Cell Cycle & Mitosis

The Circle of Life
Why are cells so small?

- Why don't we have cells that are like The Blob?
- Why aren't we one BIG cell?
- Why not gigantic two story cells?
Why are cells SO small?

- 1st-cells depend on relatively slow processes to transport important materials like O2 and glucose (remember diffusion and facilitated diffusion?). If they are tooooooo big, they will NEVER get the materials they need in time.

- OH NO! NO O2!!!!!!
Why are cells *so* small?

- As a cell grows the **surface area to volume ratio decreases**, so there is far less cell membrane (outside) to cell inside.
- For example, a 1 cm per side cell has a surface area to volume ratio of 6 to 1 while a 10 cm per side cell 6 to 10.
- As a cell size **INCREASES** in size the surface area to volume ratio **DECREASES**.
Why are cells SO small?

1. 2nd -cells are totally at the mercy of the workings of DNA and the processes it codes for.
2. DNA codes for the RNA and proteins that determine what happens in the cell, too big, and the DNA cannot keep up → DNA overload.
Why are cells SO small?

- Split (divide) or DIE!
Cell Cycle

- Prokaryotic cells (AKA bacteria) usually divide by a process called **binary fission**
- Two identical cells are produced, this is a form of asexual reproduction
Cell Cycle—the forms of DNA

• **Chromosome**—made up of DNA tightly coiled many times around proteins called histones *(46 in human body cells)*

• **Chromatin**—DNA when chromosomes are not visible, *working DNA*

• **Chromatid**—when DNA is doubled, X shaped, each side is a sister chromatid

• **Centromere**—region to which the spindle fibers attach to the chromosome during mitosis or meiosis
Cell Cycle-the forms of DNA
Cell Cycle

- BEFORE dividing cells must both grow and replicate (copy) their DNA
- Interphase is when cells do their job as cells, grow and when DNA is replicated
- The three parts or phases of INTERPHASE are G1, S and G2
Cell Cycle

- **G1** is when the new cell has just been “made” through mitosis and needs to grow and begin working as a cell.
- **S** phase is when DNA is replicated.
- **G2** is when the final growth of the cell and preparation for mitosis occurs.
Cell Cycle

- Click on the link below and answer questions 4-9 or use textbook
- [http://www.cellsalive.com/cell_cycle.htm](http://www.cellsalive.com/cell_cycle.htm)
Mitosis - asexual reproduction

- **Mitosis**, the formation of new, identical body cells (AKA somatic cells) through the *division of the nucleus* followed by *cytokinesis* which is the division of the cytoplasm and the rest of the cell.

- Click on the link below for more information about mitosis.

  - [http://www.cellsalive.com/mitosis.htm](http://www.cellsalive.com/mitosis.htm)
Why Mitosis?????

- Cells can only grow so big because of limits on diffusion and DNA.
- Mitosis produces new cells so a multicellular organism can grow.
- Mitosis also replaces damaged or dead cells to repair “heal” a multicellular organism.
Mitosis-PMAT

- Four Stages:
  - Prophase (pro- means first or before)
  - Metaphase (meta- means middle/after)
  - Anaphase (ana- means apart)
  - Telophase (telo- means far away/end)
Mitosis & the cell cycle is a cycle that has no beginning or end...
prophase

- The nucleolus fades and chromatin (replicated DNA and associated proteins) condenses into chromosomes.
- Each chromosome comprises two chromatids.
- Microtubules grow the mitotic spindle from the region of the centrioles or aster.
- Nuclear membrane dissolves.
- Spindle fibers attach to centromeres.
metaphase

- Tension applied by the spindle fibers aligns all chromosomes in one plane at the center of the cell
- Chromosomes are aligned at the cell equator
anaphase

- Spindle fibers shorten and the chromatids (daughter chromosomes) are pulled apart and begin moving to the cell poles.
telophase

- The daughter chromosomes arrive at the poles and the spindle fibers that have pulled them apart disappear.
- Nuclear membranes reform *(two nuclei per cell now)*
- Chromosomes relax back into chromatin
cytokinesis

- Cell membrane pinches in to form two identical diploid daughter cells
- Plants—cell plate connects with outer cell wall to complete division
- Microtubules then reorganize into a new cytoskeleton for the return to interphase.
Which phases can you see?

- Prophase
- Metaphase
- Anaphase
- Telophase
- Interphase
What about *ME*, the Cell Wall???

- Where *am I* when the cell divides?
- A cell plate forms between the daughter cells as the final step of cytokinesis with plants cells and other cells with cell walls!
Cell Plate

- Not a Dinner plate!
What would happen if a cell did mitosis and NOT cytokinesis???
What are **CANCER** cells?

- Cells that don’t play using the rules
- Form when the cell cycle is out of CONTROL
- The normal regulators of the cell cycle no longer work and out-of-control mitosis occurs

*What happens if a cell is not in interphase for an extended period of time?*
CDKs and Cyclins

- These are regulatory proteins that help maintain the cell cycle
- When they do not function properly, this can trigger tumors or cancer to occur in previously normal tissue
CANCER

- Review the normal cell cycle
- Draw what YOU think would happen in a cancer cell cycle
Cancer/tumor cell problems include:

- Take up space/squish and damage normal cells
- DO NOT do their cell job
- Use up resources needed by the organism

http://outreach.mcb.harvard.edu/animations/checkpoints.swf
http://www.cancerquest.org/cancer-cell-division