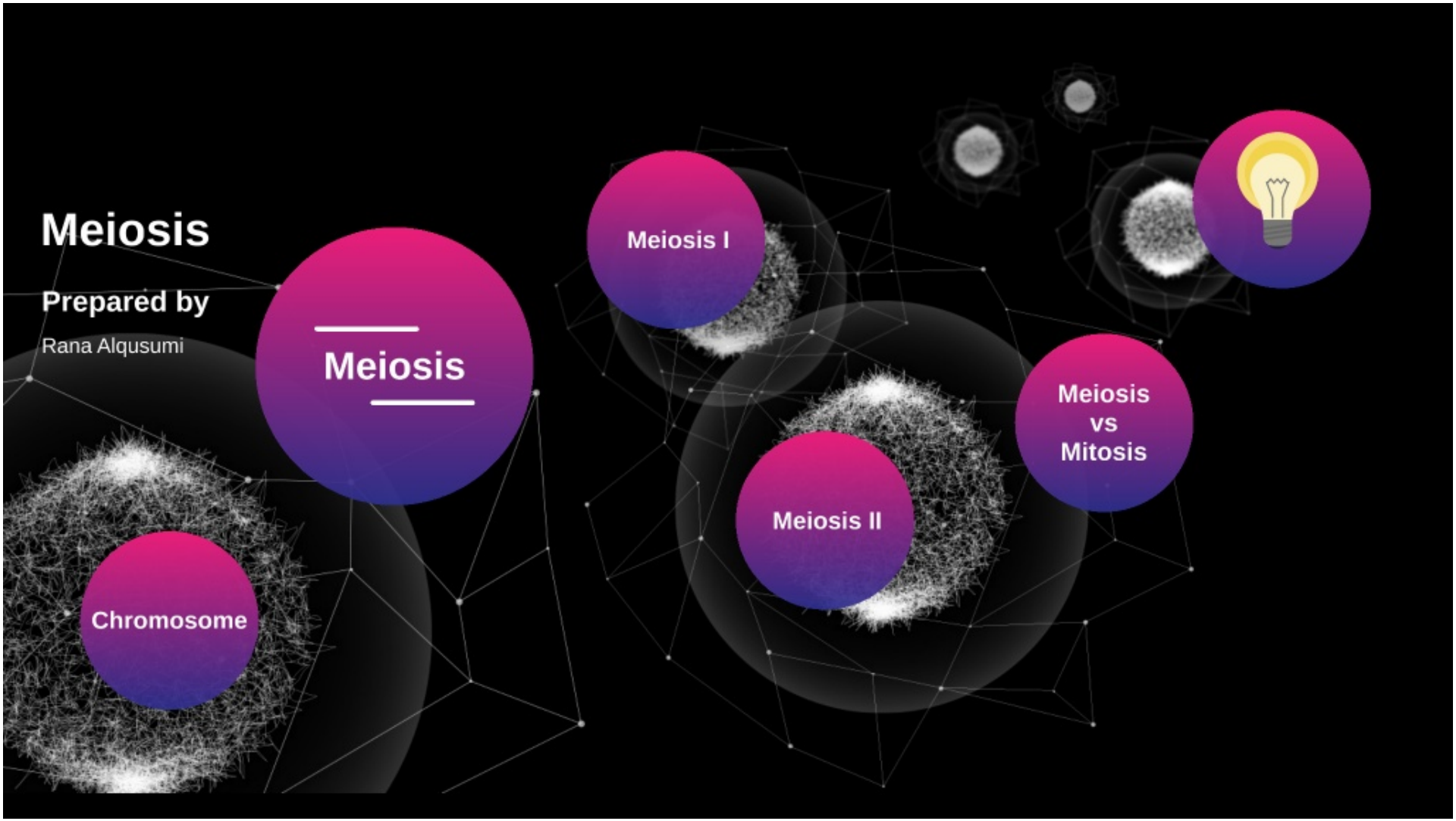
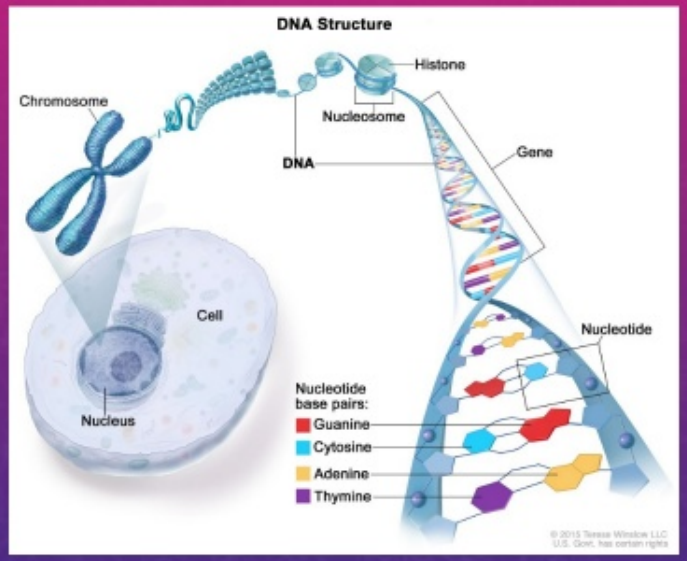
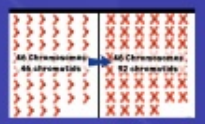
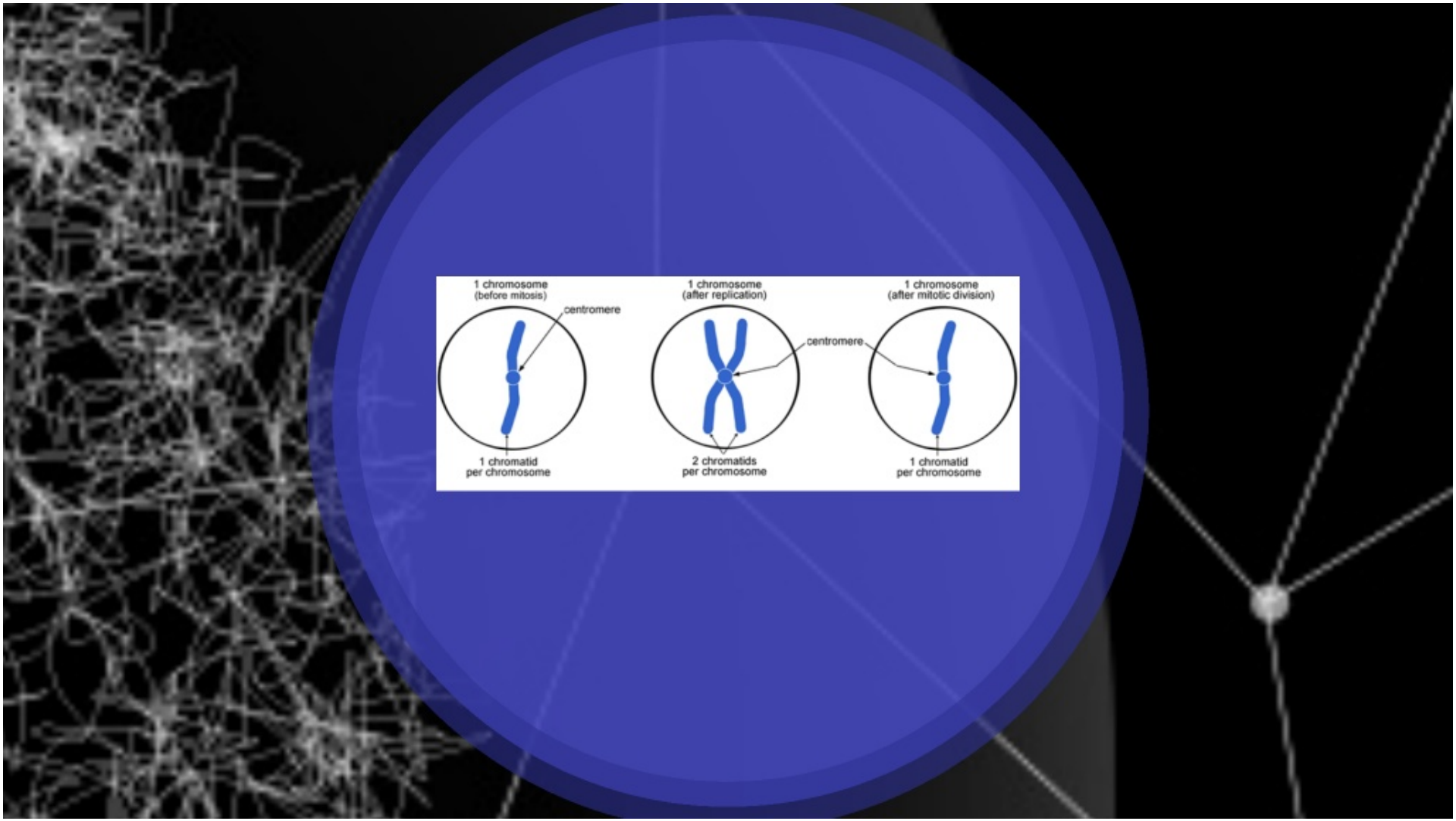

Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

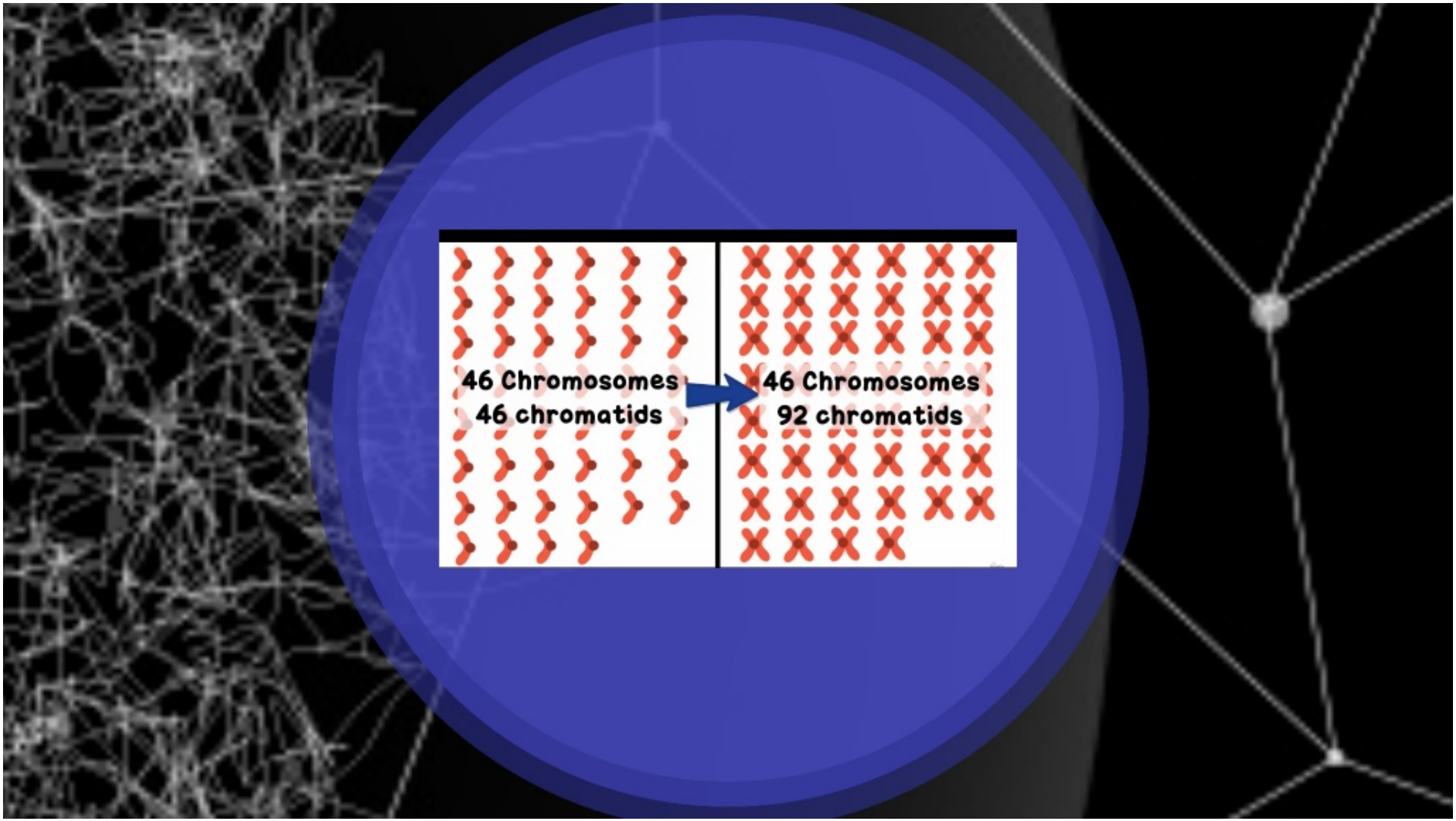
Chromosome Structure

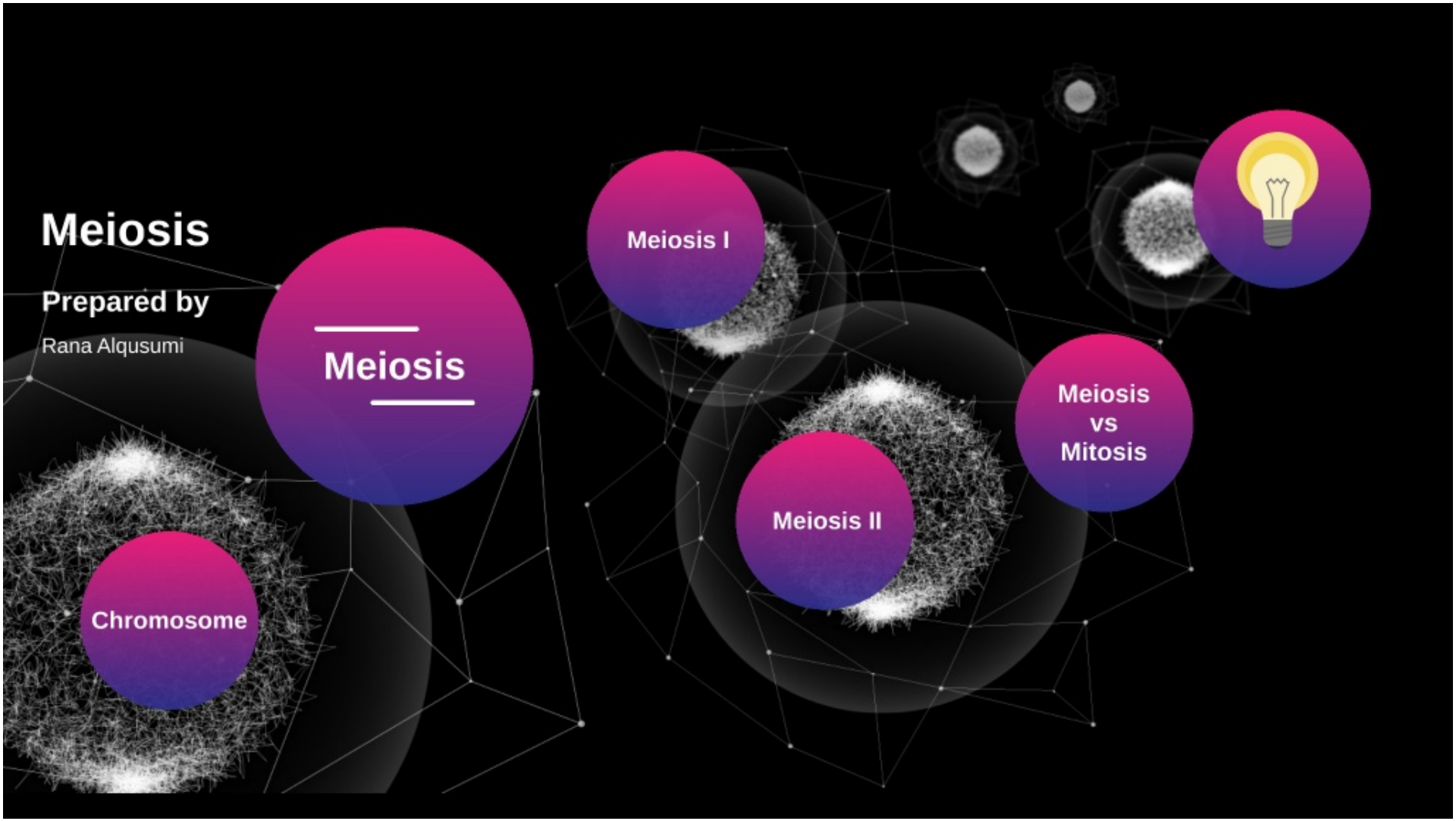


Chromatid




1 chromosome
(before mitosis)
centromere
1 chromatid
per chromosome
1 chromosome
(after replication)
centromere
2 chromatids
per chromosome
1 chromosome
(after mitotic division)
1 chromatid
per chromosome

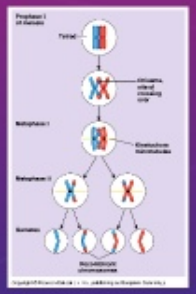

46 Chromosomes
46 chromatids
46 Chromosomes
92 chromatids

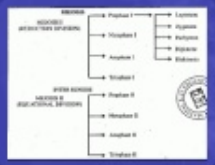

Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

Meiosis

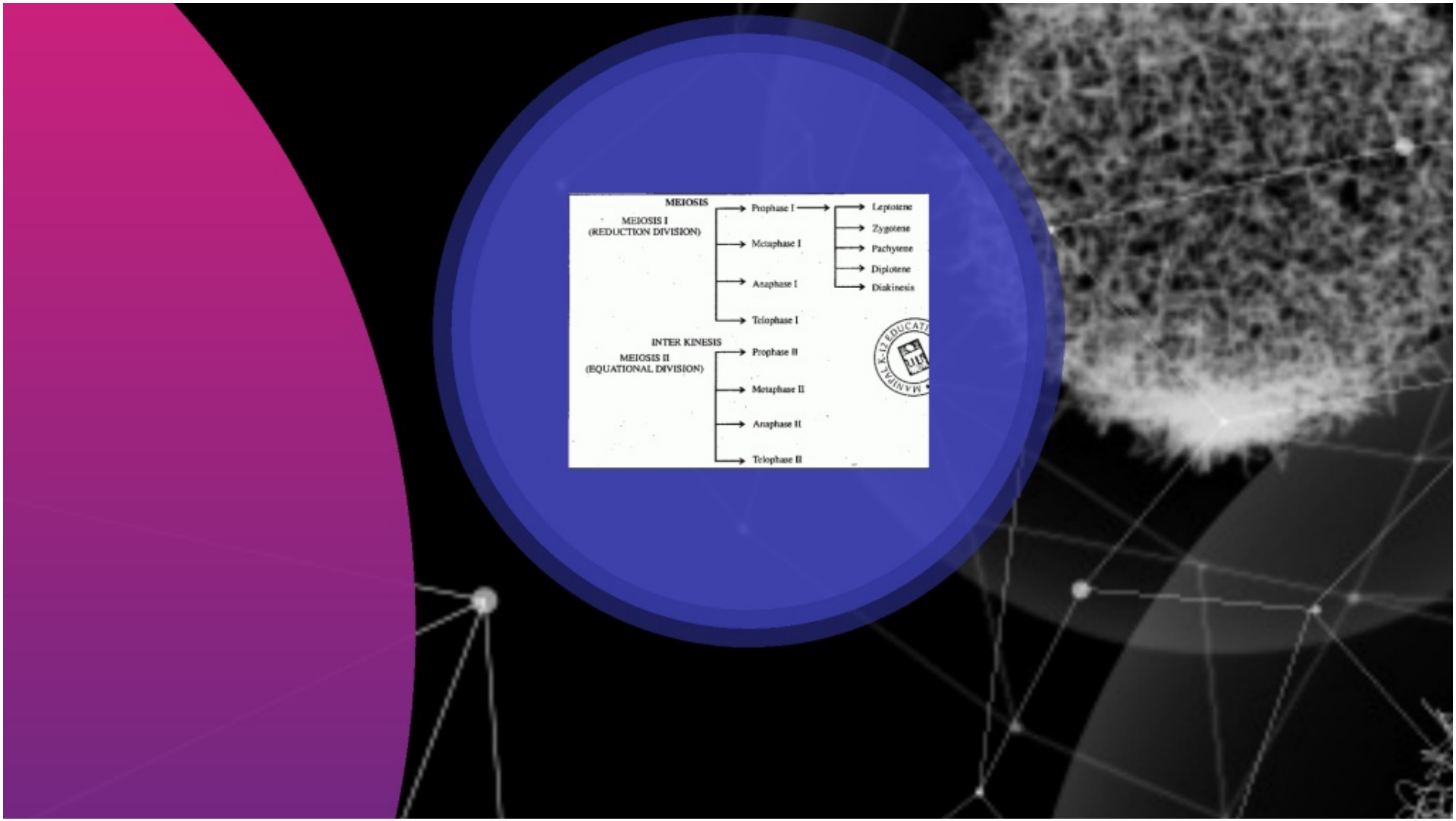
The result is four hiploid (2n) cells
The function of this division is :
1-Produce gametes
Like mitosis it involves DNA replication during the interphase in the parent cell, but this is followed by 2 cycles of nuclear division called meiosis I and meiosis II. thus a single diploid cell gives rise to four haploid cells

.





Meiosis Phase


MEIOSIS
MEIOSIS I
(REDUCTION DIVISION)
Prophase I
Leptotene
Zygotene
Pachytene
Diplotene
Diakinesis
Metaphase I
Anaphase I
Telophase I
INTER KINESIS
MEIOSIS II
(EQUATIONAL DIVISION)
Prophase II
Metaphase II
Anaphase II
Telophase II

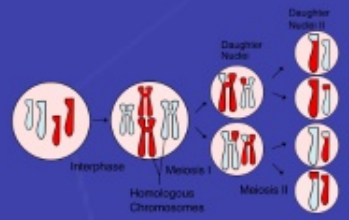
Meiosis phase

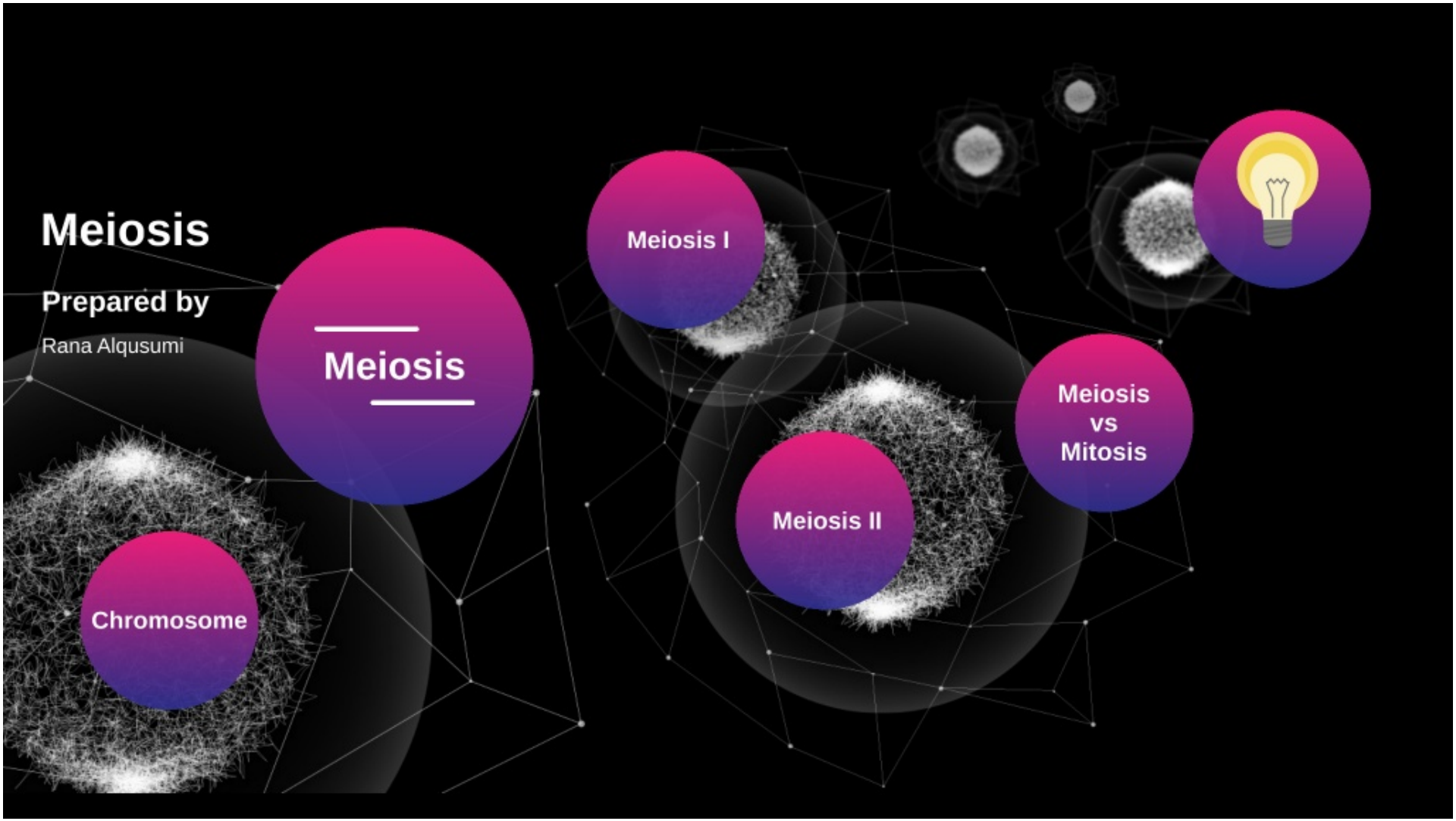
In many ways, meiosis is a lot like mitosis.
The cell goes through similar stages and uses similar strategies to organize and separate chromosomes. In meiosis, however, the cell has a more complex task. It still needs to separate sister chromatids (the two halves of a duplicated chromosome), as in mitosis.

But it must also separate homologous chromosomes.

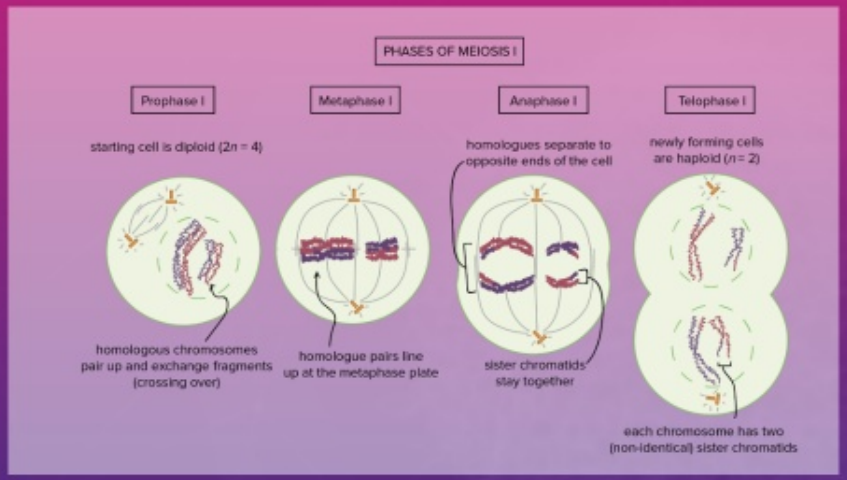
These goals are accomplished in meiosis using a two-step division process. Homologue pairs separate during a first round of cell division, called meiosis I. Sister chromatids separate during a second round, called meiosis II.

Since cell division occurs twice during meiosis, one starting cell can produce four gametes (eggs or sperm). In each round of division, cells go through four stages: prophase, metaphase, anaphase, and telophase.




Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

Meiosis I



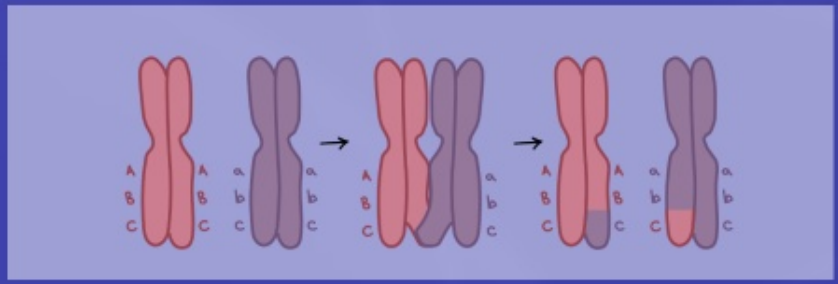
Prepared by:Rana AlQusumi

- Prophase I
- Metaphase I
- Anaphase I
- Telophase I

Prophase I

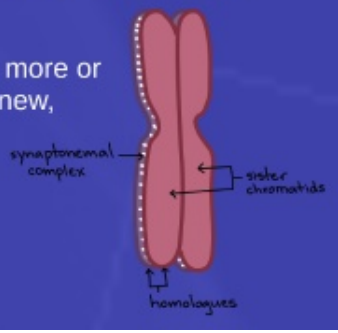
- During prophase I, differences from mitosis begin to appear. As in mitosis, the chromosomes begin to condense, but in meiosis I, they also pair up. Each chromosome carefully aligns with its homologue partner so that the two match up at corresponding positions along their full length.

For instance, in the image below, the letters A, B, and C represent genes found at particular spots on the chromosome, with capital and lowercase letters for different alleles, of each gene. The DNA is broken at the same spot on each homologue—here, between genes B and C—and reconnected in a criss-cross pattern so that the homologues exchange part of their DNA.



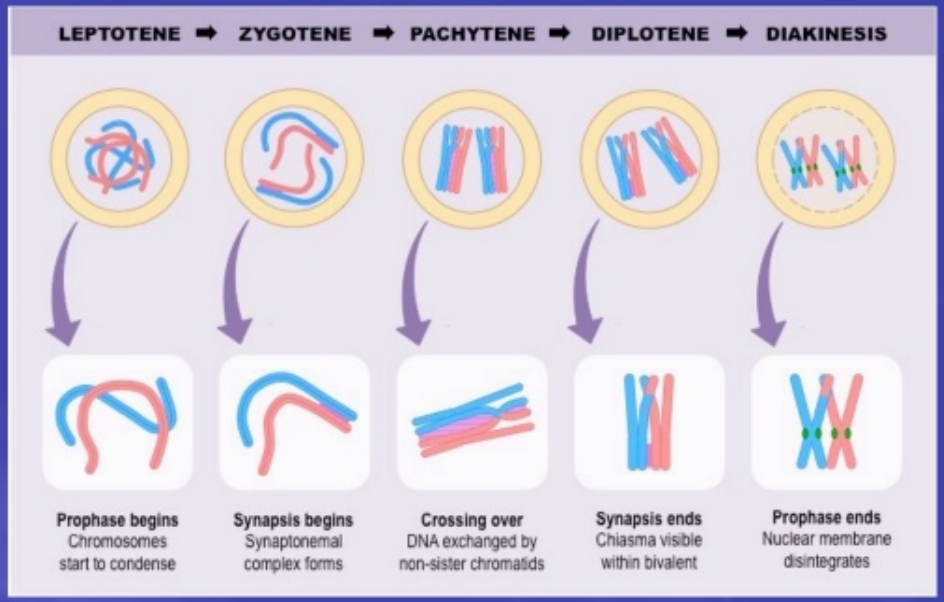
You can see crossovers under a microscope as chiasmata, cross-shaped structures where homologues are linked together. Chiasmata keep the homologues connected to each other after the synaptonemal complex breaks down.

The spots where crossovers happen are more or less random, leading to the formation of new, "remixed" chromosomes with unique combinations of alleles.



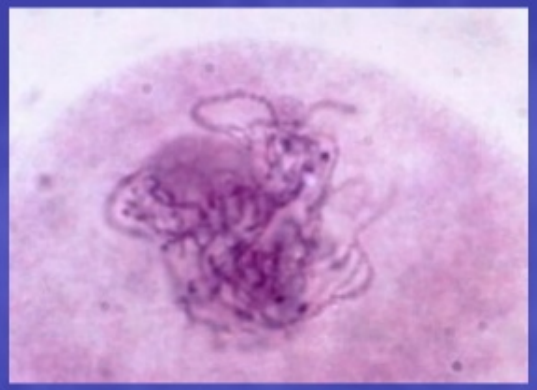
More details

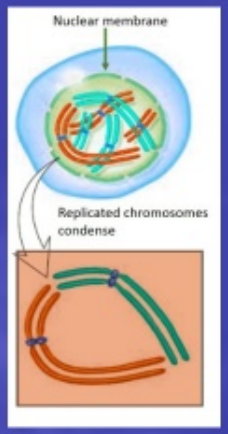
It is the longest phase and is divided into five substages:
1-Leptotene
2-Zygotene
3-Pachytene
4-Diplotene
5-Diakinesis.



Leptotene:

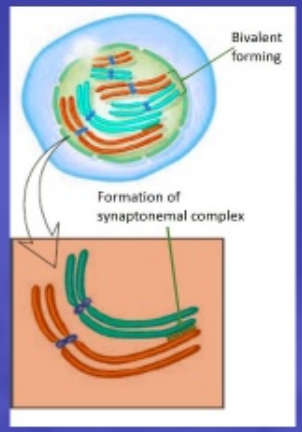
It occurs after interphase chromosomes appear as long slender threads with many bead-like called **chromomeres** along their length.





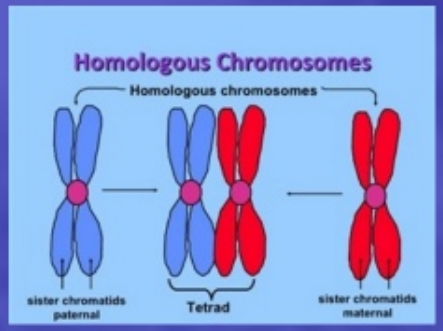
Zygotene

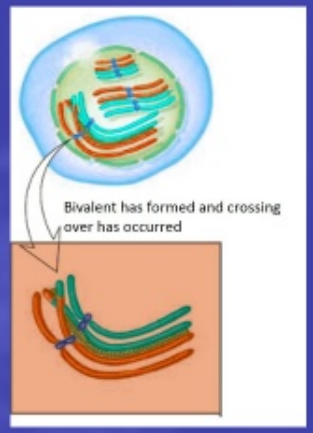
During this stage homologous chromosomes attract each other and form pairs (synapsis). Pairing occurs in a zipper-like fashion.



Pachytene

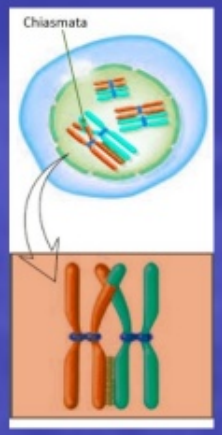
Chromosomes in this stage undergo shortening and coiling. The two sister chromatids of a homologous chromosome associated with two sister chromatids of their homologous partner.This group of four chromatids is known as tetrad.
A series of exchanges of genetic material (exchange of segments of chromatids) occur between non-sister homologous chromatids. It is called **crossing over** or recombination.





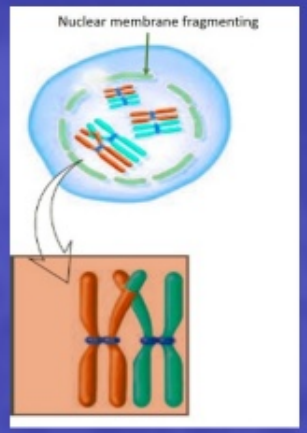
Diplotene

Chromosomes further shortened and coiled. Homologous pair of chromosomes starts separating from one another. Homologous chromosomes are visible crossing each other at certain points along the length. Such points of crossing between homologous chromosomes are called chiasmata (singular chiasma). These are the places of crossing over and appear X-shaped, i.e., exchange of chromatids segments.



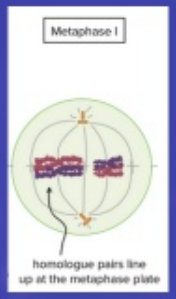
Diakinesis

Coiling and contraction of chromosomes continue until they are thick.
In this process bivalent usually migrate close to nuclear membrane and become evenly distributed. Nucleolus now disappears. In the later part of this stage, nuclear membrane dissolves



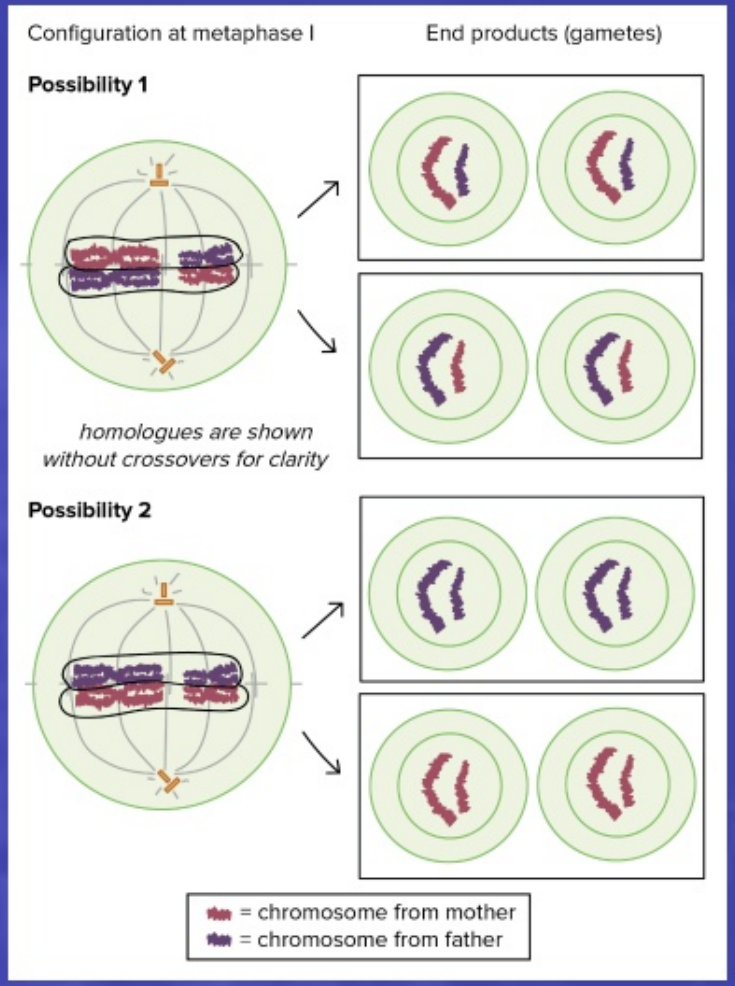
Metaphase I

After crossing over, the spindle begins to capture chromosomes and move them towards the center of the cell (metaphase plate). This may seem familiar from mitosis, but there is a twist. Each chromosome attaches to microtubules from just one pole of the spindle, and the two homologues of a pair bind to microtubules from opposite poles. So, during metaphase I, homologue pairs—not individual chromosomes—line up at the metaphase plate for separation.



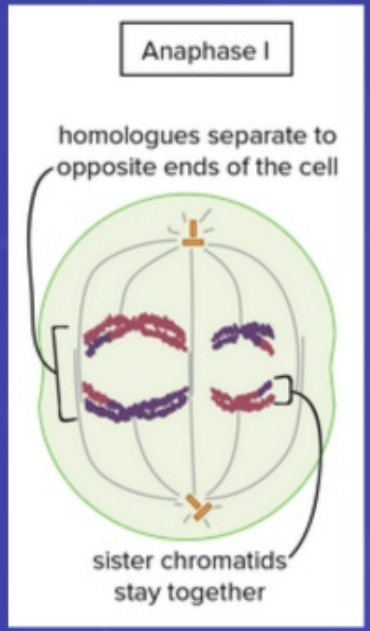
When the homologous pairs line up at the metaphase plate, the orientation of each pair is random. For instance, in the diagram above, the pink version of the big chromosome and the purple version of the little chromosome happen to be positioned towards the same pole and go into the same cell. But the orientation could have equally well been flipped, so that both purple chromosomes went into the cell together. This allows for the formation of gametes with different sets of homologues.

Prepared by:Rana AlQusumi


Configuration at metaphase I
End products (gametes)
Possibility 1
homologues are shown
without crossovers for clarity
Possibility 2
= chromosome from mother
= chromosome from father

Aanaphase I

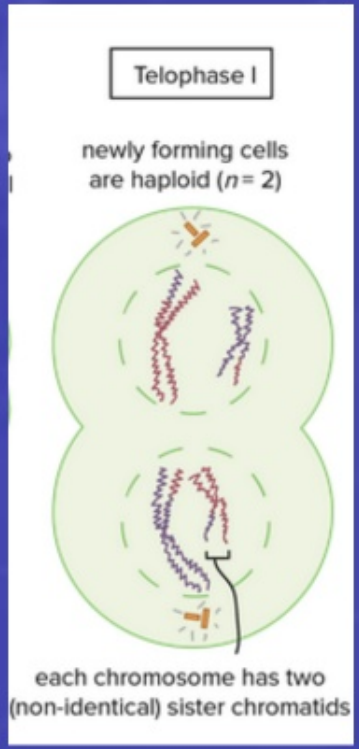
the homologues are pulled apart and move apart to opposite ends of the cell. The sister chromatids of each chromosome, however, remain attached to one another and don't come apart.



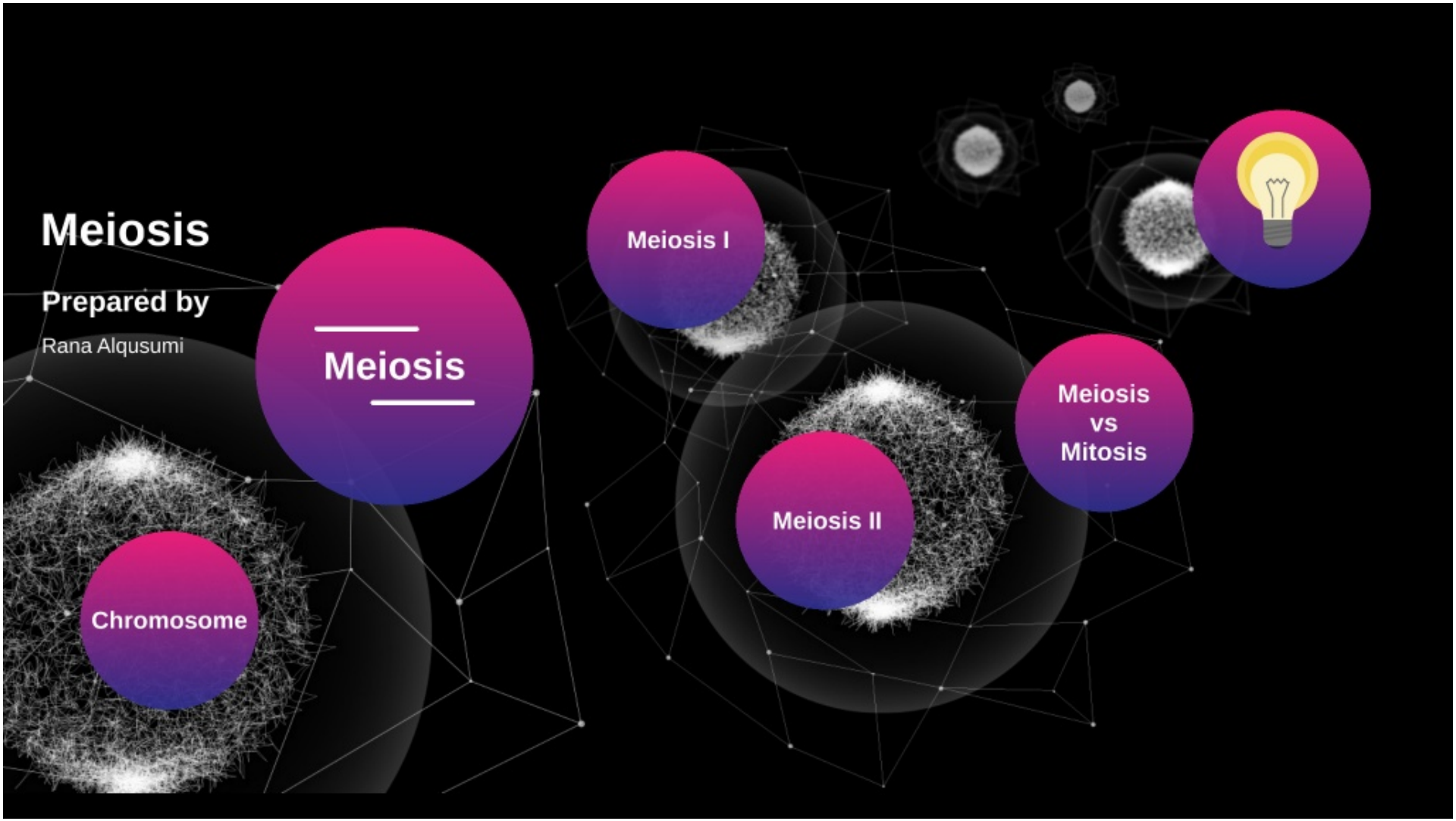
Prepared by:Rana AlQusumi

Telophase

- the chromosomes arrive at opposite poles of the cell. In some organisms, the nuclear membrane re-forms and the chromosomes decondense, although in others, this step is skipped—since cells will soon go through another round of division, meiosis II
- . Cytokinesis usually occurs at the same time as telophase I, forming two haploid daughter cells.

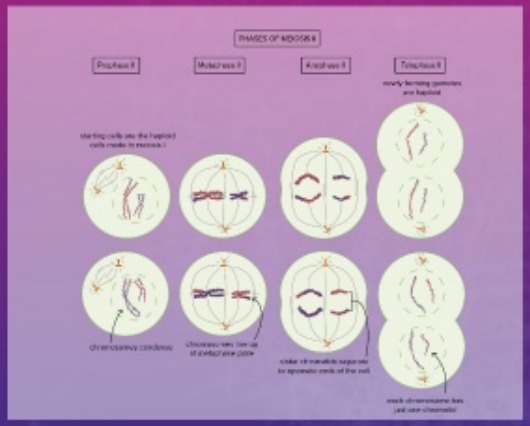


Prepared by:Rana AlQusumi


Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

Meiosis II

Cells move from meiosis I to meiosis II without copying their DNA. Meiosis II is a shorter and simpler process than meiosis I, and you may find it helpful to think of meiosis II as “mitosis for haploid cells."
The cells that enter meiosis II are the ones made in meiosis I. These cells are haploid—have just one chromosome from each homologue pair—but their chromosomes still consist of two sister chromatids. In meiosis II, the sister chromatids separate, making haploid cells with non-duplicated chromosomes



Prepared by:Rana AlQusumi

Prophase II

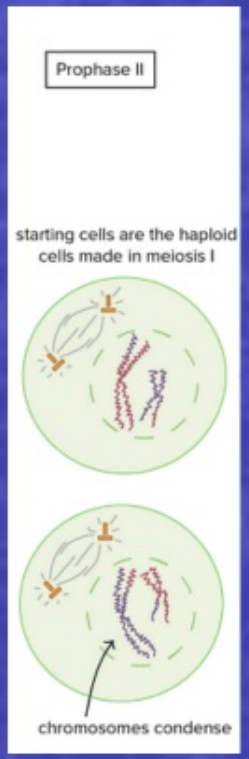
Metaphase II

Anaphase II

Telophase II

Prophase II

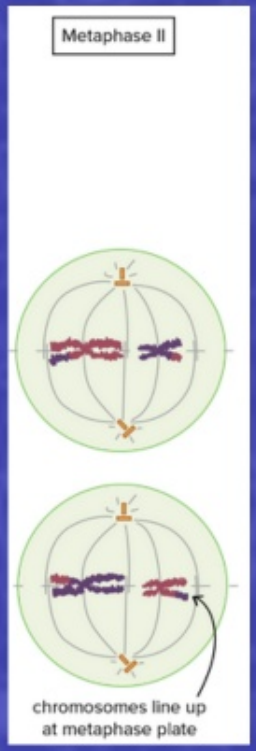
- chromosomes condense and the nuclear envelope breaks down, if needed. The centrosomes move apart, the spindle forms between them, and the spindle microtubules begin to capture chromosomes.



Prepared by:Rana AlQusumi

Metaphase II

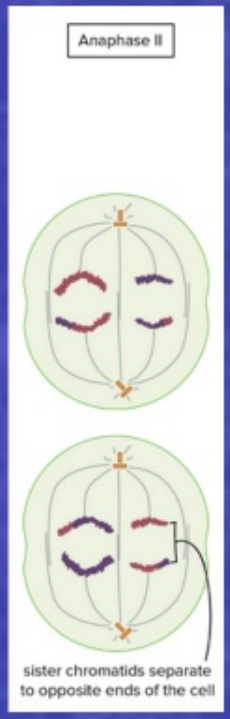
The two sister chromatids of each chromosome are captured by microtubules from opposite spindle poles.
In metaphase II, the chromosomes line up individually along the metaphase plate.



Prepared by:Rana AlQusumi

Anaphase II

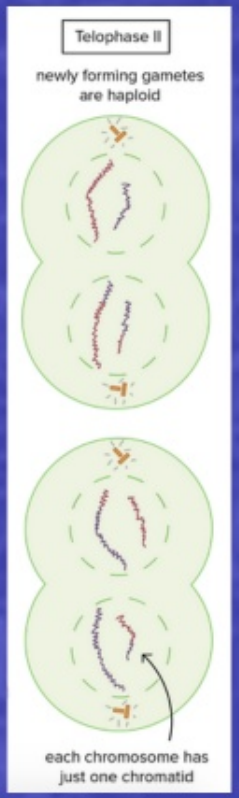
the sister chromatids separate and are pulled towards opposite poles of the cell.



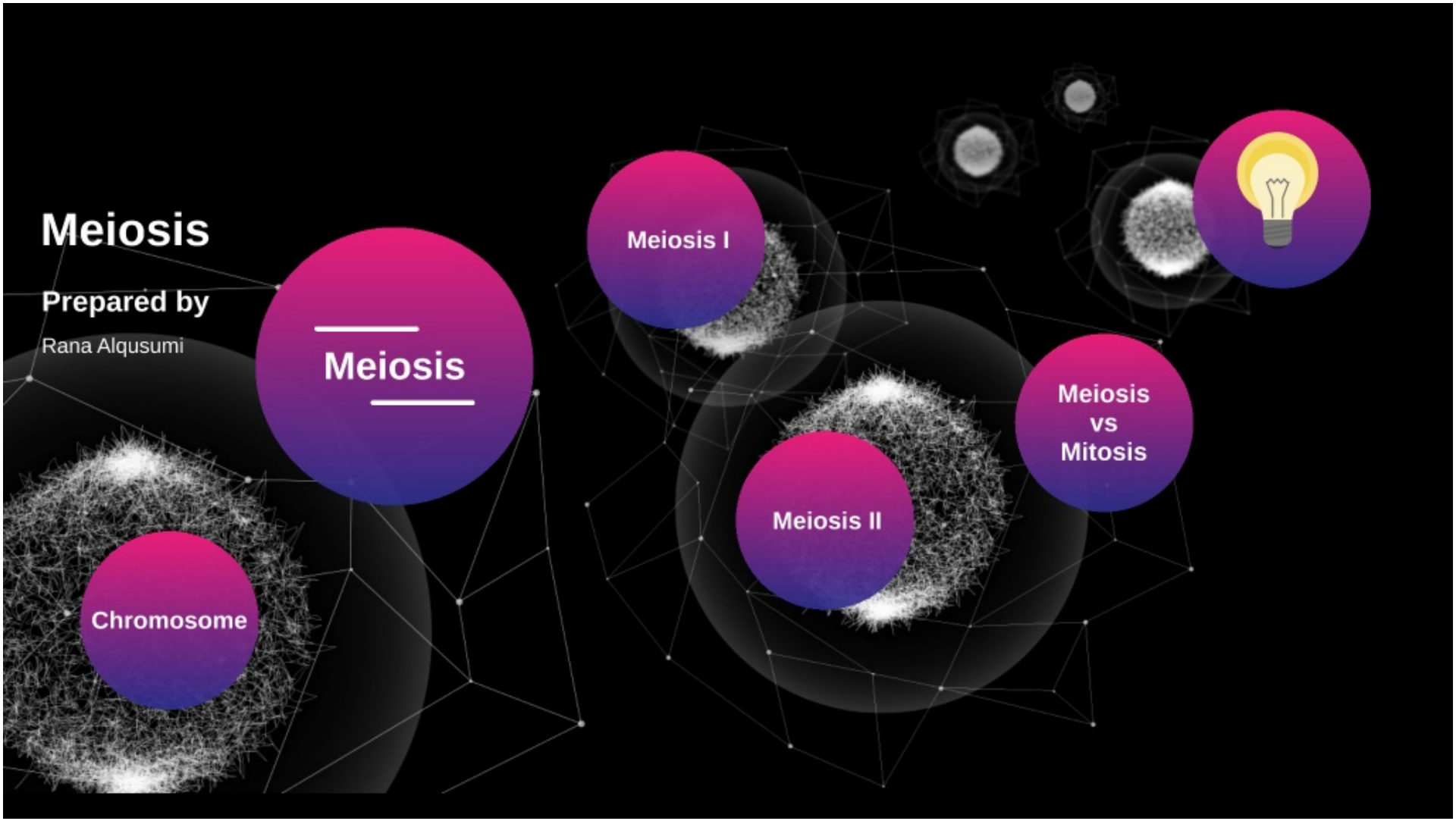
Prepared by:Rana AlQusumi

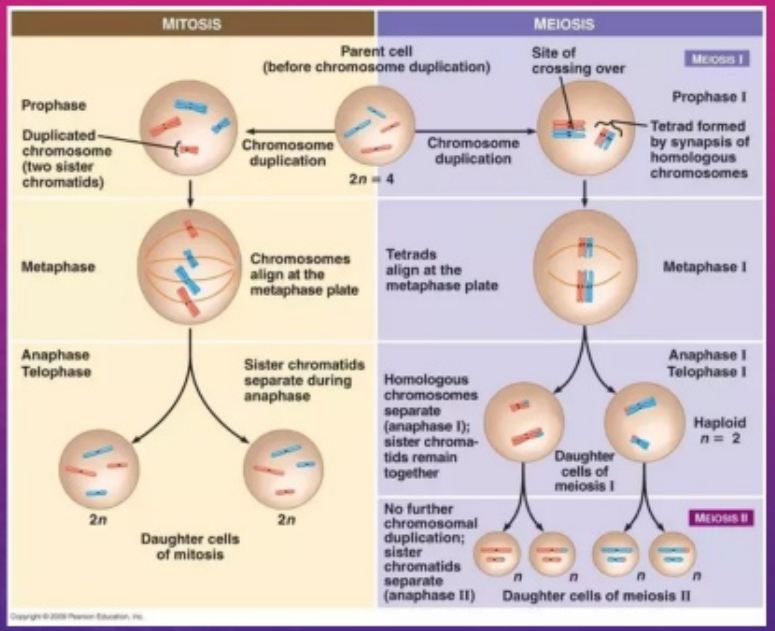
Telophase II

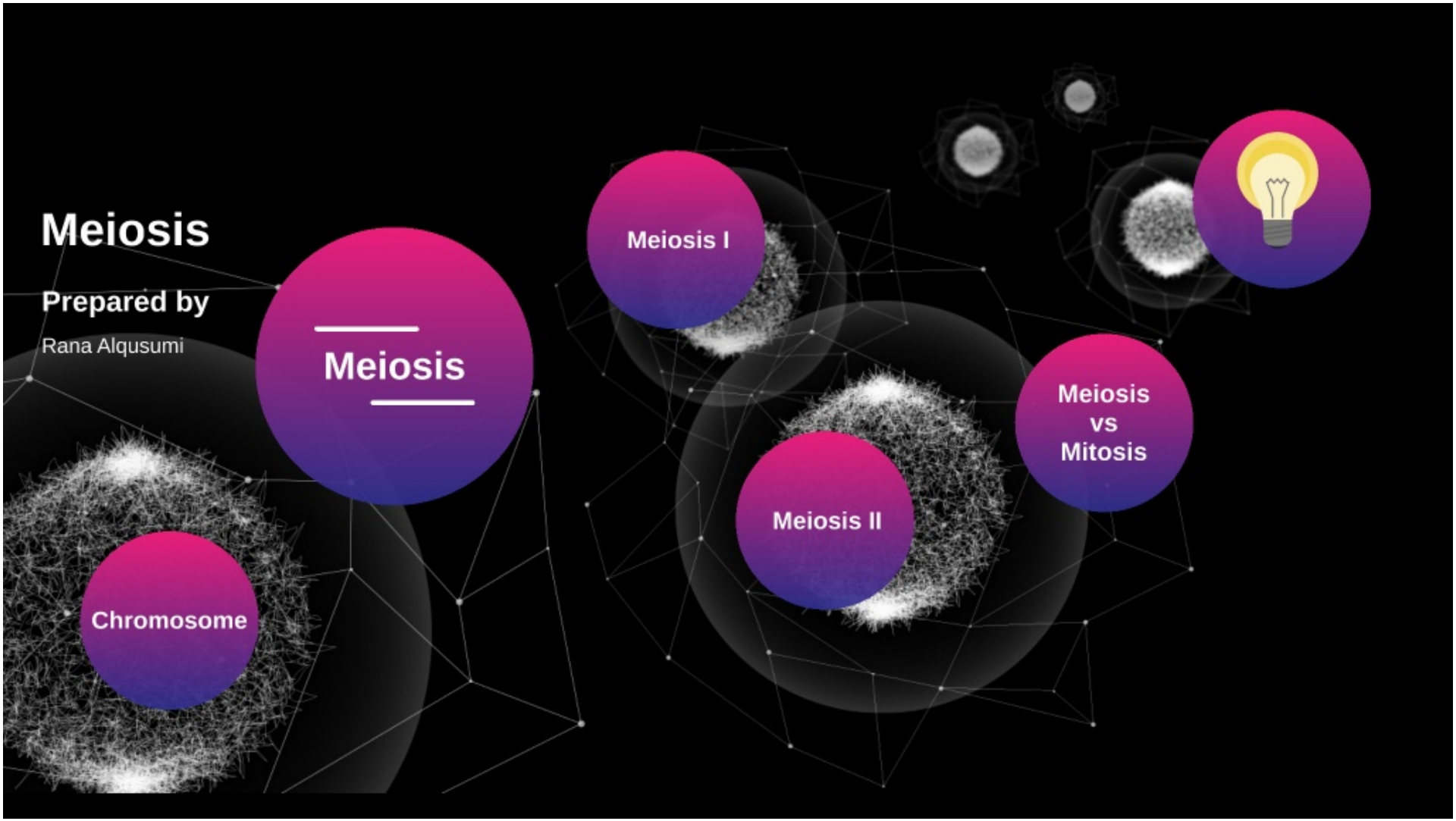
- nuclear membranes form around each set of chromosomes, and the chromosomes decondense. Cytokinesis splits the chromosome sets into new cells, forming the final products of meiosis: four haploid cells in which each chromosome has just one chromatid.
- In humans, the products of meiosis are sperm or egg cells



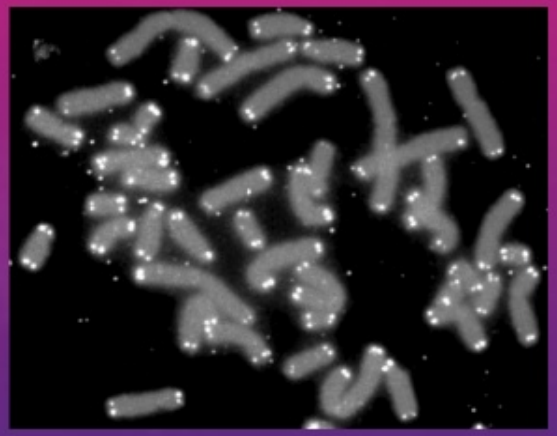
Prepared by:Rana AlQusumi

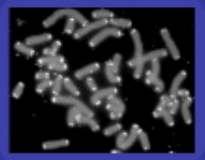

Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

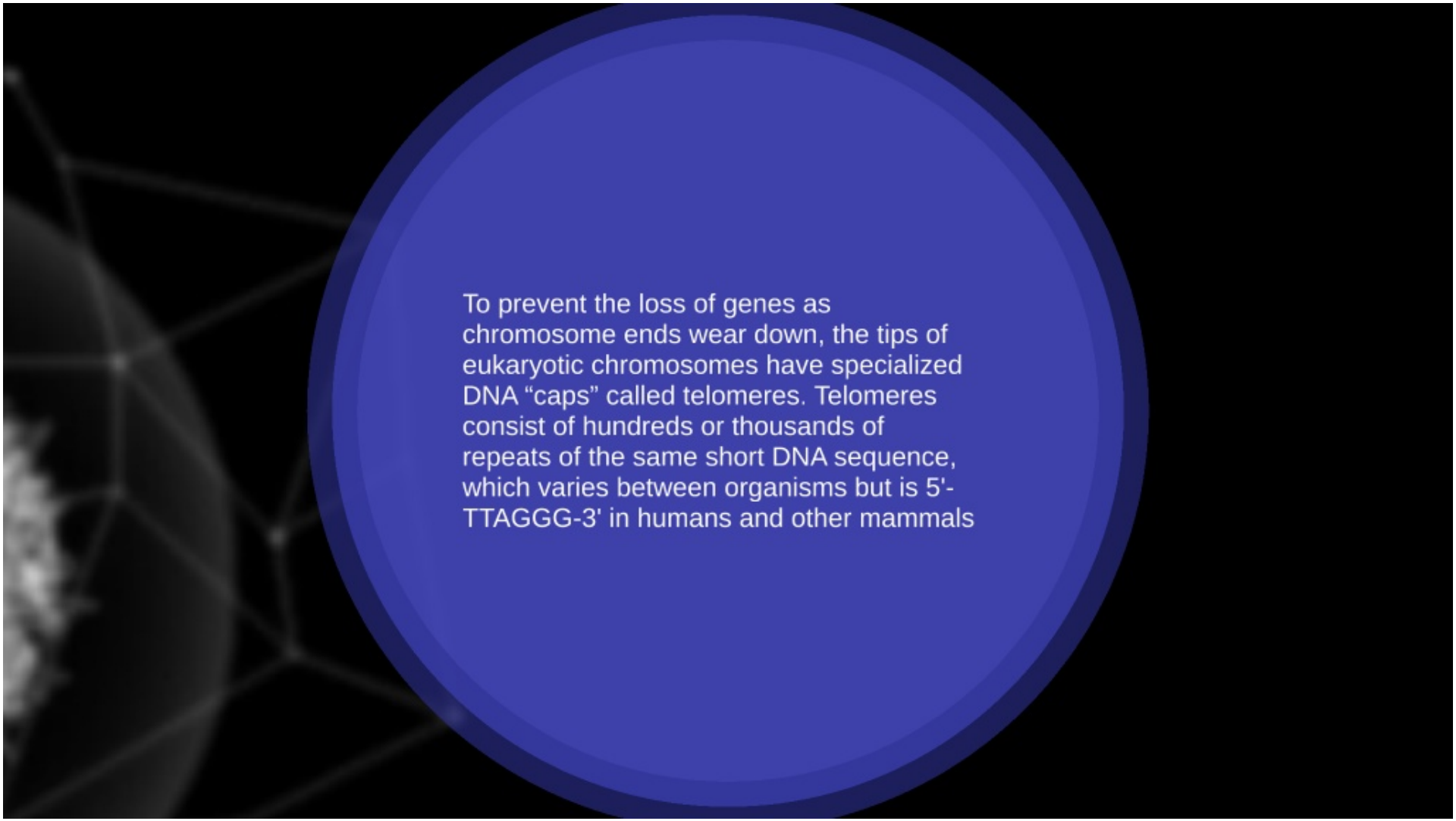

MITOSIS
MEIOSIS
Parent cell
(before chromosome duplication)
Site of
crossing over
Meiosis I
Prophase
Prophase I
Duplicated
chromosome
(two sister
chromatids)
Chromosome
duplication
Chromosome
duplication
Tetrad formed
by synapsis of
homologous
chromosomes
2n = 4
Metaphase
Chromosomes
align at the
metaphase plate
Tetrads
align at the
metaphase plate
Metaphase I
Anaphase
Telophase
Sister chromatids
separate during
anaphase
Anaphase I
Telophase I
Homologous
chromosomes
separate
(anaphase I);
sister chroma-
tids remain
together
Haploid
n = 2
Daughter
cells of
meiosis I
2n
2n
Daughter cells
of mitosis
No further
chromosomal
duplication;
sister
chromatids
separate
(anaphase II)
Meiosis II
n
n
n
n
Daughter cells of meiosis II


Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome

What is this?

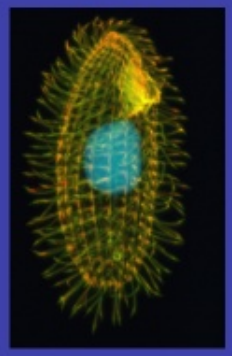




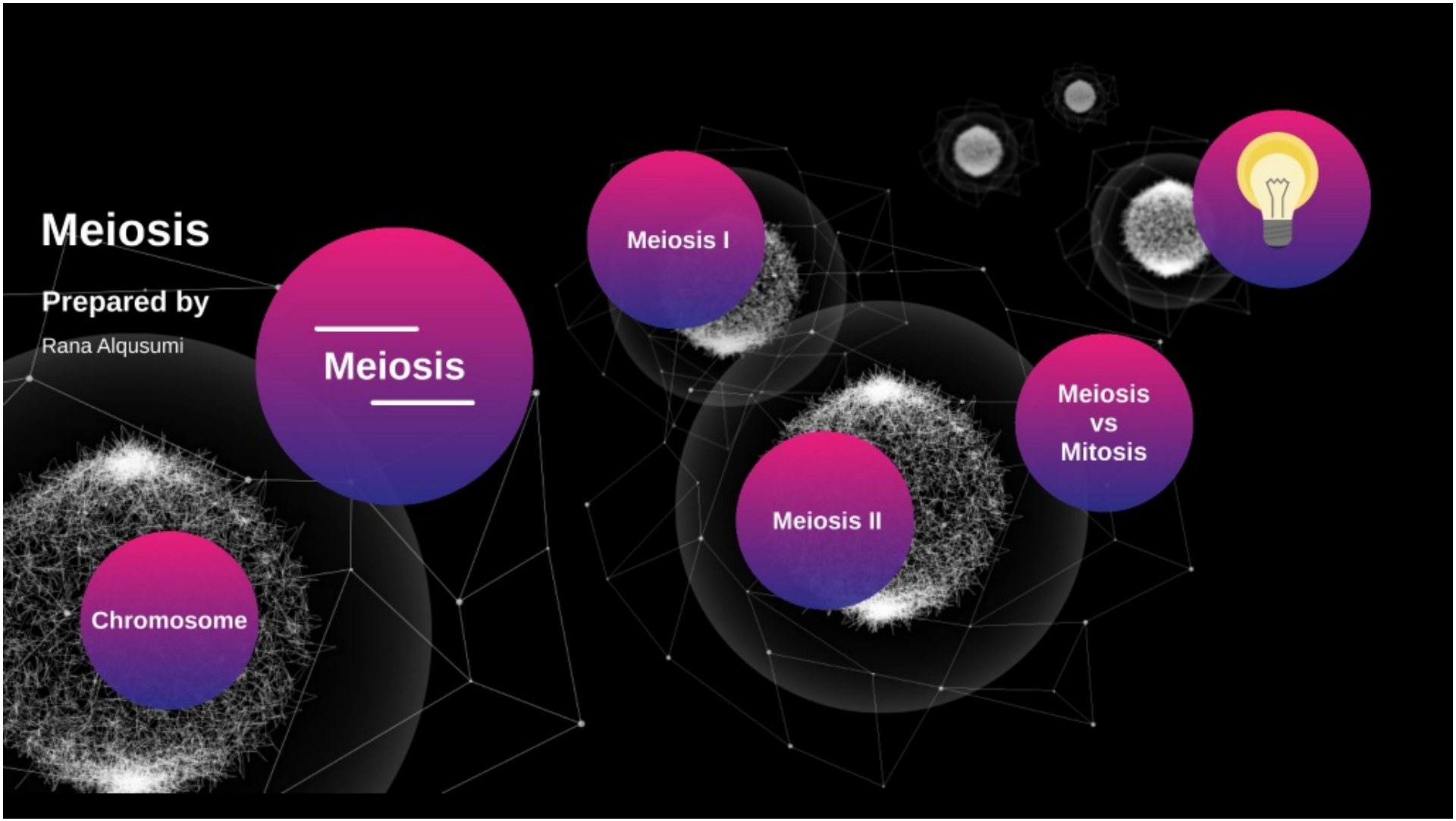

To prevent the loss of genes as chromosome ends wear down, the tips of eukaryotic chromosomes have specialized DNA “caps” called telomeres. Telomeres consist of hundreds or thousands of repeats of the same short DNA sequence, which varies between organisms but is 5'-TTAGGG-3' in humans and other mammals

Tetrahymena

the cell that never get old



Telomeres are made of repeating DNA sequences at the end of chromosomes that enhance their stability and protect their ends during replication. Changes in telomere length, usually a shortening of the sequences, are associated with disease. As we age, telomeres become shorter. Elizabeth Blackburn and Carol Greider discovered the enzyme, telomerase, that makes and can replenish the telomeric sequences at the ends of DNA


Meiosis
Prepared by
Rana Alqusumi
Meiosis
Meiosis I
Meiosis II
Meiosis vs Mitosis
Chromosome