

## Syllabus for Update Course in Molecular Biotechnology (Fall, 2001)

*(handouts listed in italics next to topics)*

**Goal of Course:** to introduce teachers to the theory and practice of modern molecular biotechnology particularly as it relates to human health; to offer teachers the skills to develop exercises that could be used in the classroom, particularly exercises that make use of the vast array of online resources.

### Types of Activities:

The course will be comprised of three types of activities:

- (1) lecture topics that deal with current topics including the human genome project, gene therapy, stem cells, and cloning;
- (2) online exercises that introduce teachers to biotechnology resources such as NCBI, Biology Workbench, the HHMI site, and the Cold Spring Harbor site;
- (3) laboratory exercises that will illustrate basic concepts in molecular biotechnology. Each teacher will amplify their own mitochondrial DNA, clone it into a plasmid vector and transform it into bacteria, isolate plasmid DNA, and analyze the resulting DNA sequence (the instructor will sequence your DNA-you are welcome to participate in this if you wish!).

### Week 1:

Lecture Topic:

- Overview of basic molecular genetics [*see Beginner's Guide to Molecular Biology*]

Online Computer Exercise:

- Summary of online resources related to molecular biology and biotechnology [*see Online Molecular biology resources*]
- Detailed tour of National Center for Biotechnology Information Online Resources [*see NCBI Navigation and National Center for Biotechnology Information handouts*]
- Review of what can be done with online resources: a sample assignment: "*Using NCBI: A Sample Exercise, Anthrax*" and *Anthrax Sample exercise Answer Key*

### Week 2:

Lecture Topics:

- Overview of the Human (and Other) Genome Projects: *Understanding the Human Genome Project* by Dr. Michael Palladino and "*The Science Behind the Human Genome Project*" and *Positional Cloning*

Online Exercises:

- Review of Genetic Disease Online Resources: *How To Conquer a Genetic Disease*
- Introduction to Biology Workbench-logging in and completing the sickle cell anemia tutorial:

*Biology Workbench, How to Use Biology Workbench v. 3.2, Sickle Cell Anemia: Understanding the Molecular Biology*

Laboratory Topics:

- Overview of today's laboratory procedures: isolation of your DNA from buccal cells [*BuccalAmp DNA Extraction Kit*], setting up the Polymerase Chain Reaction to amplify mitochondrial DNA [*Wiretol II Micropipet, An Introduction to PCR, Human Mitochondrial DNA Kit AT*]

**Week 3:**

Lecture Topics:

- Overview of Gene Therapy: [*Online Gene Therapy Resources, [Trangenics, Gene "Knockouts"]*]

Laboratory Topics:

- Run out PCR product on gel to determine if the reaction was successful [see *Electrophoresis*]

Ligate product into a plasmid vector [see *TOPO-TA Cloning Kit*]; Transform plasmid into E. coli bacteria [see *Bacterial Transformation*]

**Week 4:**

Lecture Topics:

- Review of the science (and controversy) surrounding "stem cells"

[*Online Stem Cell Resources*]

[*Stem Cells: A Primer*]

[*The Science of Stem Cells*]

Laboratory Exercises:

- Isolation of Plasmid DNA from your transformed colonies: [see *Isolation of Plasmid DNA Protocol (Wizard Prep)*]
- Electrophoresis on Gel to visualize the DNA

**Week 5:**

Lecture Topics:

- "Cloning: Carrots, Frogs, Sheep, Mice and Humans .... [*Carrot cloning, Amphibian Cloning, Mammalian Cloning*] *Why Clone Mammals? From Scott Gilbert, Developmental Biology (2000)*

Online and Laboratory Exercises:

- Review of DNA sequencing [*DNA Sequencing*]
- Analysis of your mitochondrial DNA using online tools (your DNA was sequenced for you this past week). Here we will identify the vector sequence and remove it using NCBI tools, perform a Blast search, and then compare your DNA with other mitochondrial DNA sequences using the Cold Spring Harbor Laboratory site. [*Analysis of Mitochondrial DNA Sequence*]