Hello everybody, happy test week! Study hard, and check out last week’s resource if you would like extra practice with topics/concepts or practice problems. This week marks the beginning of second unit material for all sections, so please take the opportunity to get ahead!

Remember: the Tutoring Center offers free individual and group tutoring for this Genetics. Our Group Tutoring sessions will be Thursdays from 5:15-6:15 PM at the Sid Rich basement, room 75! You can reserve a spot at https://baylor.edu/tutoring. I hope to see you there!

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

**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 **crossover** 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

*All diagrams, tables and figures are the property of Benjamin A. Pierce; Genetics: A Conceptual Approach. Additional sources are the property of The National Basketball Association, McGraw Hill Biology, and NBC Universal*
**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 \((f_R)\): \[
\frac{\text{number of recombinant progeny}}{\text{total progeny}} \times 100%
\]

\(f_R\) 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 \(1/2\) the \(f_R\).

**Simplification**: frequency of recombinant gametes = \(1/2 f_R\)

**Testcross**: an individual with hetero- or homozygous dominant 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 dominant and both recessive alleles are present (at their respective locus) on each homolog \( \frac{A}{a} \frac{B}{b} \)

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

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

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

[https://www.youtube.com/watch?v=Gd09V2AkZv4](https://www.youtube.com/watch?v=Gd09V2AkZv4)

**Symbols used in pedigrees:**

[Image: Diagram of pedigree symbols]

**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*
Week 4 Concept Check:

1. What pattern of inheritance is displayed by the pedigree?
2. True/False Two alleles, A\textsuperscript{o} and A\textsuperscript{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?

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{A}{\bar{A}} \frac{B}{\bar{B}} )</td>
<td>82</td>
</tr>
<tr>
<td>( \frac{a}{\bar{a}} \frac{b}{\bar{b}} )</td>
<td>78</td>
</tr>
<tr>
<td>( \frac{A}{\bar{A}} \frac{b}{\bar{b}} )</td>
<td>8</td>
</tr>
<tr>
<td>( \frac{a}{\bar{a}} \frac{B}{\bar{B}} )</td>
<td>4</td>
</tr>
</tbody>
</table>

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.

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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 $\geq 50$, 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 Week 3:**
[https://docs.google.com/forms/d/e/1FAIpQLSc7uszVJmMFnA4nSn_9eK7R7g7sNtuzOa24Br1irF7ENZN-eQ/viewform?usp=sf_link](https://docs.google.com/forms/d/e/1FAIpQLSc7uszVJmMFnA4nSn_9eK7R7g7sNtuzOa24Br1irF7ENZN-eQ/viewform?usp=sf_link)

Note: also includes **Chapter 8** questions since Dr. Fernandez-Luna’s class covers this week 4

**CONGRATS:** You made it to the end of the resource! Again, group tutoring will be every Thursday from 5:15-6:30 PM. You can reserve a spot at [https://baylor.edu/tutoring](https://baylor.edu/tutoring). I hope to see you there!

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**Answers:**
1. X-Linked Dominant
2. False
3. $f_r = 0.0698$

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