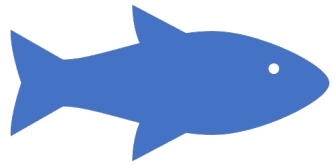
Marine Ecosystems



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Special Features of the Marine Ecosystems

Oceans occupy 70% of the earth's surface.

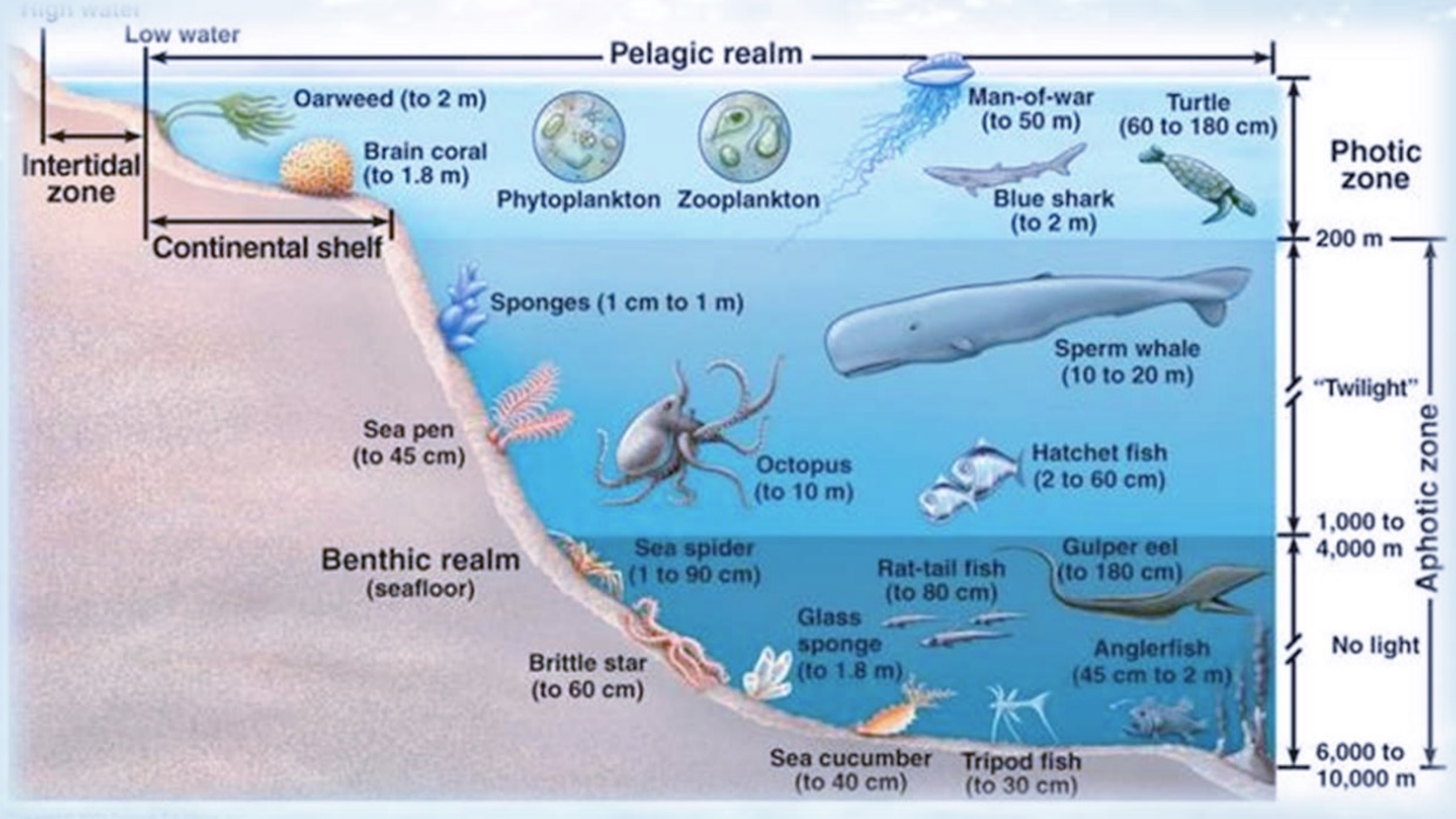
All the oceans are interconnected by currents, dominated by waves, influenced by tides and are saline.

Marine Ecosystems

Those that occur in or near salt water

Found from sandy beach to the deepest parts of the ocean

Make up most of the earth


High water
Low water
Pelagic realm
Oarweed (to 2 m)
Brain coral (to 1.8 m)
Intertidal zone
Continental shelf
Phytoplankton
Zooplankton
Man-of-war (to 50 m)
Turtle (60 to 180 cm)
Blue shark (to 2 m)
Photic zone
200 m
Sponges (1 cm to 1 m)
Sperm whale (10 to 20 m)
"Twilight"
Sea pen (to 45 cm)
Octopus (to 10 m)
Hatchet fish (2 to 60 cm)
1,000 to 4,000 m
Aphotic zone
Benthic realm (seafloor)
Sea spider (1 to 90 cm)
Rat-tail fish (to 80 cm)
Gulper eel (to 180 cm)
Glass sponge (to 1.8 m)
Brittle star (to 60 cm)
Anglerfish (45 cm to 2 m)
No light
Sea cucumber (to 40 cm)
Tripod fish (to 30 cm)
6,000 to 10,000 m

Types of Marine Ecosystems

- Sandy beaches
- Rocky shores
- Salt marshes
- Coral reefs
- Mangroves
- Deep sea
- Hydrothermal vents

Coastal Ecosystems

Coastal Area or Coastal Zone

An extremely dynamic environment where interface between land, water and air is seen

Types of Coastal Environments

Estuarine – where freshwater and sea water meet

Salt marshes in temperate region

Mangroves in the tropics

Intertidal zone

- mudflats
- sandy beaches
- rocky intertidal

Two Important Physical Factors in the Intertidal Zones

Waves

Tides

Wave Exposure

- Energy in waves can influence the
  - particle size
  - ability of organisms to remain attached to the substrate

Tidal Exposure

Vertical gradient - higher areas have longer exposure to air than lower areas

Exposure to air can have two negative effects for marine organisms

- Dessication – water loss
- Thermal stress – temperature very high

Seashores

Alternately exposed and submerged by tides

Seashore regions marked by extreme high water mark and extreme low water mark.

- Particle Sizes

scale	Size range (metric)	Size range (approx. inches)	(Wentworth Class)	Other names
−8 <	256 mm <	10.1 in <	Boulder	
−6 to −8	64–256 mm	2.5–10.1 in	Cobble	
−5 to −6	32–64 mm	1.26–2.5 in	Very coarse grave;l	Pebble
−4 to −5	16–32 mm	0.63–1.26 in	Coarse gravel	Pebble
−3 to −4	8–16 mm	0.31–0.63 in	Medium gravel	Pebble
−2 to −3	4–8 mm	0.157–0.31 in	Fine gravel	Pebble
−1 to −2	2–4 mm	0.079–0.157 in	Very fine gravel	Granule
0 to −1	1–2 mm	0.039–0.079 in	Very coarse sand	
1 to 0	½–1 mm	0.020–0.039 in	Coarse sand	
2 to 1	¼–½ mm	0.010–0.020 in	Medium sand	
3 to 2	125–250 µm	0.0049–0.010 in	Fine sand	
4 to 3	62.5–125 µm	0.0025–0.0049 in	Very fine sand	
8 to 4	3.90625–62.5 µm	0.00015–0.0025 in	Silt	Mud
> 8	< 3.90625 µm	< 0.00015 in	Clay	Mud
> 10	< 1 µm	< 0.000039 in	Colloid	Mud

Wave Energy and Shore Particle Size

Larger particles require more energy to be moved.

Thus, the size of the shore particles is influenced by the energy of the waves striking them.

High energy shores contain larger particles than low energy shores.

Types of Shores According to Size of Particles

Rocky Shore

Boulder Beach

Cobble Beach

Gravel Beach

Sandy Beach

Mud Beach


Sandy Shore

Marine Life on the Sandy Beach

- Sea turtles
- Seals, sea lions
- Algae
- Invertebrates such as crabs, clams, worms, snails, flies
- Birds


alamy stock photo

Rocky Shores

Rocky Shores

May be marked with rock cliffs, small and large boulders, small and large rocks and tide pools.

Tide pools – puddles of water that can contain an array of marine life

Also shows intertidal zone between low and high tide

Littoral Zone

Part of the time covered with water and part of the day exposed to air

Dominated by daily rise and fall of tides

Species living in the littoral zone face the problem of living on both marine and terrestrial habitats

Intertidal Zonation

- Zonation in Rocky Intertidal Shores

Marine Life in Rocky Shores

- Marine algae
- Lichens
- Birds
- Invertebrates like crabs, lobsters, starfish, sea urchins, mussels, barnacles, snails, limpets, sea squirts, sea anemones
- Fish
- Seals, sea lions

- **Organisms in the Rocky Intertidal Zone**


SEA URCHIN
MERMAID'S PURSE
ANEMONE
STARFISH
SEAWEED
LIMPETS

Features of the Rocky Intertidal Zone

- Distribution and abundance of organisms determined by abiotic and biotic factors
- Shows steep vertical gradients
- With variable physical conditions
- Mostly sessile or sedentary organisms
- Small organisms with high density

- Pools of water may become isolated and hold water for periods ranging from hours to several days
- When pools isolated
  - Water evaporates
  - Salinity increases
  - Temperature increases
- Pools can fill during rains
  - Salinity decreases
  - Temperatures decrease

Tide Pools

Salt Marshes

Provide a buffer between the sea and the mainland

Flooded at high tide and are composed of salt tolerant plants and animals

Important in many ways

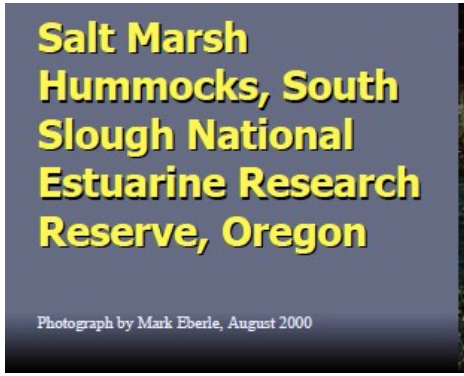
- Provide habitat for marine life, birds and migratory birds
- Important nursery areas for fish and invertebrates
- Protect the rest of the coastline by buffering wave action
- Absorb water during high tides and storms

Salt Marsh


Salt marsh -
a type of wetland subject to
occasional or regular flooding by tides

Organisms Found in a Salt Marsh

- Algae
- Birds
- Fish
- Invertebrates like crustaceans



Coral Reefs

Found in areas penetrated by sunlight and beyond the low water mark

Formed by hermatypic or reef-forming coral species that contain zooxanthellae

Hard and soft corals of many sizes

Various groups of invertebrates

All kinds of fishes including sharks

Also marine vertebrates such as mammals and reptiles

Coral Reef

Marine Organisms Found in Coral Reefs

Invertebrates: hard and soft corals, sponges, anemones, crabs, shrimps, lobsters, bryozoans, polychaetes, starfishes, sea urchins, crinoids, sea cucumbers, nudibranchs, octopus, squids, cuttlefish, gastropods, bivalves

Vertebrates: cartilaginous and bony fishes, sea turtles, sea snakes, marine mammals like seals, dolphins

Mangroves

Marine areas composed of salt-tolerant plant species

Found generally in warm areas between 32 degrees north latitude and 38 degrees south latitude

Provide shelter for various marine life and important nursery areas for other marine vertebrates

Mangroves

- Inhabited by tropical trees and shrubs that can tolerate conditions in the intertidal zone along tropical coastlines
- Possess adaptations to allow them to live in periodically flooded regions with high salt content
- Approximately 70 species of mangrove plants belonging to 20 different plant families

Environmental Problems Faced by Mangroves

- Soil is very fine and waterlogged making it difficult for the root system to support the plant.
- Waterlogged condition also makes it difficult for the roots to extract oxygen from the soil.
- The intertidal location of the mangroves means high salt concentrations.
- Saturated soil lacks oxygen.

Prop Roots

Aerial Roots and Pneumatophores

Marine Organisms in Mangroves

- Algae
- Invertebrates such as tunicates, sponges, crabs, shrimps, oysters, snails, insects
- Fish, sharks
- Reptiles such as sea turtles, land turtles, alligators, crocodiles, caymans, snakes, lizards
- Birds
- Mammals like dolphins, manatees

Importance of Mangrove Ecosystems

Serve as nurseries for many species of marine fishes and invertebrates – juveniles seek shelter among the prop roots until they are large enough to move to the reef.

The mangrove roots protect the shore from the effects of storms and surges and tsunamis – documents are present on parts of Southeast Asia with mangrove forests that were protected from the impact of tsunamis compared with those that were deforested of mangroves.

Mangrove Restoration
Thailand

Oceans of the World

- Atlantic
- Pacific
- Indian
- Arctic
- Southern (Antarctic)


The Oceans
ARCTIC OCEAN
North America
ATLANTIC OCEAN
Europe
Asia
PACIFIC OCEAN
Africa
PACIFIC OCEAN
INDIAN OCEAN
South America
ATLANTIC OCEAN
Australia
N
W
E
S
SOUTHERN OCEAN
Antarctica
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Types of Open Sea Ecosystems

- Pelagic
- Benthic

Organisms in the Pelagic Ecosystem

- Phytoplankton
- Zooplankton
- Nekton

Phytoplankton

- Dominant primary producers in the sea
- Don’t need well developed supporting structures
- Drifting on the surface
- Restricted to areas where there is light

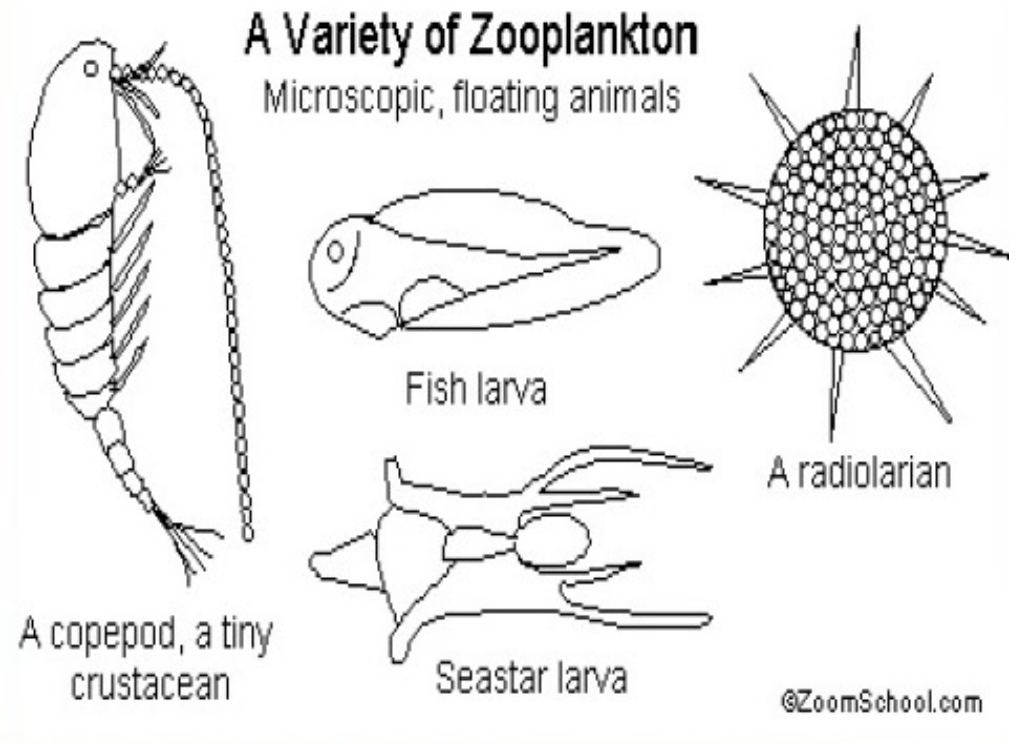
Zooplankton

- Graze on phytoplankton (herbivores)

Ex. Copepods, planktonic arthropods, krills (euphausiids)

- Eat herbivorous zooplankton (carnivores)

Ex. Larval forms of invertebrates like ctenophores and chaetognaths

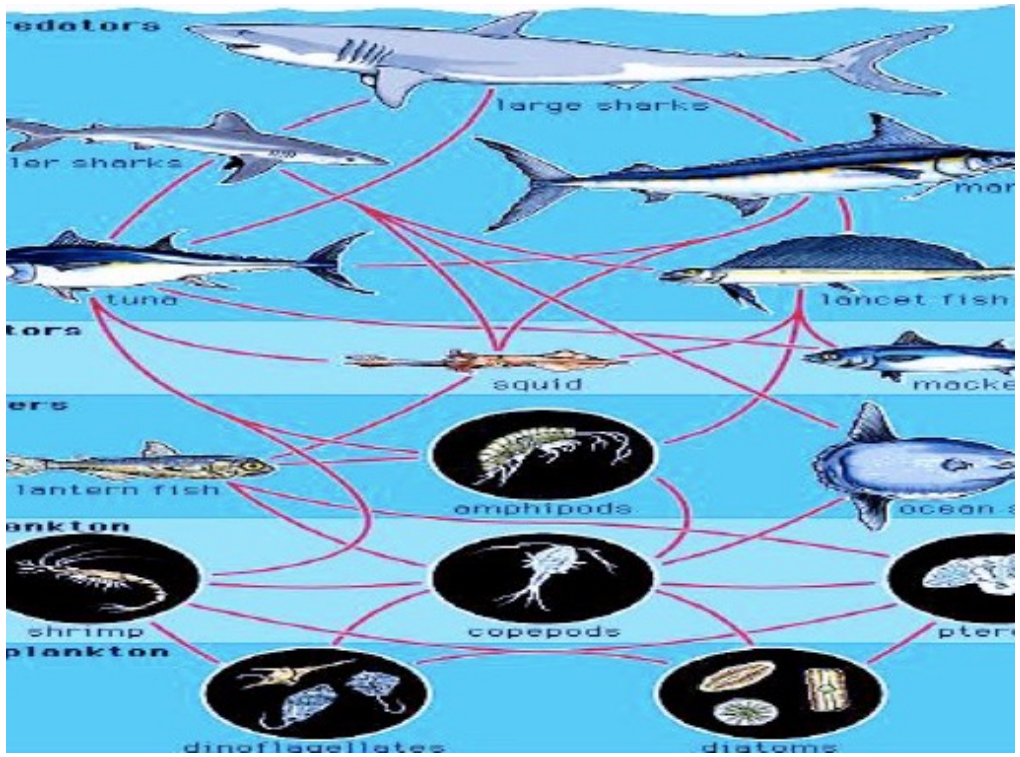


Nekton

- Swimming organisms that can move at will and can swim against the current

Ex. Fishes, marine mammals

- Can be highly predacious like sharks or killer whales
- Or plankton feeders like whale sharks



Organisms in the Benthic Ecosystem

Benthos – organisms that live on or in the bottom of the water

Epifauna or epiflora – on surface of rocks or hard surface

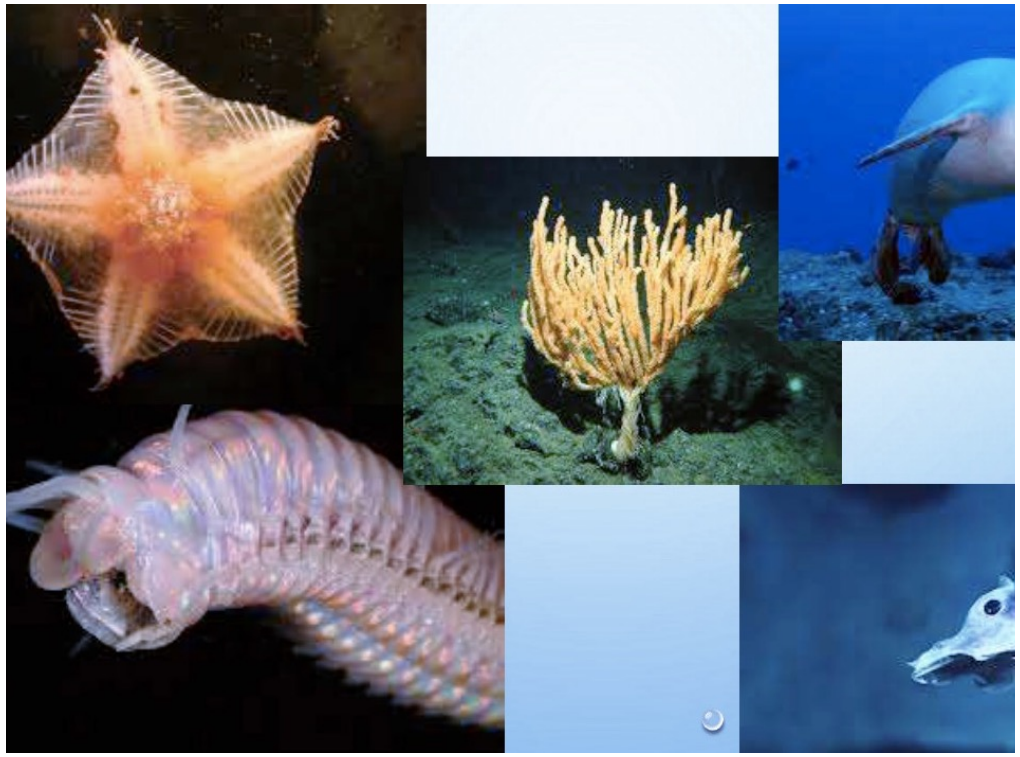
Infauna – within the substrate

Deep Sea

- Parts of the ocean that are over 1,000 meters or 3,281 feet deep
- Deepest parts of the ocean are over 30,000 feet like the trenches

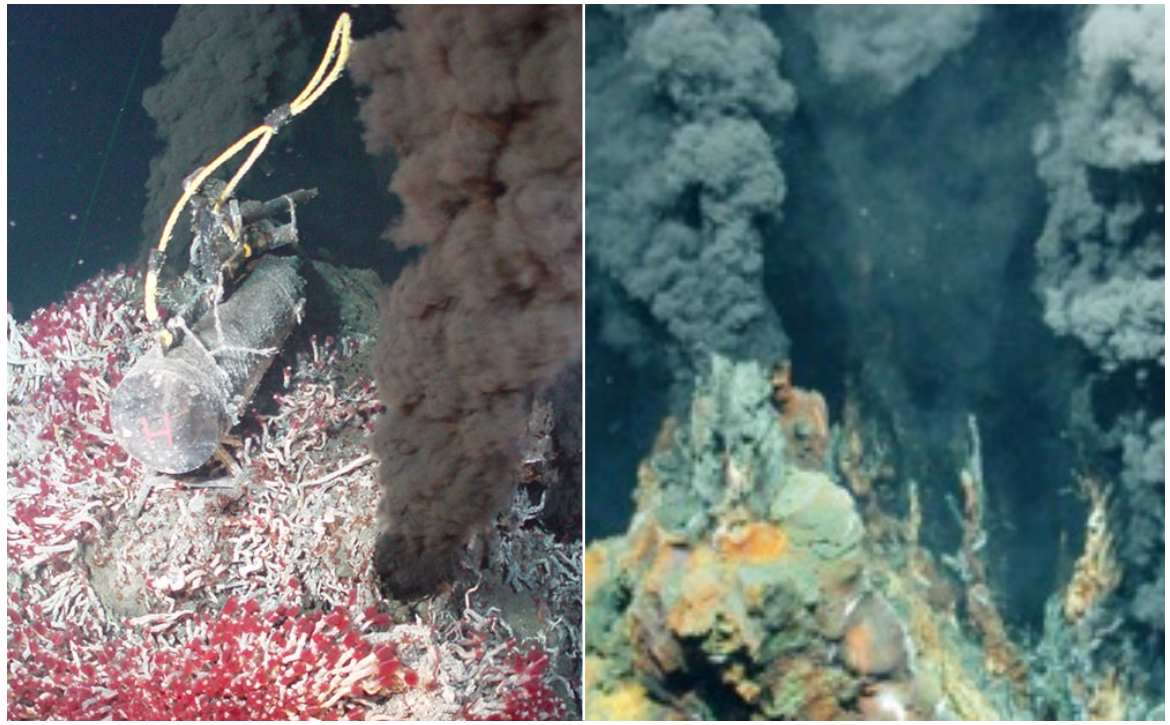
Organisms in the Deep Sea

- Invertebrates such as corals, crabs, worms, jellyfish, squids, octopus
- Fish such as angler fish and sharks
- Deep-diving marine mammals like sperm whales and elephant seals



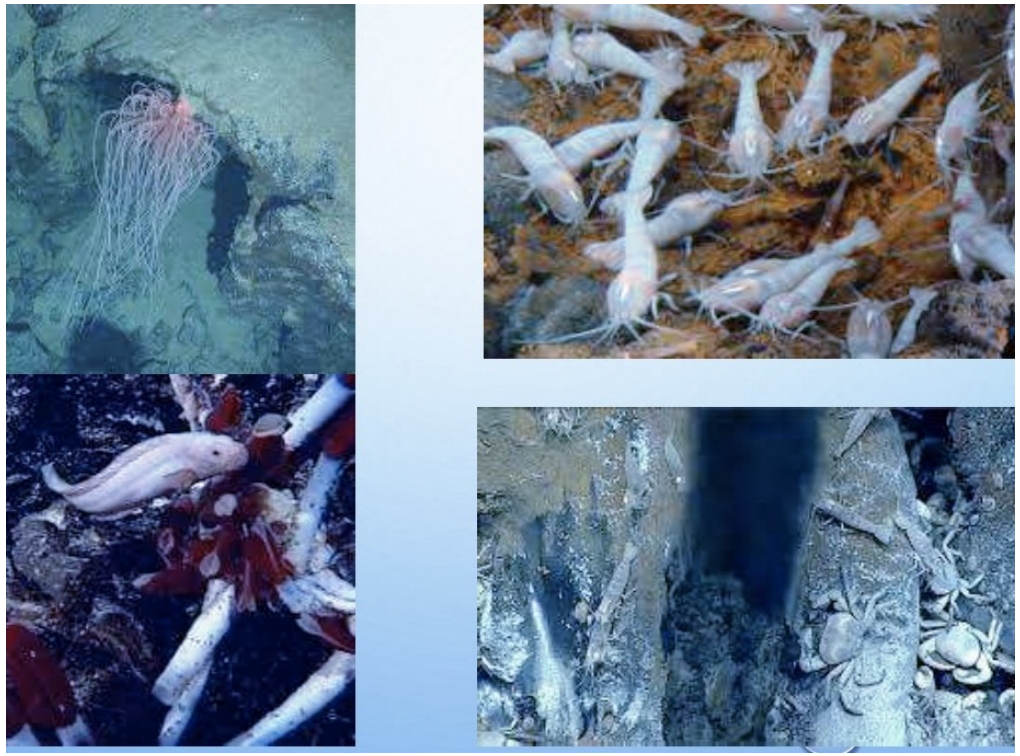
Hydrothermal Vents

- Located in deep sea
- First hydrothermal vent discovered in 1977
- Scientists noticed a number of organisms living around the vent



Marine Life in Hydrothermal Vent Ecosystem

- Archaea – bacteria-like organisms that use chemosynthesis for production where chemicals around the vents are converted into energy. These organisms are the base of the food chain in the hydrothermal vent ecosystem.
- Invertebrates such as tubeworms, limpets, clams, mussels, crabs, shrimps, lobsters, octopuses
- Fishes



Chemosynthesis VS Photosynthesis

Photosynthesis:

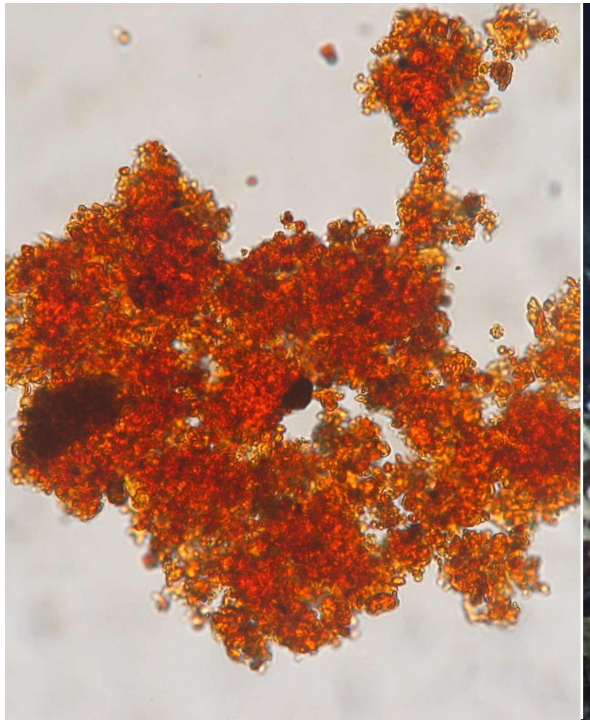
$6CO_2 + 6H_2O + Light \rightarrow C_6H_{12}O_6 + 6O_2$

Chemosynthesis:

$CO_2 + 4H_2S + O_2 \rightarrow CH_2O + 4S + 3H_2O$

Food chain in the Hydrothermal Vent Ecosystem

- Bacteria that oxidize/fixate inorganic material
- Tubeworms (Preyed by Deep Sea Clams and Crabs)



Why Chemosynthesis in Hydrothermal Vent Ecosystem

- Certain species have their niches in dark places
- Allows diversity in product depending on gases absorbed
- Forms the biomolecules essential for organic life
- Limited only by application of products and amount of chemoautotrophs

Estuaries

Point where freshwater meets saltwater (ecotone)

Areas between moving and still water

Offer habitat to many different plants and animals

Organisms in estuaries have the ability to survive in both freshwater and saltwater ecosystems.

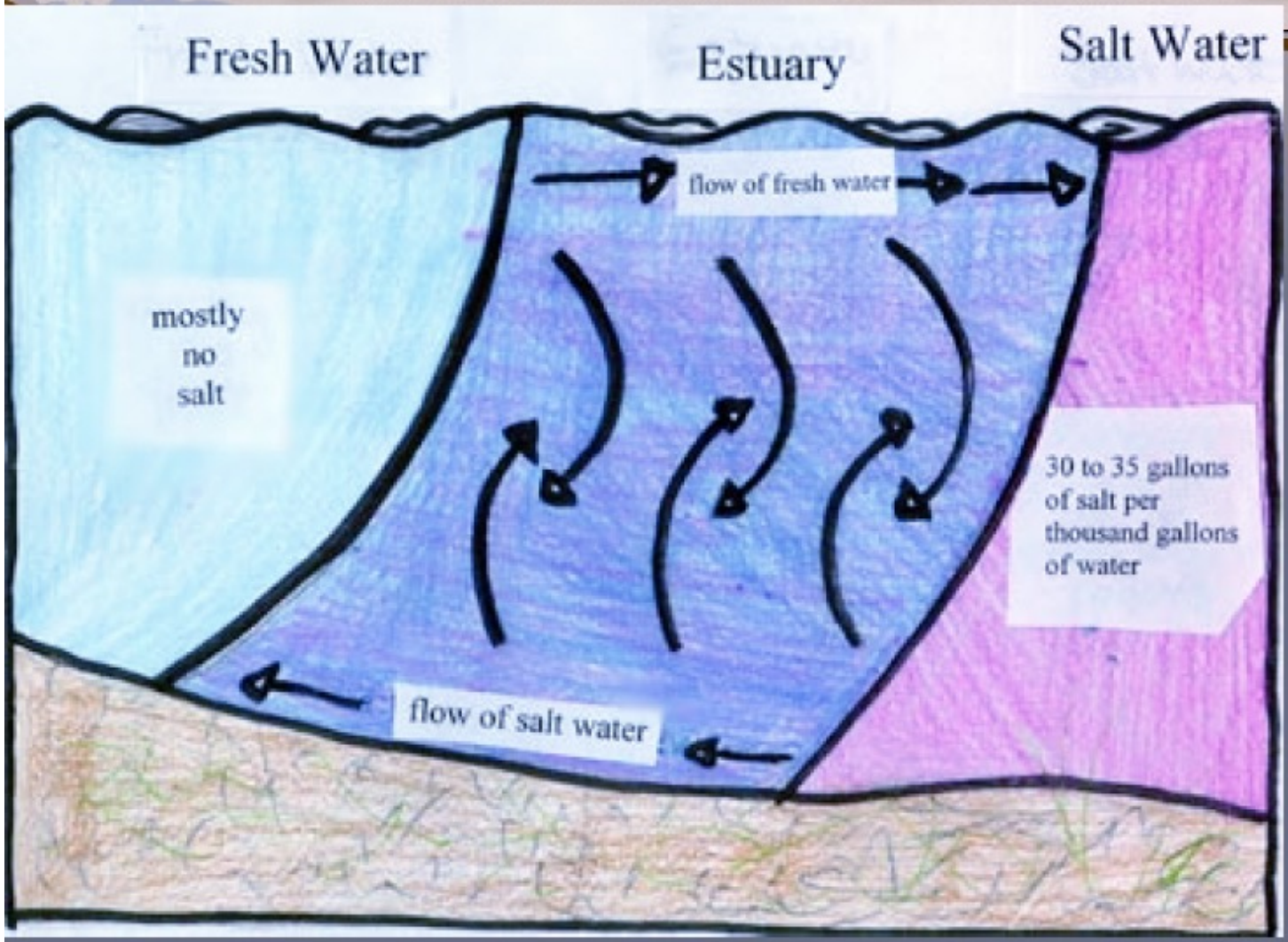
Freshwater meets Saltwater

Moving water meets still water

Estuary - The part of the wide lower course of a river where its freshwater current is met by the brackish tides

Salt Marsh Hummocks, South Slough National Estuarine Research Reserve, Oregon

Photograph by Mark Eberle, August 2000



Estuaries and coastal waters are among the most productive ecosystems on Earth, providing ecological, economic, cultural, and aesthetic benefits and services.

Acknowledgement

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