**Study Guide for Limnology Exam #2**

**Overall**

* Be able to answer the italicized questions in the lecture outlines
* Be familiar with the general ideas in the readings:
  + [Schindler 1974](http://science.kennesaw.edu/%7Ejdirnber/limno/Schindler%201974.pdf)
  + [Dirnberger 2011](http://science.kennesaw.edu/%7Ejdirnber/limno/Dirnberger%20Bloom%20MS.pdf)
  + [Brooks and Dodson 1965](http://science.kennesaw.edu/%7Ejdirnber/limno/Brooks%20and%20Dodson.pdf)
  + [Dodson 1990](http://science.kennesaw.edu/%7Ejdirnber/limno/Dodson%201990%20VertMigr.pdf)
* Be able explain the factors drive eutrophication (i.e. understand the diagram below).



[**Chemical Limnology of Lakes**](http://science.kennesaw.edu/%7Ejdirnber/limno/LecChem/LecChem.html) **(Exam #2 covers the second part of this lecture starting with “pH and Carbon dioxide”)**

* Describe the relationship between carbon dioxide and pH.
* Explain what if means if alkalinity of water is high.
* Know how carbon dioxide and pH are related, and what biological process would result in changes in pH in lake water.
* Define what is meant by a limiting nutrient (i.e. Lieberg’s Law of the Minimum).
* Know which nutrient is considered most likely to be limiting in freshwater systems and why?
* For phosphorous and nitrogen, know sources and provide an example of biological molecules that they are used in. Based on this, deduce which of the two is needed in greater quantity.
* Know the different forms that phosphorus can exist in lakes, and the pathways and associated transformations from one form into another within a lake.
* Describe under what condition phosphorus becomes soluble, and explain how this influences primary productivity in autumn, and over the long-term as a lake becomes more eutrophic.
* Know the different forms that nitrogen can exist in lakes, the pathways (nitrification, denitrification, nitrogen fixation, chemosynthesis, assimilation, and ammonification) that may transform one form into another (and the advantage each transformation for the organisms involved), and how it would affect the distribution of these nitrogen forms in a thermally stratified lake.
* Explain what the benefits are for organisms that use nitrification and that use chemosynthesis.

[**Biological/Ecological Limnology of Lakes**](http://science.kennesaw.edu/%7Ejdirnber/limno/LecBio/LecBio.html)

* Know which group of organisms are the main primary producers in large, deep lakes.
* What is the “paradox of the plankton” as described by G.E. Hutchinson and how did he explain this apparent paradox? Based on the paper by Dirnberger (2011), what type of environmental change may result in opposite effects and why?
* Describe the characteristics of the three major groups of phytoplankton in lakes (cyanobacteria, diatoms, and flagellated greens).
* Describe morphological adaptions used by phytoplankton to stay suspended.
* Explain how primary productivity is measured in lake given that respiration occurs simultaneously with photosynthesis.
* Explain how biomass (standing crop) of phytoplankton is estimated
* Explain how phytoplankton biomass and primary productivity are related.
* Know what parameters are used in the Trophic State Index (TSI) to indirectly estimate what parameter.
* Describe the characteristics of the three major groups of zooplankton in lakes (rotifers, cladocerans, and copepods).
* Describe the direction and timing of diel vertical migration in zooplankton, and the adaptive advantage for migration.
* Contrast the influence of fish predators and invertebrate predators on zooplankton body size, and explain why the effects are different.
* Describe the three modes of planktivore feeding.
* Explain the idea behind the trophic cascade hypothesis distinguishing bottom-up management from top-down management.
* Identify factors that influence the distribution of benthic organisms in lakes.
* Define primary productivity, cyclomorphosis, detrital loop (microbial loop), phytoplankton, zooplankton, nekton, meiofauna (psammon), and neuston.
* Provide an example of how organisms take advantage of the surface tension created at the air-water interface. Provide an example of how surface tension created at the air-water interface might be a disadvantage for some organisms.