The Cell Cycle
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All cells come from pre-existing cells. Cell division creates two new cells, and the cell that divides ceases to exist. Cell division serves three major functions:

- Unicellular organisms reproduce via cell division.
- Multicellular organisms use cell division for growth and development.
- Multicellular organisms use cell division for tissue renewal, replacing dead or destroyed cells and cells that are lost from the organism.

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In a eukaryotic cell, DNA is complexed with histone proteins, forming a mixture called chromatin. When a cell nears the time of cell division, the chromatin condenses into more compact strands that become visible microscopically. These strands continue to condense into a species-dependent number of much more compact structures called chromosomes.

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By the time chromosomes appear, the DNA has already been replicated in the cell, producing enough DNA for two cells. A replicated chromosome consists of two genetically identical halves, called sister chromatids, that are connected to each other at a region called the centromere. Later, the sister chromatids will separate and be placed in separate daughter cells that are created when the original cell divides. After separation, they are no longer chromatids, but rather chromosomes, though they are then non-replicated, because each is just one copy of DNA (enough for one daughter cell).

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The cell cycle includes all events from the time of creation of a cell (when the previous cell divided) to the time at which that cell itself divides. The cell cycle includes two primary subdivisions: interphase and the mitotic (M) phase. Interphase includes three secondary subdivisions: G_1, S, and G_2. The mitotic phase includes two secondary subdivisions: mitosis and cytokinesis. G_1 includes all the normal activities of that specific type of cell. During the S phase, the DNA is replicated. G_2 includes activities in preparation for cell division. The mitotic phase is the phase of cell division. Mitosis is division of the nuclear contents (the replicated chromosomes); cytokinesis is division of the cytoplasmic contents, and it ends in the complete separation of the daughter cells.

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In G_2, chromatin is not yet condensed, so no chromosomes appear in the nucleus. Mitosis includes five phases:

- Prophase - The two centrosomes begin to move toward opposite poles within the cell. They are pushed apart by interaction between non-kinetochore microtubules that grow from each centrosome. The combination of the two centrosomes and the microtubules is called the mitotic spindle. The nuclear envelope is still intact. Within the nucleus, the chromatin is condensing into chromosomes.
- Prometaphase - The centrosomes have now finished moving to opposite poles. The chromosomes continue to condense. The nuclear envelope has disintegrated, allowing kinetochore microtubules (growing from the centrosomes) to connect to the kinetochores found on either side of the centromere of each replicated chromosome.
- Metaphase - The replicated chromosomes move along the mitotic spindle's microtubules until all chromosomes are in the metaphase plate, a plane that is midway between the two centrosomes. The replicated chromosomes are now maximally condensed.
- Anaphase - Each replicated chromosome splits, and its two sister chromatids separate, becoming non-replicated chromosomes that move in opposite directions. Each non-replicated chromosome moves along the spindle to one of the two poles, so that each of the two cells that will be created will receive one of the two copies of the DNA.
- Telophase - The non-replicated chromosomes reach the poles. A new nuclear envelope forms around each pole's set of chromosomes, forming two nuclei. The chromosomes in each nucleus begin to uncoil, so their genes can begin to be transcribed.

Cytokinesis begins before telophase ends. Cytokinesis ends in the full separation of the two daughter cells. The original cell no longer exists.

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Each centromere of a replicated chromosome features two kinetochores that are situated on opposite sides of the centromere. Each kinetochore corresponds to its own sister chromatid. The kinetochores are the points of connection between the chromosomes and the mitotic spindle, via the kinetochore microtubules.

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Experimental evidence indicates that non-replicated chromosomes during anaphase reach the poles (centrosomes) by using motor proteins (contained in the kinetochores) to "walk" along kinetochore microtubules. The kinetochore microtubules are disintegrated into their constituent proteins after the chromosomes pass, because the "road" behind them is no longer needed.

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Cytokinesis proceeds differently in animal cells compared to plant cells, because animal cells do not feature a cell wall. In animal cells, cytokinesis involves a cinching off of the plasma membrane at the site of the metaphase plate, much like the tightening of a drawstring. This occurs because of increased overlap of microfilaments associated with the interior of the membrane. As the cinching continues, a cleavage furrow develops and gets deeper. At the end of cytokinesis, the original cell is completely divided into two daughter cells. In plant cells, no cleavage furrow is able to form, because the rigidity of the cell wall prevent its formation. Instead, vesicles containing cell-wall material form at the metaphase plate. The vesicles enlarge and eventually coalesce into a cell plate. When the cell plate reaches the plasma membrane, it becomes a new cell wall situated between two separated daughter cells.

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Many prokaryotes divide by binary fission, which includes a preliminary replication of the cell's DNA, followed by a splitting of the cell.

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Mitosis occurs differently in different groups of eukaryotes, but mitosis always involves a division of replicated chromosomes in the nucleus.

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Experimental evidence indicates that control of the cell cycle occurs via chemical signals. A G_1-phase cell that is fused with an M-phase cell will be induced into immediately entering the M phase because of chemical signals in the cell already in the M phase.

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The cell cycle's control system includes sets of chemical conditions known as checkpoints. Under the correct conditions, a checkpoint is able to be crossed, and the cell proceeds to the next phase of the cell cycle.

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Some cells never cross the G_1 checkpoint, and they therefore never go on to divide. These cells enter what is known as G_0.

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Experimental evidence indicates that growth factors act as chemical signals that induce isolated cells to multiply by undergoing cell division. Without those signals, the cells do not divide.

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Animal cells exhibit anchorage dependence and density-dependent inhibition. Anchorage dependence refers to the need for these cells to be attached to a surface for them to be signaled into dividing. Density-dependent inhibition refers to the fact that these cells are signaled into dividing only so long as surface is available to be filled by cells, after which the cells stop dividing. Cancer is some malfunction of the cell cycle's control system. A cancerous cell will not be signaled into stopping cell division, so cancerous cells continue to multiply and form a tumor.

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It's possible for some cells from a tumor to separate from the tumor and move to other places in the body, forming new tumors at these destinations. This is called metastasis.