

39.314 INTRODUCTORY CYTOGENETICS

MID-TERM EXAMINATION

1 p.m. to 2:20 p.m. Tuesday, October 22, 2002

This examination is worth 15% of the course grade. There are 8 questions totalling 100 points.

Hand in these question sheets along with your exam book.

1) (10 points) Meiosis - Fill in the blanks.

Chromosome condensation begins in ____a____ but does not become evident until ____b____. During ____c____, a homology searching mechanism is suggested to explain the fact that two homologous chromosomes begin pairing. During zygotene, the ____d____ forms. In pachytene, ____e____ occurs. After diplotene is complete, individual chromatids can be visualized during ____f____. In many animals meiosis in oocytes is arrested at ____g____. Arrest at this point entails ____h____, facilitating gene expression. At meiotic Anaphase I, the first ____i____ division occurs. The resultant cells, entering meiosis II, are ____j____ploid.

2) (10 points) In this figure, the human X and Y chromosomes pair in a sort of "wishbone" configuration. What is the likely explanation for this?



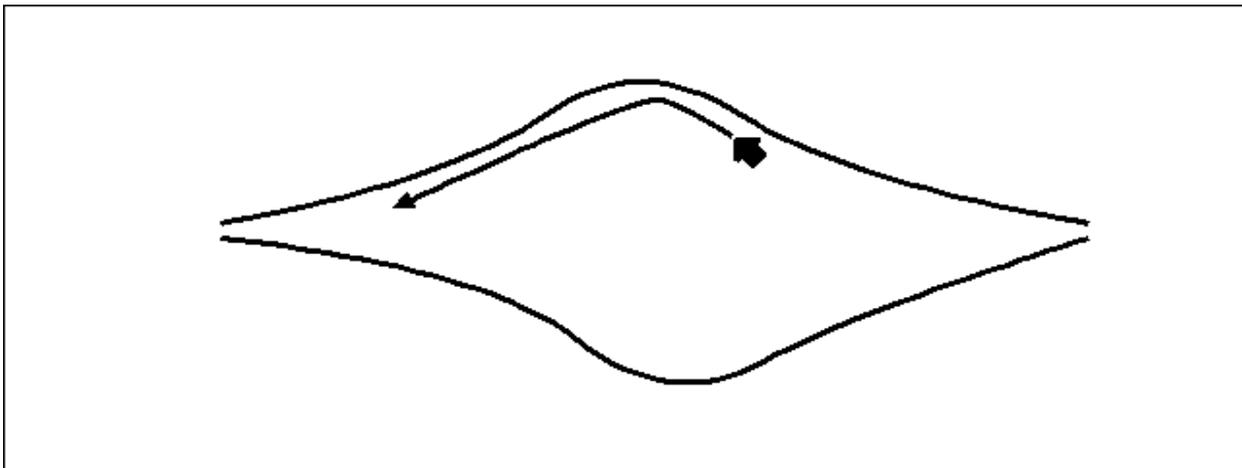
3) (10 points) Why does crossing over occur in meiotic prophase I, as opposed to meiotic prophase II? That is, what would not occur if crossing over happened in meiotic prophase II?

4) Definitions (20 points)

- a) polytene chromosomes
- b) somatic cells
- c) FISH
- d) chromosome band
- e) staining

5) (10 points) List the 5 major histones, and indicate how many of each would be found per nucleosome, in highly-condensed chromatin.

6) (10 points) The figure below shows some of the details of a replicon, consisting of two replication forks. Re-draw a more complete figure. Indicate 5' and 3' ends of template and replicating strands, show Okazaki fragments.



7) (15 points) The table below summarizes the various levels of chromatin packageing discussed in class.

level	# of nucleotides
a) nucleosome	146 - 200 bp
b) 30 nm solenoid	1200 bp
c) domain	50,000 bp
d) Filipski et al. I	300 kb
e) Filipski et al. II	9000 kb

For each of the following, tell which level(s) of chromatin folding is most likely being detected by a given experimental method, and explain why.

- i) General DNaseI sensitivity
- ii) DNaseI hypersensitivity
- iii) nicking due to Topoisomerase II inhibitors

8. (15 points) The figure at top shows several recombinant DNA constructs containing sequences including the yeast Leucine synthase gene (LEU), the yeast centromere (CEN), the yeast origin of replication (ARS) and the yeast telomere (TEL). The bottom figure illustrates several experiments in which yeast mutants deficient in leucine biosynthesis (ie. *leu⁻*) were transformed with one of these constructs and plated first on complete media, and later plated on minimal media to test for growth without leucine. For each of the five constructs (A - E), indicate which of the experimental results (1-4) would be seen and explain why.

- A)
- B)
- C)
- D)
- E)

