Meiosis

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SOS IN BOTANY

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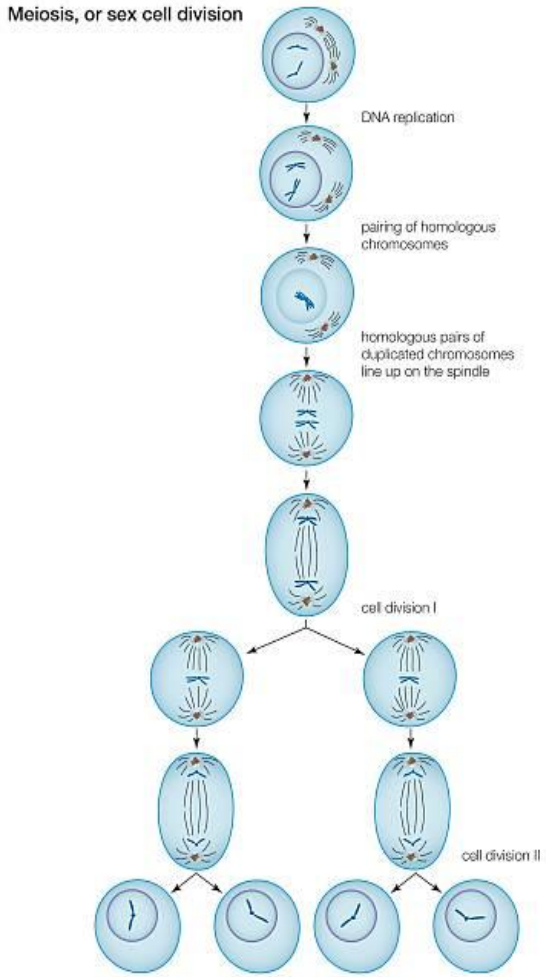
What is meiosis cell division?

- Meiosis is a special type of cell division necessary for Sexual Reproduction.
- Meiosis begins with one diploid cell co ntaining two copies of each chromoso me.
- One from the organism's mother and o ne from it's father.
- Produces for haploid cells containing o ne copy of each chromosome.



History of meiosis

- Meiosis was discovered and described for the fir st time in Sea Urchin eggs in 1876 by the Germa n biologist Oscar Hertwig.

- It was described again in 1883, at the level of ch romosomes, by the Belgian zoologist Edouard V an Beneden in Ascaris worm's eggs.

- The term "Meiosis" was coined by J.B. Farmer a nd J.B. Moore in 1905.

Where it occurs?

- Meiosis occurs in eukaryotic life cycles involvin g sexual reproduction.
- It always occur in reproductive cells.
- In lower plant meiosis occur after fertilization i n zygote.
- In higher plant it occurs before fertilization in t he time of gamete formation.

Phases of meiosis-I & meiosis-II

Prophase-I

- -Leptotene
- -Zygotene
- -Pachytene
- -Diplotene
- -Dikinesis

Metaphase-I

Anaphase-I

Telophase-I

- Prophase-II
- Metaphase-II
- Anaphase-II
- Telophase-II

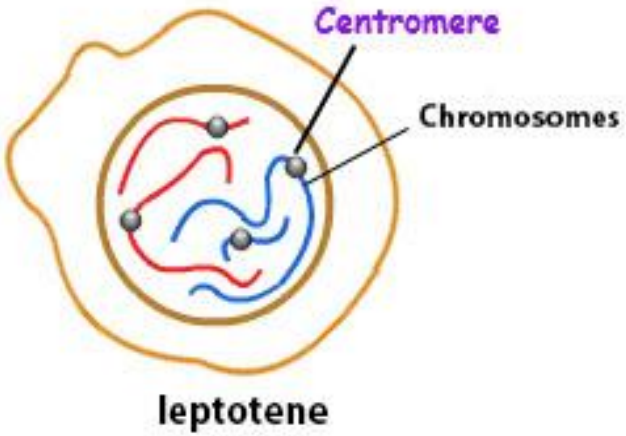
(Meiosis-II is the mitotic division of 2 haploid cells to produce 4 haploid daughter cells)

Prophase-I

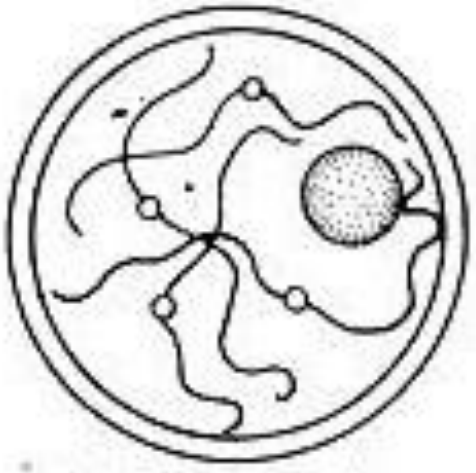
- During prophase-I, DNA is exchanged between homologous ch romosomes in a process called homologous recombination. T his often results in chromosomal crossover.
- The paired and replicated chromosomes are called bivalents o r tetrads.
- The process of pairing the homologous chromosomes are call ed Synapsis.
- At this stage, non-sister chromatids may cross-over at point ca lled Chiasmata.

Leptotene

- The first stage of prophase-I is the Leptote ne stage.
- Leptotene (Greek; Leptonema- thin thread s)
- During this stage, individual chromosomes begin to condense into long strands within the nucleus.
- However, the two sister chromatids are sti ll so tightly bound that they are indistingui shable from one another.

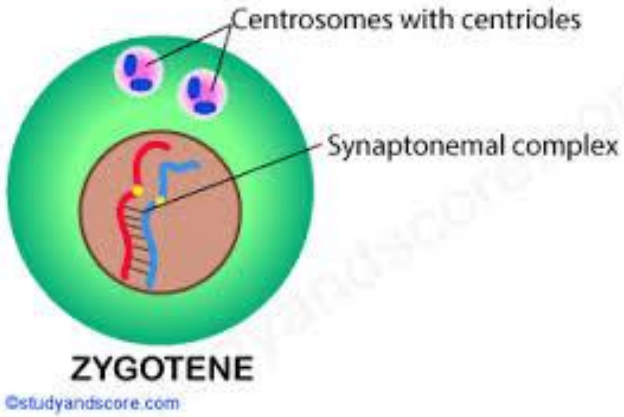


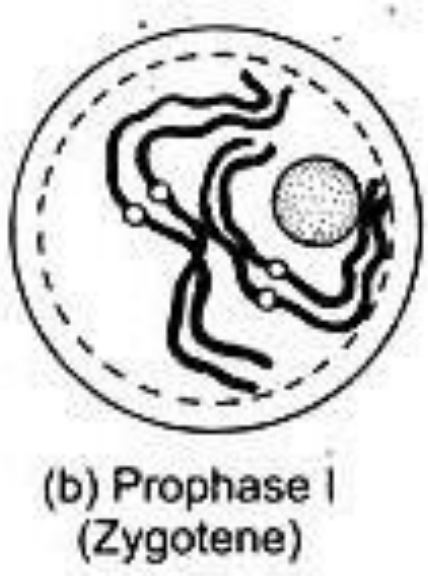
leptotene


(a) Prophase I
(Leptotene)

Zygotene

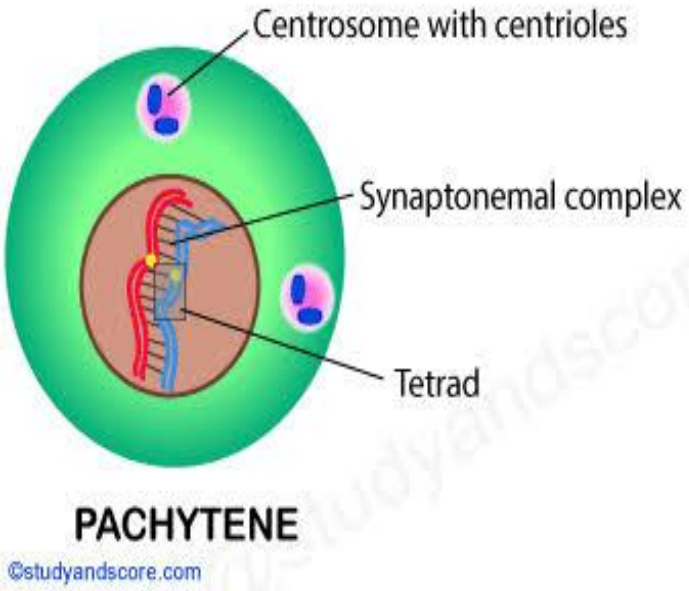
- Zygotene (Greek; zygonema- pair ed threads)
- Zygotene, occurs as the chromos omes approximately line up with each other into homologous chro mosomes.
- The combined homologous chro mosomes are said to be bivalent.





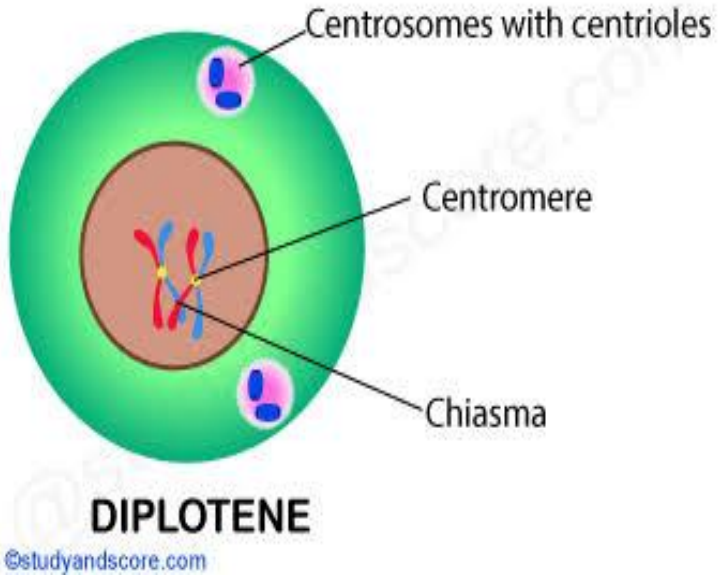
Pachytene

- In pachynema, the homologous chromosomes become much m ore closely associated. This process is known as Synapsis.
- The synapsed homologous pair of chromosomes is called a tetra d, because it consists of four chromatids.
- It can't be observed until the next stage, but the synapsed chro mosomes may undergo crossing over in pachynema.
- The chromosomes continue to condense.



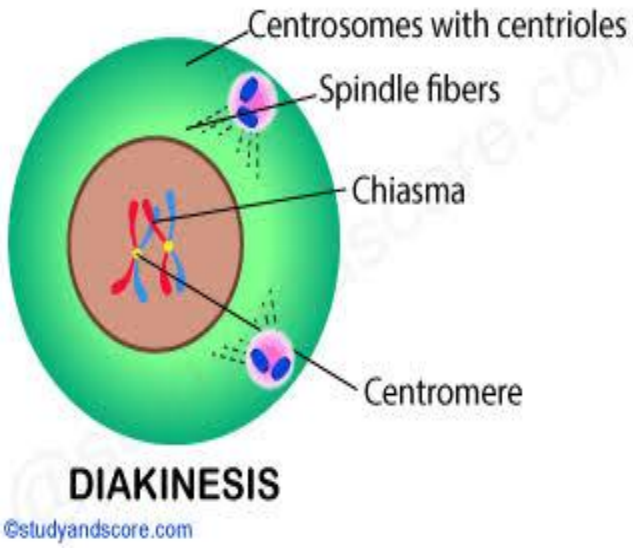
Diplotene

- Diplotene (Greek; diplonema- two threads)
- In this stage, crossing over takes place.
- The homologous chromosomes separete from one another litt le.
- Nuclear membrane and nucleolus begins to disappear.



Diakinesis

- Chromosomes condense further during the diakinesis stage.
- In this stage, the homologous chromosomes separate further, and the chiasma terminalize due to contraction of the tetrad.
- Spindle fibre begin to form.

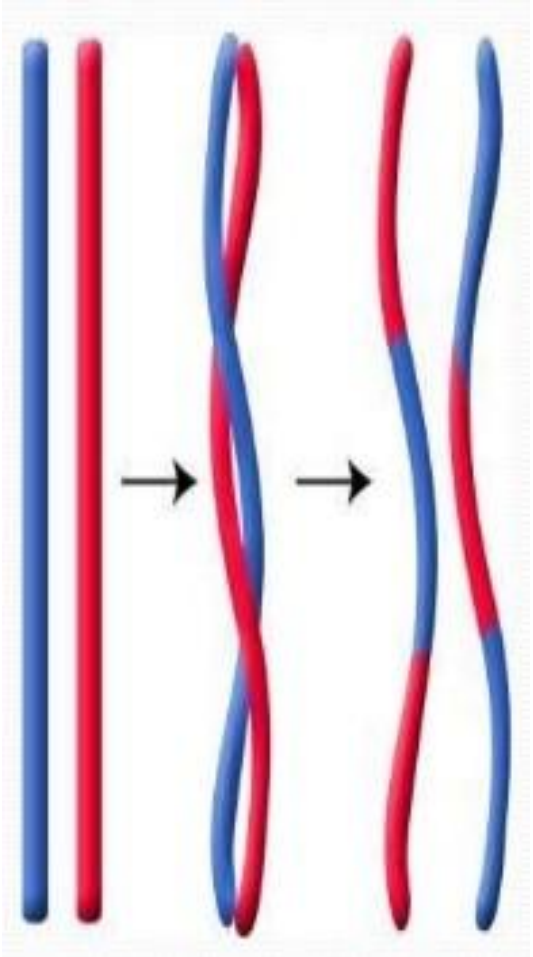


Crossing over

- Crossing over is a process by wh ich two chromosomes of a hom ologous pair exchange equal se gments with each other.

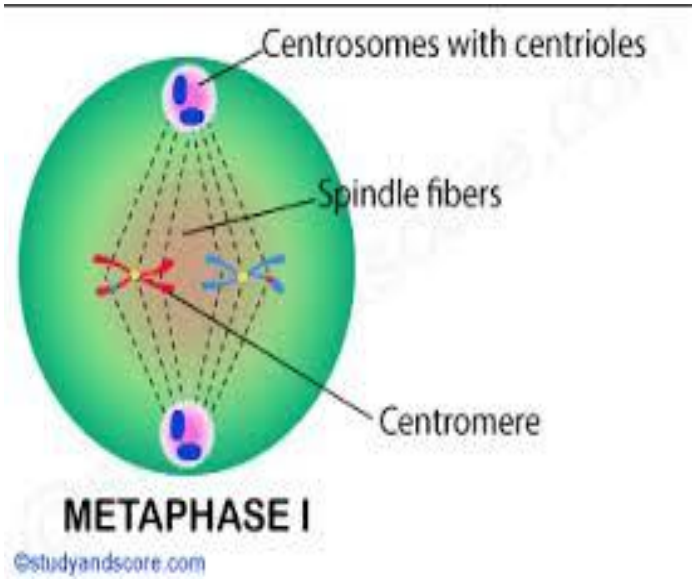
Importance-

1. Produces new combinations of traits.
2. Helps in mapping of chromosomes.
3. Selection of useful recombinations.



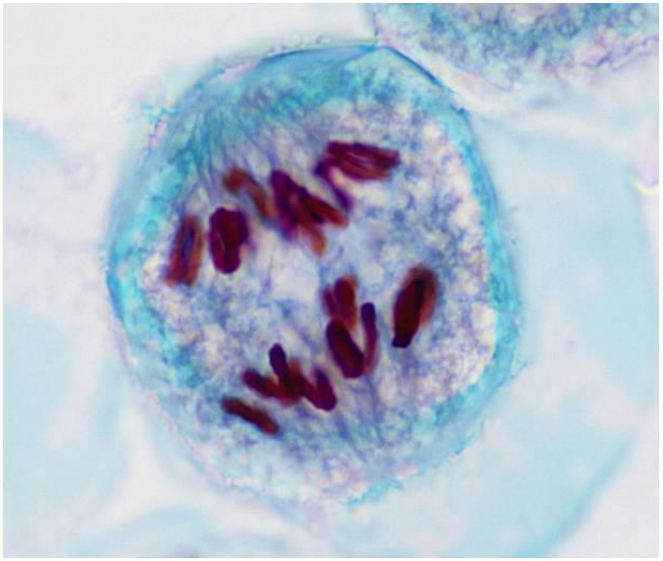
Metaphase-I

- Metaphase-I is the second phase of meiosis.
- The spindle fibres organized between two poles and get attached to the centromere of chromosomes.
- Chromosomes moves to equater.



Anaphase-I

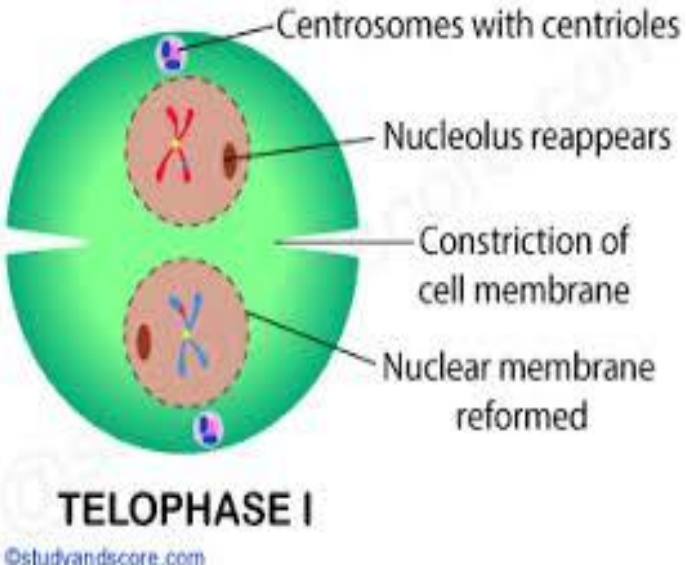
- Anaphase-I begins when the two chromosomes of ea ch bivalent separate and start moving toward opposit e poles.
- In this stage, the sister chromatids remain attached a t their centromeres and move together toward the p oles.

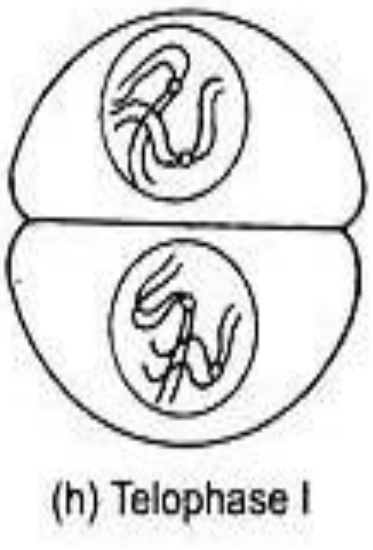


(g) Anaphase I

Telophase-I

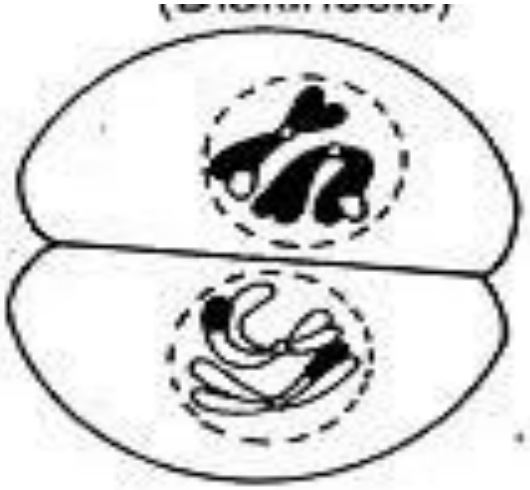
- The homologous chromosome pairs reach the poles of the cell .
- The homologous chromosome pairs complete their migration to the two poles.
- A nuclear envelope reforms around each chromosome set, th e spindle disappears, and cytokinesis follows.





Prophase-II

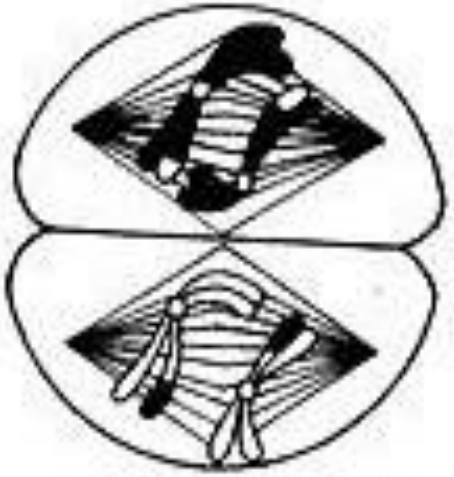
- Meiosis-II begins without any further r eplication of the chromosomes. The n uclear envelope breaks down and the spindle apparatus forms.
- The dyads chromosome becomes thick er and shorter.
- Nuclear membrane and nuceolus disa ppear.
- Spindle fibre starts to form.



(i) Prophase II

Metaphase-II

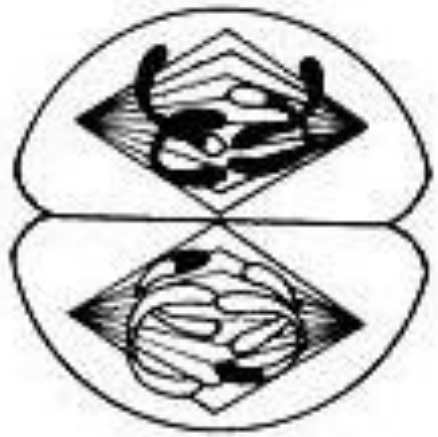
- Centromeres are arranged in aline called equa torial plate of invisible spindle apparatus.
- Spindle fibres organize between poles and att aches to centromere of chromosome.



(j) Metaphase II

Anaphase-II

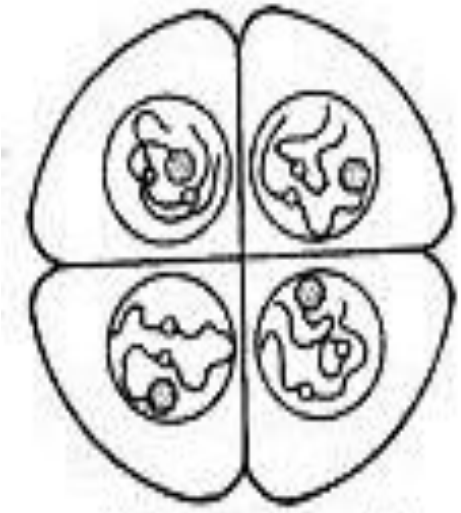
- Centromere of each chromosome divides and sister chromatids separates to form two daug hter chromosome.
- Spindle fibre contracts and pull the daughter c hromosome apart towards opposite pole.



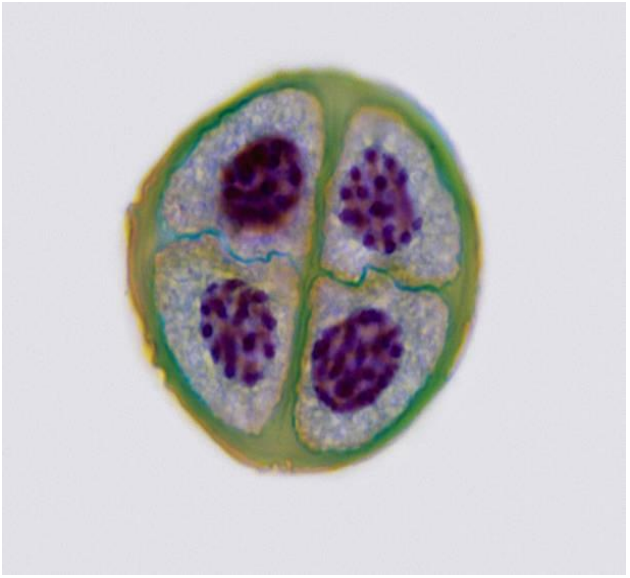
(k) Anaphase II

Telophase-II

- Nuclear envelope forms around each set of chromosomes.
- Nucleolus appears in each nucleus.
- Chromosome elongates to form thin networks of chromatin.
- Nuclear membrane and nucleolus reappears.



(I) Telophase II



Importance of meiosis

1. Produces haploid gametes so that the diploid number of the species remains constant generation after generation.

2. Source of genetic variation because crossing-over brings together new gene combination on chromosome.

conclusion

- Meiosis is the reductional cell division occurs in germ cells producing four cells of half chromosome number from that of parent cell .
- Nucleus divides twice in meiosis-I and meiosis-II.
- Meiosis-I involves the separation of homologous(reduction division) while in meiosis –II , separation of chromatids occur (equational division).
- To maintain the chromosome number constant in a sexually reproducing species , meiosis is essential .

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- Internet : www. Biologydiscussion.com


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