Ocean Water

Chapter 21

Properties of Ocean Water

Chapter 21, Section 1

Section 21.1 Objectives

- Describe the chemical properties of ocean water.
- Describe the physical properties of ocean water.

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Introduction

- Pure liquid water is tasteless, odorless, and colorless.
- Solids and gases dissolved in water form a solution called *ocean water* or *sea water*.
- Physical properties: temperature, density, and color.
- Chemical properties: determine composition and enable it to dissolve other substances.

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Composition of Ocean Water

- Each year, rivers carry 400 billion kg of dissolved solids into the ocean.
- Most are salts.
- Water evaporates from the ocean.
- Salts and other minerals stay behind.
- So, the ocean is salty, but rain and freshwater are not.

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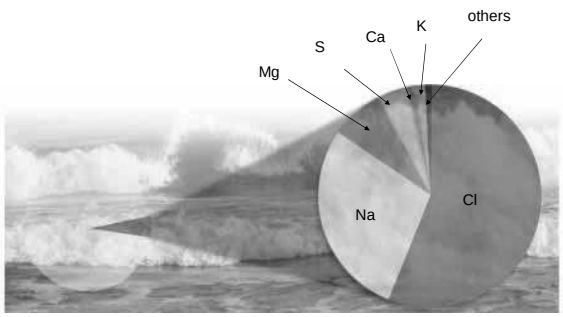
Elements in Ocean Water



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Dissolved Gases

- 3 principal gases dissolved in ocean water are…
  - Nitrogen
  - Oxygen
  - Carbon dioxide (dissolves most easily)
- Temperature affects the amount of gas that dissolves in water.
- Warmer water dissolves solids better, colder water dissolves gases better.

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Salinity of Ocean Water

- Sodium Chloride (NaCl) makes up 78% of the ocean's dissolved solids.
- The rest is other salts and minerals.
- **Salinity**: the amount of dissolved solids present in ocean water.
- Evaporation and freezing increase salinity.
- Thus, tropical waters are more salty than polar waters.

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Temperature of Ocean Water

- Ocean water can absorb infrared light from the sun.
- Absorption of IR heats the water.
- The Sun can directly heat the surface water.
- Deep water is usually about 2℃.
- Ocean water freezes at - 2℃.

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Surface Temperature

- Movement of ocean water moves surface heat down 100m to 300m.
- Surface waters maintain relatively constant temp.
- Equatorial waters are warmer
- Temp drops as latitude increases.
- Polar regions usually drop below - 2℃, so surface water freezes, making **pack ice**.

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The Thermocline

- **Thermocline**: zone of rapid temperature change just below the surface of the ocean.
- Cold water and warm water do not mix easily because they are different density.
- The thermocline marks the separation between the warmer surface water and the colder deep water.

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Density of Ocean Water

- **Density** is the mass of a substance per unit volume.
- Example: 1 cubic cm of pure water has a mass of 1 g. So, it's density is 1g/cm^3
- 2 factors affect density: temp & salinity
- As temp increases, density decreases
- As salinity increases, density increases.

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21.1 Review

- Why does the water of the Arctic Ocean have relatively low salinity?
- What is a thermocline?
- How does temperature affect the density of ocean water?
- Why would surface water in the North Sea have a higher percentage of dissolved gases than surface water in the Caribbean Sea?

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Life in Ocean Water

Chapter 21, Section 2

Section 21.2 Objectives

- Explain how marine life alters the chemistry of ocean water.
- Explain why plankton can be called the foundation of life in the ocean.
- Describe the major zones of life in the ocean.

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Introduction

- Fossil evidence indicates that life began in the oceans more than 3 billion years ago.
- Since then, organisms have changed along with the physical and chemical properties of the ocean.
- Most marine organisms rely on 2 factors
  - Essential nutrients in the water
  - Sunlight
- Changes in either affects the ability of marine organisms to survive and flourish.

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Ocean Chemistry & Marine Life

- Organisms remove all the nutrients and dissolved gases they require for carrying out life processes.
- At the same time, they return a variety of nutrients & gases to the water.

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Sunlight & Marine Life

- All marine plants and many microscopic marine organisms require sunlight as well as nutrients in the water.
- **Plankton**: free-floating microscopic plants and animals.
- **Phytoplankton**: photosynthetic plankton
- **Zooplankton**: animal-like plankton
- **Nekton**: free-swimming ocean life
- **Benthos**: bottom-dwelling organisms.

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Ocean Environments

- See page 416, Figure 21-8
- Divided into 2 general environments.
- benthic zones (bottom), 5 zones
- pelagic zones (water), 2 major zones
- The amount of sunlight, temperature, and water pressure determine the distribution of marine life in these zones.

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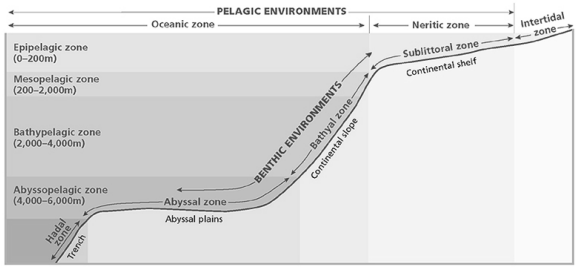
Ocean Environments



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Benthic Zones

- **Intertidal**: shallowest, lies between high and low tide. Crabs, clams, mussels, sea anemones and seaweed.
- **Sublittoral**: shallow. Largest # of benthic organisms. Sea stars, brittle stars, sea lilies.
- **Bathyal** (dark): begins @ continental slope & extends to 4,000m. Octopus, sea star, brachiopods.
- **Abyssal** (dark): extends to 6,000m. Sponges, worms, sea cucumbers.
- **Hadal** (dark): below 6,000m, virtually unexplored, life is sparse and depends on food that falls from higher levels.

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Pelagic Zones

- **Neritic zone**: located above continental shelves.
- 1st pelagic zone
- lots of sunlight
- moderate temp, low pressure.
- Ideal for marine life.
- Lots of plankton & nekton. Source of most fish & seafood.

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Pelagic Zones 2

- **Oceanic zone**: deep ocean waters beyond the continental shelf.
  - *epipelagic* uppermost area (sunlit) tuna, dolphin, and mats of floating sargassum weed
  - *mesopelagic* (dark)
  - *bathypelagic* (dark)
  - *abyssopelagic* (dark)
- The dark zones occur at increasing depth.
- Generally less marine life in as depth increases.

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Section 21.1 Review

- In addition to the action of waves and tides, what other process causes deep ocean water to move upward?
- Describe the 2 main types of plankton.
- Describe the intertidal, neritic, bathyal, and abyssal zones and mane some organisms found in each.

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Ocean Resources

Chapter 21, Section 3

Section 21.3 Objectives

- Describe three important resources of the ocean.
- Explain the threat to ocean life posed by water pollution.

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Fresh Water from the Ocean

Desalination: a process of removing salt from ocean water

- One method of desalination is distillation. During **distillation**, ocean water is heated to remove salt.
- Another method of desalination is *freezing*. This process requires about one-sixth the energy needed for distillation.
- *Reverse osmosis desalination* is a popular method for desalinating ocean water. This method forces ocean water through a membrane that blocks dissolved salts.

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Minerals from the Ocean

- Nodules are a valuable source of manganese, iron, copper, nickel, cobalt, and phosphates.
- Recovery of nodules is expensive and difficult because they are located in very deep water.
- Magnesium & bromine can be extracted directly from ocean water easily.

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Minerals from the Ocean (2)

Petroleum

- The most valuable resource in the ocean is petroleum found beneath the ocean floor.
- Offshore oil and natural gas deposits exist along continental margins around the world.
- About one-fourth of the world's oil is now obtained from offshore wells.

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Food from the Ocean

Aquaculture: the raising of aquatic plants and animals for human use or consumption

- A major problem for aquaculturalists is that the ocean farms are susceptible to pollution and that the farms may be a local source of pollution.
- Under the best conditions, an ocean farm could produce more food than an agricultural farm of the same size.

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Ocean Water Pollution

- The oceans have been used as a dumping ground for many kinds of wastes including garbage, sewage, and nuclear waste.
- The growth of the world population and the increased use of more-toxic substances have reduced the ocean's ability to absorb wastes and renew itself.
- Ocean-water pollution threatens both marine organisms and humans by damaging food resources in the ocean.

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Section 21.3 Review

1. Name & describe 3 methods for desalinating ocean water.
2. What ocean resource might eventually replace some minerals now mined on land?
3. What is aquaculture, and why is it important?
4. How does ocean water pollution threaten the quality of life on Earth?

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