The Cell Cycle
Presenter:

• Hello, my name is insert name here.
• I am in insert grade here.
• Today, we are going to discuss mitosis and meiosis. Most of this should be a review, so you do not need to write down all the notes, just information that you are not familiar with. These notes will be online if you would like to review them further.
Animated Cycle

http://www.cellsalive.com/cell_cycle.htm
MITOSIS
Mitosis

The process of somatic (body) cell division which results in the production of two daughter cells from a single parent cell.

The daughter cells are identical to one another and to the original parent cell.
Mitosis can be divided into stages

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase & Cytokinesis
Interphase
The cell prepares for division

• Animal Cell
  – DNA replicated
  – Organelles replicated
  – Cell increases in size

• Plant Cell
  – DNA replicated
  – Organelles replicated
  – Cell increases in size
Interphase

Animal Cell

Plant Cell

Photographs from: http://www.bioweb.uncc.edu/biol1110/Stages.htm
Prophase
The cell prepares for nuclear division

- Animal Cell
  - Packages DNA into chromosomes

- Plant cell
  - Packages DNA into chromosomes
Prophase

Animal Cell

Plant Cell

Photographs from: http://www.bioweb.uncc.edu/biol1110/Stages.htm
Metaphase
The cell prepares chromosomes for division

- **Animal Cell**
  - Chromosomes line up at the center of the cell
  - Spindle fibers attach from daughter cells to chromosomes at the centromere

- **Plant Cell**
  - Chromosomes line up at the center of the cell
  - Spindle fibers attach from daughter cells to chromosomes at the centromere
Metaphase

Animal Cell  Plant Cell

Photographs from: http://www.bioweb.uncc.edu/biol1110/Stages.htm
Anaphase
The chromosomes divide

- **Animal Cell**
  - Spindle fibers pull chromosomes apart
  - $\frac{1}{2}$ of each chromosome (called chromatid) moves to each daughter cell

- **Plant Cell**
  - Spindle fibers pull chromosomes apart
  - $\frac{1}{2}$ of each chromosome (called chromatid) moves to each daughter cell
Anaphase

Animal Cell

Plant Cell

Photographs from: http://www.bioweb.uncc.edu/biol1110/Stages.htm
Telophase
The cytoplasm divides

- Animal Cell
  - DNA spreads out
  - 2 nuclei form
  - Cell membrane pinches in to form the 2 new daughter cells

- Plant Cell
  - DNA spreads out
  - 2 nuclei form
  - New cell wall forms between to nuclei to form the 2 new daughter cells
Telophase

Animal Cell

Plant Cell

Photographs from: http://www.bioweb.uncc.edu/biol1110/Stages.htm
Mitosis Animation

http://www.cellsalive.com/mitosis.htm
Animal Mitosis -- Review

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Interphase

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## Plant Mitosis -- Review

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Diploid vs. Haploid

Ploidy- Number of sets of chromosomes in a biological cell.
Diploid vs Haploid

- **Diploid (2n)**
  - Means 2
  - two complete sets of chromosomes
  - In humans: 23 pairs = 46
  - mitosis

- **Haploid (n)**
  - Means half
  - Half the number of diploid
  - In humans:
    - Only 23 in Egg
    - Only 23 in Sperm
  - Meiosis
Diploid vs Haploid

• A frog has 26 total chromosomes (2n). What is the haploid number?
• Carp fish eggs have 52 chromosomes. What is the total number of chromosomes in the fish (diploid)?
• Broad beans have 12 chromosomes. How many chromosomes does the bean pollen have (haploid)?
MEIOSIS
Meiosis is the type of cell division by which germ cells (will become eggs and sperm-called gametes if they will undergo meiosis) are produced.

The joining of these cells will produce zygotes.
Meiosis

One parent cell produces four daughter cells.

Daughter cells have half the number of chromosomes found in the original parent cell.
Meiosis

During meiosis, DNA replicates once, but the nucleus divides twice.

Four stages can be described for each division of the nucleus.
Meiosis I

First division of meiosis
Meiosis

First Division of Meiosis

• **Prophase 1**: Each chromosome duplicates and remains closely associated. These are called sister chromatids.

• **Metaphase 1**: Chromosomes align at the center of the cell.

• **Anaphase 1**: Chromosome pairs separate with sister chromatids remaining together.

• **Telophase 1**: Two daughter cells are formed with each daughter containing only one chromosome of the chromosome pair.
Prophase 1

Early prophase I

Nuclear envelope

Chromatin

Middle prophase I

Centrosomes

The chromatin begins to condense following interphase

Synapsis aligns homologs, and chromosomes shorten

http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html
Prophase I

Middle prophase I  Late prophase I

Chiasmata

Pairs of homologs

Chiasmata become evident

Coiling and shortening of the chromosomes continue
Cross Over (During Prophase I)

- A process where two chromosomes pair up and exchange segments of their genetic material.
- Results in new combinations of genes creating genetic diversity (why EVERYONE is different).
Metaphase I

The chromosomes line up on the equatorial (metaphase) plate

The homologous chromosomes move to opposite poles of the cell

http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html
Independent Assortment

• The process of random segregation and assortment of the maternal and paternal chromosomes, resulting in unique gametes.

• Various ways chromosomes may be aligned during metaphase I.
Nondisjunction

• “Not coming apart”
• Failure of chromosome pairs to separate during anaphase of meiosis I or II
• This could result in a loss of chromosome (Monosomy- Turner Syndrome) or gain in chromosomes (Trisomy- Down Syndrome).
Telophase I

The chromosomes gather into nuclei, and the original cell divides

http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html

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Meiosis

Second Division of Meiosis
Second Division of Meiosis

- **Prophase 2**: DNA does not replicate.

- **Metaphase 2**: Chromosomes line up at the center of the cell

- **Anaphase 2**: Centromeres divide and sister chromatids move separately to each pole.

- **Telophase 2**: Cell division is complete.

*Four haploid daughter cells are formed.*
The chromosomes condense again, following a brief interphase in which DNA does not replicate.

[Link to the original source](http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html)
Metaphase II

Kinetochores of the paired chromatids line up across the equator of each cell

The chromatids of the chromosomes finally separate, becoming chromosomes in their own right, and are pulled to opposite poles

http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html
Telophase II

The chromosomes gather into nuclei, and the cells divide. Each of the four cells has a nucleus with a haploid number of chromosomes.

http://everyschool.org/u/logan/cellreproductionx/rogersa/research/meiosis.html
Meiosis


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Meiosis Animation

Description of the meiosis

http://www.rothamsted.bbsrc.ac.uk/notebook/courses/guide/movie/meiosis.htm
Mitosis vs Meiosis

- **MITosis** takes the cell and **Makes It Two** (diploid)
- **Meiosis** has to do with **sex**
- From the cell’s point of view:
  - m**ITosis** results in **Identical Twins**
  - m**EioSis** results in **Egg and Sperm** (haploid)
Differences in Mitosis & Meiosis

• Mitosis
  – Asexual
  – Somatic Cells
  – Cell divides once
  – Two diploid daughter cells
  – Genetic information is identical

• Meiosis
  – Sexual
  – Cell divides twice
  – Four haploid daughter cells
  – Genetic information is different
Comparison Animations

http://www.pbs.org/wgbh/nova/baby/divi_flash.html

http://www.usoe.k12.ut.us/curr/science/sciber00/7th/genetics/sciber/animatin.htm