Teacher's Name: _____

Lesson Title: *Meiosis*

I. Identification

Course title: *Biology/Life Science*

Teaching unit: "*Meiosis: The Steps to Creating Life*"

CDE Standards Addressed: *Biology/Life Sciences*

a. *Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.*
b. *Students know only certain cells in a multicellular organism undergo meiosis.*
c. *Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.*
d. *Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).*
e. *Students know why approximately half of an individual's DNA sequence comes from each parent.*
f. *Students know the role of chromosomes in determining an individual's sex.*
g. *Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.*

Lesson number in this unit: *#1*

Length (time): *1-2 class periods*

II. Specific Instructional Objective(s): *Upon completion of this lesson student should be able to:*

- *Analyze how Meiosis maintains a constant number of chromosomes within a species.*
- *Infer how Meiosis leads to variation within a species.*
- *Relate Mendel's laws of heredity to the events of Meiosis.*
- *Describe the process of fertilization in living organisms.*
- *Discuss the transmission of genes through meiotic division to form sperm and ova*
- *Define the terms phenotype, genotype, haploid, diploid, homozygous, heterozygous, segregation, and homologous and use them correctly in discussing meiosis and the genetic makeup of organisms.*

III. Equipment, materials, supplies, books, resources needed for this lesson (attach handouts):

- *Textbook – Glencoe Science Biology: The Dynamics of Life (2005 Edition)*
- *BrainPOP – Online Science Video* http://www.brainpop.com/science/cellularlifeandgenetics/genetics/
- *Meiosis Chapter 10 Section 2 PowerPoint Presentation*
- *Meiosis Chapter 10 Section 2 Student Notes Handout*
- *Meiosis Chapter 10 Section 2 Reinforcement and Study Guide Worksheet (Glencoe Science Biology: The Dynamics of Life)*

IV. Academic Vocabulary:

- *Diploid*
- *Haploid*
- *Homologous Chromosome*
- *Meiosis.*
- *Sperm*
- *Egg*
- *Sexual Reproduction*
- *Genetic Recombination*
- *Nondisjunction*

V. Teaching procedures:

a. Anticipatory set: *Good morning everyone! Today we are going to be talking about where babies come from! That's right, babies! However, I do not mean babies in the traditional sense. Instead, we are going to be discussing the types of cells that are used in sexual reproduction and how they come together to from offspring. Before we get started we are going to watch a short video on Genetics. (Show "BrainPOP" video).*

b. Stated objective(s): *Today we are going to be learning about Meiosis and the phases it plays in sexual reproduction.*

c. Purpose: *Understanding Meiosis and the many phases it plays in sexual reproduction allows for us to determine how and why different genetic traits occur in offspring.*

d. Input (presentation):

Subject Matter (outlined)	Teaching Methods
Definitions • ***Diploid:*** *cell with two of each kind of chromosome.* • ***Haploid:*** *cell with one of each kind of chromosome.* • ***Homologous Chromosome:*** *paired chromosomes with genes for the same trait.* • ***Meiosis:*** *type of cell division where one body cell produces four gametes, each containing half the number of chromosomes as a parent's body cell.* • ***Sperm:*** *haploid male sex cells produced by meiosis.* • ***Egg:*** *haploid female sex cells produced by meiosis.* • ***Sexual Reproduction:*** *pattern of reproduction that involves the production and subsequent fusion of haploid cells.* • ***Genetic Recombination:*** *major source of genetic variation among organisms caused be reassortment or crossing over during meiosis.* • ***Nondisjunction:*** *failure of homologous chromosomes to separate properly during meiosis.* ***Genes, Chromosomes and Numbers*** 1. *Genes do not exist free in the nucleus of a cell; they are lined up on chromosomes.* 2. *Typically, a chromosome can contain a thousand or more genes along its length.* ***Diploid and Haploid Cells*** 1. *In the body cells of animals and most plants, chromosomes occur in pairs.* 2. *A cell with two of each kind of chromosome is called a diploid cell and is said to contain a diploid, or 2n, number of chromosomes.* 3. *This pairing supports Mendel's conclusion that organisms have two factors—alleles—for each trait.* 4. *Organisms produce gametes that contain one of each kind of chromosome.* 5. *A cell containing one of each kind of chromosome is called a haploid cell and is said to contain a haploid, or n, number of chromosomes.* 6. *This fact supports Mendel's conclusion that parent organisms*	*Have students follow along with the "Meiosis Chapter 10 Section 2 PowerPoint Presentation" notes while filling in the "Meiosis Chapter 10 Section 2 Student Notes Handout".*

give one allele for each trait to each of their offspring.

7. *This table shows the diploid and haploid number of chromosomes of some species.*

Homologous Chromosomes

1. *The two chromosomes of each pair in diploid cell are called homologous chromosomes.*
2. *Each pair of homologous chromosomes has genes for the same traits.*
3. *On homologous chromosomes, these genes are arranged in the same order, but because there are different possible alleles for the same gene, the two chromosomes in a homologous pair are not always identical to each other.*

Why Meiosis?

1. *When cells divide by mitosis, the new cells have exactly the same number and kind of chromosomes as the original cells.*
2. *Imagine if mitosis were the only means of cell division*
3. *Each pea plant parent, which has 14 chromosomes, would produce gametes that contained a complete set of 14 chromosomes.*
4. *The F1 pea plants would have cell nuclei with 28 chromosomes, and the F2 plants would have cell nuclei with 56 chromosomes.*
5. *There must be another form of cell division that allows offspring to have the same number of chromosomes as their parents.*
6. *This kind of cell division, which produces gametes containing half the number of chromosomes as a parent's body cell, is called meiosis.*
7. *Meiosis consists of two separate divisions, known as meiosis I and meiosis II.*
8. *Meiosis I begins with one diploid (2n) cell.*
9. *By the end of meiosis II, there are four haploid (n) cells.*
10. *These haploid cells are called sex cells—gametes.*
11. *Male gametes are called sperm.*
12. *Female gametes are called eggs.*
13. *When a sperm fertilizes an egg, the resulting zygote once again has the diploid number of chromosomes.*
14. *This pattern of reproduction, involving the production and subsequent fusion of haploid sex cells, is called sexual reproduction.*

The Phases of Meiosis

1. *During meiosis, a spindle forms and the cytoplasm divides in the same ways they do during mitosis.*
2. *However, what happens to the chromosomes in meiosis is very different.*

Interphase

1. *During interphase, the cell replicates its chromosomes.*
2. *After replication, each chromosome consists of two identical sister chromatids, held together by a centromere.*

Prophase I

1. *The chromosomes coil up and a spindle forms.*
2. *As the chromosomes coil, homologous chromosomes line up with each other gene by gene along their length, to form a four-part structure called a tetrad.*
3. *The chromatids in a tetrad pair tightly.*
4. *In fact, they pair so tightly that non-sister chromatids from homologous chromosomes can actually break and exchange genetic material in a process known as crossing over.*
5. *Crossing over can occur at any location on a chromosome, and it can occur at several locations at the same time.*
6. *It is estimated that during prophase I of meiosis in humans, there is an average of two to three crossovers for each pair of homologous chromosomes.*
7. *Crossing over results in new combinations of alleles on a chromosome.*

Metaphase I

1. *During metaphase I, the centromere of each chromosome becomes attached to a spindle fiber.*
2. *The spindle fibers pull the tetrads into the middle, or equator, of the spindle.*

Anaphase I

1. *Anaphase I begins as homologous chromosomes, each with its two chromatids, separate and move to opposite ends of the cell.*
2. *This critical step ensures that each new cell will receive only one chromosome from each homologous pair.*

Telophase I

1. *Events occur in the reverse order from the events of prophase I.*
2. *The spindle is broken down, the chromosomes uncoil, and the cytoplasm divides to yield two new cells.*
3. *Each cell has half the genetic information of the original cell because it has only one chromosome from each homologous pair.*

The Phases of Meiosis II

1. *The second division in meiosis is simply a mitotic division of the products of meiosis I.*
2. *Meiosis II consists of prophase II, metaphase II, anaphase II, and telophase II.*
3. *During prophase II, a spindle forms in each of the two new cells and the spindle fibers attach to the chromosomes.*
4. *The chromosomes, still made up of sister chromatids, are pulled to thecenter of the cell and line up randomly at the equator during metaphase II.*
5. *Anaphase II begins as the centromere of each chromosome splits, allowing the sister chromatids to separate and move to opposite poles.*
6. *Finally nuclei reform, the spindles break down, and the cytoplasm divides during telophase II.*
7. *At the end of meiosis II, four haploid cells have been formed from one diploid cell.*

8. *These haploid cells will become gametes, transmitting the genes they contain to offspring.*

Meiosis Provides Genetic Variation

1. *Cells that are formed by mitosis are identical to each other and to the parent cell.*
2. *Crossing over during meiosis, however, provides a way to rearrange allele combinations.*
3. *Thus, variability is increased.*

Genetic Recombination

1. *Reassortment of chromosomes and the genetic information they carry, either by crossing over or by independent segregation of homologous chromosomes, is called genetic recombination.*
2. *It is a major source of variation among organisms.*

Nondisjunction

1. *The failure of homologous chromosomes to separate properly during meiosis is called nondisjunction.*
2. *The effects of nondisjunction are often seen after gametes fuse.*
3. *When a gamete with an extra chromosome is fertilized by a normal gamete, the zygote will have an extra chromosome.*
4. *This condition is called trisomy.*
5. *Although organisms with extra chromosomes often survive, organisms lacking one or more chromosomes usually do not.*
6. *When a gamete with a missing chromosome fuses with a normal gamete during fertilization, the resulting zygote lacks a chromosome.*
7. *This condition is called monosomy.*
8. *An example of monosomy that is not lethal is Turner syndrome, in which human females have only a single X chromosome instead of two.*
9. *When a gamete with an extra set of chromosomes is fertilized by a normal haploid gamete, the offspring has three sets of chromosomes and is triploid.*
10. *The fusion of two gametes, each with an extra set of chromosomes, produces offspring with four sets of chromosomes—a tetraploid.*

e. Check for understanding (write it out fully):

1. *What is the difference between haploid and diploid? Haploid cells are cells with one of each chromosome. Diploid cells are cells with two of each chromosome.*
2. *What are homologous chromosomes? Homologous chromosomes are paired chromosomes with genes for the same trait.*
3. *How is Meiosis different from Mitosis? Meiosis is the type of cell division where one body cell produces four different gametes, each containing half the number of chromosomes as a parent's body cell. Mitosis is the type of cell division where one body cell produces two identical daughter cells each containing a full set of chromosomes.*
4. *What is crossing over? Crossing over occurs when two chromosomes pair so tightly that they break causing them to recombine with different chromosomes. Happens during Prophase I.*
5. *What is Nondisjunction? Nondisjunction is the failure of homologous chromosomes to separate properly. This can result in either too little or too many chromosomes.*

g. **Guided practice (application … bullets or paragraph):** *Students can begin working on the "Chapter 10 Section 2 Reinforcement and Study Guide" worksheet. What students do not finish in class will become homework.*

h. Quest activities (optional, if time permits): *Students can make flash cards to help them study for the upcoming Meiosis Quiz.*

i. Closure (Select one or more. Review, summarize, evaluation, synthesis, prep for tomorrow*.):* *Good job today. Now that we have discussed Meiosis and the many phases/roles it plays in sexual reproduction, we can take our newly found knowledge and apply it to the project and lab we will be doing for the remainder of this week.*

j. Independent practice (homework): *Read Chapter 10 Section 2*

k. **Ell / Special Needs:** *Allowing students to work in teams (paring up bilingual students with ELL), using visuals & handouts, repeating directions, demonstrating directions while saying them aloud, and including guided practice of the topic.*