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No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Family of flowering plants in order Liliales, including lilies LiliaceaeTemporal range: 68–0 Ma Pre€ € O S D C P T J K Pg N Late Cretaceous - Recent Lilium candidum Scientific classification Kingdom: Plantae Clade: Tracheophytes Clade: Angiosperms Clade: Monocots Order: Liliales Family: LiliaceaeJuss.[1] Type genus LiliumL. Sp. Pl. 1: 302. (1753)[3] Type species Lilium candidumL. Sp. Pl. 1: 302. (1753)[3] Subfamilies and tribes subfamily: Streptopoideae subfamily: Calochortoideae subfamily: Medeoloideae subfamily: Lilioideae tribe: Lilieae tribe: Tulipeae sensu APWeb[2] Diversity About 600 species ✶ or ÷ P3+3 A3+3 G(3)General floral formula of the Liliacaeae: Flowers actinomorphic or slightly zygomorphic and hermaphrodite with 6 undifferentiated tepals in two whorls of three, the same number and arrangement of stamens, and a superior ovary with 3 fused carpels. Individual species and genera may have more or less derived formulas. The lily family, Liliaceae, consists of about 15 genera and 610 species of flowering plants within the order Liliales.[2] They are monocotyledonous, perennial, herbaceous, often bulbous geophytes. Plants in this family have evolved with a fair amount of morphological diversity despite genetic similarity. Common characteristics include large flowers with parts arranged in threes: with six colored or patterned petaloid tepals (undifferentiated petals and sepals) arranged in two whorls, six stamens and a superior ovary. The leaves are linear in shape, with their veins usually arranged parallel to the edges, single and arranged alternating on the stem, or in a rosette at the base. Most species are grown from bulbs, although some have rhizomes. First described in 1789, the lily family became a paraphyletic "catch-all" (wastebasket) group of lilioid monocots that did not fit into other families and included a great number of genera now included in other families and in some cases in other orders. Consequently, many sources and descriptions labelled "Liliaceae" deal with the broader sense of the family. The family evolved approximately 68 million years ago during the Late Cretaceous to Early Paleogene epochs. Liliaceae are widely distributed, mainly in temperate regions of the Northern Hemisphere and the flowers are insect pollinated. Many Liliaceae are important ornamental plants, widely grown for their attractive flowers and involved in a major floriculture of cut flowers and dry bulbs. Some species are poisonous if eaten and can have adverse health effects in humans and household pets. A number of Liliaceae genera are popular cultivated plants in private and public spaces. Lilies and tulips in particular have had considerable symbolic and decorative value, and appear frequently in paintings and the decorative arts. They are also an economically important product. Most of their genera, Lilium in particular, face considerable herbivory pressure from deer in some areas, both wild and domestic.[4][5] Liliaceae floral morphologySection through flower of Fritillaria meleagrisLilium flower with perigonium of six undifferentiated tepals, arranged in two trimerous whorls and side-connected (dorsifixed) anthers.Sego lily (Calochortus nuttallii) with tepals in two clearly distinguished whorls of three sepals and three petals.Tulipa clusiana with three sepals resembling petalsTricyrtis flower with patterned tepalsLilium longiflorum: 1. Stigma, 2. style, 3. stamens, 4. filament, 5. tepalErythronium revolutum flower with three stigmata and pseudo-basifixed anthers surrounding the filament tipLilium with longitudinal dehiscence of anthersLilium anthers in cross sectionLilium auratum pollen with typical single-grooved (monosulcate) pattern Tulipa humilis flower showing multiple connate (fused) carpels surrounded by stamens.Lillium fruit capsule The diversity of characteristics complicates any description of the Liliaceae morphology, and confused taxonomic classification for centuries. The diversity is also of considerable evolutionary significance, as some members emerged from shaded areas and adapted to a more open environment (see Evolution).[6] The Liliaceae are characterised as monocotyledonous, perennial, herbaceous, bulbous (or rhizomatous in the case of Medeoleae)[7] flowering plants with simple trichomes (root hairs) and contractile roots.[8] The flowers may be arranged (inflorescence) along the stem, developing from the base, or as a single flower at the tip of the stem, or as a cluster of flowers. They contain both male (androecium) and female (gynoecium) characteristics and are symmetric radially, but sometimes as a mirror image. Most flowers are large and colourful, except for Medeoleae. Both the petals and sepals are usually similar and appear as two concentric groups (whorls) of 'petals', that are often striped or multi-coloured, and produce nectar at their bases. The stamens are usually in two groups of three (trimerous) and the pollen has a single groove (monosulcate). The ovary is placed above the attachment of the other parts (superior). There are three fused carpels (syncarpus) with one to three chambers (locules), a single style and a three-lobed stigma. The embryo sac is of the Fritillaria type. The fruit is generally a wind dispersed capsule, but occasionally a berry (Medeoleae) which is dispersed by animals. The leaves are generally simple and elongated with veins parallel to the edges, arranged singly and alternating on the stem, but may form a rosette at the base of the stem. Inflorescence Usually indeterminate (lacking terminal flower) as a raceme (Lilium); sometimes reduced to a single terminal flower (Tulipa). When pluriflor (multiple blooms), the flowers are arranged in a cluster or rarely are subumbellate (Gagea) or a thyrse (spike).[9] Flowers Hermaphroditic, actinomorphic (radially symmetric) or slightly zygomorphic (bilaterally symmetric),[10] pedicellate (on a short secondary stem), generally large and showy but may be inconspicuous : (Medeoleae). Bracts may (bracteate) or may not (ebracteate) be present. The perianth is undifferentiated (perigonium) and biseriate (two whorled), formed from six tepals arranged into two separate whorls of three parts (trimerous) each, although Scoliopus has only three petals, free from the other parts, but overlapping. The tepals are usually petaloid (petal like) and apotepalous (free) with lines (striate) or marks in other colors or shades. The perianth is either homochlamydeous (all tepals equal, e.g. Fritillaria) or dichlamydeous (two separate and different whorls, e.g. Calochortus) and may be united into a tube. Nectar is produced in perigonal nectaries at the base of the tepals.[9][11][12][13] Androecium Six stamens in two trimerous whorls, with free filaments, usually epiphyllous (fused to tepals) and diplostemonous (outer whorl of stamens opposite outer tepals and the inner whorl opposite inner tepals), although Scoliopus has three stamens opposite the outer tepals.[14] The attachment of the anthers to the filaments may be either peltate (to the surface) or pseudo-basifixed (surrounding the filament tip, but not adnate, that is not fused) and dehisce longitudinally and are extrorse (dehiscing away from center). The pollen is usually monosulcate (single groove), but may be inaperturate (lacking aperture: Clintonia, some Tulipa spp.) or operculate (lidded: Fritillaria, some Tulipa spp.),[15] and reticulate (net patterned: Erythronium, Fritillaria, Gagea, Lilium, Tulipa).[9][11][14] Gynoecium Superior ovary (hypogynous), syncarpous (with fused carpels), with three connate (fused) carpels and is trilocular (three locules, or chambers) or unilocular (single locule, as in Scoliopus and Medeola). There is a single style and a three lobed stigma or three stigmata more or less elongated along the style. There are numerous anatropous (curved) ovules which display axile placentation (parietal in Scoliopus and Medeola),[14] usually with an integument and thinner megasporangium. The embryo sac (megagametophyte) varies by genera, but is mainly tetrasporic (e.g. Fritillaria).[11] Embryo sacs in which three of the four megaspores fuse to form a triploid nucleus, are referred to as Fritillaria-type, a characteristic shared by all the core Liliales.[6][9][11][16] Fruit A capsule that is usually loculicidal (splitting along the locules) as in the Lilioideae,[6] but occasionally septicidal (splitting between them, along the separating septa) in the Calachortoideae and wind dispersed, although the Medeoleae form berries (baccate).[6] The seeds may be flat, oblong, angular, discoid, ellipsoid or globose (spherical), or compressed with a well developed epidermis. The exterior may be smooth or roughened, with a wing or raphe (ridge), aril or one to two tails, rarely hairy, but may be dull or shiny and the lack of a black integument distinguishes them from related taxa such as Allioideae that were previously included in this family, and striate (parallel longitudinally ridged) in the Steptopoideae. The hilum (scar) is generally inconspicuous. The bitegmic (separate testa and tegmen) seed coat itself may be thin, suberose (like cork), or crustaceous (hard or brittle). The endosperm is abundant, cartilaginous (fleshy) or horny and contains oils and aleurone but not starch (non-farinaceous). Its cells are polyploid (triploid or pentaploid, depending on the embryo sac type). The embryo is small (usually less than one quarter of seed volume), axile (radially sectioned), linear (longer than broad) or rarely rudimentary (tiny relative to endosperm) depending on placentation type, and straight, bent, curved or curled at the upper end.[9][11][17][18] Leaves Simple, entire (smooth and even), linear, oval to filiform (thread-like), mostly with parallel veins, but occasionally net-veined. They are alternate (single and alternating direction) and spiral, but may be whorled (three or more attached at one node, e.g. Lilium, Fritillaria), cauline (arranged along the aerial stem) or sheathed in a basal rosette. They are rarely petiolate (stem attached before apex), and lack stipules. The aerial stem is unbranched.[9][11][12][19][20] Genome The Liliaceae include a species with one of the largest genome size within the angiosperms, Fritillaria assyriaca (1C=127.4 pg), while Tricyrtis macropoda is as small as 4.25 pg.[21] Chromosome numbers vary by genus.[11] Some genera like Calochortus (x=6-10), Prosartes (6,8,9,11), Scoliopus (7,8), Streptopus (8, 27) and Tricyrtis (12–13) have a small and variable number of chromosomes while subfamily Lilioideae have a larger and more stable chromosome number (12) as have the Medeoleae (7).[7][22][23][24] Phytochemistry The seeds contain saponins but no calcium oxalate raphide crystals,[14] chelidonic acid[6] (unlike Asparagales) or cysteine derived sulphur compounds (allyl sulphides), another distinguishing feature from the characteristic alliaceous odour of the Allioideae. Fritillaria in particular contains steroidal alkaloids of the cevanine and solanum type.[9] Solanidine and solanthrene[25] alkaloids have been isolated from some Fritillaria species.[26][27] Tulipa contains tulipanin, an anthocyanin. (see also: Toxicology) Characteristics often vary by habitat, between shade-dwelling genera (such as Prosartes, Tricyrtis, Cardiocrinum, Clintonia, Medeola, Prosartes, and Scoliopus) and sun loving genera. Shade-dwelling genera usually have broader leaves with smooth edges and net venation, and fleshy fruits (berries) with animal-dispersed seeds, rhizomes, and small, inconspicuous flowers while genera native to sunny habitats usually have narrow, parallel-veined leaves, capsular fruits with wind-dispersed seeds, bulbs, and large, visually conspicuous flowers.[7] (See also Evolution). Main article: Taxonomy of Liliaceae The taxonomy of the Liliaceae has a very complex history. The family was first described in the eighteenth century, and over time many other genera were added until it became one of the largest of the monocotyledon families, and also extremely diverse. Modern taxonomic systems, such as the APG which is based on phylogenetic principles using molecular biology, have redistributed many of these genera resulting in the relatively small family that is currently recognised. Consequently, there are many different accounts of the Liliaceae in the literature and older uses of the term occur commonly. To distinguish between them, the Latin terms sensu lato and sensu stricto are frequently used (together with their abbreviations, s.l. and s.s.) to denote the broader or stricter sense of the circumscription respectively, e.g. Liliaceae s.s.. The family Liliaceae was described by Michel Adanson in 1763 and formally named by Antoine Laurent de Jussieu in 1789. Jussieu defined this grouping as having a calyx of six equal colored parts, six stamens, a superior ovary, single style, and a trilocular (three-chambered) capsule. By 1845, John Lindley, the first English systematist, unhappily acknowledged the great diversity in the circumscription of the family, and that it had expanded vastly, with many subdivisions. As he saw it, the Liliaceae were already paraphyletic ("catch-all"), being all Liliales not included in the other orders, but hoped that the future would reveal some characteristic that would group them better. He recognized 133 genera and 1200 species.[28] By the time of the next major British classification – that of Bentham and Hooker in 1883 (published in Latin) – several of Lindley's other families had already been absorbed into the Liliaceae.[29] Over time the family became increasingly broad and somewhat arbitrarily defined as all species of plants with six tepals and a superior ovary, eventually coming to encompass about 300 genera and 4,500 species within the order Liliales under the Cronquist system (1981). Cronquist merged the Liliaceae with the Amaryllidaceae, making this one of the largest monocotyledon families.[30] Many other botanists echoed Lindley's earlier concerns about the phylogeny of the Liliaceae, but various schemes to divide the family gained little traction. Dahlgren (1985) suggested there were in fact forty – not one – families distributed over three orders (predominantly Liliales and Asparagales).[31][32] In the context of a general review of the classification of angiosperms, the Liliaceae were subjected to more intense scrutiny. Considerable progress in plant phylogeny and phylogenetic theory enabled a phylogenetic tree to be constructed for all of the flowering plants, as elaborated by the Angiosperm Phylogeny Group (1998).[6] The Angiosperm Phylogeny Group (APG) made rapid progress in establishing a modern monophyletic classification of the flowering plants by 2009.[33] Despite establishing this relative degree of monophyly (genetic homogeneity) for the family Liliaceae,[34][35] their morphology remains diverse[7] and there exists within the Liliaceae clade or grouping, a number of subclades (subgroups). Particularly enigmatic were Clintonia, Medeola, Scoliopus, and Tricyrtis. Of the fifteen genera within the Liliaceae, the ten genera of the Lilioideae subfamily form one morphological group that is characterised by contractile bulbs and roots, and a Fritillaria-type embryo-sac (megagametophyte with four megaspores). Within the Lilioideae, Clintonia and the closely related Medeola form a subclade, and are now considered a separate tribe (Medeoleae).[36] The other major grouping consists of the five genera constituting the Streptopoideae (including Scoliopus) and Calochortoideae (including Tricyrtis) subfamilies characterised by creeping rhizomes, styles which are divided at their apices, and by megagametophyte development of the Polygonum-type (a simple megaspore and triploid endosperm) embryo-sac. The development of a phylogenetic approach to taxonomy suggested the Liliales formed some of the earliest monocots.[37] Molecular analysis indicates that divergence amongst the Liliales probably occurred around 82 million years ago. The closest sister family to the Liliaceae are the Smilacaceae with the Liliaceae separating 52 million years ago. Liliaceae thus arose during the late (Maastrichtian) Cretaceous to early (Paleocene) Paleogene periods.[21] Major evolutionary clades include the Lilieae (Lilium, Fritillaria, Nomocharis, Cardiocrinum, Notholirion) from the Himalayas about 12 mya and the Tulipeae (Erythronium, Tulipa, Gagea) from East Asia at about the same time. The Medeoleae (Clintonia and Medeola) may have appeared in North America but were subsequently dispersed, as may have the Streptopoideae and Calochortoideae.[6][38][39][40] Liliaceae fossils have been dated to the Paleogene[41] and Cretaceous[42] eras in the Antarctic. The Liliaceae probably arose as shade plants, with subsequent evolution to open areas including deciduous forest in the more open autumnal period, but then a return of some species (e.g. Cardiocrinum). This was accompanied by a shift from rhizomes to bulbs, to more showy flowers, the production of capsular fruit and narrower parallel-veined leaves. Again, some reversal to the broader reticulate-veined leaves occurred (e.g. Cardiocrinum).[6] Examples of the four subdivisions of LiliaceaeMedeoleae: Leaves and fruit of Clintonia borealis, Quebec, CanadaLilieae: Flower of Nomocharis aperta, Yunnan, ChinaCalochortoideae: Flower of Calochortus catalinae, CaliforniaStreptopoideae: Leaves and berries of Streptopus lanceolatus, Ontario, Canada Due to the diversity of the originally broadly defined Liliaceae s.l., many attempts have been made to form suprageneric classifications, e.g. subfamilies and tribes.[23] Classifications published since the use of molecular methods in phylogenetics have taken a narrower view of the Liliaceae (Liliaceae s.s.). The Angiosperm Phylogeny Website (APweb)[2] recognizes three subfamilies, one of which is divided into two tribes.[11] Main article: List of Liliaceae genera Various authorities (e.g. ITIS 16,[43] GRIN 27,[44] WCSP,[45] NCBI,[46] DELTA[19]) differ on the exact number of genera included in Liliaceae s.s., but generally there are about fifteen to sixteen genera, depending on whether or not Amana is included in Tulipa and Lloydia in Gagea. Currently the APWeb lists fifteen genera, arranged as shown in this table:[2][11][47] APweb Distribution of subfamilies, tribes and genera of Liliaceae Subfamily Tribe Genus Lilioideae Eaton Medeoleae Benth. (synonyms: Medeolaceae Takht., Medeoloideae Benth.) Clintonia Raf. - bead lilies Medeola Gronov. ex L. - Indian cucumber-root Lilieae Ritgen (synonyms: Erythroniaceae Martinov, Fritillariaceae Salisb., Liriaceae Borkh., Tulipaceae Borkh.)| Amana Honda Cardiocrinum (Endl.) Lindl. - giant lilies Erythronium L. – trout lily Fritillaria Tourn. ex L. – fritillary or mission bells Gagea Salisb. (including Lloydia Salisb. ex Rchb.) – yellow star-of-Bethlehem Lilium Tourn. ex L. (synonym Nomocharis Franch.) – lily Notholirion Wall. ex Boiss. Tulipa L. – tulip Calochortoideae Dumort. (synonyms: Calochortaceae Dumort., Compsoaceae Horan., nom. illeg., Tricyrtidaceae Takht., nom. cons.) Calochortus Pursh - mariposa, globe lilies Tricyrtis Wall. – toad lily Streptopoideae (synonym: Scoliopaceae Takht.) Prosartes D.Don – drops of gold Scoliopus Torr. – fetid adder's tongue Streptopus Michx. – twistedstalk The largest genera are Gagea (200), Fritillaria (130), Lilium (110), and Tulipa (75 species), all within the tribe Lilieae. The name "Liliaceae" (English: /ˌlɪliˈeɪsi, -si,aɪ, -si,eɪ, -si,i/) comes to international scientific vocabulary from Neo-Latin, from Lilium, the type genus, + -aceae,[48] a standardized suffix for plant family names in modern taxonomy. The genus name comes from the Classical Latin word lilium, "lily", which in turn came from the Greek leírion (λείριον). The Liliaceae are widely distributed, but mainly in the temperate regions of the Northern Hemisphere. The centre of diversity is from southwest Asia to China. Their distribution is diverse, mainly in plains, steppes, and alpine meadows, but also in deciduous forests, Mediterranean scrub and arctic tundra.[6][9] Tulipa and Gagea provide examples of ornamental geophyte biomorphological types representing continental thermoperiodic zones (Irano-Turanian region), characterised by cessation of underground growth at high temperatures in early summer and requiring low winter temperatures for spring flowering.[40] While some genera are shade-dwelling, such as the Medeoleae, and Streptopoideae, Tricyrtis, and Cardiocrinum, others prefer a more open habitat. The Liliaceae are ecologically diverse.[6] Species of Liliaceae bloom at various times from spring to late summer. The colorful flowers produce large amounts of nectar and pollen that attract insects which pollinate them (entomophily), particularly bees and wasps (hymenopterophily), butterflies (psychophily) and moths (phalaenophily).[20] The seeds are dispersed by wind and water. Some species (e.g. Scoliopus, Erythronium and Gagea) have seeds with an aril structure that are dispersed by ants (myrmecochory).[6] The proliferation of deer populations in many areas, due to human factors such as the elimination of their animal predators and introduction to alien environments, is placing considerable herbivory pressure on many of the family's species.[4] Fences as high as 8 feet may be required to prevent them from consuming the plants, an impractical solution for most wild areas.[5] Those of the genus Lilium are particularly palatable, while species in Fritillaria are repellant. Scarlet lily beetle (Lilioceris lilii) 17th-century painting of affected Tulipa 'Semper Augustus', showing 'breaking' Liliaceae are subject to a wide variety of diseases and pests, including insects, such as thrips, aphids, beetles and flies. Also fungi, viruses and vertebrate animals such as mice and deer.[49][50] An important horticultural and garden pest is the scarlet lily beetle (Japanese red lily beetle, Lilioceris lilii) and other Lilioceris species which attack Fritillaria and Lilium.[51] Lilium species may be food plants for the Cosmia trapezina moth. A major pest of Tulips is the fungus, Botrytis tulipae. Both Lilium and Tulipa are susceptible to a group of five viruses of the family Potyviridae, specifically the potyvirus (named for potato virus Y) group, which includes the tulip-breaking virus (TBV) and the lily streak virus (lily mottle virus, LMoV) resulting in 'breaking' of the color of the flowers. The viruses are transmitted by aphids. This breaking effect was of economic importance during the tulip mania of the seventeenth century, because it appeared to be producing new varieties.[52][53] In modern times tulip breeders have produced varieties that mimic the effect of the virus, without being infected. One of these varieties is known as 'Rembrandt', after the Dutch artist of that name. Contemporary tulip owners commonly had Rembrandt and other artists paint their flowers to preserve them for posterity, hence the 'broken' tulips were known as Rembrandt tulips at that time. Another modern variety is 'Princess Irene'.[54][55][56] One of the tulip breaking viruses is also named the Rembrandt tulip-breaking virus (ReTBV).[57][58] CultivationTulipa varieties are popular ornamental flowers in public and private spaces in the springTulip production, Hillegom, the NetherlandsLily production, Japan Many species of Lilieae (in genera Tulipa, Fritillaria, Lilium, and Erythronium) and Calochortoideae (Calochortus and Tricyrtis) are grown as ornamental plants worldwide. Within these genera a wide range of cultivars have been developed by breeding and hybridisation. They are generally used in outdoor gardens and other displays, although in common with many bulbous flowering plants they are often induced to bloom indoors, particularly during the winter months. They also form a significant part of the cut flower market, in particular Tulipa and Lilium. Tulips have been cultivated since at least the tenth century in Persia.[59] Tulip production has two main markets: cut flowers and bulbs. The latter are used, in turn, to meet the demand for bulbs for parks, gardens, and home use and, secondly, to provide the necessary bulbs for cut flower production. International trade in cut flowers has an approximate total value of 11 billion euros, which provides an indication of the economic importance of this activity. The main producer of tulip bulbs is the Netherlands, a country that accounts for 87% of the global cultivated area, with approximately 12,000 hectares. Other leading producers include Japan, France and Poland. Approximately ten other countries produce commercial tulips, largely for the domestic market. By contrast, the Netherlands is the leading international producer, to the extent of 4 billion bulbs per annum. Of these, 53% are used for the cut flower market and the remainder for the dry bulb market. Of the cut flowers, 57% are used for the domestic market in the Netherlands and the remainder exported.[60][61] Original Tulipa species can be obtained for ornamental purposes, such as Tulipa tarda and Tulipa turkestanica. These are referred to as species, or botanical, tulips, and tend to be smaller plants but better at naturalising than the cultivated forms. Breeding programs have produced a wide range of tulip types, enabling blooming through a much longer season by creating early, mid- and late spring varieties. Fourteen distinct types are available in addition to botanical tulips, including Lily-flowered, Fringed, Viridiflora, and Rembrandt. In addition to blooming season, tulip varieties differ in shape and height, and exhibit a wide range of colours, both pure and in combination.[62] The largest area of production is also the Netherlands, with 76% of the global cultivated area, followed by France, Chile, Japan, the United States, New Zealand and Australia. Approximately ten countries produce lilies commercially altogether. About half of the commercial production is for cut flowers. Many of these countries export bulbs as well as supplying the domestic market. The Netherlands produces about 2,200 million lily bulbs annually, of which 96% is used domestically and the remainder exported, principally within the European Union. One particularly important crop is the production of Lilium longiflorum, whose white flowers are associated with purity and Easter.[60] Although many Lilium species such as Lilium martagon and Lilium candidum can be obtained commercially, the majority of commercially available lilies represent the products of a very diverse hybridisation program, which has resulted in a separate horticultural classification, including such groupings as Asian, Oriental and Orienpet. In addition to a very wide variety of heights, lilies can be obtained in many colours and combinations of colours, and if properly selected can produce an extensive blooming season from early summer to autumn.[63] Because of the history of Liliaceae, many species such as Watsonia (bugle lily) that were previously classified in this family bear the name 'lily' but are neither part of the genus Lilium, or the family Liliaceae. A variety of Fritillaria species are used as early spring ornamental flowers. These vary from the large Fritillaria imperialis (crown imperial) available in a number of colours such as yellow or orange, to much smaller species such as Fritillaria meleagris or Fritillaria uva-vulpis with their chequered patterns.[64] Erythronium is less common but a popular cultivar is 'Pagoda' with its sulphur yellow flowers.[65] Calochortus (mariposa lily) may be sold as a mixture or as cultivars.[66] Bulbils in the leaf axils of Lilium lancifolium Seeds of Liliaceae species Methods of propagation include both sexual and asexual reproduction. Commercial cultivars are usually sterile. Seeds can be used for propagation of the plant or to create hybrids and can take five to eight years to produce flowering plants. Since interspecific cross-pollination occurs, overlapping wild populations can create natural hybrids.[67] Bulb offsets: Daughter bulbs that form on the mother bulb and can be detached. Micropropagation techniques including tissue culture.[68][69] Bulbils, which are adventitious bulbs formed on the parent plant's stem. Scaling and twin-scaling, used to increase production in slower-growing varieties, in which multiple whole scales are detached from a single bulb. Bulb offsets and tissue culture produce genetic clones of the parent plant and thus maintaining genetic integrity of the cultivars. Bulb offsets usually require at least a year before flowering. Commercially, plants may be propagated in vitro and then planted out to grow into plants large enough to sell.[70][71] While members of the Liliaceae s.s. have been used as food sources in humans, the bulbs of some species are poisonous to household pets (bulb toxicosis) if eaten and may cause serious complications, such as kidney failure in cats from Lilies, particularly Lilium longiflorum (Easter Lily).[72][73][74] Dogs may develop less serious effects such as gastrointestinal problems and central nervous system depression.[75] Most Fritillaria (e.g. Fritillaria imperialis, Fritillaria meleagris) bulbs contain poisonous neurotoxic alkaloids such as imperialin (peiminine),[76][77][78] which may be deadly if ingested in quantity, while other species such as Fritillaria camschatcensis and Fritillaria affinis are edible.[26][27] Tulips can cause skin irritation due to the presence of tuliposides and tulipalins,[79][80][81] which are also found in the flowers, leaves and stems of Fritillaria.[77] These are also toxic to a variety of animals.[82] Fritillaria extracts are used in traditional Chinese medicine under the name chuan bei mu, and in Latin, bulbus fritillariae cirrhosae.[26][27][83] The bulbs of Fritillaria roylei have been used as antipyretics and expectorants.[20] Lilium bulbs, particularly Lanzhou lily (Lilium davidii)[70] are used as food in China and other parts of Asia.[84] During World War II, starvation conditions in the Netherlands (Hongerwinter, hunger winter 1944) led to using Tulipa bulbs as food. Calochortus bulbs were eaten by Native Americans and by the Mormon settlers in Utah during starvation. Other members of the family used for food include Clintonia (leaves), Medeola (roots), Erythronium (corms), and Fritillaria (bulbs).[85] Lilies (far right) growing in the Paradiesgärtlein, Meister des Frankfurter Paradiesgärtleins c. 1410Lilium candidum (Madonna lily) The type genus, Lily (Lilium), has a long history in literature and art, and a tradition of symbolism as well as becoming a popular female name, and a floral emblem, particularly of France (fleur-de-lis). The cultivation of lilies has been described since at least the ninth century, when Charlemagne ordered it to be grown at his imperial palaces.[86] However, the name 'lily' has historically been applied to a wide variety of plants other than the genus Lilium. The lily appears in ancient literature associated with both sovereignty and virginal innocence, and is mentioned on a number of occasions in the Bible, such as the description in Solomon's Song of Songs (2, 1–2) "I am a rose of Sharon, a lily of the valleys. Like a lily among thorns is my darling among the young women" or the Gospel of Mathew (6, 28) "Consider the lilies of the field, how they grow; they toil not, neither do they spin" to represent beauty. Artistic representations can be found as far back as frescos from the second century BC, at Amnisos and Knossos. Early Christian churches, such as that of the Basilica of Sant' Apollinare in Classe were sometimes decorated with lilies. While predominantly depicted as white, those seen at Akrotiri are red lilies. The white lily has long been seen as a symbol of purity, coming to be associated with the Virgin Mary in the Middle Ages, from which came the name ‘Madonna lily’ (Lilium candidum). A well-known example is Leonardo da Vinci's Annunciation (1472–1475) in which the archangel Gabriel bears a Madonna lily. Other symbolic meanings include glory, love and birth. Main article: Fleur-de-lis Symbolic fleur-de-lis The stylised lily, or fleur-de-lis (lily flower) has long been associated with royalty, although it may originally have been derived from the form of an iris. It has also been associated with the head of a spear.[87] Its three parts have been associated with the three classes of mediaeval society,[88] or alternatively faith, wisdom and chivalry.[89] Whatever its exact derivation, it has come to be associated with France and the French monarchy since the earliest Frankish kings. Consequently, it became incorporated into not only French heraldry but also into many heraldic devices in jurisdictions where there had been historic French influence, such as Quebec and New Orleans. In modern times it appears in many forms, symbolic and decorative, and can be used on compasses to indicate the direction north, as well as the Scouting movement. Main article: Tulip Mania Allah, Hagia Sophia, Istanbul Ceramic dish, Iznik ca. 1600, with tulips, roses and hyacinths Tulips (Tulipa) also have a long cultural tradition, particularly in the Islamic world. The Persian word for tulips, lâleh (لاله), was borrowed into Turkish and Arabic as lale. In Arabic letters, lale is written with the same letters as Allah, and is used to denote God symbolically. Tulips became widely used in decorative motifs on tiles, fabrics, and ceramics in Islamic art and the Ottoman Empire in particular,[59] and were revered in poetry, such as that of Omar Khayam in the twelfth century.[59][90] Tulips were an essential part of the gardens of Persia, having been cultivated from the Steppes. As the Seljuks – Oghuz-Turkic leaders originated from the steppes – moved to Persia, and then west, they took tulips with them to Turkey, where many escaped cultivation and became naturalised. Today there are a number of places in Turkey called Laleli (‘with tulips’). Tulips first appeared in the decorative arts in Turkey in the thirteenth century and flourished under the Ottomans, in particular in the royal palaces, and was adopted by the Osmans as their symbol. Further species were collected from Persia and the spreading Ottoman Empire saw to it that tulip culture also spread. By the sixteenth century it was a national symbol, hence the designation "Tulip era", by which time they were becoming of economic importance.[59] By 1562 the tulip trade had reached Europe with the first shipment to Antwerp,[91] where they were mistaken for vegetables,[92] although they had been cultivated in Portugal since 1530, and first appeared in illustration in 1559, and the first tulip flowers were seen in the Netherlands in 1625. Tulips spread rapidly across Europe in the seventeenth century, and became an important trading item, initially in France before concentrating in the Netherlands.[59][93] Eventually speculative trading in tulips became so intense as to cause a financial bubble which eventually collapsed, a period known as tulip mania (tulipomania), from 1634 to 1637,[94][95] similar to the Ottoman Empire's Tulip era. Nevertheless, since then the tulip has become indelibly associated with the Netherlands and all things Dutch. it was during this period that the tulipiere, a ceramic vase for growing tulips indoors was devised, and the Golden Age of Dutch Painting was replete with images of tulips. Although tulip festivals are held around the world in the spring, the most famous of these is the display at Keukenhof. One of the better-known novels on tulips is The Black Tulip by Alexandre Dumas, père in 1850, dealing with a contest to grow a black tulip in late seventeenth-century Haarlem. Fritillaria are also often used as floral emblems, for instance as the county flower of Oxfordshire, UK.[96] Calochortus nuttallii, the sego lily, is the official state flower of Utah.

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The dictionary definition of Liliaceae at Wiktionary Media related to Liliaceae at Wikimedia Commons Retrieved from " The lily family, also known as Liliaceae, is a diverse group of plants that includes over 4,000 species. These plants are characterized by their showy flowers, which are often trumpet-shaped and come in a variety of colors, including white, yellow, pink, and purple. While many members of the lily family are popular ornamental plants, others are grown for their medicinal properties or as a source of food.One of the most well-known members of the lily family is the Easter lily, which is often used as a symbol of purity and rebirth during the Christian holiday of Easter. Other popular lilies include the tiger lily, which is native to Asia and has bright orange flowers with black spots, and the calla lily, which is known for its elegant, trumpet-shaped flowers and is often used in wedding bouquets. In addition to these ornamental plants, the lily family also includes a number of important food crops, such as garlic, onions, and asparagus.Despite their many differences, all members of the lily family share certain characteristics, such as the presence of six petals and six stamens, and a tendency to grow from bulbs or rhizomes. Many members of the lily family are also known for their medicinal properties, and have been used for centuries to treat a variety of ailments, including coughs, colds, and digestive problems. With such a wide range of uses and applications, it’s no wonder that the lily family continues to be a popular and important group of plants today. The Lily family, scientifically known as Liliaceae, is a monocotyledonous group of angiosperms. This family consists of 16 genera and around 635 species of herbaceous flowering plants. The plants in this family are distributed globally, and they can be found in various habitats, including grasslands, forests, and deserts.The classification of the Lily family has undergone several changes over the years. Initially, all the genera were placed in the order Liliales. However, with advancements in molecular studies, the classification has been revised, and some of the genera have been moved to other orders. The genera that remain in the Liliales order include Lilium, Fritillaria, Tulipa, Erythronium, Clintonia, and Tricyrtis.The most well-known genus in the Lily family is Lilium, which contains around 110 species of herbaceous flowering plants. The plants in this genus are popular for their showy, trumpet-shaped flowers that come in various colors, including white, pink, red, yellow, and orange.The classification of the Lily family has been a topic of debate among taxonomists. The family’s traditional classification was based on morphological features, which led to the grouping of the genera based on their flower structures. However, molecular studies have shown that the traditional classification was paraphyletic, meaning it did not represent the evolutionary history of the family accurately.Recent studies have suggested that the Lily family is a monophyletic group, meaning it consists of a common ancestor and all its descendants. The family’s evolutionary history can be traced back to the early Cretaceous period, around 120 million years ago. The Lily family’s diversification and expansion were influenced by various factors, including pollinators, geographic isolation, and climate change.In conclusion, the Lily family is a diverse group of herbaceous flowering plants that are distributed globally. The family’s classification has undergone several changes over the years, and it is currently placed in the order Liliales. The most well-known genus in the family is Lilium, which contains around 110 species. The family’s evolutionary history can be traced back to the early Cretaceous period, and recent studies suggest that it is a monophyletic group. of the lily family (Liliaceae) are characterized by their herbaceous, perennial nature. They have a variety of structures including stems, leaves, bulbs, rhizomes, and roots. The stem of these plants is usually unbranched and erect, with leaves arranged alternately along its length. The leaves of lilies are typically long and narrow, with parallel veins and a pointed tip.Lilies are known for their showy and fragrant flowers that are composed of six tepals, which are petal-like structures that are not differentiated into petals and sepals. The tepals are arranged in two whorls of three, with the inner three being slightly smaller than the outer three. The reproductive parts of the lily flower include the ovary, which is located at the base of the flower, and the stamens, which are located around the ovary. The stamens consist of anthers, which produce pollen, and a filament, which supports the anther. The stigma is located at the top of the ovary and is where the pollen is deposited during pollination. The style connects the stigma to the ovary.Lilies have a number of adaptations that allow them to thrive in a variety of environments. They are found in both temperate and subtropical regions of the world, with many species being native to the northern hemisphere. Lilies have adapted to a range of soil types, from well-drained sandy soils to heavy clay soils. They are also able to tolerate a wide range of temperatures, from cold winters to hot summers. Some lilies have bulbs or rhizomes that allow them to survive periods of drought or other environmental stress.In terms of reproduction, lilies have evolved a number of strategies to ensure pollination. Some species are pollinated by insects, while others are pollinated by wind. The fruit of the lily is typically a berry that contains numerous seeds. These seeds are often dispersed by birds or other animals that eat the fruit.Overall, the morphology and growth of plants in the lily family are diverse and fascinating. From their unique flower structure to their adaptive strategies, lilies are a fascinating group of plants that have captured the attention of botanists and gardeners alike.The lily family of plants has been revered for centuries for its cultural and symbolic significance. This section will explore the historical uses, symbolism, and traditions associated with this family of plants.The lily family has been used for various purposes throughout history. In China, lilies were used for medicinal purposes, as they were believed to have healing properties. In Europe, the Madonna lily was used in religious ceremonies as a symbol of purity and was often associated with the Virgin Mary. In Japan, the lily was used as a food source and was considered a delicacy.Lilies have been used as symbols of purity, innocence, and renewal. In Christianity, the Easter lily is often associated with the resurrection of Jesus Christ. In Japan, the lily is a symbol of good luck and prosperity. In China, the lily is a symbol of motherhood and is often given as a gift to new mothers.Traditionally, lilies have been used in weddings and funerals. They are often given as gifts to express sympathy or congratulations. In Eastern North America, the lily is associated with the arrival of spring and is a welcome sight after a long winter.In conclusion, the lily family of plants has a rich cultural and symbolic significance. From its historical uses to its symbolism and traditions, the lily has played an important role in many cultures around the world.Lilies are popular garden plants that are grown for their beautiful flowers. There are many different varieties of lilies, including Asiatic, Oriental, and trumpet lilies. Asiatic lilies are known for their bright colors and are easy to grow, while Oriental lilies have a strong fragrance and are popular for cut flowers. Trumpet lilies have large, trumpet-shaped flowers and are often used as a focal point in garden beds.Tulips are also members of the lily family and are popular garden plants. They come in a wide range of colors and are often planted in large groups for a dramatic effect. Tulips are typically grown from bulbs, which are planted in the fall and bloom in the spring.Lilies and tulips are both perennial plants that grow from bulbs. They prefer well-drained soil and full sun to partial shade. When planting bulbs, it is important to plant them at the correct depth and spacing. Bulbs should be planted with the pointed end facing up, and should be spaced about 6 inches apart.Propagation of lilies and tulips can be done by seed or by dividing bulbs. Dividing bulbs is the more common method and should be done in the fall after the foliage has died back.Lilies and tulips are susceptible to a variety of pests and diseases. Common pests include aphids, thrips, and mites. These pests can be controlled with insecticidal soap or neem oil. Diseases such as botrytis and powdery mildew can be prevented by ensuring good air circulation around the plants and avoiding overhead watering.In conclusion, lilies and tulips are beautiful and popular garden plants that can be easily grown with proper cultivation techniques and pest management.The lily family includes a diverse group of plants that are found in a variety of natural habitats. Many of these habitats are under threat due to habitat loss and climate change. To preserve the natural habitats of these plants, it is important to identify and protect areas that are critical to their survival. This can be achieved through the establishment of protected areas, such as national parks and nature reserves.In addition to protecting natural habitats, it is also important to promote the conservation of wild populations of lilies. This can be achieved through the implementation of sustainable harvesting practices and the establishment of captive breeding programs.Despite efforts to preserve natural habitats and conserve wild populations, many species of lilies remain endangered. Habitat loss, climate change, and other environmental factors continue to pose significant threats to the survival of these plants.One of the biggest challenges facing lily conservation efforts is habitat loss. As human populations continue to grow and expand, natural habitats are being destroyed at an alarming rate. This not only affects lilies, but also other plant and animal species that depend on these habitats for survival.Another challenge facing lily conservation is climate change. Changes in temperature and rainfall patterns can have a significant impact on the growth and survival of these plants. In addition, climate change can also lead to the spread of invasive species, which can outcompete native lilies for resources.Overall, the conservation of lilies is a complex and multifaceted issue that requires a coordinated effort from scientists, policymakers, and the general public. By working together, we can help to ensure that these beautiful and important plants continue to thrive in their natural habitats for generations to come.The Liliaceae family is a large group of flowering plants that includes many popular garden plants such as lilies, tulips, and daffodils. Other common members of this family include garlic, onions, leeks, and chives.Plants that belong to the Liliaceae family can be identified by their characteristic flowers, which have six petals and are often trumpet-shaped. The leaves of these plants are usually long and narrow, and they grow from bulbs or rhizomes.Several vegetables are classified within the Liliaceae family, including garlic, onions, leeks, and chives. These vegetables are known for their pungent flavor and are commonly used in cooking.The scientific name for the lily plant is Lilium. This genus includes many different species of lilies, which are known for their showy flowers and pleasant fragrance.No, there are no trees that are considered a part of the Liliaceae family. This family is composed entirely of herbaceous plants, which means that they have soft, green stems that do not produce woody tissue.Here are some examples of plants that belong to the Liliaceae family:Garlic (Allium sativum)Onion (Allium cepa)Leek (Allium ampeloprasum)Chive (Allium schoenoprasum)Lily (Lilium spp.)Tulip (Tulipa spp.)Daffodil (Narcissus spp.)Images of these plants can easily be found online for further reference. Family of flowering plants in order Liliales, including lilies LiliaceaeTemporal range: 68–0 Ma Pre€ € O S D C P T J K Pg N Late Cretaceous - Recent Lilium candidum Scientific classification Kingdom: Plantae Clade: Tracheophytes Clade: Angiosperms Clade: Monocots Order: Liliales Family: LiliaceaeJuss.[1] Type genus LiliumL. Sp. Pl. 1: 302. (1753)[3] Type species Lilium candidumL. Sp. Pl. 1: 302. (1753)[3] Subfamilies and tribes subfamily: Streptopoideae subfamily: Calochortoideae subfamily: Medeoloideae subfamily: Liliioideae tribe: Lilieae tribe: Tulipeae sensu APWeb[2] Diversity About 600 species ✶ or ÷ P3+3 A3+3 G(3)General floral formula of the Liliaceae: Flowers actinomorphic or slightly zygomorphic and hermaphrodite with 6 undifferentiated tepals in two whorls of three, the same number and arrangement of stamens, and a superior ovary with 3 fused carpels. Individual species and genera may have more or less derived formulas. The lily family, Liliaceae, consists of about 15 genera and 610 species of flowering plants within the order Liliales.[2] They are monocotyledonous, perennial, herbaceous, often bulbous geophytes. Plants in this family have evolved with a fair amount of morphological diversity despite genetic similarity. Common characteristics include large flowers with parts arranged in threes: with six colored or patterned petaloid tepals (undifferentiated petals and sepals) arranged in two whorls, six stamens and a superior ovary. The leaves are linear in shape, with their veins usually arranged parallel to the edges, single and arranged alternating on the stem, or in a rosette at the base. Most species are grown from bulbs, although some have rhizomes. First described in 1789, the lily family became a paraphyletic "catch-all" (wastebasket) group of lilioid monocots that did not fit into other families and included a great number of genera now included in other families and in some cases in other orders. Consequently, many sources and descriptions labelled "Liliaceae" deal with the broader sense of the family. The family evolved approximately 68 million years ago during the Late Cretaceous to Early Paleogene epochs. Liliaceae are widely distributed, mainly in temperate regions of the Northern Hemisphere and the flowers are insect pollinated. Many Liliaceae are important ornamental plants, widely grown for their attractive flowers and involved in a major floriculture of cut flowers and dry bulbs. Some species are poisonous if eaten and can have adverse health effects in humans and household pets. A number of Liliaceae genera are popular cultivated plants in private and public spaces. Lilies and tulips in particular have had considerable symbolic and decorative value, and appear frequently in paintings and the decorative arts. They are also an economically important product. Most of their genera, Lilium in particular, face considerable herbivory pressure from deer in some areas, both wild and domestic.[4][5] Liliaceae floral morphologySection through flower of Fritillaria meleagrisLilium flower with perigonium of six undifferentiated tepals, arranged in two trimerous whorls and side-connected (dorsifixed) anthers.Sego lily (Calochortus nuttallii) with tepals in two clearly distinguished whorls of three sepals and three petals.Tulipa clusiana with three sepals resembling petalsTricyrtis flower with patterned tepalsLilium longiflorum: 1. Stigma, 2. style, 3. stamens, 4. filament, 5. tepalErythronium revolutum flower with three stigmata and pseudo-basifixed anthers surrounding the filament tipLilium with longitudinal dehiscence of antherslilium anthers in cross sectionLilium auratum pollen with typical single-grooved (monosulcate) pattern Tulipa humilis flower showing multiple connate (fused) carpels surrounded by stamens.Lillium fruit capsule The diversity of characteristics complicates any description of the Liliaceae morphology, and confused taxonomic classification for centuries. The diversity is also of considerable evolutionary significance, as some members emerged from shaded areas and adapted to a more open environment (see Evolution).[6] The Liliaceae are characterised as monocotyledonous, perennial, herbaceous, bulbous (or rhizomatous in the case of Medeoleae)[7] flowering plants with simple trichomes (root hairs) and contractile roots.[8] The flowers may be arranged (inflorescence) along the stem, developing from the base, or as a single flower at the tip of the stem, or as a cluster of flowers. They contain both male (androecium) and female (gynoecium) characteristics and are symmetric radially, but sometimes as a mirror image. Most flowers are large and colourful, except for Medeoleae. Both the petals and sepals are usually similar and appear as two concentric groups (whorls) of 'petals', that are often striped or multi-coloured, and produce nectar at their bases. The stamens are usually in two groups of three (trimerous) and the pollen has a single groove (monosulcate). The ovary is placed above the attachment of the other parts (superior). There are three fused carpels (syncarpus) with one to three chambers (locules), a single style and a three-lobed stigma. The embryo sac is of the Fritillaria type. The fruit is generally a wind dispersed capsule, but occasionally a berry (Medeoleae) which is dispersed by animals. The leaves are generally simple and elongated with veins parallel to the edges, arranged singly and alternating on the stem, but may form a rosette at the base of the stem. Inflorescence Usually indeterminate (lacking terminal flower) as a raceme (Lilium); sometimes reduced to a single terminal flower (Tulipa). When pluriflor (multiple blooms), the flowers are arranged in a cluster or rarely are subumbellate (Gagea) or a thyrse (spike).[9] Flowers Hermaphroditic, actinomorphic (radially symmetric) or slightly zygomorphic (bilaterally symmetric),[10] pedicellate (on a short secondary stem), generally large and showy but may be inconspicuous : (Medeoleae). Bracts may (bracteate) or may not (ebracteate) be present. The perianth is undifferentiated (perigonium) and biseriate (two whorled), formed from six tepals arranged into two separate whorls of three parts (trimerous) each, although Scoliopus has only three petals, free from the other parts, but overlapping. The tepals are usually petaloid (petal like) and apotepalous (free) with lines (striate) or marks in other colors or shades. The perianth is either homochlamydeous (all tepals equal, e.g. Fritillaria) or dichlamydeous (two separate and different whorls, e.g. Calochortus) and may be united into a tube. Nectar is produced in perigonal nectaries at the base of the tepals.[9][11][12][13] Androecium Six stamens in two trimerous whorls, with free filaments, usually epiphyllous (fused to tepals) and diplostemonous (outer whorl of stamens opposite outer tepals and the inner whorl opposite inner tepals), although Scoliopus has three stamens opposite the outer tepals.[14] The attachment of the anthers to the filaments may be either peltate (to the surface) or pseudo-basifixed (surrounding the filament tip, but not adnate, that is not fused) and dehisce longitudinally and are extrorse (dehiscing away from center). The pollen is usually monosulcate (single groove), but may be inaperturate (lacking aperture: Clintonia, some Tulipa spp.) or operculate (lidded: Fritillaria, some Tulipa spp.),[15] and reticulate (net patterned: Erythronium, Fritillaria, Gagea, Lilium, Tulipa).[9][11][14] Gynoecium Superior ovary (hypogynous), syncarpous (with fused carpels), with three connate (fused) carpels and is trilocular (three locules, or chambers) or unilocular (single locule, as in Scoliopus and Medeola). There is a single style and a three lobed stigma or three stigmata more or less elongated along the style. There are numerous anatropous (curved) ovules which display axile placentation (parietal in Scoliopus and Medeola),[14] usually with an integument and thinner megasporangium. The embryo sac (megagametophyte) varies by genera, but is mainly tetrasporic (e.g. Fritillaria).[11] Embryo sacs in which three of the four megaspores fuse to form a triploid nucleus, are referred to as Fritillaria-type, a characteristic shared by all the core Liliales.[6][9][11][16] Fruit A capsule that is usually loculicidal (splitting along the locules) as in the Lilioideae,[6] but occasionally septicidal (splitting between them, along the separating septa) in the Calachortoideae and wind dispersed, although the Medeoleae form berries (baccate).[6] The seeds may be flat, oblong, angular, discoid, ellipsoid or globose (spherical), or compressed with a well developed epidermis. The exterior may be smooth or roughened, with a wing or raphe (ridge), aril or one to two tails, rarely hairy, but may be dull or shiny and the lack of a black integument distinguishes them from related taxa such as Allioideae that were previously included in this family, and striate (parallel longitudinally ridged) in the Steptopoideae. The hilum (scar) is generally inconspicuous. The bitegmic (separate testa and tegmen) seed coat itself may be thin, suberose (like cork), or crustaceous (hard or brittle). The endosperm is abundant, cartilaginous (fleshy) or horny and contains oils and aleurone but not starch (non-farinaceous). Its cells are polyploid (triploid or pentaploid, depending on the embryo sac type). The embryo is small (usually less than one quarter of seed volume), axile (radially sectioned), linear (longer than broad) or rarely rudimentary (tiny relative to endosperm) depending on placentation type, and straight, bent, curved or curled at the upper end.[9][11][17][18] Leaves Simple, entire (smooth and even), linear, oval to filiform (thread-like), mostly with parallel veins, but occasionally net-veined. They are alternate (single and alternating direction) and spiral, but may be whorled (three or more attached at one node, e.g. Lilium, Fritillaria), cauline (arranged along the aerial stem) or sheathed in a basal rosette. They are rarely petiolate (stem attached before apex), and lack stipules. The aerial stem is unbranched.[9][11][12][19][20] Genome The Liliaceae include a species with one of the largest genome size within the angiosperms, Fritillaria assyriaca (1C=127.4 pg), while Tricyrtis macropoda is as small as 4.25 pg.[21] Chromosome numbers vary by genus.[11] Some genera like Calochortus (x=6-10), Prosartes (6,8,9,11), Scoliopus (7,8), Streptopus (8, 27) and Tricyrtis (12–13) have a small and variable number of chromosomes while subfamily Lilioideae have a larger and more stable chromosome number (12) as have the Medeoleae (7).[7][22][23][24] Phytochemistry The seeds contain saponins but no calcium oxalate raphide crystals,[14] chelidonic acid[6] (unlike Asparagales) or cysteine derived sulphur compounds (allyl sulphides), another distinguishing feature from the characteristic alliaceous odour of the Allioideae. Fritillaria in particular contains steroidal alkaloids of the cevanine and solanum type.[9] Solanidine and solanthrene[25] alkaloids have been isolated from some Fritillaria species.[26][27] Tulipa contains tulipanin, an anthocyanin. (see also: Toxicology) Characteristics often vary by habitat, between shade-dwelling genera (such as Prosartes, Tricyrtis, Cardiocrinum, Clintonia, Medeola, Prosartes, and Scoliopus) and sun loving genera. Shade-dwelling genera usually have broader leaves with smooth edges and net venation, and fleshy fruits (berries) with animal-dispersed seeds, rhizomes, and small, inconspicuous flowers while genera native to sunny habitats usually have narrow, parallel-veined leaves, capsular fruits with wind-dispersed seeds, bulbs, and large, visually conspicuous flowers.[7] (See also Evolution). Main article: Taxonomy of Liliaceae The taxonomy of the Liliaceae has a very complex history. The family was first described in the eighteenth century, and over time many other genera were added until it became one of the largest of the monocotyledon families, and also extremely diverse. Modern taxonomic systems, such as the APG which is based on phylogenetic principles using molecular biology, have redistributed many of these genera resulting in the relatively small family that is currently recognised. Consequently, there are many different accounts of the Liliaceae in the literature and older uses of the term occur commonly. To distinguish between them, the Latin terms sensu lato and sensu stricto are frequently used (together with their abbreviations, s.l. and s.s.) to denote the broader or stricter sense of the circumscription respectively, e.g. Liliaceae s.s.. The family Liliaceae was described by Michel Adanson in 1763 and formally named by Antoine Laurent de Jussieu in 1789. Jussieu defined this grouping as having a calyx of six equal colored parts, six stamens, a superior ovary, single style, and a trilocular (three-chambered) capsule. By 1845, John Lindley, the first English systematist, unhappily acknowledged the great diversity in the circumscription of the family, and that it had expanded vastly, with many subdivisions. As he saw it, the Liliaceae were already paraphyletic ("catch-all"), being all Liliales not included in the other orders, but hoped that the future would reveal some characteristic that would group them better. He recognized 133 genera and 1200 species.[28] By the time of the next major British classification – that of Bentham and Hooker in 1883 (published in Latin) – several of Lindley's other families had already been absorbed into the Liliaceae.[29] Over time the family became increasingly broad and somewhat arbitrarily defined as all species of plants with six tepals and a superior ovary, eventually coming to encompass about 300 genera and 4,500 species within the order Liliales under the Cronquist system (1981). Cronquist merged the Liliaceae with the Amaryllidaceae, making this one of the largest monocotyledon families.[30] Many other botanists echoed Lindley's earlier concerns about the phylogeny of the Liliaceae, but various schemes to divide the family gained little traction. Dahlgren (1985) suggested there were in fact forty – not one – families distributed over three orders (predominantly Liliales and Asparagales).[31][32] In the context of a general review of the classification of angiosperms, the Liliaceae were subjected to more intense scrutiny. Considerable progress in plant phylogeny and phylogenetic theory enabled a phylogenetic tree to be constructed for all of the flowering plants, as elaborated by the Angiosperm Phylogeny Group (1998).[6] The Angiosperm Phylogeny Group (APG) made rapid progress in establishing a modern monophyletic classification of the flowering plants by 2009.[33] Despite establishing this relative degree of monophyly (genetic homogeneity) for the family Liliaceae,[34][35] their morphology remains diverse[7] and there exists within the Liliaceae clade or grouping, a number of subclades (subgroups). Particularly enigmatic were Clintonia, Medeola, Scoliopus, and Tricyrtis. Of the fifteen genera within the Liliaceae, the ten genera of the Lilioideae subfamily form one morphological group that is characterised by contractile bulbs and roots, and a Fritillaria-type embryo-sac (megagametophyte with four megaspores). Within the Lilioideae, Clintonia and the closely related Medeola form a subclade, and are now considered a separate tribe (Medeoleae).[36] The other major grouping consists of the five genera constituting the Streptopoideae (including Scoliopus) and Calochortoideae (including Tricyrtis) subfamilies characterised by creeping rhizomes, styles which are divided at their apices, and by megagametophyte development of the Polygonum-type (a simple megaspore and triploid endosperm) embryo-sac. The development of a phylogenetic approach to taxonomy suggested the Liliales formed some of the earliest monocots.[37] Molecular analysis indicates that divergence amongst the Liliales probably occurred around 82 million years ago. The closest sister family to the Liliaceae are the Smilacaceae with the Liliaceae separating 52 million years ago. Liliaceae thus arose during the late (Maastrichtian) Cretaceous to early (Paleocene) Paleogene periods.[21] Major evolutionary clades include the Lilieae (Lilium, Fritillaria, Nomocharis, Cardiocrinum, Notholirion) from the Himalayas about 12 mya and the Tulipeae (Erythronium, Tulipa, Gagea) from East Asia at about the same time. The Medeoleae (Clintonia and Medeola) may have appeared in North America but were subsequently dispersed, as may have the Streptopoideae and Calochortoideae.[6][38][39][40] Liliaceae fossils have been dated to the Paleogene[41] and Cretaceous[42] eras in the Antarctic. The Liliaceae probably arose as shade plants, with subsequent evolution to open areas including deciduous forest in the more open autumnal period, but then a return of some species (e.g. Cardiocrinum). This was accompanied by a shift from rhizomes to bulbs, to more showy flowers, the production of capsular fruit and narrower parallel-veined leaves. Again, some reversal to the broader reticulate-veined leaves occurred (e.g. Cardiocrinum).[6] Examples of the four subdivisions of LiliaceaeMedeoleae: Leaves and fruit of Clintonia borealis, Quebec, CanadaLilieae: Flower of Nomocharis aperta, Yunnan, ChinaCalochortoideae: Flower of Calochortus catalinae, CaliforniaStreptopoideae: Leaves and berries of Streptopus lanceolatus, Ontario, Canada Due to the diversity of the originally broadly defined Liliaceae s.l., many attempts have been made to form suprageneric classifications, e.g. subfamilies and tribes.[23] Classifications published since the use of molecular methods in phylogenetics have taken a narrower view of the Liliaceae (Liliaceae s.s.). The Angiosperm Phylogeny Website (APweb)[2] recognizes three subfamilies, one of which is divided into two tribes.[11] Main article: List of Liliaceae genera Various authorities (e.g. ITIS 16,[43] GRIN 27,[44] WCSP,[45] NCBI,[46] DELTA[19]) differ on the exact number of genera included in Liliaceae s.s., but generally there are about fifteen to sixteen genera, depending on whether or not Amana is included in Tulipa and Lloydia in Gagea. Currently the APWeb lists fifteen genera, arranged as shown in this table:[2][11][47] APweb Distribution of subfamilies, tribes and genera of Liliaceae Subfamily Tribe Genus Lilioideae Eaton Medeoleae Benth. (synonyms: Medeolaceae Takht., Medeoloideae Benth.) Clintonia Raf. - bead lilies Medeola Gronov. ex L. - Indian cucumber-root Lilieae Ritgen (synonyms: Erythroniaceae Martinov, Fritillariaceae Salisb., Liriaceae Borkh., Tulipaceae Borkh.)| Amana Honda Cardiocrinum (Endl.) Lindl. - giant lilies Erythronium L. – trout lily Fritillaria Tourn. ex L. – fritillary or mission bells Gagea Salisb. (including Lloydia Salisb. ex Rchb.) – yellow star-of-Bethlehem Lilium Tourn. ex L. (synonym Nomocharis Franch.) – lily Notholirion Wall. ex Boiss. Tulipa L. – tulip Calochortoideae Dumort. (synonyms: Calochortaceae Dumort., Compsoaceae Horan., nom. illeg., Tricyrtidaceae Takht., nom. cons.) Calochortus Pursh - mariposa, globe lilies Tricyrtis Wall. – toad lily Streptopoideae (synonym: Scoliopaceae Takht.) Prosartes D.Don – drops of gold Scoliopus Torr. – fetid adder's tongue Streptopus Michx. – twistedstalk The largest genera are Gagea (200), Fritillaria (130), Lilium (110), and Tulipa (75 species), all within the tribe Lilieae. The name "Liliaceae" (English: /ˌlɪliˈeɪsi, -si,aɪ, -si,eɪ, -si,i/) comes to international scientific vocabulary from Neo-Latin, from Lilium, the type genus, + -aceae,[48] a standardized suffix for plant family names in modern taxonomy. The genus name comes from the Classical Latin word lilium, "lily", which in turn came from the Greek leírion (λείριον). The Liliaceae are widely distributed, but mainly in the temperate regions of the Northern Hemisphere. The centre of diversity is from southwest Asia to China. Their distribution is diverse, mainly in plains, steppes, and alpine meadows, but also in deciduous forests, Mediterranean scrub and arctic tundra.[6][9] Tulipa and Gagea provide examples of ornamental geophyte biomorphological types representing continental thermoperiodic zones (Irano-Turanian region), characterised by cessation of underground growth at high temperatures in early summer and requiring low winter temperatures for spring flowering.[40] While some genera are shade-dwelling, such as the Medeoleae, and Streptopoideae, Tricyrtis, and Cardiocrinum, others prefer a more open habitat. The Liliaceae are ecologically diverse.[6] Species of Liliaceae bloom at various times from spring to late summer. The colorful flowers produce large amounts of nectar and pollen that attract insects which pollinate them (entomophily), particularly bees and wasps (hymenopterophily), butterflies (psychophily) and moths (phalaenophily).[20] The seeds are dispersed by wind and water. Some species (e.g. Scoliopus, Erythronium and Gagea) have seeds with an aril structure that are dispersed by ants (myrmecochory).[6] The proliferation of deer populations in many areas, due to human factors such as the elimination of their animal predators and introduction to alien environments, is placing considerable herbivory pressure on many of the family's species.[4] Fences as high as 8 feet may be required to prevent them from consuming the plants, an impractical solution for most wild areas.[5] Those of the genus Lilium are particularly palatable, while species in Fritillaria are repellant. Scarlet lily beetle (Lilioceris lilii) 17th-century painting of affected Tulipa 'Semper Augustus', showing 'breaking' Liliaceae are subject to a wide variety of diseases and pests, including insects, such as thrips, aphids, beetles and flies. Also fungi, viruses and vertebrate animals such as mice and deer.[49][50] An important horticultural and garden pest is the scarlet lily beetle (Japanese red lily beetle, Lilioceris lilii) and other Lilioceris species which attack Fritillaria and Lilium.[51] Lilium species may be food plants for the Cosmia trapezina moth. A major pest of Tulips is the fungus, Botrytis tulipae. Both Lilium and Tulipa are susceptible to a group of five viruses of the family Potyviridae, specifically the potyvirus (named for potato virus Y) group, which includes the tulip-breaking virus (TBV) and the lily streak virus (lily mottle virus, LMoV) resulting in 'breaking' of the color of the flowers. The viruses are transmitted by aphids. This breaking effect was of economic importance during the tulip mania of the seventeenth century, because it appeared to be producing new varieties.[52][53] In modern times tulip breeders have produced varieties that mimic the effect of the virus, without being infected. One of these varieties is known as 'Rembrandt', after the Dutch artist of that name. Contemporary tulip owners commonly had Rembrandt and other artists paint their flowers to preserve them for posterity, hence the 'broken' tulips were known as Rembrandt tulips at that time. Another modern variety is 'Princess Irene'.[54][55][56] One of the tulip breaking viruses is also named the Rembrandt tulip-breaking virus (ReTBV).[57][58] CultivationTulipa varieties are popular ornamental flowers in public and private spaces in the springTulip production, Hillegom, the NetherlandsLily production, Japan Many species of Lilieae (in genera Tulipa, Fritillaria, Lilium, and Erythronium) and Calochortoideae (Calochortus and Tricyrtis) are grown as ornamental plants worldwide. Within these genera a wide range of cultivars have been developed by breeding and hybridisation. They are generally used in outdoor gardens and other displays, although in common with many bulbous flowering plants they are often induced to bloom indoors, particularly during the winter months. They also form a significant part of the cut flower market, in particular Tulipa and Lilium. Tulips have been cultivated since at least the tenth century in Persia.[59] Tulip production has two main markets: cut flowers and bulbs. The latter are used, in turn, to meet the demand for bulbs for parks, gardens, and home use and, secondly, to provide the necessary bulbs for cut flower production. International trade in cut flowers has an approximate total value of 11 billion euros, which provides an indication of the economic importance of this activity. The main producer of tulip bulbs is the Netherlands, a country that accounts for 87% of the global cultivated area

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Most showy monocot flowers with parts in threes belong to the Lily family or one of its allies. Lilies have 3 sepals and 3 petals, which are identical in size and color (often referred to as 6 tepals). There are 6 stamens, but some species lack anthers on some of the stamens. The ovary is positioned superior and consists of 3 united carpels, as indicated by the same number of stigmas. Partition walls are present, forming an equal number of chambers. The ovary matures as a capsule or a berry with 3 to numerous seeds.

Taxonomists have struggled with lily-like flowers, originally lumping them together as a conglomerate Lily family encompassing about 250 genera and 3,700 species. Numerous attempts were made to split the family into proper families and subfamilies based on actual relationships, resulting in many different classification schemes and up to 70 different proposed families. Blue camas (Camassia), for example, is listed in different sources as a member of the Lily family, Hyacinth family, Agave family, and now the Agave subfamily of the Asparagus family. The most newly defined families and subfamilies presumeably follow genetic lines and should be reasonably stable in the future. The redefined Lily family has been reduced to about 16 genera and 640 species. Many plants that were formerly included in the Lily family are now included in the Bunchflower, Amaryllis, and Asparagus families, so be sure to read about them for comparison. Key Words: Flowers with parts in threes. Sepals and petals usually identical. Please e-mail Thomas J. Elpel to report mistakes or to inquire about purchasing high resolution photos of these plants. Erythronium grandiflorum. Glacier Lily. Erythronium grandiflorum. Glacier Lily. Fritillaria atropurpurea. Chocolate Lily. Fritillaria atropurpurea. Chocolate Lily. Fritillaria pudica. Yellowbell. Fritillaria pudica. Yellowbell. Lilium columbianum. Columbia Tiger Lily. Lilium columbianum. Columbia Tiger Lily. Lilium lancifolium. Tiger Lily. Photographed in New Zealand.Medeola virginiana. Indian Cucumber. Photo contributed by Christy Fitzsimmons. Clintonia uniflora. Queen's Cup. Glacier National Park. Montana. Leucocrinum montanum. Sand Lily. Tongue Reservoir. Eastern Montana. Disporum hookeri. Hooker's Fairybell. Disporum smithii. Smith's Fairybells. Photographed along the northern California coast. Streptopus amplexifolius. Twisted Stalk. Streptopus amplexifolius. Twisted Stalk. Calochortus lyallii. Lyall's Mariposa or Sego Lily. Calochortus lyallii. Lyall's Mariposa or Sego Lily. Calochortus apiculatus. Sego Lily. Near Glacier National Park. Montana. Calochortus eurycarpus. Sego Lily. Calochortus nuttallii. Sego Lily. Montana. Calochortus nuttallii. Sego Lily. Montana. Calochortus macrocarpus. Sagebrush Sego lily. Foraging the Mountain West There are more Lily Family pictures at PlantSystematics.org. Return to the Plant Families IndexReturn to the Wildflowers & Weeds Home Page Family of flowering plants in order Liliales, including lilies LiliaceaeTemporal range: 68–0 Ma Pre€ € O S D C P T J K Pg N Late Cretaceous - Recent Lilium candidum Scientific classification Kingdom: Plantae Clade: Tracheophytes Clade: Angiosperms Clade: Monocots Order: Liliales Family: LiliaceaeJuss.[1] Type genus LiliumL. Sp. Pl. 1: 302. (1753)[3] Type species Lilium candidumL. Sp. Pl. 1: 302. (1753)[3] Subfamilies and tribes subfamily: Streptopoideae subfamily: Calochortoideae subfamily: Medeoloideae subfamily: Lilioideae tribe: Lilieae tribe: Tulipeae sensu APWeb[2] Diversity About 600 species ✶ or ÷ P3+3 A3+3 G(3)General floral formula of the Liliacaeae: Flowers actinomorphic or slightly zygomorphic and hermaphrodite with 6 undifferentiated tepals in two whorls of three, the same number and arrangement of stamens, and a superior ovary with 3 fused carpels. Individual species and genera may have more or less derived formulas. The lily family, Liliaceae, consists of about 15 genera and 610 species of flowering plants within the order Liliales.[2] They are monocotyledonous, perennial, herbaceous, often bulbous geophytes. Plants in this family have evolved with a fair amount of morphological diversity despite genetic similarity. Common characteristics include large flowers with parts arranged in threes: with six colored or patterned petaloid tepals (undifferentiated petals and sepals) arranged in two whorls, six stamens and a superior ovary. The leaves are linear in shape, with their veins usually arranged parallel to the edges, single and arranged alternating on the stem, or in a rosette at the base. Most species are grown from bulbs, although some have rhizomes. First described in 1789, the lily family became a paraphyletic "catch-all" (wastebasket) group of lilioid monocots that did not fit into other families and included a great number of genera now included in other families and in some cases in other orders. Consequently, many sources and descriptions labelled "Liliaceae" deal with the broader sense of the family. The family evolved approximately 68 million years ago during the Late Cretaceous to Early Paleogene epochs. Liliaceae are widely distributed, mainly in temperate regions of the Northern Hemisphere and the flowers are insect pollinated. Many Liliaceae are important ornamental plants, widely grown for their attractive flowers and involved in a major floriculture of cut flowers and dry bulbs. Some species are poisonous if eaten and can have adverse health effects in humans and household pets. A number of Liliaceae genera are popular cultivated plants in private and public spaces. Lilies and tulips in particular have had considerable symbolic and decorative value, and appear frequently in paintings and the decorative arts. They are also an economically important product. Most of their genera, Lilium in particular, face considerable herbivory pressure from deer in some areas, both wild and domestic.[4][5] Liliaceae floral morphologySection through flower of Fritillaria meleagrisLilium flower with perigonium of six undifferentiated tepals, arranged in two trimerous whorls and side-connected (dorsifixed) anthers.Sego lily (Calochortus nuttallii) with tepals in two clearly distinguished whorls of three sepals and three petals.Tulipa clusiana with three sepals resembling petalsTricyrtis flower with patterned tepalsLilium longiflorum: 1. Stigma, 2. style, 3. stamens, 4. filament, 5. tepalErythronium revolutum flower with three stigmata and pseudo-basifixed anthers surrounding the filament tipLilium with longitudinal dehiscence of anthersLilium anthers in cross sectionLilium auratum pollen with typical single-grooved (monosulcate) pattern Tulipa humilis flower showing multiple connate (fused) carpels surrounded by stamens.Lillium fruit capsule The diversity of characteristics complicates any description of the Liliaceae morphology, and confused taxonomic classification for centuries. The diversity is also of considerable evolutionary significance, as some members emerged from shaded areas and adapted to a more open environment (see Evolution).[6] The Liliaceae are characterised as monocotyledonous, perennial, herbaceous, bulbous (or rhizomatous in the case of Medeoleae)[7] flowering plants with simple trichomes (root hairs) and contractile roots.[8] The flowers may be arranged (inflorescence) along the stem, developing from the base, or as a single flower at the tip of the stem, or as a cluster of flowers. They contain both male (androecium) and female (gynoecium) characteristics and are symmetric radially, but sometimes as a mirror image. Most flowers are large and colourful, except for Medeoleae. Both the petals and sepals are usually similar and appear as two concentric groups (whorls) of 'petals', that are often striped or multi-coloured, and produce nectar at their bases. The stamens are usually in two groups of three (trimerous) and the pollen has a single groove (monosulcate). The ovary is placed above the attachment of the other parts (superior). There are three fused carpels (syncarpus) with one to three chambers (locules), a single style and a three-lobed stigma. The embryo sac is of the Fritillaria type. The fruit is generally a wind dispersed capsule, but occasionally a berry (Medeoleae) which is dispersed by animals. The leaves are generally simple and elongated with veins parallel to the edges, arranged singly and alternating on the stem, but may form a rosette at the base of the stem. Inflorescence Usually indeterminate (lacking terminal flower) as a raceme (Lilium); sometimes reduced to a single terminal flower (Tulipa). When pluriflor (multiple blooms), the flowers are arranged in a cluster or rarely are subumbellate (Gagea) or a thyrse (spike).[9] Flowers Hermaphroditic, actinomorphic (radially symmetric) or slightly zygomorphic (bilaterally symmetric),[10] pedicellate (on a short secondary stem), generally large and showy but may be inconspicuous : (Medeoleae). Bracts may (bracteate) or may not (ebracteate) be present. The perianth is undifferentiated (perigonium) and biseriate (two whorled), formed from six tepals arranged into two separate whorls of three parts (trimerous) each, although Scoliopus has only three petals, free from the other parts, but overlapping. The tepals are usually petaloid (petal like) and apotepalous (free) with lines (striate) or marks in other colors or shades. The perianth is either homochlamydeous (all tepals equal, e.g. Fritillaria) or dichlamydeous (two separate and different whorls, e.g. Calochortus) and may be united into a tube. Nectar is produced in perigonal nectaries at the base of the tepals.[9][11][12][13] Androecium Six stamens in two trimerous whorls, with free filaments, usually epiphyllous (fused to tepals) and diplostemonous (outer whorl of stamens opposite outer tepals and the inner whorl opposite inner tepals), although Scoliopus has three stamens opposite the outer tepals.[14] The attachment of the anthers to the filaments may be either peltate (to the surface) or pseudo-basifixed (surrounding the filament tip, but not adnate, that is not fused) and dehisce longitudinally and are extrorse (dehiscing away from center). The pollen is usually monosulcate (single groove), but may be inaperturate (lacking aperture: Clintonia, some Tulipa spp.) or operculate (lidded: Fritillaria, some Tulipa spp.),[15] and reticulate (net patterned: Erythronium, Fritillaria, Gagea, Lilium, Tulipa).[9][11][14] Gynoecium Superior ovary (hypogynous), syncarpous (with fused carpels), with three connate (fused) carpels and is trilocular (three locules, or chambers) or unilocular (single locule, as in Scoliopus and Medeola). There is a single style and a three lobed stigma or three stigmata more or less elongated along the style. There are numerous anatropous (curved) ovules which display axile placentation (parietal in Scoliopus and Medeola),[14] usually with an integument and thinner megasporangium. The embryo sac (megagametophyte) varies by genera, but is mainly tetrasporic (e.g. Fritillaria).[11] Embryo sacs in which three of the four megaspores fuse to form a triploid nucleus, are referred to as Fritillaria-type, a characteristic shared by all the core Liliales.[6][9][11][16] Fruit A capsule that is usually loculicidal (splitting along the locules) as in the Lilioideae,[6] but occasionally septicidal (splitting between them, along the separating septa) in the Calachortoideae and wind dispersed, although the Medeoleae form berries (baccate).[6] The seeds may be flat, oblong, angular, discoid, ellipsoid or globose (spherical), or compressed with a well developed epidermis. The exterior may be smooth or roughened, with a wing or raphe (ridge), aril or one to two tails, rarely hairy, but may be dull or shiny and the lack of a black integument distinguishes them from related taxa such as Allioideae that were previously included in this family, and striate (parallel longitudinally ridged) in the Steptopoideae. The hilum (scar) is generally inconspicuous. The bitegmic (separate testa and tegmen) seed coat itself may be thin, suberose (like cork), or crustaceous (hard or brittle). The endosperm is abundant, cartilaginous (fleshy) or horny and contains oils and aleurone but not starch (non-farinaceous). Its cells are polyploid (triploid or pentaploid, depending on the embryo sac type). The embryo is small (usually less than one quarter of seed volume), axile (radially sectioned), linear (longer than broad) or rarely rudimentary (tiny relative to endosperm) depending on placentation type, and straight, bent, curved or curled at the upper end.[9][11][17][18] Leaves Simple, entire (smooth and even), linear, oval to filiform (thread-like), mostly with parallel veins, but occasionally net-veined. They are alternate (single and alternating direction) and spiral, but may be whorled (three or more attached at one node, e.g. Lilium, Fritillaria), cauline (arranged along the aerial stem) or sheathed in a basal rosette. They are rarely petiolate (stem attached before apex), and lack stipules. The aerial stem is unbranched.[9][11][12][19][20] Genome The Liliaceae include a species with one of the largest genome size within the angiosperms, Fritillaria assyriaca (1C=127.4 pg), while Tricyrtis macropoda is as small as 4.25 pg.[21] Chromosome numbers vary by genus.[11] Some genera like Calochortus (x=6-10), Prosartes (6,8,9,11), Scoliopus (7,8), Streptopus (8, 27) and Tricyrtis (12–13) have a small and variable number of chromosomes while subfamily Lilioideae have a larger and more stable chromosome number (12) as have the Medeoleae (7).[7][22][23][24] Phytochemistry The seeds contain saponins but no calcium oxalate raphide crystals,[14] chelidonic acid[6] (unlike Asparagales) or cysteine derived sulphur compounds (allyl sulphides), another distinguishing feature from the characteristic alliaceous odour of the Allioideae. Fritillaria in particular contains steroidal alkaloids of the cevanine and solanum type.[9] Solanidine and solanthrene[25] alkaloids have been isolated from some Fritillaria species.[26][27] Tulipa contains tulipanin, an anthocyanin. (see also: Toxicology) Characteristics often vary by habitat, between shade-dwelling genera (such as Prosartes, Tricyrtis, Cardiocrinum, Clintonia, Medeola, Prosartes, and Scoliopus) and sun loving genera. Shade-dwelling genera usually have broader leaves with smooth edges and net venation, and fleshy fruits (berries) with animal-dispersed seeds, rhizomes, and small, inconspicuous flowers while genera native to sunny habitats usually have narrow, parallel-veined leaves, capsular fruits with wind-dispersed seeds, bulbs, and large, visually conspicuous flowers.[7] (See also Evolution). Main article: Taxonomy of Liliaceae The taxonomy of the Liliaceae has a very complex history. The family was first described in the eighteenth century, and over time many other genera were added until it became one of the largest of the monocotyledon families, and also extremely diverse. Modern taxonomic systems, such as the APG which is based on phylogenetic principles using molecular biology, have redistributed many of these genera resulting in the relatively small family that is currently recognised. Consequently, there are many different accounts of the Liliaceae in the literature and older uses of the term occur commonly. To distinguish between them, the Latin terms sensu lato and sensu stricto are frequently used (together with their abbreviations, s.l. and s.s.) to denote the broader or stricter sense of the circumscription respectively, e.g. Liliaceae s.s.. The family Liliaceae was described by Michel Adanson in 1763 and formally named by Antoine Laurent de Jussieu in 1789. Jussieu defined this grouping as having a calyx of six equal colored parts, six stamens, a superior ovary, single style, and a trilocular (three-chambered) capsule. By 1845, John Lindley, the first English systematist, unhappily acknowledged the great diversity in the circumscription of the family, and that it had expanded vastly, with many subdivisions. As he saw it, the Liliaceae were already paraphyletic ("catch-all"), being all Liliales not included in the other orders, but hoped that the future would reveal some characteristic that would group them better. He recognized 133 genera and 1200 species.[28] By the time of the next major British classification – that of Bentham and Hooker in 1883 (published in Latin) – several of Lindley's other families had already been absorbed into the Liliaceae.[29] Over time the family became increasingly broad and somewhat arbitrarily defined as all species of plants with six tepals and a superior ovary, eventually coming to encompass about 300 genera and 4,500 species within the order Liliales under the Cronquist system (1981). Cronquist merged the Liliaceae with the Amaryllidaceae, making this one of the largest monocotyledon families.[30] Many other botanists echoed Lindley's earlier concerns about the phylogeny of the Liliaceae, but various schemes to divide the family gained little traction. Dahlgren (1985) suggested there were in fact forty – not one – families distributed over three orders (predominantly Liliales and Asparagales).[31][32] In the context of a general review of the classification of angiosperms, the Liliaceae were subjected to more intense scrutiny. Considerable progress in plant phylogeny and phylogenetic theory enabled a phylogenetic tree to be constructed for all of the flowering plants, as elaborated by the Angiosperm Phylogeny Group (1998).[6] The Angiosperm Phylogeny Group (APG) made rapid progress in establishing a modern monophyletic classification of the flowering plants by 2009.[33] Despite establishing this relative degree of monophyly (genetic homogeneity) for the family Liliaceae,[34][35] their morphology remains diverse[7] and there exists within the Liliaceae clade or grouping, a number of subclades (subgroups). Particularly enigmatic were Clintonia, Medeola, Scoliopus, and Tricyrtis. Of the fifteen genera within the Liliaceae, the ten genera of the Lilioideae subfamily form one morphological group that is characterised by contractile bulbs and roots, and a Fritillaria-type embryo-sac (megagametophyte with four megaspores). Within the Lilioideae, Clintonia and the closely related Medeola form a subclade, and are now considered a separate tribe (Medeoleae).[36] The other major grouping consists of the five genera constituting the Streptopoideae (including Scoliopus) and Calochortoideae (including Tricyrtis) subfamilies characterised by creeping rhizomes, styles which are divided at their apices, and by megagametophyte development of the Polygonum-type (a simple megaspore and triploid endosperm) embryo-sac. The development of a phylogenetic approach to taxonomy suggested the Liliales formed some of the earliest monocots.[37] Molecular analysis indicates that divergence amongst the Liliales probably occurred around 82 million years ago. The closest sister family to the Liliaceae are the Smilacaceae with the Liliaceae separating 52 million years ago. Liliaceae thus arose during the late (Maastrichtian) Cretaceous to early (Paleocene) Paleogene periods.[21] Major evolutionary clades include the Lilieae (Lilium, Fritillaria, Nomocharis, Cardiocrinum, Notholirion) from the Himalayas about 12 mya and the Tulipeae (Erythronium, Tulipa, Gagea) from East Asia at about the same time. The Medeoleae (Clintonia and Medeola) may have appeared in North America but were subsequently dispersed, as may have the Streptopoideae and Calochortoideae.[6][38][39][40] Liliaceae fossils have been dated to the Paleogene[41] and Cretaceous[42] eras in the Antarctic. The Liliaceae probably arose as shade plants, with subsequent evolution to open areas including deciduous forest in the more open autumnal period, but then a return of some species (e.g. Cardiocrinum). This was accompanied by a shift from rhizomes to bulbs, to more showy flowers, the production of capsular fruit and narrower parallel-veined leaves. Again, some reversal to the broader reticulate-veined leaves occurred (e.g. Cardiocrinum).[6] Examples of the four subdivisions of LiliaceaeMedeoleae: Leaves and fruit of Clintonia borealis, Quebec, CanadaLilieae: Flower of Nomocharis aperta, Yunnan, ChinaCalochortoideae: Flower of Calochortus catalinae, CaliforniaStreptopoideae: Leaves and berries of Streptopus lanceolatus, Ontario, Canada Due to the diversity of the originally broadly defined Liliaceae s.l., many attempts have been made to form suprageneric classifications, e.g. subfamilies and tribes.[23] Classifications published since the use of molecular methods in phylogenetics have taken a narrower view of the Liliaceae (Liliaceae s.s.). The Angiosperm Phylogeny Website (APweb)[2] recognizes three subfamilies, one of which is divided into two tribes.[11] Main article: List of Liliaceae genera Various authorities (e.g. ITIS 16,[43] GRIN 27,[44] WCSP,[45] NCBI,[46] DELTA[19]) differ on the exact number of genera included in Liliaceae s.s., but generally there are about fifteen to sixteen genera, depending on whether or not Amana is included in Tulipa and Lloydia in Gagea. Currently the APWeb lists fifteen genera, arranged as shown in this table:[2][11][47] APweb Distribution of subfamilies, tribes and genera of Liliaceae Subfamily Tribe Genus Lilioideae Eaton Medeoleae Benth. (synonyms: Medeolaceae Takht., Medeoloideae Benth.) Clintonia Raf. - bead lilies Medeola Gronov. ex L. - Indian cucumber-root Lilieae Ritgen (synonyms: Erythroniaceae Martinov, Fritillariaceae Salisb., Liriaceae Borkh., Tulipaceae Borkh.)| Amana Honda Cardiocrinum (Endl.) Lindl. - giant lilies Erythronium L. – trout lily Fritillaria Tourn. ex L. – fritillary or mission bells Gagea Salisb. (including Lloydia Salisb. ex Rchb.) – yellow star-of-Bethlehem Lilium Tourn. ex L. (synonym Nomocharis Franch.) – lily Notholirion Wall. ex Boiss. Tulipa L. – tulip Calochortoideae Dumort. (synonyms: Calochortaceae Dumort., Compsoaceae Horan., nom. illeg., Tricyrtidaceae Takht., nom. cons.) Calochortus Pursh - mariposa, globe lilies Tricyrtis Wall. – toad lily Streptopoideae (synonym: Scoliopaceae Takht.) Prosartes D.Don – drops of gold Scoliopus Torr. – fetid adder's tongue Streptopus Michx. – twistedstalk The largest genera are Gagea (200), Fritillaria (130), Lilium (110), and Tulipa (75 species), all within the tribe Lilieae. The name "Liliaceae" (English: /ˌlɪliˈeɪsi, -si,aɪ, -si,eɪ, -si,i/) comes to international scientific vocabulary from Neo-Latin, from Lilium, the type genus, + -aceae,[48] a standardized suffix for plant family names in modern taxonomy. The genus name comes from the Classical Latin word lilium, "lily", which in turn came from the Greek leírion (λείριον). The Liliaceae are widely distributed, but mainly in the temperate regions of the Northern Hemisphere. The centre of diversity is from southwest Asia to China. Their distribution is diverse, mainly in plains, steppes, and alpine meadows, but also in deciduous forests, Mediterranean scrub and arctic tundra.[6][9] Tulipa and Gagea provide examples of ornamental geophyte biomorphological types representing continental thermoperiodic zones (Irano-Turanian region), characterised by cessation of underground growth at high temperatures in early summer and requiring low winter temperatures for spring flowering.[40] While some genera are shade-dwelling, such as the Medeoleae, and Streptopoideae, Tricyrtis, and Cardiocrinum, others prefer a more open habitat. The Liliaceae are ecologically diverse.[6] Species of Liliaceae bloom at various times from spring to late summer. The colorful flowers produce large amounts of nectar and pollen that attract insects which pollinate them (entomophily), particularly bees and wasps (hymenopterophily), butterflies (psychophily) and moths (phalaenophily).[20] The seeds are dispersed by wind and water. Some species (e.g. Scoliopus, Erythronium and Gagea) have seeds with an aril structure that are dispersed by ants (myrmecochory).[6] The proliferation of deer populations in many areas, due to human factors such as the elimination of their animal predators and introduction to alien environments, is placing considerable herbivory pressure on many of the family's species.[4] Fences as high as 8 feet may be required to prevent them from consuming the plants, an impractical solution for most wild areas.[5] Those of the genus Lilium are particularly palatable, while species in Fritillaria are repellant. Scarlet lily beetle (Lilioceris lilii) 17th-century painting of affected Tulipa 'Semper Augustus', showing 'breaking' Liliaceae are subject to a wide variety of diseases and pests, including insects, such as thrips, aphids, beetles and flies. Also fungi, viruses and vertebrate animals such as mice and deer.[49][50] An important horticultural and garden pest is the scarlet lily beetle (Japanese red lily beetle, Lilioceris lilii) and other Lilioceris species which attack Fritillaria and Lilium.[51] Lilium species may be food plants for the Cosmia trapezina moth. A major pest of Tulips is the fungus, Botrytis tulipae. Both Lilium and Tulipa are susceptible to a group of five viruses of the family Potyviridae, specifically the potyvirus (named for potato virus Y) group, which includes the tulip-breaking virus (TBV) and the lily streak virus (lily mottle virus, LMoV) resulting in 'breaking' of the color of the flowers. The viruses are transmitted by aphids. This breaking effect was of economic importance during the tulip mania of the seventeenth century, because it appeared to be producing new varieties.[52][53] In modern times tulip breeders have produced varieties that mimic the effect of the virus, without being infected. One of these varieties is known as 'Rembrandt', after the Dutch artist of that name. Contemporary tulip owners commonly had Rembrandt and other artists paint their flowers to preserve them for posterity, hence the 'broken' tulips were known as Rembrandt tulips at that time. Another modern variety is 'Princess Irene'.[54][55][56] One of the tulip breaking viruses is also named the Rembrandt tulip-breaking virus (ReTBV).[57][58] CultivationTulipa varieties are popular ornamental flowers in public and private spaces in the springTulip production, Hillegom, the NetherlandsLily production, Japan Many species of Lilieae (in genera Tulipa, Fritillaria, Lilium, and Erythronium) and Calochortoideae (Calochortus and Tricyrtis) are grown as ornamental plants worldwide. Within these genera a wide range of cultivars have been developed by breeding and hybridisation. They are generally used in outdoor gardens and other displays, although in common with many bulbous flowering plants they are often induced to bloom indoors, particularly during the winter months. They also form a significant part of the cut flower market, in particular Tulipa and Lilium. Tulips have been cultivated since at least the tenth century in Persia.[59] Tulip production has two main markets: cut flowers and bulbs. The latter are used, in turn, to meet the demand for bulbs for parks, gardens, and home use and, secondly, to provide the necessary bulbs for cut flower production. International trade in cut flowers has an approximate total value of 11 billion euros, which provides an indication of the economic importance of this activity. The main producer of tulip bulbs is the Netherlands, a country that accounts for 87% of the global cultivated area, with approximately 12,000 hectares. Other leading producers include Japan, France and Poland. Approximately ten other countries produce commercial tulips, largely for the domestic market. By contrast, the Netherlands is the leading international producer, to the extent of 4 billion bulbs per annum. Of these, 53% are used for the cut flower market and the remainder for the dry bulb market. Of the cut flowers, 57% are used for the domestic market in the Netherlands and the remainder exported.[60][61] Original Tulipa species can be obtained for ornamental purposes, such as Tulipa tarda and Tulipa turkestanica. These are referred to as species, or botanical, tulips, and tend to be smaller plants but better at naturalising than the cultivated forms. Breeding programs have produced a wide range of tulip types, enabling blooming through a much longer season by creating early, mid- and late spring varieties. Fourteen distinct types are available in addition to botanical tulips, including Lily-flowered, Fringed, Viridiflora, and Rembrandt. In addition to blooming season, tulip varieties differ in shape and height, and exhibit a wide range of colours, both pure and in combination.[62] The largest area of production is also the Netherlands, with 76% of the global cultivated area, followed by France, Chile, Japan, the United States, New Zealand and Australia. Approximately ten countries produce lilies commercially altogether. About half of the commercial production is for cut flowers. Many of these countries export bulbs as well as supplying the domestic market. The Netherlands produces about 2,200 million lily bulbs annually, of which 96% is used domestically and the remainder exported, principally within the European Union. One particularly important crop is the production of Lilium longiflorum, whose white flowers are associated with purity and Easter.[60] Although many Lilium species such as Lilium martagon and Lilium candidum can be obtained commercially, the majority of commercially available lilies represent the products of a very diverse hybridisation program, which has resulted in a separate horticultural classification, including such groupings as Asian, Oriental and Orienpet. In addition to a very wide variety of heights, lilies can be obtained in many colours and combinations of colours, and if properly selected can produce an extensive blooming season from early summer to autumn.[63] Because of the history of Liliaceae, many species such as Watsonia (bugle lily) that were previously classified in this family bear the name 'lily' but are neither part of the genus Lilium, or the family Liliaceae. A variety of Fritillaria species are used as early spring ornamental flowers. These vary from the large Fritillaria imperialis (crown imperial) available in a number of colours such as yellow or orange, to much smaller species such as Fritillaria meleagris or Fritillaria uva-vulpis with their chequered patterns.[64] Erythronium is less common but a popular cultivar is 'Pagoda' with its sulphur yellow flowers.[65] Calochortus (mariposa lily) may be sold as a mixture or as cultivars.[66] Bulbils in the leaf axils of Lilium lancifolium Seeds of Liliaceae species Methods of propagation include both sexual and asexual reproduction. Commercial cultivars are usually sterile. Seeds can be used for propagation of the plant or to create hybrids and can take five to eight years to produce flowering plants. Since interspecific cross-pollination occurs, overlapping wild populations can create natural hybrids.[67] Bulb offsets: Daughter bulbs that form on the mother bulb and can be detached. Micropropagation techniques including tissue culture.[68][69] Bulbils, which are adventitious bulbs formed on the parent plant's stem. Scaling and twin-scaling, used to increase production in slower-growing varieties, in which multiple whole scales are detached from a single bulb. Bulb offsets and tissue culture produce genetic clones of the parent plant and thus maintaining genetic integrity of the cultivars. Bulb offsets usually require at least a year before flowering. Commercially, plants may be propagated in vitro and then planted out to grow into plants large enough to sell.[70][71] While members of the Liliaceae s.s. have been used as food sources in humans, the bulbs of some species are poisonous to household pets (bulb toxicosis) if eaten and may cause serious complications, such as kidney failure in cats from Lilies, particularly Lilium longiflorum (Easter Lily).[72][73][74] Dogs may develop less serious effects such as gastrointestinal problems and central nervous system depression.[75] Most Fritillaria (e.g. Fritillaria imperialis, Fritillaria meleagris) bulbs contain poisonous neurotoxic alkaloids such as imperialin (peiminine),[76][77][78] which may be deadly if ingested in quantity, while other species such as Fritillaria camschatcensis and Fritillaria affinis are edible.[26][27] Tulips can cause skin irritation due to the presence of tuliposides and tulipalins,[79][80][81] which are also found in the flowers, leaves and stems of Fritillaria.[77] These are also toxic to a variety of animals.[82] Fritillaria extracts are used in traditional Chinese medicine under the name chuan bei mu, and in Latin, bulbus fritillariae cirrhosae.[26][27][83] The bulbs of Fritillaria roylei have been used as antipyretics and expectorants.[20] Lilium bulbs, particularly Lanzhou lily (Lilium davidii)[70] are used as food in China and other parts of Asia.[84] During World War II, starvation conditions in the Netherlands (Hongerwinter, hunger winter 1944) led to using Tulipa bulbs as food. Calochortus bulbs were eaten by Native Americans and by the Mormon settlers in Utah during starvation. Other members of the family used for food include Clintonia (leaves), Medeola (roots), Erythronium (corms), and Fritillaria (bulbs).[85] Lilies (far right) growing in the Paradiesgärtlein, Meister des Frankfurter Paradiesgärtleins c. 1410Lilium candidum (Madonna lily) The type genus, Lily (Lilium), has a long history in literature and art, and a tradition of symbolism as well as becoming a popular female name, and a floral emblem, particularly of France (fleur-de-lis). The cultivation of lilies has been described since at least the ninth century, when Charlemagne ordered it to be grown at his imperial palaces.[86] However, the name 'lily' has historically been applied to a wide variety of plants other than the genus Lilium. The lily appears in ancient literature associated with both sovereignty and virginal innocence, and is mentioned on a number of occasions in the Bible, such as the description in Solomon's Song of Songs (2, 1–2) "I am a rose of Sharon, a lily of the valleys. Like a lily among thorns is my darling among the young women" or the Gospel of Mathew (6, 28) "Consider the lilies of the field, how they grow; they toil not, neither do they spin" to represent beauty. Artistic representations can be found as far back as frescos from the second century BC, at Amnisos and Knossos. Early Christian churches, such as that of the Basilica of Sant' Apollinare in Classe were sometimes decorated with lilies. While predominantly depicted as white, those seen at Akrotiri are red lilies. The white lily has long been seen as a symbol of purity, coming to be associated with the Virgin Mary in the Middle Ages, from which came the name 'Madonna lily' (Lilium candidum). A well-known example is Leonardo da Vinci's Annunciation (1472–1475) in which the archangel Gabriel bears a Madonna lily. Other symbolic meanings include glory, love and birth. Main article: Fleur-de-lis Symbolic fleur-de-lis The stylised lily, or fleur-de-lis (lily flower) has long been associated with royalty, although it may originally have been derived from the form of an iris. It has also been associated with the head of a spear.[87] Its three parts have been associated with the three classes of mediaeval society,[88] or alternatively faith, wisdom and chivalry.[89] Whatever its exact derivation, it has come to be associated with France and the French monarchy since the earliest Frankish kings. Consequently, it became incorporated into not only French heraldry but also into many heraldic devices in jurisdictions where there had been historic French influence, such as Quebec and New Orleans. In modern times it appears in many forms, symbolic and decorative, and can be used on compasses to indicate the direction north, as well as the Scouting movement. Main article: Tulip Mania Allah, Hagia Sophia, Istanbul Ceramic dish, Iznik ca. 1600, with tulips, roses and hyacinths Tulips (Tulipa) also have a long cultural tradition, particularly in the Islamic world. The Persian word for tulips, lâleh (لاله), was borrowed into Turkish and Arabic as lale. In Arabic letters, lale is written with the same letters as Allah, and is used to denote God symbolically. Tulips became widely used in decorative motifs on tiles, fabrics, and ceramics in Islamic art and the Ottoman Empire in particular,[59] and were revered in poetry, such as that of Omar Khayam in the twelfth century.[59][90] Tulips were an essential part of the gardens of Persia, having been cultivated from the Steppes. As the Seljuks – Oghuz-Turkic leaders originated from the steppes – moved to Persia, and then west, they took tulips with them to Turkey, where many escaped cultivation and became naturalised. Today there are a number of places in Turkey called Laleli ('with tulips'). Tulips first appeared in the decorative arts in Turkey in the thirteenth century and flourished under the Ottomans, in particular in the royal palaces, and was adopted by the Osmans as their symbol. Further species were collected from Persia and the spreading Ottoman Empire saw to it that tulip culture also spread. By the sixteenth century it was a national symbol, hence the designation "Tulip era", by which time they were becoming of economic importance.[59] By 1562 the tulip trade had reached Europe with the first shipment to Antwerp,[91] where they were mistaken for vegetables,[92] although they had been cultivated in Portugal since 1530, and first appeared in illustration in 1559, and the first tulip flowers were seen in the Netherlands in 1625. Tulips spread rapidly across Europe in the seventeenth century, and became an important trading item, initially in France before concentrating in the Netherlands.[59][93] Eventually speculative trading in tulips became so intense as to cause a financial bubble which eventually collapsed, a period known as tulip mania (tulipomania), from 1634 to 1637,[94][95] similar to the Ottoman Empire's Tulip era. Nevertheless, since then the tulip has become indelibly associated with the Netherlands and all things Dutch. it was during this period that the tulipiere, a ceramic vase for growing tulips indoors was devised, and the Golden Age of Dutch Painting was replete with images of tulips. Although tulip festivals are held around the world in the spring, the most famous of these is the display at Keukenhof. One of the better-known novels on tulips is The Black Tulip by Alexandre Dumas, père in 1850, dealing with a contest to grow a black tulip in late seventeenth-century Haarlem. Fritillaria are also often used as floral emblems, for instance as the county flower of Oxfordshire, UK.[96] Calochortus nuttallii, the sego lily, is the official state flower of Utah.

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Archived from the original on 25 June 2012. Retrieved 22 January 2014. The dictionary definition of Liliaceae at Wiktionary Media related to Liliaceae at Wikimedia Commons Retrieved from " The Liliaceae family, also known as the Lily family, is a significant group of flowering plants belonging to the order Liliales. This family comprises a wide variety of plants, many of which are well-known for their ornamental beauty, medicinal properties, and economic value. Members of the Liliaceae family are distributed across the globe, from temperate regions to tropical areas, and play a vital role in both natural ecosystems and human agriculture. In this article, we will explore the general characteristics of the Liliaceae family, its classification, the botanical traits that define its members, and its importance to both nature and humans. We will also provide examples of notable plants from this family to illustrate the diversity and adaptability of Liliaceae species. General Characteristics of the Liliaceae Family The Liliaceae family is well-known for its diverse group of monocotyledonous plants. Monocots, as opposed to dicots, are plants that have a single embryonic leaf, or cotyledon, in their seeds. Liliaceae plants are typically herbaceous perennials, though there are exceptions, and they are characterized by their large, showy flowers. Key Features of Liliaceae Plants Perennial Herbs: Most members of the Liliaceae family are perennial herbs with underground storage structures such as bulbs, rhizomes, or corms. These storage organs allow the plants to survive unfavorable conditions and regrow annually. For example, the tulip (Tulipa) and onion (Allium cepa) have bulbs that store nutrients and water during dormant periods. Monocot Structure: As monocots, Liliaceae plants have parallel venation in their leaves, and their flower parts typically occur in multiples of three (e.g., three petals, three sepals, six stamens). This is a defining characteristic that differentiates them from dicotyledonous plants, which usually have net-like leaf venation and flower parts in multiples of four or five. Showy, Symmetrical Flowers: The flowers of Liliaceae plants are usually large, colorful, and radially symmetrical (actinomorphic), making them highly attractive to pollinators. These flowers often have six petal-like structures (three true petals and three sepals that look similar, called tepals), which form a striking floral display. Superior Ovary: Most plants in this family have a superior ovary, meaning that the ovary is positioned above the other floral parts (such as the petals and sepals). This is an important botanical trait when identifying members of the Liliaceae family. Fruit Types: Liliaceae plants typically produce capsules or berries as their fruit. A capsule is a dry, dehiscent fruit that opens when mature to release seeds, while a berry is a fleshy fruit containing seeds. For example, the lily (Lilium) produces capsules, while the Solomon’s seal (Polygonatum) produces berries. Habitat and Distribution Liliaceae plants are widely distributed across temperate and tropical regions of the world. While many species thrive in temperate climates, some are adapted to harsher environments such as deserts or alpine regions. The adaptability of Liliaceae plants to different environmental conditions has allowed them to spread and diversify into many ecological niches. For instance, Fritillaria, a genus within the Liliaceae family, is commonly found in the mountainous regions of Asia and Europe, while Aloe, another member of the broader lily family (though often placed in the related family Asphodelaceae), thrives in arid environments due to its succulent, water-retentive leaves. Classification of the Liliaceae Family The classification of the Liliaceae family has undergone significant changes over time, especially with advances in molecular phylogenetics. Traditionally, the Liliaceae family included many genera that have since been reclassified into other families, such as Amaryllidaceae and Asparagaceae. However, the core members of Liliaceae remain well-defined. Subfamilies and Genera Modern classifications of the Liliaceae family recognize about 15 genera and approximately 600 species, with the most prominent genera including Lilium, Tulipa, Fritillaria, Gagea, and Erythronium. These genera are grouped based on shared botanical traits such as flower structure, reproductive organs, and seed morphology. Lilium: The true lilies of the genus Lilium are among the most iconic members of the Liliaceae family. Known for their large, trumpet-shaped flowers, lilies are popular in gardens and floral arrangements. Examples include the Easter lily (Lilium longiflorum) and the tiger lily (Lilium lancifolium). Lilies are native to temperate regions of the Northern Hemisphere and are valued for their fragrance and ornamental appeal. Tulipa: The genus Tulipa includes the famous tulip flowers, which are widely cultivated for their brilliant colors and symmetrical blooms. Native to Central Asia, tulips have become synonymous with spring gardens worldwide. The Darwin hybrid tulip is one of the most popular cultivars, prized for its vibrant colors and sturdy stems. Fritillaria: Known for their bell-shaped flowers, the genus Fritillaria includes species such as Fritillaria meleagris, also called the snake’s head fritillary due to its unique checkered pattern. Fritillaria plants are often found in meadows and woodlands and are noted for their delicate appearance. Gagea: A lesser-known genus within the Liliaceae family, Gagea consists of small, yellow-flowered plants that grow in grassy areas across Europe and Asia. These plants are not commonly cultivated but play an important role in the biodiversity of their native habitats. Erythronium: Commonly known as dog’s-tooth violets, plants in the genus Erythronium are recognized for their nodding, delicate flowers and lance-shaped leaves. These plants are native to North America and Eurasia, and their beauty makes them popular in shaded garden landscapes. Phylogenetic Developments Historically, the Liliaceae family was much larger, with many genera that are now classified into other families. Molecular phylogenetic studies revealed that what was once considered the Liliaceae family was paraphyletic, meaning it did not include all descendants of a common ancestor. This has led to the division of the family into more specific, monophyletic groups, such as Amaryllidaceae (which includes daffodils) and Asparagaceae (which includes asparagus and hyacinths). Importance of the Liliaceae Family The Liliaceae family is important not only for its ecological contributions but also for its cultural, economic, and medicinal value. Several plants within this family are cultivated for ornamental purposes, while others have been used in traditional medicine or as food sources. Ornamental Value Many members of the Liliaceae family are renowned for their aesthetic appeal. Gardeners around the world cultivate lilies, tulips, and fritillaries for their stunning flowers and vibrant colors. Lilies, in particular, are a symbol of purity and beauty and are commonly used in religious ceremonies, weddings, and funerals. Oriental lilies and Asiatic lilies are popular varieties known for their fragrance and bold colors. Similarly, tulips are celebrated as national symbols in countries like the Netherlands, where tulip festivals attract thousands of visitors each year. Tulip bulbs have historical significance as well, particularly during the period known as Tulip Mania in the 17th century, when the flower became a symbol of wealth and social status. Medicinal Uses Several plants in the Liliaceae family have been used for medicinal purposes throughout history. For example, the bulbs of Fritillaria species are used in traditional Chinese medicine to treat coughs and respiratory conditions. Additionally, the Madonna lily (Lilium candidum) has been used in herbal medicine for its purported wound-healing properties. While some Liliaceae plants have medicinal uses, it is important to note that certain species, such as Lilium and Tulipa, can be toxic if ingested by humans or animals. For instance, lilies are highly toxic to cats, and ingestion can lead to kidney failure. Edible Plants Although the Liliaceae family is not particularly known for its edible plants, a few species have culinary applications. One notable example is the onion (Allium cepa), a member of the broader Allieaceae family, which was once included in the Liliaceae family. Onions, along with garlic, leeks, and chives, are essential ingredients in cuisines worldwide, prized for their flavor and nutritional value. Additionally, some species of Erythronium produce edible bulbs, which were consumed by indigenous peoples in North America. However, these plants are not widely cultivated for food today. Ecological Role Members of the Liliaceae family play an important role in natural ecosystems. Many species are adapted to specific habitats, such as woodlands, grasslands, and mountainous regions, where they contribute to the biodiversity and stability of the ecosystem. Their flowers are often pollinated by insects, particularly bees, which rely on the nectar and pollen provided by these plants. Moreover, the underground storage organs of Liliaceae plants (such as bulbs and rhizomes) allow them to survive in challenging environments, such as those with seasonal droughts or cold winters. These adaptations enable Liliaceae species to play a crucial role in nutrient cycling and maintaining soil health in their native ecosystems. Conclusion The Liliaceae family is a fascinating and diverse group of plants with wide-ranging significance. From the elegant lilies and tulips that grace our gardens to the medicinal properties of fritillaries and the ecological importance of wild Liliaceae species, this family of plants continues to captivate botanists, gardeners, and nature lovers alike. Whether admired for their beauty or valued for their adaptability, Liliaceae plants are a testament to the remarkable diversity of the plant kingdom. Video: Origins of Genus Homo–Australopiths and Early Homo; Variation of Early Homo; Speciation of Homo Liliaceae It is a taxonomic family consisting of a group of herbaceous and perennial monocotyledonous plants, frequently bulbous. They are characterized by their showy, large and colorful flowers, which have sepals and free or welded petals, as well as six extruded stamens and a super ovary.This family is made up of approximately 300 genera with a cosmopolitan distribution, mainly in temperate regions of the northern hemisphere. For example, the genres Lilium Y Tulipa They stand out for the diversity of species of commercial interest cultivated around the world as ornamental plants.Liliaceae are characterized by their underground reserve organs that sometimes constitute means of vegetative reproduction, such as bulbs, rhizomes or tuberous roots. Indeed, it is a very diversified family that is located in bushes, meadows, farmlands, forests and mountain areas.Most have some economic importance, but some species are cultivated as edible plants, to take advantage of their medicinal properties or for their high ornamental value. Previously, species of the genus Allium, like garlic, onion or leek, were included in this classification, but currently they constitute a separate family, the Alliaceae. General characteristics HabitLiliaceae are perennial herbs, mainly geophytes, with a starchy rhizome, tuberous roots and a bulb or tuber. Sometimes they present a typical secondary growth of monocots. The roots are contractile, long and turgid, with numerous adventitious roots or simple hairs. LeavesSimple, whole, alternate, narrow, spiral or whorled leaves are arranged around a modified stem in the form of a basal rosette. They generally lack petioles and stipules, but are sheathed at the base of the stem and have parallel venation. flowersThese species have a great variety of inflorescences. Some grouped in spikes, panicles, clusters or umbels, others solitary or paired in axillary position. Generally hermaphrodites and actinomorphic with similar very showy tepals and petaloids, double and simple, free or united at the base in a tubular way. FruitUsually the fruits are loculicidal or septicidal capsules, sometimes a globular berry, occasionally nuciform. The seeds are small, globular and flat, although sometimes with integument or aril. They store high oil content in their endosperm. Taxonomy- Kingdom: Plantae.- Division: Angiospermae.- Class: Monocotyledoneae.- Order: Liliales.- Family: Liliaceae Juss.- Subfamily 1: Lilioideae Eaton.- Genders: Tulipa, Fritillaria, Lilium Y Gagea.- Subfamily 2: Calochortoideae Dumortier.- Genders: Calochortus, Streptopus, Scoliopus, Prosartes Y Tricyrtis.- Subfamily 3: Medeoloideae.- Genders: Clintonia Y Medeola. Habitat and distributionThe different species that make up the Liliácea family have colonized diverse environments from fields and meadows, to bushes and forests. Indeed, they are located altitudinally from sea level to mountain areas at 2,500-3,500 meters above sea level.This family is made up of about 300 genera and more than 3,000 species distributed in a cosmopolitan way across the globe. In addition, they are found wild or commercially cultivated in temperate regions, mainly in the northern hemisphere.They are generally species adapted to flat terrain such as countryside, mountain meadows or open ecosystems. In fact, many species have adapted to arid climates, so their structure has been transformed for the storage of water and nutrients.Indeed, in times of drought they store liquids in their modified underground stems such as bulbs, tuberobulbs, tubers or rhizomes. In addition, the leaf area acts as storage structures, since the thickened epidermal layers of its leaves prevent water loss.In their natural habitat they are very abundant in Mediterranean environments, where they are located in different environments such as thermophilic forests. Likewise, some species are located in the coastal maquia and degraded lands or intervened by man. ApplicationsLilies are grown primarily as ornamentals throughout the world, with lilies, lilies, and tulips being the most economically important. Among the most commercialized are lilies (Lilium sp.), tulips (Tulipa sp.), butterfly lilies (Calochortus sp.), giant lilies (Cardiocrinum sp.) or checkered (Fritillaria sp.). Representative species LiliesThe representative species of the genus Lilium are herbaceous plants with leafy stems with covered underground bulbs that develop bulblets as a means of reproduction. They are characterized by their large fragrant flowers composed of six petals in a variety of colors that includes small spots or spots and six prominent stamens.It constitutes a genus of more than 100 species native to the temperate regions of the northern hemisphere, being common throughout Europe. They are also located in the Mediterranean, Asia, Japan, India and the southern Philippines, as well as in Canada and the USA. TulipsTulips are a group of herbaceous, perennial and bulbous species, hybrids or varieties belonging to the genus Tulipa. Grown for the production of cut flowers and dried bulbs, their great diversity is guaranteed by the presence of more than 5,000 registered cultivars.Among the main representatives is the common or garden tulip (Tulipa gesneriana L.). Furthermore, the speciesTulipa agenensis, Tulipa bakeri, Tulipa fosteriana, Tulipa clusiana, Tulipacream, Tulipa purissima, Tulipa takes Y Tulipa kaufmanniana. Lilies Group of plants belonging to the genus Calochortus It comprises about 65 species of herbaceous and bulbous plants with a great diversity of floral morphology. In fact, its flowers are formed by three sepals and petals, free and differentiated, in shades of yellow, white, lavender, purple, pink or red.Native to North America, they are distributed from Canada to Guatemala, their main use being ornamental due to their attractive flowers. They are commonly known as butterfly lily, globe lily, lantern, star tulip or cat's ear, the species being Calochortus venustus, the most commercialized. Imperial crownThe imperial crown is a wild bulbous plant grown in gardening as solitary flowers or in groups in parks or gardens. The Fritillaria imperialis is a species belonging to the genus Fritillaria, native to Afghanistan, Persia, Turkey, Pakistan, and the Himalayan region.Cultivated as ornamentals, cultivars have been obtained with a wide range of yellow, red and orange tones. In fact, its flowers are formed by a tuft covered by small green leaves from which numerous campanulate flowers hang. NomocharisThe gender Nomocharis is a group of bulbous plants native to the mountainous areas of western China, northern India, and Burma. Its flowers are similar to lilies (Lilium) with the difference that in nomocharis the flower is superficial and completely flat. ReferencesGarcía Breijo, F.J. (2016) Topic 22 (7): Liliaceae Family. Botany Teaching Unit. Agroforestry Ecosystems Department, Higher Technical School for Rural Areas and Enology. Polytechnic university of Valencia.Hurrel, J.A., Deluchi, G. & Tolaba, J.A. (2012) Liliacear Juss Family. Botanical Contributions of Salta. Faculty of Natural Sciences. National University of Salta. Vol. 11, No. 11.Tormo Molina, R. (2015) Family Liliaceae. Hypertext Lessons in Botany. University of Extremadura. Recovered at: biologie.uni-hamburg.deLiliaceae. (2019). Wikipedia, The Free Encyclopedia. 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