Taxonomy, Anatomy, and Biology of the Hard Clam

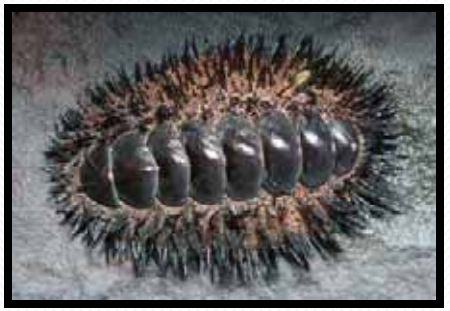
Shirley Baker
University if Florida SFRC
Fisheries and Aquatic Sciences Program
Gainesville, FL
smbaker25@ufl.edu

Leslie Sturmer
University of Florida IFAS
Shellfish Aquaculture Extension Program
Cedar Key, FL
LNST@ufl.edu

UF UNIVERSITY of FLORIDA IFAS

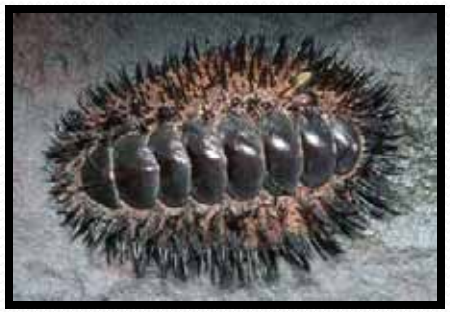
Taxonomy

- Kingdom: Animalia
- Phylum Mollusca
  - Latin for “soft things”
  - Largest and most diverse marine phylum
  - 25% of named marine organisms
  - About 100,000 recognized species



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

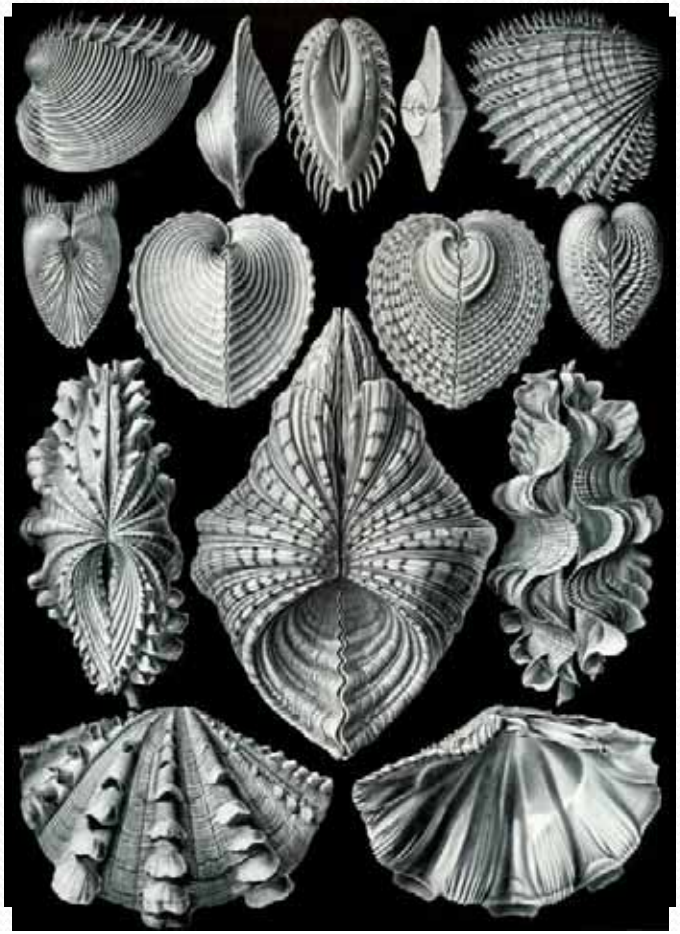
Scallops

Mussels

Shipworms

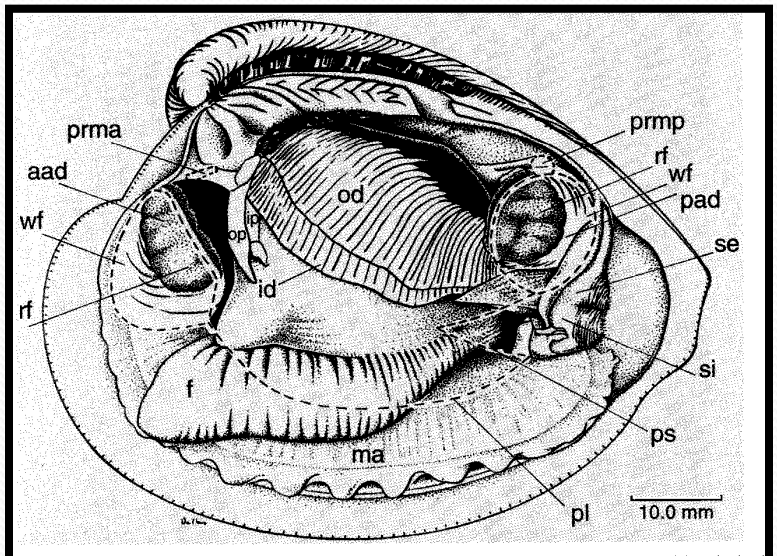
Bivalve form

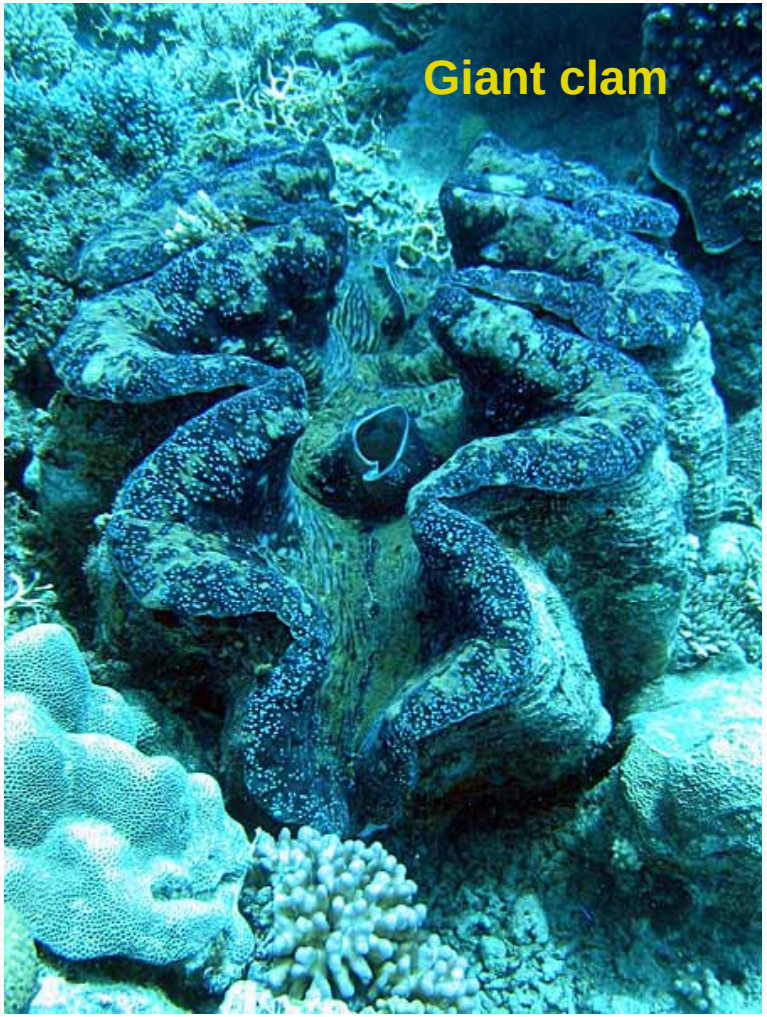
- Two valves, halves , or shells
- Bilateral symmetry - both sides the same size
- Compressed laterally (sideways)
- Shell
  - Joined by hinge ligament
  - Held closed by adductor muscles



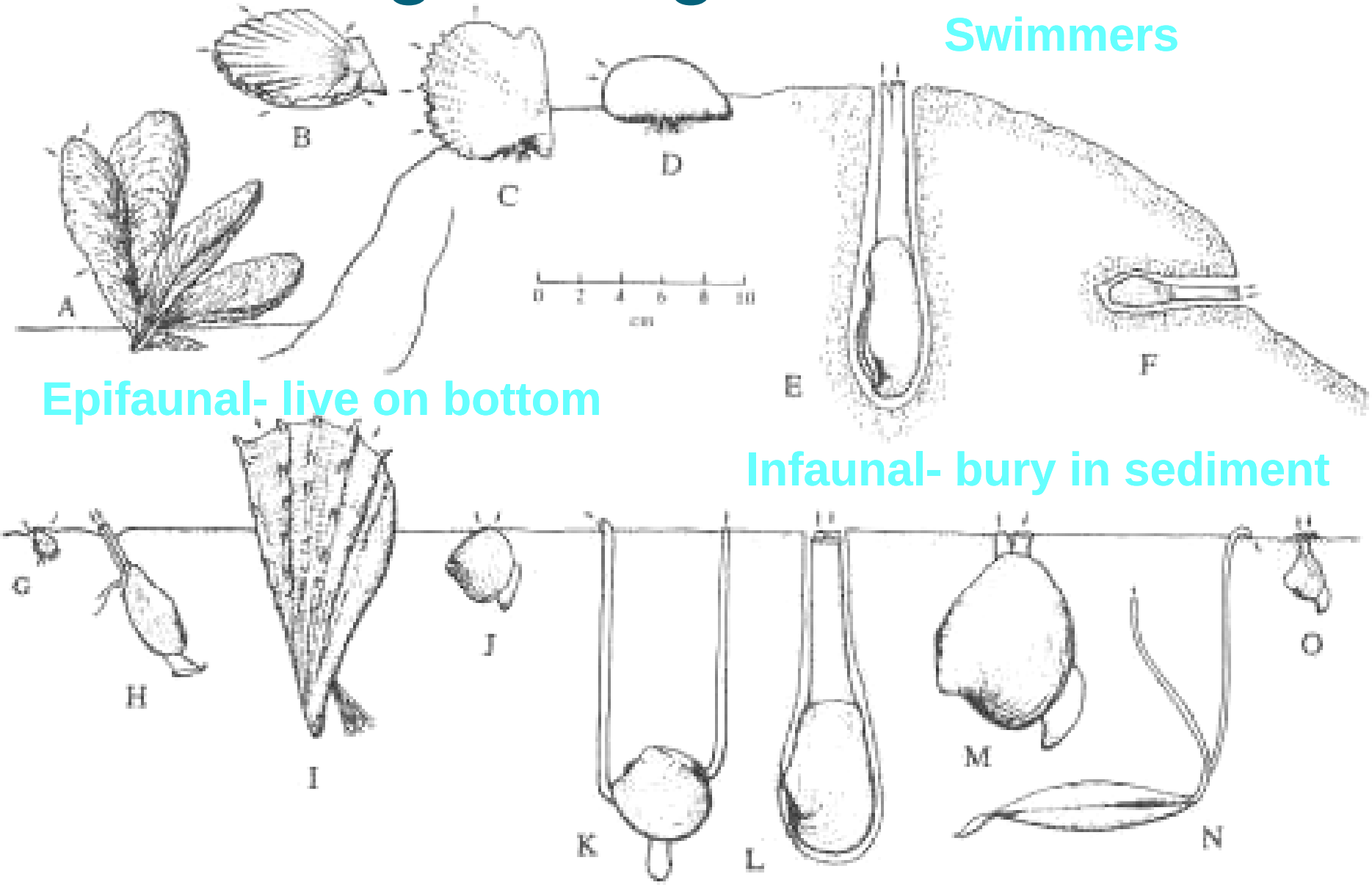
Bivalve form (continued)

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



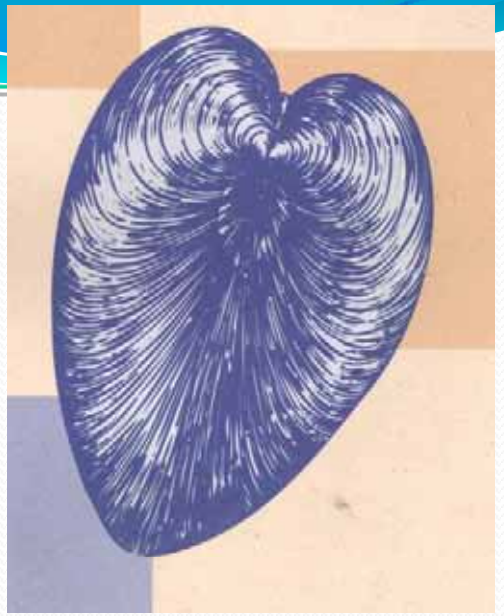


Feeding/living modes



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



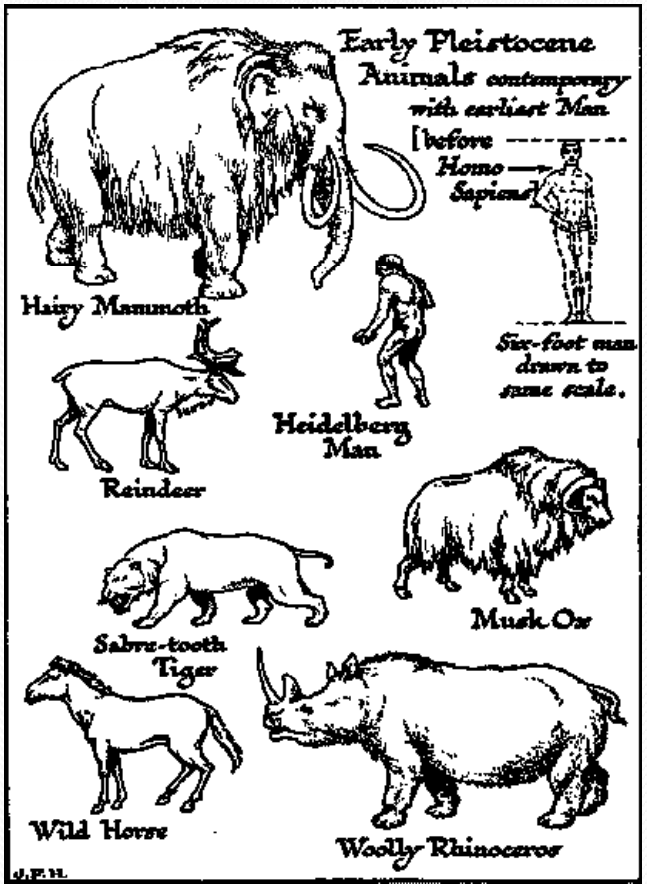
Clam Taxonomy

- 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

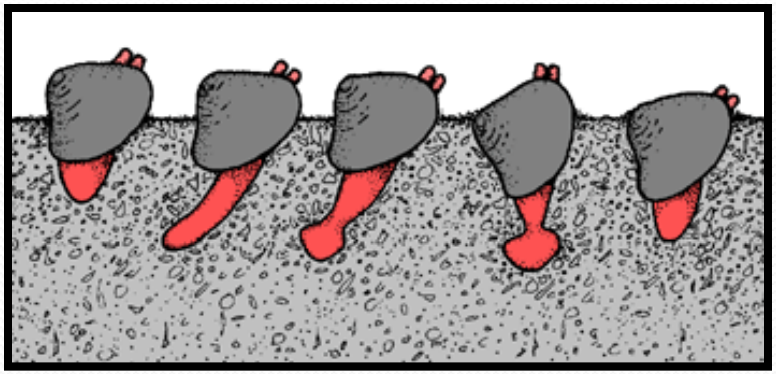
Mercenaria permagna embedded in limestone with calcite crystals collected from Fort Drum quarry in Florida



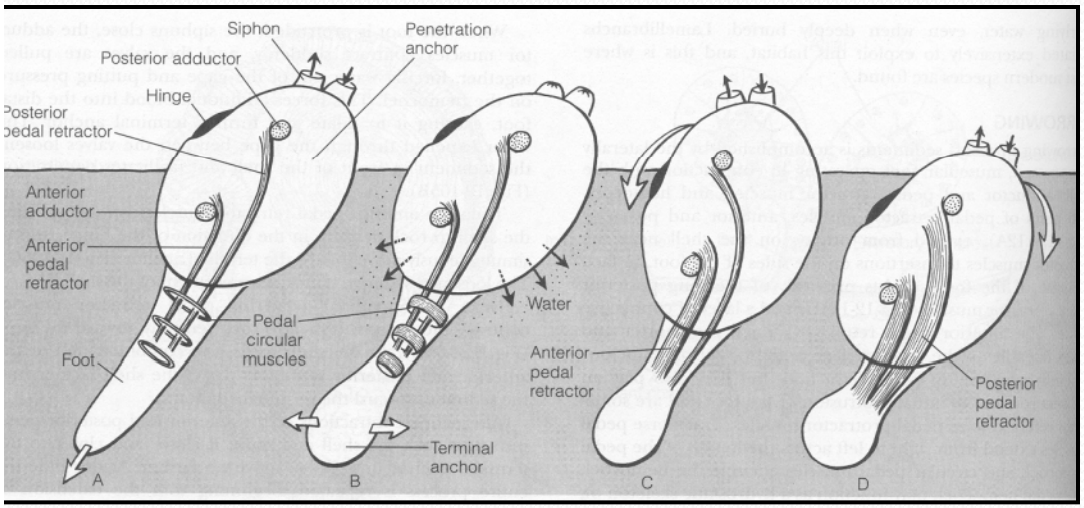
Clam Common Names

- 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

External Clam Shell Anatomy

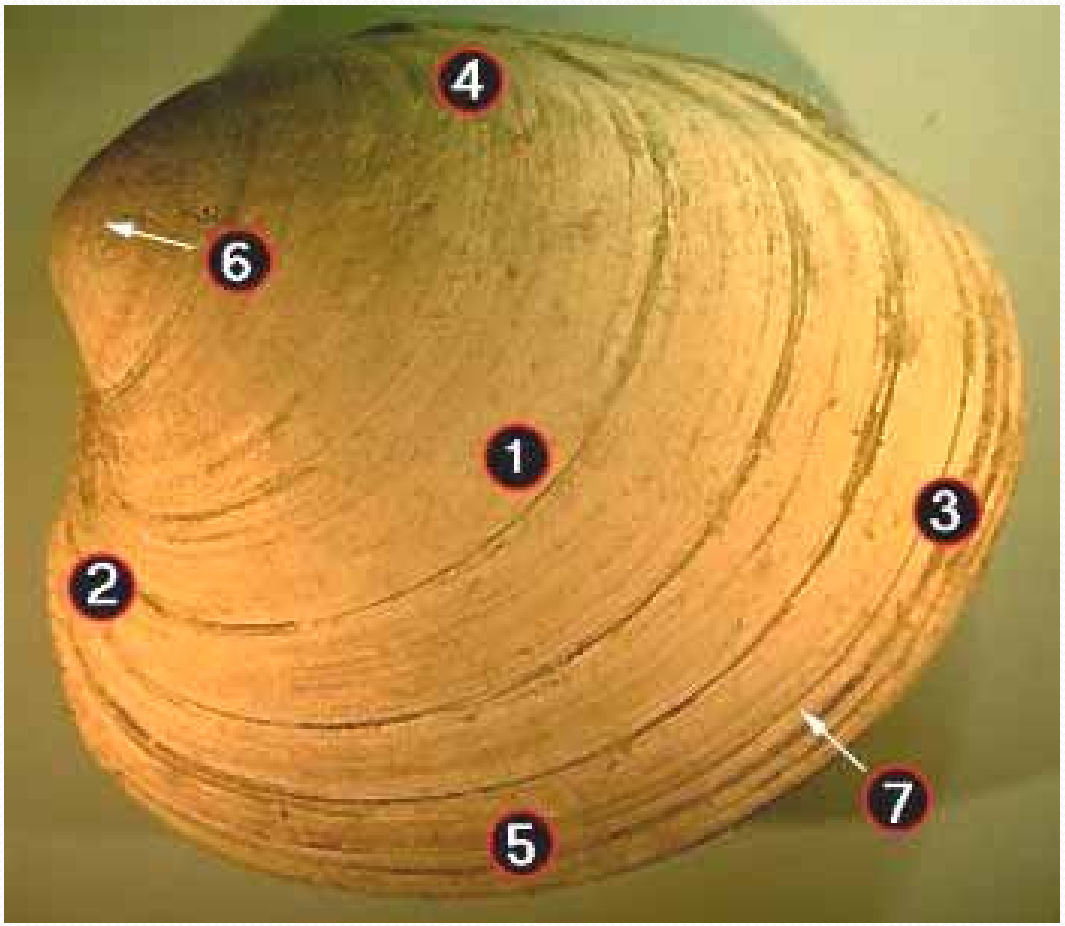


- Two fused siphons extend from posterior end of shell into water
  - "little" necks
- Two muscles keep valves closed
  - Predators or adverse environmental conditions



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

External Clam Shell Anatomy



Northern hard clam, *Mercenaria mercenaria*

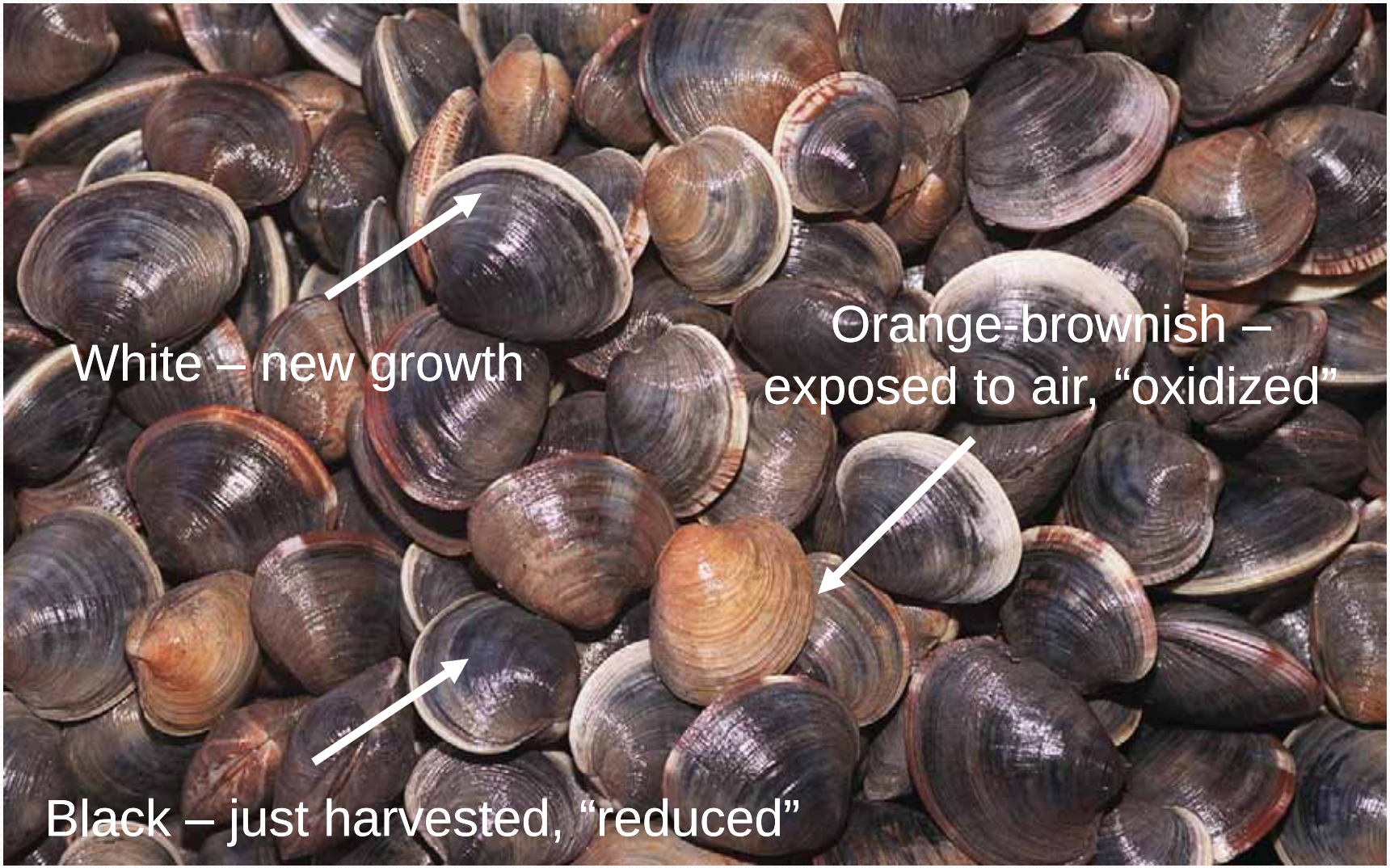
1. Left valve or shell
2. Anterior or head
3. Posterior or tail
4. Dorsal or upper
5. Ventral or lower
6. Umbo (“beak”)
   - Oldest part of the shell
7. Growth ring

Clam Growth

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

Southern Quahog, *Mercenaria campechiensis*

Clam Shell Coloration



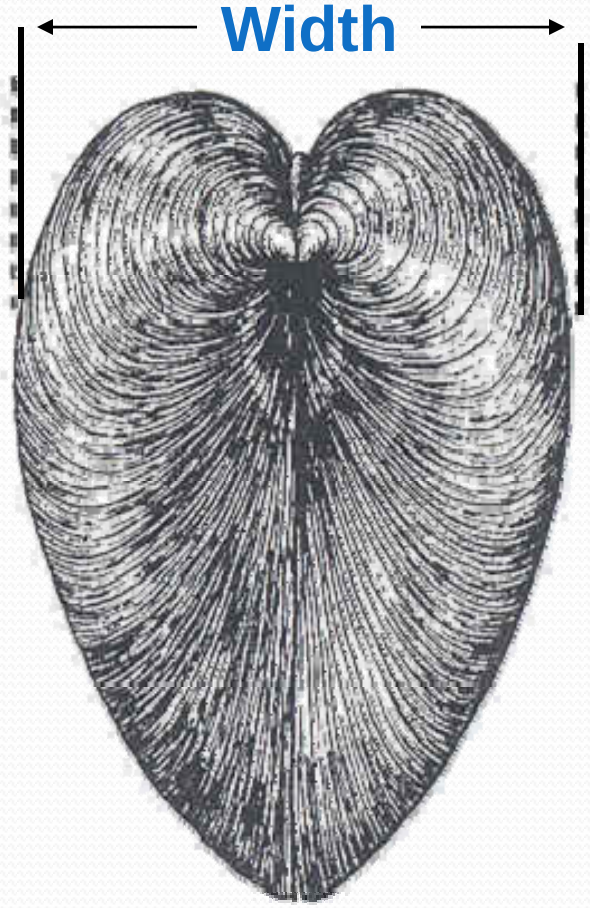
Clam Shell Coloration

- 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

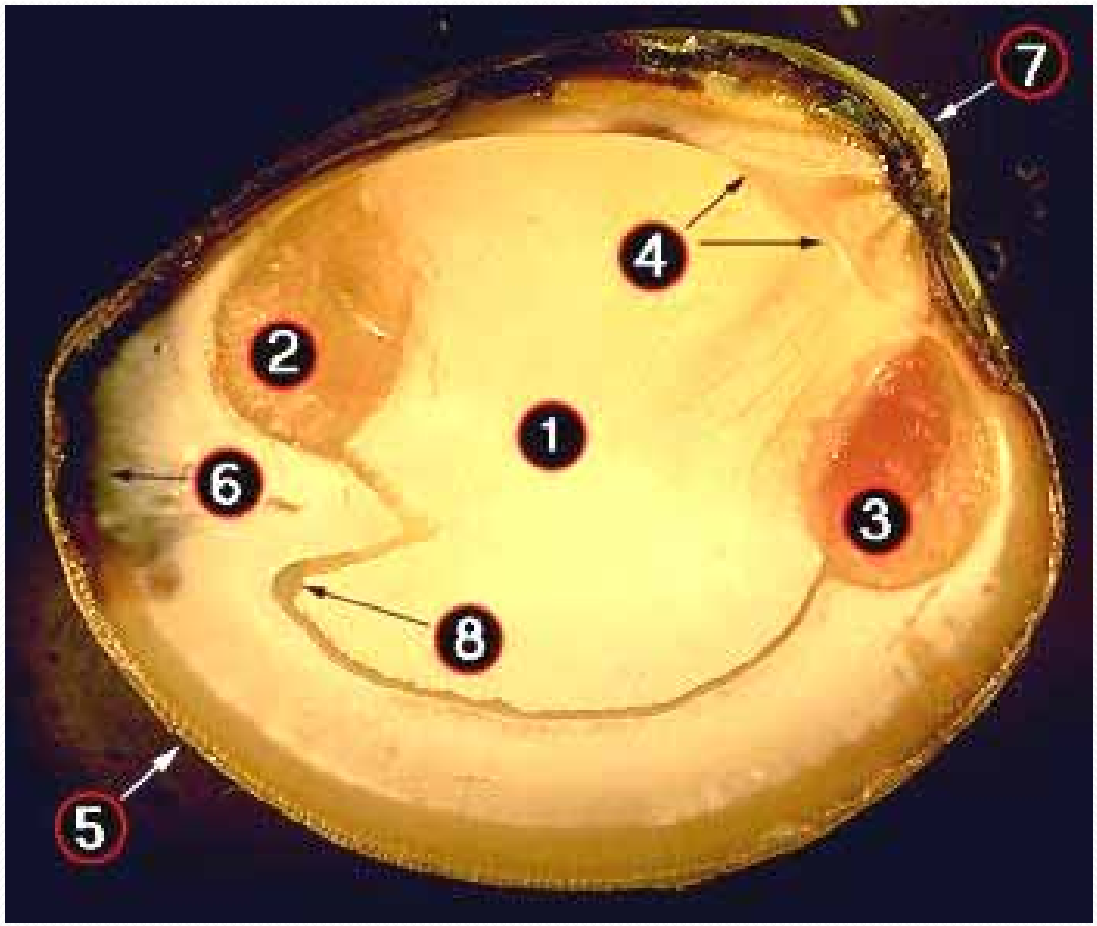
- Shell length
  - Longest dimension
  - From anterior to posterior ends
  - Used in seed sizes
- Shell Height
  - From dorsal (umbo) to ventral

Clam Measurements



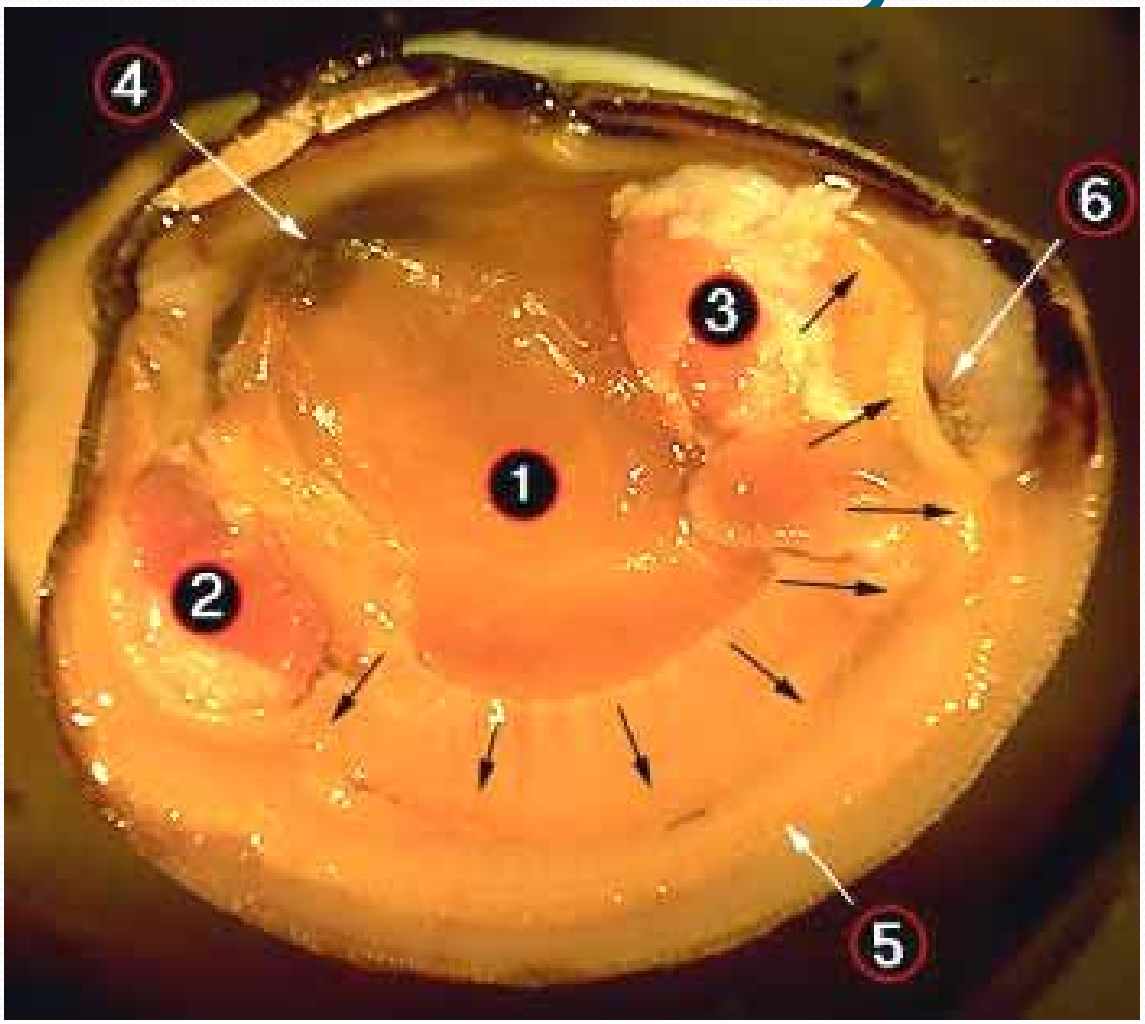
- Shell Width
  - Shortest dimension
  - Across hinge
  - Used in market sizes for cultured product
  - For “wild” harvest, must be ≥1”
- Use calibers to measure

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

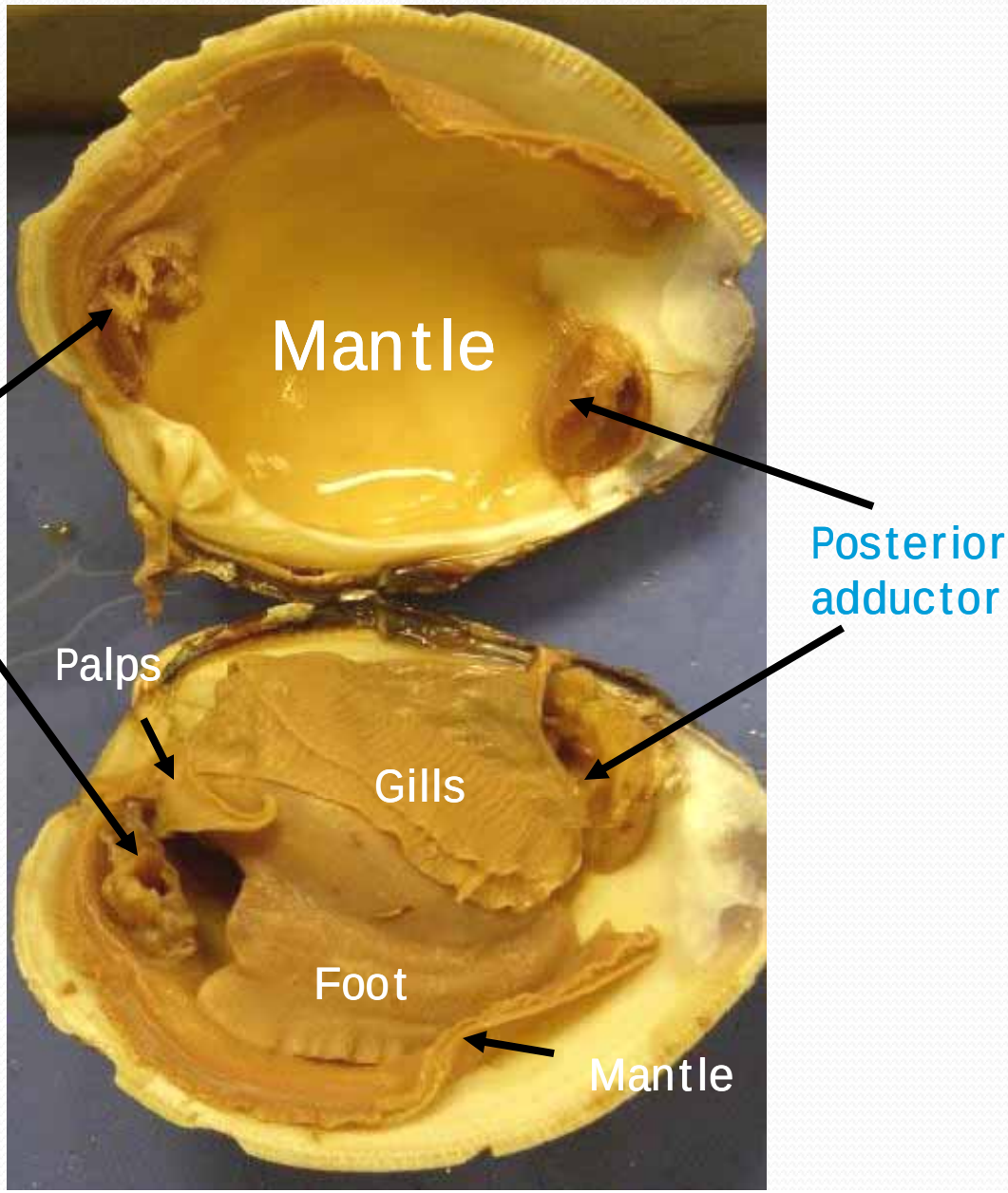
Internal Clam Shell Anatomy



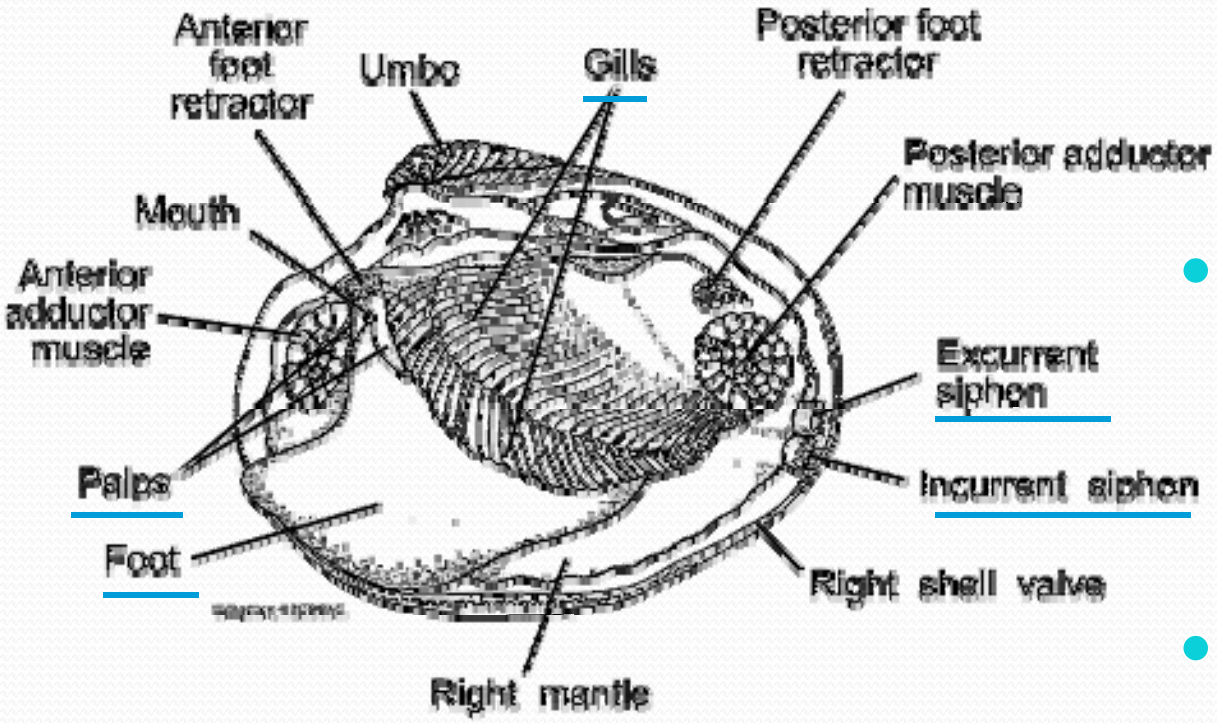
1. Mantle
   - Covers visceral or body mass
   - Holds in fluid
   - Secrets new shell
2. Ant. adductor muscle
3. Post. adductor muscle
   - Hold valves shut
4. Pericardium cavity
   - Region covered with thin, dark membrane
   - Contains 2-chambered heart and kidney in a fluid-filled sac
5. Mantle edge
6. Siphons
   - Left and right mantles join to form siphons

Internal Clam Anatomy

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



Internal Clam Anatomy



- 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

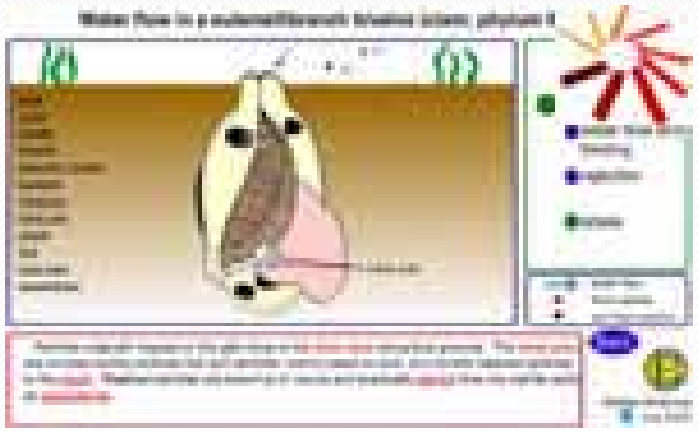
Feeding

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

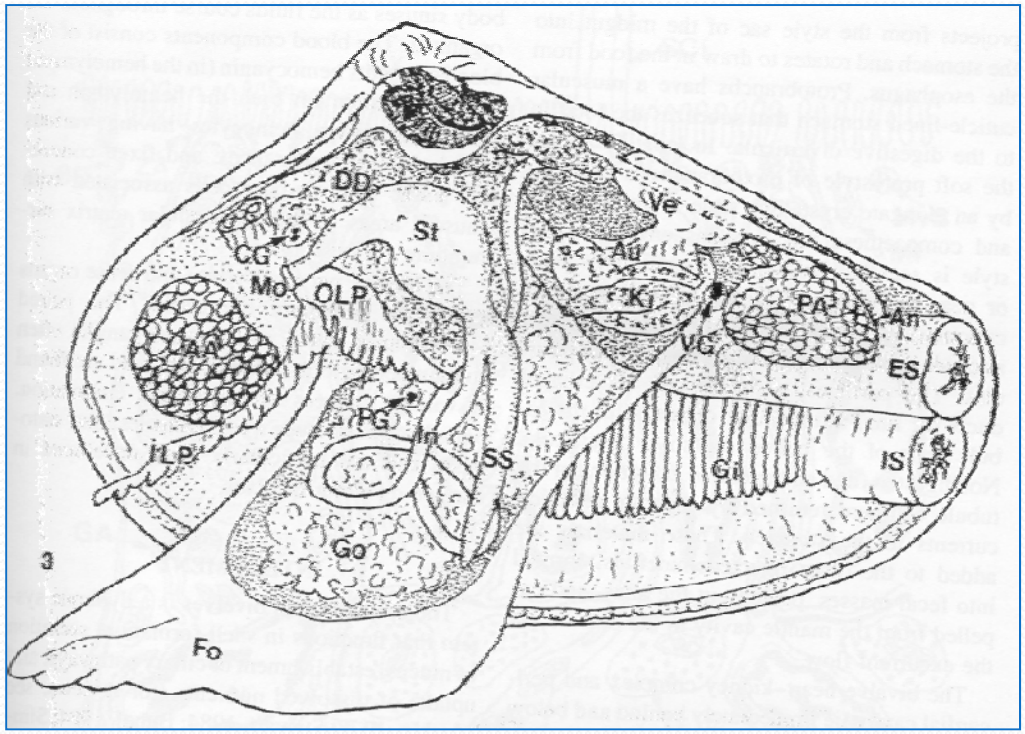
Clam feeding example - animation

- Copy and past the following website address in your internet URL for an animation of clam feeding – it's very interesting!
- http://www.biology.ualberta.ca/facilities/multimedia/?Page=252



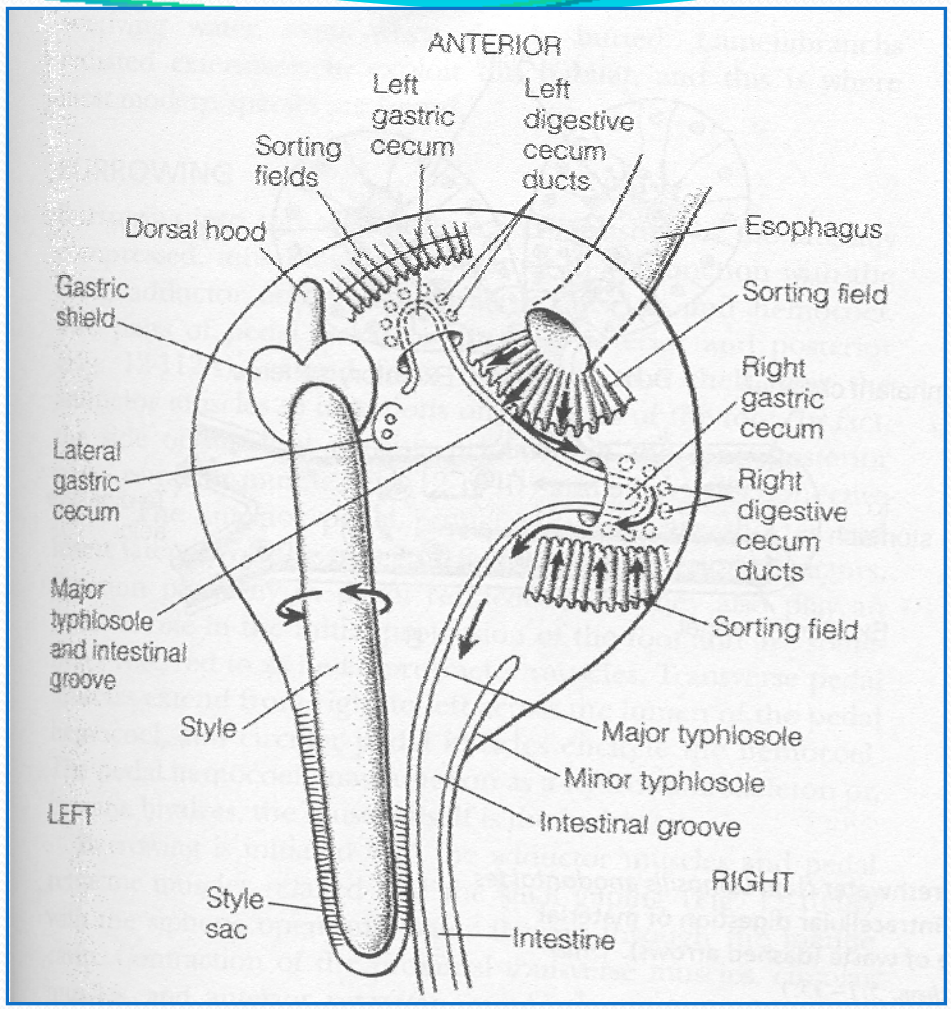
Digestive system

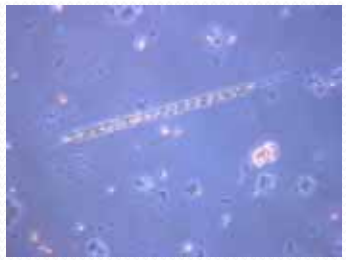
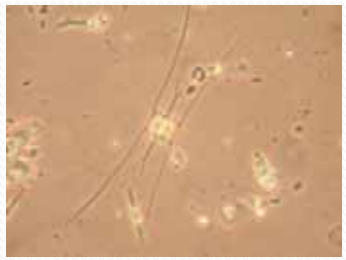
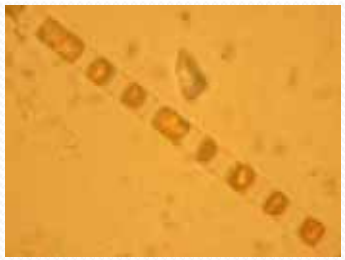
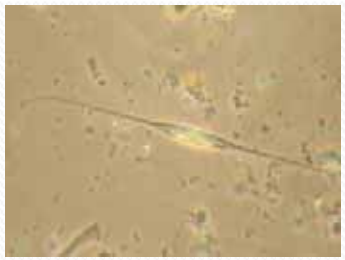
- Mouth (Mo) – between pairs of palps
- Esophagus
- Stomach (St) embedded in digestive diverticula (DD)
- Style sac (SS)
- Intestine (In)
  - Loops through gonad (Go)
  - Passes through ventricle (Ve)
- Anus (An) empties in exhalent siphon (ES)



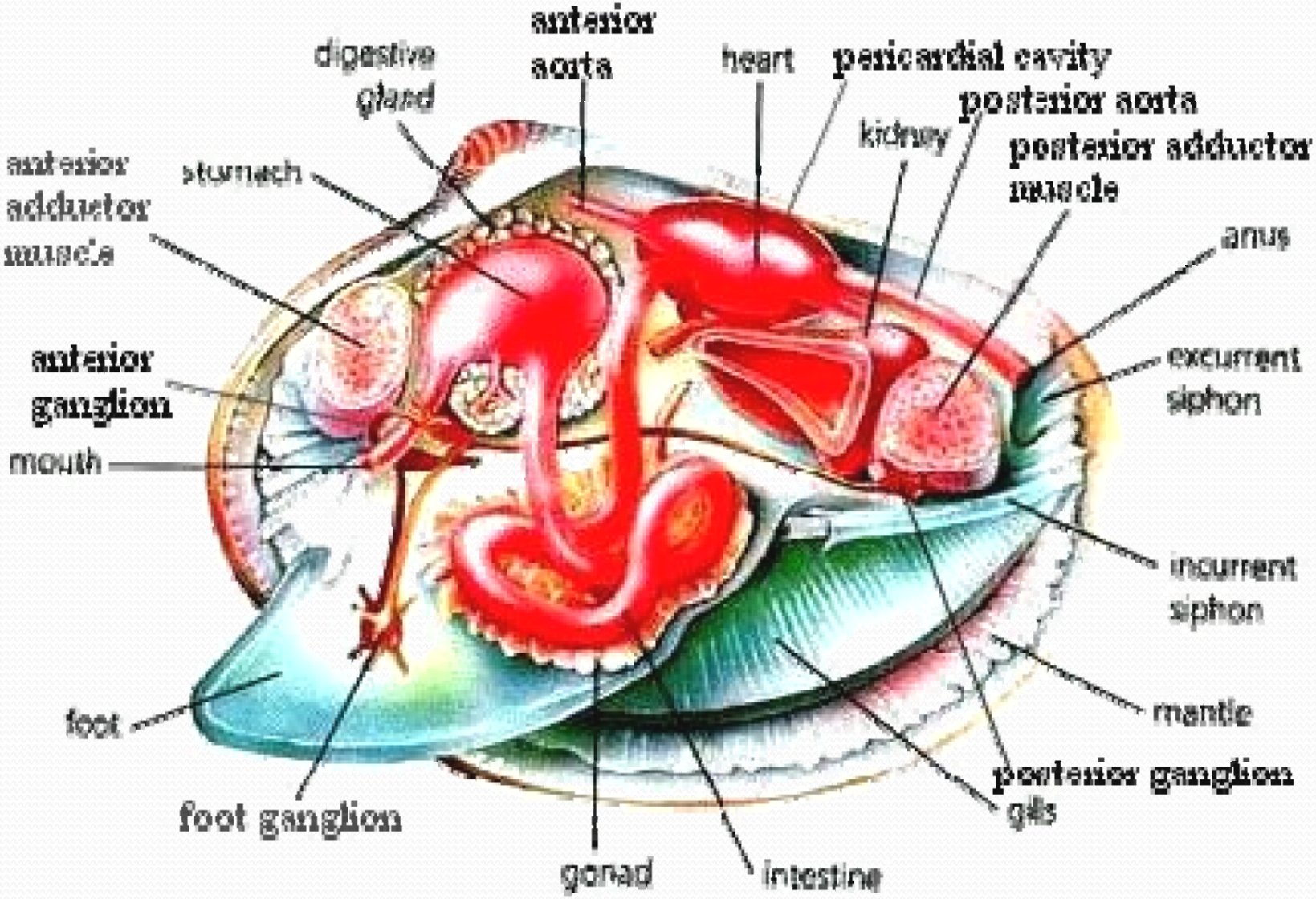
Digestion system

- 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

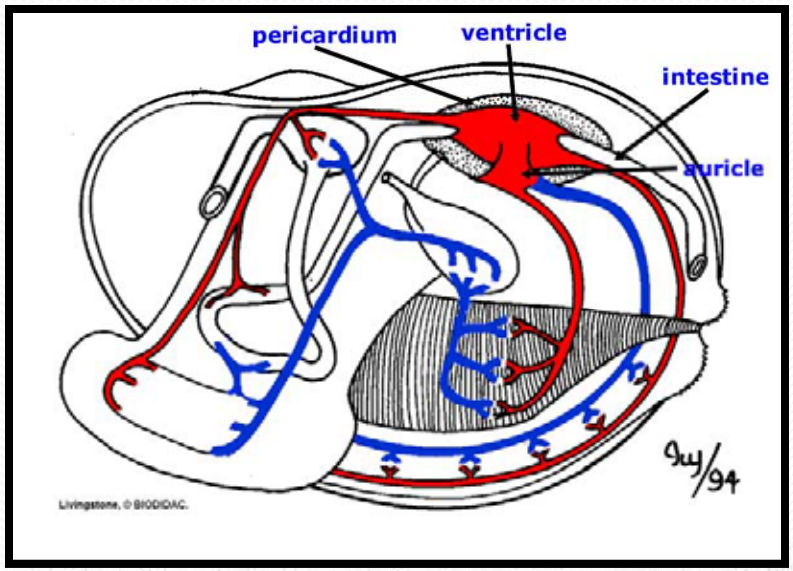


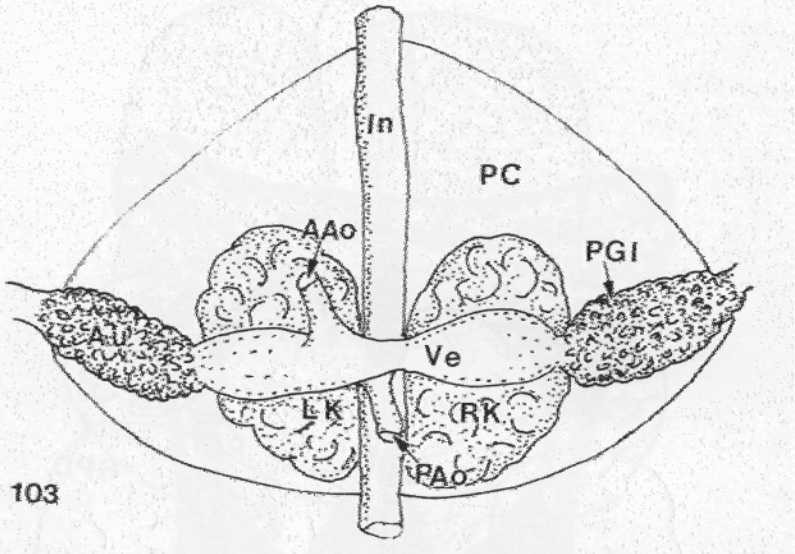






Internal Clam Anatomy



Internal transport – open circulatory system

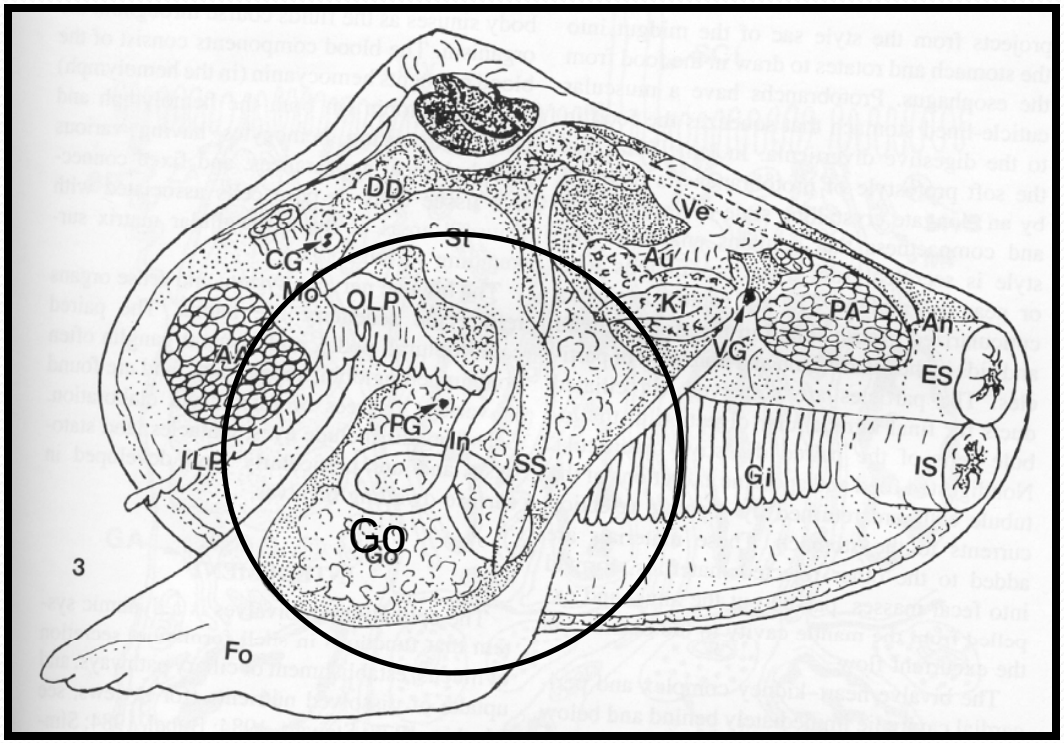




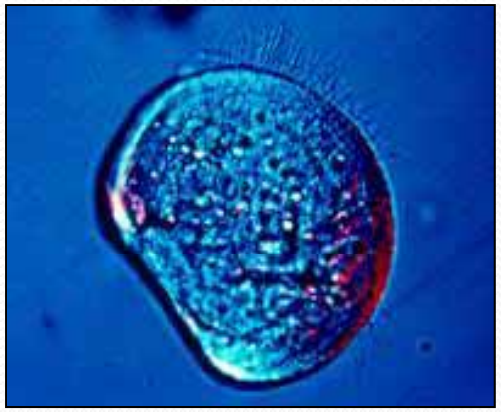
- Heart in pericardial coelom (PC)
- Three chambers:
  - 2 atria (Au)
  - 1 ventricle (Ve)
- Two aortae leave ventricle:
  - Anterior aorta (AAo)
  - Posterior aorta (PAo)
- Aortic bulb
  - Temporary reservoir for hemolymph when siphons contract

Reproductive system

- Gonadal follicles grow and ramify throughout visceral mass and foot
- Usually protandric – spawns as male first year
- Second year – about half become female at 20-35 mm
- In SE gametogenesis can occur all year
- External fertilization

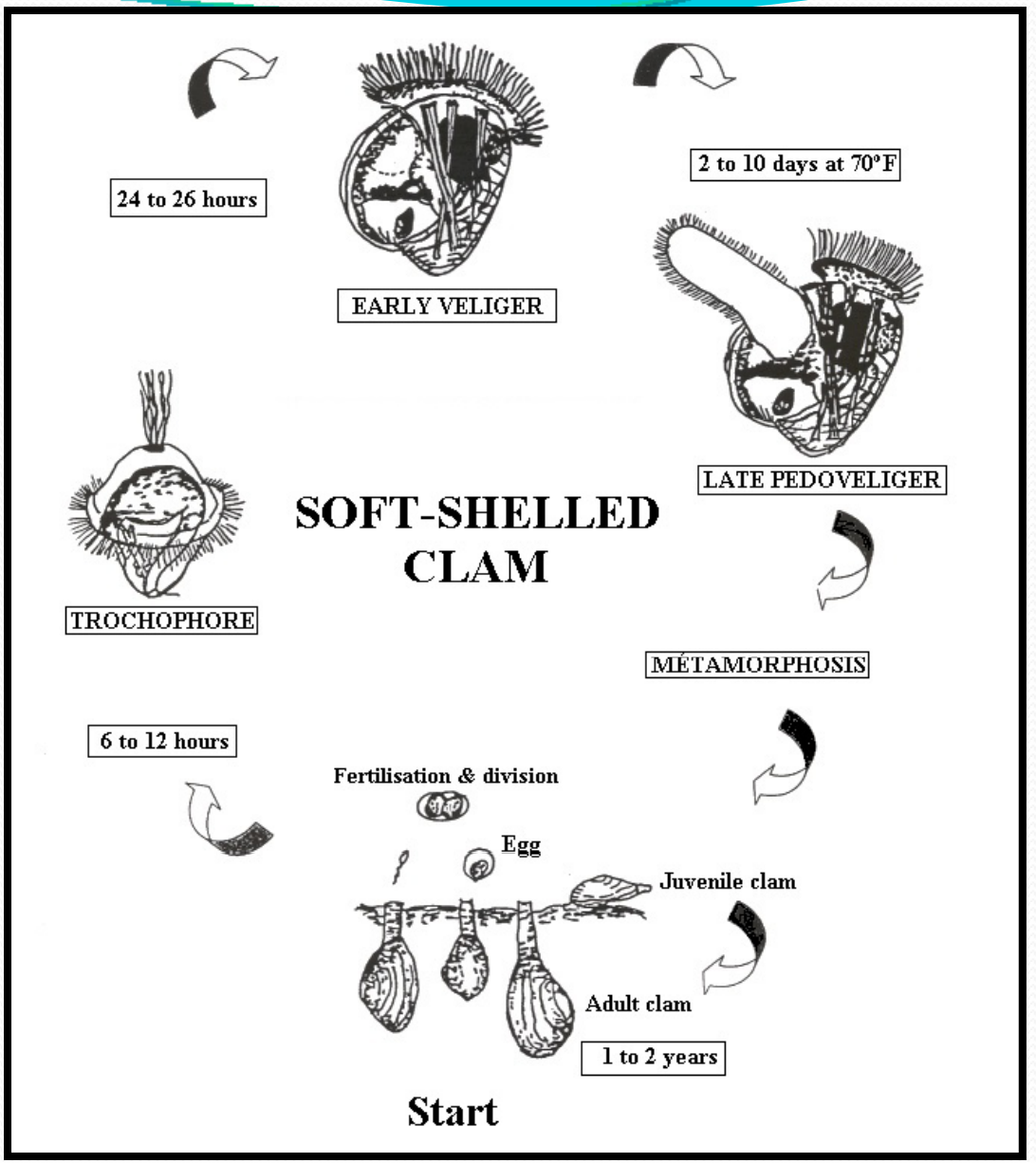


Development

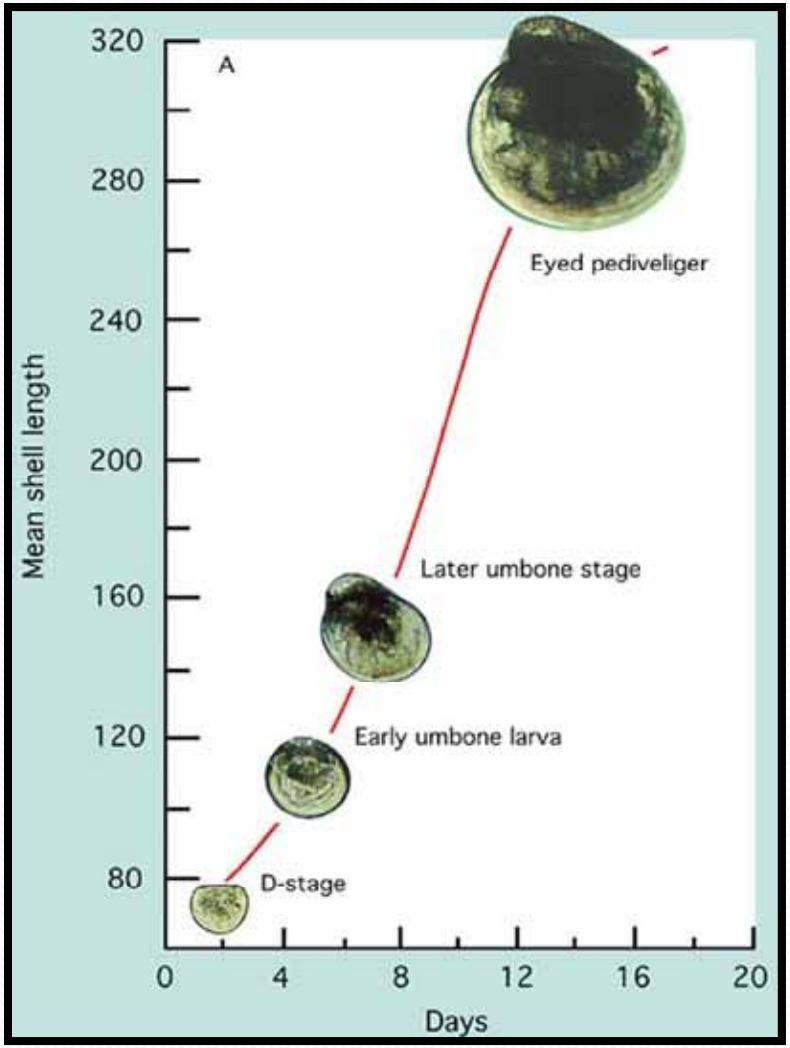


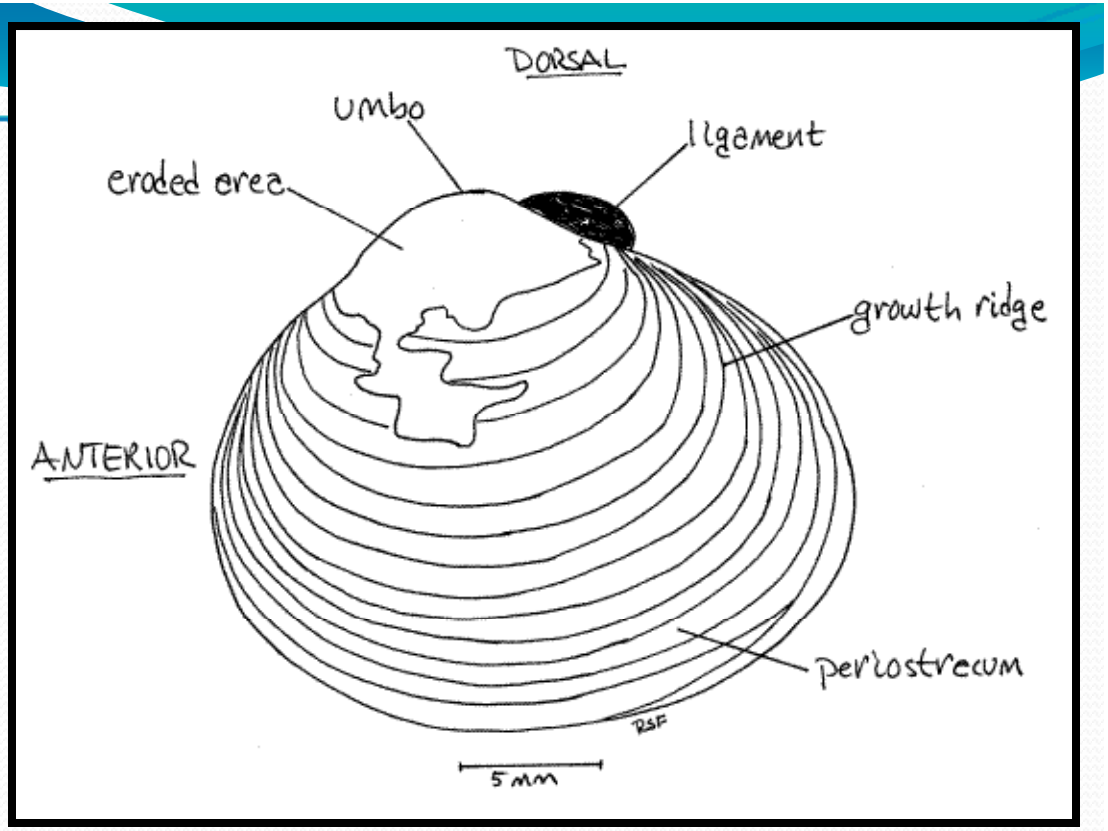
D-staged veliger

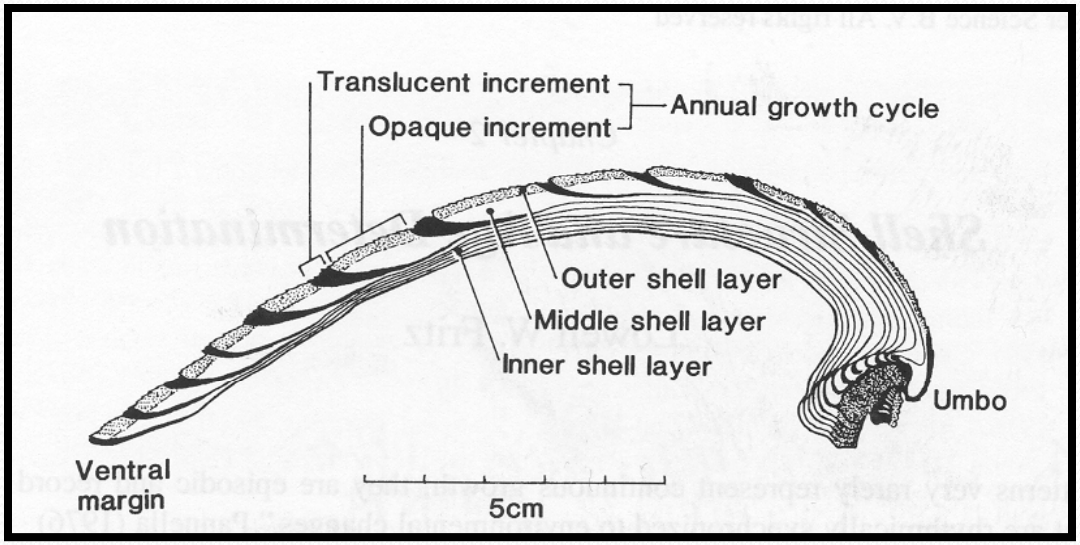
Pediveliger



Growth


A
320
280
240
200
160
120
80
Mean shell length
Eyed pediveliger
Later umbone stage
Early umbone larva
D-stage
0
4
8
12
16
20
Days


DORSAL
umbo
ligament
eroded area
growth ridge
ANTERIOR
periostracum
RSF
5 mm


Translucent increment
Opaque increment
Annual growth cycle
Outer shell layer
Middle shell layer
Inner shell layer
Umbo
Ventral margin
5cm

Clams from Florida

Thank you!