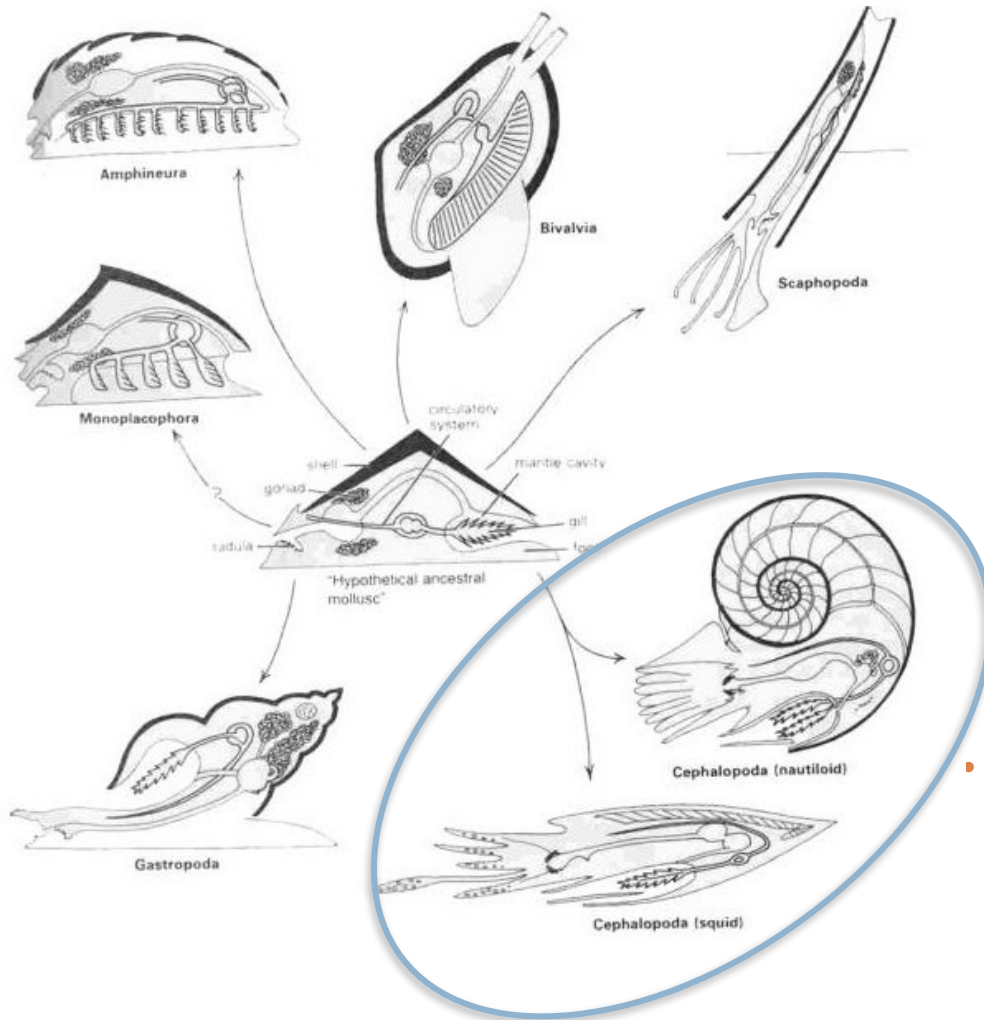




Mollusca: Class Cephalopoda

Lecture 11

Cephalophod Characteristics



- Characteristics of class
 - All marine
 - Most 6-70 cm up to 20m *Architeuthis*
 - Shell divided by septa, chambers connected by siphuncle
 - Closed circulatory system
 - Foot modification
 - Ganglia fused to form large brain in cartilaginous cranium
- ~700 species (~10K extinct) & 46 families

Cephalopod Morphology

Shell

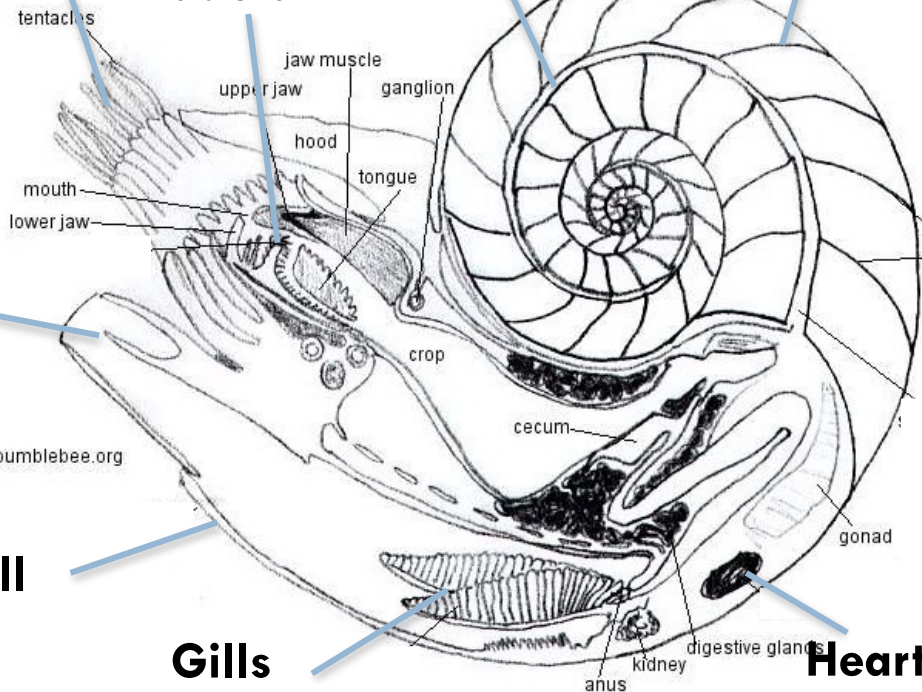


Tentacles

Siphuncle

Septa

Radula



Funnel

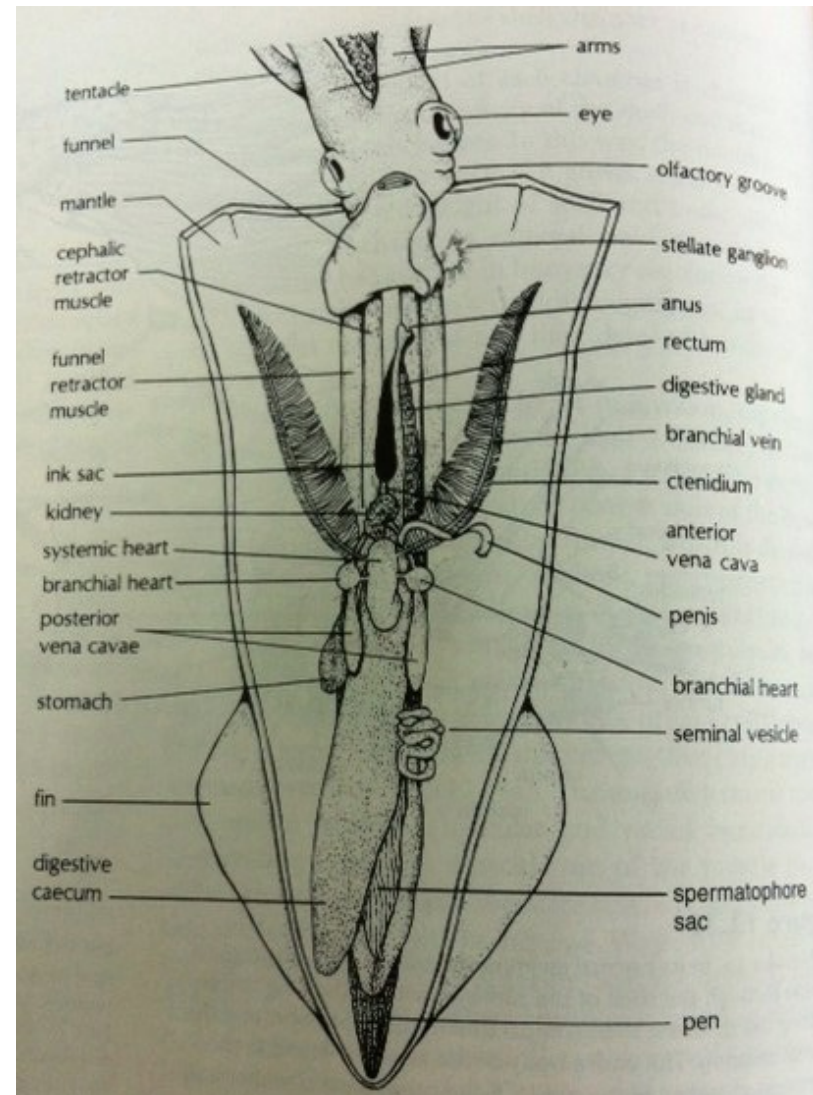
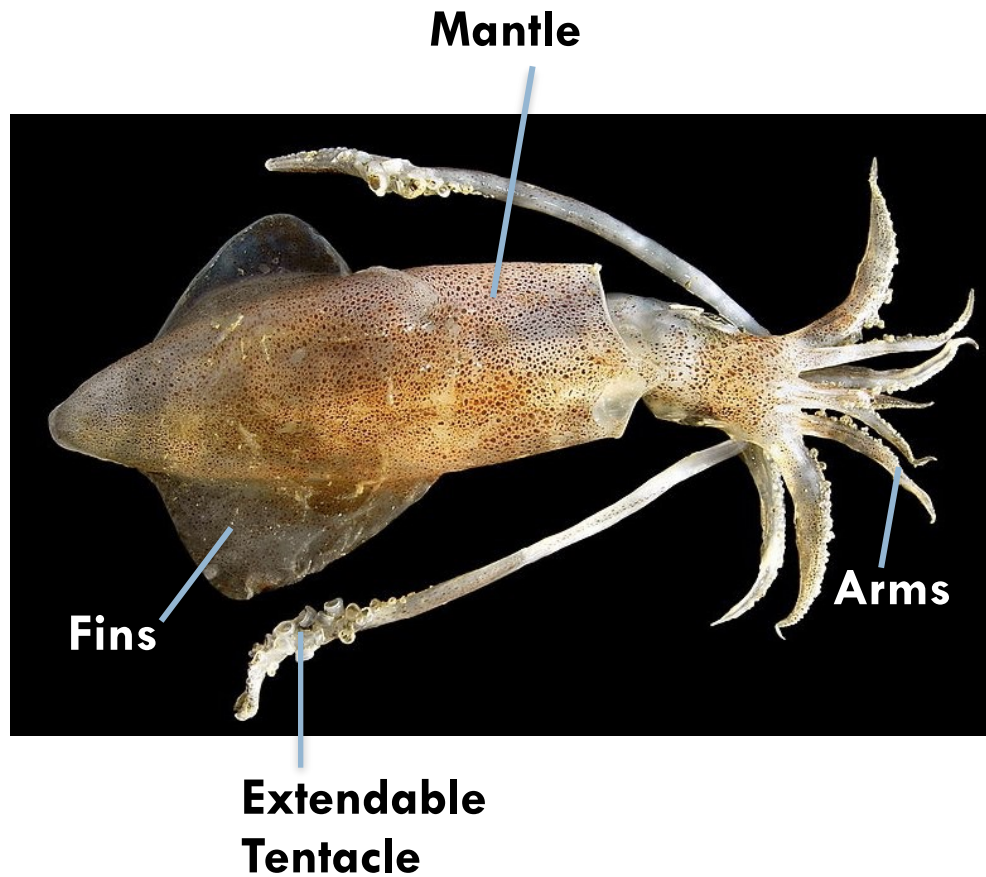
www.bumblebee.org

Shell

Gills

Heart

Cephalopod Morphology



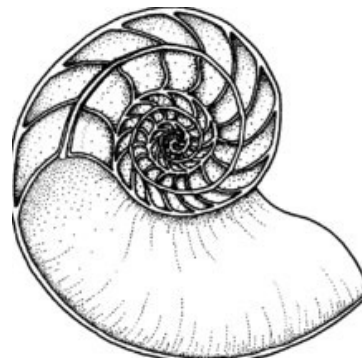
Cephalopod ecology



- Strictly marine, none can tolerate freshwater
- Occupy most depths of ocean- from abyssal plain to sea surface
- All are predators and use tentacles to catch prey, beak to consume

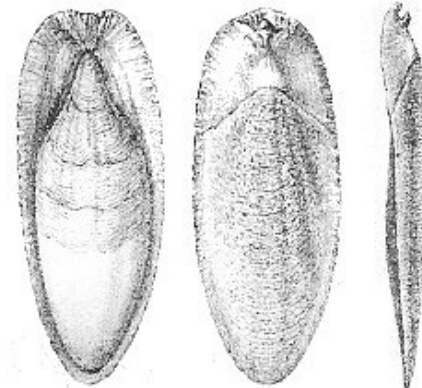
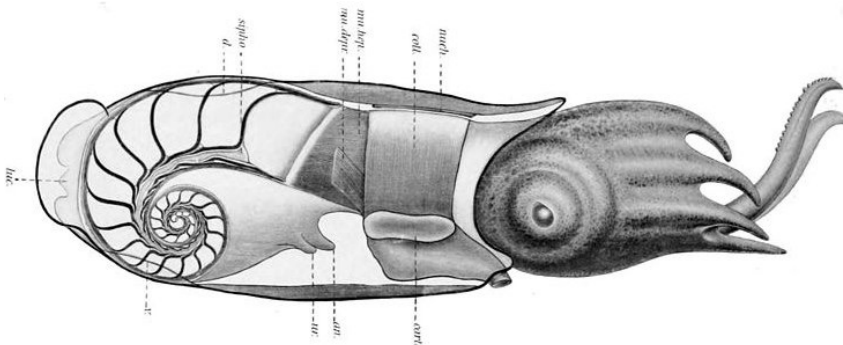
Cephalopod Shells

- Nautilus possess a true external shell
 - Hypostracum, Ostracum, Periostracum
- Shell spiral and divided by septa
 - Animal in largest outermost chamber
- Septa penetrated by siphuncle
 - Calcified tube
 - Osmotic pump empty water from chambers, buoyancy



Shells and Buoyancy Regulation

- Nautilus: chambered shell
 - Gas diffusion into gap between mantle and shell
- Cuttlefish: internal chambered shell involved in buoyancy regulation
- Squid: internalized shell=pen
- Regulate water volume



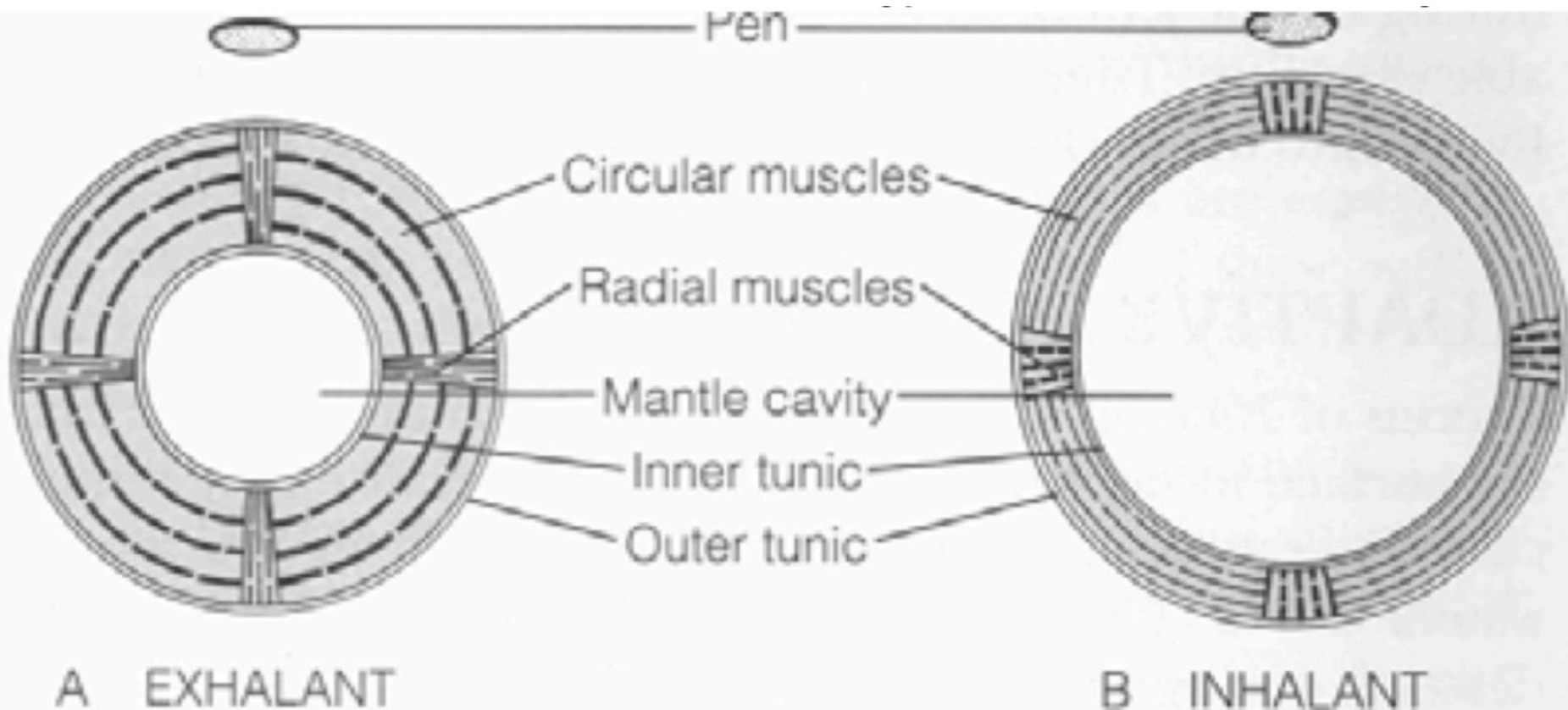
Movement

- Jet propulsion
 - Nautilus: Expel water from mantle cavity through funnel
 - Other cephalopods: contract and expand mantle tissue
 - Escaping predators and capturing prey
- Arms (Octopus) or muscular lateral fins (squid and cuttlefish)



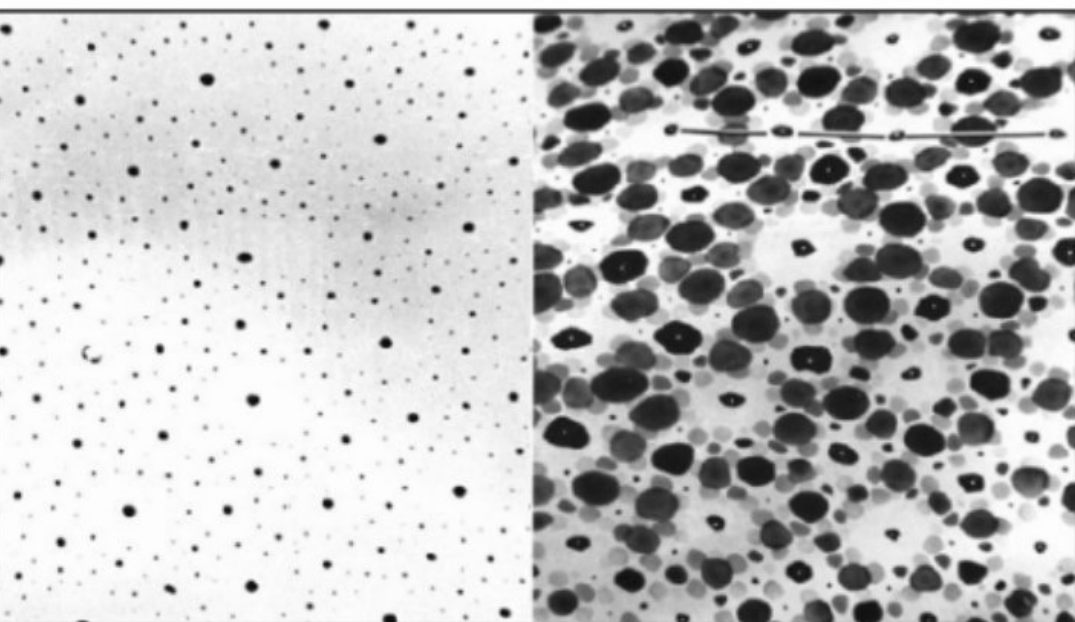
Jet Propulsion

- Circular and radial muscles
 - Contraction of circular muscles expels water
 - Contractions of radial muscle hyperextends mantle cavity



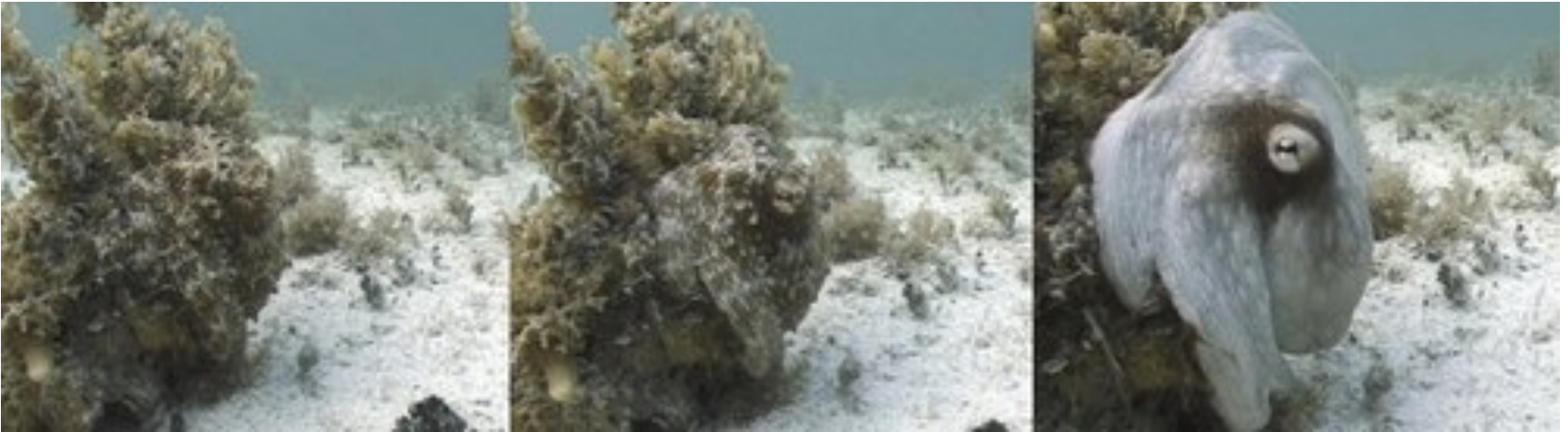
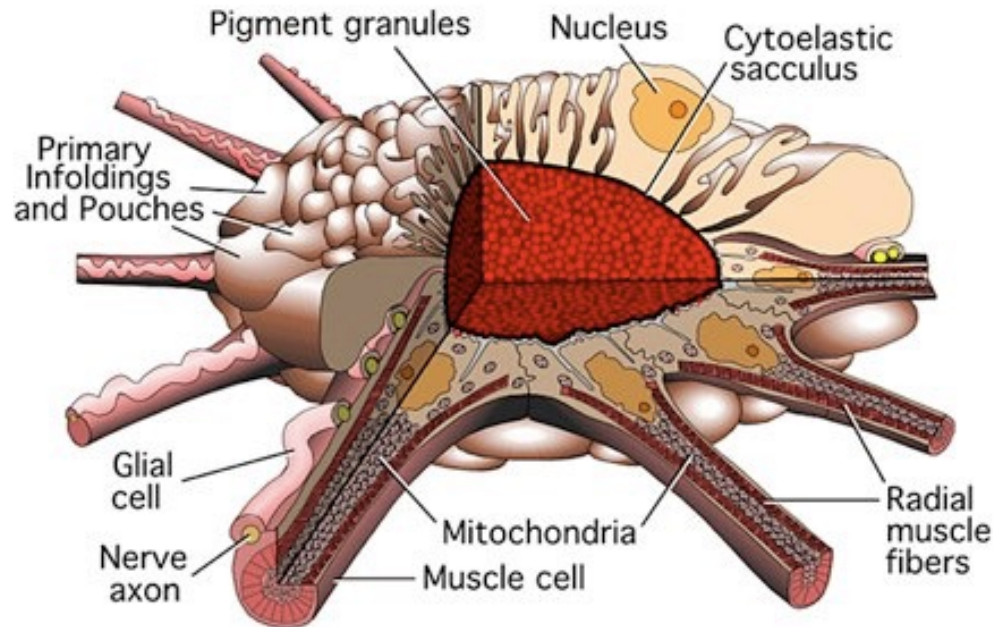
Cephalopod protection

- Chromatophores
 - Tiny colored cells or pigment sacs that overlay reflective cells (iridocytes)
 - Muscle contraction=sac expansion
 - Defensive, camouflaging, and courtship behaviors
 - Red, yellow, black and brown



Cephalopod protection

- Iridophores
 - Brain reads changing light passing through ???, trigger electrical instructions
 - Appear as shifting iridescent colors depending on the angle of light



Cephalopod protection



- Photophores- light production by biochemical reactions
 - Bioluminescence: biochemical production of light with minimal heat
 - Produced by symbiotic bacteria living within photophores
 - Attracting/recognizing mates, luring in prey, and protecting against predation

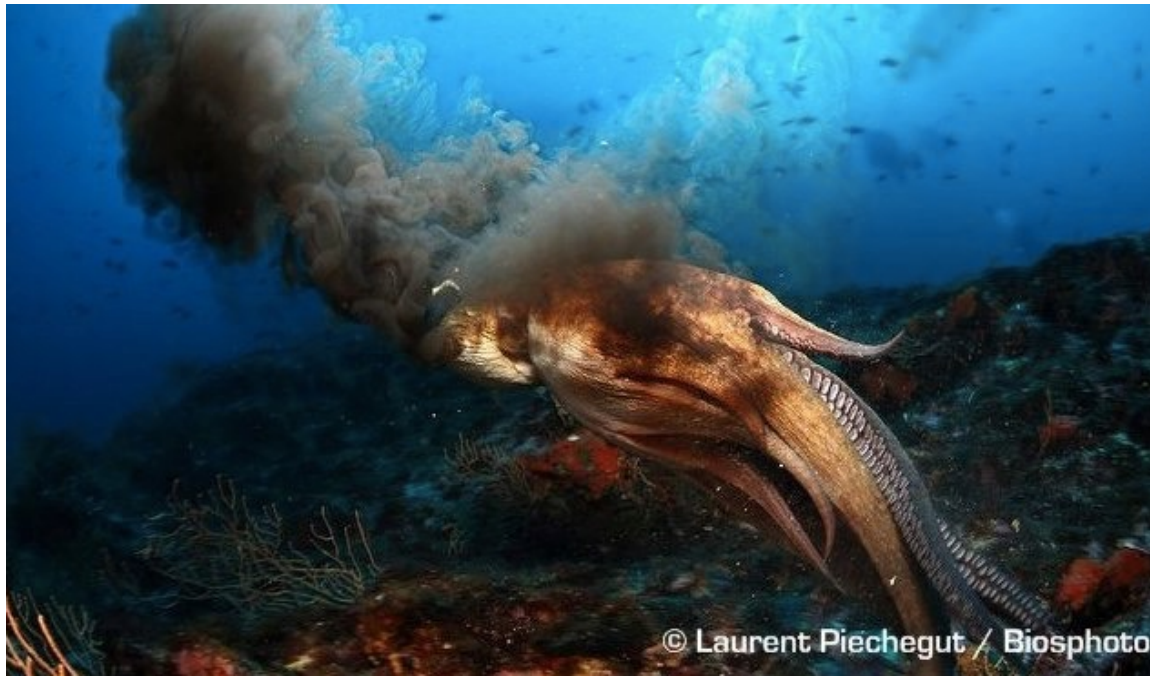
Cephalopod protection

- Ink Sac
 - Most cephalopods other than Nautilus
 - Dark-pigmented fluid=melanin and mucous
 - Form a cloud that confuses potential predators
 - May act as mild narcotic



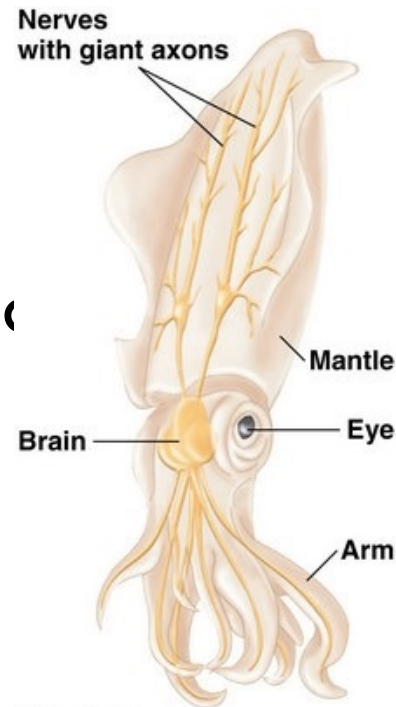
Cephalopod protection

- Ink Sac
 - Pseudomorph decoy
 - Greater mucus content
 - Resemblance to cephalopod that released it



Squid giant axon: providing clues to nerve cell repair

- Giant axon up to 1mm in diameter
- Model for nerve cell repair
- Inject membrane with fluorescent dyes visualize what occurs when nerve injured
- Axon membrane diameter shrinks and vesicles travel to site of injury

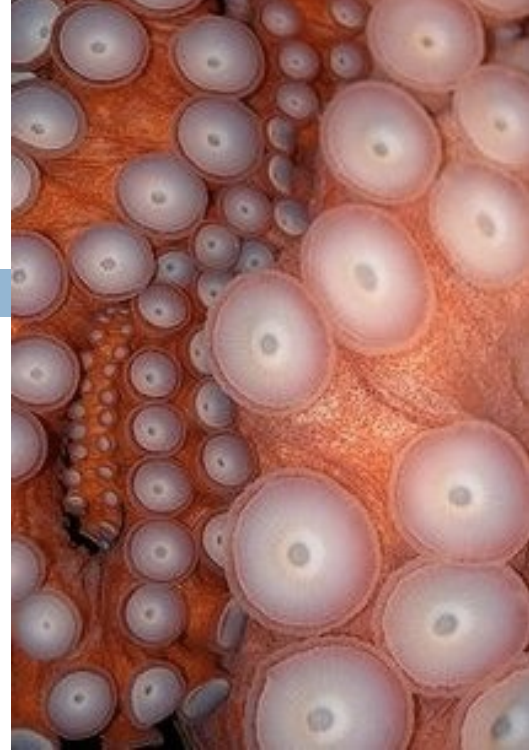


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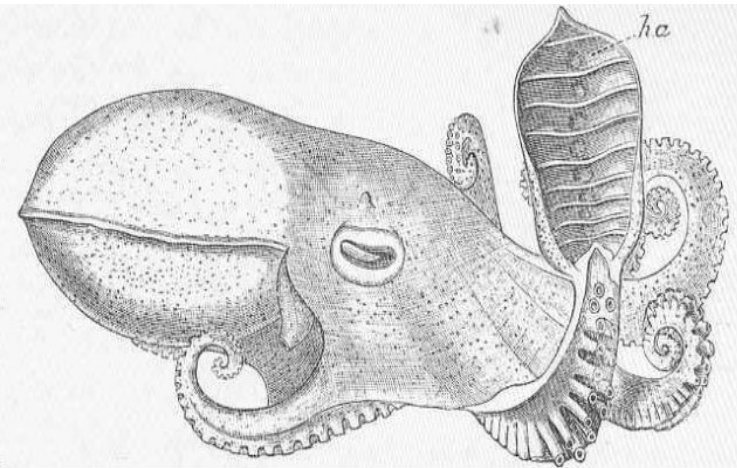
Feeding Mechanisms

- Raptorial feeding and carnivorous diet
- Tentacles with adhesive suckers
 - Rim is toothed and inner wall has hooks
- Radula
- Pair of powerful beak-like jaws
- Two pairs of salivary glands
 - Anterior=mucous
 - Posterior=poison, proteolytic enzymes (Octopus)

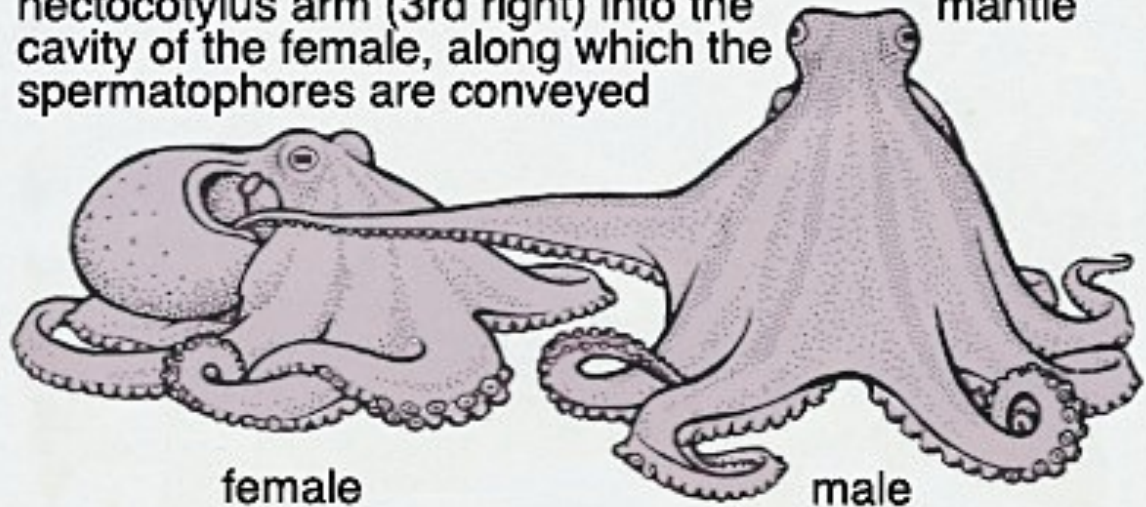


Cephalopod Reproduction

- No known hermaphrodites
- Usually dioecious: gonads in posterior of body
- Internal fertilization
 - One arm of male modified as a copulatory organ to transfer sperm (**hectocotylus**)



Copulation in octopuses involves the male inserting his hectocotylus arm (3rd right) into the mantle cavity of the female, along which the spermatophores are conveyed



Paper Nautilus: *Argonauta*

- Pelagic octopus
- Adaptation for egg deposition
- Eggcase secreted by tips of two expanded dorsal arms of female
 - Deposit eggs directly into case
 - Shell act as a brood chamber and a retreat for the female
 - Eggcase contains bubble of air used for buoyancy



Blue-ringed octopus

- Genus *Hapalochlaena*
- Tide pools and coral reefs in Indian and Pacific Oceans
- Use chromatophores to camouflage, changes color when provoked
- One of the world's most venomous animals, powerful enough to kill humans with no antivenom
 - Neurotoxin 100x more powerful than cyanide
 - Blocks sodium channels, causing motor paralysis and respiratory arrest
 - Produced by bacteria in salivary glands



The Giant Squid: *Architeuthis dux*

- Elusive creature
- Eyes among the largest in the world- adaptation
- Tentacles with suction cups with rings of chitin
- Highly complex nervous system and highly developed brain



Humboldt squid migration



- Squids moving north in response to overfishing and climate change
- Ocean acidification changing their metabolism, driving them to shallower water

