Topic 27. Botany on Campus

In this activity we wish to relate botany to what can be observed on a typical spring day.

I. Morphology of a Woody Twig (this is review from topic 1)

Ia. The Apple (*Malus)* twig. Carefully study a twig for the first few minutes of the period. Consider the following questions:

1. The twig is encased in a water-proof, air-tight covering (the periderm). What observable structure functions to allow gas exchange to the underlying living tissue?

2. Based on your observation of the dormant twig, are the leaves arranged in an opposite or alternate fashion?

3. Botanically, what are the bud scales?

4. Without looking at the cross section of the stem determine how many years growth is represented by your twig.

Note the spur shoots. In apple, flower buds are typically born on these stubby branches. The flower buds contain the preformed flower shoot. While outside, please observe the pattern of flowering of the crab apple trees.

Ib. The Basswood (*Tilia*) Twig. Carefully consider the top-most bud. Is it a terminal bud?

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How can you tell? _____

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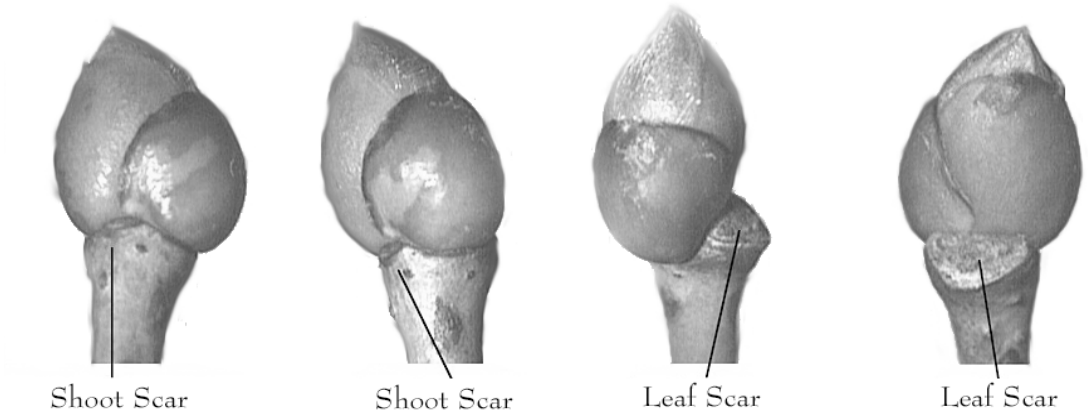
The terminal bud of basswood and of many other trees abort along with part of the young shoot in the spring. In these species a lateral bud develops that takes over the roll of the apical bud. This axillary bud is termed a pseudoterminal bud.

Pseudo-terminal Bud of *Tilia*



II. Early Growth of Tree Buds

Tree buds of temperate species are more than an undifferentiated apical meristem. Typically, buds consist of an apical meristem surrounded by leaf primordia. In the bud, the internodes are telescoped to create a tight compact miniature shoot. Some buds have bud scales and others do not. Some buds have preformed flower primordia. Early growth in the spring involves the rapid growth of plant organs formed in the bud during the preceding summer.

Observe the examples of early twig growth of hickory, horse chestnut and box elder. When outside note the various stages of growth of the woody plants in the table below.

	Dormant	Swelling	Elongating	Flowering
Apple				
Ash				
Basswood				
Buckthorn				
Cherry				
Elm				
Hackberry				
Hickory				
Honeysuckle				
Ginkgo				
Oak				
Viburnum				

III. Flowers

Dandelions: Take a head of, pull it apart and observe individual flowers. Identify the stigma, anthers, corolla, calyx, and ovary. These are composites like th emarigold studied last lab.

Asexual Life Cycle: Dandelion is a disturbance species. It is dependent on plowing, mowing, fire or some other disturbance to reproduce. *Taraxacum oficinale* is a perennial native to Europe. Some populations, including all the plants in North America, are triploid and do not reproduce sexually. These asexual plant reproduce through apomixis where the embryo in each seed is a clone of the mother plant. Both diploid and triploid populations exist in Europe.

Consider other flowers you find outside inthe table below:

	Complete	Incomplete	Monoecious	Dioecious
Amelanchier				
Birch				
Box elder				
Forsythia				
Magnolia				
Norway Maple				
Ribes				
Sugar Maple				
Willow				

IV. Conifers

Cedar - *Juniperus*: This conifer is the source of the fragrant red wood used in hope chests. This time of year microsporangiate cones and last year's ovuliferous cones are both obvious. He seed scales are fleshy and the whole cone is fruit-like. Bird's eat these cones and scatter the seeds after passage through their digestive systems. These cones are used to flavor gin.

Douglas fir: *Pseudotsuga*: This is a species native to the Pacific Northwest. It is unusual in that its sterile bracts are visible in the mature cone.

Hemlock - *Tsuga*: Hemlock grows outside of Birge Hall. This is a conifer native to Wisconsin. It isn't poisonous. Deer find it so delicious that its reproduction n northern Wisconsin is near zero.

Japanese Larch - *Larix*: Note that the leaves are deciduous and that the leaves are clustered on spur shoots. Also note the male and female cones borne on the same tree.

Japanese Yew - *Taxus*: Note the microsporangiate cones and the ovules borne alone on stalks. This family is different from other conifers in that it does not have a compound ovulate cone, and that the microsporangiate and megasporangiate structures are segregated on different plants.

Norway Spruce - *Picea*: This non-native species of spruce has huge cones. It is distinctive both ny its large cones and by its drooping branches.
Pine - *Pinus:* Mugo pine is a European species commonly planted on campus. While height varies widely, some individuals remain well below four feet. New growth in the spring is associated with the emergence of both clusters of male cones and the solitary female cones

White Cedar - *Thuja*: This is a native species found in eastern swamps. Note the microsporangiate and megasporangiate cones.

V. Some Potpourri of Natural History.

Dawn Redwood *(Metasequoia glyptostroboides)*: We have one tree behind the greenhouse, and fossils are out in the room. This species was first described from the fossil record by a Japanese paleontologist in 1941. In 1944, a grove of living trees was discovered by a Chinese forester. The species was not properly described as a new species until 1948. Also in that year, the Arnold Arboretum at Harvard conducted an expedition to collect seeds. This has resulted in the commercial distribution of *Metasequoi*a all around the world. Three fossil species have been described, and *Metasequoia* included environmentally significant species in the past, both in Asia and North America. The plants developed from the materials collected in 1948 are highly inbred.

***Ginkgo*:** Fossil ginkgoes date back to the Permian. Fossils are out in the room and we have living trees in the garden. Ginkgoes were common in the flora of both Asia and North America through the Mesozoic. The fossils found in the northern hemisphere during the Cenozoic are indistinguishable from *Ginkgo biloba*. It is possible that this is the exact same species represented by these fossils. The identified surviving trees are genetically uniform, and probably exist only due to the planting and tending done by Buddhist monks over the last 1000 years. Trees are either male or female and, since the ovules are considered gross, seedling roots are grafted on to known male scions. We have male and female trees in the garden though they are mostly dormant, you will find leaves and ovules on the ground.

Newton Apple Tree: In our garden, we have the same variety of apple Isaac Newton observed in the 17th century in his. Apples do not breed true. Like ginkgoes, commercial nurseries graft known genetic varieties onto either seedling roots, or, more commonly, on to clonal root stocks with recognized properties of dwarfing, anchorage and disease resistance. Grafting has been done since before

the days of the Roman republic, which means that apple varieties can be thousands of years old, and, potentially, immortal. This clone is at least 400 years old, and when we bite into one of these apples we share in the same experience Newton experienced (assuming he actually ate what he saw drop). A chapter in *The Botany of Desire* by Michael Pollan, presents an interesting story about how apple varieties suited to North American conditions came about. The varieties commonly grown in Europe are not really suited to the climate in North America. Johnnie Appleseed (John Chapman) really existed. He walked the American frontier (this was in Ohio in 1806) staking out land, and planted apple nurseries of seedling trees. He was vehemently opposed to grafting. Over his life he planted hundreds of thousands of genetically unique seedling trees. Those that thrived and were flavorful were preserved through grafting. So we owe this eccentric man a debt of thanks for Northern Spy, Baldwin, Red Delicious, Gold Delicious, Red Rome and many more varieties which we grow here in North America.

Dutch Elm Disease: The American elms on Bascom hill are relics of a bygone era. This is so because of two closely related ascomycete species, *Ophiostoma ulmi* and *O. novo-ulmi*. Both are pathogens of elm. The latter is the more aggressive of the two. The disease was introduced during the 1920s on diseased logs of European elm. The fungus clogs up the tracheary elements of the tree. Resistance is variable between species, and also between individuals within species, but individuals of American elm are highly susceptible. American elm was widely planted as a street tree. The impact of the disease seems to have accelerated through the 1970's probably reflecting the introduction of the more aggressive species. This has resulted in dramatic changes in the urban landscape of these large trees have succumbed to the disease. Dutch Elm Disease is spread by elm bark beetles, and, once introduced to a stand, by root grafts. The trees on Bascom Hill survive only due to a drastic treatment involving injection of fungicides into the trees every three years.

Emerald Ash Borer: One of the most common genera on campus, particularly in Bascom Woods is *Fraxinus* (ash). It seems that all the trees in this genus are all doomed due to the emerald ash borer. This beetle was first discovered in Michigan in 2002. Our native species have absolutely no resistance to this pest. The adults lay eggs in the bark and the grubs burrow all through the inner bark eventually girdling the tree. At this time there is no realistic scenario where any untreated American species of ash will survive. Please relate this to what happened to the American chestnut (a story we will related to you Saturday), and to American Elm. When we see populations of major tree species crashing, this should trigger alarm bells that something is seriously unbalanced in our woodland ecosystems.

About the large thorns of honeylocust, and who dispersed the fruit of osage orange : At the back of Birge are two osage orange trees. These bear a large multiple fruit that is dispersed by horses. Remember, in 1492 there were no horses in North America. However, horses evolved in North America, migrated to Eurasia, and later became extinct on this continent. By 1492 osage orange was reduced to a small population in Oklahoma. With the reintroduction of horses, these fruits are now well dispersed. This was also facilitated by extensive planting by people who use osage orange as hedges. A similar story can be

related about honey locust. These trees bear legumes that are like tamarind in that the flesh next to the seed is sweet and fleshy. However, these are high in the tree and nothing seems to eat the fruit anymore. One clue to the past are the large thorns found on the bark. These are huge. On theory is that they evolved to protect the beak from mammoths that reached up with their trunks to harvest the fruit. Honey locusts that are planted as street trees are bred to be thornless. A wonderful example of a wild-type tree can be seen in the woods to the north of lot 34.