Course Time and Location: June 20 - July 8, 2005 at Moss Landing Marine Laboratories.

Instructors: Dr. Simona Bartl – Moss Landing Marine Labs  
Dr. Henrik Kibak – California State University Monterey Bay

Recommended Textbooks:  
“DNA Science: A First Course in Recombinant Technology” by D. A. Micklos and G. A. Freyer  
“Introduction to Bioinformatics” by A. M. Lesk

Course Description:  
This learning experience consists of an intensive 14-day institute with enrollment limited to 15  
in-service high school biology teachers. Participants will use biotechnology and bioinformatics  
techniques to investigate a scientific question of importance to local marine fauna. Students will  
use the experience gained to prepare a lesson plan addressing California State Life Science  
Standards for use in their classroom. The goal of this National Science Foundation supported  
program is to take teachers through the hands-on process that scientists use in modern marine  
scientific research. Participants will use biotechnology techniques to generate their own DNA  
data which they will then analyze using bioinformatics software tools available at the program’s  
website. Participants will also meet local experts in the areas of biotechnology and  
bioinformatics. Each teacher will receive exportable materials and institute staff support during  
the following academic year for the incorporation of marine biotechnology and bioinformatics  
concepts into their curricula

Course Outcomes:  
- Students will be able to isolate DNA from marine invertebrates.  
- Students will be able to amplify specific DNA sequences using the Polymerase Chain  
  Reaction.  
- Students will be able to conduct quality control tests on amplified DNA.  
- Students will be able to purify amplified DNA and prepare it for sequencing.  
- Students will understand dideoxy sequencing and modern variants.  
- Students will use software tools of bioinformatics to analyze the DNA sequences of their  
  PCR products for open reading frames, similarity to sequences in the international  
  databases.  
- Students will understand how to prepare phylogenetic trees relating homologous  
  sequences.  
- Students will become familiar with the use of visualization software for the analysis of  
  protein structures.  
- Students will visit the UCSC Genome Bioinformatics Institute, several local marine  
  molecular biology labs, and at least one commercial biotechnology company.
Students will prepare a lesson plan incorporating several of the following California State High School Life Science Standards, preferably the ones in **bold**.

4. Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. As a basis for understanding this concept:
   a. Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
   b. Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.
   c. Students know how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.
   d. Students know specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.
   e. Students know proteins can differ from one another in the number and sequence of amino acids.
   f. *Students know why proteins having different amino acid sequences typically have different shapes and chemical properties.*

5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:
   a. Students know the general structures and functions of DNA, RNA, and protein.
   b. Students know how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.
   c. **Students know how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.**
   d. *Students know how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.*
   e. *Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.*

**Assessment:**

Assessment for this 5-unit graduate course is based on evidence of successful completion of the laboratory outcomes (lab book) and submission of a passing lesson plan by July 22, 2005.