

系所別:

生命科學系

科目:

遺傳

- 1) (10%) A mutant gene which produces brown eyes (*bw*) is located on chromosome #2 of *Drosophila melanogaster* whereas a mutant gene producing bright red eyes, scarlet (*st*), is located on chromosome #3. Phenotypically wild type flies (with dull red eyes), whose mothers had brown eyes and whose fathers had scarlet eyes were mated. The 800 offspring possessed the following phenotypes: wild type (dull red), white, scarlet (bright red), and brown. Most of the 800 offspring had wild type eyes while those with white eyes were the least frequent.
- (a) Using standard symbolism, diagram the cross from the P generation (brown-eyed mothers X scarlet-eyed fathers) and the F1 generation. Be certain to provide the alleles of the mutant genes.
- (b) From the information presented above, how many white-eyed flies would you expect in the F2 generation?

- 2) (10%) The following coat colors are known to be determined by alleles at one locus in horses:

palomino = golden coat with lighter mane and tail

cremello = almost white

chestnut = brown

The following table gives ratios obtained in matings of the above varieties:

Cross	Parents	Offspring
1	cremello X cremello	all cremello
2	chestnut X chestnut	all chestnut
3	cremello X chestnut	all palomino
4	palomino X palomino	1/4 = chestnut 1/2 = palomino 1/4 = cremello

A) Assign gene symbols for the genetic control of coat color on the basis of these data.

B) Diagram the last two matings.

- 3) (20%) In the fruit fly, *Drosophila melanogaster*, a spineless (no wing bristles) female fly is mated to a male which is claret (dark eyes) and hairless (no thoracic bristles). Phenotypically wild type F1 female progeny were mated to fully homozygous (mutant) males, and the following progeny (1000 total) were observed.

PHENOTYPES	NUMBER OBSERVED
Spineless	321
wild	38
claret, spineless	130
claret	18
claret, hairless	309
hairless, claret, spineless	32
hairless	140
hairless, spineless	12

- (a) Which gene is in the middle?
- (b) With respect to the three genes mentioned in the problem, what are the genotypes of the homozygous parents used in making the phenotypically wild F1 heterozygote?
- (c) What are the map distances between the three genes? A correct formula with the values "plugged in" for each distance will be sufficient.
- (d) What is the coefficient of coincidence? A correct formula with the values "plugged in" will be sufficient.

注意：背面有試題

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- 4) (15%) The genes for light eyes (*lt*; *light*) and straw bristles (*stw*; *straw*) are tightly linked on chromosome II in *Drosophila melanogaster*. The malpighian tubes of *lt* larvae and adults are maternally affected in that malpighian tubes of *lt/lt* organisms, whose mothers were *lt⁺/lt* and have more yellow pigment than those from *lt/lt* mothers. There is no maternal effect associated with the straw locus. Give the phenotypes of the offspring from the following crosses.
- | | Female | Male |
|-----------|--|---|
| Cross #1: | <i>lt stw/lt stw</i> | <i>lt⁺stw⁺/lt stw</i> |
| Cross #2: | <i>lt⁺ stw/lt stw</i> | <i>lt stw⁺/lt stw</i> |
| Cross #3: | <i>lt⁺ stw⁺/lt stw</i> | <i>lt stw/lt stw</i> |
- 5) (20%) Normal diploid somatic (body) cells of the mosquito, *Culex pipiens*, contain six chromosomes. Assign the symbols A^mA^p, B^mB^p, and C^mC^p to the three homologous chromosomal pairs. The "m" superscript indicates that the homologue is maternally derived, while the "p" indicates a paternally derived homologue. Assume that in the genus *Culex*, the sex chromosomes are morphologically identical.
- (a) For each of the cell types given below, draw and label (with reference to the symbols defined above) an expected chromosomal configuration.
- Mitotic Metaphas
 - Metaphase of Meiosis I
 - Metaphase of Meiosis II
- (b) The stage at which "sister chromatids go to opposite poles" immediately follows which of the above stages?
- (c) Assuming that all nuclear DNA is restricted to chromosomes and that the amount of nuclear DNA essentially doubles during the S phase of interphase, how much nuclear DNA would be present in each cell listed above? Note: assume that the G1 nucleus of a mosquito cell contains 3.0×10^{-12} grams of DNA.
- (d) Given that the sexes of *Culex* are determined by alleles of one gene, males heterozygous, *Mm*, and females homozygous *mm*, illustrate a labeled chromosomal configuration (involving the symbols A^mA^p, B^mB^p, and C^mC^p and the *M* locus) in a primary spermatocyte at metaphase. Assume that the *M* locus is on the A^mA^p chromosome and that crossing over has not occurred between the *M* locus and the centromere.
- 6) (15%) In *Drosophila*, a female fly is heterozygous for three mutations, *Bar* eyes (*B*), *miniature* wings (*m*), and *ebony* body (*e*). Note that *Bar* is a dominant mutation. The fly is crossed to a male with normal eyes, miniature wings, and ebony body. The results of the cross are shown below:
- | | |
|---------------------------|----------------------------|
| 111 wild, miniature, wild | 101 Bar, wild, ebony |
| 29 wild, wild, wild | 31 Bar, miniature, ebony |
| 117 Bar, wild, wild | 35 wild, wild, ebony |
| 26 Bar, miniature, wild | 115 wild, miniature, ebony |
- Please interpret the results of this cross. If you conclude that linkage is involved between any of the genes, determine the map distance(s) between.
- 7) (10%) The garden pea (*Pisum sativum*) has only seven chromosomes. It is quite often said that Mendel was very fortunate, since he studied seven genes that all do not locate in the same chromosome and he did not run into the complication of linkage during his experiments. What is your opinion regarding these statements.