GENETICS

Lab 1

(2016 - 2017)

Please read and make sure you understand the following instructions and knowledge before you go on.

Revised the Lectures:

- The Cell cycle
- Mitosis phases

1. CELL CYCLE AND MITOSIS

Objective:

Upon completion of this lab, the students should be able to:

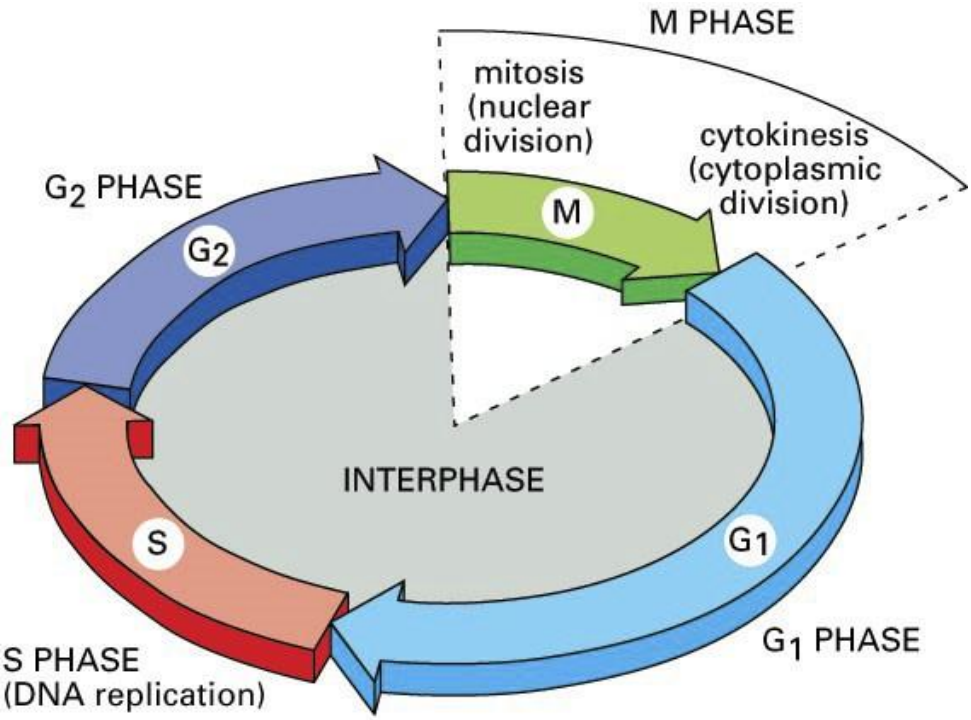
1. Understand the cell cycle process and different stages of mitosis.
2. Identify the various stages of mitosis from slides and sheets.
3. Sketch each mitotic stage and summarize the main events of each stage.
4. Describe the events during each phase of mitosis (number and structure).

Eukaryotic organisms carry out mitosis throughout their entire life to grow, develop, and asexually reproduce (some cases), as well as to renew the old and damaged cells.

CELL CYCLE

The cell cycle is the series of events that take place in a cell leading to its division and duplication (replication). In cells without a nucleus (prokaryotic), the cell cycle occurs via a process termed binary fission. In cells with a nucleus (eukaryotes), the cell cycle can be divided in three periods: **interphase**—during which the cell grows, accumulating nutrients needed for mitosis and duplicating its DNA—and **the mitotic**

(M) phase, during which the nucleus of the cell splits itself into two, forming two "daughter cells" that is completely divided in the final phase, **cytokinesis**.



Interphase

The cell cycle occurs from the completion of one division until the completion of the next division. It involves 2 phases: Interphase (G1, S and G2) and Mitosis (M) followed by Cytokinesis (C). The period between M and S is called G_1 stage and that between S and M is G_2 stage. The cell spends 90% of its time in Interphase and only 10% in Mitosis but, the duration of each phase and stage in eukaryotic cells depends on the cell type.

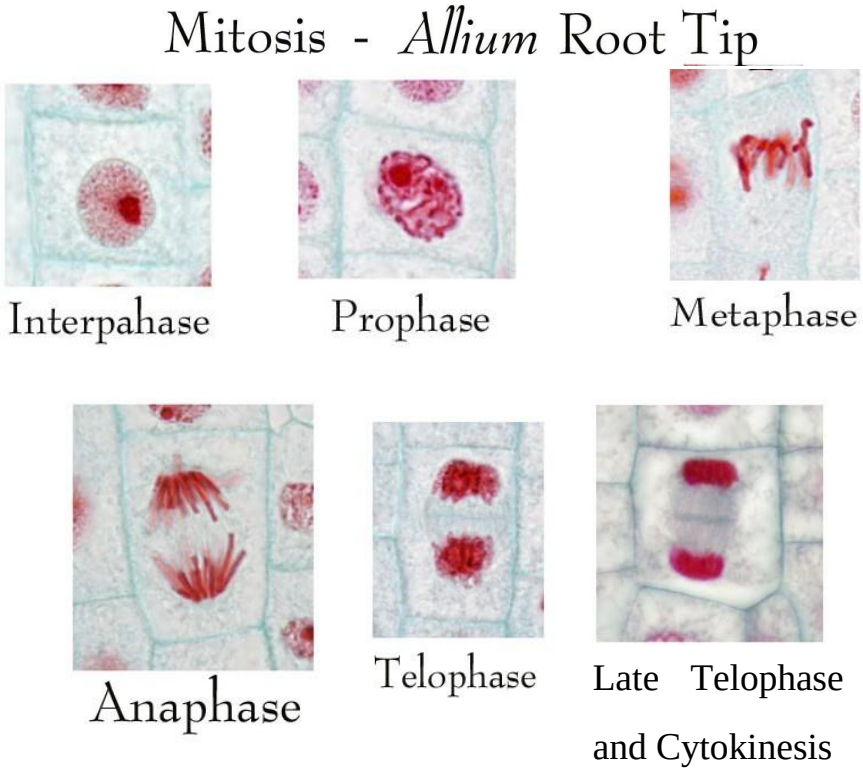
Mitosis

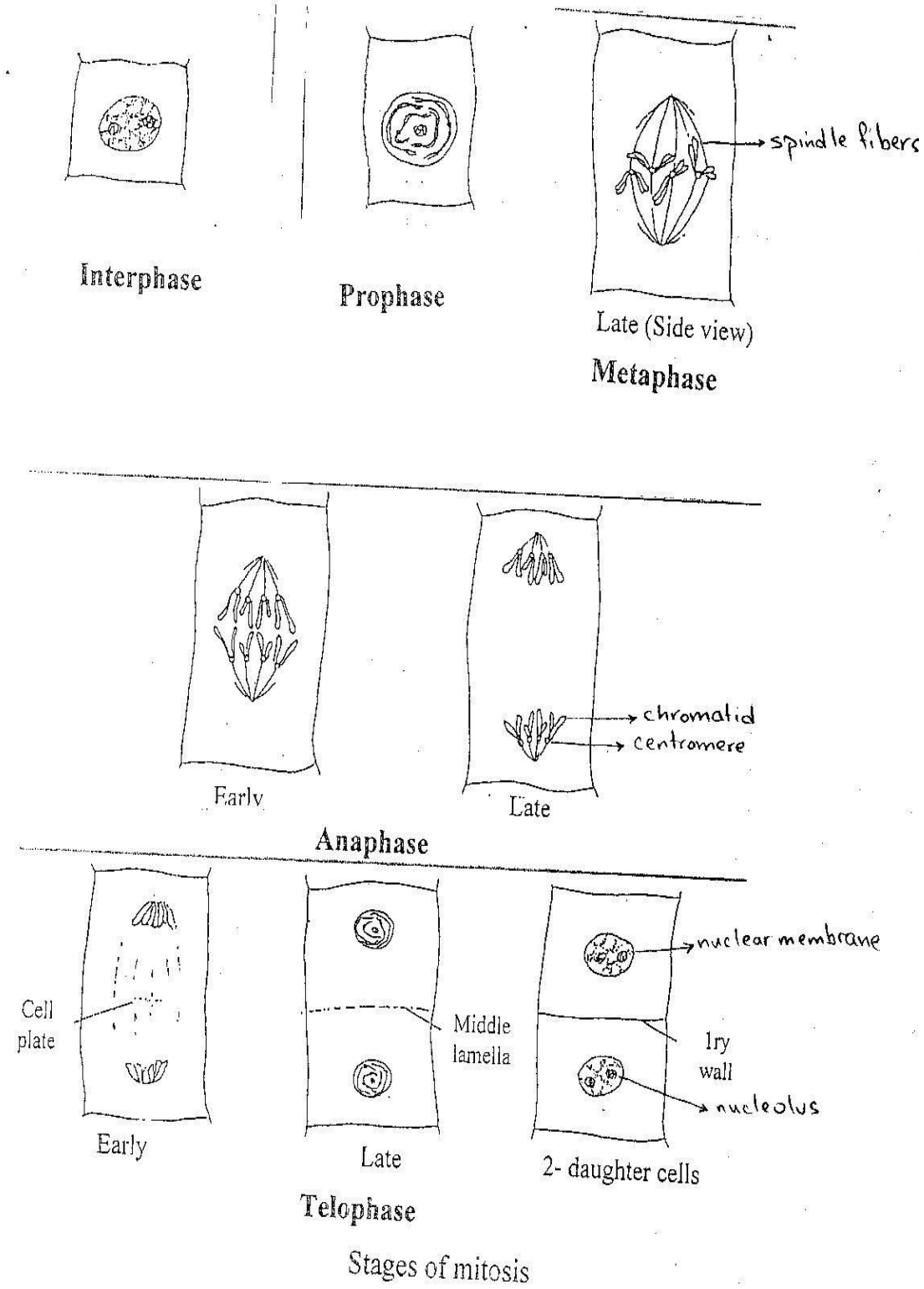
Cell growth stops at this stage and cellular energy is focused on the orderly division into two daughter cells.

The relatively brief *M phase* consists of nuclear division (karyokinesis). It is relatively short period of cell cycle. M phase is complex and highly regulated. The sequence of events is divided into phases, corresponding to the completion of one set of activities and the start of the next. These phases are sequentially known as prophase, metaphase, anaphase and telophase.

Cytokinesis

It is not part of mitosis but is an event that directly follows mitosis in which cytoplasm is divided into two daughter cells, each with the same number and same quality of chromosomes, but with different structures (dyads to monads). The cell then enters interphase - the interval between mitotic divisions.





Stages of mitosis

II. MEIOSIS

Objectives:

Upon completion of this lab, the students should be able to:

- Understand the different stages of meiosis.
- Describe the events during each phase of meiosis (number and structure).
- Put the stages of meiosis (I and II) in the proper order.

Please read and make sure you understand the following instructions and knowledge before you go on.

- Revised the Lecture: Meiosis

Introduction

Meiosis is a special type of cell division necessary for sexual reproduction in eukaryotes, such as animals, plants and fungi. The number of sets of chromosomes in the cell undergoing meiosis is reduced to half the original number, typically from two sets (diploid) to one set (haploid) known as gametes.

Meiosis takes place in two stages, Meiosis I where reduction in chromosome numbers and crossing-over occurs; and Meiosis II, which is similar to Mitotic cell division and reduction in chromosome structures occurs. Meiosis I and Meiosis II have four phases each. They are:

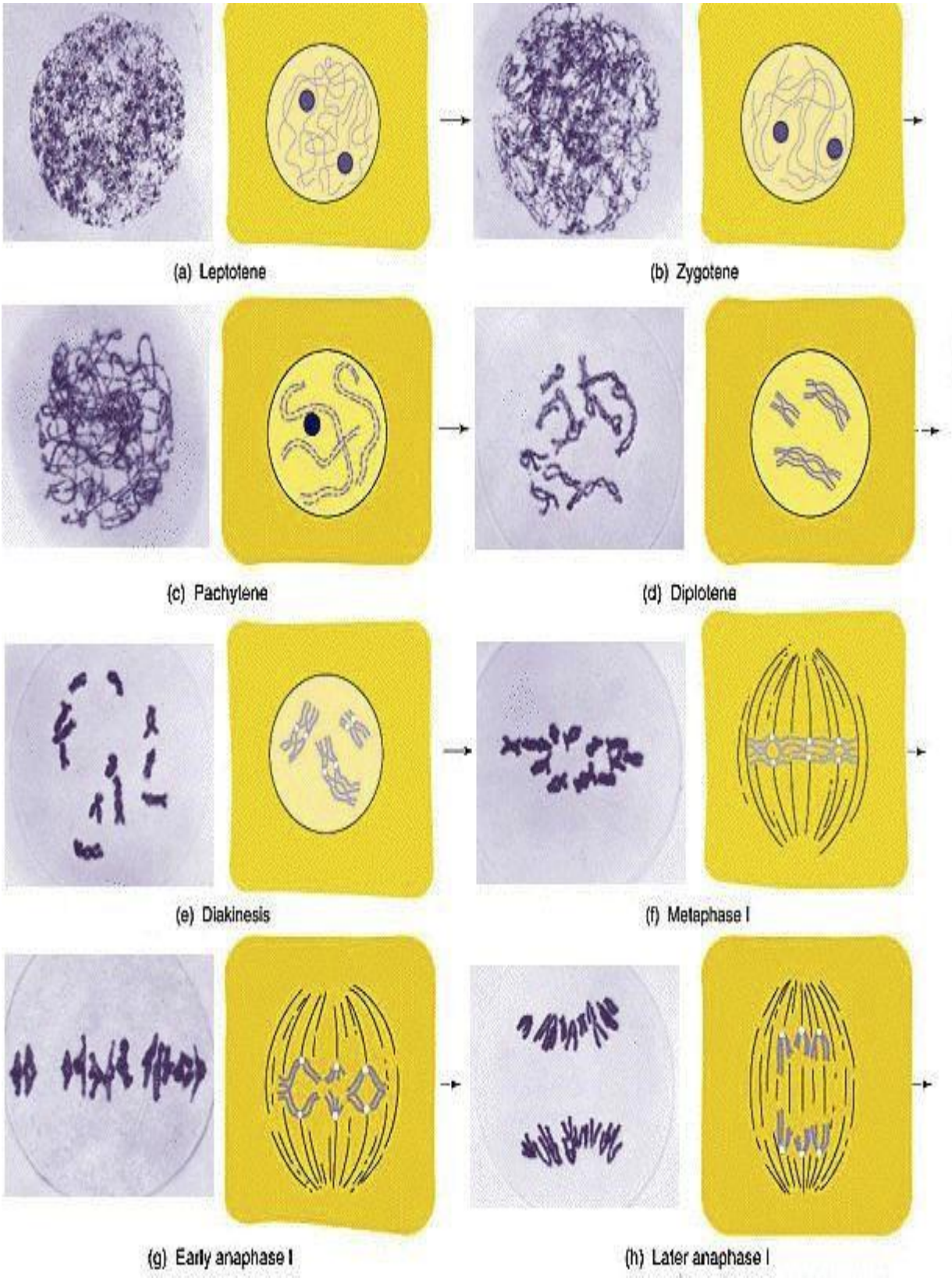
Meiosis I: prophase 1, metaphase 1, anaphase 1, and telophase 1 and Meiosis II: prophase 2, metaphase 2, anaphase 2, and telophase 2.

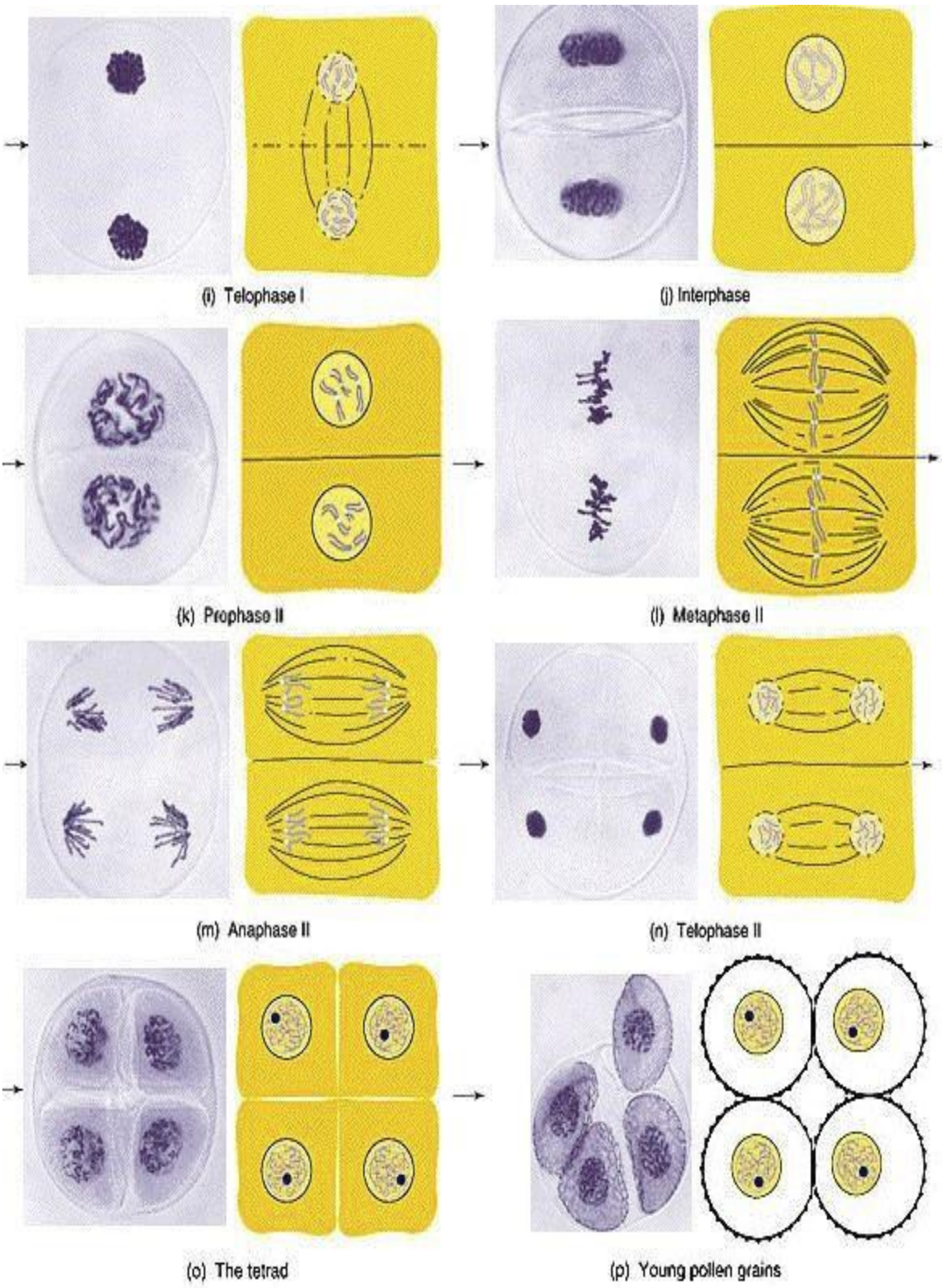
Meiosis I starts with a complete Interphase in which the monad becomes dyad. Meiosis II in contrary has no complete interphase (interkinesis) as there is no S-phase and dyad becomes monad.

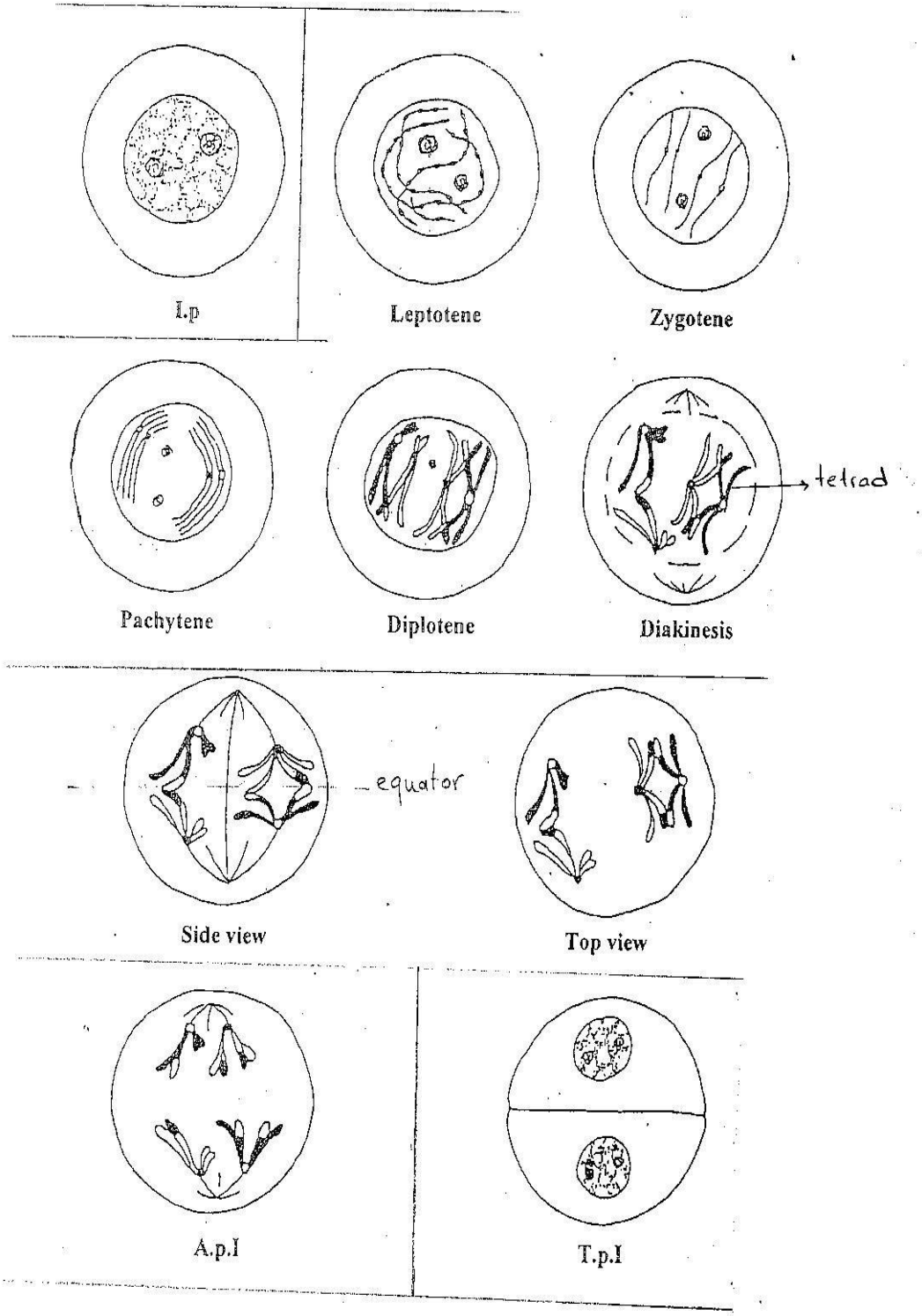
Interphase I	→	Meiosis I	→	Interkinesis	→	Meiosis II.
Monad to dyad		Dyad		Dyad		Dyad to monad
2n		2n to n		n		n

Crossover occurs in Prophase I. it consist of 5 critical substages: leptotene, zygotene, pachytene, diplotene and diaknesis.

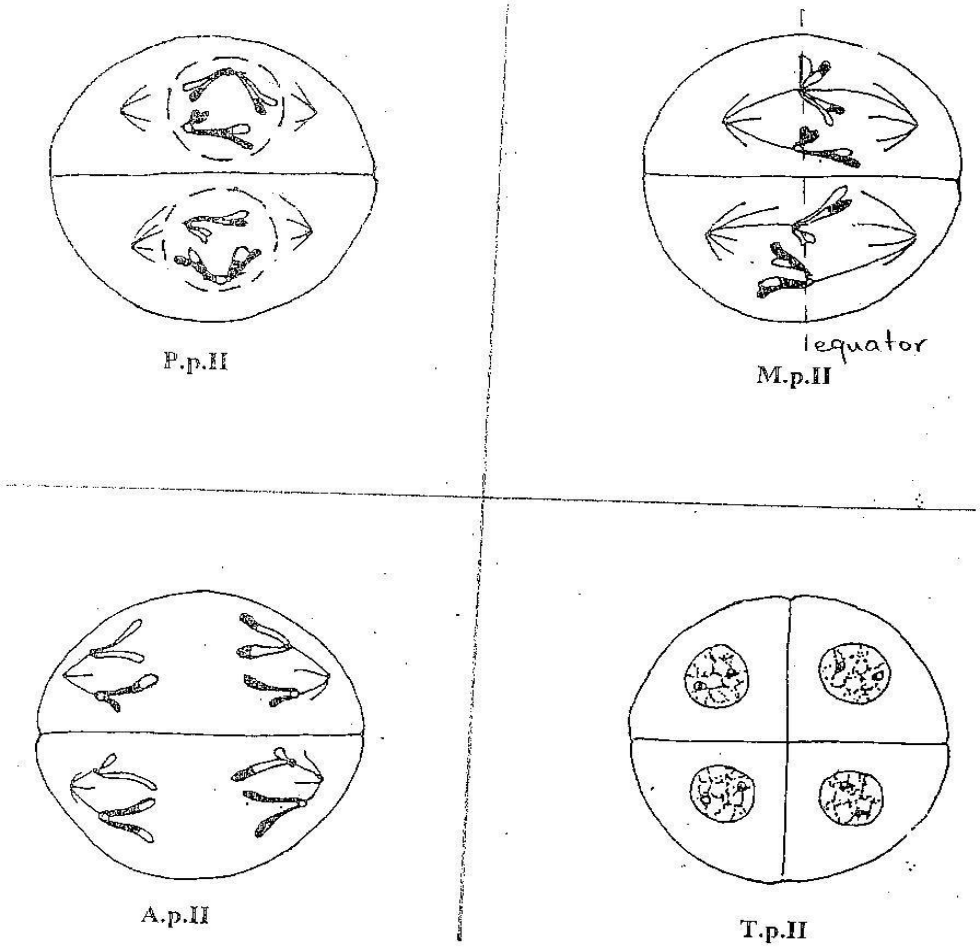
Anaphase I and II are the stages in which reduction in number or structure happens.


(a) Leptotene
(b) Zygotene
(c) Pachytene
(d) Diplotene
(e) Diakinesis
(f) Metaphase I
(g) Early anaphase I
(h) Later anaphase I


(i) Telophase I
(j) Interphase
(k) Prophase II
(l) Metaphase II
(m) Anaphase II
(n) Telophase II
(o) The tetrad
(p) Young pollen grains



Meiosis, stages of the first division.

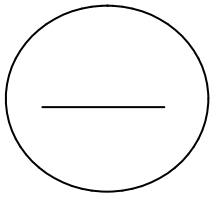


Meiosis, stages of the second division.

Student name: **Code number:**

STUDENT'S ASSINMENT

Give it to your laboratory instructor



<u>Question 1</u>: Choose the correct answer:

1. The stage of the cell cycle where each chromosome is composed of two chromatids in preparation for mitosis.

a. G1 b. S c. M d. G2

2. During which stage of mitosis do the centromeres split?

a. Prophase b. Metaphase c. Anaphase d. Telophase

3. During which stage of mitosis does the nuclear envelope begin to disappear?

a. Prophase b. Metaphase c. Anaphase d. Telophase

4. The pinching off of the cell membrane that creates two new cells (after mitosis) is called

a. Interphase b. Mitosis c. Cytokinesis d. Meiosis

5. A cell with 10 chromosomes undergoes mitosis. How many daughter cells are created? ___ Each daughter cell has ___ chromosomes.

a. 2, 10 b. 10, 2 c. 1, 10 d. 2, 20

Question 2: Put right or wrong and correct the wrong sentences:

1. The number of chromosomes in gametes produced by meiosis is twice the number of chromosomes in daughter cells produced by mitosis.

2. When we examine a skin cell during one complete cell cycle, we can never observed synapsis and crossing over.

3. The number of cells produced by meiosis is half the number of cells produced by mitosis.

4. The process of pairing the homologous chromosomes is called synapsis.

5. Prophase I of meiosis is similar to prophase of mitosis.

Question 3: Choose the correct answer of the following:

- The formation of a cell plate is beginning across the middle of a cell and nuclei are reforming at opposite ends of the cell. What kind of a cell is this?

  a. An animal cell in metaphase
  b. An animal cell in telophase
  c. An animal cell undergoing cytokinesis
  d. A plant cell in metaphase
  e. A plant cell in metaphase
  f. A plant cell undergoing cytokinesis

- Synapsis and crossing over occurs during which of the following phases of meiosis

  a. Interphase
  b. Prophase I
  c. Anaphase I

d. Prophase II

e. Telophase II

- If there are 12 chromosomes in a plant cell in the G1 stage of the cell cycle, what is the diploid number of chromosomes for this organism?

a. 6

b. 12

c. 24

d. 36

e. 48

- Which of the following is false in comparing prophase I of meiosis and prophase of mitosis?

a. The chromosomes condense in both.

b. Tetrads form in both

c. The nuclear envelope disassembles in both

d. A spindle forms in both

e. Each chromosome has two chromatids in both

- The process of male gamete formation is called

A. oogenesis. B. spermatogenesis. C. cytokinesis.

- The chromatids of a tetrad wrap around each other, break, and rejoin resulting in the exchange of genes. This is called

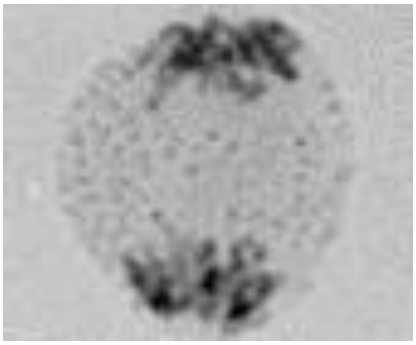
A.synapsis. B. mitosis. C. crossing-over. D. meiosis.

- What is needed for fertilization?

A. sperm only B. egg only C. both sperm and egg

- A cell produced by meiosis has the ____ number of chromosomes.
  a. diploid
  b. haploid
  c. triploid
  d. double
- In plants, meiosis occurs within the special reproductive structures called
  a. flowers.
  b. gonads.
  c. hospitals.
  d. Punnett squares.
- Complex organisms produce sex cells that unite during fertilization, which forms a single cell known as
  A. a gonad.
  B. a zygote.
  C. an embryo.
  D. a gamete.
- Circle the correct option to identify the phases of meiosis depicted below.

  a. Prophase I
  b. Anaphase II
  c. Telophase I
  d. Metaphase I



a. Prophase I

b. Metaphase I

c. Anaphase I

d. Telophase II

a. Prophase II

b. Metaphase II

c. Anaphase II

d. Telophase II

<u>Question 4:</u> True or False:

____ Meiosis occurs in animals but does not occur in plants.

____ Meiosis reduces the chromosome number from diploid to haploid.

____Four chromatids of a homologous chromosome pair are a tetrad.

____Meiosis occurs in animals but does not occur in plants.

____Meiosis reduces the chromosome number from diploid to haploid.

WORK SHEET

1. Examine the demonstrated slides under microscope to see all the mitotic stages and draw them below. Indicate the chromosome number and structure of each stage.

	Interphase	**Mitosis**	
		Prophase	**Metaphase**
Draw			
Chromosome number			
Chromosome structure			
		Anaphase	**Telophase**
Draw			
chromosome number			
chromosome structure			

2. Examine the demonstrated slides under microscope to see all the meiotic stages and draw them below. Indicate the chromosome number and structure of each stage.

	PHASES				
	INTERPHASE	**MEIOSIS I**			
		PROPHASE I Leptotene	**PROPHASE I Zygotene**	**PROPHASE I Pachytene**	**PROPHASE I Diplotene**
Draw					
Chromosome number					
Chromosome structure					

	PHASES (cont.)			
	MEIOSIS I			
	PROPHASE I **Diaknesis**	**METAPHASE I**	**ANAPHASE I**	**TELOPHASE I**
Draw				
Chromosome number				
Chromosome structure				

	PHASES (cont.)			
	MEIOSIS II			
	PROPHASE II	**METAPHASE II**	**ANAPHASE II**	**TELOPHASE II**
Draw				
Chromosome number				
Chromosome structure				