BOTANY

Presentation for Rivanna Master Naturalists April 4, 2017

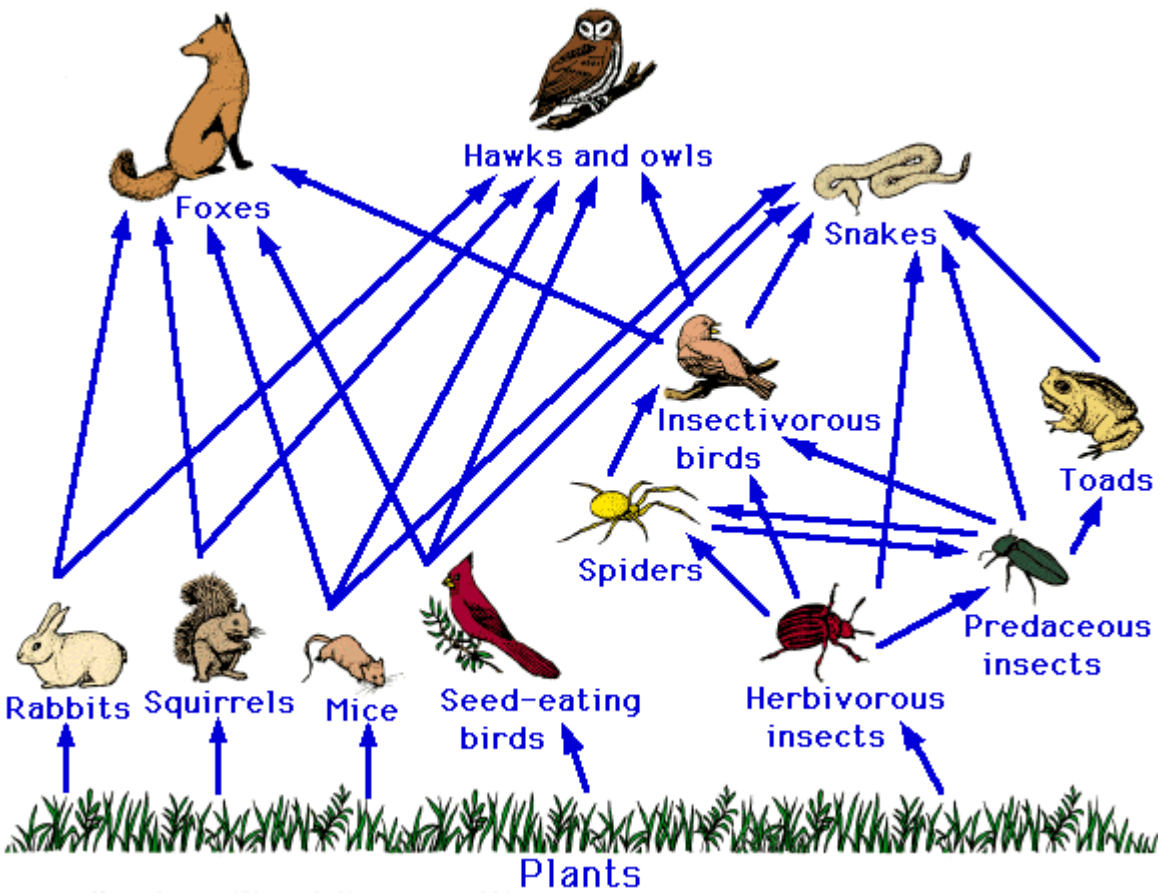
Road map for presentation

- Why study plants?
- Recap from previous sessions
- Wildflower Identification: Lara Gastinger
- Plant structures and functions
- Plants in the environment
- “Plants are cool”
- Current issues

KINGDOM PLANTAE

WHY STUDY PLANTS?

Basis for nearly all food webs



Used to characterize most ecosystems

Attractive to us though we are not pollinators

Photo by Tony Russell

In short, because we NEED them

- Oxygen
- Food
- Clothing
- Shelter

RECAP OF EARLIER PRESENTATIONS

- Ecology: plants primary producers
- Forestry and tree ID; forest communities
- Geology: evolution and geologic time; soil formed from rocks;
- Soils: plants adapted to various soils with varying chemical composition
- Climate: impact on plants: temperature, moisture, etc.

Kingdom Plantae 400,000 species

- Non-vascular: Bryophytes: mosses, liverworts, hornworts

- Vascular (specialized tissue that conducts water, minerals, sugars) 3100+ species in VA
    a. Seedless: ferns, club mosses horse tails
    b. Seed plants
    c. 3100+ species in VA

Non-vascular: Moss (and Moss Mantis)

Vascular, seedless: Fern

Vascular, seedless: Club moss

Seed plants

- Gymnosperms Naked seeds: gingko, conifers,

- Angiosperms: covered seeds
  - Monocotyledons: ex: corn
  - Dicotyledons: radishes, beans, beech trees

Gingko tree

Conifer: white pine

Seed plants

Angiosperms: Covered seeds: flowering plants

- Monocots: one seed leaf (corn)

-Dicots: two seed leaves (radishes, beans)

Parts of an Angiosperm Plant

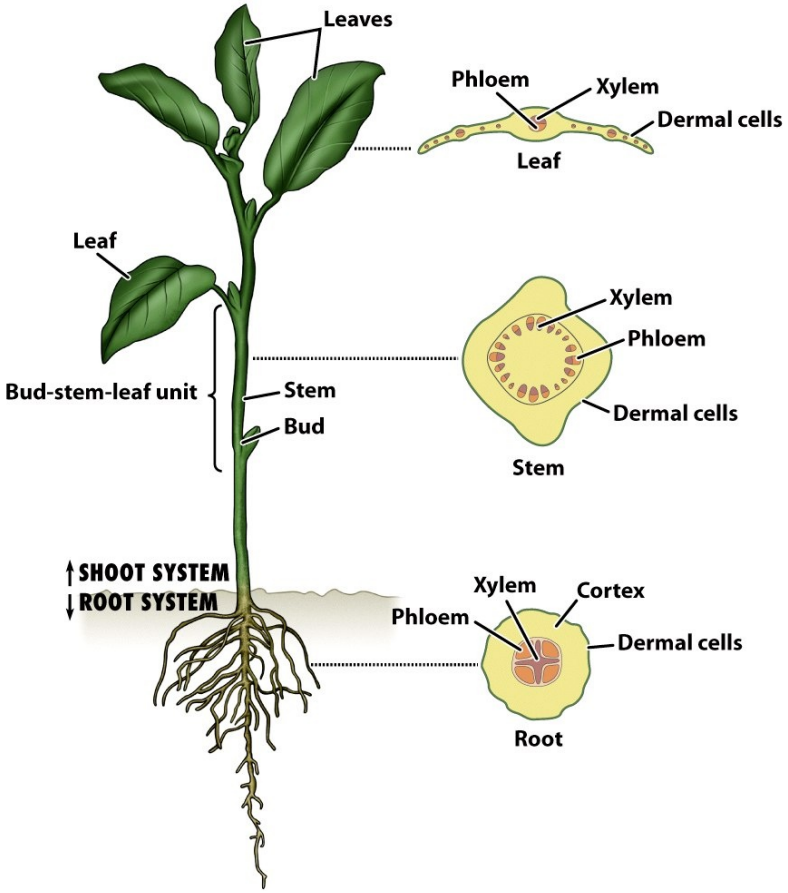


Figure 31-2 Discover Biology 3/e

Section through leaf

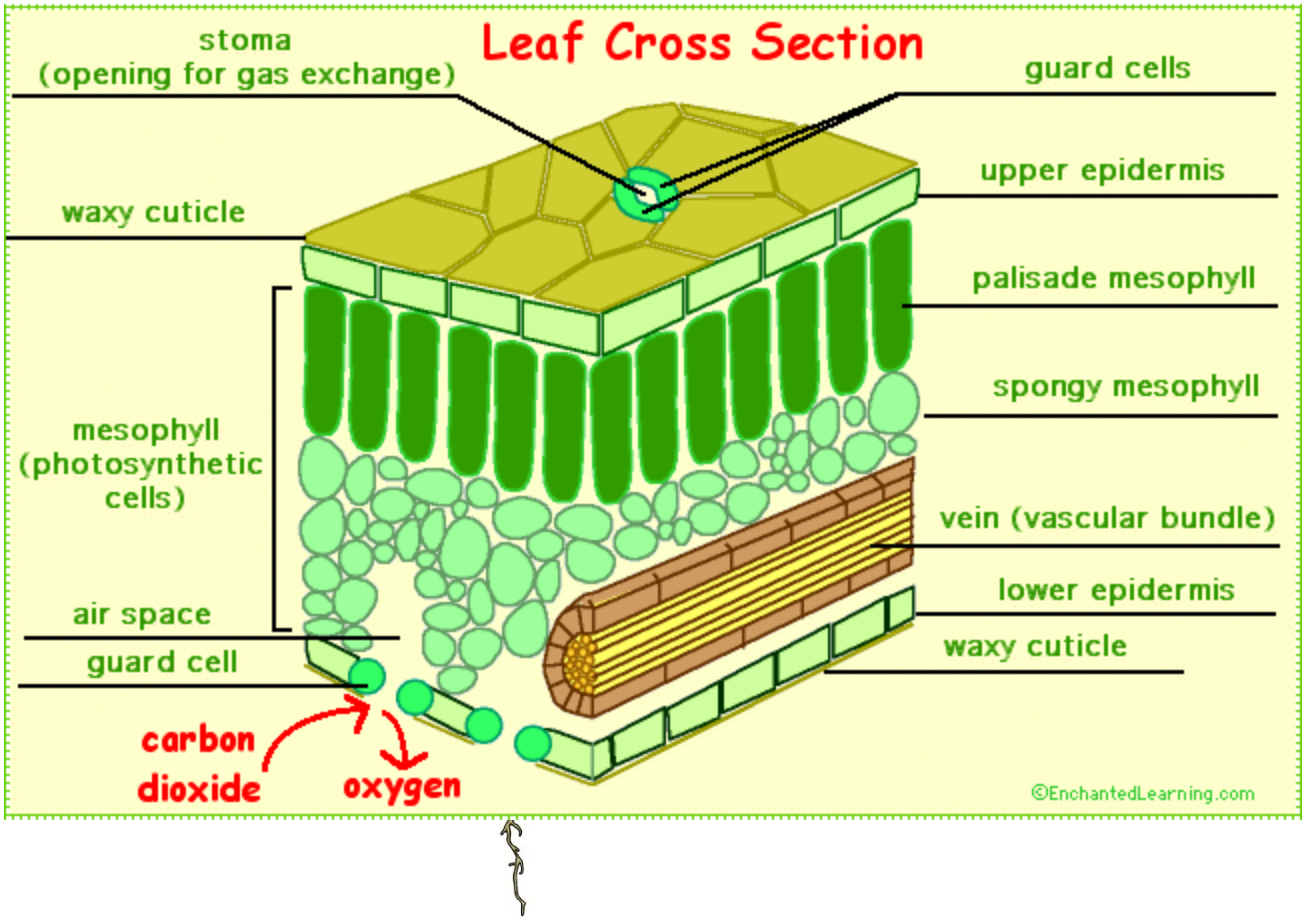
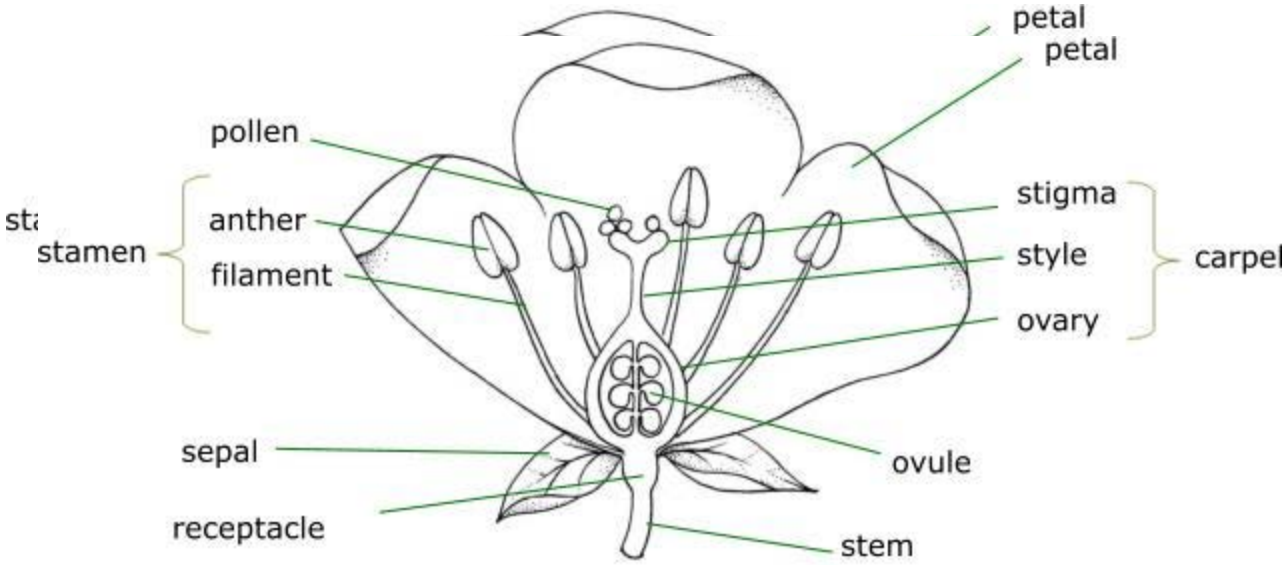


Figure 31-2 Discover Biology 3/e

Flowers

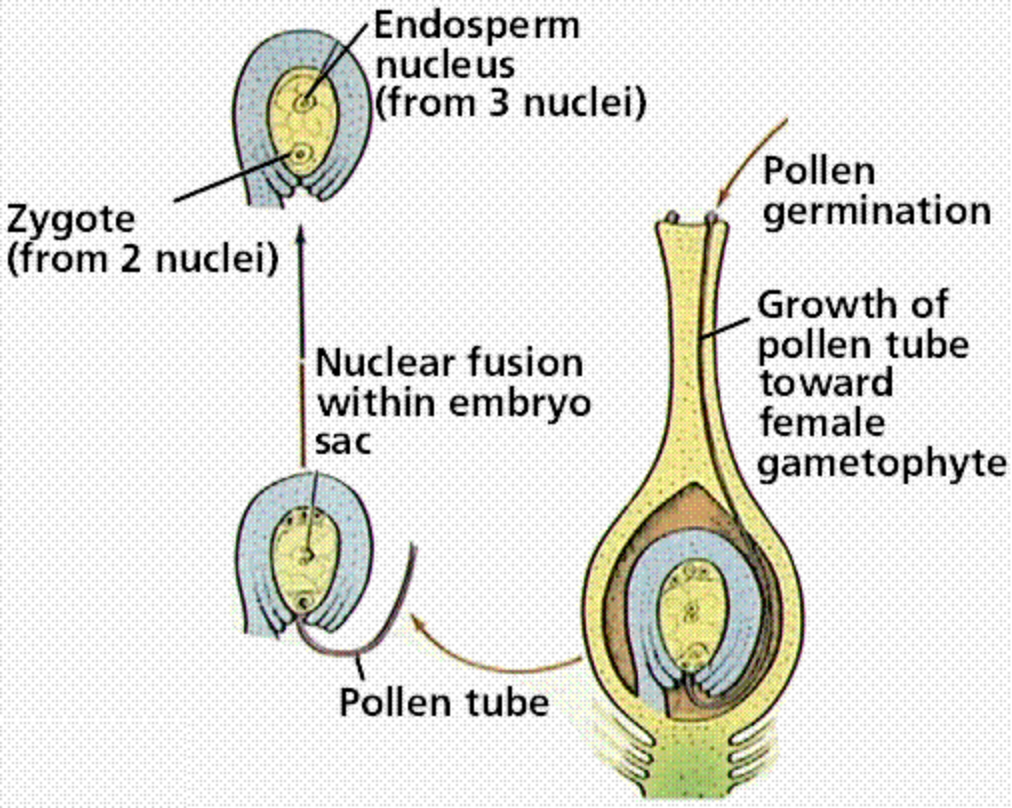
- Petals or not: depends on method of pollination, wind or animals. Petals attract pollinators but hinder wind pollination. Wind requires huge amounts of pollen


petal
petal
pollen
sta
stamen
anther
filament
stigma
style
ovary
carpel
sepal
ovule
receptacle
stem

POLLINATORS

- Andrena bee pollinating Spring beauty

Pollen grain germination: sperm cells migrate down tube to ovary, merge with egg: fertilization



SEED DISPERSAL

- Seeds contain embryo and food
- Offspring moved away from parent preventing competition
- Wind: light seeds, usually associated with structure to aid wind: orchids, composites
- Animals: cling to fur, fruit to eat
- Explosive dispersal: Touch-me-not/jewel weed

Explosive seed dispersal:
Jewel weed/touch-me-not

DANDELION SEEDS

BLOWIN’ IN THE WIND

“Hitchhiker” seeds

PLANT PHYSIOLOGY

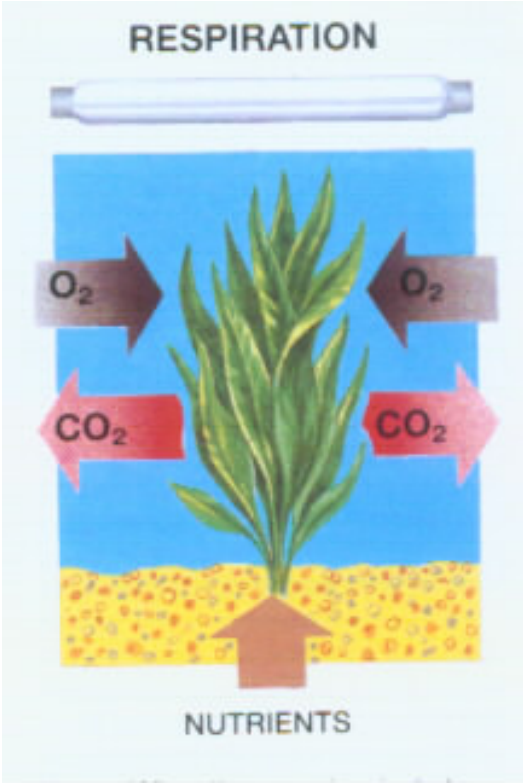
Physiology: getting and using energy

- All living things require energy to maintain life
- Energy released by metabolism of food (sugar, etc.) cellular respiration
- Green plants make, then use, their own food
- Plants without chlorophyll (such as parasites like Dodder) must acquire and digest food
- (Animals consume and digest food)

Plant and animal respiration: same basic process, including enzymes:

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$

sugar + oxygen-→ carbon dioxide + water+ energy



Photosynthesis requires light energy, chlorophyll (green) and many enzymes

- Light + $6CO_2 + 6H_2O$ ------> $C_6H_{12}O_6 + 6O_2$
- Carbon dioxide + water ---→ sugar + oxygen
  - » chlorophyll

PLANT MOVEMENTS

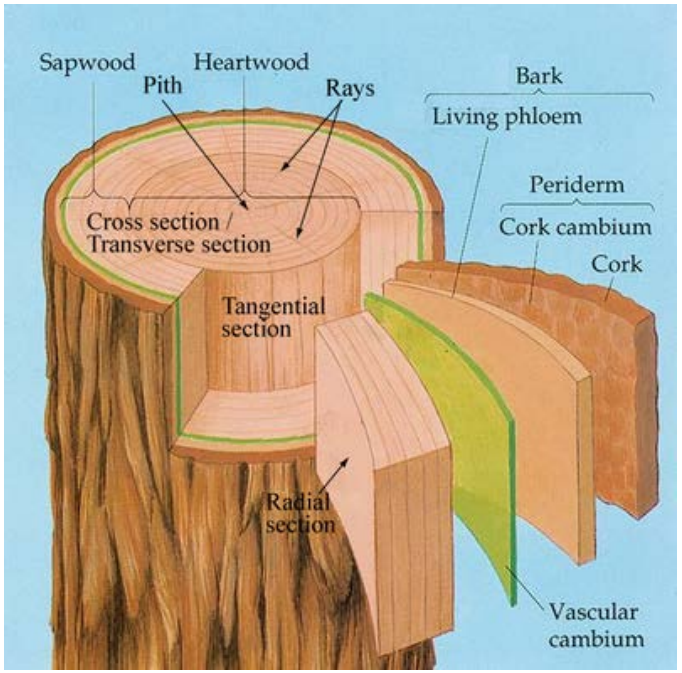
- All movement by plants is through growth via plant hormones (ex. gravity) or turgor (water) pressure changes: slow or fast
- Slow: folding of leaves of sensitive plant, Mimosa
- Fast: Venus fly trap

NUTRIENT PROCUREMENT
Roots and Mycorrhizae (fungal roots)

- Roots absorb water and dissolved minerals
- Mycorrhizal fungi associate with plant roots for exchange of nutrients and food: fungi need sugars from plants; plants need water and minerals from fungi

PLANT GROWTH

- Meristems: source of new cells for plant; somewhat like stem cells in animals
- In woody plants vascular cambium (green) produces xylem and phloem.
- Tends to be indeterminate:
- Ex. Tomato plants



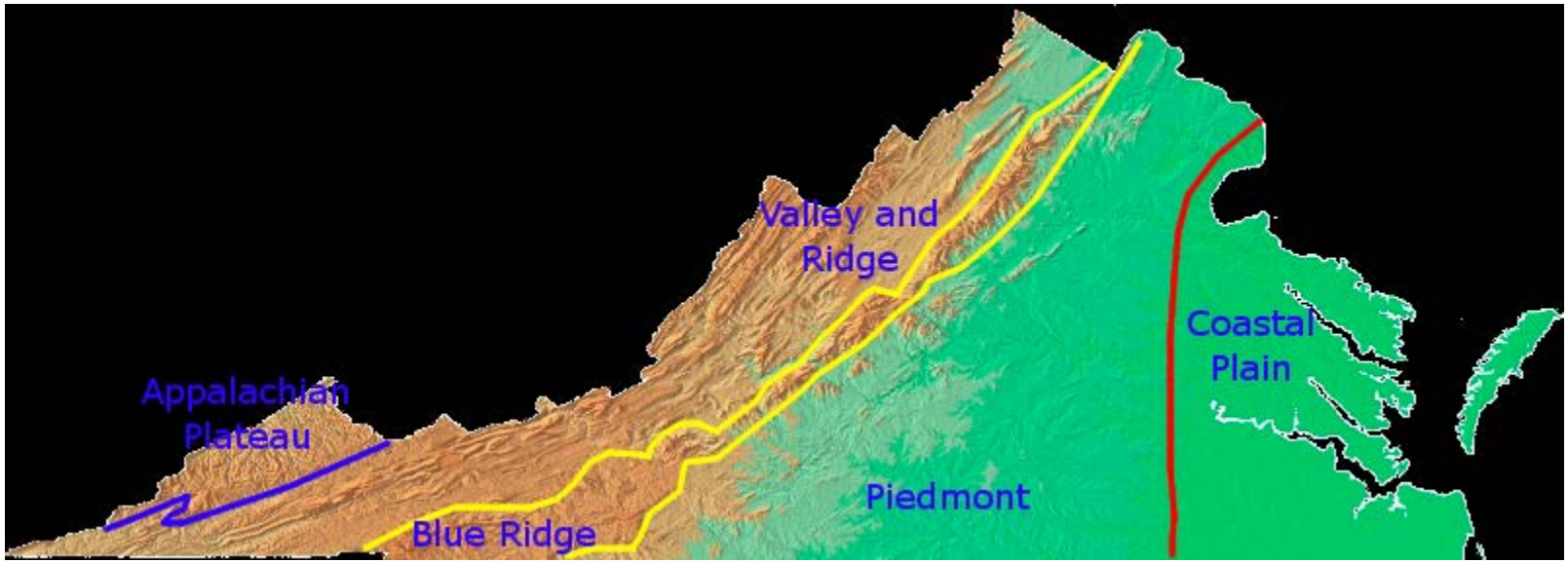
PHLOEM AND XYLEM

- Transport structures in vascular plants
- Xylem: dead cells: water transport from roots to stems and leaves
- Phloem: living cells transport sugars throughout the plant from leaves
- Water conservation: stomata open and close

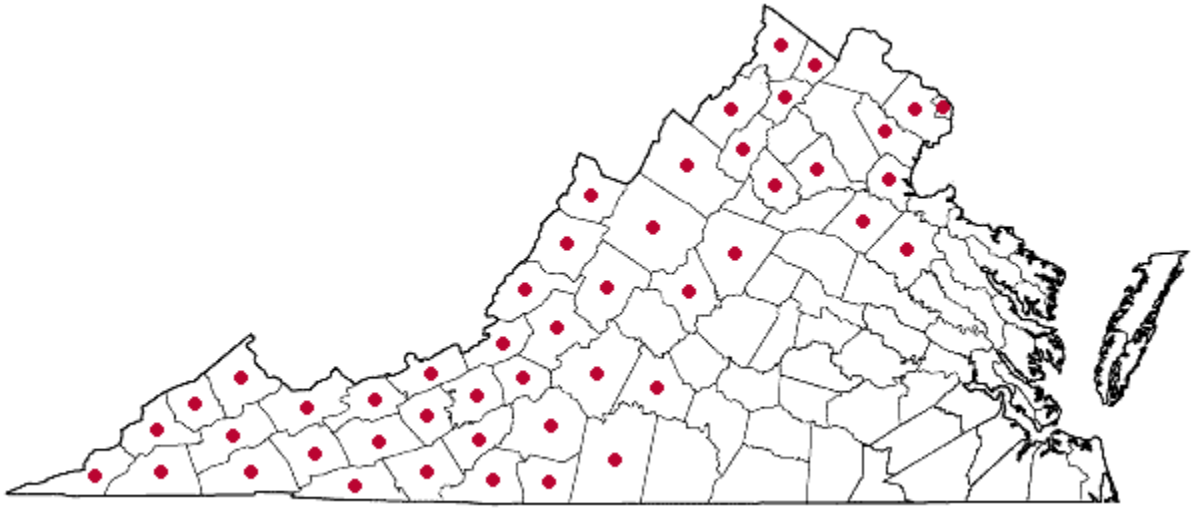
Plant distribution in Virginia

- Plants often limited to certain habitats by such factors as temperature/elevation, soil type/ underlying rock, moisture availability, plant hardiness
- Ex. Physiographic provinces in Virginia

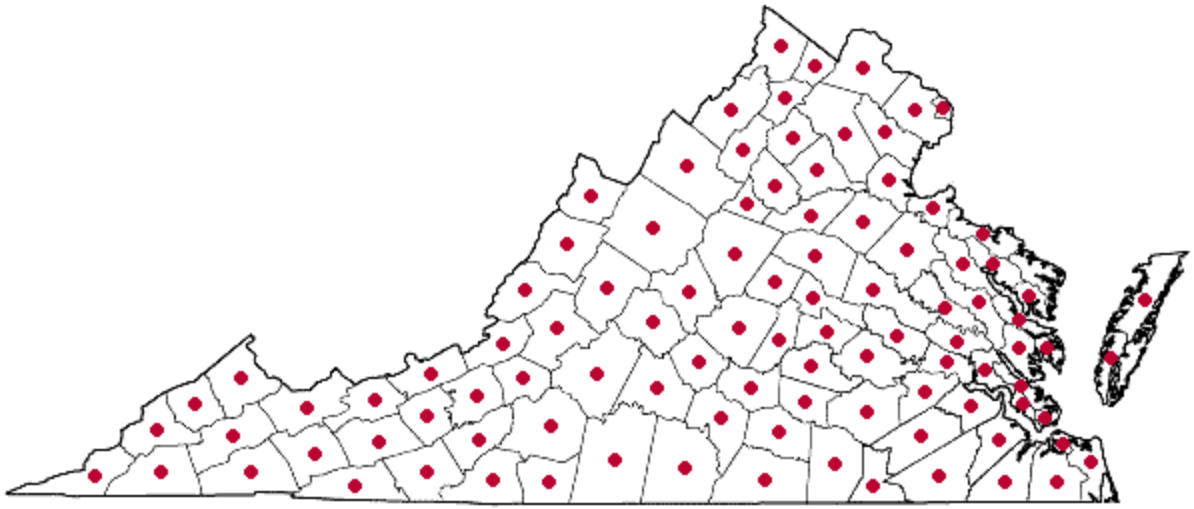
PHYSIOGRAPHIC PROVINCES IN VIRGINIA



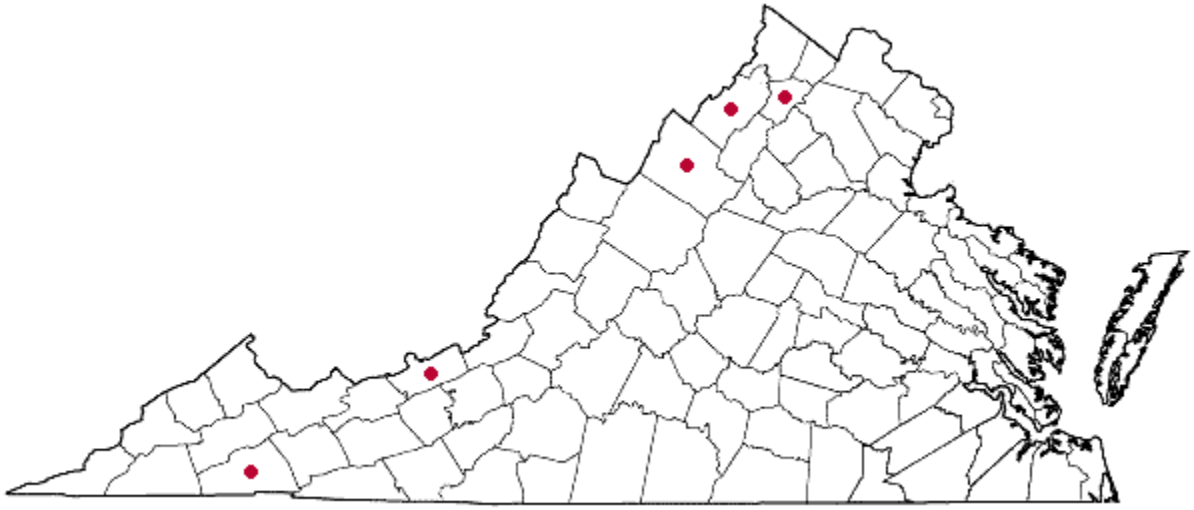
Virginia Digital Atlas:
distribution of Rhododendron maximum by county



Virginia Digital Atlas
distribution of Glechoma hederacea
(ground ivy) by county



Virginia Digital Atlas: distribution of Cypripedium reginae (showy lady slipper) by county



Plant Communities in Virginia: The work of the DCR and DNH

- DCR: Department of Conservation and Recreation
- DNH: Division of Natural Heritage (in DCR)
- "The Natural Communities of Virginia Classification of Ecological Community Groups"
- http://www.dcr.virginia.gov/natural-heritage/natural-communities/ncintro

- “As part of its work, the DCR-DNH maintains database information on the status, distribution, and ecology of rare native species and all natural communities; protects and manages these resources through a system of natural area preserves; and provides information and technical advice to other agencies, organizations, and individuals”.

- “We believe that by identifying and protecting excellent examples of all natural community types in Virginia, the majority of our native plant and animal species, including many cryptic and poorly known ones, can be protected without redundant individual attention”.

- “The Natural Communities of Virginia Classification of Ecological Community Groups”
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Riverine Forest: Field Trip

- Kricher, Eastern Forests: review Northern and Southern Riverine Forests
- Many spring ephemerals, our focus
- Trees include Sycamore, Ash, Red Maple, Box-elder, Hackberry, American hornbeam (musclewood, ironwood)
- Rich soil, renewed by flooding: silt, sand, organic material

“Strategy” of Spring Ephemerals

- Underground storage organs
- Green plant emerges very early in spring
- Rapid growth, flowering, and seed production
- Many die back after flowering “ephemeral”: ex. Spring beauty, Bluebells, Trout lilies
- Many have eliasome, attached to seed that ants are attracted to, remove seed to their nest

Spring ephemeral

Spring beauty

- PLANTS ARE COOL

Coevolution of plants and animals

long proboscis of butterflies can reach in flowers with long throat

Hummingbird sipping nectar: long bill and tongue

Plant adaptations to extreme environments: cactus/desert

Nitrogen metabolism

- Plants need N-compounds to sustain life.
- May take them up as N-compounds dissolved in water taken up by roots
- Some plants including legumes, have evolved mutualistic relationships between bacteria that can fix N and themselves. Bacteria housed in nodules of roots

Nitrogen metabolism
N-fixing bacteria in nodules of legume

Plants as parasites

- Dodder, mistletoe, beechdrops, Indian pipe

Allelopathy

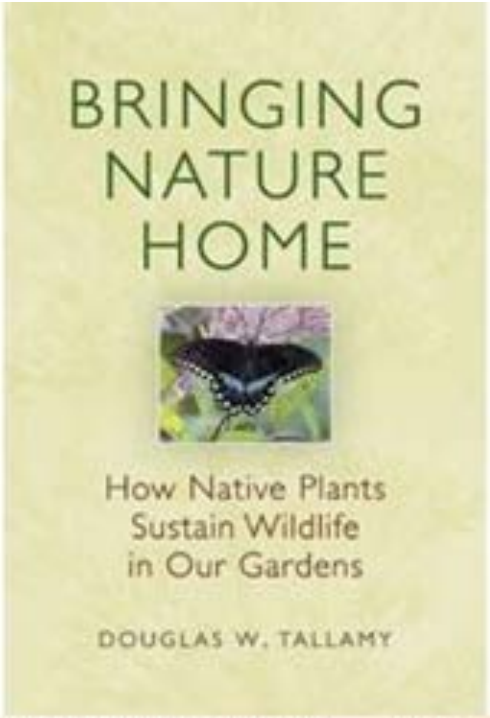
- Dictionary: “the chemical inhibition of one plant (or other organism) by another, due to the release into the environment of substances acting as germination or growth inhibitors.” Ex: Black walnut, Garlic mustard

CURRENT ISSUES WITH PLANTS

- Habitat destruction: huge areas paved or otherwise degraded
- Invasive alien plants and animals: killing and damaging individual native plants, and causing landscape-scale damage
- Pollinator declines, especially insect pollinators
- Over collection: ginseng, black cohosh, orchids, etc.
- Declines in native plants lead to declines in caterpillars, which are food for birds

Doug Tallamy: “Bringing Nature Home

Dr. Doug Tallamy, Professor and Chair Dept. of Entomology and Wildlife Ecology University of Delaware



"There is an unbreakable link between native plant species and native wildlife — native insects cannot, or will not, eat alien plants. When native plants disappear, the insects disappear, impoverishing the food source for birds and other animals." Doug Tallamy

http://bringingnaturehome.net

Xerces Society (protection of invertebrates)

Further Information: Publications

Published in February 2011

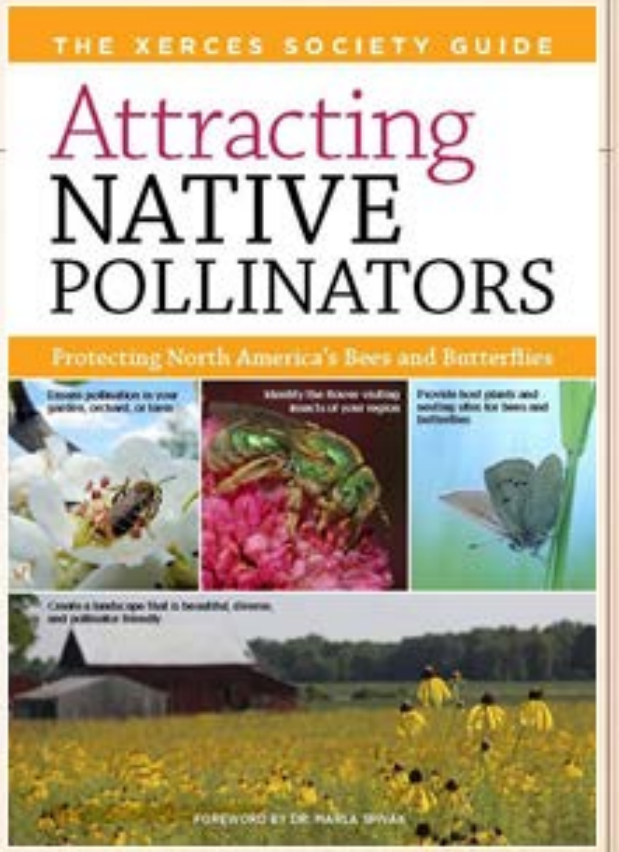
"*Attracting Native Pollinators* belongs on the bookshelf of everyone who values the future of the natural world."

- Douglas W. Tallamy, researcher and author of *Bringing Nature Home*

"Precise, elegant and thoughtful, the recommendations offered by the Xerces Society will become essential to advancing a healthy and diverse food production system."

- Gary Nabhan, author of *The Forgotten Pollinators* and *Renewing America's Food Traditions*

www.xerces.org/store



Selected RMN projects with plant ID as component

- Plant surveys: the Plant Team: Ivy Creek Natural Area, Preddy Creek Park, Old Mills Trail, Ragged Mt. Natural Area; important in assessing the ecological value of various areas
- Removal of invasive plants
- Re-location of rare plants in Virginia (VMN)
- Invasive plant education; Blue Ridge PRISM
- Native plant stewardship

The Plant Team at Preddy Creek field

Modern botany

- Taxonomy, Cladistics, and DNA sequencing
  - Plant families revised, etc.

Herbaria

- Repository for plants in a designated area, or not…
- ICNA has a small herbarium
- Of late, have been threatened