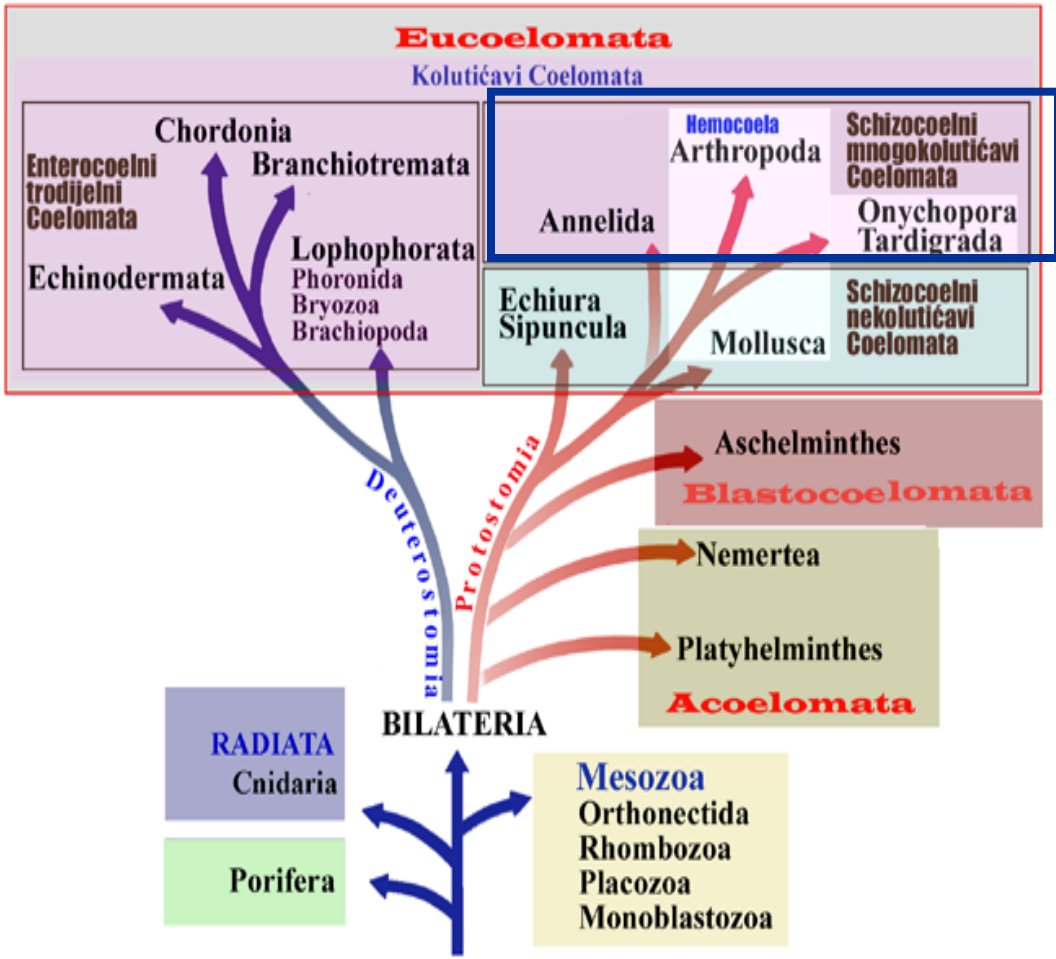
KOLUTIĆAVI SHIZOCELNI COELOMATA

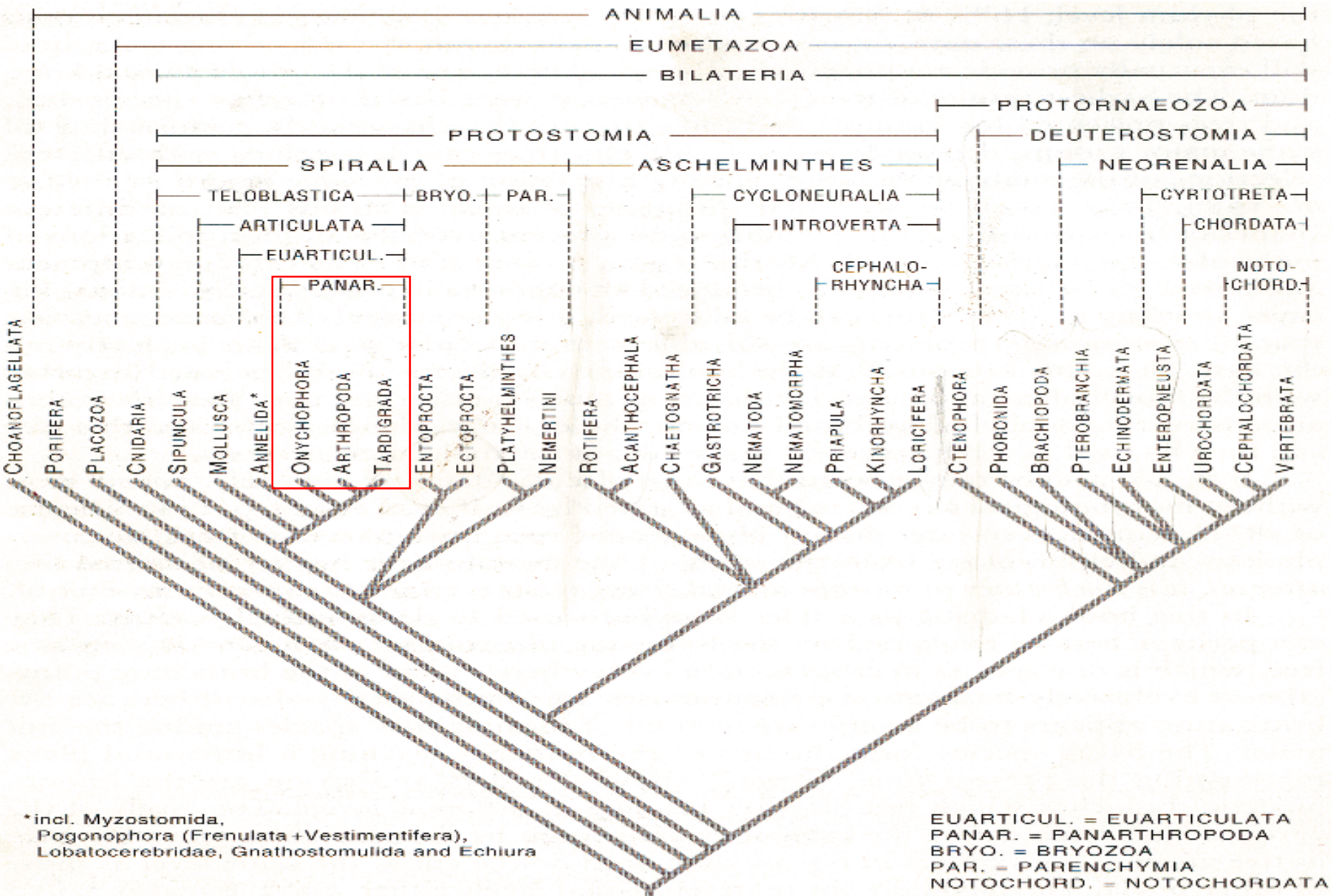
1. Annelida (kolutićavci)
2. Onychophora (crvonošci)
3. Tardigrada (dugoživci)
4. Arthropoda (člankonošci)



"ANELIDSKO-ARTROPODSKA" SKUPINA

Echiurida - zvjezdani	***Onychophora* - crvonošci**
Sipunculida - Štrcaljci	***Tardigrada* - dugoživci**
	Pentastomida - jezičari

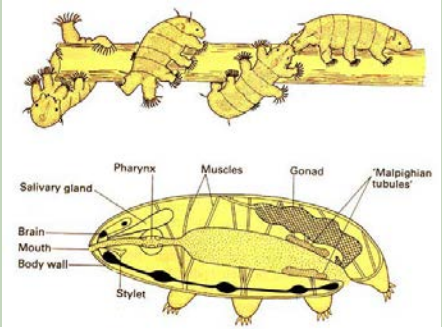
Natkoljeno: Panarthropoda

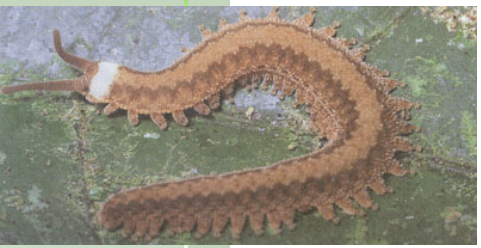


*incl. Myzostomida, Pogonophora (Frenulata + Vestimentifera), Lobatocerebridae, Gnathostomulida and Echiura

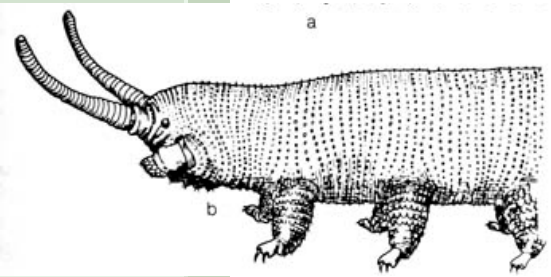
EUARTICUL. = EUARTICULATA
PANAR. = PANARTHROPODA
BRYO. = BRYOZOA
PAR. = PARENCHYMIA
NOTOCHORD. = NOTOCHORDATA

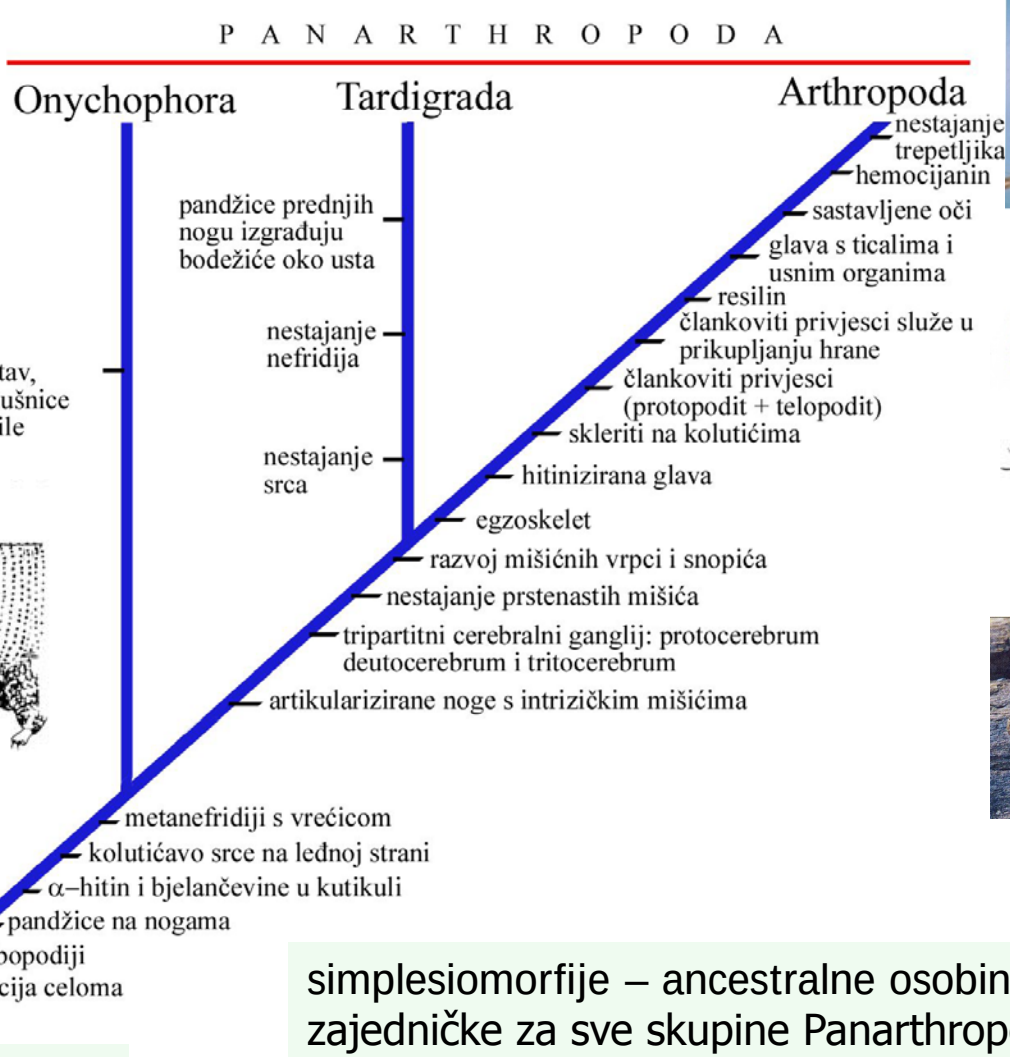
2. Panarthropoda



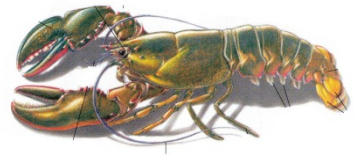


apomorfije









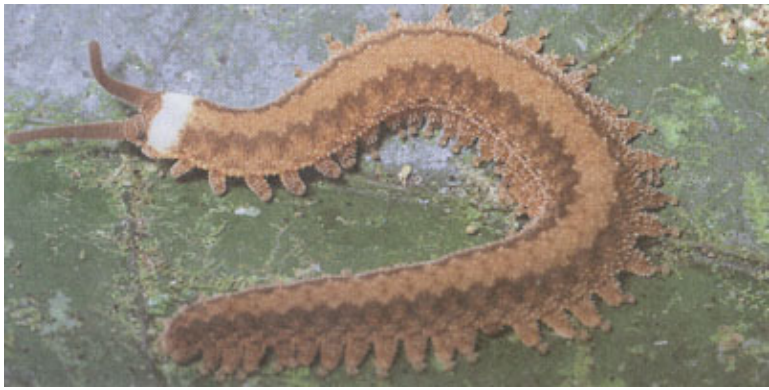




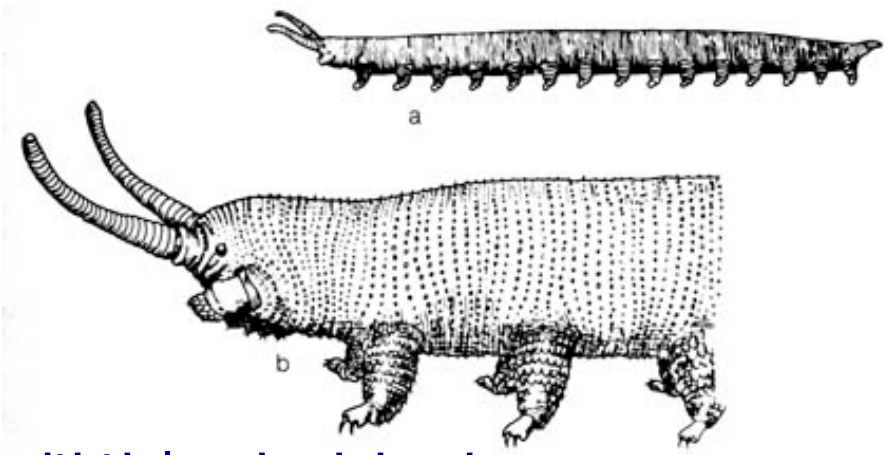
simplesiomorfije – ancestralne osobine zajedničke za sve skupine Panarthropoda

Monofiletsko podrijetlo

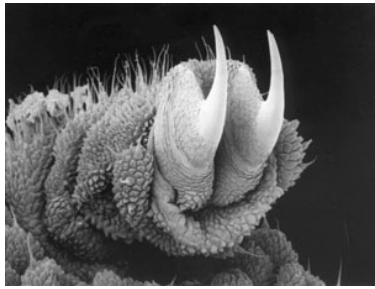
Koljeno Onychophora - crvonošci



- vrlo rano su se odvojili od glavnog razvojnog artropodskog stabla i vjerojatno sliče ranim člankonošcima



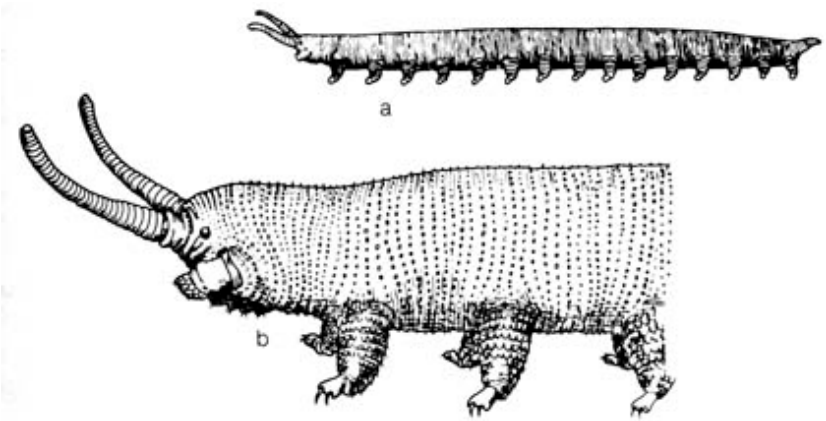
- kolutićavo tijelo;
- na svakom kolutiću su nečlankoviti tjelesni privjesci s pandžicama (lobopodiji, onkopodiji)



- prostomij (akron) – ticala
- I. trupni kolutić - 4 srpaste čeljusti (ostaci tjelesnih privjesaka)
- II. trupni kolutić - usne bradavice (preobraženi tjelesni privjesci)

Anelidske osobine:

- homonomna kolutićavost trupa
- nečlankoviti tjelesni privjesci
- metanefridiji u gotovo svim kolutićima
- mekano tijelo



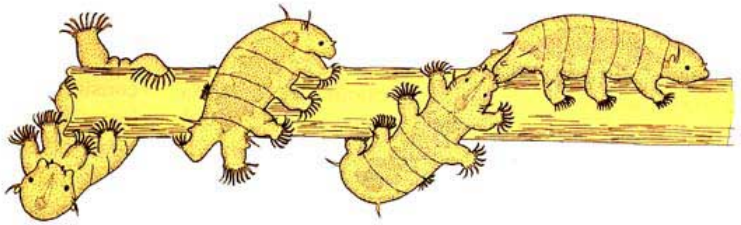
Artropodske osobine:

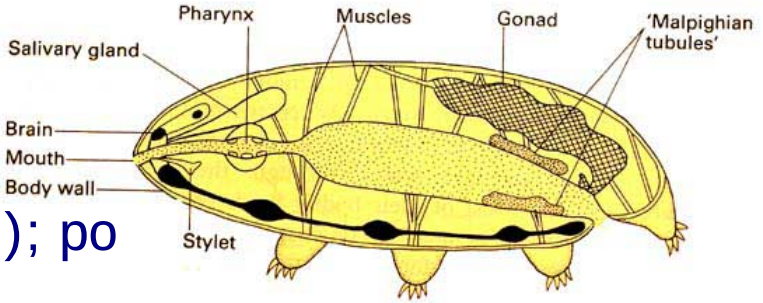
- hitinska kutikula
- preobrazba i korištenje jednog para udova za usne organe
- izgradnja pandžica na udovima
- kretanje pomoću mišića nogu (a ne peristaltikom trupa)
- reducirani celom u oblik miksocela
- postojanje srca s ostijama
- uzdušnice
- kučne (koksalne) vrećice
- superficijelno brazdanje jajeta

žive na kopnu u području tropa i južnih dijelova umjerenog pojasa;
110 vrsta;
veličina do 15 cm; *Peripatus*



Koljeno Tardigrada - dugovječnici

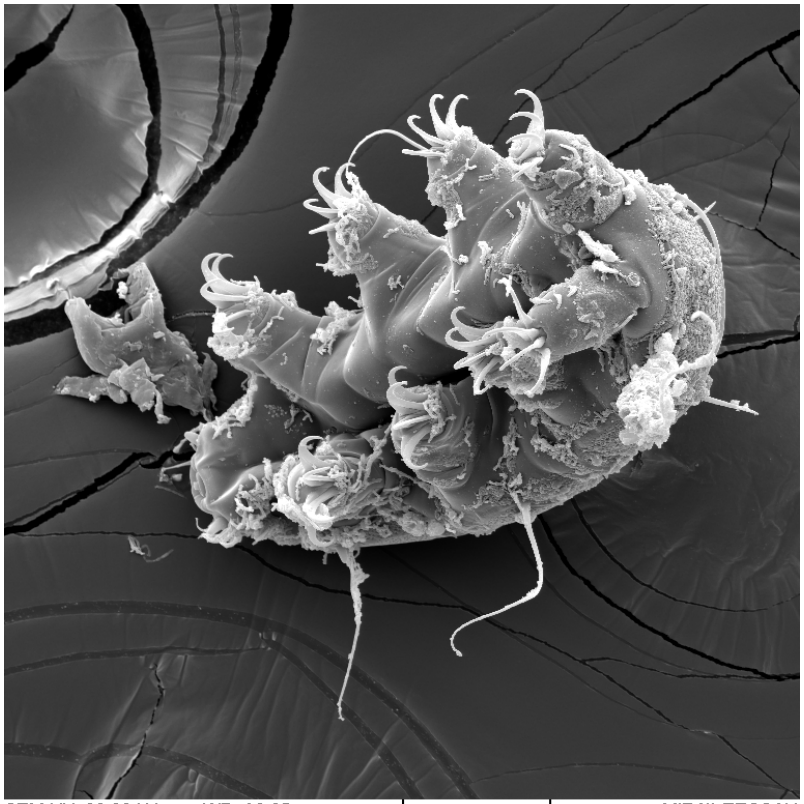


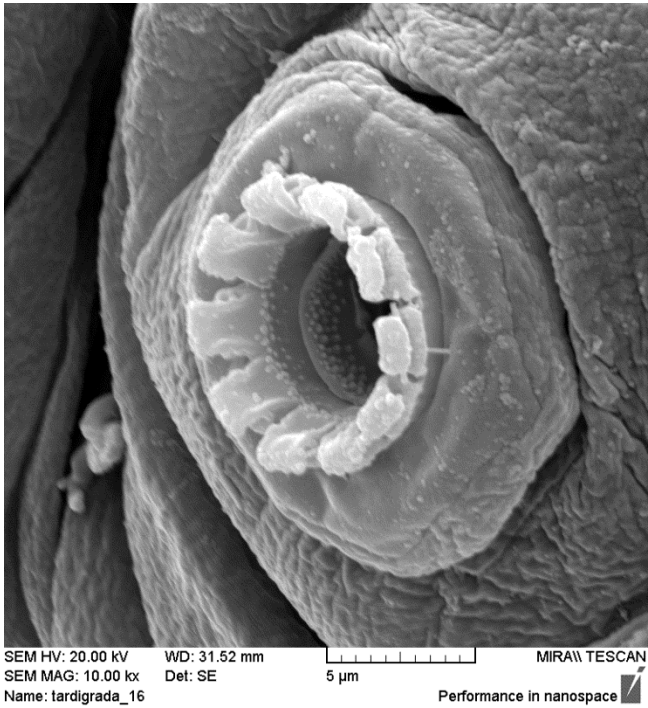


- mikroskopske veličine (50 μm-1 mm); po građi slični crvonošcima
- nožice s pandžicama
- miksocel; nedostaju dišni i optjecajni sustav
- tanka kutikula propusna za vodu - pri nestašici vode mogu se brzo osušiti i prijeći u stanje anabioze ili kriptobioze (6.5 godina, na prekide ukupno do 60 godina); u stanju anabioze su vrlo otporni na UV zračenje, visoki tlak, H_2S, izdrže 8.5 h u tekućem He na -272°C ili 20 mjeseci u tekućem zraku → lako se raznose vjetrom pa su kozmopoliti
- žive u svim biotopima; poznato oko 800 vrsta





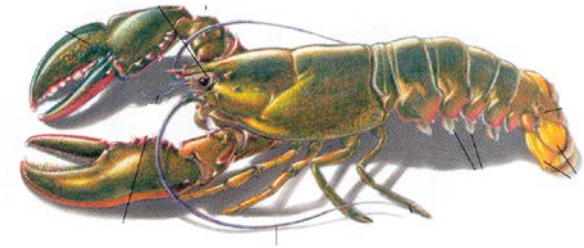

SEM HV: 20.00 kV
WD: 32.05 mm
MIRA\\ TESCAN
SEM MAG: 800 x
Det: SE
50 µm
Name: tardigrada_1
Performance in nanospace

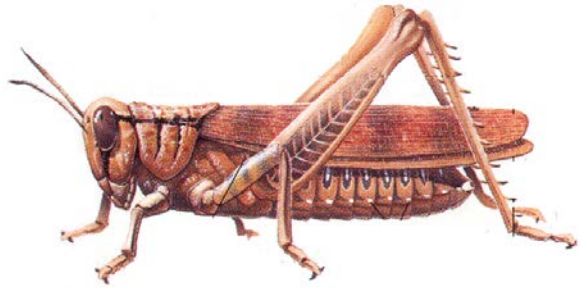

SEM HV: 20.00 kV
WD: 31.52 mm
MIRA\\ TESCAN
SEM MAG: 10.00 kx
Det: SE
5 µm
Name: tardigrada_16
Performance in nanospace

Arthropoda (člankonošci)

- egzoskelet ⇒ presvlačenje (ekdisis) ⇒ zglobna povezanost pojedinih dijelova tijela ⇒ mišići fleksori i ekstenzori ⇒ cephalizacija (viši stupanj razvoja živčanog sustava) ⇒ prilagodbe za život na kopnu
- tagmatizacija







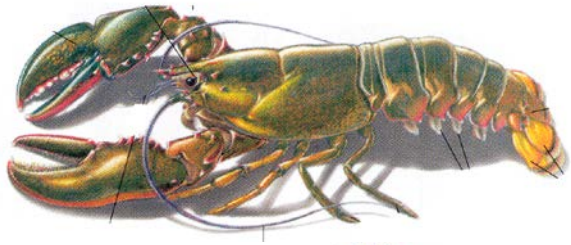


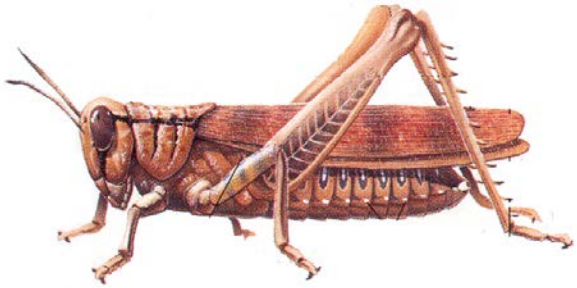
Arthropoda (člankonošci)

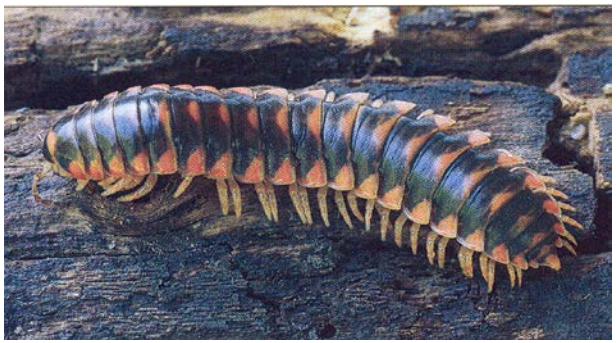


Opća obilježja:

- heteronomno segmentirani kolutićavci;
- tagmatizacija: glava, trup i zadak ili prosoma i opistosoma;
- tjelesni privjesci obavljaju različite funkcije (kretanje, hranjenje, organi za kopulaciju);
- hitinsko-proteinska kutikula - egzoskelet;
- tjelesna šupljina je miksocel;
- ljestvičavi živčani sustav;
- prohodni probavni sustav: stomodeum (ektoderm), mezenteron (endoderm) i proktodeum (ektoderm);
- metanefridiji i Malpighijeve cjevčice;
- disanje: krpasti tjelesni privjesci i uzdušnički sustav u kliještara, kukaca i stonoga;
- razdvojena spola (poznate su iznimke), jaja su centrolecitelna, brazdanje je superficijelno:







Taksonomska i biološka raznolikost člankonožaca

Koljeno: Arthropoda

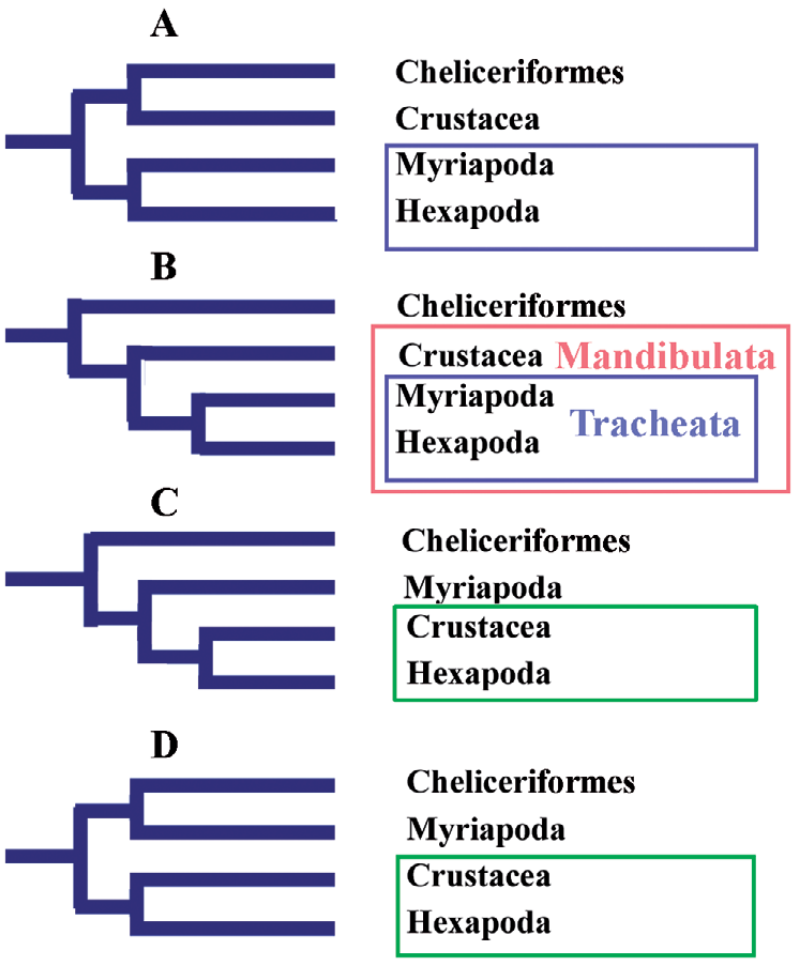
1.Potkoljeno: Trilobitomorpha

2.Potkoljeno: Cheliceriformes

3.Potkoljeno: Crustacea

4.Potkoljeno: Hexapoda

5.Potkoljeno: Myriapoda



- helicere vs mandibule (Amandibulata i Mandibulata)
- Škrge vs traheje: (Branchiata i Tracheata)
- Uniramne vs biramne noge (Uniramia i Biramia)
- Građa cerebralnog ganglija
- Stupanj tagmatizacije

Tagmatizacija artropoda

A

Kolutić	Trilobiti
akron	
1.	
2.	antene
3.	1. par nogu
4.	2. par nogu
5.	3. par nogu
6.	
7.	
8.	

Kliještari	Cerebralni ganglij
-	arhicerebrum
-	protocerebrum
-	nemaju deutocerebrum
kliješta	tritocerebrum
maksilipedi	torakalni ganglij
1. par nogu	
2. par nogu	
3. par nogu	
4. par nogu	

Rakovi	Šesteronošci	Cerebralni ganglij
-	-	arhicerebrum
-	-	protocerebrum
1. antene	1. antene	deutocerebrum
2. antene	-	tritocerebrum
mandibule	mandibule	podždrijelni ganglij
1. maksile	1. maksile	
2. maksile	2. maksile (labijum)	

B

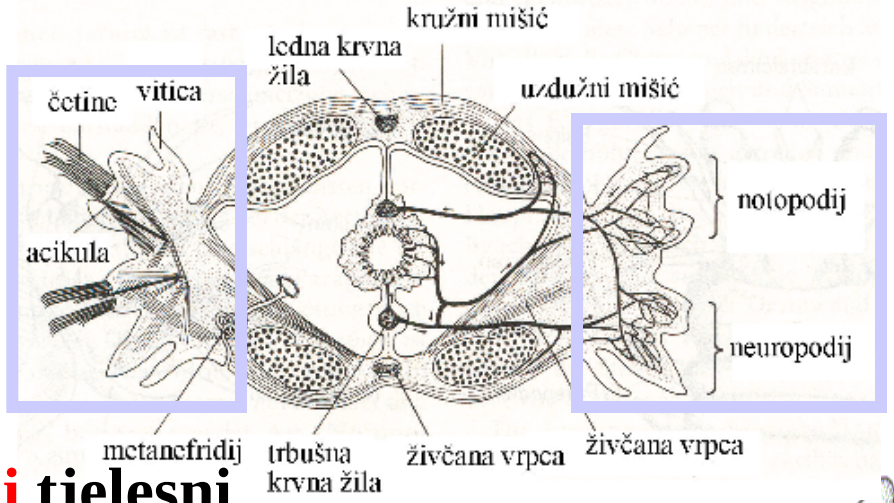
Kolutić	Trilobiti
akron	
1.	antene
2.	1. par nogu
3.	2. par nogu
4.	3. par nogu
5.	
6.	
7.	

Kliještari	Cerebralni ganglij
-	protocerebrum
-	-
kliješta	tritocerebrum
maksilipedi	torakalni ganglij
1. par nogu	
2. par nogu	
3. par nogu	
4. par nogu	

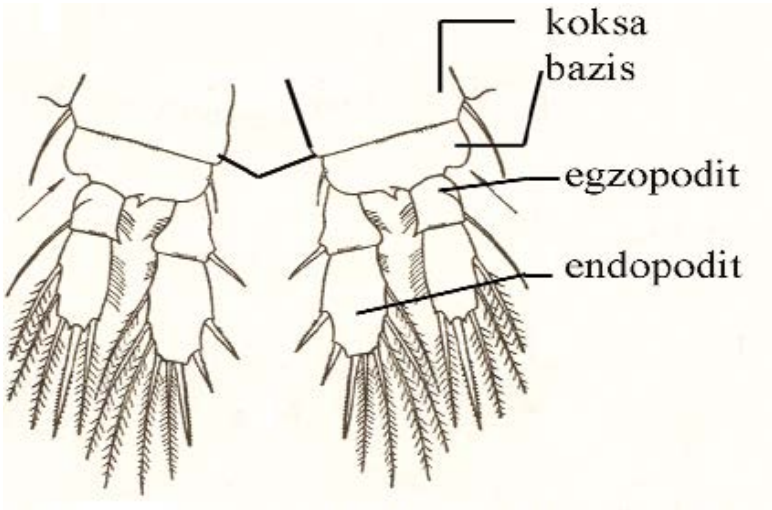
Rakovi	Šesteronošci	Cerebralni ganglij
-	-	protocerebrum
1. antene	1. antene	deutocerebrum
2. antene	-	tritocerebrum
mandibule	mandibule	podždrijelni ganglij
1. maksile	1. maksile	
2. maksile	2. maksile (labijum)	

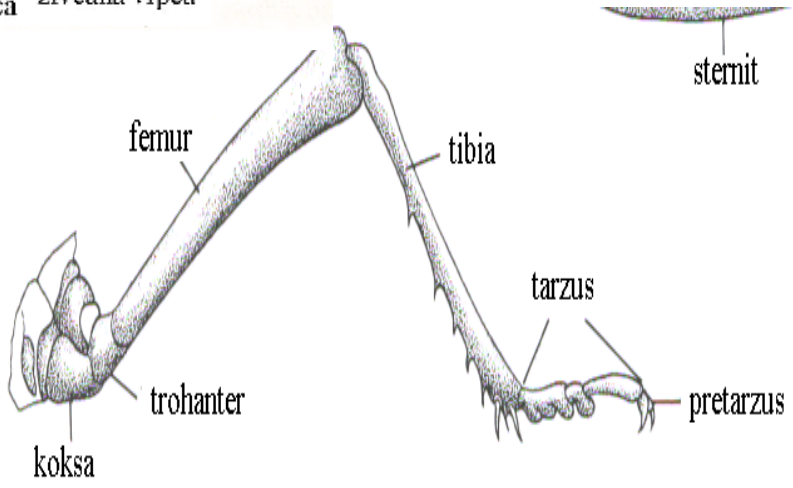
Razvoj člankovitog privjeska

Parapodij



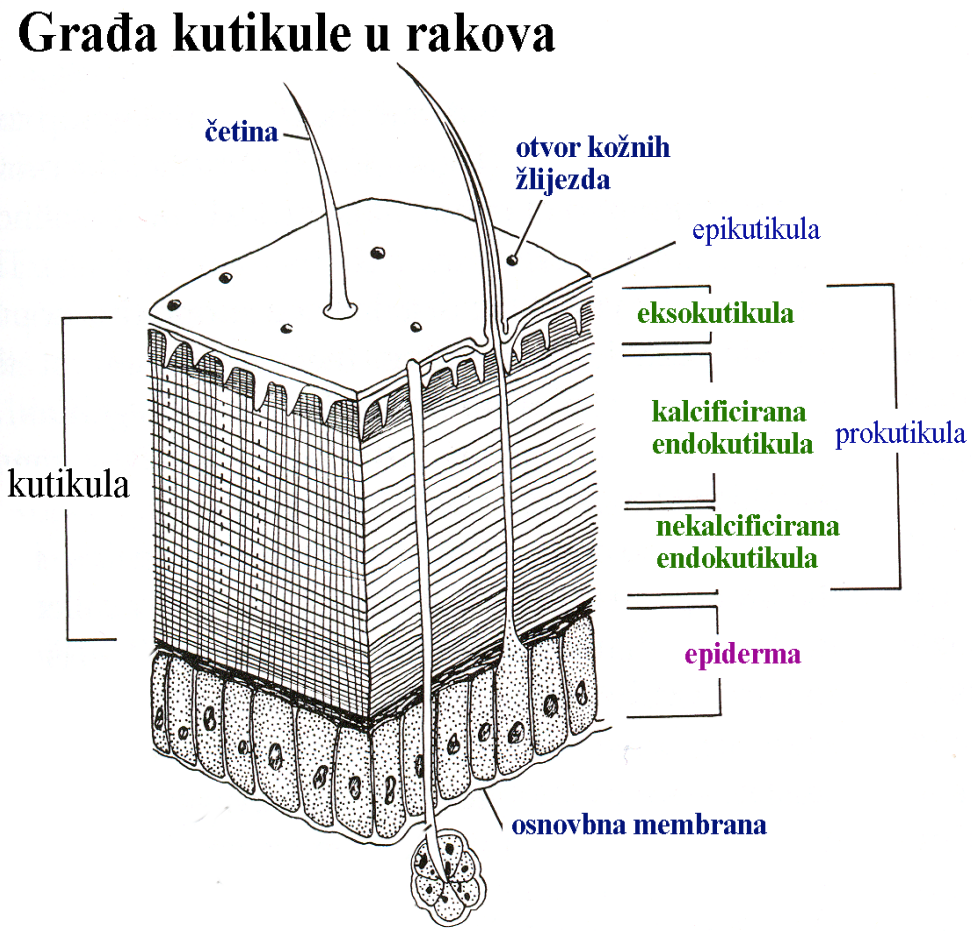
Rakovi – biramni tjelesni privjesci (rašljasta nožica)





Kliještari, kukci i stonoge – uniramni tjelesni privjesci

Integumentna i potporna funkcija u člankonožaca

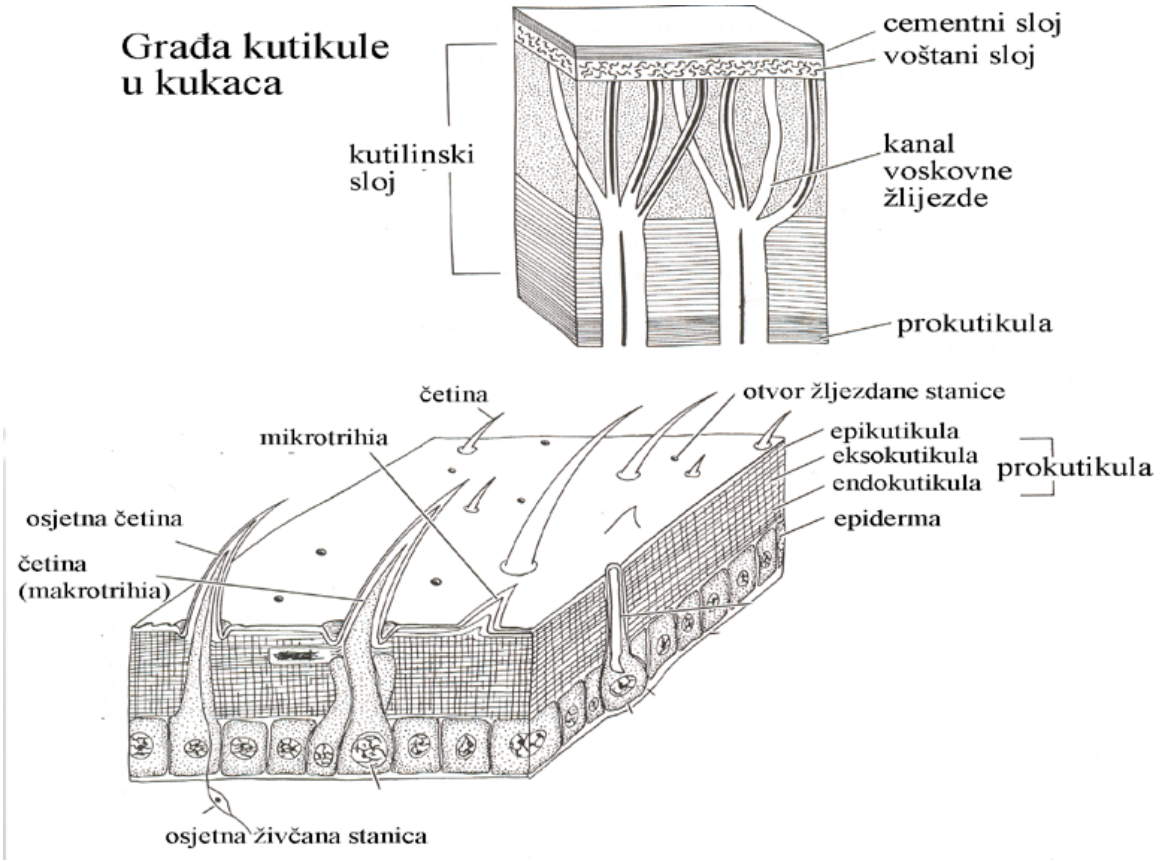


- Višeslojni hitinsko-proteinski egzoskelet

1. Epikutikula (lipidi+proteini)
2. Prokutikula (proteini+hitin):
   egzokutikula i endokutikula

Rakovi: endokutikula inkrustirana vapnencem

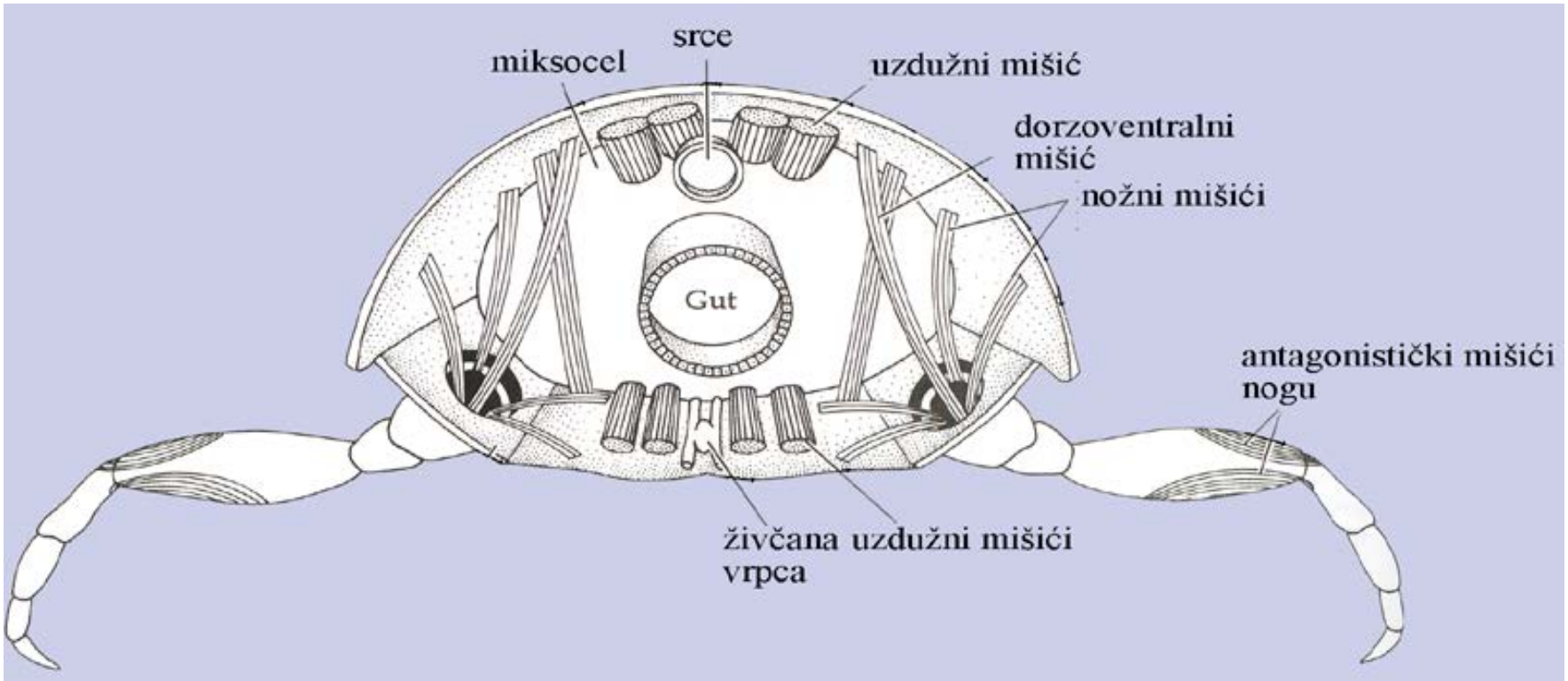
Integumentna i potporna funkcija u člankonožaca



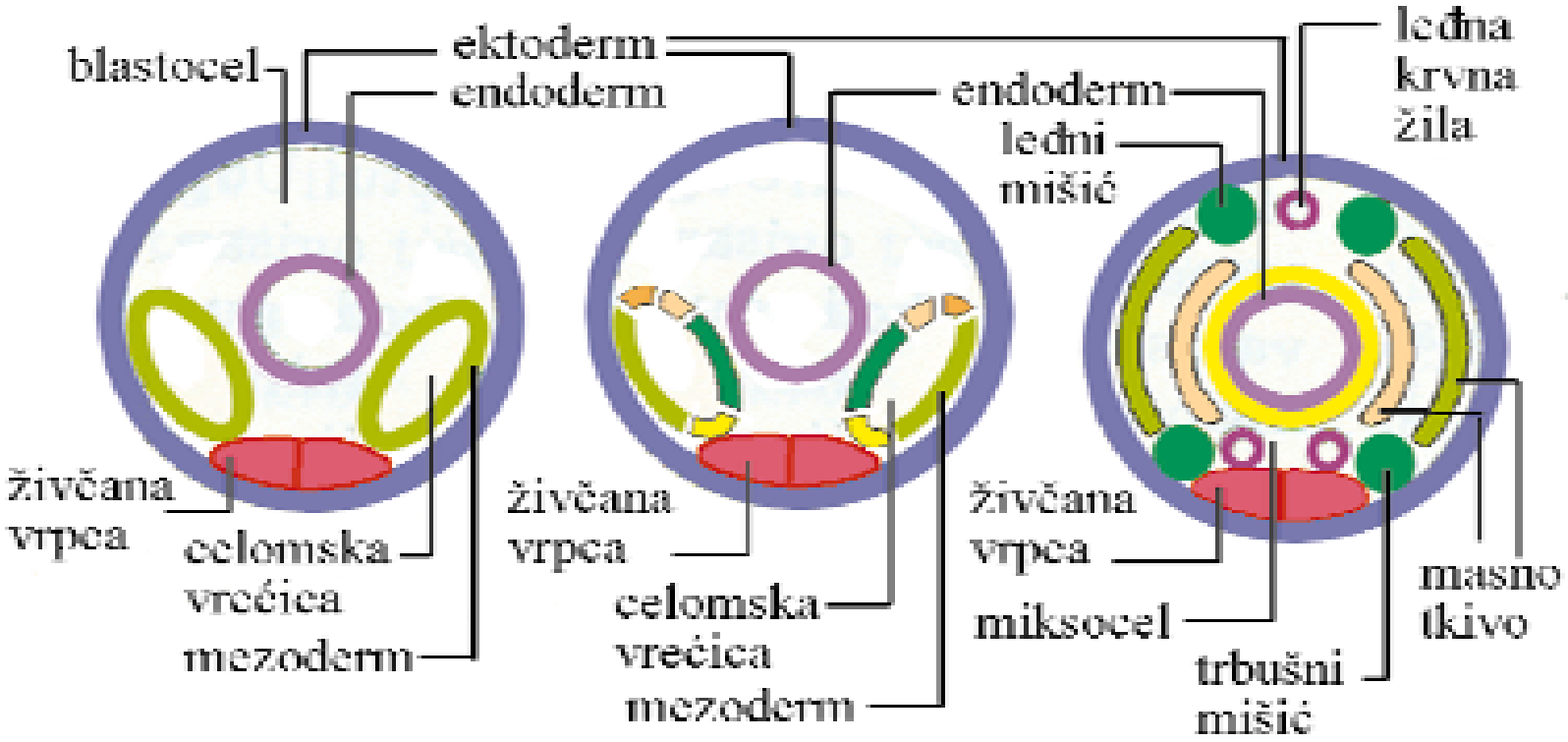
- **u kopnenih člankonožaca sa zaštitnim cementnim i voštanim slojem na površini**

Mišići i kretanje u člankonožaca

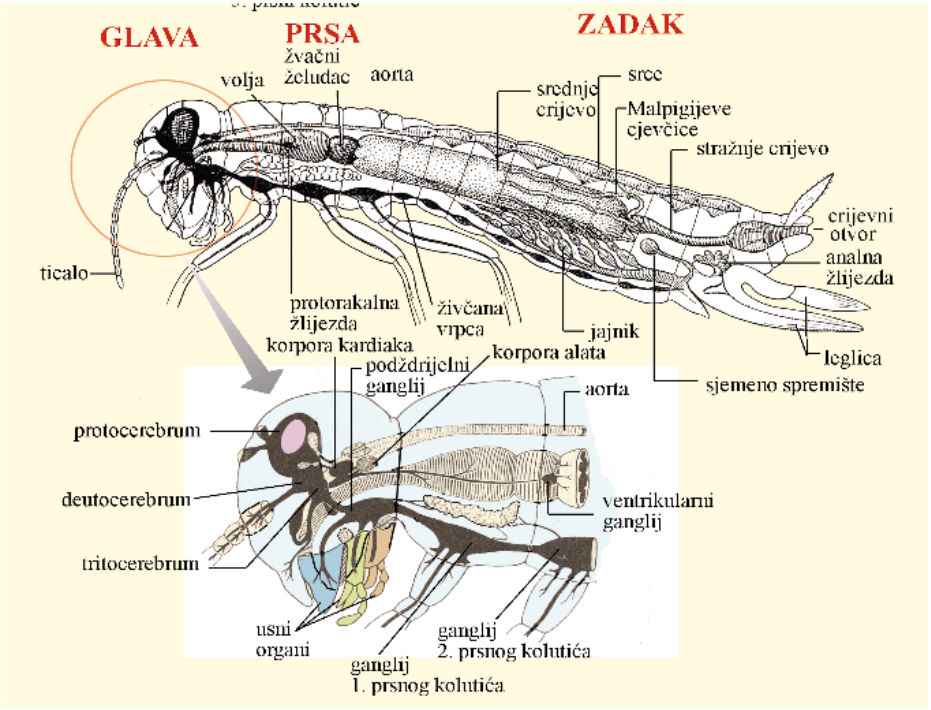
Kretanje člankonožaca zasniva se na razvoju člankovite noge i razvoja poprečno-prugastih mišića usloženih u mišićne snopove

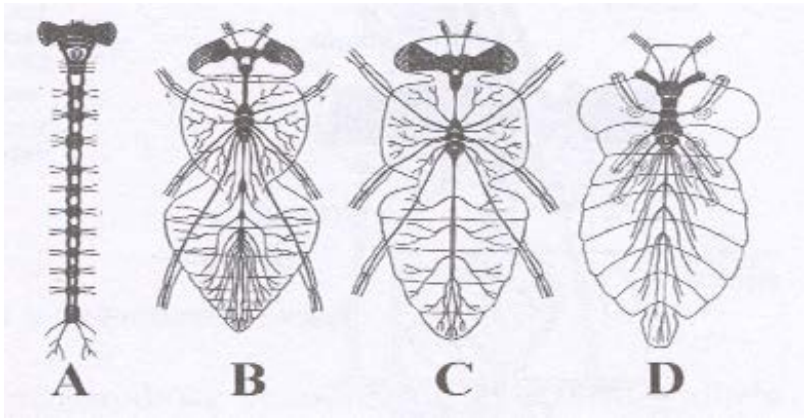


Razvoj miksocela (hemocela) u člankonožaca tijekom embriogeneze



Građa i funkcija živčanog sustava





- **Osnovna obilježja živčanog sustava**

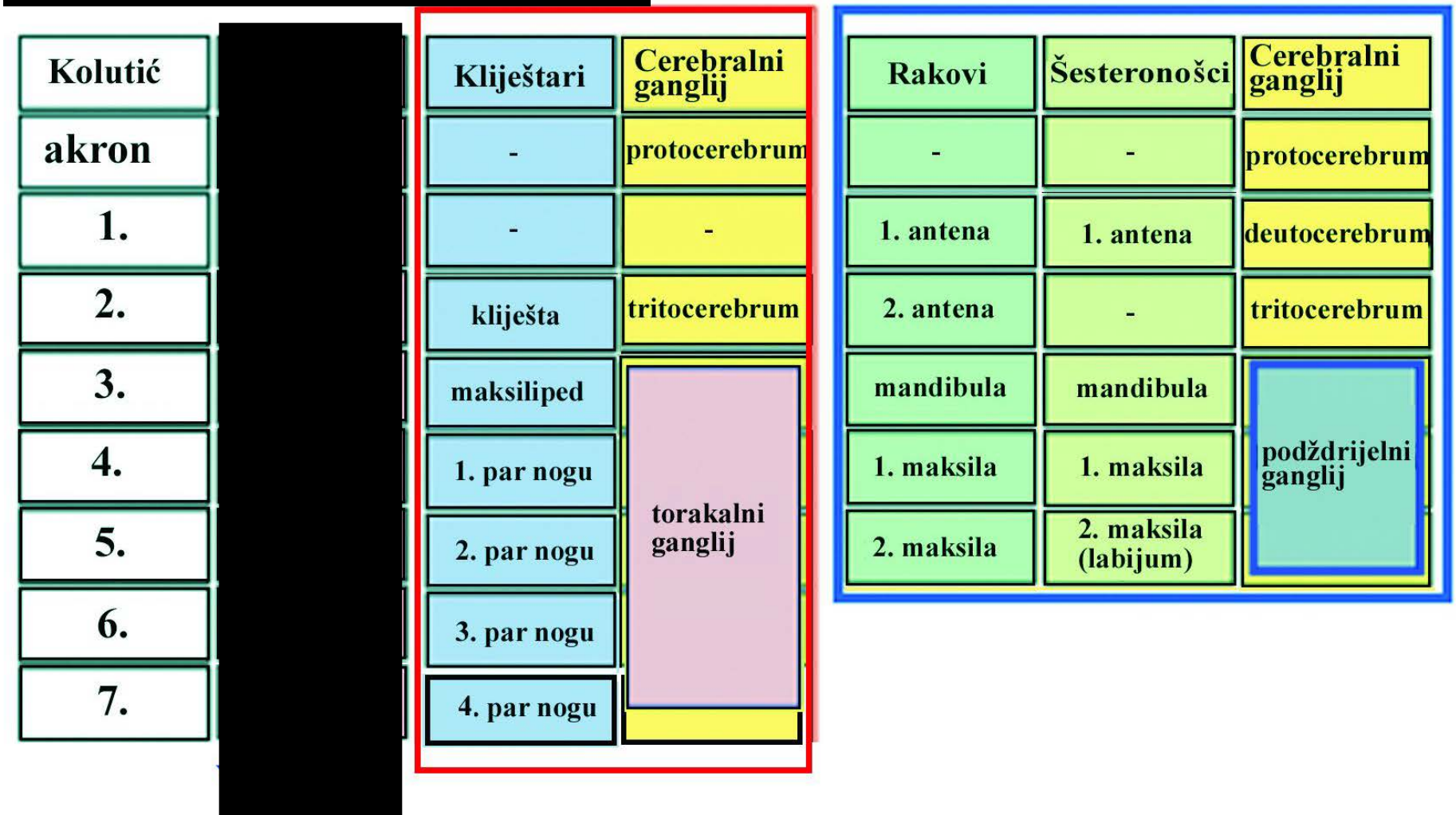
- ❑ **1. nalazi se na trbušnoj strani**
- ❑ **2. cefalizacija**
- ❑ **3. tagmatizacija**

mozak (stopljene 3 neuromere): protocerebrum, deutocerebrum i tritocerebrum

podždrijelni ganglij (stopljeni gangliji 3 kolutića)

Živčani sustav artropoda

B) Model: akron + 5 kolutića



Kolutić	Kliještari	Cerebralni ganglij
akron	-	protocerebrum
1.	-	-
2.	kliješta	tritocerebrum
3.	maksiliped	torakalni ganglij
4.	1. par nogu	
5.	2. par nogu	
6.	3. par nogu	
7.	4. par nogu	

Rakovi	Šesteronošci	Cerebralni ganglij
-	-	protocerebrum
1. antena	1. antena	deutocerebrum
2. antena	-	tritocerebrum
mandibula	mandibula	podždrijelni ganglij
1. maksila	1. maksila	
2. maksila	2. maksila (labijum)	

Osjetilni organi u člankonožaca

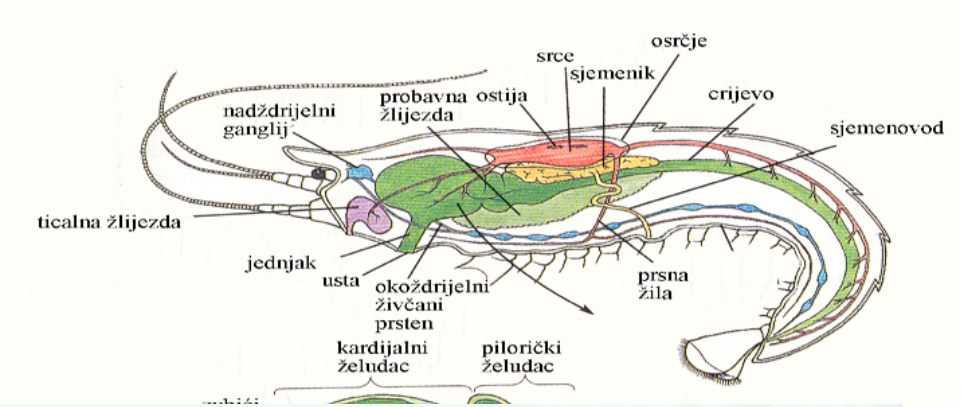
Kliještari:
- ❖tijelo je pokriveno osjetnim dlakama
- ❖lirasti organi (pukotine pored usta) su kemoreceptori
- ❖jednostavne oči ocele.

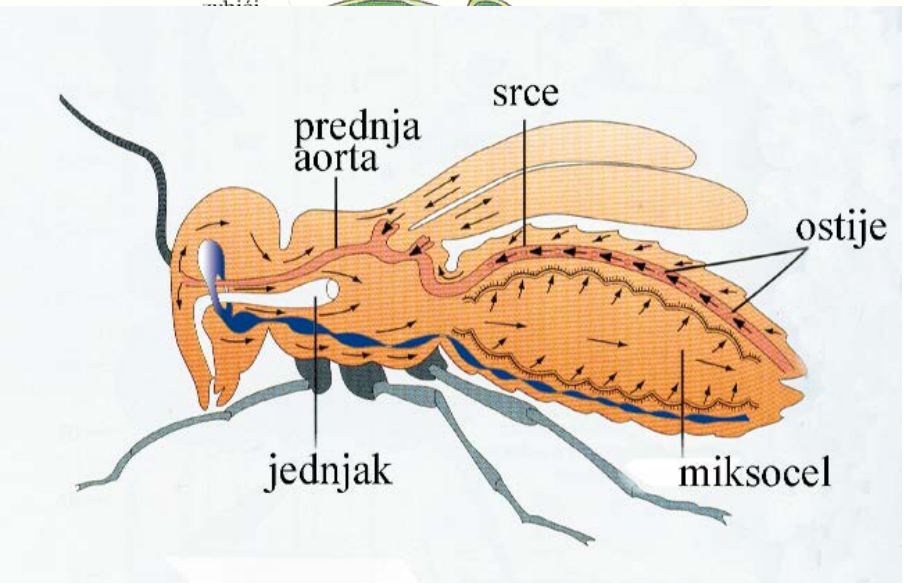
Rakovi:
- na površini tijela su osjetne četine za dodir;
- oko usta su osjetne četine za miris i okus (kemoreceptori);
- nauplijevo trodijelno oko;
- složene oči;
- statički organ.

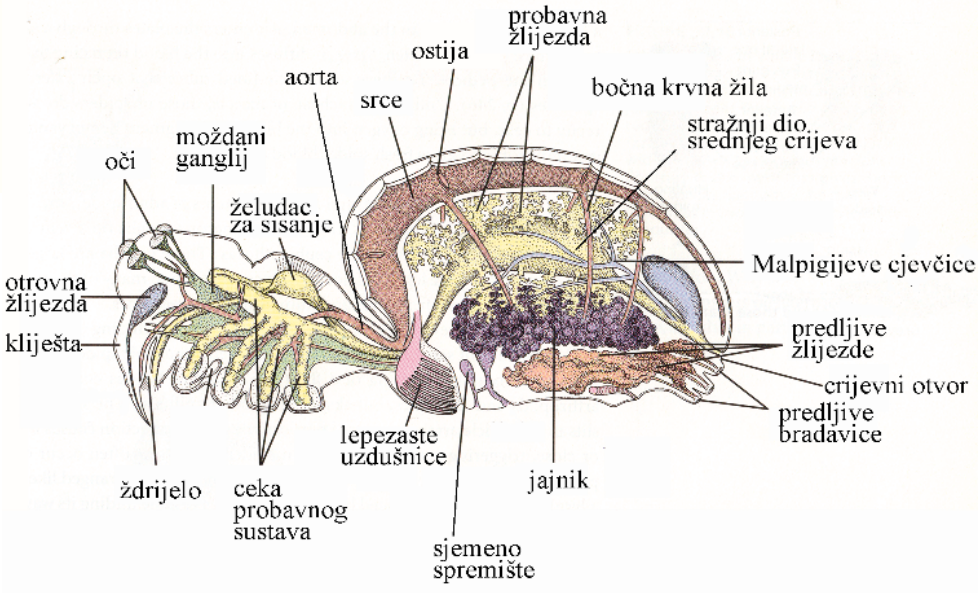
Kukci:
- ❖osjetila za dodir i toplinske podražaje smještena su na ticalima;
- ❖za zvučne podražaje su timpanalni organi;
- ❖osjetila za okus su oko usta;
- ❖hordotonalni organi su mehanoreceptori;
- ❖za svjetlosne podražaje imaju jednostavne i složene oči.

Optjecajni sustav

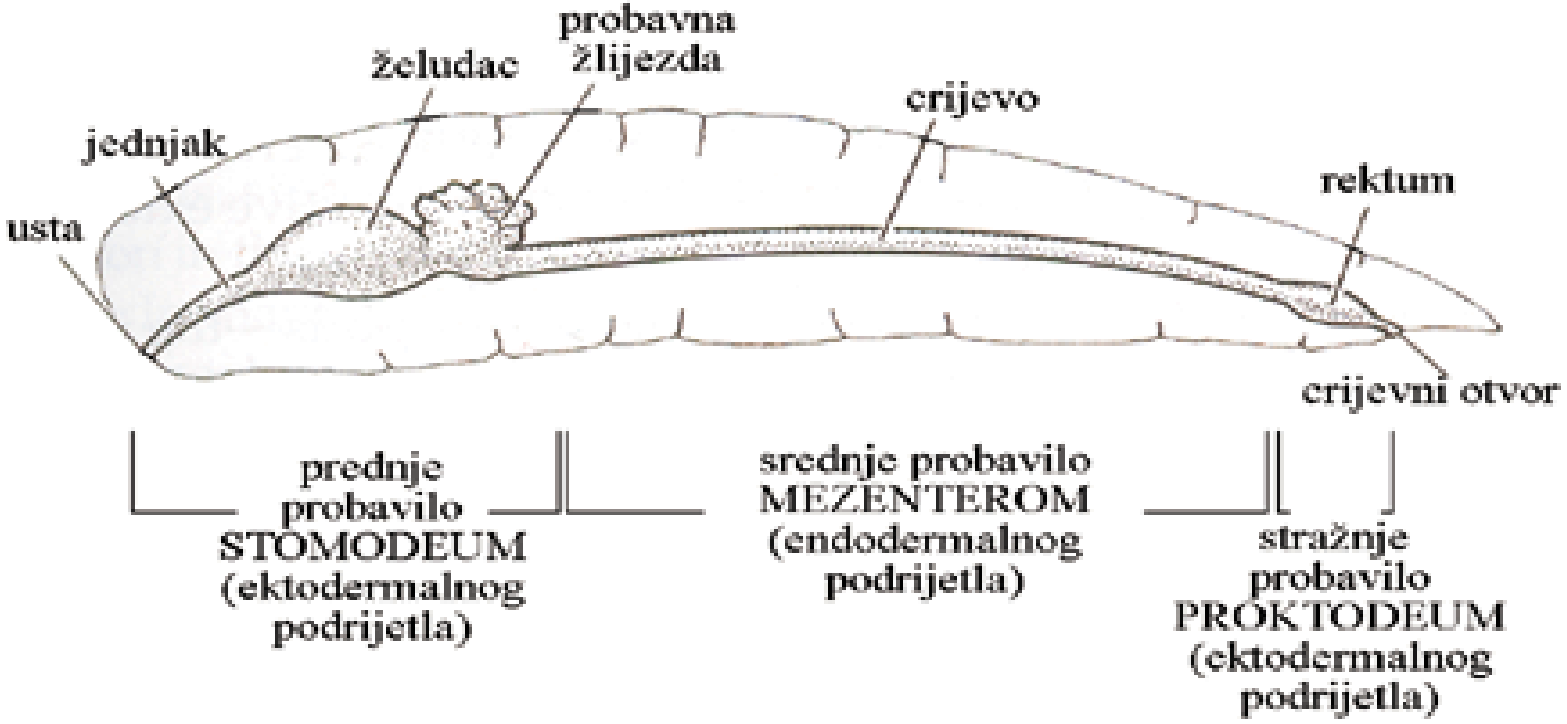
1. **otvoreni optjecajni sustav;**
2. **smješten na leđnoj strani.**





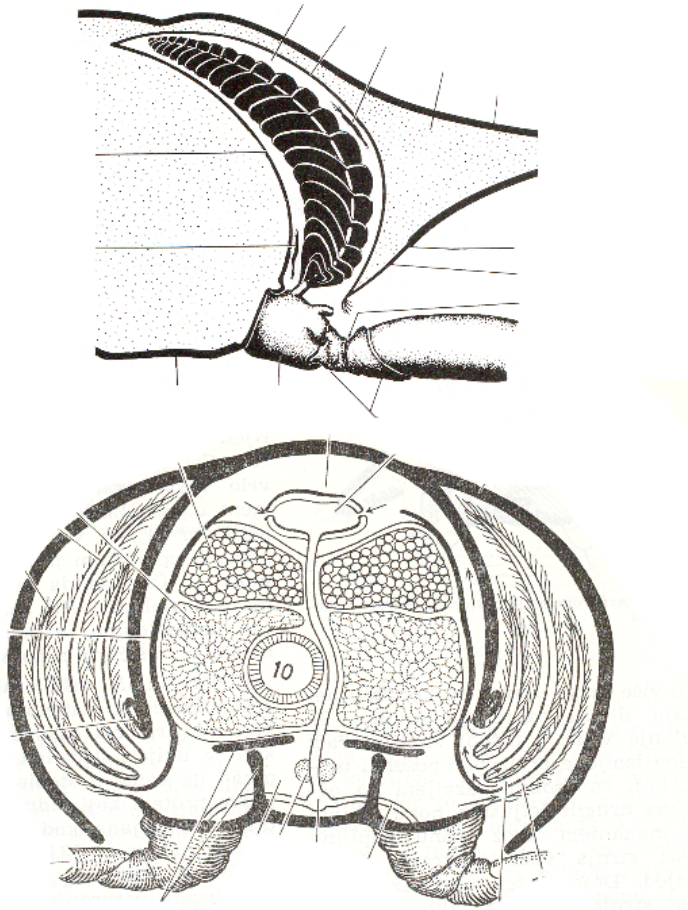


Probavni sustav



Shematska građa probavnog sustava u člankonožaca

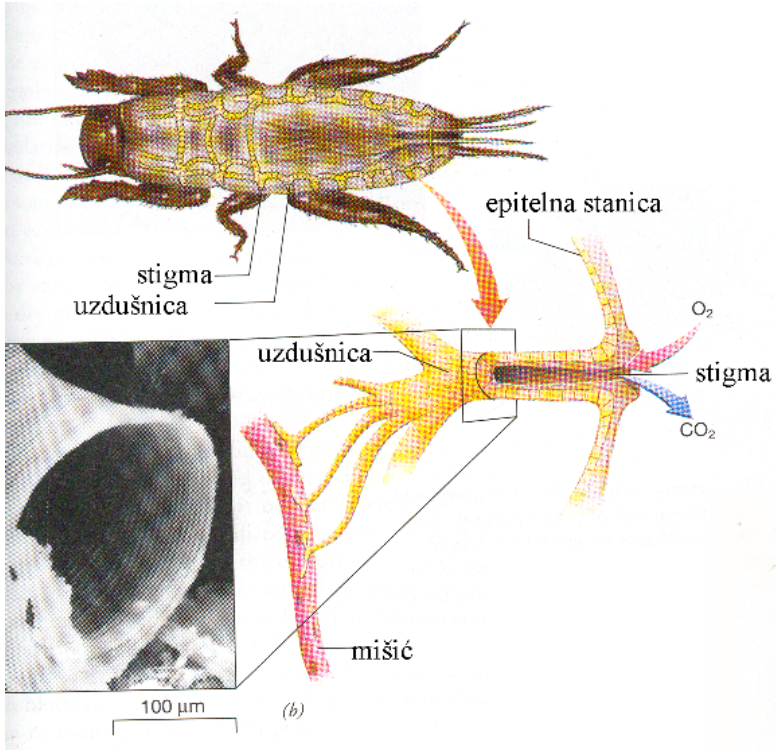
Funkcija disanja i izmjene plinova



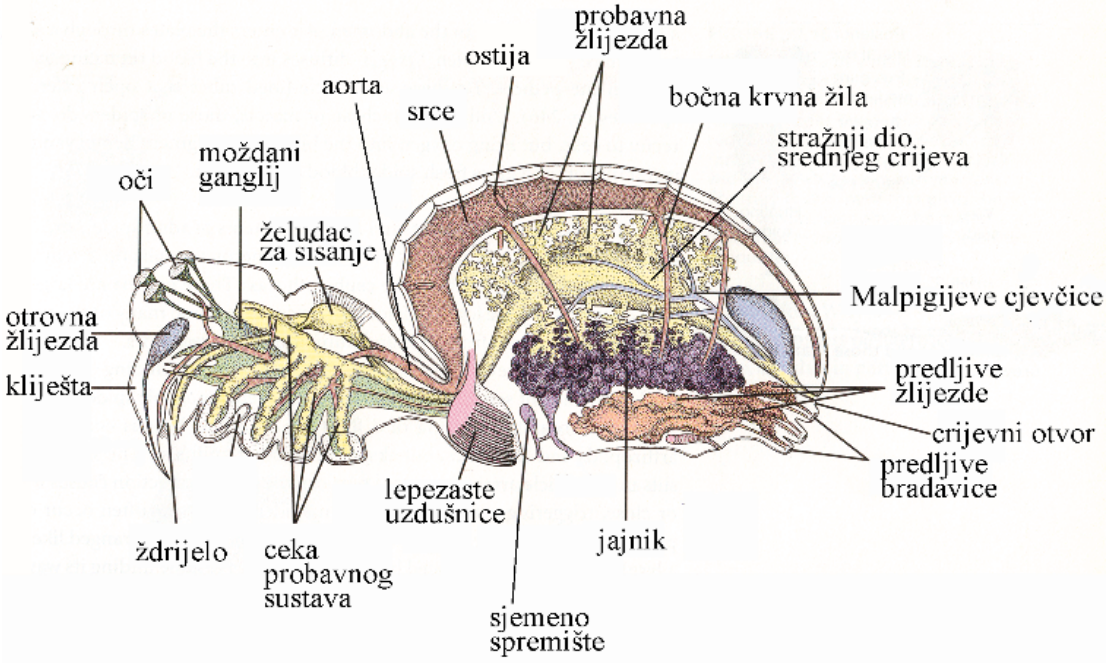
Položaj škrga u riječnog raka

- **Funkcionalna građa organa za disanje u vodenih člankonožaca**
- u sitnijih oblika difuzija metaboličkih plinova teče preko integumentnog sustava;
- u rakova respiratorne površine su škrge;
- u ličinki kukaca koje žive u vodi su trahealne škrge: izdanci na tijelu s gustom mrežom traheja

Funkcija disanja i izmjene plinova

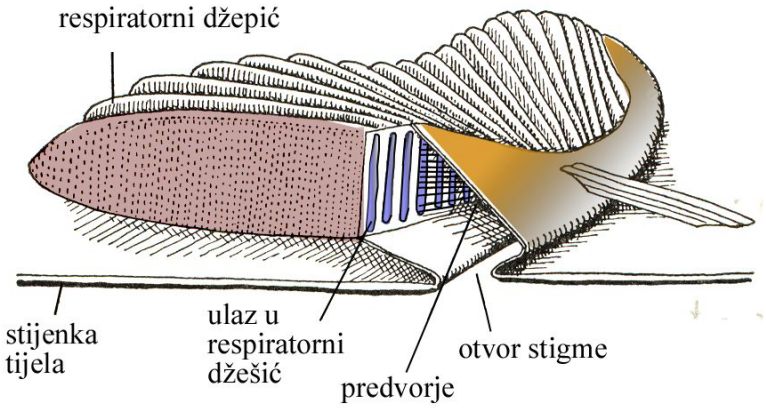


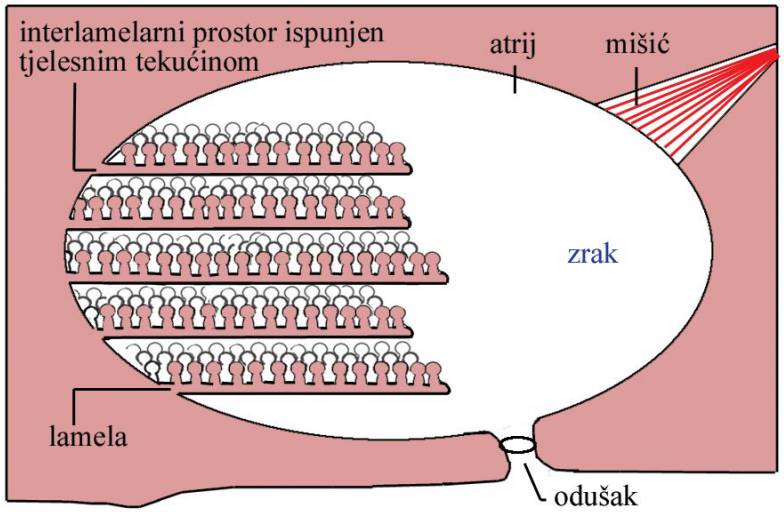
- **Funkcionalna građa organa za disanje u kopnenih člankonožaca**



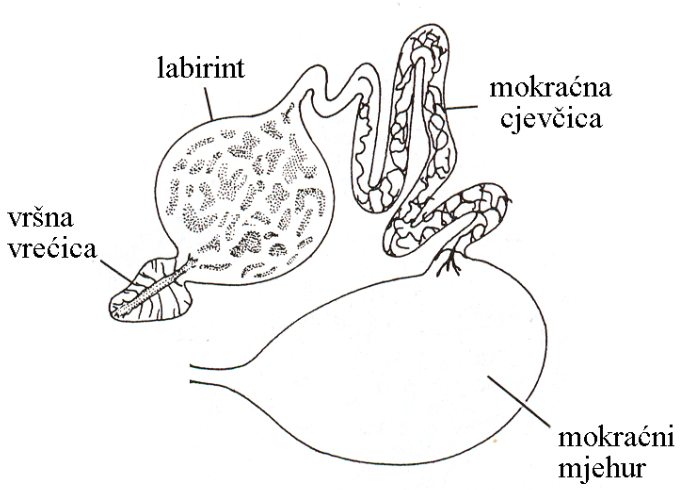
1. **trahealni sustav u kukaca**
2. **lepezaste uzdušnice u kliještara**

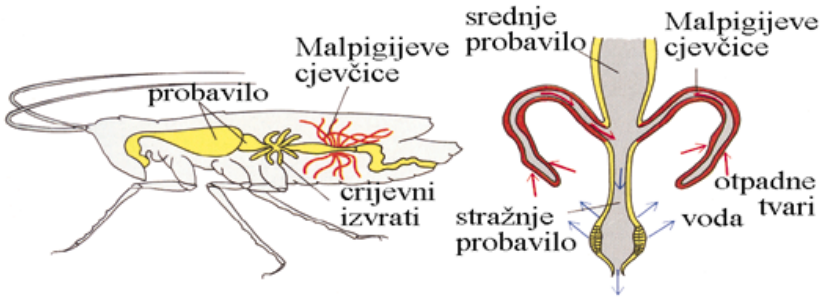
Aranae: dišni sustav – lepezaste i cjevaste uzdušnice





Osmoregulacijska i ekskretorna funkcija





1.Preobraženi metanefridiji u rakova:

- donjočeljusne (maksilarne) žlijezde (otvori na bazi 2. donjih čeljusti);
- ticalne (antenalne) žlijezde (otvori na bazi 2. ticala);

2. Preobraženi metanefridiji u kliještara:

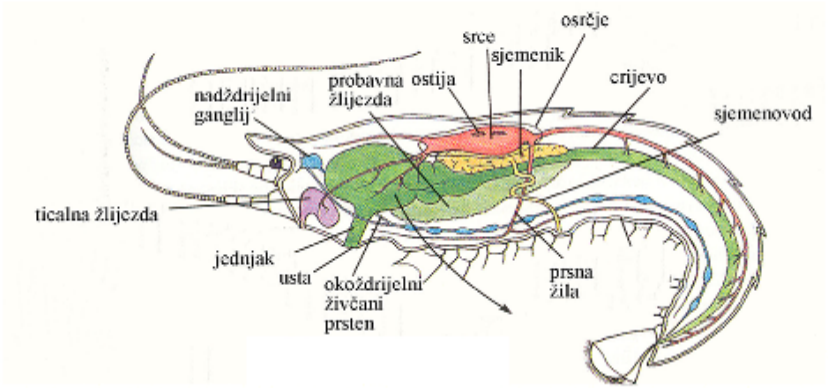
- koksalne žlijezde (otvaraju se na osnovici kokse); 1-2 para

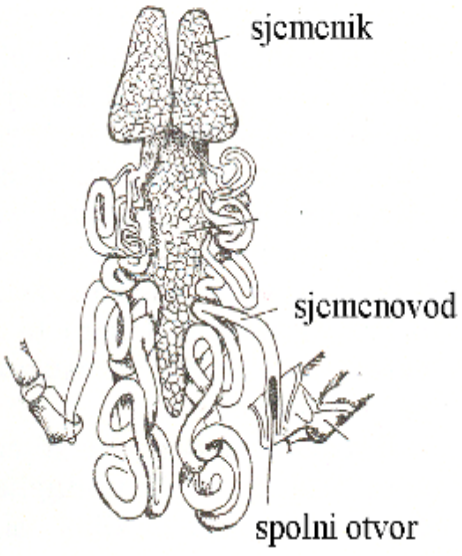
3. Malpighijeve cjevčice na granici mezenterona i proktodeuma

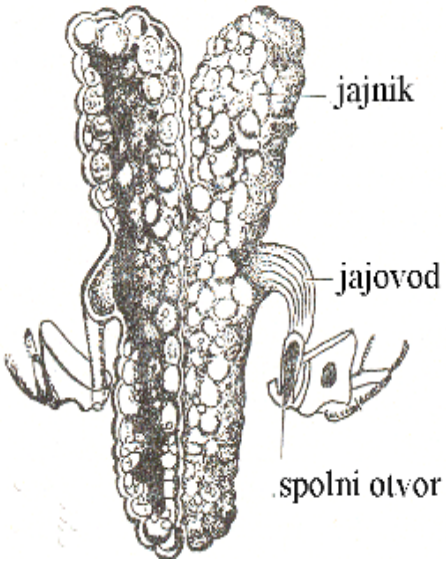
- u kliještara: izvrati (evaginacije) stražnjeg dijela mezenterona u tjelesnu šupljinu
- u kukaca i stonoga: izvrati prednjeg dijela proktodeuma u tjelesnu šupljinu

Spolni sustav člankonožaca

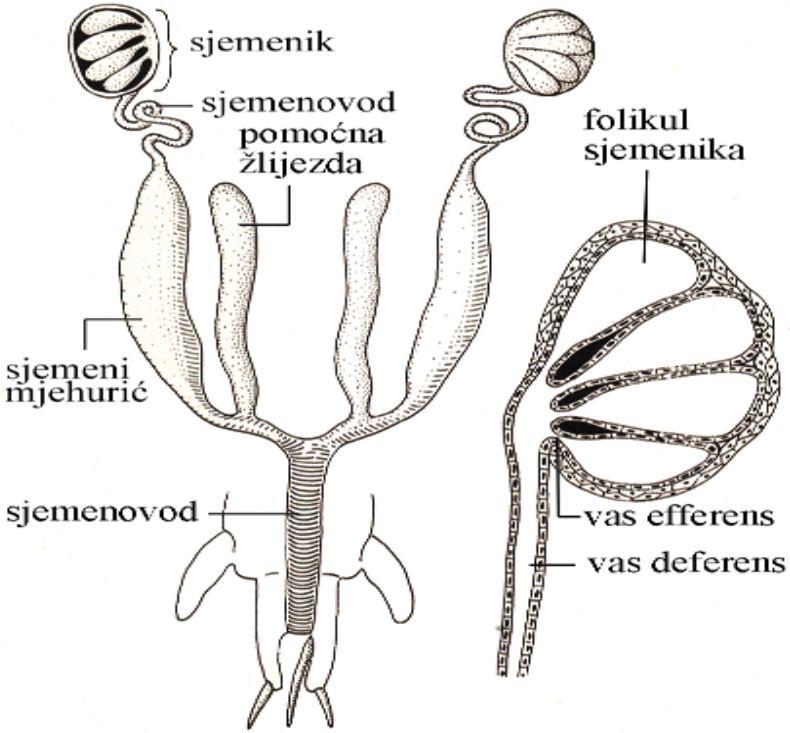
Položaj i građa spolnog sustava u rakova

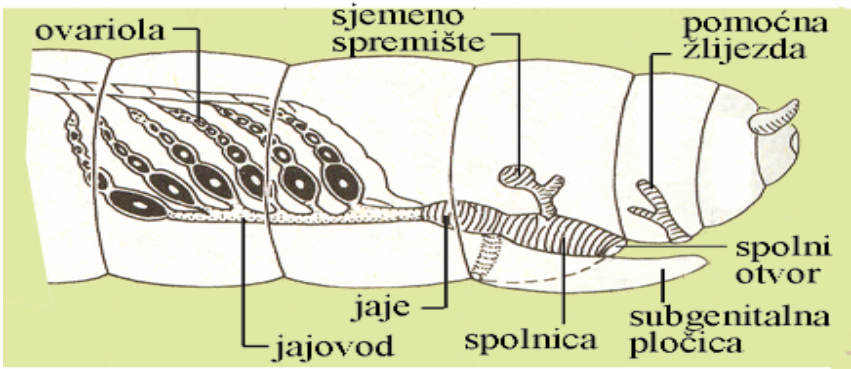






Položaj i građa spolnog sustava u kukaca





	ANNELIDA	*ARTHROPODA*
Kolutićavost:	**homonomna**	**Heteronomna → tagme: glava, prsa i zadak prosoma i opistosoma**
Tjelesni privjesci:	**parapodiji**	**člankovite noge** **razvoj usnih organa**
Mišići:	**sloj prstenastih i uzdužnih mišića**	**fleksori i ekstenzori**
Kutikula:	**tanka albuminska**	**višeslojna hitinska**
Rast:	**kontinuiran**	**diskontinuiran (presvlačenje kutikule)**
Tjelesna šupljina:	**coelom**	**miksocel**
Živčevlje:	**ljestvičavo**	**ljestvičavo** **cefalizacija (viši stupanj razvoja živčanog sustava)**

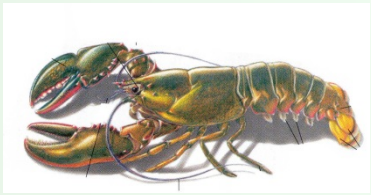
POLYMRERIA	*ANNELIDA*	*ARTHROPODA*
Oči:	mjehuraste	jednostavne sastavljene (fasetirane)
Ekskrecija:	metanefridiji (segmentalni organi)	preobraženi metanefridiji (kučne i antenalne žlijezde) Malpigijeve cjevčice
Krvotok:	zatvoren	otvoren
Disanje:	bez posebnih organa	škrge uzdušnice
Jaja:	oligolecitelna	centrolecitelna
Brazdanje:	totalno, spiralno	parcijalno, superficijelno

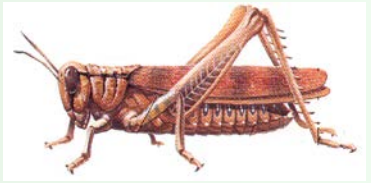
Razvoj:	lič. trohofora	preobrazba
Životni prostor:	more, vode na kopnu, kopno-vlažna staništa	prvobitno morski, KOPNO, vode na kopnu
Broj vrsta:	≈ 9.000	≈ 900.000

Koljeno: Arthropoda

1.Potkoljeno: Trilobitomorpha
2.Potkoljeno: Cheliceriformes
3.Potkoljeno: Crustacea
4.Potkoljeno: Hexapoda
5.Potkoljeno: Myriapoda









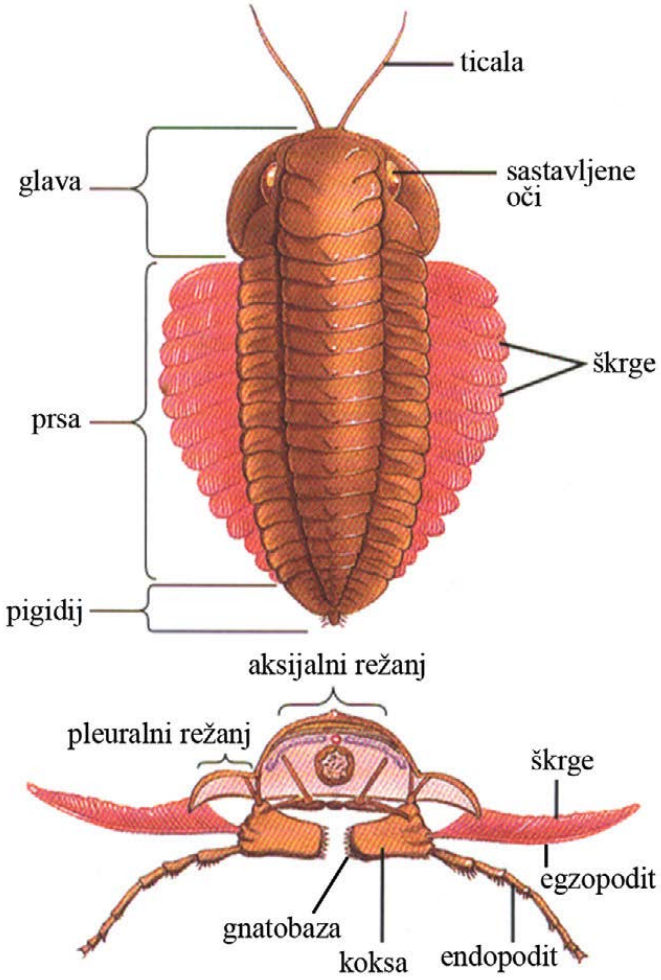
1. Potkoljeno: Trilobitomorpha



- **Opća obilježja:**
- **Veličina:**

  od 3 do 70 cm;
- **Povijesni položaj:**
  javljaju se u kambriju, maksimum razvoja dostižu u ordoviciju, nestali u permu.
- **opisano oko 4000 fosila**

Trilobitomorpha



- **Rekonstrukcija građe tijela:**
- **glava (cephalon): ticala i sastavljene oči**
- **prsa (thorax): različiti broj kolutića, svi tjelesni privjesci jednaki, biramni**
- **pigidij**
- **Dva uzdužna žlijeba dijele tijelo na 3 režnja, lobusa (naziv!)**

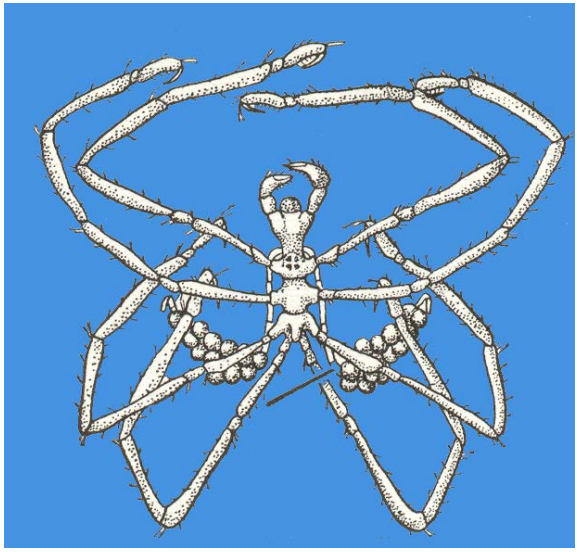
2. Potkoljeno: Cheliceriformes -kliještari



1. razred Merostomata



2. razred Arachnida



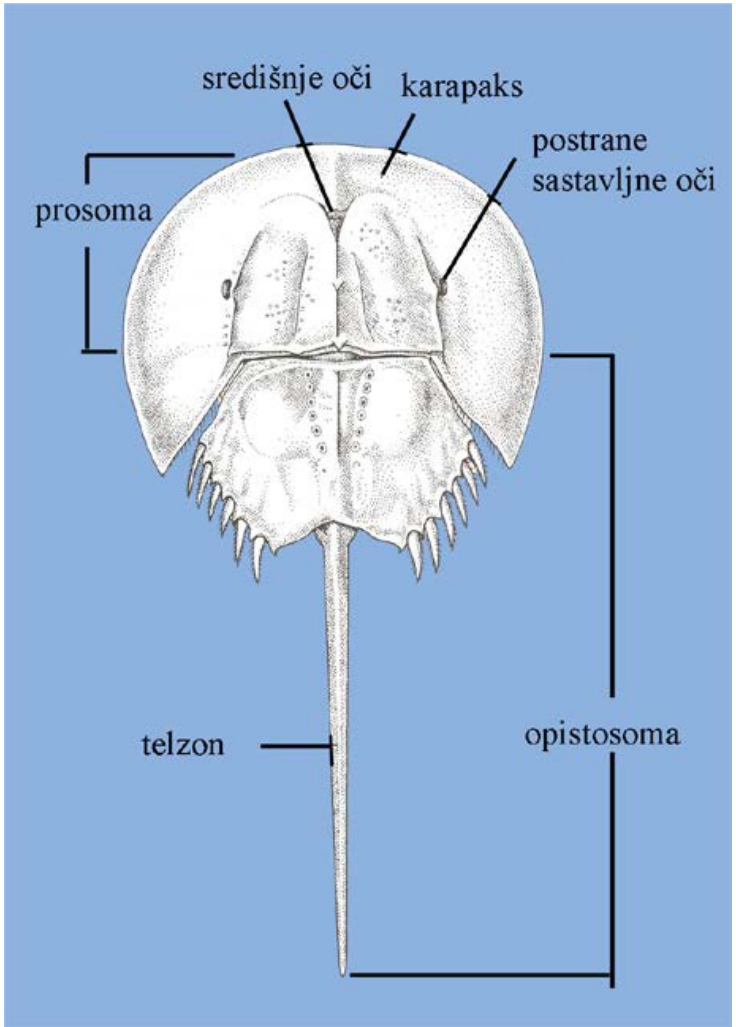
3. razred Pycnogonida

Razred: Merostomata (praklještari)



- **samo 1 red: Xiphosura (bodljaši);**
- **žive na dnu mora uz atlantsku obalu S. Amerike i u jugoistočnoj Aziji**
- ***Limulus polyphemus*: 60 cm**

Merostomata



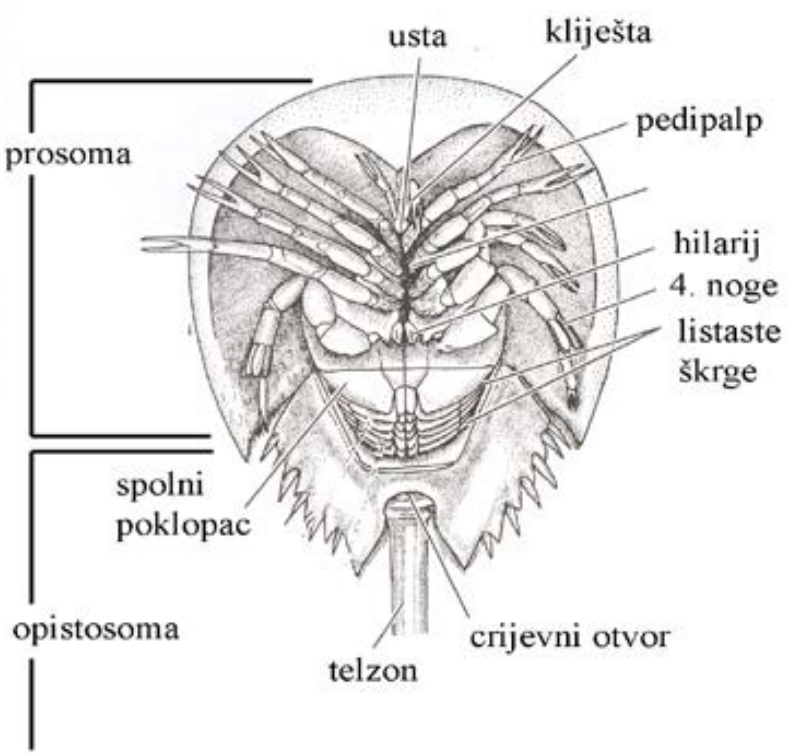
- **Tagmatiazacija:**

sličnu su trilobitima,

spljošteno tijelo podijeljeno je na: prosomu (pokrivena karapaksom u obliku potkove) i

opistosomu

Merostomata



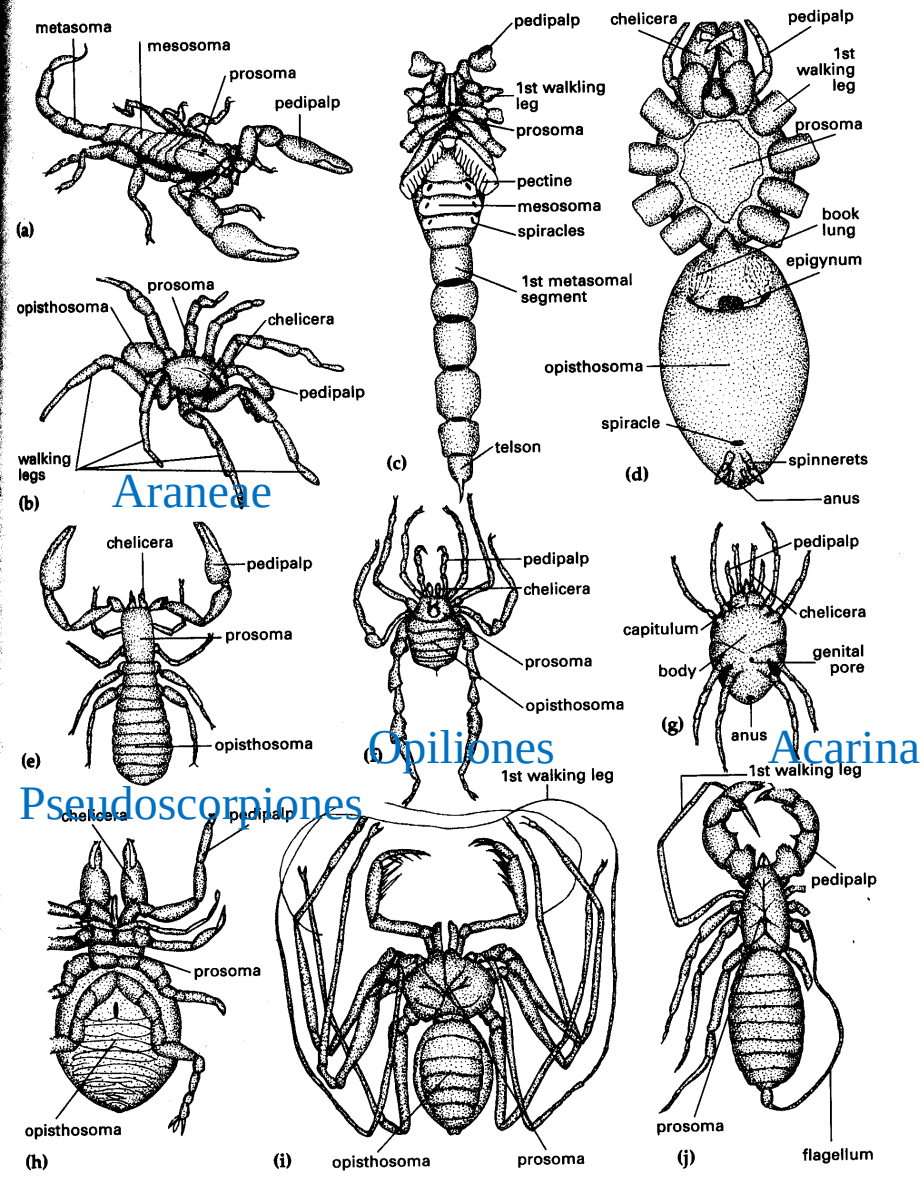
- **Tjelesni privjesci:**
- **PROSOMA**
- **akron:**
- **1. kolutić:**
- **2. kolutić: chelicerae**
- **3. kolutić: pedipalpi**
- **4. jednograne noge za hodanje**
- **5. jednograne noge za hodanje**
- **6. jednograne noge za hodanje**
- **7. jednograne noge za hodanje**

- **OPISTOSOMA**
- **1. kolutić: hilarij**
- **2. kolutić: spolni poklopac**
- **3. dvograne noge plivalice sa škrgama**
- **4. dvograne noge plivalice sa škrgama**
- **5. dvograne noge plivalice sa škrgama**
- **6. dvograne noge plivalice sa škrgama**
- **7. dvograne noge plivalice sa škrgama**
- **8.**
- **9. telzon (bodlja)**

http://www.youtube.com/watch?v=52mvinxcYjU

Razred: Arachnida (paučnjaci)

- **Rasprostranjenost:**
- **prve kopnene životinje;**
- **sekundarno žive u vodi;**
- **nametnici**
- **Biološka raznolikost:**
- **poznato je oko 60.000 vrsta;**
- **Scorpiones**
- **Araneae**
- **Pseudoscorpiones**
- **Opiliones**
- **Acarina**
- **Solifugae**
- **Ricinulei**
- **Uropygi**



Scorpiones (štipavci)



- **Rasprostranjenost:**

- poznato ih je oko 1.200 vrsta;

- noćni predatori, hrane se malim beskralježnjacima;

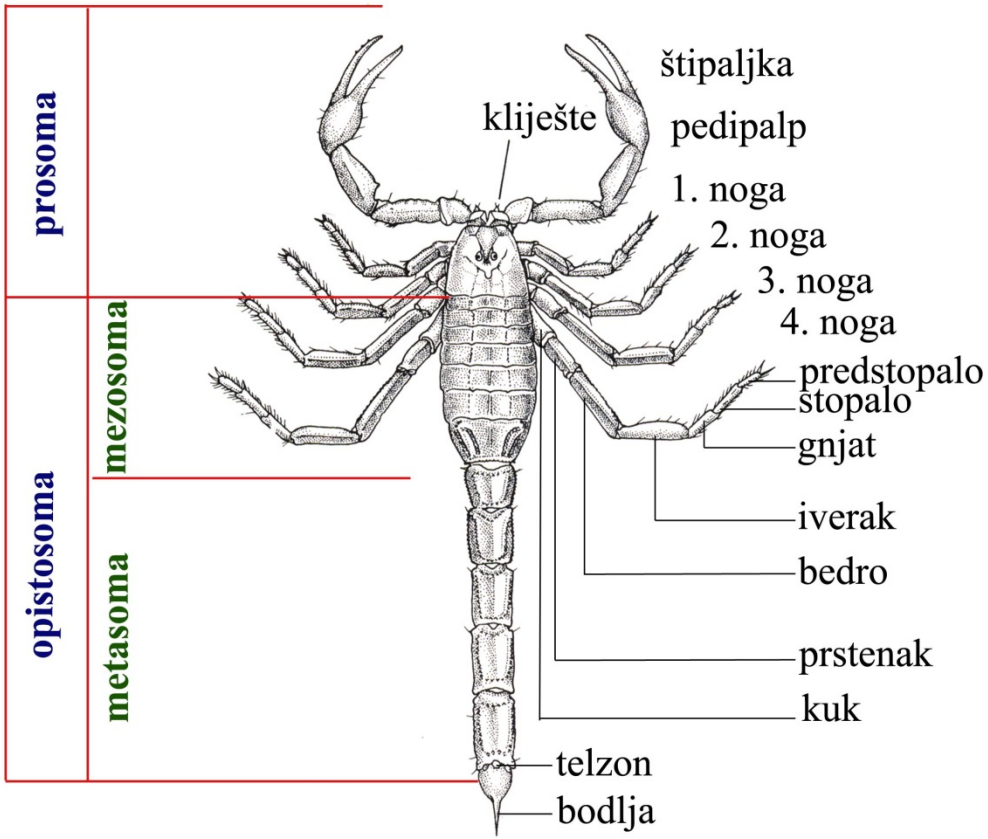
- žive u tropskom i suptropskom pojasu od šuma do pustinja;

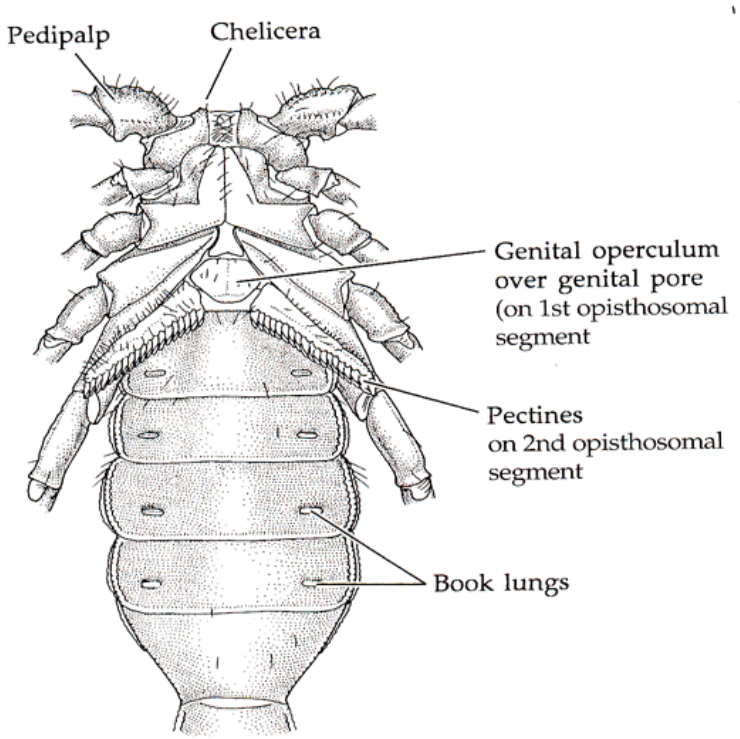
- u siluru i devonu bili su vodeni oblici;

- veliki su od 0.9 do 18 cm;

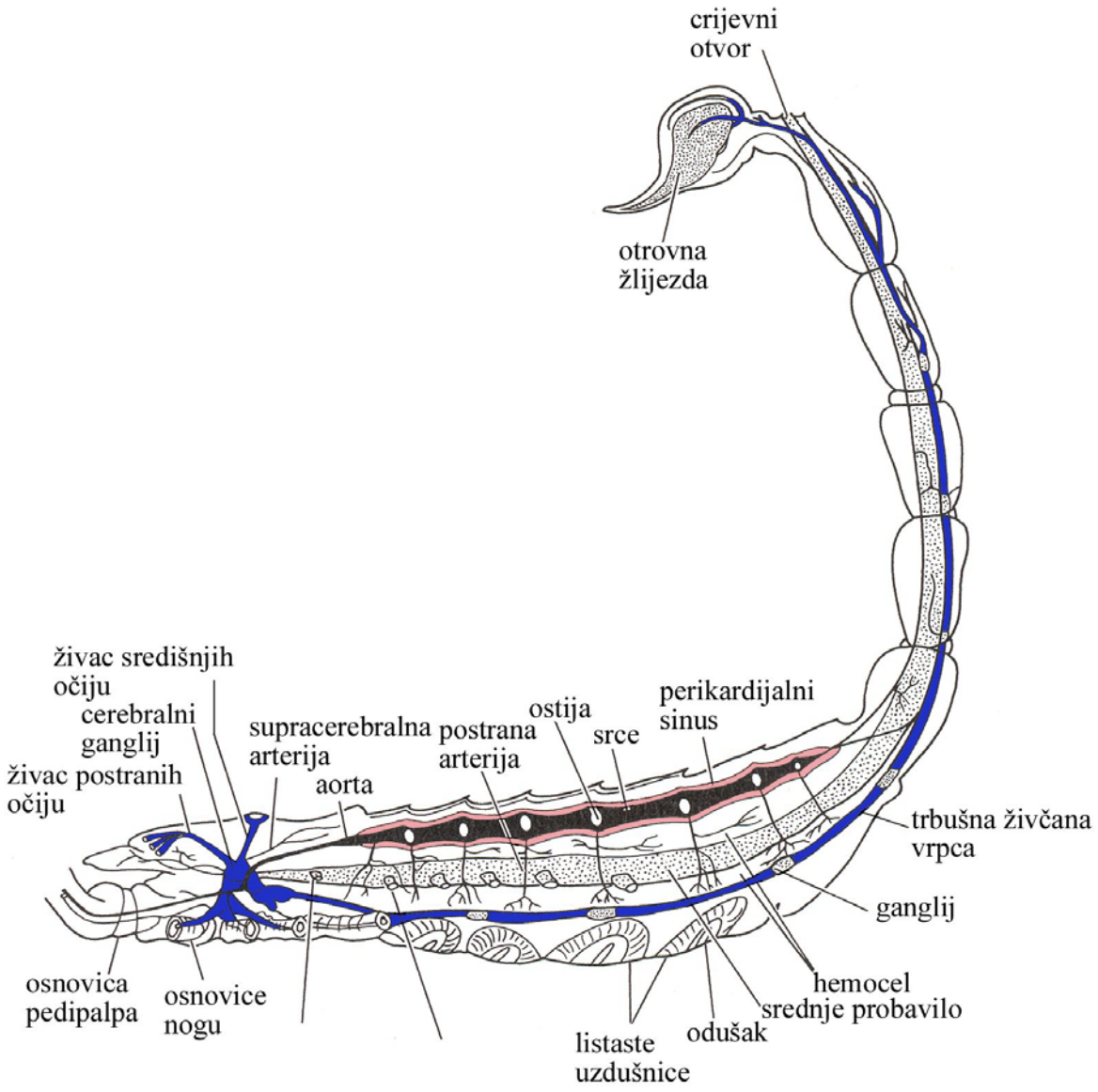
- iz karbona su poznati fosilni oblici do 86 cm

Scorpiones: građa tijela 1





Scorpiones: građa tijela 2



Scorpiones: biološka raznolikost

Porodica: **Buthidae**
Buthus occitanus (sredozemni štipavac);
Androctonus australis (Sj. Afrika);
Centruroides (Meksiko).
Porodica: **Scorpionidae**
Pandinus imperator (Afrika), kopa hodnike u zemlji
Porodica. **Chactidae**
Euscorpius italicus
E. carpathicus
E. germanicus

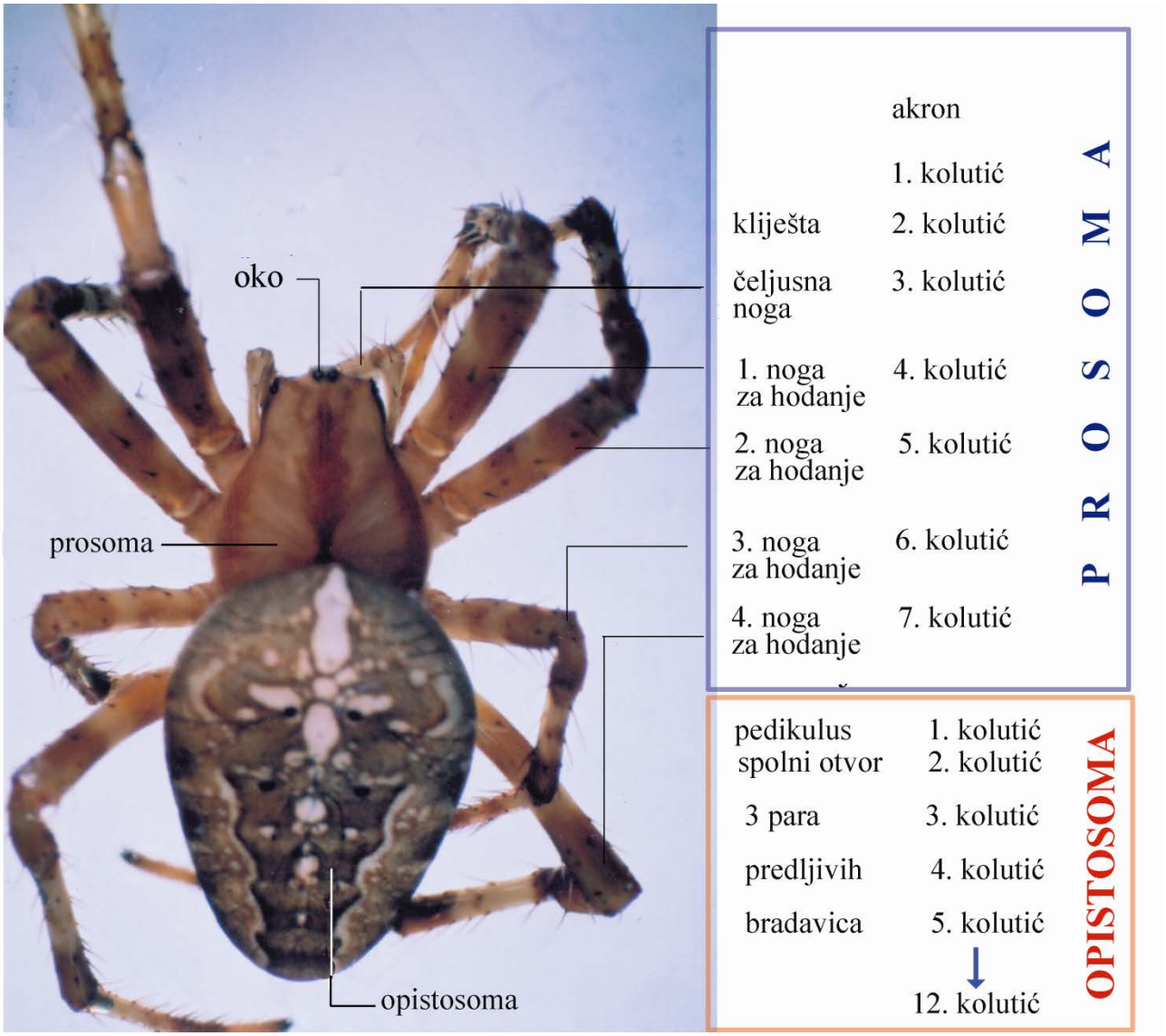


Aranae (paukovi)



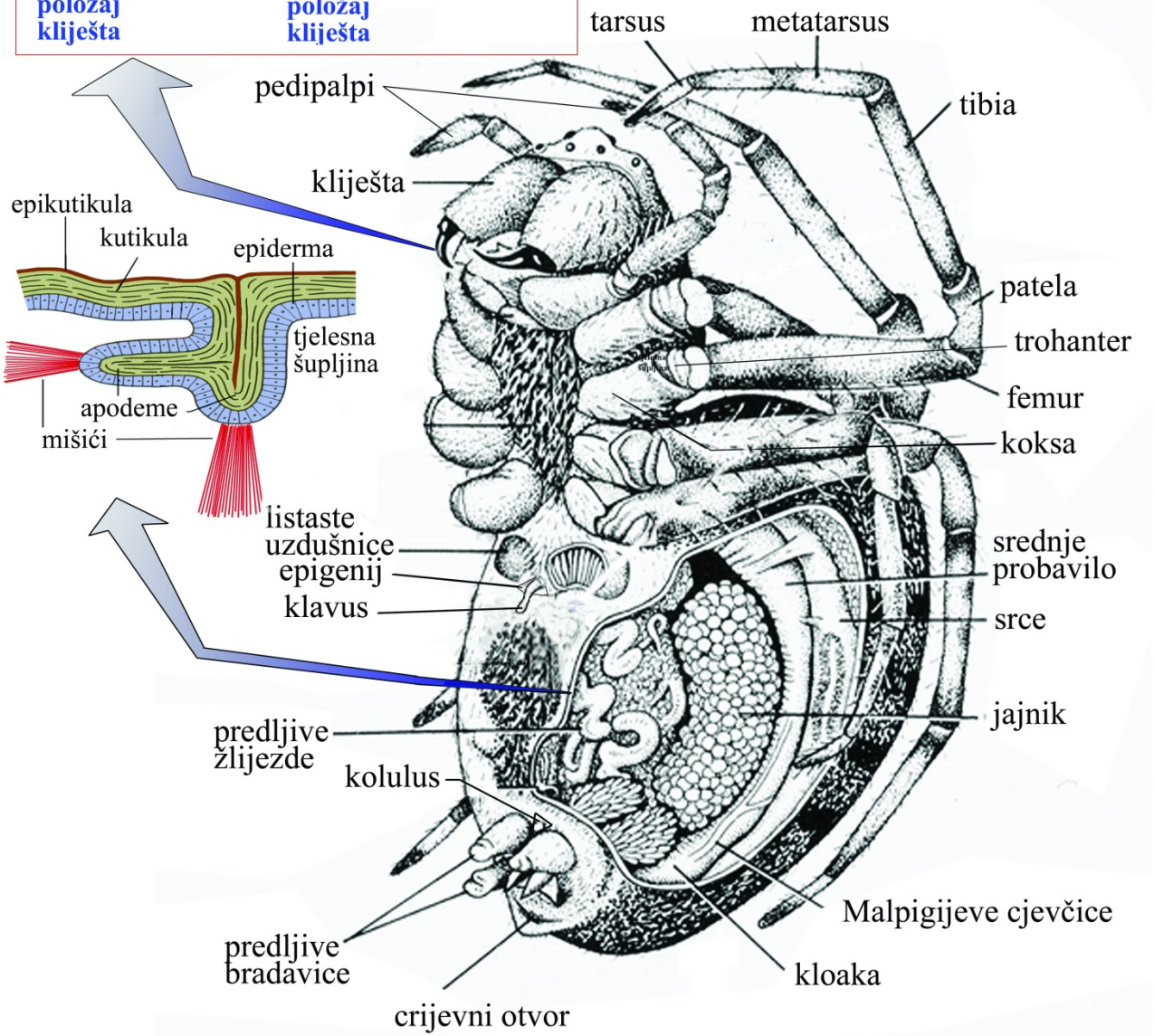
- **Broj vrsta: 32.000;**
- **Najbrojniji su u toplim područjima;**
- **Karnivorni oblici: ne grizu plijen, nego isisavaju žrtvu;**
- **Sposobnost predenja paučine;**
- **Veličina tijela: od 0.5 mm do 90 mm;**
- **Kliješta su u vezi s otrovnom žlijezdom;**
- **žive u nastambama ali najveći broj su skitnički oblici.**

Aranae (paukovi): tagmatizacija

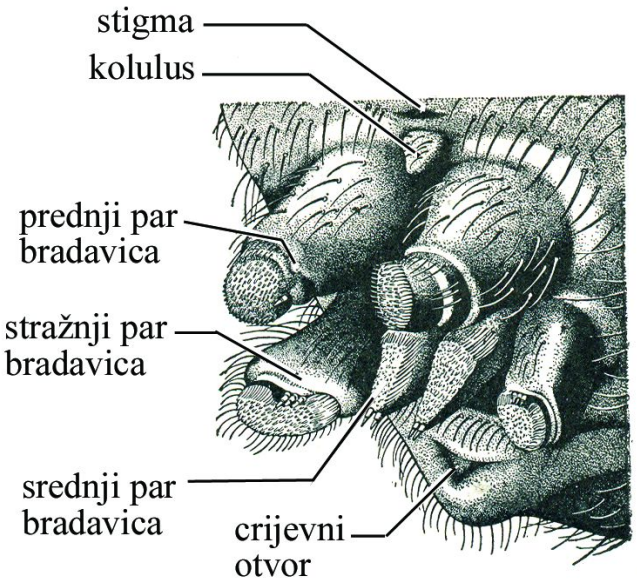


Aranae (paukovi): privjesci i predljive bradavice

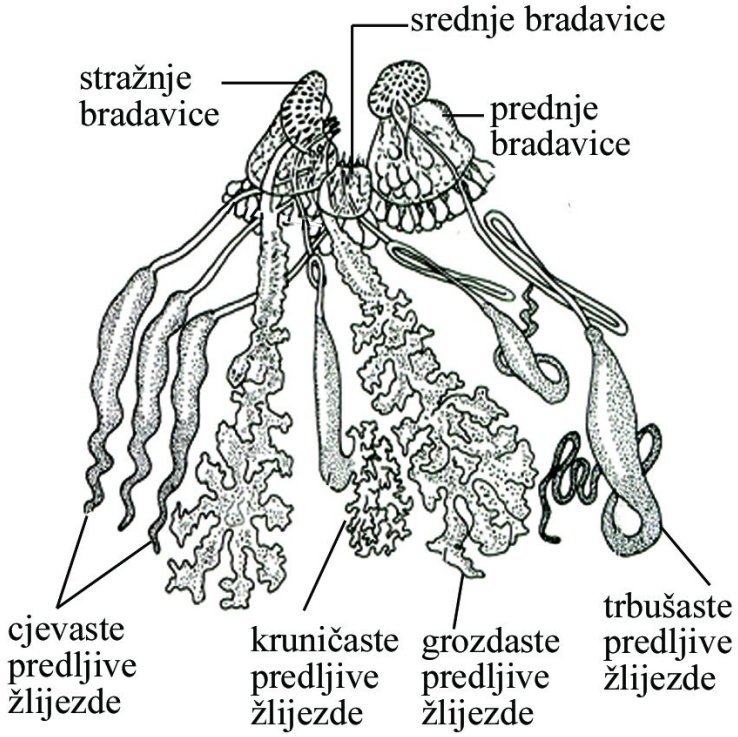


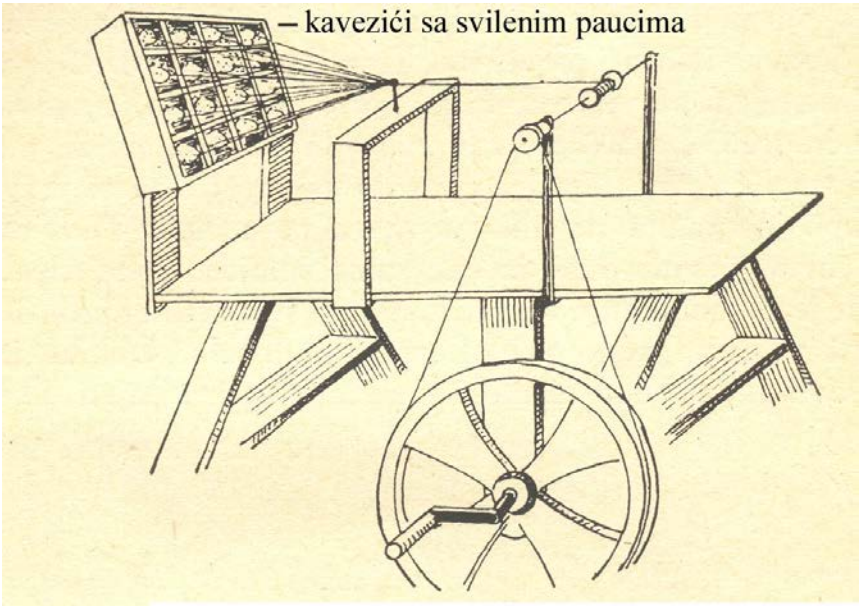


Aranae (paukovi): privjesci opistosome i predljive bradavice

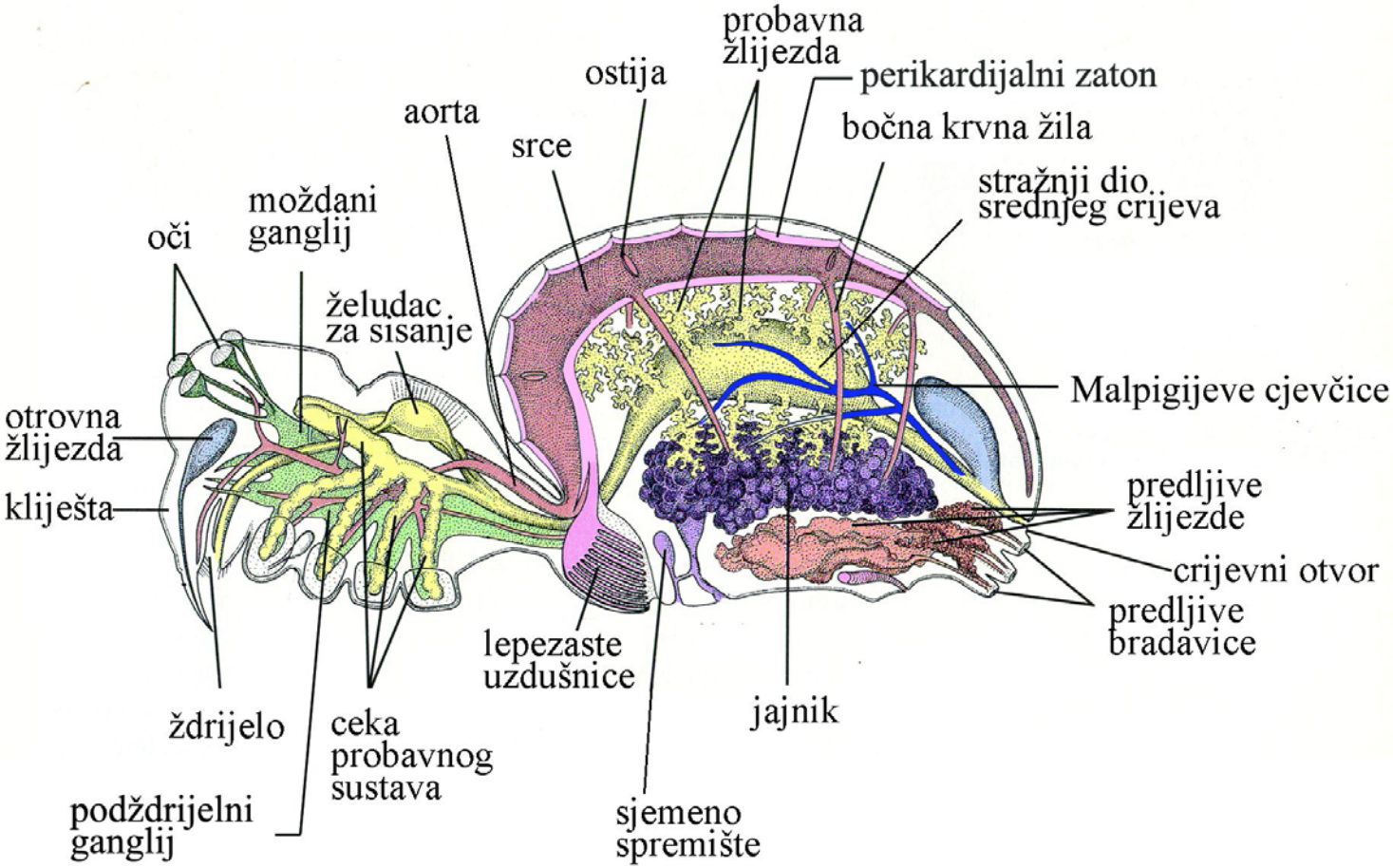








Aranae: unutrašnja: građa i funkcije

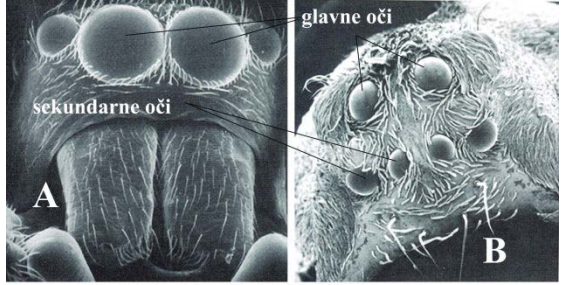


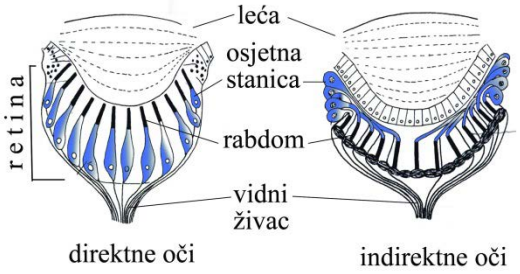
Aranae: živčani sustav i osjetila

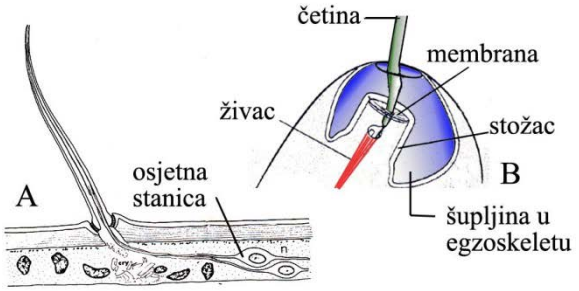
Cerebralni ganglij: protocerebrum + tritocerebrum

Osjetila:

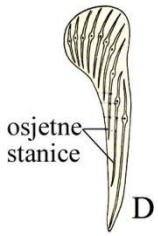
- osjetne dlake
- lirasti organi (pukotine pored usta) - kemoreceptori
- jednostavne oči ocele.

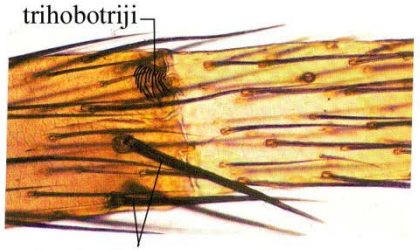


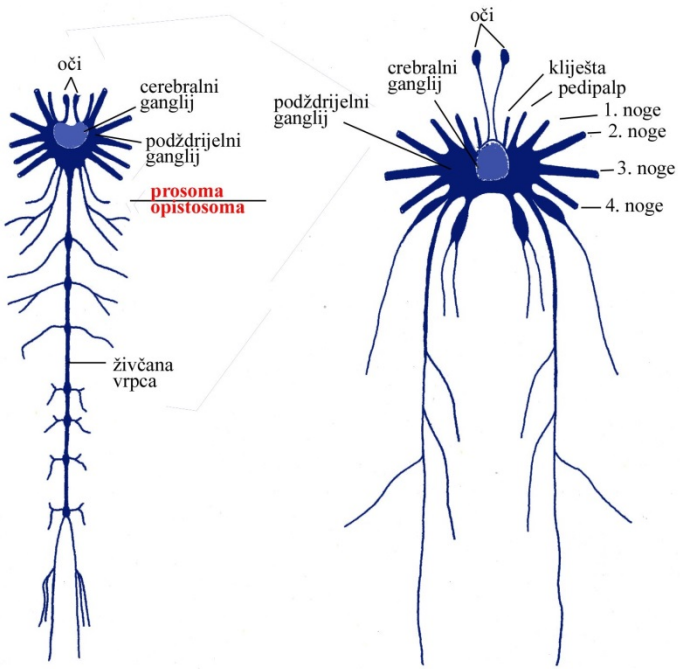




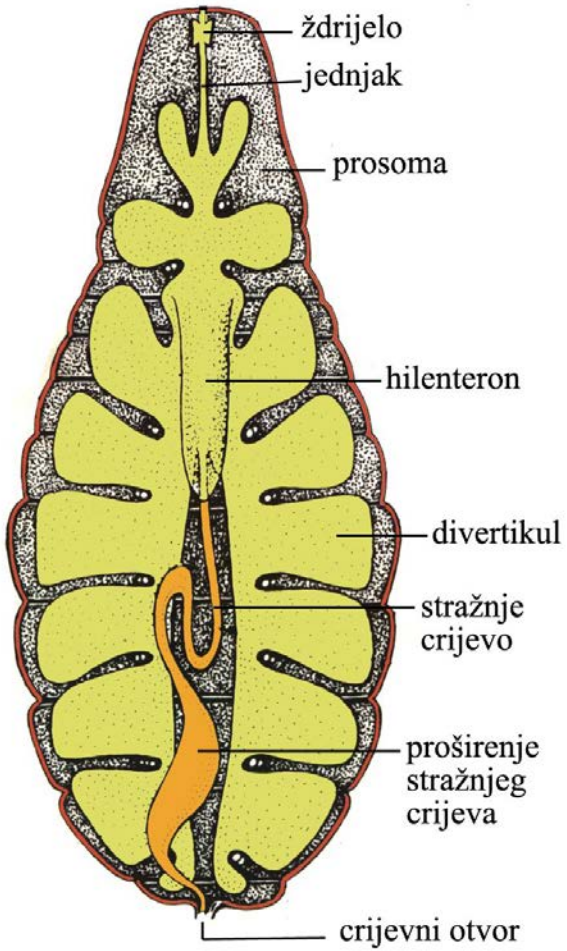




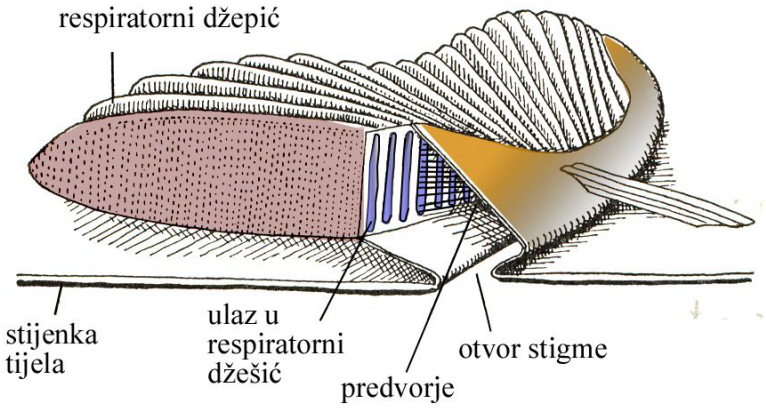


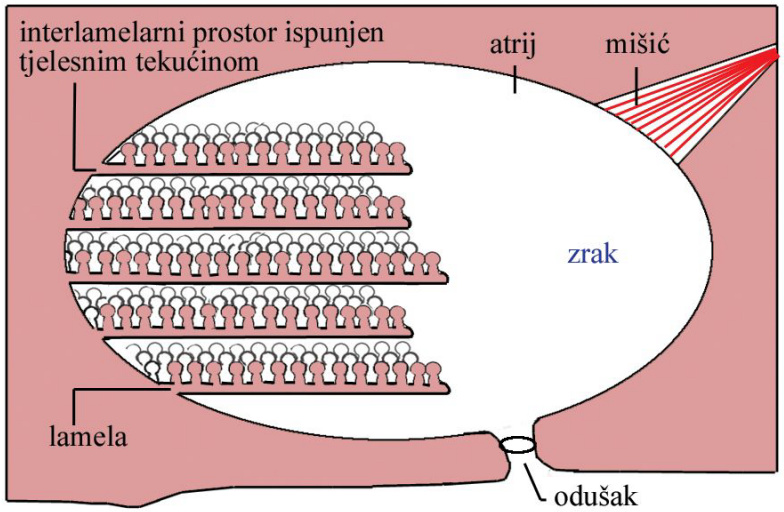


Aranae: probavni sustav



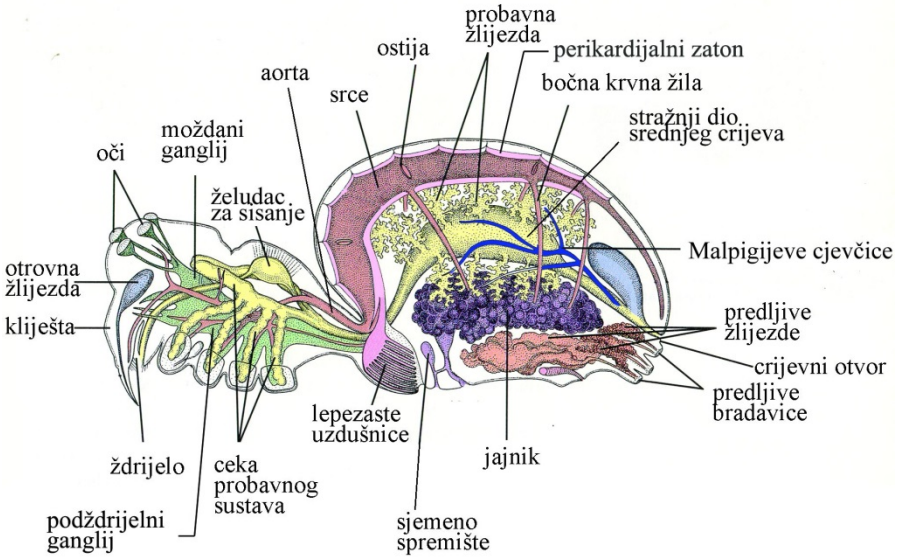
Aranae: dišni sustav – lepezaste i cjevaste uzdušnice

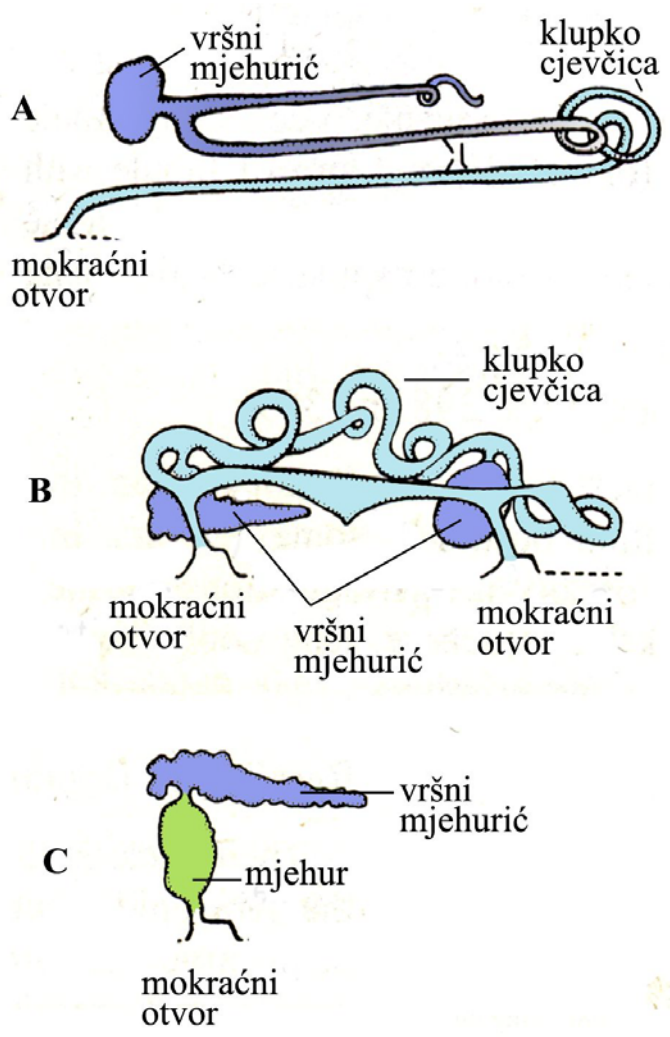




Aranae: sustav za ekskreciju

1. **Jedan do 2 para koksalnih žlijezda - preobraženi metanefridiji; vršni mjehurić + klupko cjevčica, otvor na osnovici kokse;**
2. **Malpighijeve cjevčice – evaginacije mezenterona**





Poznatiji paukovi

Porodica: Avicullariidae

Avicularia avicularia (pauk ptičar)

Porodica Theridiidae

Latrodectus mactans (crna udovica)

Porodica: Araneidae

Araneus diadematus (pauk križar)

Nephila madagascariensis

***Argiope* spp.**

Porodica Lycosidae (vučjaci)

Lycosa tarentula

Porodica: Agenelidae

***Argyroneta aquatica* (srebrosjeni vodenpauk)**

Porodica: Thomisidae











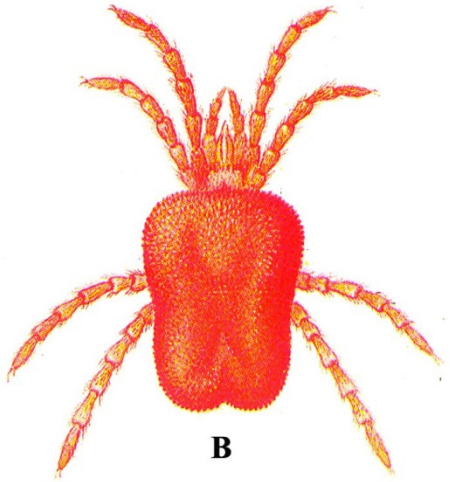




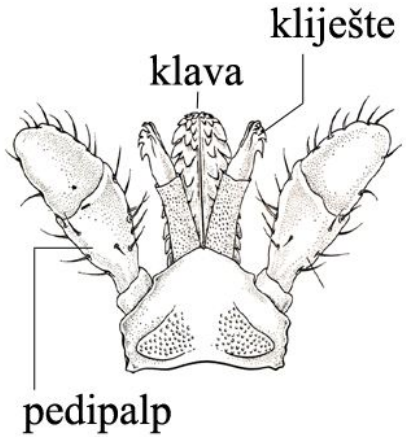


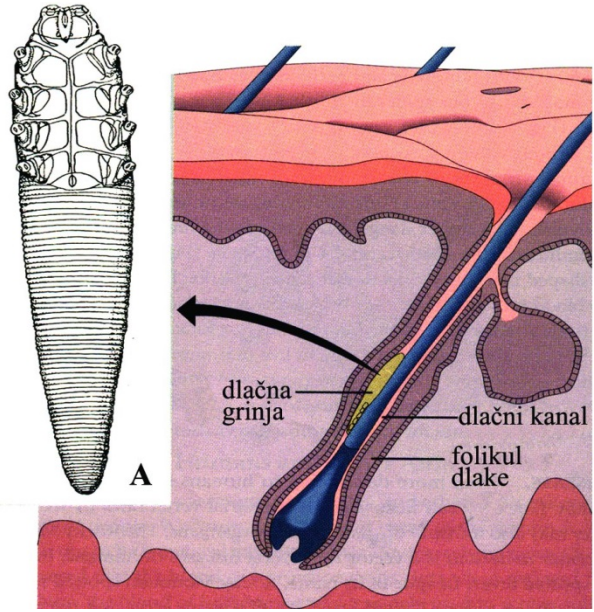
Acarina (grinje)

Porodica: Ixodidae (krpelji)- ***Ixodes ricinus***
Porodica: Argasidae (stajski krpelji)- prijenosnici povratne groznice
Porodica: Sarcoptidae (šugarci)- ***Sarcoptes scabiei***

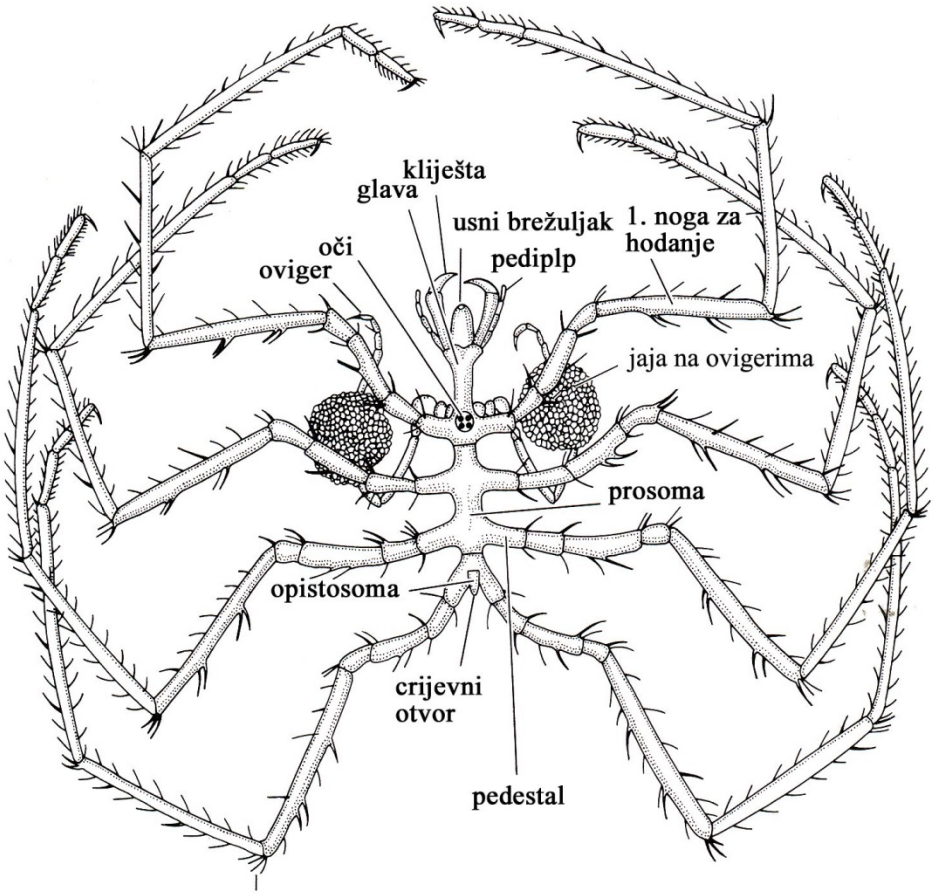








Pycnogonida (krakači)



- **Duge noge**
- **Opistosoma reducirana**
- **Oko 1000 vrsta**
- **kozmopolitski rasprostranjeni u bentosu mora**