Joy M. Lapseritis April 2006

Undergraduate Lesson Plan: Communicating Ocean Science

DNA Organization

My experience.- It is difficult to compare what teaching methodologies worked better or worse in my experiences as an undergraduate student because it's difficult to identify "lessons." Most lessons or class meetings in my recollection were in a continuous sort of lecture format, following a book-type order of contents, each day picking up where we last left off. This has the advantage of providing structure and continuity, especially when paired with a good textbook that becomes a student reference. Other times, this lecture methodology ends up like a book-on-tape.

As a master's student I took a course in Molecular Biology of Eukaryotic Organisms that represents a mixed graduate and advanced undergraduate class. This course was unusual in that it had no text (a reference was on reserve, and we used journal articles frequently), and the professor organized the syllabus around his own research program to provide a framework for exploring essential principles from eukaryotic (and prokaryotic) transcription to genomics-era bioinformatics. While I found this to be a great teaching/learning mechanism, when I look back at my notes, DNA organization and its relationship to transcription is *missing* – and I take *detailed* notes! I must have picked up my knowledge of histones, nucleosomes, and chromatin on the way though – but where? Beyond hazy recollections of high school biology and intro bio, an article from Science Times has stuck in my head for years as a point of reference, a successful effort to bring science to the public, so I've based this lesson on that.

I have further based the format of my lesson on an assignment used in a class for which I was a teaching assistant during that same period of time. During the course of the semester, each student was to select a topic from the textbook (just a paragraph, really) and find and read the original literature the textbook author had used to compile that information. The students then had to write a textbook paragraph of their own, making decisions about what to include and how interpret the literature. They also had to

critique the textbook author's choices, and ultimately assess whether they got the real message of the primary literature through their reading of the book. In an attempt to meet the needs of students who will go on to study more biology *and* those who will take the knowledge they gain from my class into other areas, I am designing this lesson to take textbook material both back to primary literature as well as to the literate public, stressing communication of scientific ideas.

Undergraduate Activity:

DNA Organization (Nucleosomes & Chromatin)

Preparation.- Read text (Lodish *et al.* 2000) pgs. 320-324; (pretend) also skim Luger *et al.* (1997). *Teacher preps 6 foot lengths of yarn for each student, plus a supply of spools and pipe cleaners.*

Invitation.- There are over 6 feet of DNA in each of your cells – yet the DNA, and even the cells are invisible to the naked eye. How can such large molecules be compacted into such tiny packages? How can such efficient packaging also provide access to specific sections of DNA for gene expression? *(assess prior knowledge and/or misconceptions and/or reading questions with short discussion)*

Exploration.- Pass out 6 foot lengths of yarn: students will twirl the yarn until tangled and twisted. This represents the DNA in your own cells right now; but how can it keep from being TANGLED? Read Wade (1997; in class). Now imagine that the spools are histones and the pipe cleaners are the histone tails. Organize your DNA (yarn) by constructing nucleosomes using histones (spools) and tails (pipe cleaners). *Teacher led demonstration and class participation.*

Concept Introduction.- Extend the imagery in a short lecture on chromatin & chromosome construction, and transcription complex access to DNA, promoters, enhancers, etc. Use information from newer references [Richmond & Davey (2003), and Schlach *et al.* (2005)] to illustrate advances since textbook was written.
5-10 minute Powerpoint presentation.

Application.- Given the NYT article by Nicholas Wade (1997) and selections from Luger *et al.* (1997) and your text, critique Wade's synopsis of the work in *Nature*. Did Wade include all the major findings of Luger's article? How did Wade massage the information to be accessible to the general public? Was your understanding of nucleosomes enhanced by Wade's article? What is the importance of this research to understanding the world better, or why is this being presented in the NYT? *Discussion…*

Homework for next week (choose one).- Update and edit the textbook version (Lodish, pgs. 320-324) to reflect advances published by the Richmond research group [Richmond & Davey (2003), and Schlach *et al.* (2005)]. Alternatively, write an article for NYT Science section using these same new articles following Wade's style.

Resources:

Lodish, *et al.* 2000. Molecular Cell Biology. W.H. Freeman and Company, pgs. 320-324.

Luger, K, *et al.* 1997 Crystal structure of the nucleosome core particle at 2.8A resolution. Nature 389:251-260.

Richmond, TJ & CA Davey. 2003. The structure of DNA in the nucleosome core. Nature 423:145-150.

Schlach, T, *et al.* 2005. X-ray structure of a tetranucleosome and its implications for the chromatin fibre. Nature 436:138-141.

Wade, Nicholas. 1997. "How cells unwind tangled skein of life." New York Times, Science section. 21 October 1997.