Cell Cycle

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The cell cycle is a series of events in which a cell grows, prepares for division, and divides to form two daughter cells.

Some cells divide constantly. Epithelial cells are a good example of this, such as skin cells, GI tract cells from the mouth all the way to the anus, and the respiratory tract cells of the nasal passages and the bronchi. The rapid cell division in these kinds of tissues helps us understand why most cancers are from epithelial cells.

Some cells divide rarely. Certain connective tissue types are good examples of this, such as the chondrocytes that form cartilage, and the fibroblasts that form tendons and ligaments. This slow cell division helps us understand why damaged joint tissues take a very long time to heal.

Some cells don't divide at all once they have initially formed. Examples of this are neurons and muscle cells. These tissues are highly organized such that to divide a neuron would destroy its ability to communicate, and to divide a muscle fiber would inhibit its coordinated contraction with neighboring muscle cells. Cells that don't divide are said to be in a stage called G0, meaning they have exited the cell cycle. So the cell cycle steps we'll now look at do not include these non-dividing cell types.

We'll use this circle to represent the activities that occur during the cell cycle. The first portion is called G1. The G sometimes is said to stand for "Growth" and sometimes I see it described as "Gap". Either way, G1 of interphase is a time of rapid growth in size of the cell, as it accumulates lots of enzymes necessary for the upcoming division, and duplicates organelles and most everything EXCEPT the DNA.

A checkpoint occurs here, double-checking that the cell is healthy and prepared to divide. Mutations in the DNA or other serious cell problems would block the cell from going further in the cell cycle, and probably trigger apoptosis, which is an organized form of cell death that prevents potentially cancerous cells from dividing.

Cells that pass the checkpoint now enter S phase, which stands for synthesis of interphase. Now, all the DNA of the cell is replicated. For humans, this will be 46 linear strands of DNA that are duplicated. Another checkpoint ensures that cells that made too many mistakes during synthesis do not get to proceed to divide. Amazingly, our cells have multiple "Editing" enzymes that can correct many kinds of errors. The last part of interphase is G2 of interphase, and it is when the cell finalizes preparation for division, making sure everything is ready!

A 3rd checkpoint confirms the cell is healthy and ready to divide.

Finally, the cell enters mitosis, which is divided into 4 phases with the acronym PMAT. Prophase is when the newly duplicated DNA condenses into tightly packaged chromosomes. Metaphase is when these chromosomes line up in the center of the cell, after which a final checkpoint confirms that the chromosomes are lined up nice and straight, and properly attached to spindle fibers. Anaphase is when the spindle fibers pull ½ of the chromosomes to either side of the cell, and telophase is when the chromosomes begin to uncoil a bit and get surrounded by new nuclear membranes. The cell visibly begins to pinch down and begins to separate

into two cells; however, the actual final part of mitosis is called cytokinesis of mitosis, during which the cell entirely pinches apart, forming two identical daughter cells.

Although there are many names and subphases in the cell cycle, start by always remembering that it really only has two parts - interphase, which includes G1, S, and G2; and mitosis, which includes PMAT and cytokinesis.