Teacher's manual and expectations- Worksheet 1

Königssee	Mr. Müller's lake
- clear, good depth of visibility - very deep - mountain lake, rare input of nutrients - lakeshore zone without seaweeds - no mud (less biomass) - barely any fish (low numbers of individuals but great biodiversity)	- murky - flat - large input of nutrients - a lot of plankton - muddy ground (a lot of biomass) - a lot of fish (high numbers of individuals but large biodiversity)
Speculations: • nutrient content • photosynthesis • fish population • biomass production • depth of visibility	
Comparison with trio-game: ➔ OLIGOTROPHIC	Comparison with trio-game: ➔ EUTROPHIC

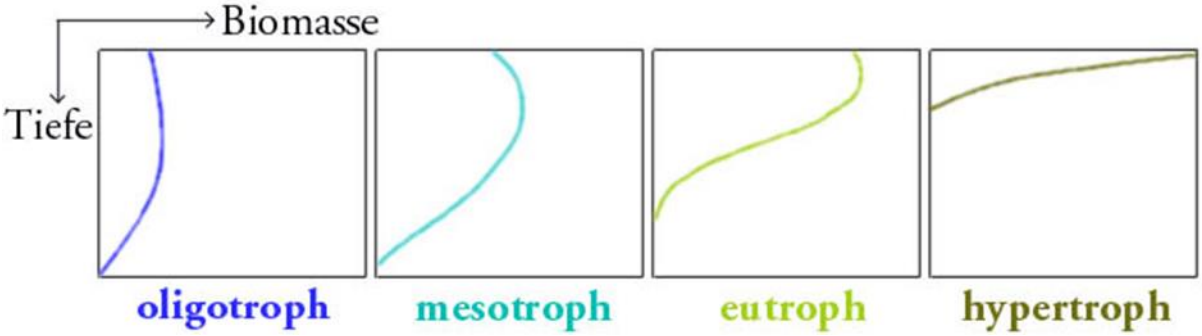
Oligotrophic:
An oligotrophic lake is a lake with low primary productivity due to its low nutrient content. These lakes have low algal production and consequently the water is very clear. Therefore they often have a high drinking-water quality. The bottom waters of such lakes typically have a high oxygen content. There is no lack of biodiversity, such lakes often even support many fish species. After all, these lakes are unproductive, characterised by their nutrient deficiency. They are most common in cold regions (mountain lakes).[1]
"In oligotrophic lakes, oxygen is found at high levels throughout the water column. Cold water can hold more dissolved oxygen than warm water, and the deep region of oligotrophic lakes stays very cold. In addition, low algal concentration allows deeper light penetration and less decomposition. When algae, zooplankton and fish die, they sink to the bottom and are decomposed by microbes and invertebrates. This decomposition process uses up oxygen. Since oligotrophic lakes are less fertile and have less algae and other organisms, there is less decomposition and the oxygen doesn't get used up."[2]

Mesotrophic:
"Mesotrophic lakes behave differently than oligotrophic lakes in that they stratify, meaning they separate into layers in the summer. The top layer of water becomes warm from the sun and contains algae. Since the by-product of photosynthesis is oxygen, oxygen concentration remains high at the surface of the lake. The bottom layer remains cooler and can become anoxic in mid-summer. This change occurs because, as all the algae and other organisms die and are decomposed at the bottom of the lake, oxygen gets used up. Since this bottom layer of water does not mix with the top layer of water in the summer, oxygen cannot be replenished. The implications of anoxia are that no fish or other organisms can live where there is no oxygen; therefore, in late summer, fish move shallower where there is still oxygen available."[3]

[1] Vgl. URL: http://en.wikipedia.org/wiki/Trophic_state_index; vom 06.01.15
[2] URL: http://rmbel.info/lake-trophic-states-2/; vom 06.01.15
[3] URL: http://rmbel.info/lake-trophic-states-2/; vom 06.01.15

Eutrophic:
"Eutrophic lakes are very fertile from all the nutrients carried into the lake from the surrounding landscape. These nutrients (Phosphorus and Nitrogen) support high densities of algae, fish and other aquatic organisms. Since eutrophic lakes have so much biomass, there is a lot of decomposition occurring at the bottom. This decomposition uses up oxygen, causing the bottom of the lake to become anoxic in the summer. In very shallow lakes, the whole lake can become anoxic, causing a fish kill. Fish, invertebrates and other organisms need oxygen to survive."
"The process of eutrophication can occur naturally or by human impact on the environment."[4]

Hypertrophic:
"Hypereutrophic lakes are very nutrient-rich lakes characterized by frequent and severe nuisance algal blooms and low transparency. The excessive algal blooms can also significantly reduce oxygen levels and prevent life from functioning at lower depths creating dead zones beneath the surface. "[5] Due to the enormous biomass production there is also a thick layer of putrid slime on the bottom of the lake. [6]



URL: http://de.wikipedia.org/wiki/%C3%96kosystem_See#mediaviewer/File:SeeBiomasse.png; vom 11.01.15

Oligotrophic lakes are characterized by a great diversity of species, but with a limited number of each. Due to the large input of fertilizers from intensive agricultures and an inflow of waste water, these lakes increasingly become eutrophic.[7] The term **eutrophication** in general means the enrichment of nutrients (nitrates and phosphates) above a certain threshold, and thus an undesirable increase of plant nutrients in the water. The result of eutrophication is a disturbance of the ecological balance and the emergence of hypertrophic lakes.[8] Because hypertrophic lakes no longer provide a living space for most fish and other organisms, it is very important to reduce the human-influenced factors on eutrophication. Here are a few examples of how everyone should contribute:[9]
• Use biodegradable and non-phosphate detergents and do not use fabric softeners.
• Never dump waste water directly into rivers, lakes or the sea.
• Do not use chemicals that could get into the ground or water.
• Only buy food from organic farms, because they rely only on natural fertilizers

[4] URL: http://rmbel.info/lake-trophic-states-2/; vom 06.01.15
[5] URL: http://en.wikipedia.org/wiki/Trophic_state_index; vom 06.01.15
[6] Vgl. URL: URL: http://de.wikipedia.org/wiki/%C3%96kosystem_See; vom 11.01.15
[7] Vgl. URL: http://de.wikipedia.org/wiki/Eutrophierung, vom 28.02.2015
[8] Ebd.
[9] Vgl. URL: http://wwf.panda.org/what_we_do/where_we_work/baltic/howyoucanhelp/tips/;vom 28.02.2015

Teacher's manual and expectations- Worksheet 2

(http://de.wikipedia.org/wiki/Trophiesystem)

Trophic states	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	**Hypertrophic**
Depth of visibility (m):	5-10, maximum 15-20	1-2, maximum 5-10	less than 1, maximum 2-3	less than 1
Lowest height of vegetation (m):	12-30	5-10	less than 2	less than 1
Primary producers:	very few	few	many	very many
Biomass production:	very little	little	much	very much
Biodiversity:	very high	high	low	very low
Phosphate content (mg/m^3):	4-10	10-35	35-100	more than 100
Nitrate und Ammonium content in autumn (mg N pro l):	maximum 1	maximum 1	more than 2	more than 2
Chlorophyll content in summer (mg/ m^3):	less than 3,5	less than 7,0	less than11	more than 11
O_2 content (mg/l):	more than 8	6-8	2-4	0
Depth:	very deep	deep	flat	very flat

Trophic states	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	**Hypertrophic**
Depth of visibility (m):				
Lowest height of vegetation (m):				
Primary producers:				
Biomass production:				
Biodiversity:				
Phosphate content (mg/m^3):				
Nitrate and ammonium content in autumn (mg N pro l):				
Chlorophyll content in summer (mg/ m^3):				
O_2 content (mg/l):				
Depth: