

# **Meiosis**

## *Formation of Gametes (Eggs & Sperm)*

# Facts About Meiosis

- ✓ Preceded by interphase which includes **chromosome replication**
- ✓ Two meiotic divisions --- **Meiosis I** and **Meiosis II**
- ✓ **Called Reduction-** division
- ✓ Original cell is **diploid ( $2n$ )**
- ✓ Four daughter cells produced that are **monoploid ( $1n$ )**

# Facts About Meiosis

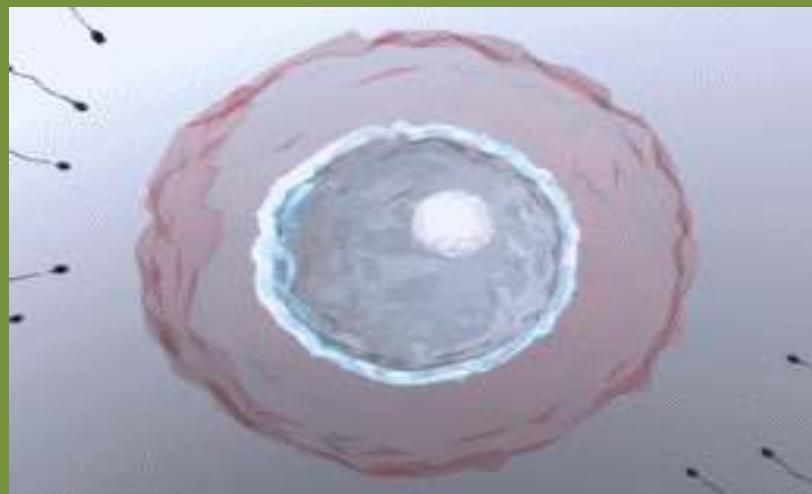
- ✓ Daughter cells contain half the number of chromosomes as the original cell
- ✓ Produces gametes (eggs & sperm)
- ✓ Occurs in the testes in males (Spermatogenesis)
- ✓ Occurs in the ovaries in females (Oogenesis)

# More Meiosis Facts

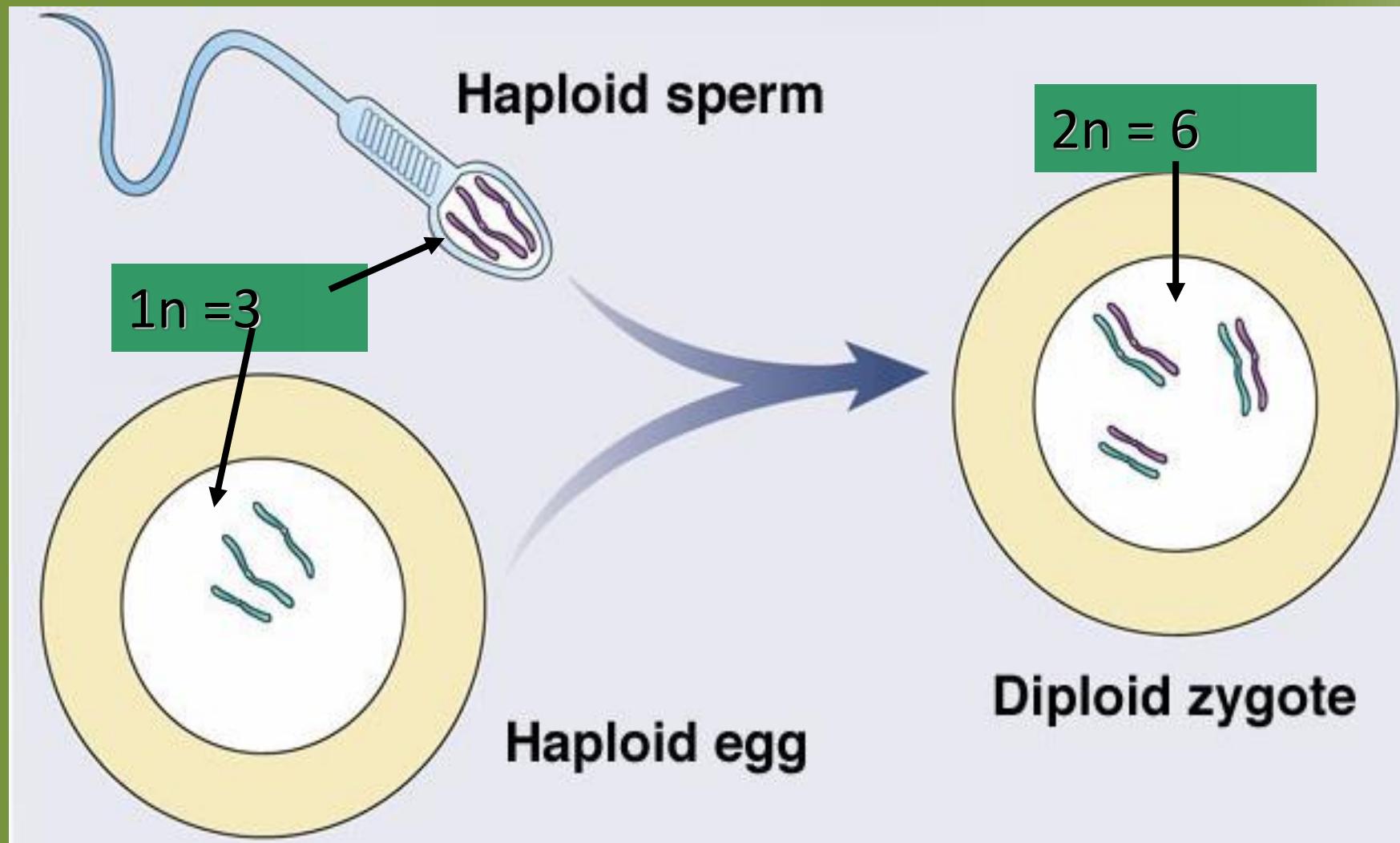
- ✓ Start with 46 double stranded chromosomes ( $2n$ )
- ✓ After 1 division - 23 double stranded chromosomes ( $n$ )
- ✓ After 2nd division - 23 single stranded chromosomes ( $n$ )
- ✓ Occurs in our germ cells that produce gametes

# Why Do we Need Meiosis?

- ✓ It is the fundamental basis of sexual reproduction
- ✓ Two haploid ( $1n$ ) gametes are brought together through fertilization to form a diploid ( $2n$ ) zygote



# Fertilization - “Putting it all together”



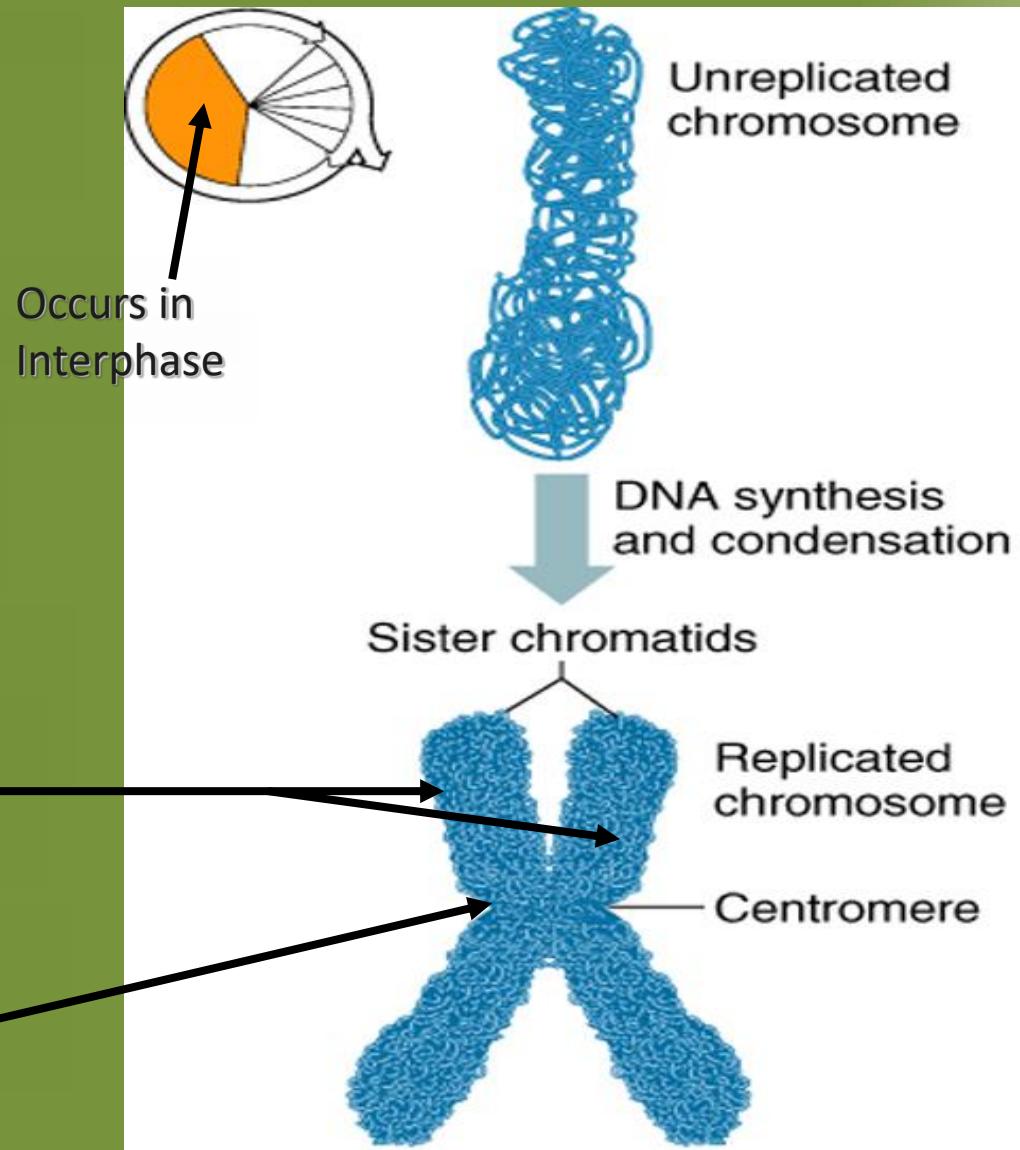
# Replication of Chromosomes

✓ Replication is the process of duplicating a chromosome

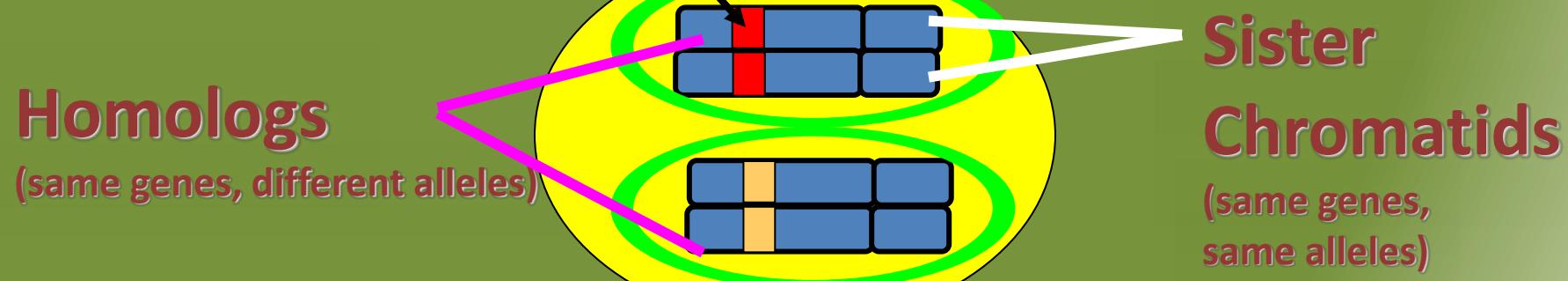
✓ Occurs prior to division

✓ Replicated copies are called sister chromatids

✓ Held together at centromere



# A Replicated Chromosome

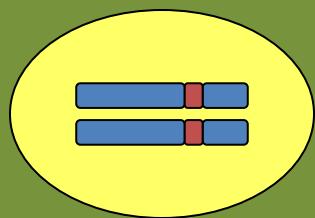


**Homologs separate in meiosis I and therefore  
different alleles separate.**

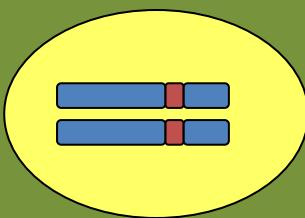
# Meiosis Forms Haploid Gametes

- ✓ Meiosis must reduce the chromosome number by half
- ✓ Fertilization then restores the  $2n$  number

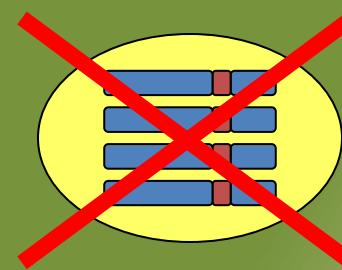
from mom



from dad

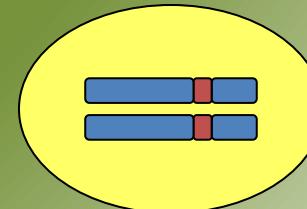
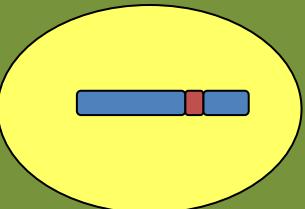
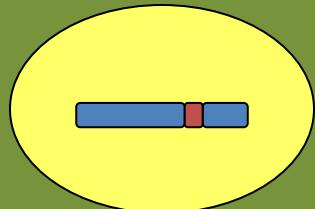


child



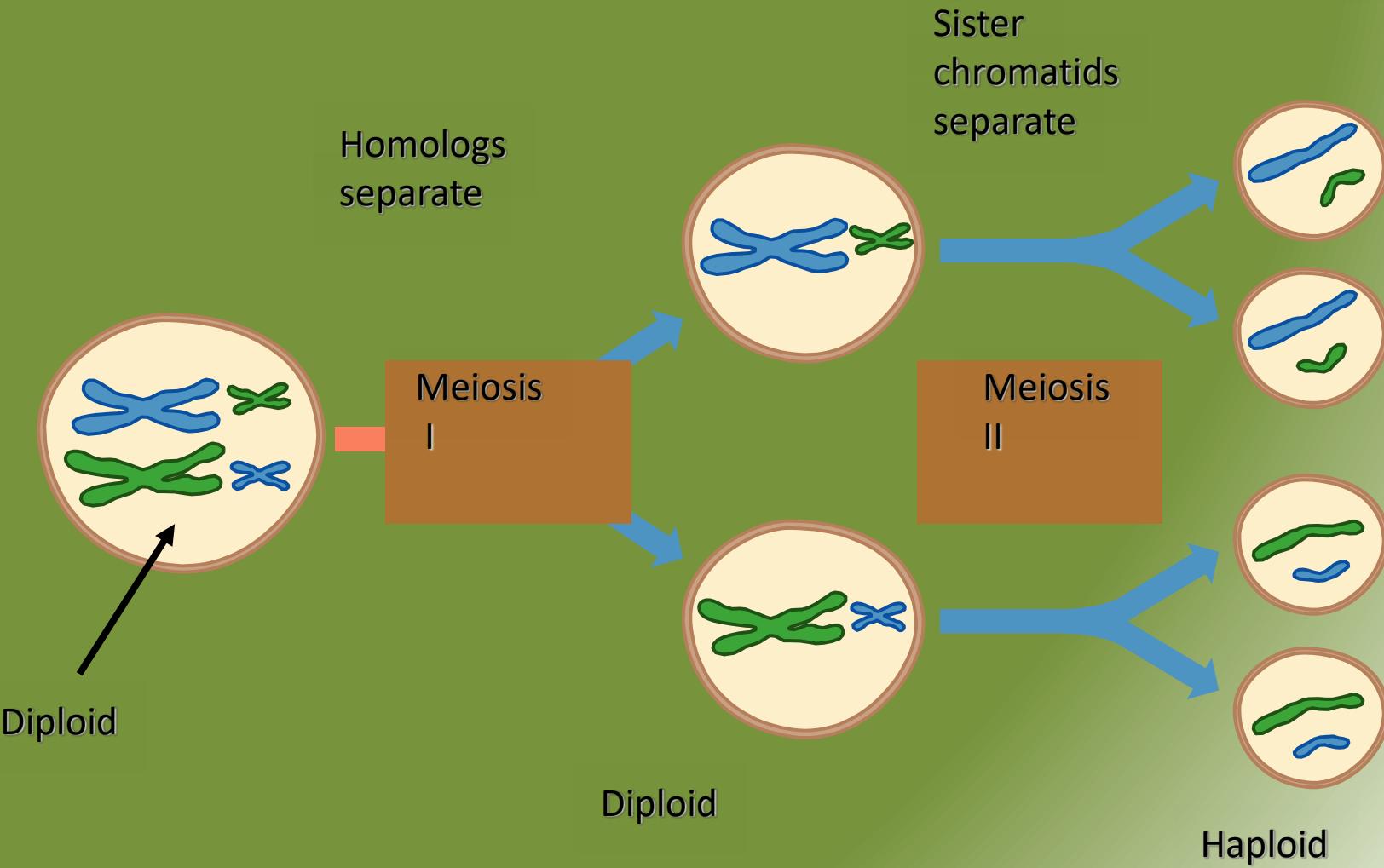
too  
much!

meiosis reduces  
genetic content

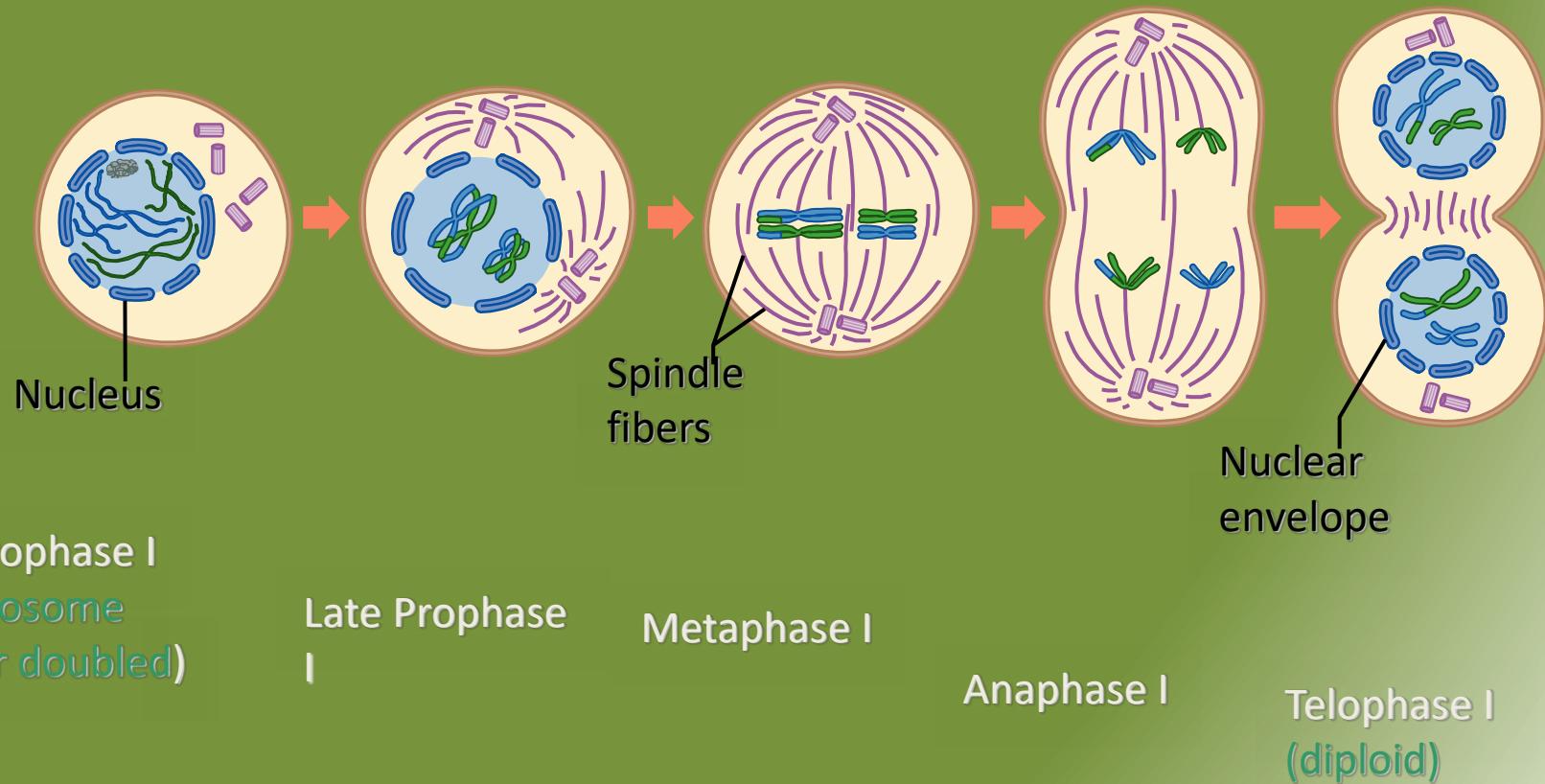


The right  
number!

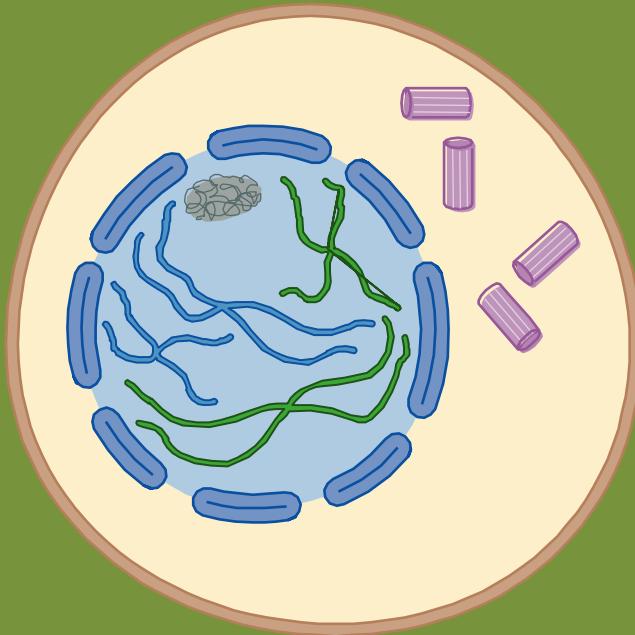
# Meiosis: Two Part Cell Division



# Meiosis I: Reduction Division

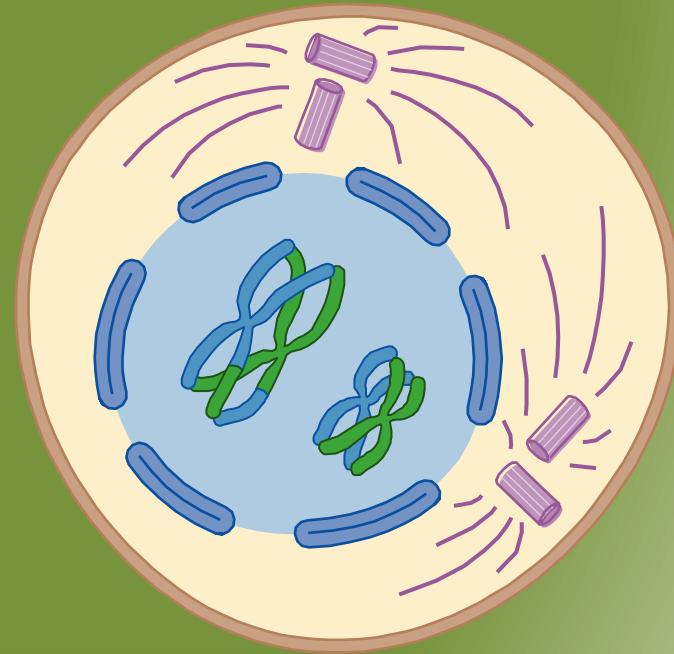


# Prophase I



**Early prophase**

- ✓ Homologs pair.
- ✓ Crossing over occurs.



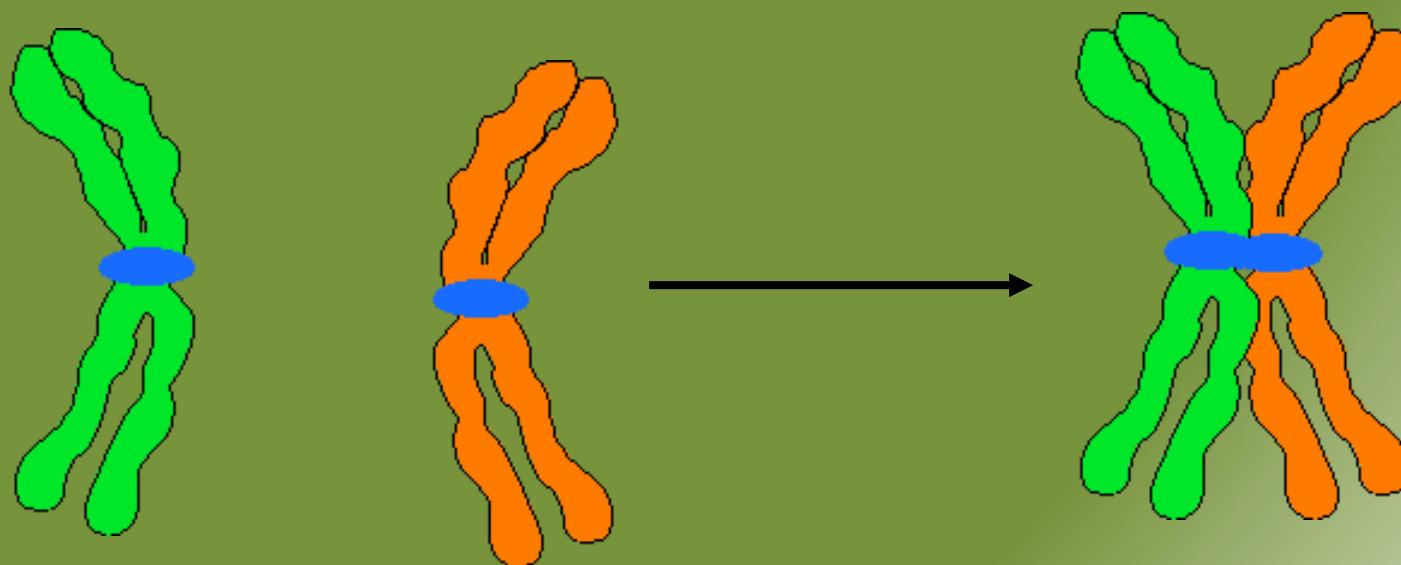
**Late prophase**

- ✓ Chromosomes condense.
- ✓ Spindle forms.
- ✓ Nuclear envelope fragments.

# Tetrads Form in Prophase I

Homologous chromosomes  
(each with sister chromatids)

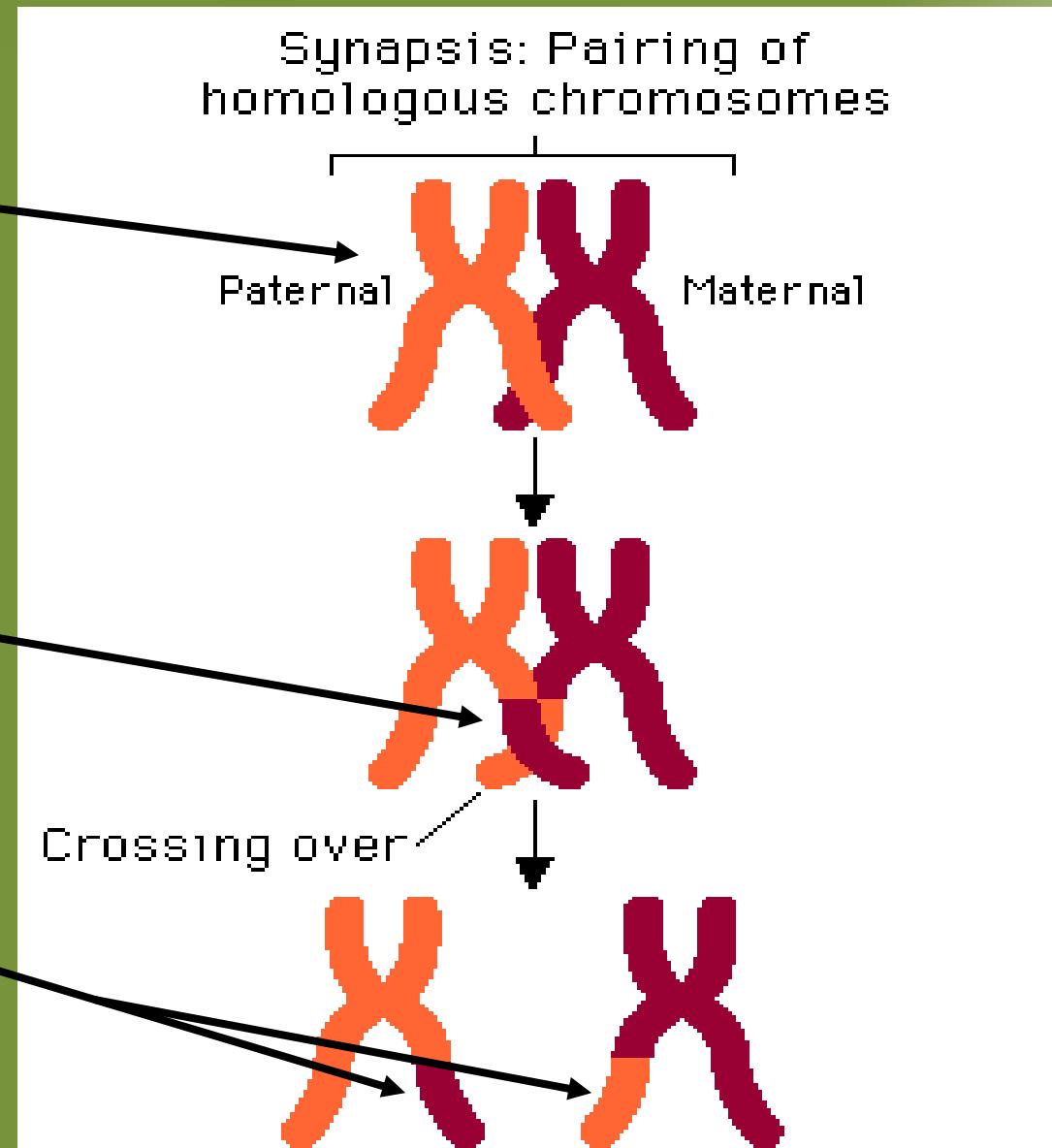
Join to form a TETRAD



Called Synapsis

# Crossing-Over

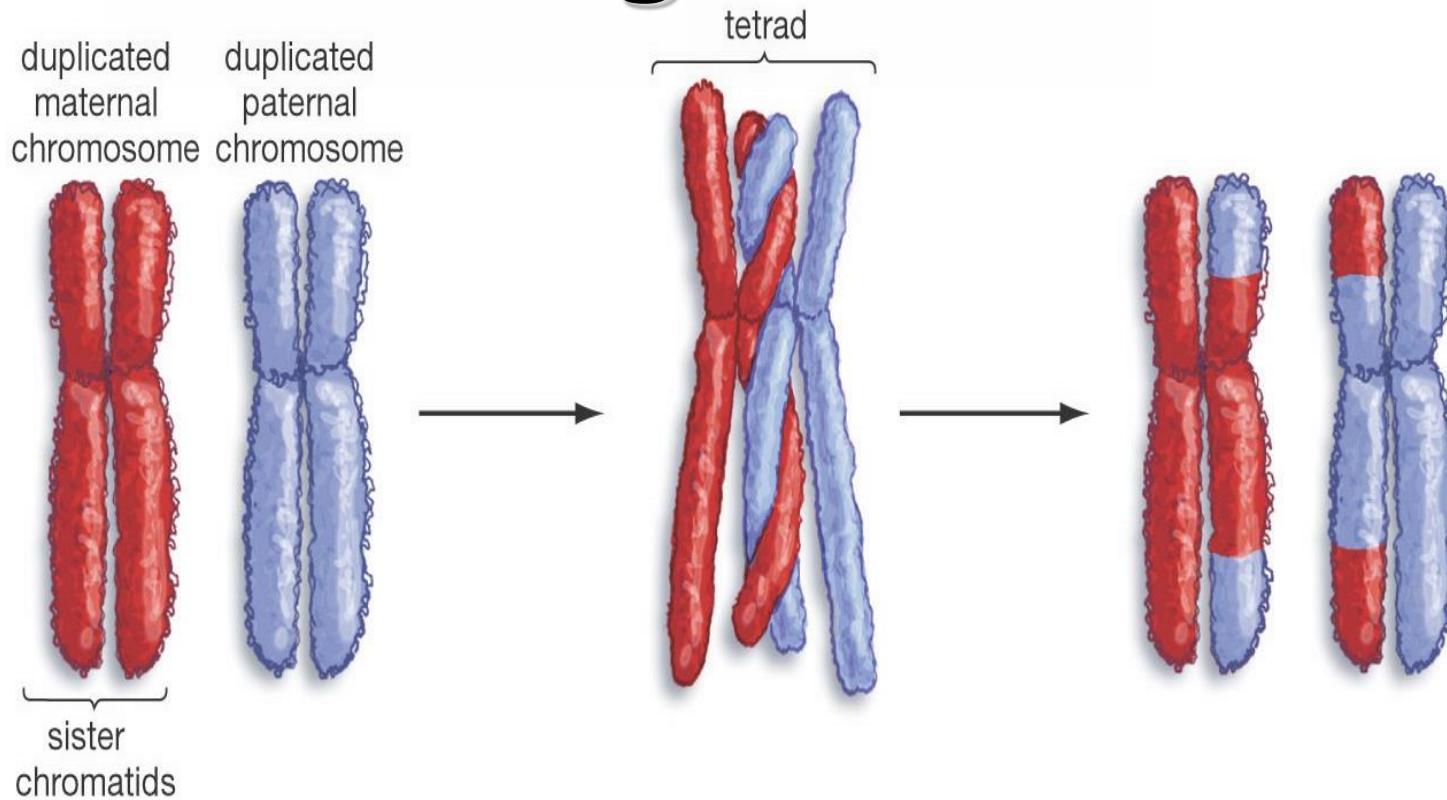
- ✓ Homologous chromosomes in a tetrad cross over each other
- ✓ Pieces of chromosomes or genes are exchanged
- ✓ Produces Genetic recombination in the offspring



# Homologous Chromosomes During Crossing-Over

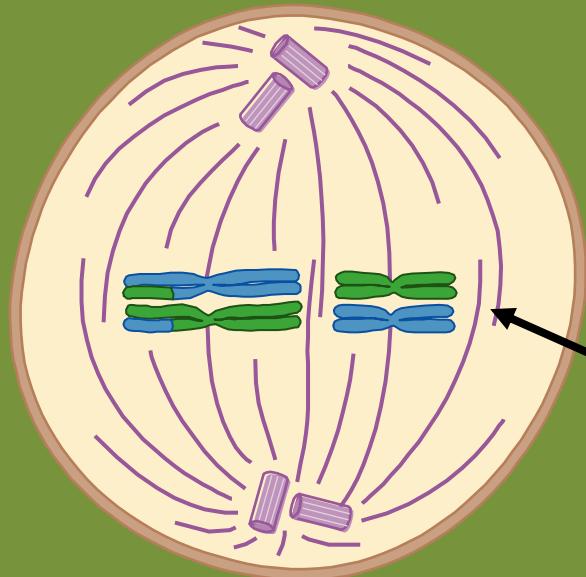


# Crossing-Over



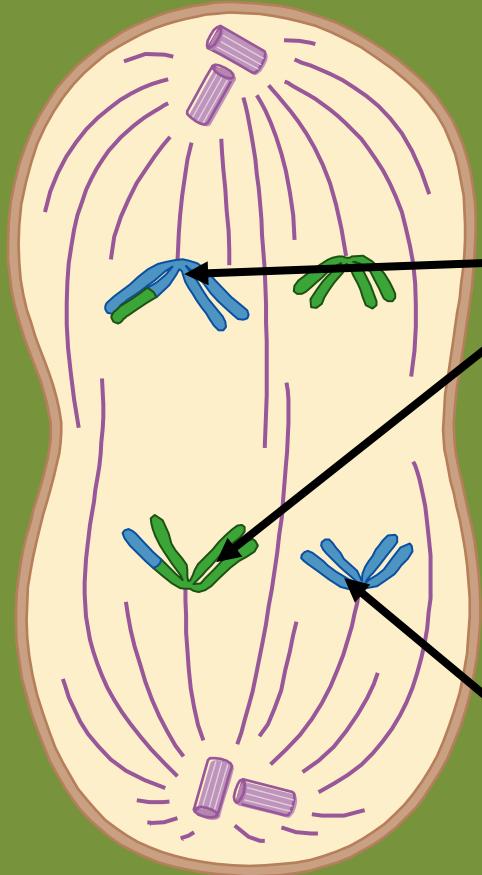
Crossing-over multiplies the already huge number of different gamete types produced by independent assortment

# Metaphase I



Homologous pairs of chromosomes align along the equator of the cell

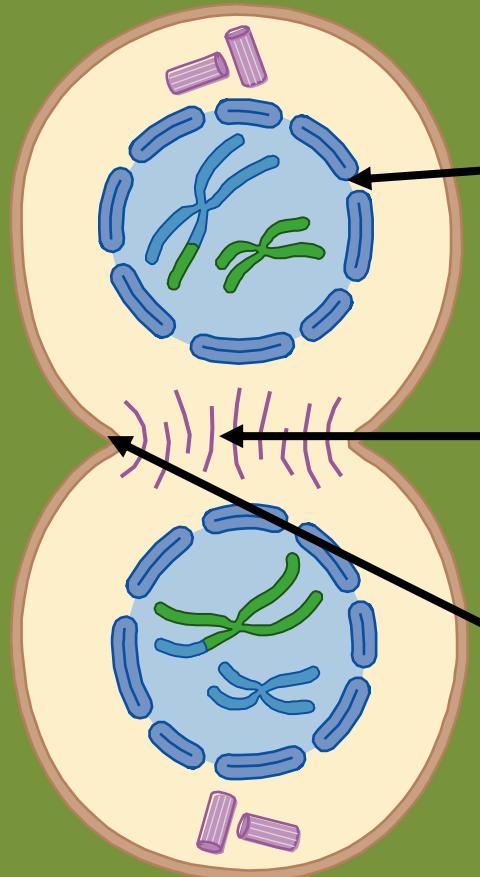
# Anaphase I



Homologs separate and move to opposite poles.

Sister chromatids remain attached at their centromeres.

# Telophase I

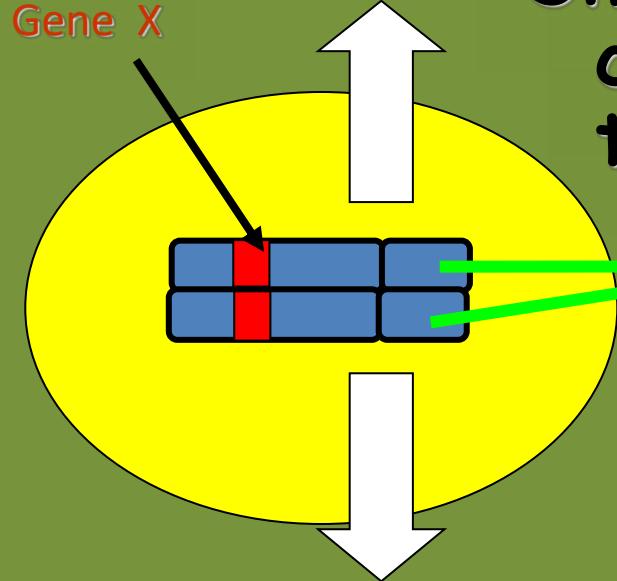


Nuclear envelopes reassemble.

Spindle disappears.

Cytokinesis divides cell into two.

# Meiosis II

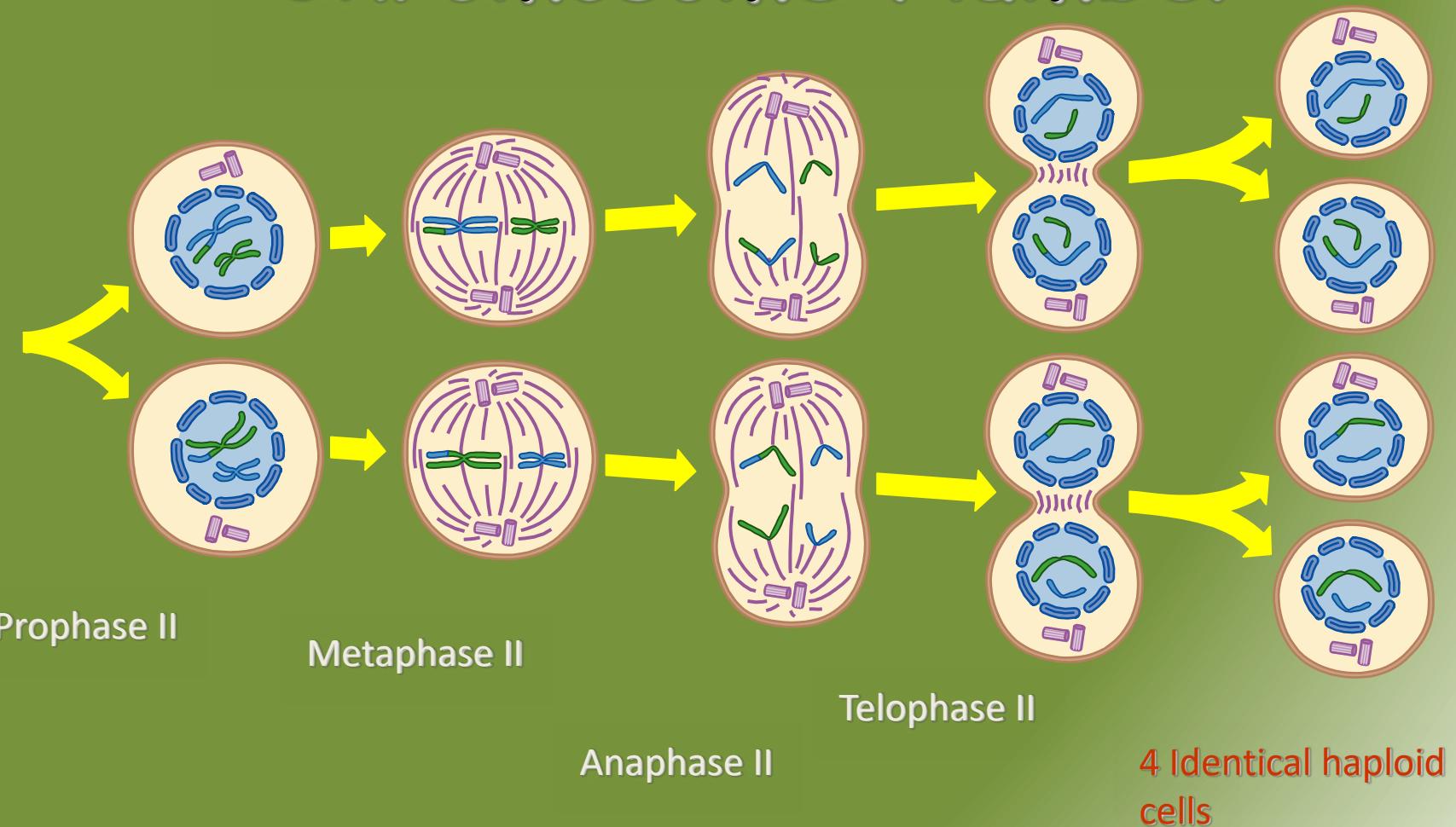


Only one homolog of each chromosome is present in the cell.

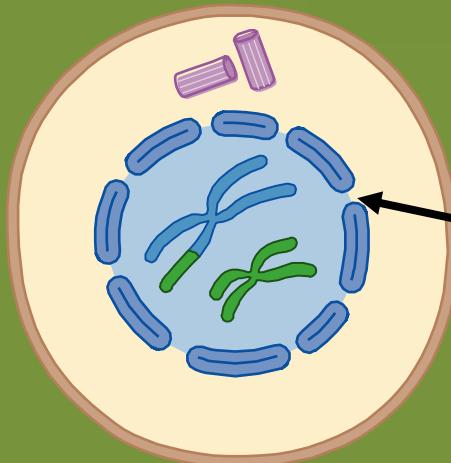
Sister chromatids carry identical genetic information.

Meiosis II produces gametes with one copy of each chromosome and thus one copy of each gene.

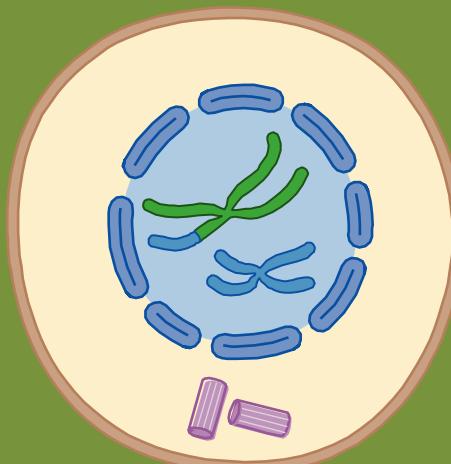
# Meiosis II: Reducing Chromosome Number



# Prophase II

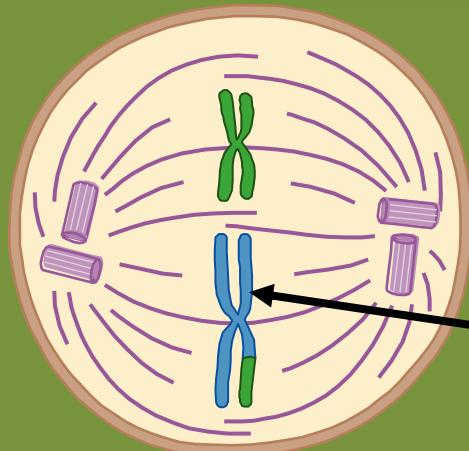


Nuclear envelope  
fragments.

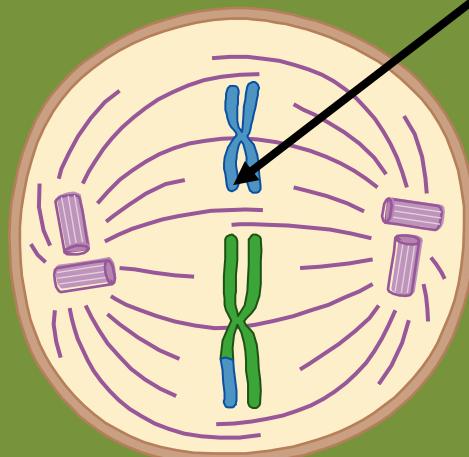


Spindle forms.

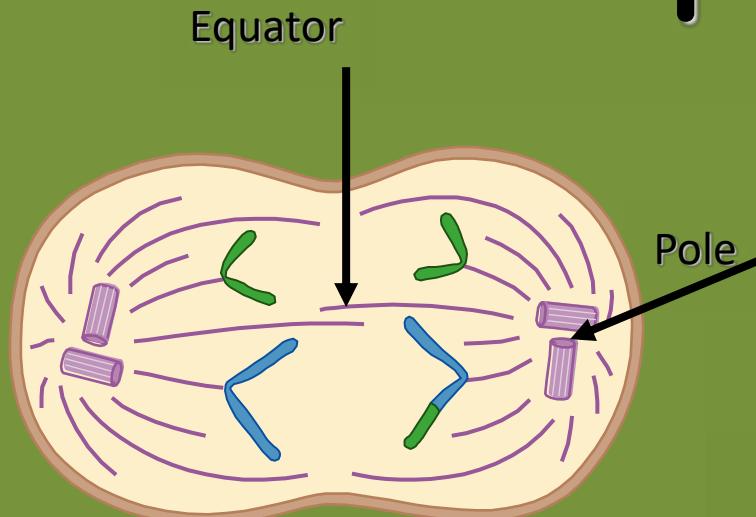
# Metaphase II



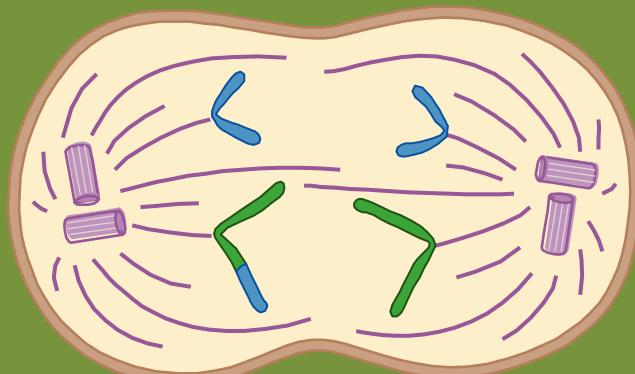
Chromosomes align along **equator** of cell.



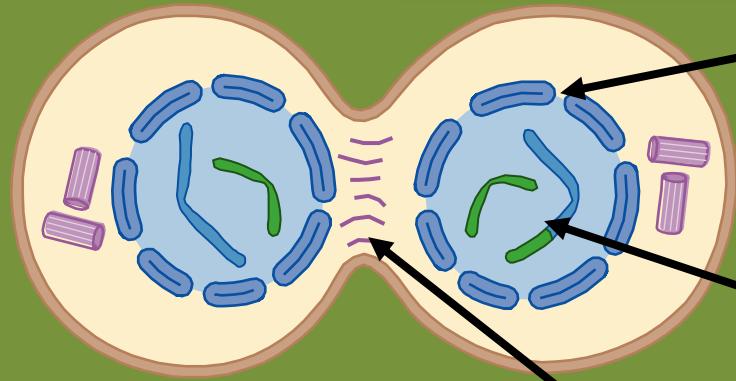
# Anaphase II



Sister chromatids  
separate and move  
to opposite poles.



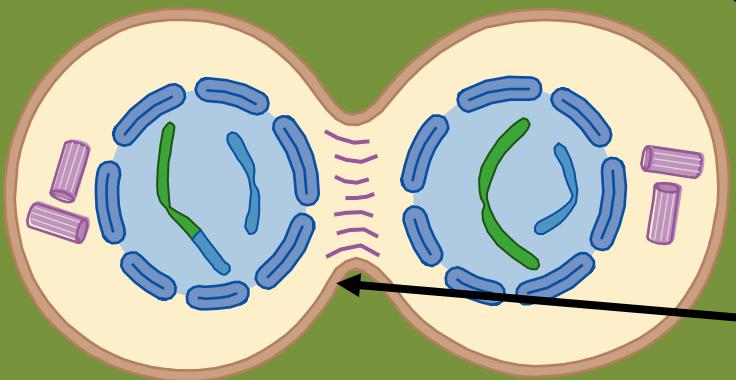
# Telophase II



Nuclear envelope  
assembles.

Chromosomes  
decondense.

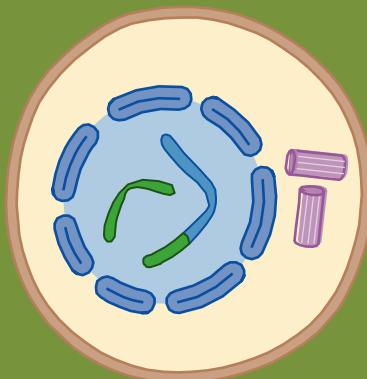
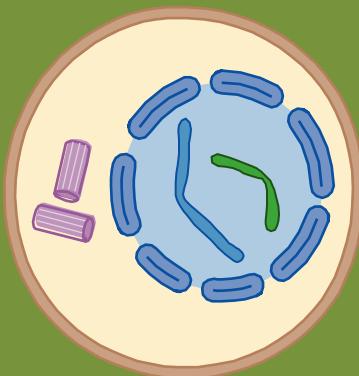
Spindle disappears.



Cytokinesis divides cell  
into two.

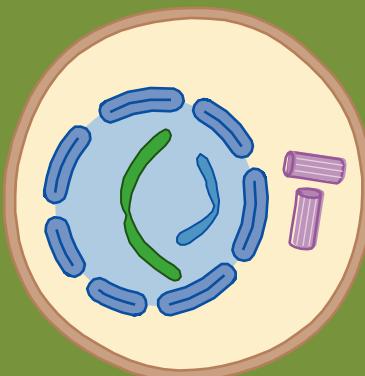
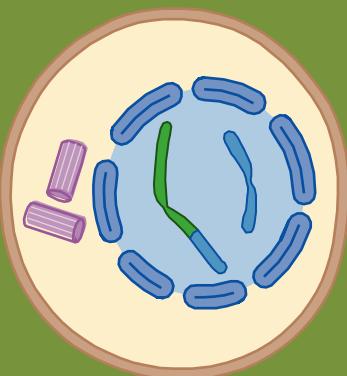
# Results of Meiosis

Gametes (egg & sperm) form



Four haploid cells with one copy of each chromosome

One allele of each gene



Different combinations of alleles for different genes along the chromosome

# Gametogenesis

Oogenesis

or

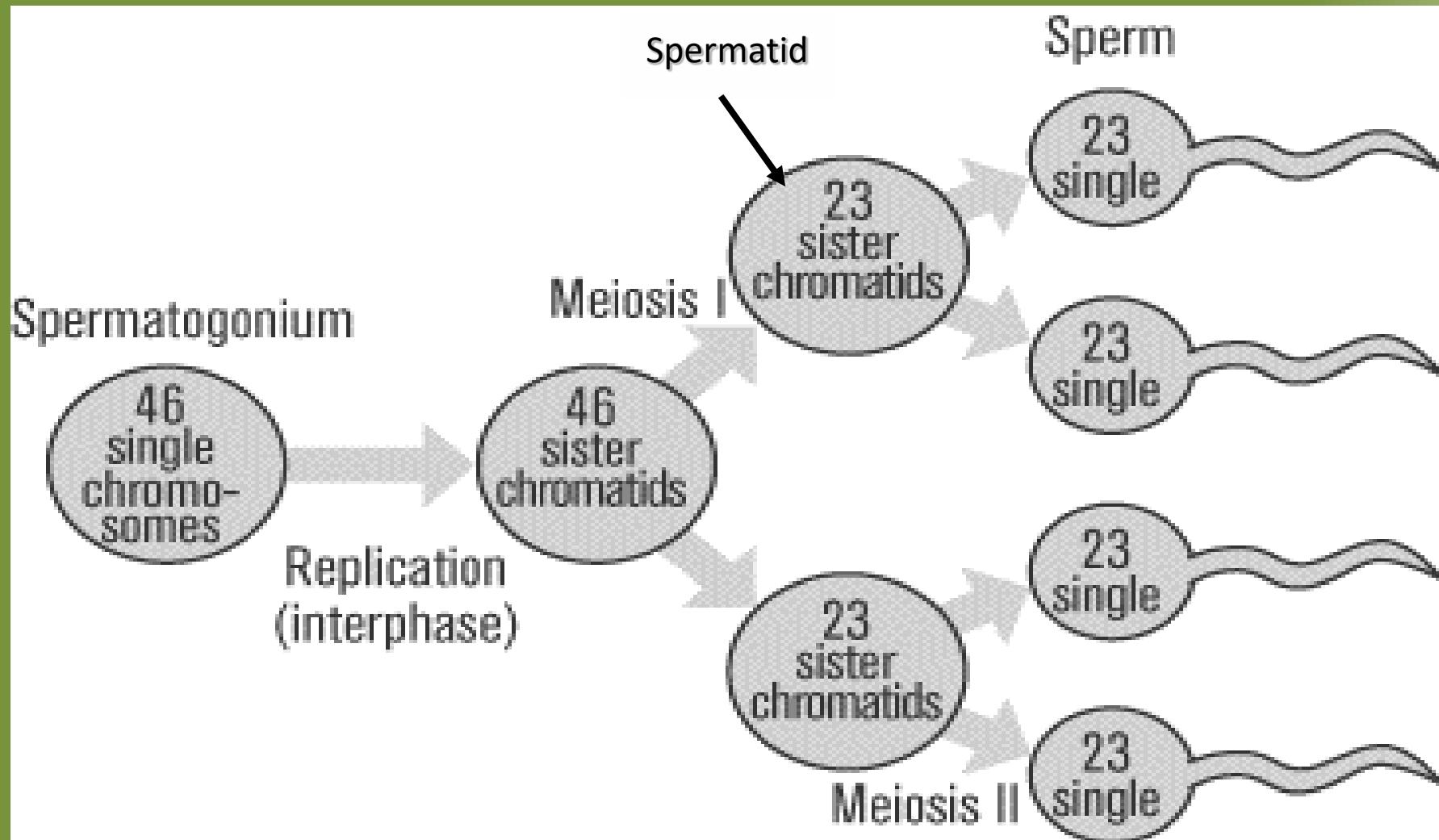
Spermatogenesis

# Spermatogenesis

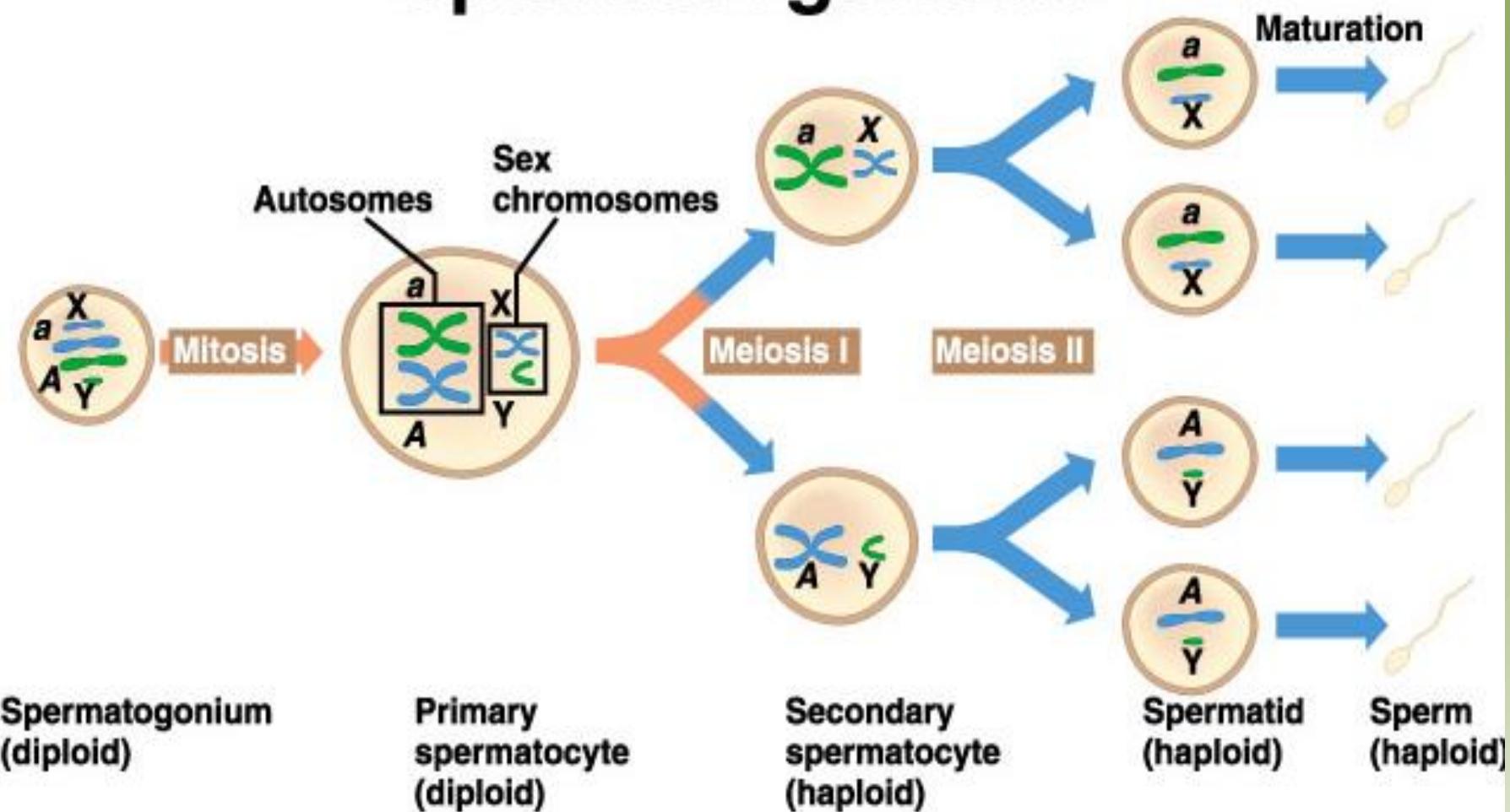
- ✓ Occurs in the testes
- ✓ Two divisions produce 4 spermatids
- ✓ Spermatids mature into sperm
- ✓ Men produce about 250,000,000 sperm per day



# Spermatogenesis in the Testes



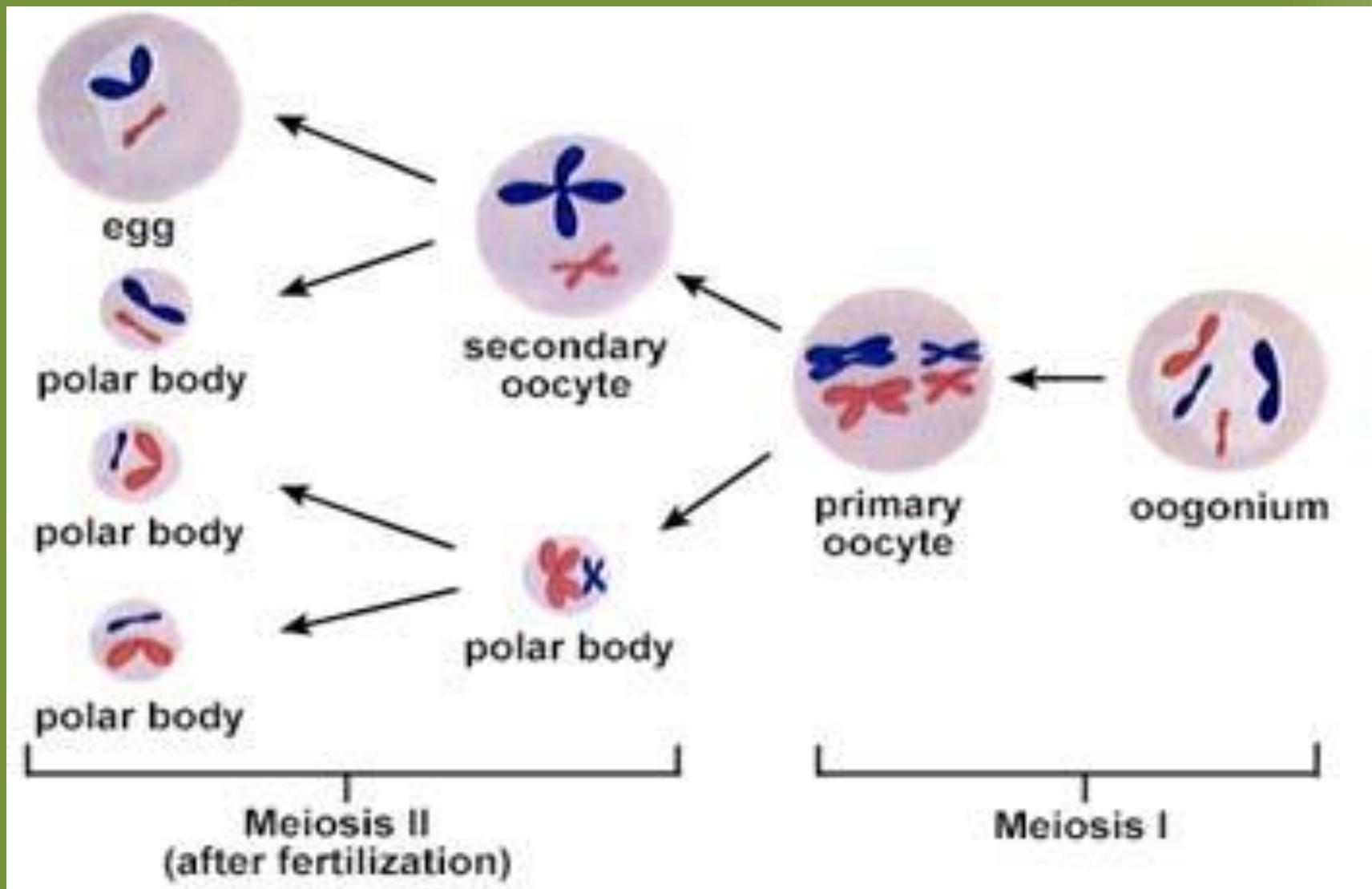
# Spermatogenesis



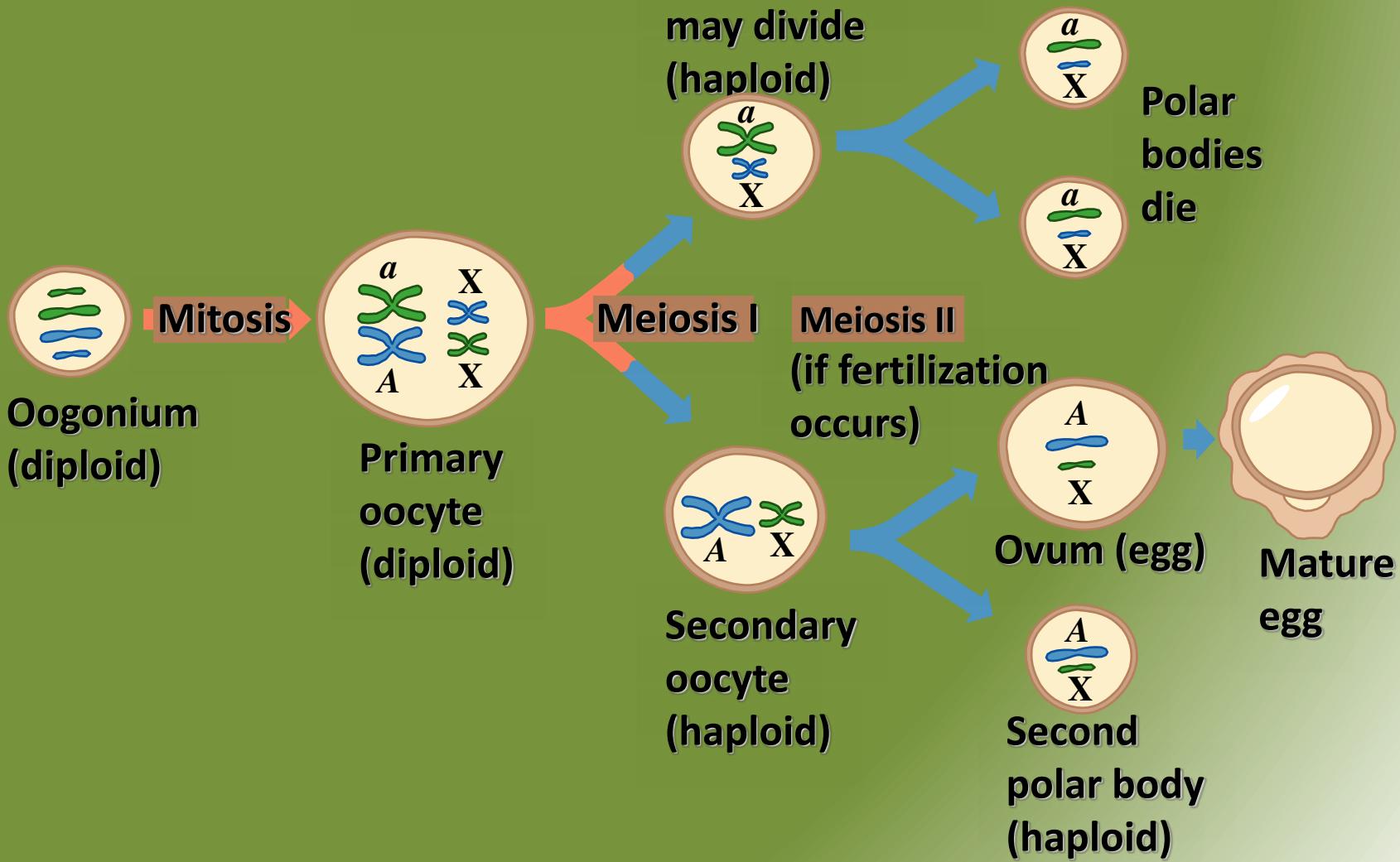
# Oogenesis

- ✓ Occurs in the ovaries
- ✓ Two divisions produce 3 polar bodies that die and 1 egg
- ✓ Polar bodies die because of unequal division of cytoplasm
- ✓ Immature egg called oocyte
- ✓ Starting at puberty, one oocyte matures into an ovum (egg) every 28 days

# Oogenesis in the Ovaries



# Oogenesis



# **Comparing Mitosis and Meiosis**

# Comparison of Divisions

	Mitosis	Meiosis
Number of divisions	1	2
Number of daughter cells	2	4
Genetically identical?	Yes	No
Chromosome #	Same as parent	Half of parent
Where	Somatic cells	Germ cells
When	Throughout life	At sexual maturity
Role	Growth and repair	Sexual reproduction