

# Bio Chemistry

- Bio= life
- Chemistry = how things interact
- Biochemistry= the branch of science in which you study the chemical and physical processes that occur in an organism.

Or

- Study of Biochemistry shows how the collections of inanimate molecules that constitute living organisms interact to maintain and perpetuate life governed solely by the physical and chemical laws that govern the nonliving universe.
- **Father of Biochemistry: Carl Alexander Neuberg**

# Major Molecules of Life

- Carbohydrate
- Proteins
- Lipids
- Nucleic acid

# Water as a Biological Medium



# **Life has originated in aquatic medium**

- ✓ Water covers 71% of the Earth's surface.

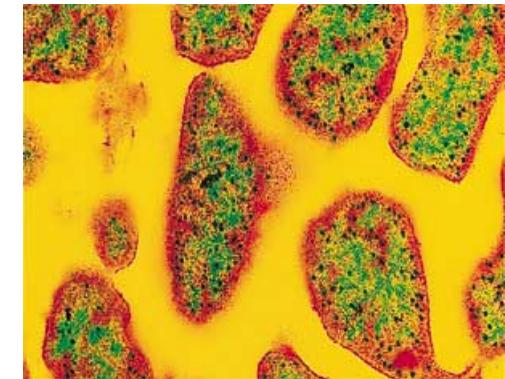
Oceans hold 97% of surface water

Glacier and polar ice caps 2.4%

1.6% of water below ground

Rivers, lakes and ponds 0.6%.

0.001% in the air as vapour, clouds (formed of solid and liquid water particles suspended in air)



A very small amount of the Earth's water is contained within biological bodies and manufactured products.

# General Properties

- Water is a simple molecule, yet it is fundamental to life
- In active living cells, two-thirds, or often more, of the area is occupied by water
- It is the only substance which can be found naturally in all three states - solid (ice), liquid and gas (water vapour)
- It has high melting and boiling point
- Water is also very good at ionizing substances and a good solvent

# **Property of water**

## **A. Physical property**

**Density**

**Buoyancy**

**Wave and current**

**Temperature**

**Salinity**

**Light and turbidity**

**Colour etc.**

## **B. Chemical property**

**DO**

**pH**

**Hardness**

**Alkalinity**

**CO<sub>2</sub> etc.**

# **Study of water**

**Hydrology:** The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere

**Hydrography:** **Hydrography** is the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and river

**Limnology:** the study of bodies of fresh water or inland with reference to their plant and animal life, physical properties, geographical features etc

**Lentic water: Stagnant water**

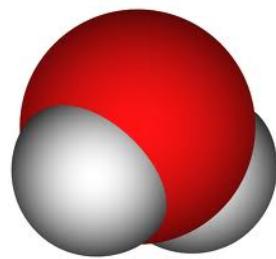
**Lotic water: Running water**

**Oceanography:** The scientific study of oceans, the life that inhabits them, and their physical characteristics, including the depth and extent of ocean waters, their movement and chemical makeup, and the topography and composition of the ocean floors

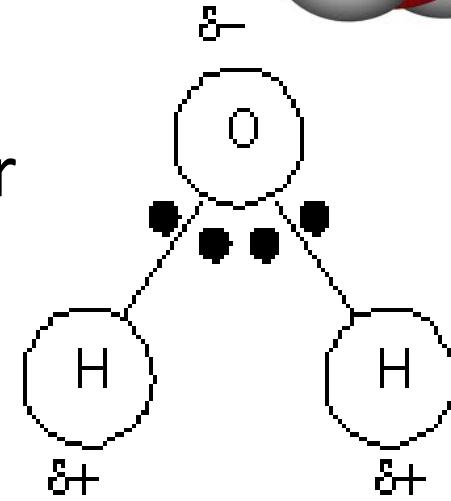
# **Water as a *Major Cell Constituent***

- In most organisms there is 60-90% water
- The lowest water content can be found in plant seeds (20%), and the highest in jellyfish (99%).
- In cell, water is found mainly in the protoplasm and here it plays vital roles in ***metabolism***

# Water as a *Solvent*



- Formula H<sub>2</sub>O
- Atoms are covalently bonded together
- ***Oxygen electronegative***
- ***Hydrogen electropositive***
- The molecule is said to be ***polar***
- Hydrogen atoms of one water molecule are weakly bonded to the oxygen atoms in adjacent water molecules. These weak bonds are called ***hydrogen bonds***
- This is the reason behind the unexpectedly high melting and boiling points of water



# Water the Universal Solvent

- Convert food in soluble form (like **from starch to glucose**) that can be transported and taken by various cells/tissues
- Helps in **removal of metabolic waste products** in the form of urine, sweat etc
- Helps in **respiration** like supply of oxygen from heart to tissue and intake of CO<sub>2</sub> from tissue to heart via blood
- Helps in **gas exchange**, In aquatic habitat oxygen is dissolved in water which is taken by the aquatic organisms

# Water in the process of *Transport*

- **Blood** is used to transport food, hormones, oxygen, waste products etc and similarly in plants, **sap** is used to transport food and other substances. Both of these mediums for transports (blood and sap)are mainly water

# Water as a *Reactant*

- The most basic example of this is ***photosynthesis***
- The equation for photosynthesis shows that water is a vital reactant in the reaction
$$6\text{H}_2\text{O} + 6\text{CO}_2 = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
- **Condensation**, during conversion of glucose to starch water releases
- **Hydrolysis**, during digestion water require like conversion of starch in to glucose

# Water as a mechanism of Support

- Aquatic organisms have weaker skeletons than organisms living on land, as the water's '*buoyancy effect*' makes them '*lighter*', thus giving them extra support

# Water as a *Lubricant*

- Bones meet at *joints*, and at these joints lubrication must be provided to make sure the bones do not scrape against each other causing damage, and enabling free easy movement by reducing friction
- A *synovial membrane* at joints encloses a fluid called *synovial fluid*, which acts as the lubricant. Water is a major part of this fluid
- *Cerebro-spinal fluid (Brain)*
- *Pleural fluid (Lungs)*
- *Aqueous and vitreous humours (eyes)*
- *Amniotic fluid (fetus)*
- *Mucus (gut)*

**Provides support, lubrication and some possible function**

# Water in *Sexual Reproduction*

- In most of the fishes, **external fertilization** takes place in water
- During fertilization, the sperm is often transported in a fluid medium known as *semen*, which contains mostly water.

# **Water as Temperature Controller**

- Water has a **high specific heat** capacity approximate value is **4200J/kg°C** so the temperature of water is not easily changed. A large mass of water, such as an ocean will heat up slowly during the day, and cool slowly at night, so its temperature does not change much. This provides an ideal habitat for marine organisms with only small variations in temperature.
- The high water content of cells gives them insulation, and protects them from rapid temperature changes, thus helping to keep cells at a fairly constant optimum temperature

# **Water as a Habitat**

- **Freshwater Ecosystem**

Ponds, river, lakes, beels etc.

- **Marine Ecosystem**

Ocean

- **Survival of aquatic life in winters**

water has highest density at 4 degree Celsius