BIO 1305 – Modern Concepts in Bioscience I – Campbell Textbook
Week 9 – Chapters 12 & 13

Hi guys! I can't believe we are halfway through the semester! I hope you are enjoying your biology class. Today we are going to talk about chapter 12, which covers the cell cycle, and we are going to start talking about the genetics aspect of biology in chapter 13. 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!

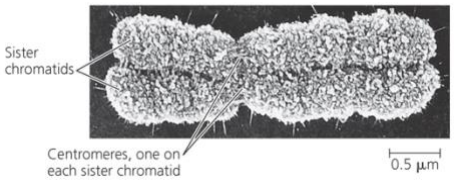
Keywords for this week: Cell Cycle, Binary Fission, Mitosis, Meiosis

As usual, I've linked **videos** to aid you as you read through the resource. After you read each section, watch the videos as review!

Chapter 12: The Cell Cycle

Cell division is vitally important and is the reason you are who you are! Before we talk about cell division, let's talk about some *cellular features* that will play a role in the cell's life cycle.

Each one of your cells contains a copy of your **genome**, which is all of your genetic information. Your genome is packaged into *chromosomes* which have to be copied before your cells can divide. Our ***somatic cells (body cells)*** specifically have 46 chromosomes, while our ***gametes (reproductive cells***) have 23 chromosomes.

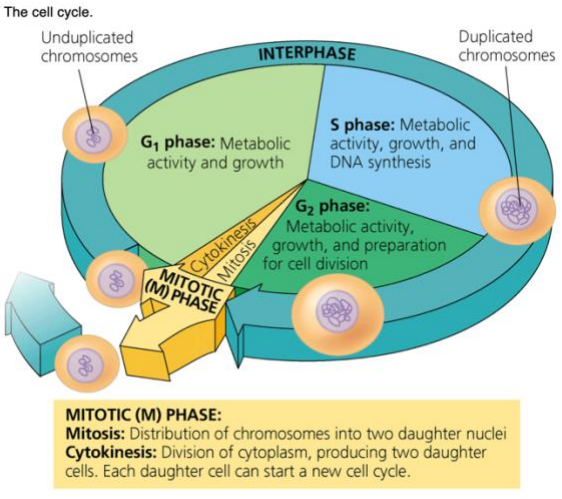


After chromosomes are copied before division, each chromosome will have two **sister chromatids** that are attached to each other. The picture on the right shows that the sister chromatids of a single chromosome are attached at their *centromeres*.

Video: Cellular Organization and Bacterial Cell Division

Now we can start laying the foundation of cell division. There are **two main phases** in a cell's division:

Mitosis: division on genetic material
Cytokinesis: division of cytoplasm



Stages of the Cell Cycle

Mitosis is part of the cell cycle, but it is actually the *shortest part* of the entire life cycle of a cell. When a cell is not dividing, it is in ***interphase***, a period of growth and development. Interphase consists of several distinct phases:

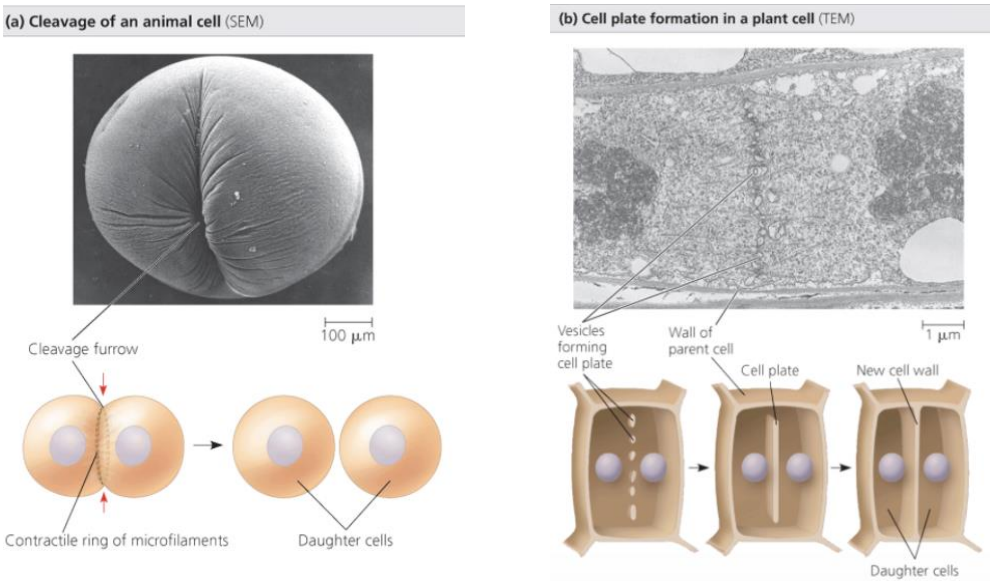
G1 – growth
S – "synthesis"
G2 – more growth

As you can see, mitosis makes up only a small part of a cell's life. However, it is extremely important and consists of many stages. Your book has a very detailed picture of these steps, but for now I just listed the **main points** for each stage:

Prophase—DNA condenses, mitotic spindle begins to form
Prometaphase—nuclear envelope breaks down, kinetochore forms
Metaphase—chromosomes line up at the center
Anaphase—sister chromatids pull apart
Telophase—nuclei reform, chromosomes relax
Cytokinesis—cytoplasm divides and two daughter cells are formed

Video: Phases of Mitosis

Looking closer at *cytokinesis*…
When a cell enters cytokinesis, a **cleavage furrow** forms and essentially "pinches" the cell into two. Specifically in plants, a cell **plate forms** and grows until it fuses with the cell membrane.



Binary Fission

Everything we just listed is specific to eukaryotic cells. Division in ***prokaryotic cells*** is different and is called **binary fission**. Here, the prokaryotic cell grows to twice its size before it splits in half.

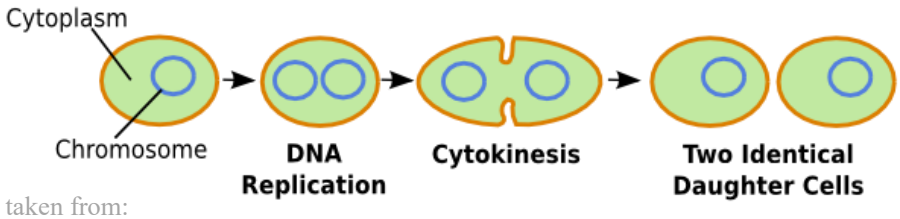
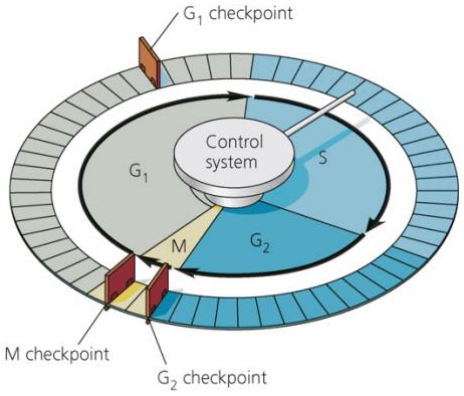


Image taken from:
https://study.com/academy/lesson/binary-fission-definition-steps-examples.html

Cell Cycle Control System



So how does a cell know what to do in the cell cycle? The life of a cell is directed by a ***control system*** in which specific molecules activate the cycle and push the cell through it. The control center consists of several **checkpoints** that decide whether or not a cell is prepared to divide.

The molecules that regulate this control system:

Protein kinases and cyclins

The *concentrations* of these molecules within the cell determines how the cell proceeds through the cycle.

Video: Cell Cycle Controls and Cancer

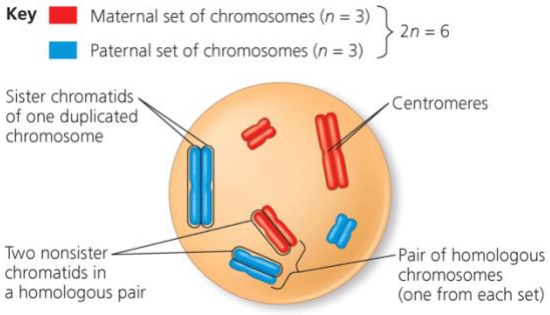
Chapter 13: Meiosis and Sexual Life Cycles

Now that we know the basics of cell division, we can start talking about **genetics**! Here are some basic terms to have down before moving forward:

Genes: hereditary units
Locus: a gene's location on the chromosome
Homologous chromosomes: a pair of chromosomes where one comes from mom and one comes from dad
Sex chromosomes: chromosomes that determine sex
Autosomes: all other chromosomes besides sex chromosomes

Video: Chromosomes and Sexual Life Cycles

Our body cells are ***diploid cells***, meaning they have *two sets* of chromosomes—one from our mother and one from our father. In other words, our cells that have 46 chromosomes have 23 from our mom and 23 from our dad. This is an important concept to understand before moving on in genetics.

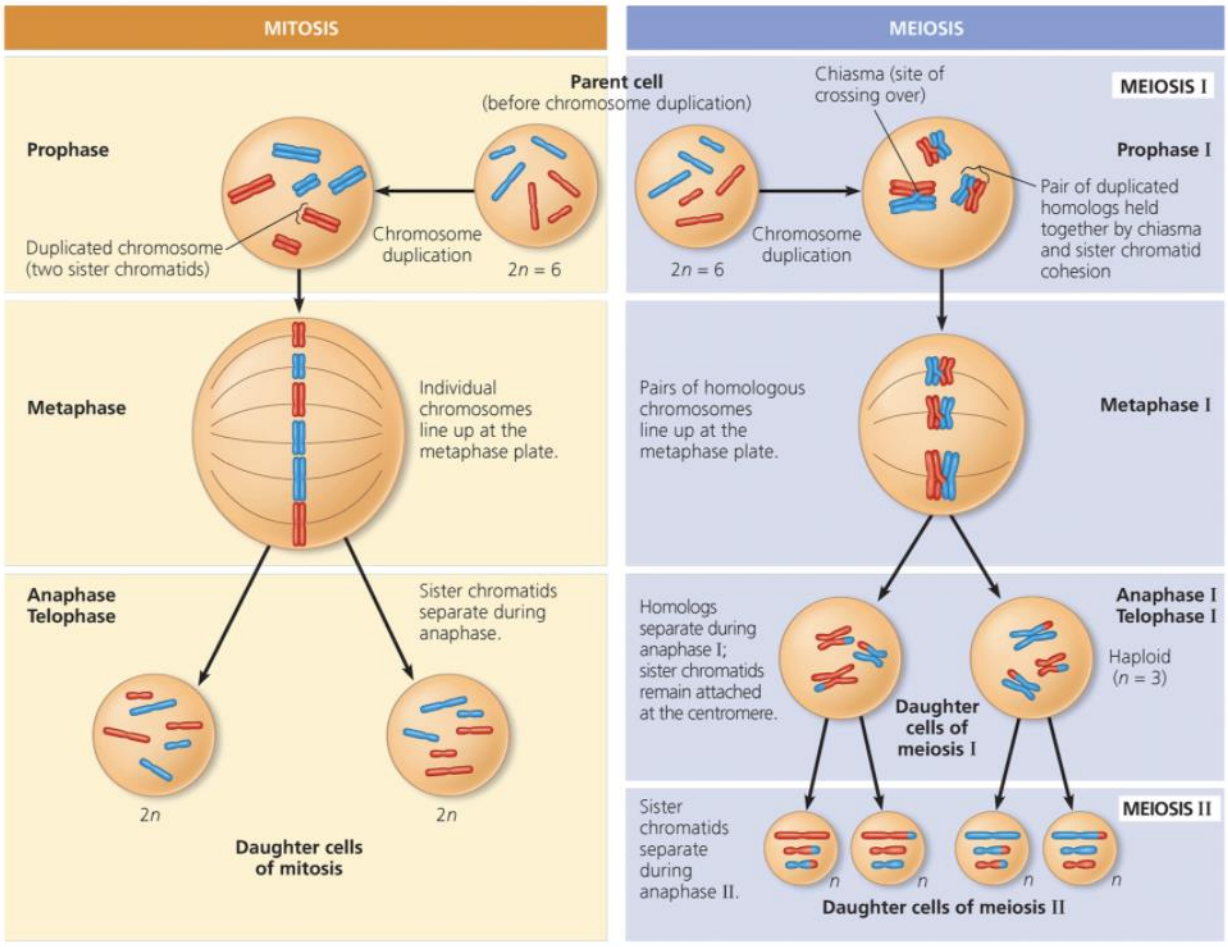


Haploid cells contain only *one set* of chromosomes. Gametes (egg and sperm cells) are haploid because when they meet at fertilization, their sets combine to make a diploid zygote. So, how do gametes come to have just one set of chromosomes? This happens through ***meiosis***! Meiosis is very similar to mitosis in several ways, but there are some key differences:

Meiosis consists of *two cell divisions*, meiosis I and meiosis II. Each of these divisions contains steps prophase, metaphase, anaphase, telophase, and cytokinesis. Notice that meiosis does not have a prometaphase. Your book also has a very detailed picture of each stage of meiosis that I highly recommend you look at.

Video: Stages of Meiosis

This helpful image shows the main differences between mitosis and meiosis:



Three things occur in meiosis I that make it unique from mitosis:

- Synapsis and crossing over
- Homologous pairs align at metaphase plate
- Homologs separate

Video: Mitosis vs Meiosis

One last key thing to note about meiosis is the way that it generates *genetic variation*. There is a concept that is extremely important to understand if you plan to take a genetics class later on:

- ***Independent assortment of chromosomes*** – during meiosis I, homologous chromosomes line up at the metaphase plate. Homologs arrange themselves randomly! In the image above, notice in metaphase I that the red and blue pairs of chromosomes do not all link up on the same side. This generates *variation* in the chromosome composition of the daughter cells at the end of the process.

Video: Origins of Genetic Variation among Offspring