Lecture 1 (FW)
January 21, 2009
DNA is the hereditary material
Reading Assignment: pp. 1-6; 93-94; 327-328 in Robinson.

I. Introductory course mechanics

A. No discussion sections this week. It is necessary to attend next week in order for you to be enrolled in the course. All sections are full. You may only attend the section in which you are currently enrolled. We will try, though we cannot guarantee, to accommodate section changes because of hardship.

The procedure for section change requests will be outlined in your first discussion section. In brief, you need to send an e-mail to the GSI of the section you wish to leave, and another to the GSI of the section you wish to join. As space opens up you will be notified if you can switch. **Your request must be submitted by Jan. 29** and you will be notified on Jan. 30.

B. All necessary information about the course will be posted on the web site

http://mcb.berkeley.edu/courses/MCB41/

There will only be a few paper hand-outs after today. Today's hand-out contains the syllabus, and the schedule of lectures and examinations. This information is also posted on the course web site. Read it carefully; it should answer most of your questions.

C. A note on reading assignments. You will find reading assignments on the web site lecture notes. There is some material in the reading assignments that will **not** be covered in lecture. The emphasis of exams will be on material that **is** covered in lecture. However, you will find the reading will help you understand the material covered, and there are illustrations and examples that may clarify the principles involved or their relevance to every day life.

II. What are the topics considered in this course?

There are three lecturers in the course, and 3 overlapping and related themes: 1) What is a gene, how does it work and how is it transmitted? 2) How can we use knowledge of genes to learn about origins and migrations of living things, and how can manipulation

of genes be used for the benefit of mankind. 3) How do stem cells provide opportunities for dealing with "genetic mishaps"? How do spontaneous and induced changes (mutations) of genes affect human health and behavior?

III. Lecture Notes (FW)

At the beginning of each of the posted lecture notes will the primary point of the lecture will be stated. This provides a focus for listening, reading and learning, i.e. what is the big deal. Also, a few words in the notes will be highlighted; these are key concepts, or in some cases, words the meaning of which contain the essence of what we're driving at. If you can install these words (or phrases) into the memory and thinking bank, you'll do well in the course.

First Lecture: DNA is the Hereditary Material

The primary goal: Outline the key evidence for the assertion that the chemical, DNA, is the material that Genes are made from. As a by-product, we will examine just what is meant by evidence in a scientific context.

I. Discovery of Genes

A. Mendel postulated that units of heredity are discrete and particulate.

B. Frederick Griffiths' experiments (1928) with pneumonia causing bacteria showed that factors governing heredity were a chemical, called the transforming factor.

a. Griffiths' experiment was designed to find out what made the bacteria that caused pneumonia so deadly.

b. The essence of the experiment is that lethal pneumonia could be caused if you mixed heat-killed, (previously) lethal bacteria with a live innocuous strain. The live innocuous bacteria became **transformed** into killers, and the change was heritable.

c. It was concluded that something in the heat killed bacteria changed the innocuous ones, permanently.

d. In other words, the "transforming factor" was responsible for the inheritance of a trait, and it is also responsible for the trait manifesting itself. We may generalize to say that genes are the agents of heredity, and that they also govern the machinery responsible for a trait.

This is a huge and important generalization.

Do you think this generalization is justified? If not, how would you go about testing whether it is justified?

e. Please note that the efficiency of transformation (i.e., how many bacteria in a population are actually changed) is very low, typically less than 0.01%.

So, how can so few transformed bacteria cause death?

C. A little quiz: (pick the best response)

A gene is:

something that causes pneumonia.
A unit of heredity
a chemical in heat-killed bacteria
a toxic poison

II. DNA is the transforming principle

A. Avery, McCleod and McCarty, working at Rockefeller Institute in NY, purified the transforming factor.

B. They concluded the transforming factor is DNA. This is a relatively simple **polymer** (a string of repetitive simple chemicals called nucleotides , like beads of a necklace). DNA had been discovered and characterized by Miescher in Germany in the 1860's.

1. Very few scientists believed the result. It didn't fit with the popular beliefs or scientific models of that day.

2. Avery, McCleod and McCarty devised a simple experiment to support their model. Digest the purified transforming principle with specific enzymes. DNAse kills the transforming ability of the purified materials, while Proteases do not.

a. We'll discuss what enzymes are, how they work, and how they are named.

IV. Some follow-up.

1. Words to know: particulate, bacterial transformation, protein, enzyme, polymer, nucleotide.

2. Something to think about

a. If DNA from dead bacteria can transform live ones, how do different kinds of bacteria maintain their identity? (How much "horizontal transmission" is there?)

b. Resistance of bacteria to antibiotics is primarily caused by genes. Could genes from antibiotic resistant bacteria transform sensitive bacteria so that resistance is passed from one bacterium to another? What would be the consequences of that?

V. Reading assignment for next lecture:

Cell structure and chromosomes, pp 19-26; mitosis, pp 31-36, DNA structure and replication, pp, 81-104.