PLNT3140 INTRODUCTORY CYTOGENETICS

MID-TERM EXAMINATION

1 p.m. to 2:20 p.m. Tuesday, October 21, 2008

Answer any combination of questions totalling to exactly 100 points. This exam is worth 15% of the course grade.

Hand in these question sheets along with your exam book.

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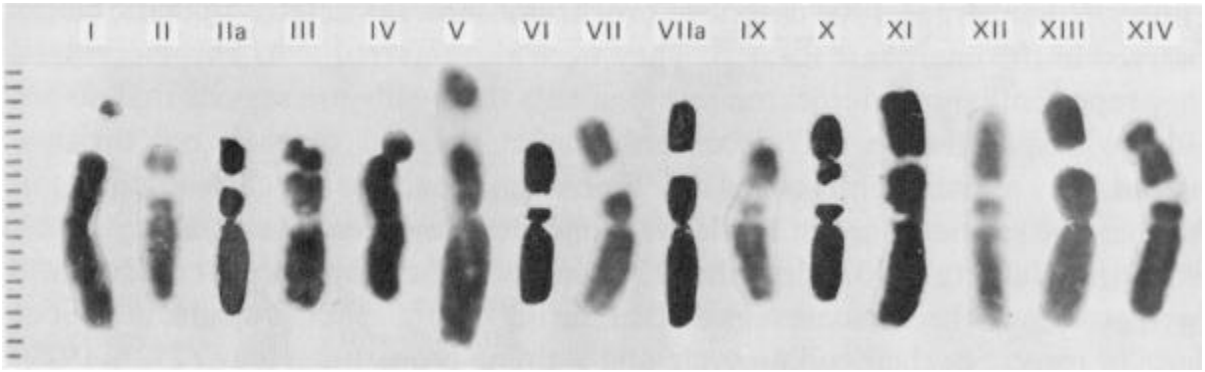
1. (15 points) Give 3 reasons why the eukaryotic cell cycle requires more time and energy than cell division in prokaryotes. Explain each reason.

2. (10 points) G2 was originally referred to as a "resting phase" between S phase (DNA replication) and prophase, when the chromosomes can first be seen in the microscope. Why is this erroneous? In other words, what important events happen in G2?

3. (20 points) In a single sentence, define any 5 of the following:

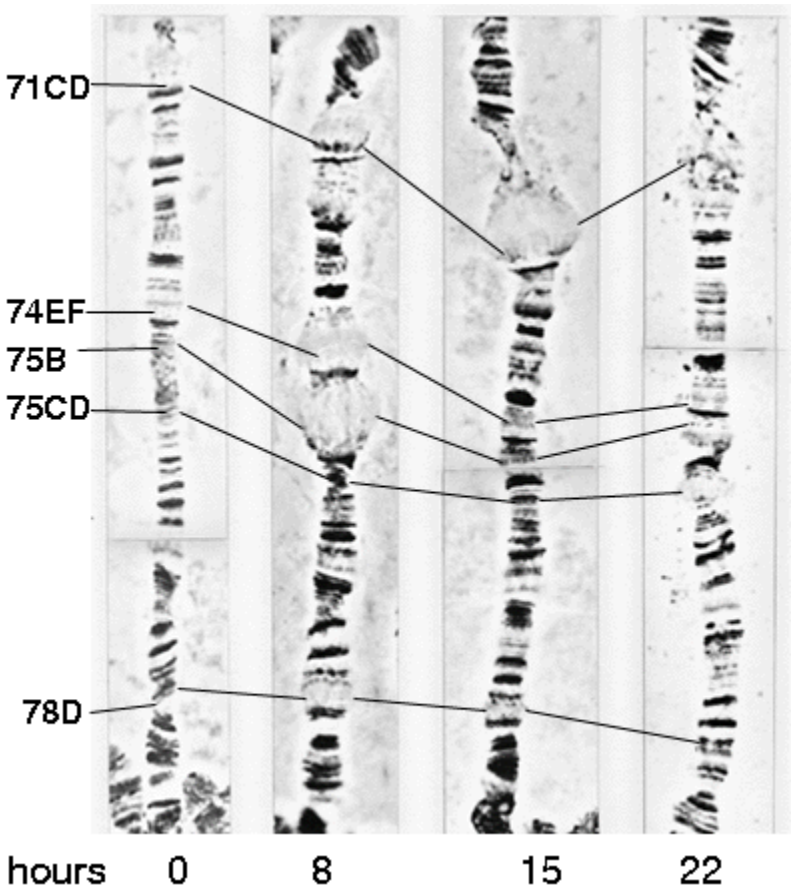
a) synapsis
b) cytokinesis
c) crossing over
d) centrosome
e) terminalization
f) kinetochore

4. (5 points) In many organisms, chromosomes appear to have "satellites", as pictured below. What are chromosome satellites, and what causes their appearance under the microscope?



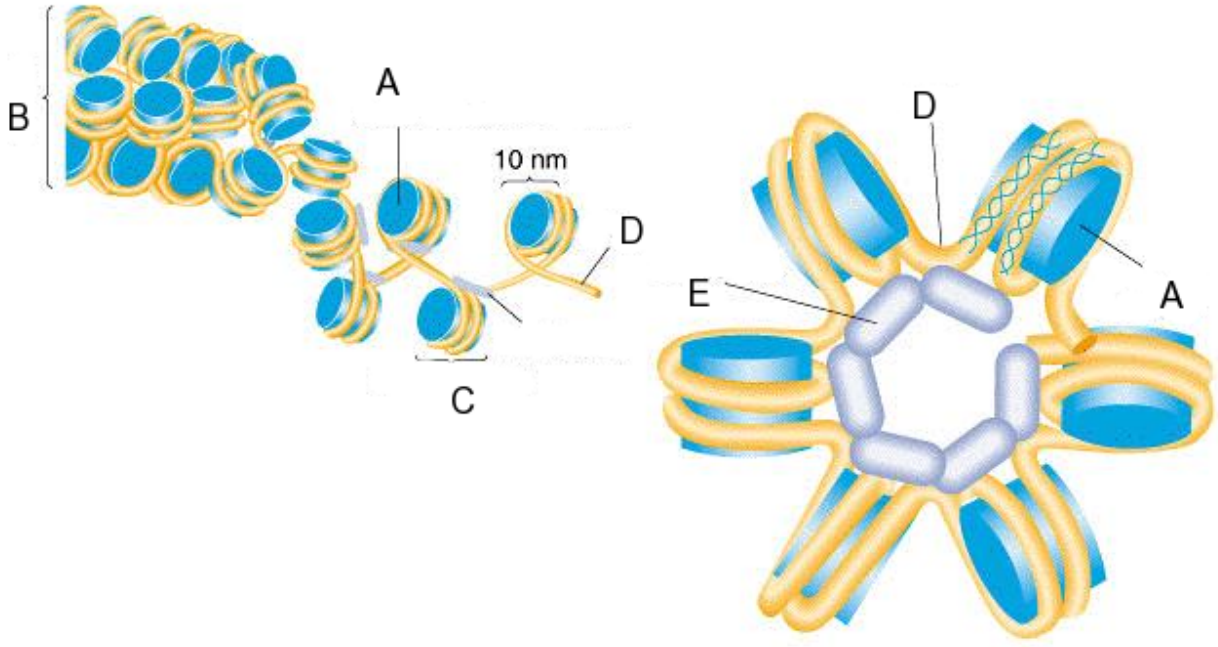
5. (10 points) Histones are among the most highly conserved proteins in evolution. For example, Histone H4 is 102 amino acids long, with only two amino acid substitutions found between pea and cow. Other chromatin-associated proteins have numerous mutations, when proteins are compared between distantly-related species. Suggest an explaination for these observations.

6. (10 points) The figure at right shows part of chromosome 3 in the salivary glands of *Drosophila melanogaster* over a 22 hour time period during larval development. At five loci shown in the figure, these polytene chromosomes exhibit "puffs", which are evidence of changes in chromatin structure. You may assume that the genes encoded at these five loci have a function in larval development. Based on these observations, describe what you think is happening at the level of transcription and chromatinn structure for each of these five loci.



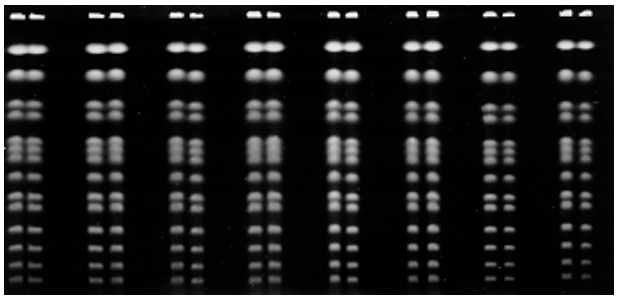
7. (10 points) Name the chromatin components labeled in the image below. Where a label is used twice, you can assume it is the same structure.

A.
B.
C.
D.
E.

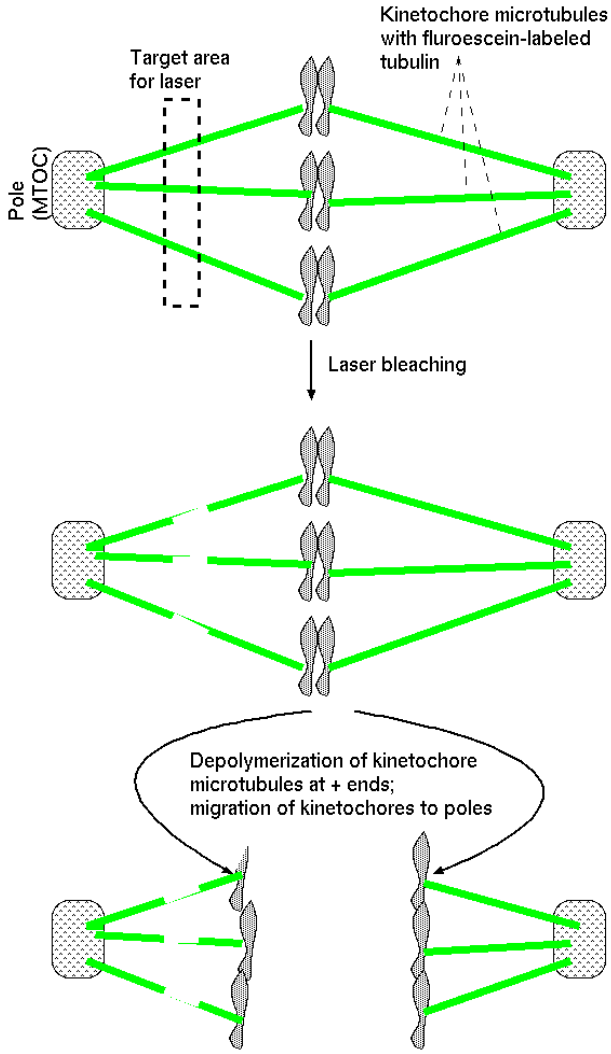


8. (5 points) The figure below shows Pulsed Field Gel Electrophoresis (PFGE) of yeast (*Saccharomyces ceriviscea*) chromosomal DNA. Each band corresponds to a chromosome, and the sizes of the chromosomes are all known.

Suppose you had a cloned sequence for a gene from the ascomycete fungus, *Neurospora crassa*. What would be a simple way to find out which chromosome has the corresponding yeast gene?



9. (10 points) State two alternative hypotheses that could be distinguished by this experiment. What prediction is made by each hypothesis, and which is the correct hypothesis?



10. (10 points) Telomerase (telomere terminal transferase) adds repeat units of a specific DNA sequence to the 3' protruding ends of telomeres.

a. Where does the sequence information come from to add these repeats?

b. Why can't DNA polymerase simply fill in the gaps left during DNA replication, after RNA primers are removed?

11. (5 points) The sequence below shows the Simian Virus 40 origin of replication, as annotated in Sumitra et al. (1986) Mol. Cell. Biol. 6:1663-1670. Recalling what you know about DNA, is there a feature of this sequence which might be particularly important to facilitating formation of a replication fork? Explain your answer.

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                     Early Palindrome    T antigen binding                AT
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GGCCTCCAAAAAAGCCTCCTCACTACTTCTGGAATAGCTCAGAGGCCGAGGCGGCCTCGGCCTCTGCATAAATAAAAAAAATTA
CCGGAGGTTTTTTCGGAGGAGTGATGAAGACCTTATCGAGTCTCCGGCTCCGCCGGAGCCGGAGACGTATTTATTTTTTTAAT
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12. (10 points) Each chromosome is a very long DNA molecule, containing thousands of genes. An alternative way that the eukaryotic chromosome might have evolved is to have each gene as a separate dsDNA molecule. In this model, the chromosome would be a protein matrix holding many short dsDNAs. List 2 disadvantages of this alternative kind of chromosome.