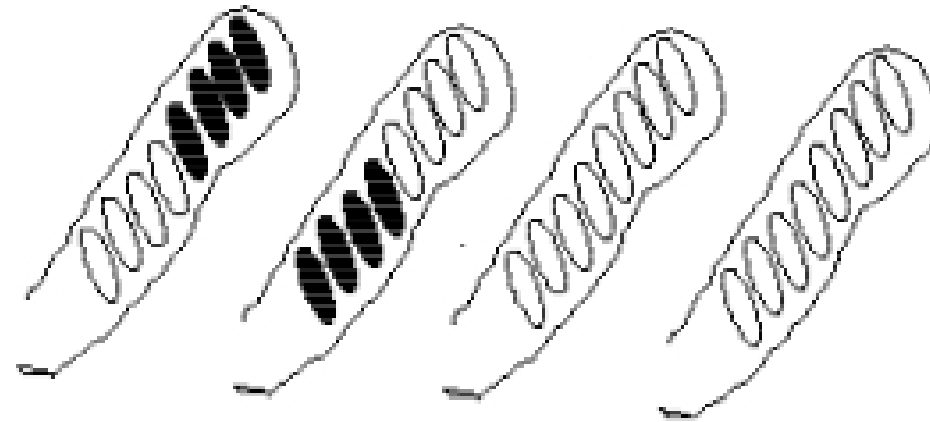
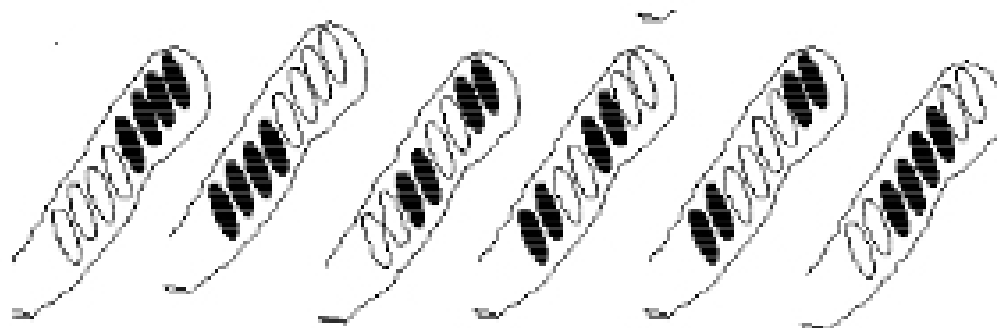


Gene 603  
Exam III  
November 30, 2001

I. Suppose that a single nucleotide polymorphism exists in the centromere of chromosome 5 in *Neurospora crassa*. Use as many of the "ordered asci" as needed in figure A below to show the expected segregation pattern(s) by shading spores with one of the "alleles". FIG A

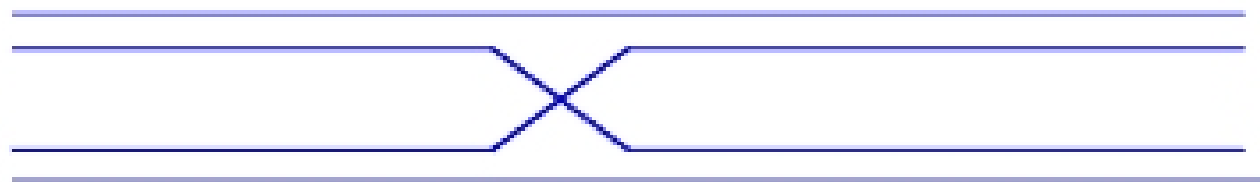


The *ws* mutation (white spore) is about 8 map units from the centromere of LG-5. Use as many of the "ordered asci" as needed in figure B below to show expected segregation pattern(s), with expected frequency, from a cross between a *ws* mutant and a *ws*<sup>+</sup> strain (darken ascospores with the + allele; equivalent arrangements need not be shown). FIG B



% 42 42    4    4    4    4

II. What is the basis for the precision seen in crossing over (recombination)?  
(a drawing may be the easiest way to answer)



heteroduplex formed by base pairing of matching DNA sequences serves as the initiation of crossing over

How does the precision relate to gene conversion?

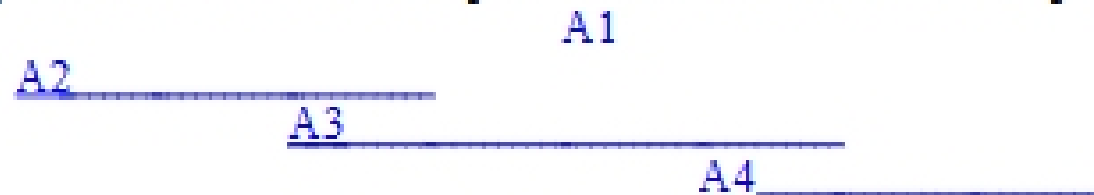
Gene conversion results from mismatch repair in heteroduplex regions.

III. Pairwise crosses were made on *E. coli* B between 4 rII-A mutants and 1 rII-B mutant. The number of plaques produced when  $10^6$  progeny from each cross were spread in lawns of *E. coli* K, are shown in the table below:

Pair	A1	A2	A3	A4	B1
A1	20	210	10	200	400
A2		0	0	60	360
A3			0	0	300
A4				0	220
B1					20

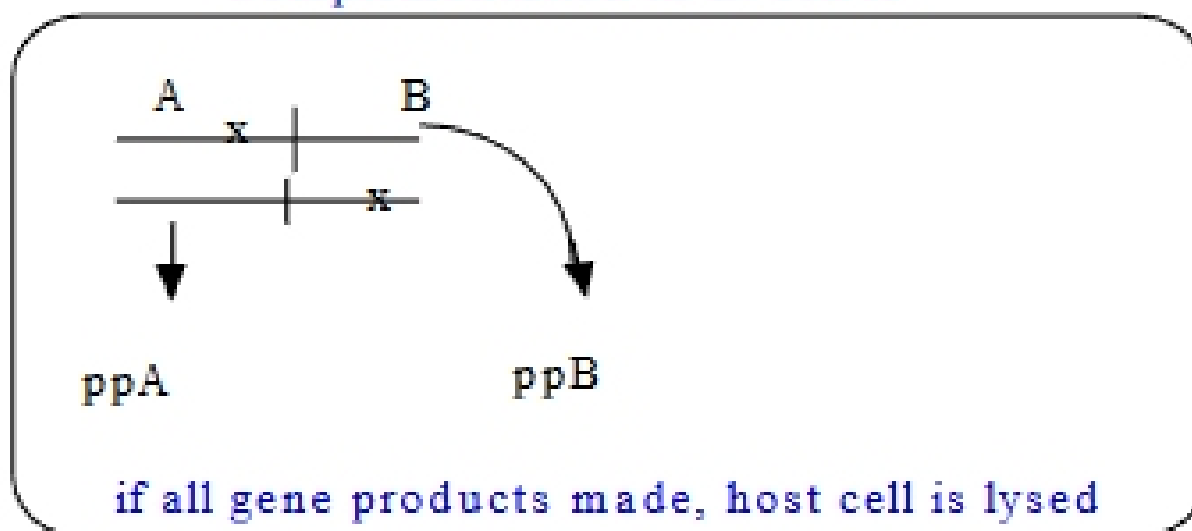
Which mutations are point mutations? How do you know? A1 and B1; they revert (+ progeny when "selfed")

Make a map that shows relative positions of deletions and point mutations.



Use a picture to describe the test and results that led to the classification of some mutants as rII-A and others as rII-B

Complementation in *E. coli* K



IV. Rank the following situations / aberrations in the order from most likely (1) to least likely (4) to have a child with trisomy 21:

- 1 \_\_\_\_\_ 21 years old; 45 XX T14-21      4 \_\_\_\_\_ 40 years old; 46 XY  
 3 \_\_\_\_\_ 21 years old; 45 XY T14-21      2 \_\_\_\_\_ 40 years old; 46 XX

V. Show that  $q^2 + pqF = q^2(1-F) + qF$  : substituting  $1-q$  for  $p$  gives:

$$q^2 + (1-q)qF = q^2 + qF - q^2F = q^2(1-F) + qF$$

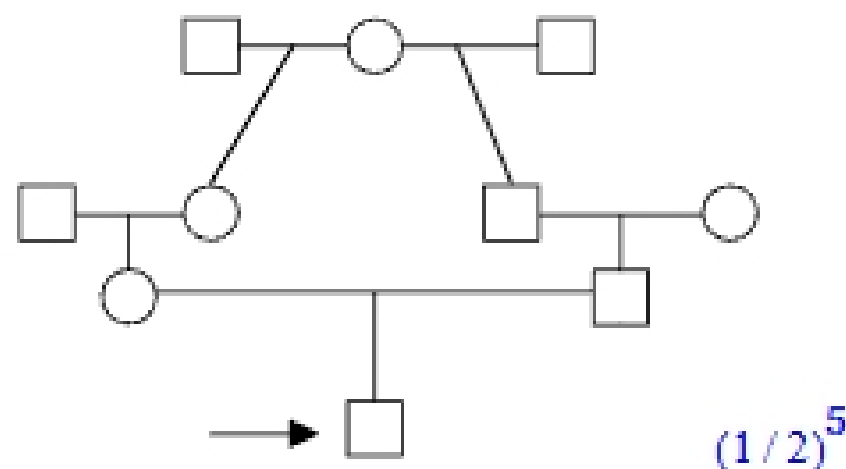
a) Suppose that a homozygous recessive condition that prevents reproduction occurs 1 in 250,000 births. What are the "gene" frequencies.

$$q = \text{Square root of } 4 \times 10^{-6} = 2 \times 10^{-3} (0.002) \quad p = 0.998$$

b) Why/How is this recessive allele maintained in the population?

in heterozygotes with selection balanced by mutation.

c) Calculate  $F$  for the individual indicated by an arrow in the pedigree diagrammed below.



d) What is the probability that the child would have the condition described above?

$$(\text{= } q^2 \text{ from random mating plus } pqF \text{ from inbreeding}) = 6.6 \times 10^{-5}$$

VI. In alfalfa, which is an autoteraploid, presence of at least one  $P$  allele results in purple flowers. A cross between white and purple flowered plants gave 1/2 purple:1/2 white.

A) Give the genotypes of the purple and white parents.

$$Pppp \times pppp$$

B) What ratio(s) would be expected in progeny of a self-pollination if the purple-flowered plant?

$$3/4^{\text{th}} \text{ purple and } 1/4^{\text{th}} \text{ white}$$

VII Shown in diagrammatic form are the gene arrangements of chromosomes I and II in 4 populations of *Drosophila*. Assume that each population is