What’s In a Name?

Why Botany and Taxonomy Are Important for Aromatherapists
(2012 Revision)

Doroda azul, *Hyptis suaveolens*
Ecuador

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The material in this book is a guide to the practice of aromatherapy. It is not a replacement for traditional health care, medical diagnosis, or medical treatment for illness. Refer to a licensed medical practitioner for medical care.

About the Author

Linda is President of the Institute of Spiritual Healing & Aromatherapy. She is certified in holistic nursing, Healing Touch, Healing Touch Spiritual Ministry, holistic health and in aromatherapy. As creator of a certification in clinical aromatherapy program, Linda has created a unique offering that enhances the study of clinical aromatherapy by adding the study of vibrational frequencies of the oils, emotional and spiritual aspects of healing with oils and energetic healing techniques. When students graduate from this 300 hour course of study, they will have learned much more than the national requirements to become an aromatherapist. Linda lives in Arvada, Colorado but can be found most weekends teaching somewhere throughout the world. Her “calling” is to help restore healing to Christianity and so she takes a Christian approach to the presentation of essential oils—God’s healing pharmacy.

Linda is also an expert article writer on the internet and has published well over 250 articles for ezine articles primarily on aromatherapy and topics concerning Healing Touch Spiritual Ministry. To see a list of her published works you can google Linda Lee Smith or go to http://www.ezinearticles.com/?expert=Linda Lee Smith For more free aromatherapy education, you can go to Linda’s blog at http://EssentialOilEducation.com for the latest news and short articles on aromatherapy.
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Introduction

Isn’t a rose just a rose? Or lavender just lavender? Actually, there is a world of differences depending on which “species” you are referring to. To be an effective aromatherapist working with clients, it is critical that we understand the importance of using only therapeutic or medicinal grade essential oils. Do you know where they came from? What the particular species is, where it was grown, harvested, distilled, even bottled? Do you know from what part of the plant the oil came from? Does that plant produce only one kind of oil or do we get different oils from different parts of the plant? Don’t under-estimate the importance of each of these questions.

As aromatherapists, it is our responsibility to be the most knowledgeable about healing plants. Doctors and medical institutions will not know this information—but we should so we can advise those who come to us by showing them the literature and giving our own testimonials on how therapeutic oils can help the body/mind/spirit come into balance and heal itself. To be able to select the right oils for self or others, we need a basic knowledge of some aspects of botany and at the very least, be familiar with the nomenclature.
Chapter 1
Why Botany and Taxonomy Are Important Subjects for All Aromatherapists

In the 1700’s, identifying plants by agreed upon names was a daunting task which no one could agree upon. That changed when Swedish naturalist Carolus von Linné or Linnaeus as his name is sometimes spelled,(1707-1778) devised a binominal system and applied it universally so that we could have precise identification of plants recognized by everyone around the world. Binominal means a two name system so that every plant gets two names. For instance, my name is Linda Smith—Linda is my personal (specific) name and Smith is my family name. In the plant kingdom, plants get a generic name and an individual specific name which may give us a clue about its history. An example from the plant kingdom would be *Piper nigrum* (black pepper) or *Artemesia alba*—the white flowering species of the genus *Artemesia*. Their names get written in italics and are the genus and species of the plant.

Linnaeus observed that plants could be grouped according to similarities in how plants formed their reproductive organs, their flowers and especially the number of their stamens and styles. This would allow for the unique identification of new plants and enable correct classification by observing their structure and flower. The Latin binomial system he developed is still in use to this day.

**Taxonomy (Systematic Botany)**

Over the centuries this system has been repeatedly tweaked but is still the core of the international taxonomic system used today. Taxonomy is the science of classification for organisms which enables us to identify and name them. The word taxonomy is from the Greek words *taxis* which means arrangement and – *nomia* which means method. So taxonomy is a method of arranging. Taxonomy is also called systematic botany. Botany is the study or the science of plants.
There are at least 500,000 living species that have been described in the plant kingdom. Don’t fear—even a top taxonomist in their field would only be able identify a few thousand species.

Just to make life more interesting for the studious aromatherapist, as taxonomists continue their research, they revise and refine their work in light of new knowledge—this often calls for a name change! For example, the Labatiae family is now called the Lamiaceae family and the Compositate family is now called the Asteraceae family. You may recall from the information taught in the 302 course that the compound 1,8 Cineole used to be called Eucalyptol and the compound methyl chavicol used to be known as estragole.

**A Short History of Plant Development**

Just to give you a perspective on how long plants have been around, here is a timeline I found in Kurt Schnaubelt’s book *Medical Aromatherapy*, (pgs. 32-48):

500 million years ago

Mosses, fungi, algae, lichens

Mosses contain phenolic compounds such as cinnamic acid; also monoterpenes including limonene and pinene; a wide assortment of sesquiterpenes; alcohols like geraniol and borneol; aldehydes; ketones; and esters like linalyl and bornyl acetates.

400 million years ago

Land plants (ferns) appeared
300 million years ago

Needle trees (gymnosperm—plants with naked seeds and whose reproductive body is a cone of overlapping scales). Representatives include Ginkgo, pine, fir, Douglas fir, sequoia, thuja, juniper and cypress—the conifers. Conifers are the only group belonging to the gymnosperms which produce essential oils. These trees produce oils primarily made up of monoterpenes—limonene, pinene, plus borneol (monoterpene alcohol), carvacrol and thymol (phenols) and figured prominently in the chemistry of life on this planet.

100 million years ago

Leafy green plants (plants with hulled or covered seeds). These are what are called “angiosperm plants.” Representatives include star anise, ylang ylang, (pictured to right), cinnamon, and nutmeg. Essential oils are predominantly made up of products from phenylpropanoids and terpenes.

As angiosperms developed even higher degrees of organization—their essential oil composition changed toward a predominance of terpenoid components—approximately 80% of all essential oil matter today. These plants develop multiple flowers and their root is woody and sometimes swells as a food store. Among the numerous examples we have are chamomile, roses, and mints.

Note of importance for aromatherapists: Essential oils are found in the higher flowering plants or angiosperm.
What’s In a Name?

5 million years ago  First hominids roamed the earth—by then all the medicinal plants needed were already here!

120 thousand years ago  Homo sapiens arrived with a well developed frontal cortex.

Present Day  Are we destroying the environment that sustains us? It would appear that “homo scientificus” is rather short-sighted as Kurt Schnaubelt observes. Our desire to improve upon nature by creating pharmaceuticals in the chemistry lab just keeps getting us into trouble.

Plant-Human Relationships

Plants as we have seen have been around a lot longer than humans and were fully developed before we came onto the scene. Plants are necessary for our very survival—they are a source of food, medicine, shelter, clothing, and fuel. Knowledge of how a plant is formed, how it functions and how it creates essential oils (its life blood) brings us closer to understanding the nature of plant’s healing abilities. The more we understand, the more we come to a place of respect for all of life.

Knowing about the source of our healing plants is an important grounding for the practice of aromatherapy.

We are dependent upon plants for our very existence. Here are a few concepts for you to consider. Plant-Human relationship is one of—

- Survival
- Appreciation
- Sustenance
- Medicine
- Source of life

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Categorizing Plants

Getting back to categorizing plants, if I wanted to tell you about the “genealogy” of say, lavender, this is how I could arrange (categorize) it:

Kingdom: Plantae
Division: Tracheophyta
Subdivision: Spermatophyte
Class: Dicotyledons
Subclass: Asteridae
Order: Lamiales
Family: Lamiaceae
Genus: Lavandula
Species: angustifolia

Mercifully as aromatherapists, we only need be familiar with the last 3 arrangements—family, genus and species plus any varieties or chemotypes if they exist. Within a family there are many different groups. A single group is a genus. The different members of a genus are known as species. Now within species we also have various groupings which are subgroups including variety and chemotypes.

Family—this is the category (family) the plant belongs to—all family names end in -aceae. A family is a group of plants having a strong particular resemblance. For example, in the carrot family—the distinguishing characteristic is the umbrella-like form of the flowers. Within a family—you will have various groups. A single group is called a genus.

Genus—Latin for race or kind within a family—this is a generic name and it will be based on structural characteristics and represents a group of closely related species. It is always written in italics with the first letter always capitalized.

Species—these are actually descriptive or adjective names describing the smallest unit of that particular genus and represent the various members of a genus/group. It describes something distinctive about the plant or gives in Latin form the name of a person associated with it in some way or it may even capture something about its history. Here are a few examples: Artemesia alba indicates
the white flowering species of the genus *Artemisia*. *Rosmarina officinalis* indicates the species used by medical monks in their *officium* or surgery. So species are a group of individuals of the same ancestry, have nearly identical structure and behavior. The names are also written in italics but the first letter is not capitalized.

With all that said—this particular species of lavender is best known as *Lavandula angustifolia*.

### Further Divisions

There are actually several further divisions beyond species which need to be mentioned since you will see these appear in the plant names.

**Subspecies**—may refer to a geographical variation of a species. Usually a subspecies is partially or wholly isolated geographically.

**Variety**—The names will have ‘var.’ in them and the var. is not in italics. This indicates a major subdivision of a species or maybe even a variant but may not necessarily be tied to geography or being isolated. For example *Citrus aurantium* var. *amara*. The common name for this plant is actually Bitter Orange. [The rind produces the bitter orange essential oil through cold-pressing while the leaves of this tree produce]
Petitgrain essential oil and the blossoms produce Neroli Essential oil through steam distillation. Bitter orange is a different “variety” of orange tree and the oil is different than the oil from the sweet orange tree.] Varieties happen naturally but often are a horticultural origin or importance.

Cultivar—indicates that the species is cultivated or developed by a particular grower. Their names are non-Latinized and non-italicized and will appear in quotation marks. For instance Lavandula angustifolia ‘Maillette’. Often the name in quotation marks represent the name of the originator or grower and in this case, it is a Monsieur Maillette.

Clone—propagation is not through sexuality of the plant, but through cuttings or budding (nonsexual). Clones are like identical twins but even closer. For example, there are over twenty-five different identified clonal selections of Basil.

Chemotype—is a subclass of a species and indicates visually identical plants but having different chemical compounds that result in different therapeutic properties. The chemical variation happens naturally in the wild, especially in the Lamiaceae family in the Mediterranean area. It is thought to be created by different altitudes, light or other environmental factors. Luckily, only a handful of plants ever produce chemotypes or else naming plants would present quite a challenge. Chemotypes can be propagated by cuttings for cultivation. You can recognize whether a plant is a chemotype by looking at the name—it will have CT followed by the chemical constituent. For example, Thymus vulgaris ct. thujanol-4, T. vulgaris ct. geraniol, T. vulgaris ct. carvacrol, and so on. In fact it is actually thought that Thymus vulgaris (pictured above) has over a hundred different chemotypes though only a hand full are used in aromatherapy. The thyme plants may all resemble each other from the outside but will have different chemistries.

Hybrid—Hybrids indicate natural or artificially produced crosses between species. There will be an ‘x’ in the name which means the hybrid was produced by sexual
crossing. For example, *Mentha x piperita* is actually a cross between *Mentha aquatica* and *Mentha spicata*, two very different species of peppermint.

**Concerned About Pronunciation?**

Don’t be—just make your own attempt at pronunciation. There actually are no rules but if you were lucky enough to have studied Latin in high school or college, it should be easy. The world counts how it is spelled, not on how it is pronounced.

**Factors That Can Account for the Differences within a Species**

Think about it—weather, location, rainfall, time of the year, sun exposure, altitude, temperature—can all affect and account for chemical differences in plants. As a living being, plants are constantly responding to their environmental conditions. The plants can vary the production and composition of their aromatic compounds. Even water stress can provoke a change in the chemistry. Too much or too little water, or unseasonable temperatures—hot or cold can affect the quantity and the quality of the compounds produced. Altitude will give different degrees of ultraviolet light. We know that lavender grown at different altitudes will yield different percentages of their compounds with the higher altitude yielding the better composition. It is known that the best rose otto comes from roses grown in Bulgaria and the highest quality cinnamon is from Sri Lanka.

Then, add in the differences in growing and distillation techniques and we have quite a few important variables that can account for differences within a species.
# List of the Aromatic Plant Families

There are approximately 280 families within the plant kingdom, but only about 25 families with aromatic members. The following is a list of those aromatic families along with the plant characteristics and examples. I found this list in Vicki Pitman’s book: *Aromatherapy, A Practical Approach*, pgs. 91-92 to which I have added information from Marcel Lavabre’s *Aromatherapy Workbook*, pgs. 68-104 plus my own investigation into the aromatic families.

<table>
<thead>
<tr>
<th>Family</th>
<th>Characteristics</th>
<th>Examples</th>
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</thead>
<tbody>
<tr>
<td>Betulaceae</td>
<td>Trees and shrubs. Wind pollination with male and female flowers separate in the same plant. The fruit is a small ridged nut.</td>
<td>Birch trees</td>
</tr>
<tr>
<td>(birch family)</td>
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<tr>
<td>Burceraceae</td>
<td>Primarily grows in desert or tropical habitats that have intense sunlight. Form gum resins. EOs of this family are used for ulcers, gangrene, gastric and intestinal fermentation, skin preservation, rejuvenation and emotions. Spiritually—they purify the mind and induce clarity and inner calm.</td>
<td>Desert Areas: Frankincense, myrrh (Frankincense tree) Tropics: Elemi, Palo santo</td>
</tr>
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<tr>
<td>Annonaceae</td>
<td>Most are small trees found in tropical areas of America, Asia and Australia. Ylang ylang is a typical example and produces a sweet, exotic fragrance. Used for skin and hair care, skin diseases, to prevent fever, lowers blood pressure and is considered an antidepressant.</td>
<td>Ylang ylang</td>
</tr>
<tr>
<td>Family</td>
<td>Description</td>
<td>Example Plant</td>
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<tr>
<td>Cistaceae</td>
<td>Small bush growing in dry rocky areas of the Mediterranean countries. Leaves exude gum called labdanum. Oil is a tonic, astringent, sedative, antispasmodic used for diarrhea, dysentery, intestinal troubles, nervousness, insomnia and ulcers.</td>
<td>Cistus</td>
</tr>
<tr>
<td>Asteraceae (Compositae)</td>
<td>Plant has a flowering head containing many small florets. Displays great diversity of form, wide range of habitat—seashore, mountain, desert and swamp. Has the largest number of members, 800 genus and 13,000 species. They are very adaptive and intensely associated with light.</td>
<td>Dandelion, chamomile—German and Roman varieties, goldenrod, helichrysum, mugwort, fleabane, tarragon, calendula, tansy, yarrow, and wormwood.</td>
</tr>
<tr>
<td>Cupressaceae (Coniferae)</td>
<td>Gymnosperm trees and shrubs. Great longevity with typically no oil vessels but with resin canals. Everything is structured around the central vertical trunk with branches shaped like small trees and the leaves are reduced to long needles placed in spirals around the twigs. Habitat is frigid and temperate both hemispheres, or tropical zones at high altitudes. Oils and resins in trunks, branches, cones, needles. Very warming oils and resins to balance a cold habitat.</td>
<td>Cedarwood, red cedar, cypress, blue cypress, juniper, thuja</td>
</tr>
<tr>
<td>Ericaceae</td>
<td>These are low-growing perennial flowering shrub like plants. Well known plants include cranberry, blueberry, azalea, rhododendron, and various common heaths and heathers.</td>
<td>Ledum (Labrador Tea), Wintergreen.</td>
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<tr>
<td>Family</td>
<td>Description</td>
<td>Example</td>
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<tr>
<td>Geraniaceae</td>
<td>Herbs or low shrubs with spreading flower heads or single flowers. Has a strong adaptability indicative of immune-stimulant properties.</td>
<td>Geranium (over 250 species)</td>
</tr>
<tr>
<td>Gramineae/Poaceae, the grass family</td>
<td>Widest of habitats from polar to equatorial, swamp to desert. Very adaptable and diverse with powerful root systems. Leaf structure is linear. Their strength lies in the root system forming an intricate network. This family is entirely dedicated as a nutritious family – its leaves and seeds are used by the animal kingdom.</td>
<td>Lemongrass, vetiver, citronella, palmarosa (Vetiver)</td>
</tr>
<tr>
<td>Lamiaceae (Labiateae)</td>
<td>Herbs or small shrubs with square stems, leaves in opposite pairs, often hairy with glands producing volatile oil. Flowers irregular. These plants prefer and love heat and do well in median climates. They like altitude and often rocky spaces. All labiatae plants have some curative power. Fragrances are invigorating, stimulating. Some have the ability to produce chemotypes.</td>
<td>Basil, clary sage, dorado azul, hyssop, lavender, lavandin, marjoram, melissa, mt. savory, peppermint, oregano, patchouli, rosemary, sage, spearmint, thyme (Basil)</td>
</tr>
<tr>
<td>Lauraceae</td>
<td>Tropical and subtropical trees, shrubs; evergreen. Cinnamon is one of the oldest known spices which traveled the spice route 4000 years ago.</td>
<td>Cinnamon, cassia, laurel or bay, ocotea, ravintsara, rosewood (Cutting cinnamon bark)</td>
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### What’s In a Name?

<table>
<thead>
<tr>
<th>Family</th>
<th>Description</th>
<th>Example Plants</th>
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</thead>
<tbody>
<tr>
<td><strong>Leguminosae</strong> (Fabaceae)</td>
<td>Means flowering plants. They are found throughout the world, growing in many different environments and climates.</td>
<td>Copaiba (copal)</td>
</tr>
<tr>
<td><strong>Myrtaceae</strong></td>
<td>Tropical zones every continent. Evergreen leaves are strong and simple. Pollination is accomplished by insects and birds. The family produces sweet spices and sweet fruits.</td>
<td>Cajeput, lemon myrtle, manuka, pomegranate, guava, clove, eucalyptus, melaleuca, myrtle. (Eucalyptus leaves)</td>
</tr>
<tr>
<td><strong>Myristicaceae</strong></td>
<td>Found in tropical Asia. Flowers are male and female on separate plants. Fruit is a fleshy drupe splitting on both sides to release a single seed.</td>
<td>Nutmeg (Myristica fragrans)</td>
</tr>
<tr>
<td><strong>Oleaceae</strong></td>
<td>Over 600 species of shrubs, trees and occasionally vines like jasmine. This group contains the olive tree.</td>
<td>Jasmine</td>
</tr>
<tr>
<td><strong>Pinaceae</strong></td>
<td>Tall conical trees with resinous wood, branches in whorls. Abundant in northern hemisphere. Needle-like leaves in clusters or solitary. Flower is a cone, male and female. Seeds are winged.</td>
<td>Pine, spruce, all fir trees, tsuga. (Pine)</td>
</tr>
</tbody>
</table>
### What’s In a Name?

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<thead>
<tr>
<th><strong>Piperaceae</strong></th>
<th>Long history as an ancient spice and even used as currency in the Middle Ages. Medicinal properties include stimulant, tonic, digestive, antitoxic, analgesic rubefacient, and aphrodisiac. Leaves contain oil cells, fruits are often aromatic.</th>
<th><strong>Black Pepper</strong></th>
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<tr>
<td></td>
<td><img src="image" alt="Pepper vine" /></td>
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<tr>
<td><strong>Rosaceae</strong></td>
<td>Large number and variety. Herbs, shrubs and trees many of food or ornamental value. Flowers are open and scented. Oil is uplifting, anti-depressant, tonic, astringent, aphrodisiac, and a stimulant for the heart chakra.</td>
<td><strong>Rose, rosehip</strong></td>
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<td></td>
<td><img src="image" alt="Rosa damacena" /></td>
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<tr>
<td><strong>Rutaceae</strong></td>
<td>Tropical heat. Mostly small, thorny trees with hard wood, often resinous, firm green leaves. Flowers in symmetrical stars, fruits juicy or small hot, spicy berries. Action is cooling, refreshing, sedative.</td>
<td><strong>Bergamot, grapefruit, lime, orange, lemon, mandarin, petitgrain, neroli, rue.</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Bitter orange" /></td>
<td></td>
</tr>
<tr>
<td><strong>Santalaceae</strong></td>
<td>Small family of herbs, trees or shrubs with individual leaves. Flowers are very small, often greenish. Fruit is 1-seeded.</td>
<td><strong>Sandalwood</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Sandalwood tree" /></td>
<td>Sandalwood tree growing off the roots of another tree</td>
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<table>
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<th>Family</th>
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<th>Example</th>
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</thead>
<tbody>
<tr>
<td>Styracaceae</td>
<td>Small family of flowering plants which occur in warm temperate and subtropical regions. It also includes species popular as ornamental trees valued for their decorative white flowers. Benzoin resin, used in herbal medicine and perfumes is extracted from the bark of styrax species.</td>
<td>Onycha (Benzoin)</td>
</tr>
<tr>
<td>Umbelliferae</td>
<td>Stems stout with hollow internodes. Leaves much divided. Strong root or rhizome. Vegetation grows rapidly, seeds hollow. Many members used for food or aromatic seasoning. Has a special affinity for the digestive system.</td>
<td>Caraway, fennel, carrot, anise, coriander, cumin, dill, angelica, lovage, celery, galbanum and parsley.</td>
</tr>
<tr>
<td>Valerianaceae</td>
<td>Plants are generally herbaceous and foliage often has a strong, disagreeable odor.</td>
<td>Spikenard, valerian</td>
</tr>
<tr>
<td>Verbenaceae</td>
<td>Family of herbs, shrubs, trees or woody climbers. Leaves are usually opposite without stipules. Fruit is often a berry or drupe with one or more stones. True lemon verbena is a small bush with an abundant leaf system.</td>
<td>Lemon verbena</td>
</tr>
<tr>
<td>Zingiberaceae</td>
<td>Family of perennial aromatic herbs with fleshy rhizomes and tuberous roots. Used for thousands of years for medicinal properties and culinary uses.</td>
<td>Ginger, cardamom, turmeric</td>
</tr>
</tbody>
</table>
Chapter 2

Welcome to Basic Plant Structure

Plant structure or morphology, comes from the Greek work *Morphos* which means form. Learning about botany is like being a detective and a sleuth. You may even have to learn a foreign language—well maybe, just a little foreign language. Once you get the hang of it, you will find it getting easier and easier to differentiate between plant families and different types of plants. The organization of plants will become quite simple and before you know it, you will be able to identify patterns in the plant world. Don’t forget you will also need a healthy dose of intuition to help you develop your skills in choosing the right oils for yourself or others to match the physical/emotional/spiritual needs presented. A clear understanding of botany will give you a more precise ability in developing your synergistic blends.

Photosynthesis

We can liken each plant to a miniature chemical factory capable of transforming the energy from the sun into energetic substances which are then used by the plant. The plant gathers water and minerals from the earth through its roots and draws in carbon dioxide from the air through its leaves. These raw materials are then converted into simple 6-carbon sugars which provide food for the plant’s growth. The glucose is the energy source for the plant’s metabolism. A waste product of this chemical change is oxygen which of course we need. The whole process is called photosynthesis. Special cells containing chloroplasts (which have chlorophyll in them) conduct this photosynthesis. Secondarily the plant produces alkaloids, bitters, glycosides, gums,
mucilages, saponins, steroids, tannins and essential oils. For our purposes here, we are interested in the essential oils.

In order for plants to survive they need good growing conditions. Here are some of the essentials for them to survive and thrive:

- Essential minerals
- Carbon dioxide
- Water
- Sunlight
- Protection from extreme weather and predators

What Purpose Do the Essential Oils Play in the Plant?

- Insect repellent
- Prevents attack by bacteria, fungi and other microorganisms
- Aids pollination by attracting bees and other insects
- Wound healing of the plant
- Helps survival in difficult growth conditions
- Prevents dehydration
- ? unknown factors

There is some evidence that volatile oils help regulate the plant’s own hormones which then trigger growth and reproduction. In this regard, they may be acting like chemical messengers.

Stressing a plant in times of drought can cause the plants to increase the production of essential oils suggesting that these volatile compounds are part of some kind of an adaptive response in order to survive. On hot dry summer days, aromatic plants like sage, thyme, lavender, rosemary and oregano will release their essential oils forming a haze around the plants. This not only helps to reduce water loss by coating the leaves with a thin, protective film but also retards the growth of other seedlings ensuring the survivability of the mature plants.
Why Do You Think Plants Smell?

Actually there may be two very basic reasons: defense and attraction. According to Jeanne Rose (*Essential Oils and Hydrosols, 1999*) the essential oil smell from leaf, root, and bark **DEFEND** plants against being eaten or chewed on; while flower and fruit scents **ATTRACT** animals for pollination and seed dispersal. These are two very different strategies sometimes within the same plant. The leaves of some plants taste so bad that animals will not eat them twice! The flowers are equally smart in attracting any pollinators—bees, insects, birds, animals and humans to help spread their pollen to other plants. The nature of the flower odors will vary according to the group of pollinators. For instance, flowers that attract bees and butterflies often have pleasant sweet fragrances but not overpowering. Flowers that attract moths are typically heavy sweet odors. Flowers that attract bats produce a musky or rotting fruit odor. I have a watercolor picture of a coyote smelling a desert flower. When I spoke to the artist, he said that he actually saw a coyote go up to the flower, close its eyes, and smell the delicious aroma. Hmmm, and we thought only humans appreciated the flowers. We are actually the last ones in the chain to appreciate what nature has to offer. There are scientists who even speculate that there is communication on some level between certain species of flowers and humans. Our attraction to these flowers may be because of their beauty and/or their scent which causes us to propagate them widely—for instance, roses, and lavender.

Here are some of the words we use in English to describe the perfume of essential oils. **Floral, fruity, citrus, conifer, minty, green, vegetable, woody, herbaceous, hay, smoky, earthy, mossy, musky, balsamic, and spicy.**
What Else Does the Essential Oil Do in a Plant?

Some scientists speculate that these volatile essential oils within plants may regulate the plant’s own hormones which in turn trigger growth and reproduction. They may be an important part of timing.

Scientists have also observed the role of heat in causing stress on plants. Stress will cause an increase in volatile oil production—a sort of self-help mechanism for self-preservation. Photographs of plants during hot Mediterranean summer months of plants like sage, thyme, lavender, rosemary and oregano show a haze surrounding the plants. This is actually the release of the volatile oils which helps reduce water loss and coats the leaves with a thin protective film.

The gum resin produced by conifers and other trees like frankincense (pictured at right) get released when the bark is damaged—wound healing function? Scientists certainly think so.

Before we go much further, let’s take a look at the actual plant structures.
Parts of the Plant
(Vicki Pitman gives us an in-depth look at the parts of a plant in her book: *Aromatherapy, a Practical Approach*, pgs. 93-105.)

Below Ground Parts

Root

Roots are underground and anchor the plant in the earth. They absorb water and minerals, store nutrients and send these necessary nutrients up into the plant above the earth. Root systems will vary with some having a main taproot that goes down deeply, others will have spreading roots or creeping roots. Roots may have side hairs for absorbing water and nutrients. The roots are the main storehouse for nutrients.

Aromatic compounds of roots are typically your base notes.

Rhizomes

Rhizomes are actually not roots but a modified stem growing just beneath the soil surface. A rhizome will have a series of nodes where leaves form often with roots coming out. An example is ginger or turmeric. Ginger is pictured to the right.

Tubers

This is a stem modified actually for food storage with ‘eyes’ from which new shoots grow. Example: potato is a tuber.

Bulb

A bulb has a flattened stem with the leaves growing from it. Example: lily, onion, hyacinth, tulip.
Corm
This is a stem swollen to a very thick, short, form, fleshy part. It produces roots from the base, and leaves and flowering stems from the top. An example: Iris.

Above Ground Parts

Stem
The stem is the trunk or stalk of the plant. It provides structure that supports the leaf, flower and fruit and will contain inner vessels for transporting water, minerals and glucose. The stem links the roots with the leaves. Aromatic examples include the mints. In cinnamon and in Palo Santo, the outer bark is fragrant. In sandalwood (pictured to the right), the inner bark (heartwood) is fragrant.

Leaf
The leaf is the organ of respiration*, transpiration* and photosynthesis. Leaves can also absorb water. The structure, size, shape and texture are determined by their many adaptations for photosynthesis but also for water metabolism, food storage or defense. Leaves may be classified by overall shape. Descriptions include by shape: linear, oval, elliptical, rounded; by margins: serrated or entire; by base: cuneate or truncate; by apex: acute, acuminate or mucronate. The overall arrangement of leaves can be spiral, alternate, opposite, or whorled.

Some aromatic examples: rosemary, lavender, pine needles, oregano, sage, eucalyptus, etc.
What’s In a Name?

*Respiration is the chemical breakdown of carbohydrates with oxygen inside the cells and tissue of animals and plants to provide energy and release carbon dioxide and water.

*Transpiration is the release of water from the leaves.

**Flower**
The flower is the reproductive sex organ that contains male and/or female parts. The form, color and texture of the petals assist with fertilization by attracting pollinating insects. Aromas produced in some flowers are thought to attract pollinators or ward off pests which threaten the species survival.


**Fruit**
Fruit is the seed-bearing organ which is the product of the fertilized, ripened ovary of the flower. A nut is actually a dried fruit, a single seed within a woody wall. Types of fruit: fleshy—animals are attracted to fleshy fruit and eat it and then disperse the seeds. A Drupe is a seed inside a stony layer surrounded by fleshy fruit, for example an apricot or peach. A berry has one or more seeds from one ovary, for example a blackberry. Another type of fruit is called a dehiscent dry—the seed sac splits open for release of seeds for the wind to disperse. Indehiscent is a seed sac that does not split by itself, for example a nut or grain.
Seed
This is the fertilized, mature ovule and the origin of a new plant. Seed parts include an outer protective husk, an inner layer called the endoderm, inner germ that contains the embryo, a proto root and the cotyledon, the one or two proto leaves that become the seedling on germination. An aromatic example includes fennel, cardamom, coriander and cumin (pictured below and pine to the right).

Where Do We Find the Oil in the Plant?

Well that depends on the species! These wonderful aromatic substances are formed and stored in certain organs of the plant. As to why some plants produce these aromatic compounds, science hasn’t completely figured that out as yet. So far as we know, aromatic compounds are not essential for primary metabolism like photosynthesis.

Microscopic investigation of plant structures gives us clues as to the relationship between the oils and plant life. We still don’t know exactly what role the essential oils play in the life of plants but these pictures will give you stunning insights into the secret life of plants. Electron microscopy (SEM) allowed high magnification. Since SEM is incapable of recording color, all images produced using this method were manually enhanced using computer techniques.

The following pictures are taken from an article in HerbalGram, “a Closer Look,” 53:34-43, 2001. This article used images and text excerpted and adapted from Secretory Structures of Aromatic and Medicinal Plants: A Review and Atlas of Micrographs by Katerina and Tomas Svoboda, and Andrew D.Syred.

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What’s In a Name?

**Glandular Cells, Glandular Hairs,** and **Glandular Scales** are single or multi-cell protuberances, or ‘pockets,’ on the surface of the plant’s epidermis. This is true for all plants in the Lamiaceae family. Examples of plants in this family storing oil in this way include thyme, marjoram, rosemary, oregano, mint, and sage. Pictured to the left is a glandular trichome* x390 of **Lavandula angustifolia.**

*A trichome is a modified glandular hair and can be found covering leaves, stems and even parts of flowers in many of the Lamiaceae family. This is a secretory trichome x278 of **Mentha piperita.**

A secretory trichome x780 of **Origanum vulgare.**

(These three photos are from the photo library of www.Microscopix.co.uk )

(The following photos are from the photo library of www.psmicrographs.co.uk/science-images/flowers-and-plants

**Rosmarinus officinalis**

**Salvia sclarea**

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Hyssopus officinalis

Origanum majorana

Melissa officinalis

Salvia officinalis

Thymus vulgaris, CT Thymol
Epidermal Cells and Resin Cells—Aromatic compounds originate here and then diffuse through the plant. Essential oil yield is very low in these plants. Examples include the Laurel family (Lauraceae) and can be found in Laurel, cinnamon and cassia and also in plants like rose, jasmine, acacia. Pictured here is the oil glands of the dried petal of clove magnified 607 times. Other plants include rose, jasmine and acacia (Yield of essential oil is very low in these species.)

Oil or resin Canals—The oil here is stored in intercellular spaces in the plant tissues. They form tubular canals or ducts. Essential oils formed in this way will be found in the fruits of the Apiaceae family and include examples like caraway, aniseed, fennel, coriander and celery, in the Asteraceae and include chamomile, and the Pinaceae family including pine. Conifers actually have large resin canals. Huge quantities of resin can be extracted from a damaged tree. And, some resins are gathered by “tapping” such as copaiba. Pictured to the right is the upper leaf surface of Roman chamomile with sessile secretory glands and non-secretory trichomes x417.

Oil Reservoirs—These are secretory reservoirs or cavities formed inside a plant as a secondary cavity formation and are more or less spherical structures. These oil reservoirs are in the Rutaceae family (Citrus varieties) like lemon, orange and bergamot; also found in the Burseraceae family like frankincense, myrrh and elemi and in Myrtaceae family specifically, the eucalyptus trees. They are also found in the flower buds of cloves.

Pictured above is a rhizome of ginger showing oil globules within the membrane of its secretory cell magnified 2,149 times.

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Wildcrafting Plants

Plants from which we get our essential oils can be “wildcrafted” or cultivated. Wildcrafting refers to plants that are gathered in the wild and that have self-sown themselves from the wind blowing the seeds or animals eating the plants and then dispersing the seeds. Wildcrafting can also refer to how we gather the oil from trees that naturally occur in nature such as the Palo Santo trees found in South America or the frankincense trees in Oman, Somalia and Yemen. The problem with wildcrafting is adequate knowledge of the gatherers. For many centuries, traditional knowledge gained over time told them when to gather a particular plant. There are other factors to be considered: altitude, water, soil, etc. Because of various inconsistencies, growers have come to the conclusion that cultivating some varieties will produce a more consistent chemistry in the oils. To the right is a picture of a ylang ylang field of young trees cultivated in Ecuador.

Cultivation and Harvesting Techniques

Growers must know their plants. When cultivating, growers are able to control for adequate watering, soil improvement (not chemical fertilizers or pesticides though), and depending on where the plant is grown, harvest a plant that has less exposure to pollution from rain and winds. Pictured to the left are worms! They provide natural fertilizer enabling growers to go “green” and “organic” without the use of man-made chemistry.
These growers are able to do small quantity testing to see when the plant should be harvested. For instance, in *Lavandula angustifolia*, you want the amount of linalyl acetate and linalool to be at a certain level before harvesting in order to get the best quality oil. Testing make be everyday for a week before the percents are just right for harvesting. Another example is *Mentha piperita*. It will produce a greater yield if harvested when the flowers are just at the budding stage. Yet another example is *Salvia officinalis*. It contains more α-thujone after flowering than before the flowers come on the plant. Each plant has to be known by the grower—its chemistry, time of harvesting, need for water, type of soil, altitude, etc. in order to produce a quality therapeutic grade oil.

If you examine growers around the world, traditional extraction has been done on a small scale by artisans committed to the craft. For many plants, distillation needs to take place at the site where the plants are grown and harvested since many plants must go into the “cooker” (distiller) within a short period of time and cannot wait for days when travel is involved. This is particularly true for leaves and flowers. However for seeds, roots and barks, the material can stand some storage. This is particularly true for frankincense. In Oman they are now able for the first time to distill frankincense oil within their borders.

Since the majority of essential oils are extracted to meet the standards of the food and perfume or cosmetic industries, there isn’t the same care taken in the distillation process as needed for medicinal or therapeutic grade oils. For the food and perfume industry, it is a commonly accepted practice to add synthetic compounds when the chemistry of the oil is off or when a particular molecule is removed and sold off because it brings a higher price. However for aromatherapy, this is totally unacceptable. Here we need the whole oil with nothing extracted and nothing added to it.

**Testing for Quality, Purity and Therapeutic Value**

*Gas chromatography* and *mass spectrometry* are the two state of the art methods of testing for quality, purity and therapeutic value of an oil. The French
have set the standards known as ISO (International Standards Organization), AFNOR (Association French Normalization Organization Regulation) and EC (European Community). The problem with these standards is that they are not set for every oil leaving the user of essential oils to wonder why some oils have these standards printed on the bottles while other oils from the same company do not have these standards on the labels. Some would assume that the company produces some oils that meet the standards and others that do not when that is not the case at all.

One North American company which owns 5 GC machines and a GC-mass spectrometry machine has set the standard even higher for “therapeutic grade” essential oils and is now putting “YLTG” as the standard on their labels. They are setting the bar very high for all their growers who know that if their oil does not meet the YLTG standard, it will be sent back. This company test every single batch of essential oils—no exclusions.

**Gas Chromatography**

Analyzing an essential oil by gas chromatography is a very complex process. The machine needs to be calibrated to the French standards or else you can’t compare apples to apples. What a GC graph looks like is a series of spikes indicating the percents of each constituent compound found in the oil. It does have its limitations though—a GC can’t always tell the difference between a natural chemical from a synthetic one. Adding a chiral column to the GC can help in distinguishing between synthetic and natural oils. However, it takes a chemist to be able to properly read a gas chromatograph chart.

**Mass Spectrometry or GC-MS**

As the molecules emerge from the GC column they are fractured by bombarding them with electrons. The spectrometer identifies each component by the pattern that is produced. Sound confusing? Not if you are a trained chemist. If a sample has been adulterated by addition of a synthetic or a cheaper natural constituent, it can be detected because the
structural pattern will be different. Pictured at left is the laboratory for Young Living. Below are drums of essential oils from around the world awaiting GC-MS testing before being accepted for bottling. Do other companies do similar testing? Yes—but not all of them. I recommend that you always check.
Summary

Aromatherapy is more than just beautiful scents. The essential oils used in therapeutic or medicinal aromatherapy are living substances from hundreds of different plant species, each with its own characteristics, chemistries, scents and purposes. Herbal medicine has been around for a very long time and is still practiced in many parts of the world as the primary system of healing. Modern science often validates what our ancestors instinctively knew about the healing power of plants. Although we may be a bit closer to understanding how plants work on the body, we are no closer to understanding what makes a plant work. Actually most of what we know about plant medicines came through the plants themselves. “They have an innate ability to communicate with people” says Rosemary Gladstar, founder of the California School of Herbal Studies and author of *Family Herbal*, 2001.

Through the centuries we have called them Wise Women healers, midwives, medicine women, green witches, herbalists, healers, botanists and keepers of the green. Traditionally, these herb gatherers asked permission from the plant before harvesting it for medicine. It was a gesture of respect but also done to make sure the healing ability was retained in the plant.

Taxonomy is the science of identifying all these plants by family, genus and species and botany is the science of plants.

Understanding how plants and humans interact will give you an understanding of their healing abilities. Knowing how a plant is formed, how it functions, and why and how it creates essential oils will bring you closer to the essence of the plant. Plant life is necessary for our very survival. Likewise, we are in a position as humanity to preserve what is in nature since the natural balance in nature can so easily be upset through our actions.

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Bibliography


Also please visit: [http://www.microscopix.co.uk](http://www.microscopix.co.uk) to view pictures of secretory trichomes on the surface of plants producing essential oils.

[www.psmicrographs.co.uk/science-images/flowers-and-plants](http://www.psmicrographs.co.uk/science-images/flowers-and-plants)

These are high quality scanning electron micrographs (SEMs) and photo micrographs.

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