Angiosperms division. Overview of the main orders and families of angiosperms.
A subclass of Magnoliids.

The Division of Angiosperms, or Flowering plants, includes 2 classes: dicotyledonous and monocotyledonous, 12 subclasses, about 533 families, 13000 genera and at least 2500000 species.

The dicotyledonous and monocotyledonous classes differ in the following characteristics.

Monocotyledons are flowering plants or angiosperms bearing seeds with a single cotyledon or embryonic leaf. Also called Monocotyledonous plants are also referred to as monocots.

Dicotyledons are flowering plants or angiosperms bearing seeds with two cotyledons or embryonic leaves. Dicotyledonous plants are also referred to as dicots.

Species. Monocotyledon is a smaller group of flowering plants with 60,000 species of plants.

Dicotyledon is a larger group of flowering plants with about 200,000 species of plants.

Root. Monocots have an adventitious or fibrous root system. Most dicots have a tap root system. However, some dicots have an adventitious root system. In monocots, the root has about 8-10 xylem rays. In dicots, the root has about 2-4 xylem rays.

Stem. The stem in most monocots is herbaceous. But, some plants have arboraceous stems. The stems in dicots are either herbaceous or arboraceous. The Monocot arboraceous stem is unbranched and fleshy. Dicot arboraceous stem is branched and hard. Within the stem of monocots, the vascular bundles are scattered in no particular pattern. Within the stem of dicots, the vascular bundles are arranged in concentric circles. Most monocot stems lack a lateral meristem or cambium. A lateral meristem or cambium is present in the stems of dicot plants.

Secondary growth. Monocots do not undergo secondary growth due to the absence of cambium. Secondary growth occurs in dicots as the cambium is present.

Leaf. The leaf in monocots is isobilateral and radial in symmetry. The leaf in dicots is dorsoventrally flattened. Monocots usually have long, narrow, and slender leaves. Dicots usually have broad leaves, but the shape and size of the leaves vary according to the species. Monocot leaves have stomata on both upper and lower surfaces and thus are termed amphistomatous. Dicot leaves have stomata only on one of the surfaces of the leaf and thus, are termed epistomatous.

Venation of leaf. The leaves in monocots have a parallel venation system. The leaves in dicots have a reticulate venation system.

Flowers. Monocot flowers are usually trimerous, meaning the number of parts of the flowers is either three or it's multiple. Dicot flowers are usually tetramerous or pentamerous, meaning the number of the flower parts is either five or four or their multiple.

Germination. The seed germination in the monocot embryo is hypogeal. The seed germination in the dicot embryo is either hypogeal or epigeal.

Embryo. The embryo in monocots contains only one cotyledon or seed leaves. The embryo in dicots contains two cotyledons or seed leaves. Embryo in monocots produces a single leaf that grows as a long and narrow structure during germination. Embryo in dicots produces two seeds that develop into different shapes than their true leaf.

Examples

Bamboos, bananas, asparagus, ginger, tulips, lilies, palms are some examples of monocots.

Roses, oak trees, daisies, peas, beans, cactus are some examples of dicots.

Basis for Comparison	Monocotyledons (Monocots)	Dicotyledons (Dicots)
Embryo	As the name suggests, the dicot embryo has two cotyledons.	Monocotyledons have one cotyledon in the embryo.
Leaf venation	Leaf veins are reticulated (branched).	Leaf veins are parallel.
Type of leaves	Dorsiventral	Isobilateral and radial

Basis for Comparison	Monocotyledons (Monocots)	Dicotyledons (Dicots)
Stomata in leaves	Some dicots are epistomatous i.e., they have stomata only on one surface on their leaves.	Monocots are amphistomatous i.e., monocot leaves have stomata on both the upper and lower surface.
Bulliform cells	Dicot leaves do not have bulliform cells.	Many monocots have bulliform cells on their leaves to regulate the loss of water.
Flowers	Petals in multiples of four or five. May bear fruit (if tree).	Petals in multiples of three.
	Taproot system	Fibrous roots
Secondary growth	Often present	Absent
Stem and vascular system	Bundles of vascular tissue arranged in a ring. The vascular system is divided into a cortex and stele.	Bundles of vascular tissue scattered throughout the stem with no particular arrangement, and has no cortex.
Pollen	Pollen with three furrows or pores.	Pollen with a single furrow or pore.
Presence or absence of wood	Both herbaceous and woody	Herbaceous
of seed leaves	2 seed leaves	1 seed leaf
Examples	Legumes (pea, beans, lentils, peanuts) daisies, mint, lettuce, tomato and oak are examples of dicots.	Grains, (wheat, corn, rice, millet) lilies, daffodils, sugarcane, banana, palm, ginger, onions, bamboo, sugar, cone, palm tree, banana tree, and grass are examples of plants that are monocots.

There are exceptions in each point, but more often than not, dicotyledons and monocotyledons can be easily distinguished from each other by a combination of features.

https://www.youtube.com/watch?v=xe99TGccbxo
https://www.youtube.com/watch?v=7DqsZbSdbrk
https://www.youtube.com/watch?v=ajWr4DuaAj4

Since the emergence of botany as a science, disputes about the relationship and origin of orders and families of angiosperms have not subsided. A huge num-

ber of very diverse systems have been built, which are based on various morphological and genetic characteristics.

Currently, a new phylogenetic system of angiosperms is being created, which is based on the structure of DNA. However, since it is far from being completed and is revised almost annually due to newly discovered data, we will study taxonomy using the traditional system proposed by the Russian botanist Armen Leonovich Takhtajyan and by Arthur Cronquist. The Cronquist system is a taxonomic classification system of flowering plants.

I attached a link where you can get acquainted with the current trends in angiosperm taxonomy in the text of the lecture. http://www.mobot.org/MOBOT/research/APweb/

Eudicotes (Latin eudicotes, from Greek εὖ- "good", "true" and Latin dicotyledones "dicotyledonous plants") is a group (clade) of indefinite rank, used in the systems of Classification of Cladophytes developed by Angiosperm Phylogeny Group (APG) - APG I (1998), APG II (2003) and APG III (2009).

As for other groups of taxa of a higher order, the authors of the APG systems did not establish a botanical (Latin) name for the group eudicots, establishing only the English name for this group. In the Russian literature, the translation "true dicotyledons" is sometimes given for this group.

Eudicots is a monophyletic group; it includes most of the taxa that were formerly assigned to the class Dicotyledonous. At the same time, it has been determined that some ancient taxa of Angiosperms (e.g., Amborellaceae, Austrobaileyales, Schisandraceae, Chloranthaceaeae, Nymphaeaceae, which traditionally belonged to the Dicotyledon class, are the remains from different basal groups and cannot be combined with "true dicotyledons" into a monophyletic group (sometimes the set of these remains from basal groups is combined into a paraphyletic group, called palaeodicots).

The origin of the different subclasses of monocotyledonous and dicotyledonous plants can be represented by the table .

It is believed that all subclasses of both classes descended from common ancestors. The most archaic is the Magnoliid subclass, the ancient representatives of which are considered the ancestors of all other flowering plants.

Before we begin to understand the systematics of angiosperms, let's remember which signs of a flower are considered progressive and which are primitive.

So:

Primitive sign:

receptacle convex, elongated
large number of perianth members
spiral arrangement of members flower
actinomorphic flower

large solitary flowers
polypetalous and polysepalous flower

Progressive sign:

receptacle shortened, flat, even concave
reduced number of perianth members
circular arrangement of members flower
zygomorphic flowers
small brightly ornamented, aggregated in inflorescences
gamopetalous and gamosepalous flower

The combination of primitive and progressive features in one flower can be the most bizarre and the most progressive features can be combined with very primitive ones. However, the more primitive signs a flower has, the older the plant is considered, the more progressive signs, the younger the plant is considered.

Class Dicotyledons. Magnoliopsida / Dicotyledons includes 8 subclasses, 429 families, about 200000 species.

The following features are characteristic of representatives of this subclass:

1. Two cotyledons in the embryo of. Every a cotyledon with three vascular bundles.
2. Reticulated or fingered venation of leaves.
3. The leaves are simple and compound more or less divided into a petiole and a plate.
4. Predominantly (but not always) a taproot system.
5. The presence of secondary growth due to cambium
6. Stems have open vascular bundles arranged in a circle, or stems have annular non-bundled structure.
7. Flowers are mainly 5- rarely 3- 4-membered.

The dicotyledonous class includes 8 subclasses:

1. Magnoliids - Magnoliidae
2. Ranunculids - Ranunculidae
3. Caryophyllids - Caryophyllidae
4. Hamamelids -Hamamelidae
5. Dilleniidae- Dilleniidae
6. Rosids - Rosidae
7. Lamiids - Lamiidae
8. Asterids - Asteridae

Subclass Magnoliids - Magnoliidae

The most archaic currently living flowering plants are included in the subclass of magnoliaids. The main and central group of magnoliths, the Magnoliaidae order, is particularly primitive. However, the primitiveness of individual representatives of the subclass is very relative. As a result of adaptive radiation of evolution of ancient magnoliids, various families, orders and even superorders, which evolved in different directions, appeared. Thus, they all underwent specialization, and different parts of the plant (different organs and even different tissues) changed in different branches. If in some magnoliids the flower was modified, which in some cases was strongly reduced (as, for example, in Chloranthaceae), in other cases vegetative organs underwent much greater changes, which was especially pronounced in parasitic forms. It is quite understandable, therefore, that no plant with the entire complex of archaic signs of the subclass could be preserved among modern magnoliids, including those of the order Magnoliales. The primitive characters of the order Magnoliales and of the subclass Magnolidae are generally scattered, and very irregularly, among individual representatives. Moreover, many dicotyledons bizarrely combine very primitive, archaic characters with signs of specialization, sometimes quite high. Different traits of organization appear as if on different levels of evolutionary development.

When we say that a subclass of Magnoliidae is the original group, from which other subclasses and orders are evolved, we mean the subclass as a whole, but not its individual representatives. Clearly, the ancestral forms that gave rise to the major phylogenetic branches of flowering plants are long extinct. But when we say that they are evolved from Magnoliidae or even from the order Magnoliales, we believe that if the ancestors were known to us, taxonomically we would assign them exactly to these groups.

The subclass of magnoliids is relatively small, but, as a result of adaptive radiation, which already started at the dawn of the evolution of flowering plants, it has strongly differentiated, and you can clearly distinguish not only the well separated orders, but also separate groups of orders, which in some modern systems are called supraorders.

Order Magnoliales .

Representatives of the order are mostly trees and shrubs. Leaves with or without stipules. Vessels present or absent. Flowers are spiral, spirocyclic or cyclic, often pollinated by beetles. Stamens are usually numerous, often ribbon-like, and often of very primitive structure. Pollen grains are uni-bearded or derived from the uni-bearded type. The gynoecium is mostly apocarpic, rarely paracarpic or syncarpic. Endosperm is cellular or nucleate (Myristicaceae).

Families: Winteraceae, Myristicaceae, Magnoliaceae, Degeneriaceae, Eupomatiaceae, Annonaceae, Canellaceae, Austrobaileyaceae, Himantandraceae, Lactoridaceae.

Family Magnoliaceae

The family consists of 12 genera and 230 species. The main mass of species is concentrated in subtropical areas of the northern hemisphere. On the territory of Russia naturally grows only 1 species *Magnolia obovate*. *Magnólia grandiflóra* is widely cultivated in the south of the country.

The range of magnolias is disjunctive and dissected into a number of isolated parts.

Members of the Magnolia family are evergreen or deciduous trees, less commonly shrubs, with simple alternate leaves. Stipules are large, spanning the stem, but fall off early. Flowers are actinomorphic, usually ovipotent (bisexsual), often rather large, solitary, located at the tips of branches or in leaf axils, with bracts. Perianth is 3-6 members, simple, in two or more circles; perianth members are loose, more or less similar; outer members of some species are smaller, green, and resemble sepals. Stamens are numerous, free, spirally arranged. The gynoecium is almost always apocarpous, consisting of numerous, also spirally arranged carpels. The number of ovules in each carpel varies from 14 to 2. All parts of the flower are on a conical receptacle. Example flower formula: $P_9A_\infty G_{\underline{\infty}}$.

Fruits are apocarpic, most often cone-shaped multilocular. Less often (in the Liriodendron) are etaerio of achenes and etaerio of follicles. Seeds are usually two in number, covered with a fleshy seed coat. The embryo is small, surrounded by a large endosperm.

Alkaloids, sexquiterpene lactones, lignans, and essential oils are found in them.They are used in ornamental horticulture and in perfumery. Tincture of M. largeflower leaves is used as a hypotensive medicine.

Order Illiciales.

Members of this order are thought to be descended from the order Magnoliales, most likely from the ancestors of Vinteraceae. They are small trees, shrubs or lianas. Leaves lack stipules. Vessels always present, usually with scalariform perforation. Flowers are bisexsual or unisexual. Perianth is spiral. Stamens are mostly numerous, usually arranged spirally, either loose or fused. Pollen grains are 3- or 6-bearded. The fruiting tracts are arranged cyclically or spirally. Endosperm is cellular.

The family Schisandraceae.

Two genera, 45 species of woody lianas.

Occurs in East and Southeast Asia. *Schisandra chinensis* in the north of its range reaches Amur and Sakhalin. A characteristic feature is an elongated receptacle of flowers; plants are monoecious and dioecious. After flowering, the receptacle becomes very elongated and by the time the fruit matures, it takes the form of a bunch-shaped berry-like, one- or two-seeded red flashy etaerio follicles.

The bark has a lemony odor, the seeds have a peculiar pine flavor. Contains lignans, which are responsible for the tonic effect of the fruit, used in scientific medicine.

* $P_{\infty}A_0\underline{G_{\infty}}$ *$P_{\infty}A_{3-7}G_0$

The family Iliiciaceae

Representatives of the order are apparently descended from magnoliaceae and have a common ancestor with the Schisandraceae. Some taxonomists conflate them with them. They are short trees or shrubs, including climbing or creeping ones. Leaves without stipules. Flowers are with double perianth, both or unisexual, spiral or spirocyclic. Stamens are usually numerous. Gynoecium is apocarpic. In the family there is one genus, which is Illicium, an evergreen, often aromatic shrub or short tree with leathery leaves. Fruits are leathery or ligneous etaerio follicles that contain an essential oil similar in composition to that of anise. The genus includes over 40 species, in East and Southeast Asia - from India to Japan and on Sumatra and Kalimantan Islands, and in America - in eastern Mexico, West Indies and southeast North America. The fruits of star anise (*I. verum*), from Southeast Asia, are used as a spice.

* $P_{\infty}A_{\infty}\underline{G_{\infty}}$

Order Laurales.

Closely related to the order Magnoliales, but more advanced. Representatives of the order are, for the most part, trees and shrubs, rarely semishrubs and herbs. Leaves without stipules. Vessels for the most part present, ranging from very primitive to very specialized. Flowers are usually cyclic, bisexual or less frequently unisexual. Stamens are mostly of a highly specialized type and often form reduced bundles. Pollen grains are uni-bearded or derived from the uni-bearded type (most often without aperture). The gynoecium is for the most part monocapous. Endosperm is cellular or nucleate. Embryo from small to large.

Families: Amborellaceae, Calycanthaceae, Gomortegaceae, Hernandiaceae, Idiospermaceae, Lauraceae, Monimiaceae, Trimeniaceae.

The family Lauraceae.

This family includes 40 genera and 2500 species. In Russia naturally grows in the Caucasus only 1 species - *Laurus nobilis*.

The Lauraceae is mostly evergreen trees and shrubs, which inhabit humid tropical areas, rarely chlorophyll-free parasitic climbing plants. Leaves are simple, alternate or opposite, without stipulas, often dense, leathery, often with translucent punctures, which are cavities of essential oil. Flowers are actinomorphic, bisexsual or unisexual; the perianth is simple. The perianth and androecium are 3-4 members; perianth tepals are loose, in 2 circles, greenish or yellowish-white; stamens are loose, in 3-4 circles, with filaments accreted to the perianth tepals at the base; some (all in female flowers) are reduced to staminodes. The ovary is upper. Ovule -1. Pistil - 1, simple, tips in a small cephalic stigma. Fruits are pseudomonocarpous or syncapous. It is drupes or berries. Seeds are without endosperm with a direct embryo.

* $P_4A_{0\text{staminodes}}\underline{G_1}$ *$P_4A_{\infty}G_0$

Essential oils are found in the leaves.Oily oils are common in the fruits. Alkaloids are found in some representatives. Cinnamomum verum bark is used as a spice called cinnamon.

The order Piperales.

It is most closely related to the order Laurales and probably has a common origin with the Chloranthaceae and Lactoridaceae. It is mostly herbs and shrubs. Leaves are usually with stipules. Vessels always have, with scalariform or, more often, simple perforation. Flowers are very small and unsightly, usually in dense spikes or racemes, bisexual and unisexual, without perianth. Pollen grains are small, single-bearded or non-apertural. Gynoecium apocarpic, paracarpic or pseudomocapic (Piperaceae). Ovulus orthotropic. Endosperm cellular or nucleate. Seeds with very small embryo, scanty endosperm and abundant perisperm.

Families: Saururaceae and Piperaceae.

The pepper family Piperaceae

These are herbs, shrubs, often climbing or (less frequently) small trees, with alternate entire leaves usually without stipules, often, but not always, with arching veins. Leaves of pepper plants are varied in shape; in some species they are even shield-shaped. Almost all pepper species have flowers grouped in dense spikes. They are always formed at the tips of spikes. The vegetative axis increases at the expense of lateral shoots which appear directly under the inflorescence. Thus, a sympody is formed. Inflorescences are moved aside and arranged as if in several layers. Flowers are very small, unremarkable, without perianth, in the axils of shield-shaped (peltate) leaves; they are often bisexual, less often unisexual. Stamens 1-10 (most often 2-3). Carpels 1-6 (often 3), fused. Pistil with 1-6 stigmas and unilocular ovary, with a single basal orthotropic ovulus, with 1-2 integuments. The fruit is a small drupe, juicy or dry. Seeds without endosperm, with abundant perisperm and a small embryo. Vascular bundles are scattered, in 2 or more circles. Cells containing piperine and camphor are characteristic. About 10 genera and 1400 species are known in moist tropical forests throughout the world, especially the Americas and Melanesia. Many species are epiphytes.

Among representatives of the pepper family there are also ornamental variegated species with a white pattern on the leaves. In general, they and especially representatives of the genus Peperomia are eagerly cultivated in greenhouses.

The anatomical structure of stems is completely atypical for dicotyledons. Vascular bundles are either scattered haphazardly (Peperomia) or arranged in 2 (or more) circles (Piper), but unlike monocotyledons, the cambium functions normally.

The main genera of the family: pepper (Piper) and peperomia (Peperomia), numbering 600-700 species (maybe more) each, besides external similarities, bear a number of significant differences, some of which are listed above. It should be added that the species of Peperomia are herbaceous plants, whereas in the genus Piper, shrubs predominate. Peperomia has 3 integuments (a very rare character!)

and a 16-core embryo sac.

The Piperaceae are one of the most important spice-giving families. First of all, these are species of the genus Piper rich in the alkaloid piperine. The best known of them is the black pepper (*Piper nigrum*), a climbing shrub with arch-shaped ovate-lanceolate leaves, and native to the Malabar Coast of India. It is cultivated in many tropical countries; under the name "black pepper" the unripe fruit, with the outer layers of the pericarp shrinking as it dries, is commercially available.

In books about Pacific islands one often finds references to an intoxicating drink called kava, which is made from chewed roots of the pepper (Piper methysticum). Apparently, the saliva causes the breakdown of some resins. Frequent consumption of the drink leads to weight loss, wrinkled skin, and rapid aging. In Southeast Asia and Melanesia, betel, made from the leaves of the betel pepper (Piper betle), lime, and nuts of the palm (Areca catechu) was very popular, and in some places is still used today. Frequent consumption of the drink leads to weight loss, wrinkled skin, and rapid aging. In Southeast Asia and Melanesia, betel, made from the leaves of the betel pepper (Piper betle), lime, and nuts of the areca palm (Areca catechu) was very popular, and in some places is still used today. The resulting mixture, when chewed, led to the formation of tartars, which was highly valued by many indigenous tribes.

The position of the family in the system of the angiosperms cannot be considered established. Some scientists include the pepper plants in the subclass Magnoliidae as a derivative group. Others consider this family as extremely primitive and completely isolated. There is also the opinion that the Piperaceae, together with Araceae and palms (Arecaceae) (from monocotyledons), represent a very separate evolutionary lineage, not related to the other angiosperms at all. This opinion is based on the similarity in the vegetative and generative organs between the pepperaceous and aroids as well as on the anatomical "monocotyledonous" features of the family.

The order Aristolochiales.

An order of flowering plants, division Magnoliophyta (Angiospermae), in the subclass Magnoliidae of the class Magnoliopsida (dicotyledons). It contains only the family Aristolochiaceae, with 8 or 10 genera and about 600 species, most of them in tropical and subtropical regions. Within its subclass, the order is marked by the presence of ethereal oil cells, by its uniaperturate or nonaperturate pollen and especially by its strongly perigynous to epigynous flowers, usually with united carpels, that typically lack petals and have the sepals joined into a highly irregular, corolloid calyx. Many of the species are climbing vines. Aristolochia (birthwort or Dutchman's pipe) and Asarum are well-known genera of the order.

Family Aristolochiaceae.

Among Aristolochiaceae, tropical and subtropical plants predominate, with only a few species reaching temperate latitudes. They can be found on all continents ex-

cept Australia. Totally there are 7 genera and probably about 450 species in the family (according to some authors - up to 600). Most of them are climbing shrubs (lianas), sometimes reaching a height of 10 m or more, or perennial grasses. Rarely, upright shrubs and bushes are found. Leaves are alternate, entire and often heart-shaped, less often 3-5-lobed, sometimes hyaline-pointed, without stipules. Spherical secretory cells are present in parenchyma tissues of leaves and stems.

Flowers are solitary or less often aggregated in racemose or verticillate inflorescences, bisexual, actinomorphic or zygomorphic, usually three-membered, and usually characterized by a peculiar perianth color imitating the color of decaying meat and an unpleasant odor of fallen or rotting tobacco.

The calyx is gamosepalous, 3-lobed, sometimes enlarged and petal-like, performing the function of usually absent petals. Stamens 3-6, most often 6, in 1 or 2 circles; stamen filaments free or fused with the style in a column, the so-called gynostemium. Anthers are free or adherent to the gynostemium. Gynoecium consist 4-6 carpels. It is semi-apocarpic (only in the genus Sarum) or cenocarpic, with a thick short style and stellate stigma. Ovary is lower or rarely semi-lower (in the genus Sarum and some species of Asarum), 4-6 locular or incomplete septa, with numerous ovules.

Flowers of the Aristolochiaceae are dichogamous. Stigmas mature first, and then anthers begin to open, almost eliminating self-pollination.The peculiar perianth coloring, the odor of the droplets and the zygomorphy of some flowers indicate pollination by a certain type of insects. After pollination, the ovary produces a capsule (as in the genus Aristolochia) or a one-seeded and unopened fruit, or, more rarely, a semi-apocarpic etaerio follicles (as in the genus Sarum). Seeds have abundant endosperm and very small embryo. Seeds of the Aristolochiaceae often have special adaptations for spreading. For example, Asarum grass species have fleshy, juicy appendages that are readily eaten by ants, and the seed of *Aristolochia clematitis*, which grows in flood meadows and flood-plain forests, has a belt of light proboscis tissue which allows them to remain on water for a long time without losing their germination. In other species, the light, flat seeds are equipped with wings and spread by the wind.

Order Rafflesiales.

A highly specialized and systematically very isolated order of chlorophyll-free parasitic plants, which probably evolved from one of the ancient branches of the order Magnoliales, most likely from ancestors, which were close to Annonae. Leaves are absent or represented by scales on peduncles. Vessels, when present, with simple perforation. Flowers are double or unisexual, cyclic, and lobeless. Sepals are 3-5, more or less fused into a tube. Stamens 3-20, more or less fused into a ring, a tube or, more often, into a fleshy column.

Gynoecium paracarpal, of 3-20 carpels; ovary lower or semi-lower, rarely upper. Ovules numerous, anatropic or more often orthotropic, bitegmal or more often unitegmal, tenuynucellate.Seeds numerous, small, with undifferentiated embryo; embryo very small and surrounded by abundant endosperm and perisperm or relatively large and surrounded only by endosperm (Rafflesiaceae).

Families: Rafflesiaceae

Family Rafflesiaceae

The family Rafflesiaceae includes 8 genera and no more than 55 species, mainly distributed in tropical countries.

To date, the Rafflesiaceae have not been studied fully and unevenly. This is conditioned by their habitat in hard-to-reach or sparsely populated areas, as well as by their biology. They spend most of their lives in the tissues of plant hosts or in the soil. Rafflesia seedlings are usually embedded in the roots of the host plant by suction cups (haustoria). Those parts of the seedling which remain outside the host plant tissues gradually die off, and further development of the parasite occurs exclusively in the tissues of the victim plant root or stem. The parasite body living in the tissues of the host plant is called endophyte, and this way of parasitism is called endoparasitism. The endophyte receives nutrition from the surrounding cells of the host plant.

In the host plant tissues, the parasite body spreads in the form of cell strands resembling fungal hyphae. Their arrangement, structure, branching and other peculiarities of development may be diverse.

Rafflesia flowers are laid endogenously. In some parts of a parasitic plant, rudiments of individual flowers (Rafflesia etc.) or shoots are formed, on which the whole inflorescence is later formed. These rudiments grow, develop, and finally emerge through breaks in the host plant's covering tissues. In the earlier stages of development the rudiments of flowers or shoots of the parasitic plant can be recognized by the characteristic tubercles in the roots or stems of the victim plant.

Flowers of Rafflesiaceae range from very small to unusually large, solitary and sessile or less often in spike-like inflorescences (most species of Cythinus and Bdallophyton), mostly unisexual, rarely polygamous or double-sex. Most species of the Rafflesiaceae family are dioecious. The flowers of Rafflesiaceae are petalless.

Sepals are usually 4-5, fused in the lower part into a tube or rarely free, petiolate or rarely folded (Rhizanthes), sometimes petal-like. Stamens are from 5 to many, more or less fused into a tube or, more often, into a fleshy column. The rafflesia flower is characterized by a massive column above the ovary, in which the androecium and gynoecium are united. Such a formation is found among flowering plants only in the Rafflesia and Orchids. The anthers are in 1-3 rows around the tube or column, opening with a longitudinal or transverse slit or apical pore. Gynoecium usually consists of 4-10 carpels; stigma is sessile or on a style, discoidal, cephalic or multi-lobed. Ovary is lower or semi-lower, rarely upper (Mitrastemon), unilocular or pseudomultilocular, with very numerous ovules, arranged on placentae embedded in the ovary cavity or covering the whole wall of the ovary. Fruits are berry-like. Seeds are numerous, small, with an undifferentiated embryo and oily endosperm.

Order Nymphaeales

It probably derived from one of the ancient groups of vascularless representatives of the order Magnoliales. They are aquatic herbs, mostly rhizomatous. Con-

ducting bundles of stem on cross section are scattered, as in monocotyledons. Vessels are absent. Root cap has its own initial layer (similar to monocotyledons). Flowers are solitary, double- and, rarely, unisexual, predominantly spirocyclic, with calyx and corolla, rarely without petals. Stamens are usually numerous. Gynoecium is apocarpic or more often syncarpic. Seeds usually with very small embryo, abundant perisperm and scanty endosperm, but Ceratophyllaceae are devoid of both perisperm and endosperm.

Families: Cabombaceae, Nymphaeceae, Ceratophyllaceae.

Family Nymphaeceae.

The family includes 6 genera and 75 species.

In Russia, there are 11 naturally occurring species, representatives of 4 genera. Nymphaeceae occur in shallow, running water bodies of the world and lead an aquatic life. They are perennial rhizomatous vascular grasses. Numerous adventitious roots and leaves emerge from the rhizomes. They have two types of leaves: above-water floating leaves with a broad lamina and underwater - filmy delicate leaves with a narrower lamina. The surface of the floating leaves is not wetted due to a waxy patina.

Flowers are solitary, on long pedicels, often quite large, actinomorphic, with a double perianth, some of its parts and stamens arranged spirally. Calyx has 4-5 greenish or painted sepals, petals are numerous, white or painted. Stamens are numerous, their filaments expanded, in some lilies gradually transforming into petals.

The gynoecium is cenocarpous, consisting of an indeterminate number of carpels. The ovary is uppermost (of the Nufar) or semi-inferior (of the Nymphaea). Stigmas are sessile, with radially divergent rays. Fruit is cenocarpic, capsule or dry berry, containing numerous small seeds with a small embryo surrounded by endosperm and perisperm. They are usually covered with mucus. They are pollinated by beetles or the wind.

*$Ca_4Co_{\infty}A_{\infty}G_{(\infty)}$-

The order Lotus (Nelumbonales).

Origin this order is probably in common with Nymphaeales. They are stemless aquatic herbs with very thick rhizomes and shield-shaped aerial leaves. Vascular bundles of rhizomes are scattered on a cross section. There are vessels with very primitive tracheid-like segments. Flowers are bisexual, with 2 sepals and numerous petals. Stamens are numerous, spirally arranged. The gynoecium is apocarpous, consisting of numerous pedicles embedded in a proliferated peduncle. The endosperm is cellular. Seeds have very large germ and scanty residual endosperm.

Lotus family (Nelumbonaceae)

The family is represented by only one genus lotus (Nelumbo), consisting of two species: the nut - bearing lotus (*N. nucifera*) and lotus yellow (*N. lutea*).

The lotus is an herbaceous, amphibious plant, its stems turned into creeping rhizomes, which are immersed in the sandy bottom substrate of the body of water. The rhizome is powerful, sympodially branching, with well-defined globular nodes, from which numerous roots emerge; in winter, starch is deposited in the rhizomes, making them very thick. Buds form in the nodes of the rhizomes, in which both leaves and flowers are formed. A cross section through the rhizome shows that it is pierced by numerous solitary bundles arranged in concentric circles, separated by large air-bearing cavities of schizogenous origin.

The lotus has two types of leaves: some are underwater, sessile, and broadly lanceolate in shape, scaly, with parallel veining, usually tightly enclosing young buds and rhizome growth points; others are above-water, or aerial, floating and rising high above water. The above-water leaves are roundish-shaped, with a long petiole set with styloid outgrowths. Floating leaves have a flat leaf blade, while standing leaves have a funnel-shaped leaf blade. Veins of aerial leaves are radial: 12-25 veins radially diverge from the center of the leaf from the place where the petiole is attached, with the exception of one pinnatipartite middle vein, extending to the edge of the leaf in the area of the depression on the leaf blade plate. There are large air cavities in the leaf tissues of the lotus, which allow the plant to get rid of excessive moisture. The stomata on lotus leaves are located only on the upper side, being deeply embedded in the tuberous tissue of the epidermis.

Lotus flowers are exceptionally beautiful. They are very large (up to 30 cm in diameter), solitary, axillary, oviparous, spirocyclic.

The nut - bearing lotus has bright pink flowers, though the petals are usually paler at the base than at the top. In the American lotus, the petals are yellow, with a creamy tint at the base and lighter at the top. They are high up, like the leaves, above the water on a straight long pedicel, which, like the leaf petioles, is covered with spike-like growths. Lotus flowers are heliotropic, always facing the sun. Slightly below the spot where the flower is attached, there is the so-called reaction zone, where it changes its position. The lotus has only two sepals. Petals are numerous (22-30), arranged in a spiral pattern and not quite clearly separated from the sepals. Numerous stamens are also arranged spirally; they are large, with a large fleshy connective, extending above the anthers and usually curved inside the flower, and two long anthers.

The gynoecium is apocarpous, consisting of numerous carpels embedded in a proliferated receptacle which has an inversely conical shape. Barrel-shaped carpels are arranged in a spiral or almost circular pattern and have a sessile, saucer-shaped stigma. When the carpels mature, they form one-seeded nuts (achenes) with a dark, very tough, woody pericarp and a breathing hole near the stigma. Seeds have very large germ and scanty residual endosperm. The embryo of the lotus is very large, with massive, fleshy, colorless cotyledons and a bud with the first two dark green leaves. The endosperm is cellular. The stored nutrients are contained within the cotyledons; the very scarce endosperm is consumed in its entirety during the early stages of embryo development, and the entire adult seed is filled with the embryo.

Lotus seeds do not lose germination for a very long time. It is known that lotus seeds found in the peat bogs of Northern China, which had lain there for more than a thousand years, were able to germinate and grow into flowering plants.

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