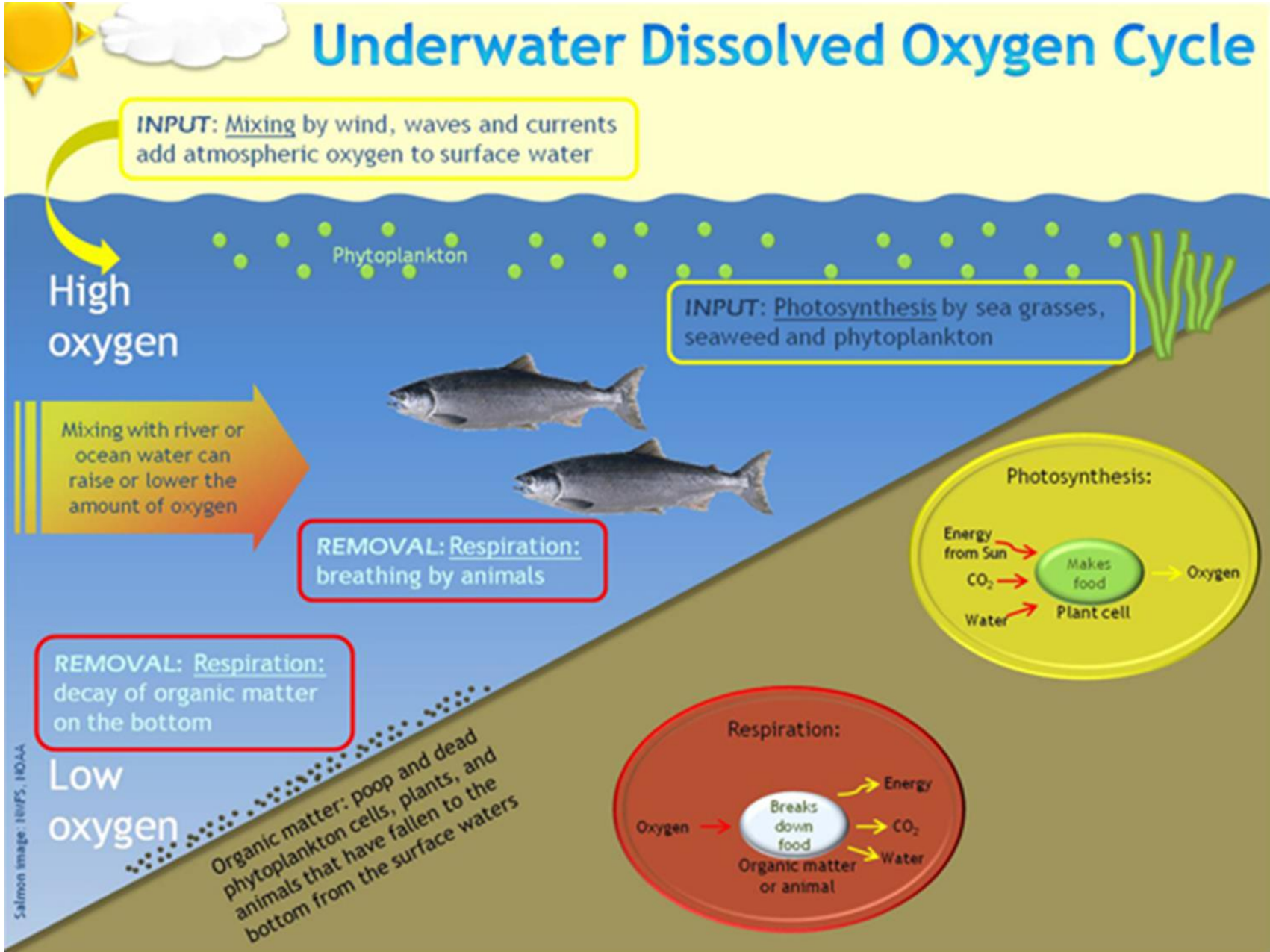
Dissolved Oxygen (DO)

- **Dissolved oxygen (DO) is the *amount of oxygen dissolved* in a given quantity of water at a particular temperature and atmospheric pressure**
- **Dissolved oxygen gets into the water by diffusion from the atmosphere. Aeration of the water as O_2 is waste product of photosynthesis**
- **It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water**
- **Amount of oxygen dissolved is expressed as mg/L or ppm**



Types of Oxygen Demand

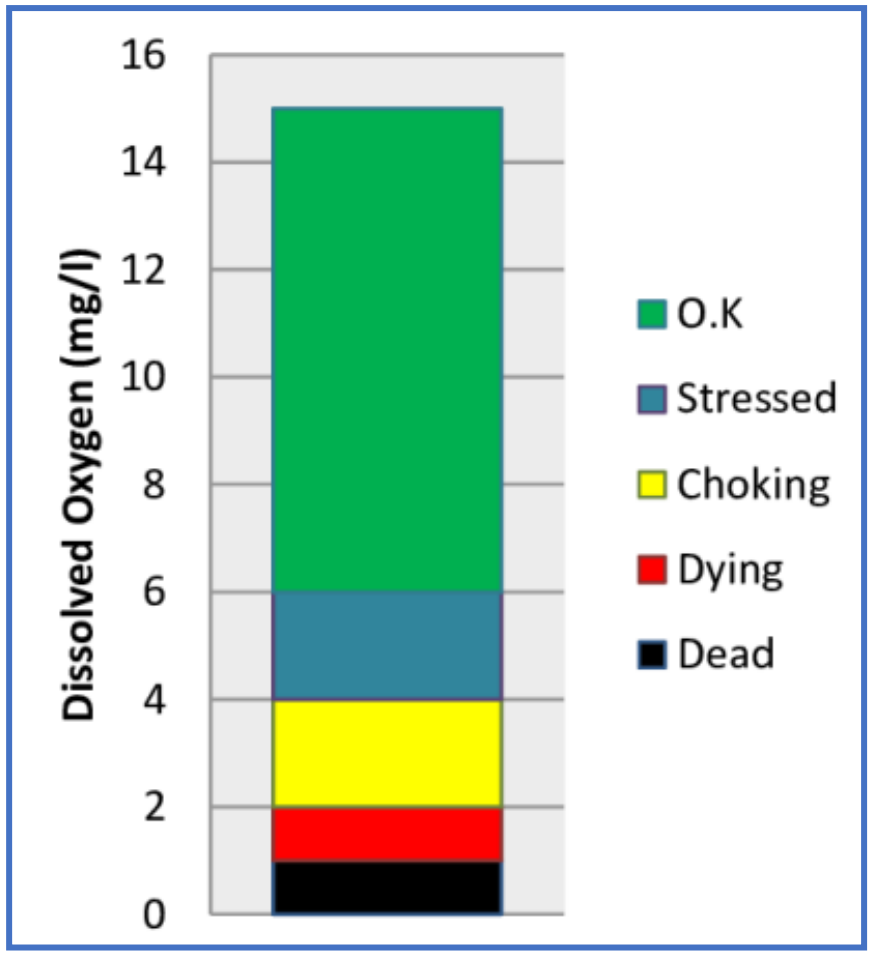
- **Biochemical Oxygen Demand (BOD):** Amount of dissolved oxygen required by bacteria/other microorganisms to break down organic material present in a given water sample at certain temperature over a specific time period.
  - To determine BOD, a measured volume of waste water is taken and its DO is measured. It is then incubated for 5 days at 20 °C and its DO is determined again.
- **Chemical Oxygen Demand (COD):** An indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution.
  - It is commonly expressed in mass of oxygen consumed over volume of solution which is milligrams per litre (mg/L).
  - A COD test can be used to easily quantify the amount of organics in water.

Causes of Low Dissolved Oxygen

- **Low dissolved oxygen (DO) primarily results from excessive algae growth caused by Nitrogen/phosphorus which generally originate from discharges from municipal and private wastewater treatment, cropland and urban storm water runoff, and natural decay of vegetation**
- **After algae die, decompose process consumes dissolved oxygen. This can result in insufficient amounts of dissolved oxygen available for aquatic species.**
- **Die-off and decomposition of submerged plants also contributes to low dissolved oxygen.**

Factors affecting DO

- Aeration
- Water temperature
- Organic wastes
- Aquatic plant populations
- Photosynthetic activity of the water
- Respiration of animals and plants
- Speed of water flow
- Altitude (atmospheric pressure)
- Human activities
- Salt concentration: The solubility of oxygen decreases with increase in concentration of the salt.
- Other dissolved gases concentrations



Estimation of DO by Winkler's method

- DO is important with respect to the species of aquatic life, It is also measure of its ability to oxidize organic impurities in water
- DO test is used to control the amount of oxygen in boiler feed water
- DO test is helps to assess the raw water quality and to keep a check on stream pollution

- It is one of the most useful titrations involving iodine
- In order to avoid loss of oxygen from the water sample, it is fixed by $MnSO_4$

DO estimation by Winkler's method

- The principle involved in this methods of determination of DO is to bring about the **oxidation of potassium iodide (KI) to iodine with dissolved oxygen** present in water sample after adding $MnSO_4$, KI and KOH
- The reaction with **manganese(II) hydroxide which is converted rapidly and quantitatively to manganese(III) hydroxide**. Here $MnSO_4$ acts oxygen carrier to enable the dissolved oxygen in molecular form to take part into the reaction
- On **acidification**, the **manganese reverts back to the divalent state** and an **equivalent amount of iodine is liberated form the KI** present
- The liberated **I_2 is titrated against standard sodium thiosulfate (hypo) solution**, using starch as indicator
- This means that **4 mol thiosulphate** is equivalent to **1 mol dissolved oxygen**

$$MnSO_4 + 2KOH \longrightarrow Mn(OH)_2 + K_2SO_4$$

$$2Mn(OH)_2 + O_2 \longrightarrow 2MnO(OH)_2$$

$$MnO(OH)_2 + H_2SO_4 \longrightarrow MnSO_4 + 2H_2O + [O]$$

$$2KI + H_2SO_4 + [O] \longrightarrow K_2SO_4 + H_2O + I_2$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI$$

❑ **Procedure:**

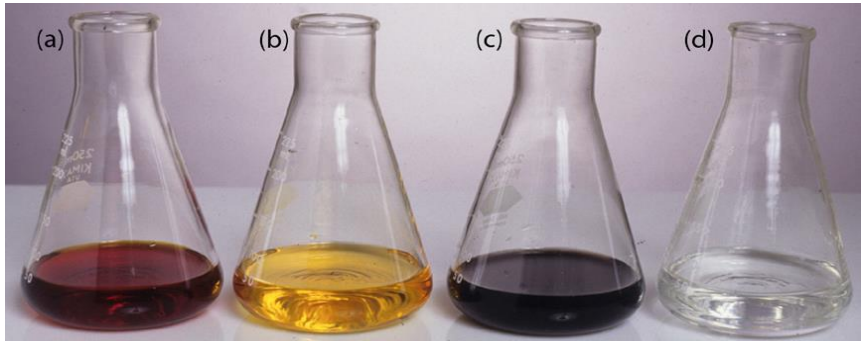
- **Standardization of $Na_2S_2O_3$**
- **Estimation of DO using standardized $Na_2S_2O_3$**

DO estimation by Winkler's method

❑ Procedure:

➢ Standardization of $Na_2S_2O_3$

- The secondary standard solution of sodium thiosulphate is standardized by titrating with a primary standard potassium dichromate using starch as indicator
- Color change occurs from straw yellow to blue to colorless



$$Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$$

$$2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$$