

Chapter Outlines

NOTE: This is intended to help students 'organize' their understanding of each topic. It is not a comprehensive study guide for quizzes or midterms, i.e. study your text!

Ocean Water & Ocean Life

I. Composition of seawater - Seawater consists of about 3.5% (by weight) dissolved minerals

A. Salinity

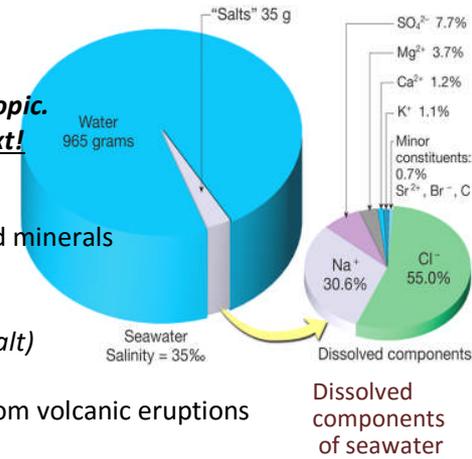
1. Average salinity is $\pm 35\%$ (35 parts per thousand)
2. Major constituent is sodium chloride (NaCl – table salt)

B. Sources of sea salts:

Chemical weathering of rocks; outgassing—gases from volcanic eruptions

C. Processes affecting seawater salinity

1. Variations in salinity are a consequence of changes in the water content of the solution
2. Processes that decrease salinity (*add water*) - precipitation; runoff from land; melting of icebergs; melting of sea ice
3. Processes that increase salinity (*remove water*) - evaporation; formation of sea ice



II. Ocean temperature

A. Surface water temperature varies with the amount of solar radiation received.

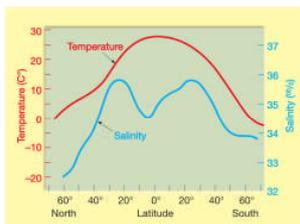
Lower surface t° in high-latitude regions, and higher surface t° are found in low-latitude regions

B. Temperature variation with depth

1. Low latitudes - high t° at the surface, & rapid decrease in temperature with depth (**thermocline**)
2. High latitudes - cooler surface temperatures, & no rapid change in temperature with depth

C. Ocean temperature over time

1. The unique thermal properties of water make it resistant to temperature changes, and a good transporter of heat (*used in most commercial buildings*)
2. Global warming will slowly influence ocean temperatures



Temperature & salinity by latitude

III. Ocean density

A. Seawater density determines the water's vertical position in the ocean

B. Factors affecting seawater density:

Salinity; temperature (t° is the greatest influence)

C. Variations with depth

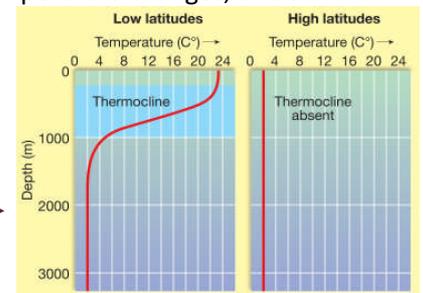
1. Low latitudes:

Low density at the surface, increasing rapidly with depth (**pycnocline**) because of colder water

2. High latitudes:

High-density (cold) water at the surface, little change in density with depth

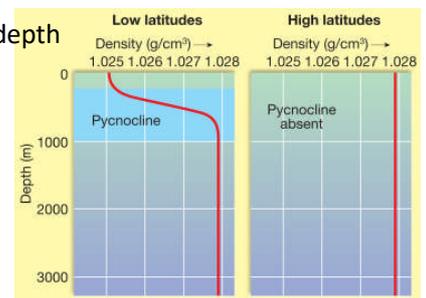
Temperature variation w/depth low & high latitudes



D. Ocean layering

1. Three-layered structure according to density:

- a. **Surface mixed zone** characteristics: Sun-warmed zone; Zone of Mixing; Shallow (± 300 meters)
 - b. **Transition zone** is between surface layer and deep zone: includes a thermocline and/or pycnocline
 - c. **Deep zone** – constant high-density water, sunlight never reaches this zone, so the temperatures are just a few degrees above freezing
2. Three-layer structure does not exist in high latitudes



Density variation w/depth low & high latitudes

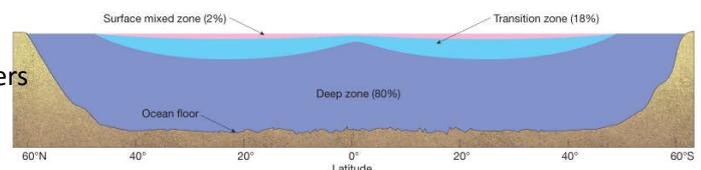
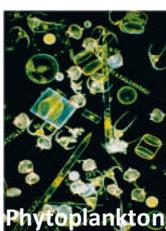
IV. Ocean life - a wide variety of organisms

A. Most organisms live within the sunlit surface waters (*photosynthesis occurs here*)

B. Classification of marine organisms

1. Plankton includes:

floaters; algae (**phytoplankton**); animals (**zooplankton**); bacteria; most of Earth's biomass



Ocean layers by density, and latitude

Benthos

2. **Nekton**—Includes all animals capable of moving independently of ocean currents

3. **Benthos** - bottom dwellers
 a. A great number of species exist on the shallow coastal floor
 b. Most live in perpetual darkness in deep water

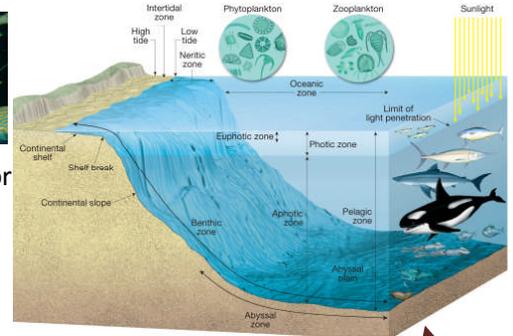
C. Marine life zones

Factors used to divide the ocean into distinct marine life zones:

- a. Availability of light
 1. **Photic (light) zone** - upper sunlit part of ocean (to $\pm 1000m$ – depends on clarity)
 2. The **Euphotic zone** is nearest the surface, where light is strong (to $\pm 100m$ depth – depends on clarity)
 i Phytoplankton use sunlight to produce food
 ii Different wavelengths of light are absorbed at different depths
 3. **Aphotic (without light) zone** – deep, no sunlight
- b. Distance from shore
 1. **Intertidal zone**—area where land and ocean meet and overlap
 2. **Neritic zone**—seaward from the low tide line, the continental shelf out to the shelf break
 3. **Oceanic zone**—beyond the continental shelf

c. Water depth

1. **Pelagic zone**—open ocean of any depth
 2. **Benthic zone**—includes any sea-bottom surface
 3. **Abyssal zone**—a subdivision of the benthic zone
 a. Deep; extremely high water pressure; low t° ; no sunlight; sparse life
 b. Food sources: decaying particles from above; hydrothermal vents



Zones based on:
 • light,
 • distance from shore,
 • depth

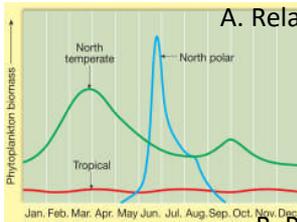
Basis	Marine Life Zone	Subdivision	Characteristics
Available sunlight	Photic	Euphotic	Sunlit surface waters Has enough sunlight to support photosynthesis
		Aphotic	No sunlight; many organisms have bioluminescent capabilities
	Aphotic		
Distance from shore	Intertidal		Narrow strip of land between high and low tides; dynamic area
	Neritic		Above continental shelf; high biomass and diversity of species
	Oceanic		Open ocean beyond the continental shelf; low nutrient concentrations
Depth	Pelagic		All water above the ocean floor; organisms swim or float
		Benthic	Bottom of ocean; organisms attach to, burrow into, or crawl on seafloor
		Abyssal	Deep-sea bottom; dark, cold, high pressure; sparse life

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V. Oceanic productivity

A. Related to primary productivity

1. The amount of carbon fixed (taken into a compound from its free state) by organisms through the synthesis of organic matter
 2. Sources of energy - **Photosynthesis (solar radiation)**; **Chemosynthesis (chemical reactions)**
 3. Influenced by - availability of nutrients, and the amount of solar radiation
 4. Most abundant marine life exists where there are: ample nutrients, good sunlight



B. Productivity in polar oceans

1. Nutrients rising from deeper water produce high nutrient concentrations in surface waters
 2. Low solar energy limits photosynthetic productivity

C. Productivity in tropical oceans

1. Low in the open ocean
 2. Thermocline eliminates the supply of nutrients from deeper waters below

D. Productivity in temperate oceans

1. Winter - low productivity due to shorter days and low sun angle
 2. Spring - spring bloom of phytoplankton is quickly depleted and productivity is limited
 3. Summer - strong thermocline develops, so surface nutrients are not replaced from below, and phytoplankton population remains relatively low
 4. Fall - thermocline breaks down and nutrients return to the surface. There is a short-lived fall bloom of phytoplankton

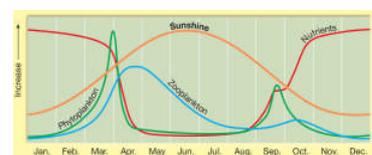
E. Highest overall productivity occurs in temperate regions

VI. Oceanic feeding relationships

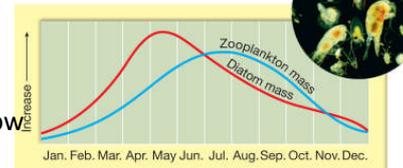
- A. Main oceanic producers include:
 marine algae; plants; bacteria; bacteria-like archaea
 B. Only a small percentage of the energy taken in at any level is passed on to the next ($\pm 2\%$)
 C. **Trophic levels** - an organism's level in the food chain
 Beginning with algae, energy is transferred to higher trophic levels through feeding
 D. Food chains and food webs

1. **Food chain**—a sequence of organisms through which energy is transferred
 2. **Food web** - feeding on a number of different animals, provides better chance of survival

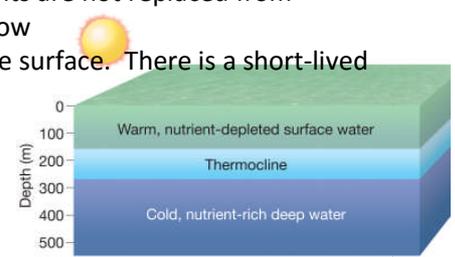
Comparison of productivity: ↑ tropical, temperate, polar



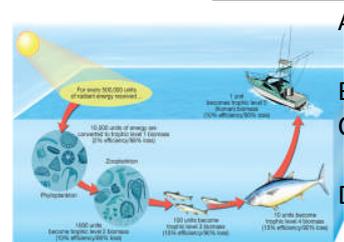
Productivity in temperate oceans



Polar productivity



Permanent thermocline in the tropics



Ecosystem energy flow