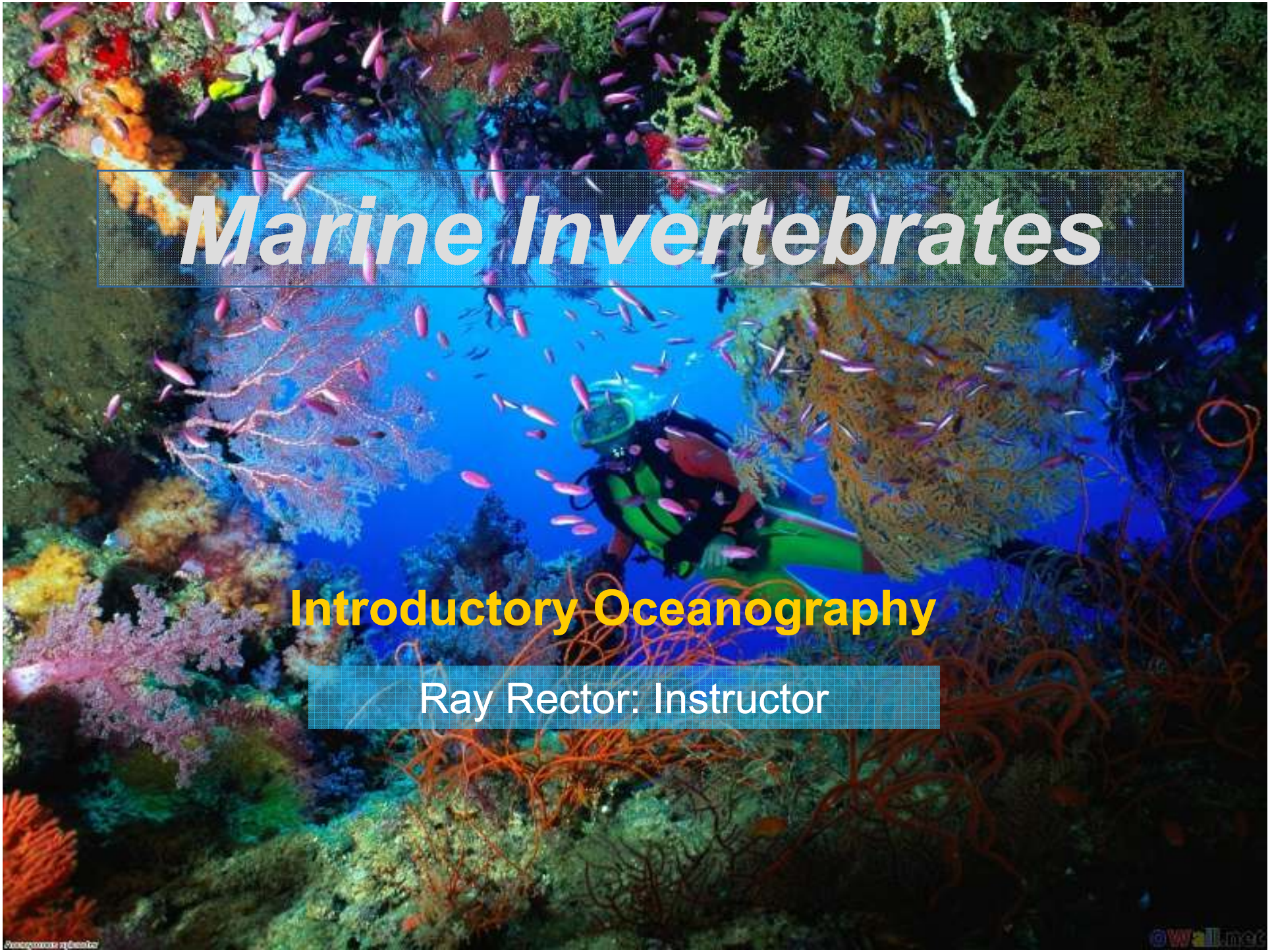


Marine Invertebrates

Introductory Oceanography

Ray Rector: Instructor

Marine Invertebrates

Main Concepts – Marine Invertebrates

1) Marine invertebrates are *Metazoans* with no backbone

- Eukaryotic heterotrophs having multi-cellular bodies, with 3-layered wall and an internal digestive cavity, but lacking a vertebral column.
- Radial- and/or bilateral-shaped bodies, with or without a head.
- Most have tentacles or filtering systems for collecting food.
- Nearly all have minute free-swimming larvae for dispersal.

2) Twelve major groups of marine macro-invertebrates:

Phylum **Porifera**
Phylum **Cnidaria**
Phylum **Ctenophora**
Phylum **Mollusca**
Phylum **Chordata**

Phylum **Arthropoda**
Phylum **Brachiopoda**
Phylum **Bryozoa**
Phylum **Echinodermata**
Phylum **Phoronida**

Phylum **Annelida**
Phylum **Phoronida**
Phylum **Nematoda**
Phylum **Platyhelminthes**
Phylum **Chaetognatha**

- Each phylum has an independent evolution - dating back over 600 million years – distinguished by a diversity of unique form and function

3) Lifestyles are very diverse: from sessile infaunal to motile pelagic - littoral to hadal – most are benthic

The Major Marine Invertebrate Phyla

1) Phylum **Porifera** = Sponges

2) Phylum **Cnidaria** = Jellyfish, Sea Anemone, and Coral

3) Phylum **Ctenophora** = Comb Jellies

4) Phylum **Mollusca** = Bivalves, Gastropods, and Cephalopods

   - Class **Bivalves** (clams, mussels, oysters, scallops.), Class **Gastropods** (snails, slugs, and nudibrachs), and Class **Cephalopods** (squids, cuttlefish, octopusm, nautilus)

5) Phylum **Arthropoda** = Class **Crustacea** = Shrimp, Crabs, Lobsters, Krill, Copepods, and Barnacles

6) Phylum **Echinodermata** = Sea Urchins, Sea Stars, Brittle Star, and Sea Cucumber

7) Phylum **Bryozoa** = Moss-like animals

8) Phylum **Brachiopoda**= Lamp-shelled animals

9) Phylum **Annelida** = Segmented worms (polychaetes)

10) Phylum **Nematoda** = Roundworms

11) Phylum **Phoronida** = Tube worms

12) Phylum **Platyhelminthes** = Flatworms

13) Subphylum **Tunicata** – Sac-like, nano-corded animal

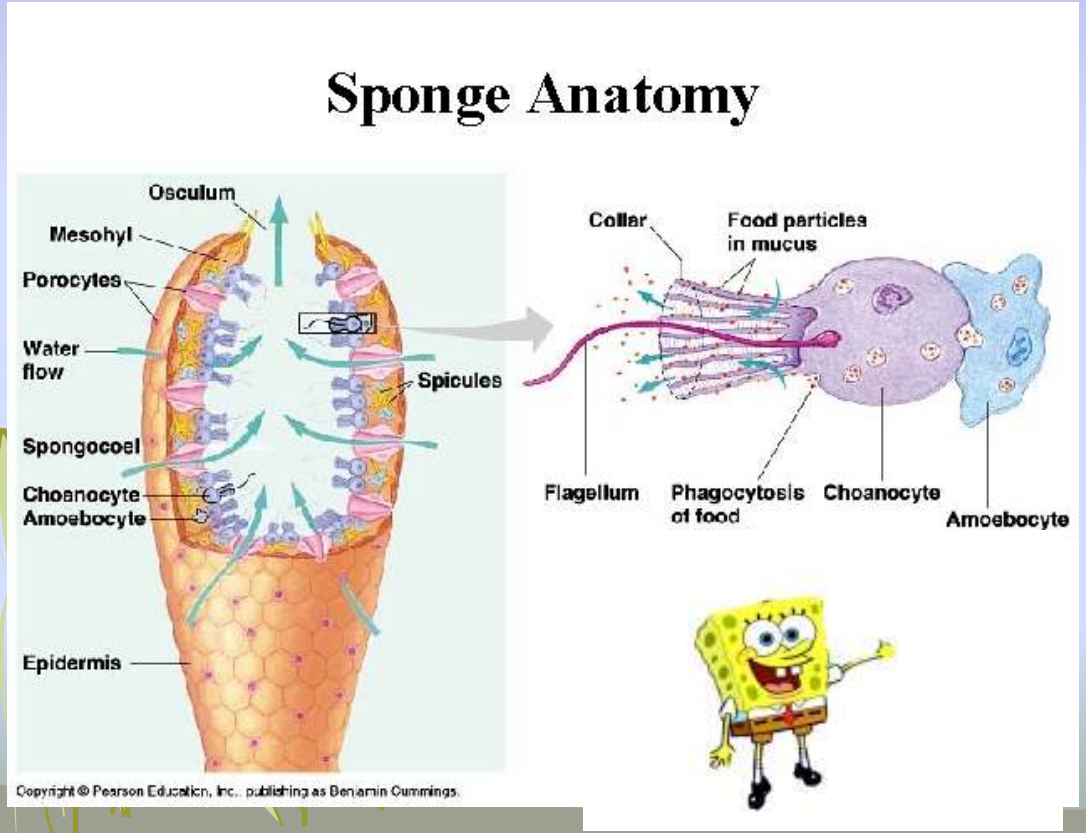
Habitat, Population, Community, Niche

- Every marine organism lives in a unique set of physical conditions within a given region of ocean, termed its ***habitat***.
- A group of marine organism of the same species living together within the same local habitat is termed a ***population***.
- A number of different populations living together within the same local habitat is termed a ***community***.
- Every marine organism has a unique lifestyle within its community, defined by its trophic level, specific place of residence, movement style, feeding, defense, and reproductive strategies – its community relations - termed its ***niche***

Phyla Porifera – The Sponges

Phyla Porifera – The Sponges

- *Porous, vase-like forms with specialized cells, but no organs*
- *Unique features are **choanocytes** (collar cells) and **spicules** (solid supports)*
- *Sponges are sessile and have habitats and niches similar to that of the corals*
- *Sponges are filter-feeders and reef-builders*



Sponges on YouTube

Phyla Cnidaria – The Stinging Animals

Phyla Cnidaria – Jellyfish, Sea Anemone, and Coral

1) Polyp and medusa forms with specialized cells, few organs - no brain

*2) Unique features are **nematocysts** (stinging cells) and diablastic form*

3) Some cnidarians have rudimentary light-sensing apparatus

4) Coral and sea anemone are benthic, sessile, epifaunal polyps

5) Jellyfish are pelagic, drifting and swimming medusae

6) Corals and anemones may have micro-algae living in their tissue

*7) Cnidarians prey on zooplankton and small fish and crustaceans using their stinging tentacles – corals and anemones also harvest **Zoothanthellae***

Jellyfish

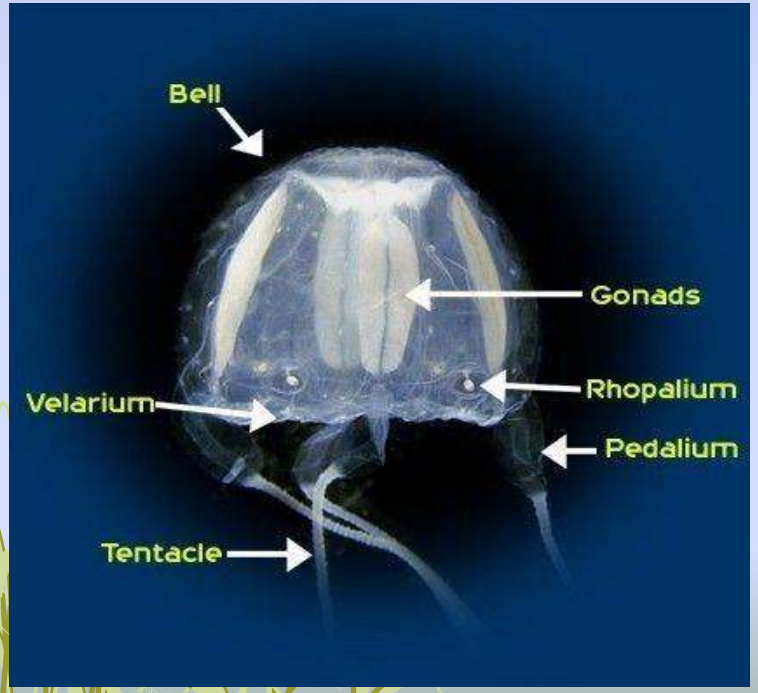
Sea Anemone

Coral

Phyla Cnidaria – The Jellyfish

Phyla Cnidaria – The Jellyfish

- *Floating medusa forms with specialized cells, but no organs or brain*
- *Unique features are **nematocysts** (stinging cells) and diablastic form*
- *Adult jellyfish is a pelagic medusa; juvenile stage is a drifting polyp*
- *Wide variety of jellyfish = nearly all are passive predatory*
- *Live in a wide variety of shallow pelagic environments – preferably warm*



Basic Anatomy

Floating Medusa Forms - Link

Common Varieties of Jellyfish

Cclorata

Scyphozoa

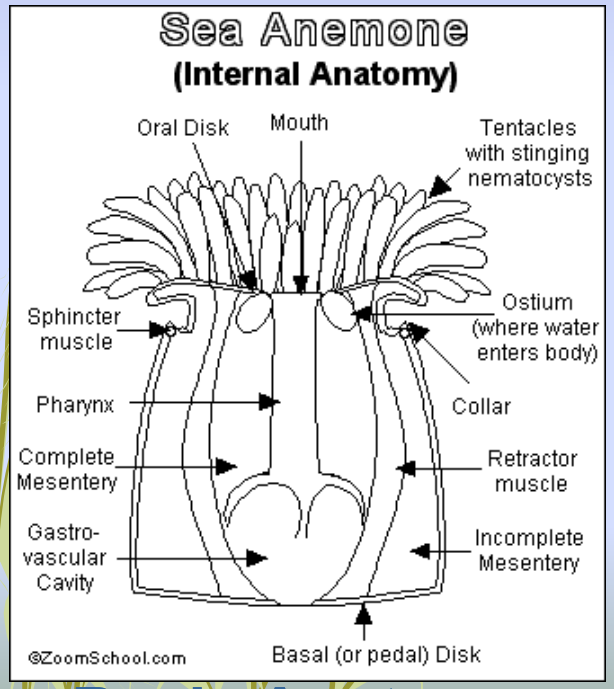
By-the-Wind Sailor

Chironex – Sea Wasp

Phyla Cnidaria – The Anemones

Phylum Cnidaria – Sea Anemone

- *Sessile epifaunal polyp forms with specialized **nematocysts** (stinging cells)*
- *Juvenile stage is a drifting polyp - Adult sea anemone are sessile polyps*
- *Live in a wide variety of epifaunal shallow to deep benthic environments*
- *Sea Anemone are passive predatory – catch small prey with their tentacles*
- *Shallow water anemones may possess zoothanthellae in their tissue*



Basic Anatomy

Epifaunal Sessile Polyp Form

Common Varieties of Sea Anemone

Green Anemone - Anthopleura

Purple Anemone – Actiniaria - Link

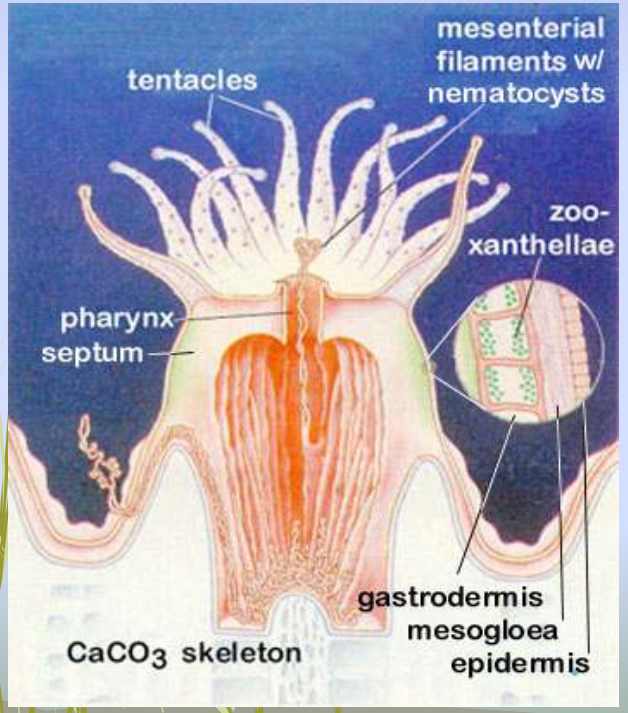
Mystery Anemone - Cereus

Giant Mushroom Anemone - Amplexidiscus

Phyla Cnidaria – The Corals

Phyla Cnidaria – The Corals

- *Cup-supported polyp forms with specialized cells, but no organs or brain*
- *Unique features are **nematocysts** (stinging cells) and Zooxanthellae (algae)*
- *Adult coral is a sessile polyp; juvenile stage is a drifting medusa*
- *Wide variety of corals = solitary or colonial filter-feeders and reef-builders*
- *Coral like warm, clear salty waters, free from terrigenous influences*

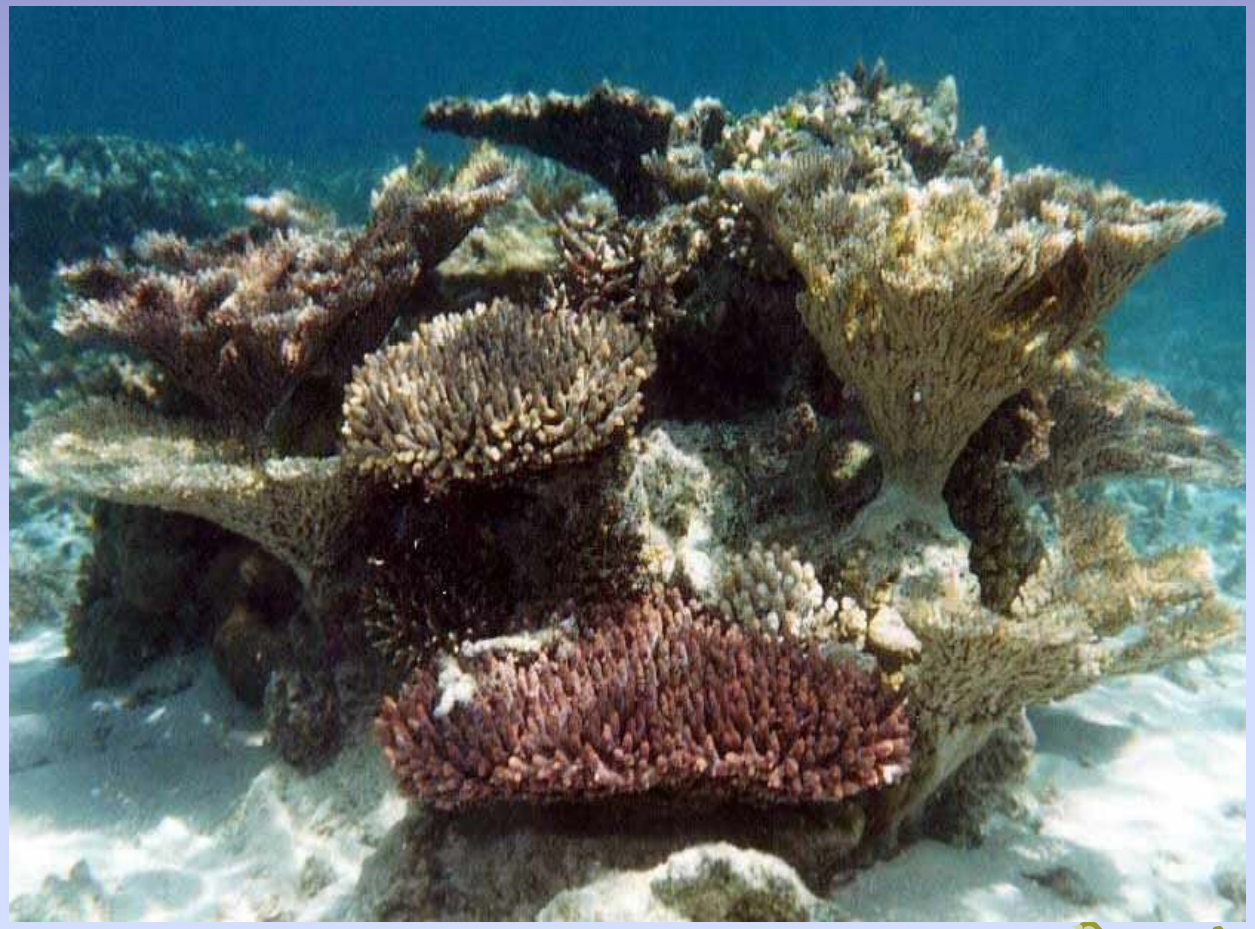


Feeding Corals - Link

Corals – The Reef Builders

Critical Factors

- ***Water Temp***
- ***Sunlight***
- ***Nutrients***
- ***Water Clarity***
- ***Pollution***
- ***Humans***
- ***Food***



Great Barrier Reef Documentary

Common Varieties of Coral

Antler Coral

Brain Coral

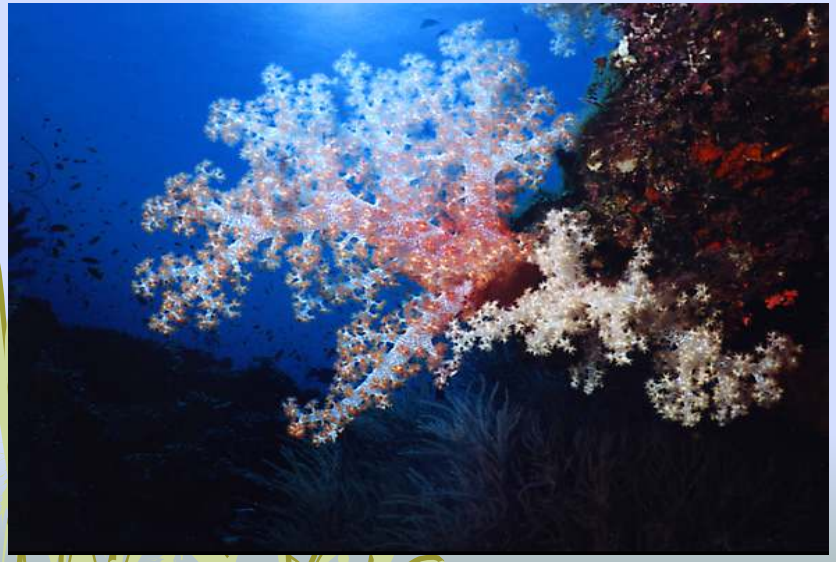
Cauliflower Coral

Razor Coral

Common Varieties of Coral

Lace Coral

Tube Coral



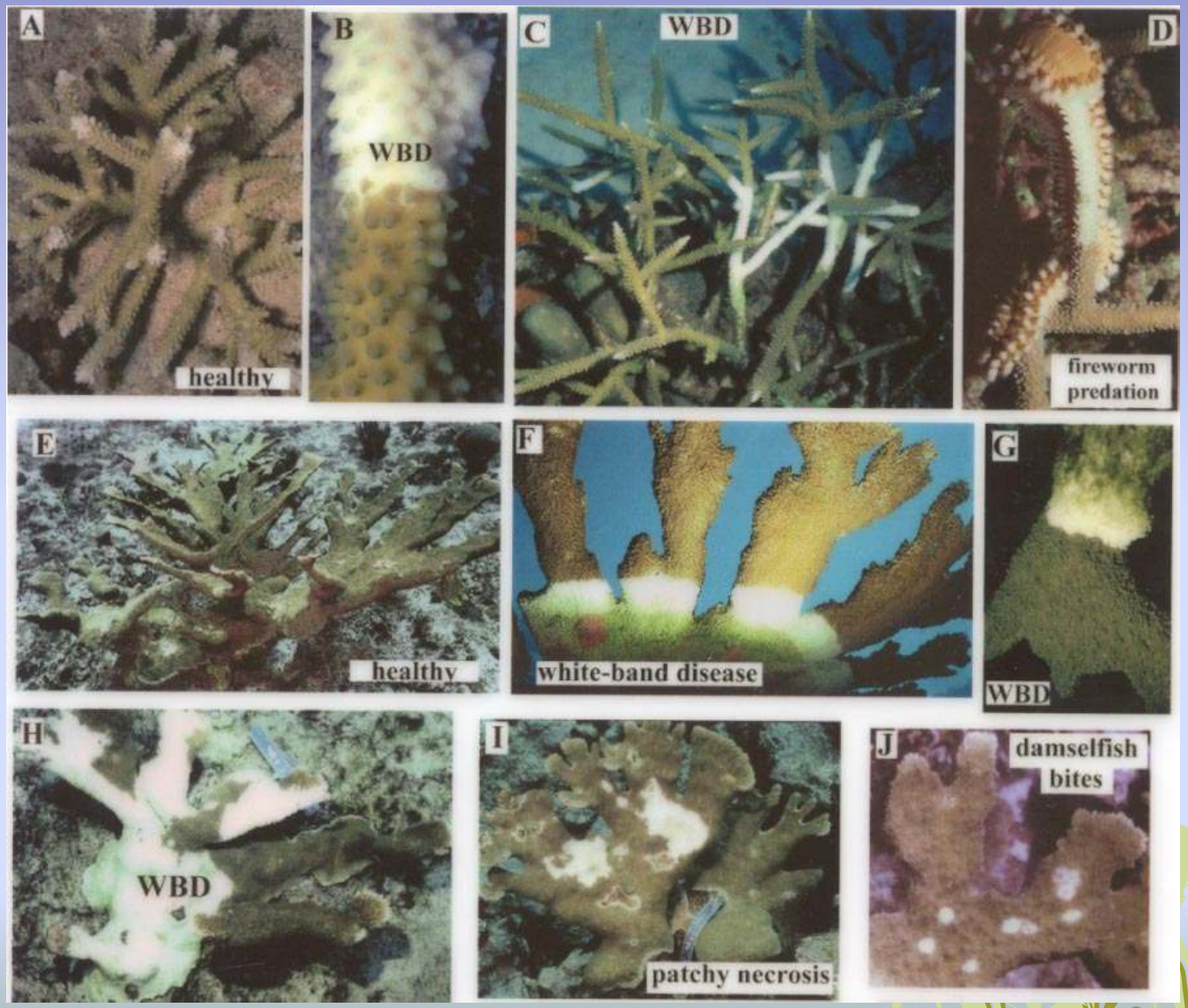
Soft Coral

Staghorn Coral

Coral Diseases – Environmental Stressors

Factors

- ***Bleaching***
- ***Bacteria***
- ***Viruses***
- ***Predation***
- ***Water Temp***
- ***Sediments***
- ***Sunlight***
- ***Pollution***
- ***Humans***



Phylum Ctenophora - The Comb Jellies

Phylum Ctenophora - The Comb Jellies

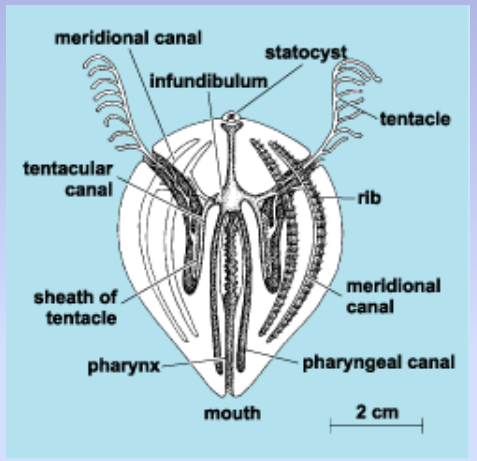
1) Jellyfish-like with bi-radial symmetry, gelatinous body and possess sticky cells

2) Most are pelagic, moving by bands of beating cilia, arranged in vertical rows

3) Common residents of both nearshore and open sea habitats

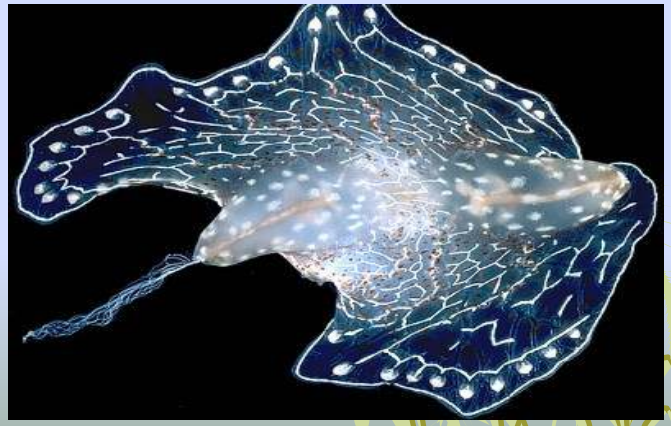
4) Prey on zooplankton, catching them with sticky tentacles

5) Fall prey to jellyfish, fishes, sea turtles and the sunfish



Anatomy

Pelagic Comb Jellies - Link



Benthic Comb Jelly

Phylum Mollusca - The Head-Foot Animals

Phyla Mollusca

Bivalves, Gastropods, and Cephalopods

1) Bilaterally-symmetrical coelom body that is strongly cephalized

*2) Unique features are **head-foot design** and the **mantle***

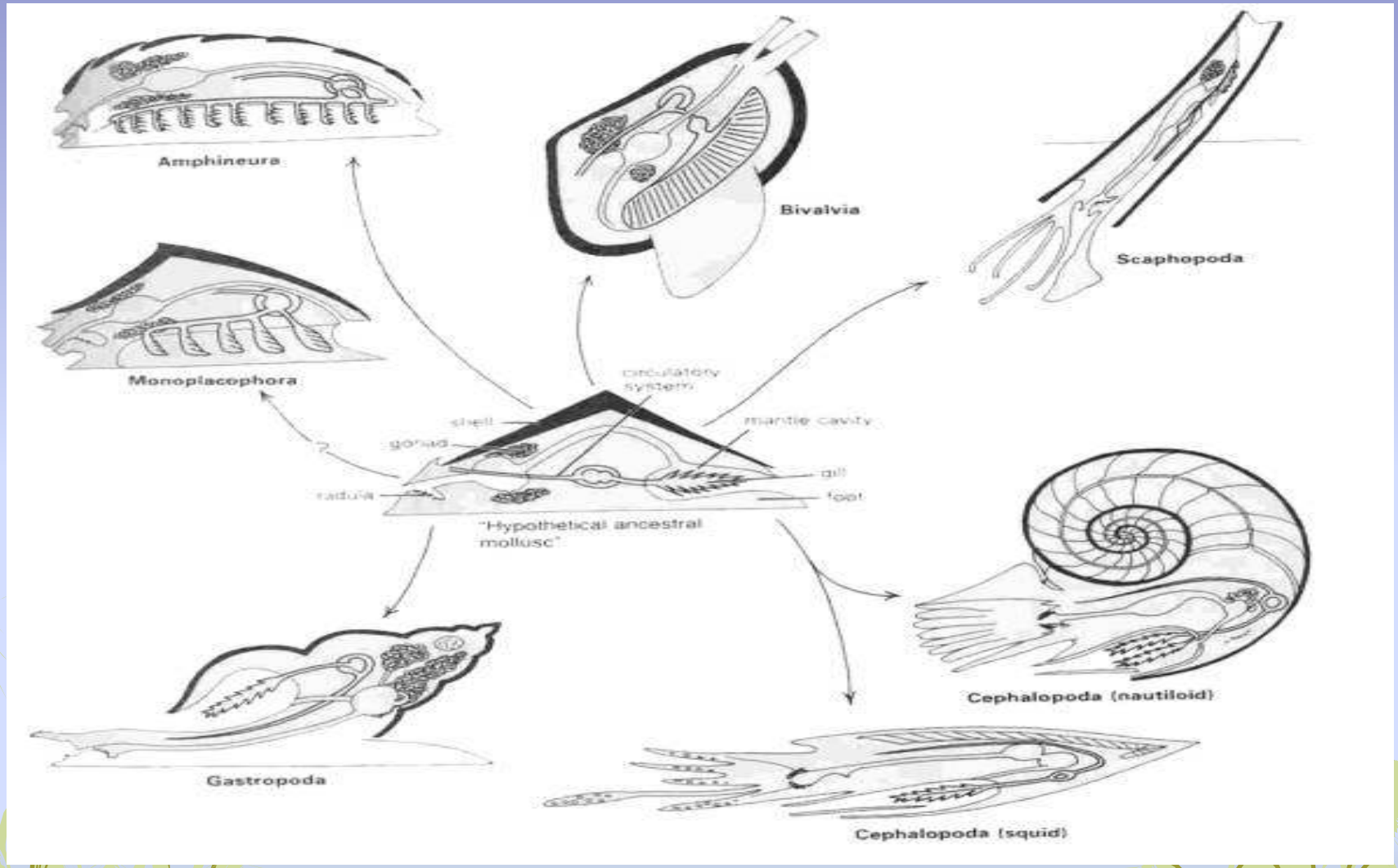
3) All mollusks have well-developed organ set, including digestion, circulation and nervous systems – only cephalopods have a brain

4) Mollusks are very diverse with sessile infuanal or epifaunal, or pelagic types

5) Bivalves are filter feeders, whereas the rest are predatory

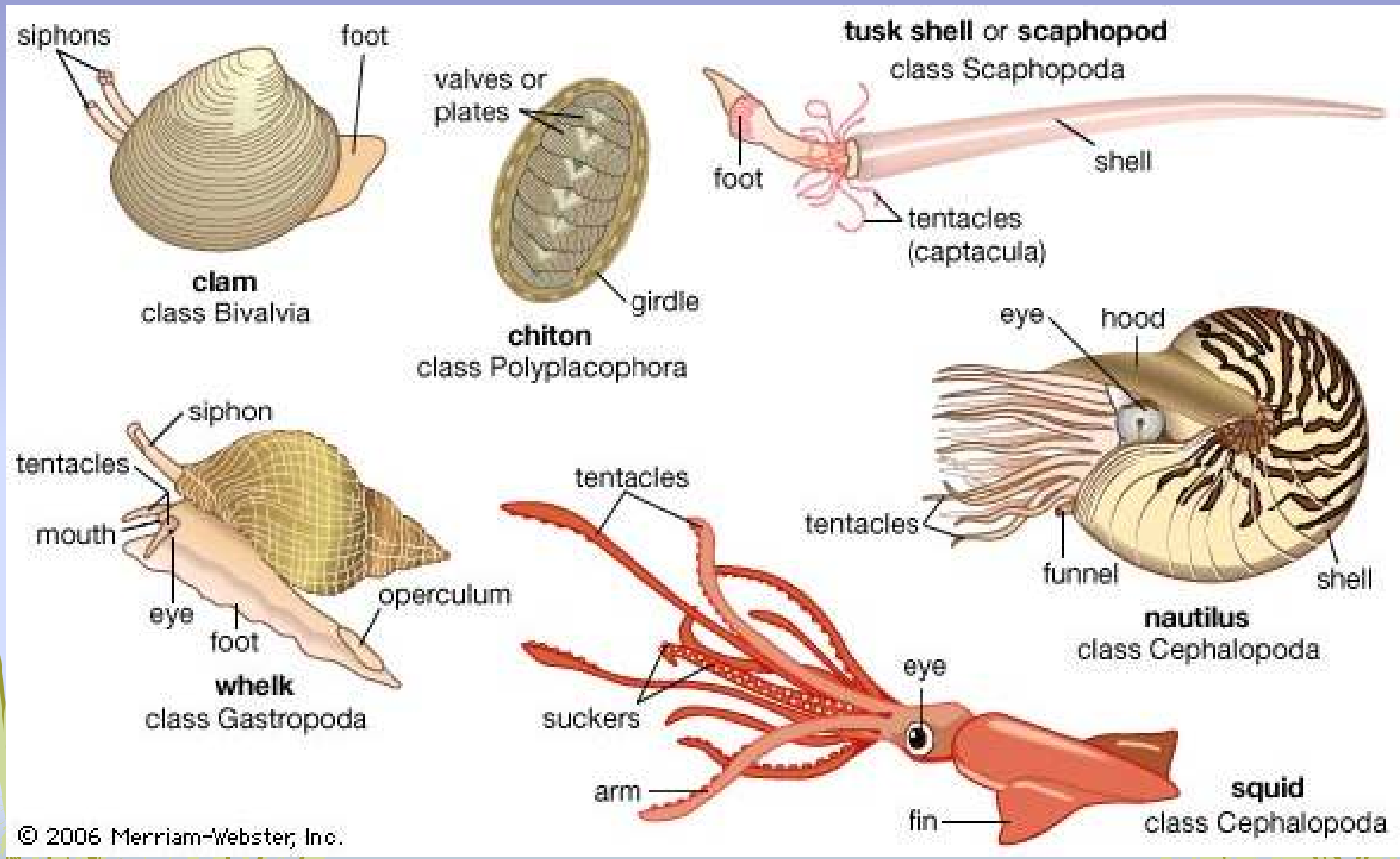
5) Mollusks are found in every ocean habitat

Variations of Molluscan Anatomy



All Mollusks are Variations of the Common Head-Foot Design

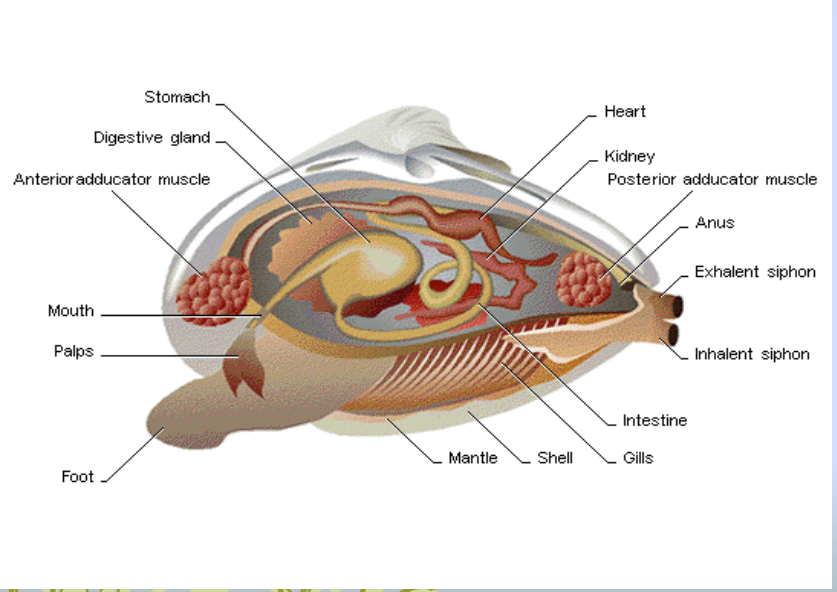
Variations of Molluscan Anatomy



All Mollusks are Variations of the Common Head-Foot Design

Phylum Mollusca – *Bivalves*

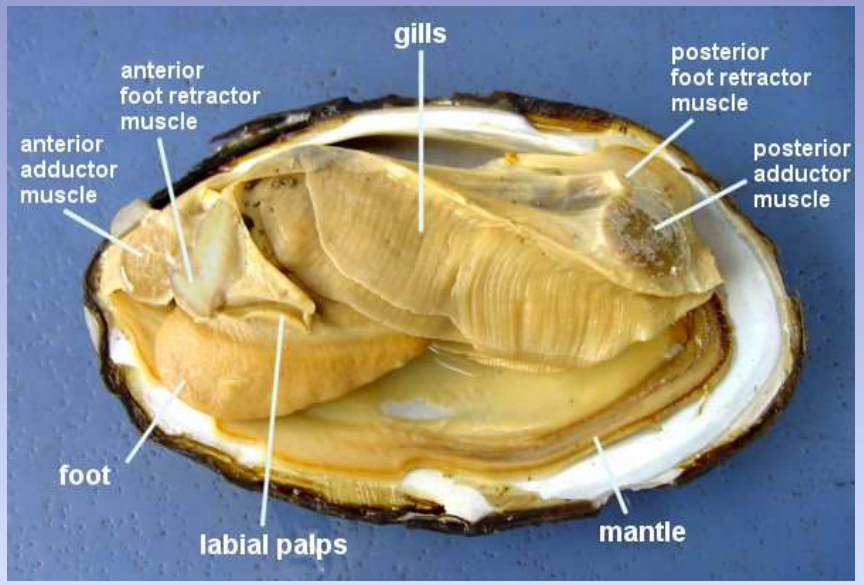
- *Bilaterally-symmetrical coelom body that is encased in a hinged set of shells*
- *Unique features are **head-foot design** and the **mantle***
- *Bivalves have well-developed organs including digestion, circulation and nervous systems – bivalves do not have a brain*
- *Bivalves are mainly sessile filter feeders - either infuanal or epifaunal*
- *Bivalves are a diverse group that include **clams**, **oysters**, **scallops**, **mussels***



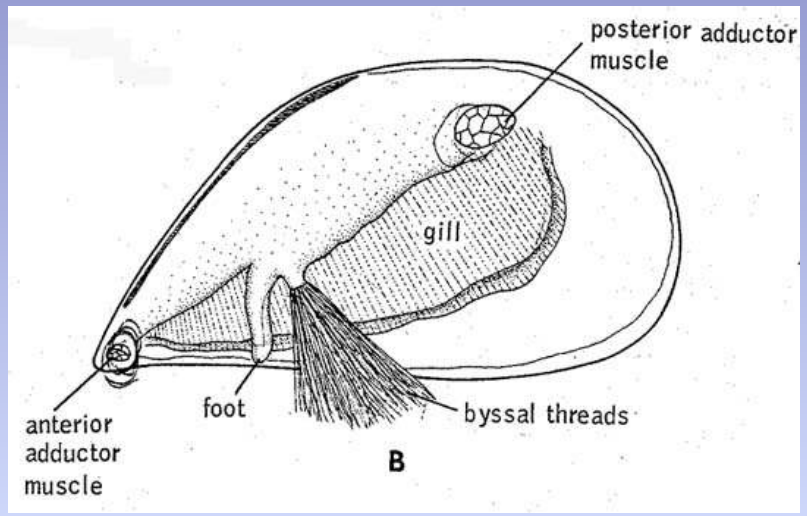
Anatomy

Giant Clam

Class Bivalvia - Clams

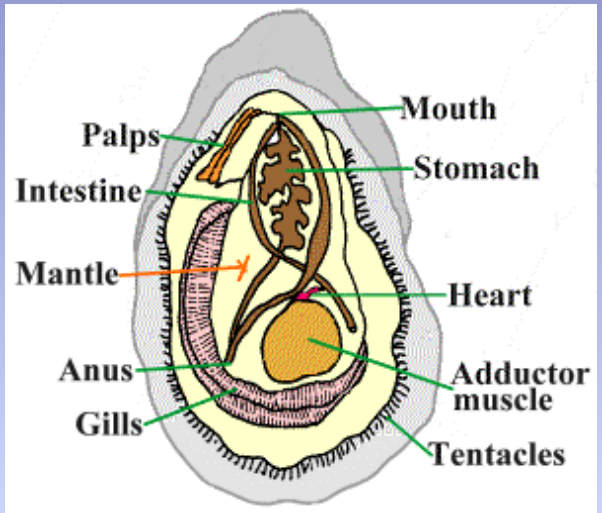


Class Bivalvia - Mussels



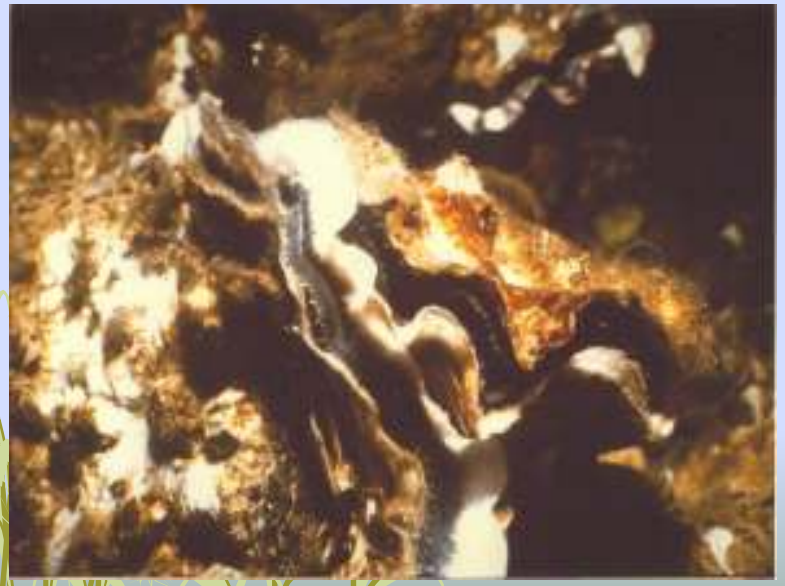
Mussel Anatomy

Class Bivalvia - Oysters



Oyster Anatomy


Harvesting cultured pearls from within the oyster.



Phyla Mollusca – The Gastropods

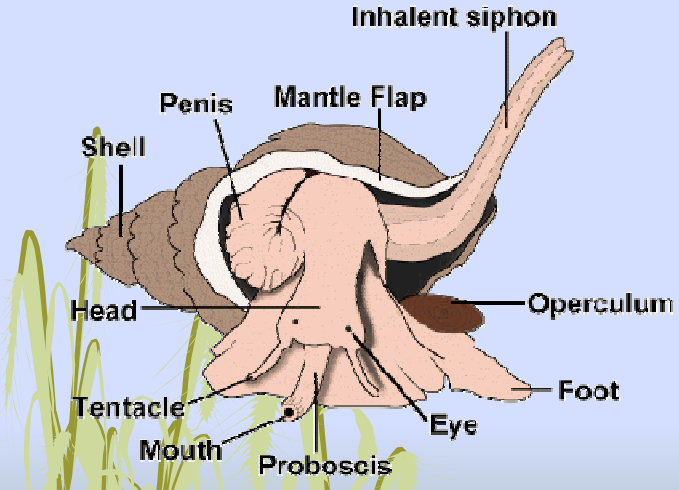
1) Bilaterally-symmetrical coelom body that is encased in a single shell

*2) Unique features are **head-foot design** and the **mantle***

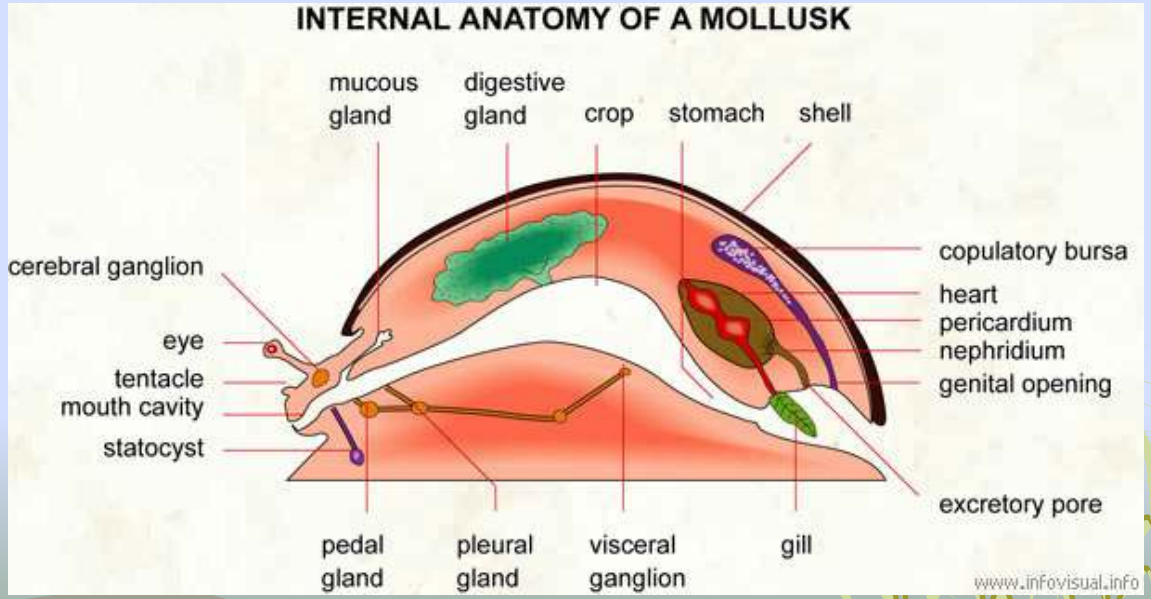
3) Gastropods have well-developed organs including digestion, circulation and nervous systems – gastropods have a rudimentary brain

4) Gastropods are benthic – either sessile or motive – primarily epifaunal

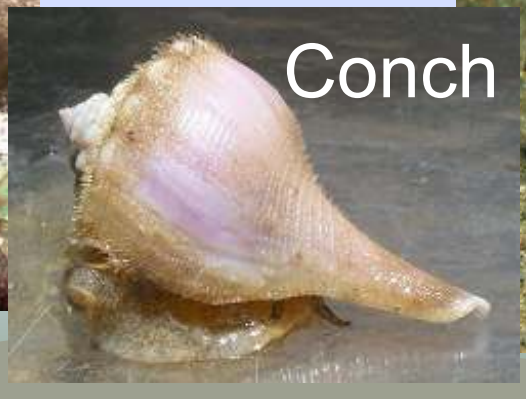
❖ *Gastropods are a diverse group that include **snails**, **abalone**, **limpets**, **conch**, **sea slugs, and nudibranchs***



Anatomy



Class Gastropoda – *Sea Snails*

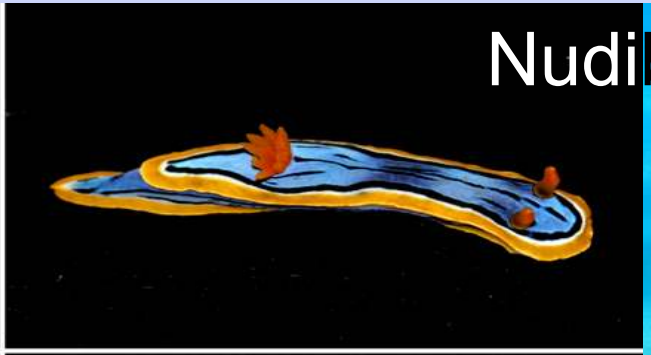


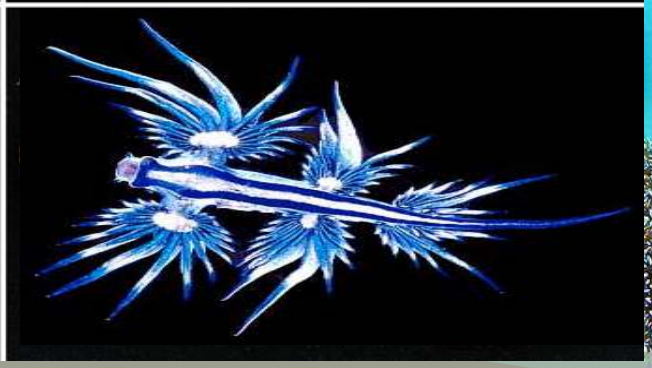
Class Gastropoda – Sea Slugs

The California Sea Slug – aka “Sea Hare”

(Aplysia californica)

Nudibranchs





Class Cephalopoda – *Squid, Octopus & Nautilus*

- *Bilaterally-symmetrical coelom body that*
- *Unique features are **head-tentacle design** with a large **mantle-head***
- *Cephalopods have well-developed organs including digestion and circulation systems and relatively well-developed nervous system, brain, and eyes*
- *Cephalopods are generally predatory – either benthic or nektonic*
- *Cephalopods include **squid**, **cuttlefish**, **octopus**, and **nautilus***
- *Only the nautilus has an external chambered shell*

Squid - Link

Cuttlefish - Link

Octopus - Link

Nautilus - Link

Class Cephalopoda – Squid and Cuttlefish

Giant Squid

Cuttlefish

Class Cephalopoda – *Octopus*

Class Cephalopoda – Octopus and Nautilus

Octopus

Octopus Camouflage

Suction Cups

Phyla Arthropoda - Crustaceans

Phyla Arthropoda - Crustaceans

❖ Bilaterally-symmetrical coelom body that is encased in an external skeleton, with two compound eyes, swimming legs, and strong fan-like tail.

❖ Unique features are *chitin* ***exoskeleton*** *and dextral* ***segmented appendages***

❖ Crustaceans have well-developed organs including digestion, circulation and nervous systems. No brain or heart, though.

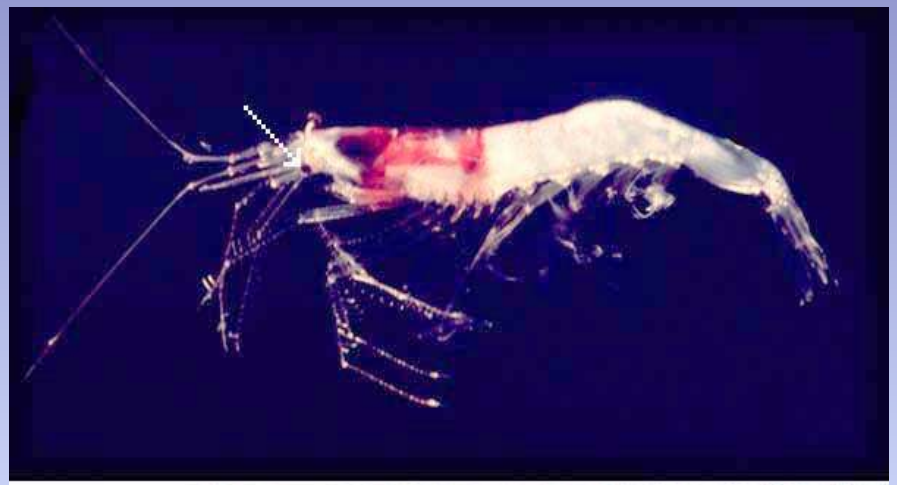
❖ Crustaceans are either ***motile*** *or* ***sessile*** *-* ***bottom feeders*** *or* ***nektonic***

❖ *Most crustaceans are scavengers*

❖ Crustaceans include ***crabs***, ***lobsters***, ***shrimps***, ***copepods, and shrimp***

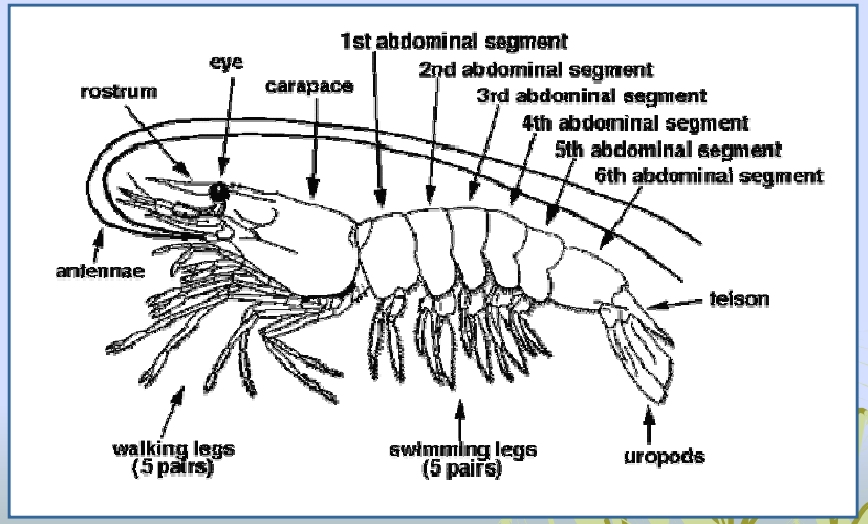
Crab versus Shrimp - Video

Class Malacostraca - Shrimp



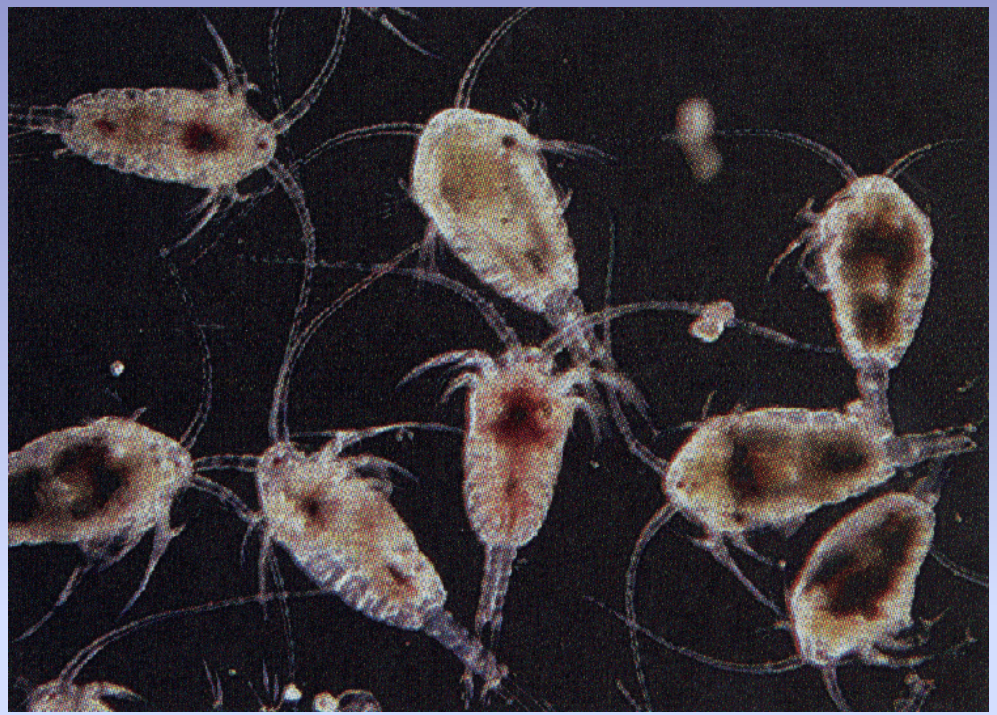
Pelagic Shrimp

Cleaner Shrimp



Shrimp Anatomy

Class Malacostraca - Copepods

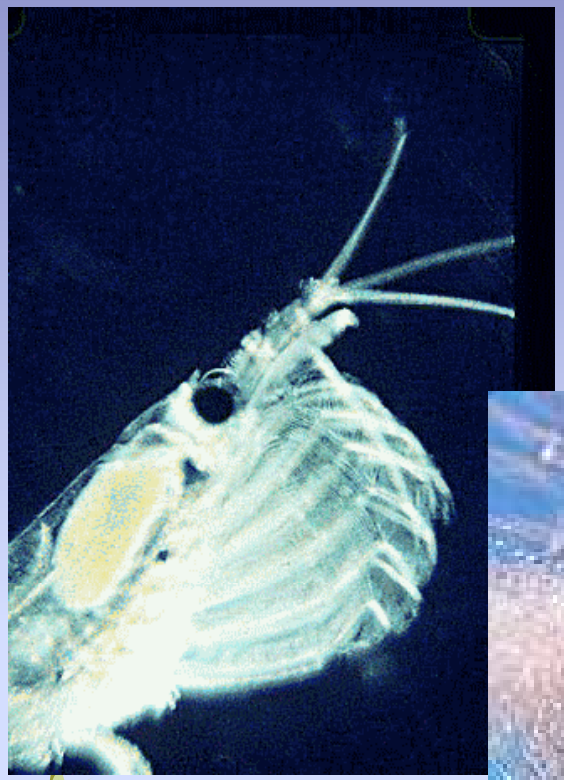


Pelagic Copepods

3 Life-Stages of a Copepod

- ✓ Most numerous animal on the planet
- ✓ King of the zooplankton – 30 min Video
- ✓ Eat the phytoplankton – w/ Video
- ✓ Major food source for secondary consumers

Class Malacostraca - *Krill*



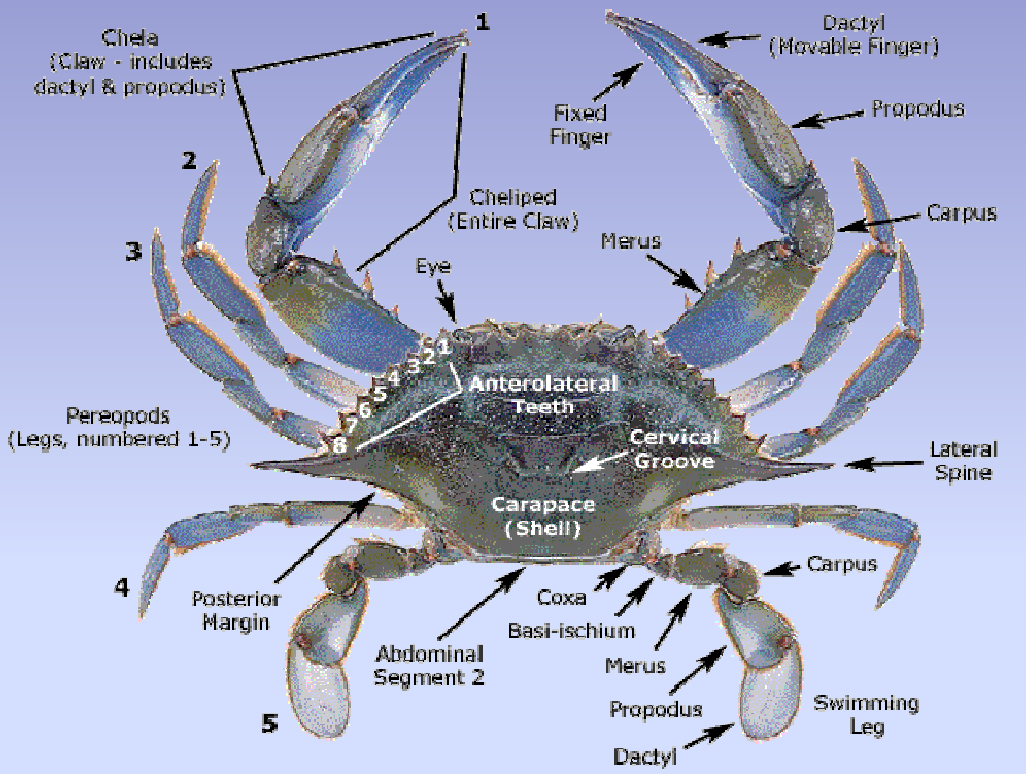
Euphausia superba

Krill Boogie

Class Malacostraca - Krill

#1 Baleen Whale Food

Class Malacostraca - Crabs

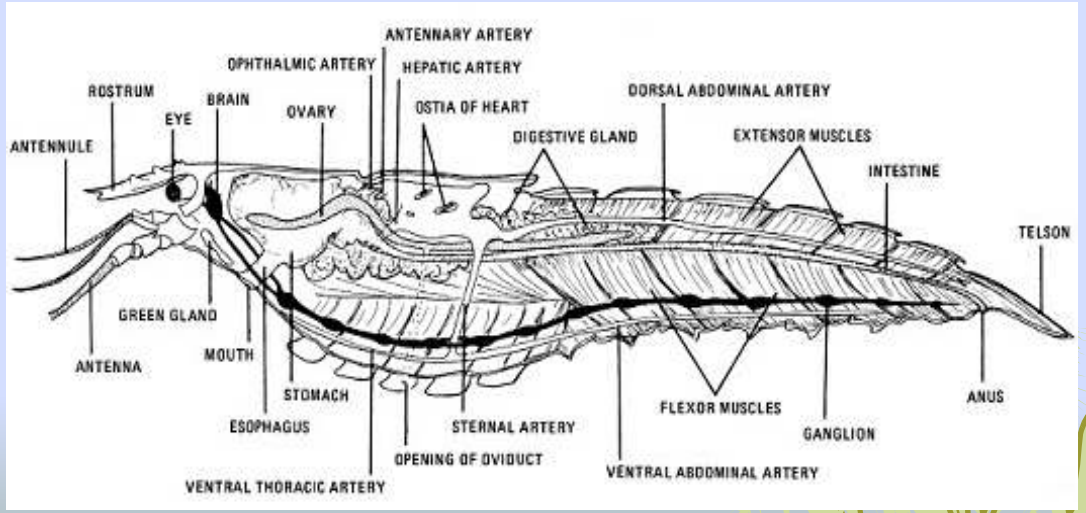


Crab Anatomy

- ✓ *Motile benthic crustacean*
- ✓ *Typically a scavenger*
- ✓ *Eats small invertebrates and dead food matter*
- ✓ *Considered a prized seafood by many people*

Class Malacostraca - Lobsters

- ✓ *Benthic crustacean*
- ✓ *Typically a scavenger*
- ✓ *Clawed and unclawed*
- ✓ *Prized seafood*



Lobster Anatomy


Class Malacostraca - Lobsters
Dinner Anyone?


Class Malacostraca - Lobsters
Sea Salt
Dinner Served!

Phyla Echinodermata – *Urchins, Stars, and Sand Dollars*

- Radially symmetrical calcium carbonate external shell with “tube feet”
- Unique features are ***hydraulic tube feet*** *and* ***pentagonal symmetry***
- Echinoids have organs including digestion, circulation and nervous systems.
- Echinoids are ***motile bottom feeders*** – *predatory and/or scavenging*
- Echinoids include ***sea urchins***, ***sand dollars***, ***sea stars***, ***brittle stars, and sea cucumbers***

Phyla Echinodermata — *Urchins, Stars, and Sand Dollars*

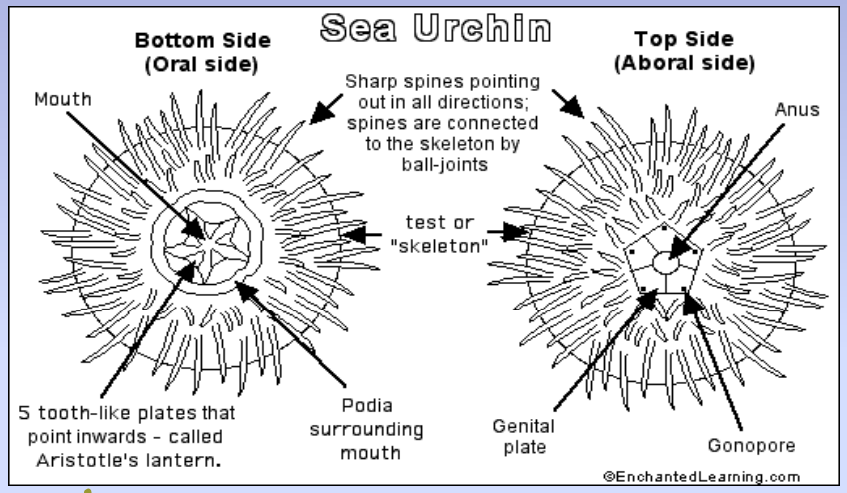
Sea Stars – Class Asteroidea

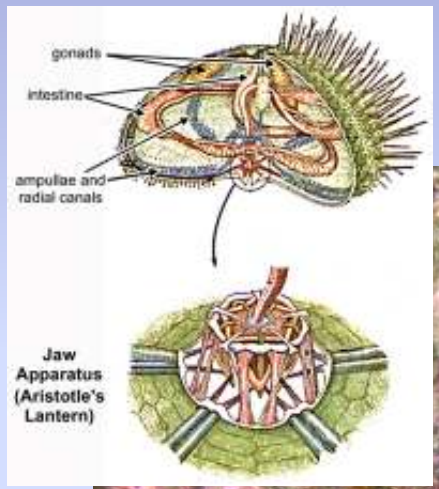
A Keystone Species on our West Coast

- **Pisaster ochraceus -** Common sea star in the rocky marine intertidal zone
- Benthic motile predator that controls grazing animals - especially bivalves
- Very strong arms equipped with 1000's of tube feet and an extendable gut
- *Thrives in the mid- to lower zones of rocky intertidal communities*
- *Favorite food is the mussel Mytilus californianus – keeps them in check*

Sea Urchin – *Class Echinoidia*

- Benthic grazing animal with a big appetite – especially for all types of algae
- Spiny, radial-shaped shell with tube feet and a strong, multi-beaked mouth
- **Habitat -** Common in kelp-studded rocky intertidal and shelf and coral reefs





Sea Urchin – *A Kelp Forest's Worst Enemy*

1) Sea urchins are a common member of kelp forest communities

2) Favorite food off California coast is giant kelp Macrocystis pyrifera

3) Worst enemies are sea otters, wolf eels, and urchin divers

4) Where urchins are unchecked, they will decimate the habitat = urchin barren

5) 18,000,000 lbs. of urchin harvested off California in 2008

Uni: in-situu

Main Concepts – Marine Invertebrates

1) Marine invertebrates are *Metazoans* with no backbone

- Eukaryotic heterotrophs having multi-cellular bodies, with 3-layered wall and an internal digestive cavity, but lacking a vertebral column.
- Radial- and/or bilateral-shaped bodies, with or without a head.
- Most have tentacles or filtering systems for collecting food.
- Nearly all have minute free-swimming larvae for dispersal.

2) Twelve major groups of marine macro-invertebrates:

Phylum **Porifera**	Phylum **Arthropoda**	Phylum **Annelida**
Phylum **Cnidaria**	Phylum **Brachiopoda**	Phylum **Phoronida**
Phylum **Ctenophora**	Phylum **Bryozoa**	Phylum **Nematoda**
Phylum **Mollusca**	Phylum **Echinodermata**	Phylum **Platyhelminthes**

- Each phylum has an independent evolution - dating back over 600 million years – distinguished by a diversity of unique form and function

3) Lifestyles are very diverse: from sessile infaunal to motile pelagic - littoral to hadal – most are benthic

Discussion