2024

Lesson 3: Comparing Mitosis and Meiosis

Name: _____ Section: _____

Date: _____ Score: _____

LEARNING WORKSHEET SHEET

CELL CYCLE : COMAPARING MITOSIS AND MEIOSIS

Fouth: QUARTER	Subject : Biology
Topic: Heredity: Inheritance and Variation of Traits: STAGES OF MEIOSIS	Learning Competency/ies: Explain the significance of meiosis in maintaining the chromosome number -S8LT-IVe-17

I. CONCEPT NOTES

LESSON 4: Cell Division: MEOISIS

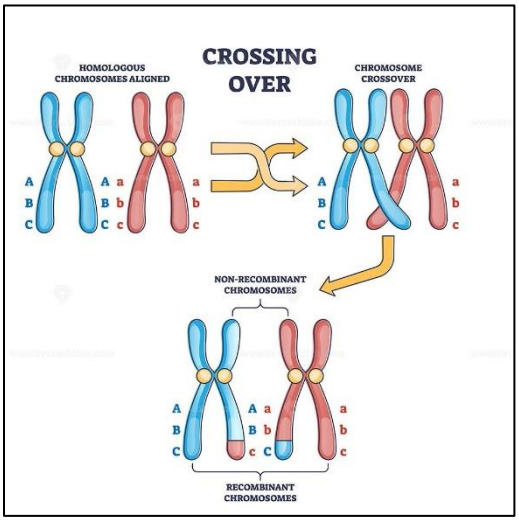
Objectives:

1. Explain the significance of meiosis in maintaining the chromosome number in an organism and its significance among sexually reproducing organisms;

2. Compare mitosis and meiosis and their roles in the cell division;

3. Discuss how the union of the egg and sperm cell results in the variation of the organism:

3. Appreciate the importance of the occurrence of meiosis in humans. (MELC Week 1 S8LT-IVa-13)



VOCABULARY WORDS:

Diploid Cell (2N) – means the nucleus of our body contains two sets of homologous chromosomes that we inherited half from our father (n=23) and half from our mother (n=23)

Haploid cells (n) – a gamete (either sperm or egg) containing a half set of chromosomes.

Crossing over -the exchange of genetic materials that produce a combination of genes along chromosomes. It brings variation to organisms that no one is exactly alike.

XY Chromosomes

XX Chromosomes

Figure1 : Homologous Chromosomes showing crossing -over 6d8a1ee9417918d136011015caf2b436.jpg (1000×1000)

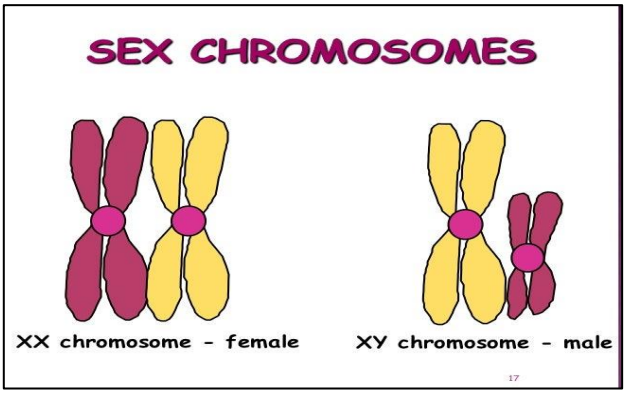


Figure 2 : Human Sex Chromosomes (XY, XX) (17).PNG (960×720)

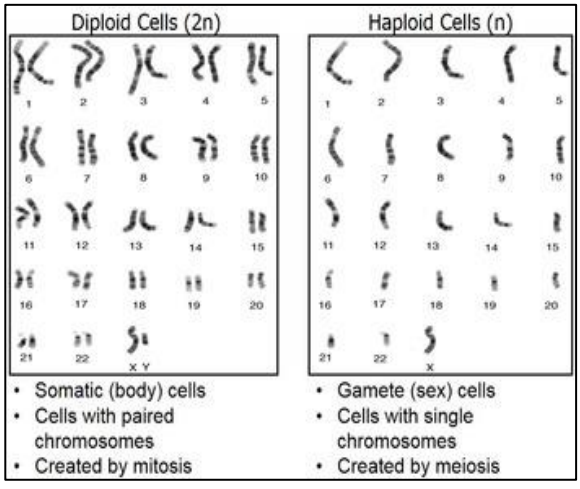


Figure 3; Human Karyotype with 46 diploid and 23 haploid original-2457464-1.jpg (350×263)

MEIOSIS: DIPLOID AND HAPLOID CHROMOSOMES

There are two main types of cells possessed by multicellular eukaryotic organisms: **somatic, or body cells, and gametes, or sex cells**. The majority of the cells are called somatic or body cells. These consist of two complete sets of chromosomes, making them diploid in number (2N).

Humans have 46 chromosomes. This is our **diploid number (2N).** Diploid means the nucleus of the nucleus of our body contains two sets of homologous chromosomes. We inherited half of these chromosomes from our father and half from our mother 2(23). **Homologous chromosomes** mean that they both carry the genes controlling the same traits. The exception is our reproductive cells – the ***egg and the sperm***, collectively known as ***gametes***.

Each egg or sperm has a single set of chromosomes composed of 22 autosomes and one pair of sex chromosomes, which either be **X** or **Y**. Therefore, our gametes are **haploid cells (N**) since they carry a single set of chromosomes.

The number of chromosomes normally remains the same within the species. It does not double or triple for every generation. This suggests that different kinds of cell division must take place in an individual. This kind of cell division is called **meiosis**, from the Greek word that means "**to make smaller"**, Meiosis reduces the chromosomes number in half. It is a form of sexual reproduction that takes place in the **ovaries** (egg cell) **and testes** (sperm cell) of animals during the formation of **gametogenesis (spermatogenesis and oogenesis).** Meiosis is a special type of cell division where the cell undergoes two cellular divisions: Meiosis 1 and Meiosis II.

Meiosis I.

The first meiotic division, also known as Meiosis I, is a **reduction division phase (diploid - haploid).** There are two daughter cells produced after Meiosis 1, each daughter cell is carrying haploid number of chromosomes. This consists of four stages, namely, prophase I, metaphase I, anaphase I, and telophase I. Another important event is **crossing-over** where the exchange of genetic materials may bring variation to organisms.

Prophase I Stage

Meiosis starts with this stage and includes the following substages: leptotene, zygotene, pachytene, diplotene, and diakinesis. Figure 2 and 3 shows the homologous chromosomes with the occurrence of crossing-over and different substages of prophase I respectively.

Leptotene – Each chromosome is made up of two long threads of sister chromatids because of replication during the S phase of the cell cycle.

Zygotene – The chromosomes begin to pair off. Pairs of chromosomes are called **homologous** chromosomes, and this pairing process is exact.

Pachytene – The chromosomes contract due to repeated coiling. **Crossing-over** takes place where a segment of the sister chromatid of one of the chromosomes is exchanged with the same segment of the sister chromatid of the homologous chromosomes through the formation of a cross-linked of the segments called **chiasma**. After crossing over, the sister chromatids of each chromosome may no longer be identical to each other based on the genetic material they contain

Diplotene – The chromosomes begin to uncoil.

Diakinesis – The paired chromosomes disperse in the nucleus.

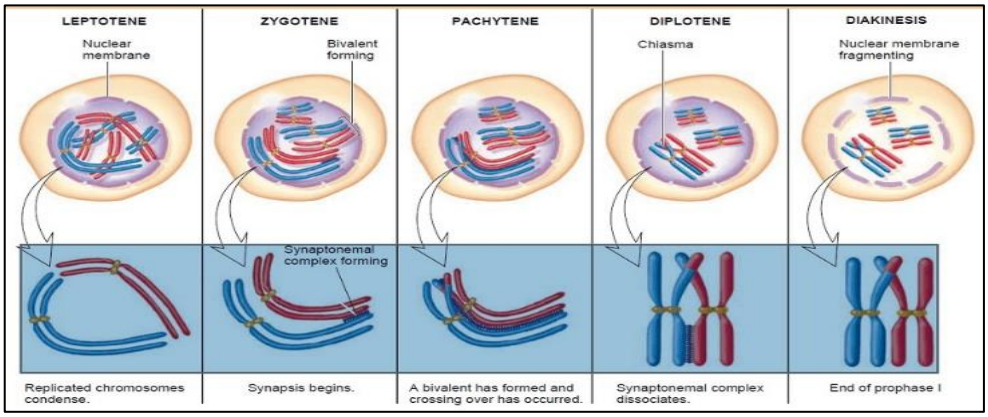


Figure 3: Showing the Prophase Stage of Meiosis
Source:

Metaphase 1 – The paired chromosomes arrange themselves along the equatorial plate.

Anaphase 1 – Spindle fibers form and attach to the centromeres of the chromosomes. The homologous chromosomes separate from each other completely and start their movement towards the poles of the cells as they pulled by the spindle fibers. As the centromere of each other chromosomes do not divide, the sister chromatids remain together.

Telophase 1 – In this stage the chromosomes reach their respective poles. **Cytokinesis** follows and two daughter cells are formed. Each cell now has half the chromosome number because only one chromosome from each other pair goes to the daughter cell. This is called the **haploid condition**. In difference to the diploid condition at the beginning of the meiosis I where each chromosome pair is intact. Telophase comes after by interphase II.

Take note that each chromosome still has two sister chromatids; it is therefore required for the cells to undergo another round of division.

The second meiotic, also known as **meiosis II**, it contains the following stages: **prophase II, metaphase II, anaphase II, and Telophase II**; these stages are identical to mitotic stages. The outcome is four cells, two from each daughter cell from meiosis I, with one-half the diploid chromosome number and wait only one sister chromatid for each chromosome. Figure 10 shows the stages of Meiosis I and Meiosis II. In meiosis I, the two homologous chromosomes separate which results in two haploid (n) daughter cells with chromosomes with two chromatids each. In meiosis II, four haploid (n) daughter cells are formed. Each cell is carrying a haploid number of chromosomes.

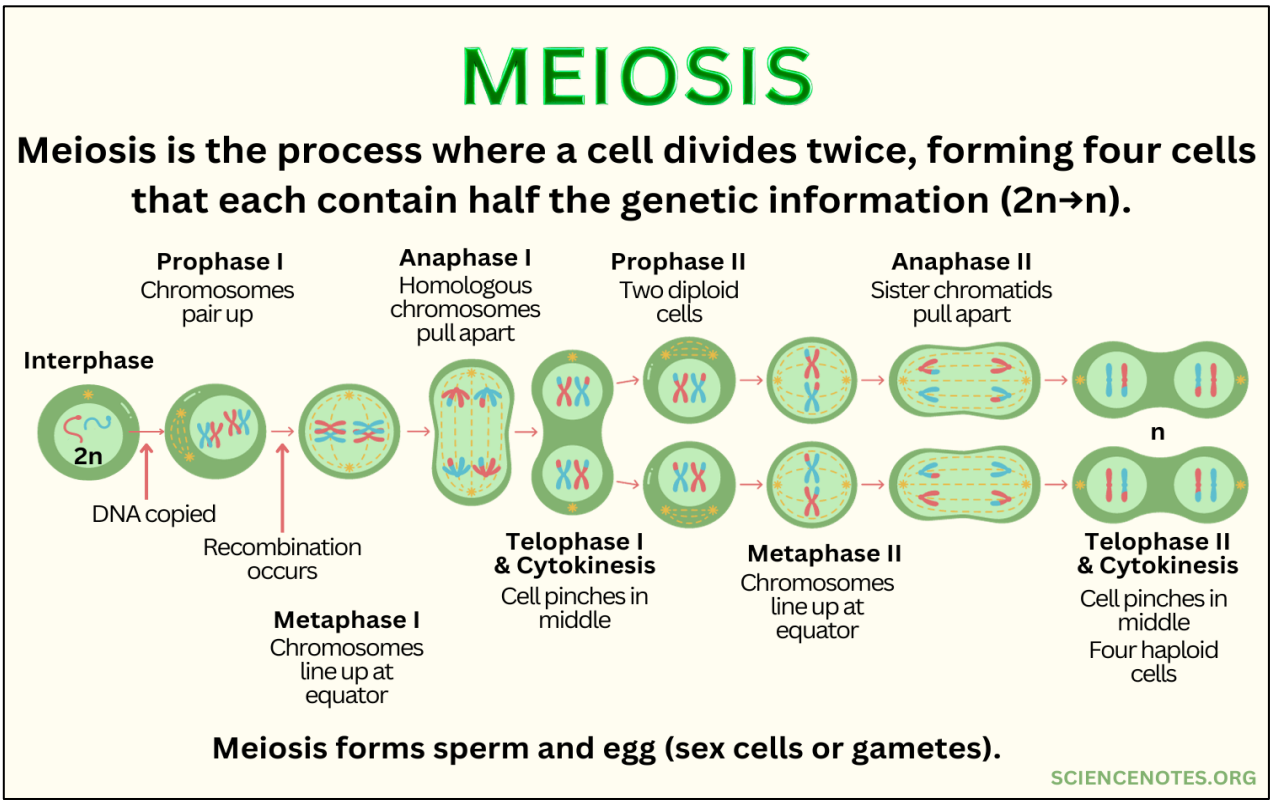


Figure 4: Meiosis Division

Source: Meiosis Definition, Diagram, Steps, and Function

- In meiosis one cell divides twice, forming four cells.
- The daughter cells are haploid (n), having half of the chromosome number of the original cell, which is diploid (2n).
- Meiosis produces sex cells, while mitosis replicates cells from growth and repair. Both begin with DNA replication, but mitosis involves one division step, while meiosis has two divisions.

COMPARISON BETWEEN MITOSIS AND MEIOSIS

Table 1: Difference between Mitosis and Meiosis

Characteristics	Mitosis	Meiosis
Location	Somatic cells	Reproductive cells
Chromosome number of the parent cell	Diploid (2n) or haploid (n)	Haploid (n)
Chromosome number of daughter cell	Diploid (2n)	haploid (n) Haploid (n)
Number of daughter cells produced	two	four
Number of nuclear divisions	One	Two
Steps required to complete the cell division phase	Prophase Metaphase Anaphase, and Telophase	Prophase I, Metaphase I, Anaphase I, Telophase I, Prophase II, Metaphase II, Anaphase II, and Telophase II
Occurrence of synapsis	None	Yes
Occurrence of crossing over	None	Yes
Presence of chiasma	Absent	Present
Present Kind of reproduction associated with	Asexual	Sexual

Table 2 : Role of Mitosis and Meiosis in Cell Division

MITOSIS	MEIOSIS
1. For somatic or body cell production **-** The repeated cell division through mitosis increases the number of somatic cells which is important for the growth of organisms.	**1. For gametes or sex cell production** - The diploid parent sex cells divide twice resulting to four genetically different haploid (N) daughter cells.
2. For asexual reproduction -Unicellular (single-celled) organism reproduce fast and easily by mitosis that will result to the production of genetically identical offspring. Among plants, reproduction is also possible through cloning, grafting and marcotting, all of which do not involve gametes**.**	**2. For sexual reproduction** - Most multicellular organisms start as a single cell – a fertilized egg known as zygote. This zygote is the result of fertilization or the union of a female gamete, an egg, with a male gamete, a sperm that are produced through meiotic cell division.
3. For genetic stability - During mitosis, the resulting two daughter cells have the same type and number of genes as the original parent cell, thereby preserving and maintaining the genetic composition of a particular population.	**3. For genetic diversity** - Complex or multicellular organisms produce gametes that contain only one half of the information carried by the parent gamete. During fertilization, these gametes unite allowing genes from each parent to combine which results to differences in the DNA sequences of offspring.
4. For the repair of damaged cells/ tissues - Mitosis helps in the repair of worn-out body cells and replaces damaged cells and tissues through repeated cell division	**4. Aids in the repair of genetic defects** - Meiotic recombination is also used in DNA repair, whereby pieces of DNA are broken and recombined to produce new combination of alleles (form of gene). Recombination replaces defective gene with the healthy allele giving way to healthy offspring.

The Role of Meiosis in Gametogenesis

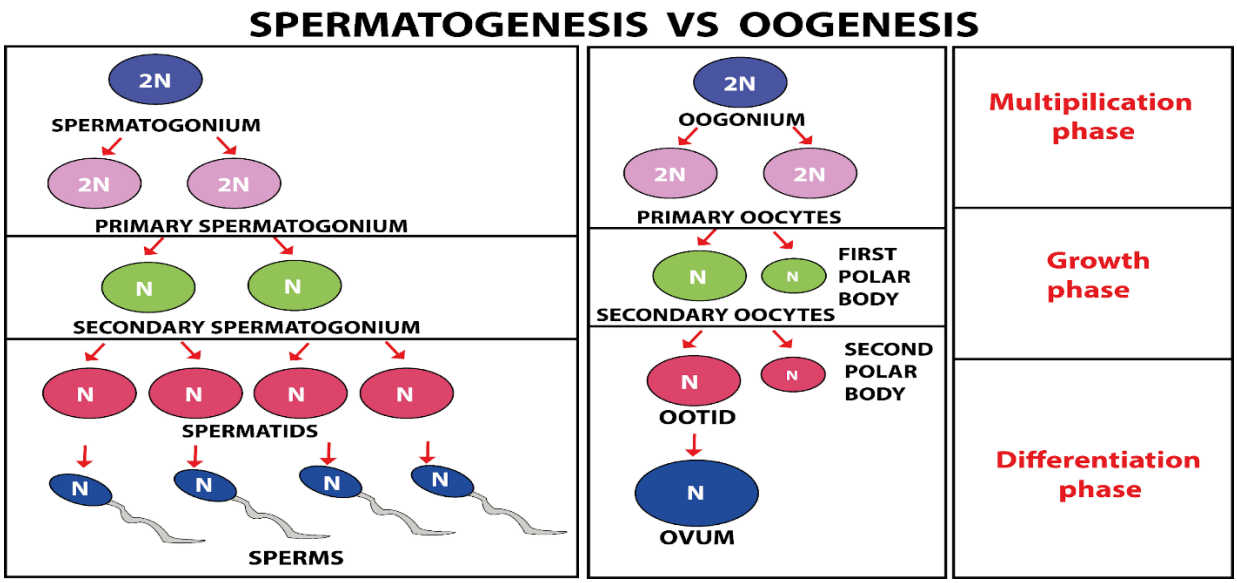


Figure 4 : Showing the difference between the gametogenesis
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Spermatogenesis and Oogenesis

Similarities:

Both involves in the formation of haploid gametes

Both processes involved mitosis, growth and meiosis

Table 3. Difference between Spermatogenesis and Oogenesis

Difference	Spermatogenesis	Oogenesis
Location	testes	Ovary
Number of gametes produces	Lifelong production (millions)	Fixed amount (only 400-mature)
Gametes per germ cell	4 haploid spermatids (sperm cell)	I haploid ovum (egg cell) and 3 polar bodies
Beginning of process	Begins at puberty	Begins during fetal development
Timing of gametes formation	Continuous anytime	Once a month (menstrual period)
End of process	Fertility its lifelong but reduces	Fertility stops at menopause
Timing of gamete release	anytime	Monthly cycle

When Something Goes Wrong During Meiosis

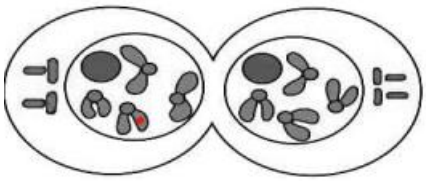
Meiosis may not always proceed normally. Accidents sometimes happen. These may affect the functioning of the spindle fibers or the movement of one or more chromosomes. In humans, some accidents have been known to cause abnormal condition. For example: when chromosomes in pair fail to separate from each other may cause mutation. It is either Human Chromosome Mutation or Human Autosome Mutation: If chromosome # 21 fails to separate it cause Down Syndrome, there are 47 chromosomes instead of 46 that for a normal human. Down Syndrome is usually associated with pregnancy in women above 35 years of age. Another example is the Ed

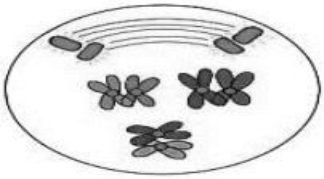
II. PERFORMANCE TASK

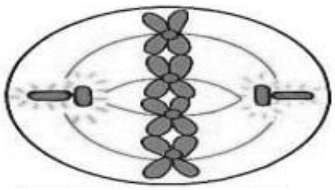
Worksheet 1a.: iLearn

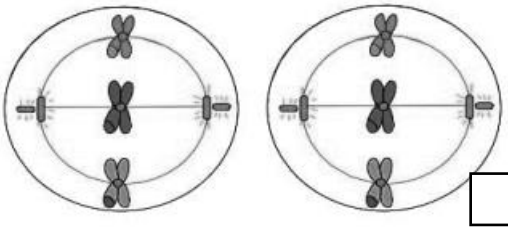
Direction: Use the correct word from the word bank to tell the correct stages of cell division shown below. Each word should be used only once. Write the letter of your answers on a separate sheet of paper. (Hint: Notice the traces of synapsis and crossing over in the chromosomes during meiosis.).

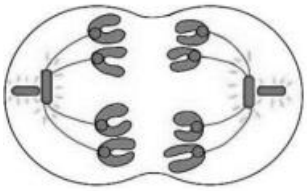
A. Anaphase	D. Metaphase	G. Prophase	J. Telophase
B. Anaphase I	E. Metaphase I	H. Prophase I	K. Telophase I
C. Anapahse II	F. Metaphase II	I. Prophase II	L. Telophase II

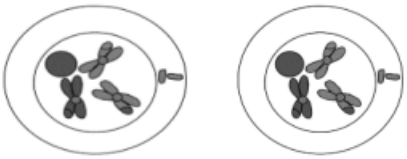
1. 

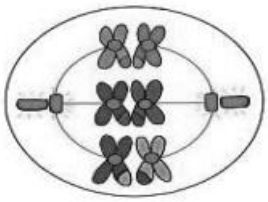
2. 

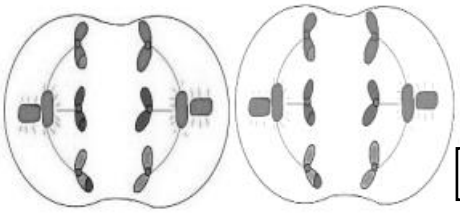
3. 

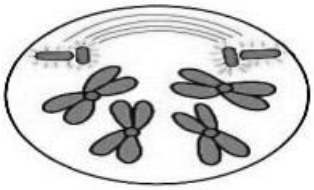
4. 

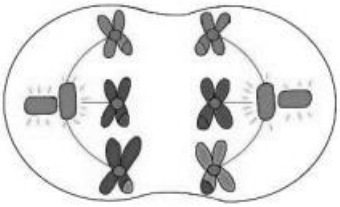
5. 

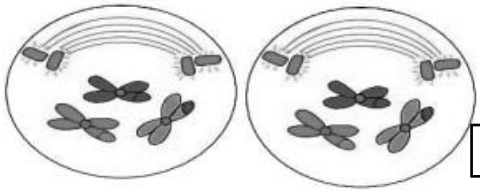
6. 

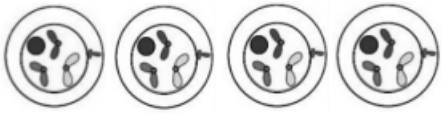
7. 

8. 

9. 

10. 

11. 

12. 

Guide Questions:

1. What is the difference of metaphase in mitosis and meiosis? _____
2. Where does the crossing-over happen and cite the importance of crossing over?

_____

3. How many daughter cells are produced during meiosis division? _____
4. What will happen if homologous chromosomes do not separate during the anaphase stage?

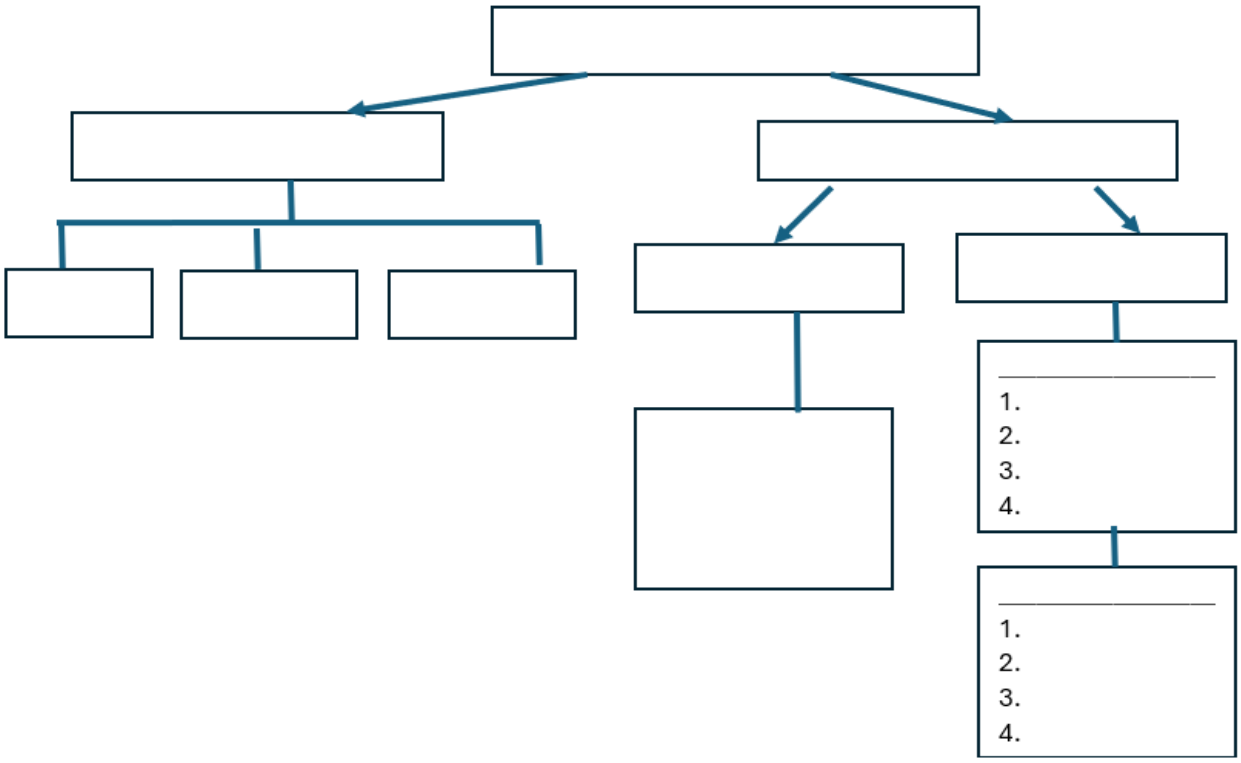
Worksheet 2: TELL ME MORE!

Direction: The table below summarizes the difference between mitosis and meiosis. Write M1 for mitosis, M2 for Meiosis and B3 for both if it describes mitosis or meiosis or both.

Basis for Comparison	Mitosis (M1) Meiosis (M2) Both (B3)
Produce body cell	
Ensure genetic stability	
Divide the parent cell once	
Produce four daughter cells	
Gives way to genetic diversity	
Divide the cell twice	
Produce daughter cell that are the same number of chromosomes with the mother	
Aids in the genetic defects	
Associated with asexual reproduction	
Associated with sexual reproduction	
Helps in the repair of damage cells and tissues	
Occurs in the testes and ovaries (gametogenesis)	
Produce diploid or haploid daughter cell	
Produce two identical daughter cells	
Gives variation to organism	

Worksheet No. 3 Concept Mapping

Summarize the Cell Cycle process with stages of Interphase and stages of Mitosis and Meiosis division in correct sequence. Write your answer in the box provided below.



WRITTEN WORKS: EVALUATION

Direction: Read and understand each question, then choose the correct answer. Write the letter of your choice on a box before each number.

[ ] 1. Meiosis results in the formation of _____
A. 2 haploid daughter cells C. 2 diploid daughter cells
C. 4 haploid daughter cells D. 4 diploid daughter cells

[ ] 2. Which of the following cells undergo meiosis
A. sperm cell B. liver cells C. unicellular organisms D. all of these

[ ] **3.** In what phase of meiosis do synapsis and crossing over happened?
A. Anaphase II B. Interphase I C. Telophase II D. Prophase I

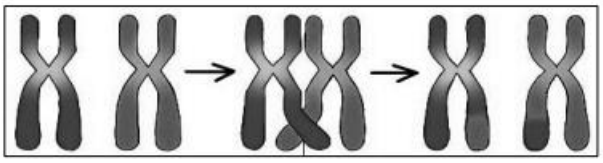
[ ] 4. a. A cell with a diploid number of chromosomes of 46 undergo meiosis 1. How many chromosomes will each resulting daughter cell have? _____

[ ] b. How about in meiosis II?_____
A. 6 B. 12 C. 23 D. 48

[ ] 5. What is the substage of prophase I where pairing of chromosome begins?
A. diplotene B. pachytene C. leptotene D. zygotene

[ ] 6. What stage of development as human being when you were just one cell?
A. infant C. baby
C. fetus D. zygote

[ ] 7. What process is shown in the illustration?



A. synapsis only
B. crossing over only
C. synapsis and crossing over
D. pulling apart of chromosomes

[ ] For item 8, refer to the table below.

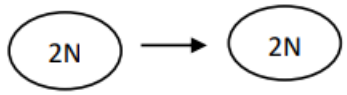
Basis for comparison	Mitosis	Meiosis
Number of daughter cell	2	
Chromosome number	2N or N	

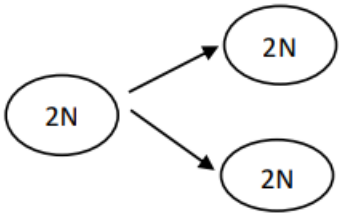
What information is provided to complete column 3 under meiosis?
A. 2-2N or diploid C. 2- 2N or haploid
B. 4-2N or diploid. D. 4-N or haploid

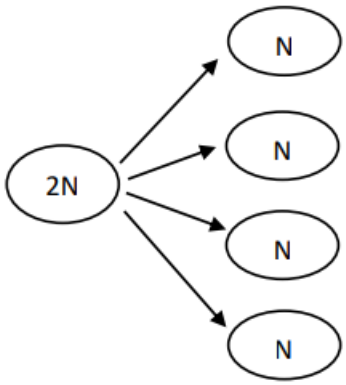
[ ] 9. The following statements are true about meiosis EXCEPT.
A. It occurs in reproductive cells.
B. It results in four haploid (N) daughter cells.
C. Exchanging of genetic materials does not occur.
D. Pulling apart of homologous pairs of chromosomes occurs.

☐ 10. Which diagram is the correctly illustrated the process of meiosis?

A. 

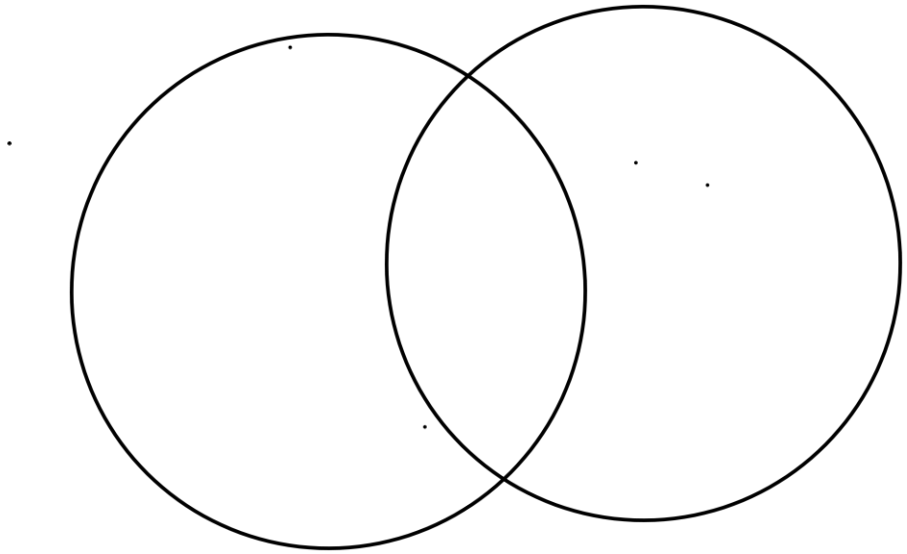
B. 

C. 

D. 

Make a Venn Diagram about sexual (meiosis) and asexual reproduction (mitosis). Write important vocabulary, on the right is mitosis on the left is meiosis in the middle is both. Please refer to the information on the box below.

1 parent	Type of reproduction in living things	2 parents
Exact copies	Pass DNA	Daughter cells are diverse
Somatic cells		Traits from each other
Binary fission		Sperm and Egg



Congratulations you got correct answers! We will now proceed with the next lesson