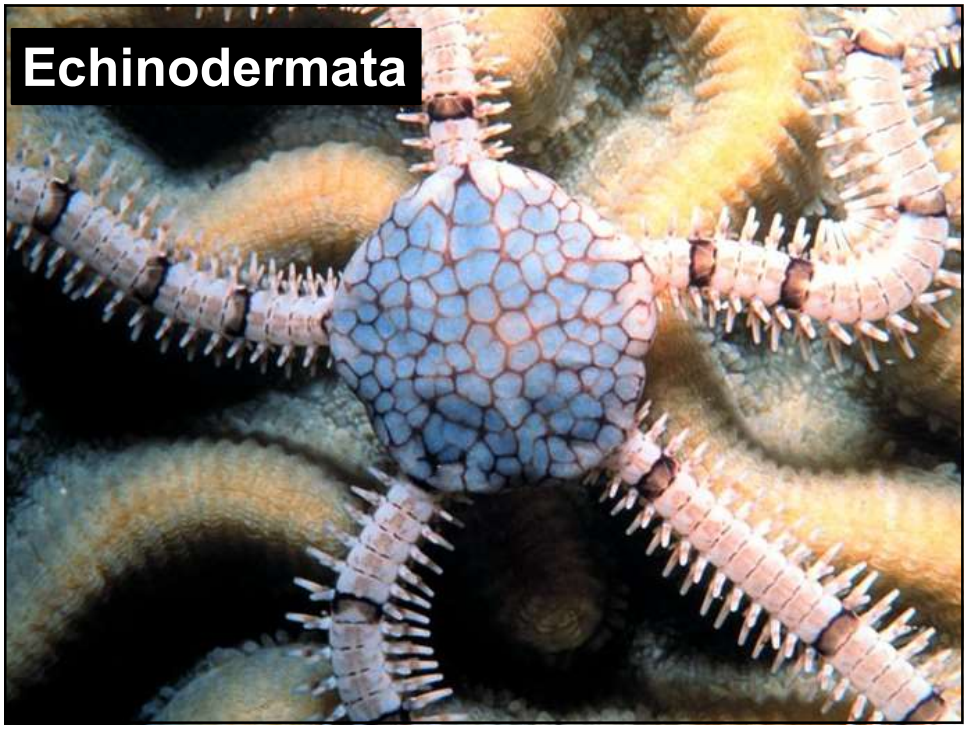
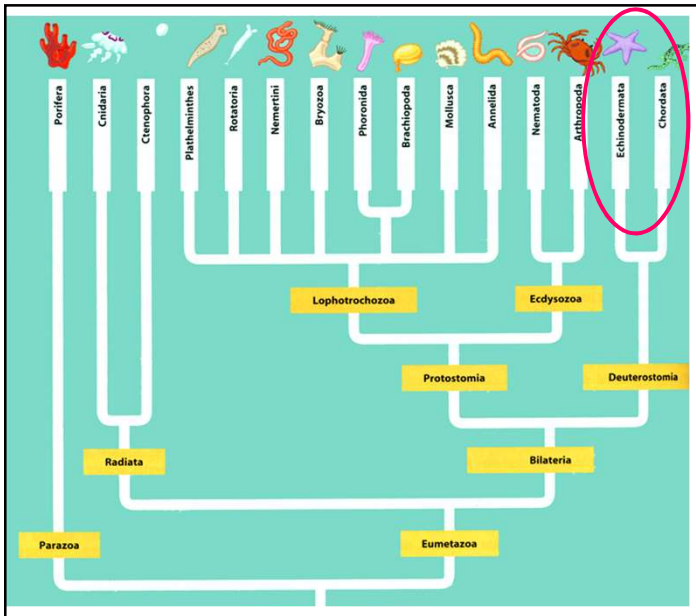
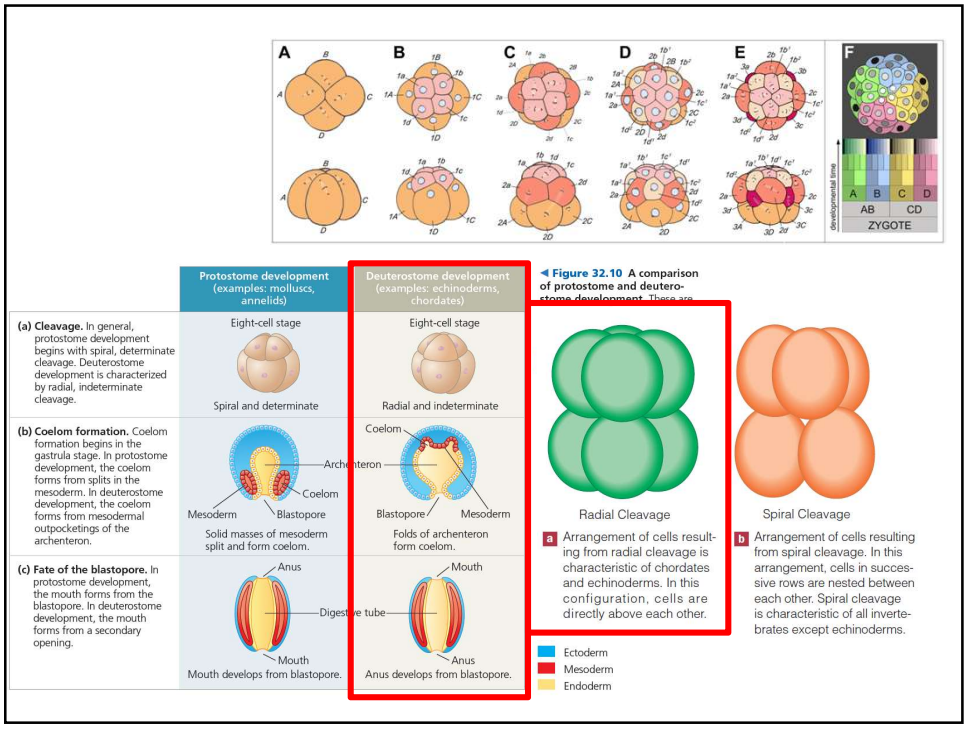




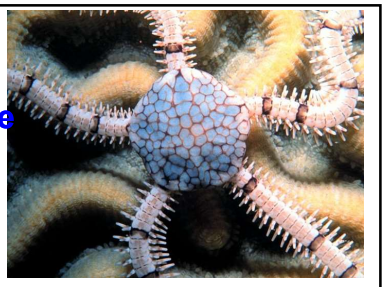
Campbell, N.A. 2003



Echinodermata

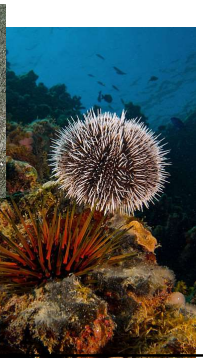
Marini con simmetria prevalentemente pentamera nello stadio adulto

Stelle marine, ricci di mare, Dollari della sabbia, cetrioli di mare, Gigli di mare, …
Dal Cambriano ad oggi.



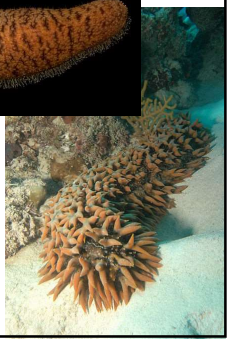
Asteroidea

Holothuroidea

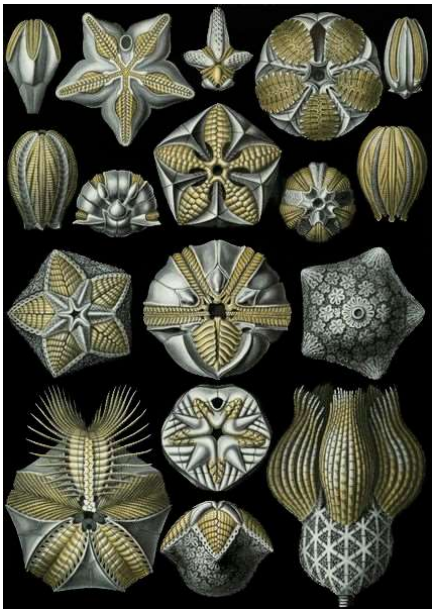


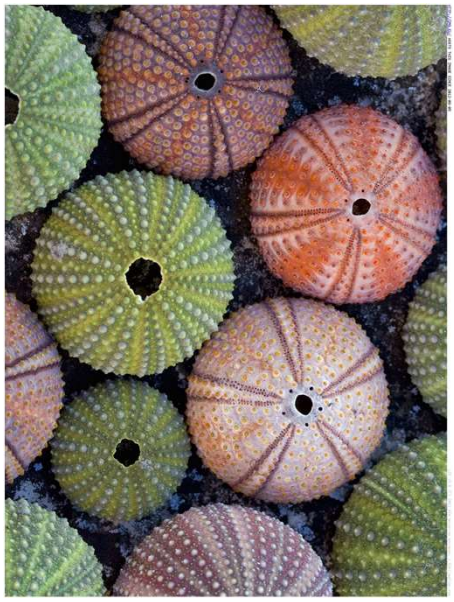
Echinoidea

Crinoidea



Echinodermi sono anche Bilateria





Il sistema vascolare degli Echinodermi: Sistema Ambulacrale a canali acquiferi

tf = Ambulacral tube

sp. = spine
ped. = Pedicellariae

pm = peristomial membrane
bs = buccal sacs

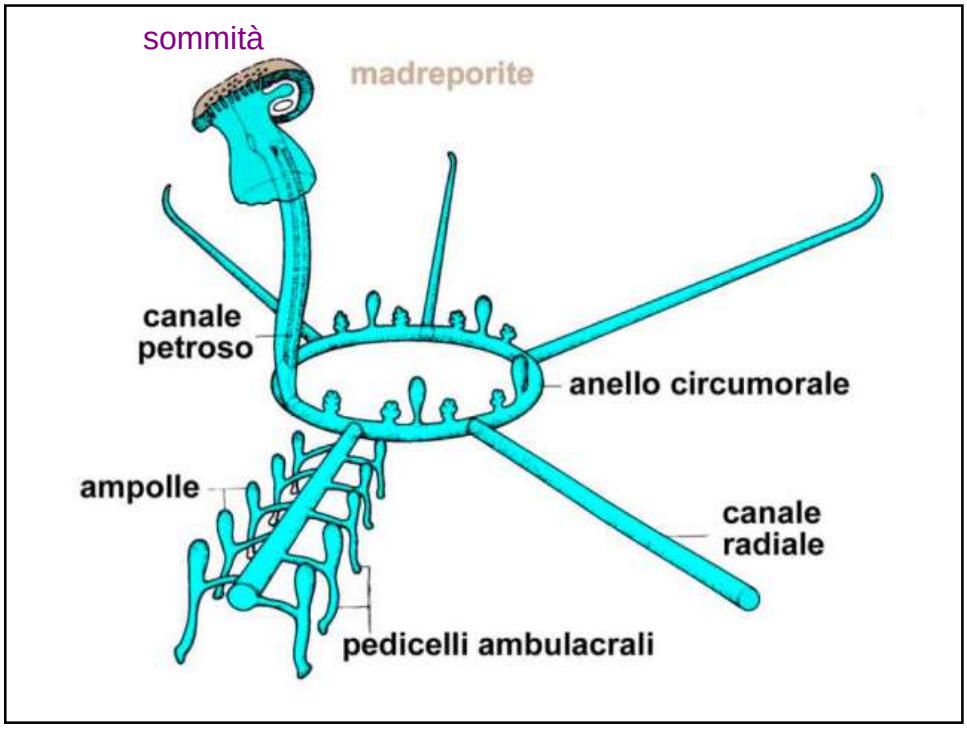
Locomozione
Nutrizione

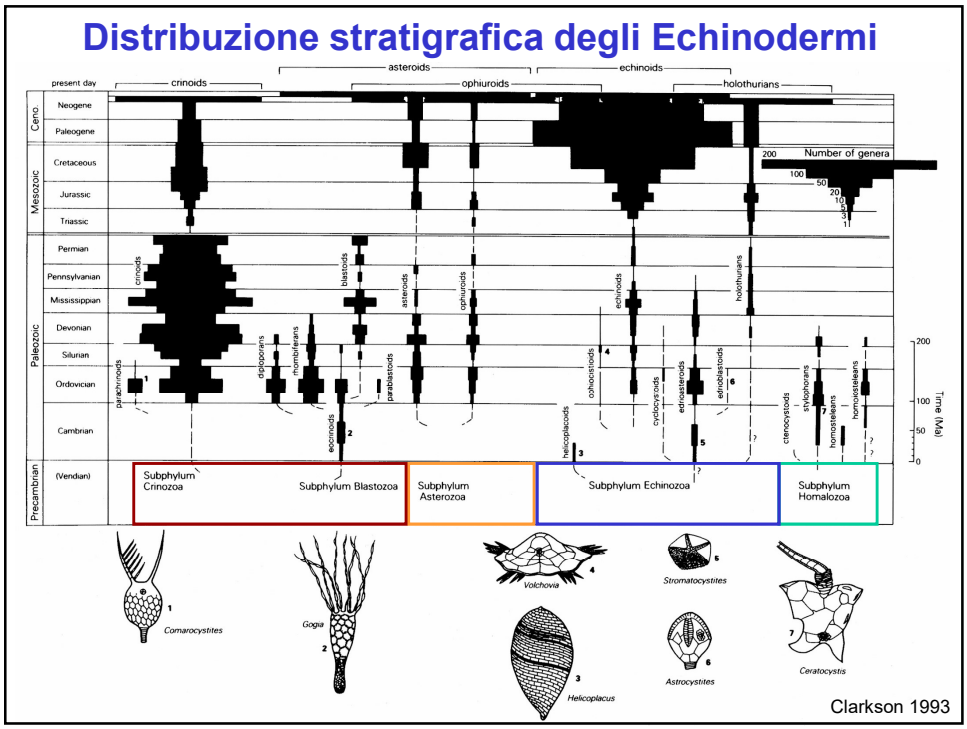
Sistema a Pompa idrica

Organismi bentonici vagili

Permette la distribuzione dell'acqua in tutto l'organismo per muoversi e nutrirsi

SISTEMA AMBULACRALE





DA SAPERE PER L'ESAME! menù degli echinodermi

Alimentazione

Crinoidei: **Filtratori**. Pedicelli rivestiti di muco deputati alla captazione delle particelle alimentari ed al loro trasporto lungo i solchi ambulacrali fino alla bocca.

Ofiure: **predatrori e spazzini**. Utilizzano braccia e pedicelli per spazzare il substrato e raccogliere alimenti convogliati alla bocca. Canale alimentare incompleto privo di intestino ed ano. Bocca stellata con cinque mandibole triangolari.

Echinoidei: **onnivori**. Si nutrono di alghe, briozoi, polipi di coralli e resti di animali morti. I pedicelli intorno alla bocca manipolano il cibo. Dalla bocca sporge una struttura che serve per masticare che è detta Lanterna di Aristotele.

Asteroidei: **prevalentemente carnivori**. Alla bocca, segue un breve esofago che si congiunge con un stomaco (stomaco orale o cardiaco e stomaco aborale o pilorico) a cui segue un breve intestino ed un ano che termina sulla superficie aborale.

Oloturoidei: si nutrono di **detriti**, che ingeriscono insieme alla sabbia o al fango, o di cibo sospeso, che raccolgono con i tentacoli boccali.

Sistematica degli Echinodermi

Ust. Homalozoa (=Carpoidea)	**Completamente asimmetrici**
Ust. Crinozoa (=Pelmatozoa) Kl. Eocrinoidea Kl. Paracrinoidea Kl. Cystoidea Kl. Blastoidea Kl. Parablastoidea Kl. Edrioblastoidea Kl. Crinoidea	**Simmetria pentamera con stelo basale**
Ust. Asterozoa Kl. Asteroidea Kl. Ophiuroidea	**Simmetria pentamera con Morfologia stellata**
Ust. Echinozoa Kl. Helicoplacoidea Kl. Edrioasteroidea Kl. Holothuroidea Kl. Echinoidea Kl. Ophiocistioidea	**Simmetria pentamera semplice**

Tutti gli echinodermi sono calcitici, pertanto sono estremamente resistenti alla diagenesi
Gli scheletri di alcune specie (es. ricci di mare) possono staccarsi.

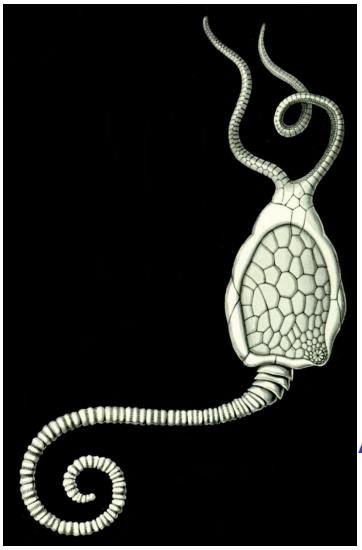
Estinte durante le anossie sul fondo marino nel Dev. medio

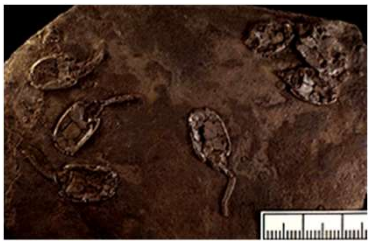
Homalozoa

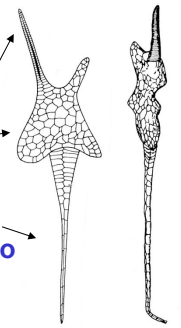
Bentonici sessili — acque basse, alta enrgia

(Cambriano inferiore – Devoniano Medio)

Ust. Homalozoa (=Carpoidea)







Completamente asimmetrici

Privi di ambulacri

Classificati negli Echinodermi per Identiche caratteristiche mineralogiche

Crinozoa

bentonici sessile

(Ordoviciano - Recente)

Ust. Crinozoa (=Pelmatozoa)

- Kl. Eocrinoidea
- Kl. Paracrinoidea
- Kl. Cystoidea
- Kl. Blastoidea
- Kl. Parablastoidea
- Kl. Edrioblastoidea
- Kl. Crinoidea

Except Crinoidea all Crinozoa are Paleozoic

Class BLASTOIDEA

- Flask-shaped theca commonly with three basal plates; ambulacra with elongate lancet plate and rows of side plates
- Ordovician (Katian) to Permian (Tatarian)

Class CRINOIDEA

- Calyx with lower cup and upper tegmen. Sea lilies and feather stars
- Ordovician (Tremadocian) to Recent.

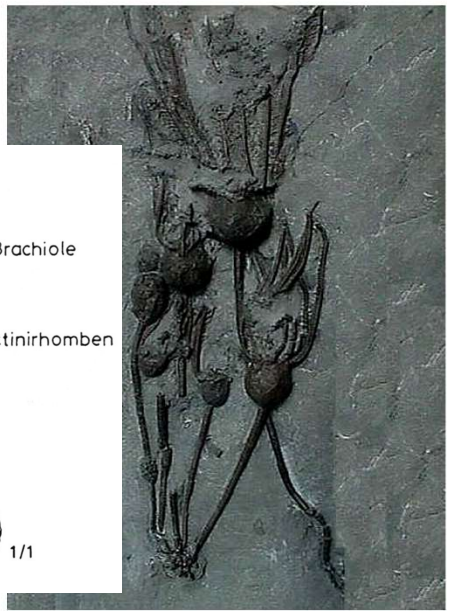
Unici attuali, gli altri estinti

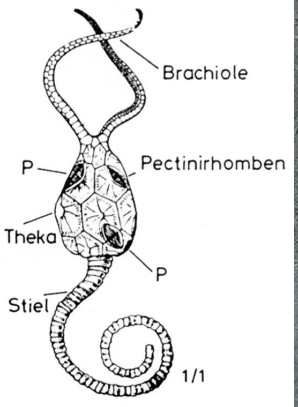
Pure questi si sono estinti con le anossie a fondo mare

Cystoidea bentonici sessili

Lower Ordovician – Lower Devonian

Crinozoa with specialized resipratory organ





Questi invece sono sopravvissuti alle anossie devoniane.

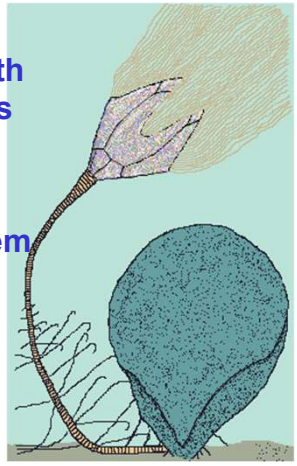
Blastoidea

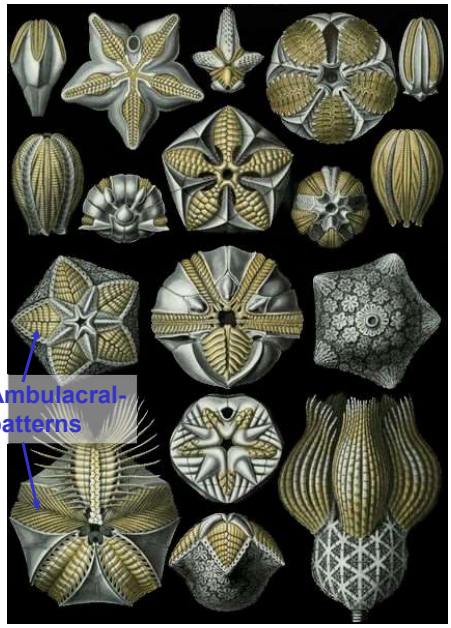
(Ordovician)-Silurian - Permian

Pronounced pentamere symmetry

Theca with brachiols

Stem





Blastoidea

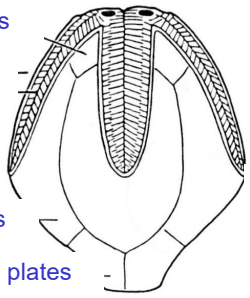
18 major plates

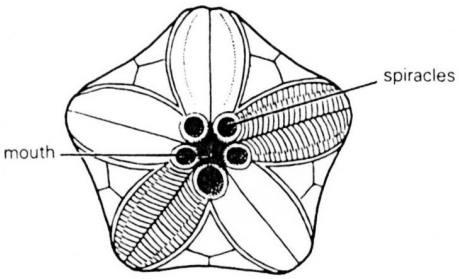
5 Deltoid plates

5 Ambulacral plates

5 Radial plates

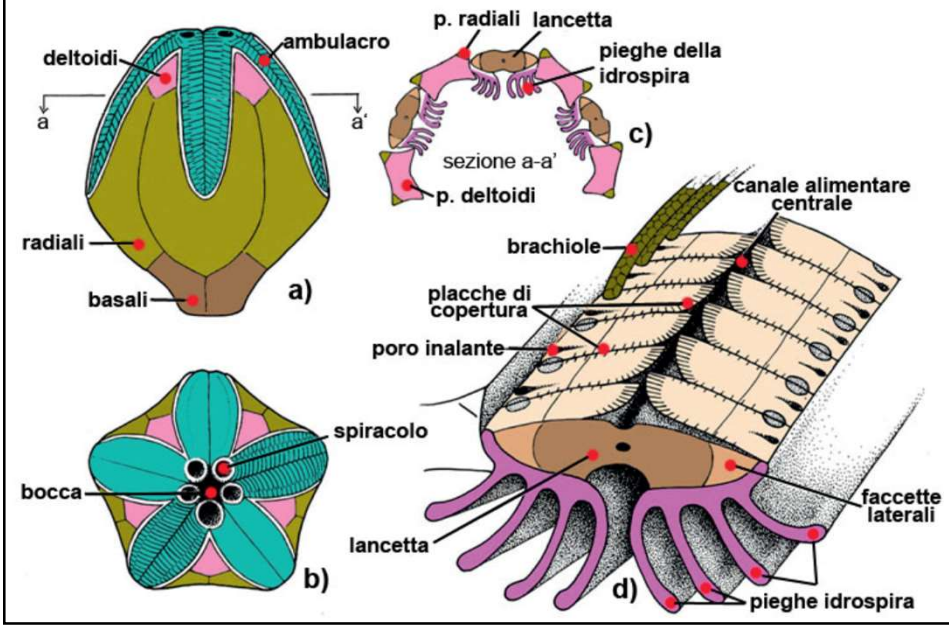
3 Basal plates

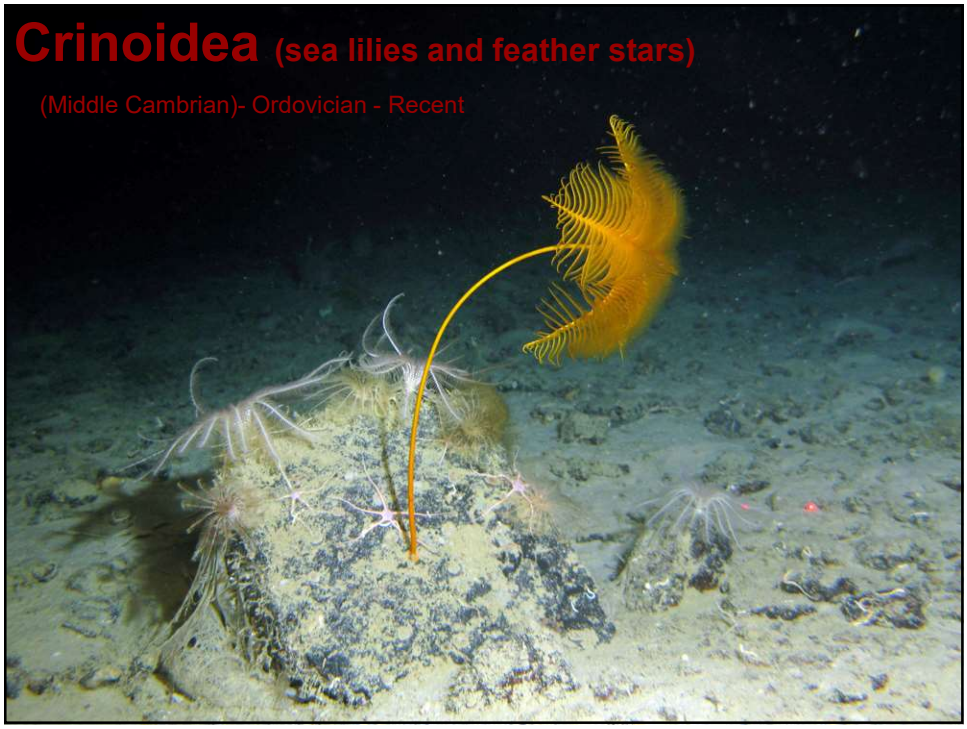




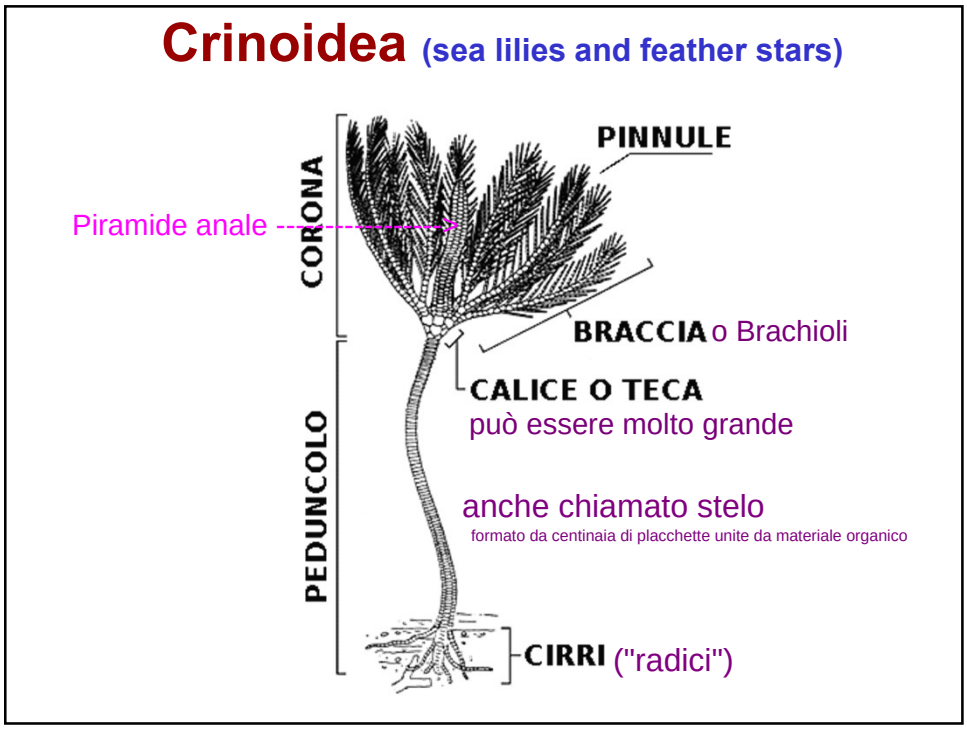
Mouth and 5 Spiraculae

Blastoidea



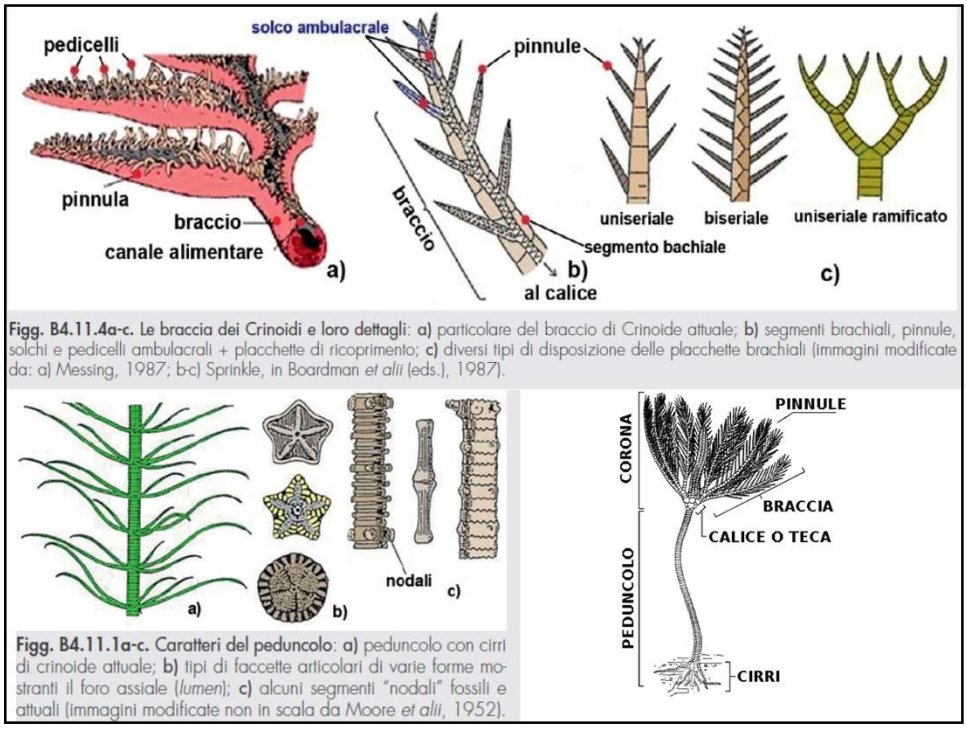


Senso della corrente d'acqua ---------->>>>>



I crinoidi sono bentonici VAGILI (solo quelli attuali gli altri sono sessili)

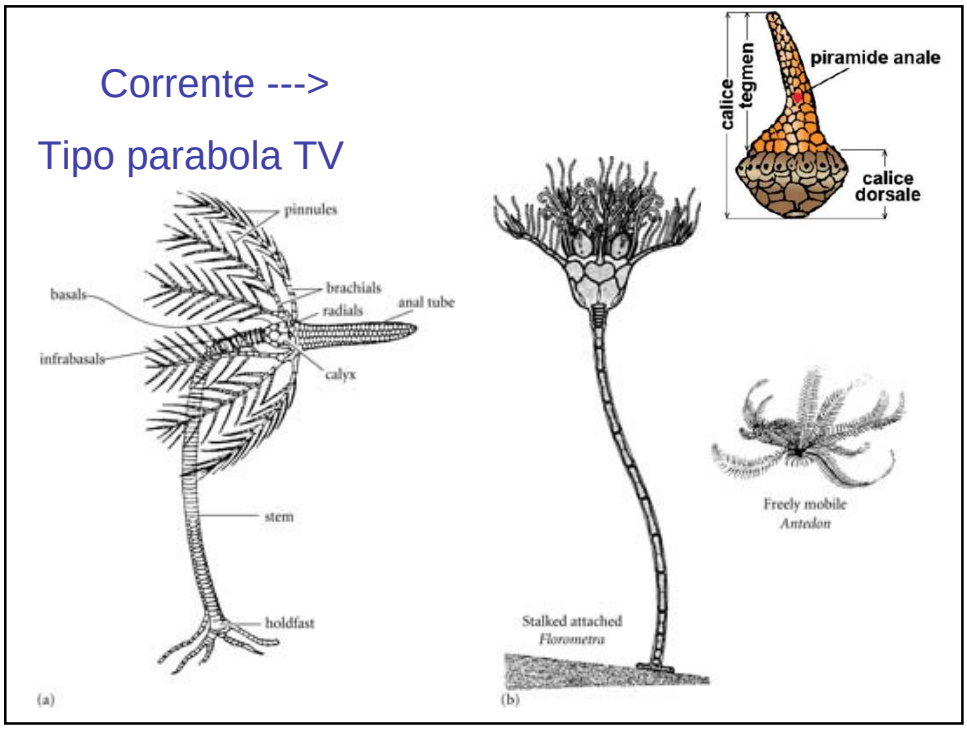
Ambiente EUTROFICO (ricco di roba in sospensione)



Figg. B4.11.4a-c. Le braccia dei Crinoidi e loro dettagli: **a)** particolare del braccio di Crinoide attuale; **b)** segmenti brachiali, pinnule, solchi e pedicelli ambulacrali + placchette di ricoprimento; **c)** diversi tipi di disposizione delle placchette brachiali (immagini modificate da: a) Messing, 1987; b-c) Sprinkle, in Boardman *et alii* (eds.), 1987).

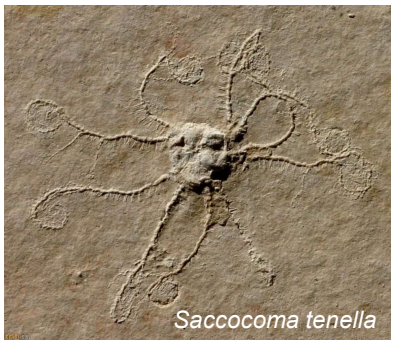
Figg. B4.11.1a-c. Caratteri del peduncolo: **a)** peduncolo con cirri di crinoide attuale; **b)** tipi di faccette articolari di varie forme mostranti il foro assiale (*lumen*); **c)** alcuni segmenti "nodali" fossili e attuali (immagini modificate non in scala da Moore *et alii*, 1952).

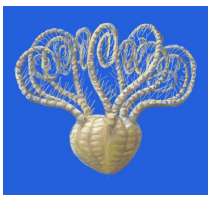
Placchette degli steli dei crinoidi



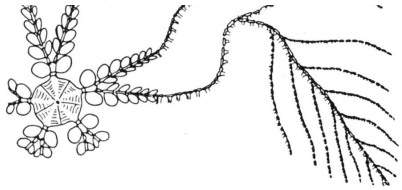
Tronco d'albero caduto in mare infestato da crinoidi

Crinoidea (sea lilies and feather stars)





Saccocoma
reduced stem



Saccocoma
Know only from the late Jurassic, Solnhofener Limestone

***Saccocoma* was a free swimming form**

Il saccocoma può essere usato come fossile guida

Ust. Asterozoa

Kl. Asteroidea
Kl. Ophiuroidea

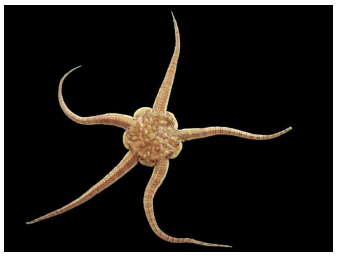
Class ASTEROIDEA

- Between 5 and 25 arms with large tube feet extend from a central disk. Starfishes or sea stars
- Ordovician (Floian) to Recent

Class OPHIUROIDEA

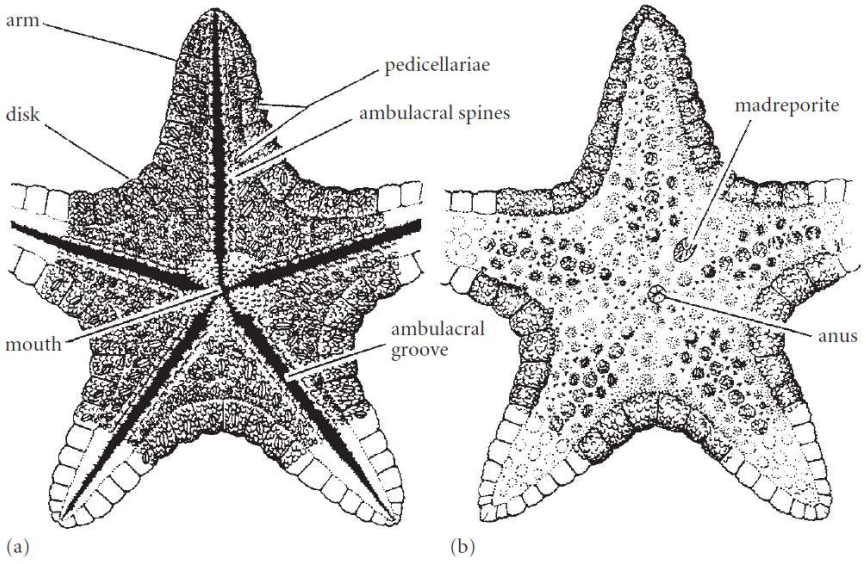
- Five long, thin, flexible arms, consisting of vertebrae and with small tube feet, extend from large, circular central disk. Brittle stars or basket stars
- Ordovician (Floian) to Recent

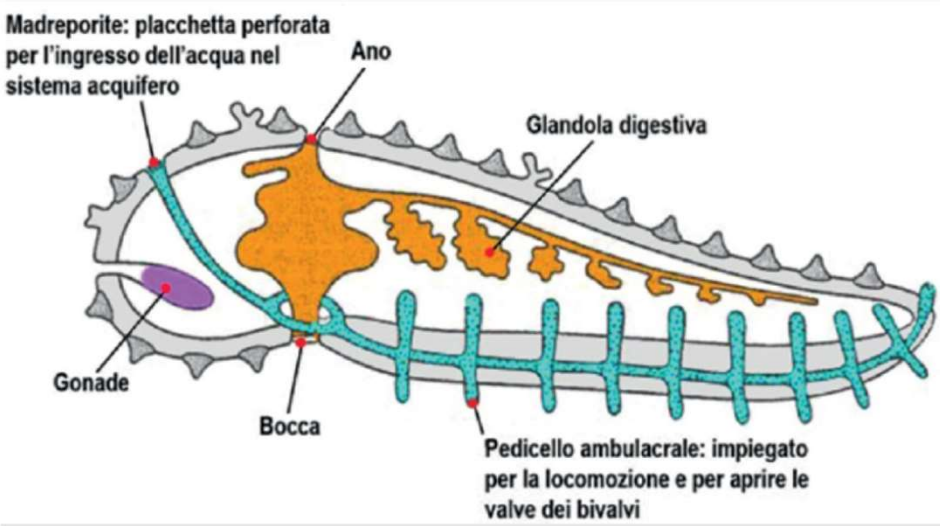
Asteroidea



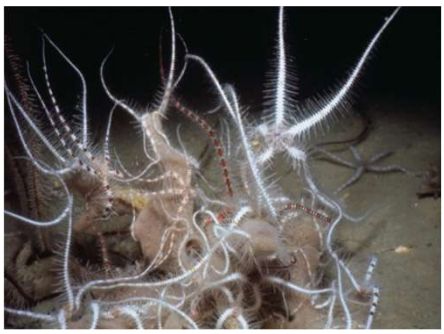
Ophiuroidea

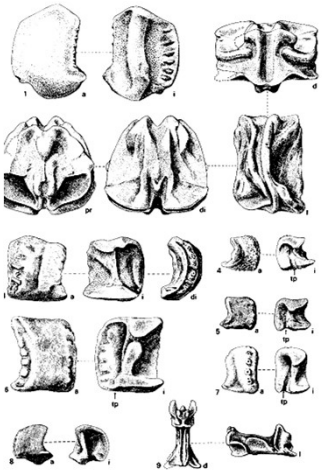
Asteroidea





Ophiuroidea





The armes build up of plates and spines, that falls apart after death → microfossils

Ust. Echinozoa

Kl. Helicoplacoidea
Kl. Edrioasteroidea
Kl. Holothuroidea
Kl. Echinoidea
Kl. Ophiocistioidea

RICCI DI MARE

Class ECHINOIDEA

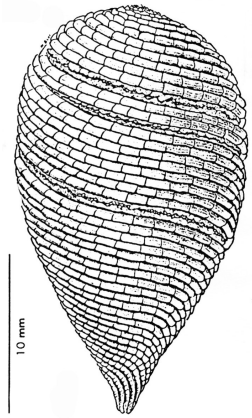
- Test is usually globular with plates differentiated into ambulacral and interambulacral areas. Mouth on underside, anus on upperside or sited posteriorly. Sea urchins, heart urchins and sand dollars
- Ordovician (Katian) to Recent

Class HOLOTHUROIDEA

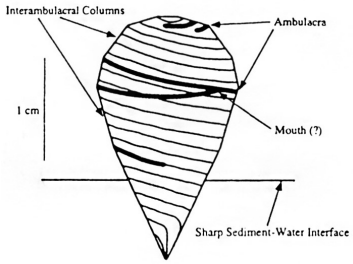
- Body is cucumber-shaped with leathery skin with muscular mesoderm and spicules. A ring of modified tube feet surround the mouth. Sea cucumbers
- Ordovician (Floian) to Recent

Echinozoa

Helicoplacoidea Early Cambrian

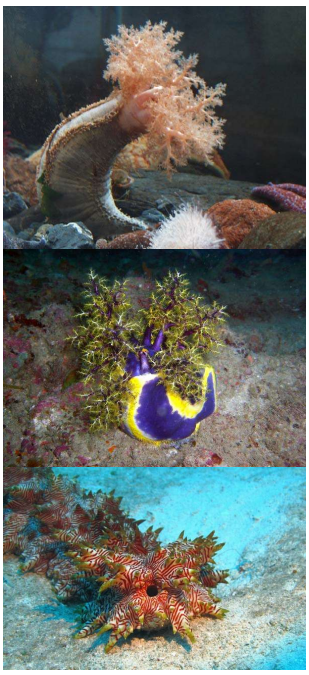


Spindle-shaped and strongly armored



Only one ambulacrum

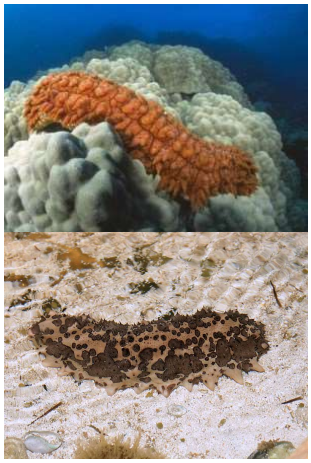
Questioned Echinoderms?



Echinozoa

Holothuroidea Ordovician - Recent

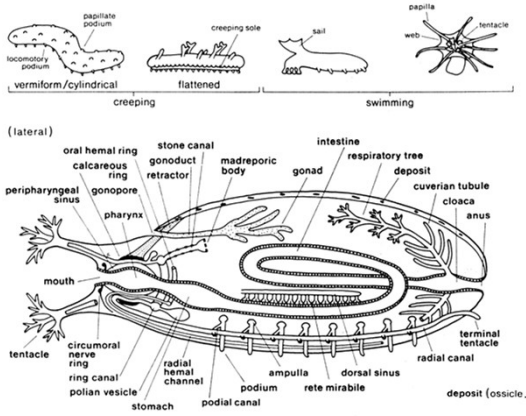
Sea cucumbers

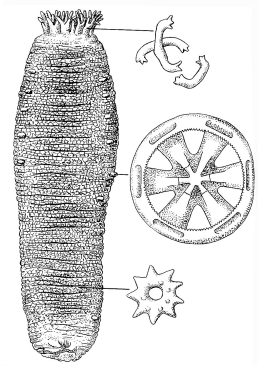


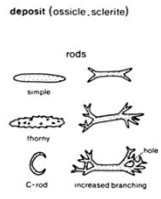
Elongated body

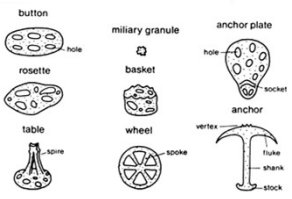
Echinozoa

Holothuroidea Ordovician - Recent







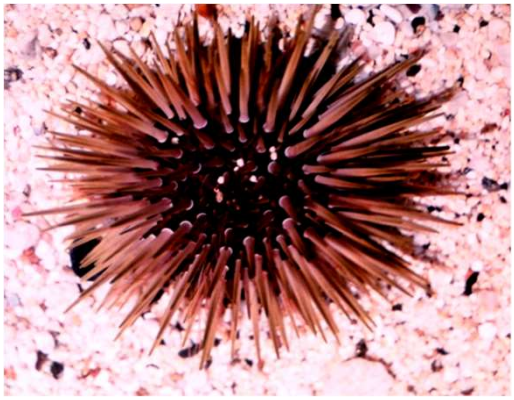


The skeleton is reduced to microscopic Skelrits

Echinozoa

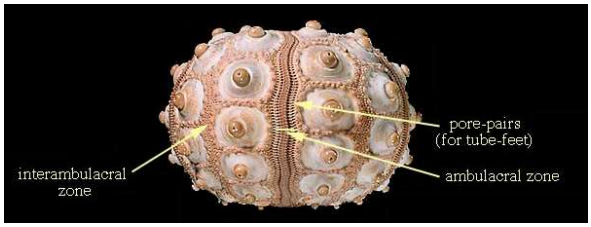
Echinoidea – Sea urchins

Ordovician - Recent



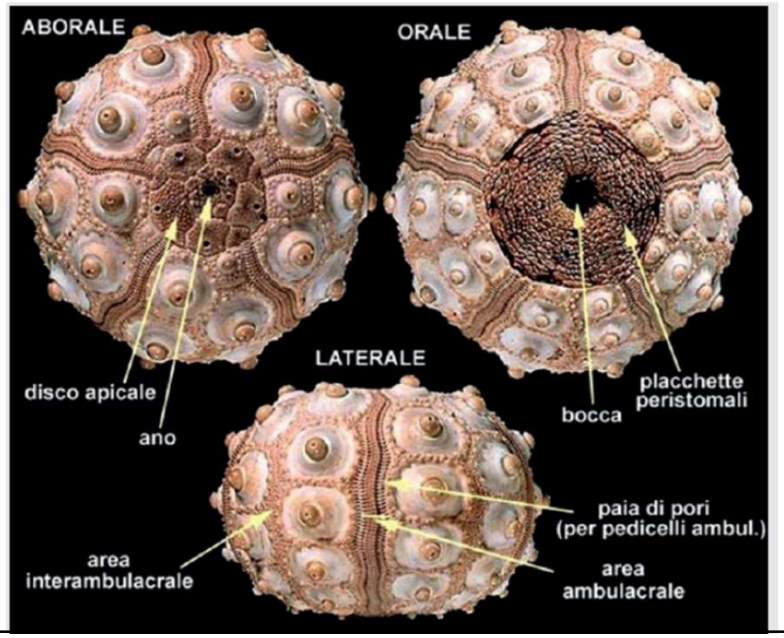
Echinozoa

Echinoidea

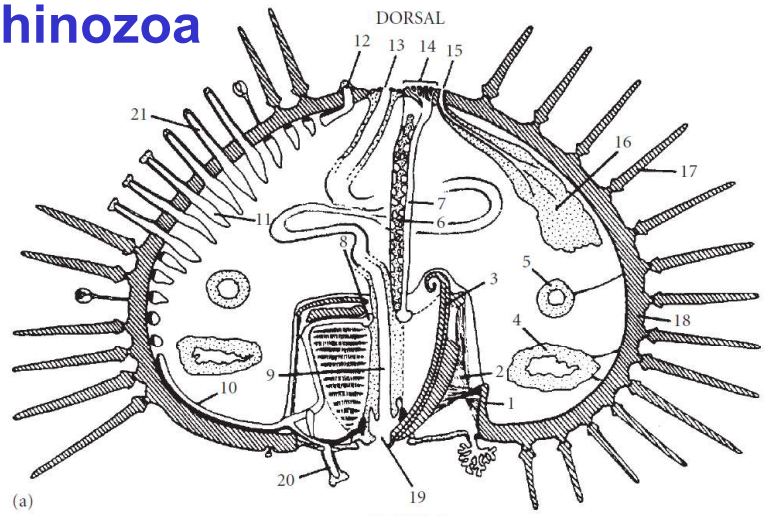


The Ambulacral plates has pores where the tube feet can protrude

Echinozoa



Echinozoa

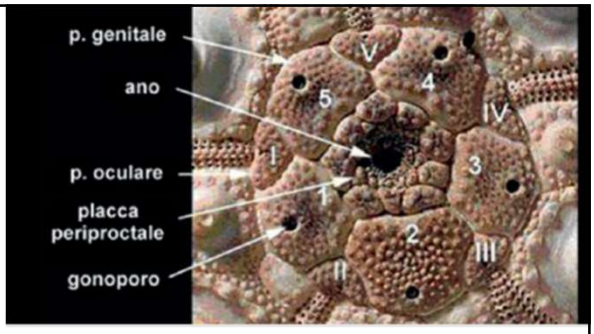


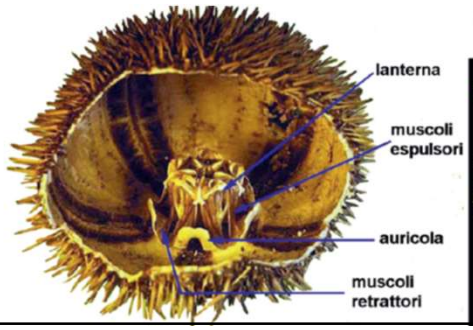
Key

1 perignathic girdle
2 lantern protractor/retractor muscles
3 tooth
4 large intestine
5 small intestine
6 axial vessel
7 stone canal
8 circumoral ring
9 esophagus
10 radial water vessel
11 ampulla
12 ocular pore
13 periproct
14 madreporite
15 gonopore
16 gonad
17 spine
18 corona
19 peristome
20 buccal tube foot
21 tube foot

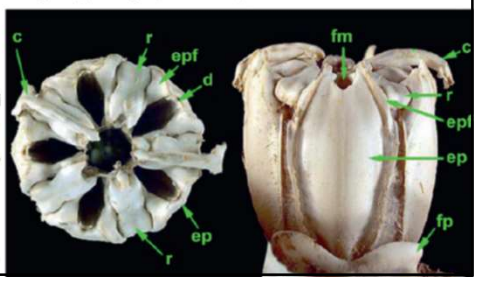
Echinozoa

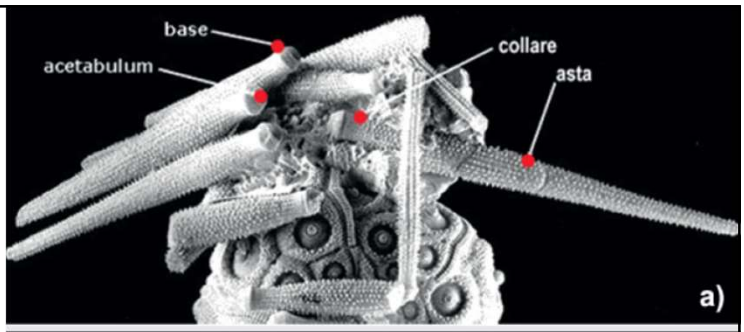
Placche apicali e lanterna di Aristotele

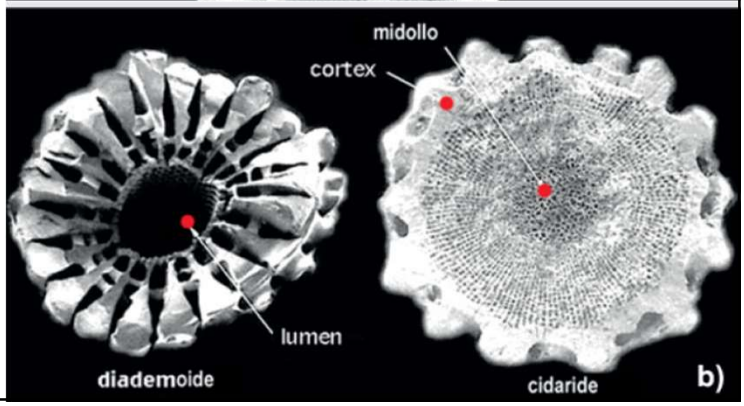


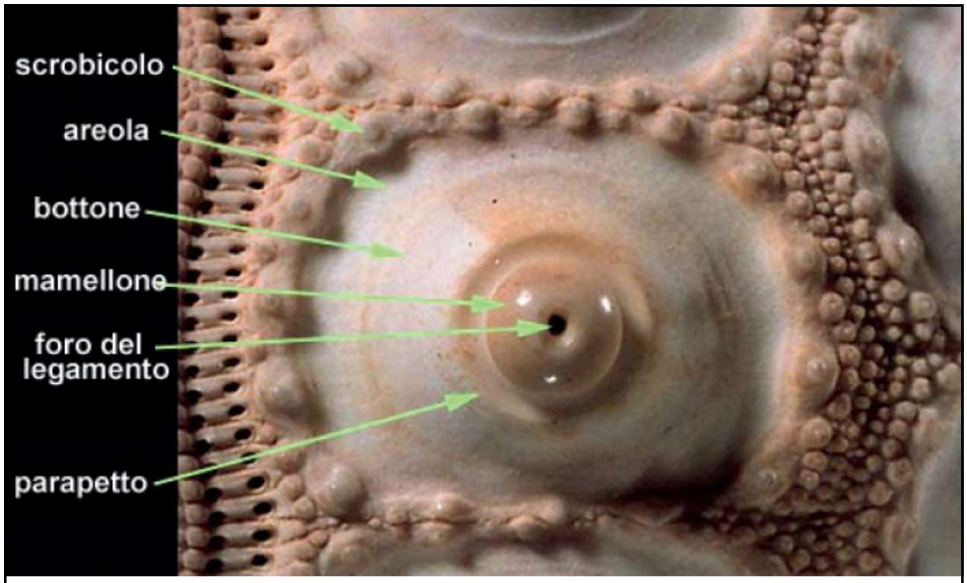


c: compasso; d: dente;ep: emipiramide; epf: epifisi; fm: foramen magnum;fp: flangia peristomale; r: rotula







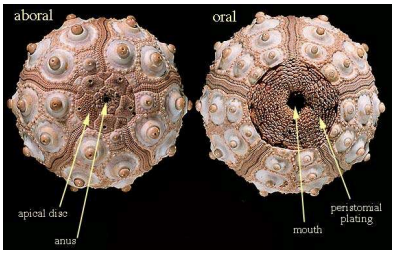


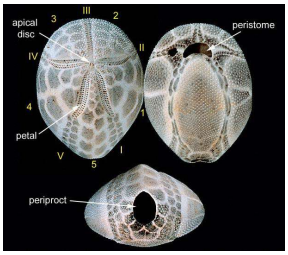
Echinozoa

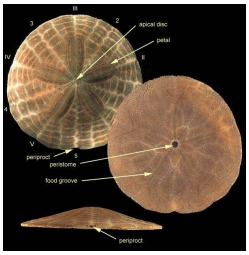
Echinoidea

Body symmetry and Position of Periproct

„Regular sea urchin“ **„Irregular sea urchin“**







Pentaradial Symmetry

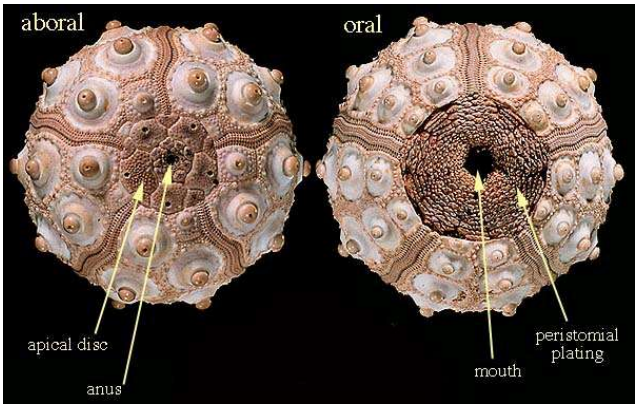
Periproct is in apical position

Bilateral Symmetry

Periproct moved from apical position

Echinozoa

„Regular Sea urchin“

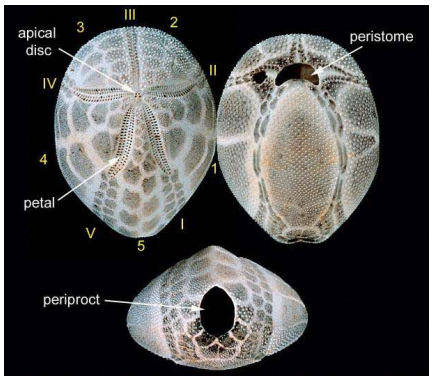


Pentaradiale Symmetry
Mouth (Peristome) → central bottom position
Anus (Periproct) → central top position

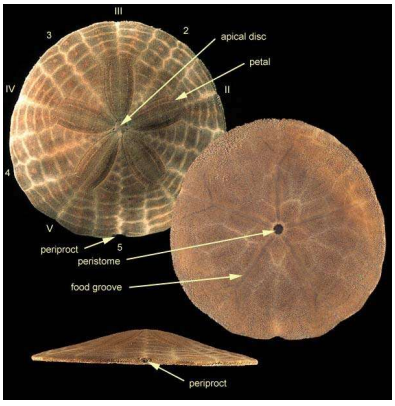
Echinozoa

„Irregulare Sea urchins“

Spatangoida (Heart sea urchin)



Clypeasteroida (Sanddollars)

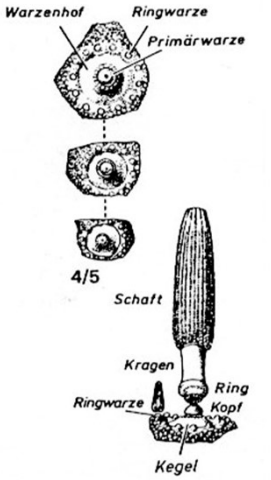


Bilateral Symmetry
Mouth (Peristom)
Anus (Periproct)

Questi vivono e muoiono all0'interno del sedimento

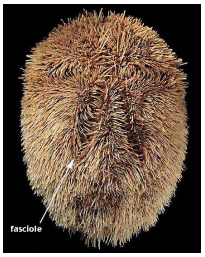
Echinozoa

Spines



Diadema

Cidaris



Brissopsis

Echinozoa

Habitat – Regular sea urchin

Hard substrate (Bioerosion!)

Echinozoa

Boring sea urchin *Echinometra*

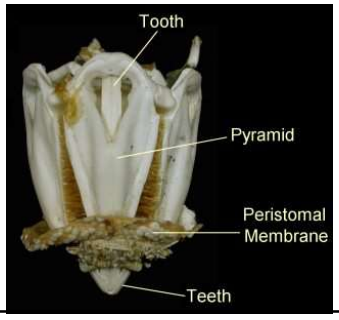
East Coast, Taiwan

Echinozoa

Boring sea urchin

Echinometra in self-made hole

Sea urchin test opened
Chewing apparatus in the centre



Chewing apparatus with teeth at bottom (Aristotle's lantern)

Echinozoa

Borings of *Echninometra* sea urchin

Boring in Pleistocene limestone, Okinawa

Borings in Pleistocene limestone, Okinawa

Borings in Pleistocene limestone, Okinawa

Borings in basalt, Hawaii

Echinozoa

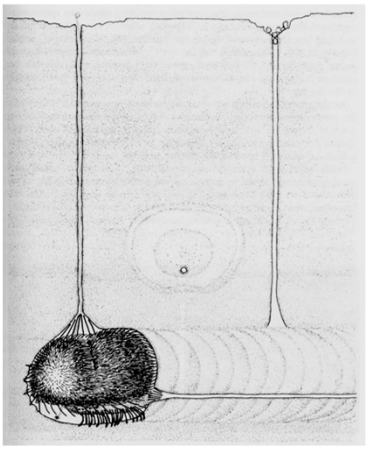
Landscape-forming sea urchins

Echinometra urchins –
each in own cavities bored during a lifetime
Okinawa

Tidal pans made by sea urchins
Okinawa

Echinozoa

Habitat – Irregular sea urchin



Deposit feeder, digging through the sediment

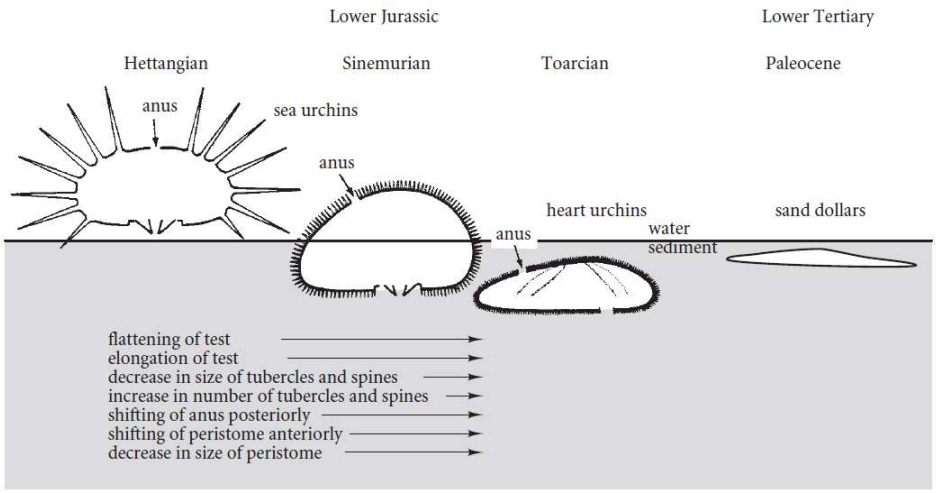
→ Bioturbation

Echinozoa

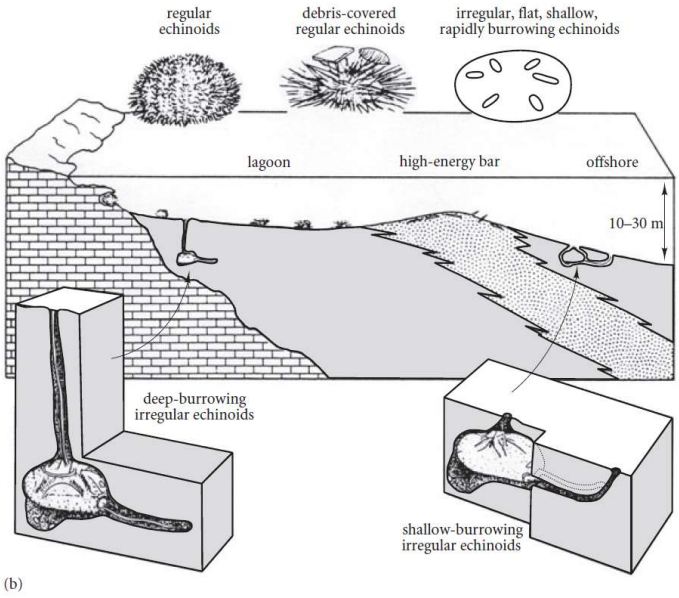
Habitat

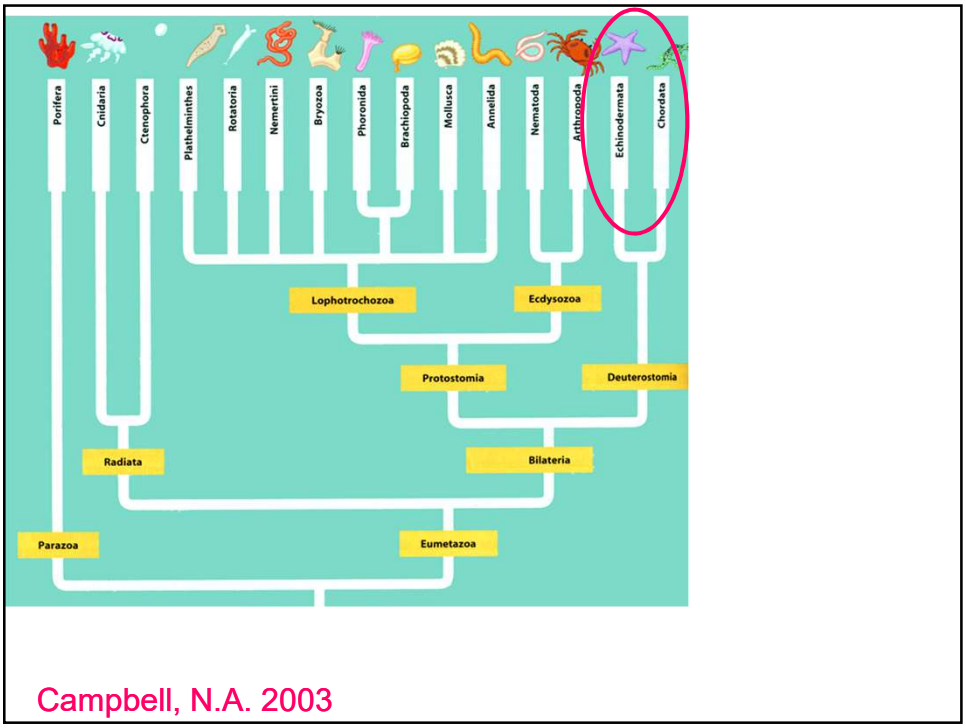
Sanddollars live in sandy sediments, in an environment with high water energy

Echinozoa

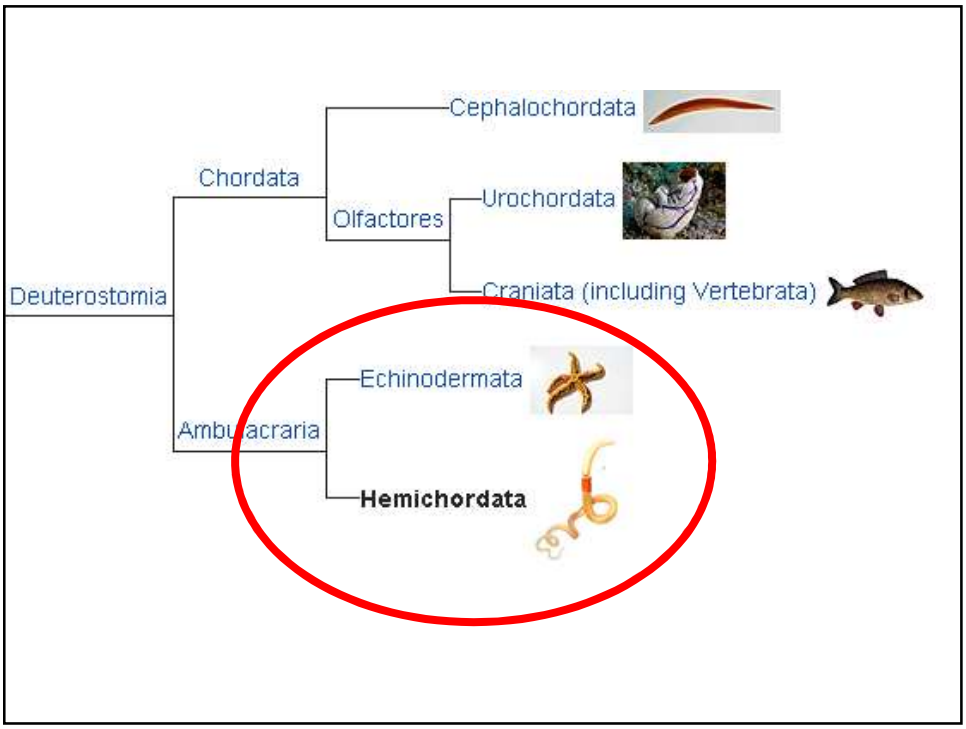


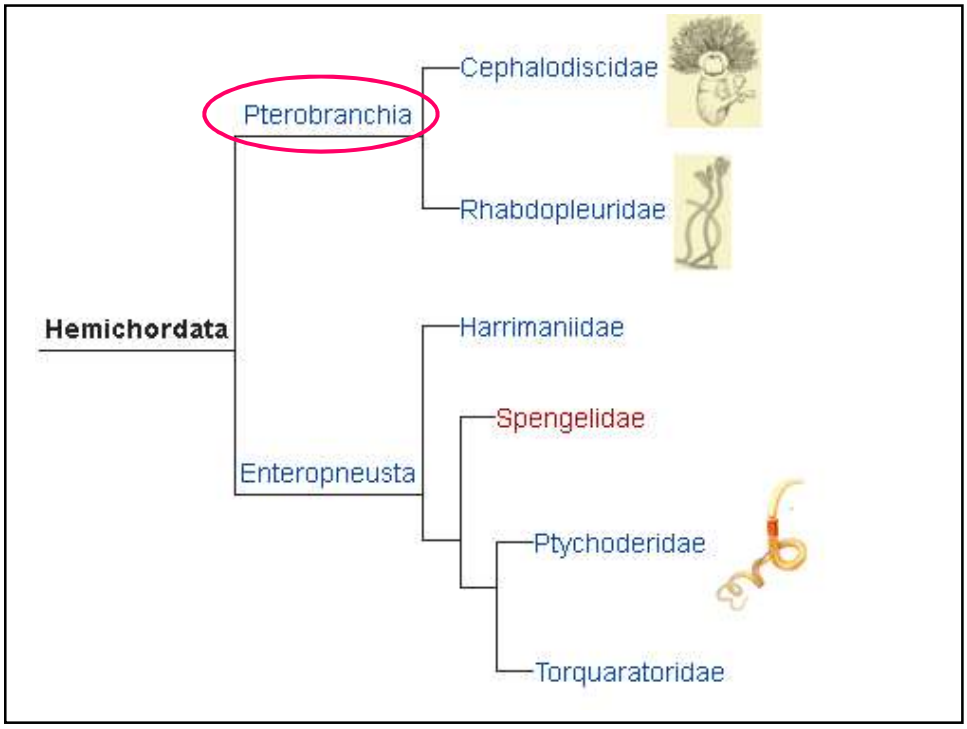
Echinozoa

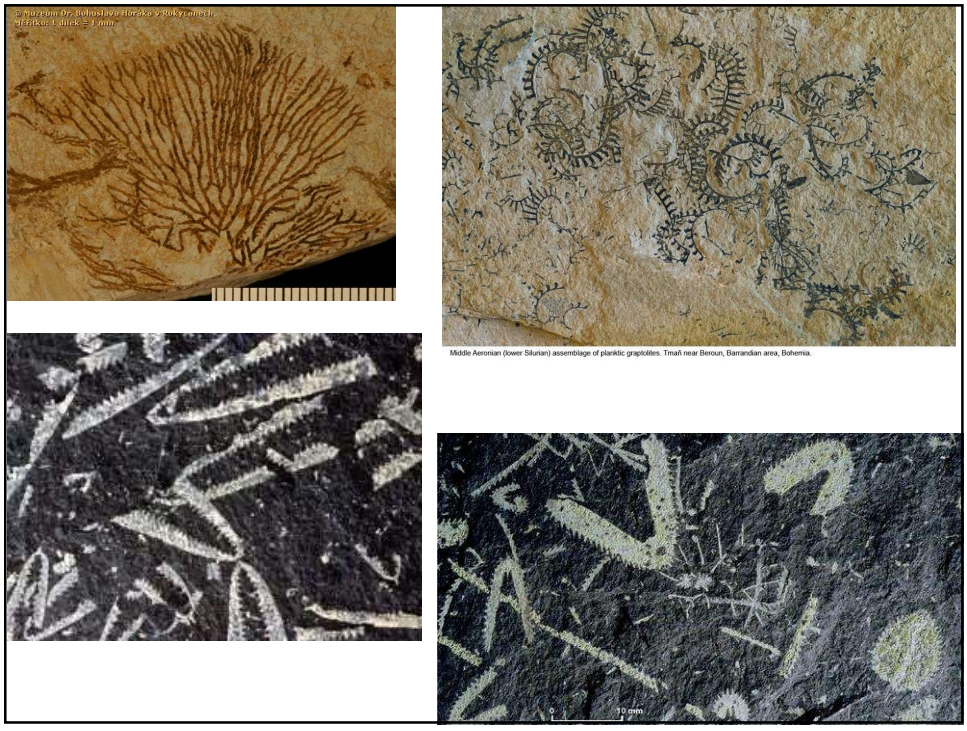


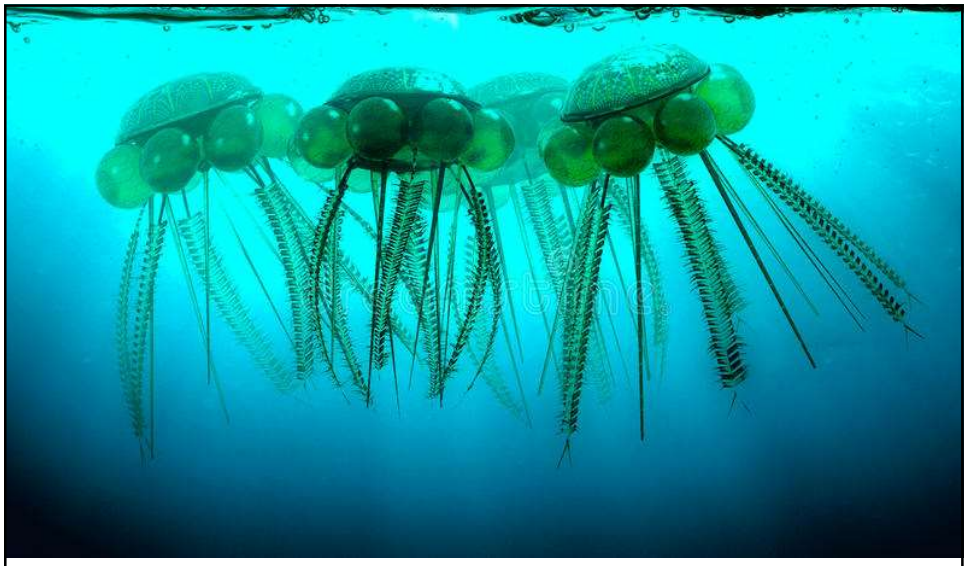


Campbell, N.A. 2003

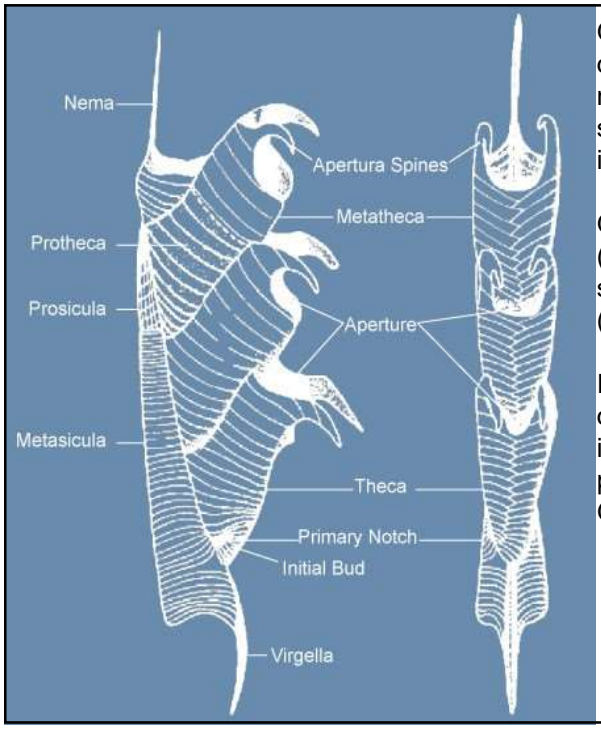



Cephalodiscidae
Pterobranchia
Rhabdopleuridae
Hemichordata
Harrimaniidae
Spengelidae
Enteropneusta
Ptychoderidae
Torquaratoridae


Middle Aeronian (lower Silurian) assemblage of planktic graptolites. Tmaň near Beroun, Barrandian area, Bohemia.
0 10 mm



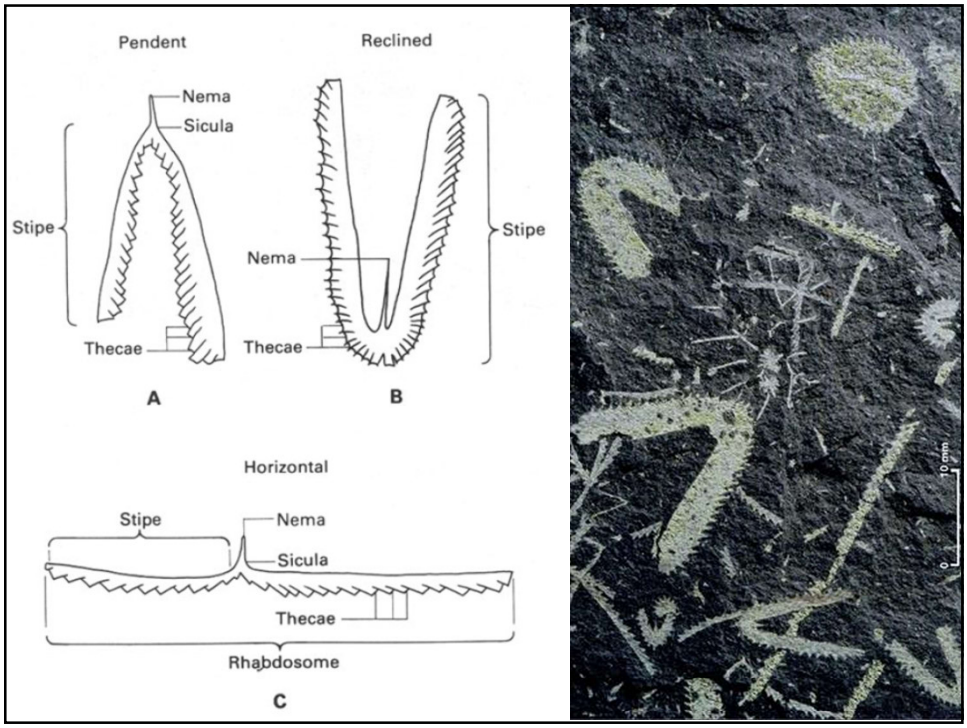
Cambriano – Devoniano inferiore

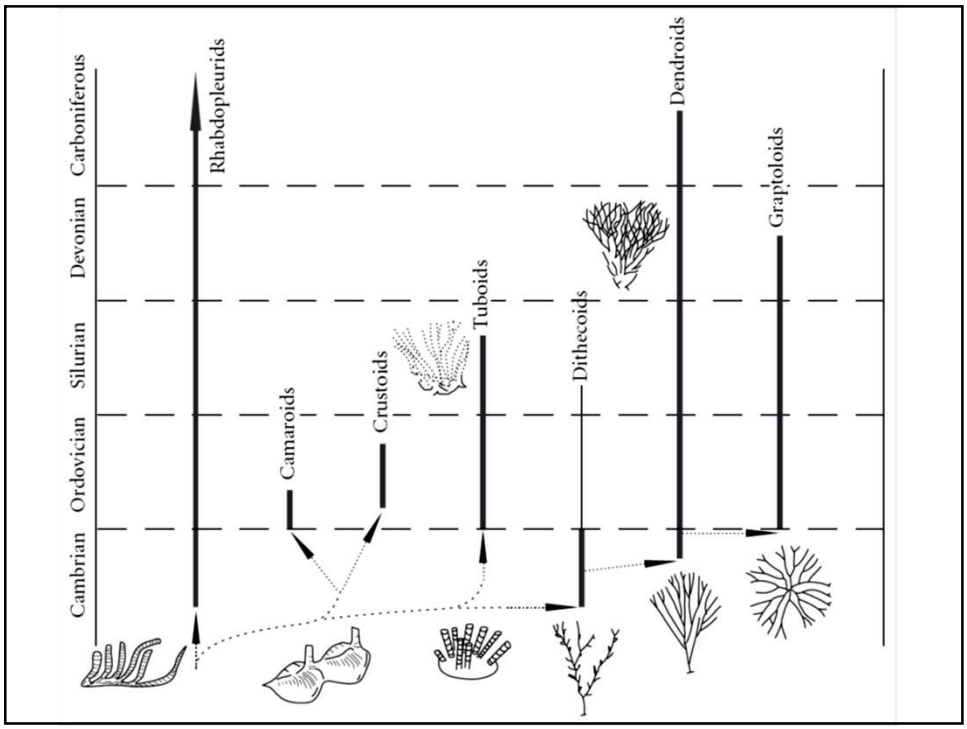


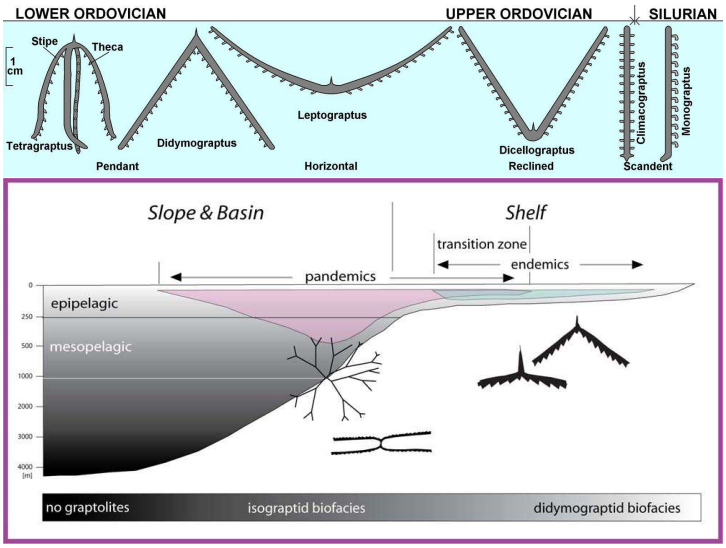
Ogni colonia di Graptoliti è detta rhabdosoma e ha un numero variabile di rami (detti stipi) che hanno origine da un individuo iniziale (detto sicula).

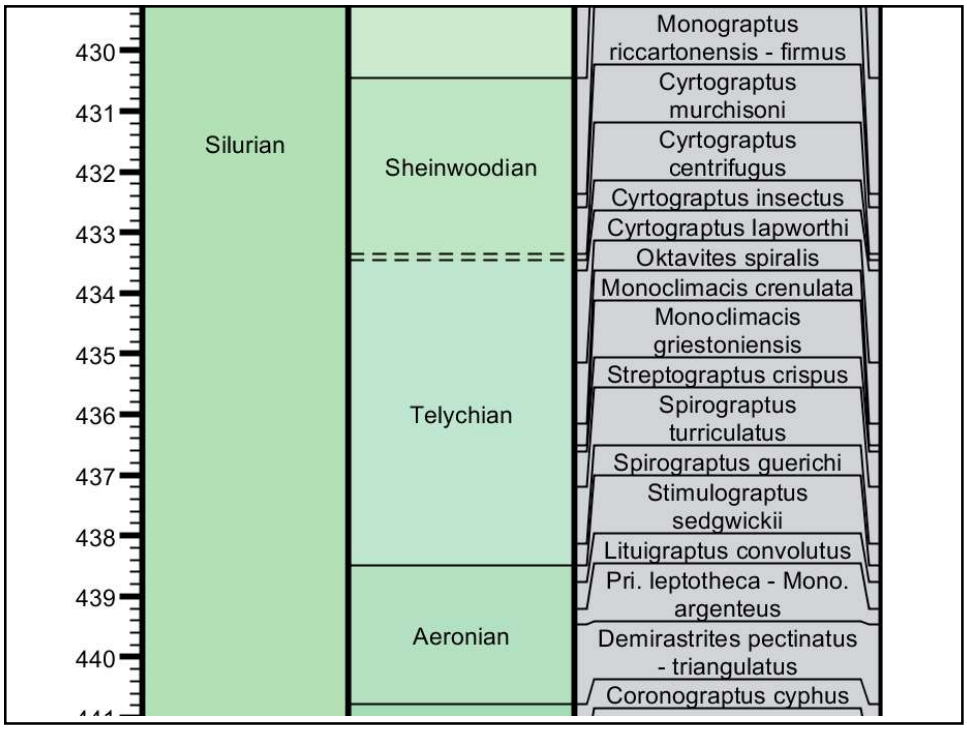
Ogni individuo successivo (zooide) è alloggiato in una struttura tubolare o a calice (theca).

Il numero di rami e la disposizione delle teche sono importanti caratteri diagnostici per l'identificazione dei Graptoliti.


Pendent
Reclined
Nema
Sicula
Stipe
Thecae
A
B
Horizontal
Stipe
Nema
Sicula
Thecae
Rhabdosome
C


Cambrian
Ordovician
Silurian
Devonian
Carboniferous
Rhabdopleurids
Camaroids
Crustoids
Tuboids
Dithecoids
Dendroids
Graptoloids


LOWER ORDOVICIAN
UPPER ORDOVICIAN
SILURIAN
Stipe
Theca
1 cm
Tetragraptus
Didymograptus
Leptograptus
Dicellograptus
Climacograptus
Monograptus
Pendant
Horizontal
Reclined
Scandent
Slope & Basin
Shelf
transition zone
pandemics
endemics
epipelagic
mesopelagic
0
250
500
1000
2000
3000
4000
[m]
no graptolites
isograptid biofacies
didymograptid biofacies


430
431
432
433
434
435
436
437
438
439
440
Silurian
Sheinwoodian
Telychian
Aeronian
Monograptus riccartonensis - firmus
Cyrtograptus murchisoni
Cyrtograptus centrifugus
Cyrtograptus insectus
Cyrtograptus lapworthi
Oktavites spiralis
Monoclimacis crenulata
Monoclimacis griestoniensis
Streptograptus crispus
Spirograptus turriculatus
Spirograptus guerichi
Stimulograptus sedgwickii
Lituigraptus convolutus
Pri. leptotheca - Mono. argenteus
Demirastrites pectinatus - triangulatus
Coronograptus cyphus