GENOME 371; A 03 Name:_____
Berg/Brewer
Practice Exam 2; Nov 1, 2003 TAs:_____

PRACTICE EXAM 2 GENOME 371 Autumn 2003

These questions are derived from exams given Winter 2002 and Autumn 2002.

Take the exam in a quiet place and only when you are sure you will have time to complete the exam uninterrupted. Time yourself. This exam should require about 60 minutes to complete.

A key is posted separately on the web. Do NOT look up the answers until you have completed the exam.

GENOME 371; A 03 Name:_____
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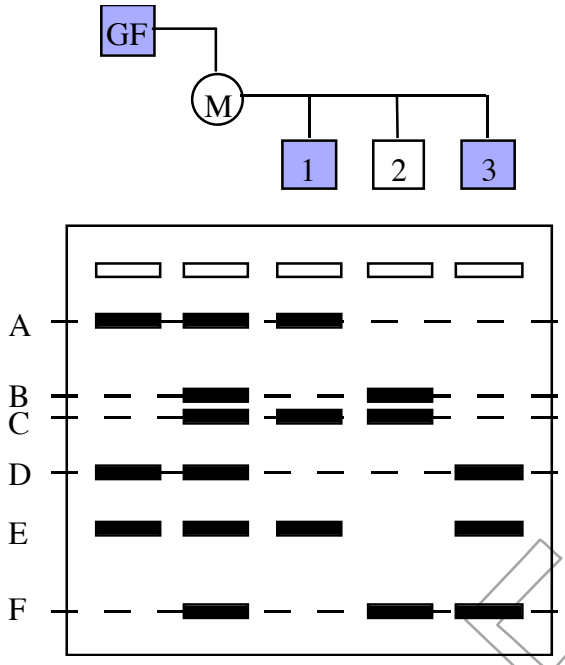
1) (21 pts) The gene for colorblindness is on the X chromosome, very near the end of the long arm. Three generations of a family in which colorblindness (shaded symbol) is segregating are shown below. Irrelevant individuals (the grandmother and the mother's husband) are omitted. Below each family member is the result of a PCR analysis in which three regions of the X chromosome have been amplified and combined in one lane of a gel.



A) What PCR alleles are on the mother's two X chromosomes?

Paternal X:_____ Maternal X:_____

B) Based on just the data from this small family, which PCR allele is likely to be closest to the colorblindness allele?

_____

C) For each son, indicate whether the X chromosome he received from his mother is recombinant or parental.

Son 1: _____

Son 2: _____

Son 3: _____

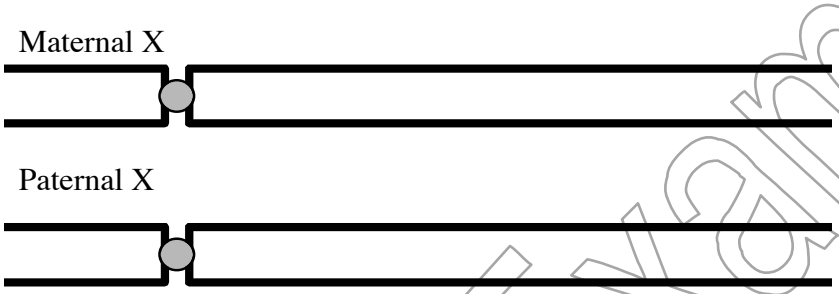
D) Which of the PCR markers are alleles of each other? That is, which PCR fragment is A's allele, etc.?

A and _____ are alleles

_____ and _____ are alleles

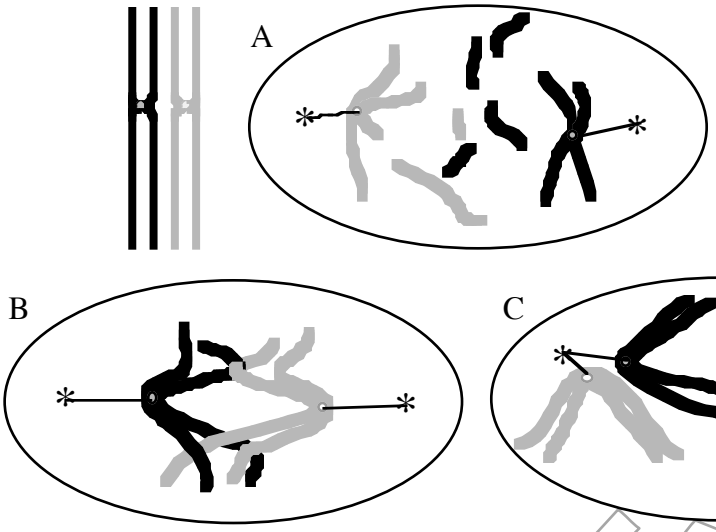
_____ and _____ are alleles

E) Show the linkage arrangements and **one possible** relative order of PCR and colorblindness alleles on the mother's two X chromosomes.



F) On the chromosomes above, illustrate the cross-over(s) that gave rise to **one** of her sons; indicate son 1, 2 **or** 3 in your answer and circle the chromatid he received.

2) (12 pts) One pair of homologues from a diploid organism is illustrated below. Three cells that are attempting anaphase I of meiosis are shown in A, B, and C. None of the divisions is proceeding correctly. Some gene product was missing from each meiosis. (Assume that the spindle is normal. In the drawings only kinetochore microtubules are shown.)



A) Match the loss of function mutations listed below with the aberrant meioses.

Mutations in a gene for...	could result in aberrant meiosis
ligase	
cohesin	
resolvase	
synaptonemal complex	
recBCD endonuclease	

B) Which of your answers to part A do you think we will mark wrong? (In other words, in which answer are you least confident?) Defend your answer as you would if you were turning this question in for a regrade!

Name:_____

TAs:_____

3) (20 pts) Celeste discovered a new fly mutant with white eyes. She crossed this male fly to a homozygous wild type female and found the following offspring:

Eye color	Females	Males	Total
Red	50	50	100
White	50	50	100

white-eyed sons

A) From these data:

Is this new mutation (circle one) Dominant Recessive?

Is this new mutation (circle one) X-linked Autosomal?

What are the genotypes of the two flies that were crossed: Define your notation. _____

white-eyed male _____ wild type female _____

B) Celeste then took **white-eyed sons** from the above cross and mated them to pure-breeding females from Morgan's white-eyed strain that was used to prove the chromosome theory of inheritance. She found the following offspring:

Eye color	Females	Males	Total
Red	1000	1	1000
White	1000	2000	3000

What are the genotypes of the parents used to generate this second set of offspring?

white-eyed sons _____ Morgan's white-eyed females _____

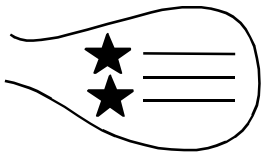
C) What is the genotype of the single red-eyed male (in the offspring of the second cross)? Remember that in flies, sex is determined by the X:Autosome ratio, not by the presence/absence of a Y.

_____

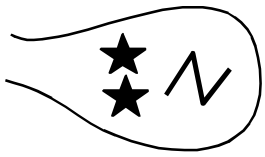
D) How did this single male arise? Be specific.

4) (25 pts) You discover a new species of fruit fly with beautiful patterns on the wings. You name the species *Flaga pterae*, because the patterns remind you of various countries' flags.

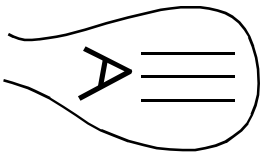
A) You mate pure-breeding flies with the African National pattern to pure-breeding flies with the Stars and Stripes pattern. All the F_1 have the African National pattern. You cross the F_1 progeny to testcross parents and obtain the following offspring:



Stars and Stripes
300



Star National
200



African Stripes
200

African National
300

What does the **phenotype of the F_1** tell you?

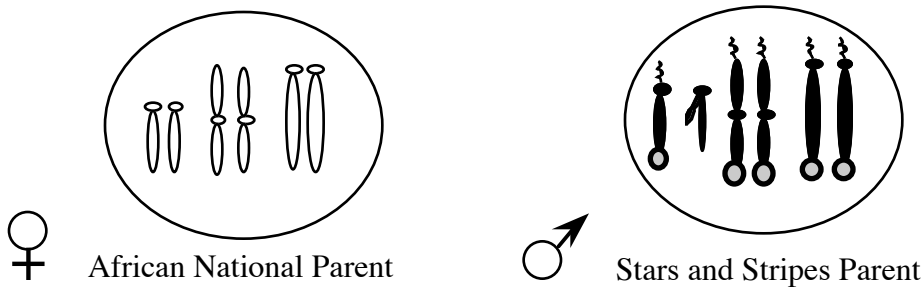
What does the **presence of four categories** of testcross progeny tell you?

What do the **numbers** of testcross progeny tell you? Be quantitative.

Name:_____

TAs:_____

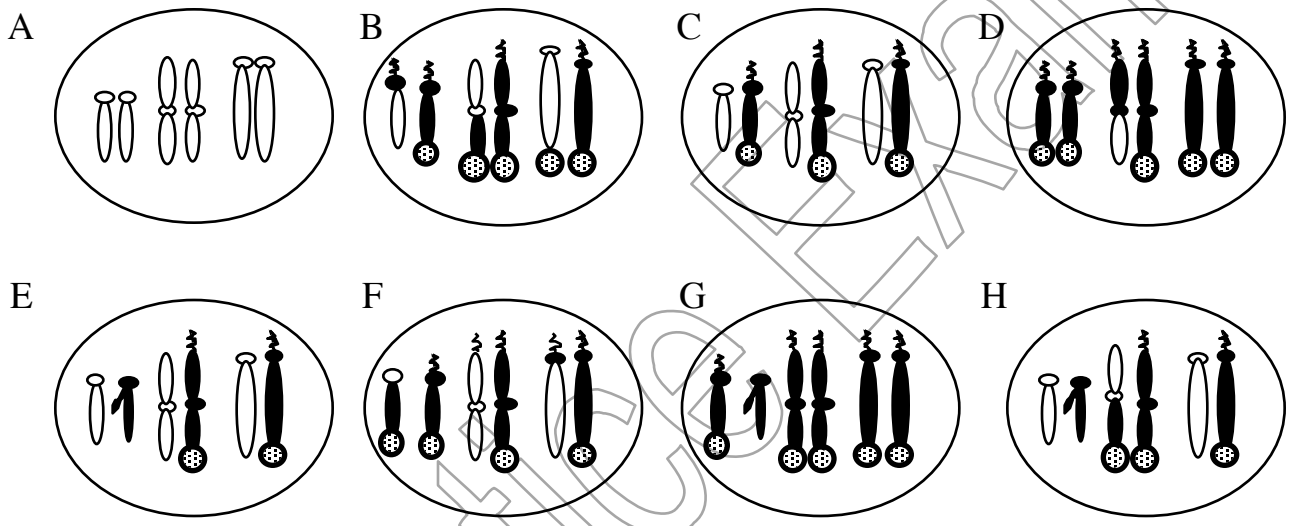
B) You isolate cells from each pure-breeding strain and analyze the chromosomes. Typical karyotypes are shown below.



Shown below are eight potential karyotypes for the F_1 progeny.

Which karyotype best fits the expected chromosomes of the F_1 female? _____

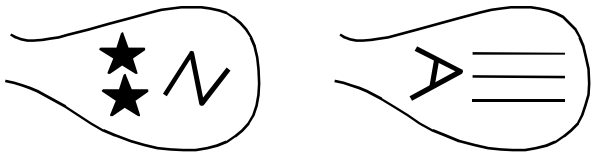
Which karyotype best fits the expected chromosomes of the F_1 male? _____



C) You now wish to map the chromosomal location of the information for wing patterning.

When you examine the karyotype for two of the Star National testcross progeny, you see that they look like B and H above.

What would be the karyotype of the African Stripes testcross progeny? Choose a letter or letters that best fit(s) the expected karyotypes.

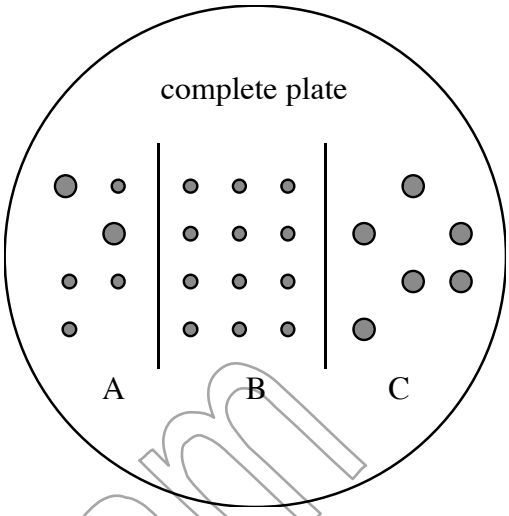


_____

D. Draw the pair of homologues from the F_1 hybrid female that carry the wing patterning loci. Show the arrangement of alleles before she undergoes any crossing over in meiosis.

5) (14 pts) The yeast genome contains 8 different loci that encode the tyrosine-tRNAs that recognize UAC codons in mRNA. These 8 wild type genes are called sup2, 3, 4, 5, 6, 7, 8 and 11. A mutation in any of these loci that changes the anticodon loop so that it now recognizes a UAG codon is called a "suppressor". SUP3 is one such dominant mutation; SUP11 is another. Haploid cells with either of these mutations are sick and make small colonies on complete plates.

The sup3 gene and the sup11 gene are not linked.



A. When a strain that contains a SUP3 mutation is crossed to a strain that contains a SUP11 mutation, the diploid survives, but it is also sick. The tetrads produced by sporulating the diploid are of three basic types illustrated on the right.

What type of tetrads are class A? _____

What type of tetrads are class B? _____

What type of tetrads are class C? _____

B. What are the genotypes of the four spores that make up the class A tetrad?

large colony _____

small colonies _____ and _____

dead colony _____

C. What is your hypothesis for why some of the spores in type A and C tetrads are dead? Explain.