Comments on Biogeochemical Cycles material in the textbook

General Background
- **Chapter 22 – sections 1 & 4**

The Hydrologic (water) Cycle
- **Chapter 3 – section 1**

The Carbon Cycle
- **Chapter 22 – sections 6-7 & Fig. 22.13**

The Nitrogen Cycle
- **Chapter 22 – section 8**
- **Chapter 15 – section 11**

The Phosphorus Cycle
- **Chapter 22 – section 9**

Although the information is located in various places in the textbook, it all relates to aspects of various global biogeochemical cycles.

Chapter 22 – sections 1 & 4 (General Introduction):

Not much information in these sections but they provide a general introduction to the concept of global biogeochemical cycles.

Be able to distinguish between gaseous and sedimentary cycles.

Chapter 3 – section 1 (Hydrologic Cycle):

Know all the terms associated with the hydrologic cycle that are given in this section: precipitation, interception, infiltration, surface runoff, groundwater, evaporation, transpiration, & evapotranspiration.

Be able to associate the terms with the arrows in Figure 3.1.

Know the rank order of the size of the various pools of water on Earth: ocean >>> ice >> groundwater >> surface water >> water vapor

Study Fig. 3.2.

Don't memorize the numbers but know general patterns noted in the text.
Water evaporated from ocean > precipitation input to ocean.
Excess water vapor in air over oceans contributes to rain on land.
Precipitation on land > evapotranspiration from land; difference flow in rivers to ocean.

FYI: the units for the values in blue in Fig. 3.2 are in 10^3 km^3 NOT 10^8 km^3 as stated in the legend

Know how to calculate the turnover time (AKA the mean residence time).

The example for the ocean and atmosphere should help if you use the correct units (see FYI note above)

Chapter 22 – sections 6-7 & Fig. 22.13 (Carbon Cycle):

Section 6:

Study Figure 22.3 carefully by noting the changes that occur during the course of one day at a height of 10 m (the middle of the canopy) and near the surface of the soil.
Note that sunrise is about 6 AM and sunset at about 6 PM.
Note that the 3rd sentence should be "By late afternoon …" (i.e. ~ 3 PM) rather than "By afternoon …" to more closely match what is shown in Fig. 22.3.
Note that in the 4th sentence the idea that respiration increases after sunset is not correct. What it should say is that after sunset photosynthesis ceases and therefore becomes lower than the rate of respiration.
Carefully study Fig. 22.4, the legend for the figure, the relevant information in the text.

What would the graph look like for a location in the Southern Hemisphere in terms of the timing and magnitude of the high and low concentrations? *Note that Barrow Alaska is in the Northern Hemisphere.*

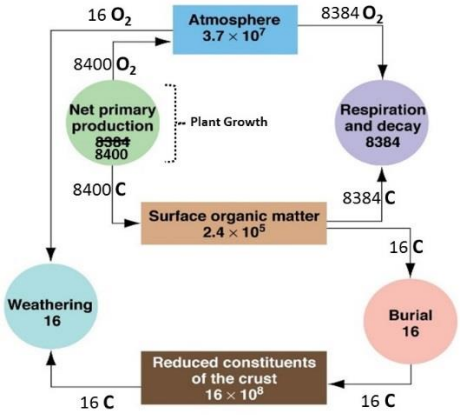
Why are the fluctuations in atmospheric CO2 levels more pronounced in the Northern Hemisphere?

Section 7:

Not a lot to get from this section.
Don't worry about all the values that are given.
Rather focus on general principles and relative size of pools – oceans vs. land vs. atmosphere etc.
Most of the information was more clearly presented in class but note the overlap where it occurs. For example, in the 3rd paragraph the recent research suggesting the terrestrial surface is acting as a C sink is referring to the "missing C sink" I went over in class.
Note the difference between actively cycled and C cycled over geologic time scales.
You can ignore the 3 questions associated with Fig. 22.5

Figure 22.13:

Note the following corrections & clarifications to the figure.



The figure and the text in the 2nd paragraph of section 22.12 describes the link between the carbon cycle and the accumulation of O_2 in the atmosphere. This was also touched on in lecture. Note the values in the circles and associated with the arrows are in flux units of 10^{12} moles per year.

The take-home message from the figure and the text is that an imbalance between C storage in plant material (via photosynthesis > plant respiration) and the respiration of that stored C by decay results in the storage of C in the slowly cycled pool of C in ocean sediments and an equivalent increase in O_2 in the atmosphere. The C storage in sediments and increase in atmospheric O_2 stay for very long periods of time (i.e. millions of years) because the weathering processes that remove them occur over geologic time scales.

Chapter 22 – section 8 (Nitrogen Cycle):

Know the various processes that make up the N cycle (N fixation, nitrification, ammonification, etc.), how they relate to each other, and what they involve.

A careful examination of Figure 22.7 should be helpful (note that the width of the arrow is proportional to the magnitude of the process).

You don't need to know all the specific organisms involved except for those mentioned in lecture (e.g. *Rhizobium*). But you should know the broad categories of organisms involved (bacteria, cyanobacteria, symbiotic organisms, free-living bacteria, etc.).

Study the global N cycle given in class rather than the one in Figure 22.8.

Know how human activity has altered the global N cycle.

Chapter 15 – section 11 (Nitrogen Cycle):

Understand how mutualistic interactions between plant roots and bacteria that fix N benefit both the plant and the bacteria.

Be familiar with the relationship between legumes and *Rhizobium*.

The material on mycorrhizal fungi will relate to what is covered in lecture on the phosphorus cycle.

You can skip the material on pages 324-325.

Chapter 22 – section 9 (Phosphorus Cycle):

Know why this is an example of a sedimentary cycle and why it can be in short supply.

Know where nearly all the phosphorus in terrestrial ecosystems ultimately comes from.

Know the major process regulating phosphorus availability for plant growth (AKA net primary production).

Know why surface waters in the ocean can be depleted in P and deep waters become enriched.

Figure 22.10 may be helpful but you don't need to know the values given.

After studying the assigned sections in this chapter you should be able to answer the following study questions:

Chapter 3, question 1 on page 51.

Chapter 22, questions 1-4 & 6-9 on page 509.