

# Sistematska botanika V

Spermatophyta - semenke

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## **Spermatophyta - SEMENKE**

pojav pred 370 000 000 leti (devon)  
razmah pred 250 000 000 leti (perm)  
podobnosti s praprotnicami:

- izmena generacij (heterosporija, homologije!)
- gametangiji
- tkiva ("brst", evstela idr.)

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## **Spermatophyta - SEMENKE**

**nove pridobitve:**

- semenska zasnova → seme (trajna oblika)
- oprašitev
- zgradba
  - monopodijalna razrast
  - traheje
  - spremljevalke
  - olesenelo deblo

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**HOMOLOGIJE MED PRAPROTNICAMI IN SEMENKAMI:**

mikrosporofil	prašnik
mikrosporangij	pelodna vrečka
mikrospora	pelodno zrno
mikrogametofit (mikroprotalij)	mikrogametofit
mikrogametangij	anteridijalna celica / ni
mikrogameta	spermatozoid / spermalno jedro

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**HOMOLOGIJE MED PRAPROTNICAMI IN SEMENKAMI:**

megasporofil	plodna luska / karpel
megasporangij	nucel (~semenska zasnova)
megaspora	enojedrni zarodkov mešiček
megagametofit (megaprotalij)	primarni endosperm / večjedrni zarodkov mešiček
megagametangij	arhegonij / ni
megagameta	jajčna celica
mladi sporofit	kalček

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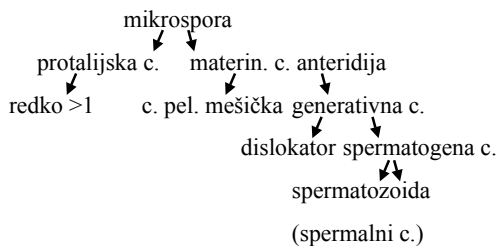
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**RAZVOJ GAMETOFITA**

**MIKROGAMETOFIT**



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## RAZVOJ GAMETOFITA

### MEGAGAMETOFIT

#### golosemenke:

pri mikropili 1-več arhegonijev, vsak 1 jajčna c. + 2 vratni c.

#### kritosemenke:

arhegonija ni, megagametofit navadno 8-celičen (4-32)

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## OPRAŠITEV

"prenos mikrospre (pelodnega zrna z razvitim mikrogametofitom) v bližino megaspore (oziroma iz nje razvitega megagametofita), tako da za oploditev ni več potrebna atmosferska voda"

- receptivna mesta (oprašitvena kapljica / brazda)
- opraševalci (sprva veter, kasneje koevolucija)
- evolucija cveta in peloda

## OPLODITEV

**spermatozoid** splava do jajčne c. (nekateri golosemenke)

**pelodni mešiček** zraste skozi tkivo in prinese **spermalni celici** do jajčne c. (vse ostale semenke)

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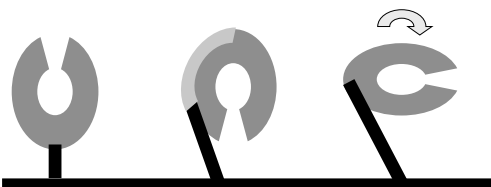
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## SEMENSKA ZASNOVA

- integument (mikropila, →testa)
- funikulus, halaza
- atropna / anatropna / kampilotropna



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## SEMENSKA ZASNOVA IN SEME

**seme:** "z ovojem obdan mladi mirujoči sporofit (**kalček**) skupaj s **hranilnim tkivom**, ki kasneje služi kalčku za prve dni samostojnega razvoja"

- odlična prilagoditev na kopenske razmere
- testa dobro varuje vsebino
- razširjevalna funkcija (seme, kasneje tudi plod)

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## SEMENSKA ZASNOVA IN SEME

### hranilno tkivo

- **primarni endosperm** (=megagametofit, haploidno tkivo)
- **klični listi** (=specializirani založni organi kalčka, preobraženi listi, tkivo diploidno)

[le pri kritosemenkah:]

- **sekundarni endosperm** (=rezultat dvojne oploditve, navadno triploidno tkivo)
- **perisperm** (=preobražen nucel, diploidno materinsko tkivo)

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## org. nivoja: golo- in kritosemenke

### GOLOSEMENKE

Gymnospermae

megasporofili prosti  
(ne tvorijo pestiča)

semenske zasnove niso  
zavarovane

oprašitvena kapljica

pelodna zrna unisulkatna

enojna oploditev s  
spermatozoidi ali sperm.  
celicami

### KRITOSEMENKE

Angiospermae

megasporofili (karpeli)  
zrasli v pestič

semenske zasnove skrite v  
plodnici

brazda

pelodna zrna raznolika

dvojna oploditev s  
spermalnima celicama

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## org. nivoja: golo- in kritosemenke

### GOLOSEMENKE

Gymnospermae

megagametofit mnogoceličen  
(primarni endosperm)

arhegoniji ali brez

lesnate rastline

### KRITOSEMENKE

Angiospermae

megagametofit maloceličen,  
ni založno tkivo

arhegonijev ni

lesne ali zelnate rastline

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## Izvor golosemenk

- ni dokončno razjasnjen
- "Pteridospermae": raznolika skupina
- podobnosti v zgradbi že pri stranskih razvojnih linijah
- **integument**: od skupine megasporangijev se jih večina sterilizira in zraste v ovoj
- sem. zasnova pogosto obdana s "**kupulo**"
- mikrosporangiji: urejeni vretenasto (→peltatni **prašnik**)
- kakih 10 izumrlih zgodnjih skupin semenk!
- devon, karbon: golosemenke v podrasti gozdov praprotnic

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## Lycopodiatae: † Lepidodendrales

- **drevesa**, sifonostela
- les spominja na **golosemenskega**, brez letnic, debela skorja
- mikrofilii, ligule bolj obstojne
- **sekundarna debelitev** (!)
- korenine vilasto razrasle, z odpadljivimi koreninicami
- večinoma **heterosporija**, orjaški viseči strobilusi, megaspore <6 mm
- "Lepidospermae" **megasporofil kor**
- SZ**
- **NISO PREDNIKI SEMENK!**



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## Polypodiatae: † Protopteridiidae

- (=Primofilices)
- potomci protovcev, heterogena skupina
- devon-perm
- **bifacialni kambij**
- terminalni do robni sporangiji
- listi lahko še nesploščeni → **mahala**
- vilasto ožiljeni
- lahko s **palisadnim tkivom**
- protostela → **evstela**
- **večinoma** izosporne, evsporangij
- 5 redov, npr. Archeopteridales  
(=Progymnospermae→SEMENKE!)




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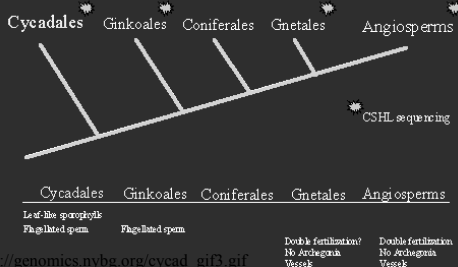
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## Semenke: izvor skupin 1

Phylogenetic relationship of the seed plants



vir: [http://genomics.nybg.org/cycad\\_gf3.gif](http://genomics.nybg.org/cycad_gf3.gif)

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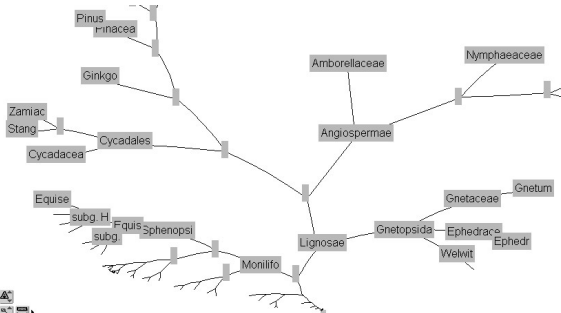
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## Semenke: izvor skupin 2



vir: <http://ucjeps.berkeley.edu/map2.html>

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## Golosemenke: klasifikacija

Cycadophytina

Gnetales:

Ephedraceae, Gnetaceae, Welwitschiaceae

Cycadales:

Cycadaceae, Zamiaceae ...

Coniferophytina

Ginkgoales: *Ginkgo biloba*

Pinales (~Coniferopsida):

Pinaceae, Araucariaceae, Podocarpaceae,

Cupressaceae, Taxaceae ...

**LE ENA OD ZASILNIH REŠITEV!!**

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## Golosemenke: Gnetales

- zelo raznolika skupina
- lesne rastline
- traheje!
- listi enostavni, nasprotni
- dvodomne
- M cvet: odevalo 1-2 para braktej,  $A_{1-6}$
- mikrogametofit 3- do 5-celičen
- oploditev s pel. mešičkom
- atropna sz, 1 do 2 para braktej
- dvojna oploditev (*Ephedra*, *Gnetum*)
- pogosta žužkocvetnost (vonj, opaš. k.)
- 3 f., 3 g.



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## Golosemenke: Gnetales

**Welwitschiaceae:**

*Welwitschia mirabilis*



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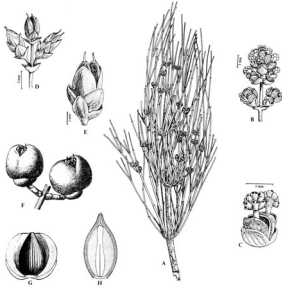
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## Golosemenke: Gnetales

Ephedraceae:

*Ephedra* sp.



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## Golosemenke: Gnetales

Gnetaceae:

*Gnetum* sp.



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## Golosemenke: Cycadales

- palmam podobna drevesa
- listi veliki, usnjati, pernato deljeni
- dvodomne rastline
- cvetovi terminalno, nav. kratki poganjki
- svetni elementi spiralasto, veliki
- "prašniki" luskasti, spodaj z več pel. vrečkami
- policiliatni spermatozoid  $<0,4$  mm!
- pelodni mešiček služi pritrjanju v nucel
- plodna luska: 2-8 sem. zasnov
- sarko- in sklerotesta
- v koralastih koreninah simbioza z MZC



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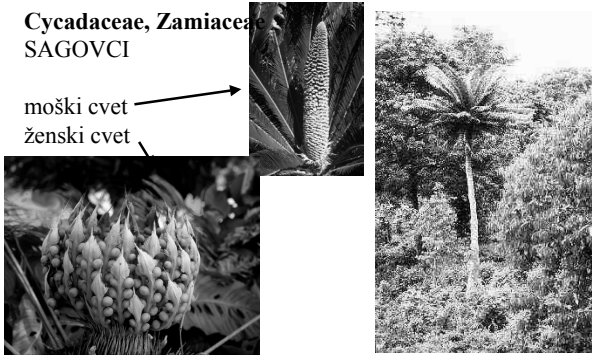
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## Golosemenke: Cycadales

Cycadaceae, Zamiaceae  
SAGOVCI

moški cvet  
ženski cvet




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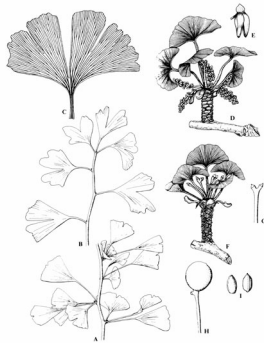
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## Golosemenke: Ginkgoales

Ginkgoaceae:  
*Ginkgo biloba*  
GINKGO




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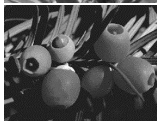
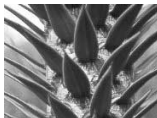
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## Golosemenke: Pinales

~Coniferopsida

- monopodijalna drevesa (grmi)
- pogosti smolni kanali
- listi vzporedno ožiljeni, igličasti/luskasti
- cvetovi enospolni
- M "mačičasti", prašniki 2-20 pel. vrečk
- mikrogametofit 4-40 celičen, sperm. c.
- oploditev s pel. mešičkom
- Ž večinoma v storžih (=socvetje)
- krovne in plodne (=cvet) luske
- integument 1 → sklerotesta
- vetrocvetke




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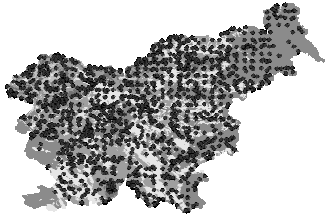
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## Golosemenke: Pinales

**Pinaceae - BOROVKE:**  
subf. Abietoideae  
*Picea abies*  
SMREKA



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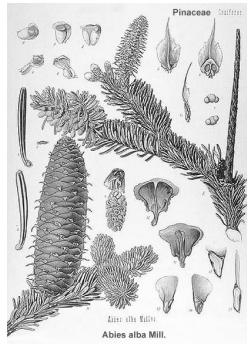
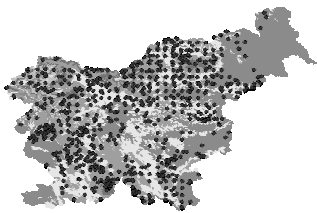
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## Golosemenke: Pinales

**Pinaceae:**  
subf. Abietoideae  
*Abies alba*  
JELKA



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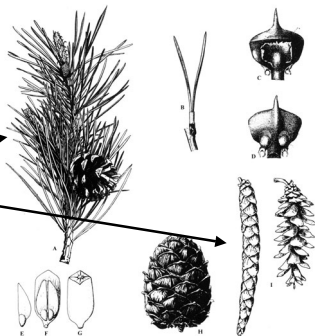
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## Golosemenke: Pinales

**Pinaceae:**  
subf. Pinoideae  
*Pinus* sp.  
BOR

subg. Pinus  
subg. Strobus



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## Golosemenke: Pinales

**Pinaceae:**  
subf. Laricoideae  
*Larix decidua*  
MACESEN  
*Cedrus*  
CEDRA



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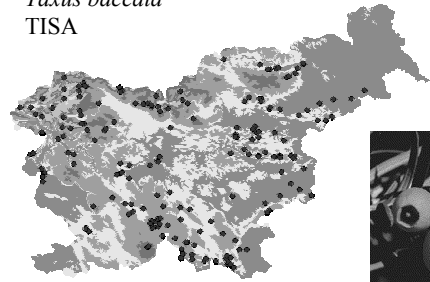
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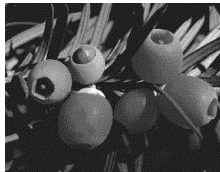
## Golosemenke: Pinales

**Taxaceae - TISOVKE:**  
*Taxus baccata*  
TISA



ZAVAROVANA!

seme!



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## Golosemenke: Pinales

**Podocarpaceae:**  
*Podocarpus*



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## Golosemenke: Pinales

Araucariaceae:  
*Araucaria*  
*Wollemia nobilis*



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## Golosemenke: Pinales

Cupressaceae - CIPRESOVKE:  
subf. *Juniperoideae*:  
*Juniperus* - BRIN  
subg. *Juniperus*  
subg. *Sabina*



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## Golosemenke: Pinales

Cupressaceae :  
subf. *Cupressoideae*  
*Cupressus* -  
CIPRESA,  
*Chamaecyparis* –  
PACIPRESA



subf. *Thujoideae*  
*Thuja* - KLEK



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