Name:_____ Period ___

Biology Unit 5 – Reproduction: Mitosis & Meiosis

Essential Skills

5-1. Students will be able to identify the purpose of **mitosis**, the types of cells it occurs in and describe how the **chromosomes** behave through each phase (including the **number of chromosomes** present at the beginning and end of the process). (HS-LS1-4)

5-2. Students will be able to identify the purpose of **meiosis**, the types of cells it occurs in and describe how the **chromosomes** behave through each phase (including the **number of chromosomes** present at the beginning and end of the process). (HS-LS3-1 & 2)

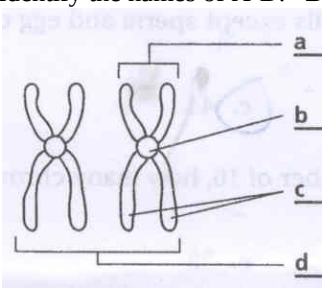
5-3. Students will know how **independent assortment** and **crossing over** during meiosis will contribute to **genetic variation**. (HS-LS3-2)

5-4. Students will able to explain, using examples, that cells containing the same **genetic information** have the ability to **differentiate** into many **specialized cells**. (HS-LS1-4)

Study Guide Questions

1. a. What is the function of DNA? Has the information for making proteins
   b. What is the difference between **chromatin** and **chromosomes**?
   Chromatin – unorganized DNA
   Chromosomes – long organized strands of DNA

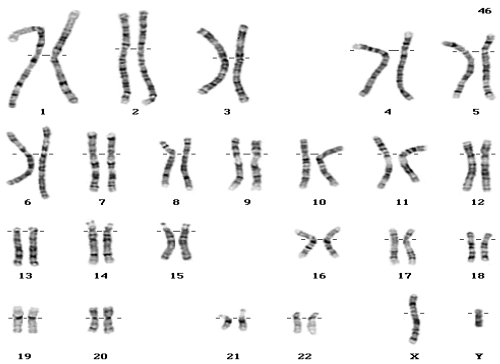
2. Identify the names of A-D. **Define <u>each</u>** of theses terms:



a) Chromosome – condensed structures of DNA strands
b) Centomere – attaches the two sister chromatids
c) Chromatids – Identical copies of the DNA
d) Homologous chromosomes – chromosomes which contain the same gene sequence, but are not identical (one came from mom, the other from dad)

3. a. Explain the difference between **autosomes** and **sex chromosomes**. Autosomes = normal chromosomes
   Sex chromosomes = determine gender
   b. What sex chromosomes determine male? Female? Male = XY Female = XX

4. a. Use the **karyotype** below to determine the number of **autosomes**, number of **sex chromosomes**, the **gender** of this individual <u>and</u> the total number of chromosomes in a human cell. Autosomes= 44 sex chromosomes = 2 gender = male total #= 46



b. Why are there two of each chromosome? One from Mom and one from Dad
c. Where did they come from? Mom and Dad

5. A karyotype shows an individual with 45 autosomes and two X chromosomes. What can you determine from this karyotype?
   Has one extra autosome (abnormal) and is a female

6. Explain the difference between **somatic cells** and **gametes**, using the terms **haploid** and **diploid**.
   Somatic cells are diploid and gametes are all haploid

7. Why is a cell's life described as a "cycle"? Draw & label a diagram showing the **cell cycle** and its **5 phases.**
   It begins in G1 and then goes through the 5 phases and after it complete cytokinesis the two new cells are right back in G1

8. Why would some cells stay at **G1** (G0) in the cell cycle? Give one example.
   If they go through S and G2 and Mitosis and Cytokinesis they stop their normal function… nerve cells, heart cells… don't want those to stop function… that would be bad…. ☺

9. What would result if a cell completed mitosis, but failed to complete **cytokinesis**?
   Two nuclei in one cell

10. Cytokinesis in an animal cell is different than cytokinesis of a plant cell. Explain how this process must be different in each cell type.
    Plant cells have to form a new cell wall to complete the separation into two new cells after the membrane pinches in.

11. What cells undergo **mitosis**? List at least 3 cells in your body and explain the reasons they would undergo **mitosis**. Describe how you are now comprised of over 1 trillion cells, when you began as just a singe cell.
    Somatic cells/Diploid cells.

    Skin – to replace and repair
    Lung – to replace and repair
    Bone – to replace, repair, grow more

    Mitosis adds more cells = growing

12. When does **DNA replicate** (copy itself)? Why does this stage take so long?
    In S phase. Replication (helicase and DNA polymerase) takes time to open and add the new nucleotides to the millions of nucleotides in our cells

13. Complete the following table regarding **Mitosis**:

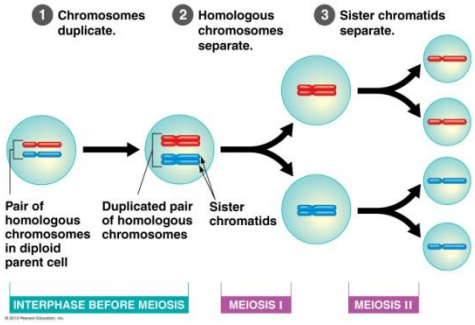
Question	MITOSIS
What types of cells are produced in this process?	Diploid/somatic/normal/2n
How many **chromosomes** are in a human cell before this process?	46
How many **chromosomes** are in a human cell after this process?	46
How many cells are produced in this process? (*starting with one cell*)	2

14. Complete the chart below regarding the 4 phases of mitosis:

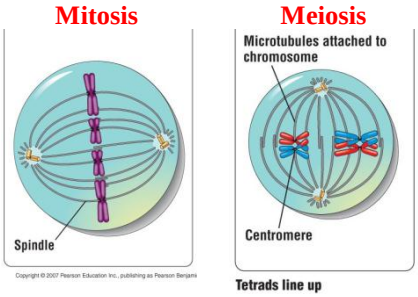
	Prophase	Metaphase	Anaphase	Telophase
Chromosomes description	Start to condense and become visible (chromatids attached)	Chromosomes line up in the middle to the cell (chromatids attached)	Chromatids pull apart to form un-duplicated chromosomes & move to opposite sides of the cell	Un-duplicated chromosomes begin to unwind and return to chromatin.
Nuclear Envelope appearance	Present, but beginning to disappear	Not present	Not present	Reform around each nucleus formed
Spindle Fiber description	Spindle fibers form & Centrioles move to opposite sides of the cell	Centrioles are on opposite sides of the cell & spindle fibers connect with centromeres	Centrioles are on opposite sides of the cell & chromatids move along the spindle fibers	Centrioles are on opposite sides of the cell & spindle fibers are no longer present
Draw a picture of each stage of mitosis showing 2 chromosomes.	See Cell Cycle & Mitosis Practice Activity			

15. What is the only purpose of **meiosis**? What are the only cells produced in **meiosis**?
    The purpose of meiosis is to produce gametes (haploid cells).

16. Describe what is happening with the chromosomes during **meiosis I** compared to what happens in **meiosis II**.
Meiosis I – Homologous chromosomes separate
Meiosis II – Sister chromatids separate

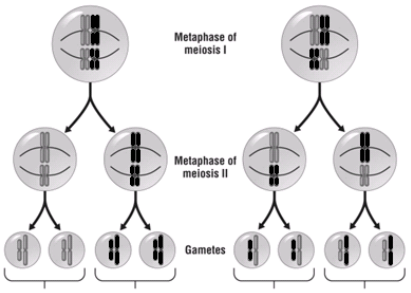


17. How are the events of **Metaphase I** of **meiosis** different than **Metaphase** of **mitosis**. Draw a picture to illustrate.
In metaphase I of meiosis chromosomes line up in homologous pairs (tetrads). In metaphase of mitosis, chromosomes line up alone.



18. Define and DRAW **Crossing-over**. When does crossing over occur? Define **Independent assortment**. When does independent assortment occur?
Crossing-over: recombines genes on chromatids, mixing maternal and paternal genes on a single chromatid
Independent assortment: maternal and paternal chromosomes separate randomly during meiosis I, gametes receive a mixture of maternal and paternal chromosomes
Both of theses events "shuffle" the genes so that each gamete receives a unique combination of genes.

19. What is **genetic diversity**? How do **Crossing-over** and **Independent Assortment** lead to so many different possible combinations of genes? Be specific for each one!
Crossing Over: this mixes up maternal and paternal genes, so that the resulting chromatids are not identical copies of the maternal and paternal genetic material. Makes new genetic combinations and ensures that no gamete will be alike, meaning no offspring (except identical twins) will be alike. Keeps a variety of different gene combinations in a population.
Independent Assortment: this means that the chromosomes will be assorted into gametes independently of one another, providing multiple different combinations for the gametes (over 8 million possible combinations for humans!). No two gametes will be exactly alike.



20. For a diploid cell with 4 chromosomes (shown to the right), how many different combinations of chromosomes are possible in the haploid gametes formed during meiosis? Which process accounts for these possible combinations?
There would be 4 possible combinations of chromosomes in the haploid gametes formed (see diagram in #19). This is due to independent assortment of chromosomes.

21. What is 1 advantage and 1 disadvantage of **asexual reproduction**? What is 1 advantage and 1 disadvantage of **sexual reproduction**? In **oogenesis**, why is only 1 of the 4 products used as the egg? How many of the cells produced in **spermatogenesis** are functional **gametes**?
An advantage of asexual reproduction is that the organism is able to pass on all of their genes to their offspring. A disadvantage of asexual reproduction is that all individuals in a population will be genetically identical and would be equally affected by a change in the environment.

An advantage of sexual reproduction is that a population of sexually reproducing organisms will have a greater genetic diversity and would be able to respond differently to changes in the environment, allowing the population to adapt. A disadvantage of sexual reproduction is that organisms are only able to pass on ½ of their genes to their offspring.
In oogenesis only 1 egg cell is produced due to an unequal division of the cytoplasm during cytokinesis. The cell that receives the majority of the cytoplasm (and organelles) will be the egg cell. In spermatogenesis, all for gametes will be functional.

22. Explain how **nondisjunction** during **meiosis** can lead to abnormal offspring. Give 2 examples of **nondisjunction disorders**.
Nondisjunction is the failure of chromosomes to separate during anaphase I or anaphase II. This causes some gametes to inherit an extra chromosome and others to be missing a chromosome. If these gametes are fertilized by a normal gamete, the zygote will suffer from trisomy (an extra chromosome, 3 instead of a pair) or monosomy (missing a chromosome, 1 instead of a pair).

23. Complete the following table regarding **Mitosis** and **Meiosis**:

Question	MEIOSIS	MITOSIS
What is the purpose of this process?	Growth, Repair/replacement of damaged cells, asexual reproduction	Formation of gametes
What types of cells are produced in this process?	Gametes	Somatic cells
How many **chromosomes** are in a human cell before this process?	46	46
How many **chromosomes** are in a human cell after this process?	23	46
How many cells are produced in this process? (*starting with one cell*)	4	2
How are the daughter cells produced in this process different or similar to the original cell?	They are genetically identical (clones).	They are each genetically unique.

24. Define **differentiation** and explain why cells in a multicellular organism would differentiate.
Differentiation is the process of cells developing different structures & functions. Cells in multicellular organisms differentiate to become the many different types of cells that make up various tissues and organs.

25. How many chromosomes are there in each of your body cells? If each of your cells contains a complete set of all of your genes, why do you have so many different types of cell?
Each of your body cells has 46 chromosomes. Only the genes that code for traits needed by each cell are expressed ("turned on"/transcribed & translated). These different patterns of gene expression lead to differentiated cells.