



EBC
EASY BIOLOGY CLASS

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GYMNOSPERMS

General Characteristics

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www.easybiologyclass.com



*“In every walk with nature one receives far more
than he seeks...”*

John Muir

Learning objectives:

- Understand Phanerogams
- What are Gymnosperms?
- General Characteristics of Gymnosperms
- How Gymnosperms differ from Angiosperms?



GYMNOSPERMS: CHARACTERISTICS



- *Naked Seed Plants*
- '*Gymnos*' = naked; '*sperma*' = seeds
- Primitive seed plants of spermatophyta (Phanerogams)
- Characterized by **naked ovules** (ovule without ovary)
- Ovules borne on the surface of **megasporophylls** (unprotected)
- Seeds are **NOT** enclosed in fruit (unlike Angiosperms)
- Also known as "*Phanerogams without ovary*"

Gnetum



Cycas



Naked seeds of Gymnosperms 4

GYMNOSPERMS: CHARACTERISTICS



Cycas



Pinus



Gnetum

GYMNOSPERMS: CHARACTERISTICS



Cedrus



Araucaria



Zamia



Thuja



Ephedra



Welwitschia mirabilis

GYMNOSPERMS: CHARACTERISTICS

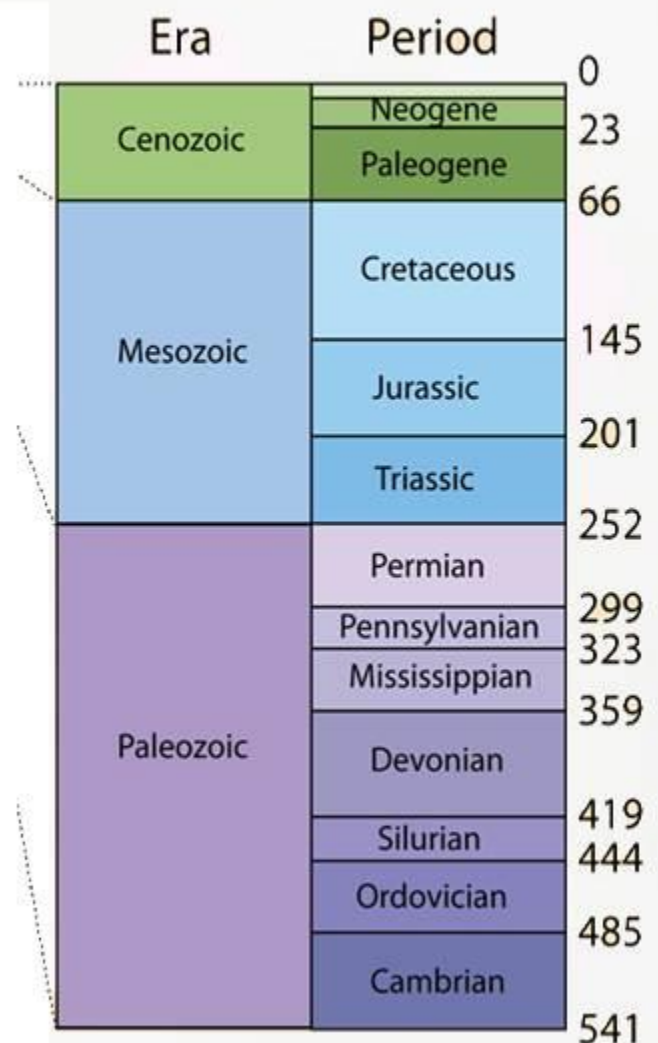
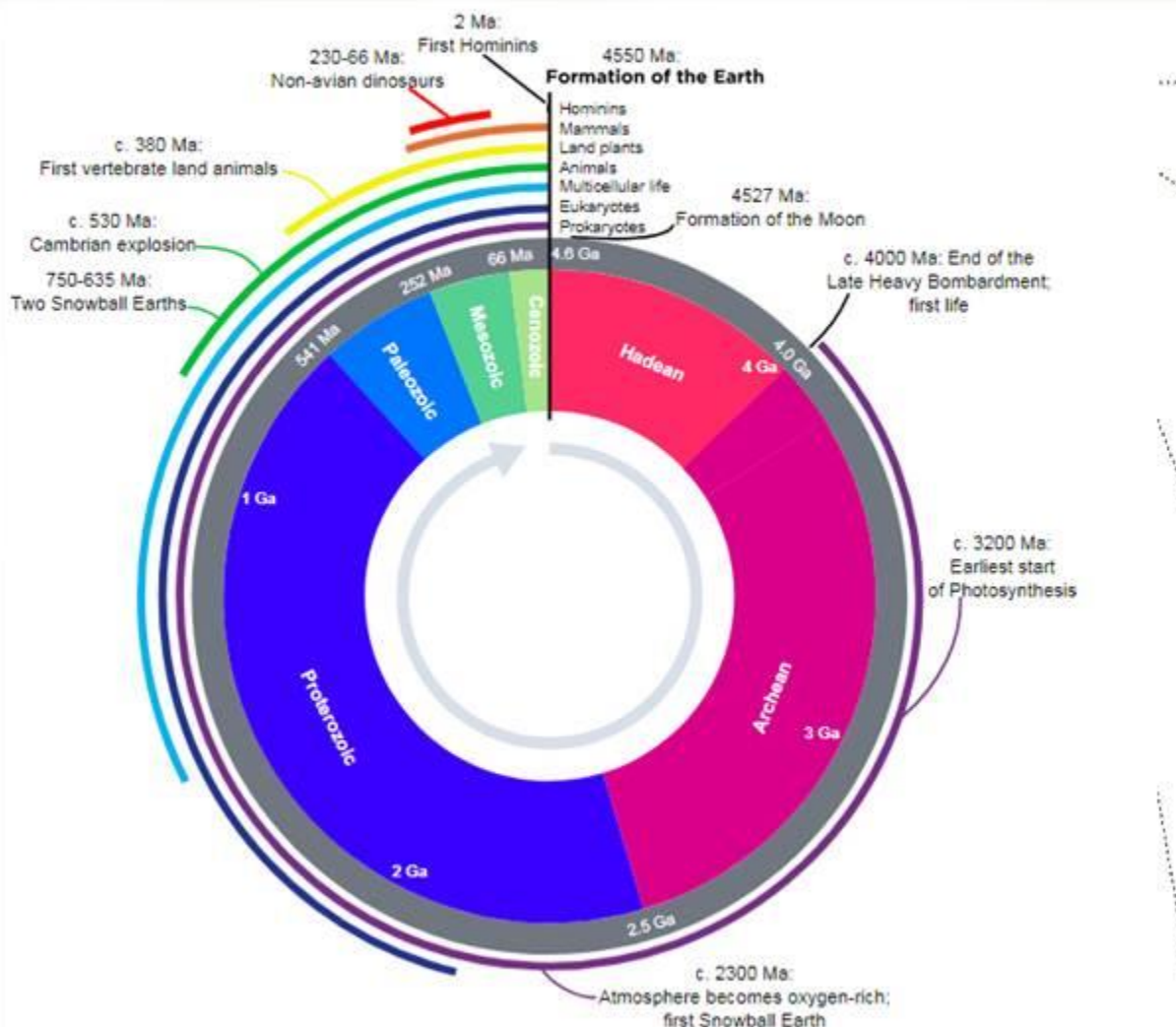


- A **Small** group of plants
- 70 Genera: 70 and Species: 725
- **Distribution:** Temperate and Tropical regions
- **Ancient** group of seed plants
- Originated in the **Paleozoic era** (541 – 252 million years ago)
- Dominant plants of **Jurassic** and **Cretaceous** periods of Mesozoic era
- Many primitive Gymnosperms were **extinct**
- Extinct: *Cycadofilicales*, *Bennettitales*, *Cordaitales*



Fossil of a Gymnosperm

GYMNOSPERMS: CHARACTERISTICS



Geological Time Scale
(Years in Million)

GYMNOSPERMS: CHARACTERISTICS



- Living forms are usually **evergreen trees** or **shrubs**
- Usually show **xerophytic** characters
- Plant body is **sporophytic** – diploid
- Differentiated into **roots, stem** and **leaves**
- Plant possesses well developed **vascular system**
- Vascular system consists of **xylem** and **phloem**



Pinus Trees



GYMNOSPERMS: CHARACTERISTICS

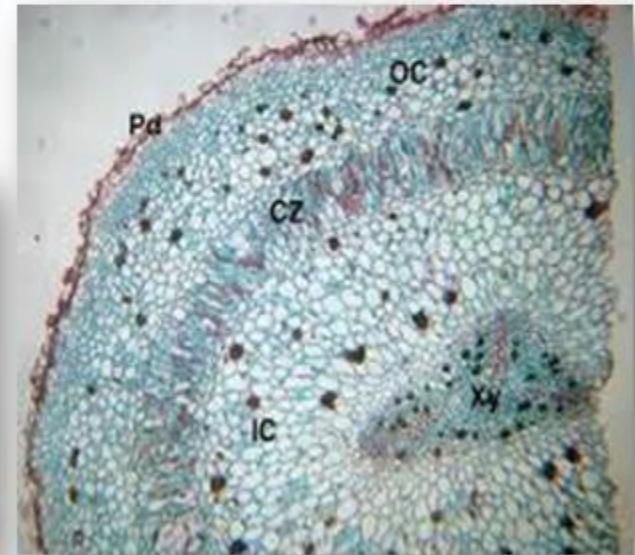
- Roots show **symbiotic** association with **fungi** or **cyanobacteria**
- Fungi: *Mycorrhizal* association of *Pinus* roots
- Fungi helps in absorption of minerals
- Algae: **Coralloid** roots of *Cycas* with *Nostoc* and *Anabaena*
- Algae helps in nitrogen fixation



Mycorrhiza



Coralloid roots



Algal zone in Coralloid roots

GYMNOSPERMS: CHARACTERISTICS

- Stem: usually **erect, branched** and woody
- Stem usually un-branched in *Cycas*
- Stem underground in *Zamia*
- Presence of **Leaf scar** is a characteristic feature of Gymnosperms



Pinus



Cycas



Zamia

GYMNOSPERMS: CHARACTERISTICS



- Leaves usually **dimorphic**: (**Foliage** leaves and **Scale** leaves)
- **Foliage leaves**: green; simple or needle shaped or pinnately compound
- **Scale leaves**: minute and deciduous
- Leaves have thick cuticle
- Stomata usually **sunken**
- *Cycas* show ***circinate vernation***



Circinate vernation - Fern



Cycas leaves



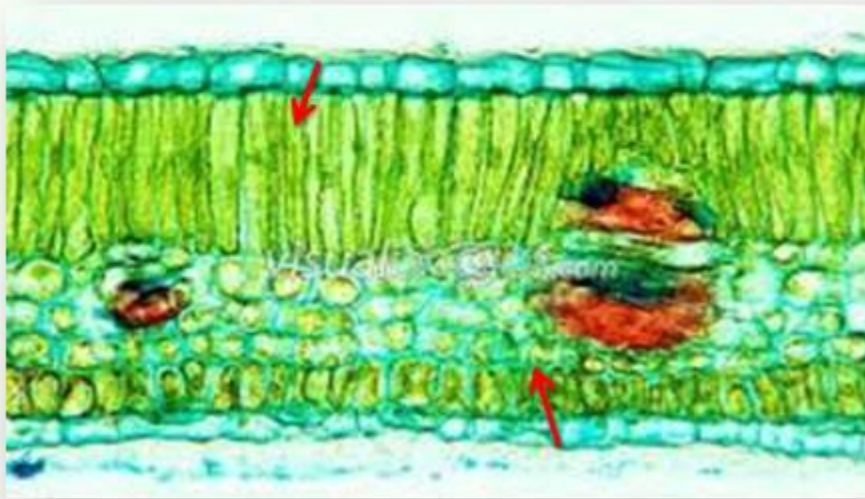
Pinus Leaves



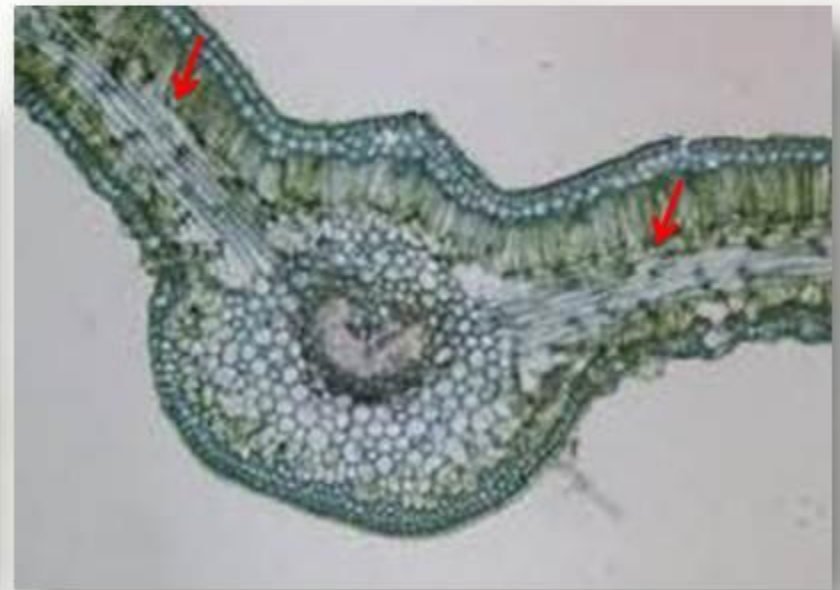
Pinus leaves

GYMNOSPERMS: CHARACTERISTICS

- Mesophyll differentiated into **palisade** and **spongy** tissue
- Mesophyll undifferentiated in *Pinus*
- Leaves do **NOT** have lateral veins
- Lateral translocation of nutrients takes place by **transfusion tissue**



CS of Leaf (Palisade and Spongy Tissue)



CS of Cycas Leaflet (Transfusion Tissue)

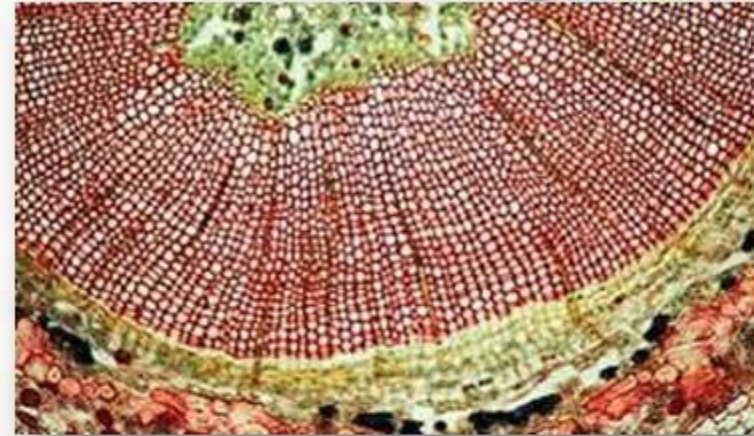
GYMNOSPERMS: CHARACTERISTICS



- Roots **diarch** to **polyarch**
- Tanniniferous cells present in cortex
- Vascular bundles: **collateral** and **open**

Xylem:

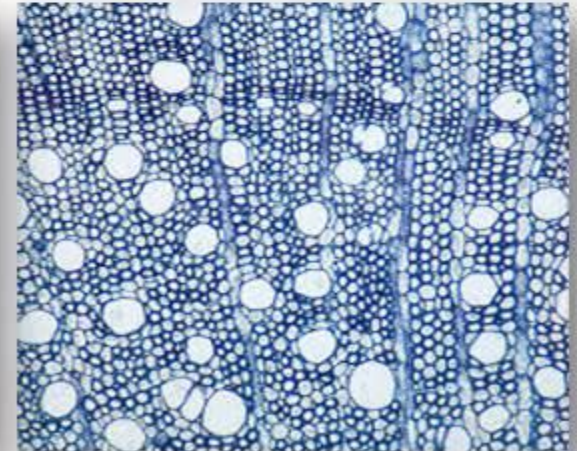
- Xylem consists of **Tracheids** and **Parenchyma**
- Vessels **absent** in the xylem
- **Vessels present in *Gnetum***



Wood of Gymnosperm



Gnetum



Wood of Gnetum with Vessels

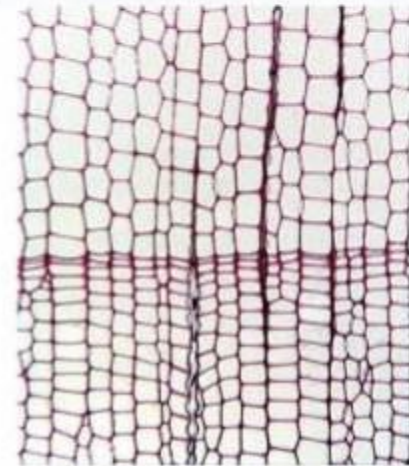
GYMNOSPERMS: CHARACTERISTICS

Phloem:

- Phloem consists of **sieve tubes** and **phloem parenchyma**
- **Companion** cells absent
- Stem shows **secondary growth**
- Wood may be **manoxylic** (*Cycas*) or **pycnoxylic** (*Pinus*)



MANOXYLIC WOOD



PYCNOXYLIC WOOD

GYMNOSPERMS: CHARACTERISTICS

- Plants are **heterosporous**
- **Megasporangia** produced on **megasporophyll**
- **Microsporangia** produced on **microsporophyll**
- Sporophylls aggregated to form **cones** or **strobili**
- Cones/strobili are **mono-sporangiage**



Cycas: Male cone



Cycus Microsporophyll



Cycas Megasporophyll



Cycas: Male cone

GYMNOSPERMS: CHARACTERISTICS



Cycas
(Male cone)



Cycas
(Female cone)



Cupressus
(Male cone)



Cupressus
(Female cone)



Pinus
(Male cone)



Pinus
(Female cone)



Gnetum
(Male cone)



Gnetum
(Female cone)

GYMNOSPERMS: CHARACTERISTICS

Male and Female Cone:

- Males cones **short lived**
- Female cones lives for many **years**
- Microsporangia formed on **abaxial** side of microsporophyll
- Microsporangia development: **eusporangiate**



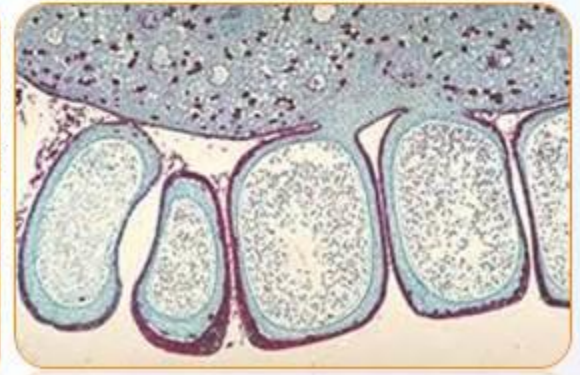
Pinus (Soft Male and Hard Female cone)



Cycas (microsporophyll)



Cycas (Sporangia)



Cycas (Sporangia)

GYMNOSPERMS: CHARACTERISTICS

Female cone:

- Female cone formed by the aggregation of **megasporophylls**
- Megasporophylls may be **foliar** (*Cycas*) or **cauline** (*Pinus*)
- Megasporangium is better known as **ovule** (naked)
- Ovules **orthotropous** and unitegmic
- Ovular integument is differentiated into **three** layers



Cycas
Megasporophyll



Pinus
Megasporophyll



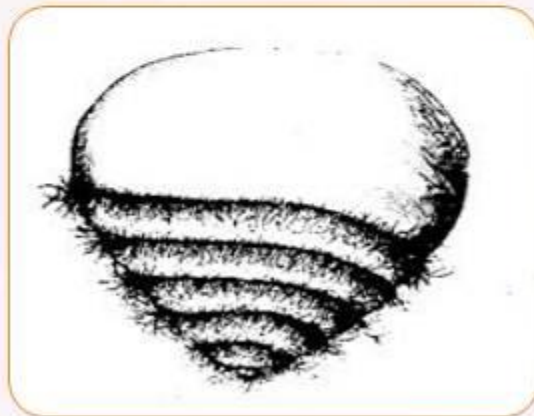
Orthotropous
Ovule



Anatropous
Ovule

GYMNOSPERMS: CHARACTERISTICS

- Microspores are liberated at various stages of the **gametophyte**
- Male gametes are **non motile** except in *Cycas* and *Ginkgo*
- Number of archegonia in female gametophyte varies
- Several archegonia in *Cycas*, only one in *Pinus*



Cycas (Sperm)



Ginkgo (Sperm)

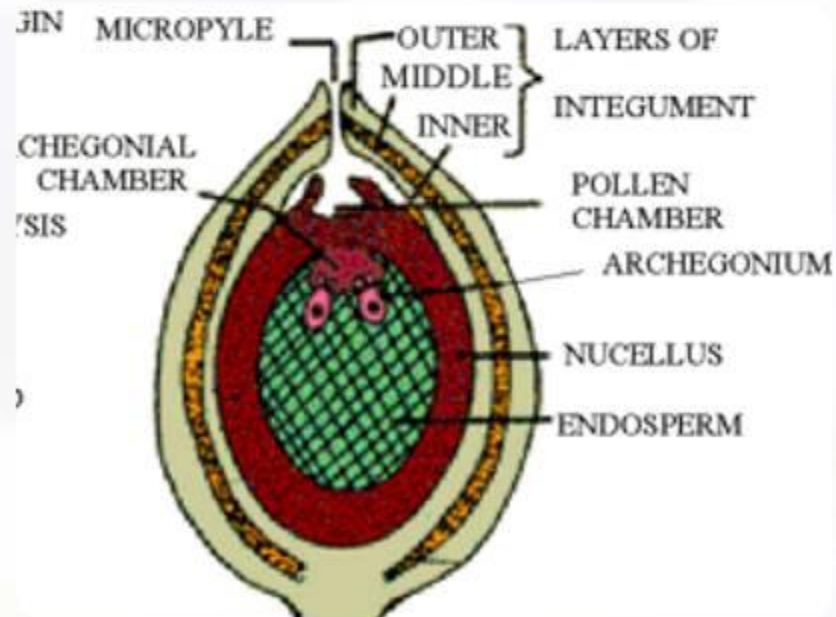


Ginkgo (Sperm)

GYMNOSPERMS: CHARACTERISTICS



- Archegonium has a **single egg** and a **venter canal cell**
- Archegonium in *Gnetum* is represented by ovum only
- **Neck canal cell absent in *Gnetum***
- Pollination: all gymnosperms are **wind** pollinated (*Anemophily*)
- Pollens deposited in the wet **pollen chamber**



GYMNOSPERMS: CHARACTERISTICS



- Fertilization **siphonogamic** (with the help of pollen tube)
- Pollen tube functions as the **sperm carrier**
- Embryo development: **meroblastic** (embryo develops from some part of zygote. Angiosperms are also shows meroblastic development)
- Endosperm present
- Development of endosperm takes place **before fertilization**
- *Endosperm is haploid*
- *Double fertilization and triple fusion absent in Gymnosperms*

GYMNOSPERMS: CHARACTERISTICS

- Poly-embryony is very common
- Poly-embryony may arise by:
 - Fertilization of more than one eggs
 - Division of zygote (**Cleavage poly-embryony**)
- Seed coat **present**
- **Integument** of ovule forms the seed coat
- Seeds winged in *Pinus*



Pinus (Winged seeds)



Cycas (seeds)



Cycas (seeds)

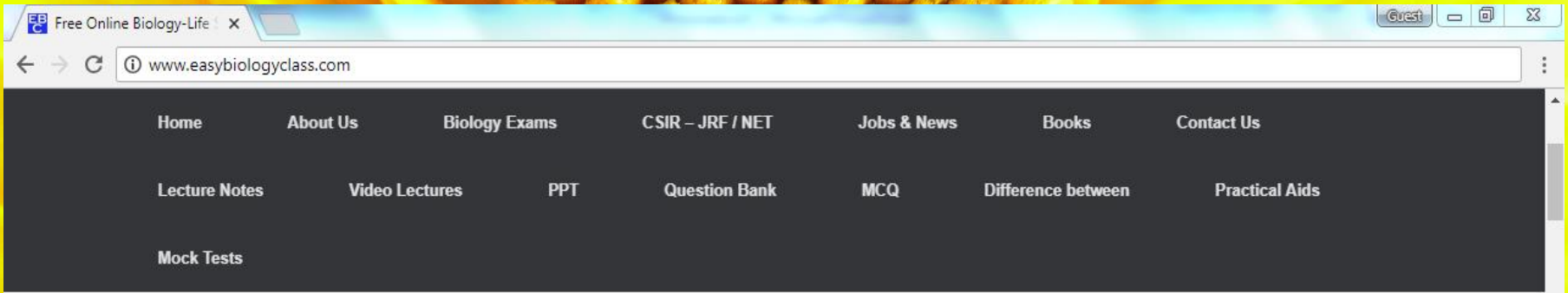
GYMNOSPERMS: CHARACTERISTICS




- Number of cotyledons may be **one** or **two** or **many**
- Seeds usually have a **resting** period
- Distinct alternation of generation
- Diploid **sporophytic generation** is dominant
- Haploid gametophytic stage is reduced
- Gametophytic phase is **depended** on sporophytic phase

For detailed description of this topic, please click on:



<http://www.easybiologyclass.com/general-characters-of-gymnosperms-lecture-notes-with-ppt/>



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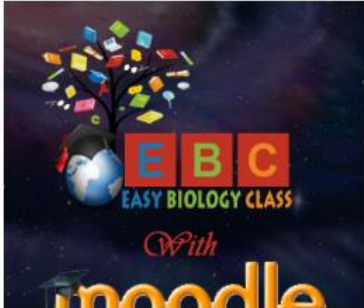


General Characters of Gymnosperms (Lecture Notes with PPT)



Gymnosperms – Characteristics
(Morphology, Reproduction and Life Cycle of Gymnosperms with PPT)

Gymnosperms are primitive seed-producing plants of Spermatophytes (Phanerogams). They are '**Naked-Seed**' Plants. The term is derived from two Greek words: '*gymnos*' meaning naked and '*sperma*' meaning seeds. They are characterized by ~~naked ovules~~ (i.e., ovules without the ovary). The ovules of



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