

Paleontology

<http://www.biltek.tubitak.gov.tr/bilgipaket/jeolojik/index.htm>

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Lecture 9



ANKARA UNIVERSITY



1. Mollusca

General characteristics
Body organisations & related terms
Classification

1.1. Bivalvia

General characteristics
Body organisations & related terms
Classification
Selected species

1.2. Gastropoda

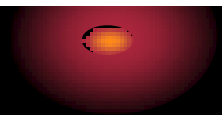
General characteristics
Body organisations & related terms
Classification

Topics



Phylum

Mollusca



Mollusca

The mollusks constitute one of the largest phyla of animals, Around 85,000 extant species of molluscs are recognized. Mollusca are the largest marine phylum, comprising about 23% of all the named marine organisms. Structurally, mollusks are quite distinct from all other animals.

A significant characteristic of mollusks is their possession of a coelom, a fluid-filled cavity that develops within the mesoderm. The coelom not only functions as a hydrostatic skeleton but also provides space within which the internal organs can be suspended by the mesenteries.

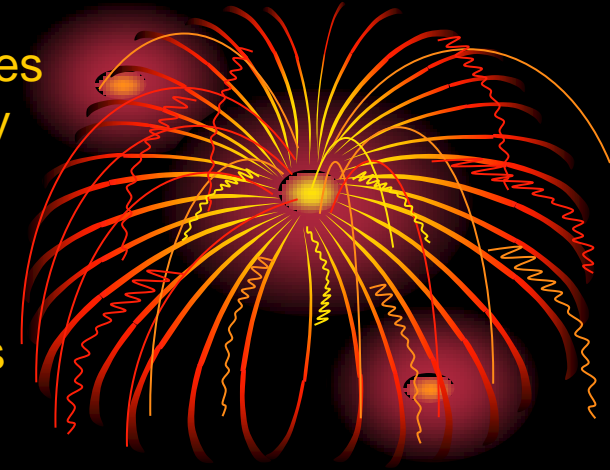
All mollusks have a **soft body** (their name is derived from the Latin word *mollus*, meaning "soft"), which is generally protected by a hard, calcium-carbonate material containing shell.

Body organizations & related terms

Mollusca

Mollusks include various types of soft body organisms. They have

- Different external views
- Different living environments
- Different life modes



Single shell

Single shell

Two shells

Terrestrial/marine

Open sea

Shallow marine

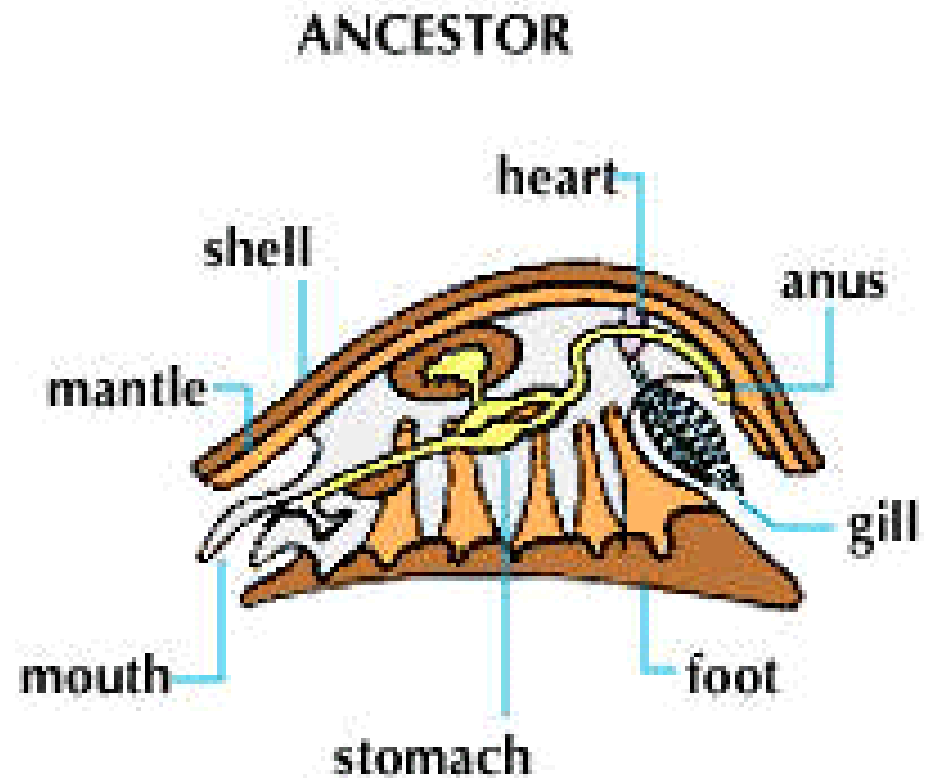
Free moving

Nectic

Benthic, epifaunal



Mollusca



This diagram shows a basic ancestor compiling the general characteristics of members of the phylum Mollusca.

Mollusca

Body organizations & related terms

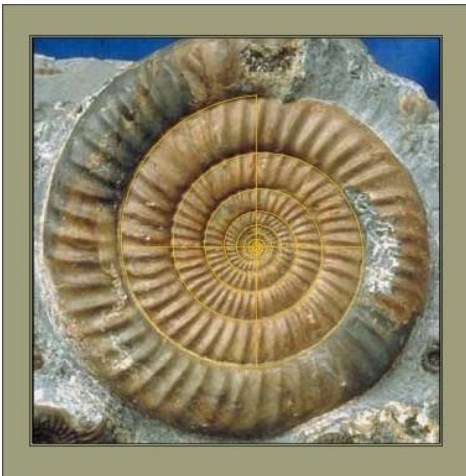
All modern mollusks have the same fundamental body plan. There are three distinct body zones: a **head-foot**, which contains both the sensory and motor organs; a **visceral mass**, which contains the **well-developed organs** of digestion, excretion, and reproduction; and a **mantle**, a specialized tissue formed from folds of the dorsal body wall, that hangs over and enfolds the visceral mass and that secretes the shell. The **mantle cavity**, a space between the mantle and the visceral mass, houses the gills; the digestive, excretory, and reproductive systems discharge into it.

Mollusks are also characterized by a toothed tongue, the **radula**, composed primarily of chitin. The radula serves both to scrape off algae and other food materials and also to convey them backward to the digestive tract. In some species, it is also used in combat.





Mollusca



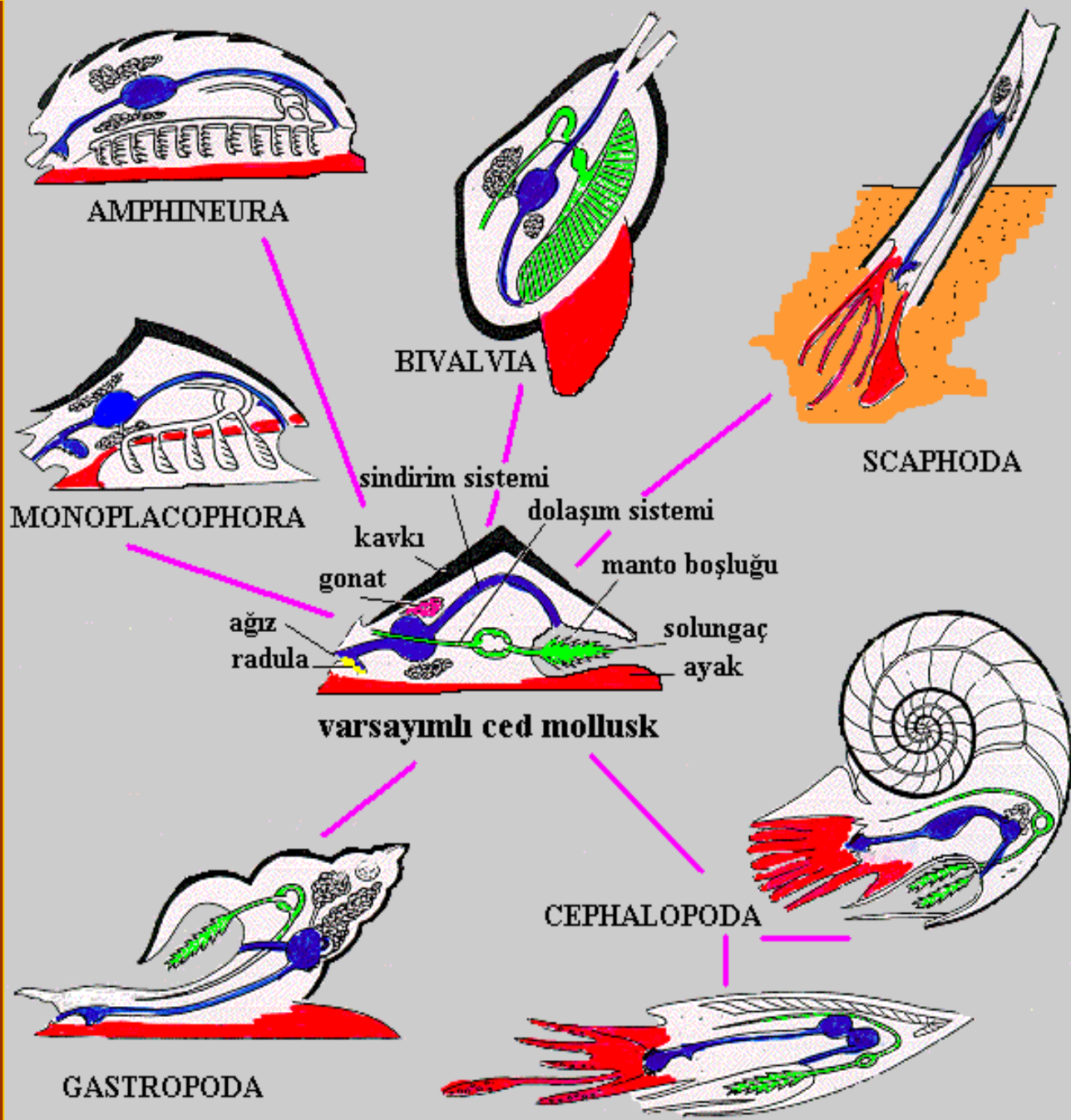
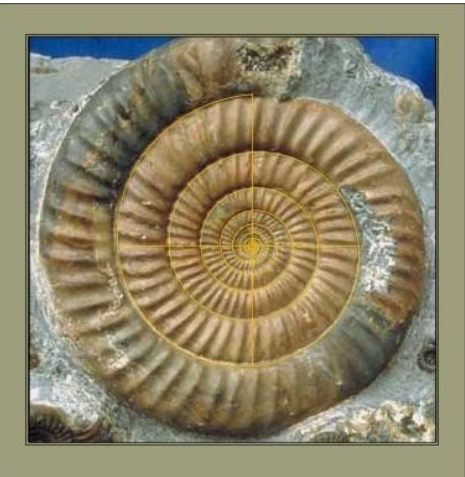
Classification

Class	Major organisms	Described living species ^[18]	Distribution
Caudofoveata ^[10]	worm-like organisms	120	seabed 200–3,000 metres (660–9,800 ft)
Solenogastres ^[10]	worm-like organisms	200	seabed 200–3,000 metres (660–9,800 ft)
Polyplacophora ^[11]	chitons	1,000	rocky tidal zone and seabed
Monoplacophora ^[12]	An ancient lineage of molluscs with cap-like shells	31	seabed 1,800–7,000 metres (5,900–23,000 ft); one species 200 metres (660 ft)
Gastropoda ^[43]	All the snails and slugs including abalone, limpets, conch, nudibranchs, sea hares, sea butterfly	70,000	marine, freshwater, land
Cephalopoda ^[44]	squid, octopus, cuttlefish, nautilus	900	marine
Bivalvia ^[45]	clams, oysters, scallops, geoducks, mussels	20,000	marine, freshwater
Scaphopoda ^[16]	tusk shells	500	marine 6–7,000 metres (20–23,000 ft)
Rostroconchia † ^[46]	fossils; probable ancestors of bivalves	extinct	marine
Helcionelloida † ^[47]	fossils; snail-like organisms such as <i>Latouchella</i>	extinct	marine



Mollusca


Classification



Calyptogena magnifica



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 More information

Mollusca
Class: Bivalvia



Mollusca

Class: Bivalvia

Note the size of bivalvia



Photograph by T. C. Roughley

SIESTA IN THE JAWS OF A GIANT CLAM SHELL

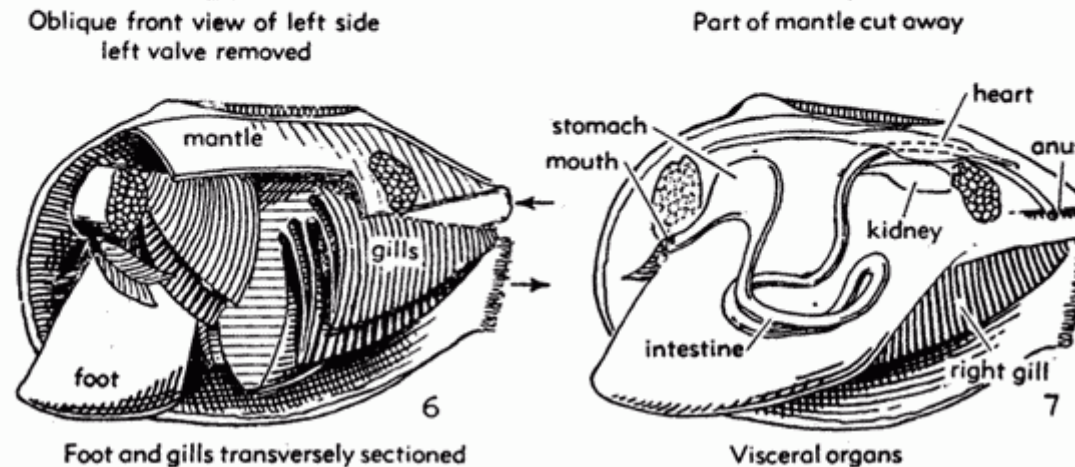
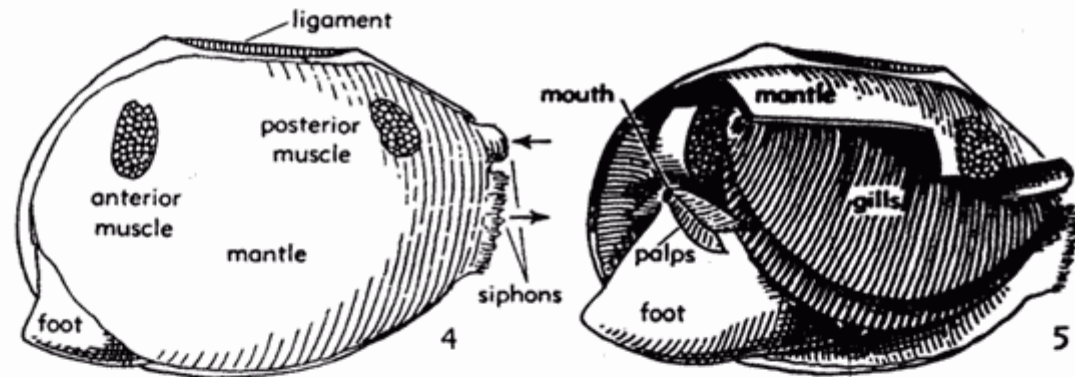
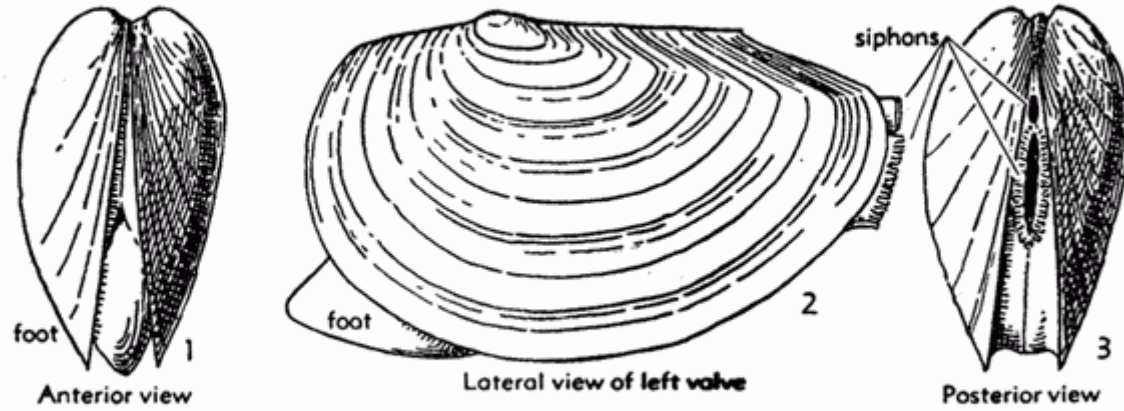
The big shellfish was a menace to naked divers when it was alive on the Barrier Reef. It was powerful enough to grab an unwary swimmer's foot and hold it in a viselike grip (page 842). This variety of shellfish is the largest in the world, sometimes reaching a length of four and a half feet, and a weight of 500 pounds. Islanders often use the shells to store fresh water.



Mytilus edulis, the common Mussel

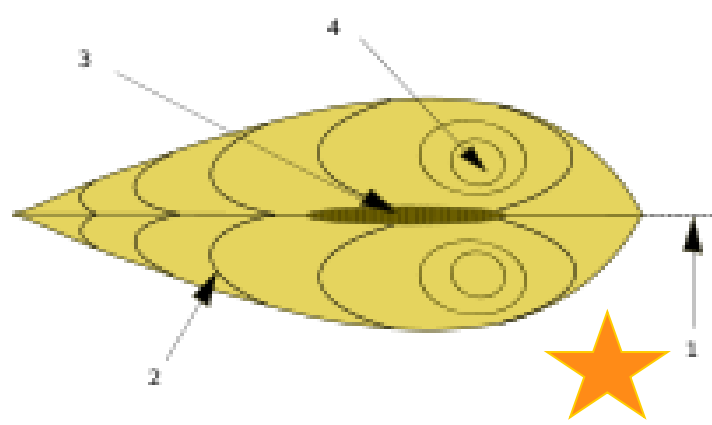
Physiology

General views



Mollusca

Class: Bivalvia



Main parts of a bivalve shell: 1: sagittal plane,
2: growth lines, 3:
ligament, 4: umbo

<http://en.wikipedia.org/wiki/Mollusca>

Symetry

Mollusca
Class: Bivalvia

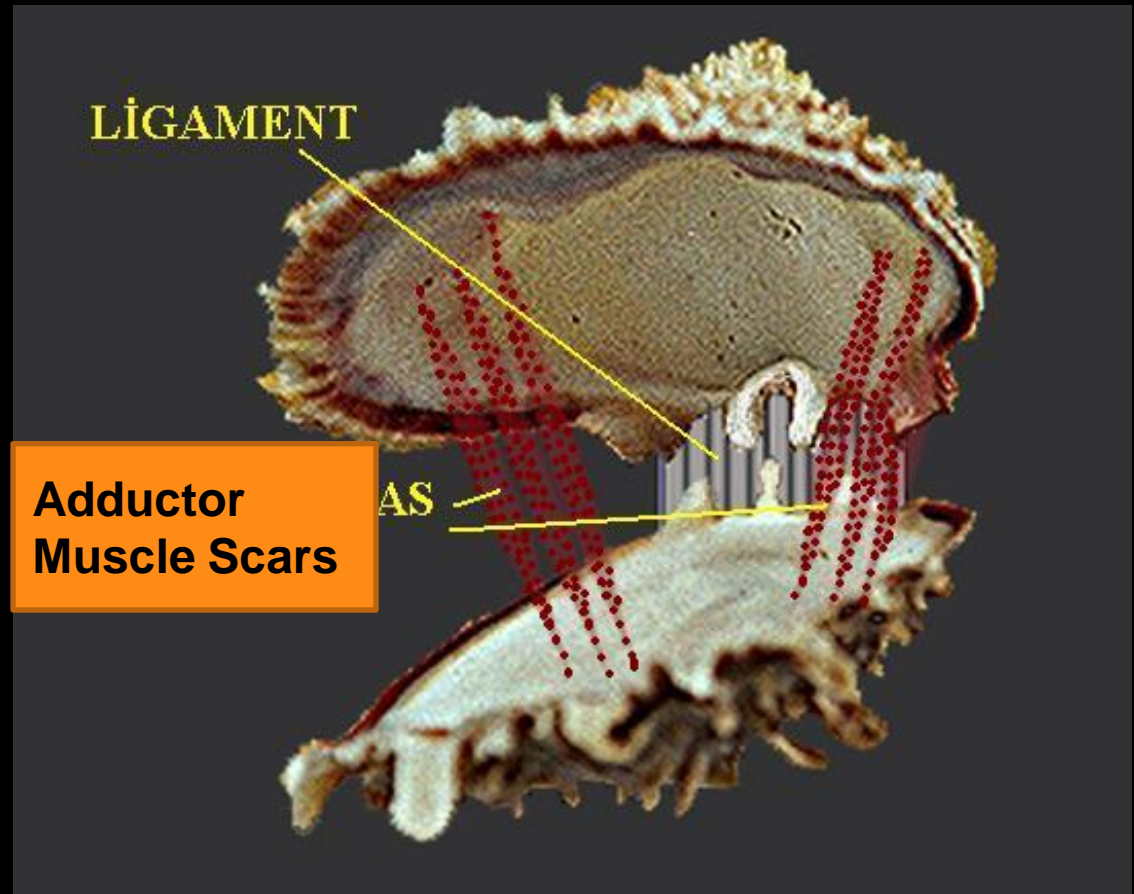




LIGAMENT: The two valves are held together at a hinge joint by a ligament composed of keratinised organic matters.

Ligament

Mollusca
Class: Bivalvia



Mollusca

Class: Bivalvia

= Lamellibranchia
= Pelecypoda 
= Mussels

Bivalvia, commonly referred to as bivalves, are the class of marine and freshwater molluscs with laterally compressed bodies enclosed by a shell in two hinged parts. They include clams, oysters, mussels, scallops, and numerous other families. The majority are filter feeders and have no head or radula. The gills have changed into ctenidia, specialised organs for feeding and breathing. Most bivalves bury themselves in sediment on the seabed, where they are safe from predation. Others lie on the sea floor or attach themselves to rocks or other hard surfaces. A few bore into wood, clay or stone and live inside these substances. Some bivalves, such as the scallops, can swim.

General characteristics

Mollusca

Class: Bivalvia

The shell of a bivalve is composed of calcium carbonate, and consists of two, usually similar, parts called valves. The shell is composed of two calcareous valves held together by a ligament. These are joined together along one edge by a flexible ligament that, in conjunction with interlocking "teeth" on each of the valves, forms the hinge. This arrangement allows the shell to be opened and closed without the two valves becoming disarticulated. The shell is typically bilaterally symmetrical, with the hinge lying in the sagittal plane. Adult shell sizes vary from fractions of a millimetre to over a metre in length, but the majority of species do not exceed 10 cm.

Bivalves have long been a part of the **diets of coastal human populations**. Oysters were cultured in ponds by the Romans, and mariculture has more recently become an important source of bivalves for food. Modern knowledge of molluscan reproductive cycles has led to the development of hatcheries and new culture techniques. A better understanding of the hazards of eating raw and undercooked shellfish has led to improved storage and processing. Besides their use as food, oysters are the **most common source of natural pearls**. The shells of bivalves are used in craftwork and the manufacture of jewellery and buttons. Bivalves have also been used in the **biocontrol of pollution**.

General characteristics

Mollusca

Class: Bivalvia

Bivalves appear in the fossil record first in the early Cambrian more than 500 million years ago. The total number of living species is approximately 9,200. These species are placed within 1,260 genera and 106 families. Marine bivalves (including brackish water and estuarine species) represent about 8,000 species, combined in four subclasses and 99 families with 1,100 genera. The largest recent marine families are Veneridae, with more than 680 species and the Tellinidae and Lucinidae, each with over 500 species. The freshwater bivalves include seven families, the largest of which is the Unionidae with about 700 species.

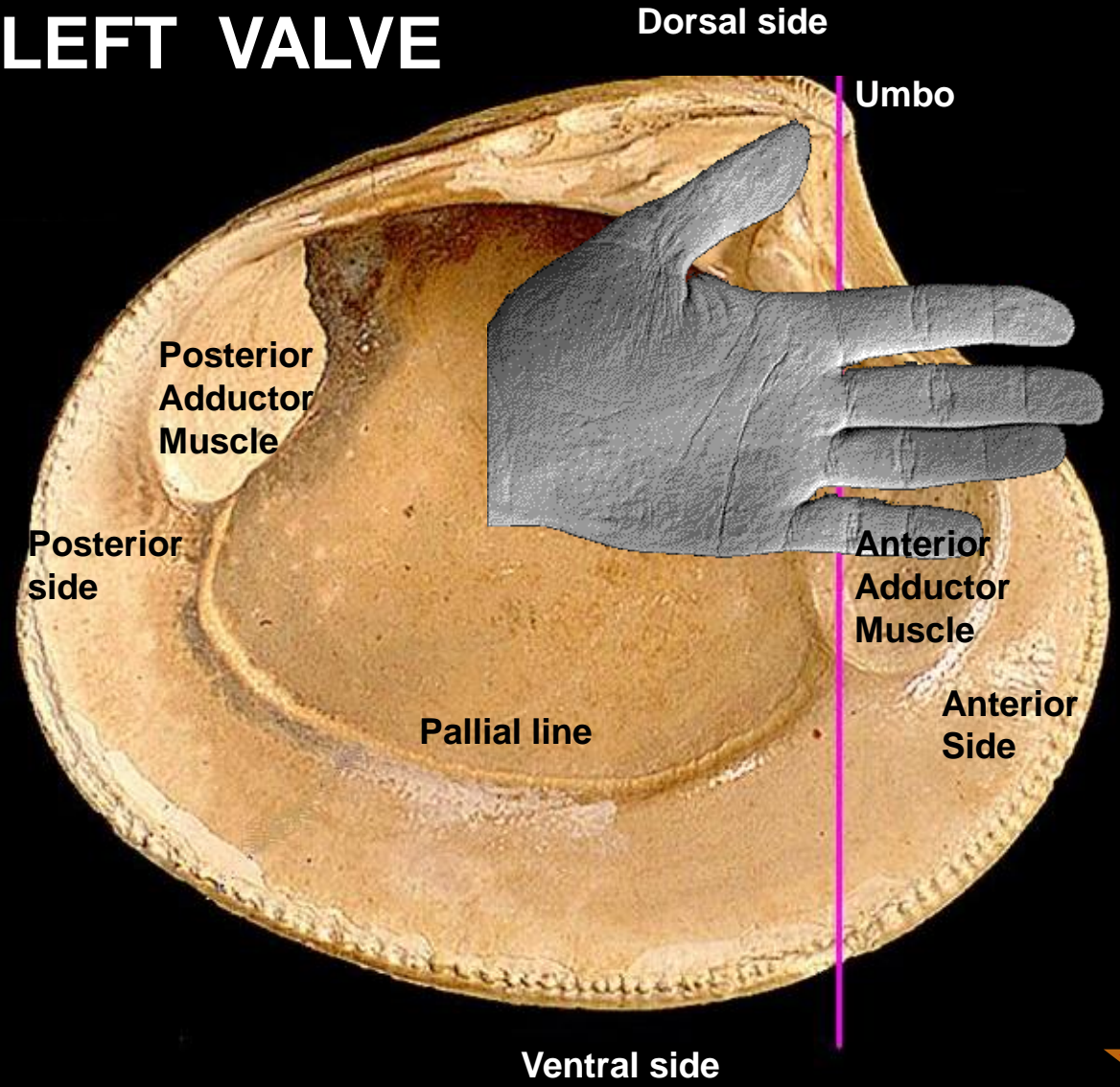
Cambrian to Recent

Mainly shallow water environment

Related terms

Mollusca
Class: Bivalvia

LEFT VALVE

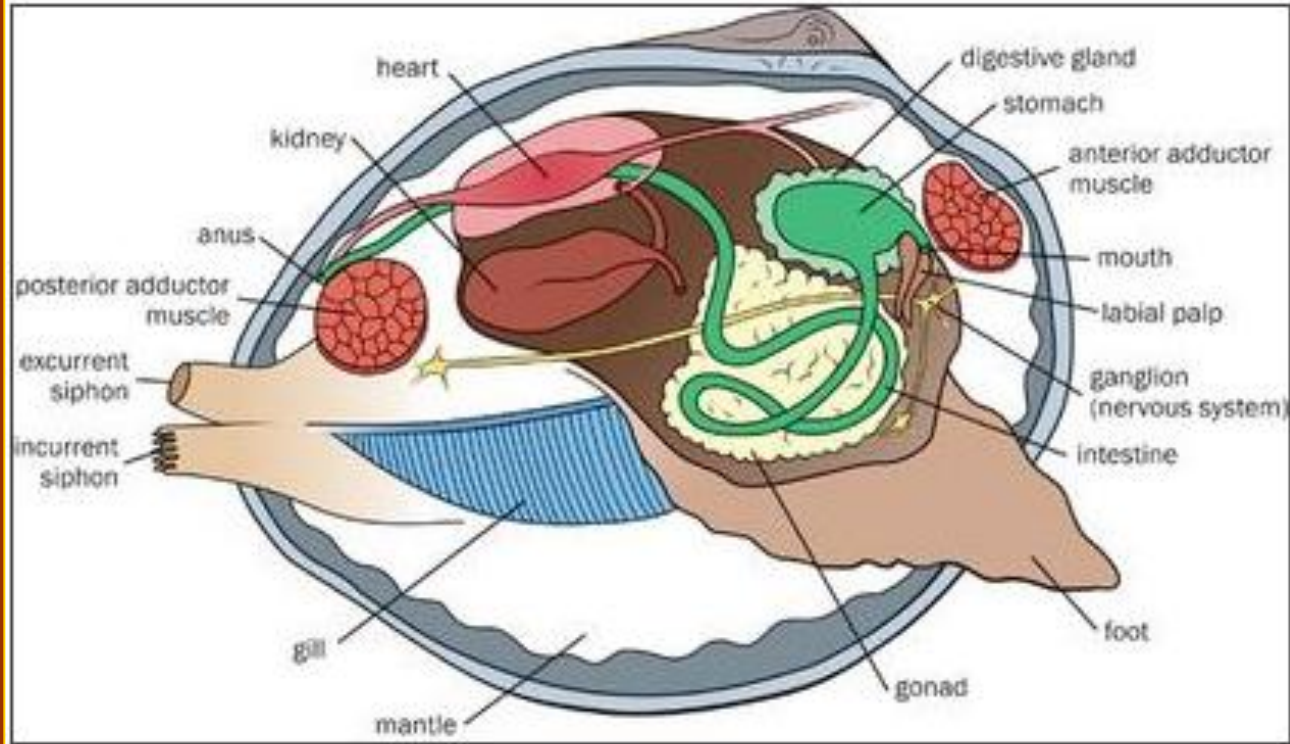


Body organizations & related terms

LEFT



Mollusca
Class: Bivalvia



RIGHT VALVE

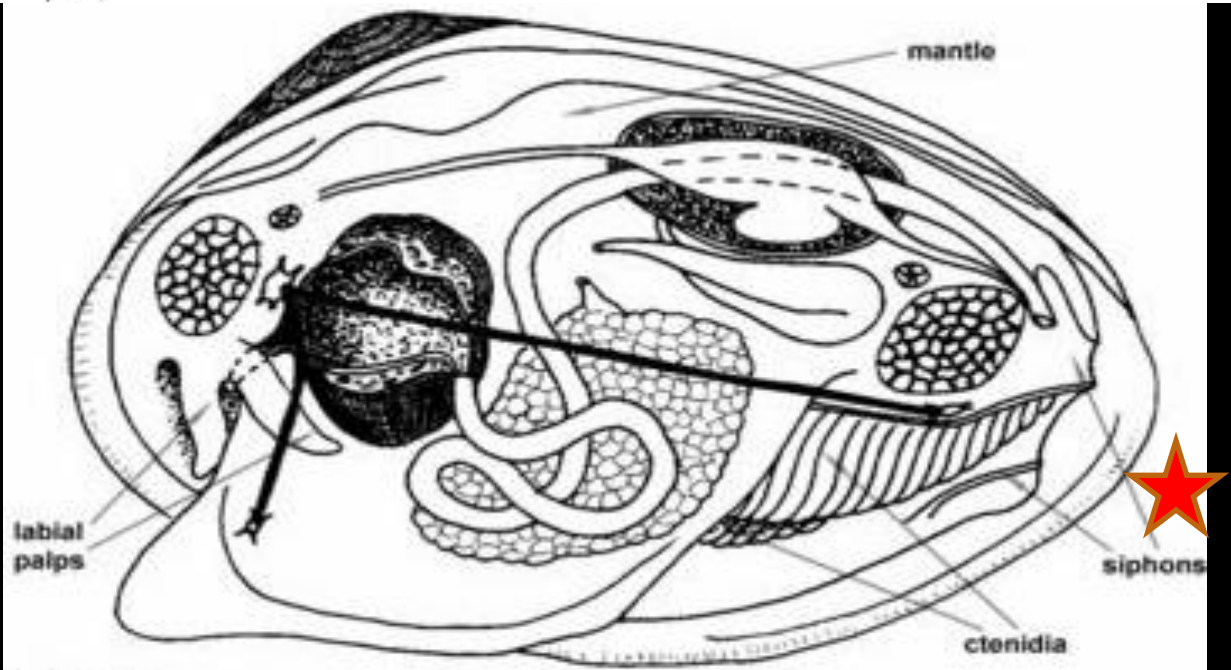
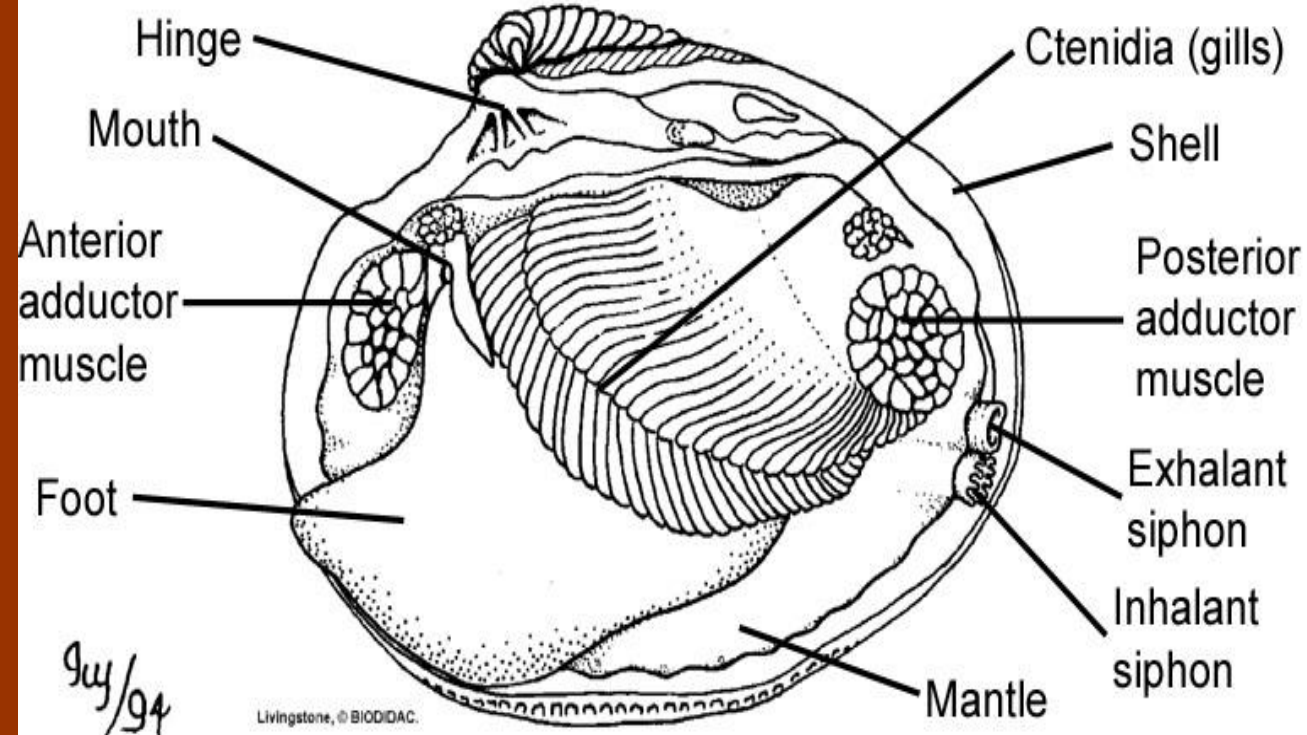


Body organizations & related terms

Mollusca

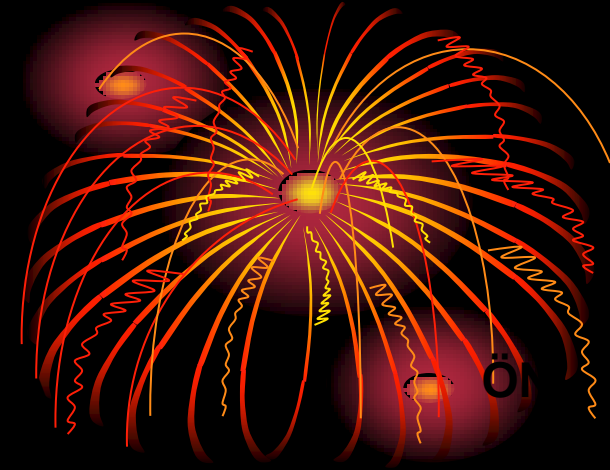
Class: Bivalvia

<http://www.marlin.ac.uk/taxonomydescriptions.php>
http://animaldiversity.ummz.umich.edu/site/resources/Grzimek_inverts/Bivalvia/v02_id345_con_bivalvat.jpg/view.html



Body organizations & related terms

Mollusca
Class: Bivalvia



LEFT VALVE

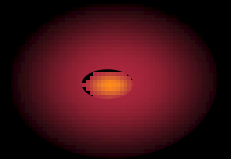
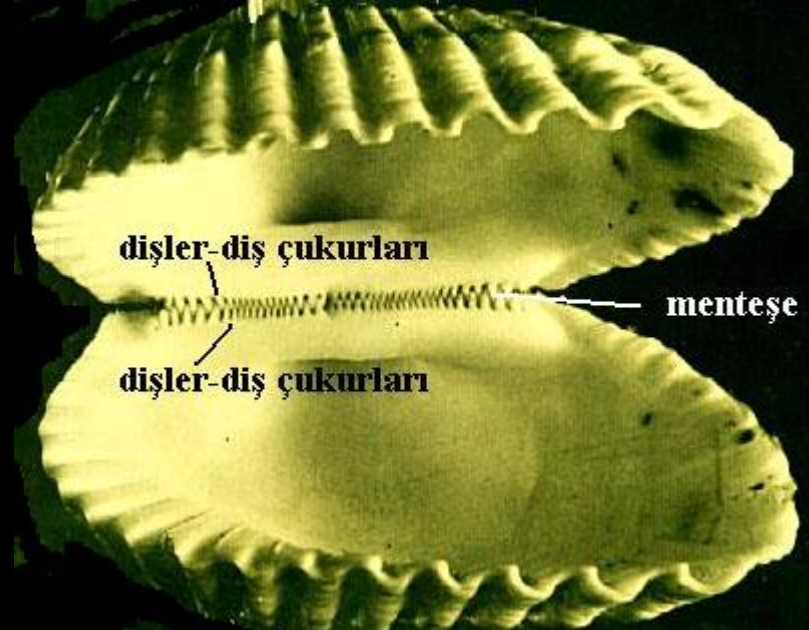
RIGHT VALVE



DORSAL view

Body organizations & related terms

Mollusca
Class: Bivalvia



Mollusca

Class: Bivalvia

Hinge types



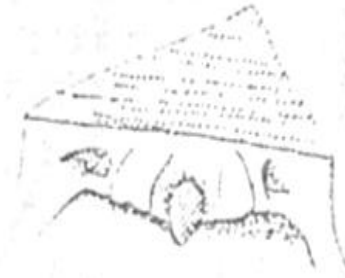
1a Taxodont

1b Dysodont

1c Isodont



1d Schizodont



1e Heterodont



1g Desmodont



1f Pachyodont



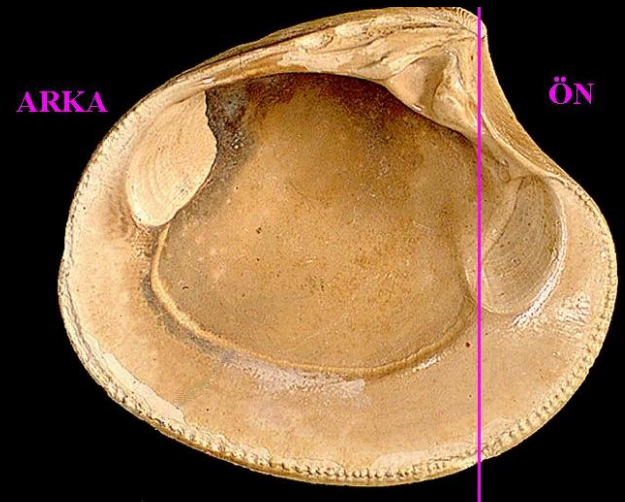
Body organizations & related terms

Mollusca
Class: Bivalvia



Taxodont

- Various Hinge Types
- Taxodont
 - Dysodont
 - Isodont
 - Heterodont
 - Pachyodont
 - Desmodont



Heterodont

Mollusca
Class: Bivalvia

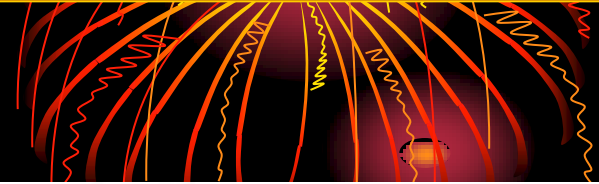
Body organizations & related terms



dysodont type hinge

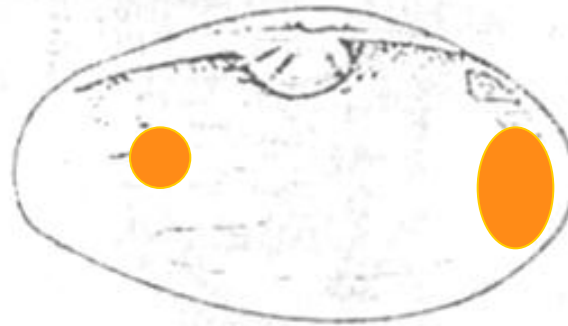


Body organizations & related terms



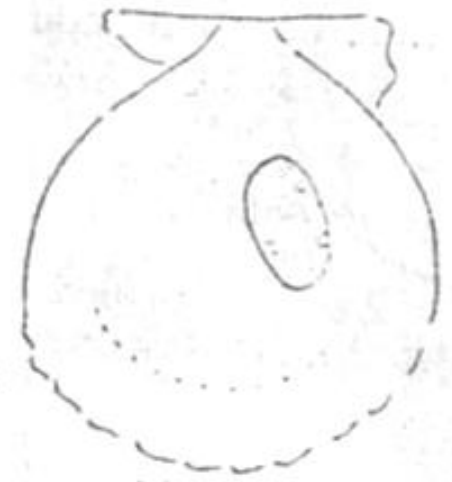
2a

Isomyar



2b

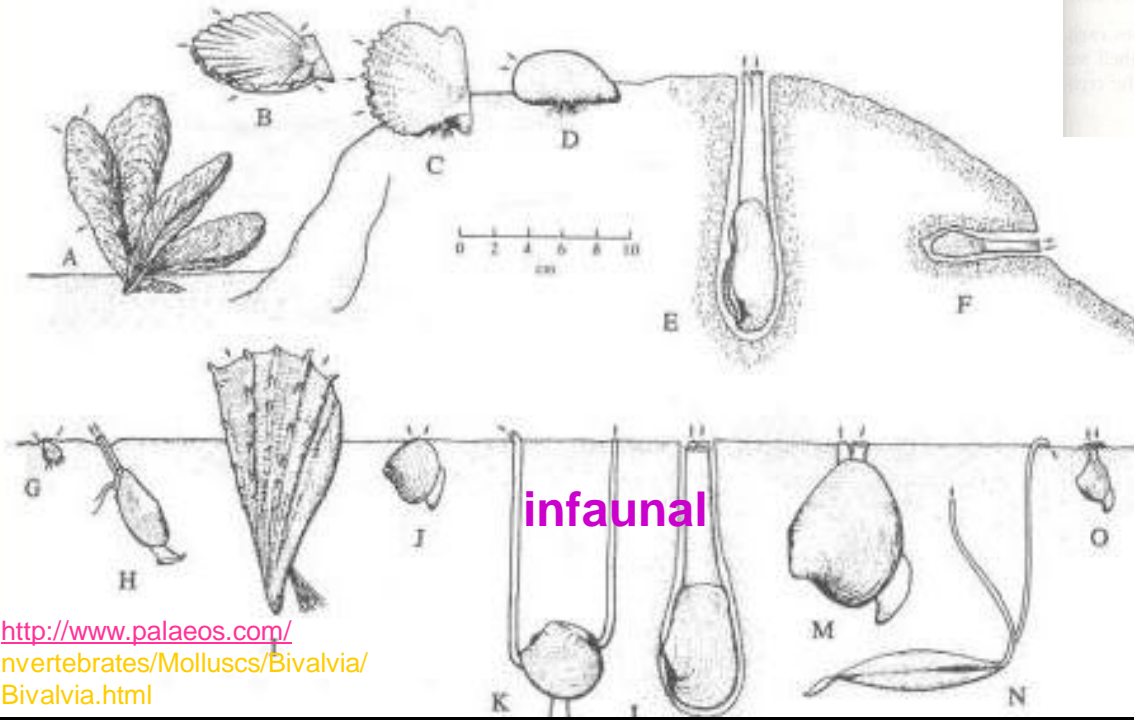
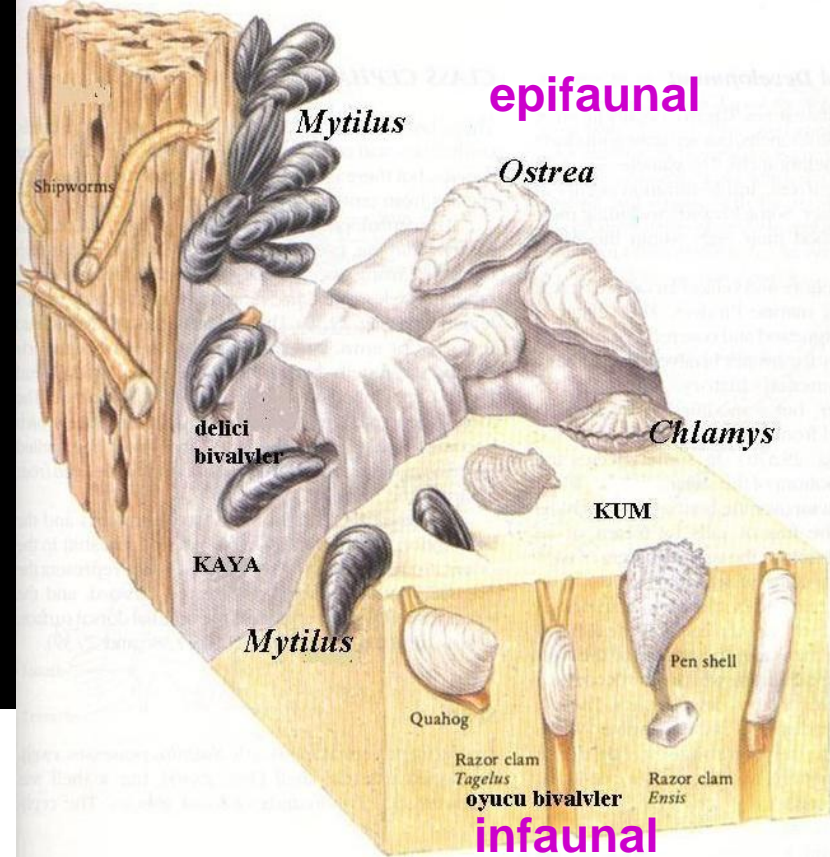
Anisomyar



2c

Monomyar



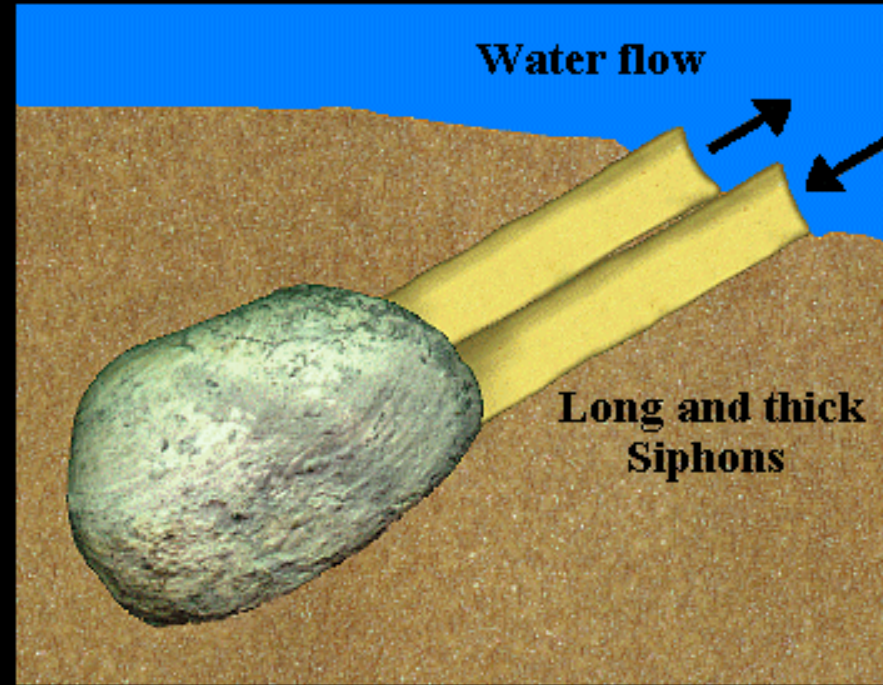


Pictures from Alkaya (Selçuk Univ.), lecture notes,

INFAUNAL

Environment & Life modes

Mollusca
Class: Bivalvia



INFAUNAL

Mollusca
Class: Bivalvia

Environment & Life modes



EPIFAUNAL

Mollusca
Class: Bivalvia

Environment & Life modes



Pictures from Alkaya (Selçuk Univ.), lecture notes,

<http://www.h-nds.de>



EPIFAUNAL

Mollusca

Class: Bivalvia



Environment & Life modes



Mollusca

Class: Bivalvia

Classification

Phylum Mollusca (mollusks)

Class Bivalvia (bivalves and clams)

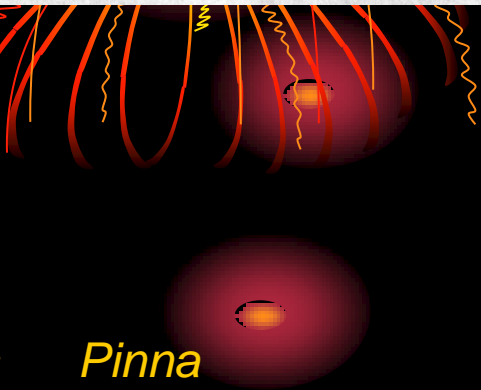
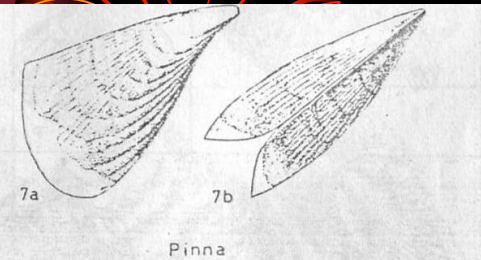
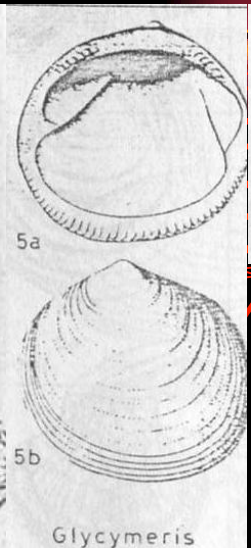
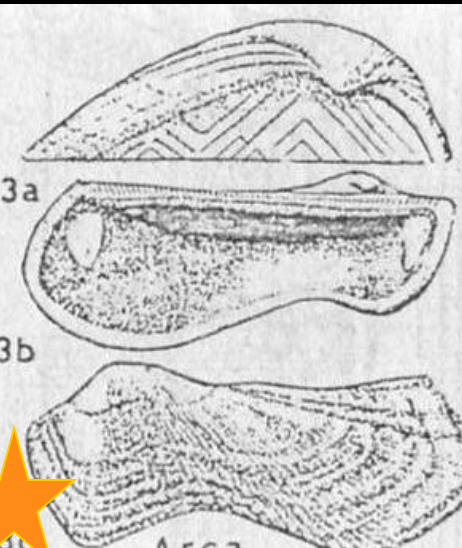
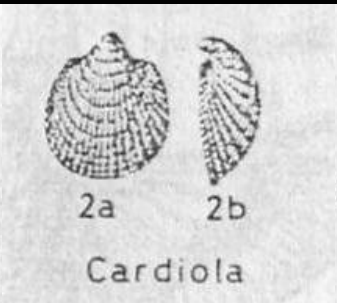
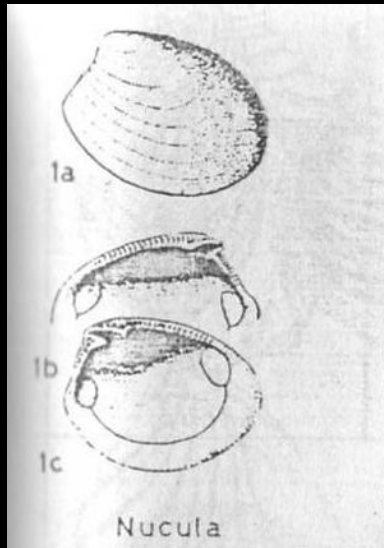
- Subclass Heterodonta
 - Order Myoida
 - Order Veneroida
- Subclass Palaeoheterodonta
 - Order Trigonioida
 - Order Unionoida
- Subclass Protobranchia
 - Order Nuculoida
 - Order Solemyoida
- Subclass Pteriomorphia
 - Order Arcoida
 - Order Limoida
 - Order Mytiloida
 - Order Ostreoida
 - Order Pterioida
- Superorder Cryptodonta
 - Order Pholadomyoida

Classification

Mollusca

Class: Bivalvia

Subclass	Order
Palaeotaxodonta	Nuculoida (nut shells)
Cryptodonta	† Praecardioida Solemyoida
Pteriomorphia	Arcoida (ark shells) † Cyrtodontoida Limoida (file shells) Mytiloida (true mussels) Ostreoida (oysters, formerly included in Pterioidea) † Praecardioida Pterioidea (pearl oysters, pen shells)
Palaeoheterodonta	Trigonioida (<i>Neotrigonia</i> is the only extant genus) Unionoida (freshwater mussels) † Modiomorpha
Heterodonta	† Cycloconchidae † Hippuritoida † Lyrodesmatidae Myoida (soft-shell clams, geoducks, shipworms) † Redoniidae Veneroida (hard-shell clams, cockles, razor shells)
Anomalodesmata	Pholadomyoida



Nucula
Sil-Recent
Polished surface

Cardiola
Sil.-Dev.

Arca
M. Jura-R.
Rectangular shape

Glycymeris
Early Cr. -R.

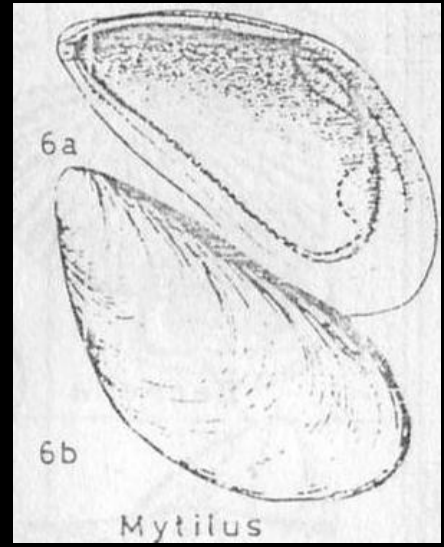
Pinna
Early Carb. -R.



<http://www.piximages.com/discover/Home/Science/Earth-Sciences/Palaeontology/Fossils/Invertebrates/Molluscs/Bivalves/Cardiola/Cardiola-1.html>

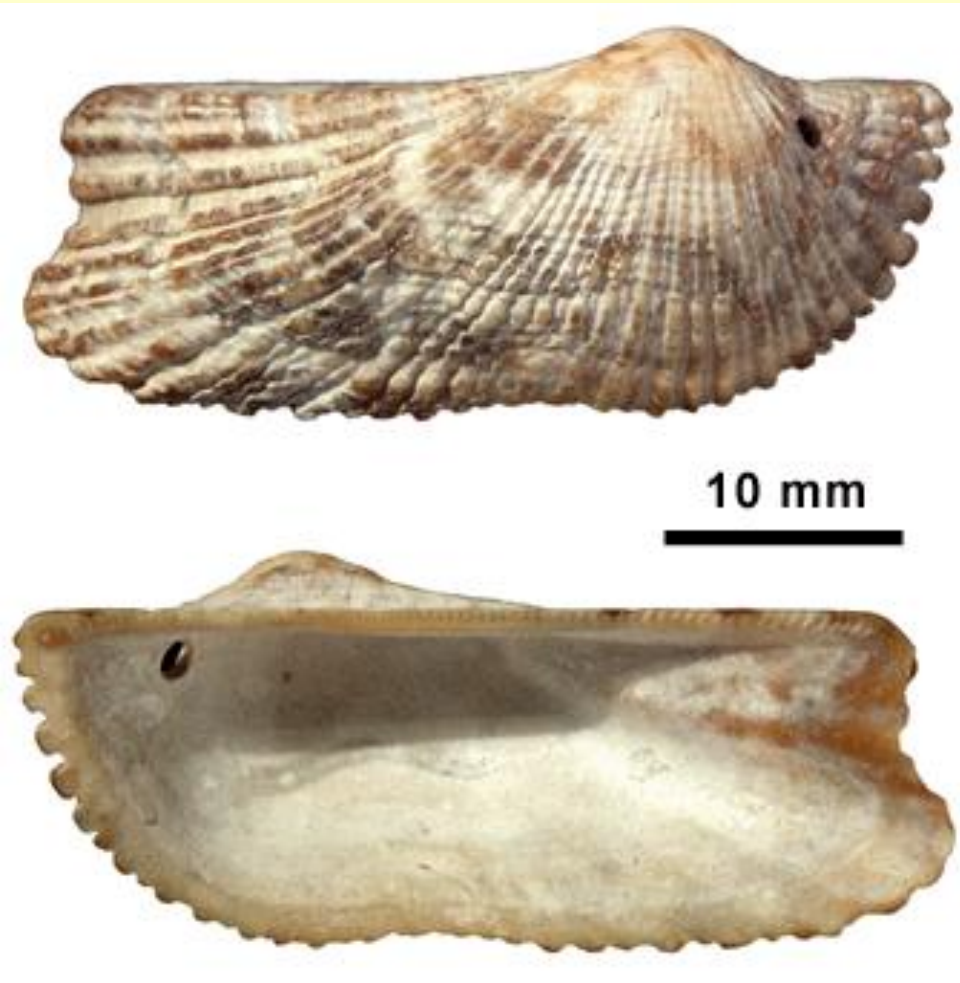
<http://www.dmap.co.uk/fossils/barton/biv/bartbiv.htm>

Mytilus
Jura-R.



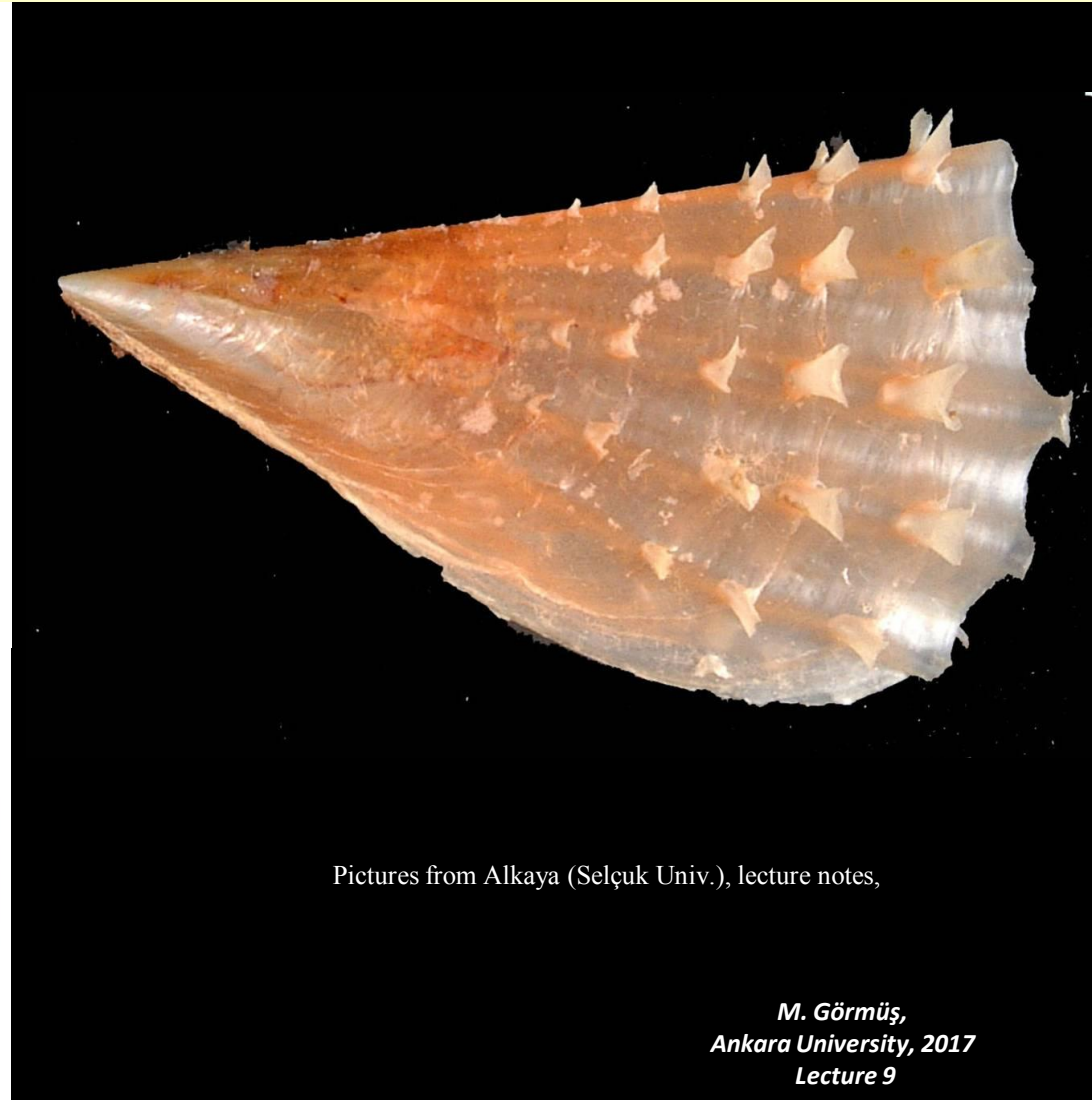
***Arca* sp.** (Middle Jurassic-Recent) ★

***Glycymeris* sp.** (Early Cretaceous-Recent)

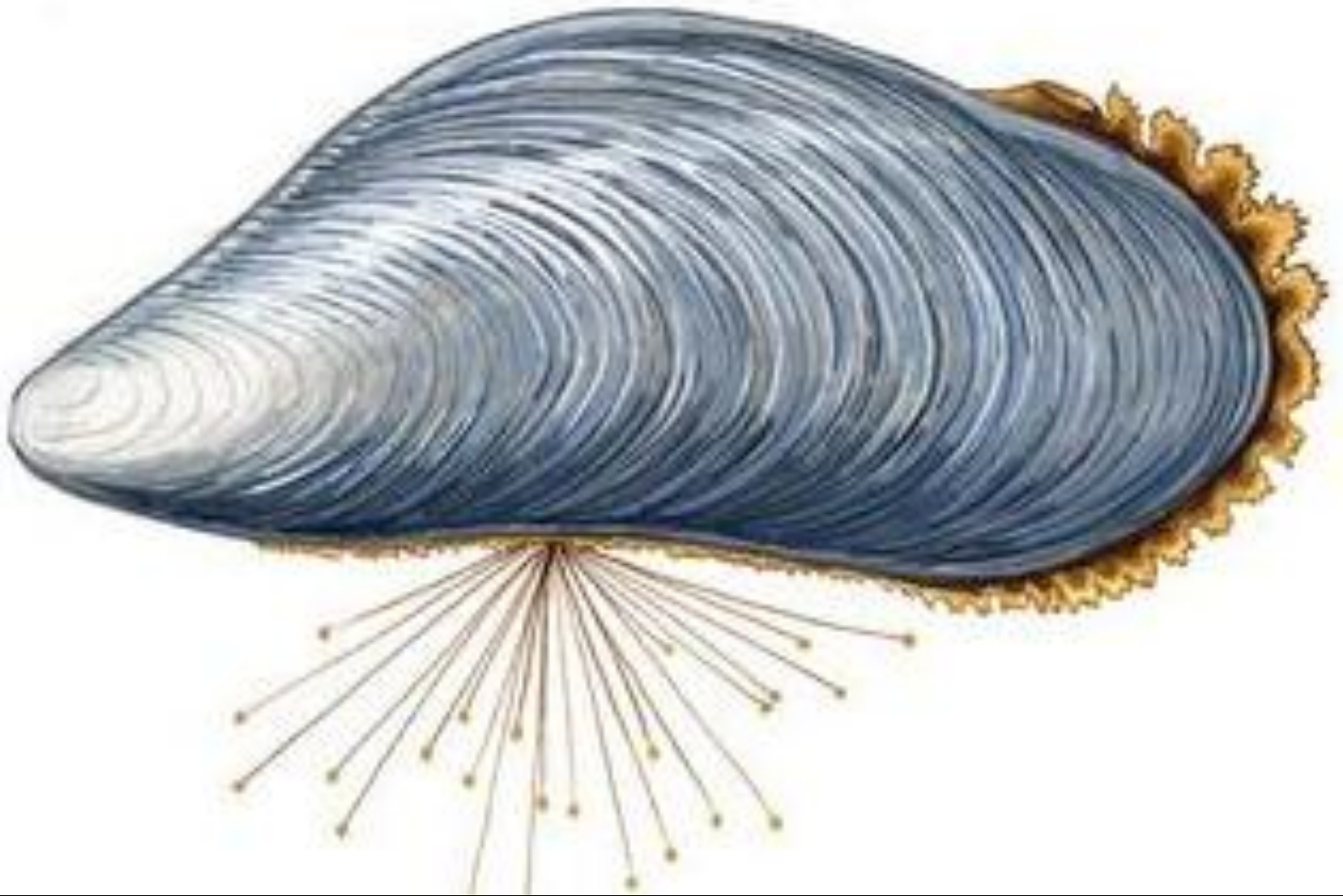


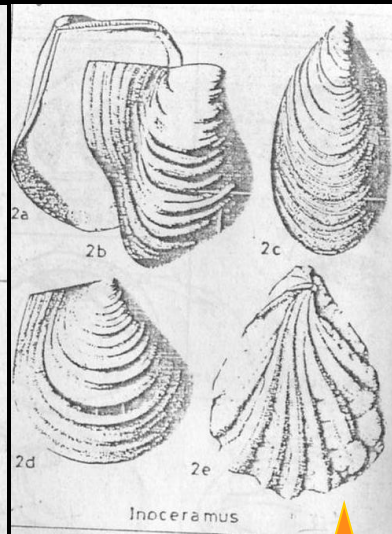
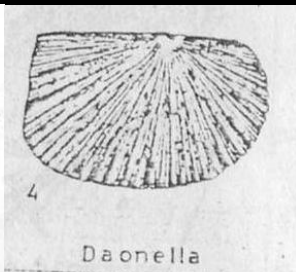
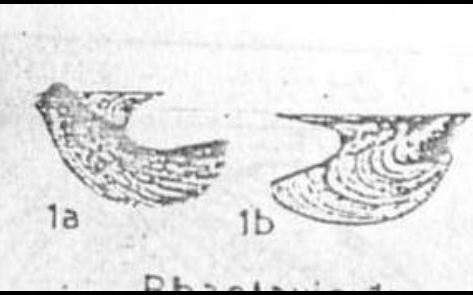
***Mytilus* sp.** (Late Jurassic-Recent) ★

***Pinna* sp.** (Early Carboniferous-Recent)



Pictures from Alkaya (Selçuk Univ.), lecture notes,





Rhaetavicula

*Daonella-
Halobia*

Inoceramus

Ostrea

Late Triassic
Kavkılar eşit değil
Arka kulakçık dar
Ve uzun

Triassic
Diktörtgen
şekil, ışınsal
süsler

Jura-Cr.
kaba konsantrik süsler
kulakçık

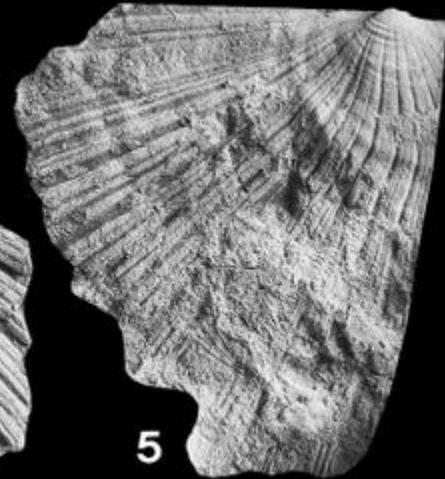
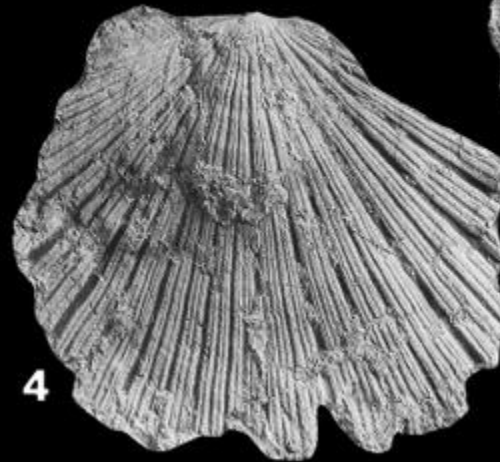
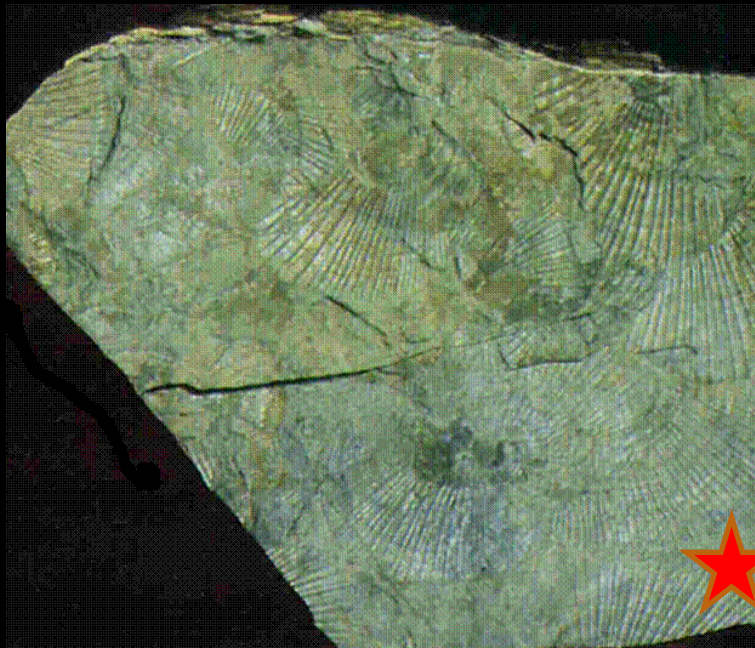
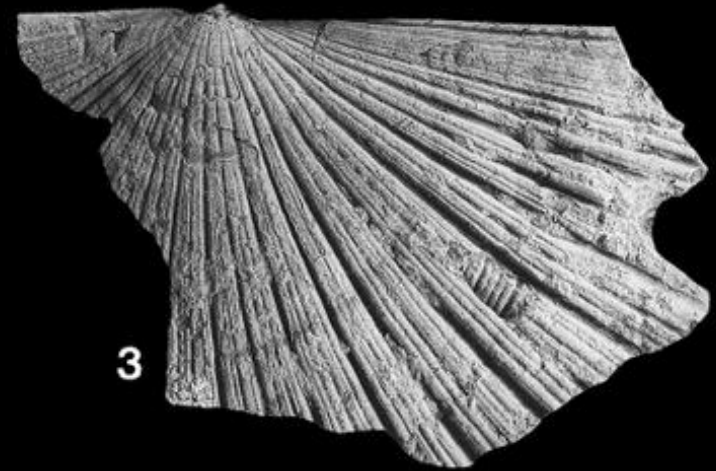
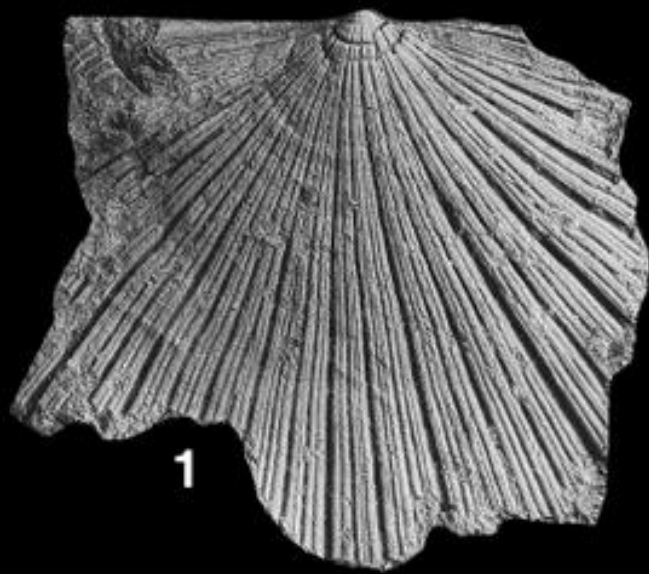
Triassic –Recent
kalın kavkı

Daonella sp. (Triassic)



Daonella lomelli

Halobia sp. (Triassic)



Halobia sp. (Triassic)



Inoceramus sp. (Jurassic-Cretaceous)



M. Görmüş,
Ankara University, 2017
Lecture 9

Picture from Alkaya (Selçuk Univ.), lecture notes,

Inoceramus sp. (Jurassic-Cretaceous)



Ostrea sp. (Triassic-Recent)





1a



1b

Lopha



2a



2b

Gryphaea



3a



3b



3c

Exogyra

Triassic-R.

Triassic-Eocene

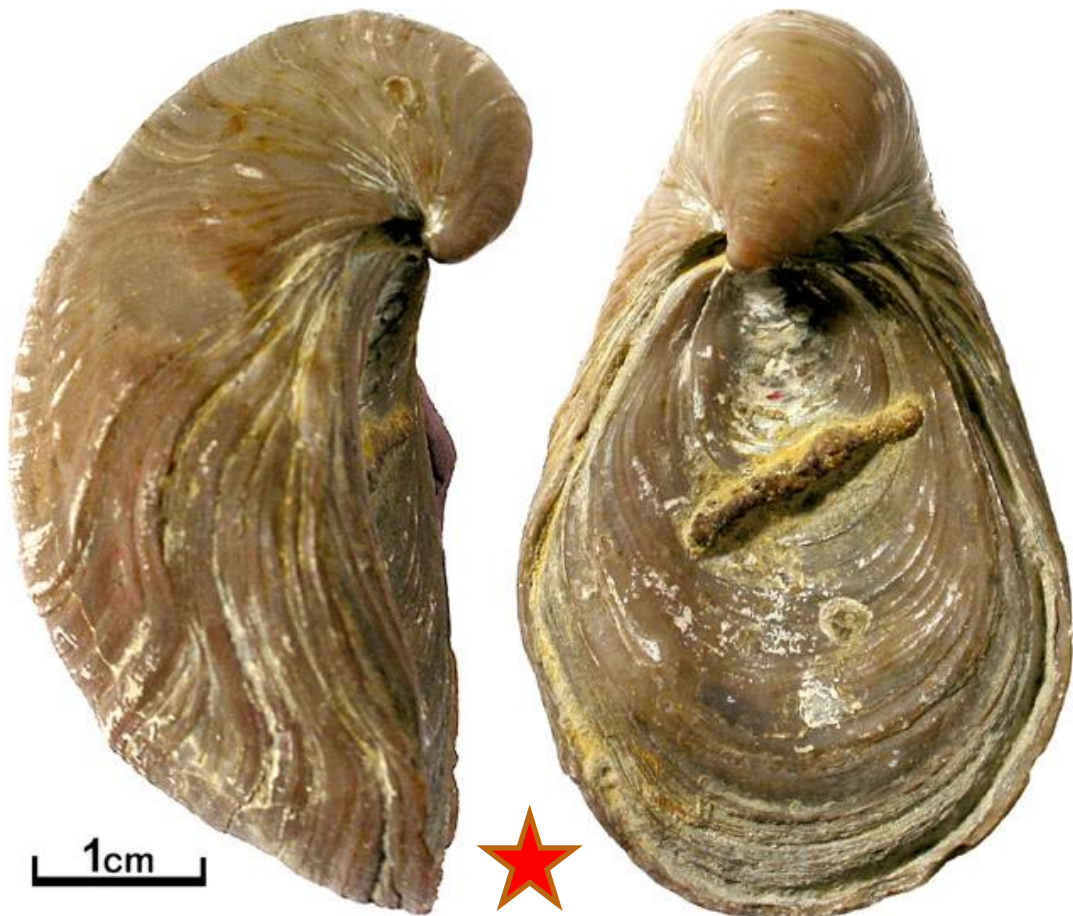
Juras.-Eocene

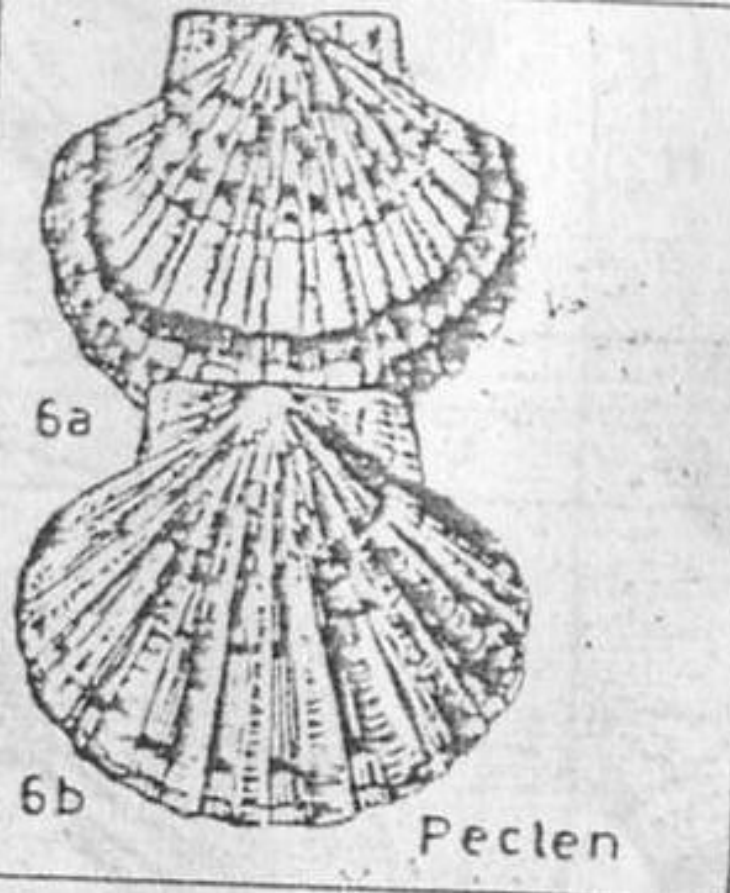


Exogyra sp. (Jurassic-Recent)



Gryphaea sp. (Triassic-Eocene)





Pecten

Late Eocene-R.



Chlamys

Triassic-R.



Spondylus

Juras.-R.



[More information](#)



Pecten sp. (Late Eocene-Recent)



Pecten sp. (Late Eocene-Recent)



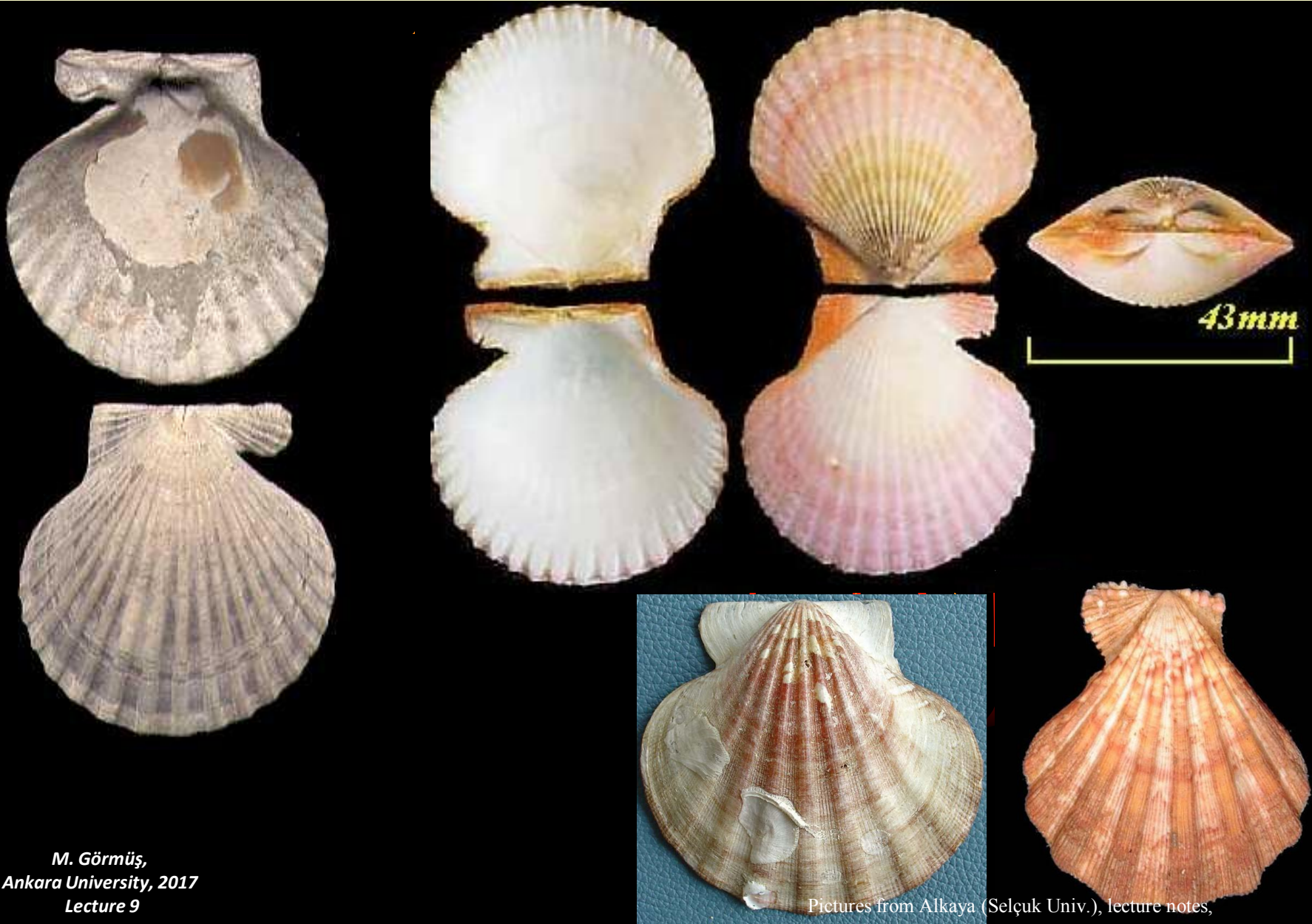
Pecten sp. (Late Eocene-Recent)



Chlamys sp. (Triassic-Recent)

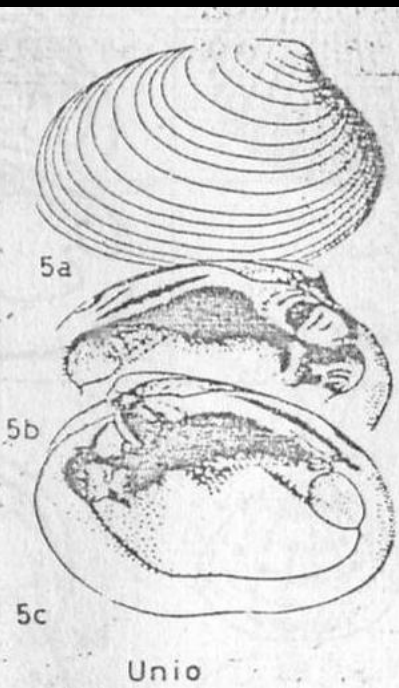


Chlamys sp. (Triassic-Recent)

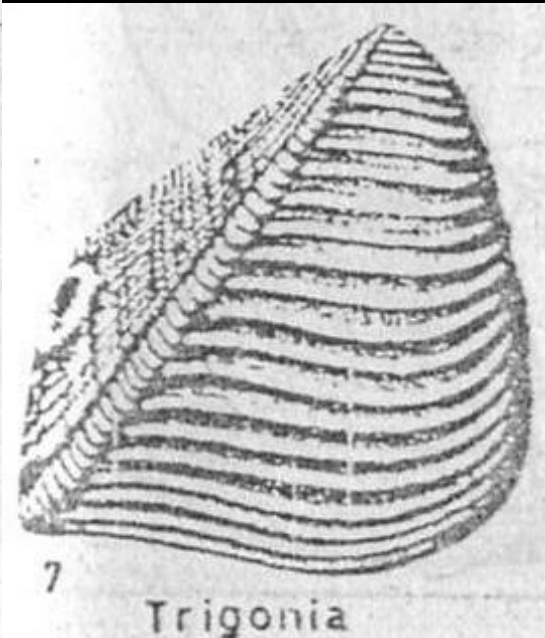


Spondylus sp. (Jurassic-Recent)





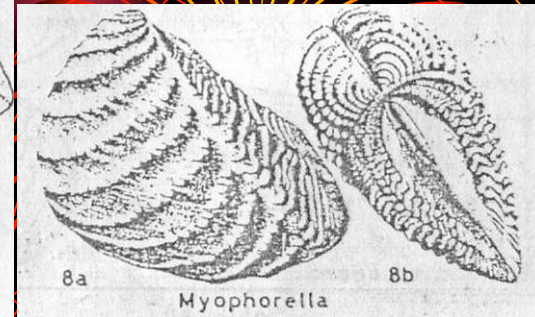
Unio



7
Trigonia



Myophoria



8a
Myophorella
8b

Triass.-R.
Freshwaters

Triassic-Cret.

Trias.

Juras.-Early Cr.



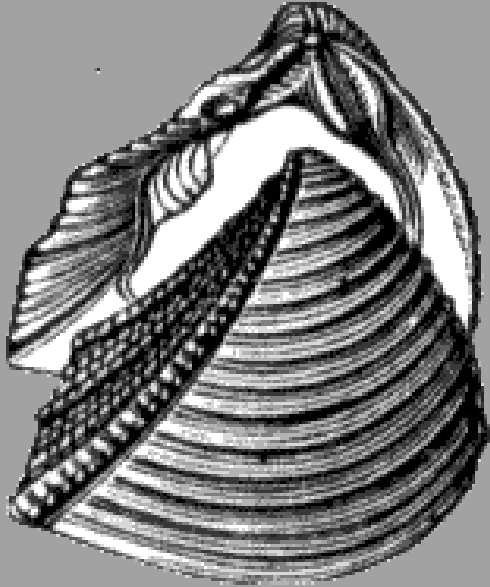
Unio sp. (Triassic-Recent)



http://upload.wikimedia.org/wikipedia/commons/5/59/Unio_pictorum_2.jpg



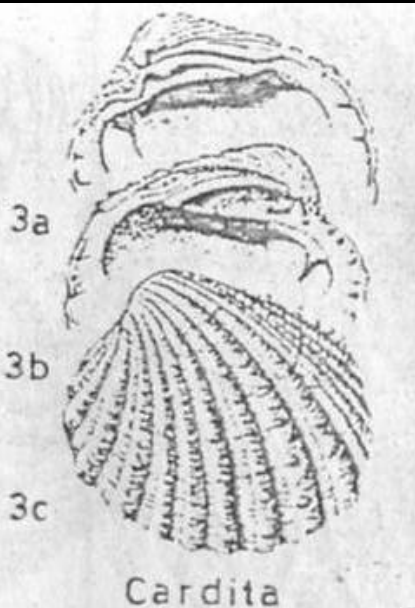
Trigonia sp. (Triassic-Cretaceous)



1cm

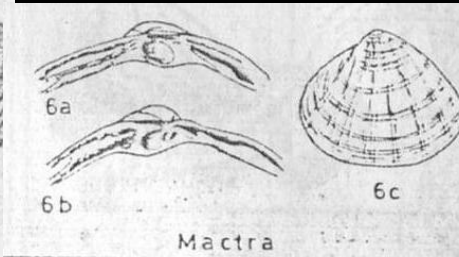
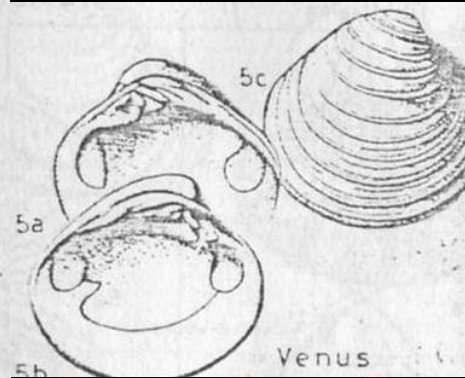
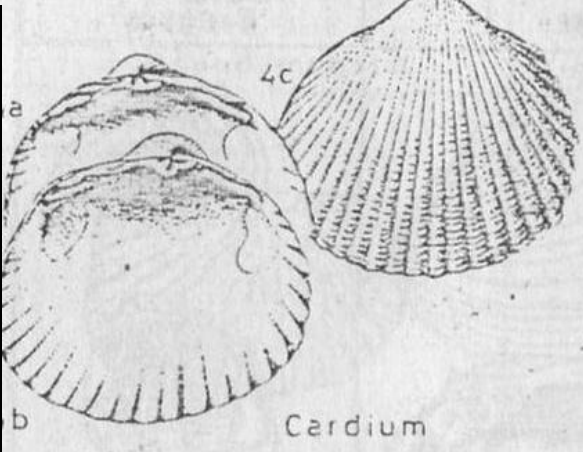
Trigonia sp. (Triassic-Cretaceous)





Cardium ringens
Senegal, Dakar, Baie de Gorée
NMR 32697. Common size 50 mm

Venus nux
Spain, Tarragona, San Carlos de la Rapita
NMR 37398. Common size 35 mm



Late Triassic-R.

Miocene – R.

Oligocene-R.

Eocene-R.

Brackish



Mactra sp. (Eocene-Recent)

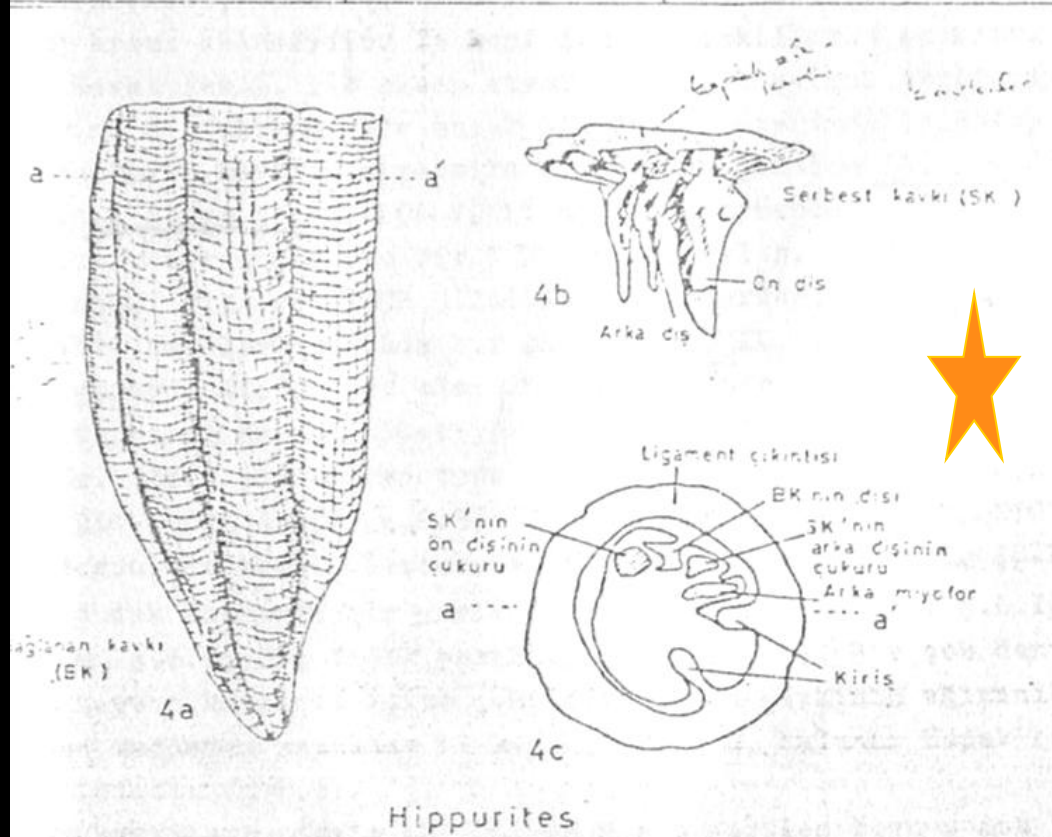
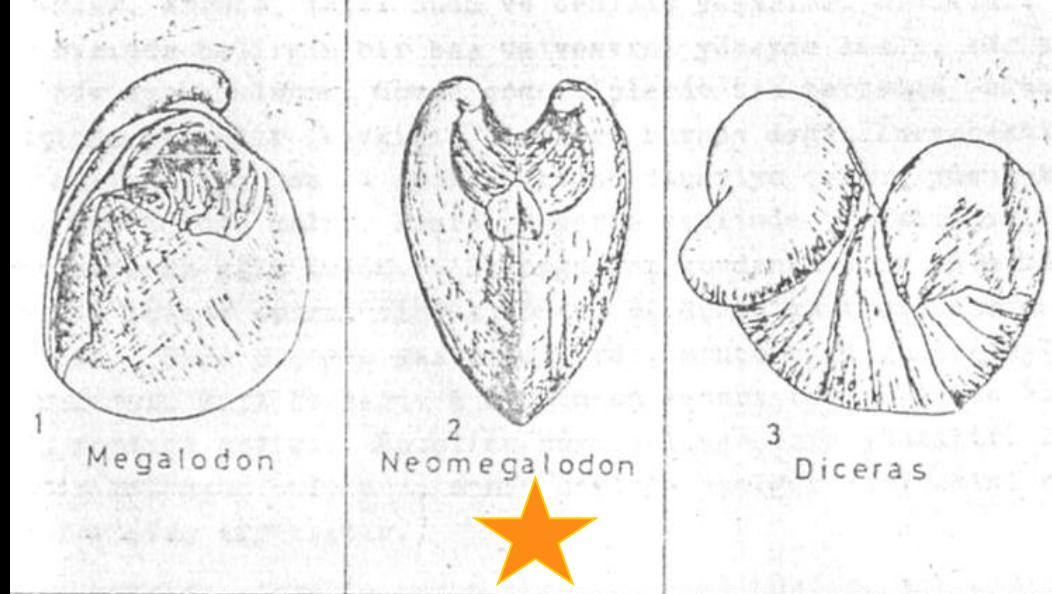


Megalodon
Middle-Late
Devonian

Neomegalodon Late
Triassic

Diceras
Late Jurassic

Hippurites
Late Cretaceous



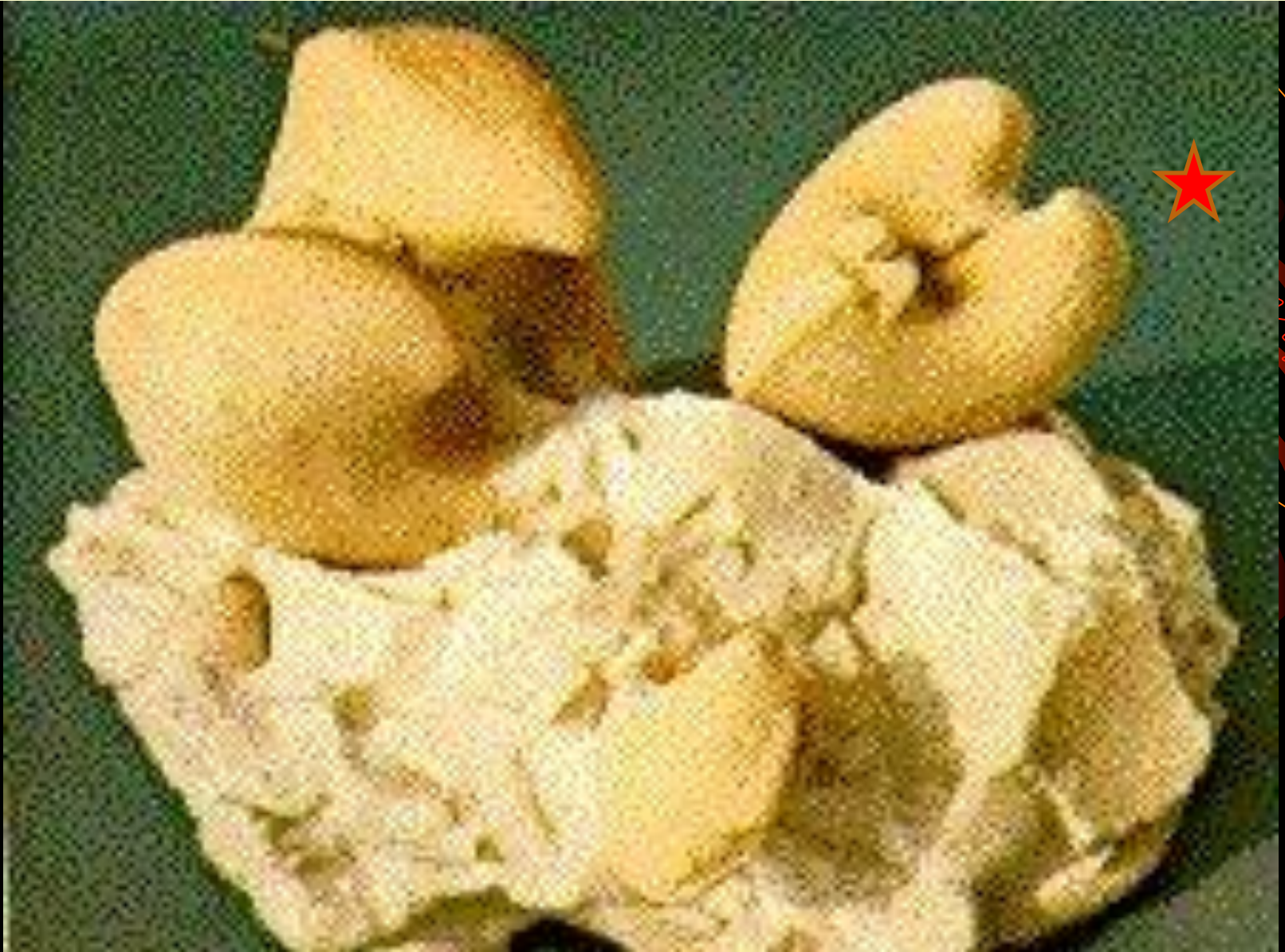
Congeria sp. (Oligocene-Pliocene)



Megalodon sp. (Devonian)

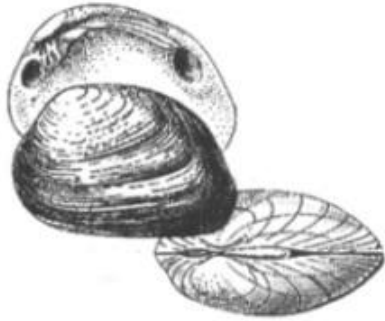


Neomegalodon sp. (Late Triassic)



Rudistid Bivalvia

'normal' bivalve



Diceras



Radiolites



Durania

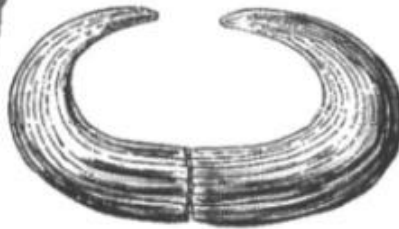


Lapeirousia



Plagiptychus

Caprinula



Titanosarcollites



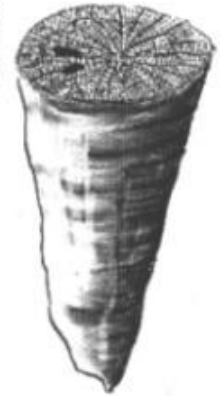
Ichthyosarcollites



Toucasia

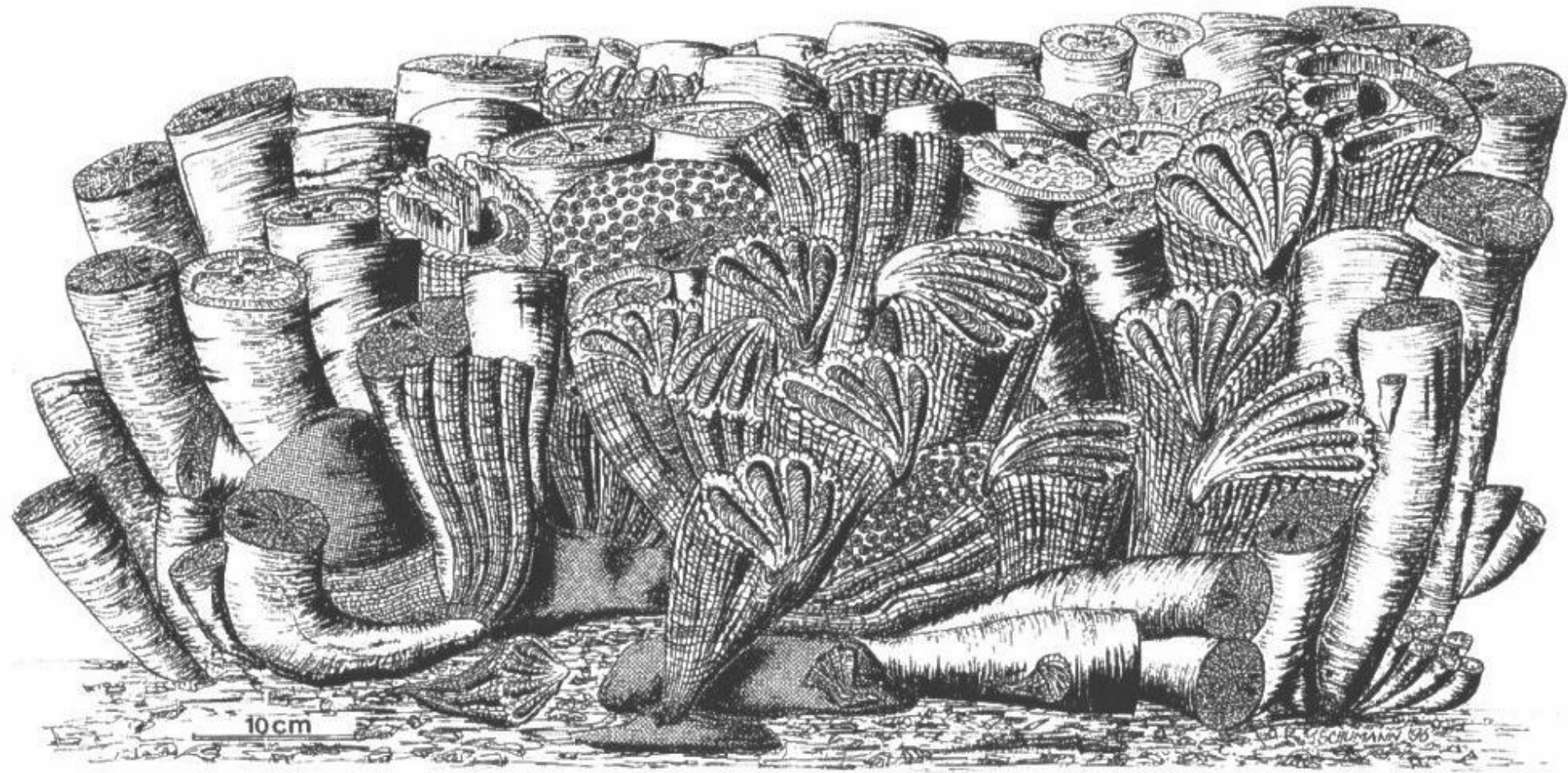


Torreites



Vaccinites

Rudistid Bivalvia



Left valve

Central body cavity

Right Valve

anterior muscle

Posterior muscle

anterior muscle

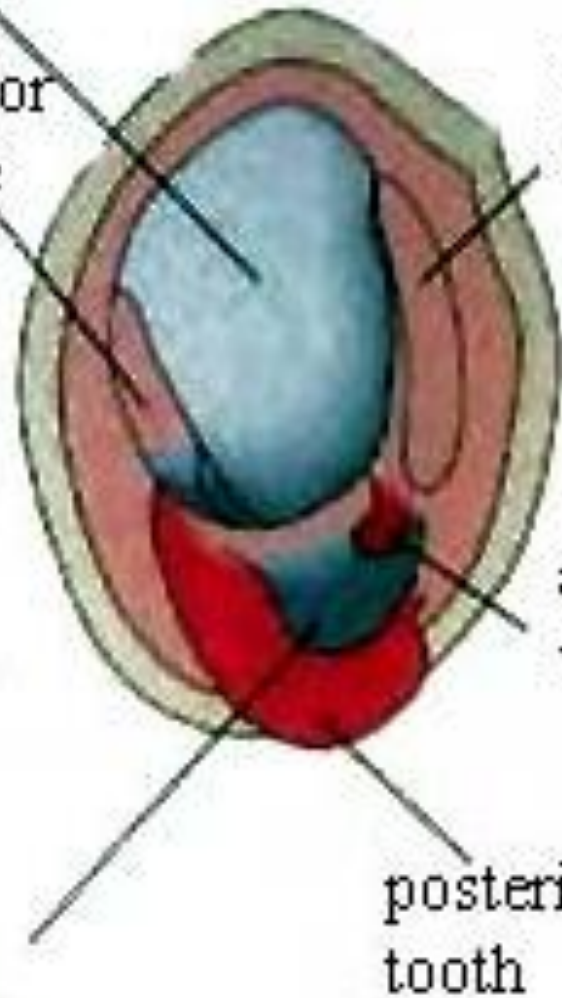
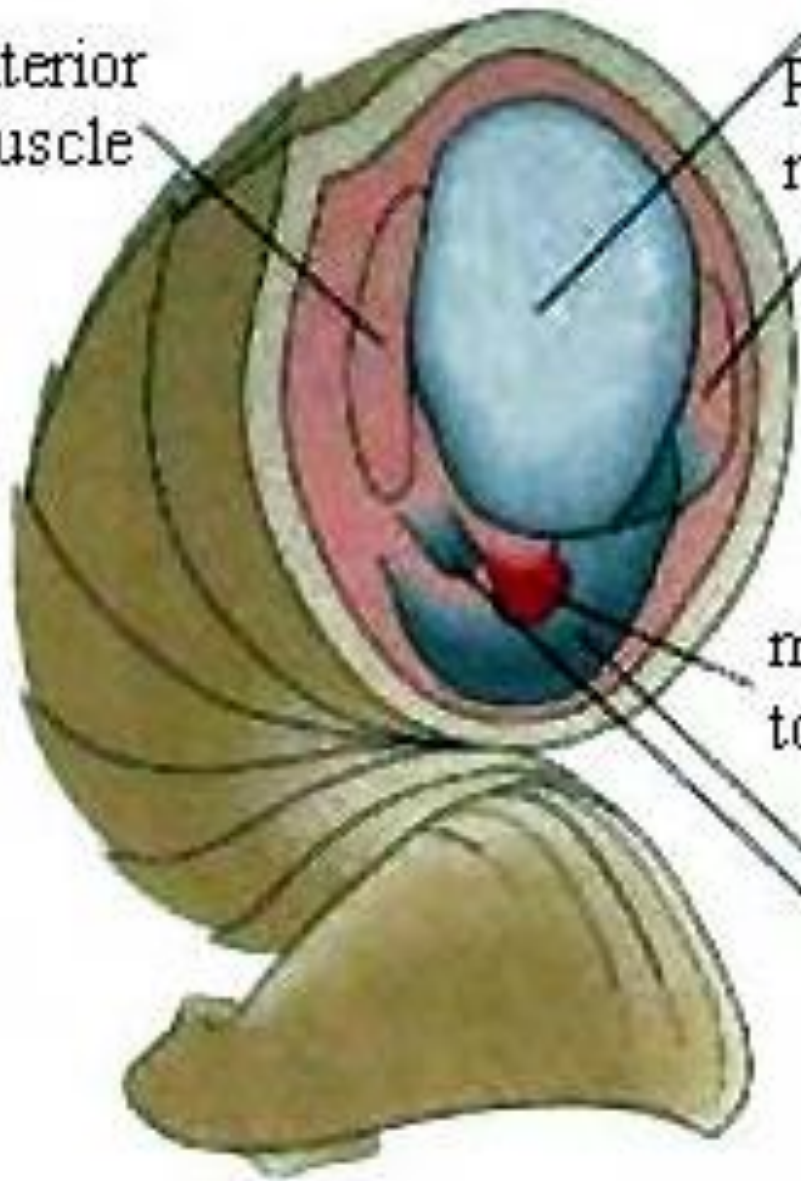
median tooth

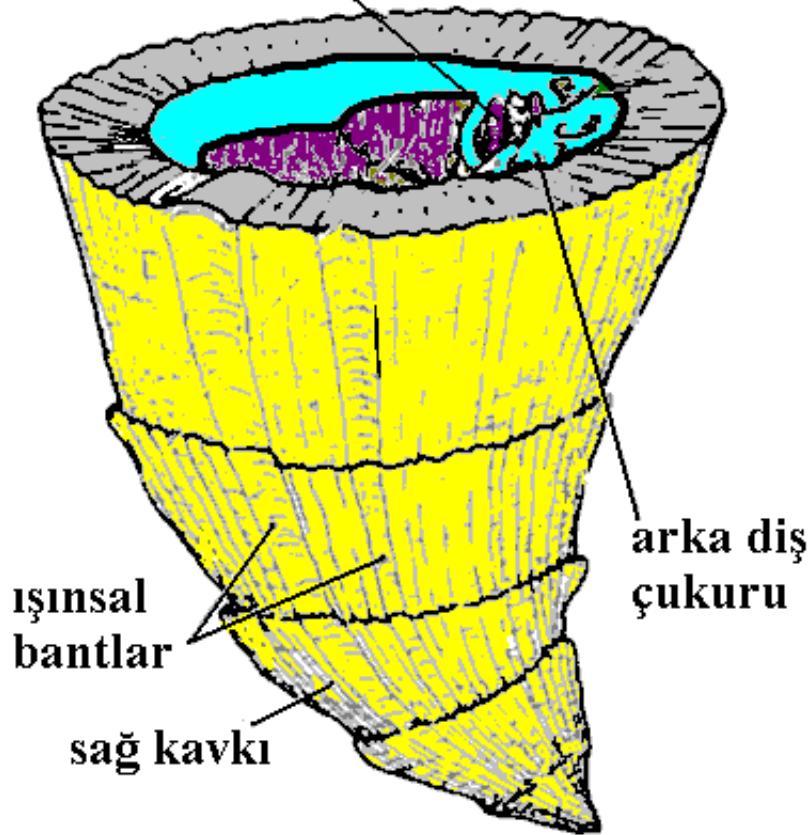
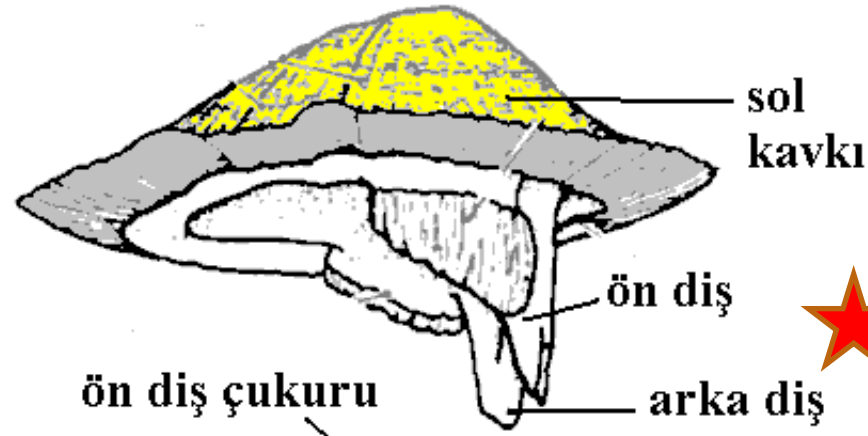
anterior tooth

posterior tooth

Cavità

Requienia





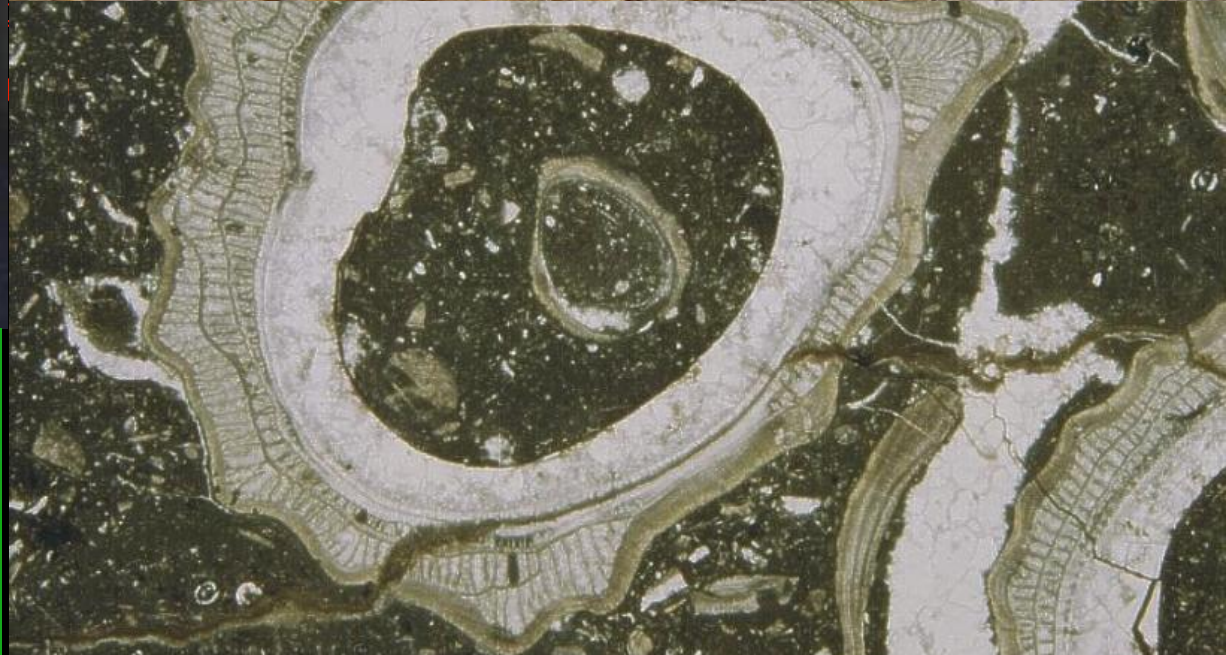






Vaccinites vesiculosus,
Umman

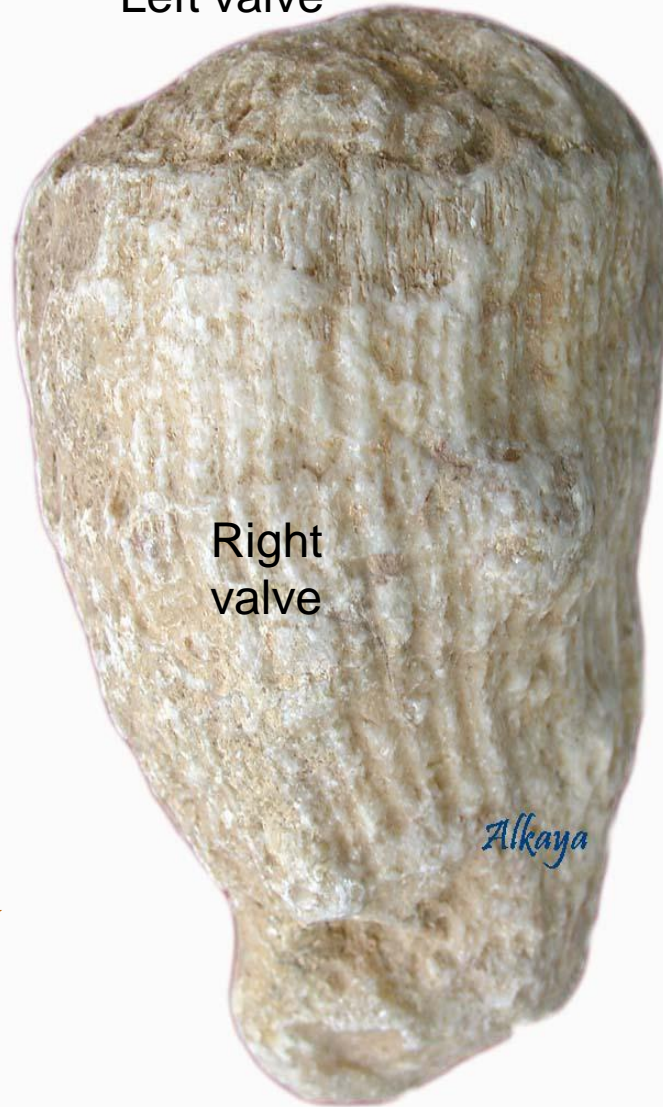




Hippurites sp. (Late Cretaceous)



Left valve



Right valve

Alkaya



Alkaya

Rudist Bivalvia (Late Cretaceous)



Mollusca
Class:
Gastropoda



Gastropoda





Terrestrial

http://animaldiversity.ummz.umich.edu/site/resources/tanya_dewey/polishsnail.jpg/view.html



Freshwater



Marine



http://animaldiversity.ummz.umich.edu/site/resources/Grzimek_inverts/Pulmonata/Helix_pomatia.jpg/view.html

Spp. with gen. aquatic distr. in perennial waters



Class Gastropoda

General characteristics

<http://classes.seattleu.edu/biology/biol235/hodin/gastropods/GASTROPODA.htm>

In general, the body of a gastropod consists of four main parts: the visceral mass, mantle, head and foot. The head is highly developed and bilaterally symmetrical. It contains a pair (sometimes two) of tentacles, a mouth, and eyes. The eyes are often located on the tips of the tentacles. The mouth contains an important device called the radula that functions in food processing, but has also adapted to serve many different purposes. The radula may contain up to a quarter of a million individual teeth that grind up food before it is passed to an esophagus and stomach.

From the radula, ciliary currents transport food through the buccal cavity to the gastropod digestive tract, the stomach. Digestion takes place via enzymes secreted by the salivary and digestive glands. In carnivorous snails, muscular action also plays a prominent role in moving food through the system. The gastropod excretory system consists of two kidneys, or nephridia, although in more advanced forms, one kidney is small or absent. Terrestrial gastropods reduce water loss by sealing the mantle cavity with an extended mantle collar.

The gastropod's easily recognizable foot is a broad, flat muscular organ used primarily for locomotion. The foot, however, has undergone numerous modifications in various groups. For instance, in pelagic gastropods the foot has adapted to become a useful tool in swimming. An interesting adaptation in some species is the ability to self-amputate the posterior portion. This self-amputation functions as a distraction since the portion continues to wriggle violently while the remaining portion of the snail slips silently away.

Class Gastropoda

Terms

Mantle: a fleshy tissue that lies over the visceral mass and it secretes the shell

Radula: a ribbonlike tongue often containing many thousands of denticles (teeth) that are projected from the mouth opening and drawn along rocks or leaves. Some carnivorous snails have radulae that bore holes through the shells of other mollusks to reach the soft flesh.

Visceral Mass: contains the excretory, digestive and circulatory organs.

Operculum: a horny plate, which closes the opening of the shell in many marine species.

Foot: the locomotory portion of the body, which may contain cilia on the ventral surface to aid in movement in some species. Others move by way of pedal wave movement, which is the slight muscle contraction on the ventral side of the foot.

Ctenidia: paired gills, part of the respiratory process of some gastropods. The gill consists of a series of flattened triangular filaments that lay adjacent to one another and are found in the mantle cavity.

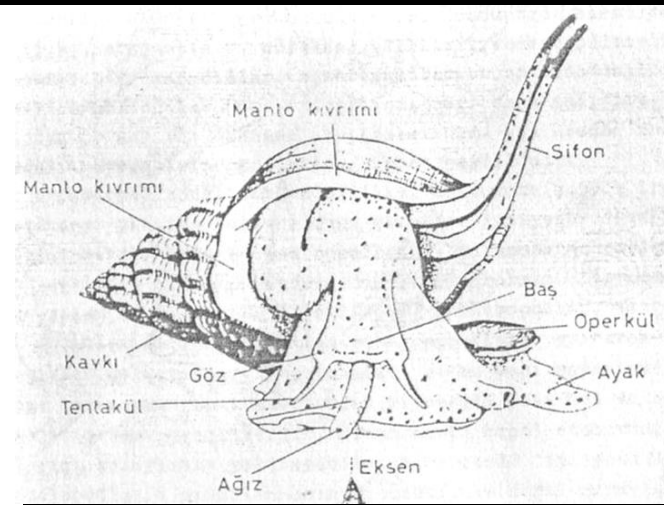
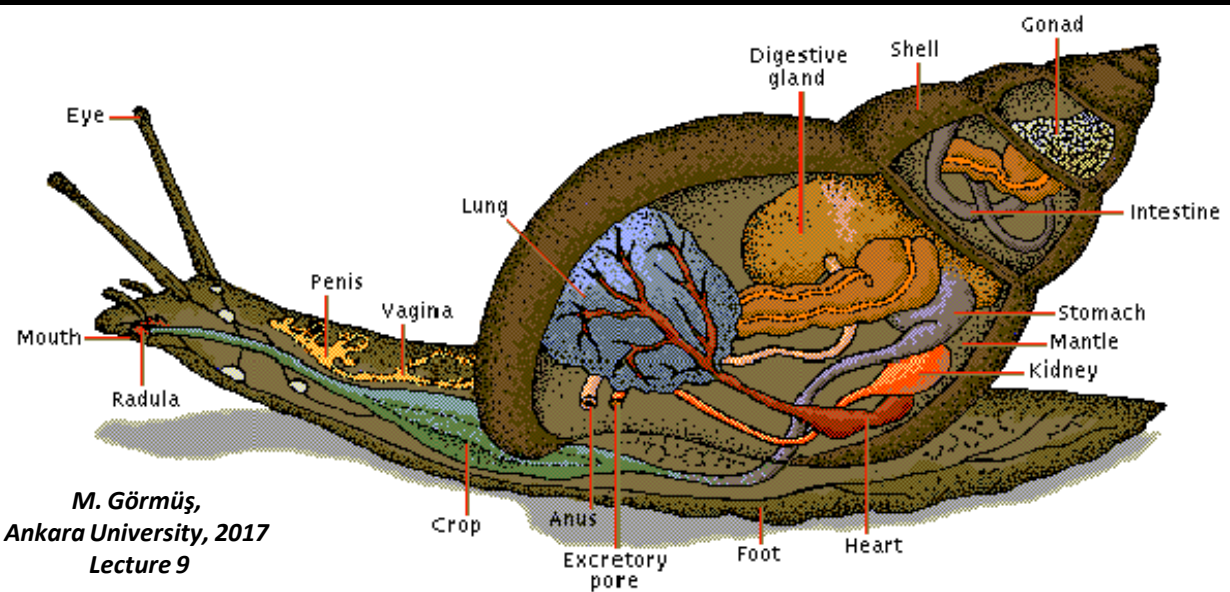
Lungs: present in the freshwater and terrestrial gastropods

Columella: the central axis of the shell

Columellar Muscle: this muscle attaches the animal to the inside of its shell and extends from within the animal's foot to the columella.



<http://alisha-smiles.blogspot.com/2010/05/gastropoda.html>



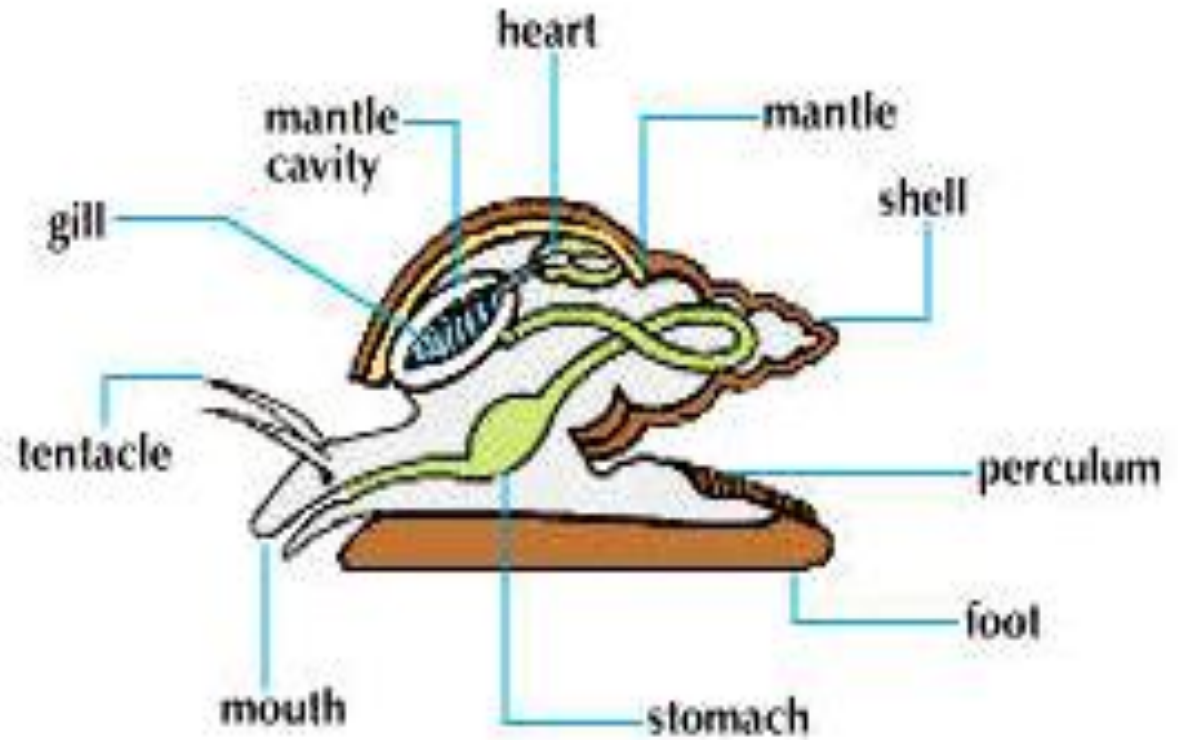
M. Görmüş,
Ankara University, 2017
Lecture 9

<http://classes.seattleu.edu/biology/biol235/hodin/gastropods/GASTROPODA.htm>

Class Gastropoda

Body view

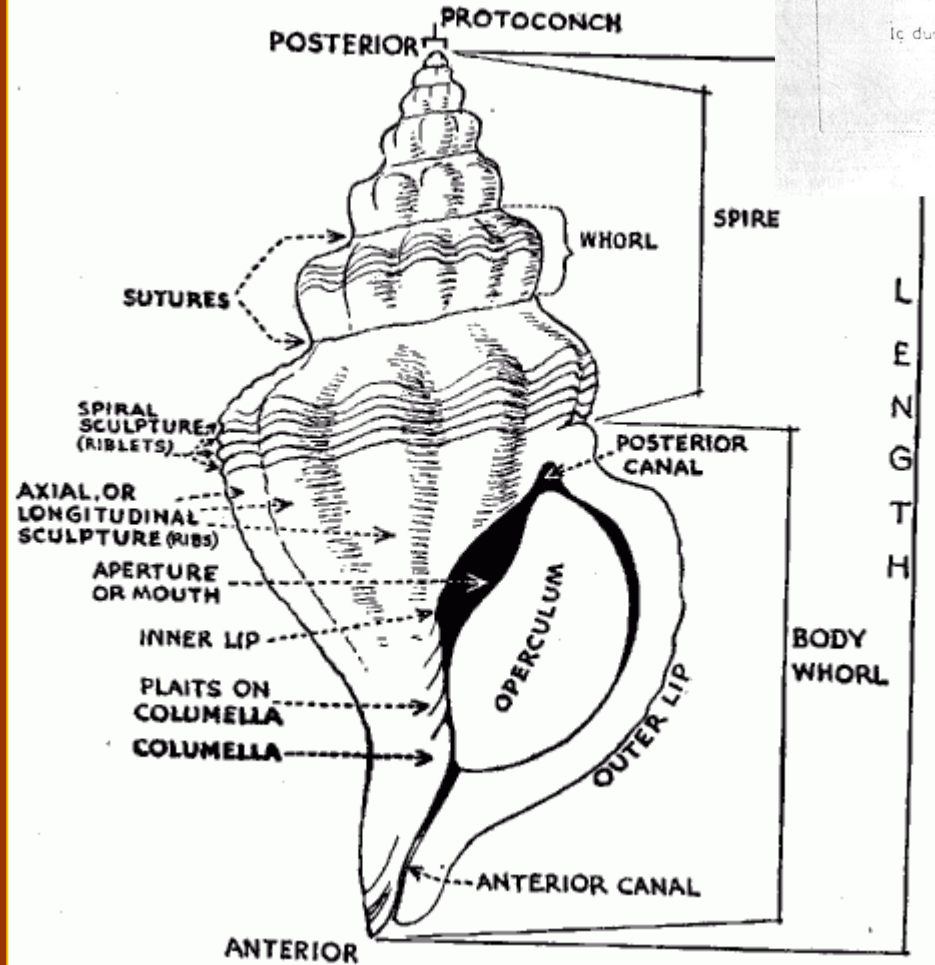
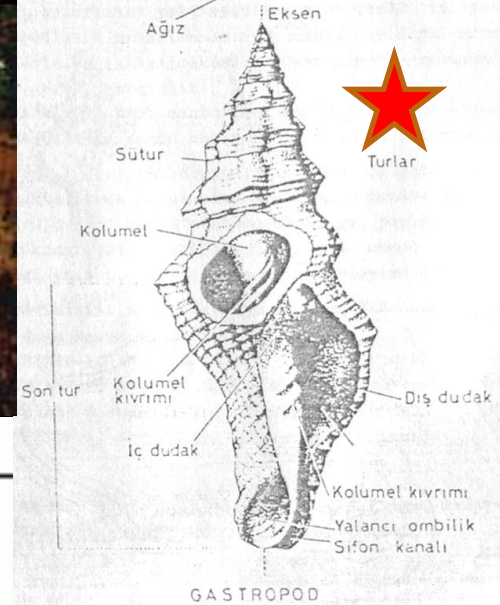
GASTROPODA



[http://infusion.allconet.org/
webquest/PhylumMollusca.html](http://infusion.allconet.org/webquest/PhylumMollusca.html)

Class Gastropoda

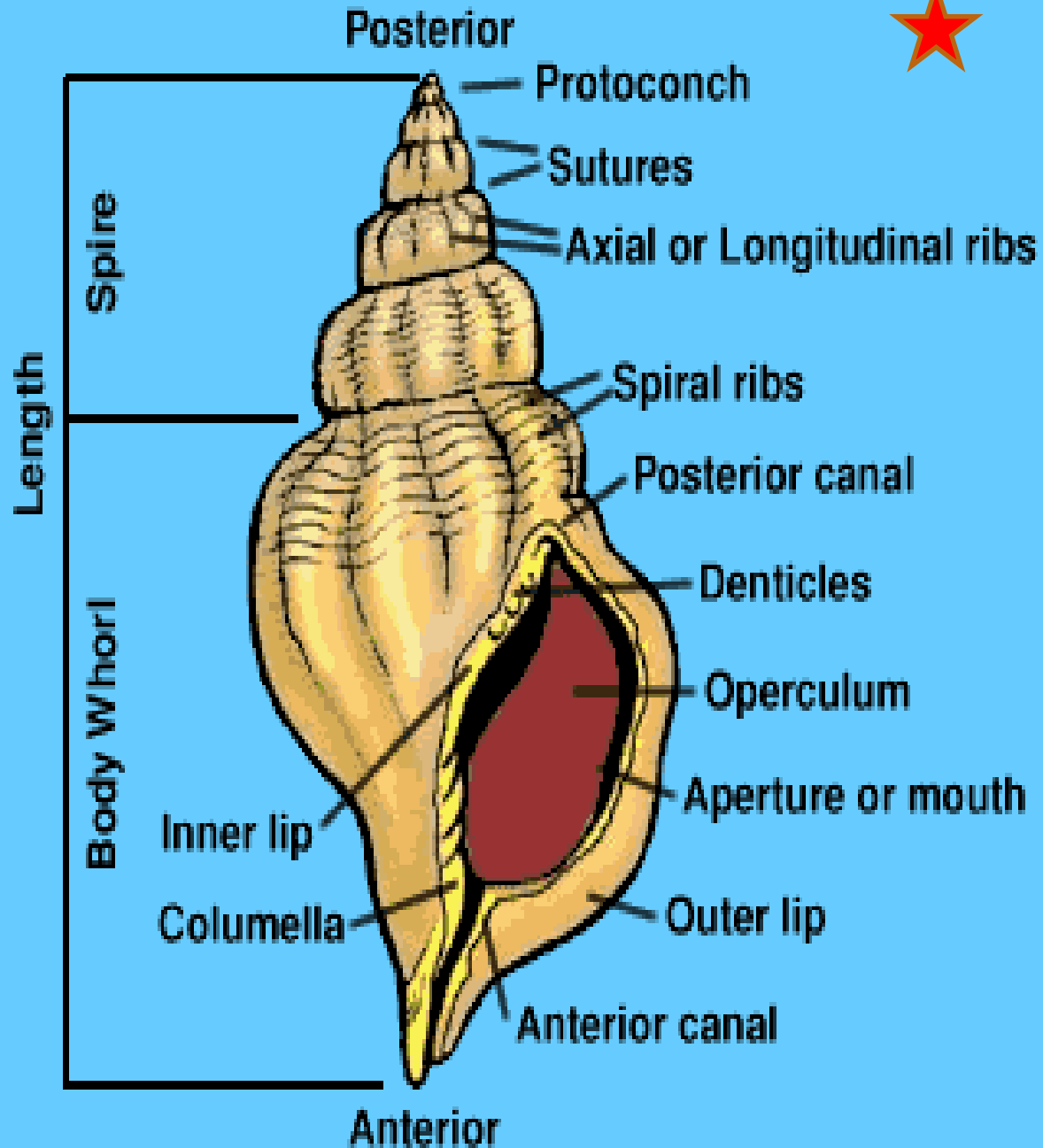
Body views & terms



Class
Gastropoda

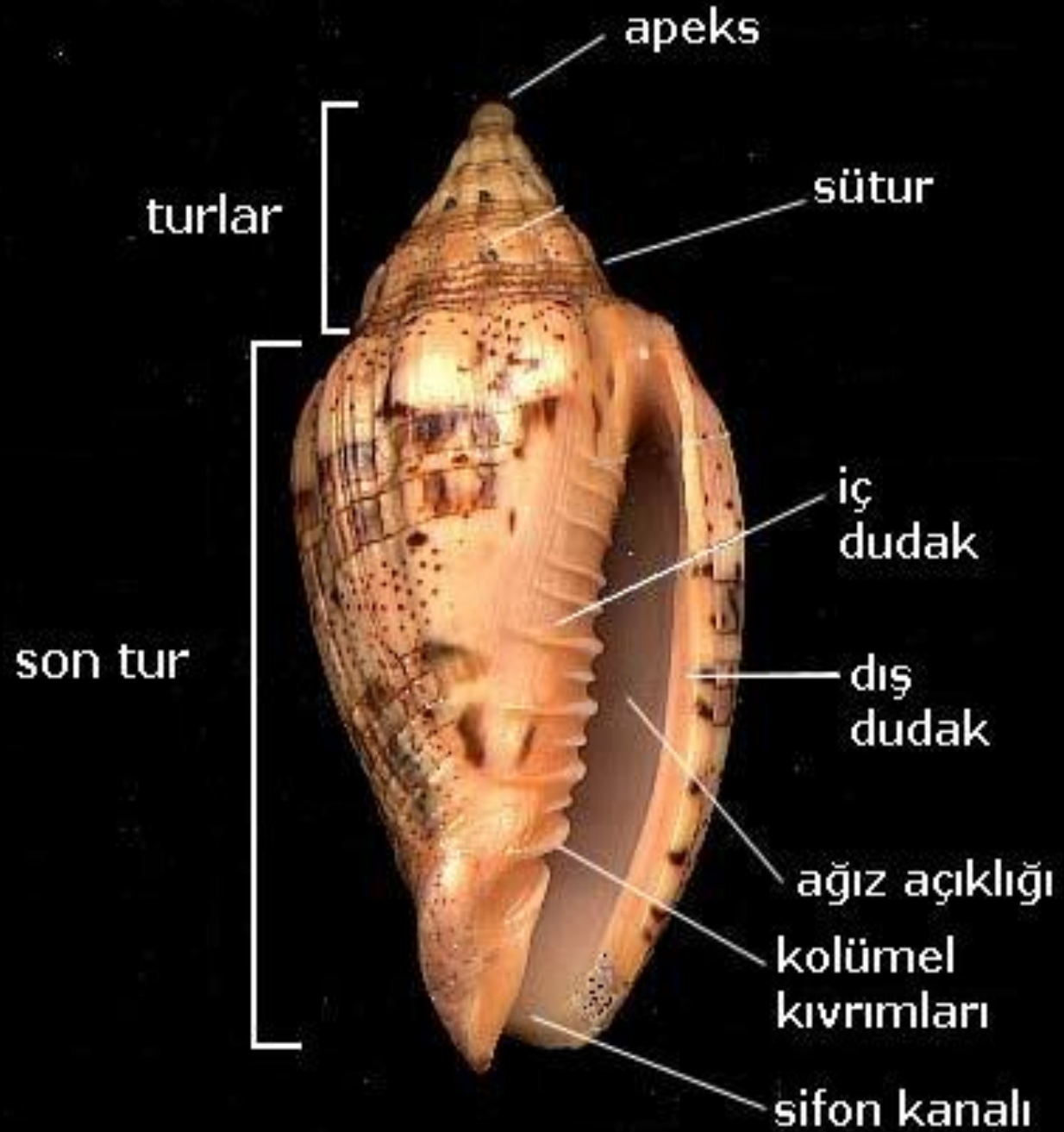
Body View & Related terms

Mollusc - Univalve Gastropod



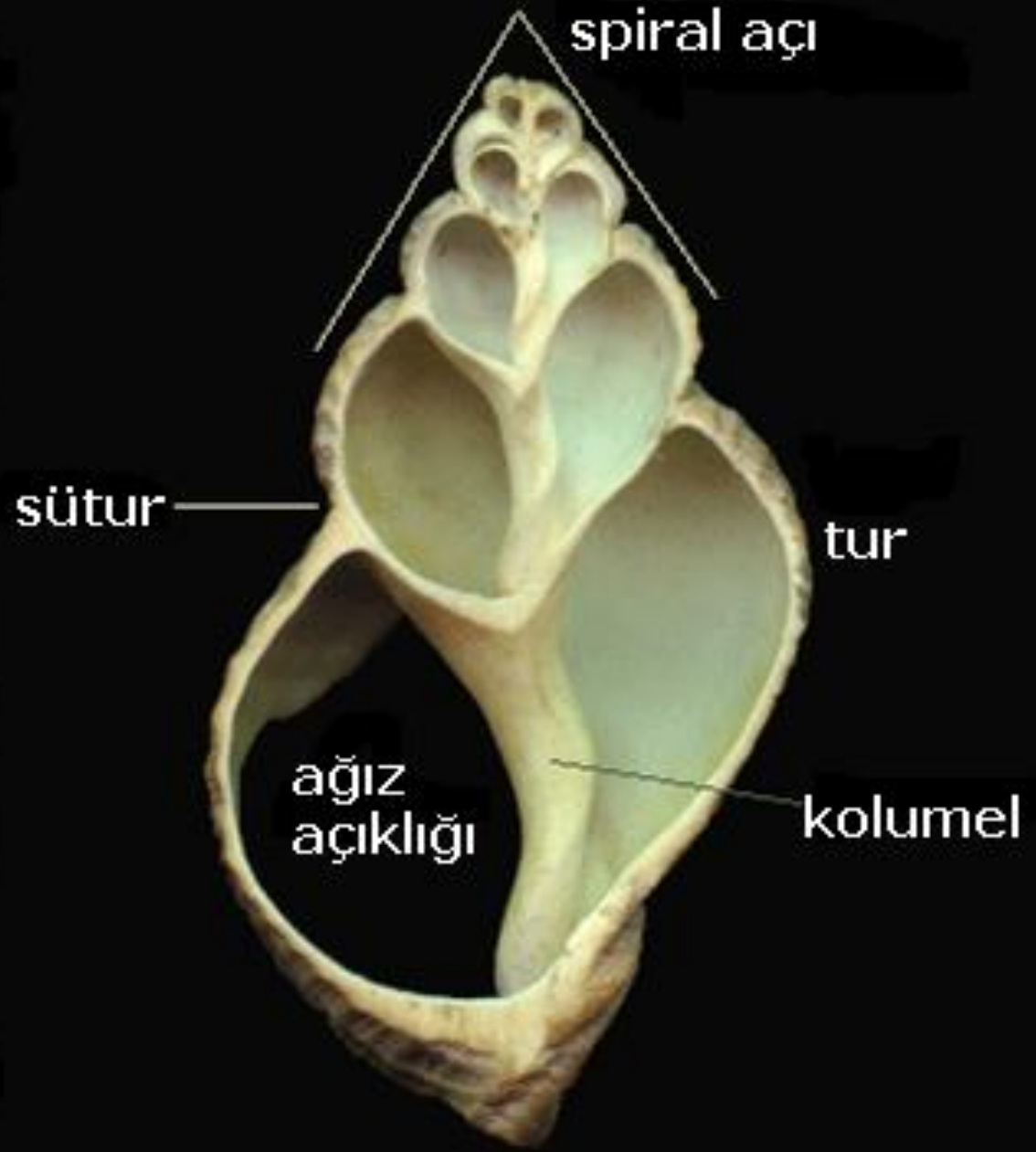
Class
Gastropoda

Body View & Related terms



Class
Gastropoda

Body View & Related terms



Class
Gastropoda

Body View & Related terms





Class
Gastropoda

Body View & Related terms



Internal
Mould
Cast



Cast



External
Mould

Planspiral
Trochospiral
Dextral shell
Sinistral shell
Sfenestom
Holostom

Class Gastropoda

Terms

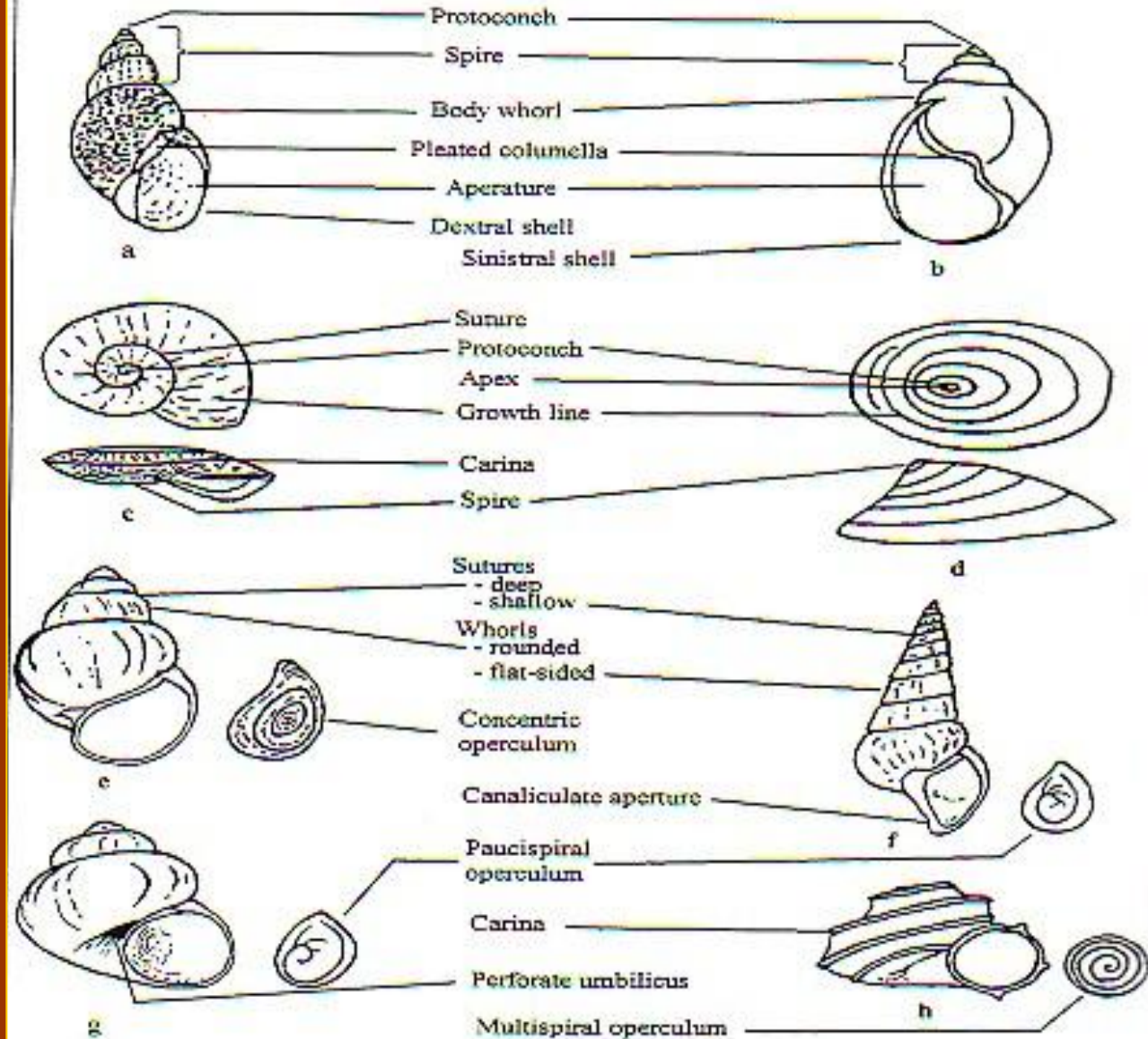
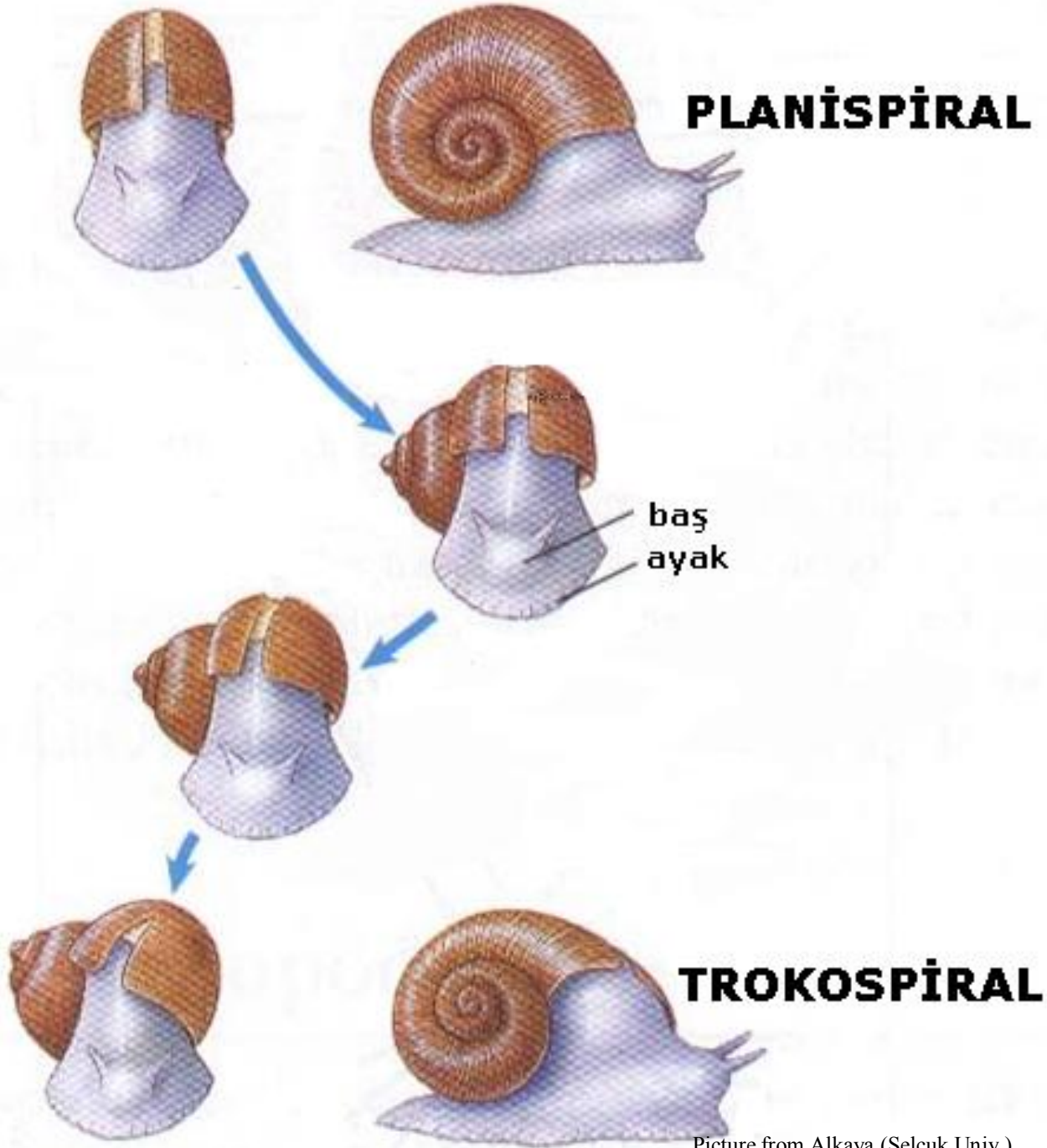


Figure 8.14. Some diagnostic features of eight families of freshwater gastropods showing (a) Lymnaeidae, (b) Physidae, (c) Planorbidae, (d) Ancyliidae, (e) Viviparidae, (f) Pleuroceridae, (g) Hydrobiidae and (h) Valvatidae.

whorling

Class
Gastropoda

Terms

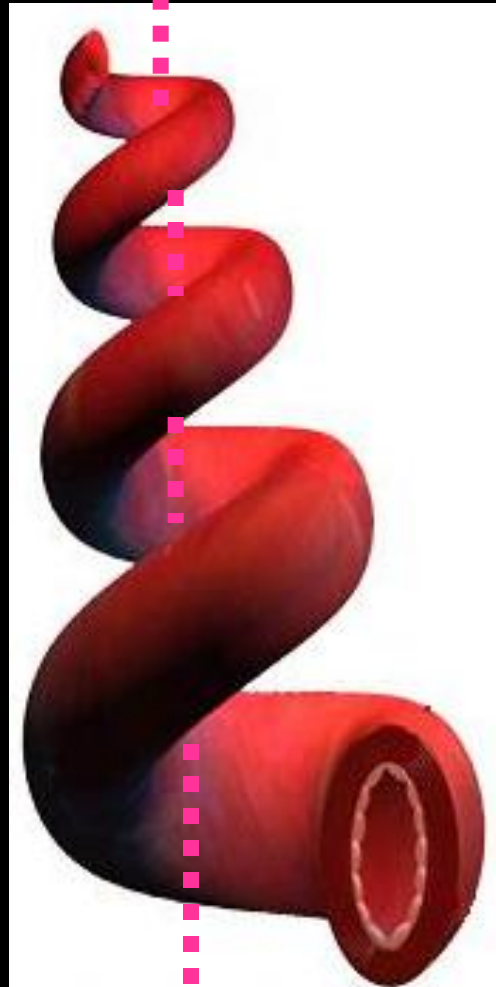


Trochospiral whorling

Class
Gastropoda

Terms

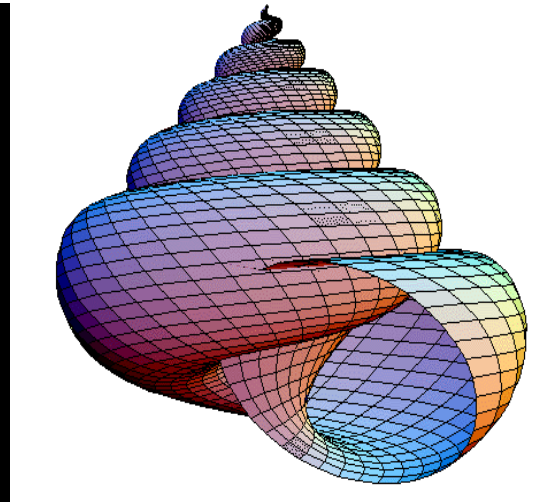
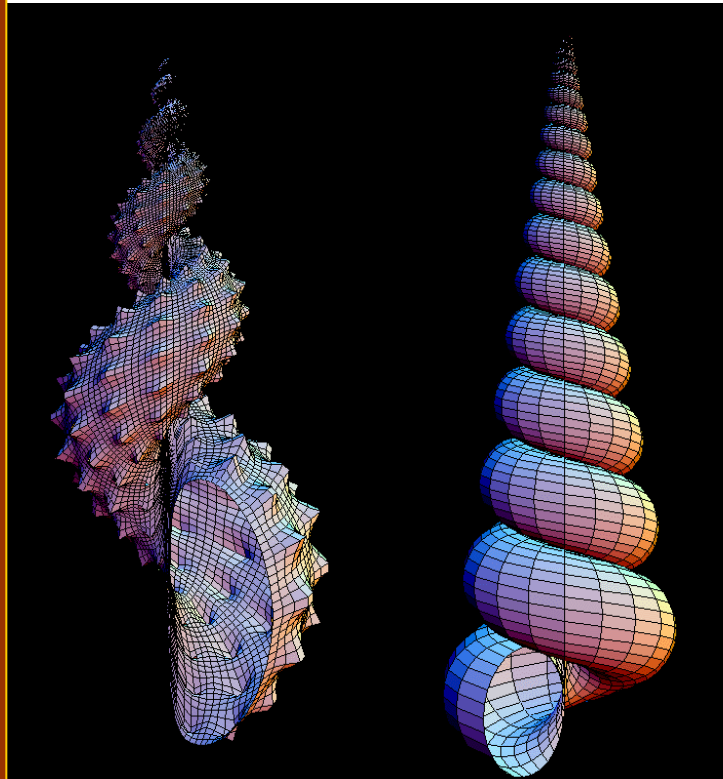
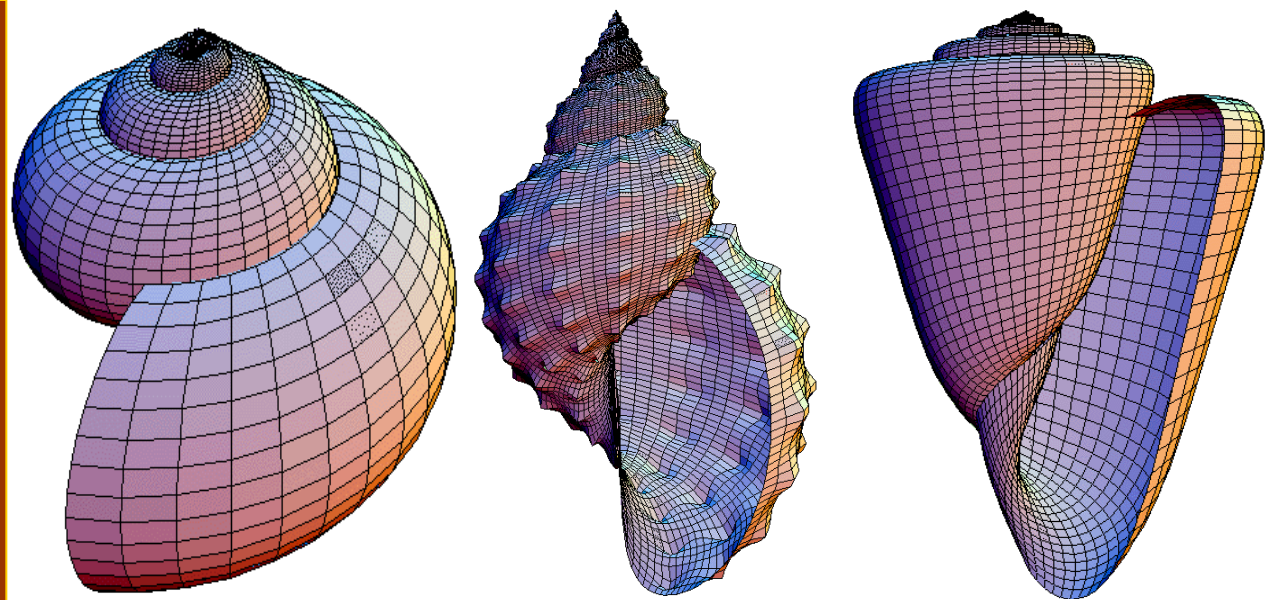
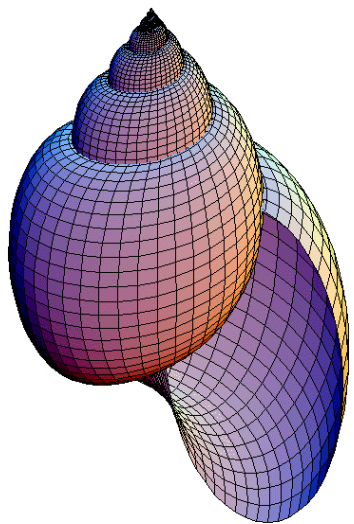
Coiling axis



Trochospiral whorling

Class
Gastropoda

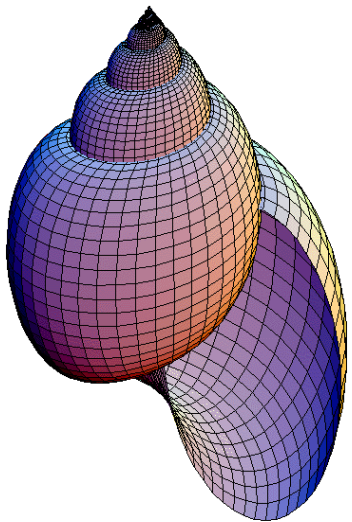
Terms



Trochospiral whorling

Class
Gastropoda

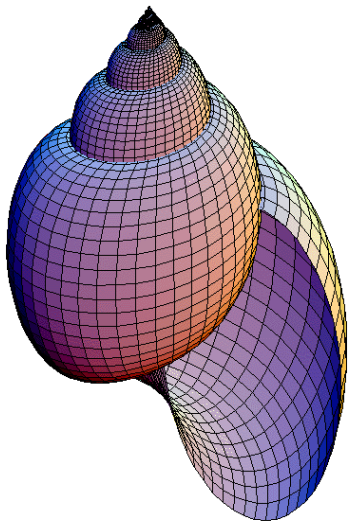
Terms



Trochospiral Whorling

Class
Gastropoda

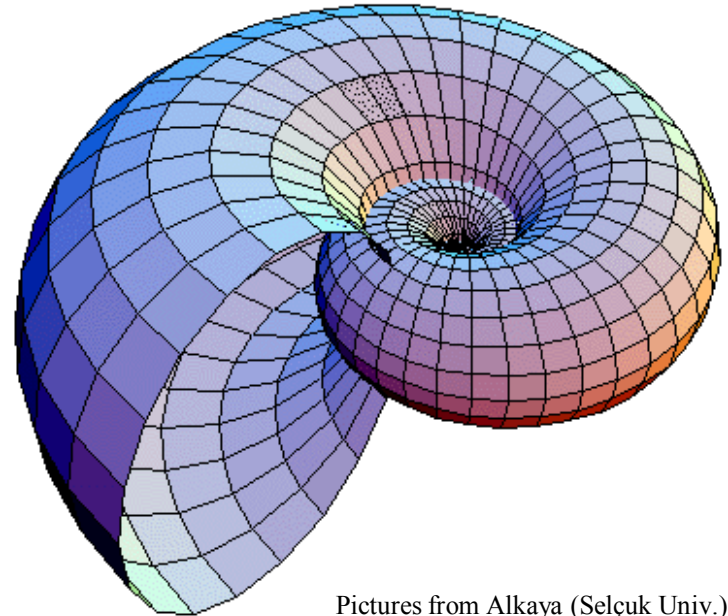
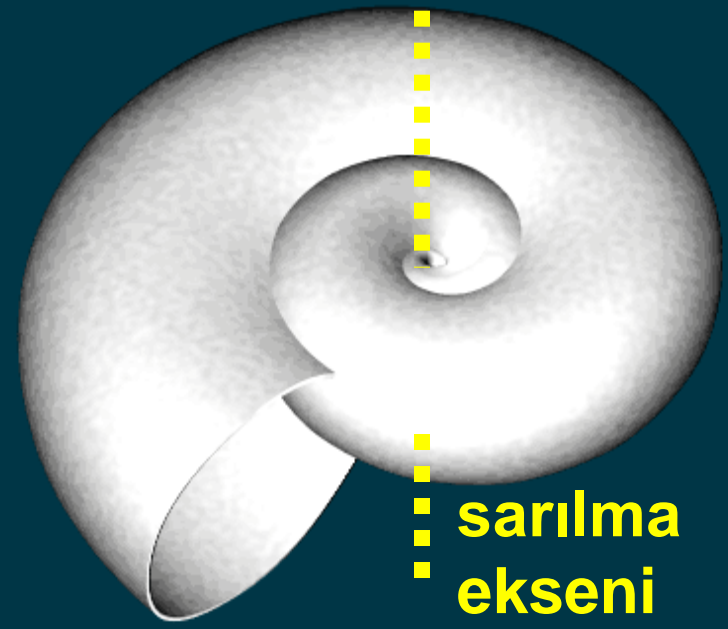
Terms



Planspiral whorling

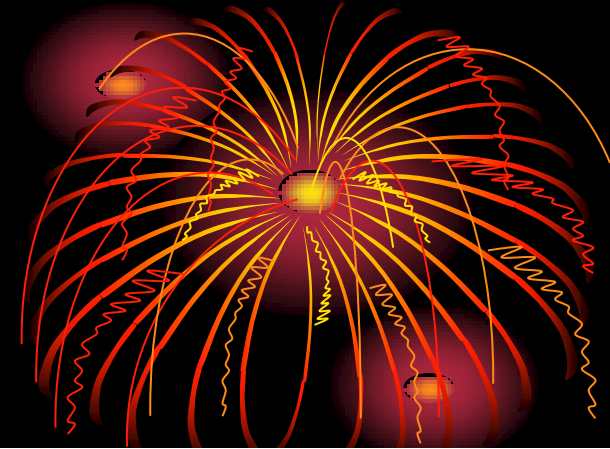
Class
Gastropoda

Terms



Class Gastropoda

Classification



The Class Gastropoda is divided into three subclasses:

- *PROSOBRANCHIA*
- *OPSITHOBRANCHIA*
- *PULMONATA*

Class Gastropoda

Classification

<http://animaldiversity.ummz.umich.edu/site/accounts/classification/Gastropoda.html#Gastropoda>

Phylum Mollusca (mollusks)

Class Gastropoda (gastropods, slugs, and snails)

-
- Pulmonata
 - Order Archaeopulmonata
 - Order Basommatophora
 - Order Stylommatophora (terrestrial snails and slugs)
 - Order Systellommatophora
- Subclass Opisthobranchia (opisthobranchs)
 - Order Acochlidioidea
 - Order Anaspidea
 - Order Cephalaspidea
 - Order Gymnosomata
 - Order Notaspidea
 - Order Nudibranchia (nudibranchs)
 - Order Sacoglossa
 - Order Soleolifera
 - Order Thecosomata
- Subclass Prosobranchia
 -
 - Order Mesogastropoda
 - Order Neogastropoda
 - Order Archaeogastropoda
 - Order Architaenioglossa
 - Order Entomotaeniata
 - Order Neritopsina
 - Family Enteroxenidae
 - Order Heterostropha
 - Order Neotaenioglossa
 - Order Patellogastropoda
 - Order Rhodopemorpha



Homework 9

Please get a stratigraphical range chart of the genera of Bivalvia mentioned in the Lecture 9.

