PCB5065 Exam 2: Recombination, crossing over and gene conversion
6 October 2008 There are 100 pts, total. USE ONLY THE SPACE PROVIDED.

1. T/F (20 pts)

a) mitotic recombination results in crossing over half the time. F

b) mitotic recombination is usually the result of gene conversion T

c) in Drosophila and most organisms, mitotic recombination differs from meiotic in that the homology search during mitotic recombination must cover the whole genome. T

d) gene conversion in meiosis results in crossing over roughly half the time. T

e) homologous chromosomes are often brought together during mitosis by double stranded breaks T

f) in mitosis, cells undergo a reductional division. F

g) in mitosis, diploid cells become 4N. T

h) in mitosis, recombination occurs mainly at the two chromatid stage. T

i) in meiosis, recombination occurs mainly at the two chromatid stage. F

j) in meiotic crossing over, the two holiday structures are always resolved with a crossover. T

2. (22 pts). Can linkage maps be generated by mitotic recombination data alone? YES

How many chromatids are usually involved in mitotic recombination? 2

Does mitotic recombination involve crossing over? Rarely

If yes, at what frequency are crossovers found? Rare or N/A

If no, how does mitotic recombination primarily occur? (ie., by what mechanism?; do not name the model). Gene conversion

Does meiotic recombination often involve crossing over? YES
If yes, how often? __1/2 of the time_____
What is the best model to explain mitotic recombination? SDSA

What is the best model to explain meiotic recombination? ECD or Consensus

Does the Double Strand Break Repair model require mismatch repair to give a) 6:2 tetrads? Y/N; b) 5:3 tetrads? Y/N; ab4:4 tetrads? Y/N. (Circle Yes or No)
NNN.

Rank the following in terms of frequency of overall occurrence in meiosis: crossing over, gene conversion, mutation. Rank the same 3 events in terms of overall occurrence in mitosis, and in meiosis as indicated.

gene conversion> crossing over> mutation.

4. (12 pts). In Neurospora, which exhibits ordered tetrads, suppose you found the following:

ag thi	ag thi	+ +	ag thi
ag thi	+ thi	ag thi	+ +
+ +	+ +	ag thi	ag thi
+ +	ag +	+ thi	+ +
800	8	1	8
PD	TT	thi conver	PD	Tetrad type
1 1	2 1	2	2 2	Segregation pattern

What are the parental genotypes? ag thi and ++ How are the ag and thi genes located on the chromosomes with respect to their centromeres and with respect to each other? Draw map. There is one unusual tetrad. What happened to the *thi* gene?

Since there are no NPDs, almost all PDs, the genes are tightly linked (3 pts). 1/2 of 8 TTs =4/817 = 0.5 cM distance (6 pts). Since second division patterns are 17 for ag and 8 for thi, and total tetrads 817, then ag is ~1 cM and thi is ~0.5 cM away from their common centromere 6 pts). Map: cen----thi----ag. Unusual tetrad is a gene conversion at thi to a 6:2.

5. (26 pts.) Diagram the currently accepted model for meiotic recombination, using as many marker genes as you need to show how crossovers and all types of gene conversions occur, with and without crossing over, including 6:2, 5:3 ab 5:3 and aberrant 4:4 conversions.

Refer class notes for Early Crossover Decision Model.

6. (10 pts). Suppose you had a yeast integrative plasmid that carried two wild type yeast genes, *ura-3* and *leu-2*. There is a restriction endonuclease cut site within both genes, *Eco*R1 within *ura-3* and *Bam*H1 within leu-2. There is also a HindIII site on your circular, integrative plasmid. Your yeast strain is auxotrophic for uracil and leucine, defective in both *ura-3* and *leu-2*. Diagram plasmid integration at *ura-3* and diagram the integrated result using a simple crossover. Do not show the details of the Watson-Crick strands, just the crossover result.

Would you cut your plasmid? yes or no (circle one)

If so, what cut site would you use to integrate at ura-3? _____*Eco*RI_____

Refer class notes and hand out for marker integration.