BIO 1305 – Modern Concepts in Bioscience I – Campbell Textbook
Week 11 – Chapters 14 & 15

Hello everyone! Welcome back to another resource! I hope your semester is going well and that you are ready to push towards the end. Things can start picking up as the end of the semester approaches, but you can finish strong! Today we are going to finish up chapter 14 by looking at pedigrees. Then we are going to talk about chapter 15 which continues discussing genetics and inheritance. Don't forget that Gabriel and I hold weekly group tutoring sessions on Thursdays from 5-6 pm. Sign up to join us here: https://baylor.edu/tutoring. We would love to see you there!

Keywords for this week: Pedigrees, Sex-Linked Genes, Linked Genes, Chromosome Alterations

Remember to use the linked **videos** to help you review concepts as you read through the resource!

Chapter 14: Mendel and the Gene Idea

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.

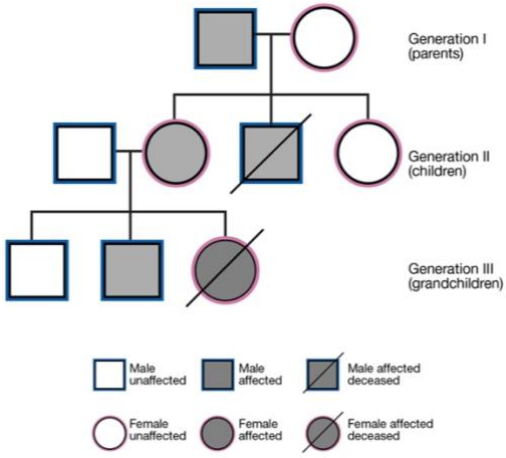


Photo taken from: https://www.genome.gov/genetics-glossary/Pedigree

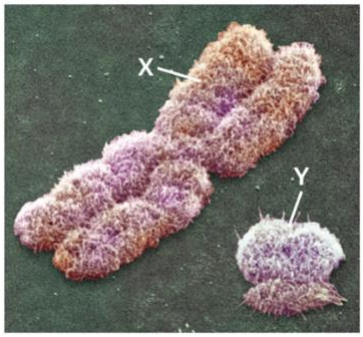
It is important to understand pedigrees because they provide a lot of insight to *how genetic diseases and disorders behave* within a family line.

Chapter 15: The 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.



Video: Chromosomal Basis of Sex

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:

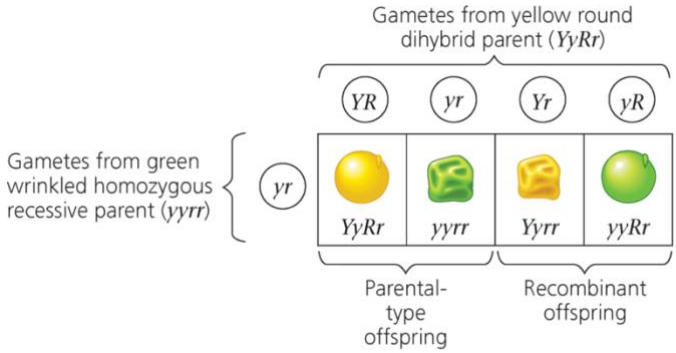
- Fathers pass the trait to all daughters but no sons
- Mothers pass the trait to sins and daughters
- If the trait is recessive, a female will only express the trait if she is homozygous
- Heterozygous and homozygous are terms that do not apply to males since they only have 1 X chromosome

Video: Inheritance of X-linked genes and X-inactivation

Linked Genes

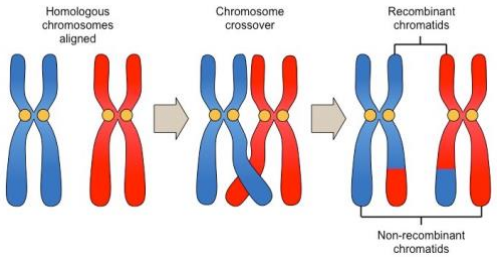
Two genes are "linked" when they are found close together on the same chromosome. Because of their close proximity, they are usually passed to individuals together.

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**.



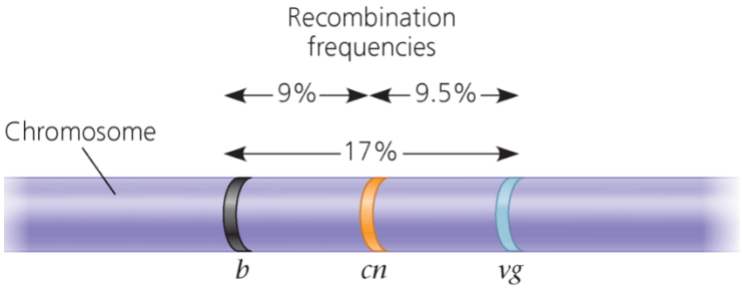
Another extremely important source of genetic variation is **crossing over.** This occurs during prophase in meiosis I. When the homologous chromosomes are paired, parts of the chromatids break and switch places.

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



Video: Genetic Recombination and Linkage

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.

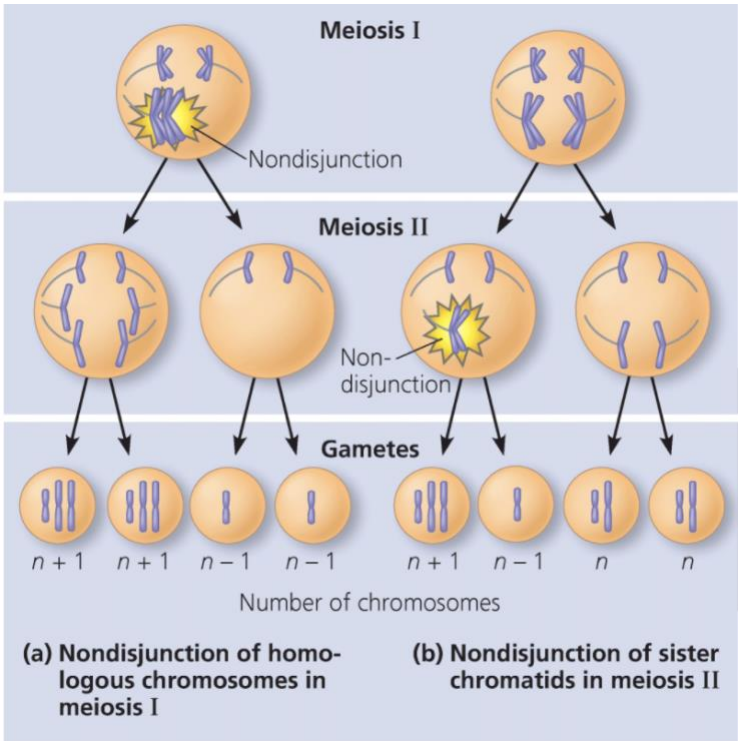


Video: Linkage Maps

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



Video: Abnormal Chromosome Numbers

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

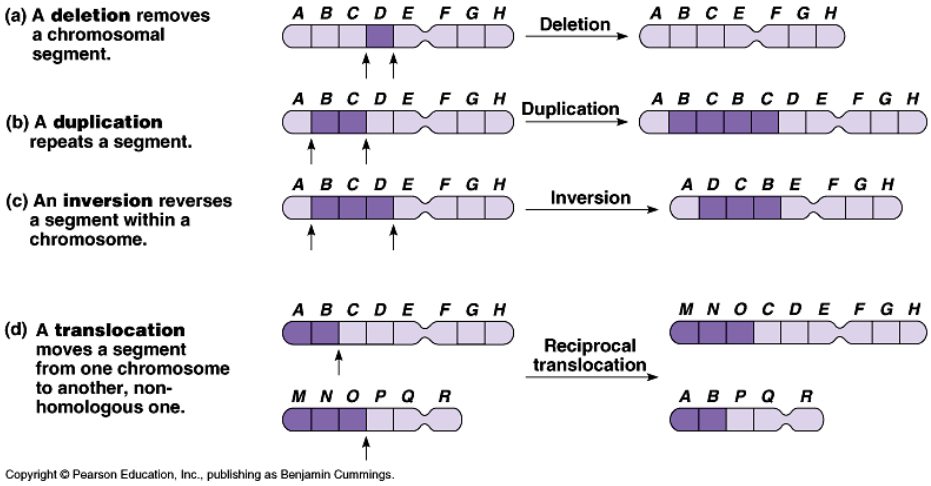


Photo taken from: https://freesciencenots.blogspot.com/2018/12/structural-alterations-in-chromosomes.html

Video: Alterations of Chromosome Structure

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.*

Video: Genomic Imprinting

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.

Video: Inheritance of Organelle Genes