Week 4
Genetics: BIO-2306

The concepts this resource covers are the topics typically covered during this week of the semester. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout the semester.

We also invite you to look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

Keywords: Pedigree, Testcross, Linked Genes, Recombination, Gene Map

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Topic of the Week: ***Linked Genes and Recombination*** (7.1-7.2)

Linked Genes: genes which do not follow mendel's second law of inheritance (in that they do not segregate independently of one another) because the **cross over** together

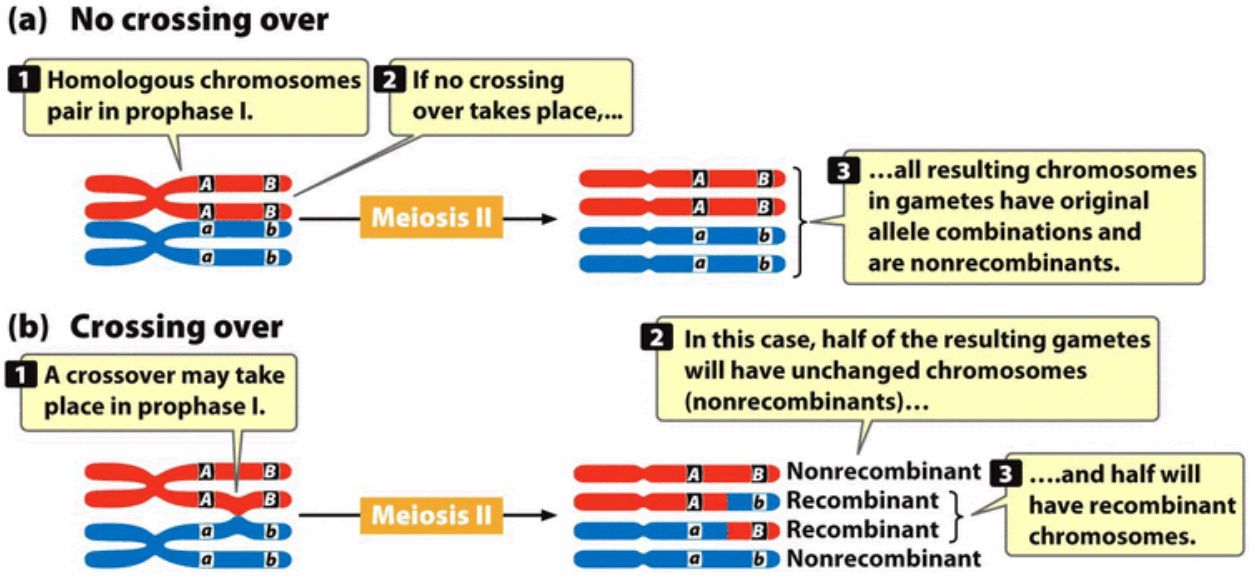
Genes at different Loci May follow one of may patterns

Completely Independent: genes at two loci always assort *independently*

*note: generally, these are genes on separate chromosomes

Incompletely Linked: genes at two loci that have a great deal of physical separation on the same chromosome; normally assort *independently*, but other times are linked

Completely Linked: genes at two loci on a single chromosome that will be linked at any crossover event



Crossing Over: exchange of material between adjacent arms on homologous chromosomes in **prophase I** of gamete formation

Recombination: the formation of novel allelic combinations not present in the parents

Recombination Frequency (f_R): $\frac{number\ of\ recombinant\ progeny}{total\ progeny}$ x 100%

$\boldsymbol{f_R}$ represents the likelihood that crossing over produces recombinant offspring at two *incompletely linked* loci

The **recombination frequency** between two *completely linked* loci would be 50% if a crossover event happened in every meiosis. This is because at a single crossover, *half* of the gametes will be **recombinant** and the *other half* will be **non-recombinant**.

Frequency of recombinant gametes: the likelihood of the creation of each gamete, which will be ½ the f_R

Simplification: frequency of recombinant gametes = ½ f_R

Testcross: an individual with hetero- or homozygoys dominat expression of a gene is crossed with an individual who is recessive at both loci

***Generally we use a double heterozygote crossed with a homozygous recessive**

What is the expected genotypic ratio of a AaBb x aabb cross?

1:1:1:1

If genes are **linked**, the number will deviate from this

Terminology:

Wild-Type: the allele most commonly seen in nature

Mutant-Type: a new allele created by natural or laboratory mechanisms which exists with a wild type allele at a locus (although many examples categorize these as recessive, they can be dominant or recessive, depending on the inheritance pattern of the *wild type* allele)

Gene Configuration: the conformation of homologous chromosomes with respect to where the how the dominant and recessive alleles are aligned at each locus

Coupling (*cis*): both dominat and both recessive alleles are present (at their respective locus) on each homolog $\frac{A\ \ B}{a\ \ b}$

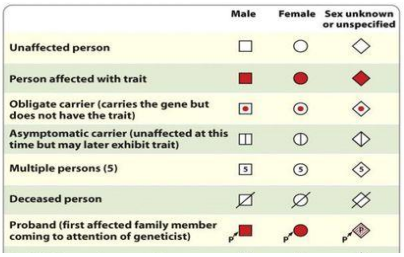
Repulsion (*trans*): 1 dominant and one recessive allele on each homolog $\frac{A\ \ b}{a\ \ B}$

*Yes, this is the same as the conformations of vinyl H-atoms in double bond stereochemistry!

Highlight #1: **Pedigree Analysis** (6.2)

https://www.youtube.com/watch?v=Gd09V2AkZv4

Symbols used in pedigrees:



Autosomal Recessive: Equal proportions in males and females; can **skip** generations/be 'hidden' by carriers (*note*: obligate carrier symbol will not always be shown in a pedigree)

Consanguinity: inbreeding/cross between cousins

Autosomal Dominant: Every affected individual must have an affected parent; **Won't** skip generations

X-Linked Recessive: Unequal proportion of males and females affected (more in males); may **skip** generations

Rule of Thumb:

When a daughter is affected, the father is affected

An affected son's mother has the trait, or is a carrier (heterozygote)

X-Linked Dominant: Every affected individual must have an affected parent; **Won't** skip generations

Rule of Thumb:

Every affected male's daughter has the trait

Sons: inherit from mom only

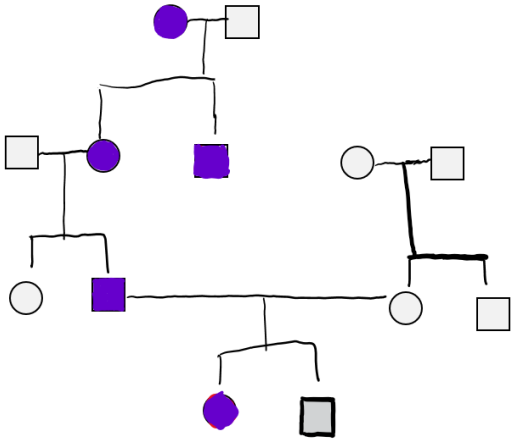
Daughters: inherit from mother or father

Y-Linked trait: Passed from father to son; doesn't skip generations (**males only**)

Note: see table 6.1 for more conditions for each of these general rules of thumb

CHECK YOUR LEARNING

Concept Check: *(Answers found on the last page)*



1. What pattern of inheritance is displayed by the pedigree?
2. **True/False** Two alleles, A^o and A^p have a recombination frequency of 43 so they are in separate linkage groups
3. Two loci, A(a) and B(b) are located near each other on a chromosome. A female in *cis* configuration is heterozygous at both loci and crosses with a recessive male. What is the recombination frequency of the following linked gene?

Genotype	Number
$\frac{A\ B}{a\ b}$	82
$\frac{a\ b}{a\ b}$	78
$\frac{A\ b}{a\ b}$	8
$\frac{a\ B}{a\ b}$	4

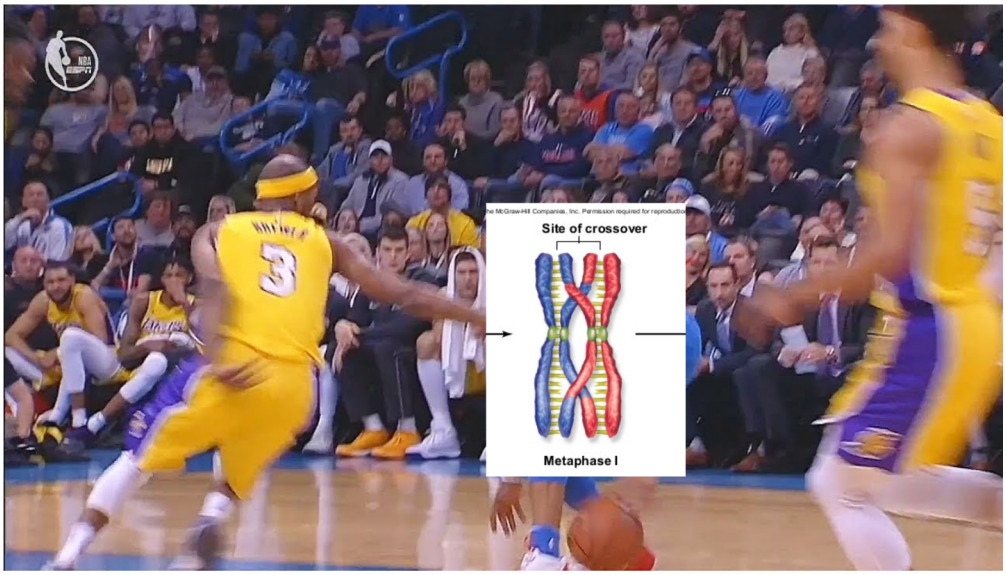
THINGS YOU MAY STRUGGLE WITH:

1. If you are stuck between multiple possible types of inheritance on a pedigree, try drawing out the crosses; sometimes, several inheritance patterns may *seem* identical, but they will have differences that can be visualized by a cross. When doing this, work from homozygous recessive individuals because you automatically know their genotype.
2. In a testcross evaluating recombination frequency, the recombinant progeny will be those which exist in the smallest numbers.
3. If the recombination frequency between two genes is ≥ 50, the two are treated as two separate *linkage groups*, or on separate chromosomes, because they **assort independently**.

You Try: Click the link to try these practice problems on google forms!

Formative Practice:

https://docs.google.com/forms/d/e/1FAIpQLSe7uszVJmMFnA4nSn_9eK7R7g7sNtuzOa24Br1irF7ENZN-eQ/viewform?usp=sf_link



CONGRATS: You made it to the end of the resource! Thanks for checking out these weekly resources! Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring!

Answers to check your learning questions are below!

Answers:

1. **X-Linked Dominant**
2. **False**
3. f_R **= 0.0698**