The Composition of Seawater

Pure water vs. Salt water

The major difference between pure water and salt water:

Seawater contains dissolved substances that give it a salty taste

Salt content makes seawater unsuitable for drinking and for irrigating crops of highly

15.1 The Composition of Seawater

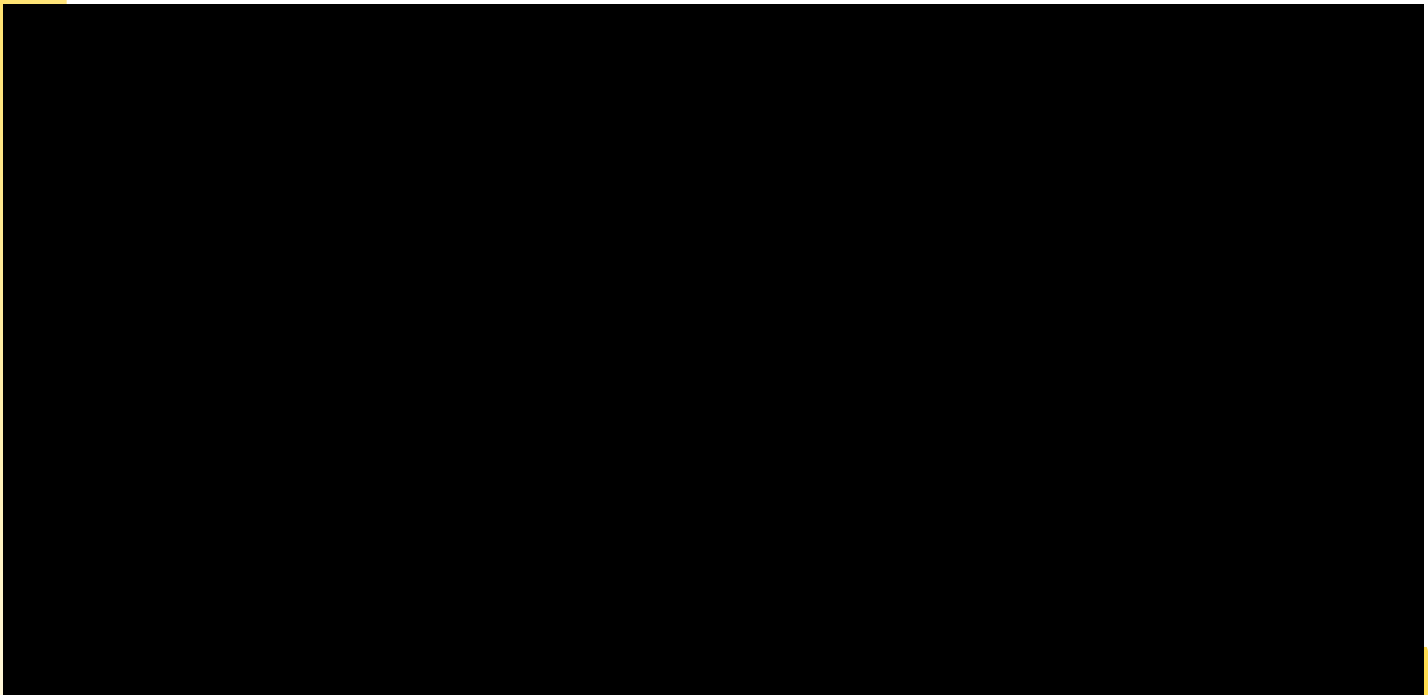
Salinity

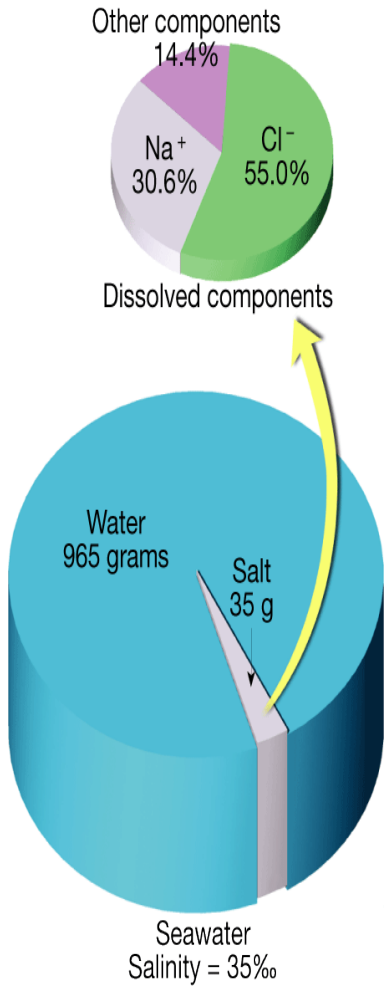
- **Salinity** = total amount of solid material dissolved in water.
- Scientists typically express salinity in parts per thousands (ppt)
- Most of the salt in seawater is sodium chloride, common table salt.

15.1 The Composition of Seawater

Salinity

- **2 Main Sources** of Sea Salt:
  - Chemical weathering of rocks on the continents
  - Earth's interior

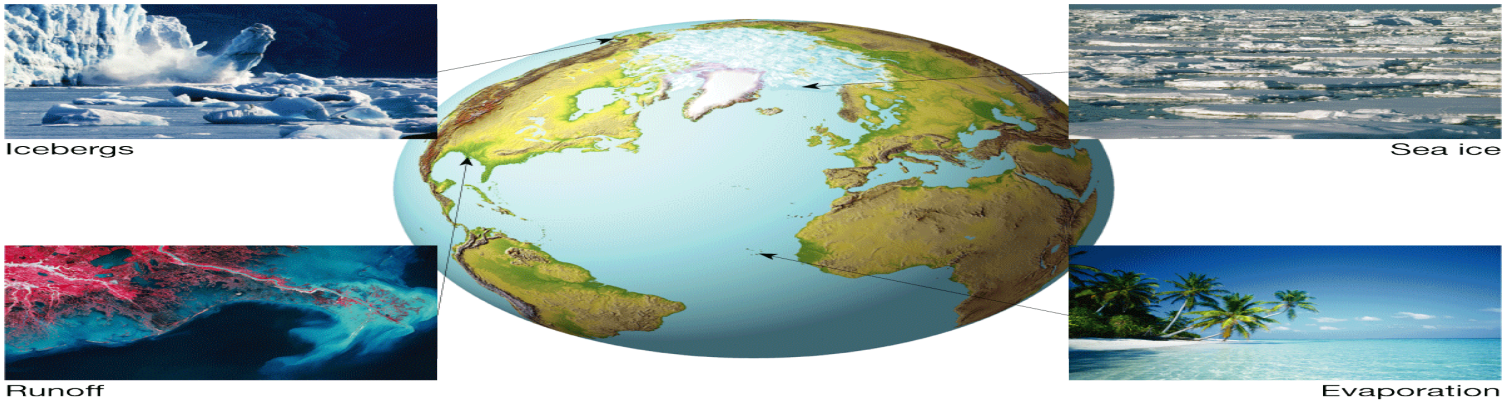




Processes Affecting Salinity

- Processes that decrease salinity:
  - **Precipitation**
  - **Runoff from land**
  - **Sea ice melting**
  - **Icebergs melting**

- Processes that increase salinity:
  - **Evaporation**
  - **Formation of sea ice**



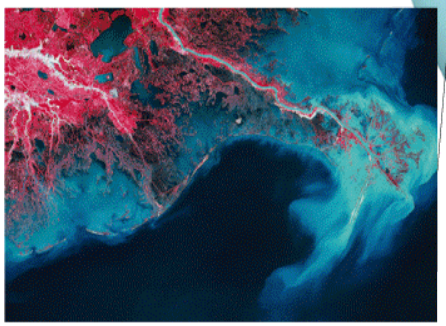
Natural processes affect the salinity of seawater...

Icebergs

Melting→ decrease

Sea ice

Melting→ decrease
Forming→ increase



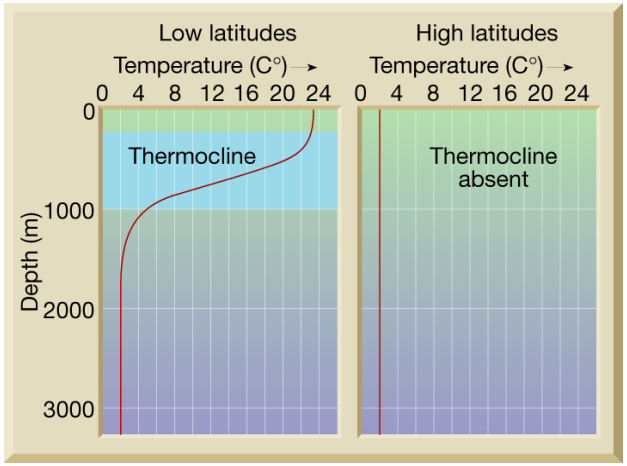
Runoff

Decrease

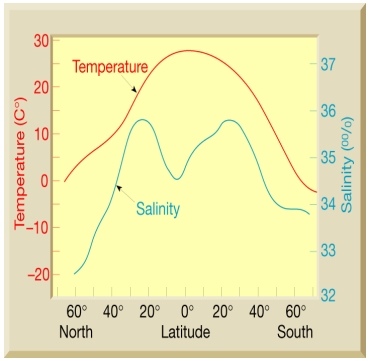
Evaporation

Increase

Ocean Temperature Variation



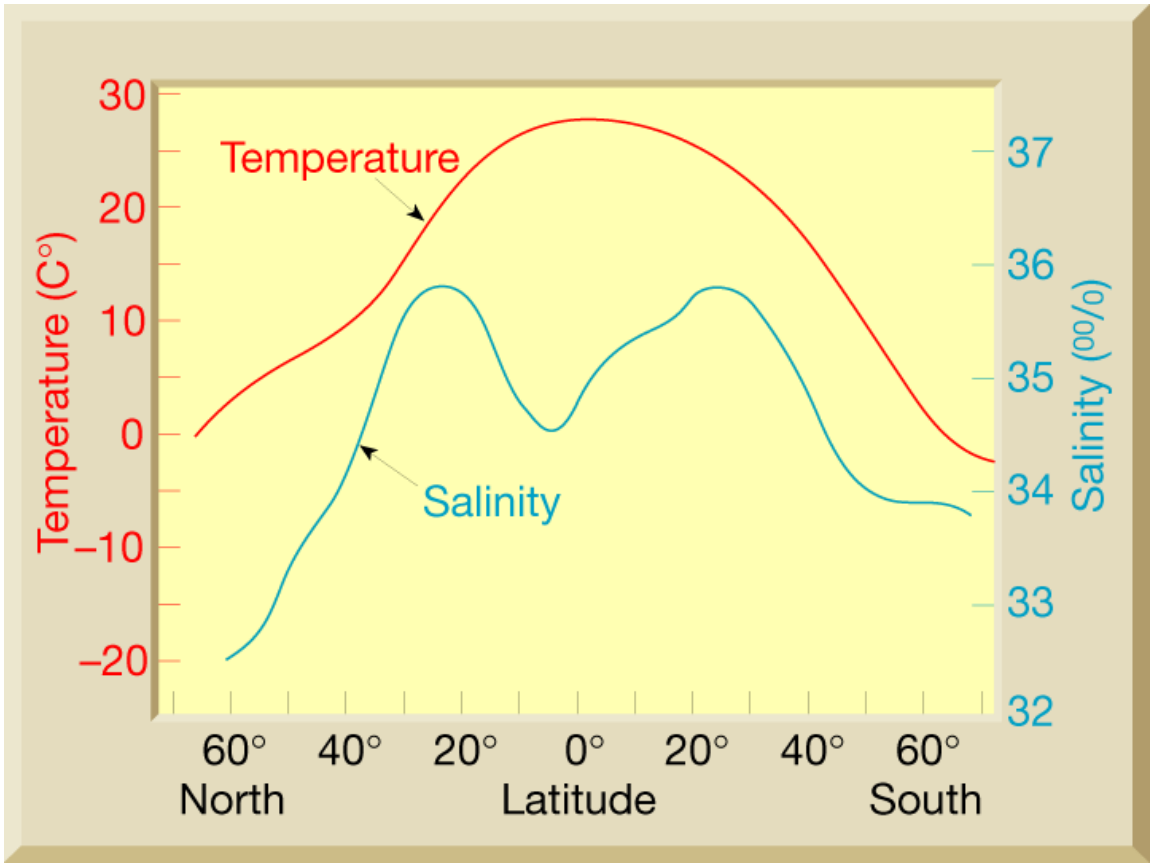
- Ocean surface water temperature varies with the amount of solar radiation received, which is primarily a function of latitude.



Temperature Variation with Depth

- **Thermocline**
  - layer of ocean water between 300 meters & 1000 meters
  - rapid change of temperature with depth.
  - create a barrier to marine life
  - there is no thermocline in high latitudes (N/S pole)

Q:
At which latitudes is sea surface temperature highest? Why?

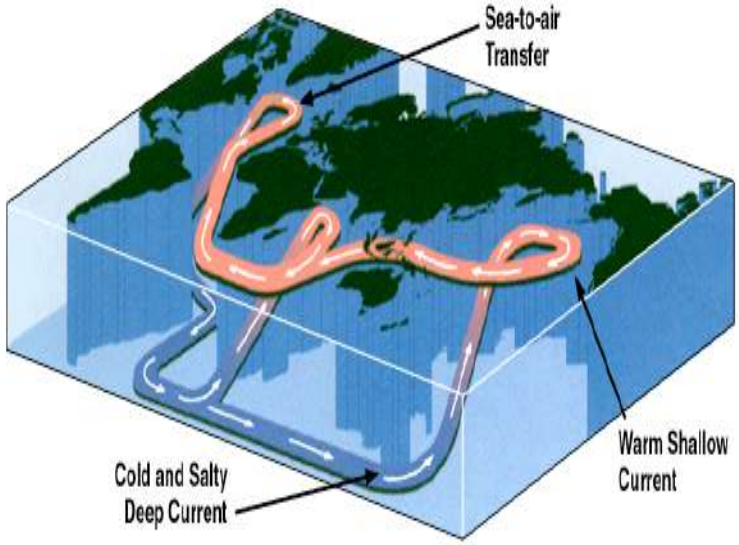


O degrees latitude (Equator) because low latitudes receive the most sunlight.

Ocean Density Variation

- Density = mass per unit volume. D=m/v
- 2 Main Factors Affecting Seawater Density:
  - * **salinity**
  - * **temperature**

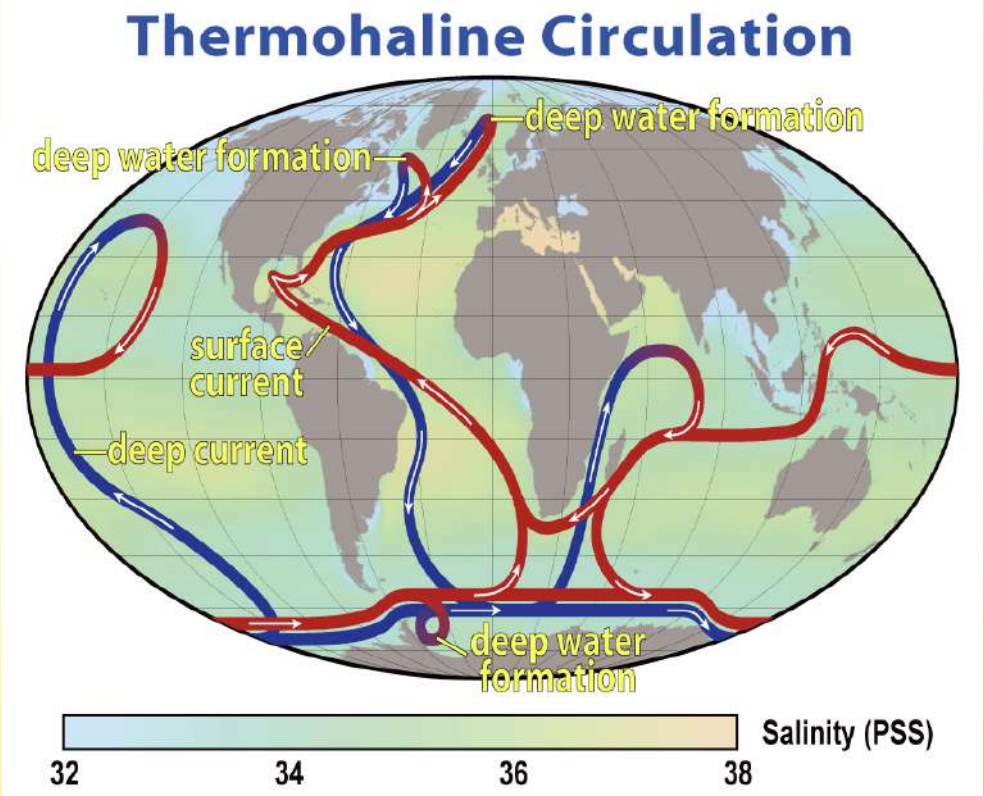
Ocean water becomes denser as it becomes colder and less dense as it becomes warmer.



Ocean Density

- Density is an important property of ocean water because it determines the water's vertical position in the ocean

- Density differences cause ocean water to sink or rise.

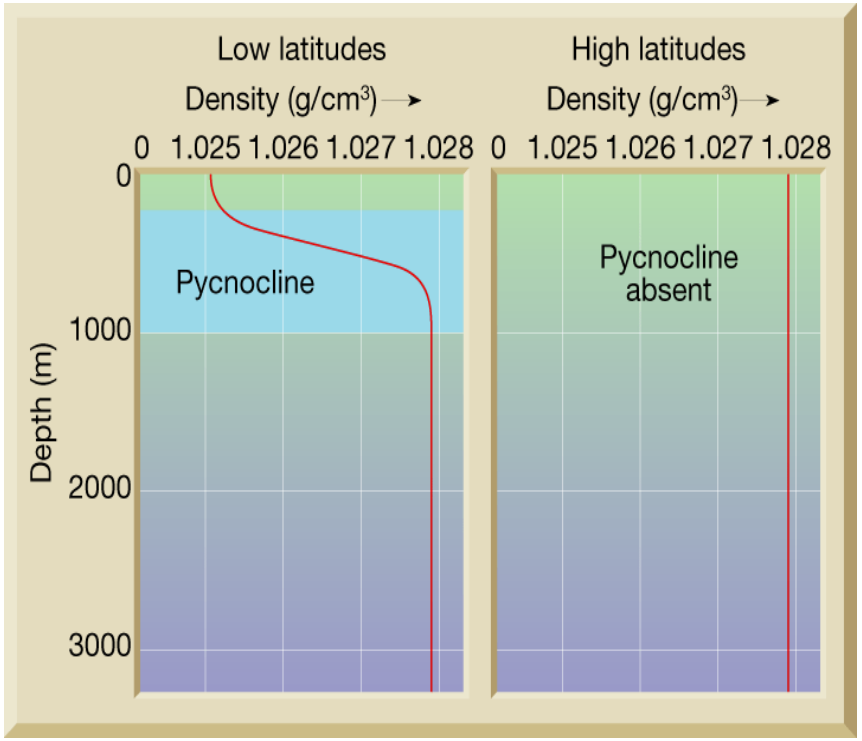


15.1 The Composition of Seawater

Ocean Density Variation

- Density Variation with Depth

- **Pycnocline**
  - layer of ocean water between 300 meters & 1000 meters
  - rapid change of density with depth
  - there is no pycnocline in high latitudes (N/S pole)

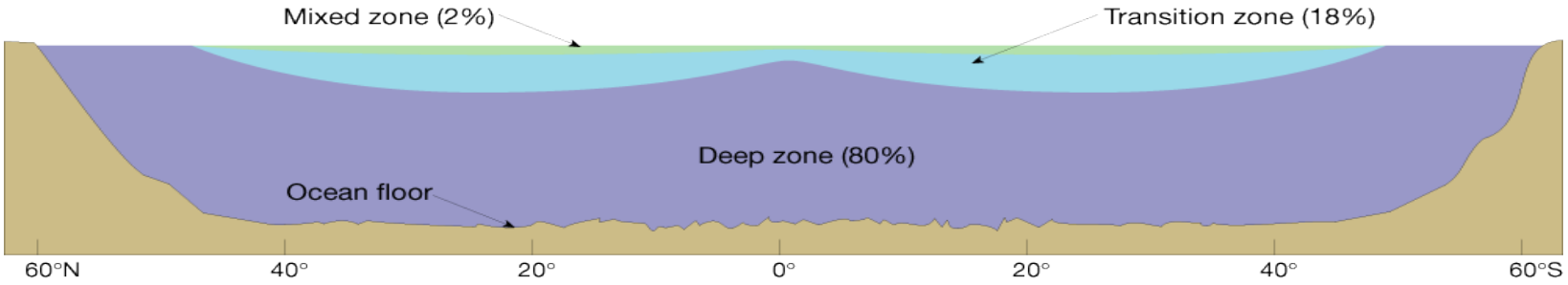


15.1 The Composition of Seawater

Ocean Layering

- Three-layered structure in most parts of the open ocean

- **Surface Zone**
  - Sun-warmed zone
  - Shallow (300 to 450 meters)
  - Zone of mixing



15.1 The Composition of Seawater

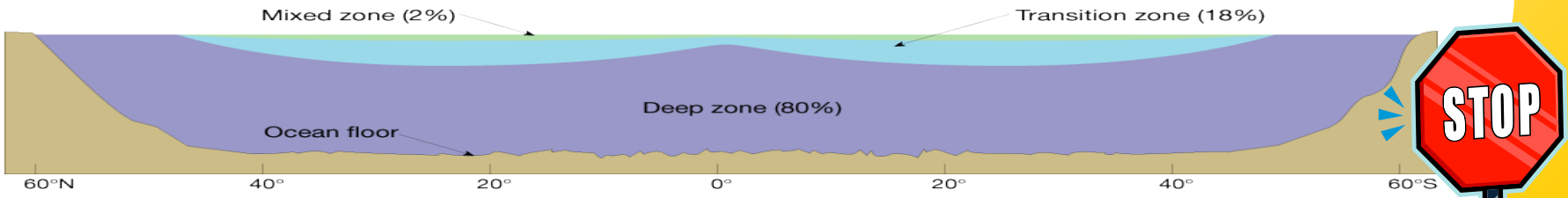
Ocean Layering

Transition Zone

- Between surface layer and deep zone
- Thermocline & pycnocline

Deep Zone

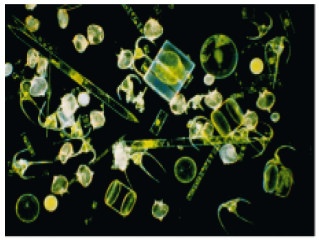
- Sunlight never reaches this zone.
- Temperatures are just a few degrees above freezing.
- Constant high-density water

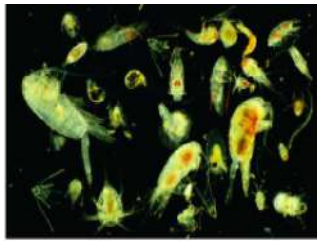


15.2 The Diversity of Ocean Life

Classification of Marine Organisms

- Marine organisms can be classified according to where they live and how they move.





- Plankton
  - **Plankton** include all organisms—algae, animals, and bacteria—that drift with ocean currents.
  - **Phytoplankton** are algal plankton, which are the most important community of primary producers in the ocean.
  - **Zooplankton** are animal plankton.

15.2 The Diversity of Ocean Life

Classification of Marine Organisms

Nekton

- **Nekton** include all animals capable of moving independently of the ocean currents, by swimming or other means of propulsion.

Benthos

- **Benthos** describes organisms living on or in the ocean bottom.

15.2 The Diversity of Ocean Life

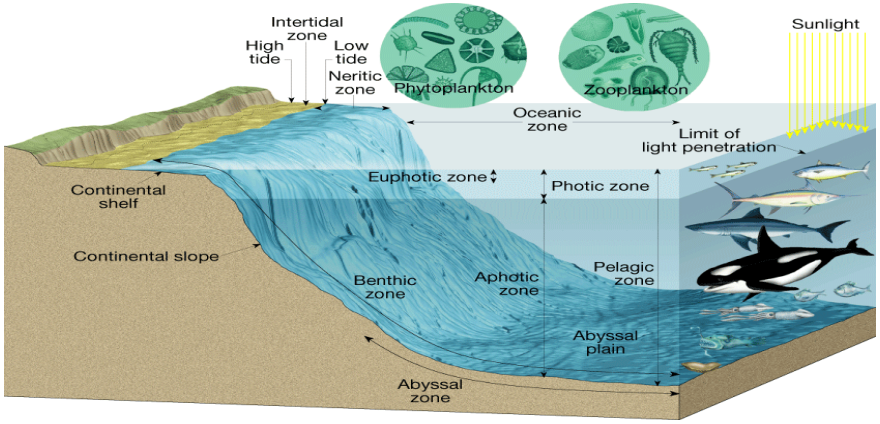
Mrs. Farrell →

Marine Life Zones

- Three factors are used to divide the ocean into distinct marine life zones: 1. **availability of sunlight**, 2. **distance from shore**, **3. water depth**.

Availability of Sunlight

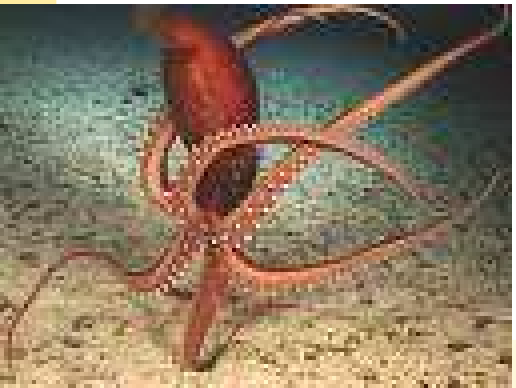
- The **photic zone** is the upper part of the ocean into which sunlight penetrates.

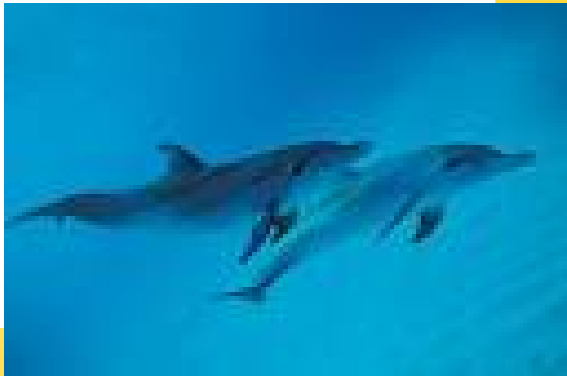


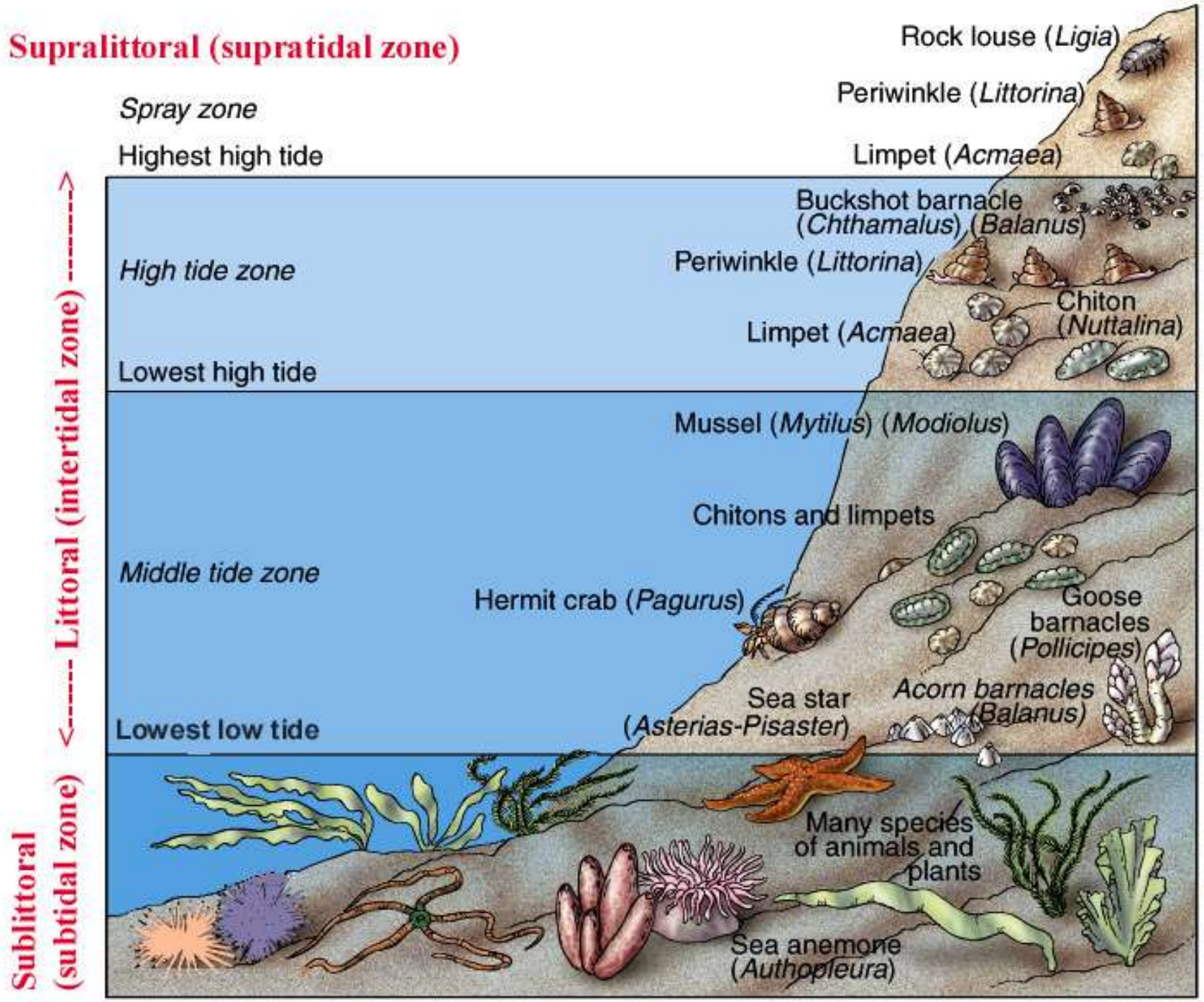
15.2 The Diversity of Ocean Life

Marine Life Zones

- Distance from Shore
  - The **intertidal zone** is the zone between high and low tides.
- The **neritic zone** extends from the low-tide line out to the shelf break.
  - The **oceanic zone** beyond the continental shelf.





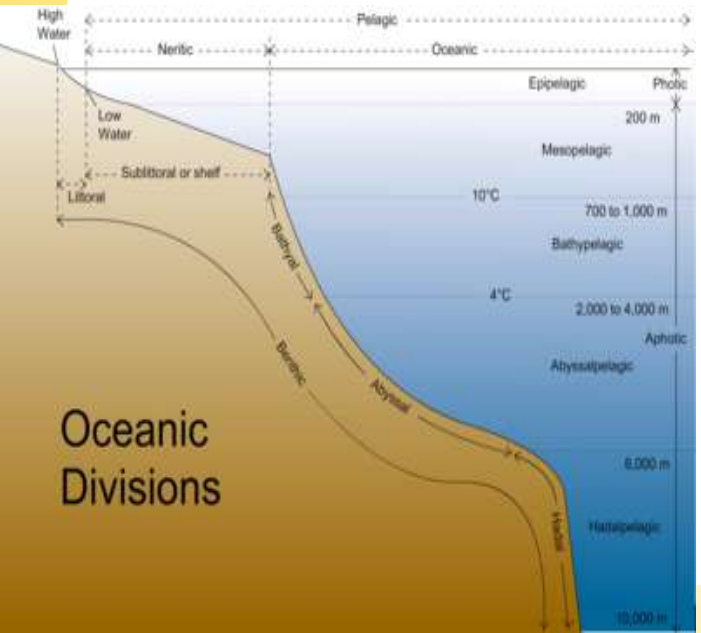

Supralittoral (supratidal zone)
Spray zone
Highest high tide
High tide zone
Lowest high tide
Middle tide zone
Lowest low tide
<------ Littoral (intertidal zone) ------->
Sublittoral (subtidal zone)
Rock louse (Ligia)
Periwinkle (Littorina)
Limpet (Acmaea)
Buckshot barnacle (Chthamalus) (Balanus)
Periwinkle (Littorina)
Chiton (Nuttalina)
Limpet (Acmaea)
Mussel (Mytilus) (Modiolus)
Chitons and limpets
Hermit crab (Pagurus)
Goose barnacles (Pollicipes)
Acorn barnacles (Balanus)
Sea star (Asterias-Pisaster)
Many species of animals and plants
Sea anemone (Authopleura)

15.2 The Diversity of Ocean Life

Marine Life Zones

◆ Water Depth

- The **pelagic zone** is open zone of any depth.
- The **benthic zone** any sea-bottom surface regardless of its distance from shore.
- The **abyssal zone** is a subdivision of the benthic zone characterized by extremely high pressures, low temperatures, low oxygen, few nutrients, and no sunlight.



15.2 The Diversity of Ocean Life

15.3 Oceanic Productivity

Primary Productivity

- **Primary productivity**: production of organic compounds from inorganic substances through photosynthesis or chemosynthesis.
- **Photosynthesis**: use of light energy to convert water and carbon dioxide into energy-rich glucose molecules.
- **Chemosynthesis**: process by which certain microorganisms create organic molecules from inorganic nutrients using chemical energy.

15.3 Oceanic Productivity

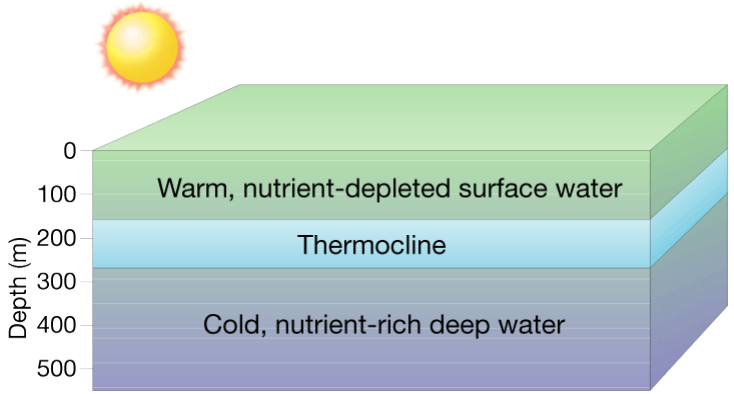
Primary Productivity

Productivity in Polar Oceans

- The low availability of solar energy limits photosynthetic productivity in polar areas.

Productivity in Tropical Oceans

- Productivity in tropical regions is limited by the lack of nutrients.



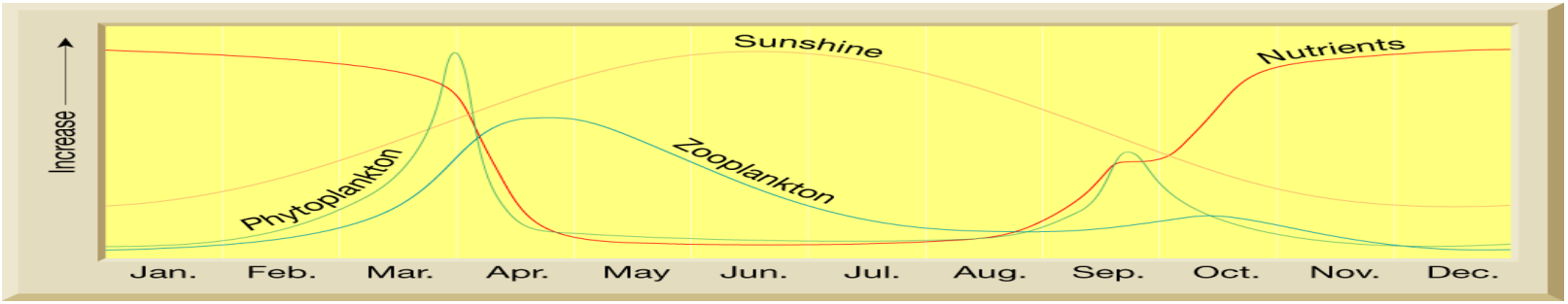
15.3 Oceanic Productivity

Primary Productivity

Productivity in Temperate Oceans

- found at mid-latitudes, a combination of these two limiting factors, sunlight and nutrient supply, controls productivity.

- **Winter** - Days are short and sun angle is low.
  - Low productivity



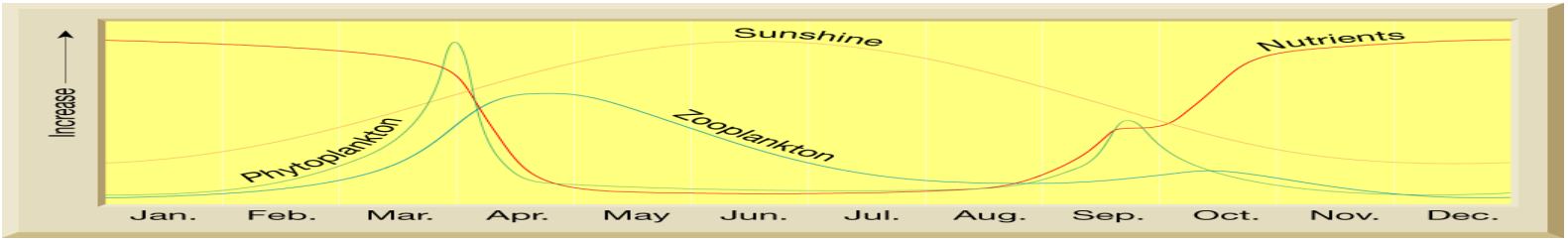
15.3 Oceanic Productivity

Primary Productivity

- Productivity in Temperate Oceans
  - **Spring**

- Spring bloom of phytoplankton is quickly depleted.
- Productivity is limited.
  - **Summer**

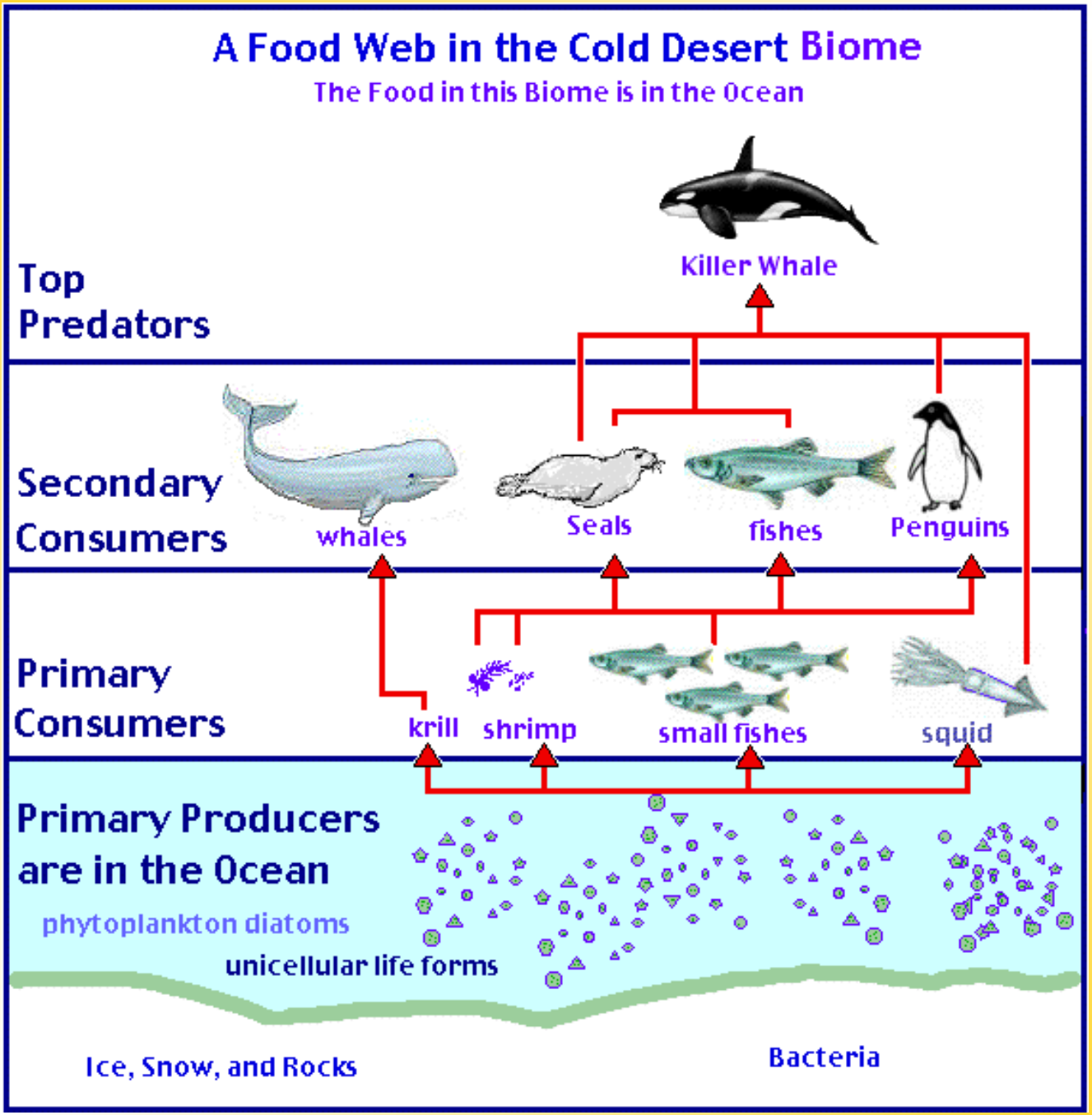
- Strong thermocline develops so surface nutrients are not replaced from below.
- Phytoplankton population remains relatively low.



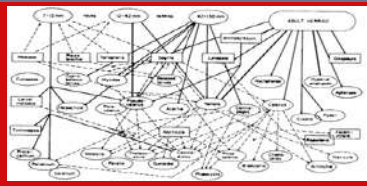
15.3 Oceanic Productivity

Oceanic Feeding Relationships

- Trophic Levels
  - A **trophic level** is a nourishment level in a food chain.
  - * *Plant and algae producers constitute the lowest level, followed by herbivores and a series of carnivores at progressively higher levels.*
- Transfer Efficiency
  - The transfer of energy between trophic levels is very inefficient.


A Food Web in the Cold Desert Biome
The Food in this Biome is in the Ocean
Top Predators
Killer Whale
Secondary Consumers
whales
Seals
fishes
Penguins
Primary Consumers
krill
shrimp
small fishes
squid
Primary Producers are in the Ocean
phytoplankton diatoms
unicellular life forms
Ice, Snow, and Rocks
Bacteria

15.3 Oceanic Productivity



Oceanic Feeding Relationships

◆ Food Chains and Food Webs

- A **food chain** is a sequence of organisms through which energy is transferred, starting with the primary producer.
  Grass → Rabbit → Fox
- A **food web** is a group of interrelated food chains.

- *Animals that feed through a food web rather than a food chain are more likely to survive because they have alternative foods to eat should one of their food sources diminish or disappear.*

Food Chains and Webs