

Taxonomy, Anatomy & Biology of Bivalve Mollusks: Hard Clams and Oysters

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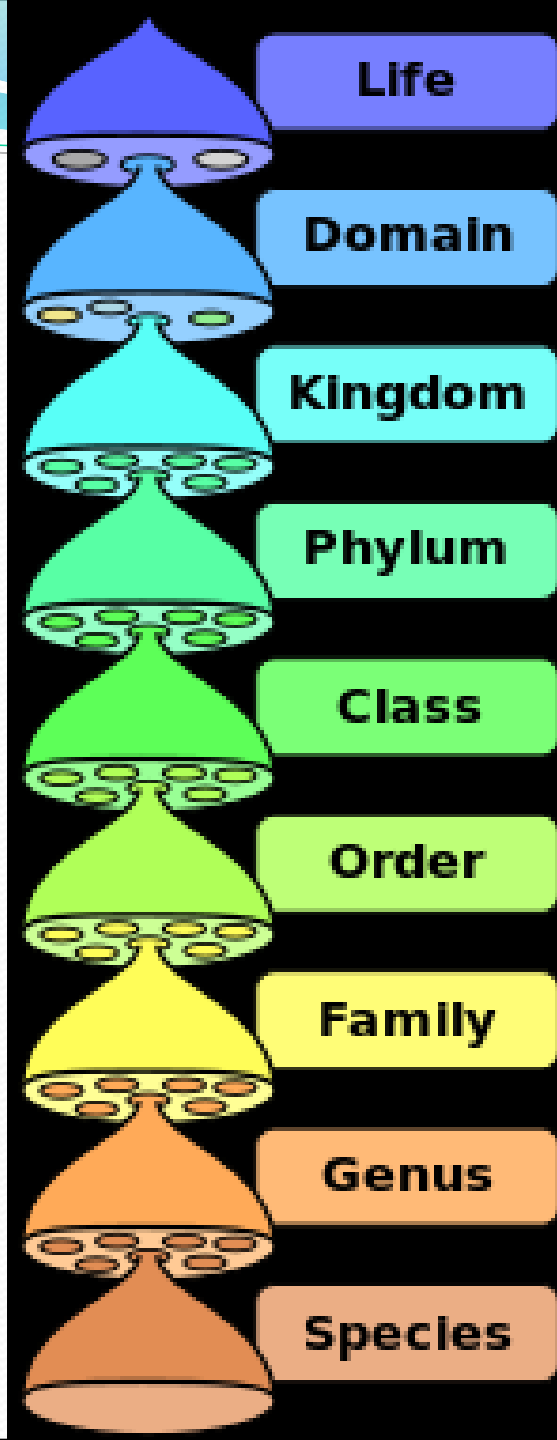
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Taxonomy

- Branch of biology that names and identifies organisms
- Science of defining groups of biological organisms with shared characteristics and evolutionary relationships
- Classification from broader categories to specific ranking



Taxonomy

- Kingdom: Animalia
- Phylum Mollusca (35 phylums)
 - Latin for "soft things"
 - Largest most diverse marine phylum
 - 25% of named marine organisms
 - About 100,000 recognized species

Class - Gastropoda
(snails, slugs, conchs,
periwinkles and sea slugs)



sea slugs



slugs



snails

Class - Bivalvia
(clams, oysters, mussels and scallops)



scallops

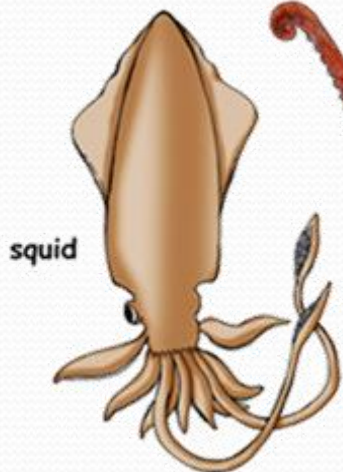


clams

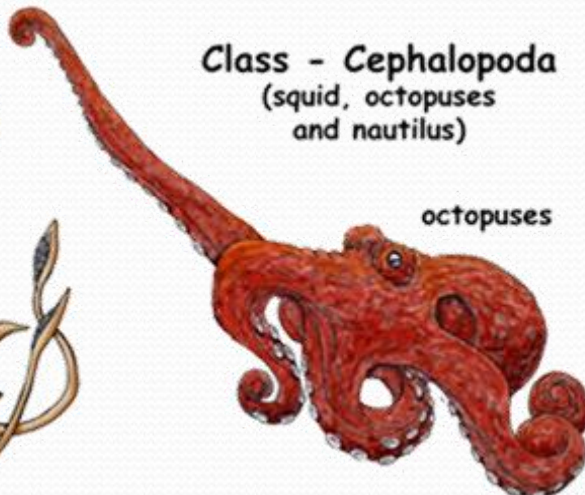


mussels

Class - Cephalopoda
(squid, octopuses
and nautilus)



squid

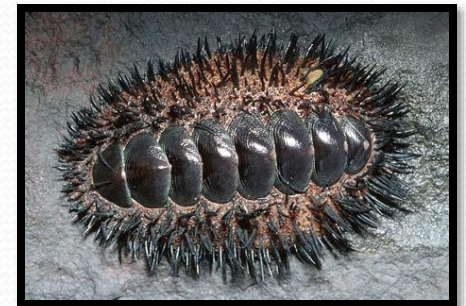


octopuses



Classes in Phylum Mollusca

- Gastropoda - snails
- Cephalopoda - squids, octopus
- Polyplacophora - chitons
- Scaphopoda - tusk shells
- Bivalvia - clams, oysters, scallops, mussels



Class Bivalvia – 20,000 described species

Clams



Oysters



Scallops



Mussels



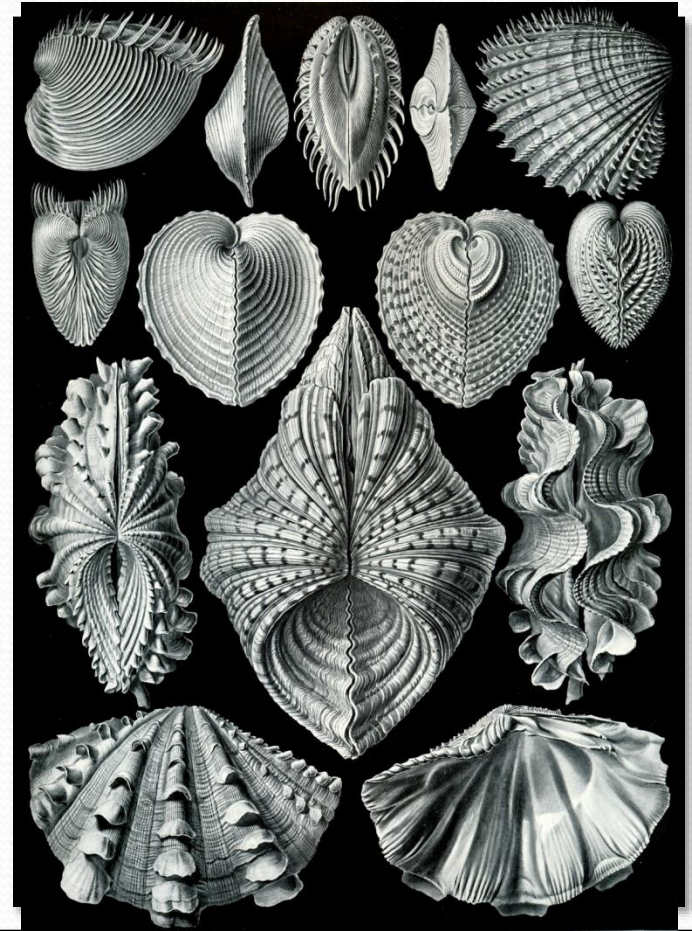
Shipworms



Bivalve form

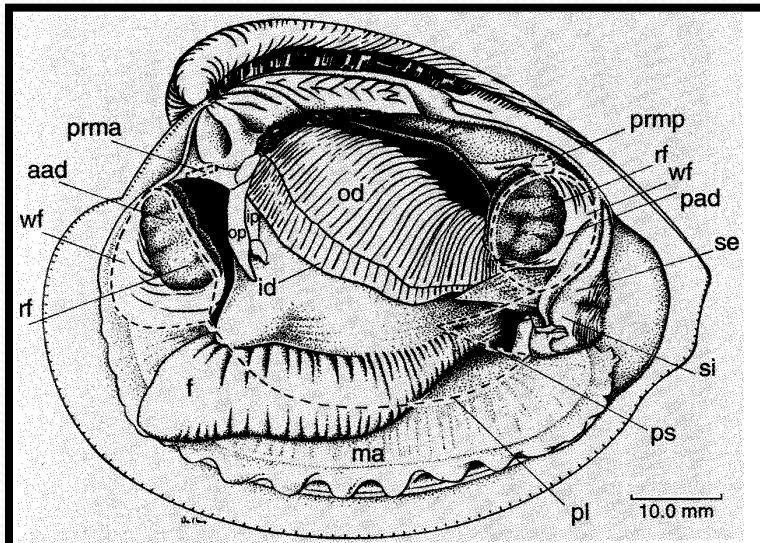


- Two valves, halves , or shells
- Bilateral symmetry - both sides the same size
- Compressed laterally (sideways)
- Shell
 - Joined by hinge ligament
 - Held closed by adductor muscles



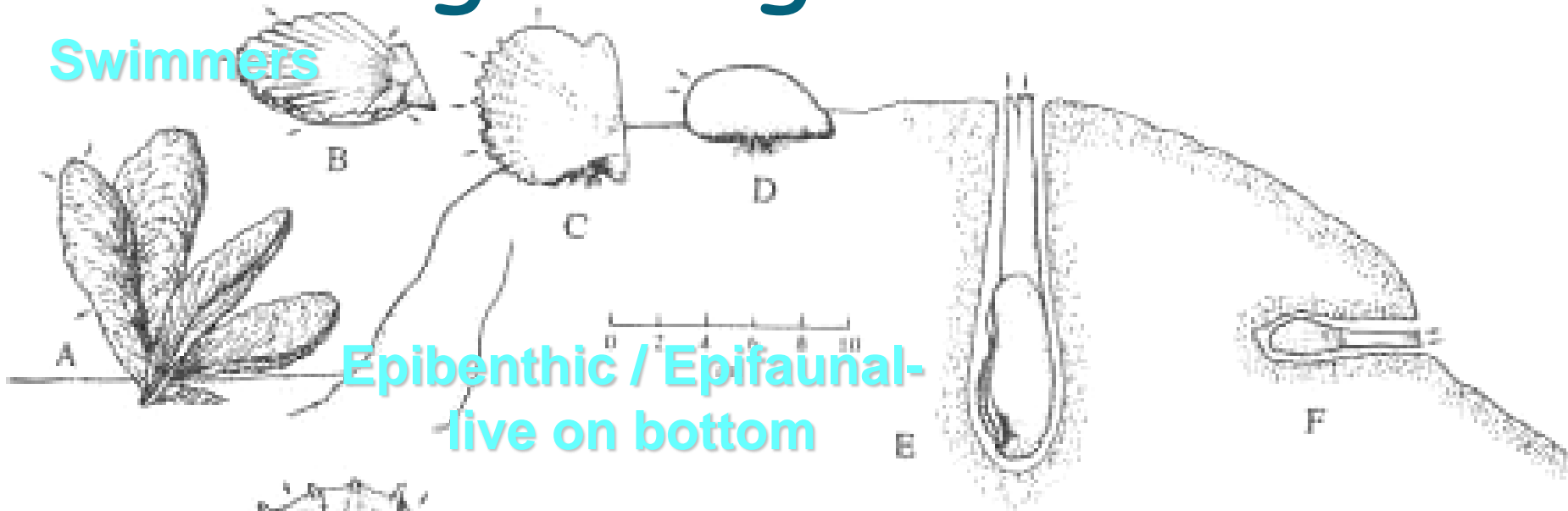
Bivalve form (continued)

- Mantle
 - Encloses body and water space
- Foot
- Gills
 - Filter feeding
 - Gas exchange

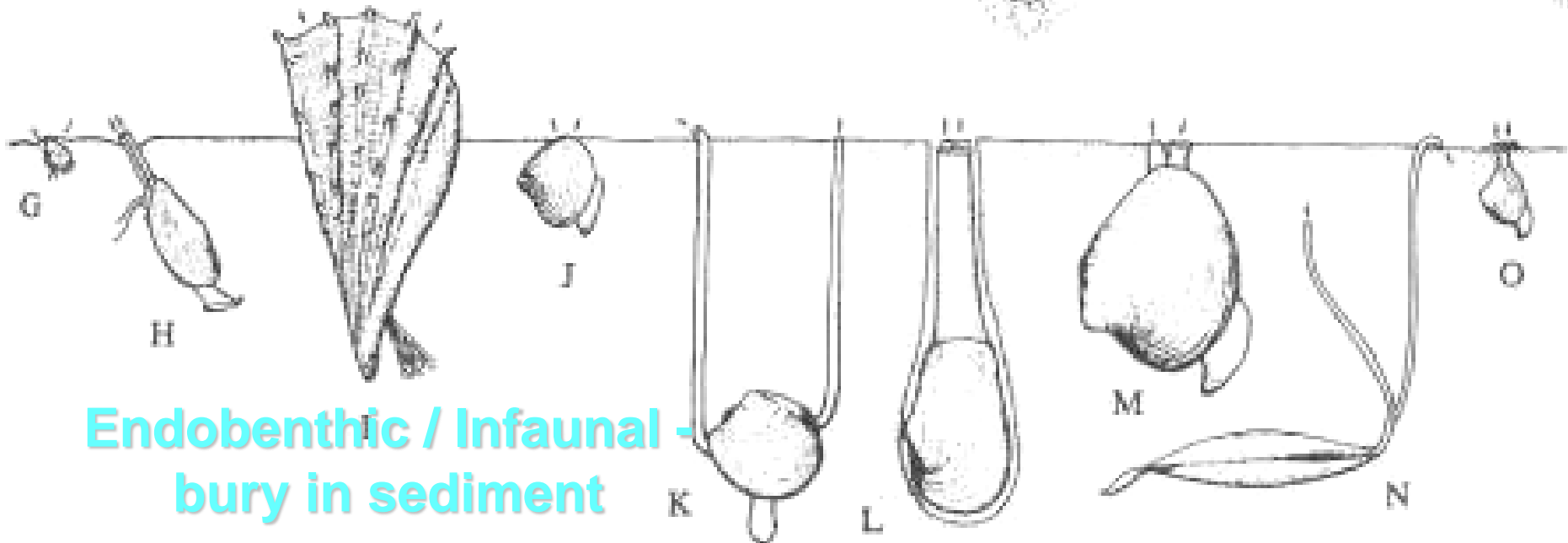


Feeding/living modes

Swimmers



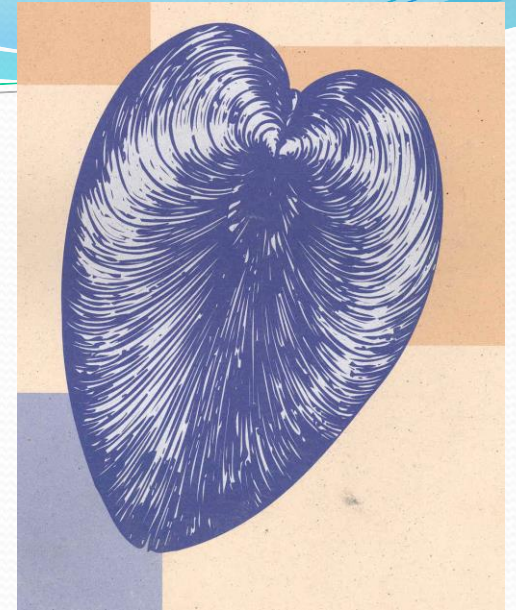
Epibenthic / Epifaunal -
live on bottom



Endobenthic / Infaunal -
bury in sediment

Clam Taxonomy

- Subclass Heterodonta - clam-like with large hinge teeth
- Order Veneroidae
- Family Veneridae
 - Venus or "heart" clam
 - Side view is cardioid (heart-shaped)
 - 53 genera and about 500 species
 - Most are edible and support valuable fisheries and aquaculture industries worldwide



Clam Taxonomy

- Genus: *Mercenaria*
Species: *mercenaria*
- Latin for "commerce"
- New England Indians made valuable beads called wampum from shells, especially the purple color, and used for trading currency

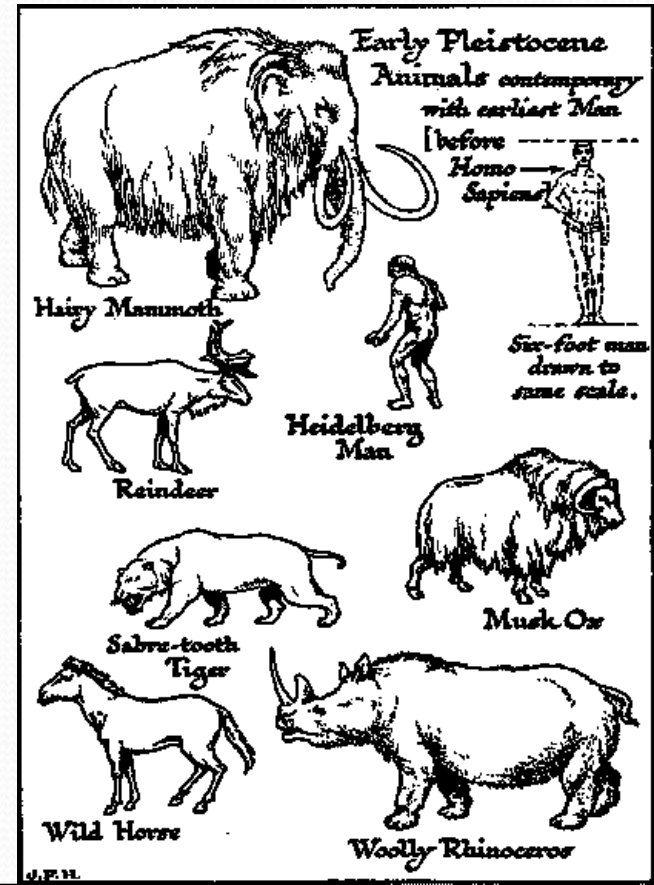


Mercenaria in history

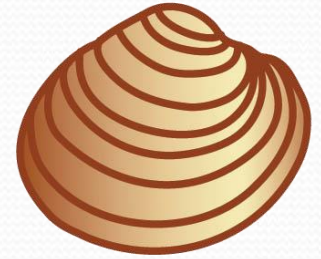
- Several species known only from fossils
- Found during Pleistocene epoch
- 780,000 to 1.8 million years ago



Mercenaria permagna embedded in limestone with calcite crystals collected from Fort Drum quarry in Florida



Clam Common Names



- Northern hard clam or hard clam
- Quahog
 - Derived from Native American words - "closed" and "shell"
- Other names refer to size
 - Chowder
 - Cherry
 - Top neck
 - Middle neck
 - Little neck

Fresh Florida Farm-Raised Clams

Clams are live products. Follow these steps to ensure the best quality and the longest possible shelf life.

DO

- Use live clams that are still or closed or just popped. Discard any clams that are open or do not close when tapped. If they do not close, they should be discarded. If they do close, they should be stored in a cool, moist environment.
- Clams should be kept in their original shucked bag and stored in the refrigerator.
- Clams should be cooked within 24 hours of shucking. Do not refreeze clams.
- Clams should be cooked with a minimum of 1/2 inch of liquid to prevent them from drying out.
- Clams should be cooked until they are open and the meat is firm. Do not overcook.
- Clams should be stored in a cool, moist environment.

DON'T

- Do not cook clams for more than 10 minutes.
- Do not cook clams in a dry pan.
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PREPARATION

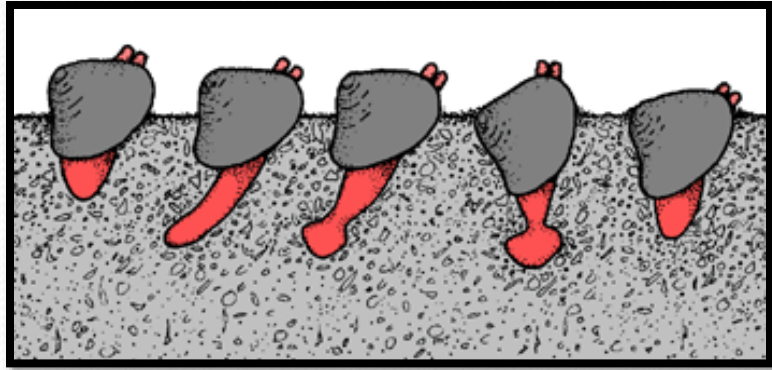
Clams are best served with a simple sauce. They can also be served with a variety of sauces. Clams should be cooked until they are open and the meat is firm. Do not overcook.

Clam Size Chart

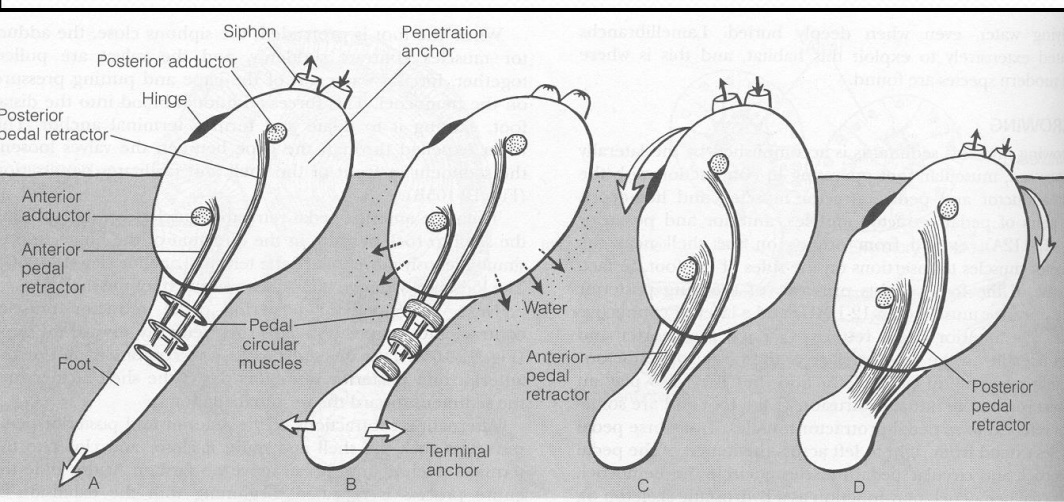
Clam Name	Number per Pound	Shells per Pound
Top Neck	8-12	11-15
Middle Neck	12-15	15-20
Little Neck	18-24	24-32
Chowder	24-32	32-40
Posta	32-40	40-50

Fresh Florida

External Clam Shell Anatomy

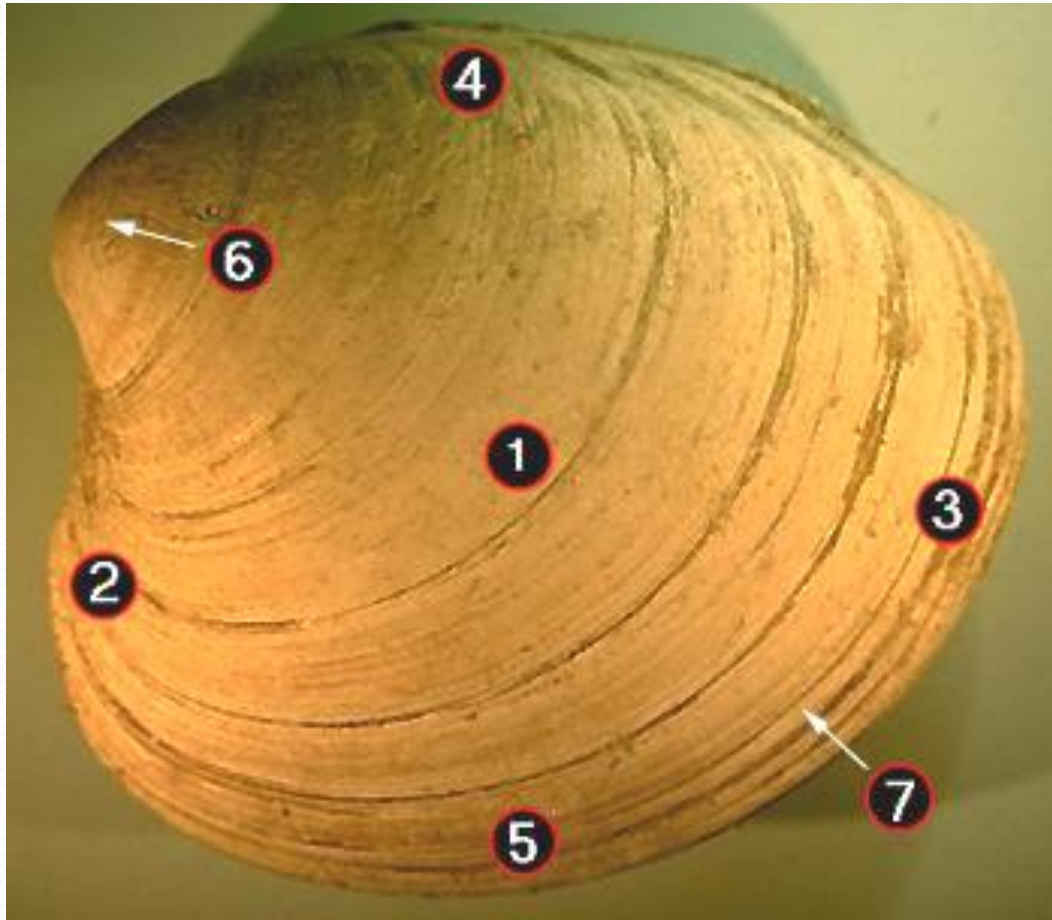


- Two fused siphons extend from posterior end of shell into water
 - "little" necks
- Two muscles keep valves closed
 - Predators or adverse environmental conditions



- Muscular foot extends beyond shell for burrowing into bottom
- Mouth near foot area - anterior end of shell

External Clam Shell Anatomy



1. Left valve or shell
2. Anterior or head
3. Posterior or tail
4. Dorsal or upper
5. Ventral or lower
6. Umbo ("beak")
 - Oldest part of the shell
7. Growth ring

Northern hard clam, *Mercenaria mercenaria*

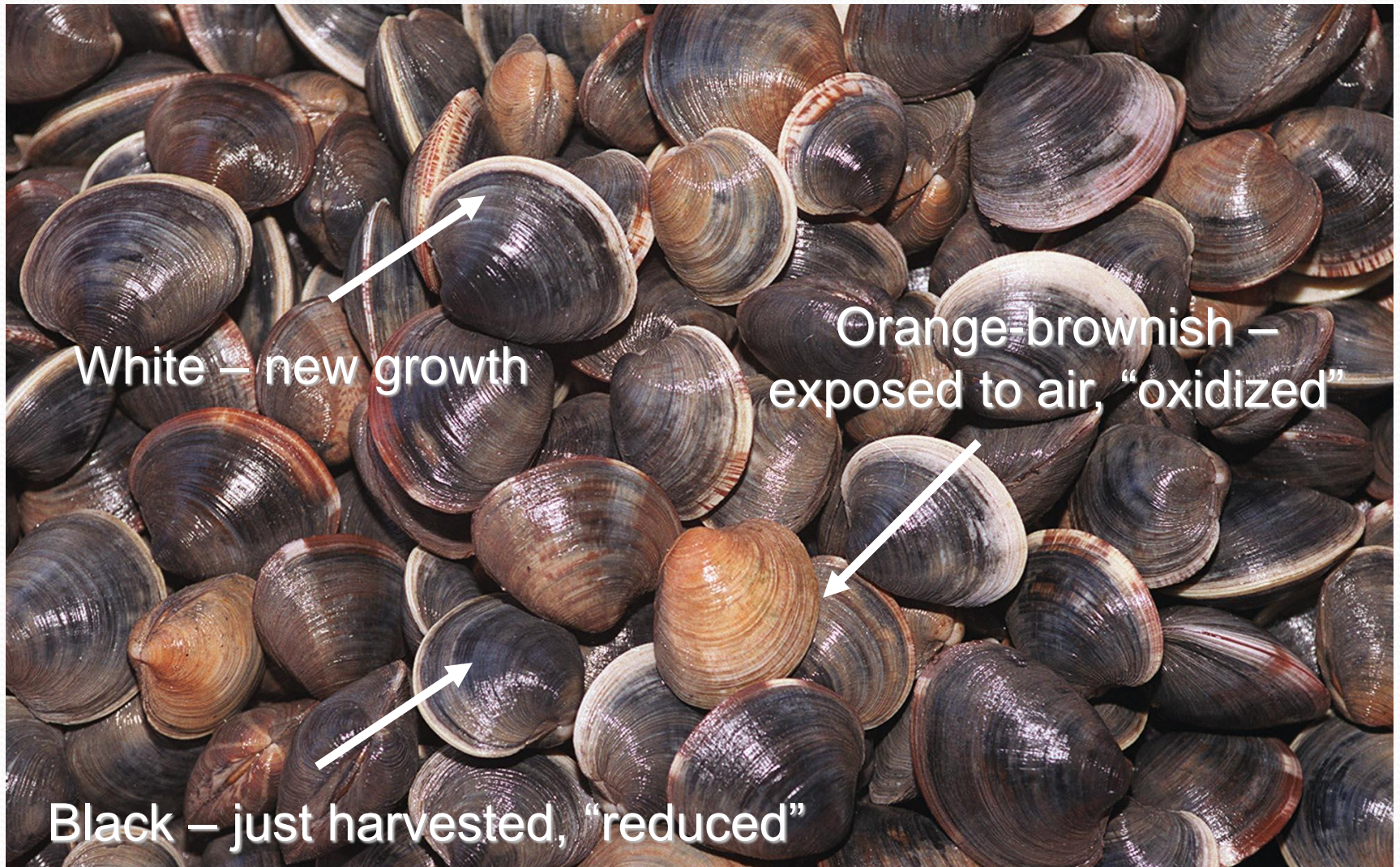
Clam Growth

- Shell consists of calcium carbonate in a crystalline form
- New shell forms at ventral end by secretion of protein matrix and calcium by mantle
- Concentric rings indicate general growth pattern
- When growth stops, a ring is formed



Southern Quahog, *Mercenaria campechiensis*

Clam Shell Coloration



White - new growth

Orange-brownish -
exposed to air, "oxidized"

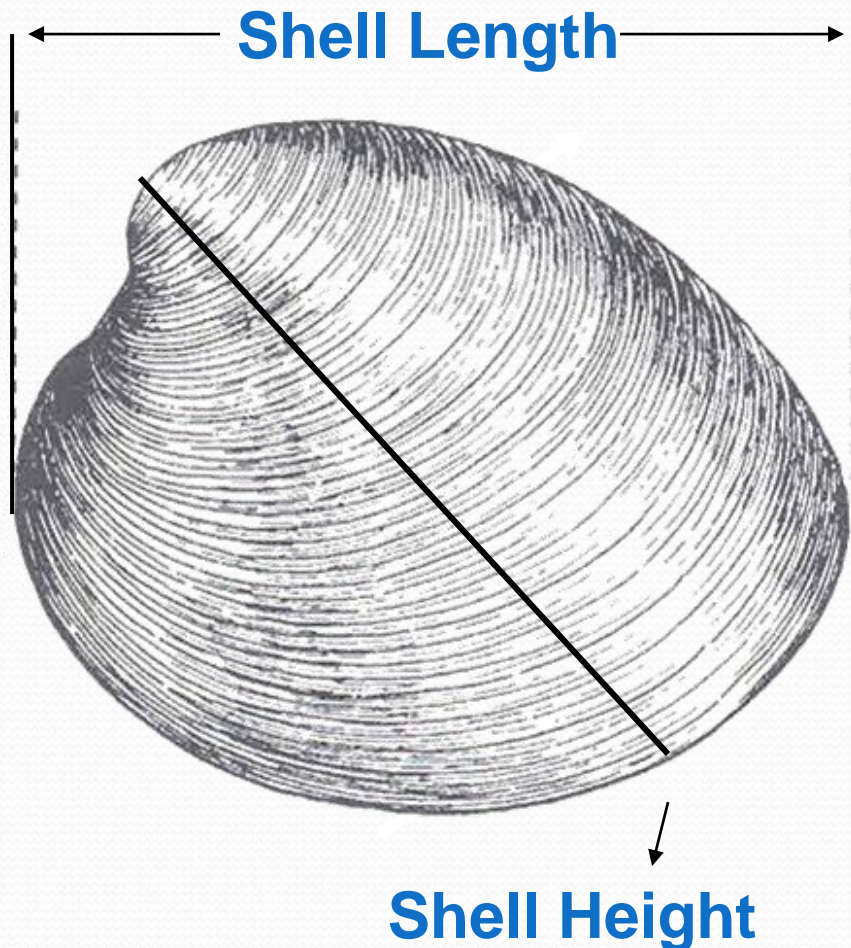
Black - just harvested, "reduced"

Clam Shell Coloration



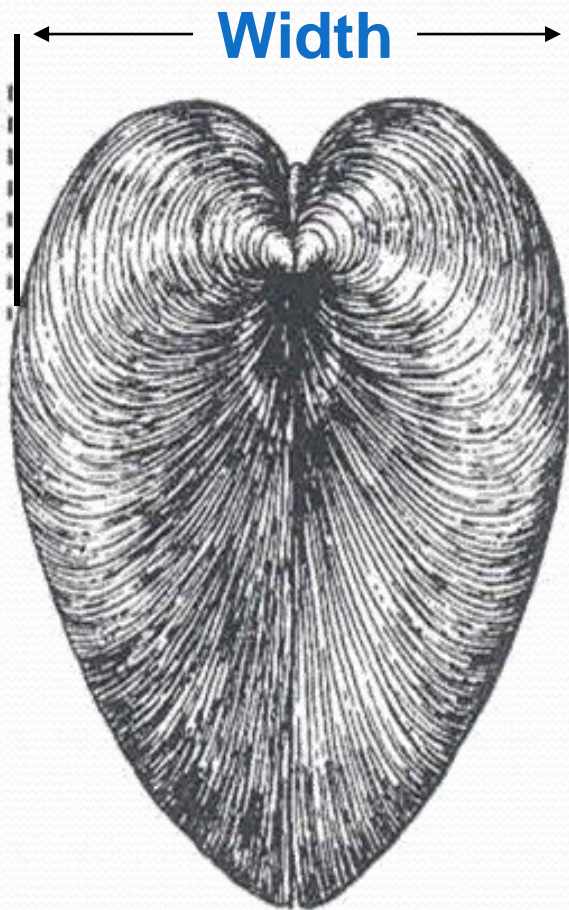
- Notata markings
 - Controversy on whether subspecies or natural form
- Chestnut-colored, chevron-shaped ("zig-zags") markings
- 1-2% occurrence in "wild" clams
- Bred into cultured clams as a marketing tool

Clam Measurements



- Shell length
 - Longest dimension
 - From anterior to posterior ends
 - Used in seed sizes
- Shell Height
 - From dorsal (umbo) to ventral

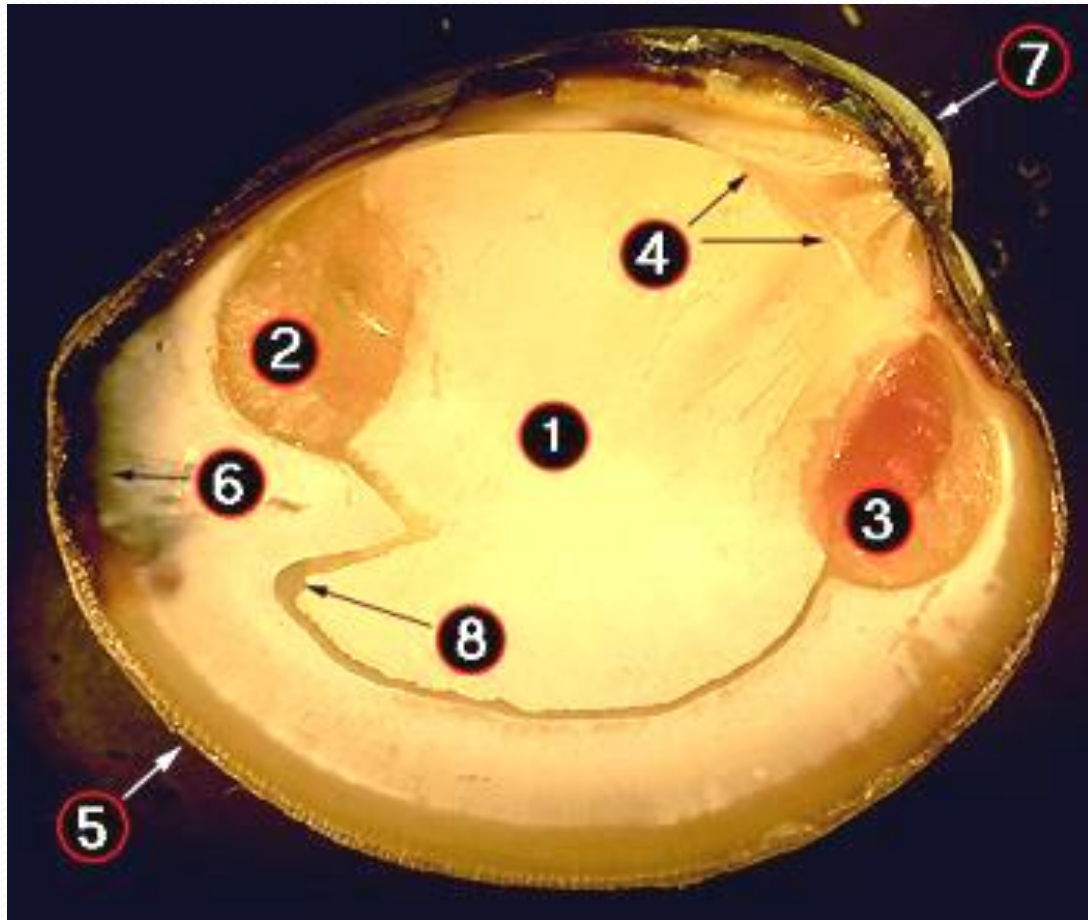
Clam Measurements



- Shell Width
 - Shortest dimension
 - Across hinge
 - Used in market sizes for cultured product
 - For "wild" harvest, must be ≥ 1 "
- Use calipers to measure

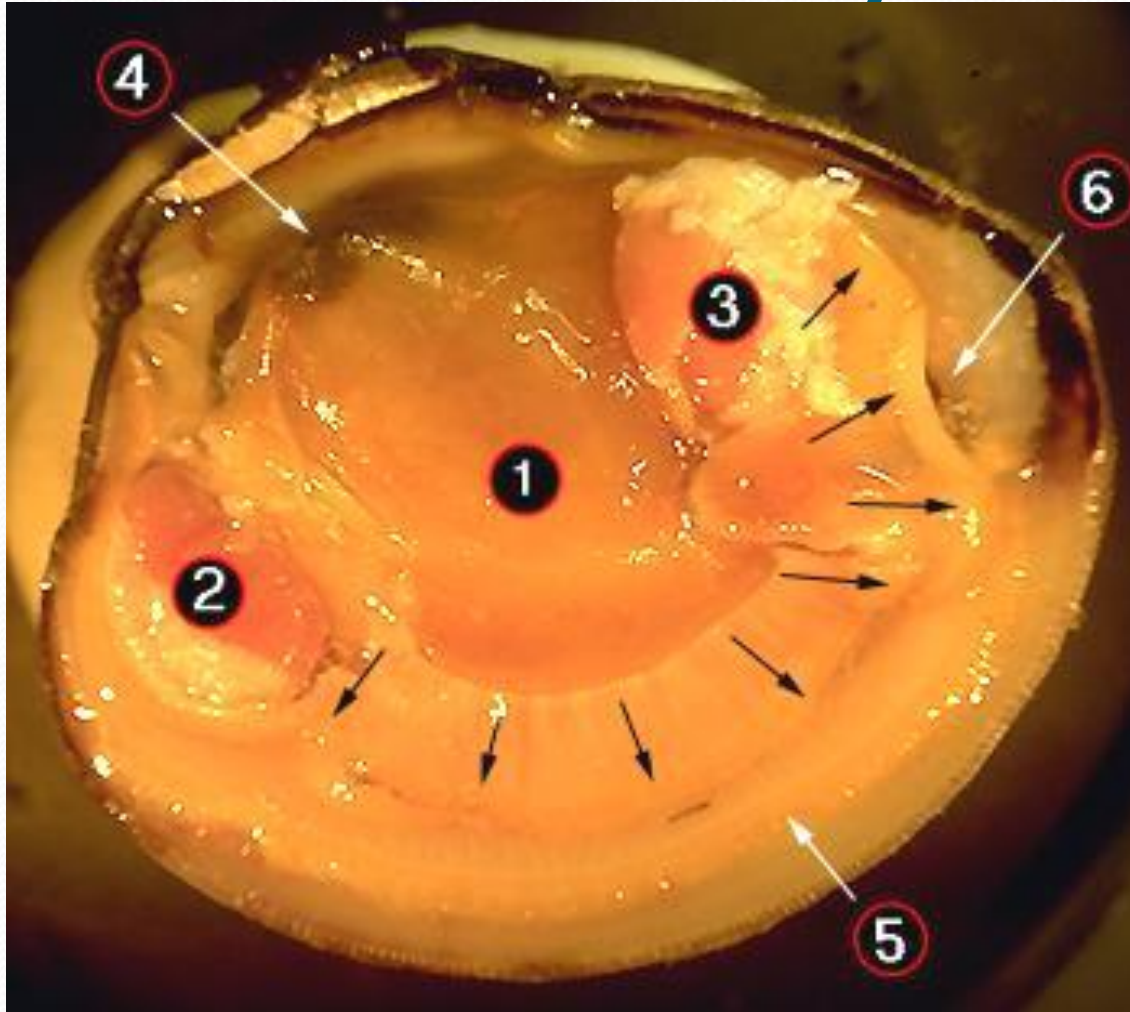


Internal Clam Shell Anatomy



1. Inner surface of left valve
2. Post. adductor muscle
3. Ant. adductor muscle
 - Hold valves shut
4. Hinges
 - Ligament holds valves together
 - Interlocking teeth prevent valves from side slipping when opening and closing
5. Teeth along ventral margin
 - Prevent valves from sliding when closes
6. Where siphons sit
7. Umbo
8. Pallial line
 - Where mantle is attached to shell

Internal Clam Shell Anatomy



1. Mantle

- Covers visceral or body mass
- Holds in fluid
- Secretes new shell

2. Ant. adductor muscle

3. Post. adductor muscle

- Hold valves shut

4. Pericardium cavity

- Region covered with thin, dark membrane
- Contains 2-chambered heart and kidney in a fluid-filled sac

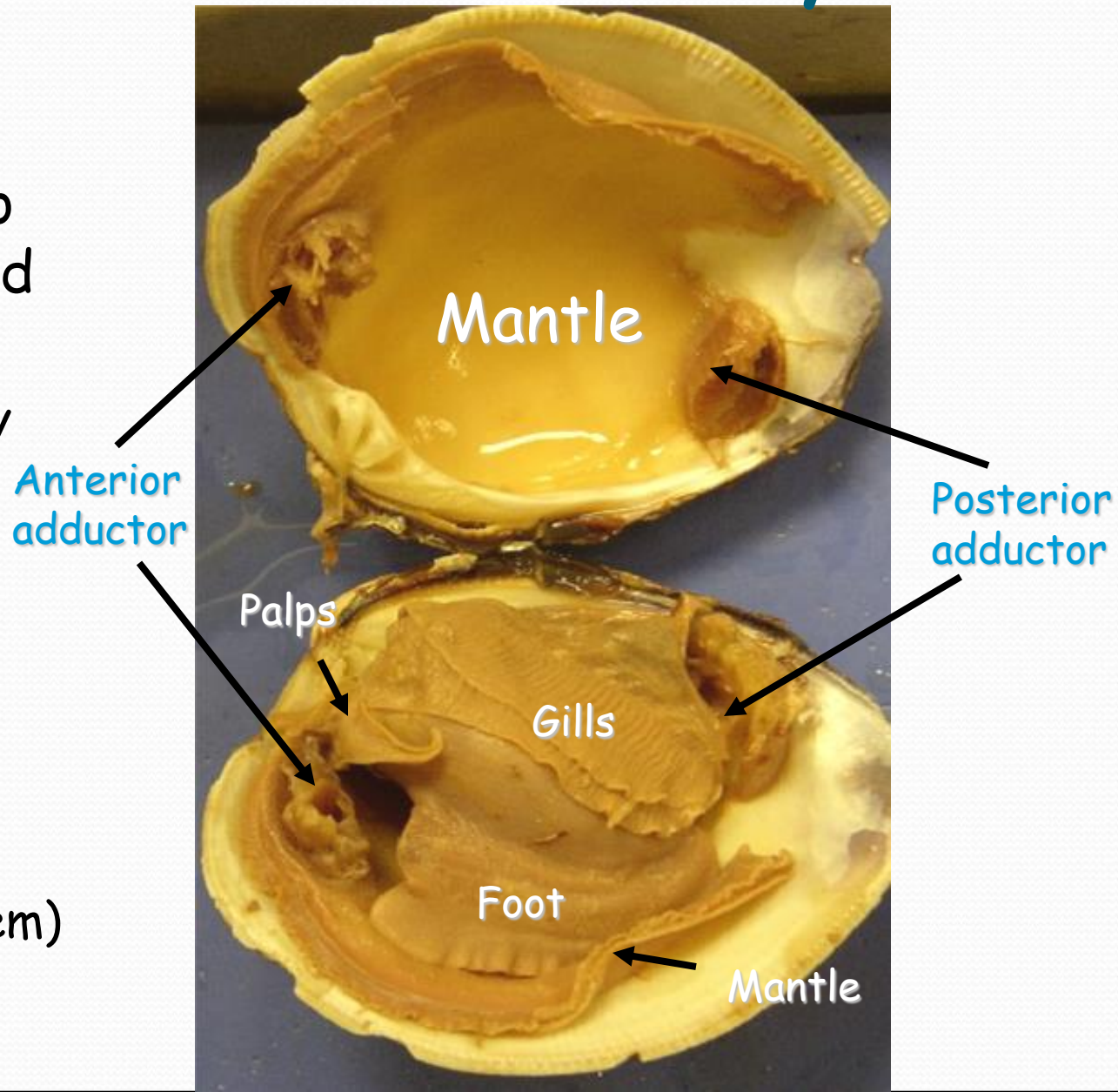
5. Mantle edge

6. Siphons

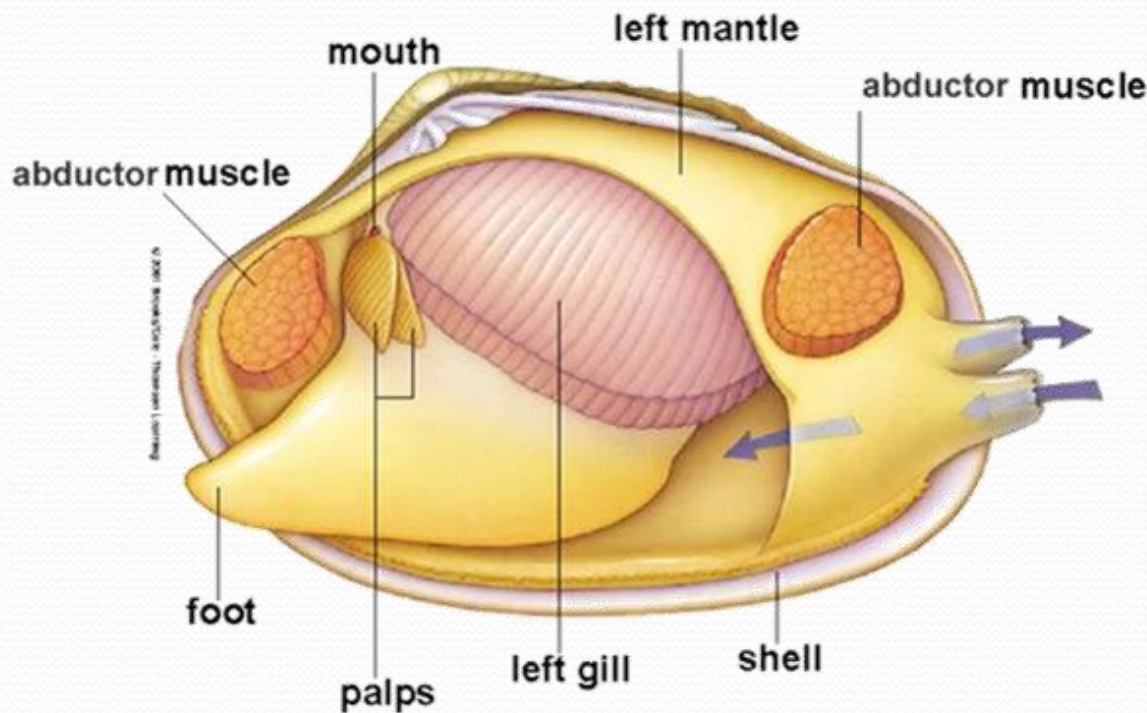
- Left and right mantles join to form siphons

Internal Clam Anatomy

- Remove mantle to observe thickened region
 - Gills (respiratory system)
 - Gonadal tissue (reproductive system)
 - Palps (digestive system)
 - Kidney and anus (excretory system)



Respiratory and Digestive Systems



- Siphons
 - Incurrent- incoming water contains oxygen and tiny food organisms
 - Excurrent- metabolic wastes are expelled
- Gills
 - 2 pairs on each side
 - Filter out food particles and provide for gas exchange
- Labial palps (2)
 - At ends of gills provide for food sorting prior to entering mouth

Feeding

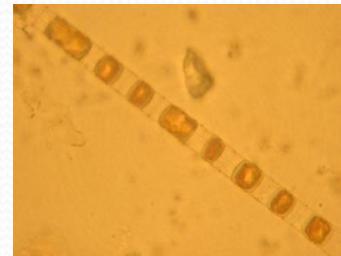
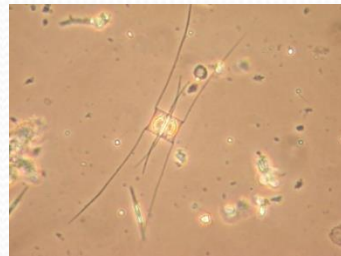
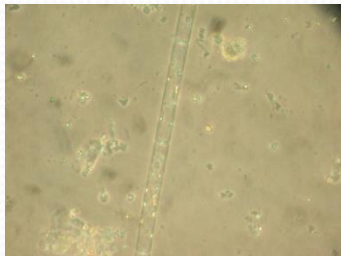
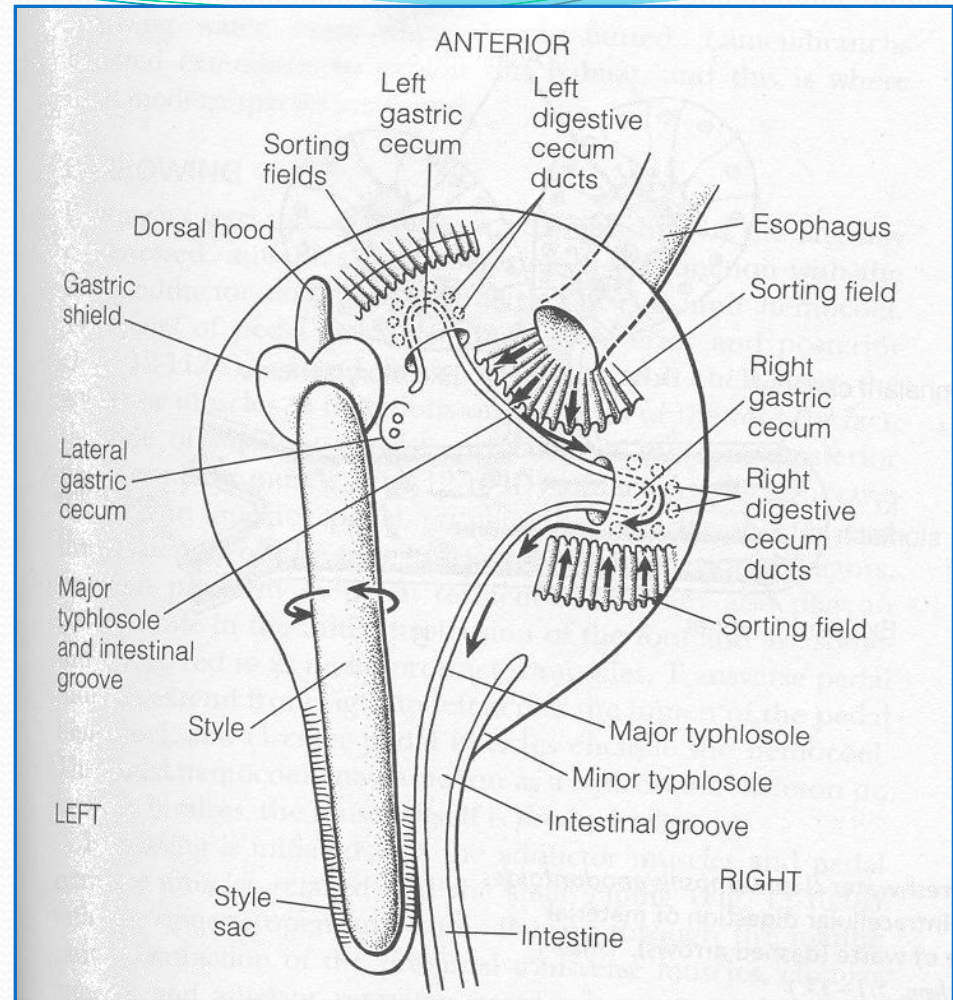


Filter feeder
Can clear 5 gallons per day of
particles as small as 2 microns

- Cilia on incurrent siphon and gill filaments move water through animal
 - Microscopic hair-like appendages
- Mucous on gills trap entering particles
- Particles moved by food groove toward labial palps
 - Like a conveyor belt
- Labial palps sort out food before entering mouth
 - Rejected matter (silt, excess phytoplankton) dropped into mantle and released as pseudofeces

Feeding

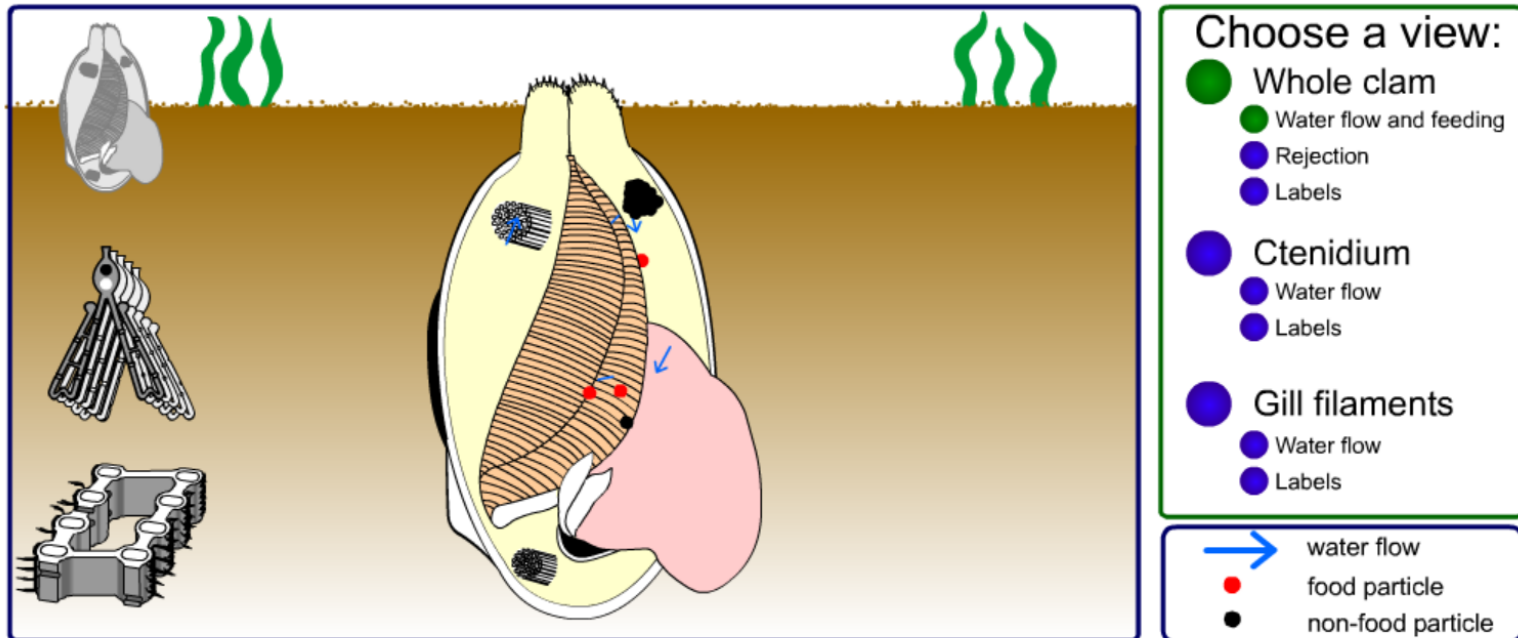
- Interesting feature
- In the stomach is a "crystalline style"
 - Thin, glass-clear organ looks like a worm
 - Contains digestive enzymes
 - Also grinds phytoplankton like a mortar and pestle



Clam example - animation

- <http://www.biology.ualberta.ca/facilities/multimedia/?Page=252>
- <http://www.biology.ualberta.ca/facilities/multimedia/uploads/zoology/Clam.html>

Water flow in a eulamellibranch bivalve (clam; phylum Mollusca)



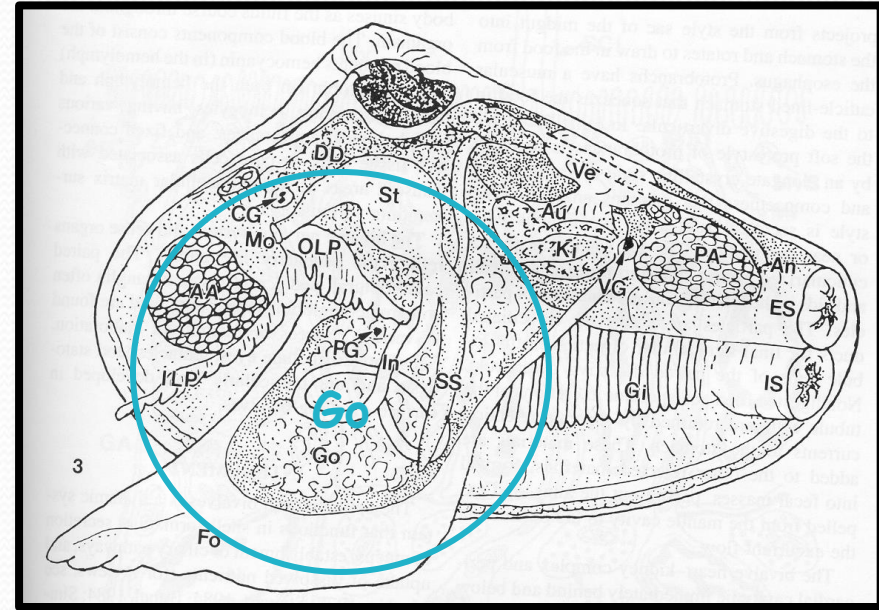
Clams typically live buried in the sediment, but extend tubular siphons to the sediment surface to obtain water for feeding. Water flows in one siphon and out the other. Fine particles are filtered with a folded, sheet-like gill (eulamellibranch ctenidium). Notice how water flows in ventrally and out dorsally, and how captured particles move along the gill margins to the labial palps where food particles are ingested but non-food particles are rejected as pseudofeces.

Back

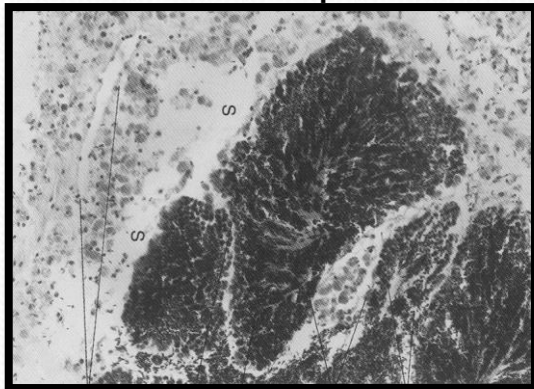


Reproductive System

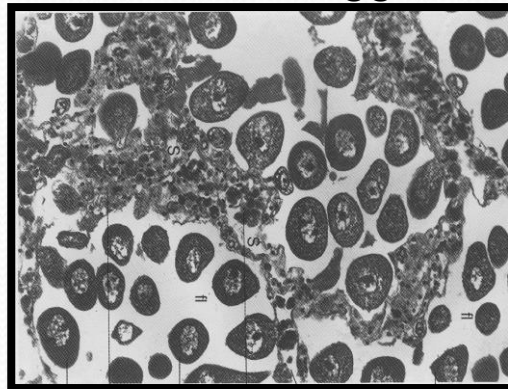
- Gonadal tissue grows throughout visceral mass and foot
- Separate sexes
- Usually protandric - spawns as male first year
- Second year - about half become female at 20-35 mm



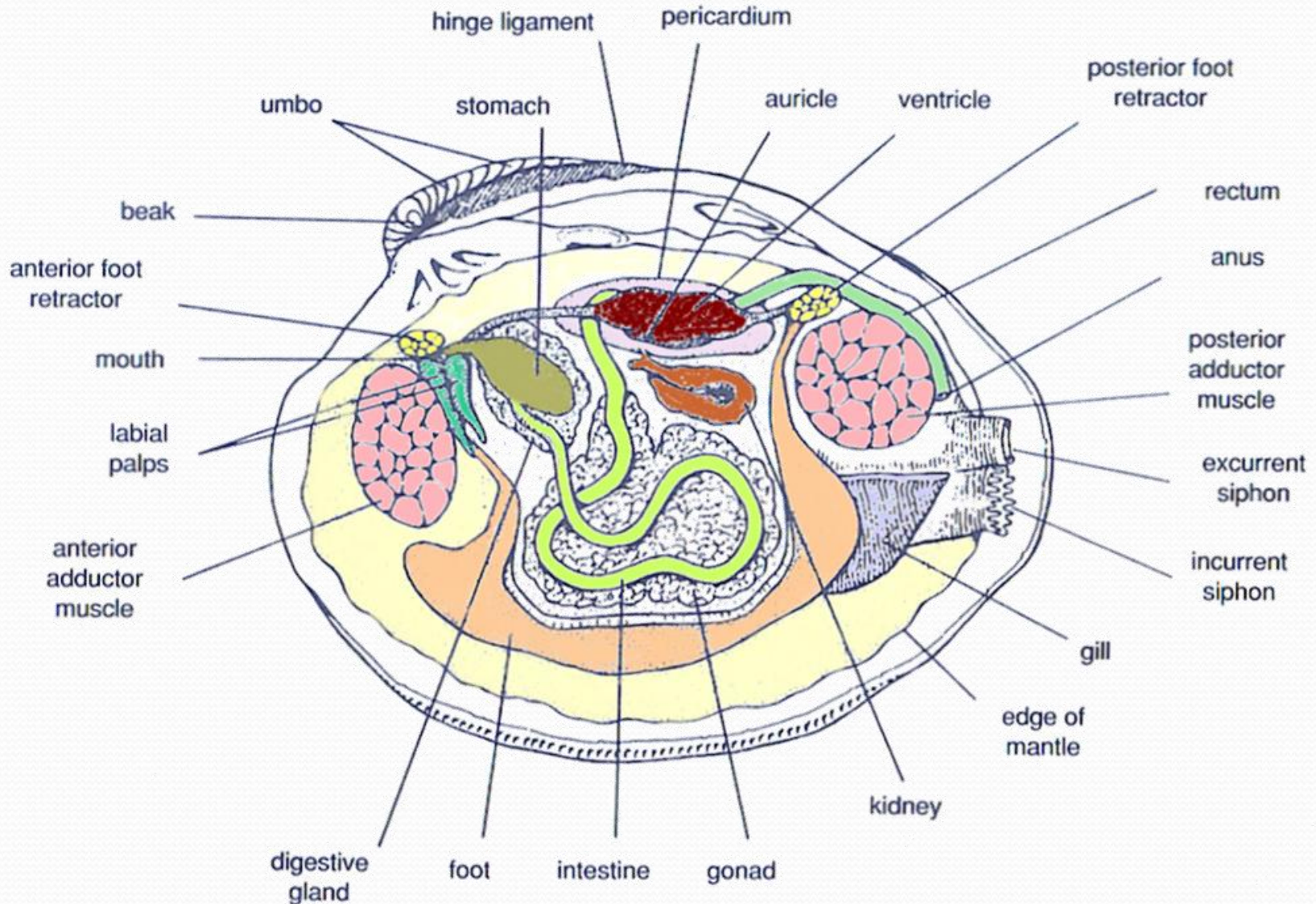
Males - Sperm



Females - Eggs



Internal Clam Anatomy



Oyster Taxonomy

- Order Ostreacea

- Family Ostreidae

- "True" oyster
- About 70 species
- Most are edible and support valuable fisheries and aquaculture industries worldwide



Kumamoto

European Flat



Atlantic

Pacific

Olympia

Oyster Taxonomy

- Genus: *Crassostrea*
Species: *virginica*
- Latin for "thick" oyster
- Called eastern, Virginia, American
- Native to Atlantic and Gulf coasts
- Today, <1% of oysters of 17th century populations remaining



Another important bivalve found in Cedar Key

Oyster Biology

- Epibenthic cemented - lives on surface of sediments, forms reefs
- "Foundation" species - provides habitat for variety of species by creating hard substrate for attachment and habitation
- Variation of shell shape due to overcrowding, orientation, substrate, environmental conditions

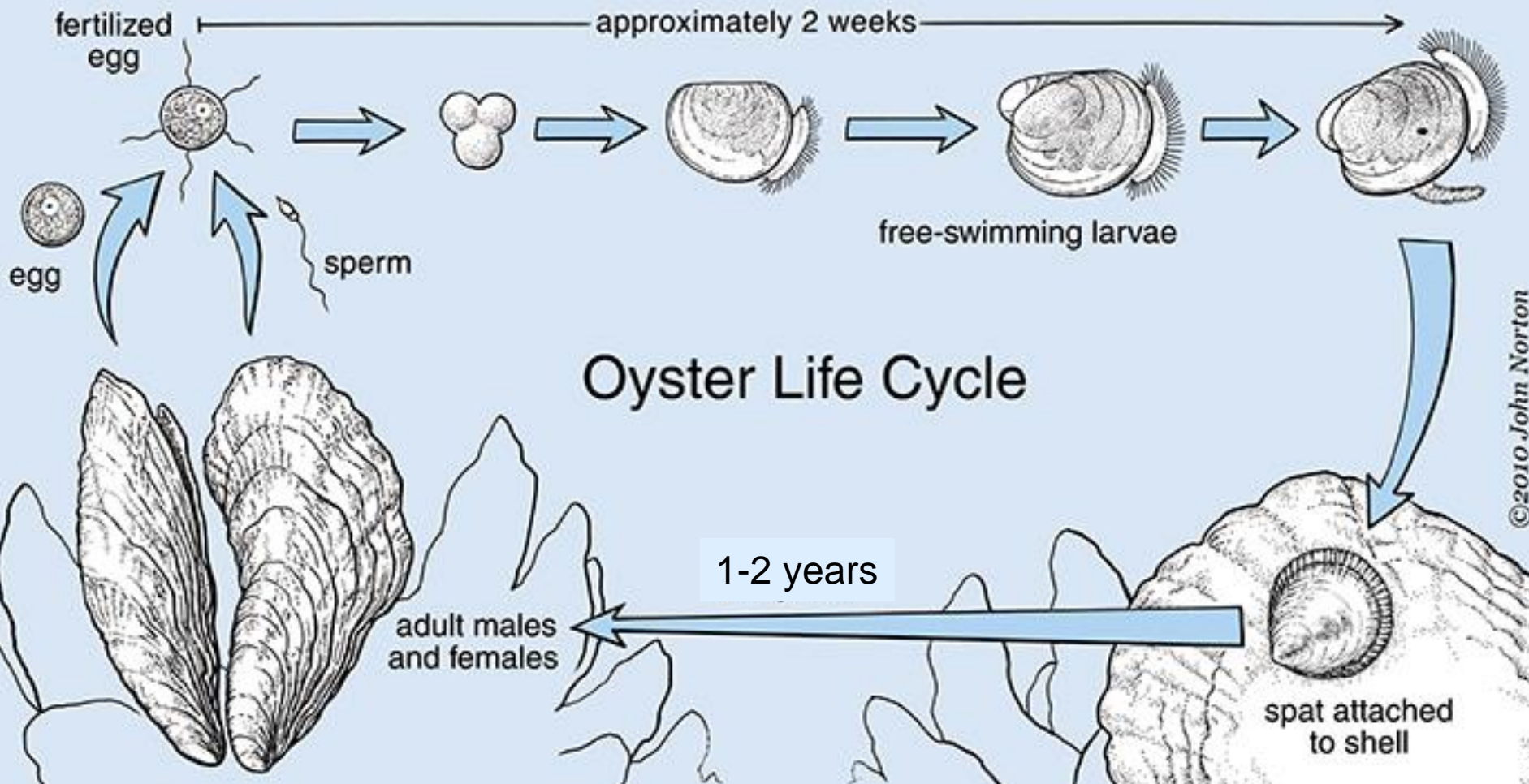


Oyster Biology

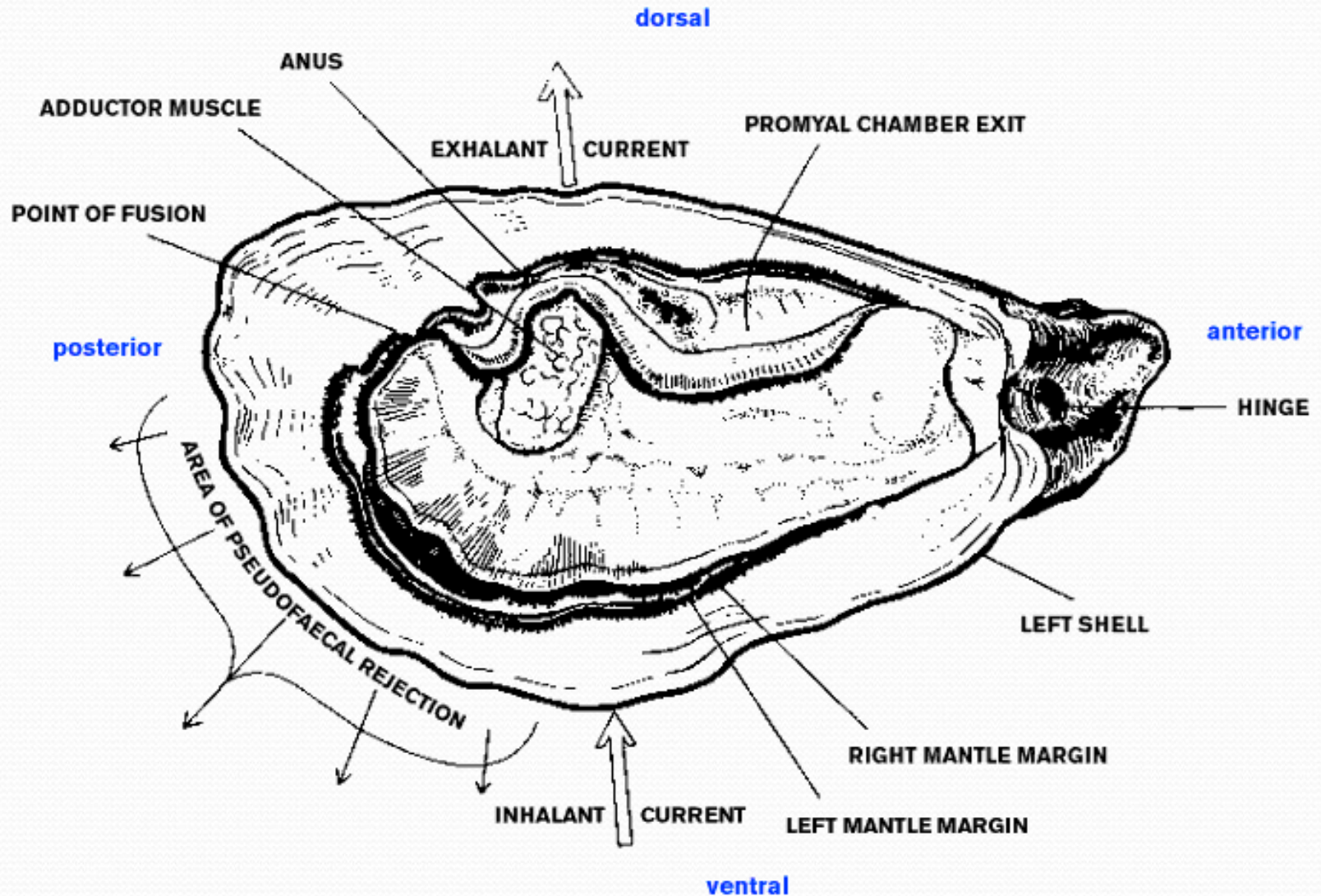
- One large central adductor muscle
- Shell has characteristic central scar marking its point of attachment
- Filter feeder
- Sexes separate, but externally indistinguishable



Oyster Life Cycle



Oyster Anatomy





Clams and oysters provide food, jobs and ecosystem services

