Botany for Gardeners

Heather Stoven

Why Botany?

- Botany = study of plants!
- Background for many principles you will be learning
  - Plant ID
  - Pruning
  - Propagation
  - Plant growth and processes
- It is fun to learn!

Today's Topics

- Survey of plants and relevant non-plants
- Anatomy of plants
  - Leaves
  - Stems
  - Flowers
- Vascular system
- Photosynthesis, respiration and transpiration
- Plant hormones

What is a plant?

- In the kingdom Plantae
- Generally..
  - Make their own food
  - Chlorophyll a & b
  - Multicellular
  - Cell walls made of cellulose
  - Limited motility

Volvox

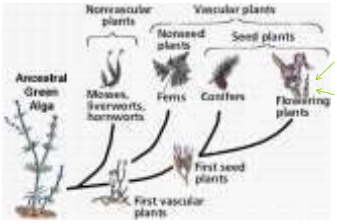
Indian pipe

Variation in plants

Photos: Linda McMahon

Kingdom Classification

A tour of the plant kingdom…



Separated into monocots and eudicots

Not Shown: Fungi, certain algae

Algae

- Some types of algae (green algae) are classified as plants others are not

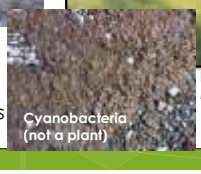


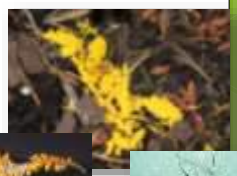
Photo: Linda McMahan

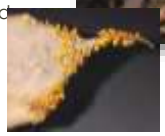
Not Plants but important…

OSU disease clinic

Slime Molds

- Slime molds are primitive single cell organisms that travel together as a crowd
- Occur on moist soil, lawns, stumps and mulch
- Not deleterious to plants





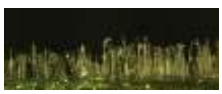
Photos: Linda McMahan

Fungi

- Often see the fruiting body above ground
- Hyphae are strands of fungus
- Most of fungal organism is underground and unseen

Fungi

- Form spores
- Fungi are decomposers and some are pathogens
- Many have positive associations with plants



ucanr.edu

cals.ncsu.edu

Symbiosis

- relationships between species
- Mycorrhizae – between plants and fungus
- Lichen – between fungi and algae

Lichens

- Can live in extreme environments as epiphytes – arctic, deserts, rocky areas
- Long lived, slow growing, many 1mm/yr
- Vulnerable to environmental disturbance

Back to Plants…

Mosses

- Reproduce via spores
- Lack an extensive vascular system

Liverwort

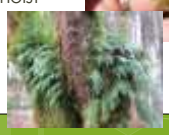
- A lot like mosses except more differentiated leaves or lobes

Horsetail

- Ancient plants – relatives were thick as forests and tall as trees
- Hollow stems and jointed
- Produce spores
- Have vascular system
- Stiff due to retention of silica

Ferns

- Reproduce via spores
- Have a vascular transport system
- Can be tree size
- Most need moist sites



Conifers

- Classified as gymnosperms – "naked seed"
- Produce cones
- Foliage is needles or scales
- In junipers, "berries" are female cones
- Most are evergreen, but some are deciduous
- Non-deciduous also shed needles each year

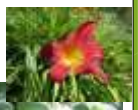
Flowering Plants

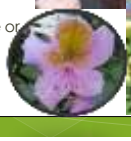
- Angiosperms – seeds enclosed
- Principle group of plants on earth
- Identifying structures
  - Leaves
  - Stems
  - Flowers
  - fruits

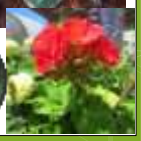
Plant identification

- Monocot vs. eudicot
- Leaf arrangement
- # petals
- Flower type
- Flower parts
- Fruit type
- Other
  - Hairs
  - thorns
  - sap

Eudicots vs. Monocots







- Monocots
  - Flower parts are in 3's, leaf veination parallel, one cotyledon
- Eudicots
  - Flowering parts typically multiples of 2, 4 or 5
  - Two cotyledons
  - Vein patterns palmate or pinnate

Monocots and Eudicots

- Plant families will be either monocots or eudicots
  - Monocot family examples:
    - Liliaceae
    - Iridaceae
    - Poaceae
  - Eudicot family examples:
    - Asteraceae
    - Brassicaceae
    - Roseaceae

Monocot or Eudicot

- Flowering parts?
- Veination?

Monocot or Eudicot

- Flowering parts?
- Veination?

Leaf structure

- Arrangement
  - Opposite/alternate/ whorled

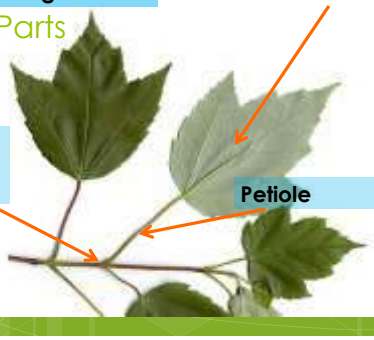
Note: Leaves have an **opposite arrangement**

Leaf Parts

Leaf blade

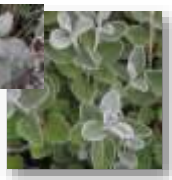
Node = place of attachment to the stem

Petiole



Leaf structure

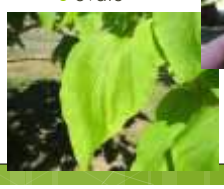
- Adaptations to the environment
  - Hairs
  - Wax
  - Trichomes



trichomes

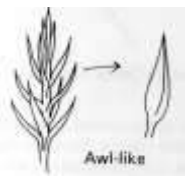
Leaf structure

- Shape
  - Chordate
  - Linear
  - ovate



Leaf structure

- shape

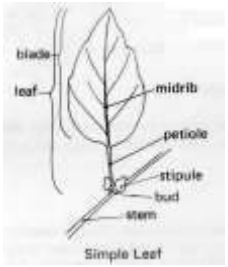


Leaf structure

- Leaf margins
  - Lobed
  - Dentate
  - Entire

Leaf structure

- Simple



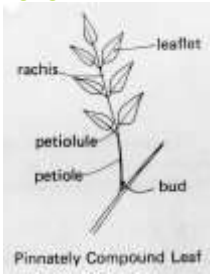
Leaf structure

- Simple

palmate

Leaf structure

- Compound



Leaf structure

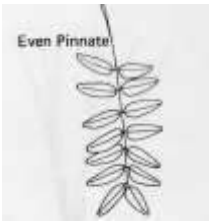
- Compound leaves

bipinnate

pinnate

palmate

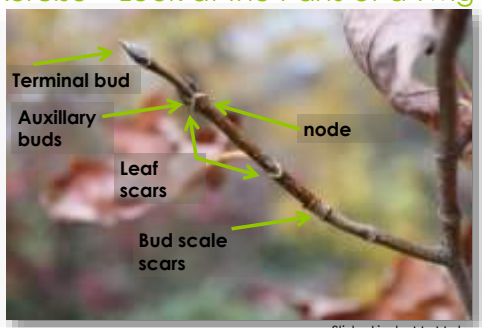
Leaf Structure



Stems

- Provide structure
- Parts of the stem: nodes and internodes

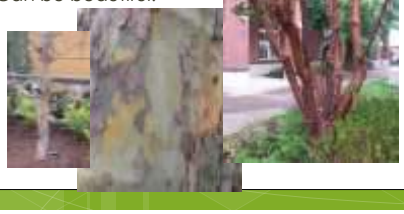
Exercise – Look at the Parts of a Twig



Slide: Linda McMahan

Bark

- Protects the tree's vital growing areas
- Can be beautiful!



Roots

- Anchor plants
- Absorb water and mineral nutrients
- Often stores food
- Can be reproductive
  - Adventitious roots, etc.
- Types of roots
  - Tap – anchorage, storage
  - Fibrous – shallow, cover large area

Tap root fibrous root

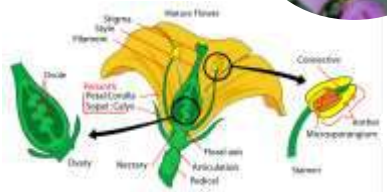
Roots

- Many "roots" are specialized stems
  - Tubers
  - Bulbs
  - Corms
  - Rhizomes

StudyPage.in

Flowers

- Contain reproductive structures



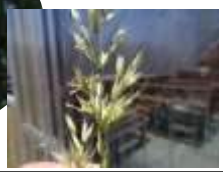
Flowers

- Petal number
- Regular (radial) vs. irregular (bilateral)
- Flower parts
- inflorescences



Flowers





Flowers

- Perfect
  - Has male and female parts
- Imperfect
  - Lacking parts
  - Called staminate or pistillate flowers

Staminate (L), Pistillate (R)

Flowers

- Imperfect flowers
  - Monoecious
    - Male (staminate) and female flowers (pistillate) on same plant
  - Dioecious
    - Male and female flowers not on same plant

Pumpkin flowers on same plant - monoecious

Skimmia - dioecious

Flowers – an example

- Flowers can be **complete** (has sepals, petals, stamens and pistils) or **incomplete** (missing one of above)
- Hydrangeas
  - An example of incomplete flowers
  - Contains sterile and fertile flowers
  - "petals" are really sepals (calyx)
  - Cluster of flowers called corymb (top photo)


Flowers – an example

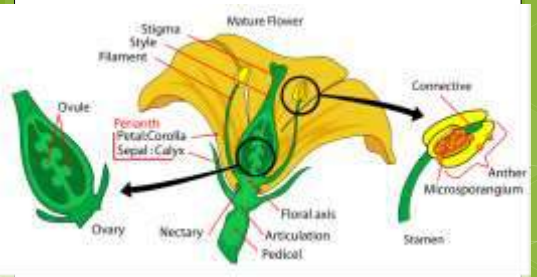
- Corn
  - An example of incomplete flowers
  - Plants are monecious
  - Imperfect - Staminate and pistillate flowers

Flowers

- Imperfect flowers are always incomplete but….
- Perfect flowers are not always complete but…
- Complete flowers are always perfect.



Exercise – Find the Parts of a Flower



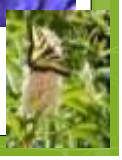
From wikipedia.org

Are your examples complete or incomplete? Perfect or imperfect? Monocot or Dicot?

Pollination and fertilization

- Methods – insects/animals, wind, rain, human
- Pollination vs. fertilization
- Incompatibility
  - Timing and genetics



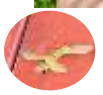


Pollination - an Example

- Hazelnuts
  - Pollination occurs in Jan-Feb
  - Fertilization takes place 4-5 mo. later
  - Hazelnuts are not self-compatible – need pollinizers
  - Wind pollinated

Fruits and berries

- Seeds are found in fruits
- Fruits provide protection and sometimes incentives for animal seed dispensers
- Seed dispersal is very important for the plant!


Fruits

- Types of fruits
  - Simple – one ovary
    - True berry
    - pomes
  - Aggregate – many ovaries
    - Blackberries, strawberries
  - Multiple- fusion of many flowers
    - Pineapples
- Fruits can be dry or fleshy

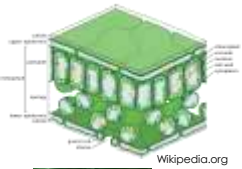
www.ag.arizona.edu


Physiology

- Leaves
- Stems
- Roots
- Photosynthesis
- Transpiration
- Respiration
- Plant hormones

Leaf structure

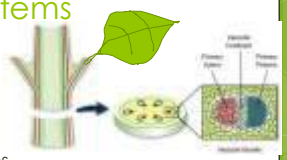
- Cellular structure and physiology
  - Epidermis
    - Adaptations – hairs, waxy cuticle
  - Mesophyll
    - Most photosynthesis takes place here



Wikipedia.org

Vascular Systems

- Xylem – water conducting tissue
- Phloem – photosynthate transport
- Cambium – divides to produce xylem and phloem in eudicots



Stems

- Cross section

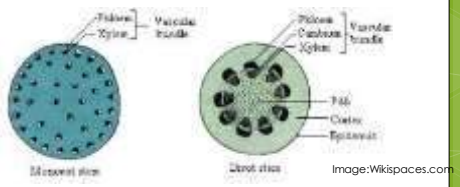
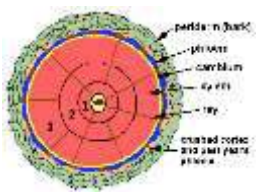


Image:Wikispaces.com

Only eudicots produce woody tissue, why?

Vascular structure also important for pest management and propagation

Stems: wood

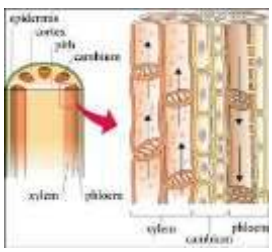


http://www.generalhorticulture.tamu.edu

Exercise: look for vascular bundles

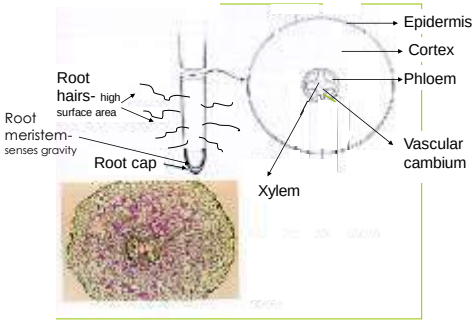
Stems

- Xylem – water conducting tissue
- Phloem – photosynthate transport
- Cambium – divides to produce xylem and phloem



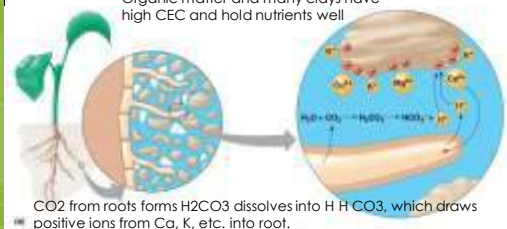
Boundless.com

Root Structure



Roots – Nutrient movement

Organic matter and many clays have high CEC and hold nutrients well



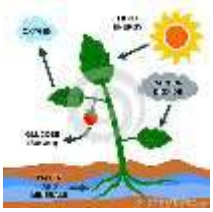
CO2 from roots forms H2CO3 dissolves into H H CO3, which draws positive ions from Ca, K, etc. into root.

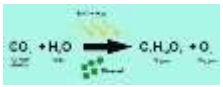
Photosynthesis

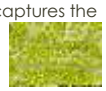
- Key to our life on earth!
- Plants make their own food
- Only plants do this

photosynthesis

- Plants are autotrophs!!!!!
- Carbon dioxide from atmosphere + water from soil + energy from sun = food for plant + oxygen
- Occurs in chloroplasts, where pigment chlorophyll captures the sun's energy



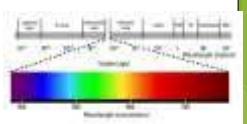


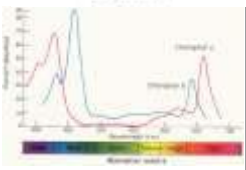


Photosynthesis

Factors affecting rate of photosynthesis

- Water availability
- Temperature
- Light
  - Plants able to use ≈ 40% of sunlight
  - Plants are green because they reflect green wavelengths!
  - Blue light = vegetative (fluorescent lights for seedlings)
  - Red & blue = flowering





What is Respiration?

- A process that <u>all</u> living things go through
- The process occurs during <u>both</u> day and night
- It is a "breaking down process"

The Process…

- Food made during photosynthesis (photosynthates) is broken down to generate energy
- This energy is used for plant growth and development
- For growth to occur photosynthesis must be greater than respiration

A Comparison

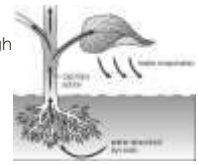
- Photosynthesis
  - produces food
  - stores energy
  - uses water
  - uses carbon dioxide
  - releases oxygen
  - occurs in sunlight
- Respiration
  - uses food
  - releases energy
  - produces water
  - produces carbon dioxide
  - uses oxygen
  - occurs in dark and light

What is Transpiration?

- Water loss (in vapor form) from a plant
- Transpiration rate is controlled by stomatal aperture, which is influenced by:
  - relative humidity
  - temperature
  - Light
- 95% of water lost through stomates
- Open when guard cells are turgid, closed when flaccid

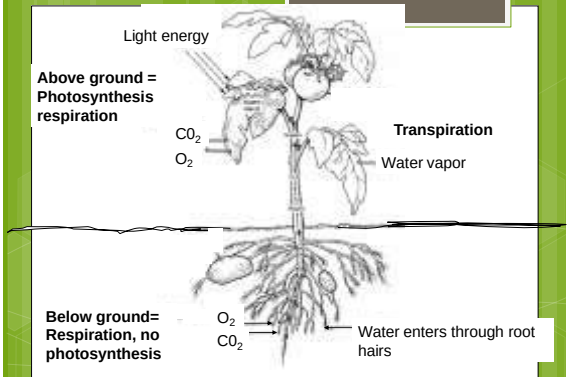
The Process…

- Water is taken up by roots, moved through the plant and then lost as vapor through stomata on the leaves
  - Helps cool plants
  - Helps move minerals through



To consider…

- Stomates need to be open for photosynthesis and releasing heat
- Transpiration is related to the environment
- Plants can be stressed and damaged especially:
  - Hot, windy
  - If ground is frozen (winter desiccation)
- Plants can adapt – smaller leaves, waxy cuticles, dormancy, different metabolic processes



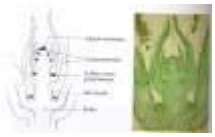
Plant hormones

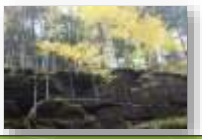
- Auxin
- Gibberellic Acid (GA)
- Cytokinin
- Ethylene
- Abscisic Acid (ABA)

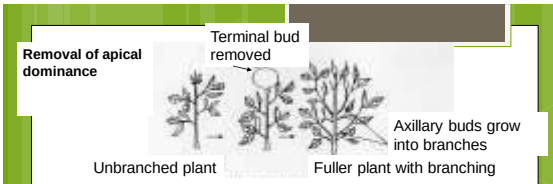
Nature.com

Auxin

- Apical dominance
  - High concentration in terminal bud
- Phototropism
- geotropism
- Synthetic auxins
  - IBA rooting hormones
  - 2,4-D herbicides







Gibberellic Acid

- Stimulates cell division and elongation - bolting
- Speeds germination
- Breaks seed dormancy

mullein

Cytokinin

- Stimulate cell division
  - Important in callus formation – used in tissue culture
- Delays senescence

Microplant Nursery

Ethylene

- Stress responses
  - Epinasty (leaves drooping downward)
  - Abscission (leaf drop)
- Promotes ripening and senescence

Abscisic Acid

- Considered the "stress hormone"
- Induces stomatal closure
- Abscission of leaves, fruits and flowers
- Induces dormancy
  - Prevents seeds from germinating

Conclusions

- Plants are very diverse, shaped by their adaptations to their environment
- Plants are our key to life on the planet
- Understanding how plants work is important for gardeners
  - Characteristics for identifying plants
  - Plant physiology for propagation, pruning, growing plants
- Use your new trained eyes to view the botanical world!

Resources

- OSU Woody plant ID system http://oregonstate.edu/dept/ldplants/plant_ident/
- OSU Landscape plant information:
  - http://oregonstate.edu/dept/ldplants/
- Botany in a Day - Elpel
- Botany for Gardeners - Capon
- Oregon Flora Project app
- Science News Daily: Botany
  - http://www.sciencedaily.com/news/plants_animals/botany/

Questions?