

# Properties of Seawater

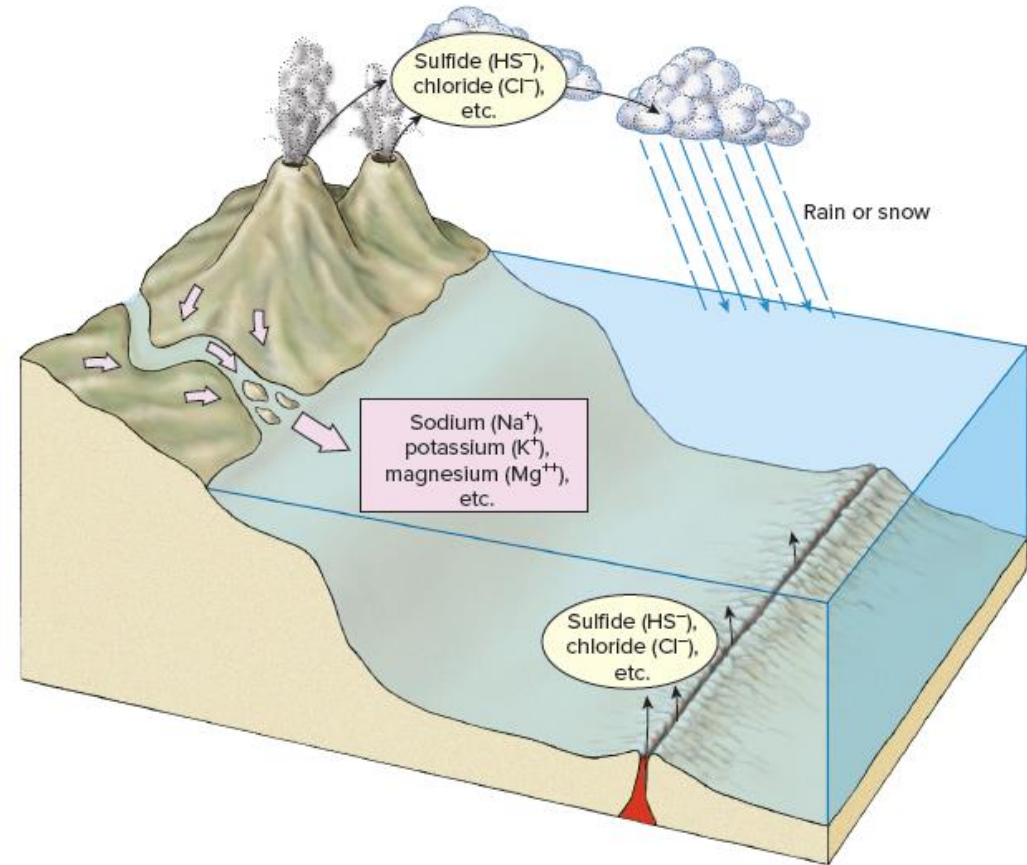
## Explicit Instruction

### Ions Entering Seawater

- The characteristics of seawater are due to the nature of pure water and to the materials dissolved in it.
- Ions dissolved in seawater come from chemical weathering of rocks on land, materials from Earth's interior, and materials released into the atmosphere by volcanoes.

The physical properties of seawater shape life in the oceans.

- Fundamental properties such as light level, pressure, and transmission of light and sound are drastically different in the oceans than on land.

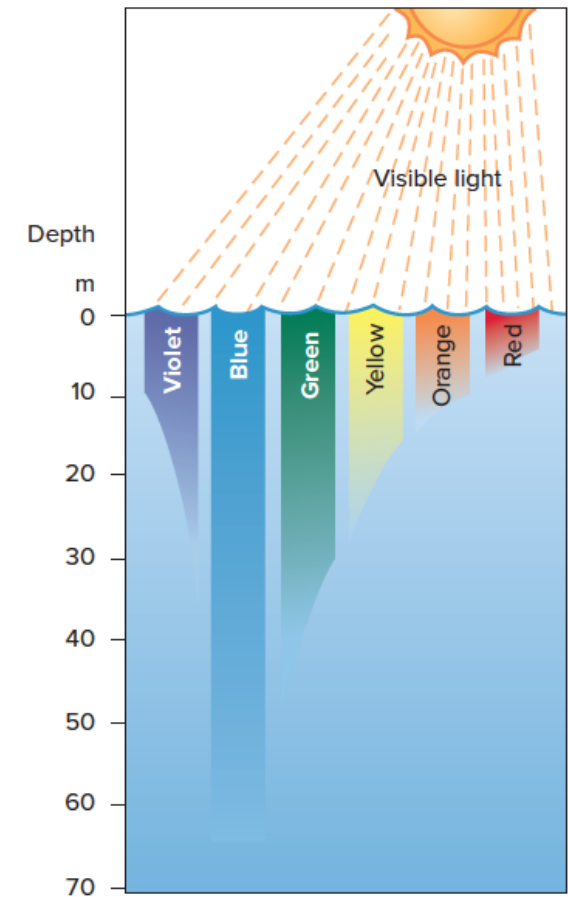


# Properties of Seawater

## Explicit Instruction

### Transparency

- Water is relatively transparent (one can see through it).
- This means that sunlight shining on the surface can penetrate the surface (crucial for the photosynthetic organisms living underwater).
- This level of penetration varies greatly depending on the materials dissolved in the water.
- Different colors of light penetrate to different depths in the ocean.

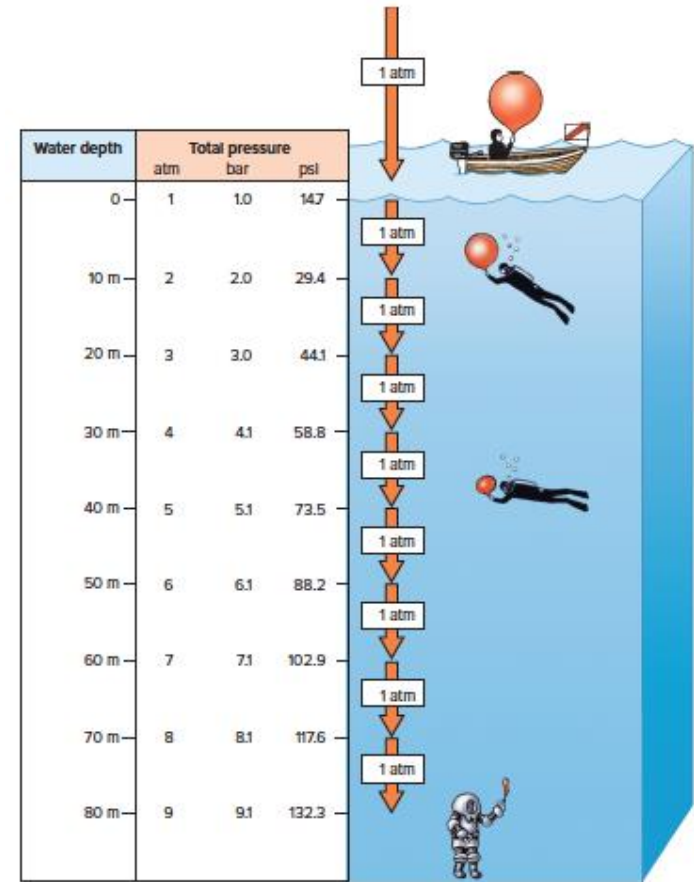


# Properties of Seawater

## Explicit Instruction

### Pressure

- Pressure increases dramatically with ocean depth.
- Organisms on land are under 1 atmosphere of pressure at sea level.
- Marine organisms are under the weight of the atmosphere and the weight of the water.
- With each 10 m of increased depth, another atmosphere of pressure is added.
- As pressure increases, gases are compressed.
- Changing pressures affect marine organisms and the scientists that study them.

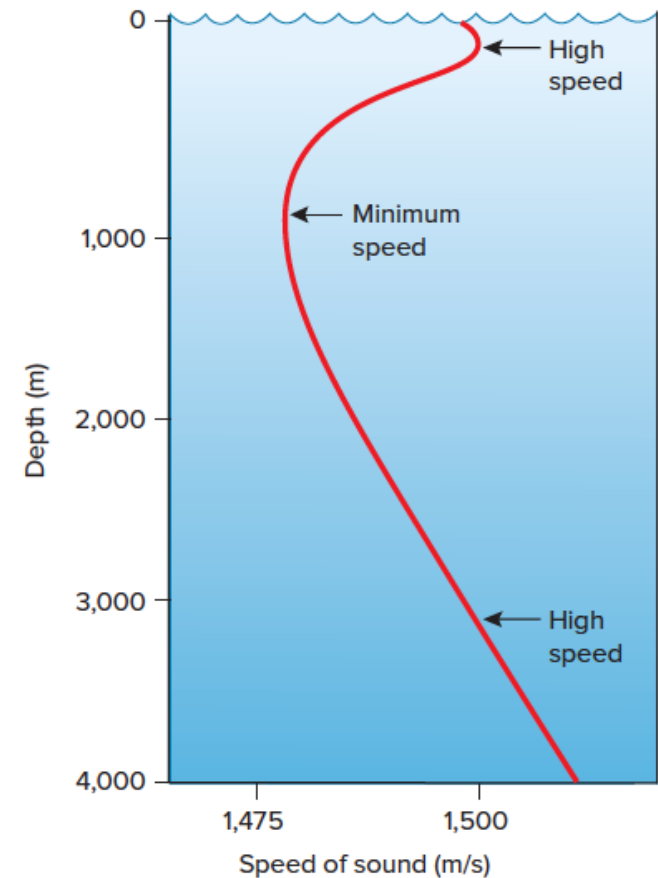


# Properties of Seawater

## Explicit Instruction

### Sound Propagation

- Water is denser than air.
- The higher density of water causes sound to travel 4.5 times faster in water than in air (340 m/s in air and about 1,520 m/s in the shallow ocean).
- In the Deep Sound Channel, low-frequency sound waves can travel uninterrupted for thousands of kilometers.
- Animals like fishes, marine mammals, and shrimps use sound for communication, navigation, reproduction, and predator and prey detection.



# Properties of Seawater

## Explicit Instruction

The chemical properties of seawater, such as salinity, distinguish it from freshwater habitats.

- Most of the solutes (dissolved materials) are made up of a small number of ions; with only six ions compose more than 99% of the material dissolved in seawater.
- Salinity is the total amount of salt dissolved in water and is usually expressed as the number of grams of salt dissolved into 1,000 grams of seawater.
- The relative percentage of the major ions in seawater remains constant even though the total amount of salt varies slightly from place to place (rule of constant proportions).
- Proportions can vary near hydrothermal vents, where rivers flow into the ocean, and where there is intense biological activity; but for the most part, the oceans are chemically well mixed (averaging about 35‰).
- Variations to ocean salinity are usually the result of the addition or removal of pure water.

**Table 3.1** The Composition of Seawater of 35‰ Salinity

Ion	Concentration ‰	Percentage of Total Salinity
Chloride (Cl <sup>-</sup> )	19.345	55.03
Sodium (Na <sup>+</sup> )	10.752	30.59
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	2.701	7.68
Magnesium (Mg <sup>2+</sup> )	1.295	3.68
Calcium (Ca <sup>2+</sup> )	0.416	1.18
Potassium (K <sup>+</sup> )	0.390	1.11
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	0.145	0.41
Bromide (Br <sup>-</sup> )	0.066	0.19
Borate (H <sub>2</sub> BO <sub>3</sub> <sup>-</sup> )	0.027	0.08
Strontium (Sr <sup>2+</sup> )	0.013	0.04
Fluoride (F <sup>-</sup> )	0.001	0.003
Other dissolved material	<0.001	<0.001

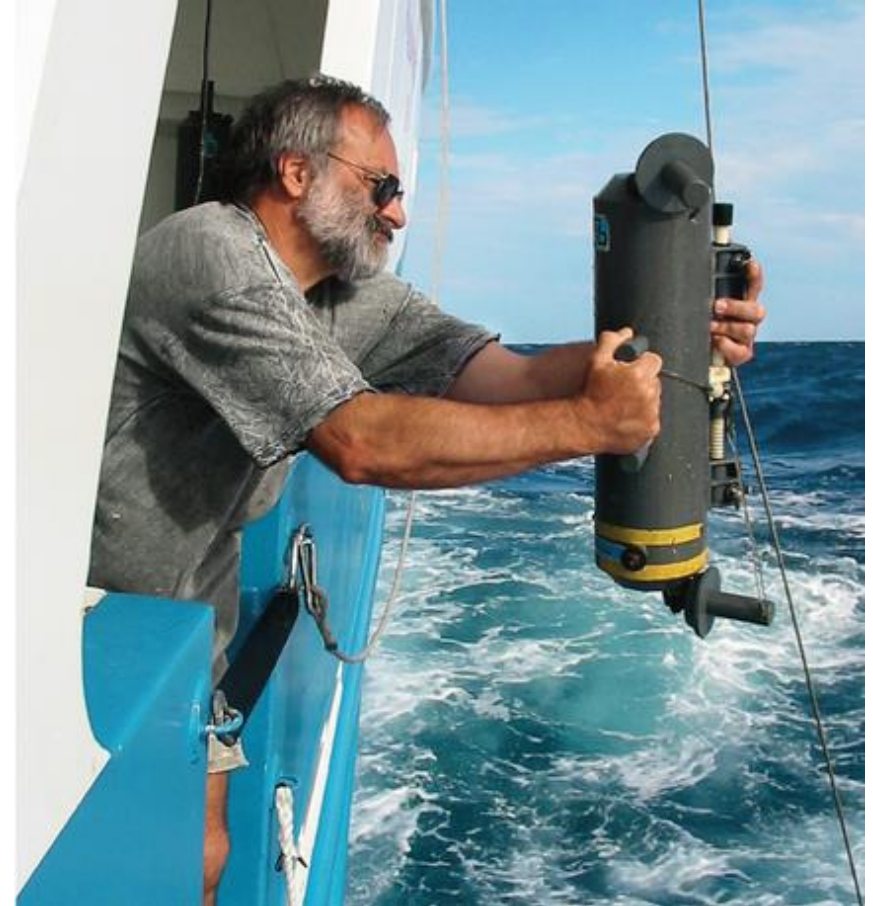
# Properties of Seawater

## Explicit Instruction

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### Salinity, Temperature and Density

- The saltier the water is, the denser it is.
- The density of seawater depends on temperature and salinity.
- Temperature in the ocean varies considerably more than salinity; so density is usually controlled more by temperature than salinity.





# Properties of Seawater

## Explicit Instruction

### Trace Elements, Nutrients and Organics

- Trace elements, usually metals and metalloids, are present in tiny amounts in the ocean.
- Trace elements usually enter the ocean through river runoff, groundwater seeps, the atmosphere, hydrothermal activity, and human-derived inputs.
- Most trace elements are removed from the ocean when they are incorporated into sinking particles.
- Many of these elements are also nutrients for marine life.

Trace Element	Concentration(ppb)*
Lithium(Li)	170
Iodine (I)	60
Molybdenum (Mo)	10
Zinc (Zn)	10
Iron (Fe)	10
Aluminium (Al)	10
Copper(Cu)	3
Manganese(Mn)	2
Cobalt (Co)	0.1
Lead (Pb)	0.03
Mercury (Hg)	0.03
Gold(Au)	0.004

# Properties of Seawater

## Explicit Instruction

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### Dissolved Gases

- Many gases are also dissolved in seawater including oxygen, carbon dioxide, and nitrogen.
- Gases from the atmosphere dissolve at the sea surface. Occasionally, the reverse happens.
- Oxygen is produced through photosynthesis by marine plants and phytoplankton.
- Many organisms in the ocean utilize oxygen and release carbon dioxide.





# Properties of Seawater

## Explicit Instruction

### The Carbon Cycle

- The carbon that forms the backbone of all organic molecules starts in the atmosphere as carbon dioxide, and then it dissolves in the ocean.
- Carbon dioxide is converted into organic compounds by photosynthesis.
- Respiration by consumers, decomposers, and producers breaks down the organic compounds and makes the carbon dioxide available to producers again.

