Chapter 8-Part 2

- First a review of mitosis
- Asexual versus sexual reproduction
- MEIOSIS!!!!
- Meiosis and genetic diversity
  - Crossing over
  - Independent assortment
  - Random fertilization

MITOSIS REVIEW

A. For each phase of mitosis pictured on the left, state the phase that is immediately PRIOR to this phase, and the phase that immediately follows this phase.

B.

Have you encouraged asexual reproduction?

In asexual reproduction, the lone parent and its offspring have identical genes.
(they are genetically identical)

MITOSIS REVIEW

C. For each phase of mitosis pictured on the left, state the phase that is immediately PRIOR to this phase, and the phase that immediately follows this phase.

D.

-MITOSIS REVIEW

- What phase of mitosis is each cell in?
- Are these plant cells or animal cells?

Species | Chrom#
---------|--------
Human    | 46     
Porpoise | 44     
Bat      | 44     
Mosquito | 6      
Apple    | 34     
Pea      | 14     
King crab| 208    
Chicken  | 78     
Camel    | 70     
Soybean  | 40     

Use the chart on the left.

How many chromosomes are in a mosquito ‘body’ or somatic cell?

CLEARLY DRAW what a dividing mosquito cell will look like at METAPHASE.

How are the duplicated chromosomes lined up?
What happens next?

- What phase of mitosis occurs next?
- What ACTUALLY happens???
- What happens to duplicated chromosomes?
- What happens to the two sister chromatids?

What would a human, somatic cell look like in metaphase? (Imagine 46 duplicated chromosomes)

Two sister chromatids of a duplicated chromosome

Where/when is mitosis occurring at the greatest rate?

- Diploid cells (meaning double in Greek) have two copies (homologs) of each chromosome
- Usually one from the mother and one from the father.
- Most somatic cells (body cells) of higher organisms are diploid.

- A diploid number of chromosomes is represented as 2n

First, let's get the numbers straight

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First, let's get the numbers straight

- **Haploid** (meaning simple in Greek) cells bear one copy of each chromosome.

- A haploid number of chromosomes is represented as \((n)\)

- What is the \((n)\) value for humans?

**Meiosis** is the process that results in cells having a haploid number of chromosomes.

Notice that this pair of chromosomes (one from mom, one from dad) is called a **homologous pair**.

The two chromosomes are identical in length and the genes they carry.

We have 26 pairs of homologous chromosomes.
Sexual Reproduction

• Requires **meiosis**

• **Meiosis** is cell division that reduces the # of sets of chromosomes from 2 to 1

• Meiosis generates **haploid gametes** (sperm and eggs)

• Gametes have a chromosome number of *n*

**Diploid (2n) organisms**

– **Somatic** cells contain two sets of chromosomes
– One set donated by ‘mother’, one set from ‘father’
– But, their **gametes** (sex cells) are **haploid**, having only one set of chromosomes (*n*)

\[
\text{sperm} + \text{egg} \rightarrow \text{zygote}
\]

Human Life Cycle: An example of Sexual Reproduction

- Begins with **Fertilization**
  – Is the fusion of sperm (*n*) and egg (*n*)
  – Creates a zygote, or fertilized egg (2*n*)

- Diploid (2*n*) zygote grows via **mitosis** into a multi-cellular organism

Asexual vs. Sexual reproduction

• Asexual reproduction occurs through mitosis and cytokinesis

• Clones result

• Sexual reproduction results in offspring that are **genetically different** from parents

**Advantages, disadvantages?**

Mitosis and Meiosis

In **meiosis**, sex cells replicate their genetic info and then divide **TWICE**, to yield a cell(s) with half of the genetic info, gametes (2*n* → *n*)

\[
2n \rightarrow n \rightarrow n
\]

In **mitosis**, somatic cells replicate their genetic info and then divide once. The newly formed cells are **IDENTICAL** to the first cell (2*n* → 2*n*)

\[
2n \rightarrow 2n \rightarrow 2n
\]
Mitosis and Meiosis

- Mitosis and meiosis are similar in some ways
  - Replication of DNA in S-phase
  - Cells divide in series of steps: prophase → metaphase → anaphase → telophase
- Unlike mitosis, in meiosis, cells divide twice, creating four, haploid (n) daughter cells

Overview of Meiosis

Meiosis occurs in two stages:

**Meiosis I**
- Homologous chromosomes Separate

**Meiosis II**
- Sister chromatids separate

Where in the human body does MEIOSIS occur?

http://www.johnkyrk.com/meiosis.html

Where in a plant does MEIOSIS occur?

Tetrad = duplicated homologous chromosome pair

- Unlike mitosis, in meiosis,...homologous chromosomes find each other, and spend time together.
- Homologous chromosomes are the same exact length.
- Homologous chromosomes carry the same GENES in the same order!!
- Alleles are different versions of genes
Meiosis I

- Pairs of duplicated, homologous chromosomes (tetrads) align at the metaphase plate.
- Crossing-over occurs between homologous chromosomes
- Duplicated homologous chromosomes are separated in Anaphase I
- The cytoplasm divides, producing two haploid cells

Meiosis II

- Sister chromatids in the haploid cells line up at the metaphase plate and are separated.
- The cell divides into 2 haploid (n) daughter cells.

Thus Meiosis of a single, diploid cell produces 4 haploid daughter cells.

Meiosis in real cells.
Meiosis and Diversity

- If meiosis is so regulated and precise, how are the offspring of sexual reproduction so diverse?

Meiosis generates genetic diversity

1. Crossing Over (Prophase I)
2. Independent assortment (Metaphase I)
3. Random Fertilization

Meiosis generates Diversity

1. Crossing over

In PROPHASE I, of Meiosis, homologous chromosomes find each other, and they swap genetic information via crossing over.

Genetic recombination

Meiosis generates Diversity

2. Independent Assortment

NOTE: which side of the Metaphase plate each doubled chromosome lined-up on is RANDOM

INDEPENDENT ASSORTMENT (greatly increases the diversity of the daughter cells)

2^23=8million
Independent Assortment movie


Meiosis generates Diversity

3. Random Fertilization

- 1 in million sperm, meets up with 1/million egg
- Over 70 trillion possibilities
- Not including variety added by crossing over!!

Who will be the strongest swimmer??

Mitosis and Meiosis

Mitosis

Onion (Allium) root tip

Fertilized egg

OR

Whitefish Blastula

-120 cells

These cells have 46 chromosomes but they are special because they undergo MEIOSIS.

These cells (sperm and egg) are the exception to the rule that all cells in our body have 46 chromosomes. They have 23.