Week 10

BIO-1305 - Biology 1 – Campbell Textbook

Hello and welcome to the weekly resources for BIO-1305 - Biology 1 – Campbell Textbook!

This week is Week 10 of class, and typically in this week of the semester, your professors are covering the topics below. 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 at 254-710-4135).

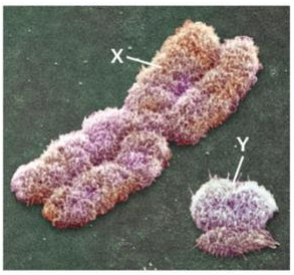
Keywords: Chromosomal Inheritance, Linked Genes, Abnormal Chromosomes

Topic of the Week: Chromosomal Basis of Inheritance

After Gregor Mendel presented his "gene idea," many other scientists began investigating his work further. A few scientists developed the **chromosome theory of inheritance**, which states that genes have loci on chromosomes, and the chromosomes separate and independently assort.

Sex-Linked Genes

The sex of a species is determined by the presence of **sex chromosomes**. There are two types of sex chromosomes: X and Y. The *X chromosome* is found in **females** while the *Y chromosome* is found in **males**. These chromosomes exist as a *homologous pair* and separate during meiosis. Therefore, after fertilization, the zygote has a 50% chance of having the X chromosome and a 50% chance of having the Y chromosome.



A **sex-linked gene** is a gene found on either the X or Y sex chromosome. If a gene is on the *X chromosome*, it is called an **X-linked gene**. Similarly, a gene found on the *Y chromosome* is a **Y-linked gene.**

Inheritance of X-Linked Genes

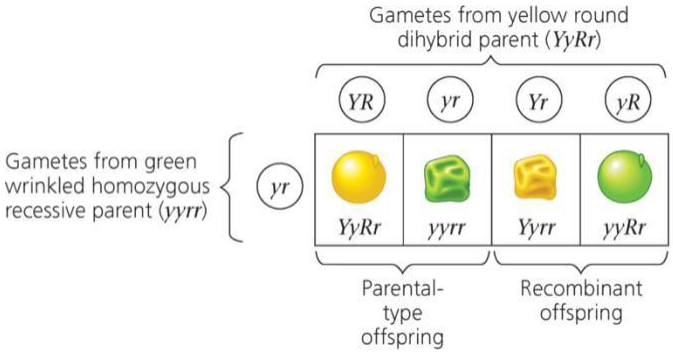
Genes found on the X chromosome exhibit interesting **inheritance patterns**. Here are some significant patterns:

- Fathers pass the trait to all daughters but no sons
- Mothers pass the trait to sins and daughters
- If the trait is recessive, a female will only express the trait if she is homozygous
- Heterozygous and homozygous are terms that do not apply to males since they only have 1 X chromosome

HIGHLIGHT #1: Linked Genes

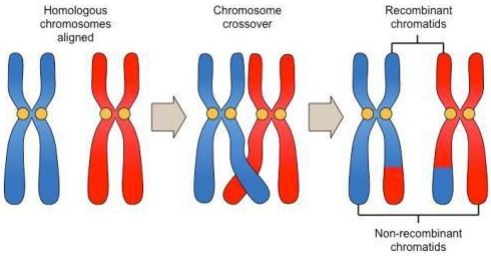
Two genes are "linked" when they are found close together on the same chromosome. Because of their close proximity, they are usually passed to individuals together.

Another concept that is important to understand is the idea of **genetic recombination**. Genetic recombination is how offspring tend to differ from their parents genetically. In the picture below, you can see how some of the offspring do not inherit the same phenotypes as their parents. These offspring are called the **recombinants**.

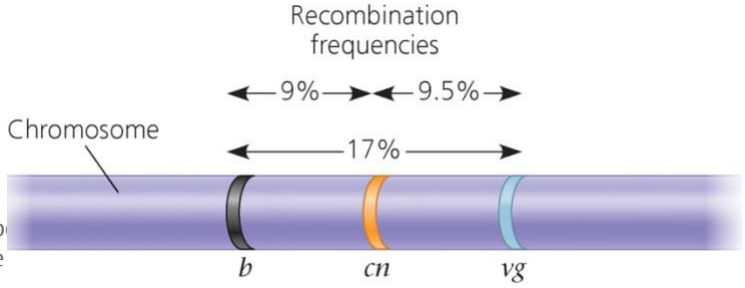


Another extremely important source of genetic variation is **crossing over.** This occurs during prophase in meiosis I. When the homologous chromosomes are paired, parts of the chromatids break and switch places.

Photo taken from https://ib.bioninja.com.au/standard-level/topic-3-genetics/33-meiosis/crossing-over.html:



When linked genes were discovered and more was known about recombination, **genetic maps** became a popular way to understand the location of particular genes of chromosomes. A **linkage map** is a type of genetic map that



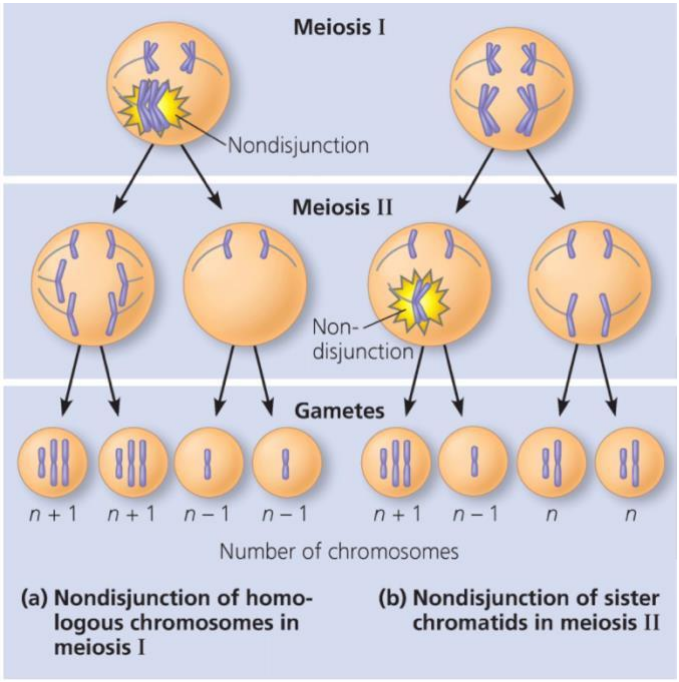
depends on recombination frequencies of certain alleles. The photo on the right is an example of a linkage map.

HIGHLIGHT #2: Errors in Chromosomes

Abnormal Chromosome Number

Sometimes, the spindle in meiosis makes an *error* and does not properly distribute the chromosomes between the daughter cells. This is called **nondisjunction** and can result in severe consequences. Here are some of the results of nondisjunction that are possible:

- Aneuploidy: abnormal number of chromosomes
  - Monosomic: missing chromosome
  - Trisomic: extra chromosome
- Polyploidy: abnormal number of sets of chromosomes
  - Triploidy: three sets
  - Tetraploidy: four sets



Alterations of Chromosome Structure

Sometimes, *damage* can occur to chromosomes. There are four types of damage that can occur:

- Deletion: part of the chromosome is lost
- Duplication: broken piece becomes attached to a separate chromosome
- Inversion: part of the chromosome breaks but reattaches in the opposite orientation
- Translocation: a broken fragment attaches to a nonhomologous chromosome

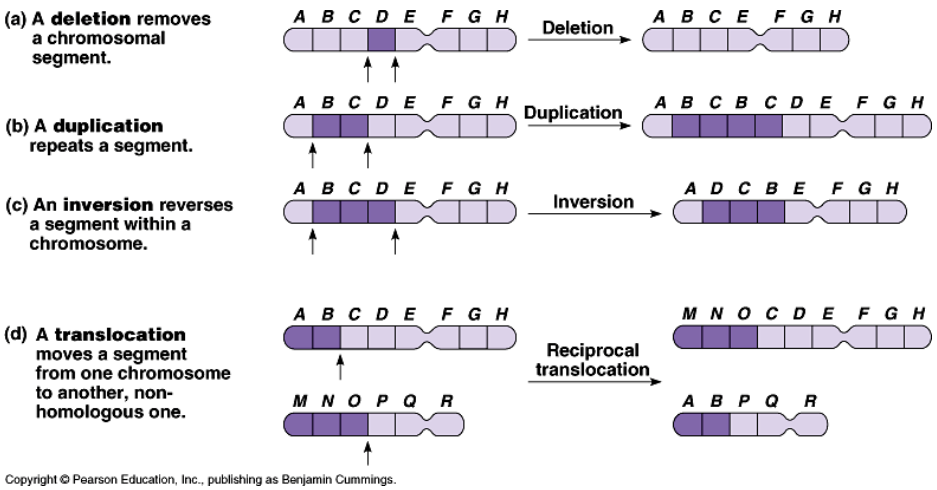


Photo taken from: https://freesciencenots.blogspot.com/2018/12/structural-alterations-in-chromosomes.html

HIGHLIGHT #3: Pedigrees, Genomic Imprinting, and Organelle Genes

Pedigrees

The genetics aspect of biology comes to life in something called a **pedigree**! A pedigree organizes information about *family genetic history* in order to show how certain traits or diseases are transmitted. The photo on the right shows how to read pedigrees and understand the symbols.

It is important to understand pedigrees because they provide a lot of insight to *how genetic diseases and disorders behave* within a family line.

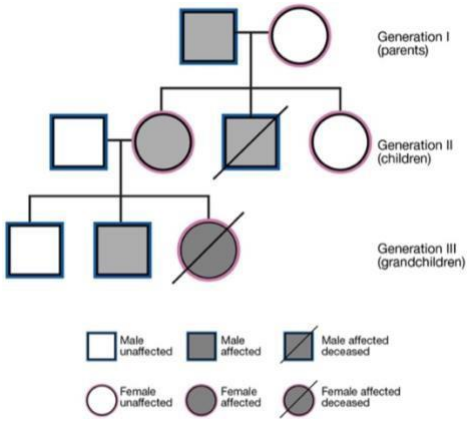


Photo taken from: https://www.genome.gov/genetics-glossary/Pedigree

Genomic Imprinting

There are few more important topics to hit in this genetics portion of bio 1. One of these is **genomic imprinting**. The idea behind genomic imprinting is that when an allele is transmitted to offspring, whether or not the offspring will express the trait *depends on if they received the allele from the mom or the dad.*

Inheritance of Organelle Genes

One last important topic must be taken into consideration before wrapping this chapter up! We have talked a lot about chromosomes and alleles passed through cell division, but what about the genes that are found in the *cytoplasm* or in *organelles* such as chloroplasts or mitochondria? How are these passed to the offspring? The simple answer is: through the cytoplasm of the egg! Because an egg is significantly larger than a sperm, most of the cytoplasm in the zygote comes from the egg, so most of the cytoplasmic genes in a zygote would resultingly be from the egg as well.

CHECK YOUR LEARNING

1. True or false: two X chromosomes pair with each other in a homologous pair.
2. In what phase does crossing over occur?

THINGS YOU MAY STRUGGLE WITH

1. Sex-linked genes are not called "linked" genes because they are close in proximity. The term "sex-linked genes" just refers to the fact that you can find them on the sex chromosomes.
2. A male cannot be heterozygous or homozygous for a gene that is found on the Y chromosome. This is because they also have one X chromosome!

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. False; one X and one Y chromosome pair together in a homologous pair.
2. Prophase I (of meiosis I)