Diversity and Evolution of Asterids

. . . gentians, milkweeds, and potatoes . . .
Core Asterids

- two well supported lineages of the ‘true’ or core asterids
  - ‘lamiid’ or Asterid I group
  - ‘campanulid’ or Asterid II group

- appear to have the typical fused corolla derived independently and via two different floral developmental pathways
Core Asterids

- two well supported lineages of the ‘true’ or core asterids

= NOT fused corolla tube

- Asterids primitively NOT fused corolla at maturity

- 2 separate origins of fused petals in “core” Asterids (plus several times in Ericales)
Early vs. Late Sympetaly

euasterids II - campanulids

Calendula, Asteraceae
also in Cornaceae of ”basal asterids”

euasterids I - lamiids

Anchusa, Boraginaceae
late
Gentianales

- order within ‘lamiid’ or Asterid I group

- 5 families and nearly 17,000 species dominated by Rubiaceae (coffee) and Apocynaceae (milkweed)

- iridoids, opposite leaves, contorted corolla

Rubiaceae

Apocynaceae
Gentianales

corolla aestivation

- quincuncial
- cochlear
- contort
- valvat
- apert
*Gentianaceae - gentians*

Cosmopolitan family of 87 genera and nearly 1700 species. Herbs to small trees (in the tropics) or mycotrophs.
*Gentianaceae - gentians*

- opposite leaves
- glabrous - no hairs!

- flowers right contorted

**Gentiana**

**Blackstonia**

**Gentianopsis**
*Gentianaceae - gentians*

CA (4-5)  CO (4-5)  A 4-5  G (2)

- flowers 4 or 5 merous
- pistil superior of 2 carpels
- parietal placentation; fruit capsular
*Gentianaceae - gentians*

**Gentiana** is 5 merous, with plaits between each petal lobe.

- *Gentiana andrewsii* - Bottle gentian
- *Gentiana puberulenta* - Prairie gentian
*Gentianaceae - gentians

Gentianopsis is 4 merous, with fringed petals

Gentianopsis procera - fringed gentian

Gentianopsis crinita - fringed gentian
*Gentianaceae - gentians

Gentianella is 4-5 merous, without fringe, and without plaits between petal lobes

_Gentianella quinquefolia_ - stiff gentian
**Gentianaceae - gentians**

- **woody gentians** common in cloud forests of the Neotropics
- **hummingbird, bat, and bee pollinated radiations**

*Symbolanthus*

*Lisianthius*
*Apocynaceae - milkweeds*

Worldwide family of trees, vines, herbs with opposite leaves - 415 genera, 4600 species.

*Pachypodium*  
*Periploca*
**Apocynaceae - milkweeds**

Worldwide family of trees, vines, herbs with opposite leaves - 415 genera, 4600 species.

*Vinca minor* - periwinkle
Introduced ground cover, often spreading

*Caralluma europea*
cactus mimic

*Asclepias syriaca*
common milkweed
*Apocynaceae - milkweeds

Milky latex commonly poisonous and source of medicinal drugs.

Catharanthus roseus
Malagasy periwinkle

Asclepias & monarch cardiac glycosides

Curare vine - South America
*Apocynaceae - milkweeds*

Family is broadly defined and includes distinctive milkweeds of old family Asclepiadaceae

Transition to more elaborated ‘milkweed’ flowers
*Apocynaceae - milkweeds*

- **Apocynum androsaemifolium**
  - Spreading dogbane
  - CA (5) CO (5) A 5 G 2
  - flowers 5 merous
  - left contorted perianth
  - 2 separate carpels - follicles

- **Periploca**
- **Vinca**
- **Apocynum androsaemifolium**
- Spreading dogbane
- **Vinca**
**Apocynaceae - milkweeds**

• 'pollen presentation' - style plunger or bottle brush to expose pollen (important! part of the suite of features in Asterid “heads” or pseudanthia)

- 5 stamens begin to be connivent
Apocynaceae - milkweeds

- stamens fuse to each other and to style region - gynostegium
- pollen forms pollinia
- more seeds with tufts of hairs

Asclepias - milkweed
*Apocynaceae - milkweeds

Note 2 free carpels slightly fused at top
*Apocynaceae - milkweeds

Corona for nectar reward

**Corona** = hood + crest
*Apocynaceae - milkweeds

Fusion of 5 stamens and top of gynoecium

Corona = hood + crest

Gynostegium = A + G
*Apocynaceae - milkweeds

Gland is attached to 2 pollinia

Corona = hood + crest
Gynoestegium = A + G
Pollinia = pollen mass
*Apocynaceae - milkweeds

Gland is attached to 2 pollinia

Corona = hood + crest
Gynoestegium = A + G
Pollinia = pollen mass
Bee removing pollinia or inserting pollinia into stigmatic cleft
“Las Vegas” strategy of pollination; but when occurs, all ∞ ovules are fertilized. Typically few follicles are produced per plant. Note seeds with coma attached for wind dispersal.

*Apocynaceae - milkweeds*

*Asclepias amplexicaulis* - Clasping milkweed
*Apocynaceae - milkweeds

* Apocynum androsaemifolium
  Spreading dogbane

* Apocynum cannabinum
  Hemp dogbane
*Apocynaceae - milkweeds*

*Apocynum androsaemifolium*
Spreading dogbane

*Apocynum cannabinum*
Hemp dogbane
*Apocynaceae - milkweeds

Asclepias syriaca - Common milkweed
Asclepias tuberosa - Butterfly weed
Asclepias incarnata - Swamp milkweed
*Rubiaceae - coffee*

Cosmopolitan family, most diverse in tropics, of 550 genera and over 10,000 species

- trees, shrubs, lianas, and herbs
- important drug family

*Psychotria nervosa*

*Houstonia caerula* - azure bluets

*Cinchona* - quinine
*Rubiaceae - coffee*

Cosmopolitan family, most diverse in tropics, of 550 genera and over 10,000 species

- opposite (whorled) leaves with *inter-petiolar stipules*
*Rubiaceae - coffee*

- 4 merous in temperate regions, 5 merous in tropics - tendency to cluster (pseudanthia!)
- only epigynous family in Gentianales
- fruit usually a 2-seeded drupe
*Rubiaceae - coffee

Galium aparine - cleavers

Cleavers and bedstraws are numerous; separated by number of whorled leaves and fruit type
*Rubiaceae - coffee

Houstonia caerula - azure bluets
*Rubiaceae - coffee

*Mitchella repens
Partridge berry, twin-berry

Note: paired flowers above with connate pistils; “twin” berry to right
*Rubiaceae - coffee

*Cephalanthus occidentalis* - buttonbush

Only shrub in Wisconsin; note “heads” of tiny 4 merous flowers “pseudanthia”
*Rubiaceae - coffee

Isertia

Coffea arabica - coffee
*Rubiaceae - coffee

\[ \text{Psychotria nervosa} \quad \text{Cephaelis tomentosa} \]

• the giant genus *Psychotria* is paraphyletic and includes more specialized genera (e.g., condensed, bracted inflorescences) “pseudanthia”!
*Rubiaceae - coffee

- the giant genus *Psychotria* is paraphyletic and includes more specialized genera (e.g., condensed, bracted inflorescences)

*Psychotria nervosa*

*Sally Kellerman*

Hot Lips Hoolihan
The genus *Hydnophytum* - ant plants and epiphtyes - along with the whole subtribe *Hydnophytinae* - are now shown to be derived out of the genus *Psychotria*!
Solanales

- order within ‘lamiids’ or Asterid I group
- 5 families and nearly 5,000 species dominated by Solanaceae (nightshade) and Convolvulaceae (morning glory)

- no iridoids, alternate leaves, plicate corolla, calyx persistent in fruit

Solanaceae

Convolvulaceae
**Solanaceae - nightshades**

Large cosmopolitan family of herbs, shrubs, or trees with nasty compounds. Important for source of foods (potato, tomato, pepper) and drugs.

- Alternate leaved
- **Cyme** or dichasium inflorescence

*Brugmansia*

*Nicotiana - tobacco*
*Solanaceae - nightshades*

- 5- merous flowers
- axile placentation
- berry fruited

CA (5)  CO (5)  A 5  G (2)

*Solanum carolinense* - Horse nettle

*Capsicum* - pepper

*Solanum dulcamara* - Bittersweet
*Solanaceae - nightshades*

- stamens often terminal pored for buzz pollination by bees (remember Ericaceae?)

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*Solanum carolinense - Horse nettle*
*Solanaceae - nightshades

CA (5)  CO (5)  A 5  G (2)

• often calyx persistent in fruit

*Physalis alkekengi - Japanese lantern*
*Solanaceae - nightshades

Solanum dulcamara - bitterweet
*Solanaceae - nightshades

*Solanum carolinense - Horse nettle
*Solanaceae - nightshades

Physalis virginiana
Ground cherry
Note: calyx surrounding berry
*Solanaceae - nightshades

edible fruits include . . .

Capsicum - pepper

Solanum - tomato & eggplant
*Solanaceae - nightshades

drug plants include . . .

*Atropa belladona*
*Solanaceae - nightshades

drug plants include . . .

Atropa belladona

Brugmansia

Datura stramonium

Nicotiana tabacum
*Solanaceae - nightshades

Introduced, hallucinogenic roadside weed

_Datura stramonium_  
Jimson-weed

. . . also called thorn-apple
*Solanaceae - nightshades

Datura stramonium
Jimson-weed

Introduced, hallucinogenic roadside weed

... also called thorn-apple

CASE REPORT

Jimson Weed Intoxication in Five Adolescents

Steven N. Soneral, DO; Neil P. Connor, MD

INTRODUCTION

Datura stramonium (Jimson weed) is a poisonous shrub that grows wildly throughout the United States with a high potential for abuse. The plant possesses potent anticholinergic properties, and ingestion can cause serious illness or death. Intentional ingestions may result in unintended poisonings for people who attempt to experience the anticholinergic-induced delirium that typically manifests after ingesting the leaves, stem, seeds, or tea brewed from the leaves. We report 5 cases of *D. stramonium* intoxication seen within a 3-day span as well as recent data regarding anticholinergic plant exposures.

Wisconsin Medical Journal 2005
*Solanaceae - nightshades

Introduced, hallucinogenic roadside weed

*Datura stramonium*
Jimson-weed
... also called thorn-apple

**Case 3**
A 16-year-old male presented with slurred, unintelligible speech and severe restlessness. Blood pressure was 130/67, and pulse was 85 beats per minute. Activated charcoal was administered. Shortly after admission to the PICU, he became aggressive, combative, and even attempted to stand on a bedside table and fly to escape from the room. Subsequently, he was sedated with intravenous lorazepam. Discharge occurred after 24 hours with normal vital signs and mental status.

**Case 4**
A 15-year-old male was brought to the ED by the police after he had been found crawling down a busy street into an intersection. He was picking at objects on his body that were not present. His only comprehensible words were obscenities. Blood pressure was 119/44, and pulse was 154 beats per minute. Skin was dry and flushed. Urine toxicology screen was negative. Activated charcoal was administered. Blood pressure and temperature remained stable. Pulse ranged from 40 to 109 beats per minute with sinus rhythm. He was sedated as necessary and discharged 40 hours later with normal vital signs and mental status.

Wisconsin Medical Journal 2005