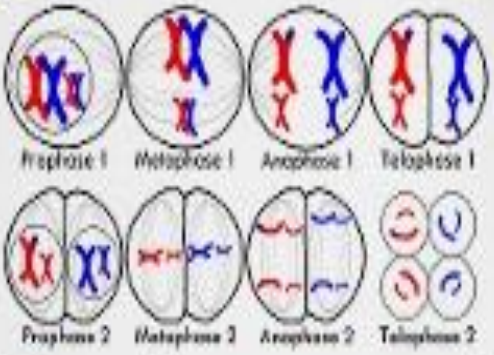
MEIOSIS



(Results may vary.)

"MEIOSIS"

SEXUAL CELL REPRODUCTION

Meiosis: The meiosis is a specialized type of nuclear division which divides a diploid cell into four haploid daughter cell. Like mitosis is preceded by the replication of each chromosome to form two chromatids attached at a centromere.

However, two events that do not occur in mitosis include final reduction of the chromosome number by half and production of new genetic combinations. Meiosis reduces the chromosome number by including two rounds of chromosome separation called Meiosis I and II. Thus, the genetic material is replicated once just before meiosis but divided twice during meiosis. This allocates half the original number of chromosomes (one of each original pair) to each daughter cell; that is, the nuclei are haploid.
The meiosis I is a reductional division producing two haploid cells from a single diploid cell. The meiosis II is an equational division which spaerates the sister chromatids of the haploid cells, the products of meiosis I.

Where does meiosis occur during sexual cell cycle?

Meiosis ---> produces cells half chromosomal number = 23 (sperm & egg - haploid)

Fertilization (sperm + egg) -----> diploid life cell (chromosomal number = 46)

A. Meiosis I

Before undergoing the meiosis I, each cell remains in the **interphase** during which the genetic materials are duplicated due to active DNA replication. The meiosis I includes a long prophase, metaphase, anaphase and telophase.

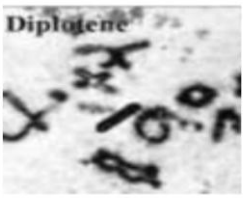
Prophase-I
Prophase-I is a very long phase, it is divided into five-sub-phases.

Leptonema:- (leptos = thin; taenia = band / stripe) The chromosomes in the beginning of the prophase-I are very thin and so can be hardly seen. The word "Lepto" means a "thin thread'. When all the chromosomes after duplication due to replication of DNA, consists of two chromatids each, they (chromosomes) become more distinct. The two chromatids of each chromosome are twined round each other so that each chromosomes does not appear to be double. Sometimes the chromosomes also appear to have small nodules known as "**Chromomeres**."

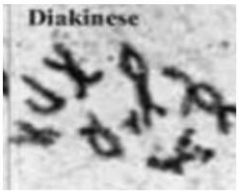
Zygonema:- (zygon = touching another) In this phase the homologous chromosomes come adjacent to each other to form pairs **(Synapsis)**. The paired chromosomes are known as "**bivalents**".

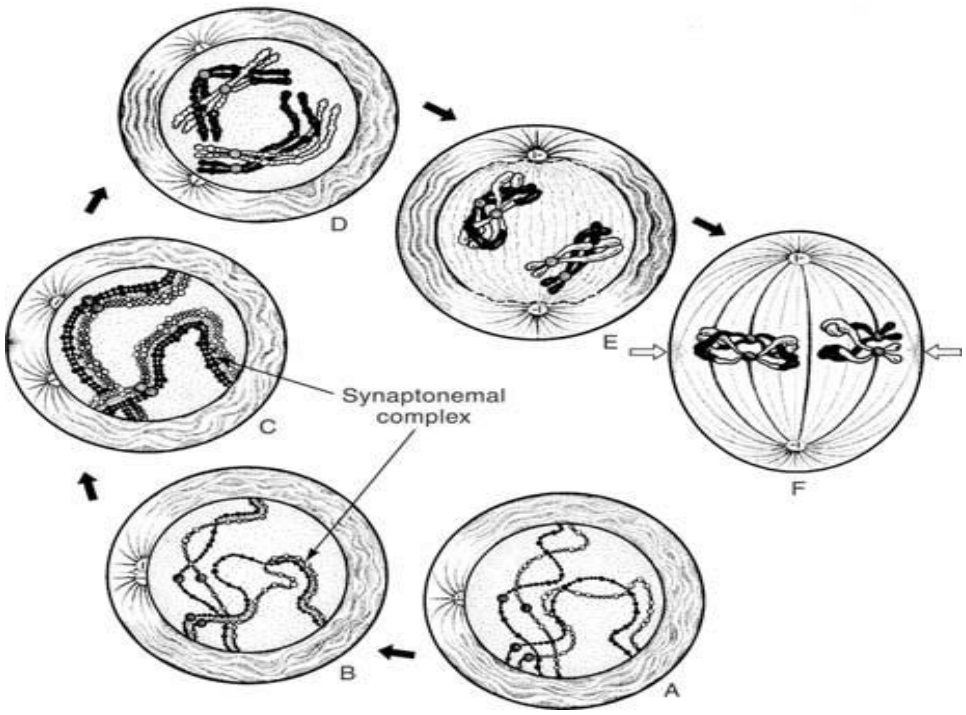
Pachynema:- (pachus = dik) The chromosomes become thick and dense on the completion of pairing in this phase. The chromatids become very distinct. As they are paired, there appear to be four chromatids in all"**tetravalent**".
Crossing over is now exhibited by the inner chromatid of each homologous pair of chromosome.

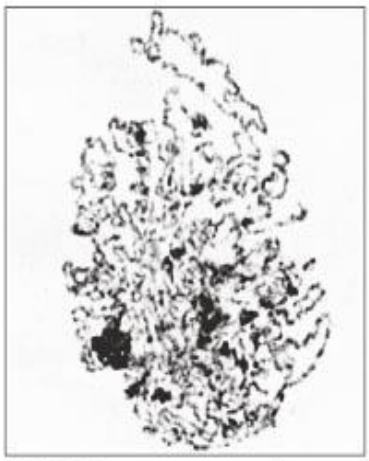
Diplonema:- (diplous = in twofold)It is comparatively a longer sub-phase. The chromosomes in each pair now stay moving away from each other. The inner chromatids are in a state of crossing over and remain attached at some loci. These loci are referred to as **chiasmata**.



Diakinesis:- (dia = apart; kinein = to move) In sub-phase Diakinesis there is an increase in the opposite pulling between the homologous chromosomes. Because of this the chromatids **break at the chiasmata** and **exchange their parts**. The opposite pulling of the homologous chromosomes here does not take them away from each other but they remain nearby.







Leptotene

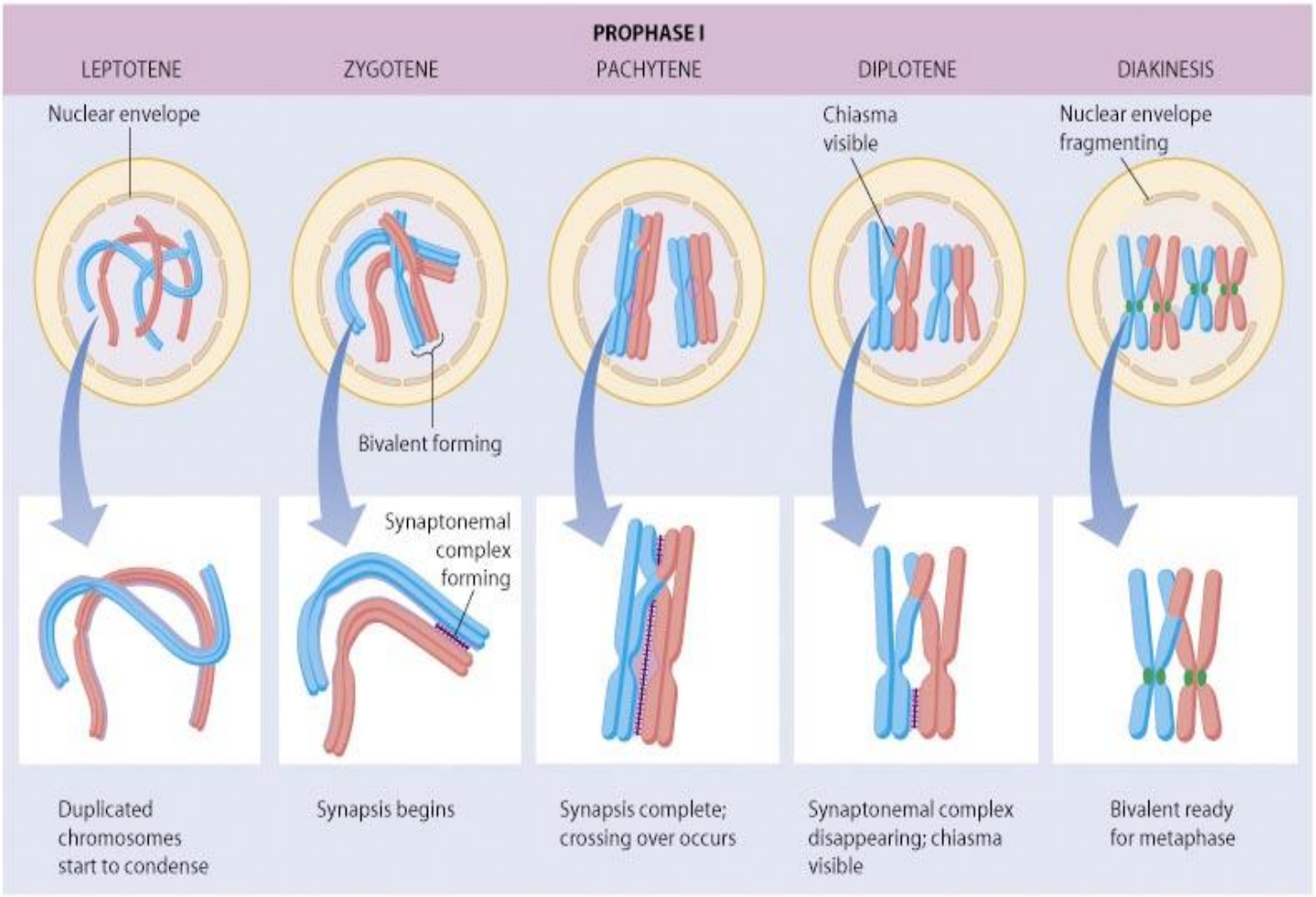
10 μm

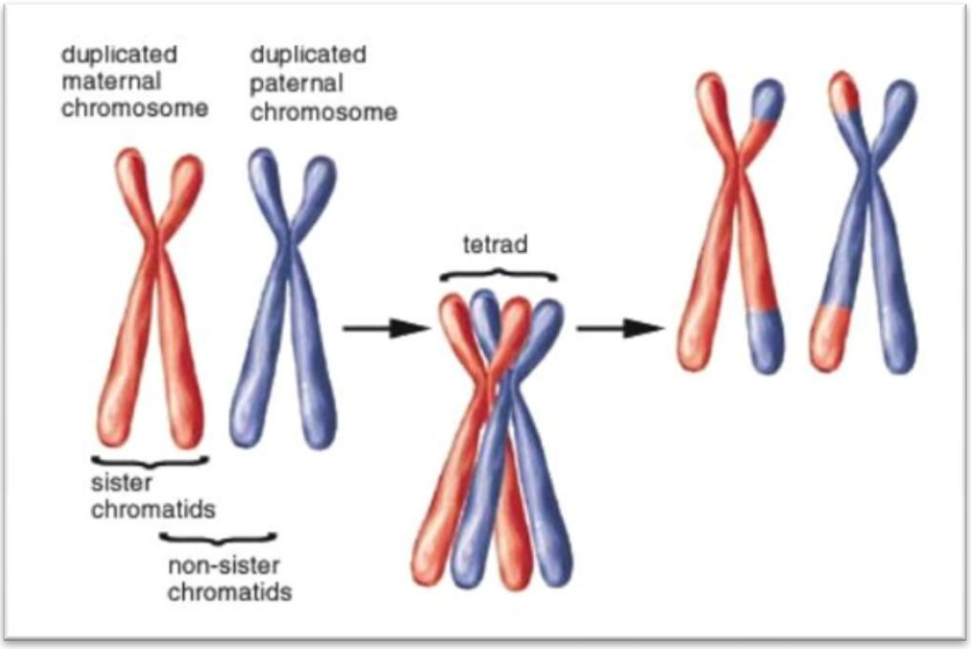
Zygotene

Pachytene

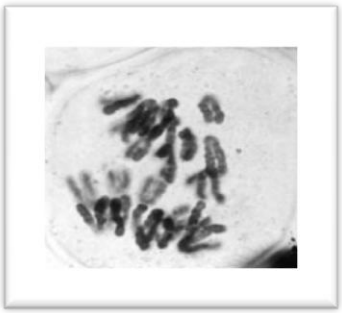
Diplotene

Diakinesis

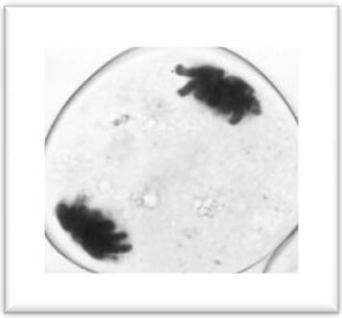




Metaphase-I: The nuclear division in Metaphase-I is just like that in mitosis. The period before the metaphase becoming clearly distinct is known as pro-metaphase. At this moment the nuclear membrane starts disappearing. The spindle fibers developing from the centrosome and get attached to the centromeres of the chromosomes. As seen in Diakinesis the homologues pair of chromosomes still remain near each other so that the two chromosomes of each homologous pair get attached to the spindle fibers of the opposite ends. As a result the chromosomes appear to be arranged in two lines on equatorial plane of the nuclear spindle.



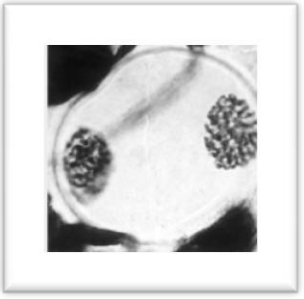
Anaphase-I:- In the sub-phase Anaphase-I the chromosomes of each homologous pair are pulled towards the opposite ends because of the contraction and ultimate shortening of spindle fibers.



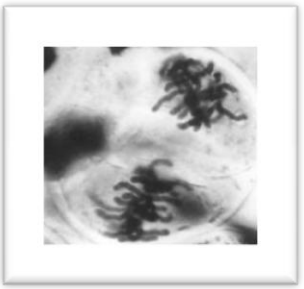
Telophase-I:- The nuclear spindle disappears on completion of the contraction of the spindle fibers. A new nuclear membrane is formed and two daughter nuclei come into existence. Each daughter nuclei has half the number of Chromosomes.

B. Meiosis II

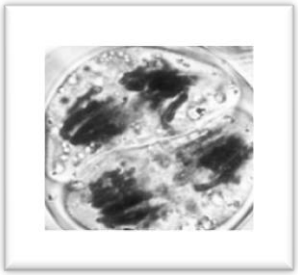
interphase II (interkinesis) do not generally occuring in samples of meiottic divisions. In many organismd these phase are even skipped; this implies that no new nuclear membrane is built around the two nuclei after anaphase I and that the cell directly proceeds to meiosis II. In other organisms telophase I and interkinesis last very shortly; the chromosome temporarily despiralize and are less visible for a period, while a nuclear membrane is formed around each new nucleus. Whatever there is no doubling of the DNA, thus also no crossing-over among chromosomes.



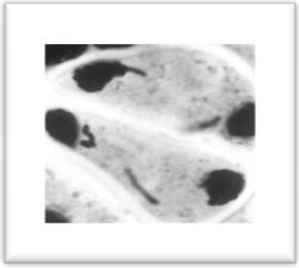
Prophase II: This stage at the beginning of meiosis II is characterized by the presence of a haploid number of chromosomes that condense again.



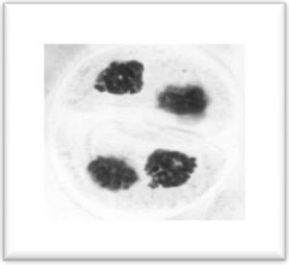
Metaphase II: The chromosomes move again to the equatorial plane between the poles. However, this plane is same to the equatorial plan of Metaphase I.



Anaphase II: The centromeres separate and the chromatides are pulled by the spindle microtubules to opposite poles.



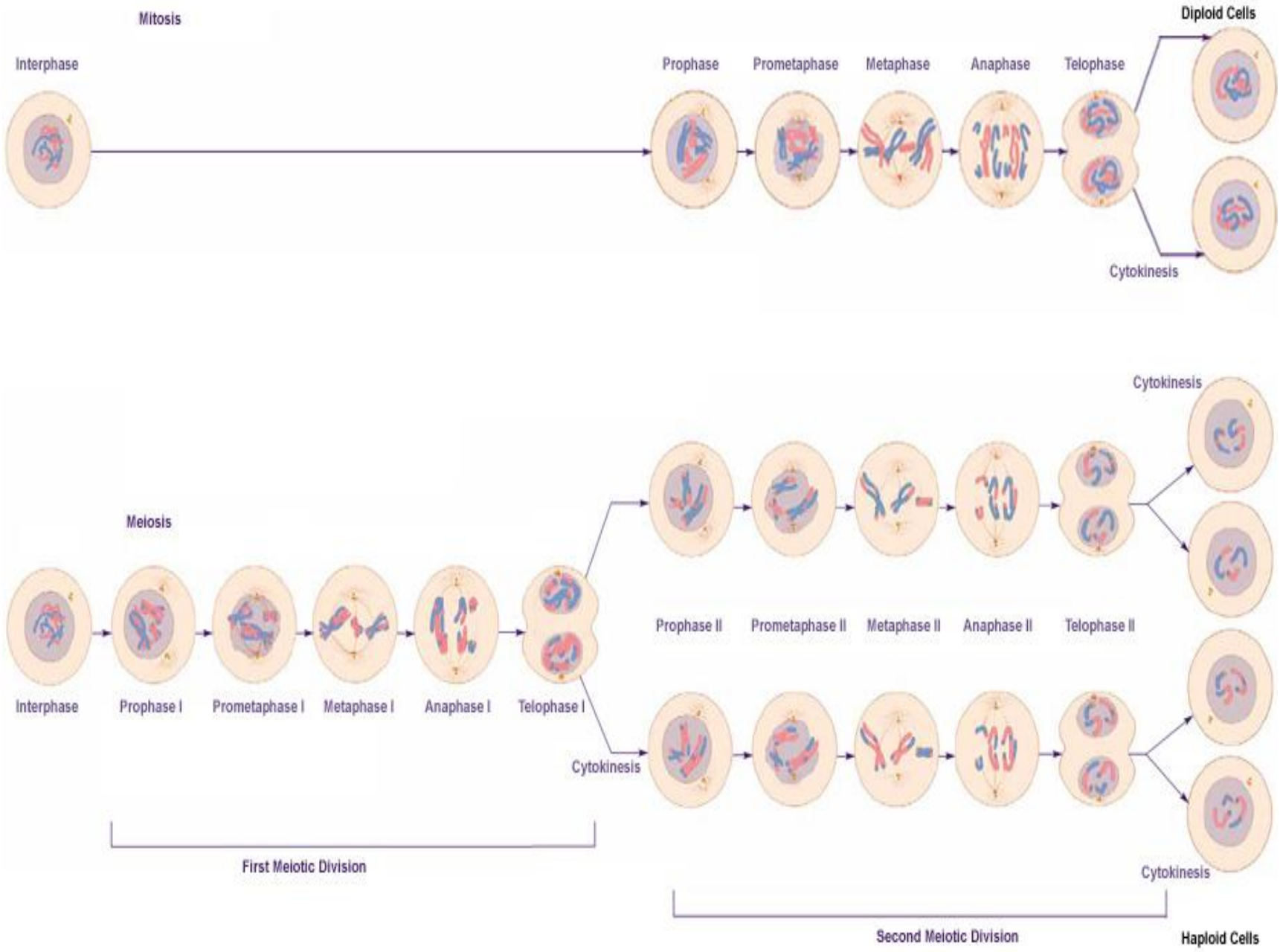
Telophase II: By the end of meiosis II a new nuclear envelop is formed around each of the four new nuclei, while the chromosomes despiralize.



Tetrad: [tetra = four] is the name given to the period within post-meiostic differentiation during which the four microspores are still together. They are only separated by a temporary cell wall.

Comparison between Meiosis and mitosis:

	Meiosis	Mitosis	
Occurrence of Crossing Over:	Yes	No	
Occurs in:	Humans, animals, plants, fungi	all organisms	
Number of Daughter Cells produced:	4	2	
Creates:	Sex cells only: Female egg cells or Male sperm cells	Makes everything other than sex cells	
Definition:	A type of cellular reproduction in which the number of chromosomes are reduced by half through the separation of homologous chromosomes in a diploid cell.	A process of asexual reproduction in which the cell divides in two producing a replica, with an equal number of chromosomes in haploid cell	
Produces:	four haploid daughter cells	two diploid daughter cells	
Steps:	The steps of meiosis are Interphase, Prophase I, Metaphase I, Anaphase I, Telophase I, Prophase II, Metaphase II, Anaphase II and Telophase II.	The steps of mitosis are Interphase, Prophase, Metaphase, Anaphase, Telophase and Cytokinesis	
Discovered by:	Oscar Hertwig	Walther Flemming	
Type of Reproduction:	Sexual	Asexual	
Genetically:	different	identical	
Cytokenesis:	Occurs in Telophase I & Telohpase II	Occurs in Telophase	
Number of Divisions:	2	1	
Pairing of Homologues:	Yes	No	
Function:	sexual reproduction	Cellular Reproduction & general growth and repair of the body	
Chromosome Number:	Reduced by half	Remains the same	
Karyokenesis:	Occurs in Interphase I	Occurs in Interphase	
Crossing Over:	Mixing of chromosomes	Does not occur	
Centromeres Split:	The centromeres do not separate during anaphase I, but during anaphase II	The centromeres split during Anaphase	


Mitosis
Interphase
Prophase
Prometaphase
Metaphase
Anaphase
Telophase
Diploid Cells
Cytokinesis
Meiosis
Interphase
Prophase I
Prometaphase I
Metaphase I
Anaphase I
Telophase I
Cytokinesis
Prophase II
Prometaphase II
Metaphase II
Anaphase II
Telophase II
Cytokinesis
First Meiotic Division
Second Meiotic Division
Haploid Cells

SUMMARY OF MEIOSIS

1. Nuclear division phase of sexual cell reproduction
2. Two successive divisions, results in 4 daughter cells...Meiosis 1 and Meiosis2.
3. Reduction/division occurs.... diploid ----> haploid daughter cells ½ number of parent cell chromosomes.
4. Stages have same nomenclature as Mitosis
   prophase, metaphase, anaphase, telophase, M1 & M2
5. Only one S phase, where DNA is duplicated
   often may be no interphase between M1 & M2
6. Homologs separate in Meiosis 1
   Chromatids separate in Meiosis 2 (mitotic-like)
7. Random Assortment occurs..... homologs align
   at equitorial plates independent of each other
8. Crossing over... may occur in Prophase I...
   synapsis = close pairing homologs allows exchange
   chiasma = point exchange of sister chromatids

PROCEDURE FOR PREPARING MEIOTIC STAGES FROM ANTER

You will do the same procedures that you have done before with root tip but we use now very young flower anther.