LAB #5:

Mitosis & Meiosis

http://www.wadsworth.org/bms/SCBlinks/mcewen/Media/fig_1_cell_mitosis.jpg
Mitosis

• Asexual Reproduction
• The end result is 2 cells that are genetically identical to each other and to the parent cell from which they formed
• Occurs in somatic cells (non-gametes)
• Stages are prophase, metaphase, anaphase, and telophase
Mitosis in Plant Cells

- Look at the region of cell division and not at the root cap
Parts of the Root Tip
Cell Division in the APICAL MERISTEM

• Cells of apical meristem contain DNA within nucleus.

• Region goes through cell cycle:
  – **Interphase**: growth phase
  – **Mitosis**: division of the nucleus (includ. DNA)
  – **Cytokinesis**: division of the cytoplasm
Estimated Duration of Onion Cell Cycle

Interphase = 22.5 hrs

Mitosis = 1.5 hrs (90 min.)

Total Cell Cycle 24 hrs.
Cell Cycle – INTERPHASE

• LONGEST stage of cell cycle (but, *not* a stage of Mitosis)

• MOST CELLS will appear in this stage.

• What do these cells look like?
  – Large nuclei
  – Condensed chromatin
  – Nuclear membrane surrounds duplicating chromosomes
Cell Cycle – INTERPHASE

Non-dividing stage of growth; cell prepares for division.

- **G₁ Phase**-
  - *Growth* of cell
  - Increased nucleotide production for next DNA replication.

- **S Phase**-
  - *Synthesis* of DNA resulting in duplicate strands of identical chromosomes.

- **G₂ Phase**-
  - General cell preparation for division.
Cell Cycle – MITÓSIS

Equal distribution of duplicated genetic material (chromosomes) into two nuclei.

- 4 Stages of Mitosis – “PMAT”
  1. Prophse
  2. Metaphase
  3. Anaphase
  4. Telophase
## Stages of MITOSIS

<table>
<thead>
<tr>
<th>Prophase</th>
<th>Metaphase</th>
<th>Anaphase</th>
<th>Telophase</th>
</tr>
</thead>
</table>
| • Chromosomes condense & are visible  
• Twin strands of ‘sister chromatids’  
• Nuclear membrane breaks down | • Chromosome (sister chromatids) align on equatorial/metaphase plate | • Sister chromatids are pulled toward opposite poles of the cell, by spindle fibers | • Nuclear membrane reforms  
• Chromosomes are grouped into 2 new daughter cells |
Cell Cycle – CYTOKINESIS

• Equal division of cytoplasm into 2 new daughter cells.

• Formation of the cell wall near equatorial plate.

• Shortest part of the cell cycle (doesn’t take long for daughter cells to completely separate).
Stages of the Cell Cycle

What do the cells look like?

http://www.eastcentral.edu/acad/depts/BI/AlliumMitosisLabels.jpg
Onion - Interphase

- Important! This is not a phase of mitosis.
Onion - early prophase

- Chromosomes condense
Onion - late prophase

- Nucleolus and nuclear envelope disappear
Onion - metaphase

- Replicated chromosomes line up in the center of the cell
Onion - Anaphase

- Chromatids separate from each other and unreplicated chromosomes travel to opposite ends of the cells (poles)
Onion - telophase

- Cytokinesis starts to occur.
  - Notice the formation of the cell wall.
  - This is done by the formation of a cell plate.
- Opposite changes of prophase.
  - Nucleus, nucleolus reforms
Use Onion Root Tip “Field of View” Counts

• This is one field of view.

• The onion images provided (2 handouts/student) were captured under 400x magnification.

• Approx. 100 cells should be visible in each field of view.

• Tabulate # of cells in each phase of the cell cycle. Use for “individual” & pooled “class data” – pie chart!!

http://www.microscopy-uk.org.uk/micropolitan/botany/mitosis_onion.jpg
Sample Pie Chart Results

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<th>Number seen 18</th>
<th>Number seen 19</th>
<th>Number seen 20</th>
<th>Total Number seen</th>
<th>% of Total</th>
<th>Duration (hrs)</th>
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</tbody>
</table>

Duration of Phases of the Cell Cycle

- Interphase: 91%
- Prophase: 3%
- Metaphase: 2%
- Anaphase: 2%
- Telophase: 2%

Sample “Pooled Class Data”
Mitosis in Animal Cells

• This is what you will see under the microscope (whitefish blastula)
• There will be several per cell.
• The blastula is made up of many cells.
  – Pick a blastula and go to high power.
Whitefish - Interphase

- Once again, a reminder that interphase is not a phase of mitosis!
Whitefish - Prophase

- Same type of changes you see in the plant cell except animals also have centrioles
  - centrioles move to opposite sides of the cell
Whitefish - Metaphase

- Chromosomes line up in the center of the cell
Whitefish - Anaphase

- Separation of chromatids and the movement of unreplicated chromosomes to opposite sides of the cell
Whitefish - Telophase

- Notice that there is no cell plate.
- Cytokinesis occurs via a cleavage furrow
  - imagine a balloon being compressed in the center
  - works from the outside in
Meiosis in the Lily Anther

- Sexual reproduction characteristic
- Get two divisions
  - meiosis I & meiosis II
- Result is 4 cells that are haploid (parent was diploid)
- The four cells are genetically different from each other.
Prophase I - lily anther

- Tetrads form
  - homologous chromosomes come together

- Crossing over occur
  - gives genetic variation
  - get new combinations of traits (not new traits)
Metaphase I - lily anther

- Tetrads line up in the center of the cell
  - In humans have 23 tetrads lining up
  - remember mitosis had 46 chromosomes lining up
Anaphase I - lily anther

- Tetrads separate from each other and move to opposite poles
Telophase I - lily anther

- Now have the haploid number of chromosomes at each pole
- No DNA division between meiosis I and meiosis II
Prophase II - lily anther

- It is easy to tell that we are in the second division since there are now two cells.
- Meiosis II is just like mitosis except we are dealing with haploid nuclei.
Metaphase II - lily anther

- Lining up in the center of the cell
Anaphase II - lily anther

- Notice two cells, each in anaphase.
  - That is a key to knowing that it is meiosis.
Telophase II - lily anther

- End result is 4 haploid nuclei
Tetrad formation

- The four cells here will eventually become pollen grains (male sex cell)
- Since there are four together, the structure is called a tetrad.
  - No relation to the tetrads formed in prophase I
Meiosis note

• In animals it is a little different
  – males produce 4 sperm
  – females produce 1 ova and 2-3 polar bodies
    • insure that cytoplasm and necessary organelles are in one ova
    • quality rather than quantity
Summary of Today’s Agenda:

1. Use Onion Root Tip (slide) to I.D. all stages of Plant Mitosis - (get signed-off)
2. Use Whitefish (slide) to I.D. all stages of Animal Mitosis - (get signed-off)
3. Use Onion “Field of View” images to do cell counts – generate Pie Chart of “Onion Cell Cycle Duration” using class data
4. Make own LIVE! garlic root tip squash & find cells undergoing mitosis - (get signed-off)
5. Simulate Meiosis using Pop-Beads/ Boards – show instructor before leaving
Post-Lab Assignment:

Hand in the following:

• “Blue handout” – all signatures & tables (raw data) must be complete.

• Pie Chart of “Duration of Onion Cell Cycle” using pooled class data (we’ll give you this).

• INDIVIDUAL Explanation of this pie chart
  – Include such things as: What’s happening? How long does each “phase” take? Where does cell spend most of its time? Compare your individual counts with pooled data. What are the differences & why?