

A Detailed Syllabus for the Lectures in Plant Biology 109, Field Botany, at the University of Vermont, as offered in the summer

I. Introductory Lecture

- A. The nature of systematics, including taxonomy, phylogeny, and speciation
- B. Comparative biology as a discipline; systematics is dependent on remote inference.

II. Morphology of Flowering Plants

- A. Vegetative Features, with emphasis on identifying stable (critical) characters useful in identification of flowering-plant families
 - 1. a survey of the features of the node, of patterns of leaf shape and dissection, and of habit --- all with homology and transformation as a theme, looking forward to inferring phylogenies.
 - 2. non-structural vegetative features of flowers (latex and latex contents e.g. alkaloids and glycosides, essential oils) with the integrated themes of ecological functions of the compounds, medicinal value, and utility in identification

B. Reproductive Features

- 1. The flower as reproductive shoot, including similarities and differences from vegetative shoots and the general functions of floral organs
- 2. The homology of floral organs, with special attention to the reproductive organs and fine focus on the gynoecium (consideration of carpels in the context of the fossil record and developmental features of the organs).
- 3. Critical (i.e. slowly evolving and useful in family identification) characters of flowers, i.e. number, fusion, and symmetry, with an introduction to floral meristems as part of the presentation on fusion and mention of the distribution of fundamental numbers across the flowering plants. This portion proceeds with the critical characters of each standard floral whorl as the theme.

Perianth

calyx (sepals) and corolla (petals): number, symmetry, and fusion --- with a substantial introduction to all three fundamental characters

- i. number: broad stability and most common numbers, i.e. 5,3,4
- ii. symmetry: radial and bilateral with attention to the two relevant variables, organ shape and distance between organs in a whorl
- iii. fusion, with an introduction to the idea, a description of the floral meristem and how it builds a calyx/corolla tube with separate lobes

Reproductive Parts

androecium: number and fusion remain important, but symmetry of the stamen group is a labile character

number: it's the number of stamens relative to the number of petals (or sepals) that is a useful character here, often stable across large groups of families

fusion: two kinds of fusion are prominent: connation (fusion of the members of a whorl) versus adnation, the commonest example of which is stamens adnate to petals

other stamen topics:

the disc, a nectar-secreting structure, is probably a transformed whorl of stamens based on position in the flower (usually to the inside of the true stamens)

stamen dehiscence, slit or poricidal, involves the merging of locules into thecae, then the opening of the thecae to the environment

hypanthium: a cup, tube, or saucer to which sepals, petals, and maybe stamens are attached --- homology to either fused perianth and filaments or to expanded receptacle is possible

gynoecium: fusion and number, an integrated approach considering both number and fusion at once --- including detective characters, to be used in deciding whether the flowers with single pistils have simple or compound pistils (if there is more than one pistil in a flower, they are all simple).

Placentation types. Origin of the carpel.

4. Reproductive biology, with special attention to anther dehiscence, interactions between stigma and style and the pollen, and development of seed and fruit
5. Inflorescence variation with attention to determinate vs. indeterminate growth
Basic inflorescence types: determinate including raceme, spike, umbel, head, and indeterminate -- the cyme
6. Fruit variation with attention to the ecology of fruit and seed dispersal, with special attention to active and passive animal dispersal
Fruit Types: fleshy (including berries and drupes) and dry, both indehiscent (achenes, nuts, and samaras) and dehiscent (follicles, capsules, schizocarps, and legumes)

C. Pollination Biology

1. Introduction to the major ecological themes: promotion of outcrossing (or selfing) and the efficiency of pollen use (change in pollen/ovule ratio) with special attention to precise placement on vectors
2. Survey of pollination syndromes, focusing on sphinx moth, hummingbird, and bumblebee, but also including bat, carrion insect, wind, and water

III. Taxonomy

- A. Early History including non-western classifications, herbals, and the renaissance
- B. Linnaeus
- C. Elements of Valid Species
- D. The type concept and the morphological species concept
- E. Species as hypotheses, changes in species circumscription, synonyms, and authorities for binomials
- F. Herbaria, kinds of types

IV. Classification

- A. The ancient and non-European systems
- B. Linnaeus's sexual system
- C. The De Jussieu, the garden at Versailles, and the beginnings of a natural system
- D. Bessey's recasting of the natural system in the light of fossil evidence and the

- explicit representation of characters and transformations
- E. Cronquist brings new characters (chemical and anatomical) to the Besseyan system.
 - F. The Angiosperm Phylogeny Group classification: review of major groups:
 1. basal groups
 2. magnoliids
 3. monocots
 4. tricolpates and eudicots
 5. rosids
 6. asterids

V. Phylogeny

- A. Characters and Taxonomic Groups
- B. Homology and Synapomorphy based on outgroup comparison
- C. Parsimony, an assumption about experimental approach, not about evolution
- D. Building a phylogenetic tree using selected Asterid families encountered in the course

VI. Speciation

- A. the general process of divergence and isolation
- B. examples providing insight into divergence and isolation
 1. Guerrant's larkspurs and rapid character divergence under natural selection
 2. Rollins's local divergence in leavenworthias under different environments
 3. Galen's sky pilots: disruptive selection yields races successful in different environments
 4. Schmitz's beachpeas and geographic centers of origin, post-glacial migration and divergence
 5. Whitten's columbines: rapid transformation between pollination syndromes and isolation.

The Practical Portion of the Curriculum for Plant Biology 109, Field Botany, at the University of Vermont, as offered in the summer

Daily work with living plants encountered in the natural areas surrounding Burlington, Vermont, focuses on

1. demonstration of critical characters useful for the identification of flowering plant families
2. recognition of prominent families in the flora of Vermont
3. significance of selected plants to the biogeography and conservation biology of the flora of the Burlington area, especially as relates to the Holocene of the Lake Champlain Basin.
4. observations of pollination biology, especially relating to
 - a. promotion of outcrossing
 - b. pollen economy, especially relating to precise placement of pollen
 - c. pollination syndromes