests, blooming in early spring, flower color ranging from white to purple. In *C. cava* there is a cavity in the tuber, and the bracts of the inflorescence are entire; whereas in *C. solida* the tuber is solid (not hollow), and inflorescence bracts are divided.

Old-fashioned bleeding-heart (*Dicentra spectabilis*) is a rhizomatous perennial plant with heart-shaped flowers. It is a popular ornamental, valued for its unique, dissymmetrical flowers, with outer pink and inner white petals.

Ordo: Nymphaeales

Familia: Nymphaeaceae – Water lily family

Members of this family are commonly called water lilies and live in freshwater areas in temperate and tropical climates. Nymphaeaceae are perennial, rhizomatous **aquatic** plants, rooting in the soil underwater, with leaves and flowers floating on the water surface. The leaves are round, with a radial notch in *Nymphaea* and *Nuphar*, but fully circular in *Victoria*. The actinomorphic **flowers** are large, conspicuous, with **spirocyclic** structure (perianth arranged in whorls, stamens and carpels spirally). Several transitory forms can be observed between the perianth and androecium: the sepals are often petal-like, and petals often intergrade with stamens. The fruit is an aggregate of nuts, a berry, or an irregularly dehiscent fleshy capsule. Characteristic compounds include sesquiterpene alkaloids and tannins.

In water lily (*Nymphaea*) the petals are much larger than the sepals, whereas in spatterdock or yellow water lily (*Nuphar*) the petals are much smaller than the sepals. The fruit maturation also differs in the two genera, with *Nymphaea* fruit sinking below the water level immediately after the flower closes, while *Nuphar* fruits are held above water level to maturity. The seeds of spatterdock are edible.

The floating leaves are very large in the genus *Victoria*: *V. amazonica*, native to the shallow waters of the Amazon river basin, has a leaf that is up to 3 m in diameter. The leaf of *Victoria* is able to support quite a large weight (up to 35 kg), if distributed evenly on the leaf surface.

Familia: Nelumbonaceae – Water lotus family

The Nelumbonaceae consist of **aquatic**, perennial herbs, native to Africa and Asia (some species to Australia), with milky latex present from articulated laticifers. The stems are rhizomatous. The leaves are simple and orbicular, the petiole **emerging high above the water**. The flowers are large, actinomorphic, long-pedunculate; the receptacle is enlarged and spongy, with numerous sunken cavities containing individual pistils. The perianth consists of an outermost whorl of two green, sepaloid tepals, and two inner whorls of numerous petaloid tepals. The stamens are numerous, spiral; the gynoecium is apocarpous, with 12-40 one-

loculed superior ovaries. The fruit is an aggregate of nuts, each sunken in an expanded receptacle. Nutritive substances are located within the cotyledons of the seeds. The rhizomes, leaves and seeds of *Nelumbo* species are consumed. The most well-known species is the sacred lotus or Indian lotus (*N. nucifera*), native to tropical Asia and Australia. Under favorable circumstances its seeds may remain viable for many (more than 1000!) years. The active substances are mainly benzyloquinoline alkaloids.

Ordo: Rafflesiales

Familia: Rafflesiaceae

Rafflesiaceae is a family of **parasitic** plants found in East and Southeast Asia, including *Rafflesia arnoldii*, the plant with the largest diameter flower of all plants. The plants are endoparasites of vines (Vitaceae) and lack stems, leaves, roots and any photosynthetic tissue. Similar to fungi, the individuals grow as thread-like strands (**mycelium roots**) of tissue completely embedded within and in intimate contact with surrounding host cells from which nutrients and water are obtained. Only the flowers emerge from the roots or lower stems of the host plants. The flowers of *R. arnoldii* attain a diameter of around 1 m and produce a strong odor of decaying flesh (hence the nickname “corpse flower”). The scent attracts insects such as flies which in turn pollinate the plant.