Meiosis and Sexual Life Cycles

Chapter 13

"Living organisms are distinguished by their ability to reproduce their own kind."

Introduction: Important Definitions

- Inheritance/heredity (Latin *heres,* heir)=
- Variation =
- Genetics =

Inheritance of Genes

- Genes

Inheritance of Genes

- Genes continued….
  - Tens of thousands of genes are inherited from parents

Reproductive cells

- Gametes =
- Fertilization =

Chromosomes

- Eukaryotic DNA is subdivided into units called chromosomes.
- Humans have 23 pairs of chromosomes
- Locus=
- Karyotyping

Asexual versus Sexual reproduction

- Asexual Reproduction
  - Single parent
  - Single parent passes all its genes to offspring
  - Gives rise to a clone or an exact copy of itself
    - Examples include hydra and yeast
  - However genetic variation can arise due to mutations (this concept will be discussed more later)
- Advantages
  - Takes less energy
  - Don't need a mate

- Sexual Reproduction
  - Two parents required
  - Never an exact replica of the parents
    - However may have a family resemblance
  - Genetic Variation occurs more often
- Advantages
  - Organisms that undergo sexual reproduction tend to be at a selective advantage in environments that undergo frequent change.

Question 13.1

- A highly specialized sequence of nucleotides is passed from a parent to an offspring. What is this sequence?

A. Gamete
B. Chromosome
C. Gene
D. Fertilization

Numbers of Chromosomes

- A single set of chromosomes is represented by *n*
- Diploid cell (2*n*) =

Gametes and Chromosome Numbers

- Gametes contain a single set of chromosomes

Question 13.2

- Dog sperm contain 39 chromosomes. What are the haploid and diploid number for dogs?
  - A. Haploid = 78, diploid =156
  - B. Haploid = 39, diploid =78
  - C. Haploid = 19.5, diploid = 39
  - D. None of the above

Gametes and Fertilization

- An unfertilized egg (ovum) contains an X chromosome (the female gamete)
- Sperm contains either an X or Y chromosome (the male gamete)
- Fertilization=

Gametes and Meiosis

- Gametes are the only cells that are not produced by mitosis (chpt 12)
- Gametes develop in the gonads
  - Ovaries of females
  - Testes of males
- Meiosis only occurs in the ovaries and testes

Introduction to Meiosis

- Gametes we know are haploid, so at fertilization the cells are back to being diploid.
  - This process takes two haploid sets and combines them to create a diploid set.
- Meiosis occurs during the production of gametes. After fertilization meiosis is complete and mitosis resumes.

Meiosis

- Very similar to mitosis, however

Meiosis Phases

- The phases of meiosis include:
  - Interphase
  - Prophase I
  - Metaphase I
  - Anaphase I
  - Telophase I and Cytokinesis
  - Prophase II
  - Metaphase II
  - Anaphase II
  - Telophase II and Cytokinesis

Meiosis: Interphase

- First stage of meiosis
- Chromosomes replicate, but they do not condense
- Each replicated chromosome consists of two genetically identical sister chromatids
- Centrosome replicates forming two centrosomes.

Meiosis: Prophase I

- Chromosomes condense
- Homologous chromosomes pair loosely
- Complex of four sister chromatids =
- Crossing-over takes place
- Formation of spindle fibers begins
- Kinetochores form; one on each chromosome
- Slowest phase (90% total time)

Meiosis: Prophase I

- Crossing over
  - Homologous chromosomes pair up and form tetrad
  - Chiasmata =
  - Synaptonemal Complex =

Meiosis: Metaphase I

- Homologous chromosomes (tetrads) are aligned at the metaphase plate
- There is one kinetochore, microtubule attachment per chromosome

Meiosis: Anaphase I

- Homologous pairs separate
- Sister chromatids are attached at the centromere and move toward the same pole.

Meiosis: Telophase I and Cytokinesis

- Cytokinesis =
- Telophase and Cytokinesis occur simultaneously
- At this point we have two daughter cells each containing a haploid set of chromosomes.

Meiosis: Prophase II and Metaphase II

- Prophase II
  - Spindle apparatus forms
- Metaphase II
  - Chromosomes align at the metaphase plate

Meiosis: Anaphase II and Telophase II and Cytokinesis

- Anaphase II
  - Sister chromatids separate in individual chromosomes
  - These chromosomes are NOT identical due to the crossing-over event
- Telophase II and Cytokinesis
  - Nuclei form
  - Cell division
- Meiosis is complete and we have four daughter cells

Question 13.3

- What would happen if gametes were diploid instead of haploid?

A. Mitosis would compensate for the extra genetic material and thus there would be no difference.
B. At the next round of fertilization the normal chromosome number would be 92.
C. The chromosomes would not separate properly.

Mitosis versus Meiosis

- Mitosis
  - Takes place in all cells of the body except the sex cells (gametes)
  - Conserves number of chromosome sets
  - Daughter cells identical to parent cells
- Meiosis
  - Only occurs in gametes
  - Reduces the number of chromosome set from diploid to haploid
  - Daughter cells differ genetically from each other
  - Meiosis II very similar to mitosis

Genetic Variation

- Independent assortment of chromosomes =
- Random Fertilization $2^n = 2^{23}$ =