Week 8 Crossing over and Linkage Continued

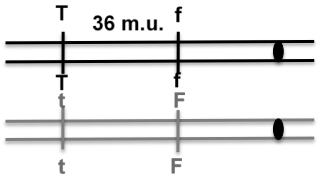
- € Attempt Part 1 before coming to tutorial and show it to your TA when you arrive in tutorial.
- € For extra practice try to answer the learning objectives.

Relevant Learning Objectives:

1. From analysis of data from a cross (phenotypes and/or genotypes) recognize crosses that must involve linked genes. Be able to justify your analysis by describing the information in the data that allows you to determine genes are linked.
2. Explain how crossing over (or recombination frequency) between two linked loci affects the genotype frequencies of the products of meiosis compared to loci that are unlinked (or very tightly linked).
3. Determine the allelic configuration of the individuals involved in the cross and explain how recombinant allele configurations were created from this arrangement.
4. Use numerical data from genetic crosses to calculate the map distance between linked genes.
5. Given the map distance between two linked loci create a potential data set, including the frequency of offspring genotypes and/or phenotypes, for a given cross
6. Use linkage information between multiple genes to construct a genetic map

Part 1 :

1. You are studying two genes that are linked. T>t, and T results in twitching behavior (t, no twitching). F>f and F results in freckles (f, no freckle). You know the T and F loci are 36 m.u. apart. You have a heterozygous female: Tf/tF, the chromosomes of this female, after DNA replication, are drawn below



a. A heterozygous female (Tf/tF) has homozygous parents. What were their genotypes? She mates with a homozygous recessive male. What is the probability they will have a female child that is twitchy and freckled?

b. If this heterozygous female Tf/tF mates with the same homozygous recessive male and they have a large number of children, what phenotypes should we see and in what proportions? Compare your answer to what you would see for independent assortment. Make two Punnett square tables, one for the real result due to linkage and one for if there was independent assortment.

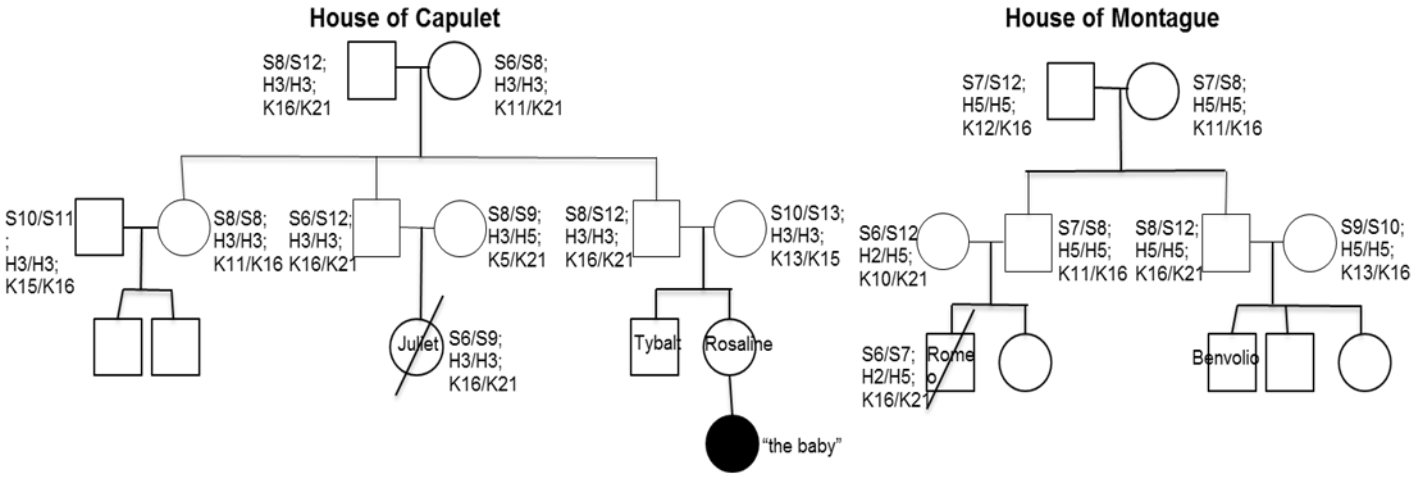
Linkage: Independent Assortment:

c. i. Which gametes in the tables above are **in the parental allele configuration**?

ii. Describe how gamete allele frequencies change in frequency from independent assortment to linkage.

iii. Why, for a testcross, can you describe some F2 phenotypes as "parental'?

2. The feuding families of the Capulets and the Montagues have made peace since the tragic deaths of their children Romeo and Juliet. However, their feud might begin again depending on who the father is of a new baby in the Capulet clan. The baby's mother Rosaline is Juliet Capulet's cousin and a former girlfriend of Romeo Montague. Although the families have made peace they still haven't actually accepted the idea of intermingling between families. The various alleles of the 3 microsatellites S, H and K have been identified for the older members of the Capulet and Montagues as well as dead Romeo and dead Juliet but the rest of the younger generation refuse a DNA test. They will allow a DNA test for Rosaline's baby. The number within each allele name indicates the number of repeats. Eg S8 = 8 repeats at the S locus. Examine the pedigree below.



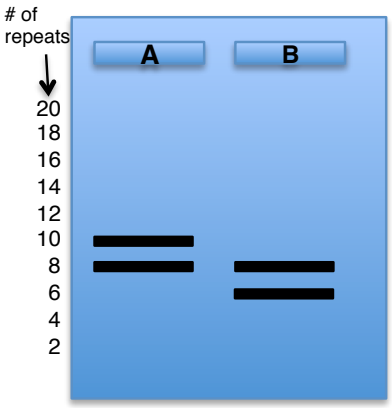
a) What information would allow you to determine if Romeo was the father of Rosaline's baby?

b) If Romeo was not the father, based on the data in this pedigree, which microsatellite marker: S, H or K could definitively be used to determine which of the two families the baby's father belongs to? Explain the reason for your choice.

i) S
ii) H
iii) K
iv) Impossible to determine

c) The S, H and K microsatellites are all dinucleotide repeats. You have two DNA samples, A and B. Explain which *marker* was tested on this gel?

i) S
ii) H
iii) K
v) Impossible to determine



d) Explain which individual or individuals could be identified by sample A?

i) III-1, III-2
ii) III-1, III-2, III-4(Tybalt)
iii) III-1, III-2, III-4 (Tybalt), III-5 (Rosaline)
iv) Everyone in Generation III except Juliet and Romeo
v) III-1, III-2, III-4 (Tybalt), III-5(Rosaline), III-8 (Benvolio), III-9, III-10

e) Which individual or individuals could be identified by sample B?

i) Juliet's Grandma
ii) Juliet
iii) Romeo's sister
iv) Juliet's Grandma and Romeo's sister
v) Juliet, her grandma and Romeo's sister

f) Could a baby of this genotype been born to Romeo and Juliet: S6/S6 ; H3/H5 ; K16/K16?