SA #24 & 25	**Aquatic Ecosystems:** Streams, Rivers, & Lakes

LOOKING Our laboratory studies and lecture discussions of soil and water conservation and the recent "Sand County Farm" scenario have emphasized ecological principles that can be applied to accomplish good stewardship of these potentially renewable resources. In addition, we have focused on the *watershed* as the logical "management unit." Now we turn our attention to some key properties of streams, rivers, and lakes which receive the water from a watershed?

FORWARD: As you consult the resources below, you will be incorporating our "Stream Ecology" lab experience with your text and making application of previous concepts of soil and water. This assignment adds only a few new concepts and aims instead toward review for Exam II.

RESOURCES: Text: Molles, Chapter 3 – pages 72-82 to "Applications", and skim pp. 82-85
Lab Procedure: "Stream Ecology"– no report. Just do computations, answer questions.
WebCT Lecture Slides (SA 24-25) will provide some figures cited in Study Questions.

STUDY APPROACH: – The following questions each highlight a characteristic of aquatic ecosystems:

LAKES – Lentic Ecosystems ("standing water"):

1. Classification – Use Part I of the attached Study Outline and WebCT lecture slides #2 and 3 to explain two different ways aquatic ecosystems are classified?

2. Structure – Relate the following terms to the zonation and stratification of a lake:
   a. Spatial arrangements of life in a lake – note classification of aquatic organisms in Slide #6, WebCT.
   b. Light attenuation – From Slide #7, what factors influence light attenuation in different lakes?
   c. Lakes have *thermal stratification* in certain seasons. Describe seasonal changes and how it relates to nutrient availability. See Text, Figure 3.38 or Slide #8, WebCt..

3. Phosphate and/or Nitrate concentrations often limit NPP of lentic systems (See Ch. 19 and slides #9-16).
   a. Apply the concept of "limiting factors" (SA #18) to phosphate or nitrate limitation of NPP.
   b. How does this characteristic of lakes (and streams) make them vulnerable to poor land practices?
   c. How could you experimentally determine whether a lake's NPP is limited by phosphate?
   d. Name two types of lakes based upon whether they are "nutrient poor" or nutrient rich?"

4. Oligotrophic lakes have a predominance of macrophytes (rooted or floating vascular plants) whereas eutrophic lakes are dominated by microphytes (floating algal autotrophs). How would you explain this difference considering how these two types of autotrophs get their nutrients and light? (See Slide #13)

5. Eutrophic lakes are so productive that the excess autotrophs can cause death of heterotrophic life. How is this possible considering that autotrophs are the base of the food chain? (Slides #14-15)

STREAMS AND RIVERS – Lotic Ecosystems ("on the move"):

6. Structure of streams and rivers can be considered in a plain along their lengths and perpendicular to flow
   a. How would you determine the actual width of a riparian zone along a stream or river?
   b. How are riffles and pools distinguished visually and in terms of their function (see "Stream Eco." lab).

7. Lotic systems are vulnerable to inputs from the land:
   a. How would release of untreated sewage (rich in phosphates, FPOM, and DOM) into a river affect aquatic life (See WebCT slide #20)?
   b. How are QHEI's and the Macroinvertebrate Biotic Index used to determine stream "health?"

LENTIC ECOSYSTEMS **BIO 213O**
SA 24-25

I. CLASSIFICATION OF AQUATIC ECOSYSTEMS ACCORDING TO..

A. SALINITY -- MARINE = ~ 3.5% SALTS
ESTUARIES = intermediate GRADIENT
FRESHWATER =~ O.2% SALTS

B. WATER MOVEMENT -- LOTIC (Flowing water)
-- LENTIC (Ponds and Lakes)

II. LENTIC SYSTEMS

A. STRUCTURE

1. HORIZONTAL VARIATION -- **Z** ____________________

2. VERTICAL STRUCTURE -- **S** ____________________

a. BIOTIC – (See Slide #6)

b. ABIOTIC – (Slides #7, 8; and Figure 3.38)

3. TURNOVER – (Figure 3.38)

B. FUNCTION

1. LIMITING FACTOR IS OFTEN AVAILABILITY OF PHOSPHATES OR NITRATES

a. O__________________ -- "poor nourishment" -- low in N and P
-- deep lakes, low surface/volume ratio; clear water -- NPP < 25 g/m^2/year

b. E__________________ -- "well nourished" – rich in N and P
-- shallow lakes, high surface/volume; high in microphytes -- NPP > 75 g/m^2/year

2. NUTRIENT STATUS INFLUENCES TYPES OF AUTOTROPH

a. OLIGOTROPHIC [LOW N,P] FAVORS M__________________
> Macrophytes immobilize N and P from sediment and as their tissues move along the food chain, N and P are released again in inorganic form, available to phytoplankton.

b. EUTROPHIC -- FAVORS M__________________ --> SHADE OUT MACROPHYTES

3. EUTROPHIC LAKES MAY BECOME “DYSTROPHIC”

   a. CULTURAL EUTROPHICATION – nutrient enrichment of body of water causing hypertrophic conditions and increased NPP

   b. ORGANIC MATTER OFTEN SETTLES OUT IN SEDIMENTS (before decayed)

   By the following process, lakes can be transformed into a dystrophic status:

DECAY DEPLETES O_2 → AEROBIC BACTERIA → ANAEROBIC BACTERIA → RELEASE of $H_2S + CH_4$ → POISONING of BENTHOS

III. LOTIC SYSTEMS

A. LOTIC SYSTEMS DO NOT DEVELOP SIGNIFICANT THERMAL STRATIFICATION

B. NUTRIENT CYCLING IN LOTIC SYSTEMS IS BETTER DESCRIBED AS NUTRIENT SPIRALING

   1. Nutrient Spiraling =

   2. Factors influencing spiral length [where S = VT] or, the inverse, nutrient retentiveness Molles, Figure 19.14 (or slide #19)

      a. Velocity and time for nutrient to complete a cycle

      b. Macroinvertebrates

C. LOTIC SYSTEMS ARE VULNERABLE TO INPUTS FROM THE WATERSHED

   1. Untreated wastewater effluent (See Slide #20)

   2. Effect on macroinvertebrate biotic index:

      a. Species richness

      b. Populations of certain tolerant species