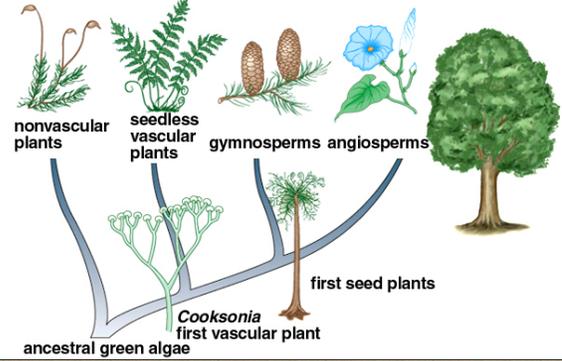


## Seed-bearing Plants

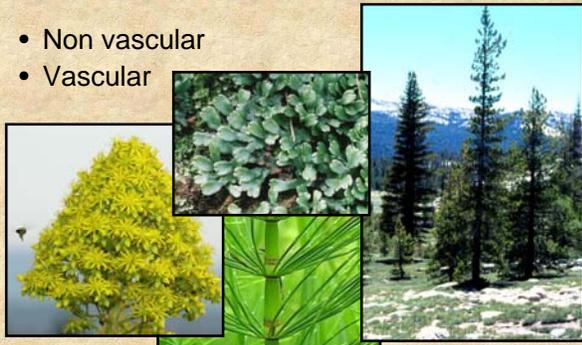


## Evolution of the major groups of plants (simplified)



## Land Plants fall into two major groups

- Non vascular
- Vascular



## Vascular Plants



- Some are seedless
- Others produce seed

Seed-bearing Vascular Plants fall into two major categories

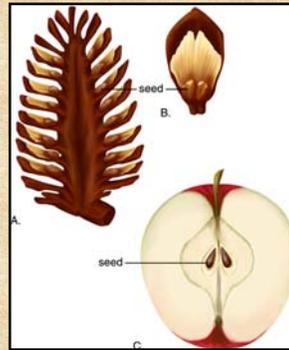


Gymnosperms



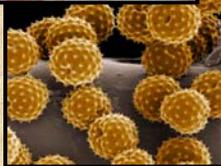
Angiosperms

Seed-bearing Vascular Plants fall into two major categories



- Gymnosperm – seeds naked on surface of sporophyll
- Angiosperm – seeds enclosed in a ripened ovary

Seed-bearing plants also produce pollen



Living Gymnosperms



Cycads



Ginkgoes



Conifers



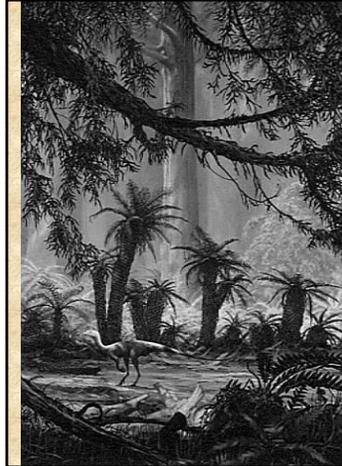
Gnetophytes

## THE CYCADS

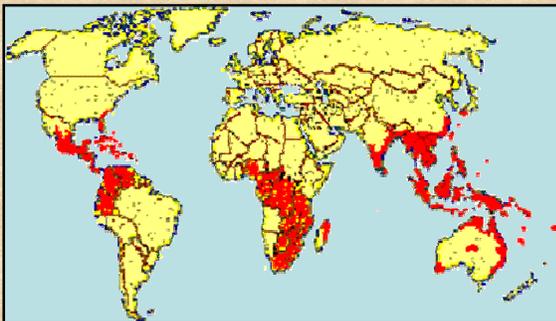


Cycads Appeared  
on Earth  
250 MYA

- Reached their greatest abundance and diversity during the Jurassic
- Declined sharply during the Cretaceous radiation of the angiosperms.



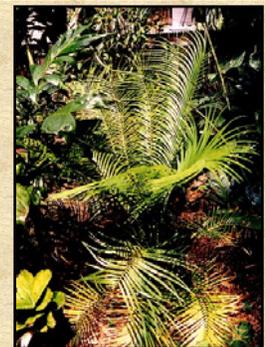
Global Distribution of Cycads is  
Tropical



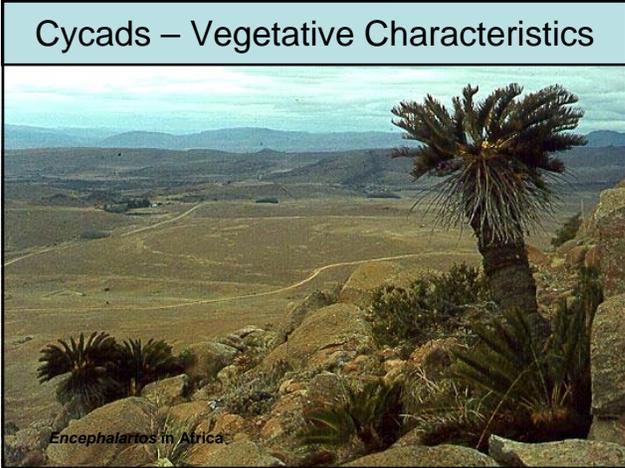
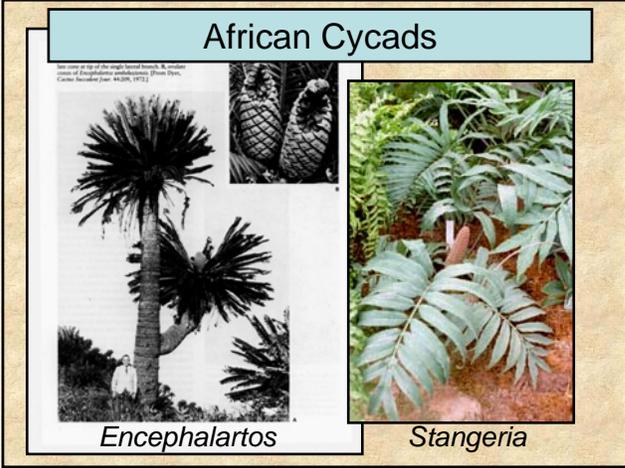
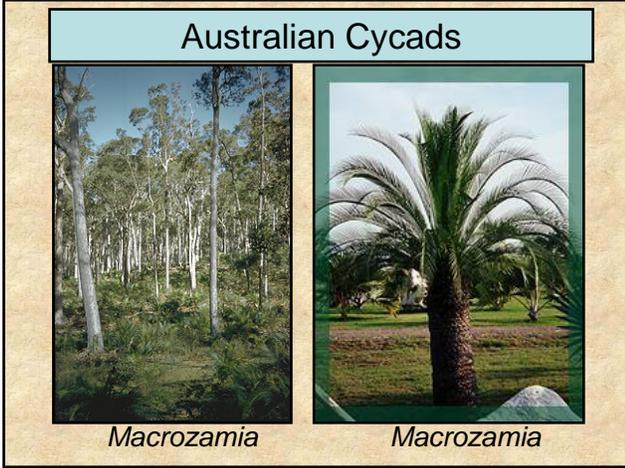
Mexican Cycads



*Dioon*



*Ceratozamia*



### Cycad Stems

- Columnar
- Little branching
- Not very woody

### Cycad Leaves

- Produced in crowns at tip of stem
- Pinnately compound

Certain roots in Cycads grow toward the soil surface

Corralloid Roots

### A Closer Look at Coralloid Roots

- Grow upward near soil surface
- Branch to form masses
- Root cortex inhabited by Cyanobacteria (carry out nitrogen fixation)

## Cycads – Reproductive Structures



## Cycads produce pollen and seeds in cones



- Cones develop at apex of stem

## All Cycads are Dioecious



Pollen Cone

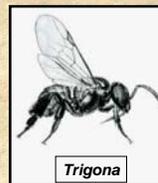
- Individual plants produce either pollen cones or seed cones



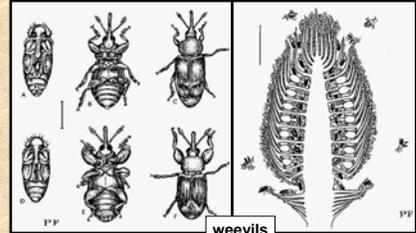
Seed Cone

*Cycas revoluta*

## Many Cycads are Pollinated by Insects



*Trigona*



weevils

- Only a few cycad species studied
- Weevils and oldest known bee genus (*Trigona*)
- Usually pollinators mate and lay eggs within female cone
- All cones except *Stangeria* produce heat. Thought to volatilize pollinator attractants
- Hence insect pollination may predate flowering plants

## Ginkgo – The Maiden Hair Tree



## Ginkgo was a common forest tree in the geological past



- Today represented by a single species
- Once occurred in North American Forests
- Presently occurs naturally only in China

## Present Distribution of *Ginkgo biloba*



- “Natural” trees may actually be plants cultivated at ancient Monasteries



## Ginkgo is also widely cultivated



### Ginkgo – Vegetative Characteristics



### Ginkgo is Deciduous



### Ginkgo is Deciduous



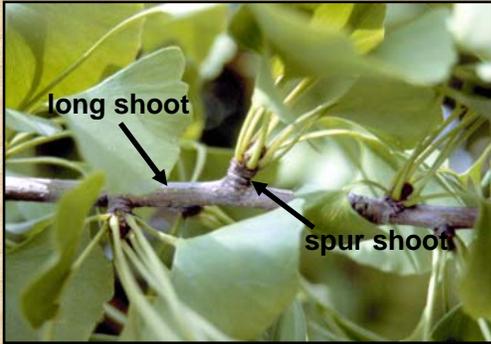
### Ginkgo Stems



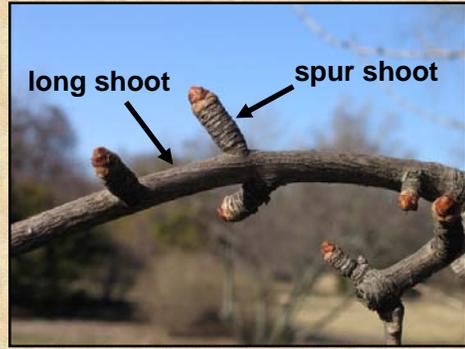
- Extensive branching
- Very woody



### Ginkgo Stems



### Ginkgo Stems



### Ginkgo Leaves

- Fan shaped
- Dichotomous branching veins



Leaf shape ranges from entire to bilobed



## All Ginkgo trees are Dioecious

- Individual plants produce either pollen "cones" or seed "cones"
- Produced on spur shoots



Pollen "Cone"



Seed "Cone"

## Ginkgo produces a seed with a fleshy seed coat

- Seed Coat contains Butyric Acid
- Seed Coat is not edible



## Ginkgo seeds are edible when fleshy seed coat is removed



Nutrition Facts	
Serving Size 155g	
Amount Per Serving	
<b>Calories</b> 172	Calories from Fat 21
% Daily Value*	
<b>Total Fat</b> 3g	4%
Saturated Fat 0g	2%
<b>Cholesterol</b> 0mg	0%
<b>Sodium</b> 476mg	20%
<b>Total Carbohydrate</b> 34g	11%
Dietary Fiber 14g	56%
Sugars	
<b>Protein</b> 4g	
Vitamin A	10%
Vitamin C	24%
Calcium	1%
Iron	2%

\*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

NutritionData.com




## Ginkgo biloba leaves are a popular herbal remedy

- Slow the progression of Alzheimer's symptoms
- Relieve depression, anxiety, headaches, ringing in the ears (tinnitus), and dizziness
- Reduce macular degeneration and control cataracts
- Optimize brain power




## Conifers – the most conspicuous gymnosperms



## Conifers

- Like the Cycads and Ginkgos, Conifers are well represented in the fossil record



*Sequoia affinis*

## Conifers are of great ecological importance

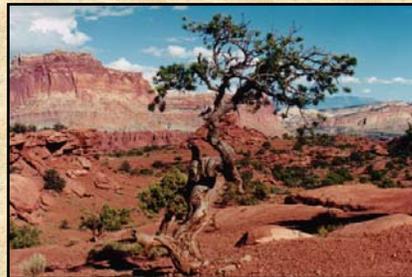


- Conifers are the dominant members of the vast Boreal forests (Taiga)



## Conifers are of great ecological importance

- Conifers are important members of other ecosystems



## Conifers are of great economic importance

- Edible Seeds
- Crates, Boxes, Matchsticks, Furniture
- Telephone Poles
- Turpentine and Rosin (Resin)
- Fuel (Pitch)
- Pulpwood
- Ornamentals
- Pharmaceuticals (Taxol)



## There are seven living families of Conifers



Norfolk Island Pines



Pines, Fir, Spruce



Sequoias and Redwoods

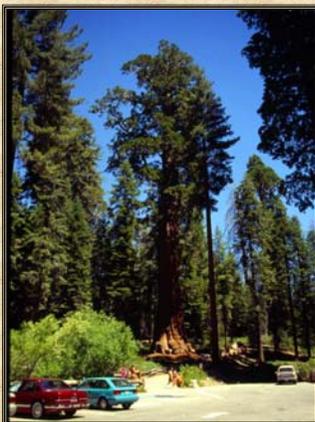
Five of the most familiar



Junipers and Cedars



Yew

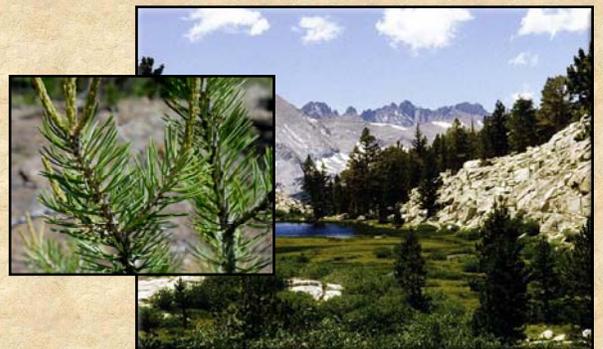


## The Largest and the Oldest Plants are both Conifers

- Giant Sequoias of the California Sierras are the largest
- Bristlecone pines of the California White Mountains are the oldest



## Vegetative Characters of Pine



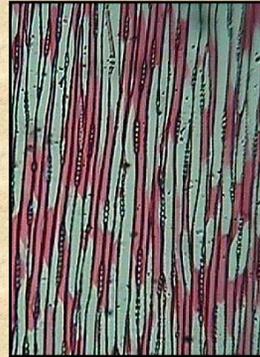
## Pine Stems



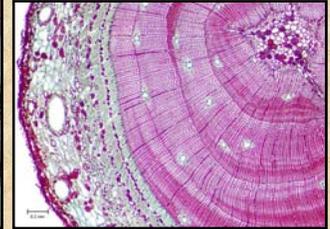
- Extensive branching
- Christmas tree shape
- Very woody



## Pine Stems

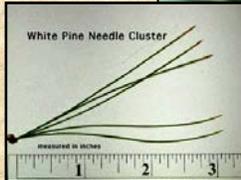


- Wood consist of tracheids only
- No fibers or vessels
- Wood is "soft"

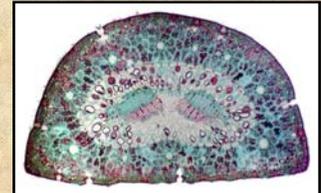


## Pine Leaves

- Needles produced in clusters (fascicles) of 1 to 5



Leaf shape in transverse section depends on number of leaves in the fascicle

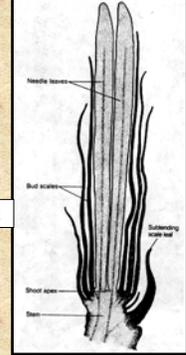


## Ginkgo Stems

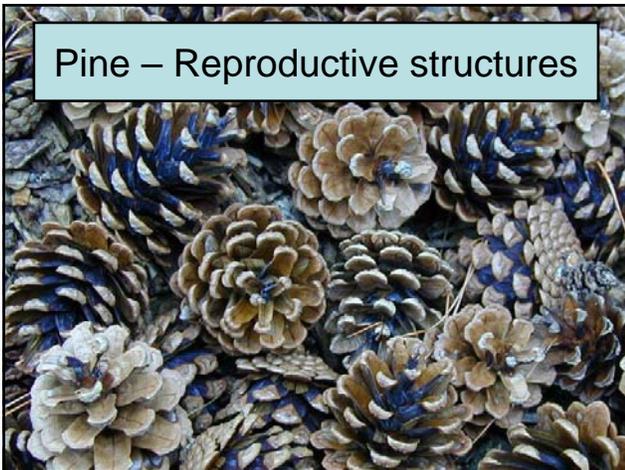


## Pine Leaves

- Each fascicle is an entire spur shoot



## Pine – Reproductive structures

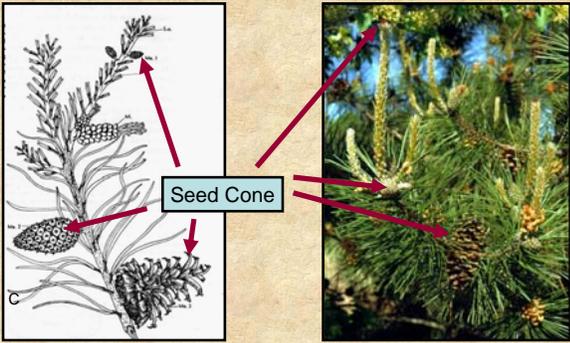


## Pines produce pollen and seeds in cones



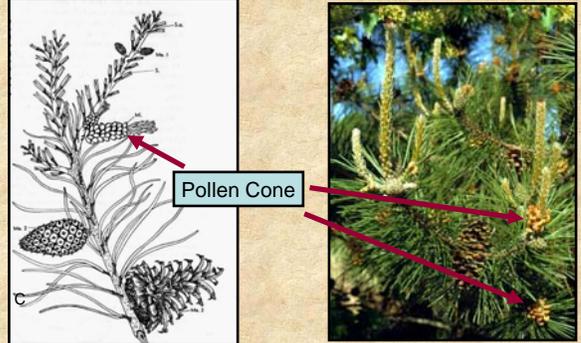
## Pines are Monecious

Individual plants produce both pollen cones and seed cones



## Pines are Monecious

Individual plants produce both pollen cones and seed cones



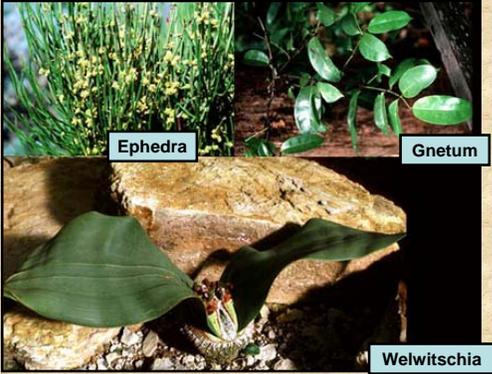
## Pollen cones produce pollen



## Seed cones produce seed



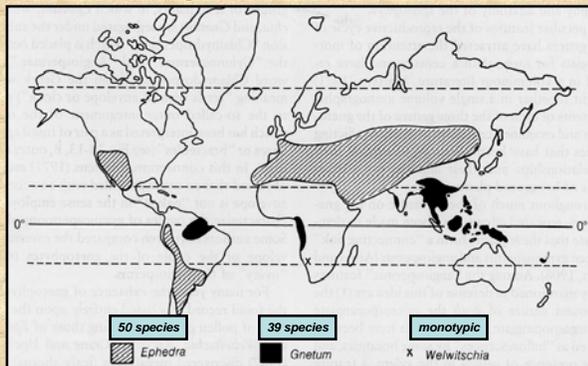
## The Gnetophytes



## *Ephedra* is a desert shrub



## *Ephedra* is distributed in arid regions of the world



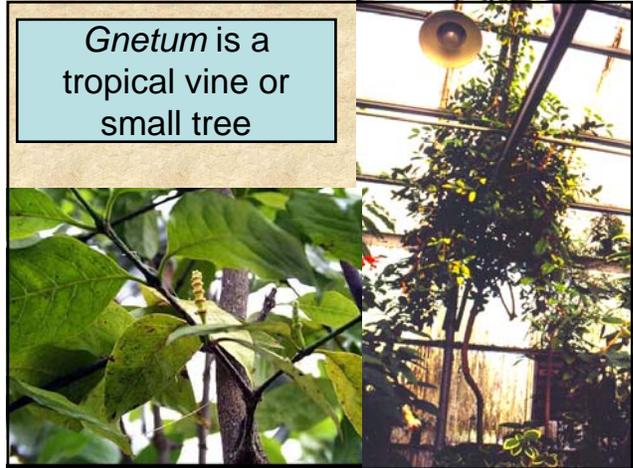
## *Ephedra* contains Ephedrine



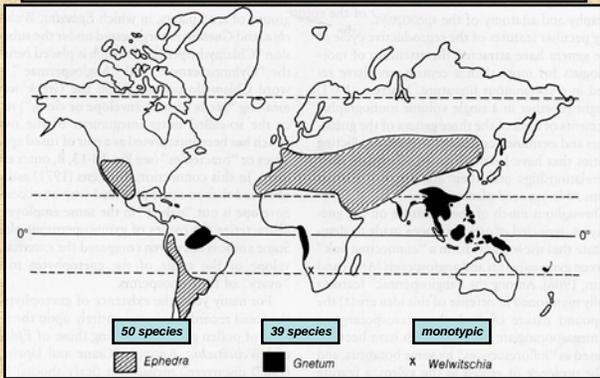
Pseudoephedrine is a Synthetic Version of Ephedrine



*Gnetum* is a tropical vine or small tree



*Gnetum* occurs in the tropics



*Welwitschia* is a bizarre plant of an extremely arid environment



