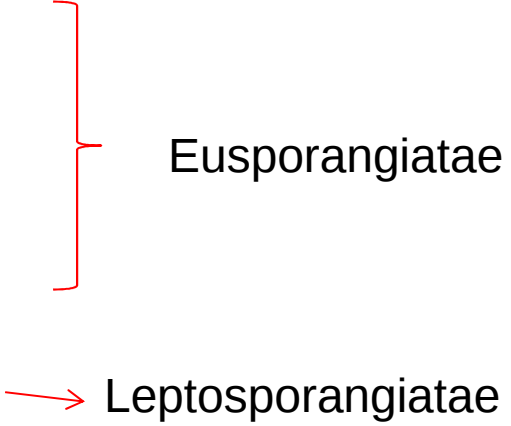
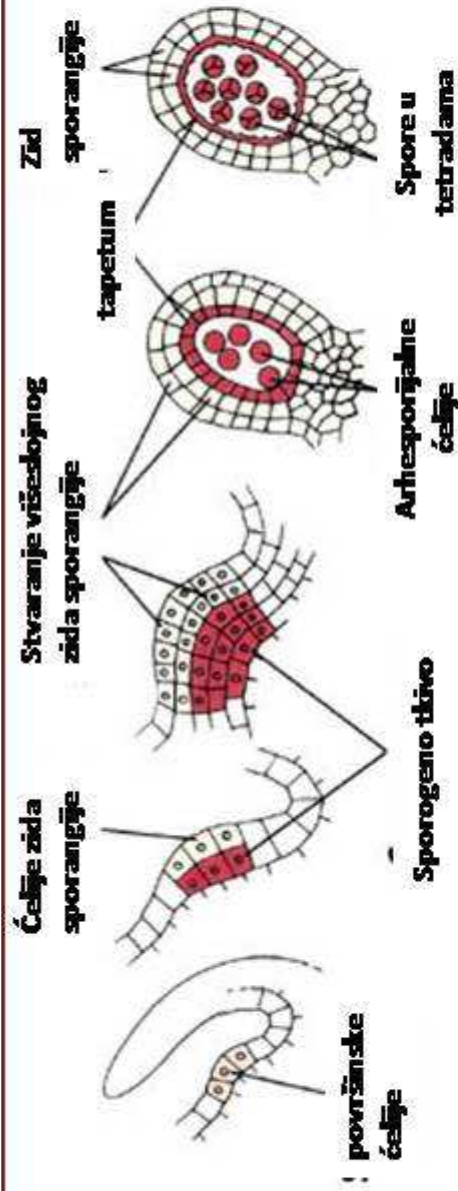


Monilophyta

- Psilotidae
 - Equisetidae
 - Marattiidae
 - Polypodiidae
- 
- Eusporangiatae
- Leptosporangiatae



Eusporangični razvoj

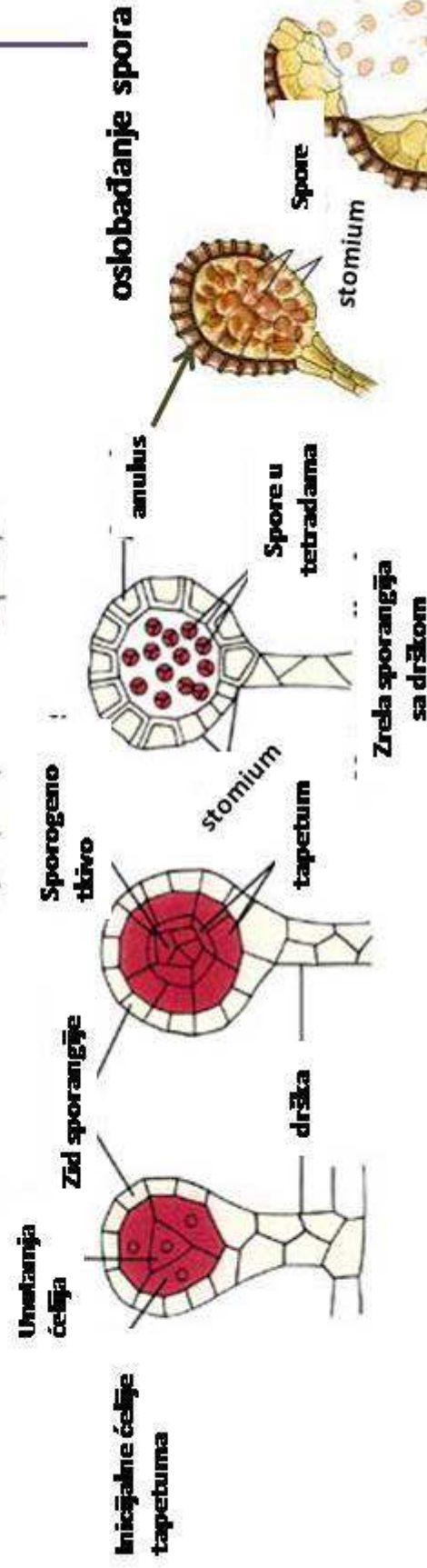
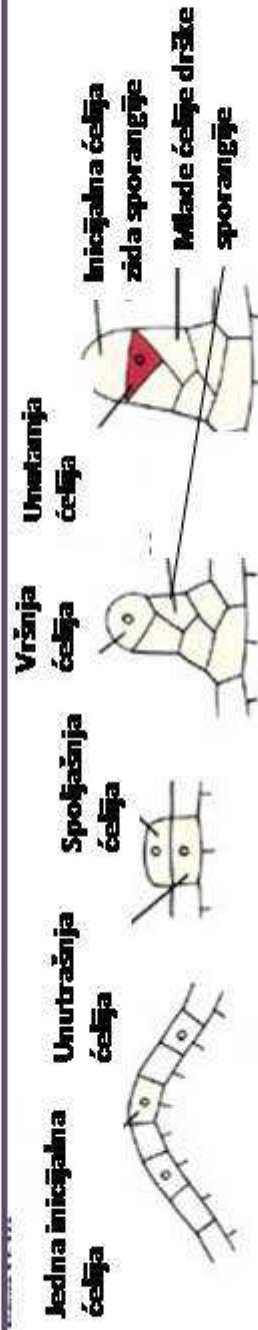


Figure 17-23b
Biology of Plants, Seventh Edition
© 2005 W. H. Freeman and Company

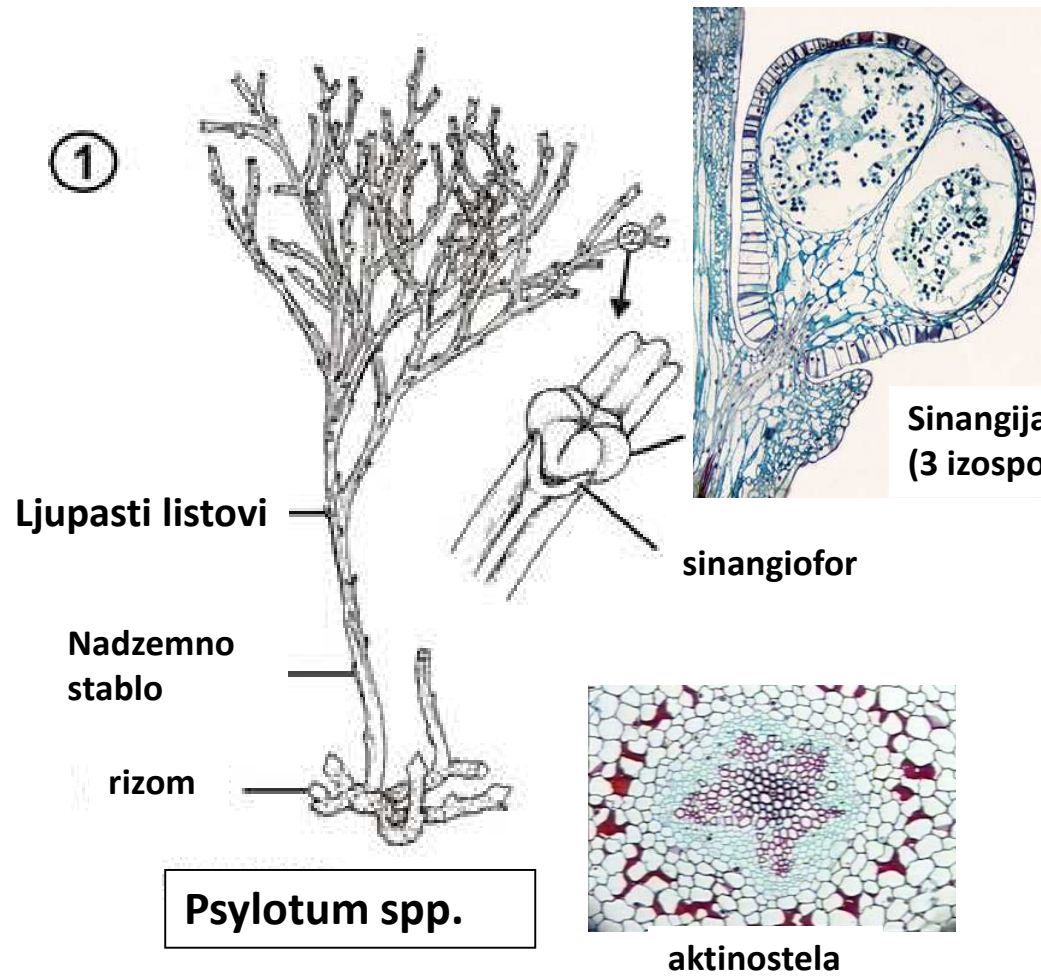
Psilotidae

(Divisio: Psilotophyta)

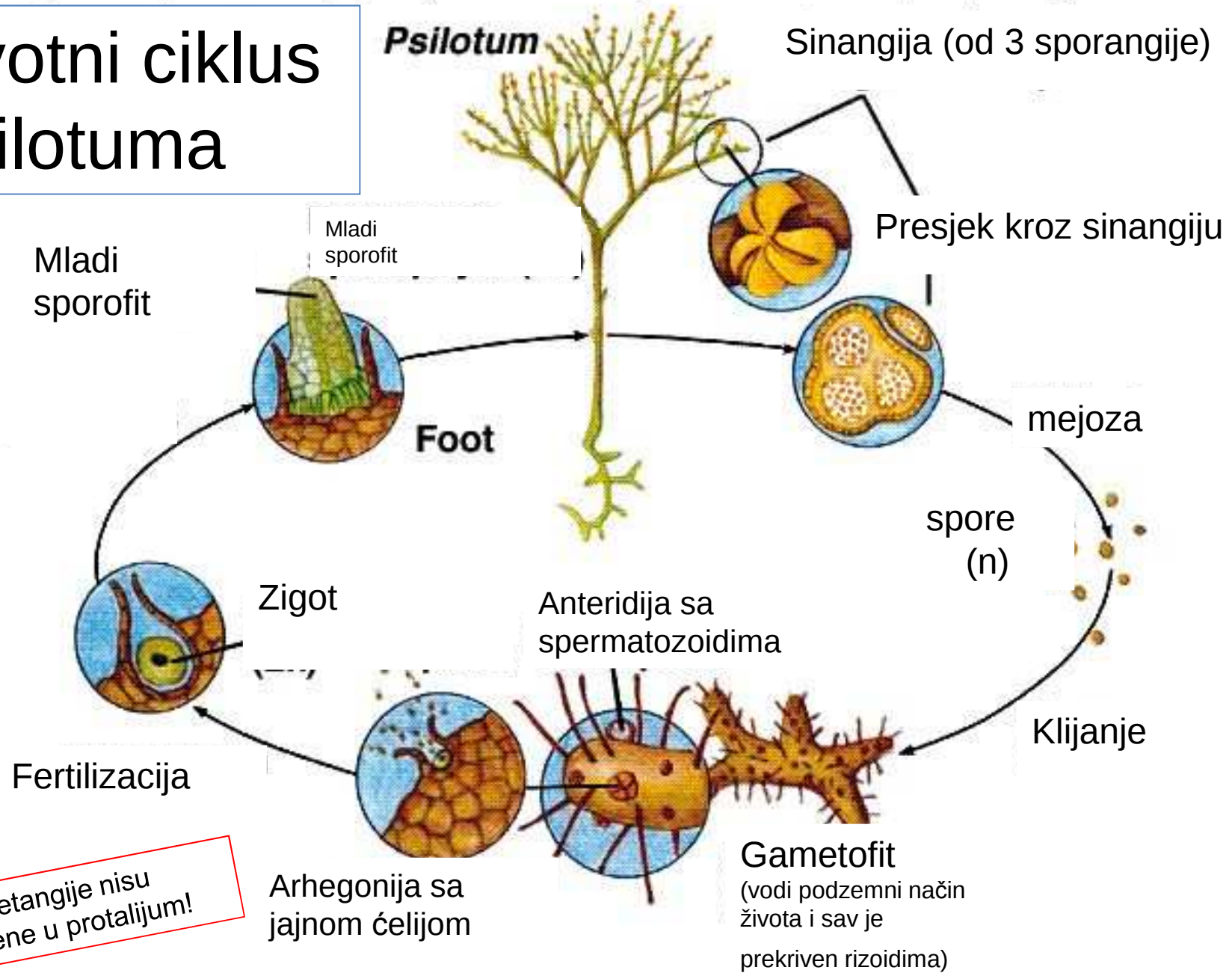
- Psilotales
- Ophioglossales

Psilotales

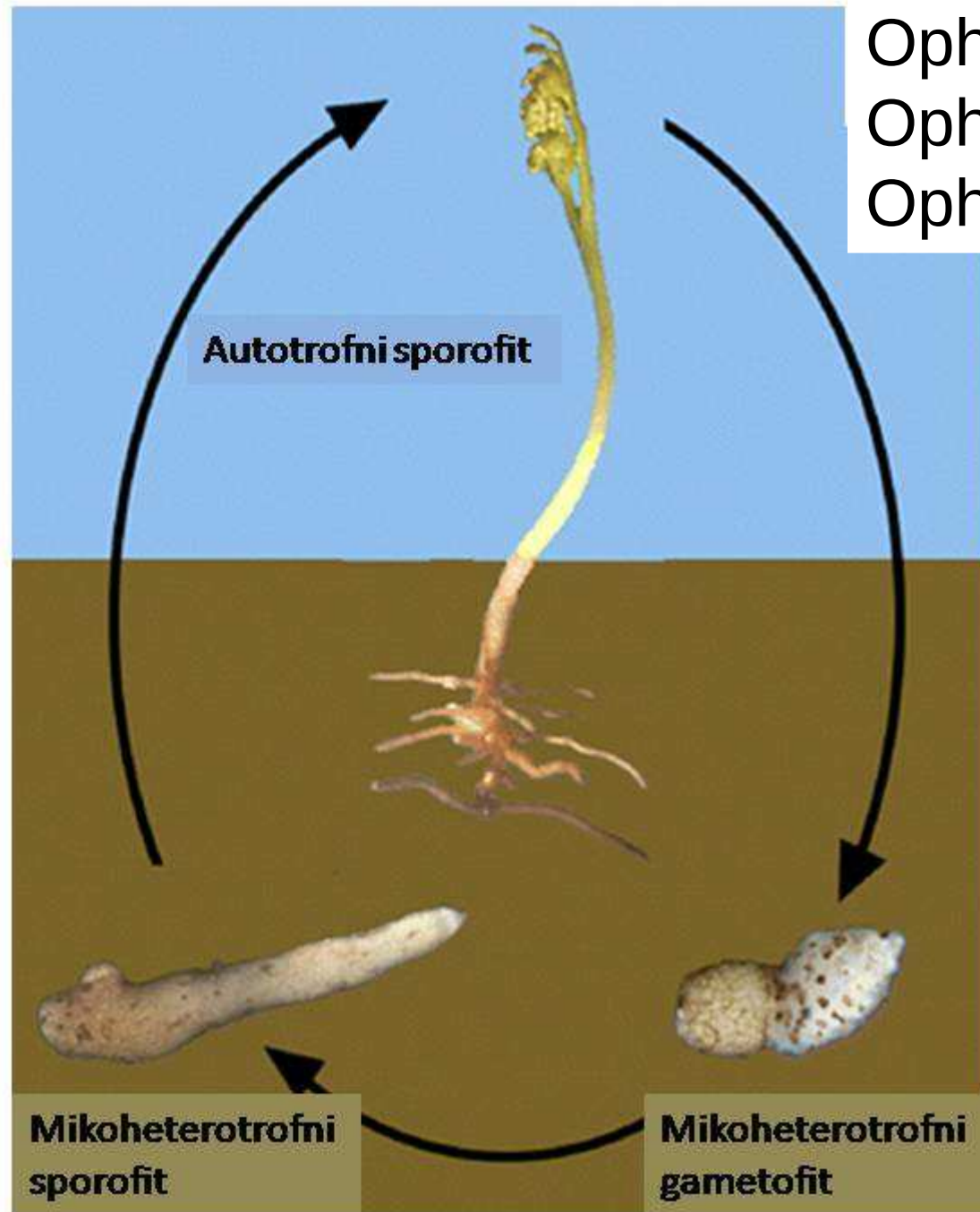
Potpuno odsustvo korjena!!!



Životni ciklus Psilotuma



Ophioglossales
Ophioglossaceae
Ophioglossum vulgatum



Fam. Ophioglossaceae



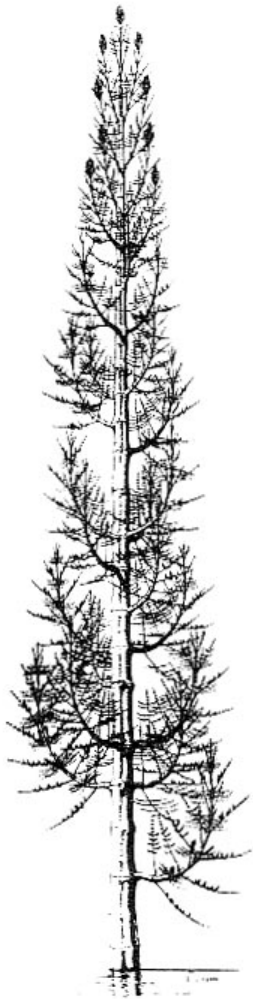
Ophioglossum ssp.
Sporofil i trofofil jednostavni!



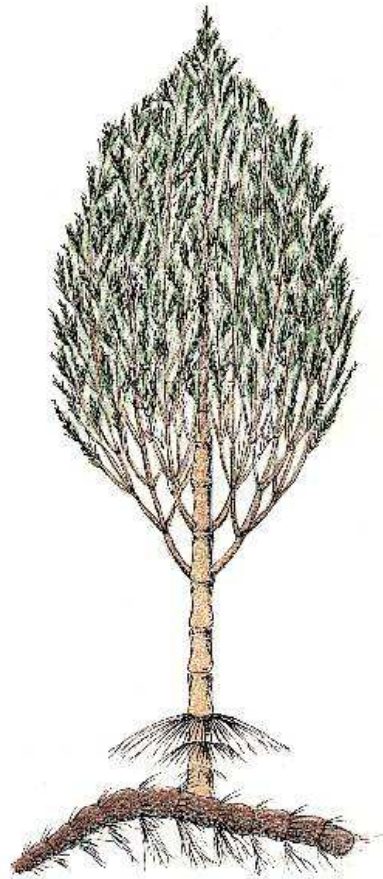
Botrychium lunaria
Sporofil i trofofil granati!

Equisetidae

(Div. Equisetophyta)



Pseudobornia ursina



Calamites spp.



Equisetum arvense

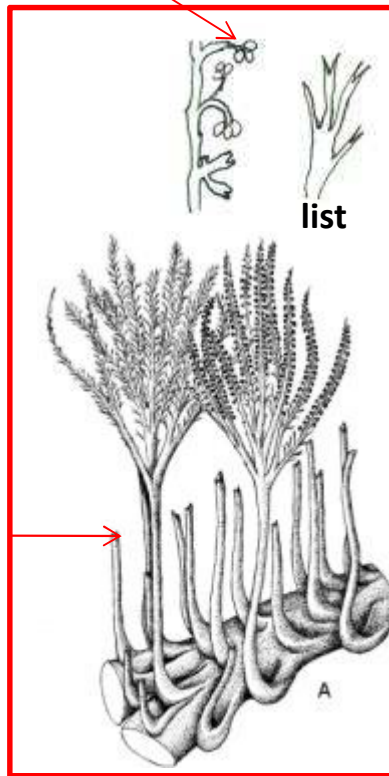
Podjela na redove

- Hyeniales (†)
- Sphenophyllales (†)
- Calamitales (†)
- Equisetales

o. Hyeniales

fam. Hyeniaceae

Tri sporangije na
dihotomo granatom
sporangioforu



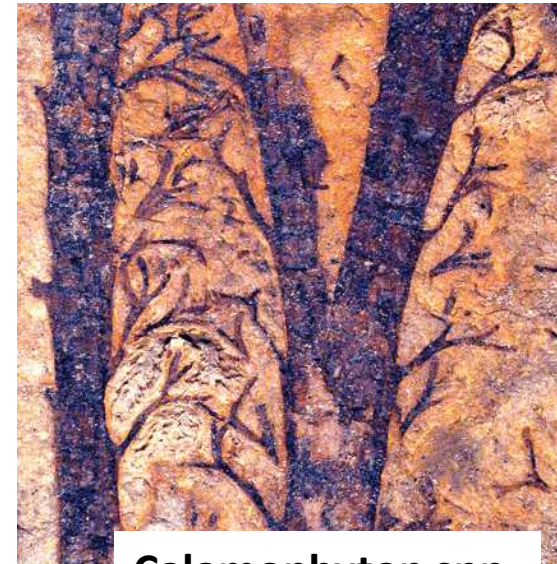
Člankovitost
stabla nije
izrazena

Hyenia spp.

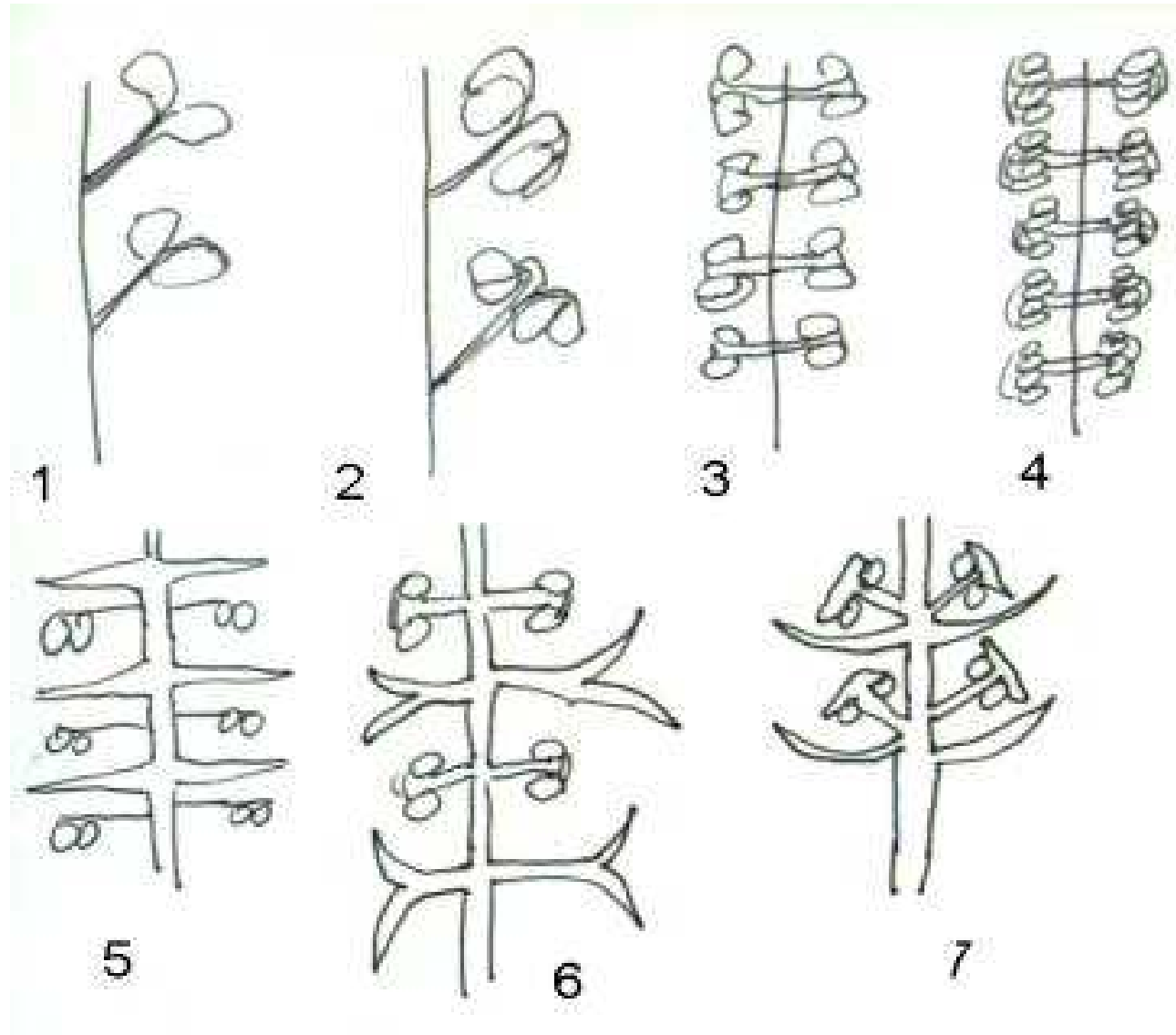


Sporangije
pojedinačne

Calamophyton spp.



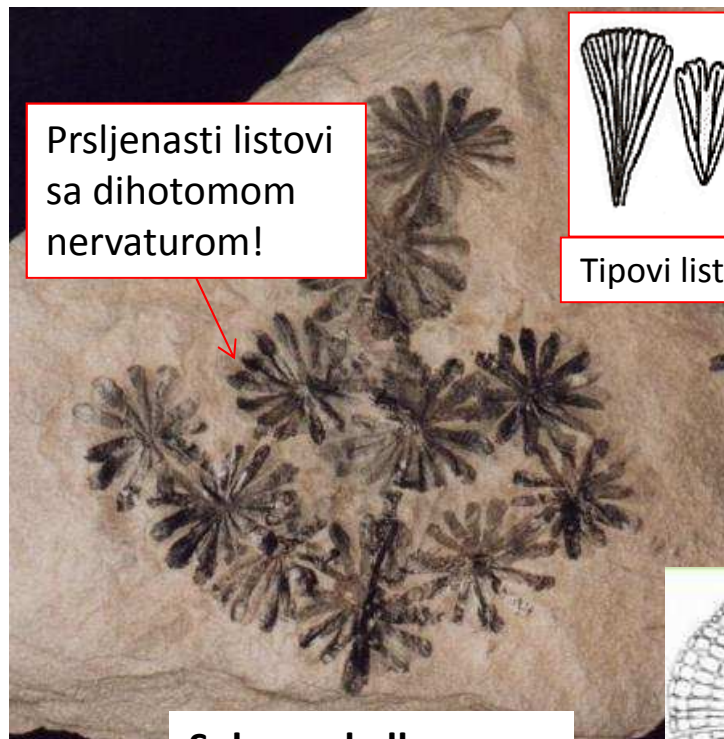
Calamophyton spp.
fosilni nalaz



1 – Calamophyton 2 – Hyenia 3- Archaeocalamites 4- Equisetum
 5 – Lingularia 6 – Calamostachys 7 – Paleostachys

o. Sphenopyllales

fam. Sphenophyllaceae

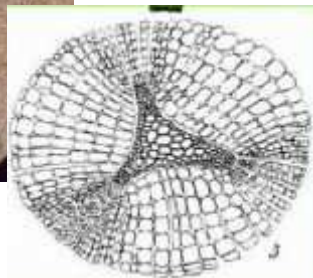


Prsljenasti listovi
sa dihotomom
nervaturom!

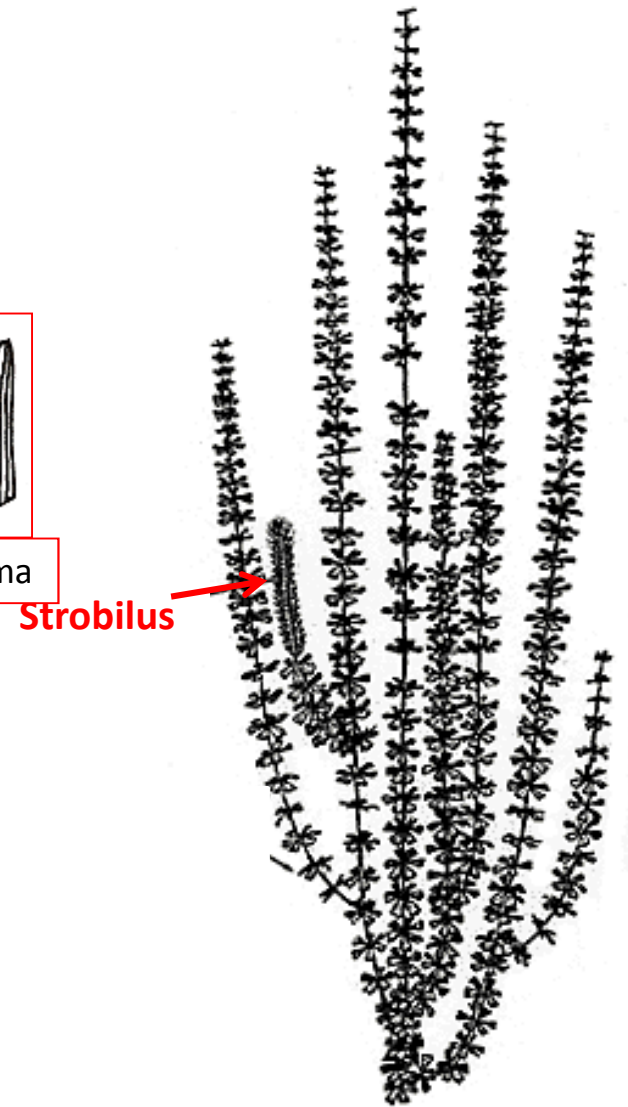
Sphenophyllum spp.
fossilni ostaci



Tipovi listova kod Sphenophylluma

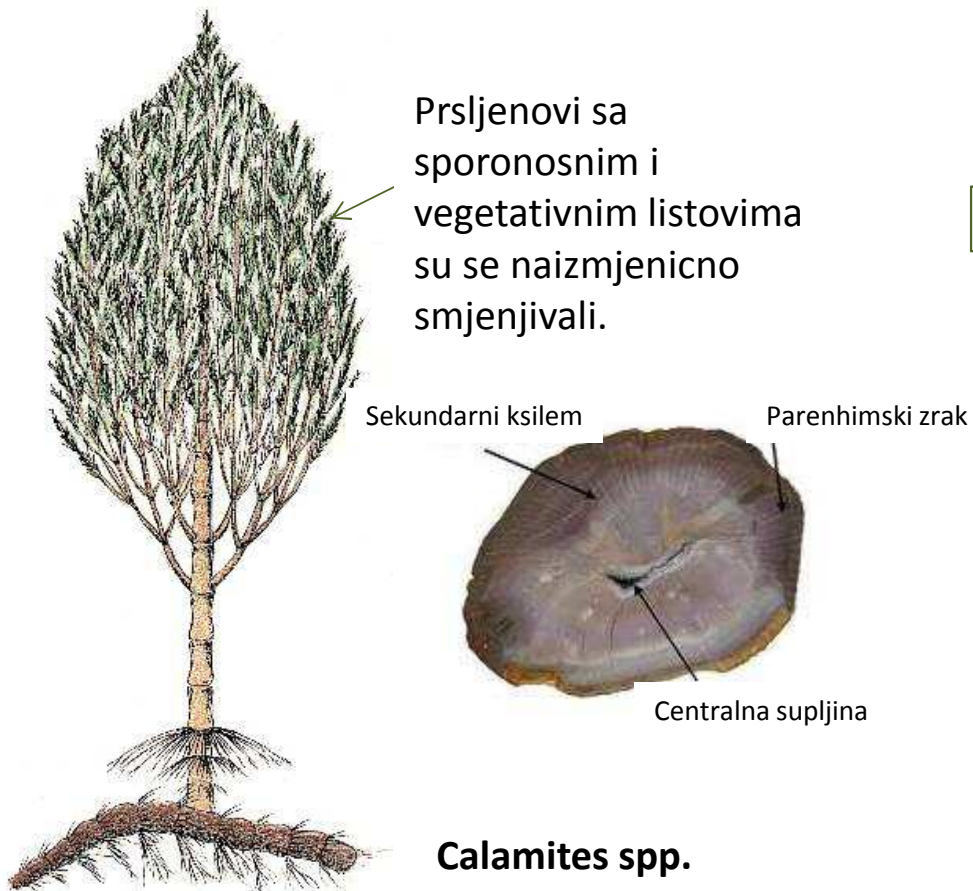


Aktinostela
(triarhna)

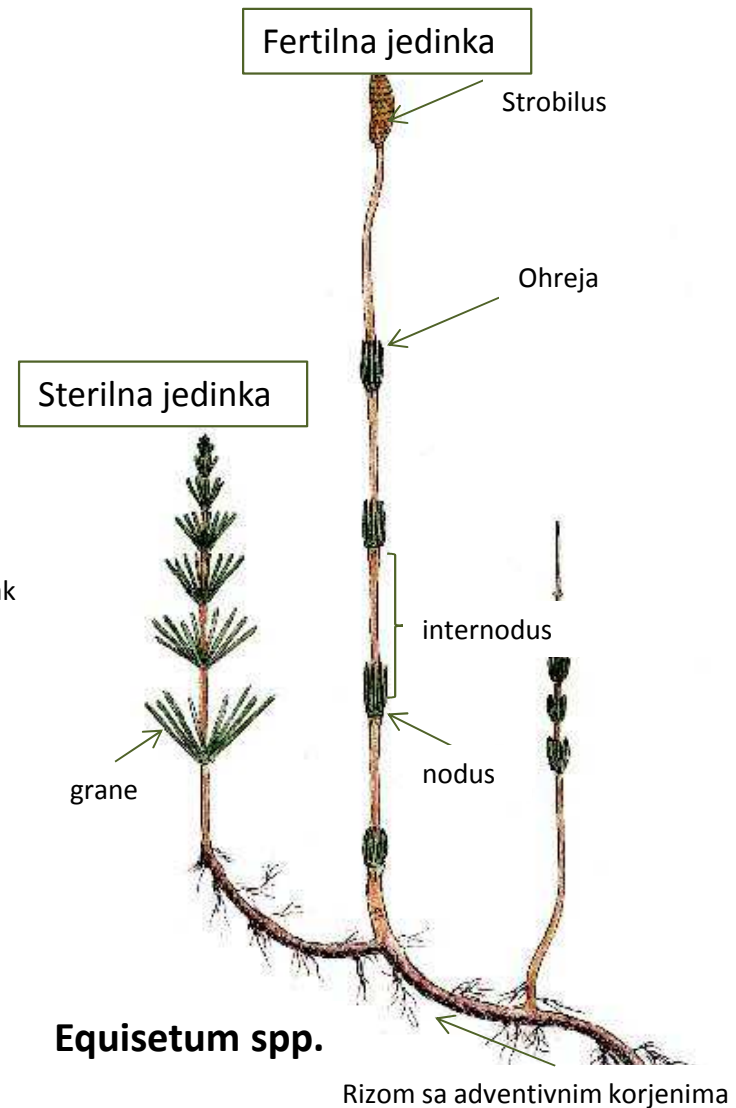


Sphenophyllum spp.
rekonstrukcija

o. Calamitales fam. Calamitaceae

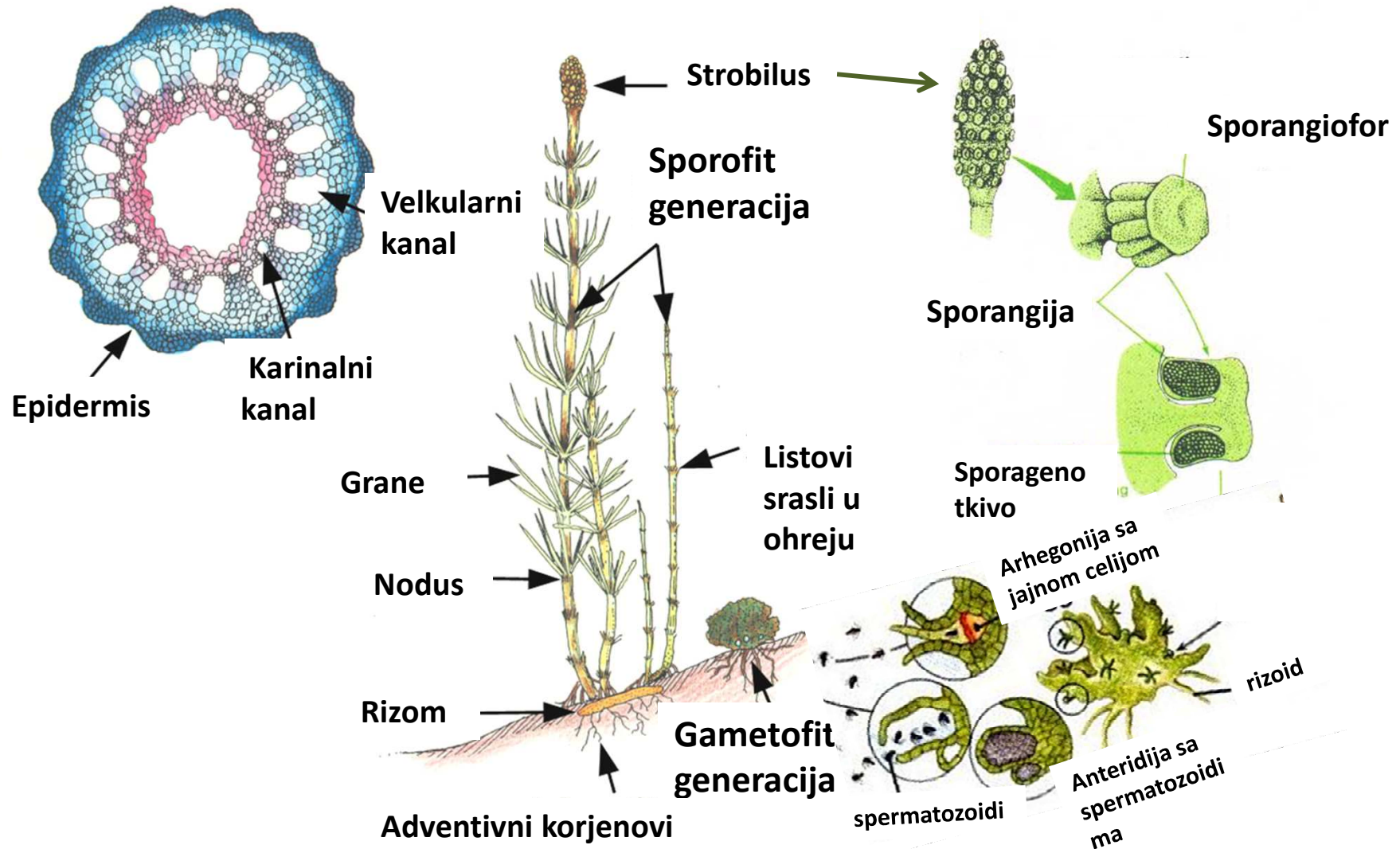


o. Equisetales fam. Equisetaceae

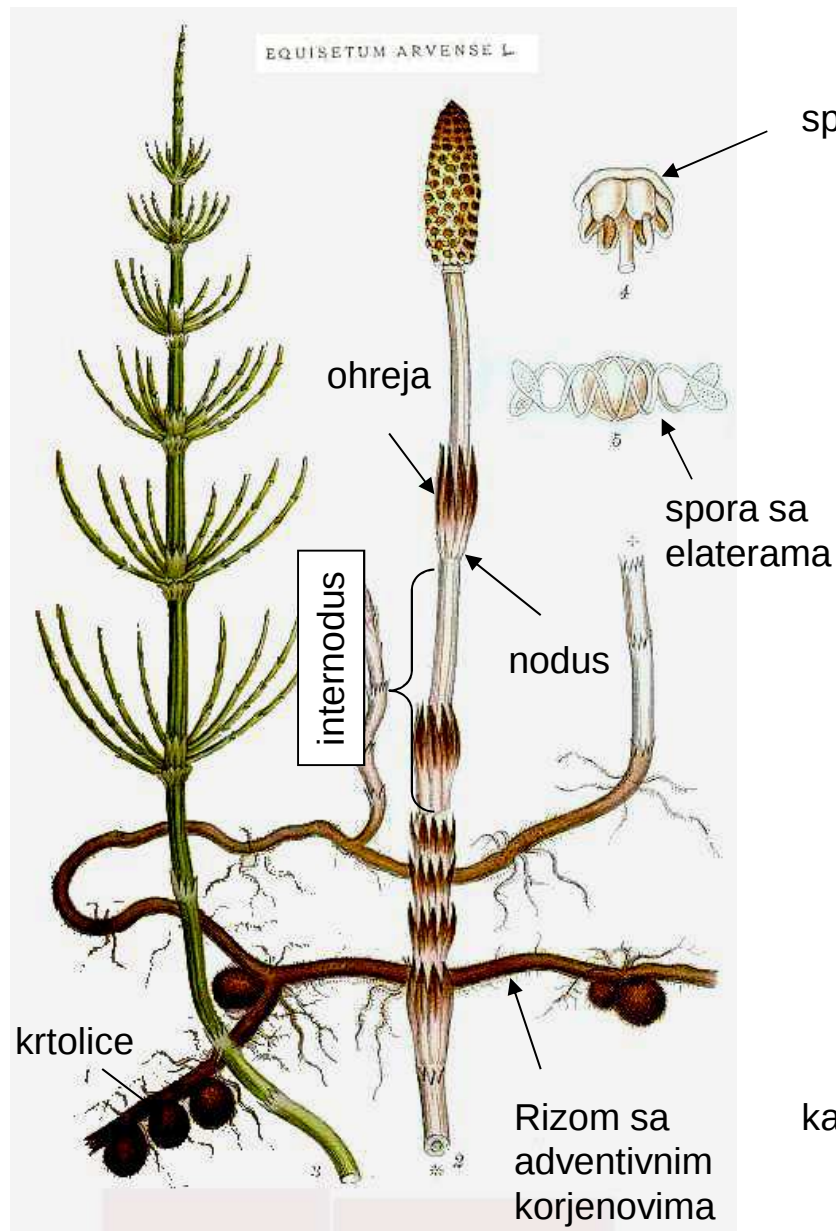


Presjek kroz
stablo

Equisetum - ciklus razvika



Morfološke odlike vrste *Equisetum arvense*



Člankovitost građe

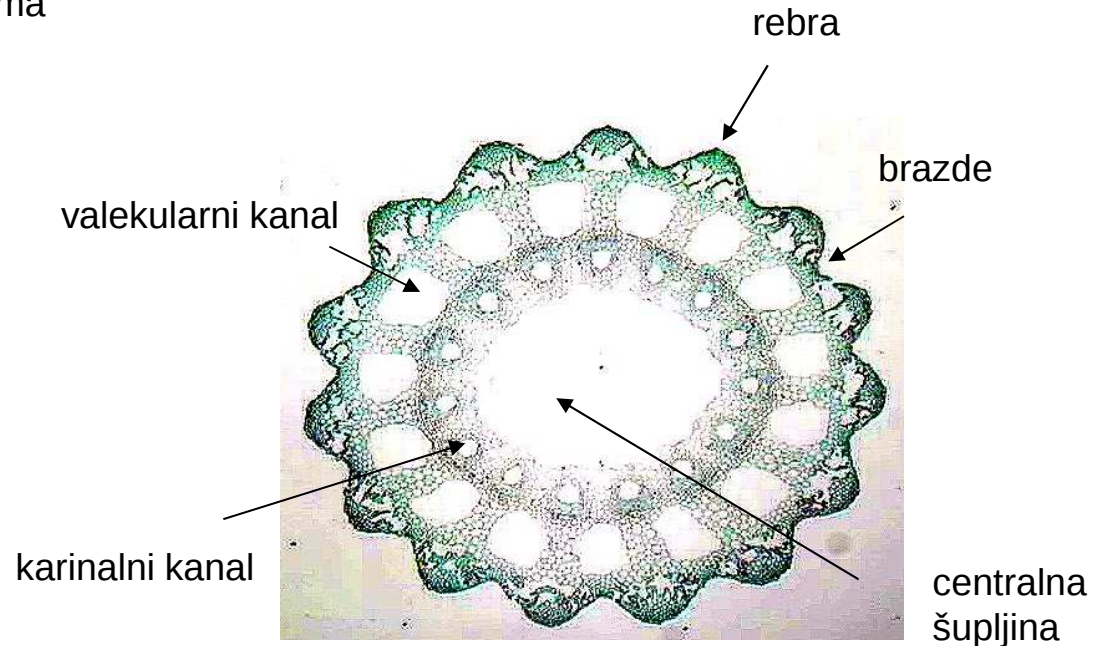
Odsustvo trajnog primarnog korjena

Redukovani listovi

Ohreje

Elatere

Izosporija



Taksonomski markeri

- Dimorfizam fertilne i sterilne jedinke
- Broj zubaca u ohreji
- Broj rebara ili brazda na stablu i vaskularnih šupljina
- Oblik vrha klasića

Izražen dimorfizam fertilne i sterilne jedinke

Equisetum arvense



6-12 zubaca u ohreji



Equisetum telmateia



20-30 zubaca u ohreji

Equisetum sylvaticum



Grane pršljenasto
granate

Equisetum pratense



Grane jednostavne



Dimorfizam fertilne i sterilne jedinke nije izražen

STROBILUSI TUPI



Equisetum palustre



Zubići bez brazde i
sa širokim obrubom



Equisetum fluviatile

STROBILUSI ŠILJATI



Zubići ,ohreje opadaju

Equisetum hiemale



Zubići ,ohreje trajni

Equisetum variegatum

Marattiidae

- Eusporangijatne paprati, sinangije
- U vegetativnim djelovima postoje smoni hodnici, nalik četinarima!

Marattiales

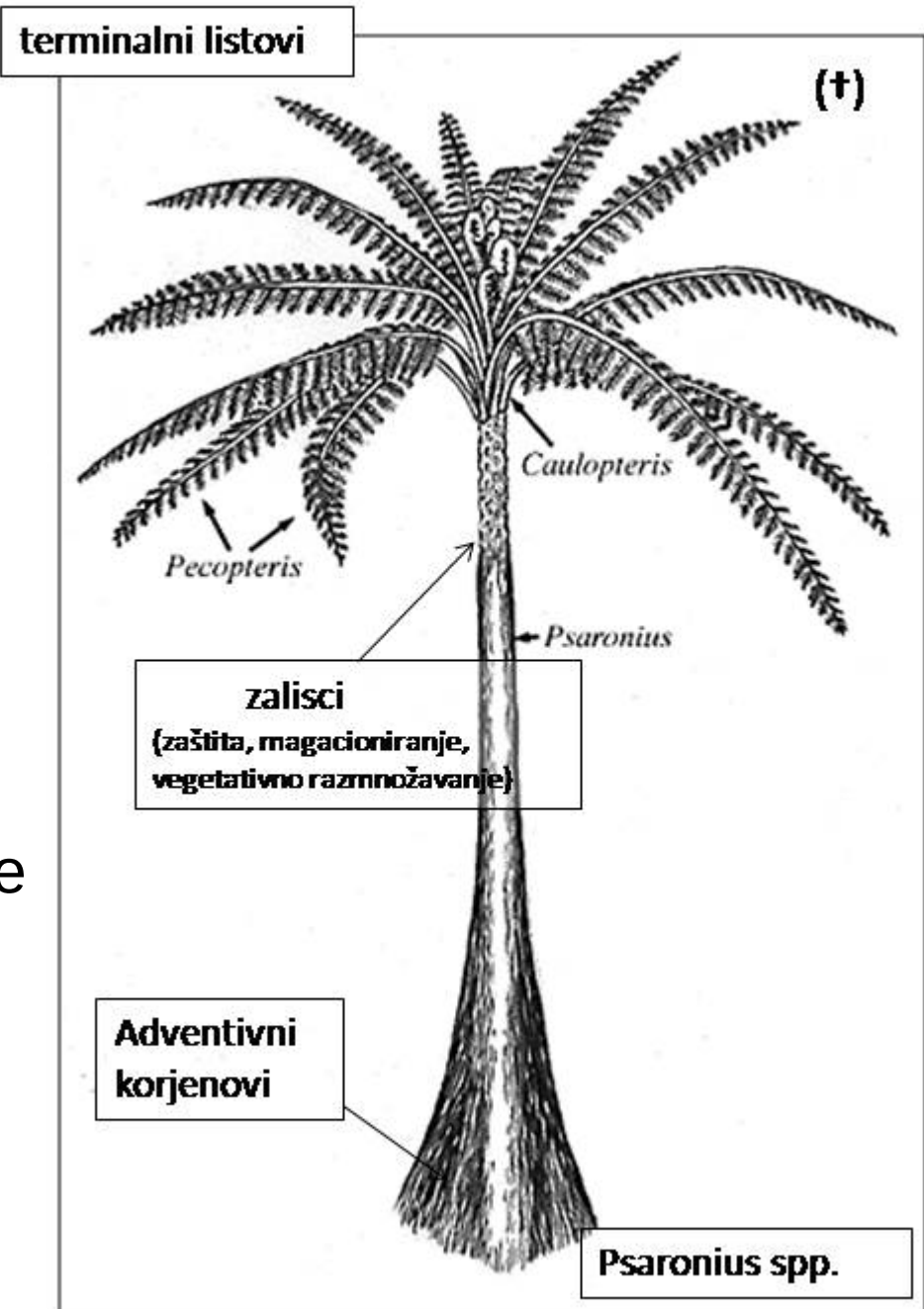
Marattiaceae

Marattia sp.

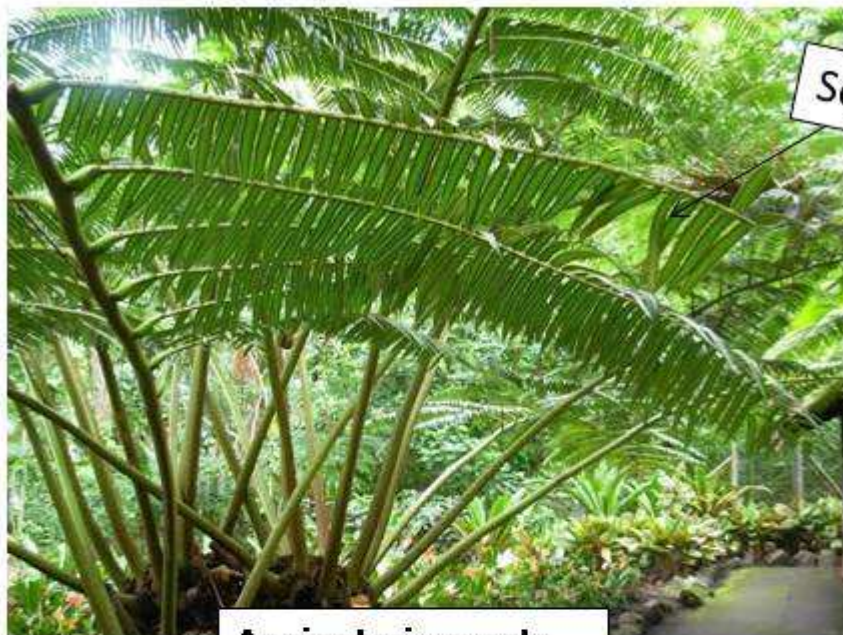
Angiopteris sp.

Psaroniaceae

Psaronius sp.



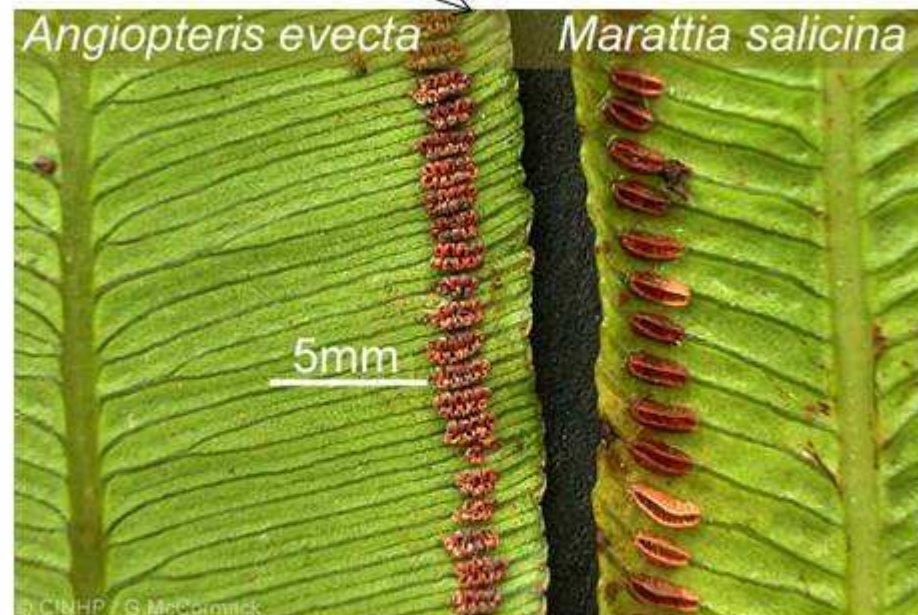
Doba karbon-perm



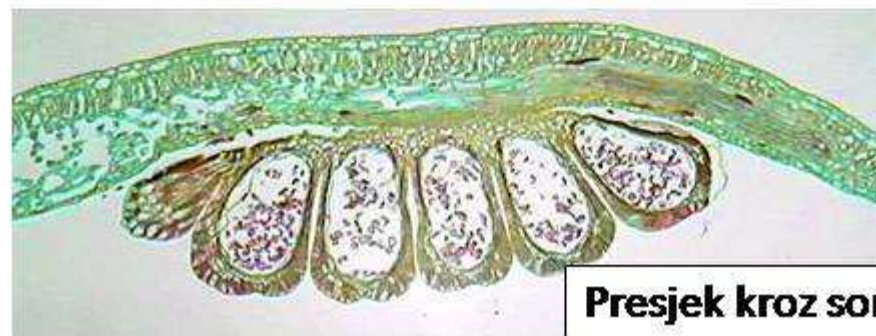
Angiopteris evecta

Sorusi na naličju

Sinangije...



Marattia spp.

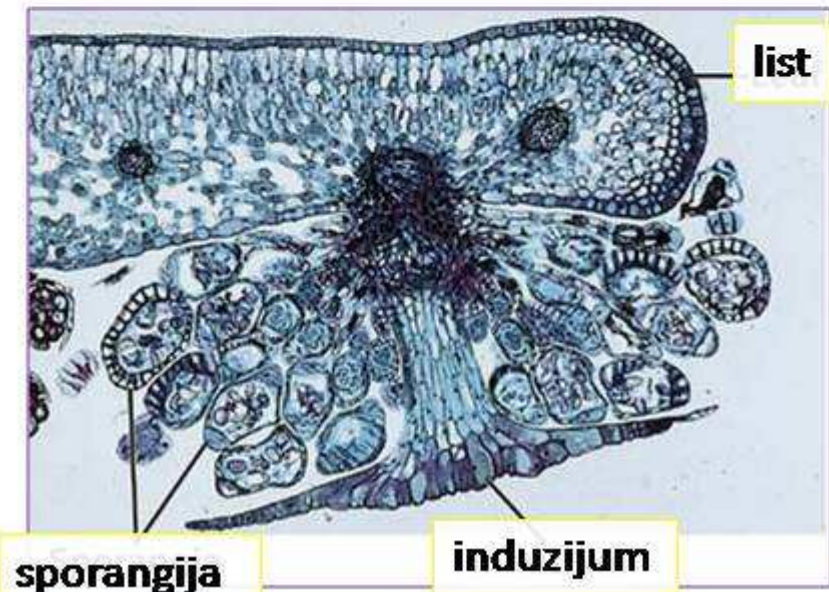
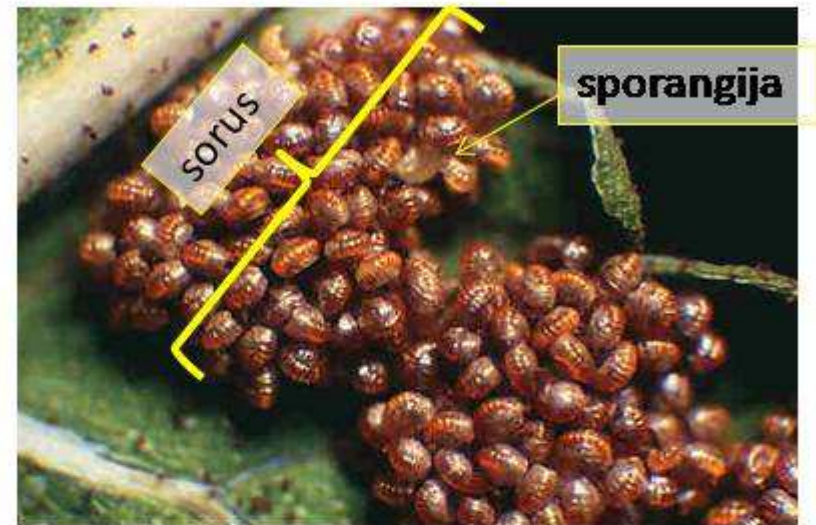


Presjek kroz sorus

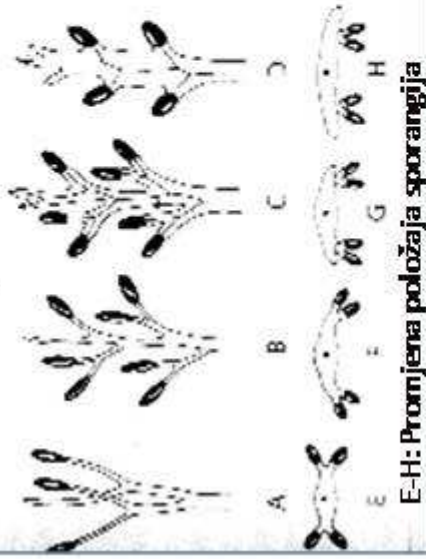
Polypodiidae

Leptosporangične paprati, rizom, izo-,
Heterosporija

List uvijen u obliku puževe kućice



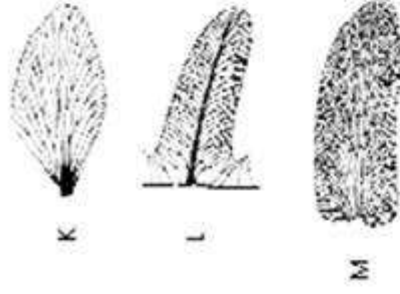
A-D: Nastanak sporofila od fertilnih grana teloma



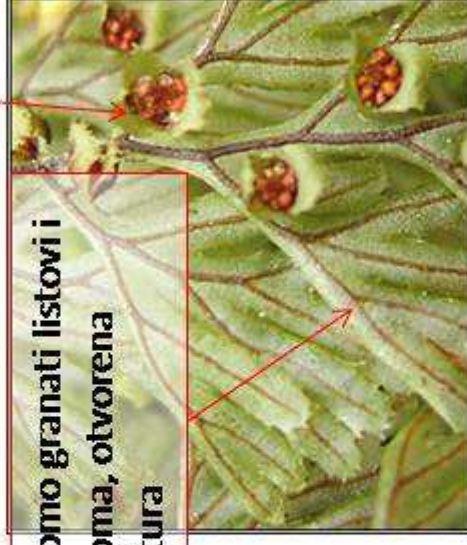
E-H: Promjena položaja sporangija

Sporofil
Acrostichum

- K-M: tipovi lisne nervature
- K- dihotoma nervatura lista
- L- perasta nervatura
- M- mrežasta nervatura

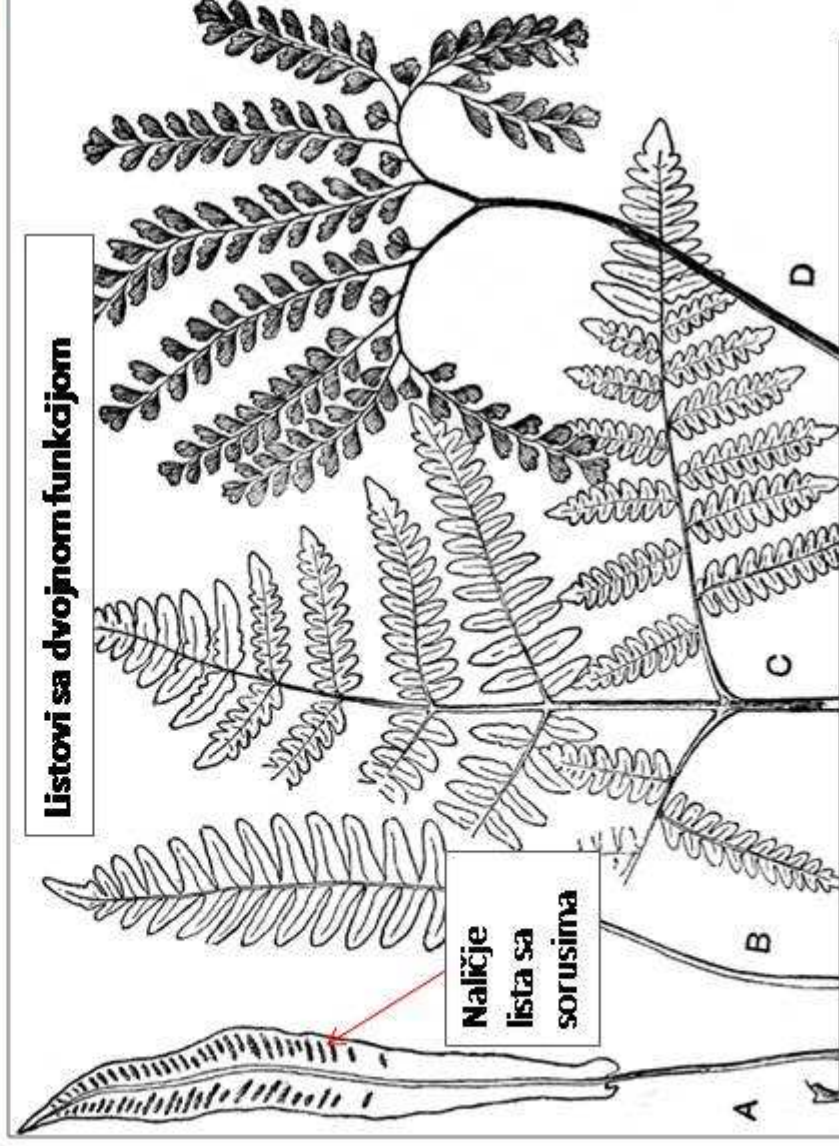


Dihotomo granati listovi i
dihotoma, otvorena
nervatura



sorus

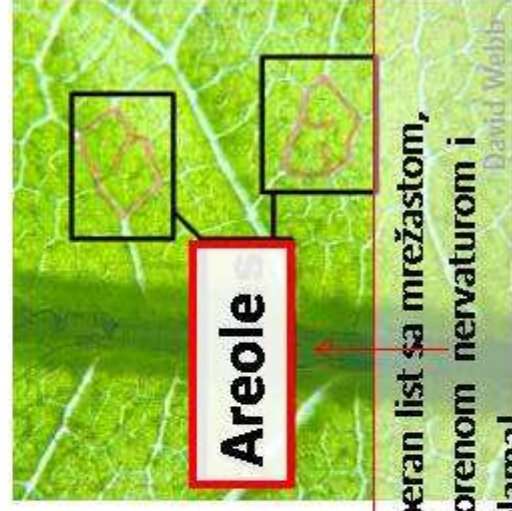
Listovi sa dvojnjom funkcijom



Naličje
lista sa
sorusima

A- Phyllitis; B- Polypodium; C- Pteridium; D- Adiantum

Fam. Hymenophyllaceae



Areole

Rasperan list sa mrežastom,
zatvorenom nervaturom i
areolama!

David Webb

Recentne paprati

Osmundales

Hymenophyllales

Gleicheniales

Schizaeales

Salviniales- imaju predstavike u flori CG!

Cyatheaales

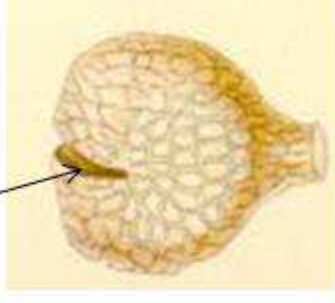
Polypodiales- imaju predstavike u flori CG!

Osmundales



Osmunda regalis

tjemena
pukotina na
izosporangiji



Sporofil

trofofil

Nemaju soruse, niti induzijum!
Anulus ili ne postoji ili je jednostran.

Cyatheaales- drvenaste paprati



Cyathea dealbata



Salviniales



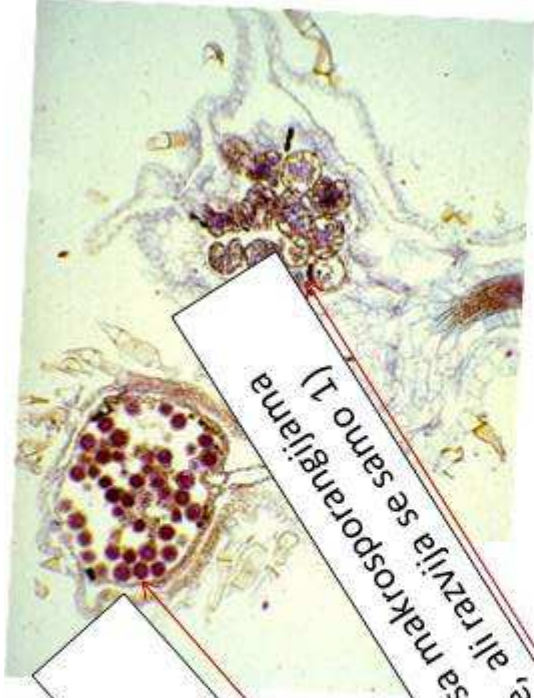
Bradavice i
dlačice na listu

Flotantni listovi



Salvinia natans

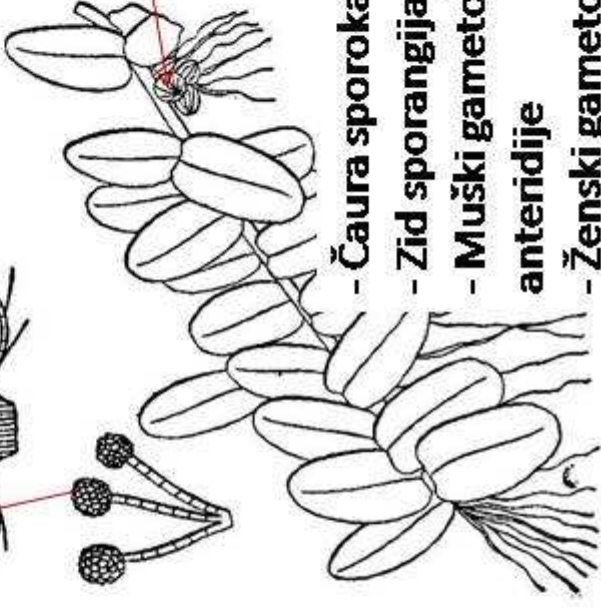
Podvodni
končasti listovi!



Sporokarp sa mikrosporangijama
u kojima nastaje po 63 spore



Sporokarp sa makrosporangijama
(32 spore, ali razvija se samo 1)



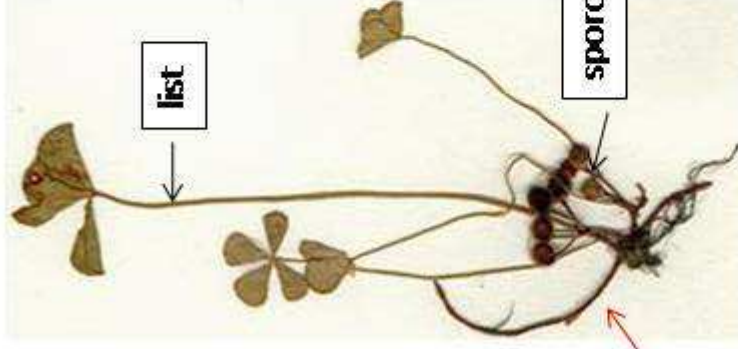
Sporokarp (sorusi)

- Čaura sporokarpa dvojna
- Zid sporangija jednoslojan!
- Muški gametofit= protalijum sa 2 anteridije
- Ženski gametofit= protalijum sa 1 arhegonijom



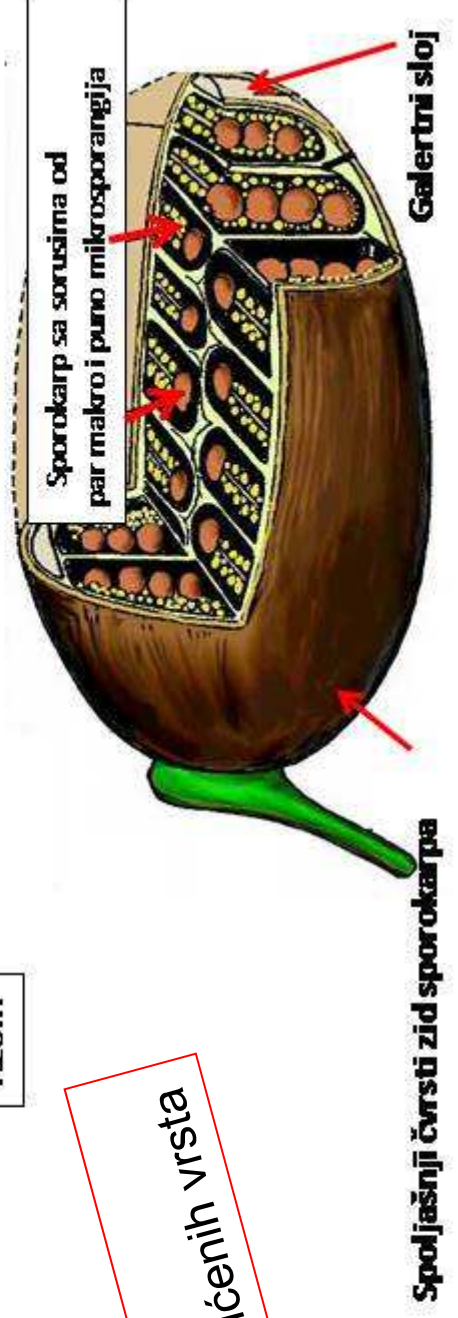
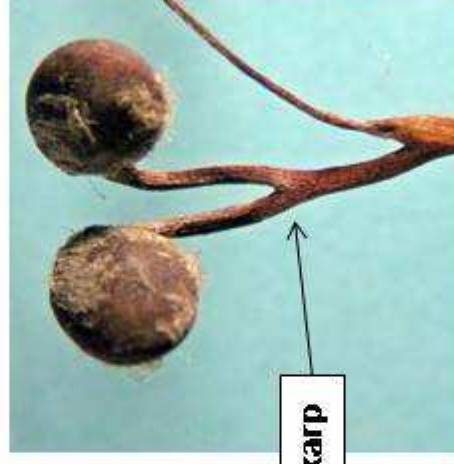
Marsilea quadrifolia

rizom



sporokarp

list



Sporokarp sa sorusima od par makro i puno mikrosporangija

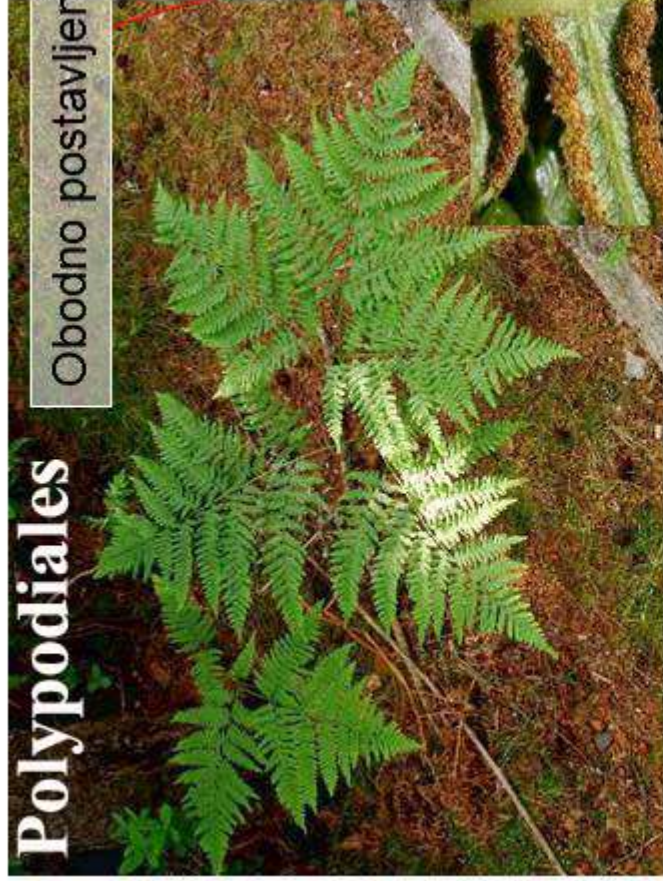
Galertrni sloj

Spoljašnji čvrsti zid sporokarpa

Zastupljena u flori CG,
i na listi zakonom zaštićenih vrsta

Polypodiales

Obodno postavljeni sorusi



Induzijum razdijeljen



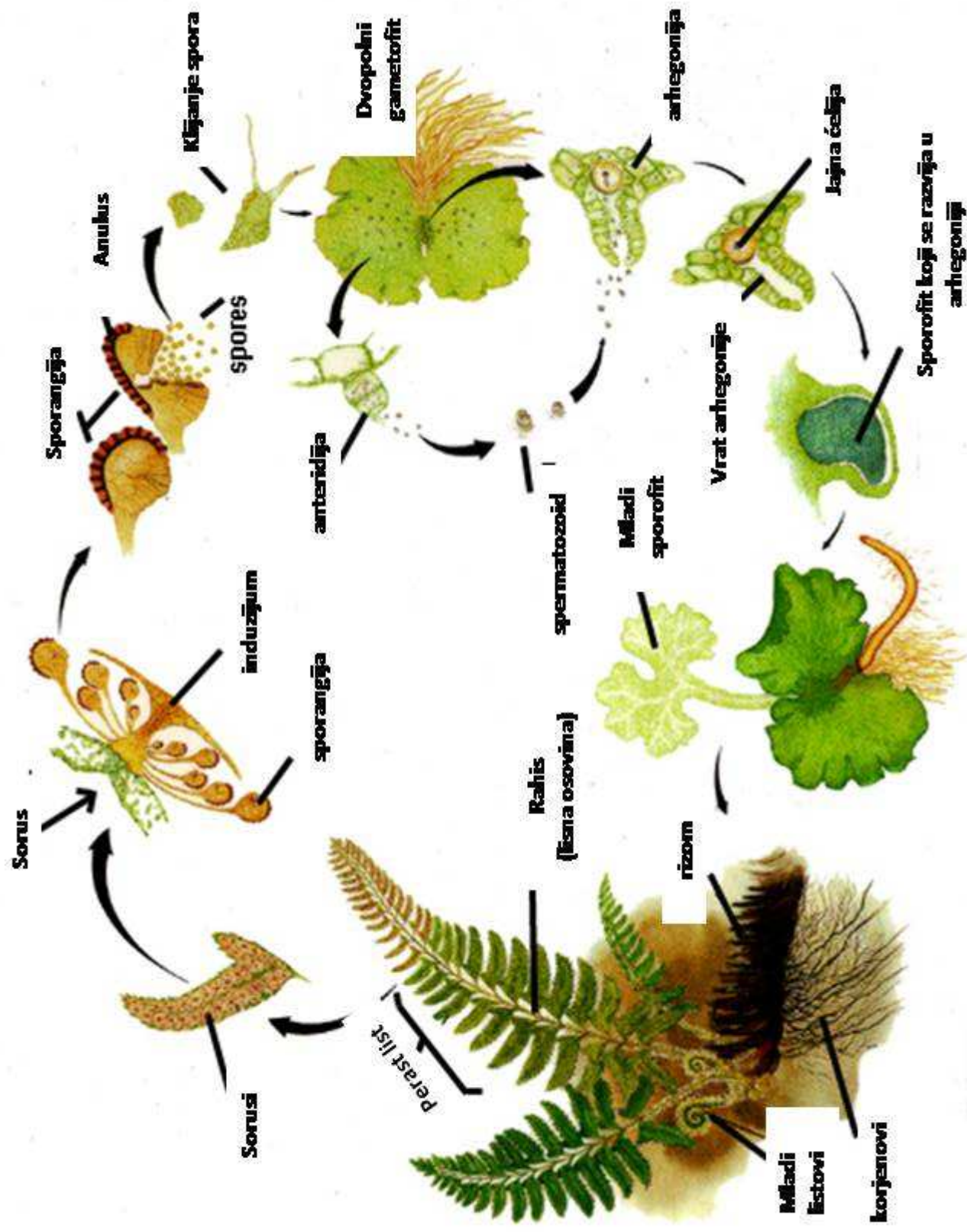
Induzijum jajast i jednostrano pričvršćen



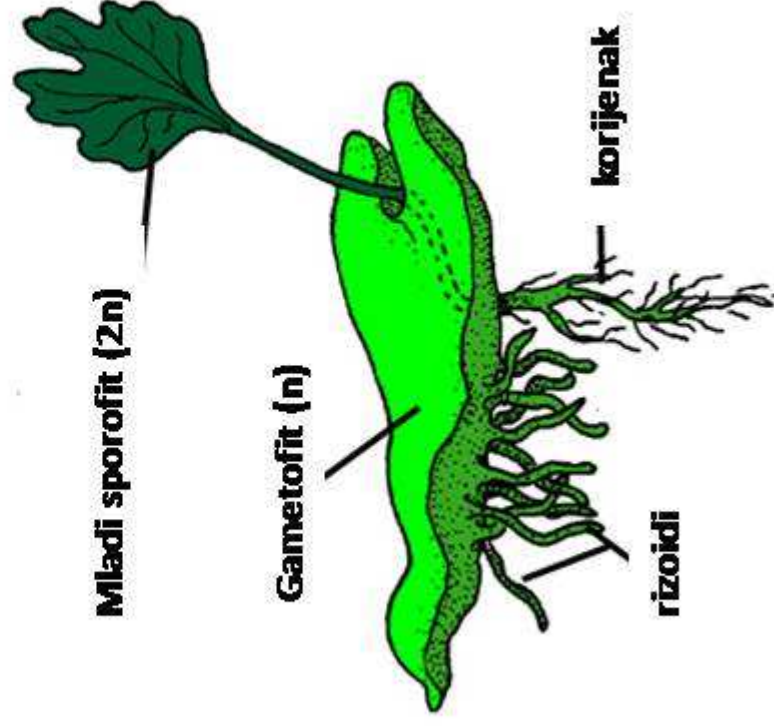
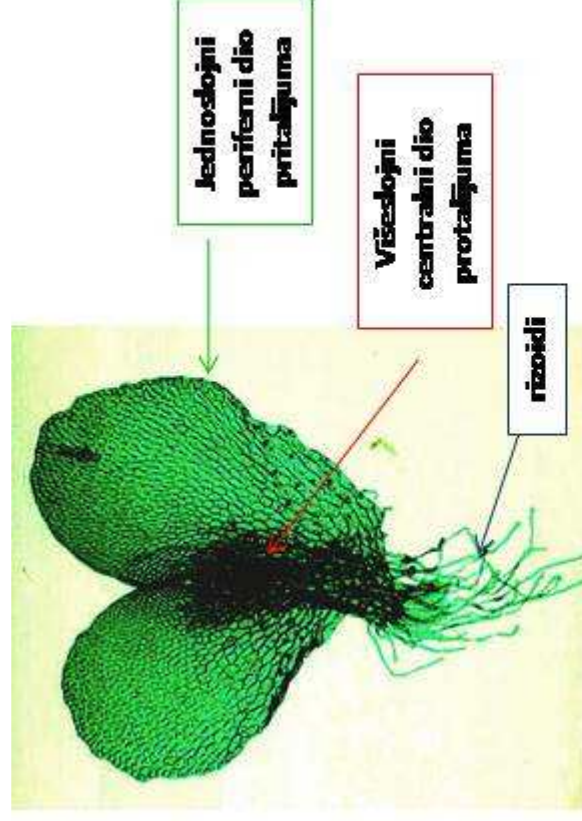
Induzijum cio i u vidu kišobrana



Opšti ciklus razvića paprati



Protalijum (autotrofan!)



Odstupanje od opšteg scenarijuma ciklusa razvića:

Apo= bez

- **Aposporija**- nastanak gametofita ne iz spore, već iz vegetativne ćelije sporofita. Gametofit je $2n$.
- **Apogamija**- nastanak sporofita iz ćelija gametofita. Sporofit je n .
- **Partenogeneza**- razvitak bez prethodnog oplodjenja. Ženski gamet je diploidan i iz njega nastaje sporofit.

Listovi cijeli

Fam: Polypodiaceae
taksonomski markeri

Listovi dijeljeni

Listovi dvobojni

Listovi jednobojni

Listovi
jednostruko
perasti

Listovi
višestruko
dijeljeni ...

Sorusi na rubu čine
neprekidnu liniju

Sorusi drugačiji

Sorusi
prekriveni
rubom listića

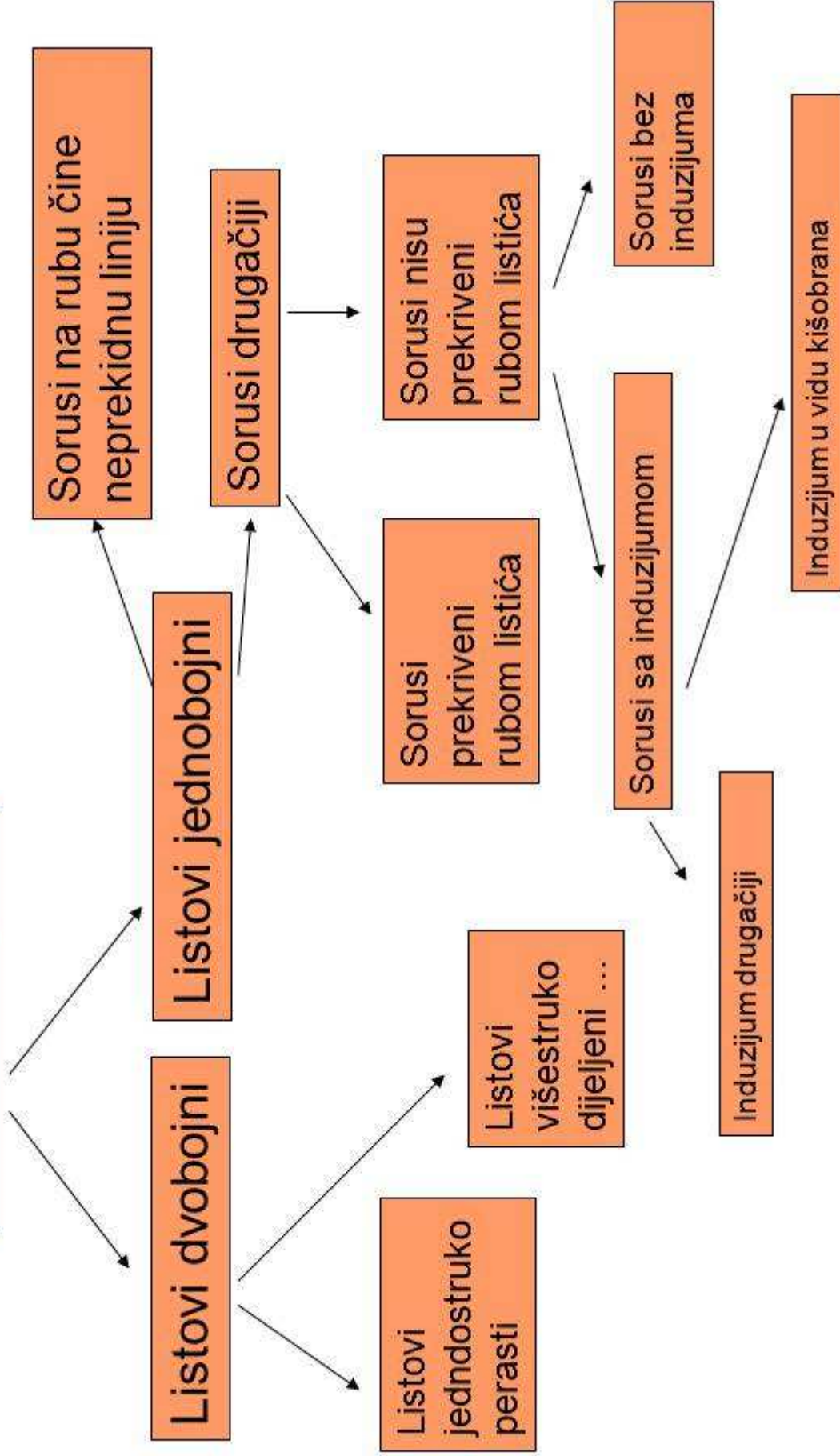
Sorusi nisu
prekriveni
rubom listića

Sorusi sa induzijumom

Sorusi bez
induzijuma

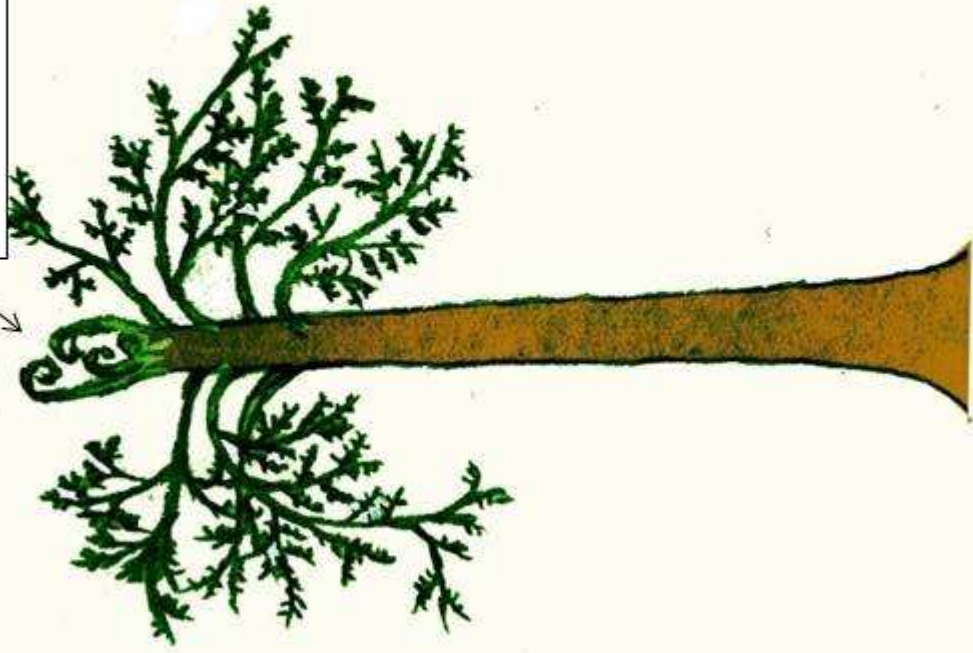
Induzijum drugačiji

Induzijum u vidu kišobrana



Izumrli predstavnici papratolikh
biljaka (Lignophyta)

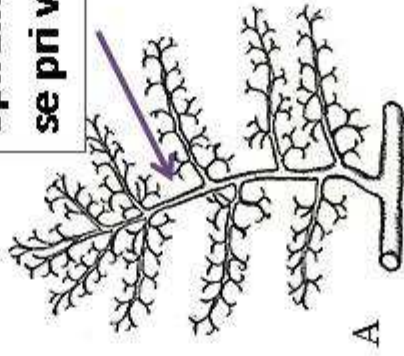
Pužasto uvijene,
mlade, bezlisne
grane



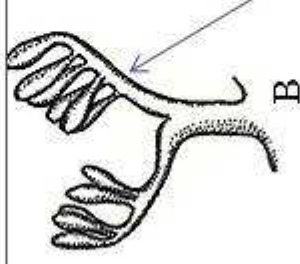
Aneurophyton spp.

... protostela

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



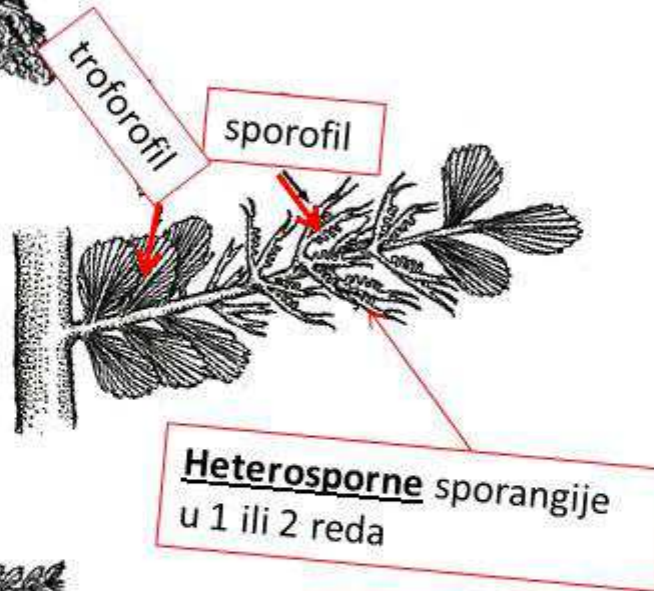
Fertilne grane, sa
izospornim,
terminalnim
sporangijama



Sekundami ksilem je slabo razvijen, pa se smatra da su biljke prije imale formu nježnogžbuna ili lijana, nego drveta.

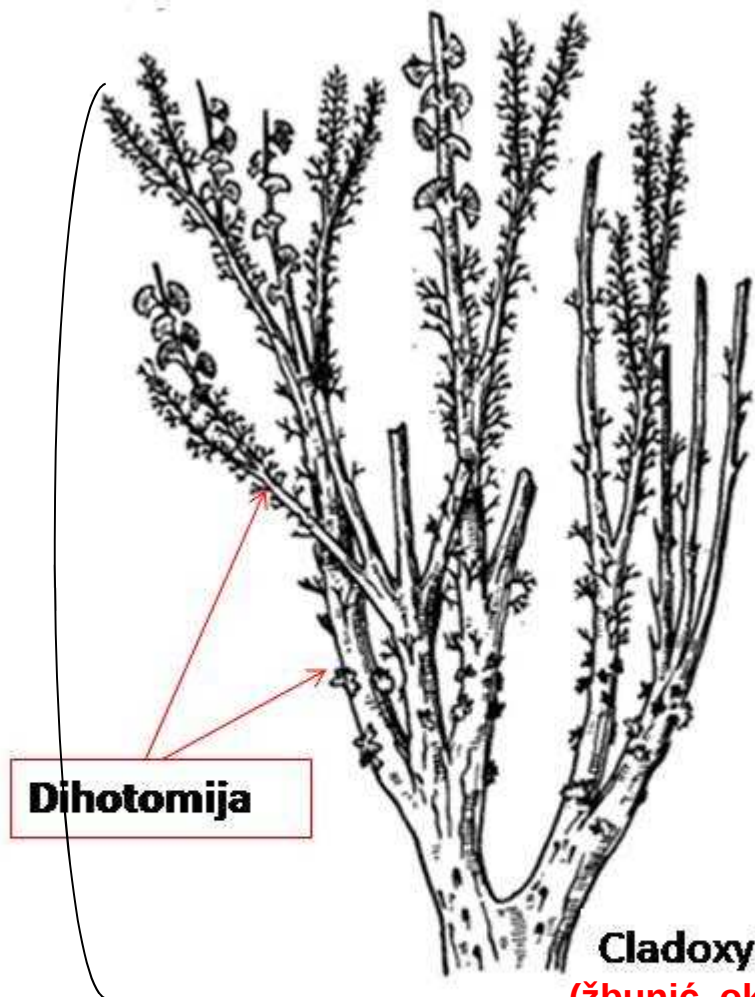


Archaeopteris spp.



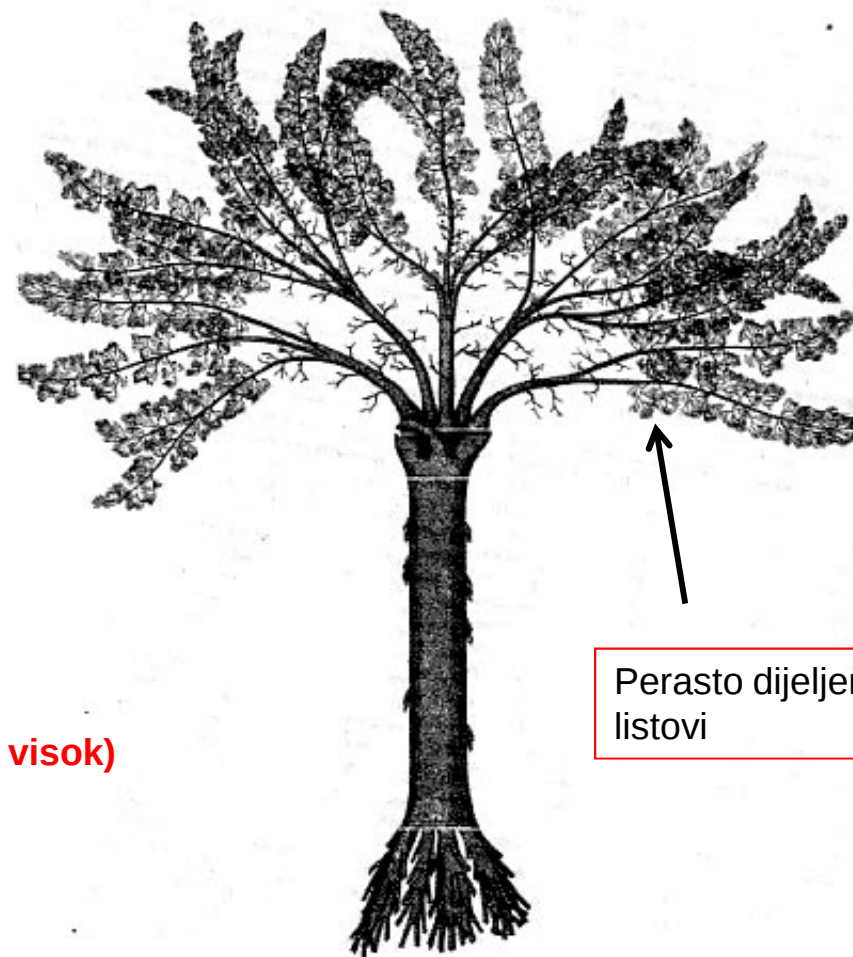
- **Listovi se pužasto ne uvijaju!**
- **Troforofil i sporofil koji se smjenjuju!**

... sifonostela

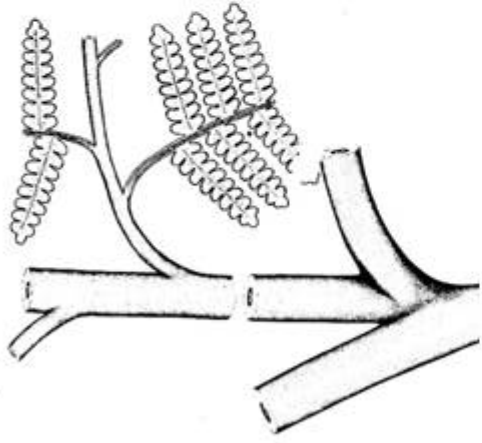


Cladoxylon spp.
(žbunić, oko 30ak cm visok)

Aktinostela ... Terminalne izosporangije

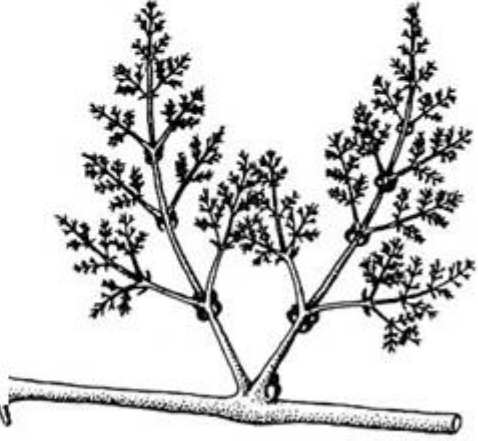


Pseudosporanchus spp.
(oniže drvo, oko 3m visoko)



Botryopteris spp.
(heterosporan)

Stauropteris spp.
(izosporan)



- Uglavnom omanje biljke, rijetko krupnije drveće
- Sporangije terminalne, gradile svojevrstne terminalne strobiluse. Otvarale se vršnom porom ili uzdužnom pukotinom (primitivni prsten!).
- Heterosporne, rijetko izosporne (Stauropteris)

Protostela, sifonostela