

# Chapter 13: Modern Understandings of Inheritance

## Learning Objectives:

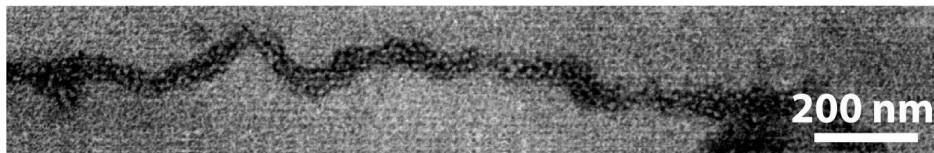
- Biology I – III 6: Explain how different types of mutations affect gene products and phenotype.

## In-Class Assignments

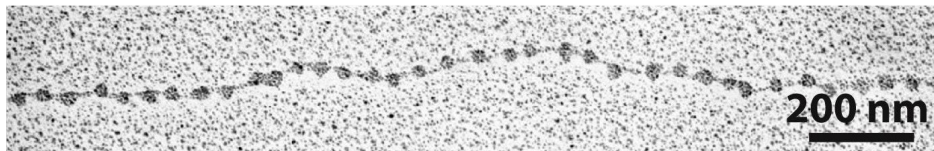
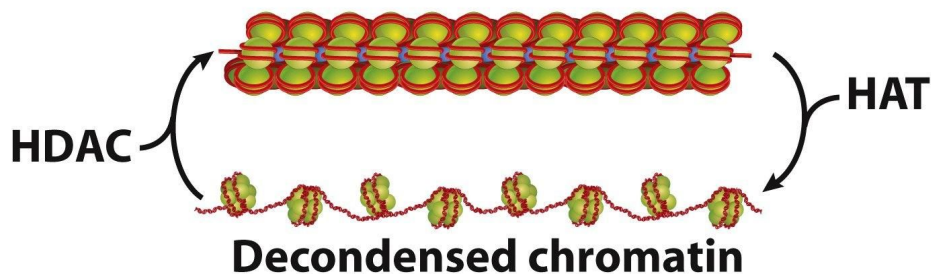
1. Complete the following tables and questions with your group.

**Chromatin:** DNA + proteins

- Supplies structure, protection, and helps regulate gene activity



**Condensed chromatin**



**Chromosome**



2 homologous  
chromosomes  
before replication.

1 Chromosome Before replication A single chromatid	1 Chromosome after replication 2 sister chromatids	2 Homologous Chromosome after replication 2 sister chromatids each
<p>The “C” words you need to know:</p> <p>Chromatin-</p> <p>Sister Chromatid-</p> <p>Chromosome (and Homologous chromosomes)-</p> <p>Centromere-</p> <p>Cleavage furrow-</p> <p>Cytokinesis-</p> <p>Cell plate-</p>		

## Mitosis

Complete the following table to describe the events of the cell cycle and mitosis using words in Column 2 and using pictures in Column 3.

Phase	Key Events to Know	Draw it!
<b>Interphase</b>	G1 =  S =  G2 =	
<b>Prophase</b>		
<b>Metaphase</b>		

<b>Anaphase</b>		
<b>Telophase</b>		
<b>Cytokinesis</b>		

## Meiosis

Complete the following table to describe the events of the cell cycle and meiosis using words in Column 2 and using pictures in Column 3.

<b>Phase</b>	<b>Key Events to Know</b>	<b>Draw it!</b>
<b>Interphase</b>	G1 =  S =  G2 =  u	
<b>Prophase I</b>		
<b>Metaphase I</b>		
<b>Anaphase I</b>		

<b>Telophase I &amp; cytokinesis</b>		
<b>Prophase II</b>		
<b>Metaphase II</b>		
<b>Anaphase II</b>		
<b>Telophase II</b>		

& Cytokinesis		
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## 2. Mitosis, Meiosis and Nondisjunction Classroom Activities

### Objective:

Chapter 13 covers nondisjunction. It is difficult to cover nondisjunction if the students have forgotten or not sufficiently learned how mitosis and meiosis work. Take the time to review both mitosis and meiosis before moving on to nondisjunction. This classroom activity will help students understand mitosis, meiosis and nondisjunction.

Using a set of chromosomes (made from pop-it beads), students will model mitosis, meiosis and nondisjunction. Kits can be purchased from a variety of places. Some examples:

<https://www.wardsci.com/store/product/8869852/ward-s-chromosome-simulation-lab-activity>

<https://www.carolina.com/dna-model-kits/carolina-biokits-chromosome-simulation-10-station/171100.pr>

### Materials Required:

Each group of students will be given the following materials in a small ziplock bag:

1 set of longer homologous chromosomes (10 beads total; 5 on each side of the magnetic centromere) – 2 red chromosomes and 2 yellow chromosomes

1 set of shorter homologous chromosomes (6 beads total: 3 on each side of the magnetic centromere) – 2 red chromosomes and 2 yellow chromosomes

Four pieces of string or yarn tied into a circle to represent the nuclear membrane ( a circle of paper may also be used)

### In Class:

Instructor should model how to use the bead kits by showing mitosis and meiosis. The groups can then work independently to model the processes and also work on modeling nondisjunction. The instructor should walk around and help as possible. If time

permits, the instructor can watch the groups perform one or more of the processes to ensure they understand the steps.

This activity can be done in conjunction with the **Mitosis and Meiosis Comparison worksheet** and the **Faulty Meiosis worksheet** (found with the Chapter 13 materials).

Video example of how kits can be used:

<https://www.youtube.com/watch?v=zGVBAHAsjJM>

### 3. Chromosomal abnormalities: When Meiosis Goes Wrong

1. When homologous chromosomes fail to separate in meiosis I or sister chromatids fail to separate in meiosis II, this is referred to as \_\_\_\_\_.

2. Match the following **genotypes** with their phenotype:

#### Genotypes

#### Phenotypes

a. XXX

Down's Syndrome

b. XO

Phenotypically Normal Female

c. Trisomy 21

Klinefelter's Syndrome

d. XXY

Turner Syndrome

3. **Case studies:** Imagine that you are a genetic counselor faced with the following scenarios.

**Case A** – A female patient reports that she has been unable to get pregnant despite trying to conceive for over a year. Her gynecologist has informed her that she has underdeveloped ovaries and as a result, she is sterile. She was referred to you for genetic counseling to determine if a chromosomal abnormality is to blame for her condition. You note that she is short in stature and has a neck that is broader at her shoulders than at the base of the head. What chromosomal abnormality are you likely to uncover?

**Case B-** A newlywed couple arrives at your office to discuss the risks of conceiving a child since the wife is 45 years old. What specific chromosomal abnormality are you likely to discuss during your meeting?

**Case C-** A male patient arrives with his wife in search of answers for their inability to conceive a child. As part of an infertility workup, all of the wife's tests came back normal, however the husband's sperm counts were zero. Upon an intake interview and examination, you note that besides having very little facial hair, the husband seems otherwise healthy and displays typical male characteristics. What chromosomal abnormality could explain this man's sterility and poor facial hair growth?

#### 4. Computer Simulations to study Chapter 13 concepts in-class or at-home

Students can complete these activities in-class (if they have smartphones, tablets or computers) or at home prior to attending class where the concepts will be presented.

In-class:

Karyotyping -

[http://www.biology.arizona.edu/human\\_bio/activities/karyotyping/karyotyping2.html](http://www.biology.arizona.edu/human_bio/activities/karyotyping/karyotyping2.html)

Recombination frequency and gene mapping –

<https://www.nature.com/scitable/topicpage/thomas-hunt-morgan-genetic-recombination-and-gene-496>

<https://www.khanacademy.org/science/biology/classical-genetics/chromosomal-basis-of-genetics/e/recombination-frequency-and-gene-mapping>