Garden of the Salish Sea

The Salish Sea is the unified bi-national ecosystem that includes Washington State's Puget Sound, the Strait of Juan de Fuca and the San Juan Islands as well as British Columbia's Gulf Islands and the Strait of Georgia.

We have unique opportunities to learn about the value of protecting shellfish, marine resources and water quality. Shellfish also fit into the context of gardening and nutrition. We are fortunate to have Puget Sound and the Salish Sea as our laboratory.

Marine resources are close to home

Marine Marathon

- Marine Marathon Kick-off pre-field trip presentation.
- Drayton Harbor Community Oyster Farm field trip.
- Field trip follow-up – share your work on the Garden of the Salish Sea website.
- Salish Sea Pledge – practice healthy watershed habits at home.

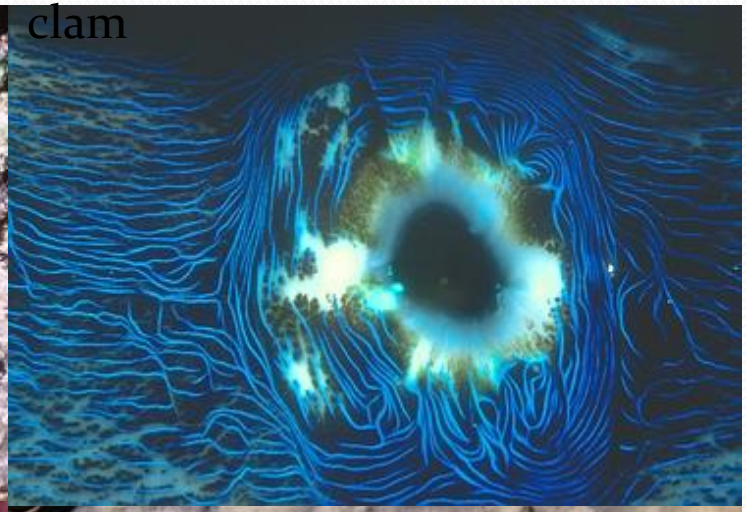
 Sponsored by PSRF, funded by Whatcom Community Foundation

SHELLFISH

Come in all shapes, colors and sizes!

Giant clam

Tridacna clam



Cockscomb oyster

Rough file clam

Geoduck clam-*Panopea generosa the largest burrowing clam can reach 8 lbs and live more than 150 years.*

Manila clam-*Venerupis philippinarum* introduced from Japan.

Pacific oyster - *Crassostrea gigas*, introduced from Japan.

Olympia oyster, *Ostrea lurida* is the only oyster native to Puget Sound. It's populations are threatened.

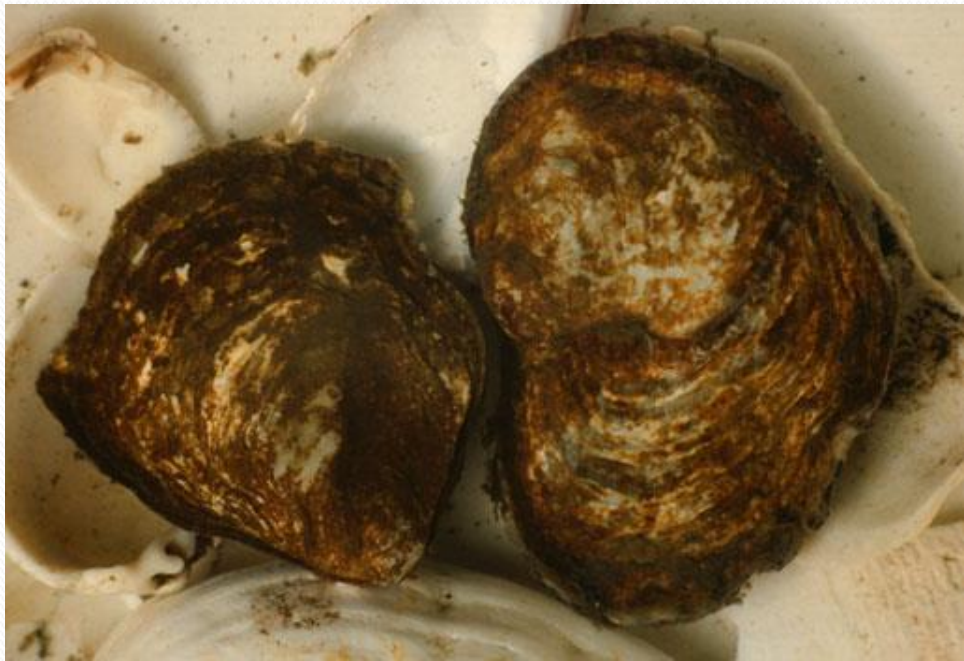


Photo by Geoff Menzies

Shellfish tell us about history

A shell midden is a heap of clam, oyster, or mussel shells where people lived or camped that can date back to the Stone Age. They are clues to how and where groups of people lived.

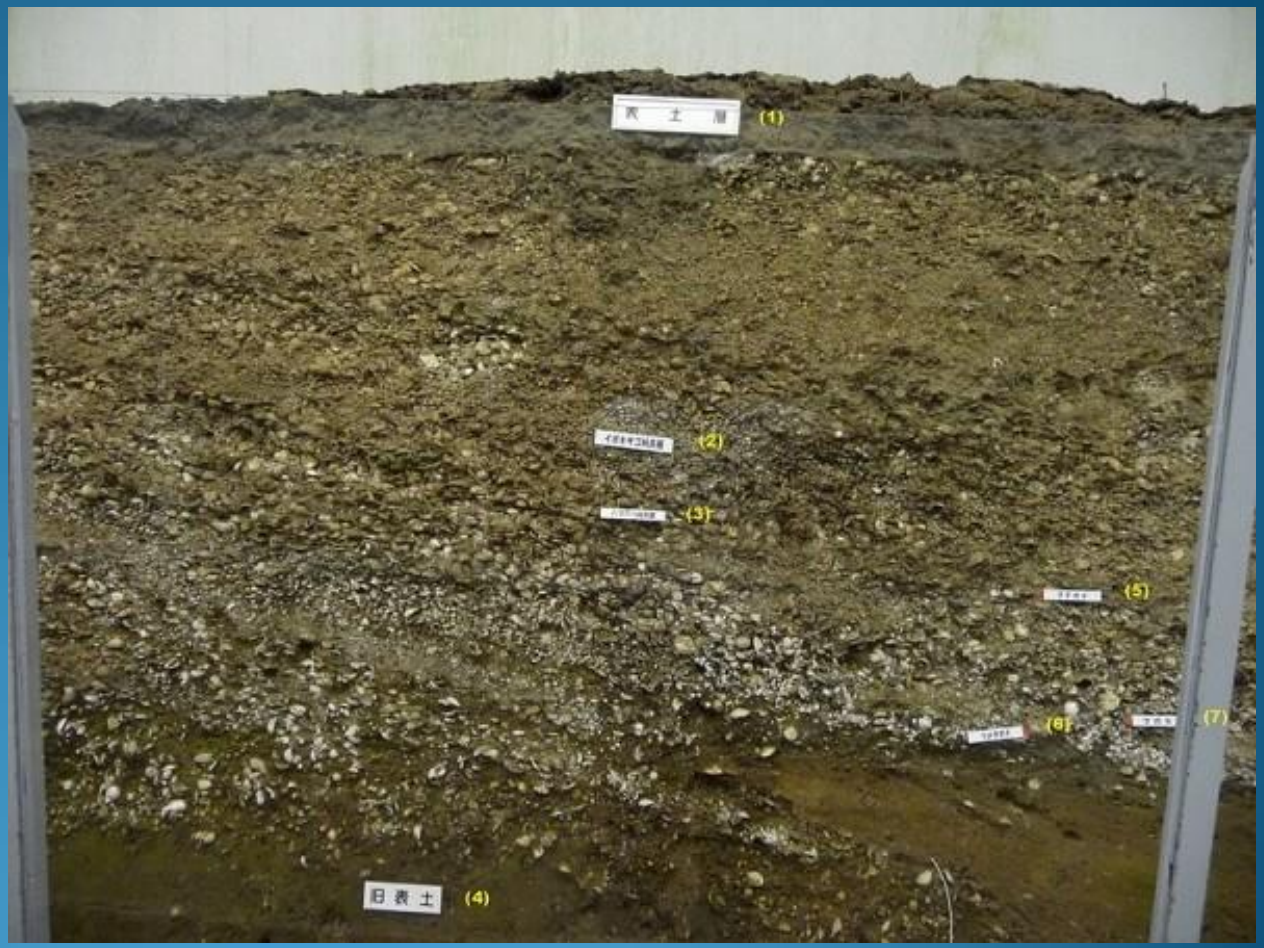
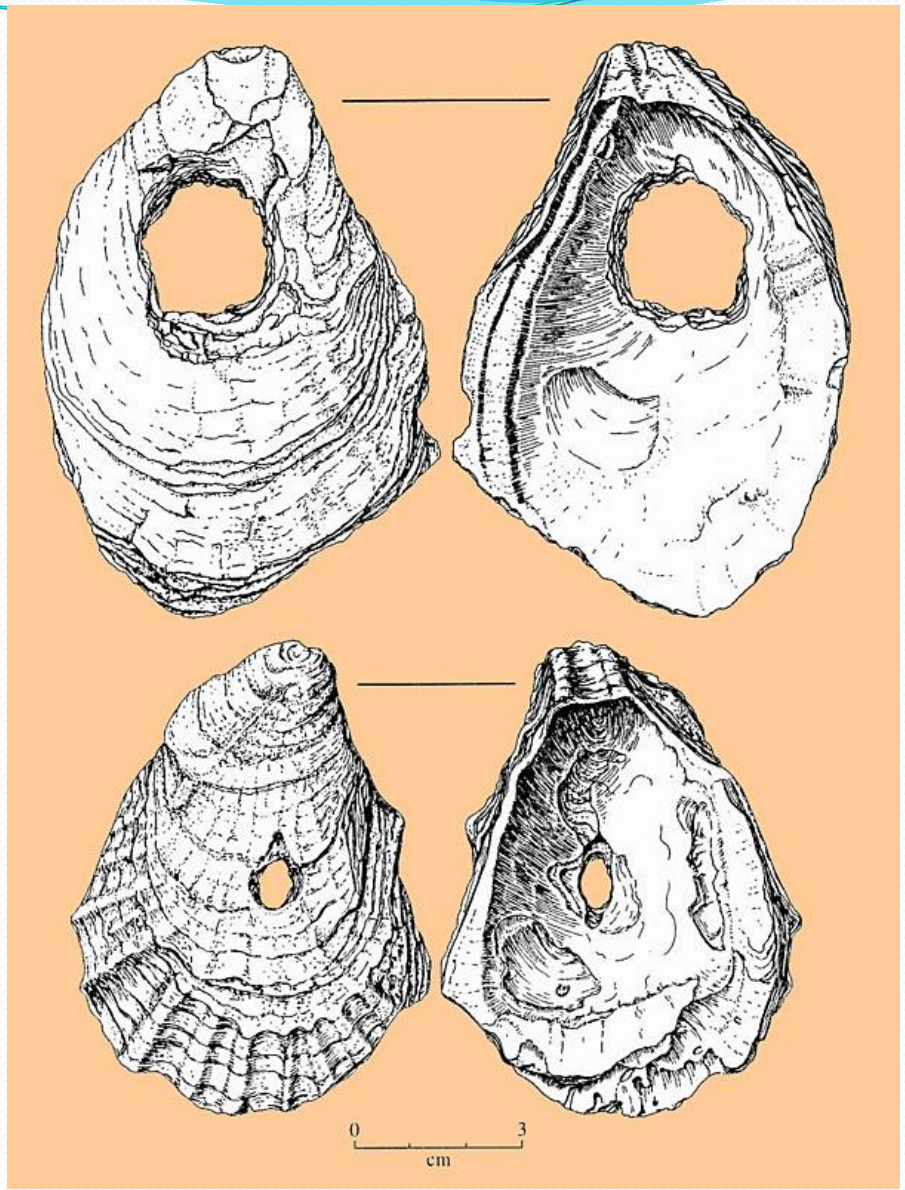


Photo public domain

Coast Salish Culture

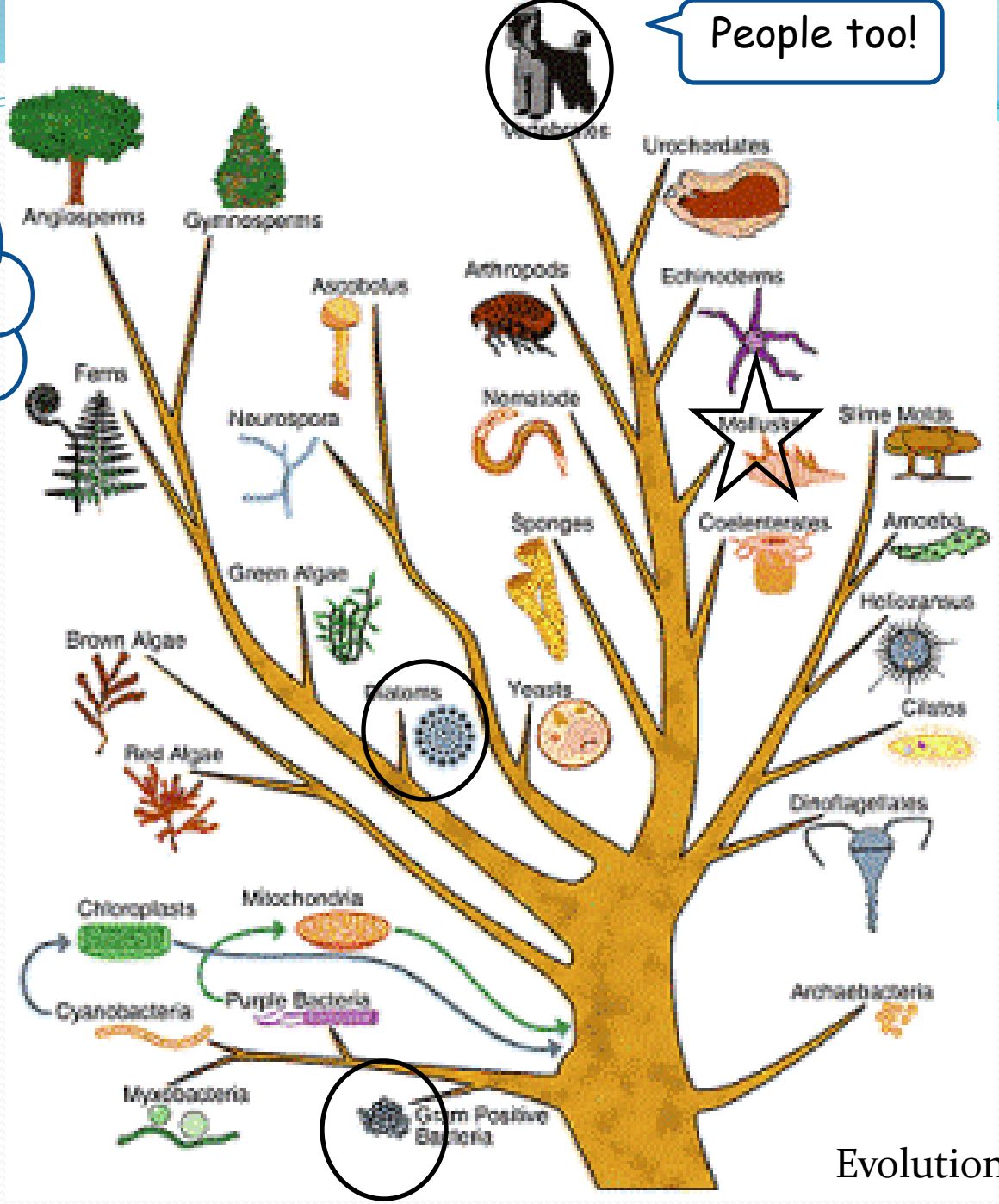
Shellfish are an important part of Native-American culture. Coast Salish people have harvested shellfish historically for food, used shells for tools and in ceremony for thousands of years.

Hoe blade



Fishing net weights

Cast of characters



Evolutionary

Shellfish classification

mollusk: invertebrate with a soft unsegmented body usually enclosed in a shell, or exoskeleton.

- Pacific oyster

  Kingdom: Animalia
  Phylum: Mollusca
  Class: Bivalvia
  Order: Ostreoida
  Family: Ostreidae
  Genus: ***Crassostrea***
  Species: ***C. gigas***
  Binomial name
  Crassostrea gigas

- Manila clam

  Kingdom: Animalia
  Phylum: Mollusca
  Class: Bivalvia
  Subclass: Heterodonta
  Order: Veneroida
  Suborder: Cephalaspidea
  Superfamily: Veneroidea
  Family: Veneridae
  Genus: *Venerupis*
  Species: ***V. philippinarum***


Intertidal Zone
Organisms
Sculpin
Tidepool
Periwinkle
snail
Barnacles
Isopods
Limpets
Barnacles
Isopods
Chitons
Sea star
Sea anemone
Sea star
Mussels
Limpets
Mussels
Isopods
Hermit crab
Crab
©EnchantedLearning.com
Spray Zone
(Usually dry)
High Tide Zone
(Wet during high tide)
Middle Tide Zone
(Wet and dry)
Low Tide Zone
(Usually wet)

Oyster Anatomy

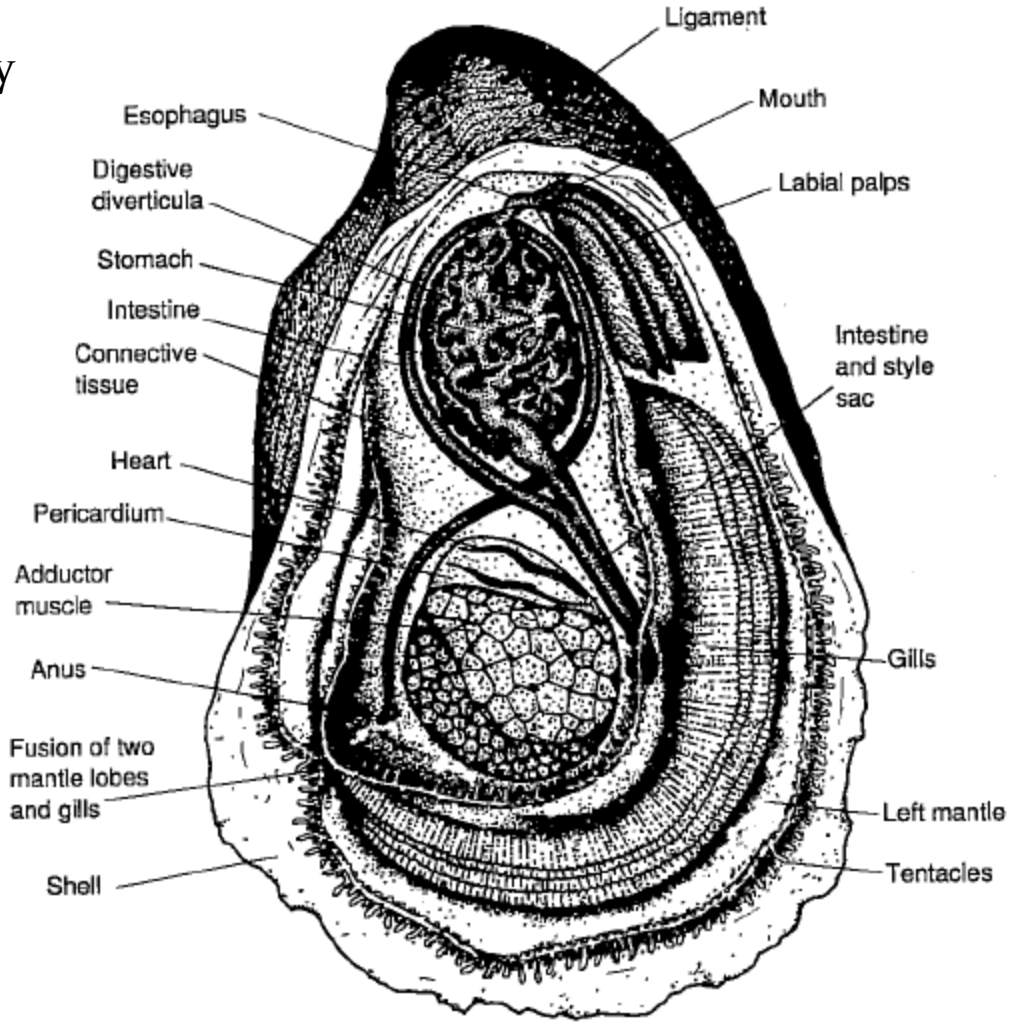
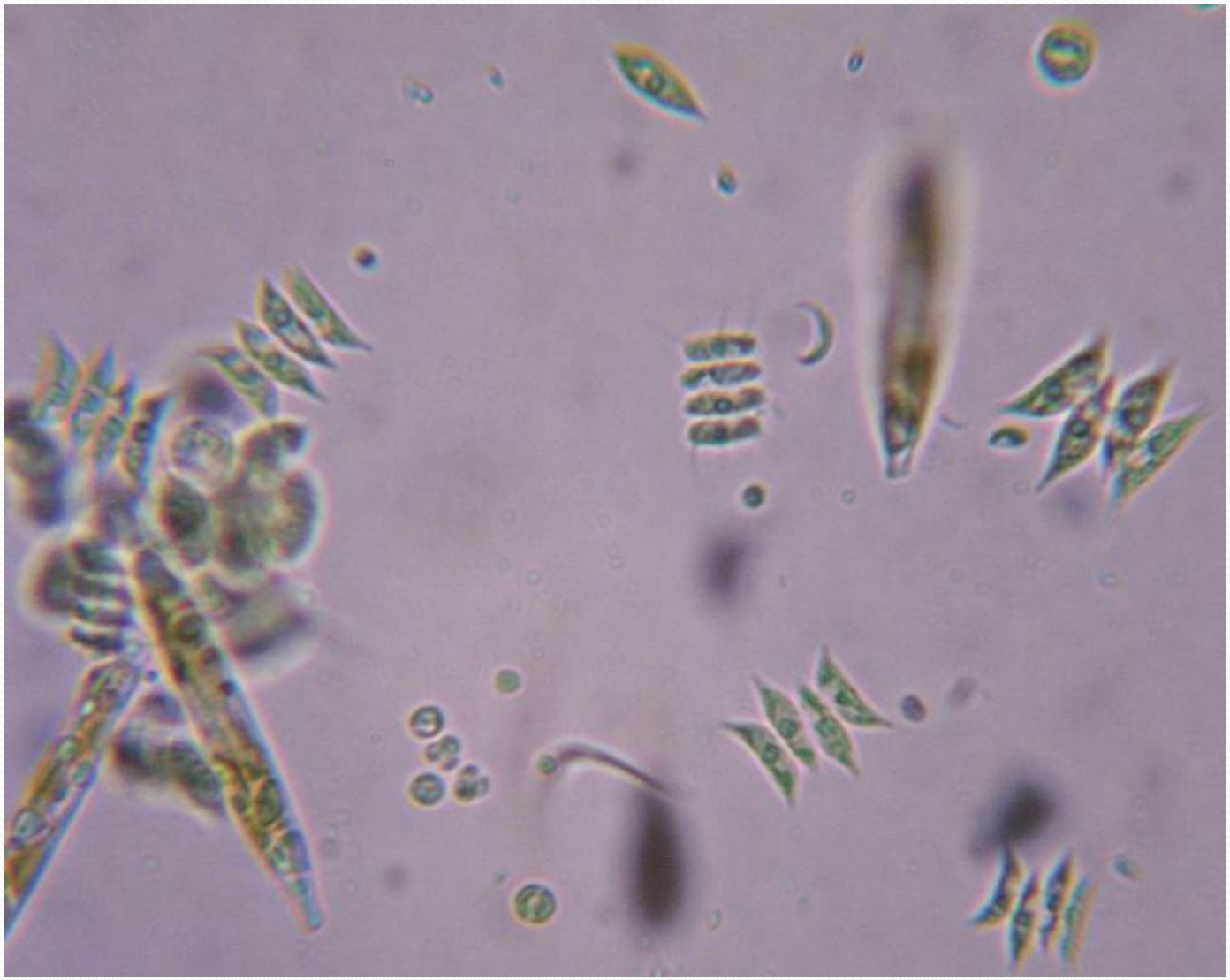


Figure 14. Adult American oyster *(Crassostrea virginica)* showing the anatomical reorganization mentioned in Figure 1. The mouth is now near the hinge region and, as in other oysters, the anterior adductor muscle has degenerated, leaving only the single larger posterior adductor muscle. After P. S. Galtsoff, *The American oyster,* Fishery Bulletin (U.S.) 64.



Each shellfish can filter up to 65 gallons per day!

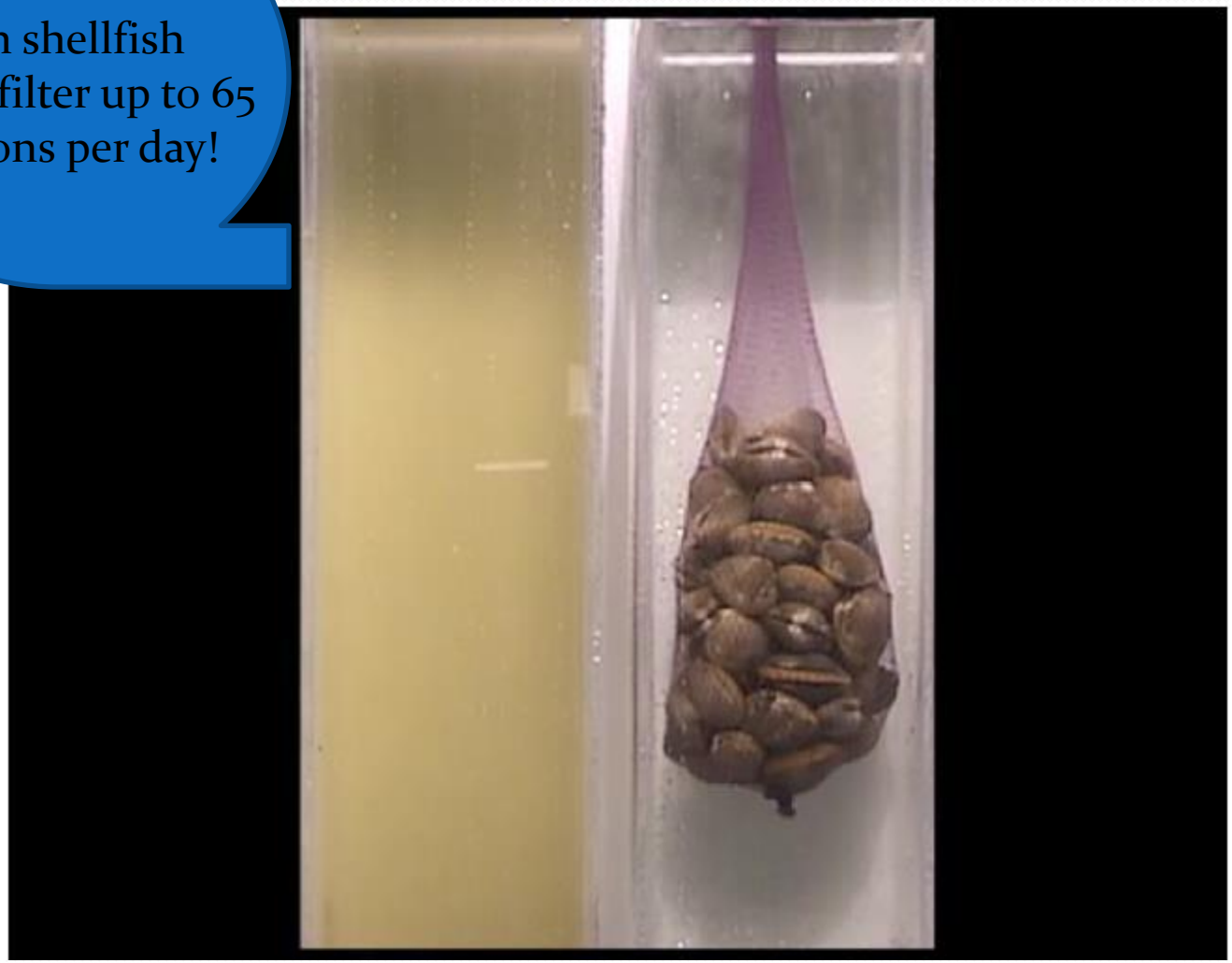
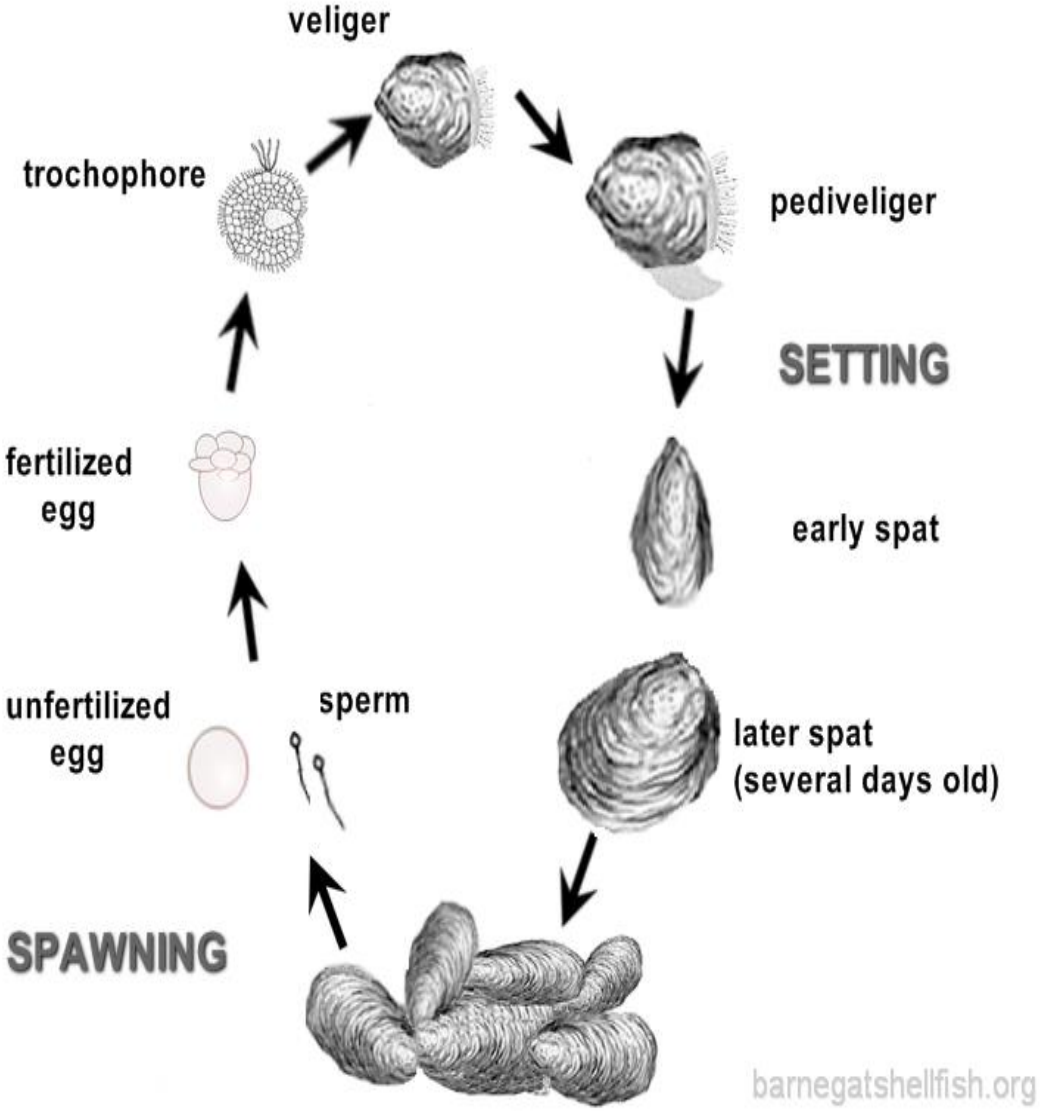


Photo by PCSGA

Life Cycle

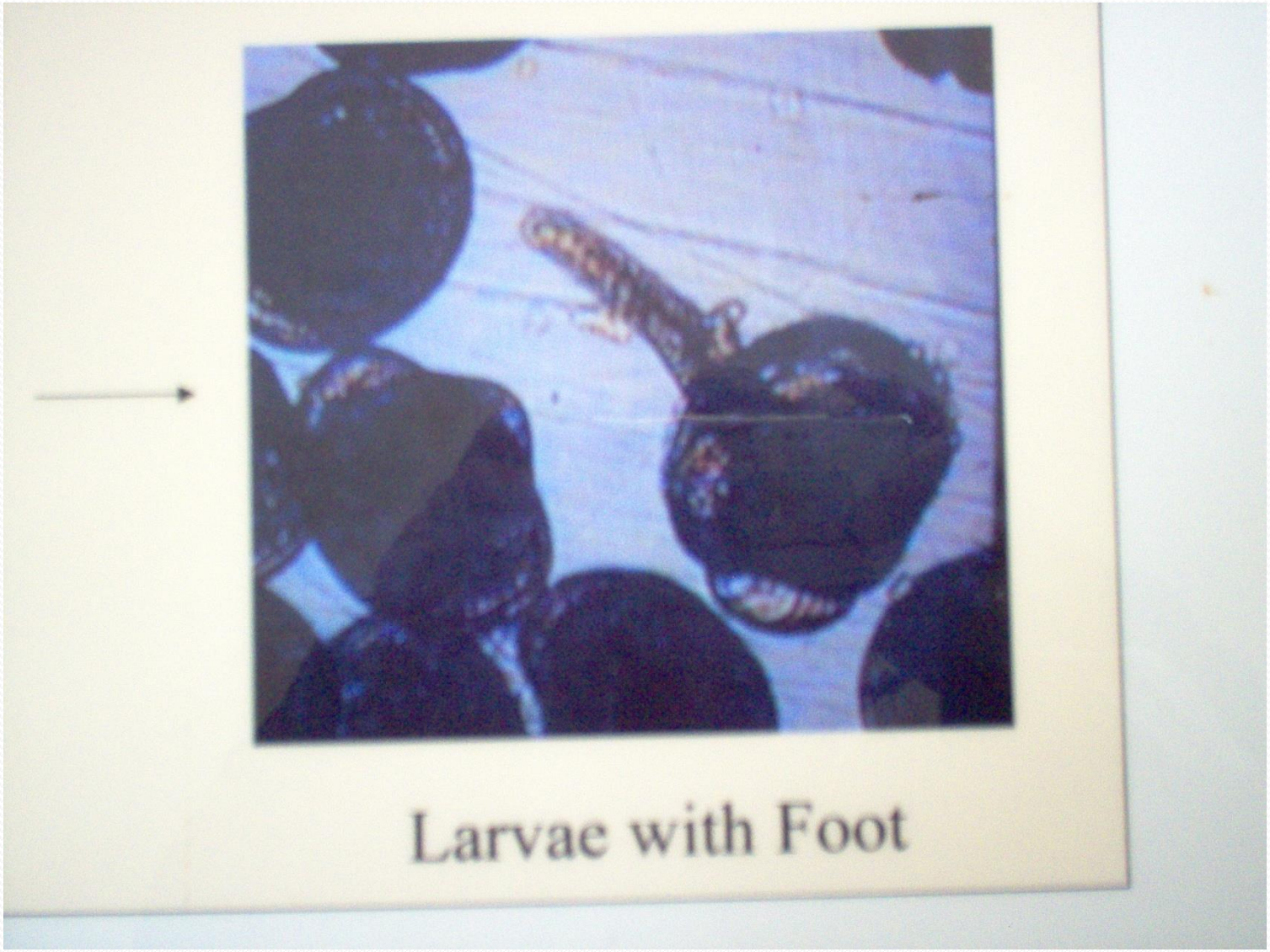
Adult oysters begin reproduction when water temperatures become greater than 68°F (~20°C). This generally occurs from May through October. Oysters are broadcast spawners, meaning they release eggs and sperm into the water column. A fertilized egg develops into a planktonic (free-swimming) trochophore larva in about 6 hours. A fully shelled veliger larva is formed within 12 to 24 hours. The larva remains planktonic for about three weeks. Towards the end of this period it develops a foot (hence, pediveliger) and settles to the bottom of the water column where it seeks a hard substrate. When a suitable surface (ideally adult oyster shell) is located, the larva cements itself and metamorphoses to the adult form. This newly attached oyster is known as a "spat."



Hey that's the study of paleontology!

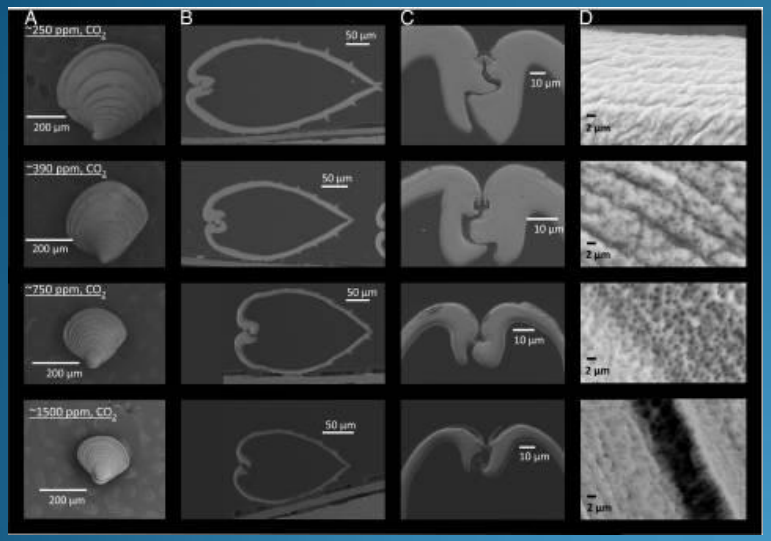
Fossils are the remains of buried prehistoric organisms like shellfish. They record the history of life from about 3.5 billion years ago .

Shell fossils tell us about extinct species and where there were prehistoric oceans.


Larvae with Foot

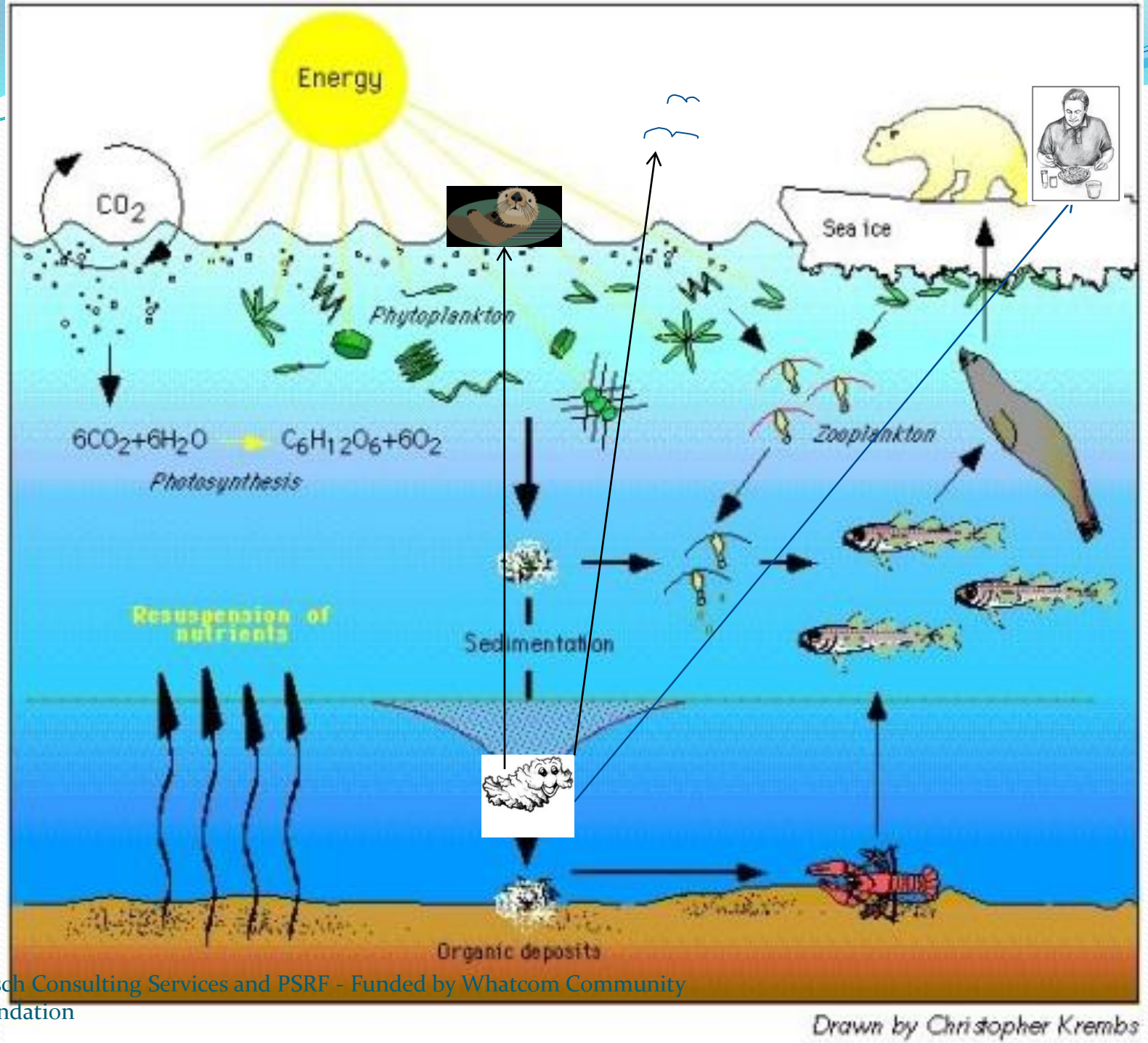
Shellfish at risk: Puget Sound becoming acidified

The waters of Puget Sound and Hood Canal are becoming more acidified as a result of rising carbon dioxide from industries, power plants and vehicles. Scientists from the University of Washington and the National Oceanic and Atmospheric Administration warn that the shifting water chemistry could damage the region's shellfish industry. *Seattle Times article June, 14 2010.*

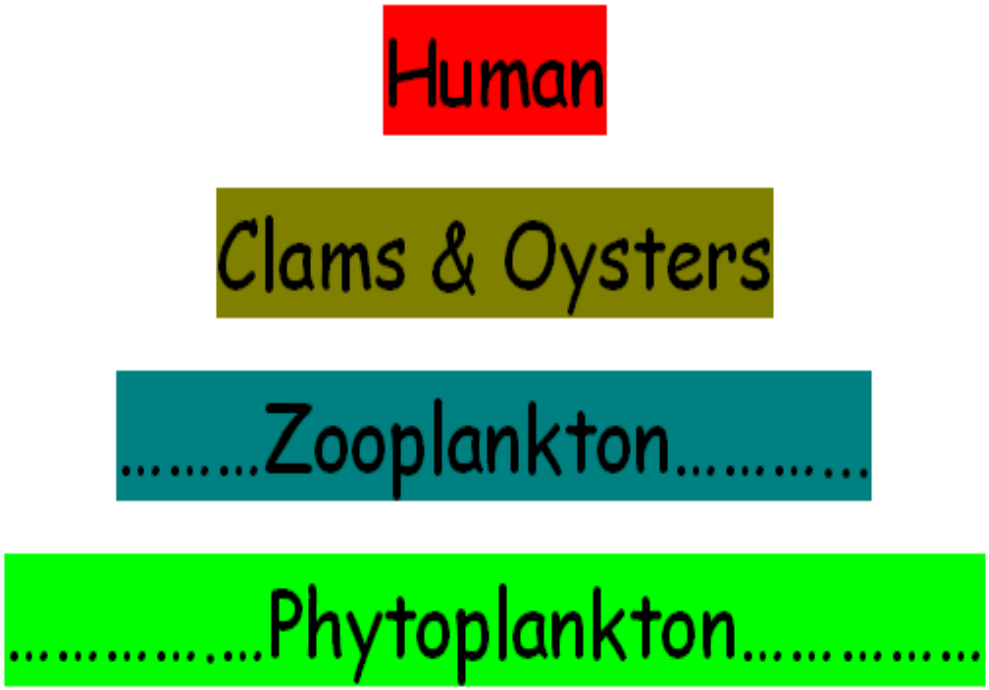


Proc Natl Acad Sci U S A. 2010 October 5; 107(40):

Atmospheric carbon dioxide dissolves in seawater, producing acids that raise the water's corrosiveness. As seawater becomes more corrosive, it can kill fish eggs and essentially dissolve the shells of small crustaceans, baby shellfish, and other tiny creatures at the base of the food web. Among the hardest hit: oyster larvae.



Hirsch Consulting Services and PSRF - Funded by Whatcom Community Foundation



Shellfish Food Chain

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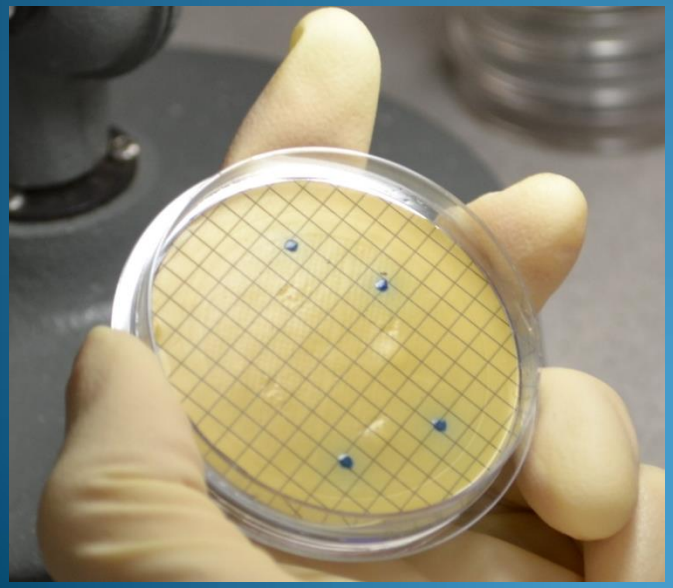
Even humans? Yep, us too.

Fecal coliform bacteria live in the guts of warm blooded animals ,

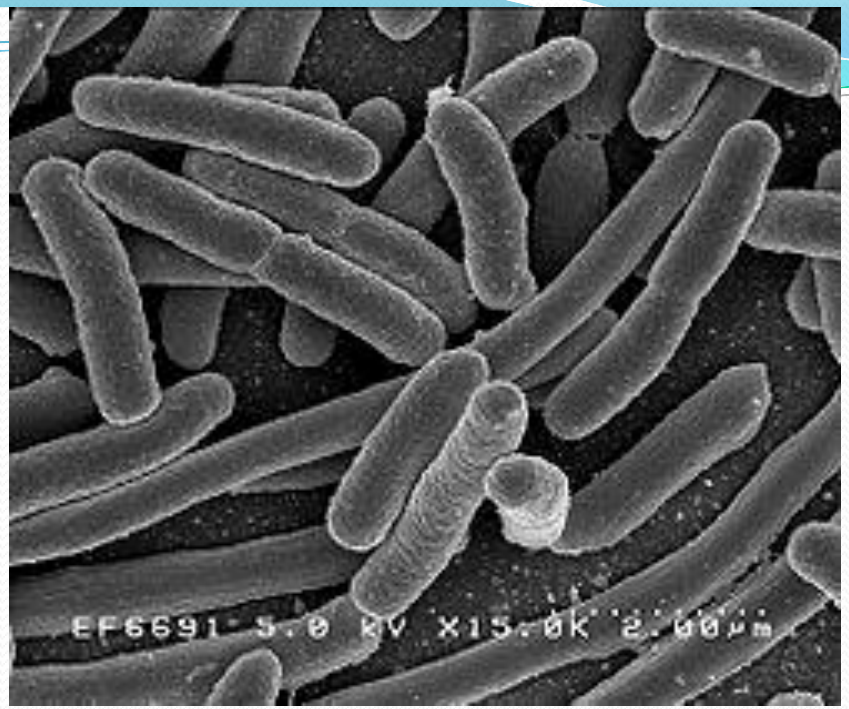
(like some disease causing organisms or *pathogens*).

They are water quality *indicators*. Fecal coliform bacteria can indicate the presence of some *pathogens like E.coli*. Too much = pollution!

1 gram of dog feces contains 23 million fecal coliform bacteria- thats 1.1 billion per pound!



That's the straight poop!



Proteobacteria

Escherichia coli

Scientific classification	
Domain:	Bacteria
Phylum:	**Proteobacteria** Stackebrandt et al., 1988 [1]

DANGER

DO NOT EAT TOXIC varnish clams!

Varnish clams in this area are unsafe to eat due to the biotoxins paralytic shellfish poisoning (PSP) or amnesic shellfish poisoning (ASP).

- Shiny brown coating on the outside
- Purple on the inside
- Oval shaped
- Up to 2.5 inches long

ĐỪNG ĂN LOẠI SÒ VARNISH (Vietnamese)

ចូរកុំបរិភោគលៀសពណ៌ភ្លឺរលោង (Cambodian)

ห้ามกินหอย VARNISH (Lao)

빛조개(VARNISH CLAMS)를 먹지마십시오 (Korean)

НЕ УПОТРЕБЛЯЙТЕ В ПИЩУ ДВУСТВОРЧАТЫХ МОЛЛЮСКОВ VARNISH CLAM (Russian)

切勿食用朦朧圓濱蛤 (Chinese)

No coma almejas amarillas púrpura barniz (varnish clams) (Spanish)

Washington State Department of Health

360-236-3330

Always check the biotoxin hotline:

1-800-562-5632 or

www.doh.wa.gov/shellfishsafety.htm

For more information, contact:

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Heaven on the half-shell

- Shellfish are good for you!
- Low in fat
- Rich in Omega-3 fatty acids
- High in protein
- “BRAIN FOOD”, rich in amino acids used by your brain
- High in minerals like iron and zinc for healthy blood and immune systems.
- *Some people have allergies to shellfish

We are what we eat!

In the Pacific Northwest, the shellfish industry injects an estimated $270 million a year into the region's economy, bringing jobs to over 3,200 people (NOAA, 2012)

Take the Salish Sea Pledge

Keep shellfish safe to eat!

Pick-up your pet's waste!

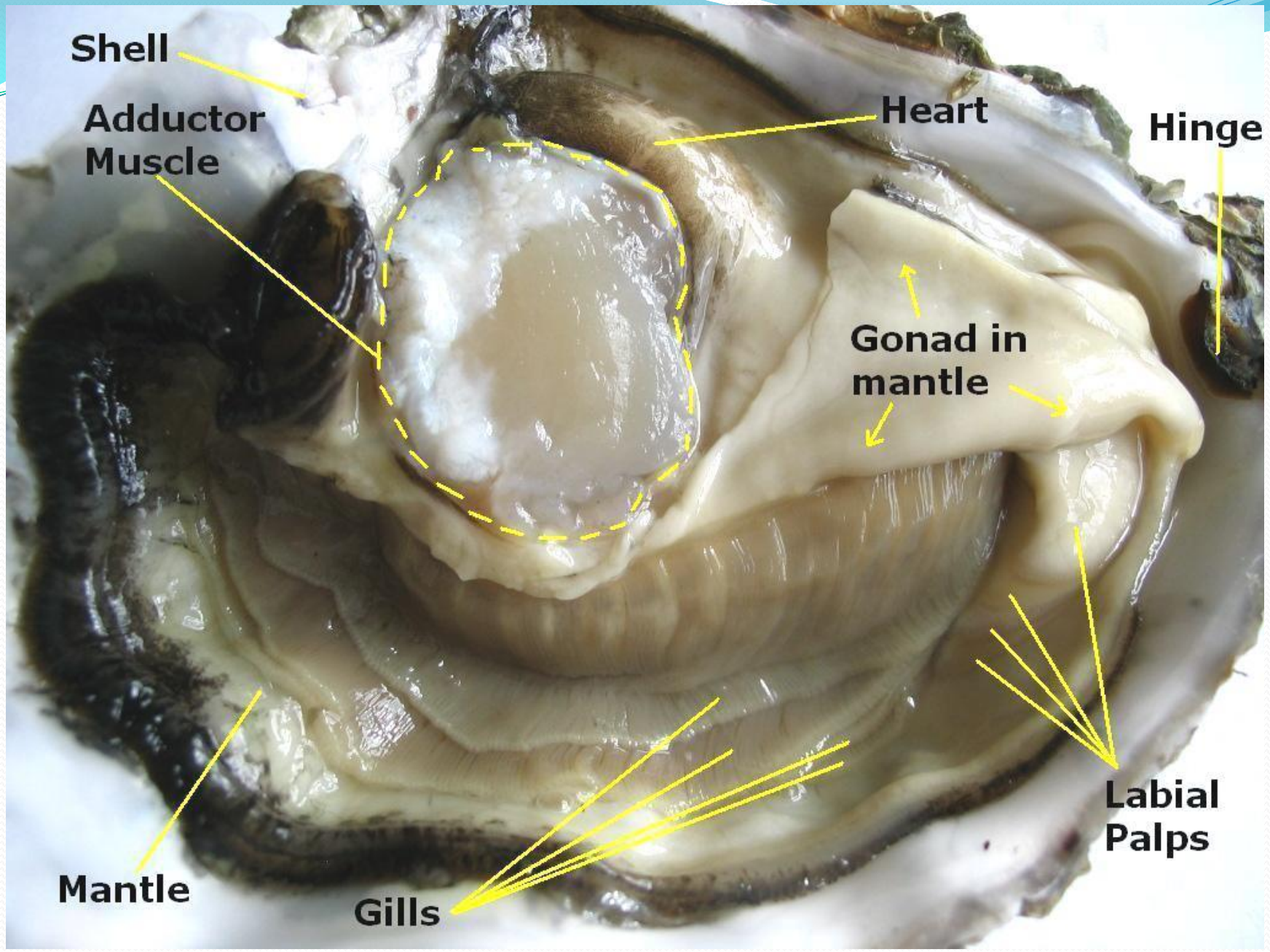
Don't release your boat's holding tank into the water!

Maintain your septic system!

Keep livestock out of creeks!

Shellfish Vocabulary

- **Filter feeder**-Animals like clams and oysters that feed by straining often microscopic food particles from water.
- **Plankton**-Greek for drifter, microscopic plants, animals or bacteria that are carried with the current. They provide a crucial source of food to larger organisms.
- **Zooplankton**-Tiny free floating animals.
- **Phytoplankton**-Microscopic drifting plants.
- **Fecal bacteria** – Bacteria from the gut of warm blooded animals that can indicate the presences of pathogens, other bacteria that can cause disease.
- **Photosynthesis**-Process used by plants to make food from light and carbon dioxide in the air, with oxygen as a bi-product.
- **Mollusk**-A soft bodied invertebrate like clams and oysters.
- **Bivalve**-A mollusk with two hinged shells, such as a scallop, clam, mussel or oyster.
- **Ocean acidification** – Too much carbon dioxide is absorbed by oceans which makes them more acidic and can prevent shellfish larvae from forming their shells.
- **Spat**- A juvenile oyster that has undergone metamorphosis, develops its shell and attaches to **substrate**.


Shell
Adductor Muscle
Heart
Hinge
Gonad in mantle
Mantle
Gills
Labial Palps