**Meiosis Notes 2019**

**Concept: Offspring acquire genes from parents by inheriting chromosomes**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are segments of DNA that code for the basic units of heredity and are transmitted from one generation to the net. In animals and plants, reproductive cells that transmit genes from one generation to the next are called gametes.

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (plural, loci) is the location of a gene on a chromosome

 -In asexual reproduction a single parent is the sole parent and passes copies of all its genes to its offspring. In asexual reproduction the new offspring arise by mitosis and have virtually exact copies of the parent’s genome. An individual that reproduces asexually gives rise to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, a group of genetically identical individuals.

Mitosis: produce cells with same information or identical daughter cells

Examples: Single-celled eukaryotes: yeast (fungi)…..Protists: Paramecium or Amoeba……Simple multicellular eukaryotes: Hydra

**Concept: Fertilization and Meiosis alternate in sexual life cycles**

What if a complex multicellular organism (like us) wants to reproduce?

-joining of egg + sperm

-Do we make egg & sperm by mitosis? No!

Advantage of Sexual Reproduction

In sexual reproduction, two individuals (parents) contribute genes to the offspring. This form of reproduction results in greater genetic variation in the offspring than asexual reproduction.

A life cycle is the generation-to generation sequence of stages in the reproductive history of an organism, from conception to production of its own offspring.

Somatic cells are any cells in the body that are not gametes. Each somatic cell in humans has 46 chromosomes. Liver cells and neurons are somatic cells.

The karyotype of an organism refers to a picture of its complete set of chromosomes, arranged in pairs of homologous chromosomes from the largest pair to the smallest pair.

Homologous Chromosomes

-Paired chromosomes: both chromosomes of a pair carry “matching” genes which control same inherited characters. homologous = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ information

-In homologous chromosomes both chromosomes of each pair carry genes that control the same inherited characteristics. If a gene for eye color is found at a specific locus on one chromosome, its homologs will have the same gene at the same locus.

-Homologous chromosomes are similar in length and centromere position, and they have the same staining pattern.

-One homologous chromosome from each pair is inherited from each parent, in other words, half of the set of 46 chromosomes in your somatic cells was inherited from your mother, and the other half was inherited from your father.

-Exceptions to the rule that all chromosomes are part of a homologous pair may be found with the sex chromosomes-in humans, it is the X and Y. Human females have a homologous pair of chromosomes XX, but males have one X chromosome and one Y chromosome. Non-sex chromosomes; that is, all the chromosomes (pairs 1-22) except the X and Y are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Concept: Meiosis reduces the number of chromosome sets from diploid to haploid**

Must reduce 46 chromosomes 🡪 23: Must \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the number of chromosomes

Alternating stages: chromosome number must be reduced from diploid 🡪 haploid (2n 🡪 n)

 -Example: humans: 46 🡪 23

-meiosis reduces chromosome number to make gametes

-fertilization restores chromosome number (2 haploid cells 🡪 diploid (n 🡪 2n)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-meaning sperm and ova (eggs)-are haploid cells. Haploid cells contain half the number of chromosomes of somatic cells. In humans, gametes contain 22 autosomes plus a single sex chromosome (X in female, either X or Y in Male), giving them a haploid number of 23. The haploid number of chromosomes is symbolized by n.

-Meiosis and fertilization are the key events in sexually reproducing life cycles. The human life cycle is typical of a sexually reproducing animal. During fertilization (the combination of a sperm cell and an egg cell), one haploid gamete from the father fuses with one haploid gamete from the mother. The result is a fertilized egg called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is diploid (has two sets of chromosomes) and may be symbolized by 2n.

-Meiosis is the type of cell division that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the numbers of sets of chromosomes from two to one. Meiosis and mitosis look similar-both are preceded by the replication of the cell’s DNA, for instance, but in meiosis this replication is followed by two stages of cell division meiosis I and meiosis II. The final result is four daughter cells, each of which has half as many chromosomes as the parent cell. Fertilization restores the diploid number as gametes are combined. Fertilization and meiosis alternate in the life cycles of sexually reproducing organisms.

Double division of meiosis

Meiosis I: 1st division of meiosis separates homologous pairs

Meiosis II: 2nd division of meiosis separates sister chromatids

1st step of meiosis is the Duplication of DNA

-Why bother?

-meiosis evolved after mitosis

-convenient to use “machinery” of mitosis

-DNA replicated in S phase of interphase of MEIOSIS (just like in mitosis)

2nd division of meiosis separates sister chromatids

Meiosis 1: interphase, prophase 1, metaphase 1, anaphase 1, telophase 1

 - 1st division of meiosis separates homologous pairs (2n 🡪 1n) “reduction division”

Meiosis 2: prophase 2, metaphase 2, anaphase 2, telophase 2

 - 2nd division of meiosis separates sister chromatids (1n 🡪 1n) \* just like mitosis \*

Interphase: Each of the chromosomes makes a copy of itself; that is, each chromosome replicates its DNA, roughly doubling the amount of DNA in the cell. The centrosome also divides during this phase.

Meiosis I: The first cellular division. It begins with a diploid cell.

Prophase I: Trading pieces of DNA

 -Crossing over

 -During prophase 1, sister chromatids intertwine. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ occurs-that is the joining of homologous chromosomes along their length. This newly formed structure is called a tetrad and precisely aligns the homologous chromosomes gene by gene. This perfect alignment is necessary for the next step-=crossing over. Crossing over has 3 steps including the cross over, breakage of DNA, and re-fusing of DNA. It results in the new combinations of traits

Mitosis vs Meiosis

Mitosis has 1 division, produces daughter cells genetically identical to parent cell, produces 2 cells, 2n 🡪 2n, produces cells for growth & repair, there is no crossing over

Meiosis has 2 divisions, produces daughter cells genetically different from parent, produces 4 cells, 2n 🡪 1n, produces gametes for sexual reproduction (sperm/egg), crossing over occurs

The value of sexual reproduction

Sexual reproduction introduces genetic variation

-genetic recombination during meiosis

-independent assortment of chromosomes: random alignment of homologous chromosomes in Meiosis 1

-crossing over: mixing of alleles across homologous chromosomes

-random fertilization: which sperm fertilizes which egg?

Driving evolution: variation for natural selection

**Concept: Genetic variation produced in sexual life cycles contributes to evolution**

Variation from genetic recombination

Independent assortment of chromosomes

-meiosis introduces genetic variation

-gametes of offspring do not have same combination of genes as gametes from parents

-random assortment in humans produces 223 (8,388,608) different combinations in gametes

Variation from crossing over

Crossing over creates completely new combinations of traits on each chromosome creates an infinite variety in gametes

Variation from random fertilization

Sperm + Egg = ? …….any 2 parents will produce a zygote with over 70 trillion (223 x 223) possible diploid combinations

Sexual reproduction creates variability

Sexual reproduction allows us to maintain both genetic similarity & differences.

Spermatogenesis:

- continuous & prolific process where each ejaculation = 100-600 million sperm

Oogenesis: eggs in ovaries halted before Anaphase 1

-Meiosis 1 completed during maturation

-Meiosis 2 completed after fertilization

-1 egg + 2 polar bodies

Not all organisms use haploid & diploid stages in same way

-which one is dominant (2n or n) differs

-but still alternate between haploid & diploid which is a must for sexual reproduction