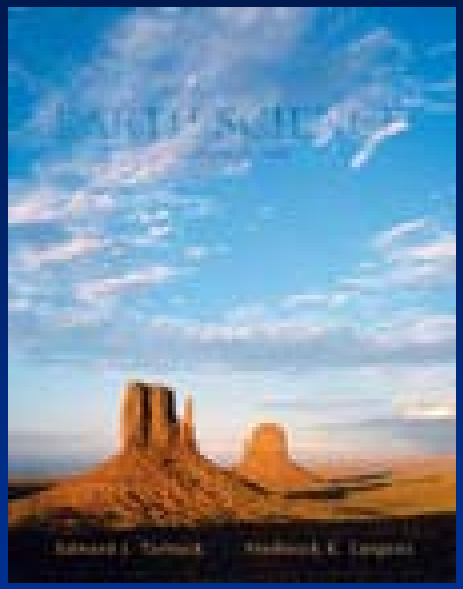

Lecture Outlines PowerPoint

Chapter 14

Earth Science, 12e

Tarbuck/Lutgens

Earth Science, 12e

Ocean Water and Ocean Life

Chapter 14

Composition of seawater

- Seawater consists of about 3.5% (by weight) dissolved minerals
- Salinity
  - Total amount of solid material dissolved in water
  - Typically expressed in parts per thousand (‰)
  - Average salinity is 35‰
  - Major constituent is sodium chloride

Relative proportions of water and dissolved components in seawater

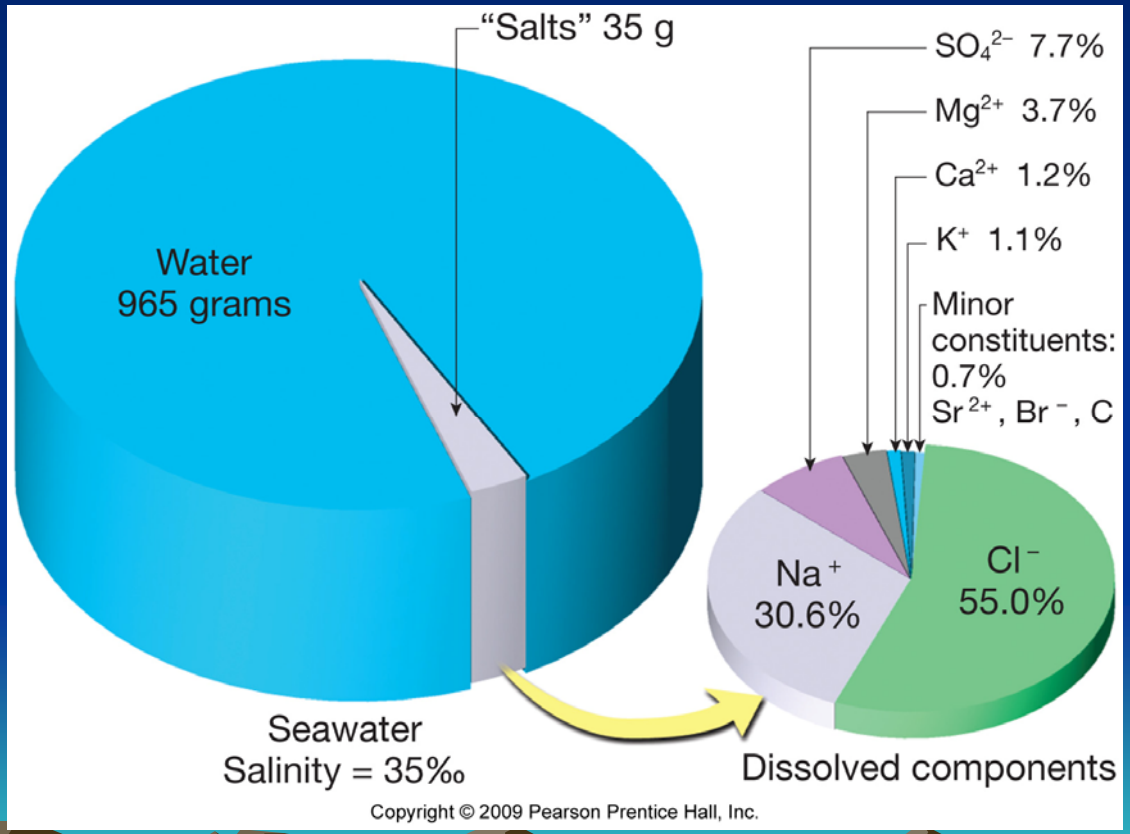

Figure 14.1

Composition of seawater

- Sources of sea salts
  - Chemical weathering of rocks
  - Outgassing – gases from volcanic eruptions
- Processes affecting seawater salinity
  - Variations in salinity are a consequence of changes in the water content of the solution

Composition of seawater

- Processes affecting seawater salinity
  - Processes that decrease salinity (add water)
    - Precipitation
    - Runoff from land
    - Icebergs melting
    - Sea ice melting
  - Processes that increase salinity (remove water)
    - Evaporation
    - Formation of sea ice

Composition of seawater

- Processes affecting seawater salinity
  - Surface salinity in the open ocean ranges from 33‰ to 38‰

Ocean temperature

- Surface water temperature varies with the amount of solar radiation received
  - Lower surface temperatures are found in high-latitude regions
  - Higher temperatures found in low-latitude regions

Ocean temperature

- Temperature variation with depth
  - Low latitudes
    - High temperature at the surface
    - Rapid decrease in temperature with depth (thermocline)
  - High latitudes
    - Cooler surface temperatures
    - No rapid change in temperature with depth

Variations in ocean water temperature with depth

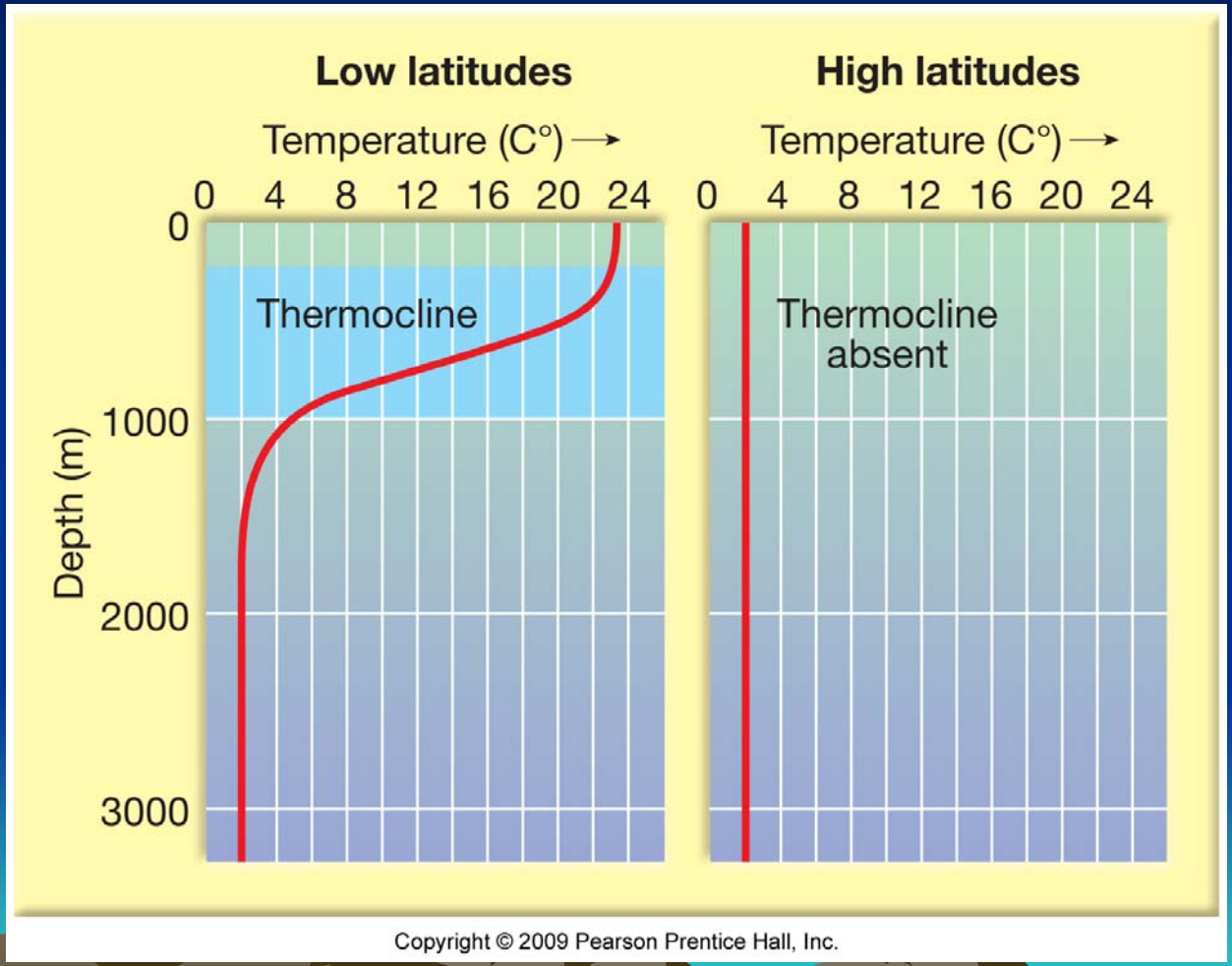

Figure 14.4

Ocean temperature

- Ocean temperature over time
  - The unique thermal properties of seawater make it resistant to temperature changes
  - Global warming could eventually influence ocean temperatures

Variations in the ocean's surface temperature and salinity with latitude

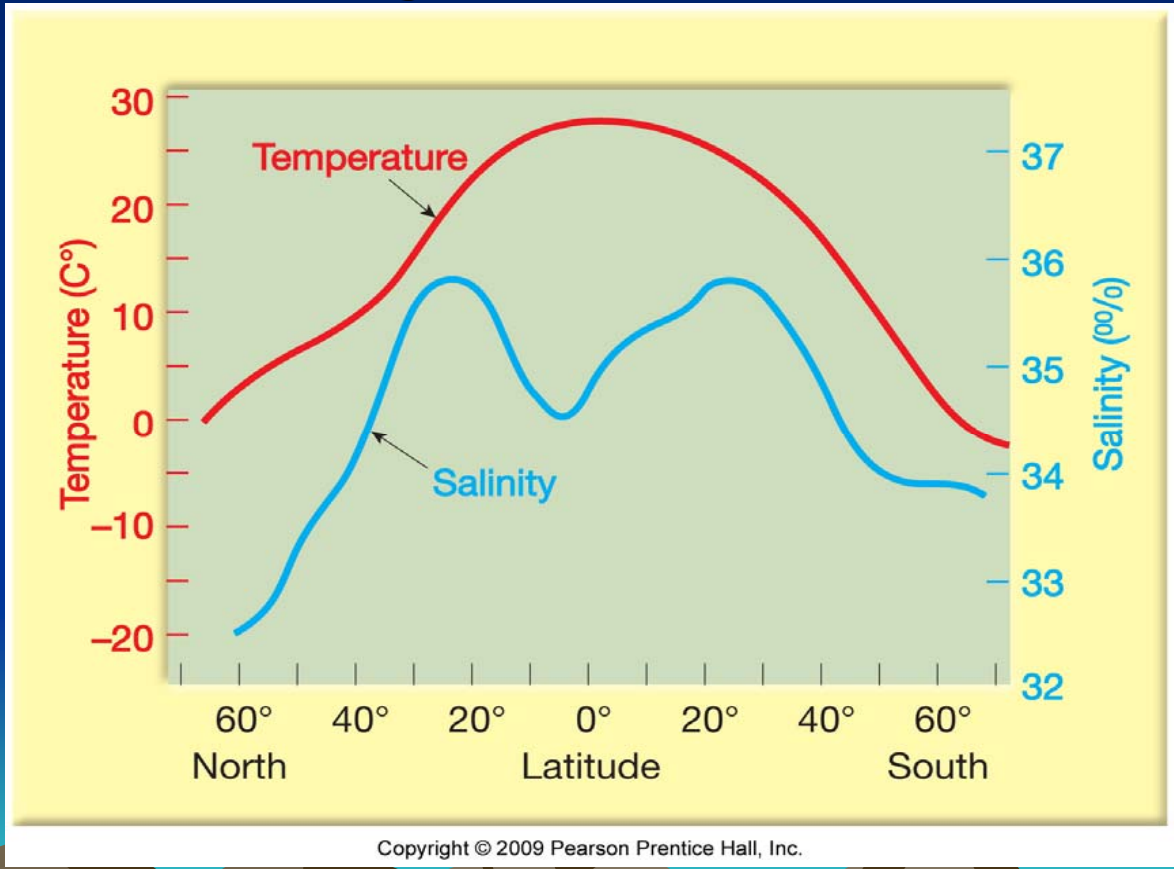

Figure 14.3

Ocean density

- Density is mass per unit volume – how heavy something is for its size
- Determines the water's vertical position in the ocean
- Factors affecting seawater density
  - Salinity
  - Temperature – the greatest influence

Ocean density

- Variations with depth
  - Low latitudes
    - Low density at the surface
    - Density increases rapidly with depth (pycnocline) because of colder water
  - High latitudes
    - High-density (cold) water at the surface
    - Little change in density with depth

Variations in ocean water density with depth

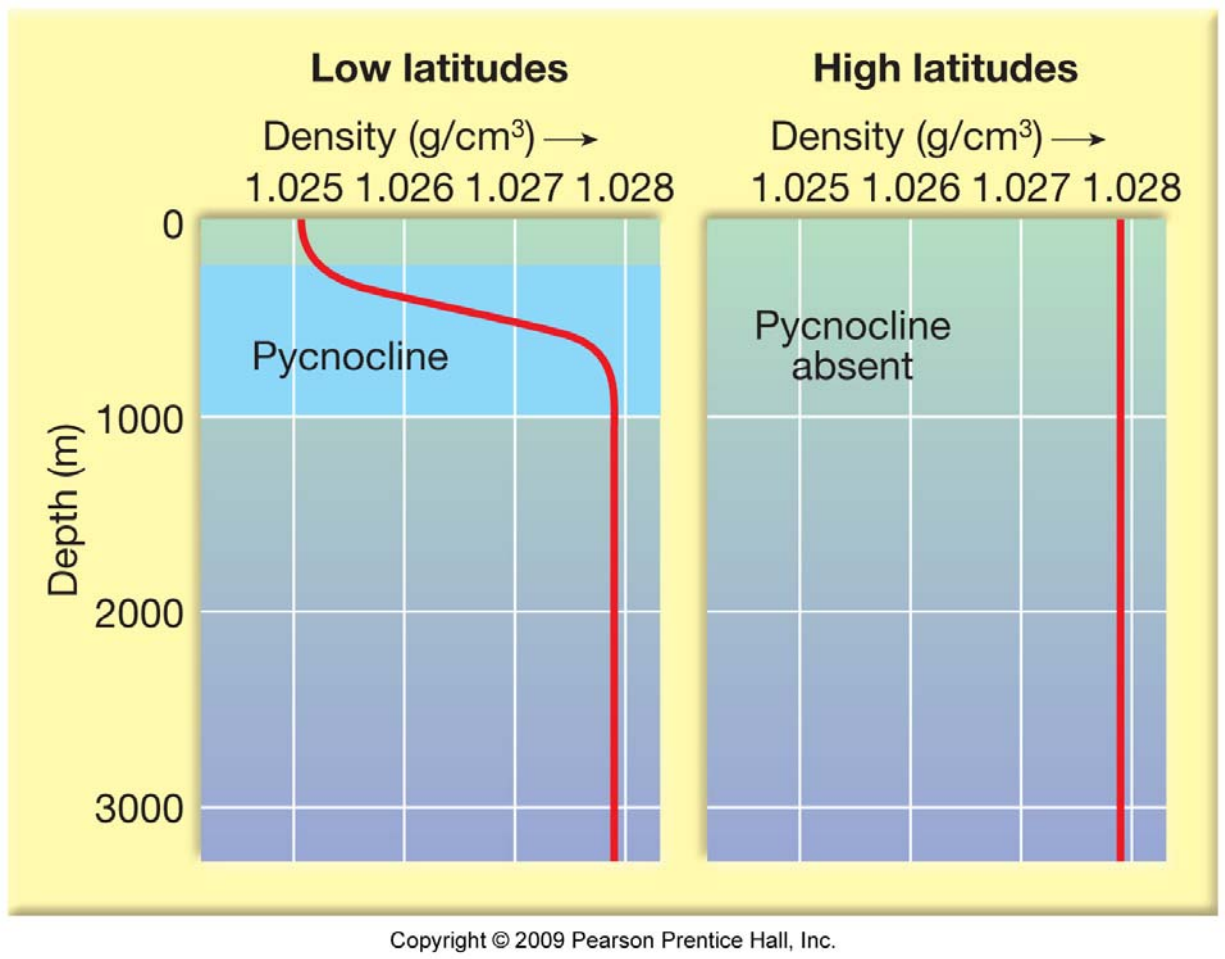

Figure 14.6

Ocean density

- Ocean layering
  - Layered according to density
  - Three-layered structure
    - Surface mixed zone
      - Sun-warmed zone
      - Zone of mixing
      - Shallow (300 meters)

Ocean density

- Ocean layering
  - Three-layered structure
    - Transition zone
      - Between surface layer and deep zone
      - Thermocline and pycnocline
    - Deep zone
      - Sunlight never reaches this zone
      - Temperatures are just a few degrees above freezing
      - Constant high-density water

Layering in the ocean

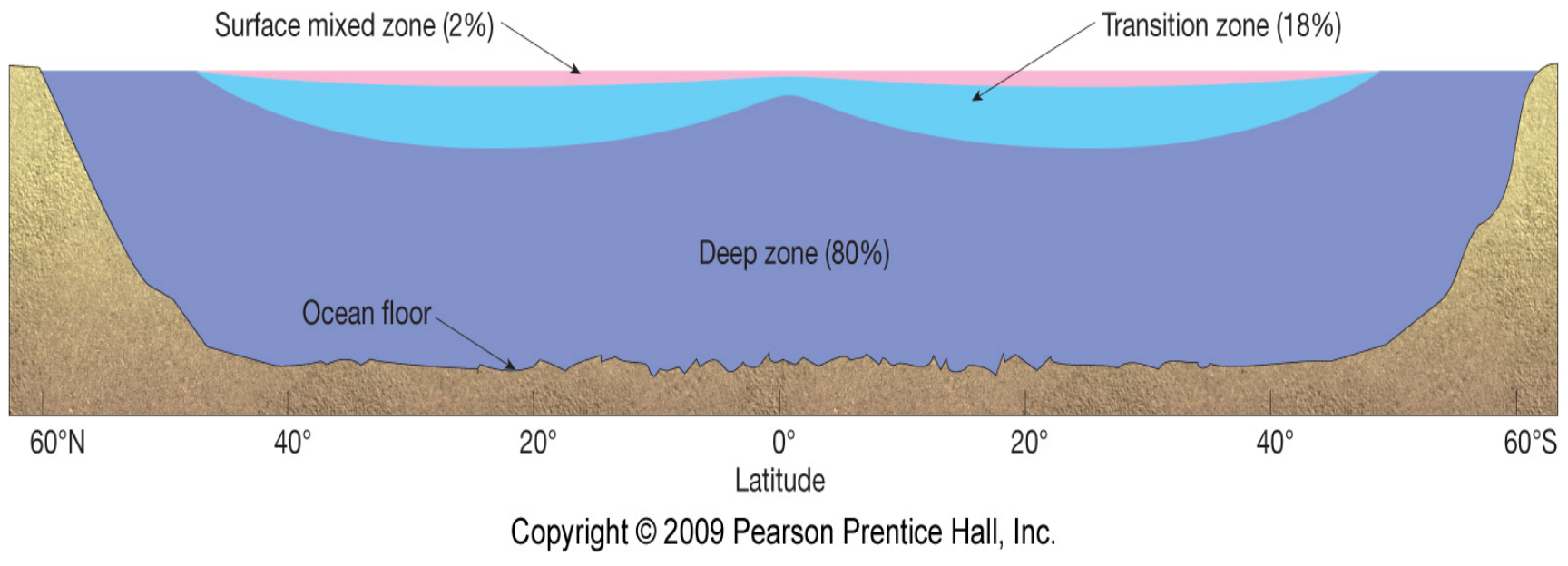

Figure 14.7

Ocean life

- Marine environment is inhabited by a wide variety of organisms
- Most organisms live within the sunlit surface waters (photosynthesis)
- Classification of marine organisms
  - Plankton
    - Floaters
    - Algae (phytoplankton)

Ocean life

- Classification of marine organisms
  - Plankton
    - Animals (zooplankton)
    - Bacteria
    - Most of Earth's biomass
  - Nekton
    - All animals capable of moving independently of the ocean currents
    - They are unable to move throughout the breadth of the ocean

Ocean life

- Classification of marine organisms
  - Benthos
    - Bottom dwellers
    - A great number of species exist on the shallow coastal floor
    - Most live in perpetual darkness in deep water

Ocean life

- Marine life zones
  - Several factors are used to divide the ocean into distinct marine life zones
    - Availability of light
      - Photic (light) zone
        - Upper part of ocean
        - Sunlit
        - Euphotic zone is near the surface where the light is strong

Ocean life

- Marine life zones
  - Several factors are used to divide the ocean into distinct marine life zones
    - Availability of light
      - Aphotic (without light) zone
        - Deep ocean
        - No sunlight

Ocean life

- Marine life zones
  - Several factors are used to divide the ocean into distinct marine life zones
    - Distance from shore
      - Intertidal zone – area where land and ocean meet and overlap
      - Neritic zone – seaward from the low tide line, the continental shelf out to the shelf break
      - Oceanic zone – beyond the continental shelf

Ocean life

- Marine life zones
  - Several factors are used to divide the ocean into distinct marine life zones
    - Water depth
      - Pelagic zone – open ocean of any depth
      - Benthic zone – includes any sea-bottom surface
      - Abyssal zone – a subdivision of the benthic zone
        - Deep
        - Extremely high water pressure
        - Low temperatures

Ocean life

- Marine life zones
  - Several factors are used to divide the ocean into distinct marine life zones
    - Water depth
      - Abyssal zone – a subdivision of the benthic zone
        - No sunlight
        - Sparse life
        - Food sources include decaying particles from above, large fragments falling, and hydrothermal vents

Marine life zones

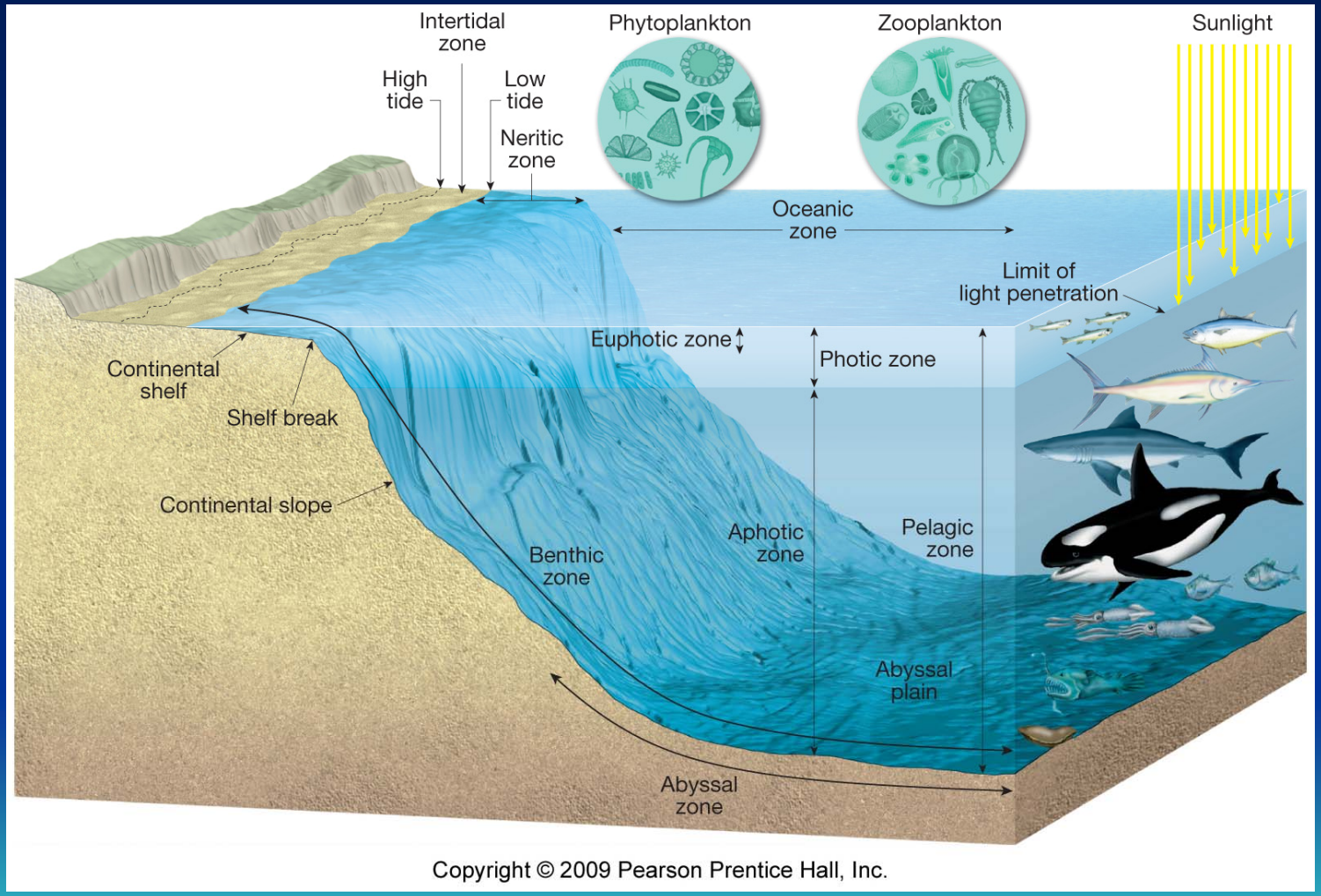

Figure 14.12

Oceanic productivity

- Related to primary productivity
  - The amount of carbon fixed by organisms through the synthesis of organic matter
  - Sources of energy
    - Photosynthesis (solar radiation)
    - Chemosynthesis (chemical reactions)
  - Influenced by
    - Availability of nutrients
    - Amount of solar radiation

Oceanic productivity

- Related to primary productivity
  - Most abundant marine life exists where there is ample
    - Nutrients
    - Good sunlight
- Productivity in polar oceans
  - Because of nutrients rising from deeper water, high-latitude surface waters have high nutrient concentrations

Oceanic productivity

- Productivity in polar oceans
  - Low solar energy limits photosynthetic productivity
- Productivity in tropical oceans
  - Low in the open ocean
  - Thermocline eliminates the supply of nutrients from deeper waters below

An example of productivity in polar oceans (Barents Sea)

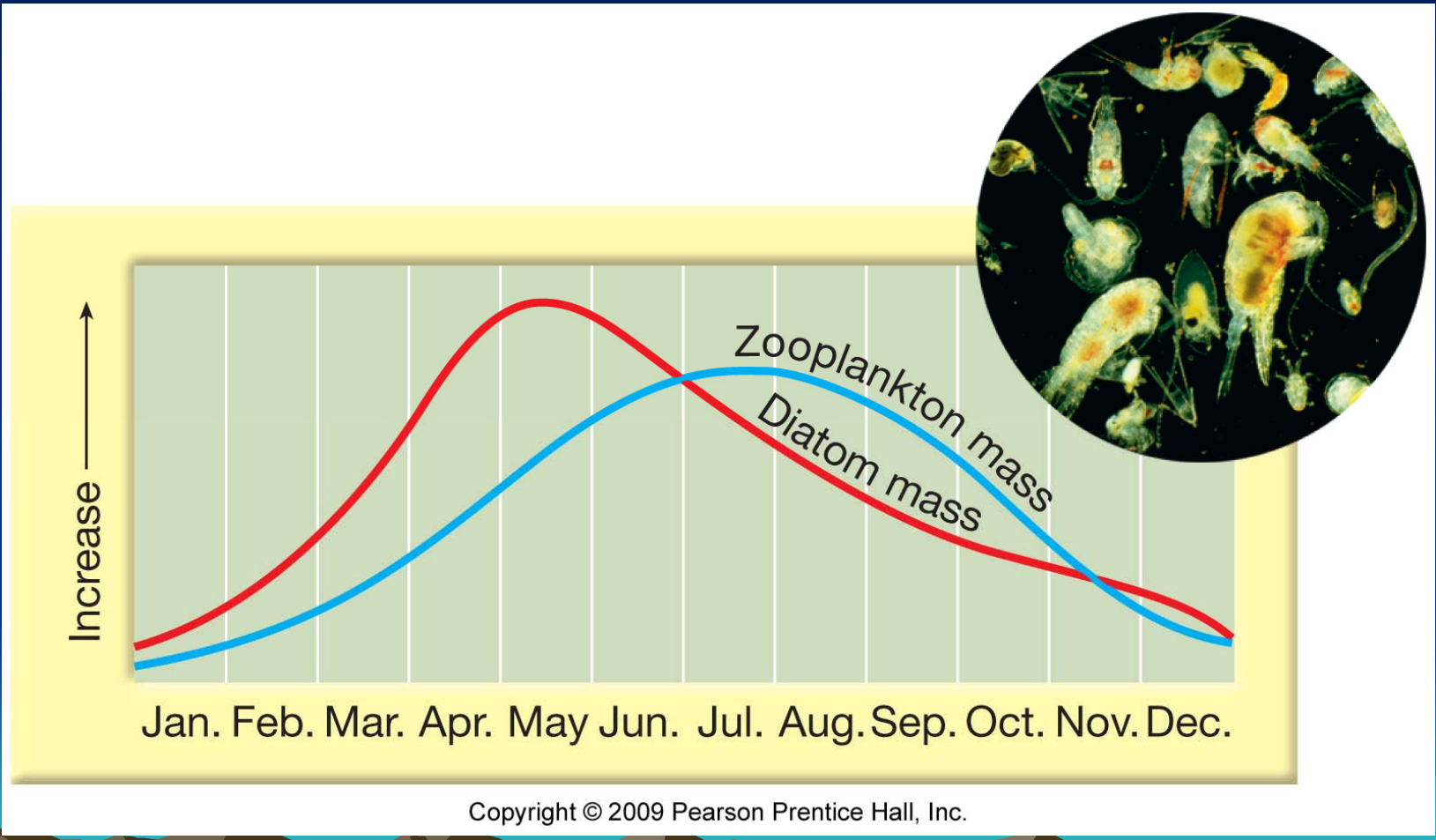

Figure 14.13

Productivity in tropical oceans

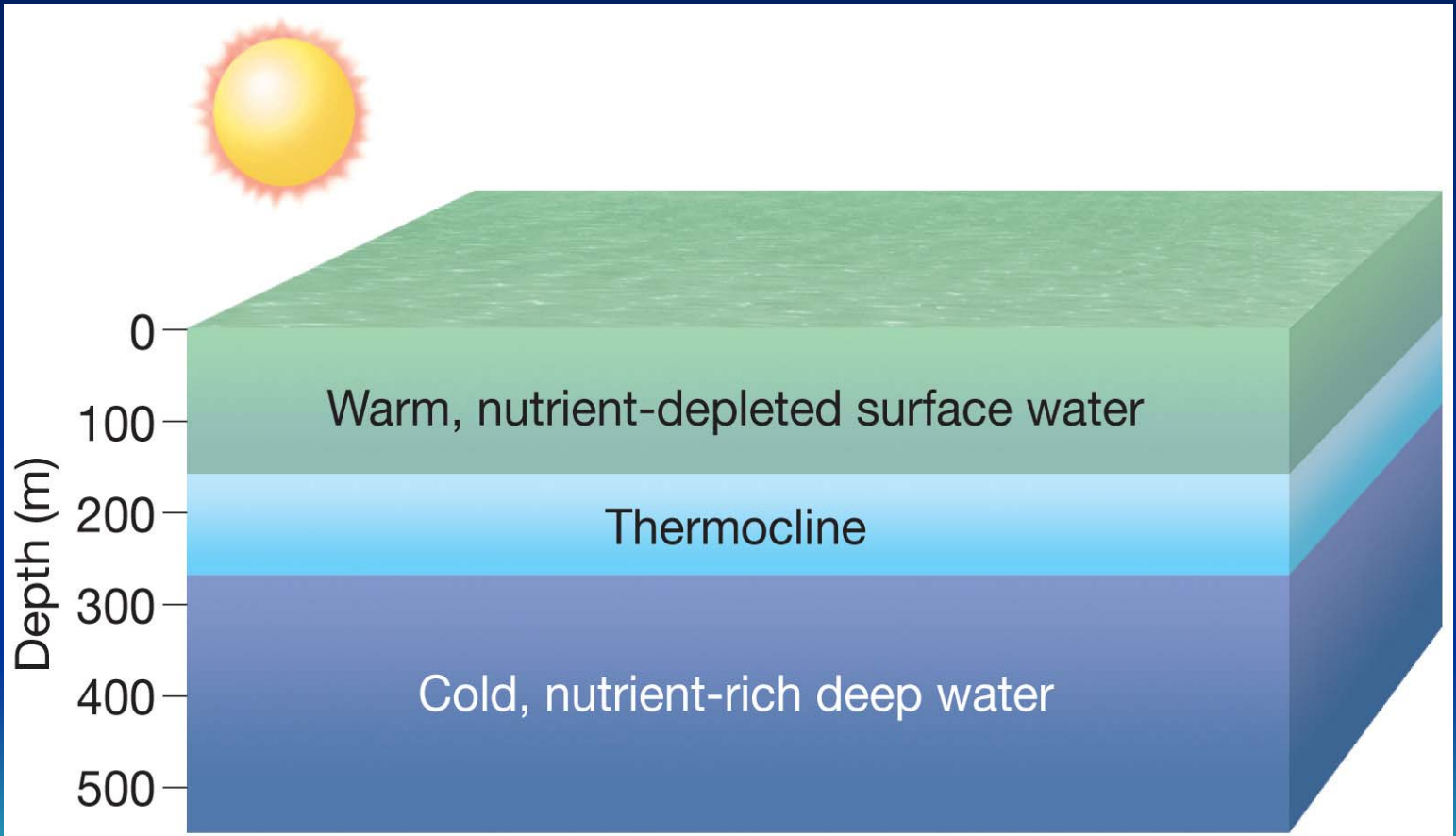

Figure 14.14

Oceanic productivity

- Productivity in temperate oceans
  - Winter
    - Low productivity
    - Days are short and sun angle is low
  - Spring
    - Spring bloom of phytoplankton is quickly depleted
    - Productivity is limited

Oceanic productivity

- Productivity in temperate oceans
  - Summer
    - Strong thermocline develops so surface nutrients are not replaced from below
    - Phytoplankton population remains relatively low
  - Fall
    - Thermocline breaks down and nutrients return to the surface
    - Short-lived fall bloom of phytoplankton
- Highest overall productivity occurs in temperate regions

Productivity in temperate oceans – Northern Hemisphere

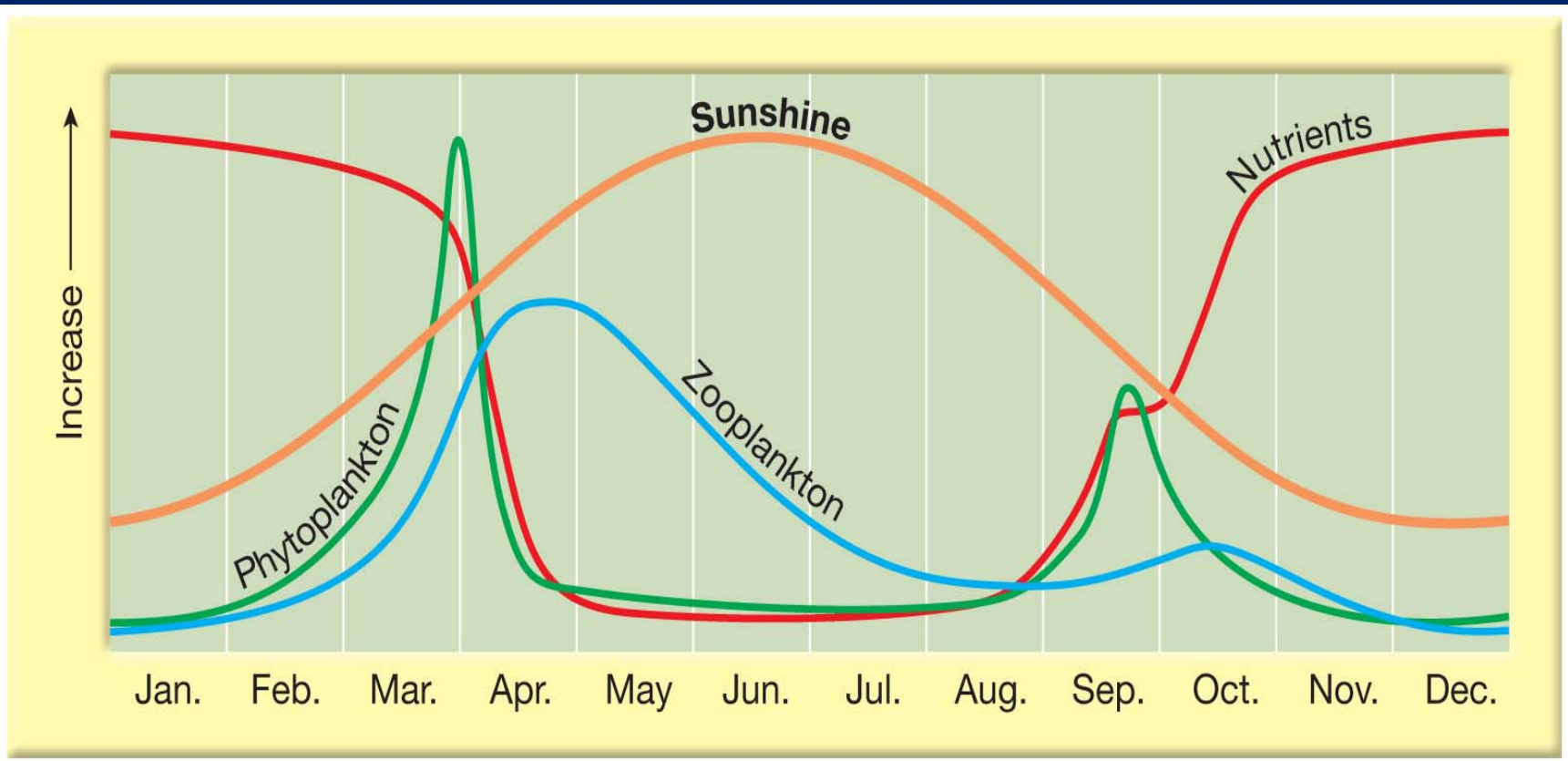

Figure 14.15

Oceanic feeding relationships

- Main oceanic producers
  - Marine algae
  - Plants
  - Bacteria
  - Bacteria-like archaea
- Only a small percentage of the energy taken in at any level is passed on to the next

Oceanic feeding relationships

- Trophic levels
  - Chemical energy stored in the mass of the ocean's algae is transferred to the animal community mostly through feeding
  - Each feeding stage is called a trophic level
- Transfer of energy between trophic levels is very inefficient (about 2 percent)

Ecosystem energy flow and efficiency

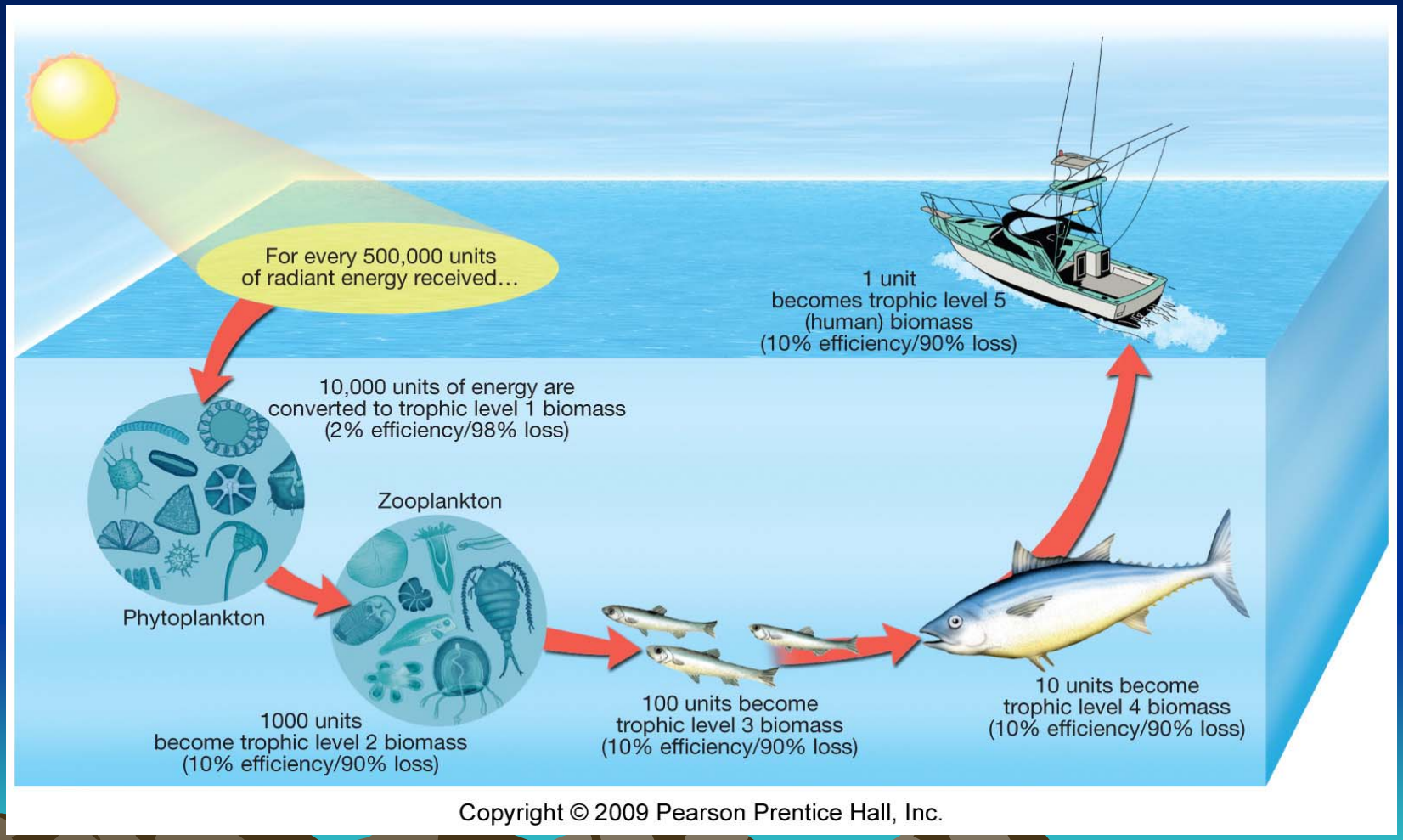

Figure 14.18

Oceanic feeding relationships

- Food chains and food webs
  - Food chain – a sequence of organisms through which energy is transferred
  - Food web
    - Involves feeding on a number of different animals
    - Animals that feed through a food web rather than a food chain are more likely to survive

Comparison between a food chain and a food web

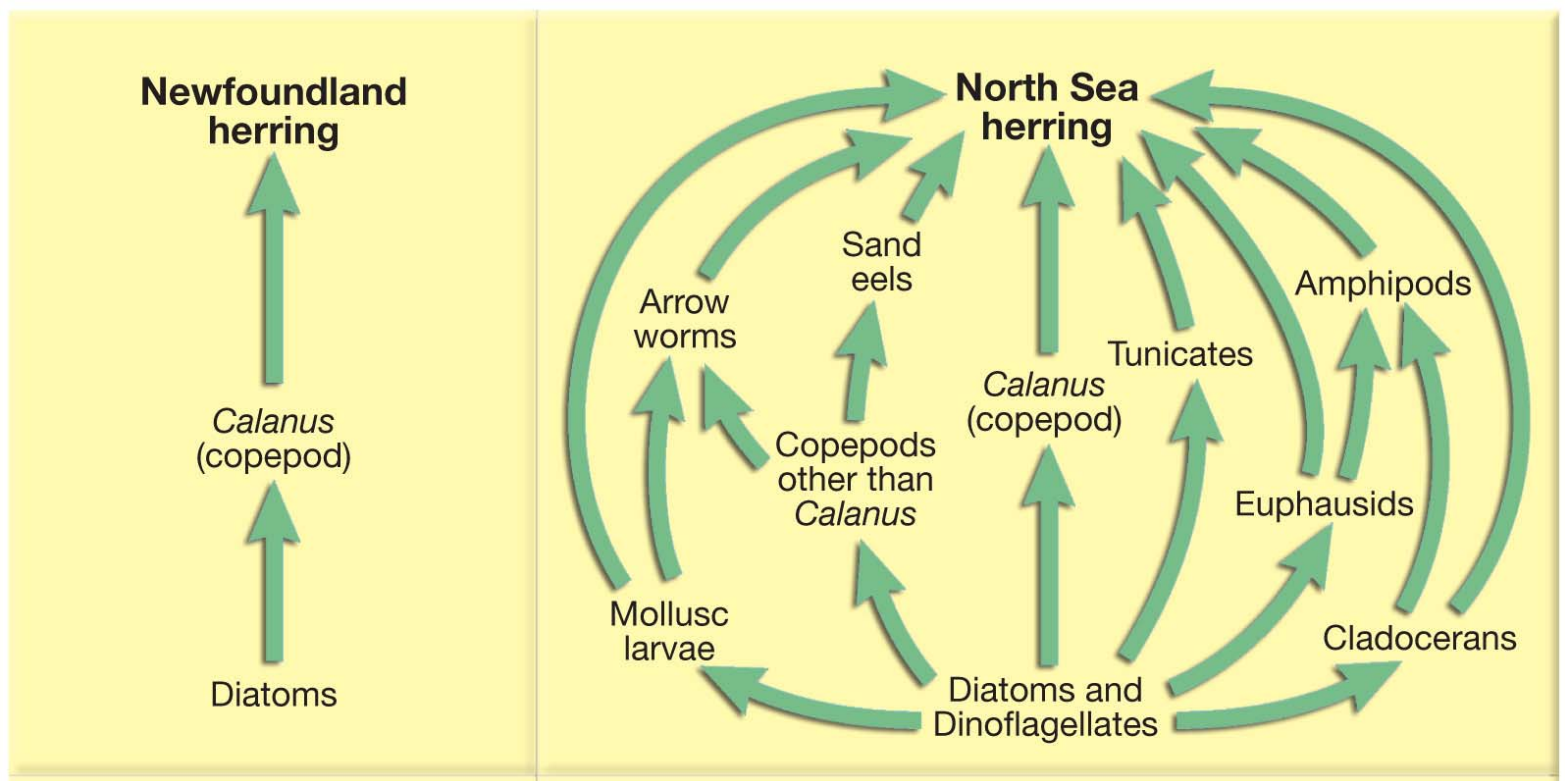

Figure 14.19

End of Chapter 14