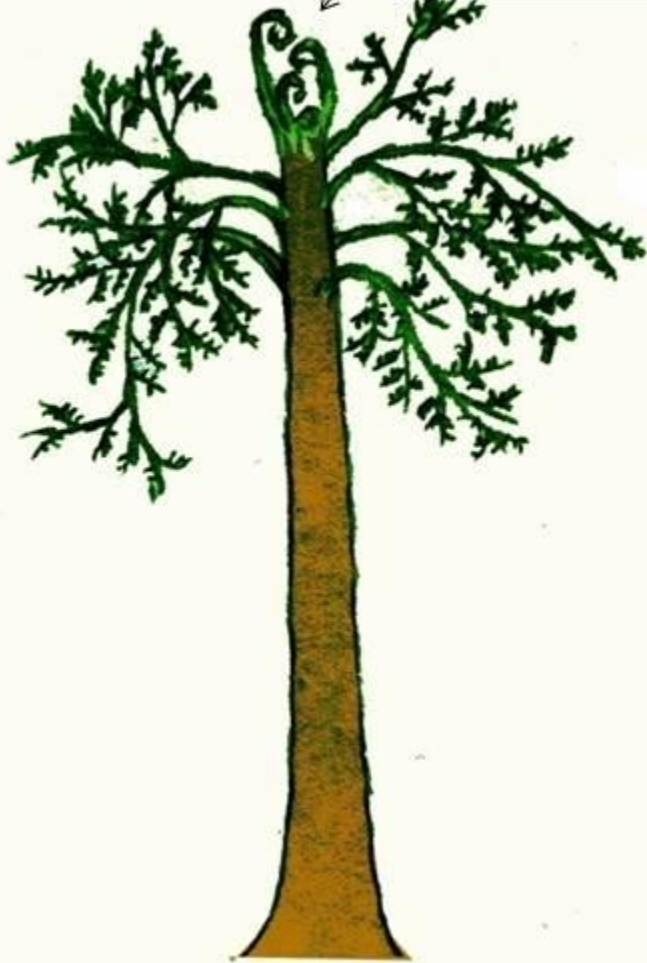


# Lignophyta – drvenaste biljke

(pragolosjemenjače, drvenaste paprati, sjemenjače)

Pužasto uvijene,  
mlade, bezlisne  
grane

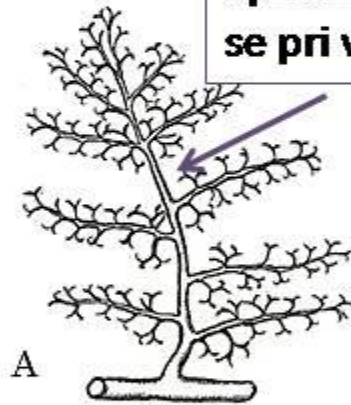


Aneurophyton sp.

... protostela

# Progymnospermae (pragosjemenjače)

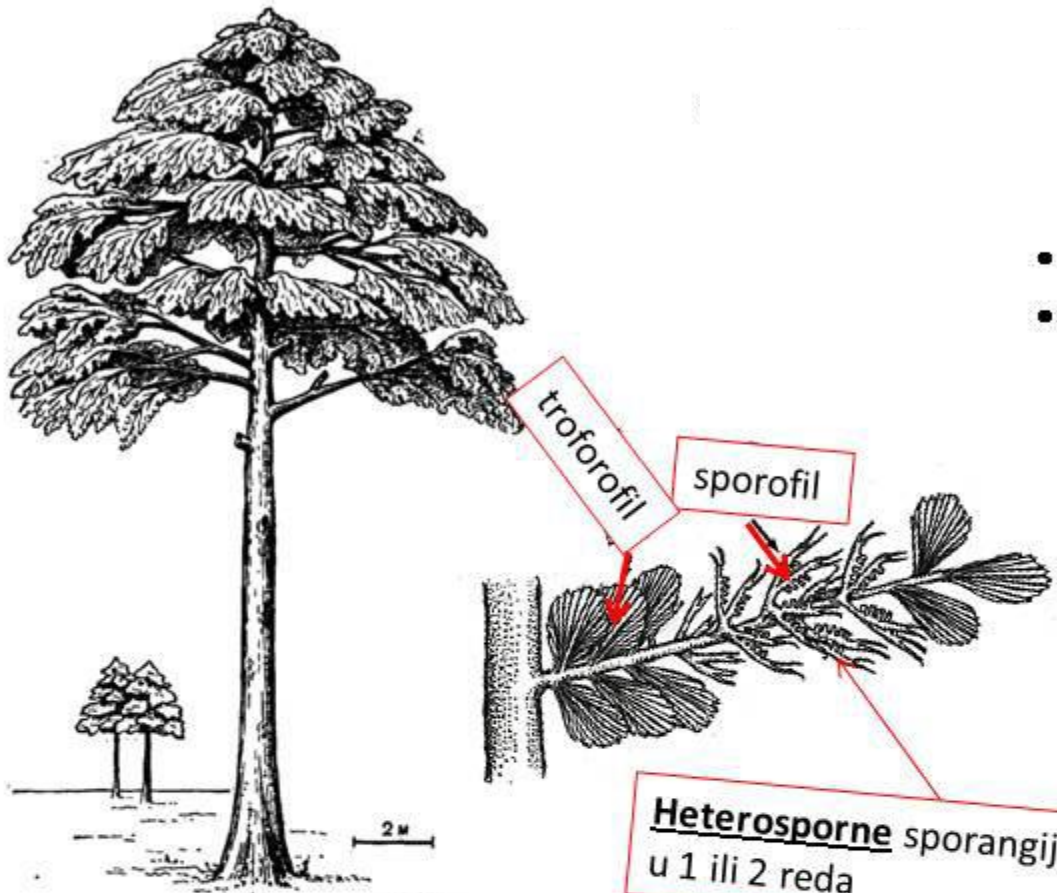
Spiralno raspoređene bočne grane, koje su se pri vrhu dihotomo račvale.



Fertilne grane, sa  
izospornim,  
terminalnim  
sporangijama

Sekundarni ksilem je slabo razvijen, pa se smatra da su biljke prije imale formu nježnog žbuna ili lijane, nego drveta.

- Listovi se pužasto ne uvijaju!
- Troforfili i sporofili koji se smjenjuju!



Heterosporne sporangije  
u 1 ili 2 reda



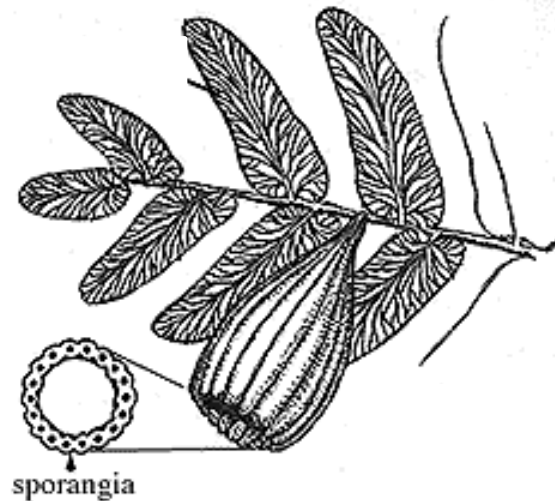
Archaeopteris sp.

... sifonostela

# Pteridospermae (sjemene paprati)



**Medullosa sp.**



sporangia



Ligynopteris sp.

# Klasifikacija recentnih biljaka sa sjemenom (Spermatophyta)

- Ginkgooidae
  - Gnetidae
  - Pinidae
  - Cycadidae
  - Magnoliidae
- Gymnospermae
- Angiospermae
-

# Cycadidae, Pinidae, Gnetidae, Ginkgooidae



**Cycas**



**Pinus**



**Gnetum**

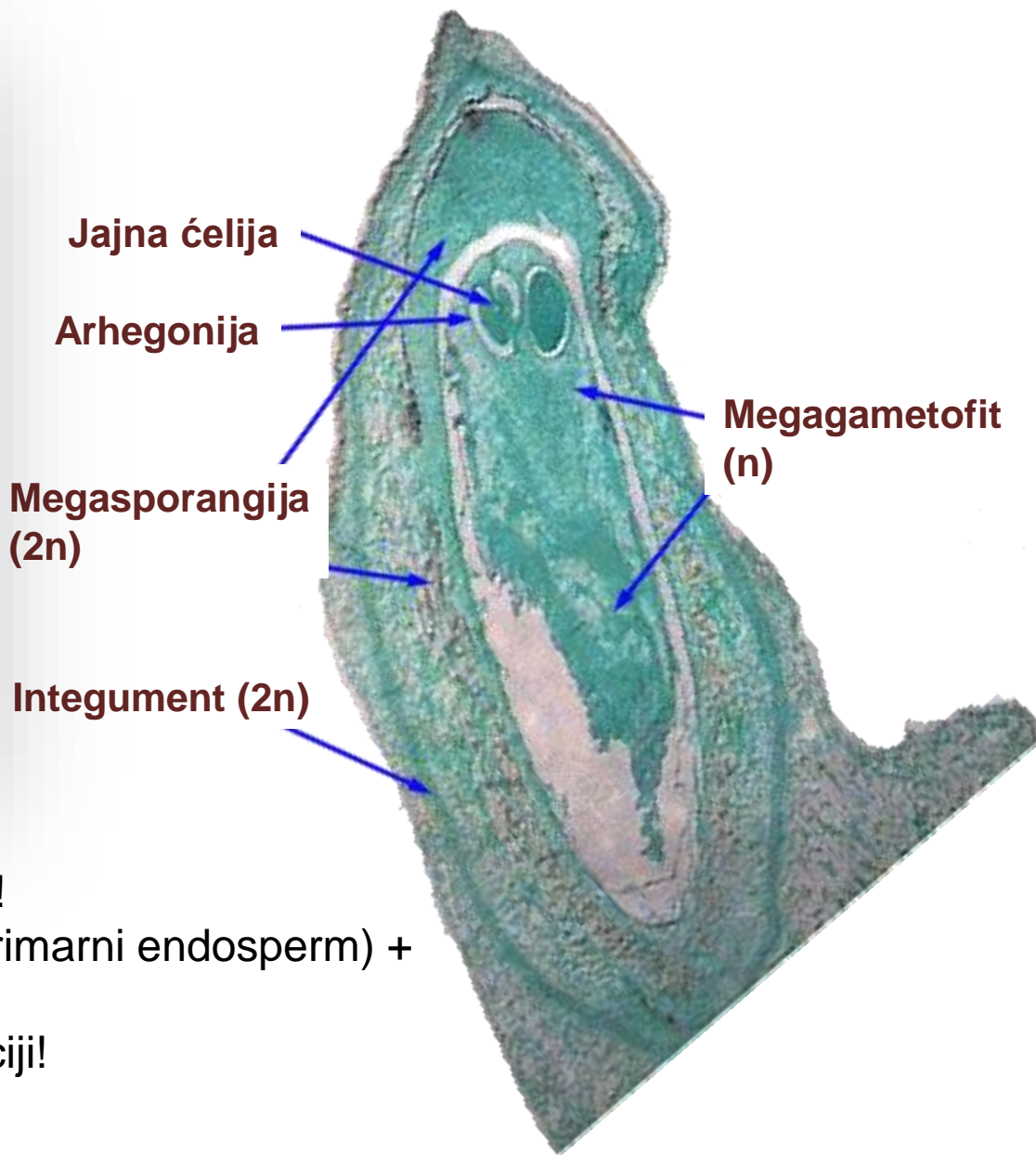
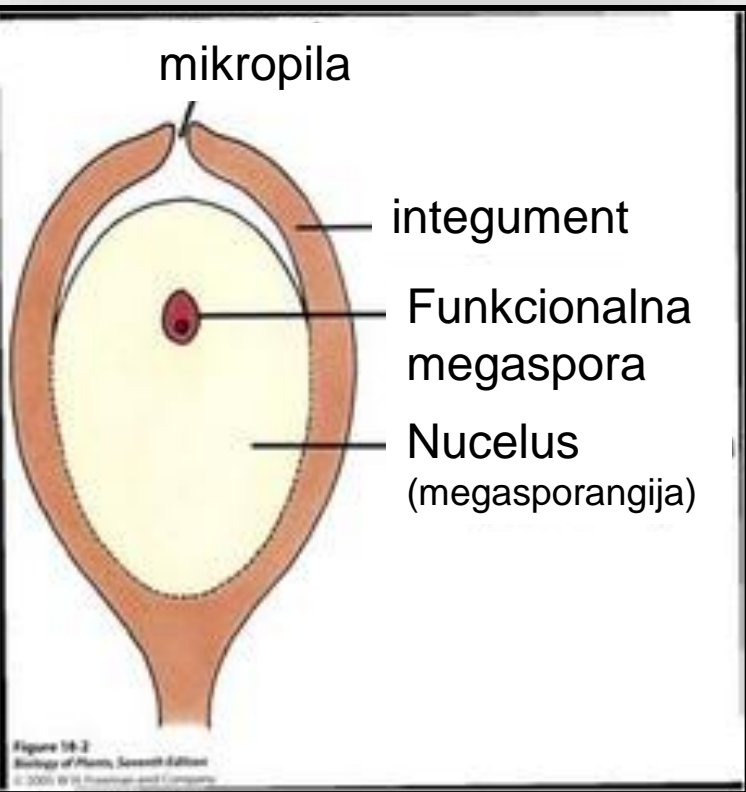


**Ginkgo**

Sjemeni zametak  
Anemofilija  
Trajan primarni korijen  
.....

# Opšta građa sjemenog zametka

# Sjemeni zametak bora (Pinus spp.)



Nucelus je homolog megasporangiji!

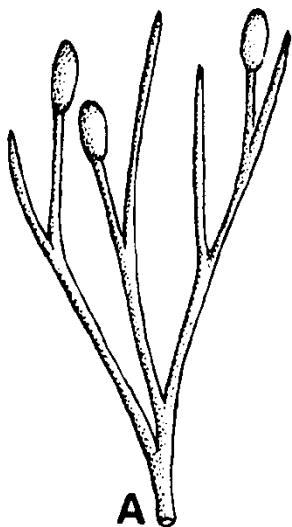
U megaspori se razvija protaljum (primarni endosperm) + 2 arhegonije sa jajnom ćelijom.

Integument- nova tvorevina u evoluciji!

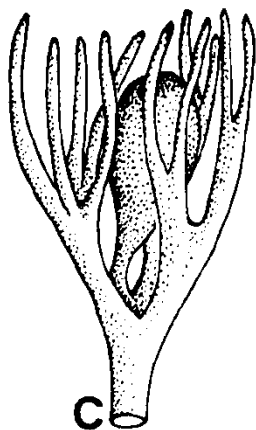
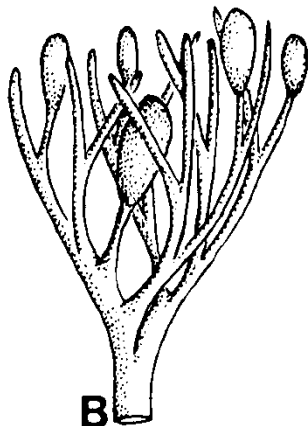


## Evolucija sjemenog zametka

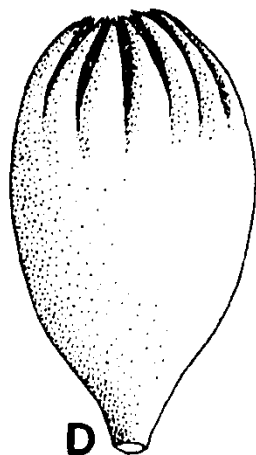
**A-** Telom sa fertilnim i sterilnim granama



**B-** Telom sa fertilnim i heterosporangijama

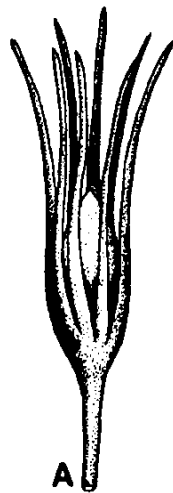


**C-** Telom sa megasporangijom okruženim sterilnim ograncima

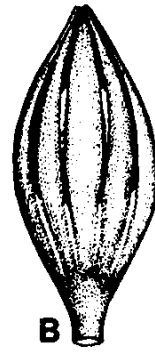


**D-** Srastanje sterilnih ogranaka koji okružuju megasporangiju

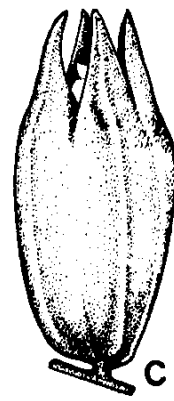
## Evolucija integumenta



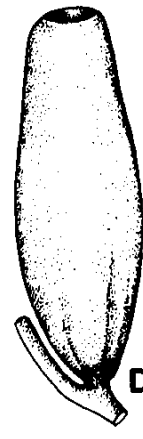
**A**



**B**



**C**



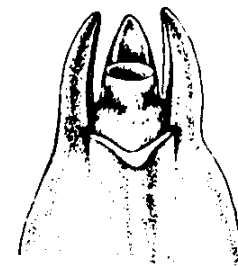
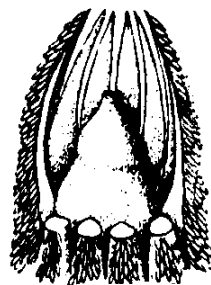
**D**

**A-** Sterilni segmenti slobodni

**B-** Segmenti djelimično srasli

**C-** segmenti većim dijelom srasli

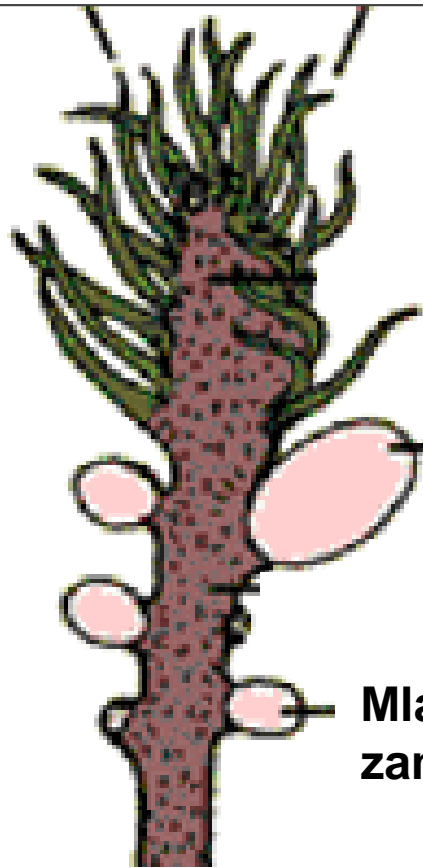
**D-** segmenti skroz srasli obodom, a na vrhu ostaje mikropila



Tipovi polenove komore

# Cycas revoluta, izgled megsporofila i građa sjemenog zametka

Perasto usiječen megasporofil



arhegonijalna komora

mikropila

spoljašnji sloj integumenta

srednjišnji sloj integumenta

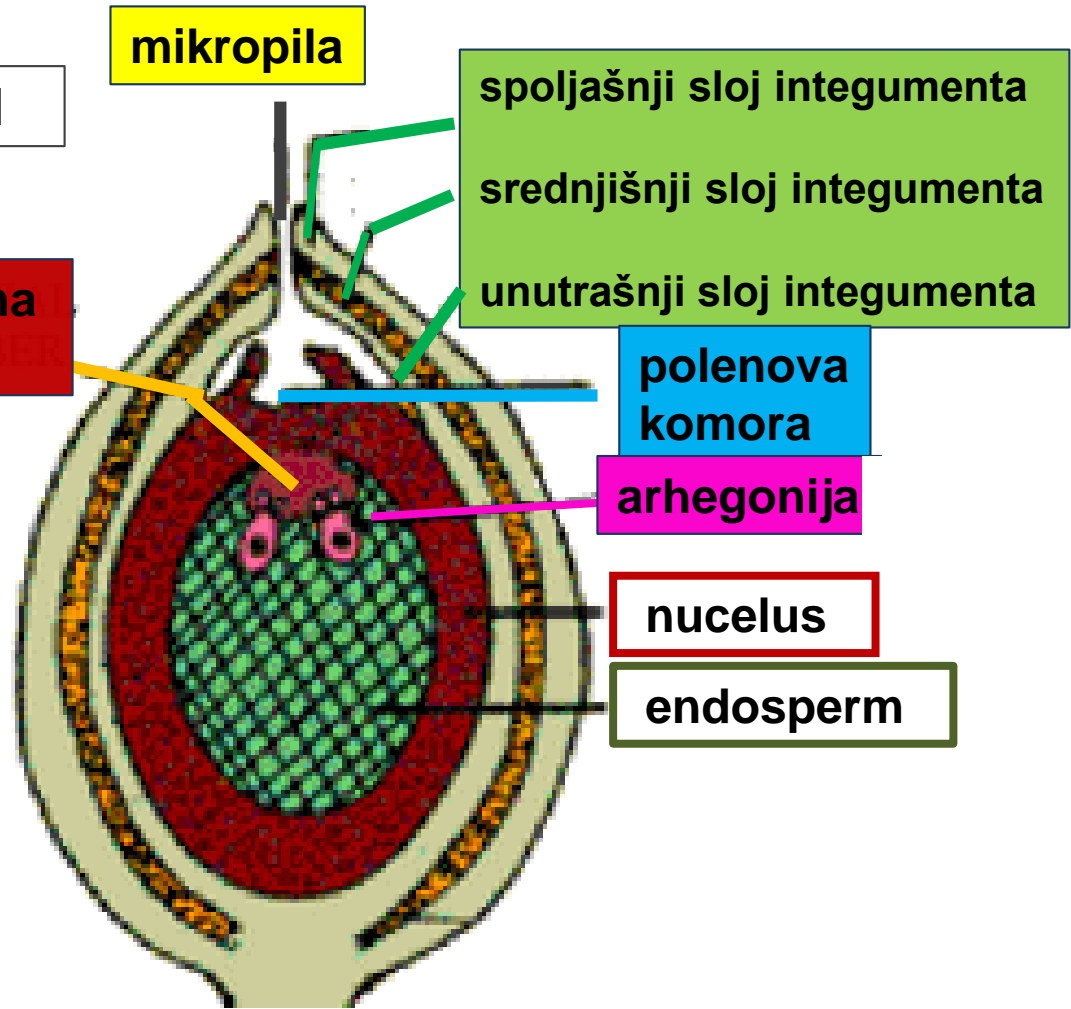
unutrašnji sloj integumenta

polenova komora

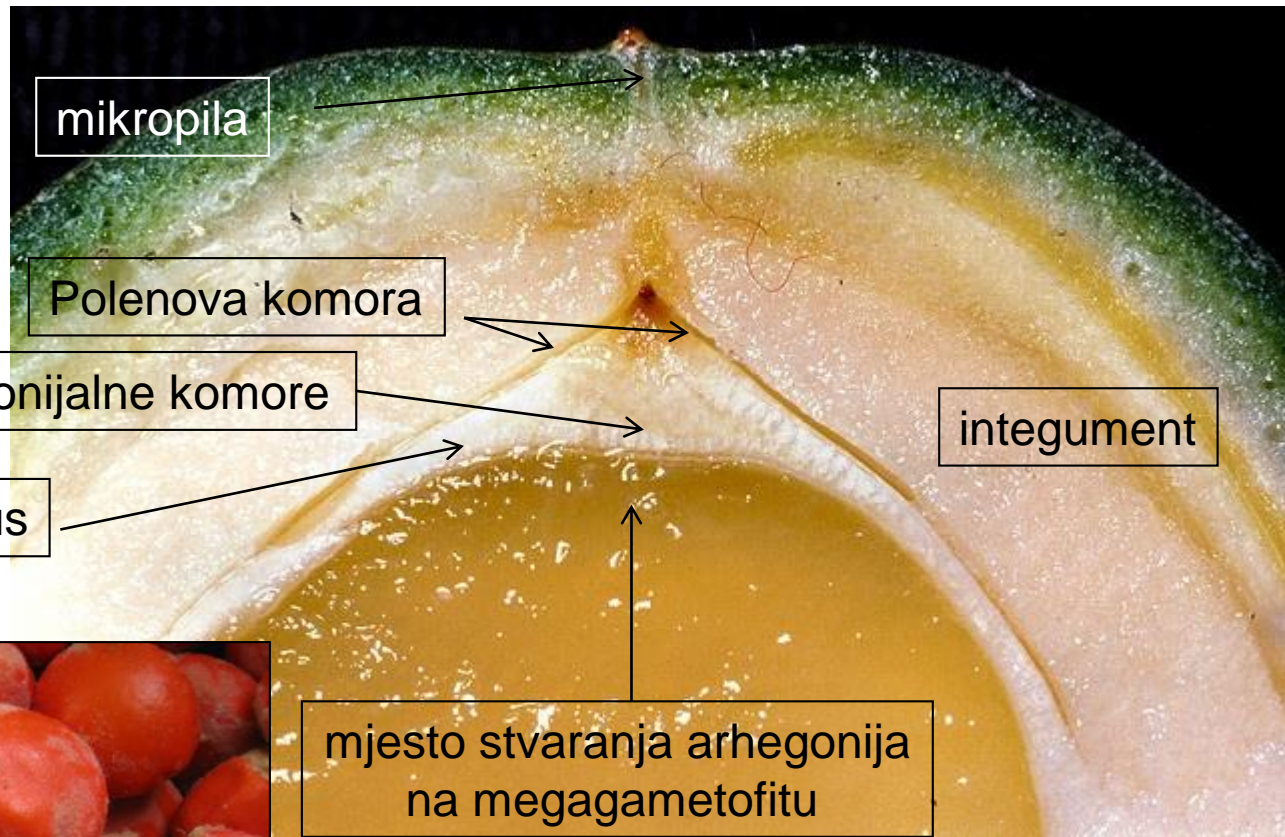
arhegonija

nucelus

endosperm



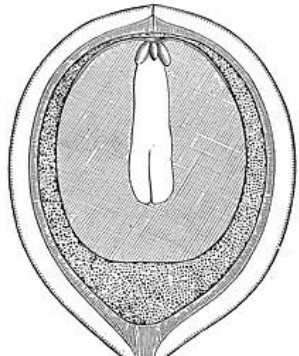
Građa sjemenog zametka



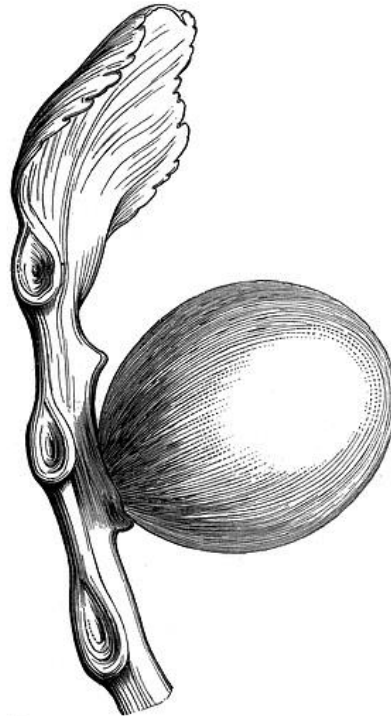
# Cycas revoluta, habitus, izgled mega- i mikrosporofila



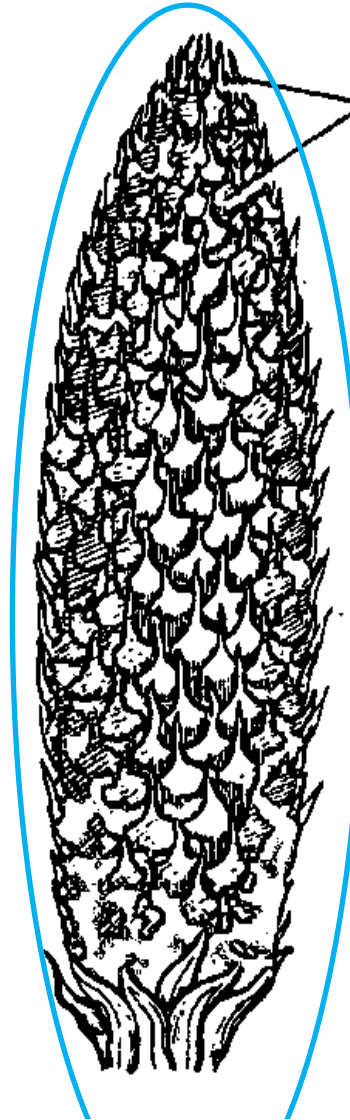
*Cycas circinalis.*



Sjemeni zametak



Megasporofil sa sjemenim zametkom  
(megasporofili nisu u strobilusima!)



Muški strobilus cikasa

Mikrosporofili

Mikrosporangije  
(polenove kese)  
na mikrosporofilu



# Cycas spp.-ciklas

megasporofil

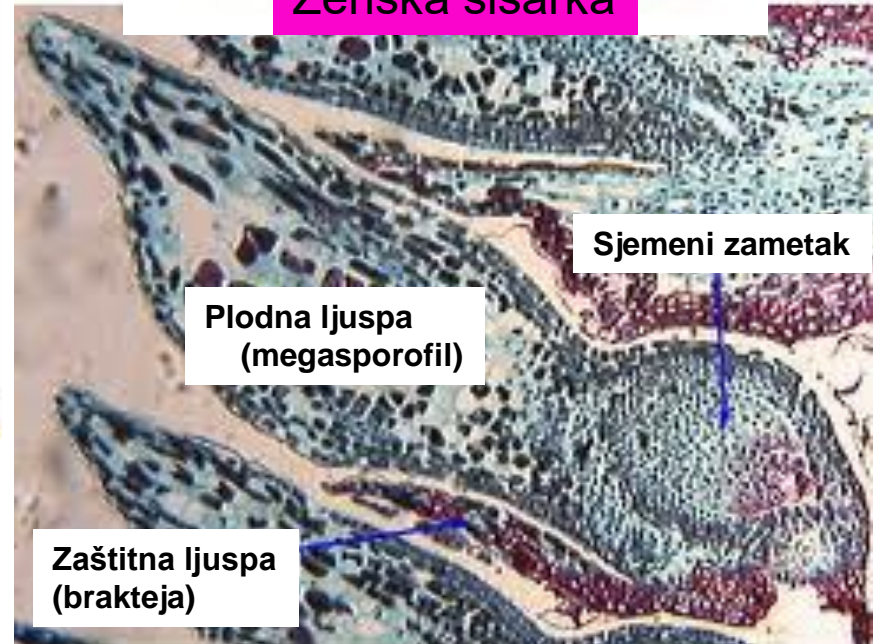
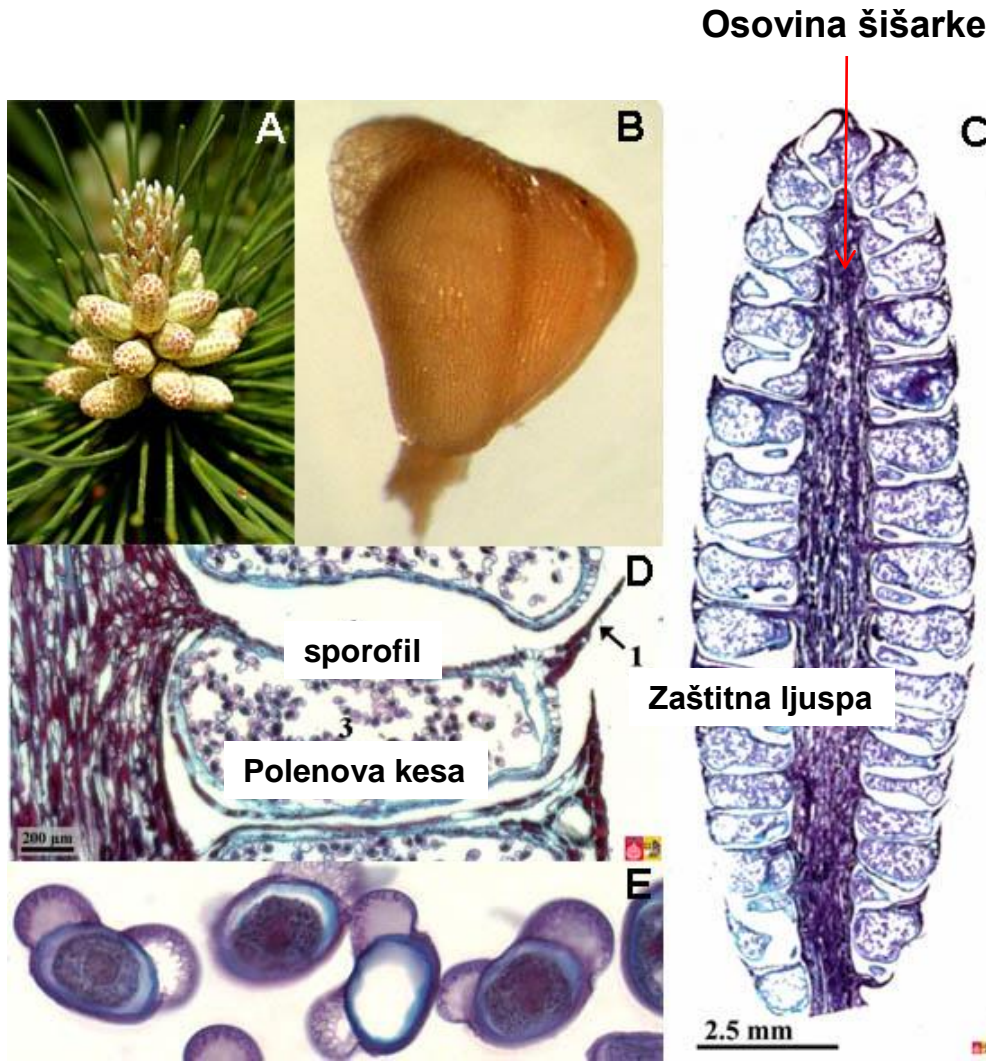


muška jedinka



ženska jedinka

# Građa šišarki bora (Pinus sp.)



- A, C - muška šišarka
- B, D- mikrosporofil i polenova kesica
- E- polenova zrna

# Ginkgooidae

Sjemeni zametak



ženska jedinka



muška jedinka



# Gnetidae

Dihazijalni strobilusi.

Ovojni listići nalik perijantu cvjetnica.

Dvojno oplođenje.

Dugačka mikropilarna cijev.

Prisustvo traheja u ksilemu.

Naspraman raspored listova.

Odsustvo smonih kanala.

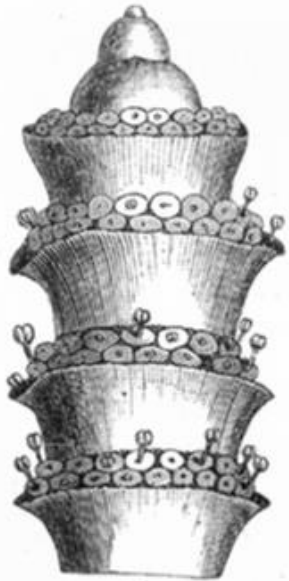




Grana sa ženskim strobilusima



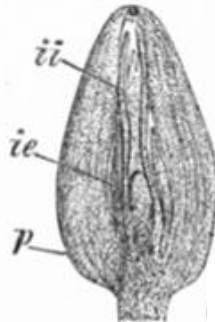
Androfor sa  
Polenovim kesama



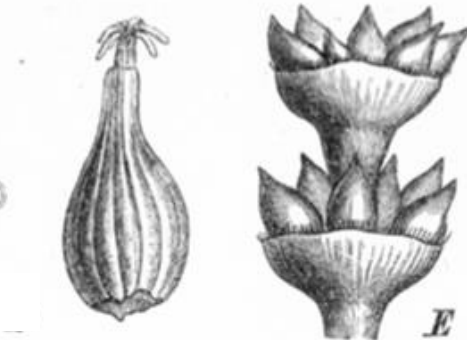
Muški strobilus



Grana sa muškim strobilusima



Sjemeni zametak



Ženski strobilus sa  
sjemenim zamecima

Gnetum sp.

# Welwitschia mirabilis

Muška jedinka



Ženski strobilus

# Pinidae

O. Pinales

Fam. Pinaceae

Fam. Cupressaceae

Fam. Taxodiaceae (nisu native u fl. CG)

Fam. Cephalotaxaceae (nisu native u fl. CG)

Fam. Podocarpaceae (nisu native u fl. CG)

Fam. Araucariaceae (nisu native u fl. CG)

Fam. Sciadopityaceae (nisu native u fl. CG)

O. Taxales

Fam. Taxaceae

- Fam. Taxodiaceae- močvarni čempresi.

Rodovi: Taxodium (Sjeverna Amerika),  
Metasequoia (Kina), Saquoia (Siera Nevada),  
Cryptomeria (Kina, Japan), Sciadopitys  
(Japan), Athrotaxis (Tasmanija), Cunninghamia  
(Kina)

- Fam. Cepalotaxaceae

Amentotaxus (Azija), Cephalotaxus (istočna  
Azija), Torreya (Azija, Sjeverna Amerika),

- Fam. Sciadopityaceae

Sciadopytis (Japan)

- Fam. Podocarpaceae

Podocarpus (Južna hemisfera)

- Fam: Araucariaceae

Araucaria (Čile i Patagonija)

A world map showing the distribution of gymnosperms. The Northern Hemisphere is highlighted in a light blue color, and the Southern Hemisphere is highlighted in a light orange color. The map shows the distribution of gymnosperms in the Northern Hemisphere (Taxodiaceae, Pinaceae, Cupressaceae, Cephalotaxaceae) and the Southern Hemisphere (Araucariaceae, Podocarpaceae).

**Sjeverna hemisfera:** Taxodiaceae, Pinaceae,  
Cupressaceae, Cephalotaxaceae

**Južna hemisfera:** Araucariaceae,  
Podocarpaceae

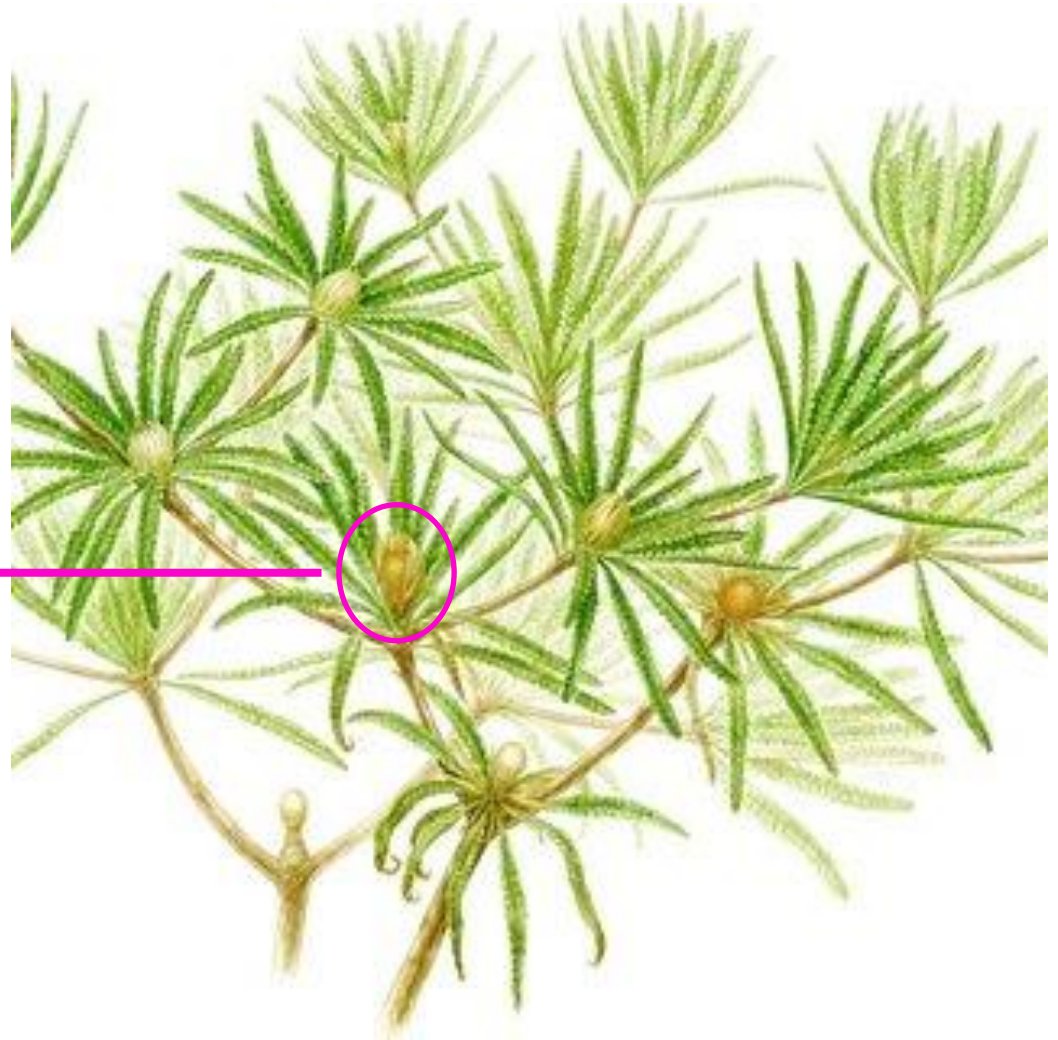
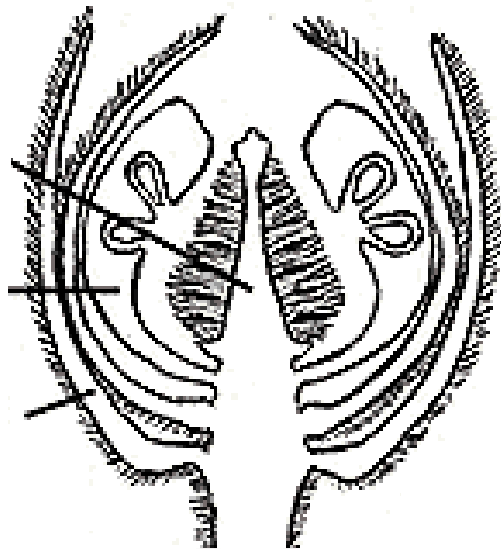
# Bennettitae (izumrle biljke)

Reproduktivne strukture  
zaodjenute ovojnim  
listovima, često dvopolne!

Sjemena  
loža  
(konusno  
izdignuta)

Sočni  
mikro-  
Sporofil

Ovojni  
listovi



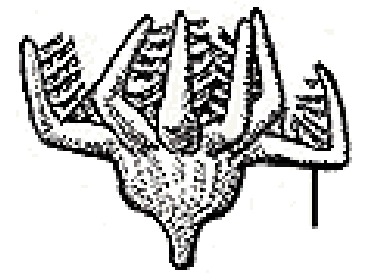
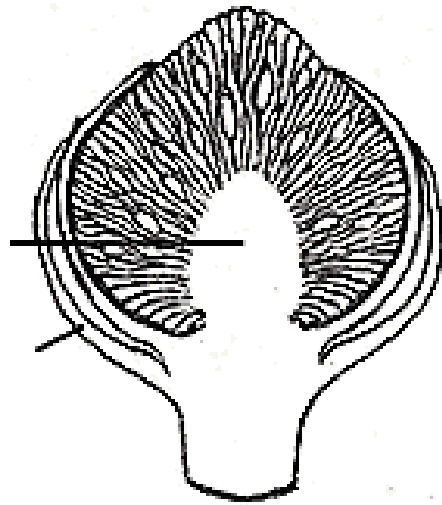
*Williamsonella* sp.



Slabo granato  
stablo

Sjemena  
loža

Ovojni  
listovi



Mikro-  
Sporofili sa  
sinangijama

*Williamsonia sp.*

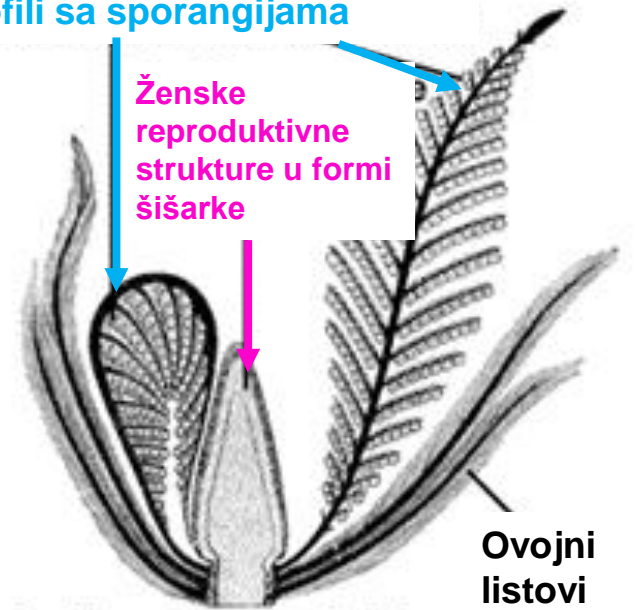




*Cycadeoidea*

Muške reproduktivne strukture  
Mikrosporofili sa sporangijama

Ženske  
reproduktivne  
strukture u formi  
šišarke



Ovojni  
listovi

- <https://www.youtube.com/watch?v=WqGhmkYXcdM&t=644s>