

The first exam covers Chapters 1 through 4. The exam will be essay and problems. No multiple choice, matching, or true/false questions will be on the exam. Although there has been an historical bent to the lectures, the exam will cover Genetics, not History.

## DNA as the genetic material

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How did F. Griffith discover the “transforming principle”?

What is the difference between positive and negative controls? Be able to identify them in experiments that we discussed the last few weeks.

How did Avery, MacLeod, and McCarty discover that DNA was the genetic material?

What is the difference between ruling theories, a working hypothesis, and multiple working hypotheses?

What are Chargaff’s rules and what was their significance?

How did Hershey and Chase show that DNA was the genetic material?

How was it determined that RNA is the genetic material in RNA viruses?

## DNA structure

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What are *all* of the major aspects of the structure of the B form of DNA as proposed by Watson and Crick? What were the implications of the structure of DNA for genetics?

What are the basics of DNA nomenclatures? Be able to draw DNA, showing the important parts.

What are the differences between the A, B, and Z forms of DNA?

What are denaturation/renaturation and what can be learned from these techniques? What are  $T_m$  and  $C_0t$  and how are they used to analyze DNA? How do higher organisms differ from *E.coli* in their  $C_0t$  curves?

How does agarose gel electrophoresis work, and how can it be used to analyze DNA.

## Replication of DNA

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How was it shown that in broad beans, DNA replication is semi-conservative.

What is autoradiography and how is it used to look at replicating DNA.

How and why were the Meselson-Stahl experiments performed, including equilibrium density gradients and how they were used for these experiments.

How did Okazaki show that DNA was made in pieces.

Why is discontinuous synthesis needed to replicate DNA.

How can we determine if DNA replicates bidirectionally or unidirectionally?

What are the major enzymes involved in DNA replication? What is the function of each? This includes DNA polymerases, dnaA, topoisomerases, DNA ligase, helicases, ssb, DNA primase, etc.

How do DNA polymerases I and III work. Know why they make few errors, what they need to replicate DNA, etc.

What are all the major steps in replicating DNA?

How have mutants been used to confirm the enzymology?

How do eukaryotes replicate their DNA? What are ARS sequences? What is an ORC? How many DNA polymerases do eukaryotes have and what are their main functions?

Why do eukaryotes need multiple origins of replication?

Why do eucaryotes need and have telomerases? How do they work?

Know how and why DNA is replicated with high fidelity.

Recombination: know the types of recombination, the mechanics and details of homologous recombination, and gene conversion.

## **Chromosome structure**

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How do bacteria compact DNA into a small cell?

What are nucleoids? What proteins are found in nucleoids?

What is supercoiling? What types of enzymes are involved in supercoiling? How does gyrase differ from the other enzymes involved in supercoiling?

What are polytene chromosomes? Where are they found? What is the explanation for the bands? How do the bands differ during development?

What are lampbrush chromosomes?

What is chromatin? What are the major types of proteins in chromatin?

When you digest chromatin with micrococcal nuclease, what pattern do you see? How do these patterns correspond with electron microscopy (EM) pictures of chromatin?

How are histones arranged in nucleosomes? Why is there less H1 than the other histones?

How is DNA packed into higher order structures in eukaryotes?

How is chromatin remodeled? What are the major modifications of histones, and what types of differences in cells do they correlate with?

What are heterochromatin and euchromatin? What are the differences between them?

What are C-banding and G-banding? What is a karyotype? What is the nomenclature for describing bands?

What is satellite DNA? Where is it found? How do we know where it is found?

What are centromeres? What are CEN? What are the major features of CEN? How do human centromere sequences differ from yeast?

What do telomere sequences look like?

What are VNTR, minisatellites, and microsatellites?

What are SINES and LINES? What is the most common SINE? What is the most common LINE? How are SINES and LINES thought to transpose?

What are multicopy genes?

What are pseudogenes?

## **Overall**

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Besides being asked things talked about in class, you will be asked about things you haven't seen, but should be able to predict from what you know in class. You may be asked to design an experiment while keeping in mind such things as controls. You may be asked to interpret an experiment or results from an experiment. You may be asked to explain how an experiment was done.

## **Old midterm questions**

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- 1) Fred Griffith discovered the transforming principle.
  - a) Explain what hypotheses he was testing.
  - b) How did he test these hypotheses? What were the controls?
  - c) What was the transforming principle?

- 2) Chargaff was one of the first people who believed that DNA could be the genetic material. What was his hypothesis and what were the experiments that supported his ideas?
- 3) Draw a schematic of a typical DNA molecule. Label the important parts.
- 4) Eukaryotic DNA and Prokaryotic DNA have some significant differences. What are three major differences? Be sure to explain what the differences are between the two types of organisms.
- 5) Denaturation and renaturation of dsDNA can tell you a number of things. Explain the following:
  - a) What  $T_m$  is and what it tells you.
  - b) What affects the  $C_0t$  values of DNA? Why does it affect the  $C_0t$ ?
- 6) Meselson and Stahl did a series of experiments to study DNA replication. Explain what their hypotheses were, how they did their experiments, what results they got, and what controls they used.
- 7) Explain how *E. coli* makes Okazaki fragments, and how they are “stitched” into longer pieces. Be sure to include any enzymes that are necessary.
- 8) In *E. coli*, the major details of homologous recombination have been worked out. Explain the steps and enzymes that are involved. Be sure to include the purpose of each enzyme.