



Nomenclature

- Carolus Linneaus (1707-1778)
 - Popularized Binomial System: *Genus species*
 - Latin: Universal across languages
 - 1737 published Genera plantarum classifying plants based primarily on number on stamens and pistils



Nomenclature



Plantae: Plants

Magnoliophyta: Flowering Plants

Magnoliopsida: Dicotyledons

Caryophyllales

Cactaceae: Cactus Family

Echinocerus Engelm - hedgehog cactus

Echinocerus viridiflorus Engelm.- nylon
hedgehog cactus

- Binomial:

- First name capitalized: *Genus*
- Second name lower case: *species*



Succulents

“A succulent (or succophyte) is a plant possessing at least one succulent tissue. A succulent tissue is a living tissue that, besides possible other tasks, serves and guarantees an at least temporary storage of utilizable water, which makes the plant temporarily independent from external water supply when soil water conditions have deteriorated such that the root is no longer able to provide the necessary water from soil.” Von Willert *et al.*
(1992)



Succulents

Can store water in one or more organ of the plant

Stem succulents

Leaf succulents

Root succulents



Succulents

- Eight major taxonomic groups of succulents
 - Agavaceae
 - Aizoaceae
 - Aloaceae
 - Asclepiadaceae
 - Cactaceae
 - Crassulaceae
 - Euphorbiaceae
 - Portulacaceae





Succulents

~2,000 species are threatened with global extinction

Habitat destruction

Over-collection for international trade

Cactaceae

Threats: Commercial collectors, agriculture, development, flooding by dams



Cactaceae

High level of endemism

Range of habitat from nearly rainless desert to tropical rain forest receiving more than 2000 mm of rain per year

Spiny stem succulents, produces reduced leaves, although these are usually quickly falling or leaves lacking





Cactaceae



Short shoots (areoles)
producing a spine or
spine cluster and
often irritating hairs
(glochids)





Cactaceae

Crassulacean acid metabolism (CAM)

The opening of the stomata to take up carbon dioxide is always connected with large losses of water. To inhibit this loss during intense sun has a mechanism developed that allows the uptake of carbon dioxide during the night. The prefixed carbon dioxide is stored and used during the daytime for photosynthesis.



Cactaceae

Leaves of long shoots alternate, simple, entire, with pinnate or obscure venation, usually reduced to lacking

Leaves of short shoots modified into spines, stipules lacking



Cactaceae

- Inflorescence determinate but reduced to a single flower
- Flowers usually bisexual, radial to slightly bilateral
- Short to elongate hypanthium
- Tepals numerous and spirally arranged, all petal-like or intergrading with outer, sepal-like tepals
- Stamens numerous
- Carpels 3 to numerous, connate





Cactaceae

Ovary almost always inferior but in some species of *Pereckia*, only half-inferior or even superior



Pereskia grandifolia

Rose Cactus



Areoles are on the axils of the leaves

Thought to be the most primitively
developed cacti

From Brazil

Are not able to store much water, must be
watered regularly



Cactaceae

Cacti show numerous specializations for survival in dry habitats

- Dimorphic stems and leaves
- CAM metabolism allows the stomates to open at night (when less water will be lost) in order to take in carbon dioxide, stored as malic acid and used in photosynthesis during the next day.
- Wide spreading, shallow root systems, sometimes also a deep taproot
- Stems with a thick cuticle and an epidermis with sunken stomates



Cactaceae



Rhipsalis elliptica
Collection Pieter Colpaert

Nearly endemic to North and South America

Rhipsalis occurs in tropical Africa, several *Opuntia* have been introduced in Africa, Australia, and India



Cactaceae

The family is monophyletic

Pereskia may be a sister to all other Cactaceae

It has many plesiomorphic character states

- Nonsucculent stems

- Well-developed and persistent leaves

- Several styles

- Sometimes superior ovaries



Agavaceae

Natural distribution in tropics and subtropics

American and Caribbean arid and tropical climes

Have adapted to habitats from the temperate woodlands and prairies of eastern North America to wet tropics and subalpine habitats of South America



Denver Botanic Gardens
www.botanicgardens.org





Agavaceae

CAM metabolism and succulence among these species allows them to remain dormant during extended seasonal droughts and periods of high temperatures

Yucca moth co-evolved with Yucca species so that reduction of the pollinator can lead to the reduced fertility and seed set in plants, reintroductions difficult without pollinators.



Agavaceae

- stout, simple sparingly branches shrubs or trees
- short rhizome or erect caudex
- leaves simple, alternate, sessile, crowded in dense rosettes at ends of stems or branches or at ground-level on a short stem, generally thickened, leathery or firm-succulent, prickly on margins and spine-tipped
- flowers in dense racemes or panicles or heads terminating the stem, or axillary and subterminal (as in Yucca)
- flowers perfect, sometimes unisexual, perianth of tepals, in 2 whorles of 3, stamens 6,
- Some very similar taxonomically to Liliaceae



Agavaceae

Agave utahensis native to northwestern Arizona,
southwestern Utah, southeastern Nevada

Elevations from 1100 to 1700 meters

Habitat: open rocky, limestone slopes of Mojave and Great
Basin desert scrub, Great Basin grassland

Flowers are 23 to 32 mm long, deep yellow in clusters of 2
to 8. Flowering time is May to June.



Aizoaceae

Second largest family of succulent plants
after Cactaceae

Divided into two subfamilies

Mesembryanthemoideae

Ruschiodeae



Aizoaceae



*Faucaria
felina*
Catjaws



Aizoaceae

- High degree of leaf succulence
- Persistent dried fruits





Aloaceae

Largest monocotyledonous family of succulent plants and second largest succulent plant family in southern Africa

Slow growing



Aloaceae

Can be 10 mm high (*Haworthia parksiana*) to trees of 20 m tall (*Aloe barberae*)





Aloaceae



Easily recognized by rosettes
of usually spiny leaves



Aloaceae

Most all are long lived succulents

Above ground storage organs (leaves and stems)

A few have subterranean storage

Some die down and become dormant during the
cold, dry season



Aloaceae

Root system shallow, utilizes the upper leaf litter layer of the soil





Aloaceae

Fruit is a three-angled, oblong, woody capsule
(*Lomatophylum* exception with fleshy berries)

Most have large, colorful, tubular flower, pollinated by
birds

Flower in dry season, fruits ripen just before rainy season



Apocynaceae

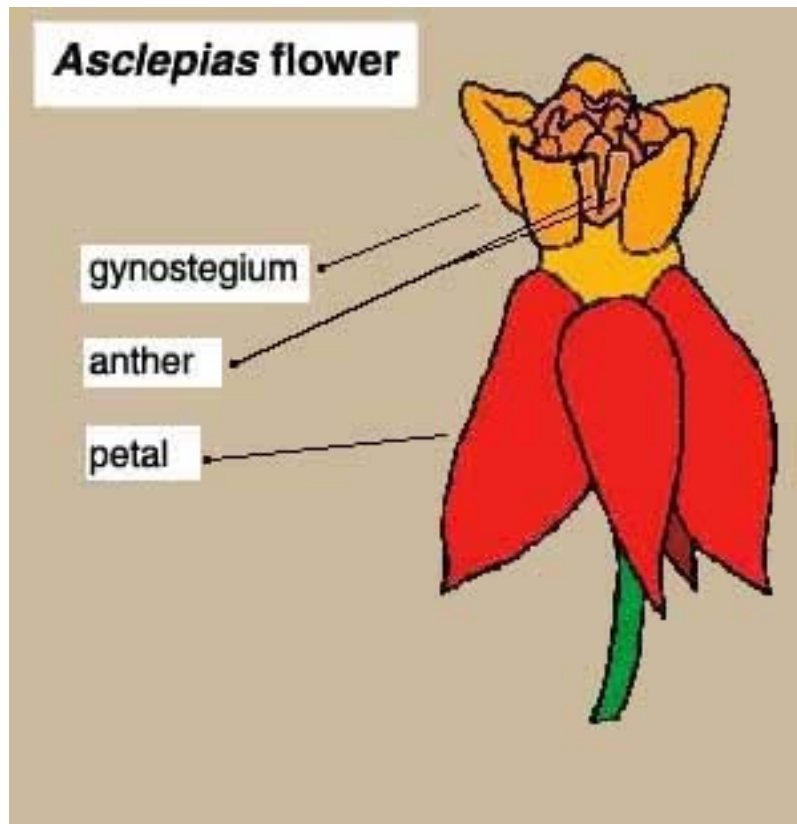
Periwinkle family

Adenium arabicum





Asclepiadaceae



Complicated flower
morphology

Highly evolved pollination
system

Life forms include herbs,
shrubs, succulents, and
trees

Succulents are uncommon



Asclepiadaceae



Orebeopsis gerstneri ssp.
elongata



Asclepias curassavica



Asclepiadaceae

Succulents include

Cynanchum

Fleshy leaves

Cynanchum katoi





Asclepiadaceae

*Asclepias, Aspidonepsis,
Cynanchum,
Statmostelma,
Stenostelma*

Succulent subterranean parts





Asclepiadaceae

*Sarcostemma, Cynanchum,
Folotsia, Karimbolea,
Platykeleba*

Stem succulents

All except *Sarcostemma* are found
in semi-arid parts of south-west
Madagascar



<http://vesmir.kavcra.cz/madagascar>
Enfnek © Pavel Hozek, Expedition LEMURIA



Crassulaceae



Stonecrop family

Herbaceous, sometimes
shrubby

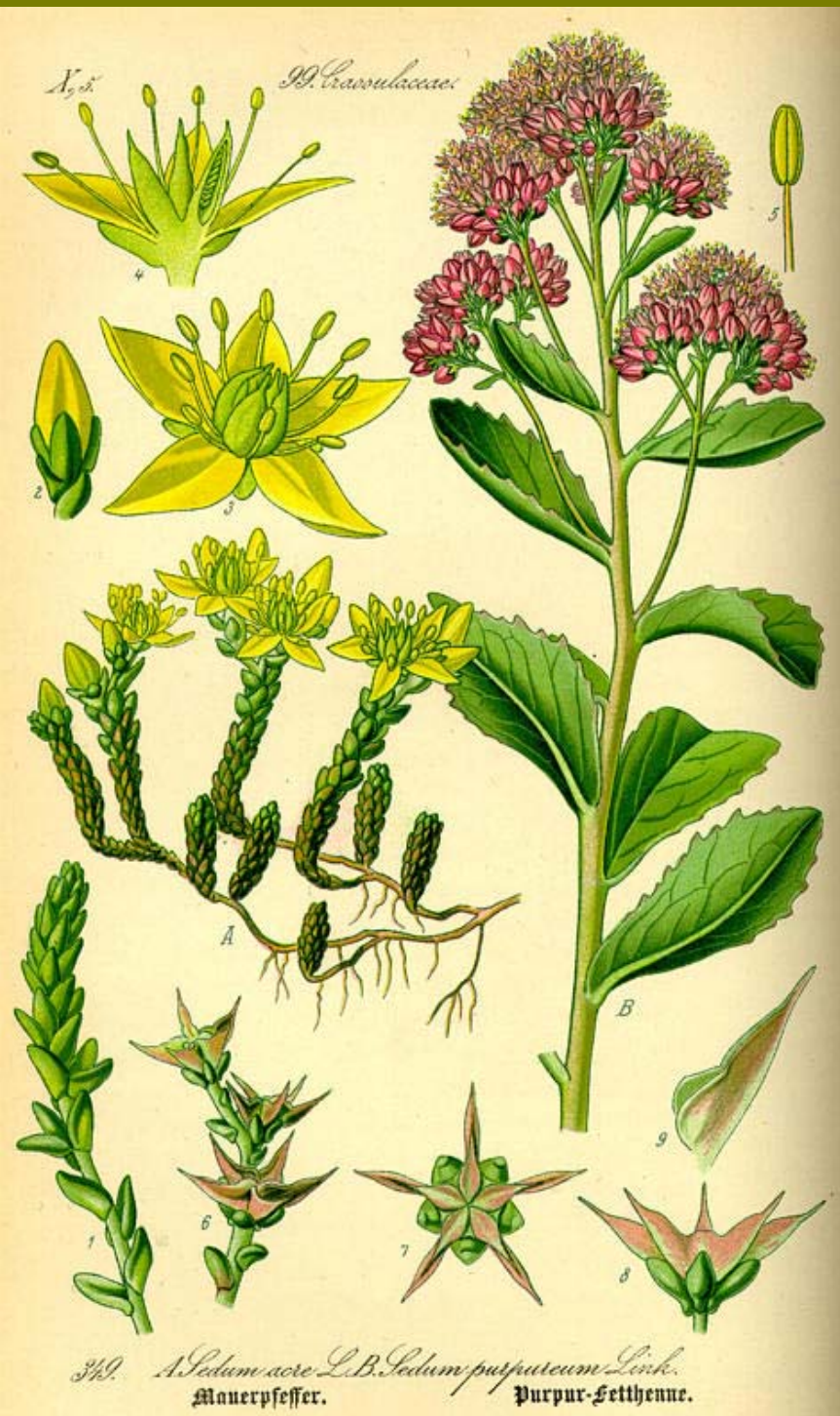
Leaf succulents with
regular flowers



Crassulaceae

Flowers:

Multiples of 5: sepals, petals,
carpels





Crassulaceae

Family distribution is cosmopolitan

Most taxa are restricted to the subtropical and temperate regions of the Northern hemisphere and southern Africa



Euphorbiaceae

Euphorbia Family

Sixth largest family among flowering plants

Over 300 genera and 5000 species

Characterized by small dihiscent fruit with each cell containing 1 or 2 seeds



Euphorbiaceae

Succulent-stemmed and succulent leaved species





Euphorbiaceae

Flowers:

inflorescence termed a cyathium

Cyathium: cup-like involucre
enclosing numerous male
flowers surrounding a solitary
female flower





Euphorbiaceae

World-wide distribution

Pedilanthus: genus of shrubs and small trees
leafy, fleshy branches, zygomorphic beaklike
cyathium (normally red)



Euphorbiaceae



Synadenium: genus characterised by entire, spreading glandular rim on the involucre

Endemic to east and southern tropical Africa

All are shrubs or small trees with semisucculent branches and large fleshy leaves



Succulent Plants

Slow evolutionary processes

Ability to store water

Convergent evolution

Found in almost every part of the world