Study Guide - Cell Reproduction (Introduction and Mitosis)

Reproduction and Growth

In our first lesson we talked about one of the characteristics of living things being their ability to reproduce or make copies of themselves. The two ways that organisms reproduce are by **asexual reproduction** and **sexual reproduction**. We also talked about and how it becomes necessary for organisms to take the energy they bring in and increase in size. In this lesson we will talk about how organisms reproduce asexually and how they can divide cells in order to grow. In our next lesson we will talk about sexual reproduction.

Prokaryotic Reproduction

The prokaryotes reproduce by way of **binary fission** (also called **prokaryotic fission**). This occurs in bacterial cells and is a type of **asexual reproduction**. In binary fission (remember that the word fission means breaking in two),within the **parent cell**, the single circular DNA duplicates itself (we will talk more of that in a couple of lessons) thus giving the cell two copies of the DNA which are identical. The circular DNA attaches to the cell membrane and fission begins. The fission is a simple **division** of the **cytoplasm** and a formation of a new cell wall or membrane. The result is two **daughter cells** that have generally the same characteristics (they are identical) to the parent cell.

Eukaryotic Reproduction and Growth

In the eukaryotic organisms reproduction takes place in two ways, asexually and sexually. We will devote an entire lesson to the sexual reproduction and **meiosis**, so here we will address the asexual reproduction or **mitosis** and **cytoplasmic division** (as it is sometimes called). When we talk about asexual reproduction with eukaryotic organisms we are generally referring to the single-celled organisms. The interesting thing about the process is that it is the same process that multi-celled organisms use for growth. For instance, the fact that you are bigger now than when you were born is due to mitosis and cell division. Lets take your skin as an example. The skin on your body now is not the same size it was when you were born, nor are there the same number of skin cells on your body as when you were born. In this lesson we are going to see what process your skin goes through to grow - so you dont burst out of your skin. The types of cells that use mitosis to grow or repair damaged cells are called **somatic cells.**

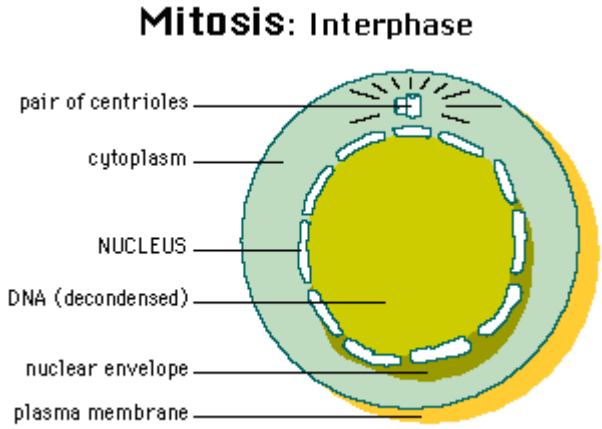
Before we get into the actual life cell cycle, we need to talk about the contents of the nucleus of the cell. The nucleus contains what we will call the hereditary material (the material that is passed from the parent cell to the daughter cells). This material is made of DNA. Remember we talked of DNA as being the molecule that directs the activities of the cell. In the nucleus it is found in long strands and while the cell is not in a reproductive or dividing state, this DNA is unbound (meaning it move is un-wound and is directing the affairs of the cell) and is referred to

as **chromatin**. Chromatin is actually DNA and an associated protein called **histone**. The DNA is wound around the **histone** and forms what we call **nucleosomes**. Throughout the **cell cycle** we will see what happens to this DNA.

Cell Cycle

There are many stages to the cell cycle, and we will cover each one individually. They can basically be divided into two phases: **interphase** and **mitosis**. Each of these is further divided for the convenience of finding out what goes on in detail.

Interphase



The cell spends most of its time in **interphase**. Interphase is when the cell performs its many functions (like the skin cells from our example) and grows in size. Interphase receives its name from being the phase between one mitosis and the next one. Interphase is further divided into 3 stages: **G1**, **S**, and **G2**.

G1 Phase

The **G1 Phase** is the period directly following **mitosis**. The DNA is found in the cell in the form of **chromosomes**. Chromosomes are the bound form of DNA. Each chromosome (in human cells there are 46 chromosomes - except the sex cells) consists of a single molecule of DNA and its protein. During this phase the chromosome unwinds itself to begin its job of directing the production of proteins and enzymes necessary for the cell to function, and it carries out the functions. Like the contractions of muscle cells, the saliva of digestive cells and enzymes, and the transport of molecules across membranes like weve seen in previous lessons.

S Phase

In the **S phase** the DNA replicates (or makes a copy of itself) in the nucleus of the cell. These are exact copies and so by the end of the S phase there are two copies of DNA for all the

chromosomes present in the G1 phase.

G2 Phase

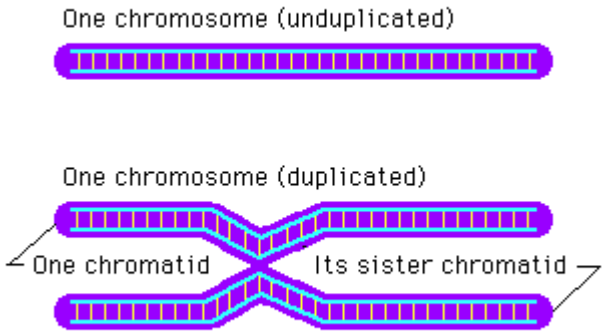
The **G2 phase** is when the cell prepares for **mitosis**. The proteins are organized into fibers called spindles.

Mitosis

Mitosis receives its name from the ”threads“ that form with in the cell during division. The word mitosis literally means **thread movement**. Lets see what these threads are as we look at the different stages of mitosis: **prophase, metaphase, anaphase, telophase**, and the **division of the cytoplasm**.

Prophase

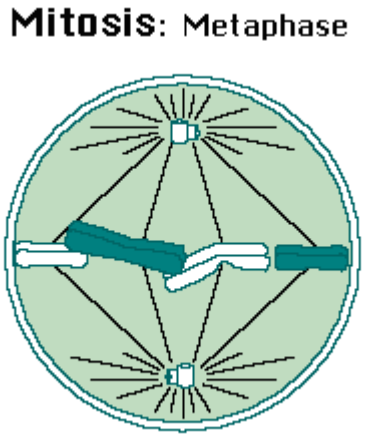
In **prophase** we see the **chromosomes** come together to form threadlike structures. Remember that there are two copies of each chromosomes and each copy is called a **chromatid**. The two chromatids are joined together at a region called the **centromere**. The pair of chromatids is



often referred to as **sister chromatids**. As we

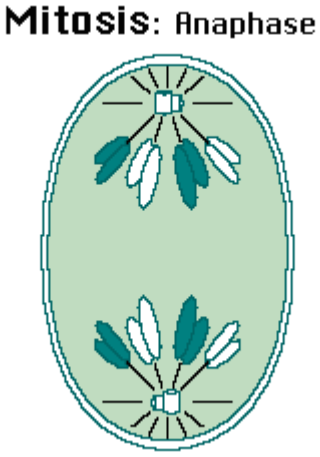
get further along in prophase the chromatids become more and more visible as pairs. Other changes also occur. **Spindle fibers** form, the **nucleolus** disappears, and the **nuclear envelope** dissolves. For animal cells, the **centrioles** begin to migrate to the opposite sides of the cell. Once they reach there they produce asters. (Centrioles are not present in most plant cells). Near the end of prophase the chromatids are attached to the spindle fibers at the centromere.

Metaphase



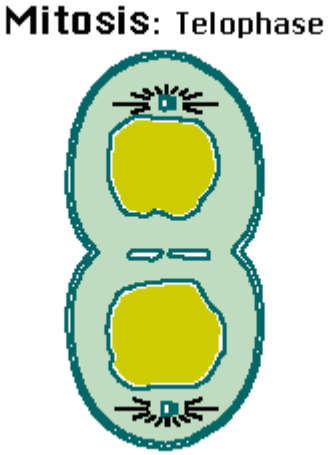
In **metaphase** the **sister chromatids** line up along the **equatorial plate**. They are lined up because they are being pulled on equally by the **spindle fibers** that are attached to them and the **poles** of the cell.

Anaphase



In anaphase the **centromere** breaks and the individual **chromatids** now begin to move to opposite ends of the cell. Once the chromatids separate, they are no longer referred to as chromatids, but are **chromosomes**. The result of anaphase is an equal separation and distribution of chromosomes.

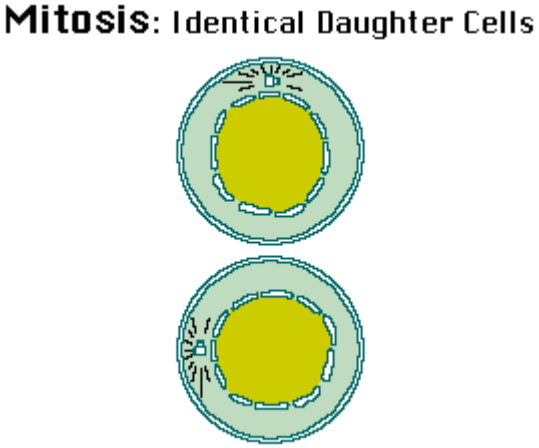
Telophase



In **telophase** the chromosomes finally arrive at the opposite ends of the cell (the **poles**). What occurs now is virtually the opposite of what took place in **prophase**. The chromosomes unwind (decondense), new patches of membrane form, the nuclear envelope begins to appear, and in many cases cytoplasmic division occurs.

Cytoplasmic Division

In **cytoplasmic division** the cytoplasm divides and the two cells separate. In animal cells a furrow begins to form and the plasma membrane begins to pinch the cytoplasm into two separate cells. This is the process of **cell cleavage**. In plant cells, the cytoplasm divides and the formation of a cell wall beings. And the result in both plant and animal cells is two new **daughter cells**.



Mitosis serves many functions - as we have already mentioned, it allows single-celled organisms the opportunity to reproduce, and it permits multicellular organisms like you and me to grow.

Things that control cell division

There are a variety of things that control cell division in organisms. Among them are the **absence of essential nutrients** (if you dont eat you dont grow), **presence of poisons** (this would inhibit growth), the **presence of growth factors** (like enzymes and molecules that stimulate growth), and **cell density** (if things are packed to tightly, it wont grow).