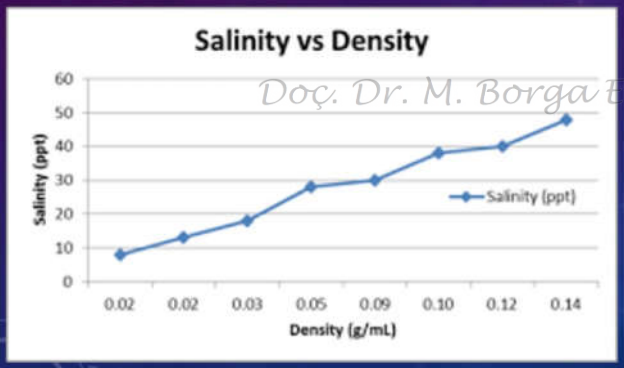
Water as an Environment

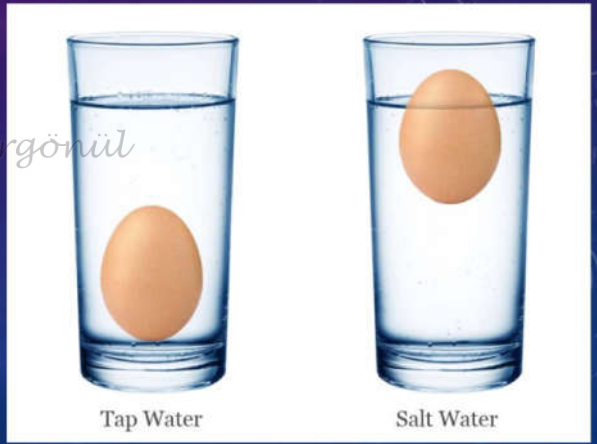
Water that serves as an habitat to many aquatic or semi-aquatic organisms has 2 major types of effects on te fauna/flora within: through its physical (heat, density, visocosity, surface tension, light penetration etc) and chemical properties (nutrients, dissolved gases, several organic or inorganic compounds etc.

Water with a density 775 times greater than that of air has a great buyoyant effect on the body or organisms which means that organisms can support their own weight with less energy. Several aquatic plants such as *Myriophyllum* or *Potamatogeton* raise their stems and leaves in the water but collapse when taken out from the water. Jelly-fish or several other polyps also become formles and motionless masses in the air.

Myriophyllum sp. in water and taken out of the water.

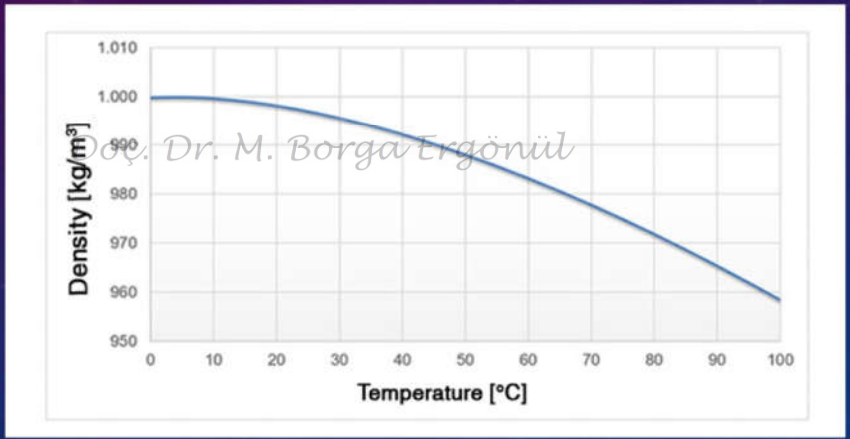
The density of water is not the same in different lakes, rivers or brooks or in different times. The density of water depends on the temperature and salt content. As a basic rule as the salt content increase, the density of the water also increase. And as the density increases the buoyancy also increases.



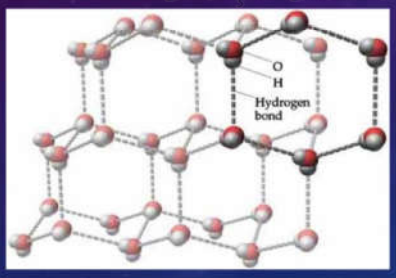


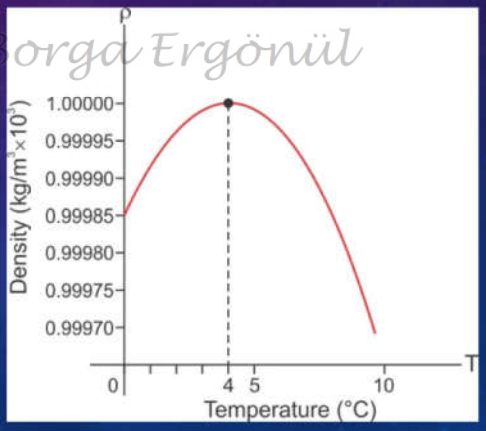
Salinity in Dead Sea: ‰ 337

The salinity of inland waters changes from one lake to another one (between 0.01 and 1 g/L; o in some extreme cases even higher). However, temporal changes in a single lake is generally lower than 0.1 g/L. The temporal changes of the density in a single lake arises from temperature, which is a very important phenomenon in aquatic habitats.

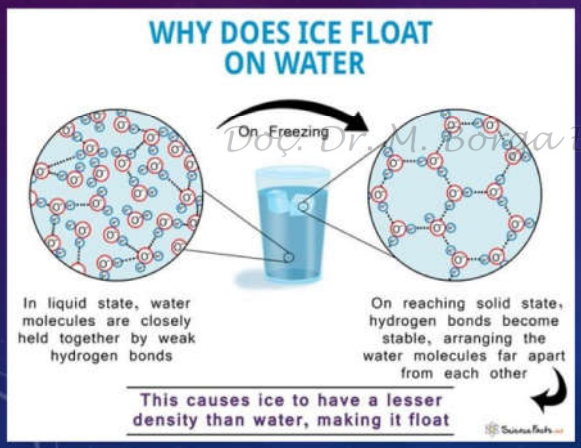


As a basic rule; the density of the water increases as the temperature decreases. However, the relationship between temperature and denisty of water is a little bit complex than this. Density DOES NOT continuosly increase with decreasing temperature. It reaches its maximum at 4°C (more precisely 3.94) and at temperatures below or above that values it again decreases.



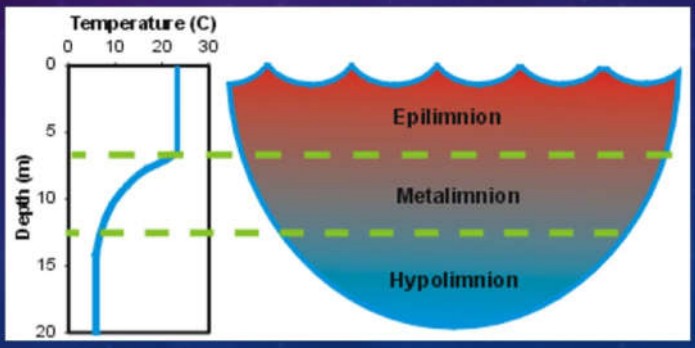


One more interesting feature about frozen water (ice) is that its density is lower than that of water at 0°C. This phenomenon is vital for life in water which means that water can only freeze on the surface and due to density the water at deeper parts of the lakes is around 4°C.

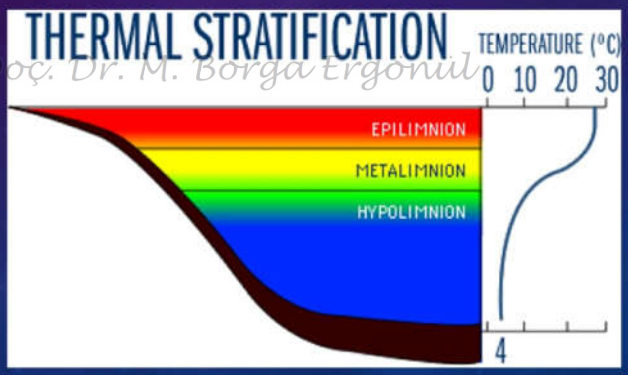


Thermal Stratification

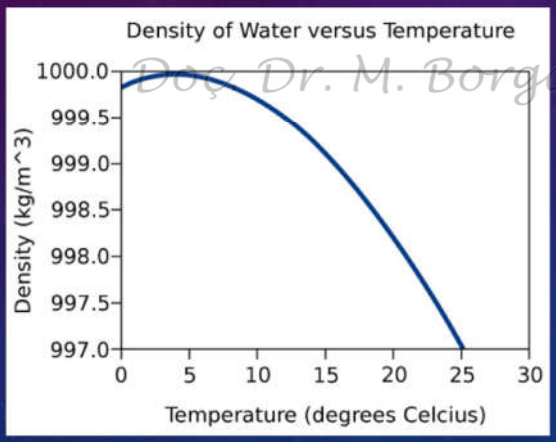
Thermal stratification is a direct result of heating by the sun. During thermal stratification 3 discrete layers of water of different temperatures are observed in a lake: warm on top (epilimnion) and cold below (hypolimnion). These layers are each relatively uniform in temperature but are separated by a region of rapid temperature change (the metalimnion or thermocline).



The water in these different layers do not mix due to density differences. The resistence to mixing linked to this density differences maintains the stratified structure in lakes, which is important to the distribution of dissolved chemicals, gases, and biota. Thermal stratification is most characteristic of deep lakes. Shallow lakes never stratify for more than short periods of time. Colder (and therefore denser) water is on the bottom; zone of rapid change above, and warmer (thus less dense) water at the surface of the lake. Although storms may stir the warm waters of the epilimnion into furious motion, little energy is transmitted through the thermocline to the cool motionless hypolimnion. Consequently, only the epilimnion is often exposed to mixing.

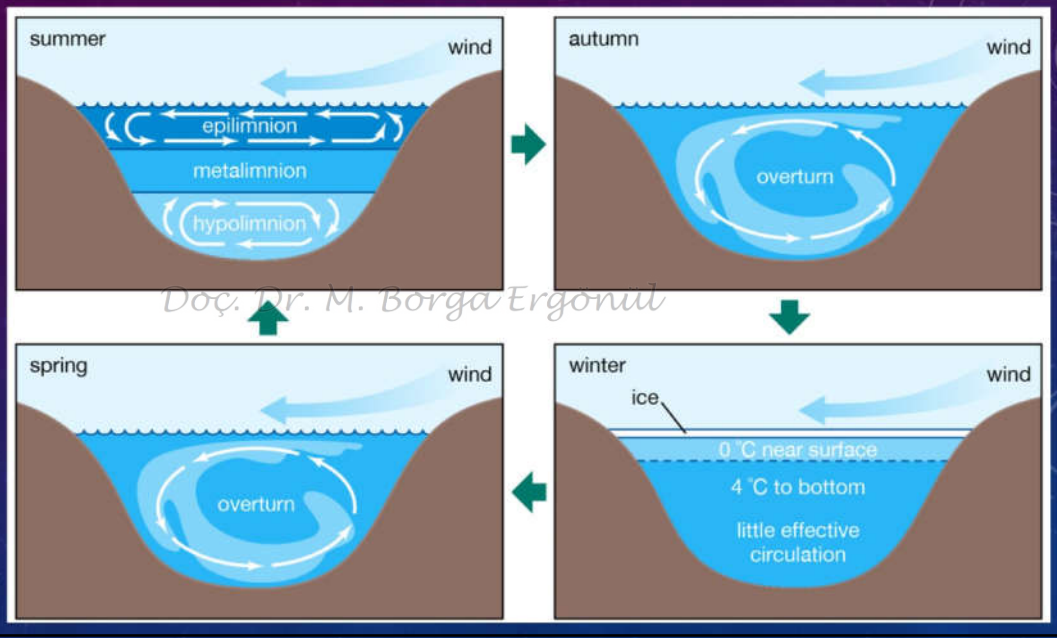


The water in epilimnion shows a great resistance to mix with colder layers. Because there is a greater density change per degree of temperature change in warm water than in cold. For example 30 times as much energy is required to completely mix equal volumes of 24 °C and 25° C water as it takes to mix the same volumes of water at 4 °C and 5 °C.



video here!

Thermal Stratification in temperate regions



The **viscosity** of the water can be defined as the frictional resistance to flow or move. Since the viscosity of water is approximately 100 times greater than that of air, aquatic animals are exposed to a greater resistance while moving. This means that they require more powerful musculer force. But smaller organisms (particularly microscopic) expolit the viscosity to support their buoyancy or to obtain a slower sinking rate.

Hydrodynamic shape is adaptive in mobile organisms

Small organisms may exploit viscosity and drag to slow sinking rate

Positively Affect Buoyancy

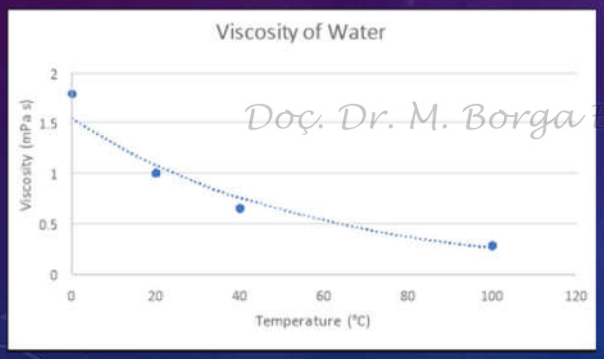
Gases (swim bladder)
Low Density Fluids
Fats, Oils

"Buoyancy" is a function of relative density of the organism to its environment.

Bone, Cartilage
Shell
Chitinous Exoskeleton
Heavy Ions

Negatively Affect Buoyancy

Since the salinity changes in a single lake is low, the effect of salinity on viscosity can be neglected in a hydrobiological perspective. But temperature has an important effect on viscosity; as the temperature rises the viscosity falls.



Temperature effects on growth and buoyancy of *Microcystis aeruginosa*

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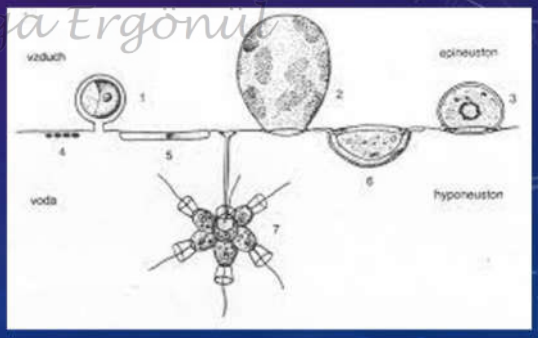
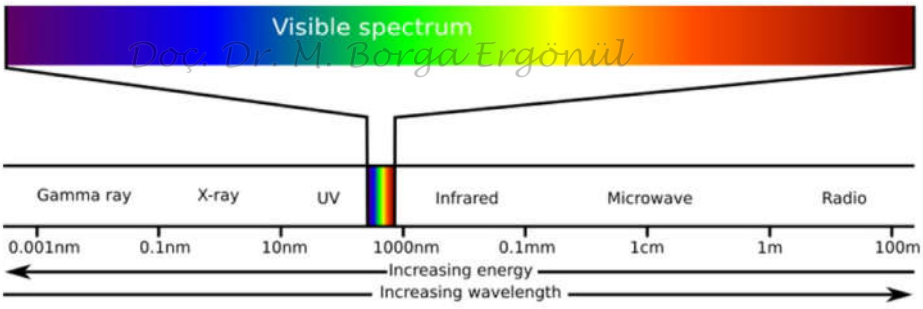
This is a pre-copyedited, author-produced version of an article accepted for publication in Journal of Plankton Research] *following peer review. The version of record* [Jiaqi You, Kevin Mallery, Jiarong Hong, Miki Hondzo; Temperature effects on growth and buoyancy of *Microcystis aeruginosa*, *Journal of Plankton Research*, Volume 40, Issue 1, 1 January 2018, Pages 16–28] *is available online at:* academic.oup.com/plankt [https://doi.org/10.1093/plankt/fbx059, DOI: 10.1093/plankt/fbx059].

The surface tension of water towards solid masses or gaseous bodies is another important feature of water for life. It serves a air-water interface and forms a special habitat for several organisms called neuston.

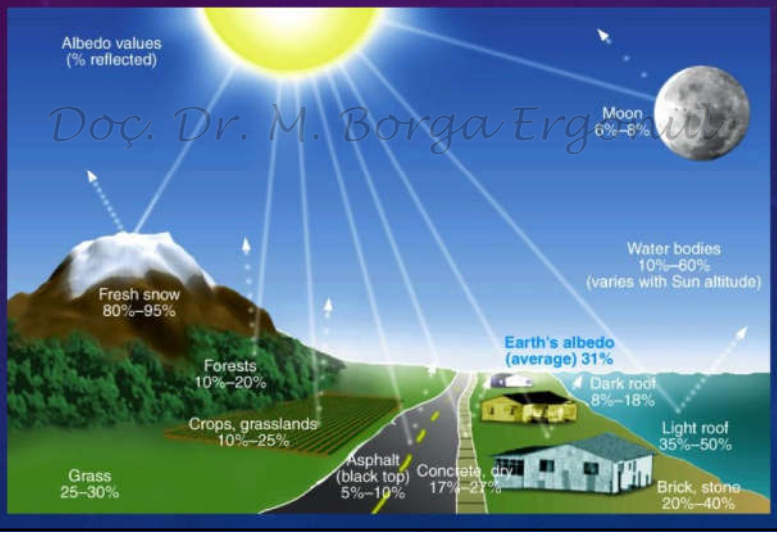


Light (Solar Radiation)

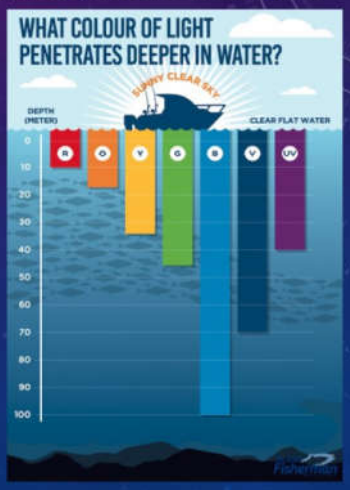
Sunlight entering the water may travel about 1,000 meters into the ocean under the some rare conditions, but there is rarely any significant light beyond 200 meters. Sunlight consists of the entire spectrum of electromagnetic radiation, which includes gamma, X, ultraviolet, visible, infrared, micro- and radio waves. The major part of solar radiation is in the form of visible and infrared rays that vary in wavelength.



Sunlight that strikes the earth's surface is either absorbed or reflected. When the angle of incidence of the sun's rays is 60 degrees or less, less than 10 percent of incident sunlight normally is reflected by a water surface. The percentage of incident light reflected by a surface is called the albedo.



Light penetrating a water surface is scattered and absorbed or quenched as it passes downward. Only about 25% of incident light reaches a depth of 10 meters in the open ocean, where water is very clear. The rate of visual light attenuation in water is greatest for red and orange rays, less for violet rays and least for yellow, green and blue rays. The presence of dissolved organic matter and suspended solids (turbidity) further impedes light penetration, and different types of solids preferentially absorb at different wavelengths.

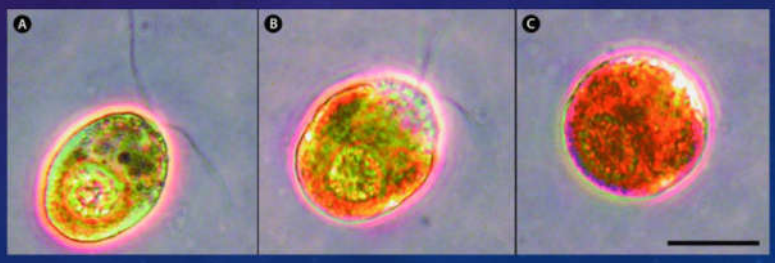


Blue light penetrates the deepest, this is why we see the oceans and the majority of lakes as blueish in color. However, the color of waters (mainly inland waters) may also vary according to several compounds dissolved in water.

The color of lakes provides important information on water quality. Clear lakes with low algae and other organic material are often blue in color (left), while lakes that have high nutrients and algae are green in color (center) and lakes that heavily forested watersheds, wetlands, or bogs around them may appear brown in color (right) due to presence of humic substances.

In some extreme cases (due to natural biota or pollution) lakes might be seen in different colors.

Tuz Lake turns in red due to extreme growth of an microscopic organism; *Dunaliella salina*.



Some unnatural cases observed in a river and a brooke due to textile industry; dye discharge.

The **turbidity** of a body of water is related to the cleanliness of the water. Waters with low concentrations of total suspended solids (TSS) are clearer and less turbid than those with high TSS concentrations. Turbidity can be caused by high concentrations of biota such as phytoplankton, or by loading of abiotic matter such as sediments. Turbidity is important in aquatic systems as it can alter light intensities through the water column, thus potentially affecting rates of photosynthesis and the distribution of organisms within the water column. Lowered rates of photosynthesis may in turn affect the levels of dissolved oxygen available in a given body of water, thus affecting larger populations such as fish. High turbidity can also cause infilling of lakes and ponds if the suspended sediments settle out of the water column and are deposited.

TURBIDITY

Causes of Turbidity Change:

- erosion
- run-off
- disturbance of water
- algae growth

Effects of Turbidity:

- increased temperature
- decrease in DO
- clogs gills in organisms
- blocks sunlight for photosynthesis

The Secchi disk (1865, Angelo Secchi) is a circular disk with a diameter of 30 cm used to measure water transparency or turbidity in lakes or sea. The disc is mounted on a line, and lowered slowly down in the water. The depth at which the disk is no longer visible is taken as a measure of the transparency of the water. This measure is known as the Secchi depth and is related to water turbidity..