	21.1 Properties of Ocean Water
Section 21.1 Objectives	➢Describe the chemical properties of ocean water. ➢Describe the physical properties of ocean water.
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.
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.
Elements in Ocean Water	The six most abundant elements dissolved in ocean water are: Chlorine, sodium, magnesium, sulfur, calcium, and potassium
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.
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.
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℃.

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**.
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.
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 $1 g/cm^3$ ➢2 factors affect density: temp & salinity ➢As temp increases, density decreases ➢As salinity increases, density increases.
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?

	21.2 Life in Ocean Water
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.
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.
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.
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.
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.
Ocean Environments (on the bottom)	**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.

Pelagic Zones (in the water)	➢**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. ➢**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.

	21.3 Ocean Resources
Objectives	➢Describe three important resources of the ocean. ➢Explain the threat to ocean life posed by water pollution.
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.
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. ➢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.
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.
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.