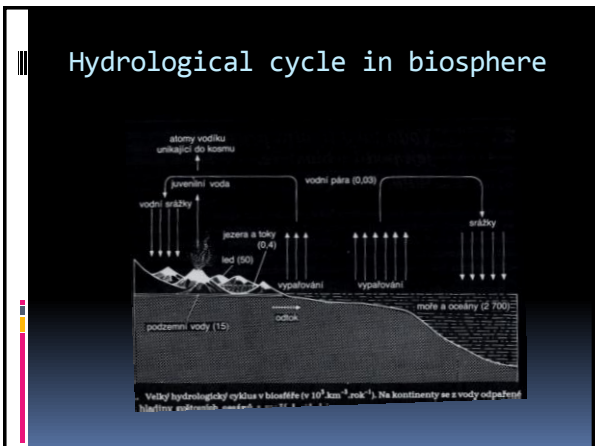




- ### What we will talk about?
- Physical characteristics of water
 - Chemical characteristics of water
 - Life in the water

- ### Broad view
- Oceans 70,8% of Earth
 - Limnic biocycle 2% of Earth
 - Water in atmosphere 12 400 km³
 - Global annual precipitation 1010 mm
 - Retainer of water in atmosphere 8,9 days

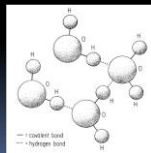
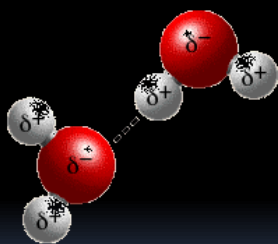


- Underground water
- Terrestrial waters
 - 1) fluvial, running waters
 - 2) lentic, standing waters

Physical and chemical characteristics of water

- Molecule of water has a shape of equale arm triangle
- Chracter of strong dipoles
- Inividual molecules are in bond
- Hydrogen bridges

Molecule of water



Physical and chemical characteristics of water

- The size of clusters is variable and temperature dependent
- With decreasing of temperature they grow and their move ability is decreasing
- In solid state each atom of hydrogen makes bridge between atoms of oxygen

Density

- The highest density of water = 4°C
- 1000 kg/m³
- When temperature is - or + density is decreasing
- 25°C = 997 kg/m³
- Density is also dependent on amount of dissolved matter in the water
- Fresh water (0,1-0,5 g/l)

Viscosity

- Internal friction
- Hydraulic friction (against its movement)
- 1kg/s.m = 1Pa.s
- Water 100x higher than air
- Highly temperature dependent
- 0-25°C viscosity decrease from 1 - to 1/2
- Movement is more easy and intensity of sedimentation is higher



Adhesion and cohesion

- Cohesion (C)
- Adhesion (A)
- Molecules of water against solid surface SF
- If $A > K$; SF = hydrophilic
- If $K > A$; SF = hydrophobic
- Hydrophoby is important for water organisms
– plastron – physical lungs



Surface tension

- On the borderline between liquid state and gaseous state
- Higher cohesion
- Surface cuticle
- Neuston
- Pleuston
- Detergents

Geris sp.

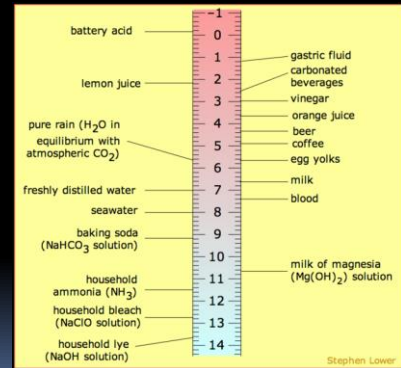


Thermal characters of water

- High specific thermal capacity
- Water 4180 kJ/kg.K
- $1 \text{ kcal} = 1000 \text{ cal} \approx 4185 \text{ J} = 4,185 \text{ kJ}$
- Heat up 1 kg water for 1°C
- Air 1003 kJ/kg.K
- Accumulator of heat
- Low thermal conductivity
- Thermostability of water environment

pH

- pH - *potentia hydrogenii*
- Pure water = pH 7
- Photosynthesis increase pH
- Low pH inhibits fixation of nitrogen
- Lower rate of decomposition

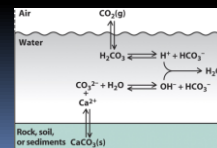


pH

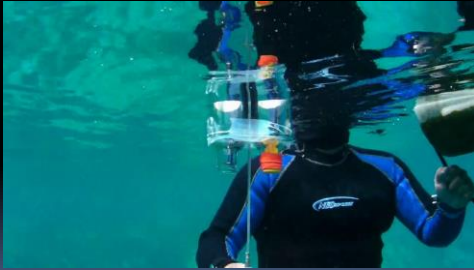


Alcality

- Ability of water neutralize acid
- Measure of buffer capacity of water
- Carbonate complex
- CaCO₃, CaHCO₃
- Presence of carbonates = higher trophy



Boyle-Mariotte law

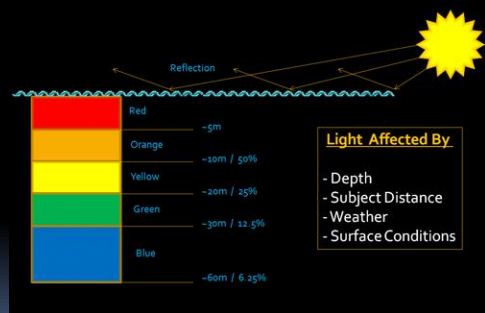


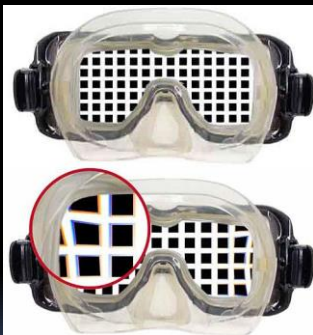
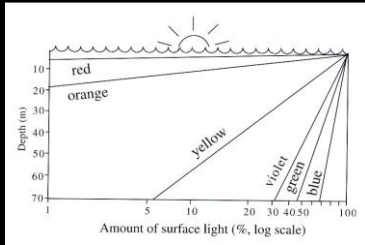
Hydrostatic pressure

- Barometric pressure on the sea surface level cca 0,1 Mpa
- Each 10m of depth 0,1Mpa
- Water is almost incompressible
- 40 Mpa (volume only for 2% smaller)
- Space with air under water
- 10m depth $\frac{1}{2}$ volume of air
- 40m $\frac{1}{5}$
- Caisson disease, barotrauma
- Stenobaric, eurybaric

Solar radiation

- On sea surface optimally 105 MW/cm²
- 300(UV 1-5%)-3000(IR 48%)nm
- Direct and diffuse
- Reflection from surface
- Diffusion on inorg. and org. matter

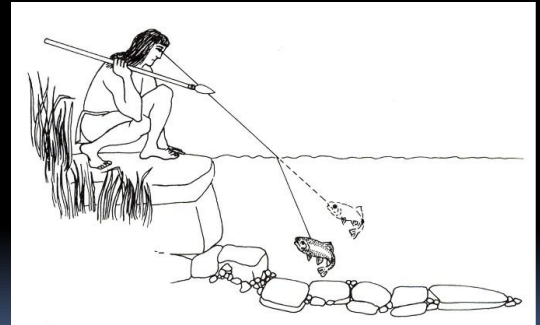




Out of water

Under water

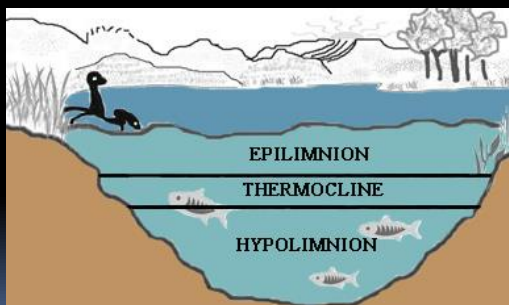
1/3 bigger 1/4 closer



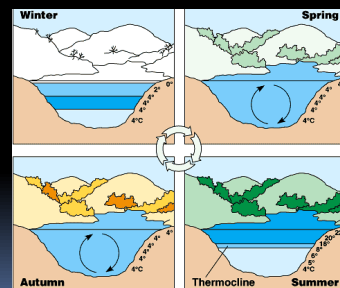
Transparency of water

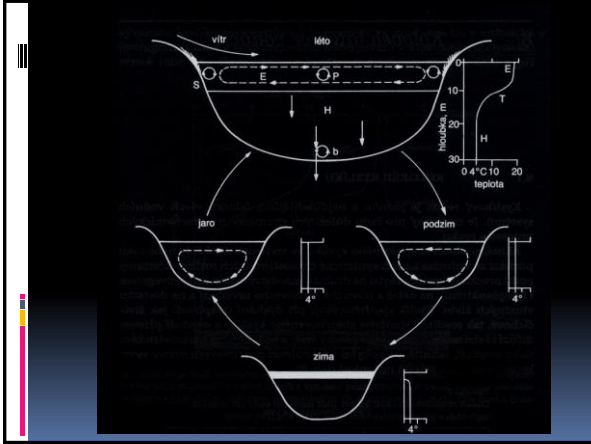
- Turbidity
- Vegetation, Inorganic matter
- Secchi disk
- Oligotrophic dam 15-20 m
- Productivity potential
- Color of water, reflection, humic matter
- Neuston (*Chromulina*, *Euglena*)

[VIDEO](#)



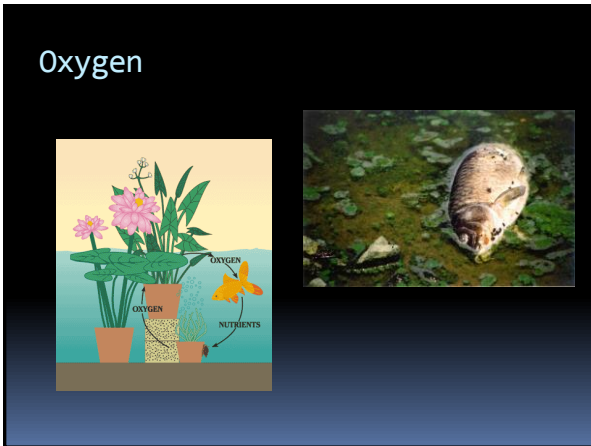
Stratification





Basic elements

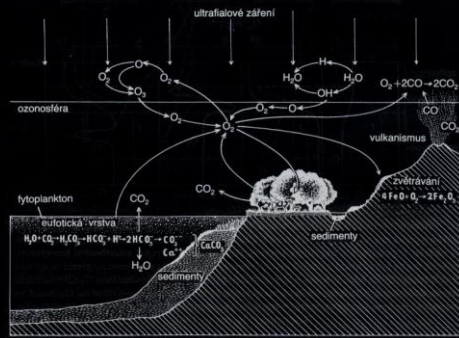
- Oxygen
- Nitrogen
- Carbon
- Phosphorus



Oxygen cycle

- From air and photosynthesis
- Respiration
- Amount of dissolved oxygen in water depends on temperature
- 0°C 14,6 mg/l, 25°C 8,11 mg/l
- Maximal conc. afternoon
- Minimal before sunrise

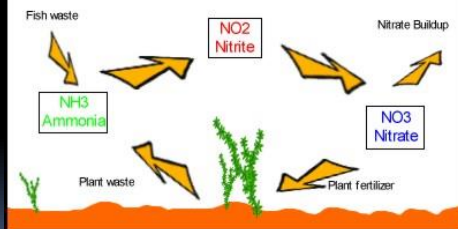
Oxygen cycle



Nitrogen

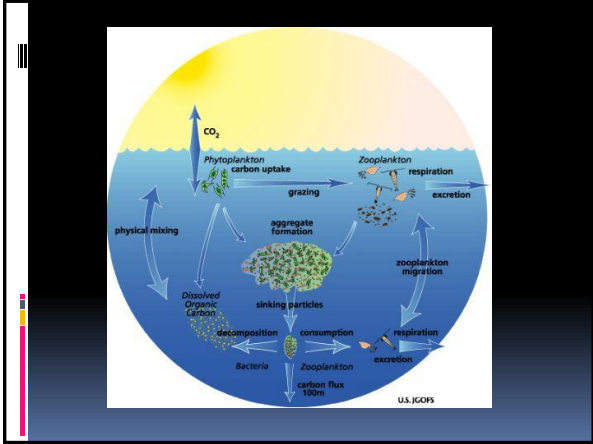
- Forms of Nitrogen
 - free (air) N_2
 - fixed
- Resources of nitrogen
 - Metabolism of animals and plants
 - Bacterial decomposition
 - Atmospheric nitrogen
- Nitrogen is essential for amino acids (body building)

THE NITROGEN CYCLE

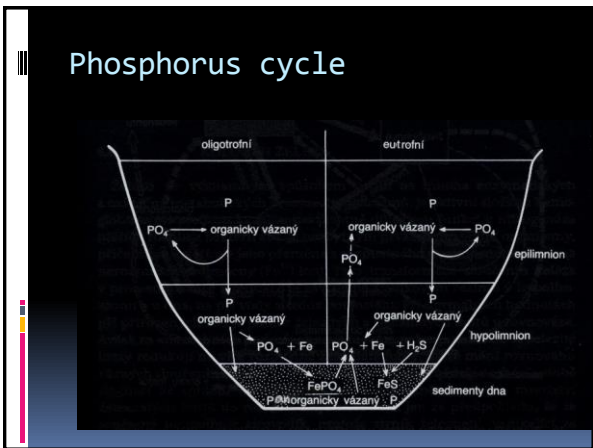


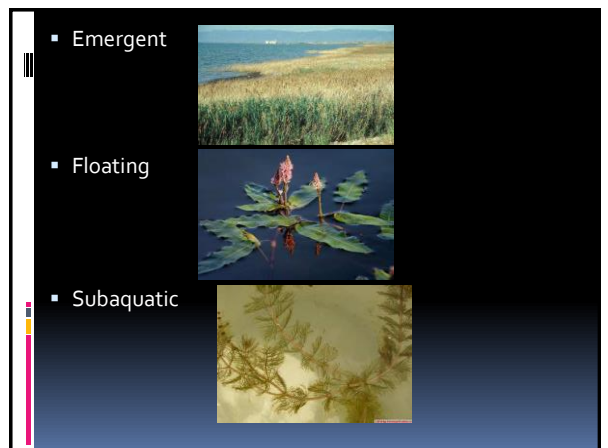
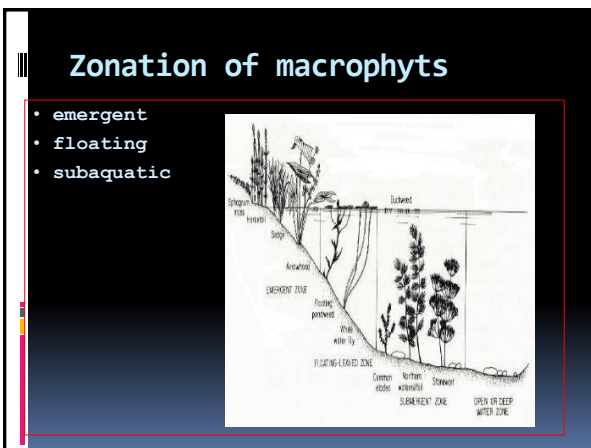
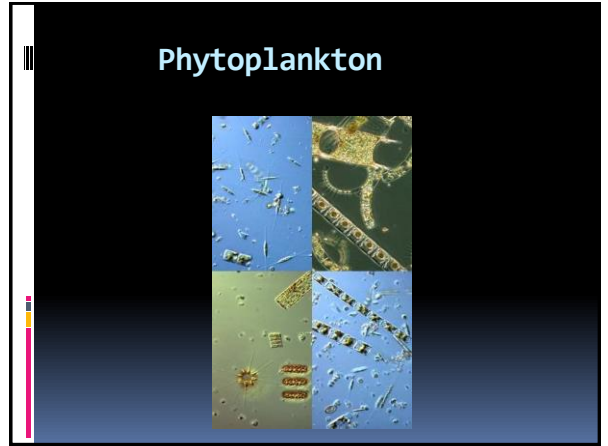
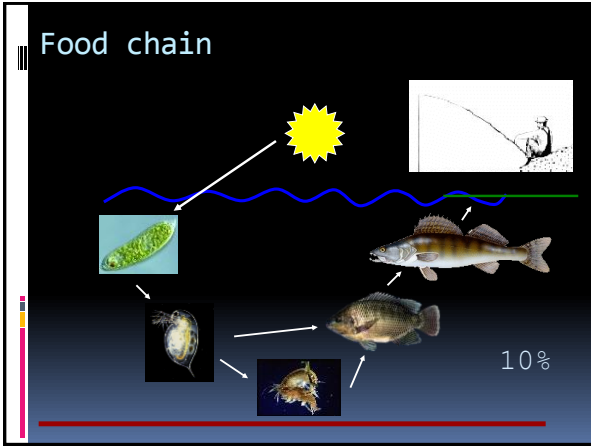
Carbon

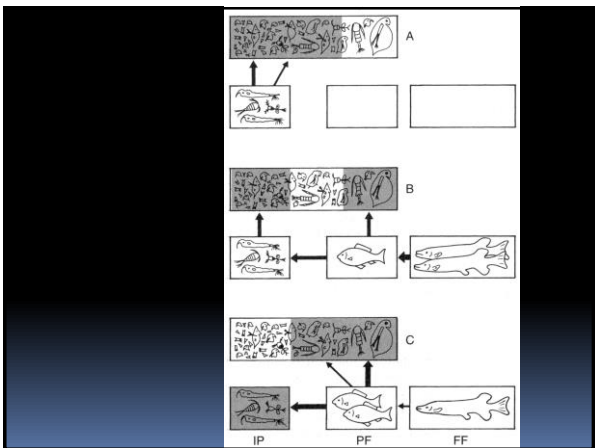
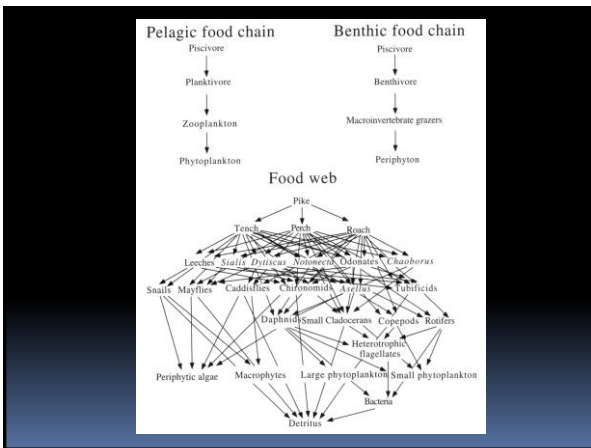
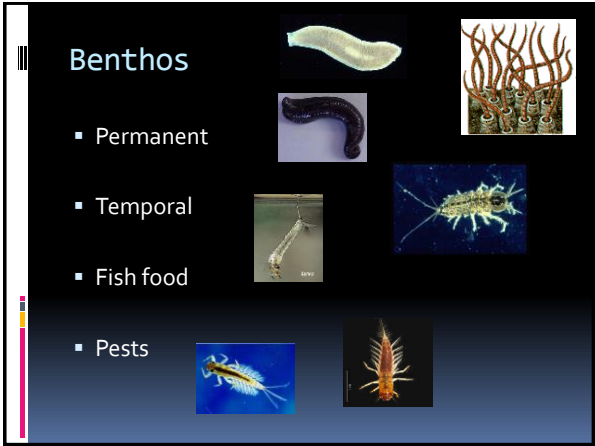
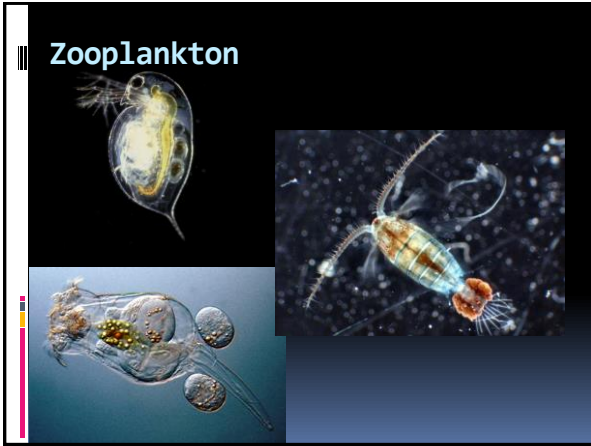
- Carbon in form of CO_2 is well dissolved in water
- Resources
 - Atmospher
 - Products of respiration
- Consumption of CO_2
 - photosynthesis
 - Aminoacids, celilose (body building)



- ## Phosphorus
- Phosphorus is most important element of eutrophication
 - Deposited in sediments
 - In plants 40C:7N:1P
 - In water 600C:20N:1P
 - $FePO_4$ indissoluble (aer. cond.)
 - From deposits during stagnation







!! BIOMANIPULATION !!

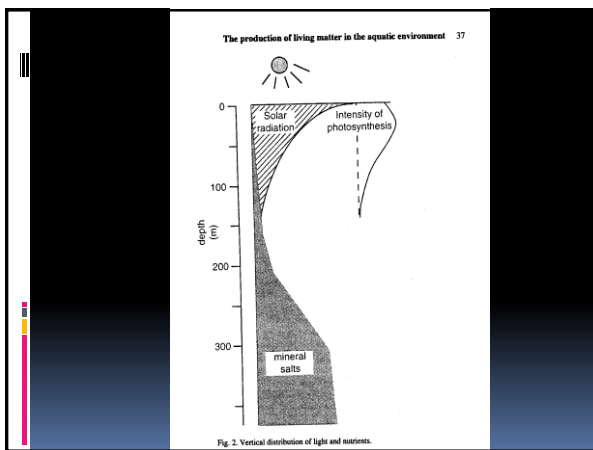
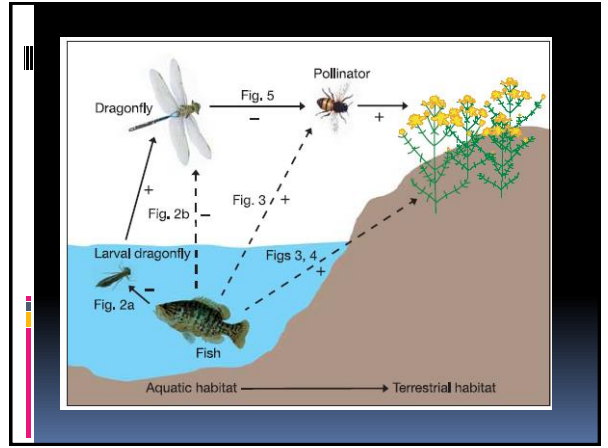
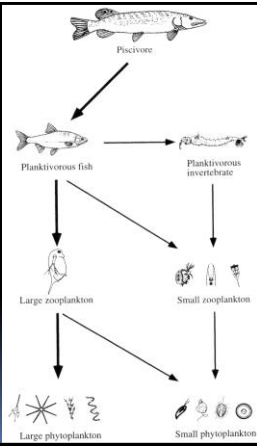


Fig. 2. Vertical distribution of light and nutrients.

