**Conifers & Allies**

(=Gymnosperms)

760 sp of gymnosperms

Conifers originated 370 MY ago and dominated the landscape for 250 MY

today less than 800 species survive

their decline coincided with the origin and diversification of flowering plants

today conifers are relegated to generally harsh habitats that are too cold or dry from most other plants

include cycads, ginkgoes, pine, spruce, fir, bald cypress, cedar, junipers, gnetophytes

by far the most abundant gymnosperms are the conifers

conifers are the dominant trees in the northernmost forests of the world

conifers group contains some of the world's largest life forms

**General Characteristics of Conifers & allies:**

1. have much more efficient vascular tissue than ferns allowing for more complex roots, stems & leaves

   makes them generally stronger and more resilient and resistant to drying

   a few related species are vines and herbaceous plants

3. most conifer leaves are simple, leathery needles or scales with thick waxy cuticle

   shaped to survive dry conditions (eg snow)

   a low surface/volume ratio

   a less exposure to extremes of environment, easier to conserve water

   often the stomata are sunken below the surface

   a reduces amount of water evaporation due to wind

4. nearly all conifers are evergreen:

   each leaf lives 2-14 years and falls off individually

   bristlecone pine needles can live 20-30 years

   can carry out photosynthesis even in winter to some degree

   in spring they can increase photosynthesis immediately (don't have to grow new leaves)

   a few are deciduous, eg: dawn redwood, larch, bald cypress

5. many conifers produce resin

   = viscous, clear organic substance

   a sticky to touch

   resin is produced in resin ducts

   a tube-like cavities that extend throughout roots, stems and leaves

   resin is aromatic and has antiseptic properties

   inhibits fungi

   deters insect attacks

   amber is fossilized resin

6. No longer produce asexual spores

   no asexual reproductive organs

   Sexual reproduction becomes the main means of reproduction

7. sexual reproductive organs are cones

   most conifers are monoecious (hermaphrodites) with separate male and female cones in different locations of same plant

   female cone: much larger than male cone; not terminal

   a stems (trunks) can grow larger, taller

   a root system can grow much deeper and extend over a wider area

   conifers group contains

   a. one of world's most massive organisms: "General Sherman" giant sequoia - California

      272' (81.6m) tall

      79' girth; >25' diameter

   b. world's tallest organism: Coastal Redwood

      385' (117m) tall

   most conifers have micorrhizal relationship with local fungi

2. nearly all are perennial trees & shrubs

   Plants that live more than one year, ie. perennials, produce secondary growth each year.

   a produce strong permanent woody tissue

   Conifers and flowering plants are the only major plant groups that have woody, perennial species

   The bark replaces the epidermis for protection of the stem in large woody plants.
In early spring the **ovulate or seed cone** begins to develop.

Takes 2 years to develop

female cones produces **ovule** with **egg**

**male cone**: terminal on short branches; ~ half inch long or less

most conifers have male cones that produce **pollen** with **sperm**

**Pollen grains** are carried by **wind** to female cone → cedar fever

no longer requires water for sexual reproduction

8. earliest living group to commonly produce **seeds**

[seeds actually first arose in a now extinct plant group called the 'seed ferns']

seed replaces the spore as the main means of reproduction & dispersal

→seed is much more effective, and resistant to drying

once egg is fertilized, **ovule** develops into **seed**

**seed** = embryonic plant

**Ecological Importance of Conifers & Allies:**

1. conifers are the predominant trees in 35% of the world’s forests

   esp northernmost forests of the world

   short growing season

   water is frozen for much of the year

   → not available to plant

   many conifers have adapted to these “dry” conditions

2. they play an essential **ecological role:**
   a. dominant species in some terrestrial ecosystems

      eg. spruce fir forests, boreal forests, pine forests, redwood forests
   b. provide food and shelter for other organisms
   c. roots hold soil in place and reduce soil erosion
   d. watersheds – absorb hold and slowly release water and help control flooding
   e. important part of biogeochemical cycles

3. cycads are a small group of shrubs native to tropical regions

4. Ginkgo’s (maidenhair trees) are example of a

unlike spore which is a single cell, seed already has an embryonic root, stem and leaf

plus **stored food supply** for germination,

surrounded by protective **seed coat**

in non-seed plants, the embryo develops from the fertilized egg in the archegonium and immediately grows to maturity

in seed plants the embryo reaches a certain size, goes dormant, and becomes an important means of dispersal

in nonseed plants the **asexual spore** is the primary means of dispersal

seeds allowed plants to colonize a much wider range of environments than ferns

conifers are one of a group of plants called gymnosperms or **“naked seeds”**

the seeds are not produced inside a flower and fruit

→they are exposed usually on a cone

eg. some cycad cones weigh up to 100 lbs

a few conifers produce seeds in fleshy, waxy “berries” which are the modified seed coats

eg. juniper berries
‘living fossil’

- Ginkgo is oldest known living genus and species of tree
  - fossil up to 210 MY old, nearly identical to today’s plants
  - one of few deciduous conifers; dioecious, unusual fan shaped leaves
  - widespread in Mesozoic (300-100MY ago), has remained unchanged for last 150 M years
  - only known as fossils and thought was extinct until rediscovered in Japanese and Chinese Monastery gardens
  - no known "natural" stands
  - since rediscovery, has spread rapidly in the past 200 years esp in parks and gardens
  - (hardy & air pollution tolerant)
  - female trees produce seeds in fleshy berry-like mass
  - at maturity the flesh rots
    - extremely offensive odor
    - same chemicals as in rancid butter and rancid cheese
  - the seed is considered a prized delicacy in China and Japan
  - has a fishy taste

Human Impacts of Conifers & Allies

1. Lumber

- worldwide, humans use over 3 Billion cubic meters of wood (=0.6m$^3$/person/yr)
  - in US most of that harvest (~80%) of timber crop is from conifers:
    a. framing lumber house construction
    - also used for flooring, some furniture, paneling and telephone poles
    b. plywood – 2 or more veneers glued together
    - strong, light weight,
    - less likely to split than solid wood
    c. fiberboard from pulp
    d. particle board from chips
    e. particle board from chips
    f. also used to make crates, boxes, matchsticks and pencils
    g. specialty woods from conifers
      - eg. cedar
      - lots of resin → resists rotting

- eg. fences, shingles, pencils
  - eg. red spruce
    - high resonant qualities, softwood, easy to work, light in relation to its strength and stiffness
    - eg. violins, pianos, ladder rails, canoe paddles, oars
  - eg. redwood
    - resistant to decay
    - eg. outdoor furniture and decks
  - eg. white pine
    - softwood, soft, uniform texture and straight grain; cuts easily in every direction; polishes well and warps or swells little
    - eg. widely used in home construction
    - eg. virtually everything from masts and matches to boxes and crates
  - eg. baldcypress
    - weather resistant without treatment
    - eg. cross ties in early days of RR,
  - eg. hemlock
    - relatively soft, light straight grained, resin-free wood, uniformly long fibers

- eg. plywood boxes, barrels, concrete forms

2. Paper products

- 90% of wood pulp for paper comes from conifers
  - US: 44 M tons/yr of paper (newsprint & others)

3. Industrial chemicals from conifer woods

- natural dyes; eg hemlock bark- red to orange
  - a. resin (pitch) is extracted mostly from conifers by tapping the trunk or extracting it from wood chips or pulp.
  - This resin can be further separated into volatiles and a waxy rosin
  - the resin itself has been used in the past to:
    - waterproof wooden boats
    - coat the inside of crockery to store wine and other liquids
    - resin is also added to a specialty Greek wine, described as an "acquired taste"
  - fossil resin = amber (some also from flowering plant species)
    - often contains pollen grains and insects
    - useful in learning about ancient ecosystems and evolution
-**volatile**s (from distillation of resins) are used to make:

- varnish
- canada balsam for making microscope slides

-**Rosin** is the residue that remains after distillation of resin.

- >1M tonnes produced /yr, ~ half produced in US.
- used to make:
  - violin rosin
  - adhesives
  - chewing gum
  - printing ink
  - rubber compounds
  - paper sizing
  - surface coatings

b. Essential Oils

- Cedar oils or cedarwood oils
- some of these oils are natural pesticides
- some oil extracts are used in perfumes

c. Industrial Chemicals

- eg. **turpentine** – from pine trees used as a solvent especially in oil based paints and varnishes
- eg. **tannin** – chemical extracted from bark of tree, used in tanning leather

eg. The greatest number of pine species that produce edible seeds are found in North America, especially SW US.
- pine nuts mainly from pinyon pines; 1-3 M kg/yr in SW US
  - pinyon nuts were an early and essential staple food for Native Americans of the SW US
- eg. pinyon nuts are also made into flower and soup
- eg. Juniper berries are ground into a spice used in sausages and for flavoring wild game; it is the only "spice" extracted from conifers
- eg. Ginkgo seeds are considered a prized delicacy in China and Japan

5. **Pharmaceuticals & Herbal Treatments**

- the bark of some conifers is used as traditional medicines by indigenous peoples in Canada, California, India

- the needles of some species were used to make a tea used to prevent scurvy

- **taxol** from bark of yew -anticancer drug

- **ephrine** from related member of conifer group, *Ephedra*, a desert shrub, used in many pharmaceuticals for treating asthma, hay fever, allergies, colds, etc

- **ephrine** is also a heart stimulant and raises blood pressure derivative also used to make methampetamines
- its also sold as a nutriceutical (herbal remedy) for weight loss but can be dangerous
  - most have not been scientifically tested for their claims; a few have:
    - eg. **ephrine**
  - the dried plant itself used as a tea is hyped as a weight loss treatment
  - scientific studies have found that it can be dangerous and has caused several deaths
  - can cause irregular heartbeats, heart attacks, stroke, seizures and psychoses (known in herbal world as "herbal ecstasy" because it has some of the effects of the street drug "ecstasy"
    - only recently taken off the market
  - eg. **Ginkgo biloba** → claim it helps memory marketed to Alzheimer’s patients and elderly
    - no significant effects on memory

6. **Landscaping & Ornamentals**

- pine, spruce and fir trees
- cycads, ginkgos
- arborvitae, norfolk island pine
- as mulch; pine “straw” and pine bark mulch

7. **Christmas trees**

   first use in the 1500’s when they were decorated with colored paper, fruits and sweets to celebrate Christmas. Were introduced into the US in early 1800’s

   over 35 M trees are harvested in US each year valued at almost $100 M

   Christmas trees are grown in all 50 states employing over 100,000 people

8. **Recreation - Tourism**

   camping
   backpacking
   picnicking