EWCE 105
Environmental Chemistry

Lecture 2

Instructor

Maj Kazi Shamima Akter, Ph.D., Engrs.

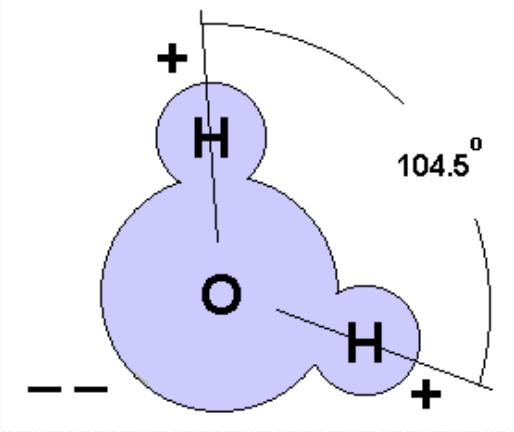
Department of EWCE, MIST



Lecture Details

Topics	References
• **Physical properties of water** • **Effects of solute on physical properties of water**	1. **Chemistry for Environmental Engineering** Authors: **Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin** 4th ed., McGraw Hill Inc. **2. The Unique and Unusual Properties of Water** - **Charles D. Riley, Jr., PE** PDHonline Course C104 (2 PDH) **www.PDHonline.org**

Physical properties of water



1. Boiling and Freezing Points

- Water has higher boiling and freezing point temperatures compared to other compounds with similar molecular structure.

- Water, with its lower molecular weight than similar compounds, would be expected to have lower boiling and freezing point temperatures.

Physical properties of water

- Due to the polar nature of the water molecule and hydrogen bonding, the boiling point of water is a remarkable 100° C and the freezing point is a remarkable 0° C.

Compound	MW	Boiling Point	Freezing Point
Hydrogen Telluride (H_2Te)	129	-2°C	-49°C
Hydrogen Selenide (H_2Se)	80	-42°C	-64°C
Hydrogen Sulfide (H_2S)	34	-60°C	-84°C
Water (H_2O)	18	100°C	0°C

Physical properties of water

2. Solid Phase

• The density of water increases as the temperature decreases until maximum density (1.000 g/ml) at about 4° C.

• Between 4° C and the freezing point at 0° C, water gradually expands and becoming less dense.

• Since the density of ice is less than that of liquid water, ice floats on water.

Physical properties of water

3. Heat Capacity

- Water has extremely high capacity to absorb heat without a significant increase in temperature

- The high heat capacity of water makes it a good coolant to use in condensers and automobile radiators to keep engines from over-heating.

4. Universal Solvent

- The highly polar nature of water makes it an excellent solvent, especially for other polar compounds – salts, alcohols, carboxyl compounds, etc.

Physical properties of water

5. Surface Tension

- With the exception of mercury, water has the highest surface tension of any other liquid.

- Polar compounds tend to have much higher surface tension than non-polar compounds.

- Hydrogen bonding of water molecules is attributed to the exceptionally high surface tension of water.

Physical properties of water

6. Medium of Life

• All known biochemical processes occur in aqueous environments.

• The composition of most living things is about 70 to 80 percent water by weight.

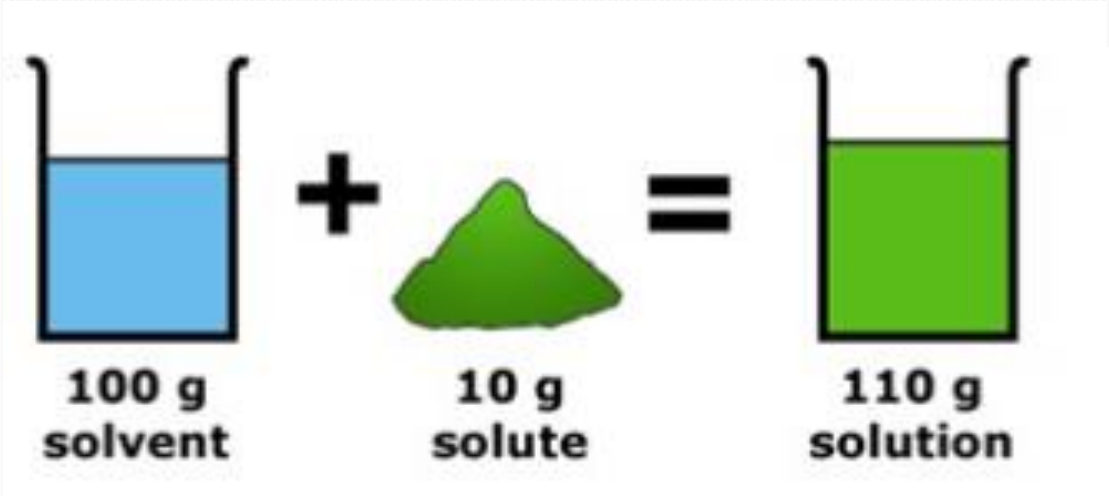
• Photosynthesis is the most basic and significant chemical reaction on earth. And water plays a significant role in the process of photosynthesis.

$$6CO_2 + 6H_2O + 672\ kcal \rightarrow C_6H_{12}O_6 + 6O_2$$

Effects of Solutes on Physical Properties of Water

Solvent – the part of the solution that is present in the largest amount

Solute – the part of solution present in the least amount

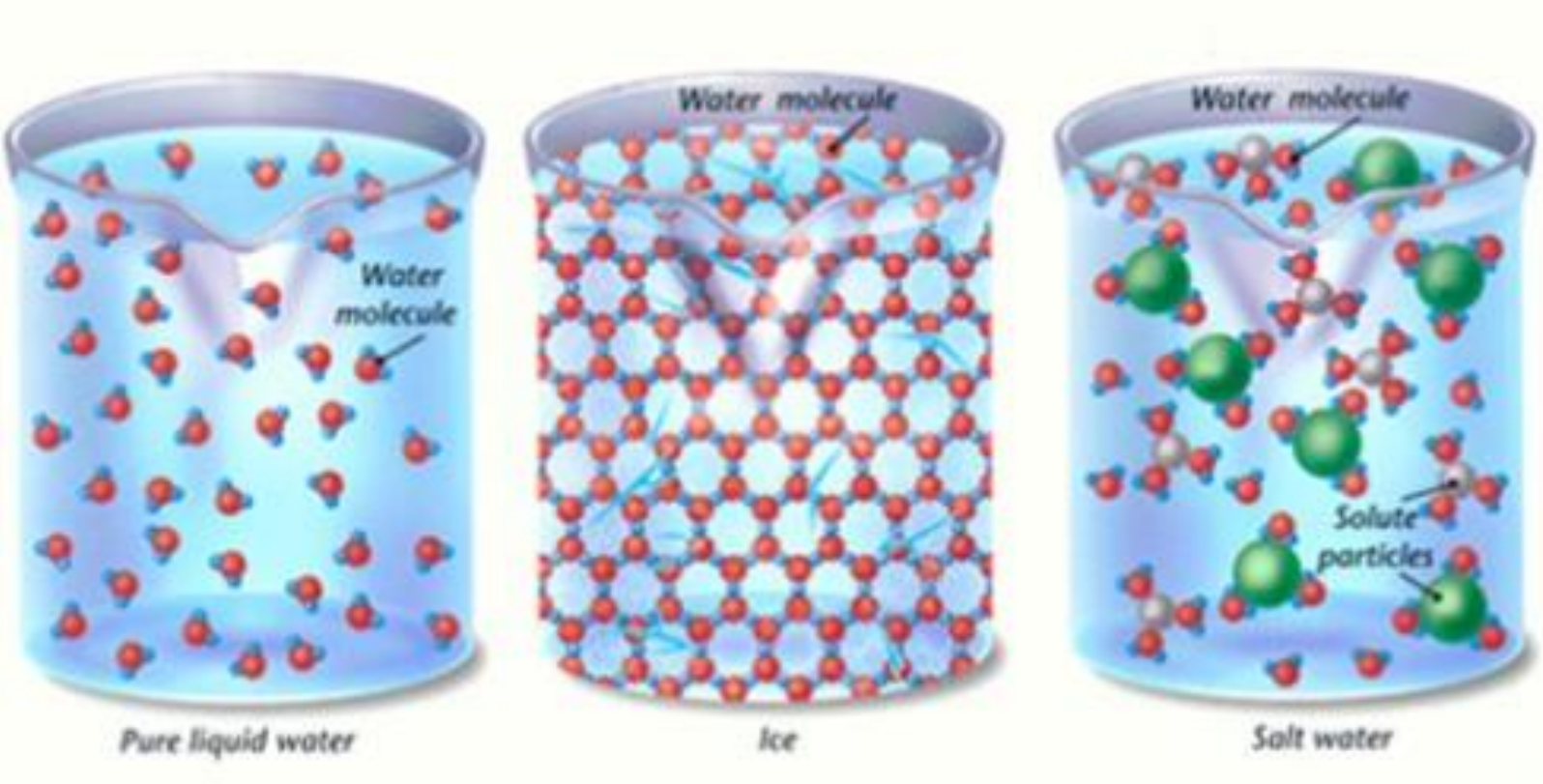




Effects of Solutes on Physical Properties of Water

Increased concentrations of solute in water will –

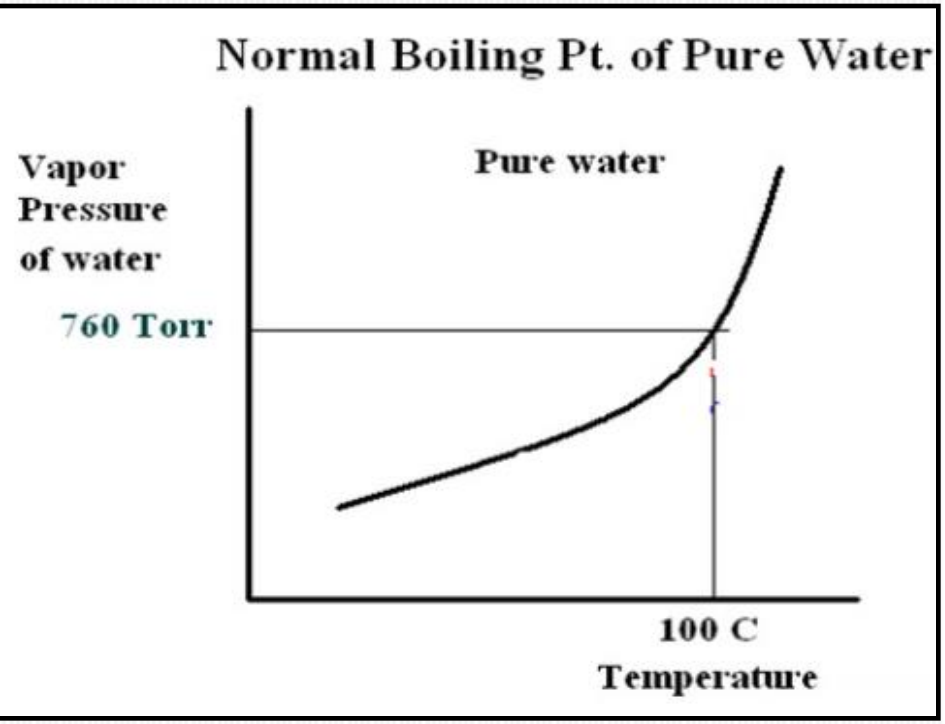
- lower its freezing point, as solute particles make it harder for water molecules to form crystals.

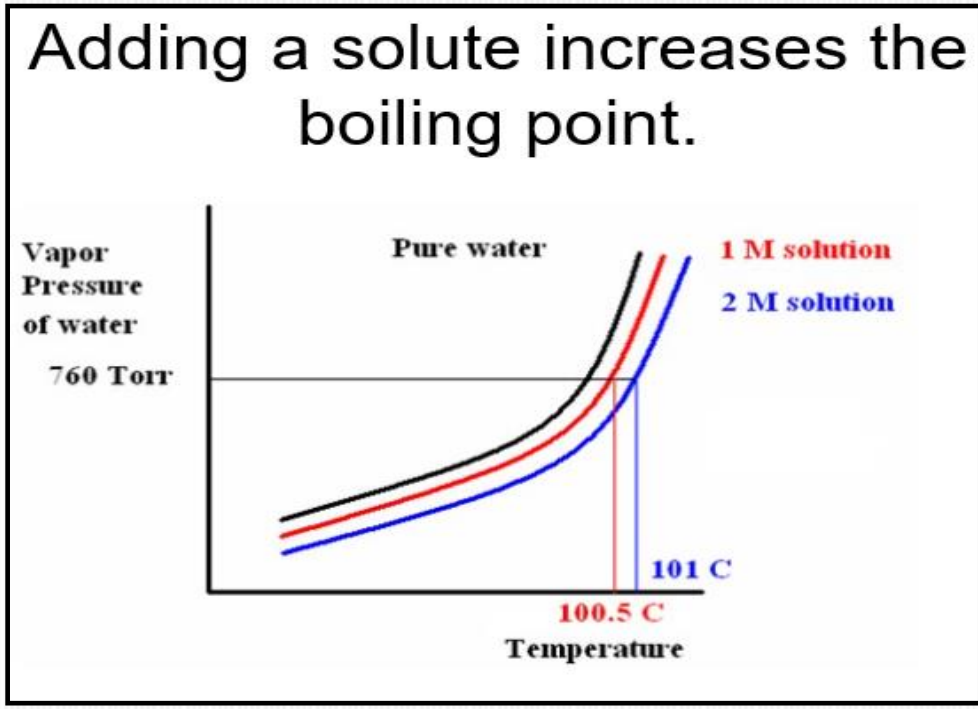


Effects of Solutes on Physical Properties of Water

Increased concentrations of solute in water will –

- increase the boiling point of the pure water, as water molecules need more energy to boil when a solute is present.





Effects of Solutes on Physical Properties of Water

Increased concentrations of solute in water will –

- decrease the vapor pressure of the pure water, as solute particles being attached to water molecules prevent them from escaping into the gaseous phage.

