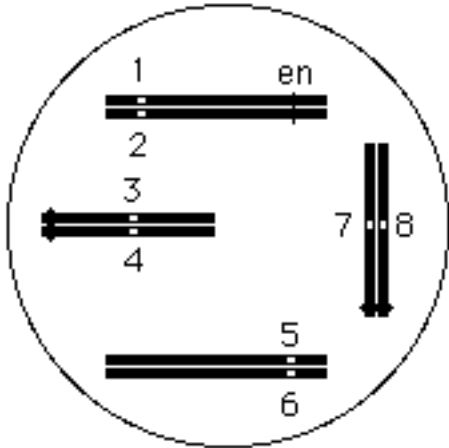


PRACTICE PROBLEMS 1

1. The diagram shows the nucleus of a diploid cell in G₂. In this organism, N = 2; chromosome 1 is metacentric with a knob near the end; and chromosome 2 is acrocentric with no knob. Numbers 1-8 refer to centromeres.



(a) A line and the letters *en* represent the location of two copies of the *en* gene; draw another line with *en* to indicate the location of the other two copies.

(b) Draw two arrows labelled **sc** pointing to any one pair of sister chromatids.

(c) Draw two arrows labelled **hc** pointing to any one pair of homologous chromosomes.

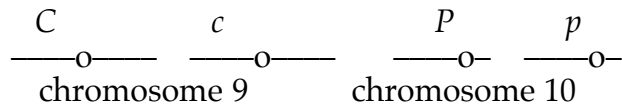
(d) Which centromere(s) will segregate from the following centromeres at mitosis?

1 ____ 2 ____ 3 ____ 4 ____

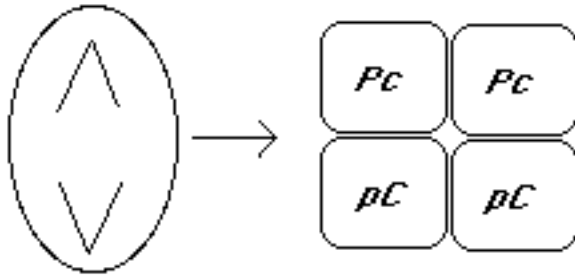
(e) Which centromere(s) will segregate from the following centromeres at meiosis I?

5 ____ 6 ____ 7 ____ 8 ____

2. The diagram below depicts a microspore mother cell of maize in anaphase of meiosis I, except that the chromosomes are missing. The maize plant is heterozygous at the *C* locus on chromosome 9 and the *P* locus on chromosome 10:



Draw the chromosomes, chromatids, and marker genes in the diagram below, attached to the chromosome fibers, assuming that this particular meiosis is going to produce four pollen grains with the indicated genotypes.



3. An organism that is heterozygous for one gene produces two different genotypes of gametes; if heterozygous for two genes, four different genotypes can be produced. How many different genotypes would you expect could be produced by an individual heterozygous for three genes? Four genes? Is there a general formula for n genes?

4. Recall that in peas, Y and y determine yellow and green peas, respectively, and T and t determine tall and short plants. A plant of genotype $YyTt$ is crossed to a short plant that developed from green seeds.

- (a) What is this kind of cross called? _____
- (b) Out of 100 progeny seeds, how many do you expect to be yellow?
- (c) Out of 100 progeny seeds, how many do you expect to be green and produce short plants?

5. Write the genotypes of all of the genetically different pure lines that can be obtained by inbreeding mice whose genotype is $a a B b C c$.

6. In guinea pigs, rough coat (R) is dominant over smooth coat (r). A rough coated guinea pig is bred to a smooth coated one, producing 8 rough and 7 smooth progeny. Write the genotypes of the parents, and the genotypes and ratios of the offspring:

Parents: _____ X _____

Offspring: _____

7. Recall that two independently-segregating genes in maize determine plant height (tall, T vs. short, t) and leaf posture (relaxed, R vs. upright, r). Two pure lines with phenotypes tall relaxed and short upright are crossed.

(a) Write the genotypes of the parents: _____ X _____

(b) Two F_1 individuals from this cross are themselves crossed to each other to produce an F_2 generation. Use probability theory to calculate the proportion of the F_2 individuals that will be tall and upright, and can produce both tall and short offspring if they are selfed.

(c) Suppose that you looked at only 16 progeny from the cross in (b). Set up the binomial theorem to calculate the probability that you would get exactly the expected proportion that you calculated in (b). (you don't have to do the actual arithmetic, just show the equation with the appropriate numbers in it).

8. A couple wants to have three children. The wife wants to have at least one girl, while the husband wants at least one boy. What is the probability that they will get their wish?

9. A naive geneticist has two *Drosophila*, male and female, both heterozygous for black body color b^+b (wild type is grey and dominant). He wants to get homozygous recessive flies to use in test crosses. He mates the two heterozygotes and throws away all but 8 eggs, claiming that he will get one female $b b$ and one male $b b$ from these eggs.

(a) What is the probability that he will get exactly this?

(b) What is the probability that he will be disappointed and fail to get at least one male $b b$ and at least one female $b b$?

10. Albinism in humans is due to a single recessive gene. A number of two-child families with normal parents are selected on the basis that they have produced *at least* one albino child. In what proportion of these families would you expect to find that the other child is also albino?

11. From a cross of peas of genotypes $R r \times r r$, two samples are taken of different sizes. In each case, the observed values differ from the expected by the same proportion ($7/3 = 70/30$). Calculate Chi-square values and the associated probabilities for each, and decide if you would accept or reject the hypothesis of ordinary Mendelian segregation. Note the effect of sample size!

(a) $N = 10$ Observed = 7 round, 3 wrinkled

(b) $N = 100$ Observed = 70 round, 30 wrinkled

12 What is the ratio of phenotypes and genotypes expected in the progeny of a cross between two organisms heterozygous for the same lethal gene?