

# CHEMOTAXONOMY



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Chemotaxonomic studies should include **investigation of the pattern of compounds occurring in plants** and preferentially in the various individual parts of the plants such as the **bark, wood, leaves, roots, cuticles and seeds** .

### **Chemistry in relation to taxonomy**

- Application of chemistry to taxonomy is called chemotaxonomy.
- Chemical evidences are used in determining the relationship among taxa of different categories.
- Some of the major classes of chemical evidence include flavonoids, alkaloids, amino acids, fatty acids, aromatic compounds, terpenoids, polysaccharides, carotenoids etc.

## The following examples to indicate the use of chemistry in solving taxonomic problems:

1. Caryophyllales produce **betalains** and not **anthocyanins**
2. Polygonales produce **anthocyanins** and not **betalains**.
3. Juglandales are aromatic plants while Fagales are non- aromatic
4. Highly aromatic compounds are found in Lamiaceae
5. Alkaloids are very common in Solanaceae
6. Sapindaceae have plenty of Tannins.



## Why do leaves change color in the Autumn?

Most of the spectacular colors of autumn have actually been in the leaves all summer, however they were "covered up" by the dominant green of the chlorophyll. As weather cools, and shorter days settle in, the chlorophyll begins to break down, revealing new and varied color pigments. The brightest colors are seen when late summer is dry, and autumn has bright sunny days and cool nights.



White Birch



### GREEN - Chlorophyll

Chlorophyll is responsible for helping trees and plants turn sunlight into food. For most months, it is the dominant color seen in most leaves until it fades away. As many trees shut down their food production, they turn to stored sugars to survive the winter.

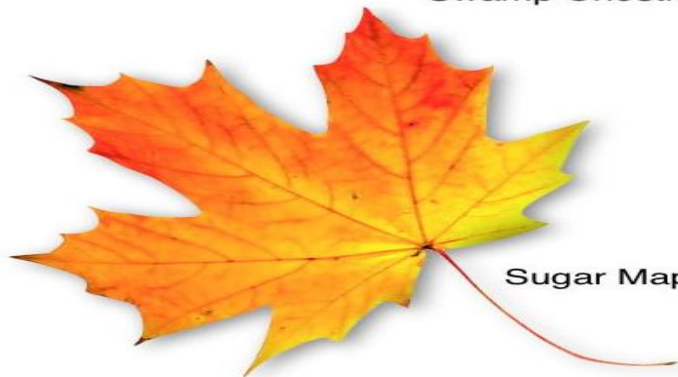


Swamp Chestnut Oak

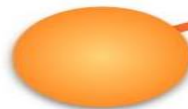


### RED - Anthocyanin

Unlike other leaf colors that always exist in the leaf, anthocyanins are produced as the chlorophyll is broken down. The anthocyanins are often seen in leaves named for their autumn splash of red including Red Maples, Scarlet Oaks, and Red Sumacs.



Sugar Maple



### ORANGE - Carotene

Sugar Maples may be one of the best examples of carotene in action. Their bright signature orange fills many hills and country roads throughout the northern US. Sassafras leaves also turn a slightly more muted orange. As its name implies, Carotenes are also the chemical responsible for giving carrots their unique coloring.



Aspen



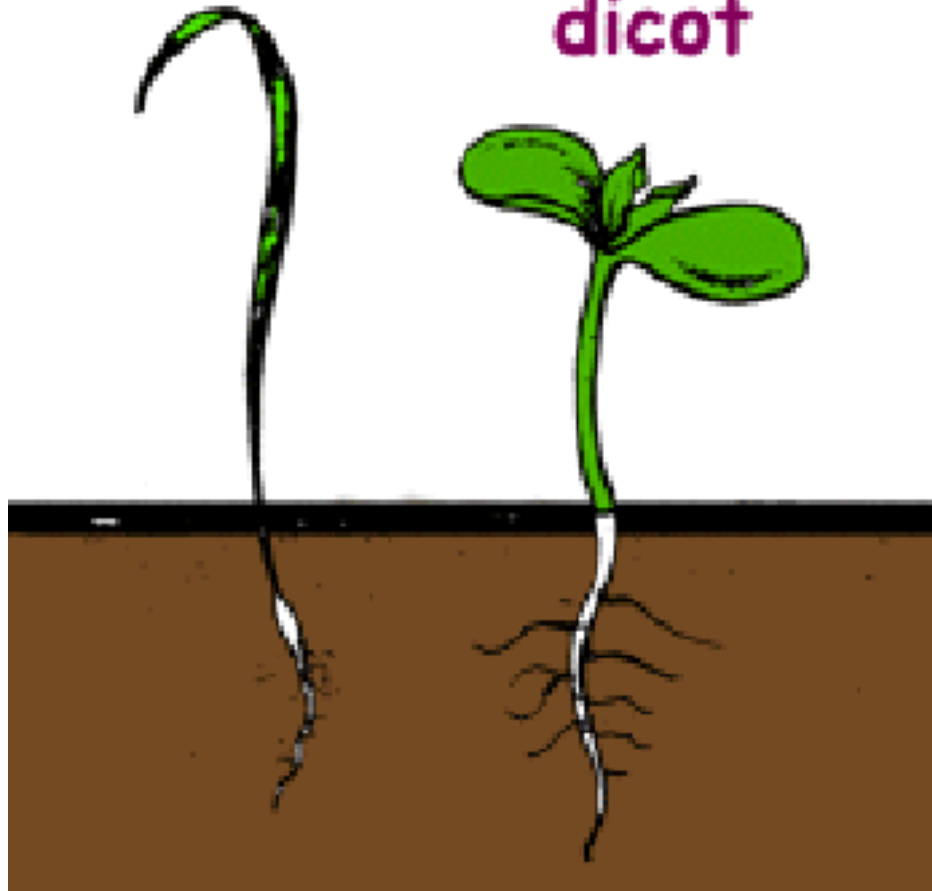
### YELLOW - Xanthophyll

Xanthophyll can be seen throughout the fall in trees including beeches, ashes, birches, aspens, and some oaks. It also contributes its bright yellow color to autumn squash and corn.

# Monocotyledon and Dicotyledon

monocot

dicot



# Angiospermae ( division) (flowering plants)

Class

Class

Monocotyledons

Dicotyledons



Subclass

About 8 orders

Archiclamydeae

Sympetalae

29 families

37 order

11 order

226 families

63 families

About 250,000 spp.

# MONOCOTS



EMBRYOS	LEAF VENATION	STEMS	ROOTS	FLOWERS
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# DICOTS



### **Monocotyledonous plants**

Seeds have a single cotyledon.

Adventitious root system present.

Leaves have parallel venation.

Flowers usually incomplete and trimerous (Floral parts are in the number of threes).

Vascular bundles in stem are numerous and scattered.

No cambium, no secondary growth in stem.

Stem usually hollow.

Seed germination normally hypogeal

### **Dicotyledonous plants**

Seeds have two cotyledons

Tap root system present

Leaves have net venation or reticulate venation.

Flowers usually complete and pentamerous (floral parts in the number of fives).

Vascular bundles in stem are fewer and arranged in circles or rings.

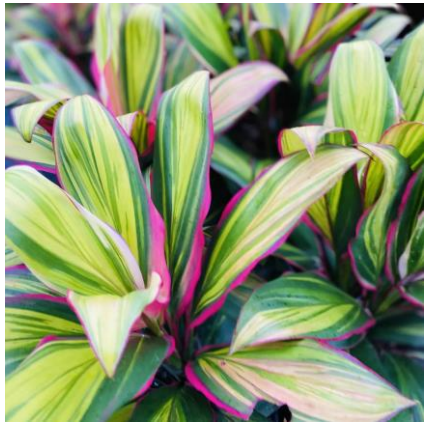
Cambium is present, secondary growth occurs.

Stem usually solid

Seed germination either hypogeal or epigeal.







# Family Asteraceae (Compositae)



**Asteraceae** is one of the largest **angiosperm families**, with more than 1,620 genera and 23,600 species of **herbaceous (herbs) plants, shrubs, and trees** distributed throughout the world

**Herb:** a usually low, soft or coarse plant with annual aboveground stems.

**Shrub:** a much-branched woody perennial plant usually with a single trunk.

**Tree:** a tall, woody perennial plant with a single trunk.



TREE



HERB



SHRUB

All angiosperms produce flowers containing the sexual reproduction structures, meaning those plants that produce their seeds enclosed with in a fruit.



**Herb**



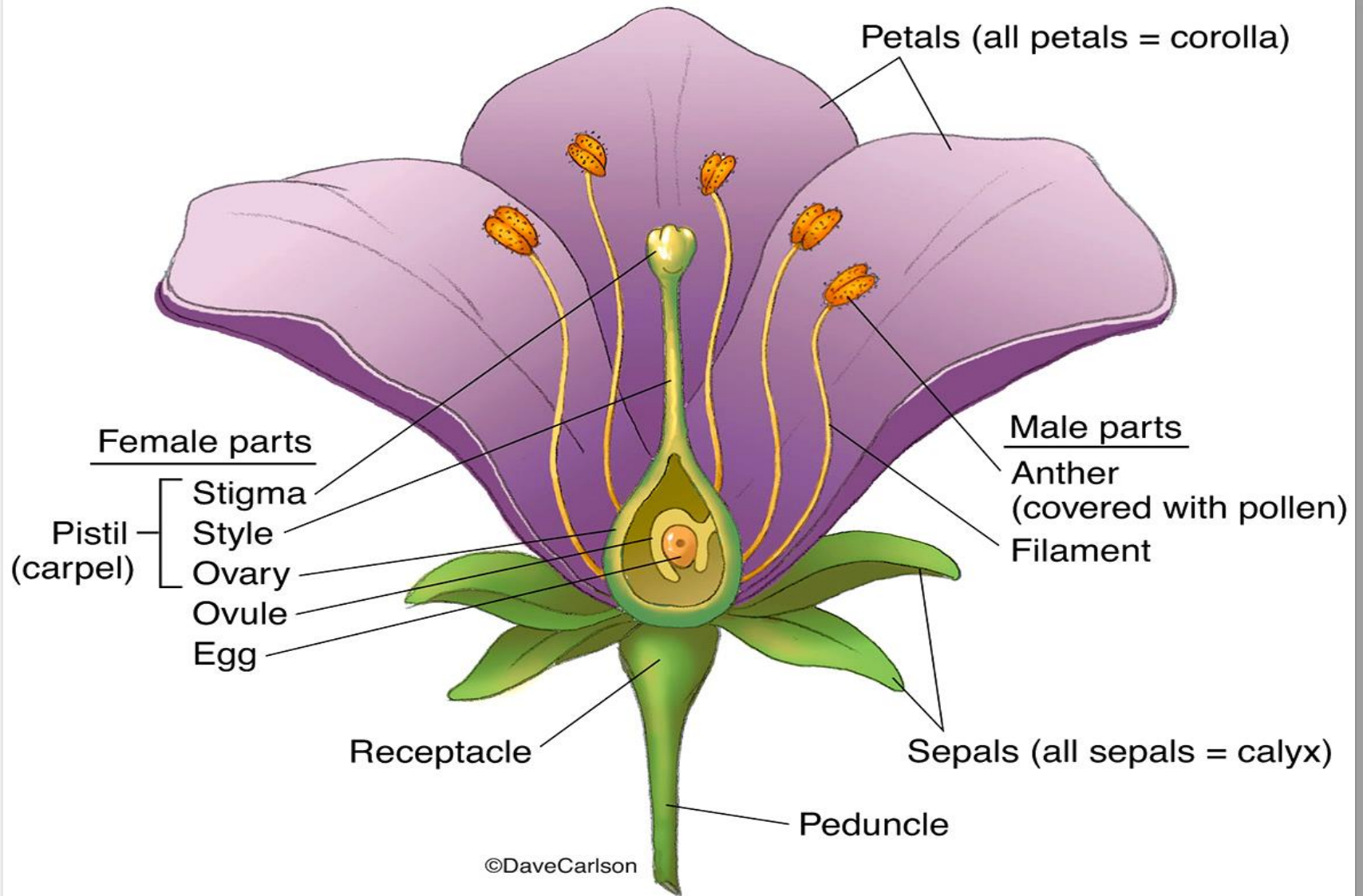
**Shrub**



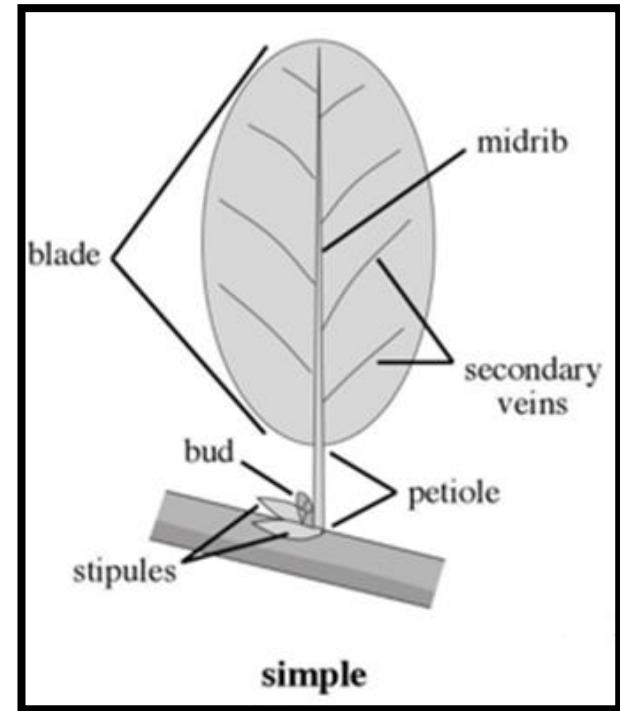
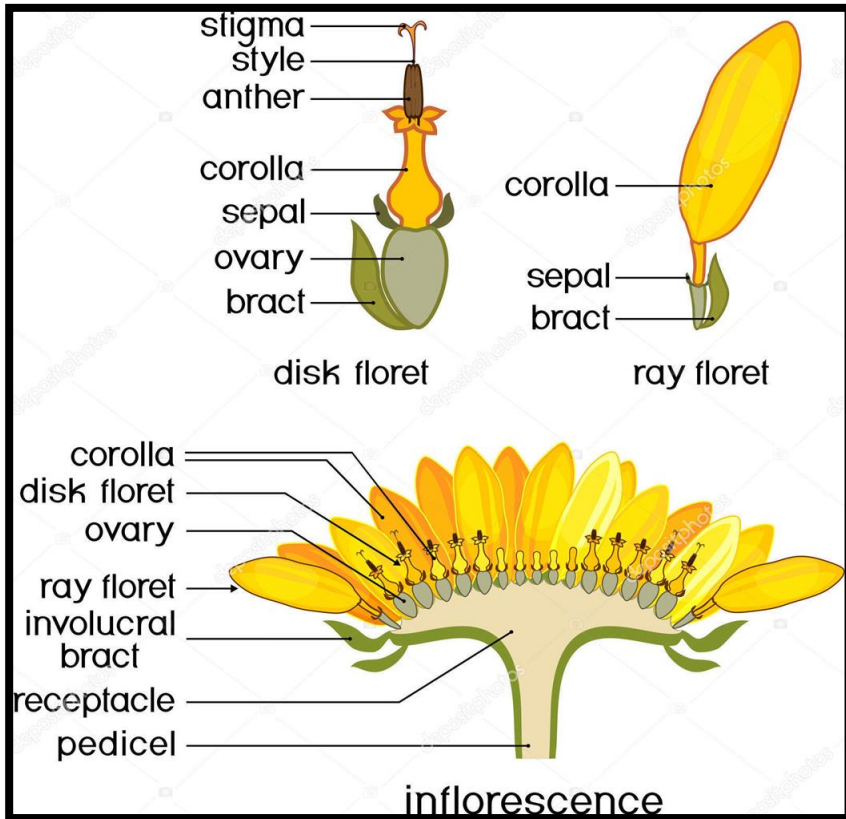
**Tree**



**Vine**



# Leaves without stipules



**Flowers small in dense heads**

## Three kinds of composite flower

**Heads composed of only ray flowers, as in dandelion & chicory.**

**Heads composed of only disc flowers, as in ageratum & burdock.**

**Heads composed of both disc and ray flowers, with disc flowers tightly packed in the head's "eye," while enlarged ray flowers function as petals radiating outward from the eye. Species in this group include sunflowers.**





In Asteraceae, the energy store is generally in the form of **inulin** rather than **starch**

Asteraceae produce secondary metabolites, such as flavonoids and terpenoids. They have produce terpenoid essential oils.

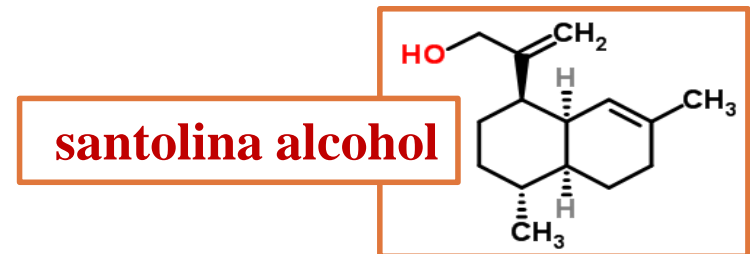
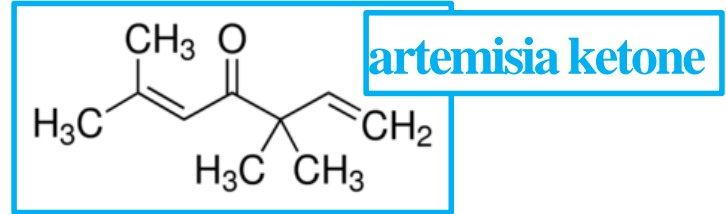
# *Achillea fragrantissima*



*Achillea fragrantissima* is a **wild herbaceous shrub** medicinal plant belonging to the Asteraceae family. *Achillea* contains around 130–140 perennial specie worldwide, it is a **white-woolly plant**, with erect stems and is widespread in Europe and temperate areas of Asia, North America, and in North Africa.

Known as **yarrow** in Arabic as **Qaysoom**. Most parts (**leaves, flowers, and seeds**) of *A. fragrantissima* contain high percentage of **volatile oils, flavonoids, tannins, sterols and triterpenes monoterpene ketones**.

The main constituents are essential oil santolina alcohol & artemisia ketone ketone



Fruits, leaves and branches have been used as a folk medicine for the treatment of various diseases. It is used as anti-inflammatory, antioxidant, capacities antimicrobial, antifungal, antiviral, and anticancer activity.

# *Anthemis nobilis* L.



Commonly known as **chamomile** (also spelled camomile) or under its synonym *Chamaemelum nobile*, **Roman chamomile**.



### **Description:**

Has **daisy-like white flowers and procumbent stems**; the leaves are alternate. The solitary, terminal flower heads, rising 20–30 cm (8–12 in) above the ground, **consist of prominent yellow disk flowers and silver-white ray flowers and its fragrance is sweet**. Although the plant is often confused with **German chamomile** (*M. chamomilla*), its morphology, properties and chemical composition are markedly different.

# Chemical constituents

- Volatile oils 0.4-1.75%
- Flavonoids: apigenin, luteolin, quercetin and their glycosides.
- Coumarins

The essential oil of *A. nobilis* is a **light blue color** due to the **terpenoid chamazulene**. The amount of the constituents isolated were differ according to the origin and the age of the flower.

# Biological activity

The biological activity of *A. nobilis* was mainly due to the flavonoids apigenin, luteolin, quercetin, patuletin and essential oil constituents.

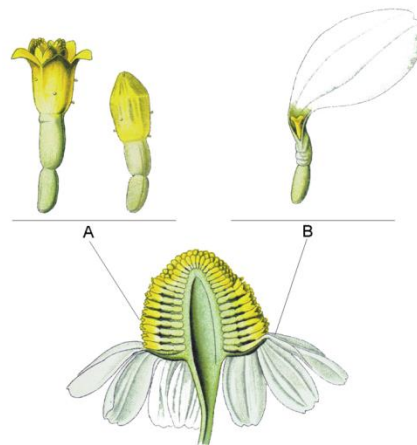
- Antimicrobial effect
- Insecticidal effect
- Anti-inflammatory effect
- Antioxidant effect
- Effect in asthma
- Hypotensive effect
- Hypoglycemic effect



# *Matricaria chamomilla* L.



- *M. chamomilla* commonly known as **chamomile** or **German chamomile**
- The **receptacle is swollen and hollow and lacks scales**. This property distinguishes German chamomile from *Anthemis nobilis*, has a **receptacle which is not hollow with scales**.



German chamomile and Roman chamomile essential oils, while both derived from chamomiles, have differences in their chemical constituents that make them useful for different therapeutic purposes. **German chamomile tends to be rich with sesquiterpene molecules like alpha- and beta-farnesene while Roman chamomile is more dominant in ester molecules like methallyl and methylamyl angelates.**

## Chemical constituents

It contains a large group of therapeutically interesting and active compound classes. **Sesquiterpenes, flavonoids, coumarins, and polyacetylenes** are considered the most important constituents.

## Biological activity

A diverse range of pharmacological properties have been demonstrated for this plant including anti-inflammatory , antimicrobial , anticancer , analgesic , anti ulcer, and acaricidal.

# *Artemisia herba-alba*



- The white wormwood, is a perennial shrub in the genus *Artemisia*. In Arabic, it is shīeh.
- Grows commonly on the dry steppes of the Mediterranean regions in Northern Africa , Western Asia (Arabian Peninsula) and Southwestern Europe.
- It is used as an **antiseptic and antispasmodic** in herbal medicine.

Phytochemical investigations have proven that this genus is rich in **sesquiterpenes, monoterpenes, volatile oils, santonin, artemisin** and **cadinene**.

**Santonin** is a drug which was widely used in the past as an anthelmintic, a drug which expels parasitic worms by paralyzing them. **Santonin** was formerly listed in U.S. and British pharmacopoeia, but it has fallen out of use with the development of safer ascaricides and is no longer registered as a drug in most countries.



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