BIO 184 - PAL Problem Set Lecture 10 (Brooker Chapter 6)
Linked Gene Transmission

Section A. Autosomal Gene Linkage

Any two genes that one selects within a genome (i.e. T=tall vs t=short; P=purple flowers vs p=white flowers) can either be found on different chromosomes or be found on the same chromosome (linkage). Explain why there is a difference in the transmission of these two genes for these two scenarios.

Which one of Mendel's laws does linked gene transmission violate? Explain.

If true breeding Tall Purple plants are crossed with short white plants for the parental generation, then will there be a difference in their offspring (F1 generation) for linked genes as compared to when they are found on different chromosomes?

How about if the F1 offspring were to be testcrossed (recall what a testcross means) to generate an F2 generation? Outline the crosses for linked genes as compared to when they are found on different chromosomes. As for the linked gene scenario, consider the genes to be <u>extremely</u> close together such that crossovers are not going to be observed. Describe what the essential differences are for the resulting offspring.

Which offspring are missing or lacking in the linked gene scenario from above?

If the linked genes are further away from each other, how would that change the ratios of the offspring?

If the linked genes were at the extreme opposite ends of the chromosome, then how would that change the ratios of the offspring?

Section B. Map Distance

How would you determine whether a gene is likely linked rather than found on a different chromosome? Hint: think of a method that would help you discern whether the data supports one of the scenarios.

When does recombination (crossing over) occur during meiosis? Can recombination occur during mitosis? Are these events considered mutations?

When the F1 testcross for linked genes outlined in section A was performed, then the resulting offspring are listed below. First, classify the 4 phenotypes as to whether they are Parental or Recombinant types. Then, determine the map distance between the gene for height (tall vs short) and flower color (purple vs white)?

Tall Purple= 52; Tall white= 22; short Purple= 18; short white=48

When examining *Drosophila* fruit flies, you come across the white eye (w) and miniature wing (m) recessive mutations which you know are linked on the same chromosome. You are interested in determining their map distance, but first you have to figure out how the true breeding parental cross was performed. You do know that the true breeding parents generated F1 dihybrids that were all wildtype (wt). The F1 offspring were then testcrossed and the following F2 ratios were observed (listed down below). First, classify the 4 phenotypes as to whether they are Parental or Recombinant types. Secondly, what are the phenotypes of the parents that were crossed to generate the F1 dihybrid? Hint: write out the genotypes for each so you can trace them back to the TRUE breeding parents that were used to generate the F1.

F1 wild type (heterozygous for both traits) x testcross

F2 offspring:
wt eyes, wt wings= 98
white eyes, wt wings= 322
wt eyes, miniature wings= 342
white eyes, miniature wings= 84

If you are given the distance between two genes on the same chromosome to be 30 map units, then what percentage of the offspring will not be recombinants (meaning parental types)?

Section C. Trihybrid Cross

In this scenario, three genes are found on the same *Drosophila* chromosome relatively close by. The mutant form of the gene in all cases is recessive (as compared to the wild type) and have the following phenotypes: white eyes (w), singed bristles (s), miniature wings (m), True breeding wild type flies were crossed with triple mutants (white eye, miniature wing, singed bristle) to generate triple hybrid F1 wild type flies. These F1 flies were then testcrossed and generated the F2 offspring data down below. Note that if the mutant phenotype is not listed when characterizing a type of fly, then it is considered wild type (e.g. white eye fly is wild type for both wings and bristles). **Classify** the different phenotypes into Parental (P), Single Crossover (SCO), and Double Crossover (DCO) types. **Which gene locus is in the middle?** Hint: convert the phenotypes into genotypes that came from the F1 (don't need to include the testcross allele since you know it is recessive; e.g. white eyes= w, s^+, m^+)

Trihybrid F1 x testcross

<u>F2 offspring:</u>
Wild type= 943

White eyes= 65

White eyes, singed bristles= 3

White eyes, miniature wings= 35

Miniature wings= 4

Miniature wings, singed bristles= 71

Singed bristles= 39

White eyes, singed bristles, miniature wings= 922

If the data from a trihybrid cross indicates that there was (positive) interference, then describe what is meant by this. Be sure to include how interference is calculated in your answer.