Illustration:

Morning Glories, *Ipomoea* spp.
Constituents: Major Categories

- Carbohydrates
- Lipids
- Amino acids & derivatives
- Phenolic compounds
- Terpenoids
- Steroids
- Alkaloids

  - betalain alkaloids
  - diterpenoid alkaloids
  - indole alkaloids
  - isoquinoline alkaloids
  - methylxanthines
  - monoterpenoid alkaloids
  - sesquiterpenoid alkaloids
  - peptide alkaloids
  - pyrrolidine alkaloids
  - piperidine alkaloids
  - pyrrolizidine alkaloids
  - quinoline alkaloids
  - tropane alkaloids
  - plus more!
Alkaloids

- Most are derived from amino acids
- Contain nitrogen, usually as part of a ring
- Many are basic (alkaline) substances
- Generally occur in plants as ‘salts’ or N-oxides
- Water/alcohol soluble
- Found in a limited number of plants
- Strong medicinal or poisonous properties
- Names end in ‘-ine’ or ‘-in’
- Different plant parts can contain different types or concentrations of alkaloids
- More than 10,000 structures known

Illustration:

Opium Poppy, *Papaver somniferum*
Illustration:

Background: Opium Poppy, *Papaver somniferum*

Inset: The basic ring systems of the alkaloids
Illustrations:

1. Indole alkaloid skeleton
2. Isoquinoline alkaloid skeleton
3. Pyrrolidine alkaloid skeleton
4. Pyrrolizidine alkaloid skeleton
5. Tropane alkaloid skeleton

Alkaloids have complex & varied structures. These are just a few examples. The purple categories contain the most common alkaloids encountered in herbal therapeutics, & are covered in this show.

See the Outline for information on the other categories.
Alkaloids: Many Categories

- Amaryllidaceae alkaloids
- Betalain alkaloids
- Diterpenoid alkaloids
- Imidazole alkaloids
- Indole alkaloids
- Isoquinoline alkaloids
- Methylxanthines
- Monoterpenoid alkaloids
- Peptide alkaloids
- Piperidine alkaloids
- Pyrrolidine alkaloids
- Pyrrolizidine alkaloids
- Quinoline alkaloids
- Quinolizidine alkaloids
- Steroidal alkaloids
- Tropane alkaloids

- Classification generally based on type of ring system & biosynthetic origin
- Some groups are defined by the plant taxa in which they occur

Illustrations:

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Illustration:

Cayenne peppers, *Capsicum frutescens*
Capsaicin is of mixed biosynthetic origin: the aromatic part of the molecule is derived from phenylalanine → ferulic acid → vanillin via the phenylpropanoid pathway; the aliphatic tail comes from a branched-chain fatty acid. It is sometimes classified as an alkaloid because of its nitrogen atom & its origin from amino acids. More specifically, capsaicin is a vanillylamide. Other systems classify it as a phenylpropanoid derivative rather than as an alkaloid.
Illustrations:

1. Vanillin
2. Vanillylamine
3. Branched-chain fatty acid moiety
4. Capsaicin

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Capsaicin: Biosynthesis

- Alkaloid? Phenylpropanoid? Mixed biosynthetic origin
- Phenylalanine → ferulic acid → vanillin: aromatic moiety
- Branched-chain fatty acid: aliphatic moiety
- Technically: a vanillylamide

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Illustrations:

TL: Adenine, a purine, is a precursor of allantoin in plants.

BL: Guanine, a purine, is another precursor of allantoin in plants.

R: Allantoin, a nitrogenous, water- and alcohol-soluble molecule derived from the metabolism of purines (adenine or guanine). It has potent skin-healing properties and is known as a ‘cell proliferant’ – a substance which encourages the growth of healthy tissue.
Illustrations:

1. Allantoin, a nitrogenous, water- and alcohol-soluble molecule derived from the metabolism of purines (adenine or guanine). It has potent skin-healing properties and is known as a ‘cell proliferant’ – a substance which encourages the growth of healthy tissue.

2. Herbs rich in allantoin include:
   TL: Plantain, Plantago
   TM: Borage, Borago
   TR: Wild Comfrey, Cynoglossum
   BL: Comfrey, Symphytum
   BR: Lungwort, Pulmonaria
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Betalain Alkaloids

- Cabbage: anthocyanins (flavonoids \(\rightarrow\) phenolics)
- Prickly Pear: betalains (alkaloids)

Illustration:

Red Cabbage (*Brassica oleracea* var. *capitata* subgroup *rubra*) leaf
Prickly Pear (*Opuntia* spp.) fruit

The purple pigments in Cabbage are anthocyanins; betalains provide the purple coloration to the fruit of the Prickly Pear cactus. Plants containing anthocyanins do not contain betalains, and vice versa.
Betelain Alkaloids

- Nitrogenous pigments found only in a few plant families, where they replace anthocyanins
- Very potent antioxidants
- Anticarcinogenic

Illustrations:

L: Pokeweed (*Phytolacca americana*) blossoms
R: Betanidin, the magenta pigment molecule in Poke berries

Betelains occur only in the order Caryophyllales, where they replace anthocyanins.

Betelains are a group of nitrogenous water-soluble pigments, derived from tyrosine via L-Dopa. Some authors classify them not as alkaloids, but as amino acid derivatives. There are two groups of betelains: the red/purple betacyanins & the yellow betaxanthins. They generally occur as glycosides, & may be complexed with phenylpropanoids.

*Phytolacca americana* is also known as Poke or Pokeweed.
Betalain Alkaloids

- Betalains are water-soluble
- Very potent antioxidants
- Anticarcinogenic
- Anti-inflammatory?
- Immunostimulant?

Illustrations:

L: Pokeweed (*Phytolacca americana*) blossoms
R: Betanidin, the magenta pigment molecule in Poke berries

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Betalain Alkaloids

- Poke (Phytolacca)
- Beets, Spinach, Chard
- Purslane
- Amaranth
- Prickly Pear cactus

Illustrations:

L: Purslane, *Portulaca oleracea*
M: Beet, *Beta vulgaris*
R: Pokeberries, *Phytolacca americana*

*Phytolacca americana* is also known as Poke or Pokeweed.
Illustrations:

L: Swiss Chard, *Beta vulgaris var. cicla*
R: Betanin, a glycoside of betanidin
Illustrations:

Poke (*Phytolacca americana*) Berries Fluid Extract from Parke, Davis & Co. The extract, sealed in its bottle with a waxed cork, still appears to be purple (date on the label: 1906).
Betalain Alkaloids: Betaxanthins

- Yellow pigments similar in structure to betacyanins
- Dietary sources: Yellow Beets, Chard
- Also found in Purslane, an excellent wild food/herb common in gardens
- Extremely powerful antioxidants
- Potent anti-carcinogenic compounds

Illustrations:

Background: Purslane, Portulaca oleracea
Inset: Purslane flowers

Both purple betacyanins and yellow betaxanthins are visible in these photos.
Betalain Alkaloids: Betaxanthins

Betaxanthins also occur in edible Prickly Pear cactus flowers

Illustration:
Prickly Pear (*Opuntia* spp.) flowers
Illustrations:

Background: Prickly Pear (*Opuntia* spp.) flowers
L: Indicaxanthin
R: Neobetanin
Illustrations:

Background: Amaranth, *Amaranthus tricolor*
M: Gomphrenin I (aka betanidin-6-O-glucoside)
Pyrrolizidine Alkaloids

- Boraginaceae: Symphytum, Borago
- Asteraceae: Senecio, Tussilago, Petasites

Illustration:

White-flowered Comfrey, *Symphytum officinale*
Illustrations:

L: Lycopsamine, a pyrrolizidine monoester
R: Symphytine, a pyrrolizidine diester
Spotlights: Necine rings

*PAs are derived from ornithine & arginine via putrescine. The pyrrolizidine nucleus is a bicyclic unit consisting of two fused five-membered rings that share a nitrogen atom at their junction. This unit is known as a 'necine' system. Toxic PAs have a double bond in the 1,2 position of this system. In all but the simple PAs, the necine nucleus is esterified to a necic acid moiety with 5 – 10 carbons (derived from acetate, isoleucine, leucine, threonine, or valine). The four major types of PAs are simple PAs, monoesters, diesters & macrocyclic compounds. PAs occur either as free bases or as N-oxides.
Pyrrolizidine Alkaloids

- Some types are considerably more toxic than others – macrocyclic esters especially toxic
- Most cases of human PA intoxication are due to crops contaminated w/high-PA weed species, e.g. Senecio vulgaris in wheat
- Some people receiving acute exposure develop VOD; many, but not all, recover

Illustrations:

L: Comfrey, *Symphytum officinale*
M: Butterbur, *Petasites* spp. [Lindman/Stueber]
TR: The necine ring system, common to all pyrrolizidine alkaloids
BR: Coltsfoot, *Tussilago farfara*

VOD: Veno-occlusive liver disease
Mucilaginous Herbs w/PAs

- Comfrey & Borage do not contain macrocyclic esters; do have mono- & diesters
- Coltsfoot has tiny amounts of senkirkine, but has never been associated with VOD

Illustrations:

L: Comfrey, *Symphytum officinale*
M: Coltsfoot, *Tussilago farfara* [Lindman/Stueber]
R: Borage, *Borago officinalis*
PAs in Cynoglossum

- Hound’s Tongue (Borage family) has high levels of heliosupine & echinatine
- Old European remedy similar to Comfrey for external use
- Poultice for sprains, bruises, swellings, broken bones

Illustrations:
- TR: Seeds of Wild Comfrey (*Cynoglossum officinale*) stick to everything!
- BR: Wild Comfrey (aka Beggar’s Lice, Hound’s Tongue) starting to bloom

See: http://www.usask.ca/agriculture/plantsci/classes/range/cynoglossum.html
PAs: Macrocyclic Esters

- Macrocyclic esters (e.g., in Senecio species) are the most toxic type of PAs

Illustrations:

L: Senecionine, a toxic macrocyclic pyrrolizidine alkaloid
   Spotlight 1: The necine system
   Spotlight 2: The macrocycle (large ring)
R: Senecio jacobaea [Thomé/Stueber]

See: http://www.ibiblio.org/herbmed/eclectic/kings/senecio.html for use of Senecio species were in Eclectic medicine.
PAs: Toxicity

- The actual toxicity arises in the liver from metabolites of 1,2-unsaturated PAs known as pyrrole or pyrrolic derivatives
- These are capable of forming DNA adducts & can act as alkylating agents which damage proteins lining the interior of blood vessels
- Veno-occlusive liver disease
- High doses damage vessels in heart & lungs

Illustrations:

TL: Senkirkine, a toxic macrocyclic pyrrolizidine alkaloid found in *Crotolaria, Senecio, Petasites*, and (in trace amounts) in *Tussilago* (Coltsfoot)
BL: Symphytine, a pyrrolizidine diester from all species of *Symphytum* (Comfrey)

Illustrations:

- TL: California Poppy, *Eschscholtzia californica*
- BL: Goldenseal, *Hydrastis canadensis*
- M: Celandine, *Chelidonium majus* (these flowers are doubled – most occur as singles)
- TR: Bloodroot, *Sanguinaria canadensis* [Walcott/SWSBM]
Illustrations:

In the human body, tyrosine (an amino acid) is the precursor of L-Dopa, which is the precursor of dopamine and subsequently the catecholamines, norepinephrine & epinephrine (adrenaline).
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In plants, tyrosine is the precursor of dopamine (via tyramine) and 4-HPPA, which combine to form norcoclaurine. This molecule is the precursor of the isoquinoline alkaloids.
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In plants, tyrosine is the precursor of dopamine (via tyramine) and 4-HPPA, which combine to form norcoclaurine. This molecule is the precursor of the isoquinoline alkaloids.
Illustrations:

L: Norcoclaurine, the precursor of many alkaloids including the simple benzylisoquinolines, the aporphines, the morphinans, the protoberberines, and the benzophenanthridines.
Illustrations:

Background: Opium Poppy, *Papaver somniferum*

L: Norcoclaurine

R: Papaverine

Norcoclaurine is the precursor of many alkaloids including the simple benzylisoquinolines, the aporphines, the morphinans, the protoberberines, and the benzophenanthridines.
Isoquinolines: Aporphines

Norcoclarine – via reticuline – is also the precursor of the aporphine alkaloids

Illustrations:
L: Norcoclarine, precursor of …
M: Reticuline, precursor of …
R: The aporphine skeleton
Aristolochic acid is a modified aporphine alkaloid.
- Found in the Aristolochiaceae
- Isolated alkaloid is nephrotoxic, carcinogenic

Illustrations:

L: The aporphine skeleton
R: Aristolochic acid

Aristolochic acid is a modified aporphine found in *Aristolochia* spp. (e.g., *A. contorta*, *A. debilis*, *A. fangchi* & *A. manshuriensis* from TCM); also occurs in Virginia Snakeroot, *A. serpentina*; anti-inflammatory, antibiotic, antifertility; isolated alkaloid is nephrotoxic, carcinogenic in animal studies.

An outbreak of serious nephrotoxicity was reported in Belgium in the 1980s among women who had taken a weight-loss formula containing, among other things, a mis-identified Chinese herb with aristolochic acid. The problem was first blamed solely on the aristolochic acid content; this conclusion has been questioned by evidence from later studies.
Illustration:

Birthwort (*Aristolochia clematitis*), traditionally used to induce labor, as an emmenagogue, as an abortifacient, and for wound healing.

*Aristolochic acid toxicity has not been reported with traditional use of this plant. Other Aristolochia species, however, which may have toxic levels of aristolochic acid, have occasionally been substituted for this one in formulas. High levels of aristolochic acid have been associated with urothelial cancer and serious kidney malfunctions.*
Illustration:

*Asarum canadense*, American Wild Ginger

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Illustrations:

L: Boldine  
R: Isoboldine

Boldine & isoboldine are found in Boldo, *Peumus boldus*, a traditional South American remedy for spasmodic gastrointestinal conditions. The plant is considered to be choleretic, stomachic, mildly sedative & mildly diuretic. Isoboldine is also found in the Opium Poppy, *Papaver somniferum*. 
Isoquinolines: Protoberberines

- Norcoclaurine is the precursor of reticuline
- Reticuline is the precursor of the protoberberines
- Reticuline is also the precursor of the morphinans

Illustrations:

L: Norcoclaurine
R: Reticuline
Protoberberines in Goldenseal

Illustrations:
- TL: Reticuline
- TR: Scoulerine
- BR: Goldenseal (*Hydrastis canadensis*) plants

Berberine is very water-soluble.
Protoberberines in Goldenseal

Illustrations:

TL: Berberine
TR: Berberastine
BL: Hydrastine

Hydrastine is a type of modified protoberberine known as a phthalamideisoquinoline alkaloid; antiseptic, uterine hemostatic
Illustrations:

L: Hydrastine, an alkaloid from Goldenseal (*Hydrastis canadensis*)

Spotlight: The isoquinoline nucleus, a fused ring system characteristic of the isoquinoline alkaloids

R: Goldenseal sprouts [Photo courtesy of www.hebes.mdx.ac.uk/.../Garden%20Pictures%20Page%205.htm]

Berberine is very water-soluble; hydrastine extracts better in moderate-to-high percentage ethanol/water mixtures.
Protoberberines: Berberine

- Antiprotozoal (Leishmania)
- Antimicrobial, antiseptic
- Anti-inflammatory, antispasmodic
- Astringent, hemostatic
- Tones mucous membranes
- Bitter digestive tonic

Illustrations:
- Background: Goldenseal (*Hydrastis canadensis*) leaves
- L: Yellowroot (*Xanthorrhiza simplicissima*) roots
- R: Oregon Grape (*Mahonia* spp.) flowers
Protoberberines in Mahonia

- Berberine & relatives predominate
- Some palmatine & jatrorrhizine
- Actions similar to Goldenseal

Illustrations:

L: Berberine, a water-soluble yellow alkaloid
   Spotlight: the isoquinoline nucleus
R: Oregon Grape (*Mahonia*) flowers
Other Herbs w/Berberine

- Yellow Root (Xanthorrhiza)
- Barberry (Berberis)
- Goldenthread (Coptis) contains berberine & coptisine

Illustrations:

L: Yellow Root, *Xanthorrhiza simplicissima*
M: Yellow Root roots
TR: Barberry, *Berberis vulgaris* [NGS/SWSBM]
BR: Goldthread, *Coptis trifolia* [Photo © Martin Wall, http://www.herbslides.com/]

Isoquinoline Alkaloids in Bloodroot

- Major constituents: sanguinarine & chelerythrine
- Sanguilutine, sanguirubine, chellutine, chelirubine
- Antifungal, antibacterial, anti-inflammatory
- Highly effective against dental plaque bacteria

Illustrations:

L: Sanguinarine
R: Bloodroot, *Sanguinaria canadensis* [Walcott/SWSBM]
Bloodroot (*Sanguinaria canadensis*) oozes a red latex when cut; the chief constituent is sanguinarine, which occurs with sanguilutine, sanguirubine, chelerythrine, chelilutine, chelirubine, & other isoquinolines. The latex is traditionally used on warts & skin cancers.
Illustrations:

Background: Bloodroot (*Sanguinaria canadensis*) leaves
TL: Chelirubine
TR: Chelilutine
BM: Chelerythrine
Protoberberines in Celandine

- Chelidonium contains a complex mixture of alkaloids in the orange latex
- Chelidonine, chelerythrine
- Berberine, coptisine, sanguinarine
- Folk remedy for warts & skin cancers

Illustrations:

Celandine, *Chelidonium majus* (these flowers are doubled – most occur as singles)
Protoberberines in Celandine

- Chelidonium contains a complex mixture of alkaloids in the orange latex
- Chelidonine, chelerythrine
- Berberine, coptisine, sanguinarine
- Folk remedy for warts & skin cancers

Illustrations:

L: Chelidonine
R: Coptisine
Illustration:

California Poppy, *Eschscholtzia californica*
Illustrations:

Background: California Poppy, *Eschscholtzia californica*
TM: Eschscholzidine
BM: Californidine
Illustrations:

Background: California Poppy, *Eschscholzia californica*

Insets: 3D views of eschscholzidine, showing the isoquinoline nucleus (in this case, the nitrogen in methylated) is still present in the complex structure
The main alkaloids in Caulophyllum are:

- baptifoline (a quinolizidine)
- anagyrine (a quinolizidine)
- N-methylcytisine (a quinolizidine)
- magnoflorine (an aporphine derivative)

Minor alkaloids include:

- thalictroidine
- taspine (an aporphine)
- 5,6-dehydro-alpha-isolupanine (a quinolizidine)
- alpha-lupanine (a quinolizidine)
- sparteine (a quinolizidine)

One study found that isolated N-methycytisine exhibited significant teratogenicity in the rat embryo culture (REC) test at a concentration of 20 μg/mL. In frogs, N-methycytisine stimulates the ganglion cells of the cardiac vagus; in dogs, it paralyzes the ganglia of the cardiac vagus; and in rabbits, it produces hyperglycemia. N-methycytisine has a strong binding affinity for nicotinic receptors and its pharmacological action is similar to that of nicotine.

Anagyrine is teratogenic to cattle, but did not exhibit teratogenicity in the REC test (it is thought that the alkaloid must be metabolized by a ruminant in order for it to become teratogenic).
Taspine demonstrated significant embryotoxicity in the REC test, but is present in very low concentrations in Blue Cohosh root.


Illustrations:

Background: Coffee (*Coffea arabica*) beans
M: Tea, *Camellia sinensis* [Köhler/Stueber]
TR: Caffeine, a methylxanthine
BR: Cocoa bean pod, *Theobroma cacao*

Methylxanthines are sometimes classified as ‘purine bases’ or ‘purine alkaloids’ because they are closely related in structure & origin to the purines, adenine & guanine (which are also found as ‘base pairs’ in DNA).
Illustrations:

L: Antique coffee grinder from the ghost town of Bodie, CA
R: Coffee, *Coffea arabica* [Köhler/Stueber]
Cacao: Psychoactive Constituents

- Theobromine is the major constituent
- Small amounts of caffeine
- Trace amounts of theophylline
- Small amounts of anandamide (endogenous cannabinoid)
- Tryptophan
- Phenylethylamine (PEA) = endogenous amphetamine
- Tyramine (migraine trigger)
- Mood elevation; depression

Illustration:
Cacao, aka Cocoa (*Theobroma cacao*) pods [Köhler/Stueber]

See: http://www.chocolate.org/index.html
Tea (Camellia sinensis)

- Caffeine is the major methylxanthine
- Theophylline is present in small amounts
- Theophylline used as a drug for asthma & bronchospasm
- ‘Side effects’ similar to caffeine
- Stimulant, diuretic

Illustration:

Tea, *Cameliasinensis* [Köhler/Stueber]
Guaraná, Kola, Yerba Maté

• Guaraná & Kola: caffeine
• Yerba Maté: caffeine, theobromine
• All contain polyphenolic antioxidants in addition to methylxanthines

Illustrations:

  L: Yerba mate, *Ilex paraguariensis* [Köhler/Stueber]
  Kola: *Cola acuminata* [Köhler/Stueber]
Steroidal Alkaloids

- Steroidal skeleton
- Antifungal, antibacterial, insecticidal & antifeedant for the plants
- Cholinesterase inhibitors
- Isolated compounds damage intestinal & gastric mucosa
- Characteristic of the Solanaceae
- Highly toxic derivatives in Hellebore (Veratrum)

Illustrations:

1. Tomato (*Lycopersicon esculentum*) fruits ripening; the steroidal alkaloids concentrate in stems, leaves; lesser amounts in unripe fruit
2. TR: Tomatidine, a steroidal alkaloid
   BR: Tomato (*Lycopersicon esculentum*) flowers have a structure characteristic of the Nightshade family

Cholinesterase inhibitors: substances which inhibit the enzyme that breaks down the neurotransmitter acetylcholine; synthetic cholinesterase inhibitors are used as pesticides; see http://www.uoguelph.ca/GTI/urbanpst/cholin_t.htm
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Illustrations:

1. Tomato (*Lycopersicon esculentum*) fruits ripening; the steroidal alkaloids concentrate in stems, leaves; lesser amounts in unripe fruit
2. TR: Tomatidine, a steroidal alkaloid
   
   BR: Tomato (*Lycopersicon esculentum*) flowers have a structure characteristic of the Nightshade family

Cholinesterase inhibitors: substances which inhibit the enzyme that breaks down the neurotransmitter acetylcholine; synthetic cholinesterase inhibitors are used as pesticides; see http://www.uoguelph.ca/GTI/urbanpst/cholin_t.htm
Steroidal Alkaloids

- Dulcamara/Bittersweet/Woody Nightshade (Solanum dulcamara)
- Dried stems for chronic eczema
- Itching skin conditions
- Respiratory tract catarrh
- Bronchitis, asthma
- Rheumatism
- Astringent, antibacterial, antifungal
- Toxic in large doses
- Steroidal alkaloids & steroidal saponins; tannins
- See King’s American Dispensatory

Illustrations:

TR: Solasodine, a steroidal alkaloid
BR: Flowers and berries of Bittersweet Nightshade, Solanum dulcamara

For Eclectic information, see:
http://www.ibiblio.org/herbmed/eclectic/kings/solanum-dulc.html
Tropane Alkaloids

- Hyoscyamine
- Scopolamine (hyoscine)
- Atropine
- Cocaine
- Belladonna
- Henbane
- Thorn Apple (Datura)
- Coca (Erythroxylum coca)

Illustrations:
TR: *Atropa belladonna* berries
BR: Hyoscyamine

*Brugmansia* spp. (Tree Daturas) are used for commercial extraction of tropane alkaloids.
Belladonna (Deadly Nightshade), *Atropa belladonna*; Atropos = Greek fate who cuts the thread of life.
Illustrations:

Background: *Datura* seed pods (from the University of Washington botanical gardens, Seattle)

Insets: the tropane alkaloids. Atropine is a racemic mixture of the (+)- and (-)- isomers of hyoscyamine. A related compound, scopolamine, is also called hysoscine.
Tropane Alkaloids

- Hyoscyamine, scopolamine, atropine have similar structures & activities
- Competitive, reversible inhibitors of acetylcholine at muscarinic receptors of parasympathetic nervous system
  - antispasmodic in GI tract
  - bronchodilators
  - anti-emetic (motion sickness)
  - antisecretory
  - dilate pupils (mydriatic)
  - narcotic, psychotropic
  - alkaloids easily absorbed through skin

Illustration:

TR: Henbane, *Hyoscyamus niger* [Lindman/Stueber]
BR: *Brugmansia*, a commercial source of tropane alkaloids
Tropane Alkaloids

Deadly Nightshade is a source of atropine

Illustrations:

TR: *Atropa belladonna* berries & leaves

Belladonna (Deadly Nightshade), *Atropa belladonna*; Atropos = Greek fate who cuts the thread of life.
Tropane Alkaloids: Datura

- Jimsonweed, Locoweed, Sacred Datura
- Ayurveda prescribed Datura for asthma thousands of years ago
- Known in Europe as ‘Potter’s asthma cure’
- Old remedy for hemorrhoids (salve)
- Antispasmodic
- Narcotic anodyne
- Psychotropic

Illustrations:

L: Sacred Datura, *Datura wrightii*, from the American west (leaves & seed pods)

M: Datura blossom unfolding

TR: *Datura stramonium* was formerly used as a medicine

BR: Datura in full bloom

See: http://www.ibiblio.org/herbmed/eclectic/kings/datura.html for an Eclectic monograph on Datura (King’s American Dispensatory).