# MEIOSIS

EQ:How are sex cells produced?

# Sexual Reproduction

Sexual reproduction requires two parents. Each parent passes on HALF its genes to its offspring.

Must have male and female: male to produce sperm and female to produce eggs.

# Sexual Reproduction

## Advantages

- All of the offspring are genetically different from each other.

## Disadvantages

- The parent must find a mate.
- Fewer offspring will be produced.
- It takes longer.

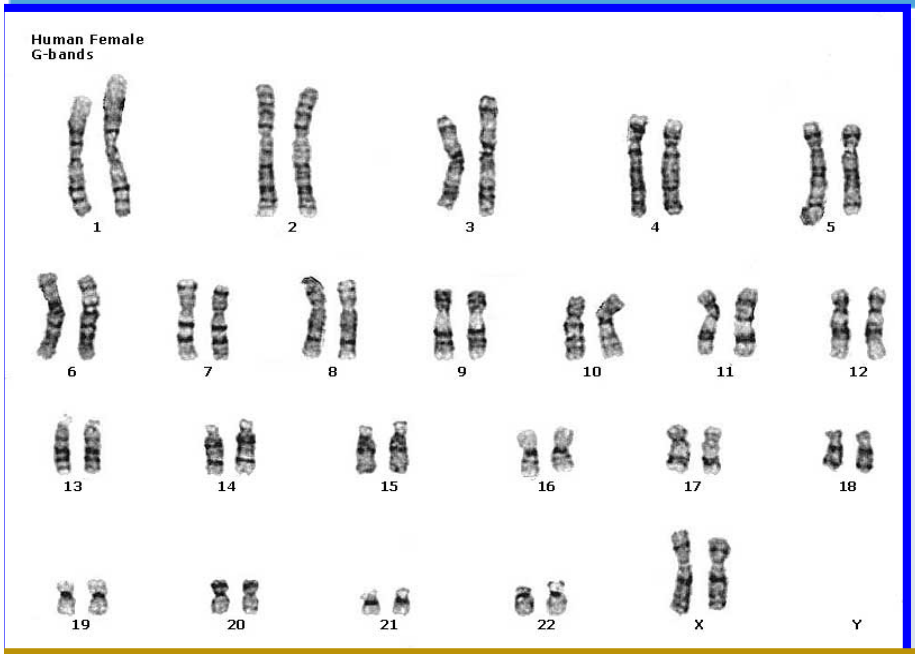
Sexual Reproduction involves:

Gametes: Sex cells (egg and sperm)

Fertilization: The union of sperm and egg.

Zygote: A fertilized egg.

# Cell Division and Chromosome Number




If an organism is the result of sexual reproduction, it will have two sets of chromosomes.

One set comes from the mother and one set comes from the father.

These two sets are called homologous chromosomes.

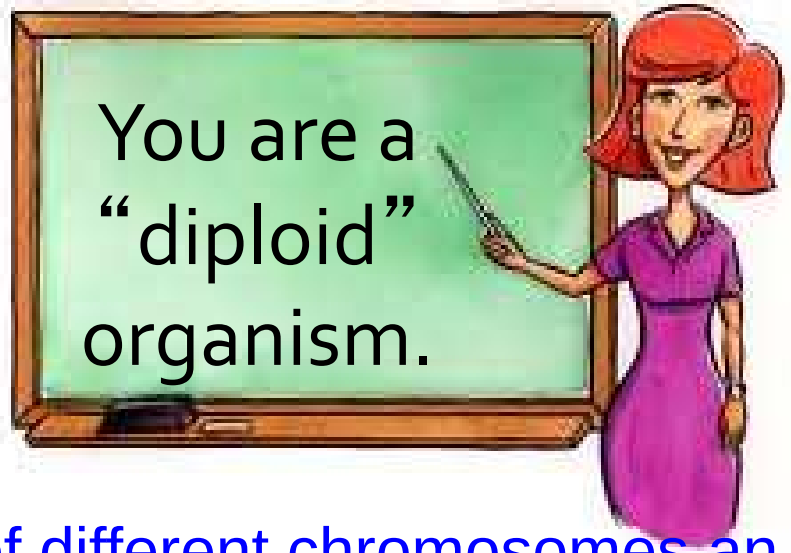
Homologous chromosomes are the two copies of each chromosome, one coming from the mother and one coming from the father.

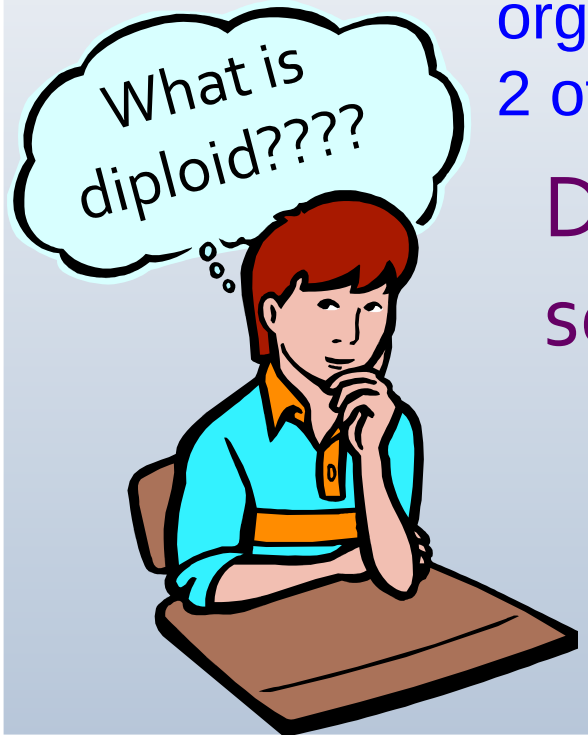
Homologous chromosomes carry the same genes, but they may have different expressions of that gene.

# Diploid means that …

…there are two of each kind of chromosome in each cell.

**The symbol for diploid is 2N.**




"N" is the number of different chromosomes an organism has. Humans are 2N because we have 2 of each kind of chromosome.

Diploid cells contain two complete sets of chromosomes.

So in mitosis:

**1 (2N) cell -------> 2 (2N) cells**

# Chromosome Number in Gametes

Egg and sperm cells must have half the number of chromosomes so that when added together, the zygote will have the proper number.

Human egg cell

Example: Gametes of the Human Body

Egg (23) + sperm (23) → zygote (46)

1N + 1N → 2N

Gametes are said to be haploid or 1N because they contain only one of each kind of chromosome.

Human sperm cells

The cells which produce eggs and the cells which produce sperm are diploid or 2N. So how do the egg and sperm cells get to be 1N?

**Meiosis!!**

Meiosis is a process of reduction division in which the number of chromosomes per cell is cut in half through the separation of homologous chromosomes.

# Phases of Meiosis

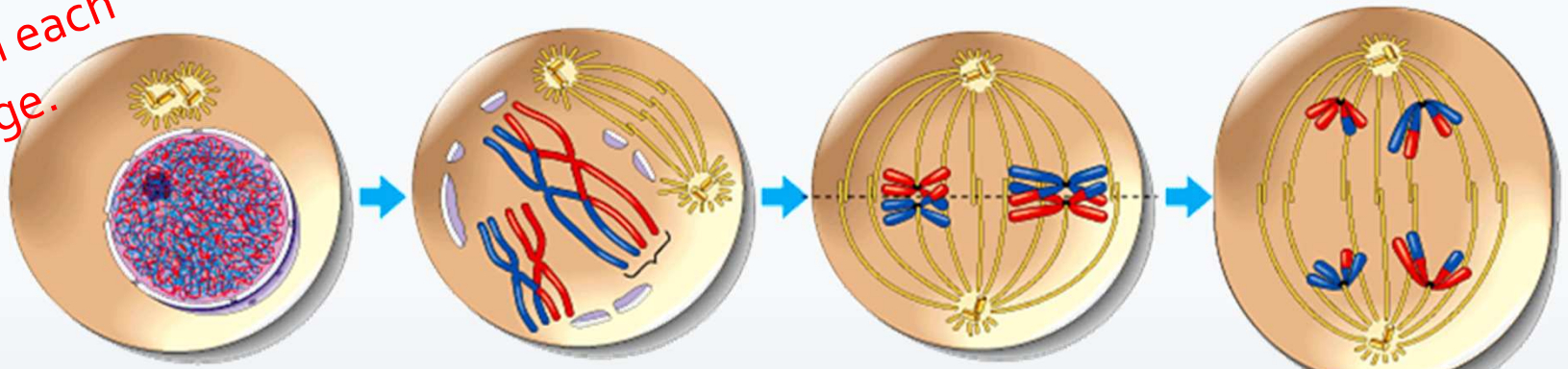
Occurs in the sex cells only: the egg and sperm.

Purpose is to reduce the chromosome number of the egg and sperm by half.

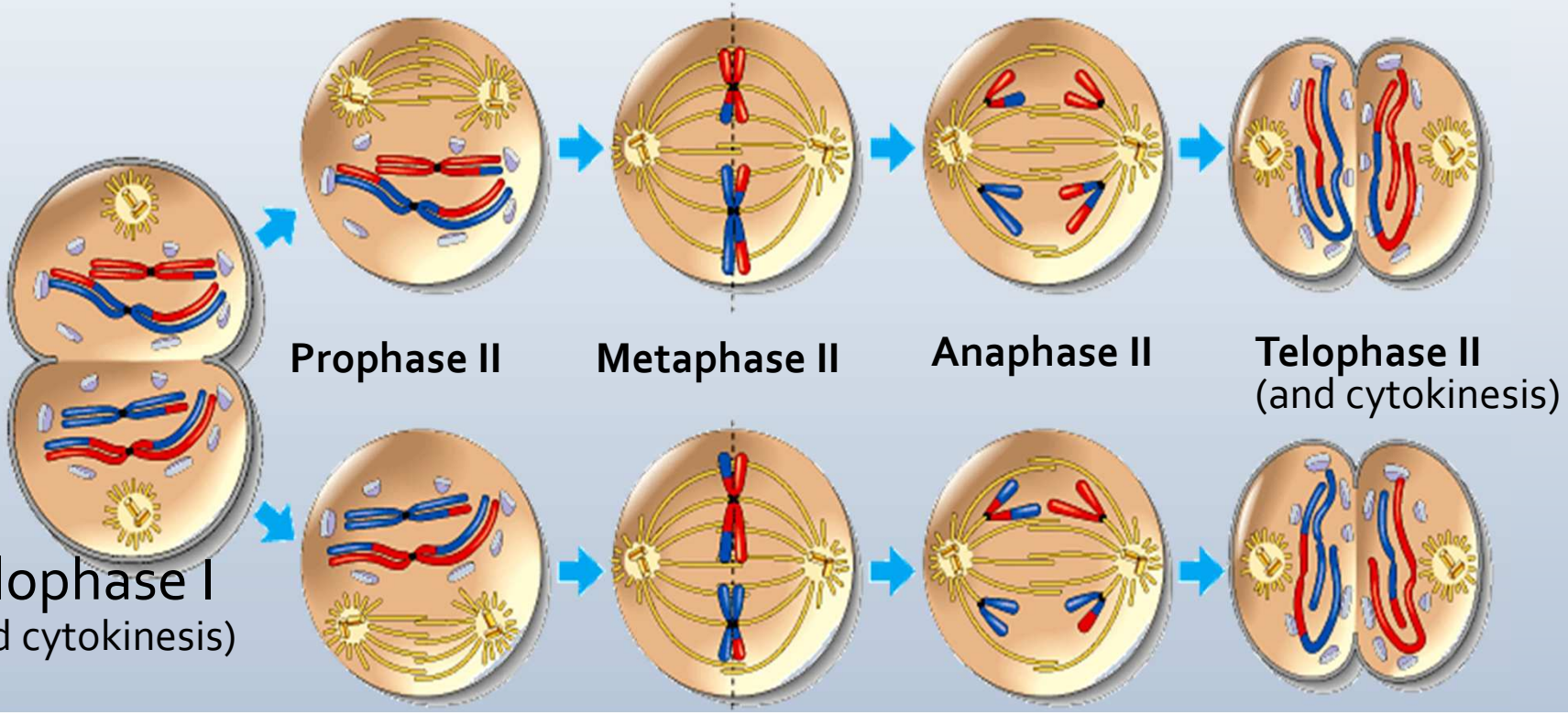
Meiosis, like mitosis, is preceded by the replication of chromosomes. Unlike mitosis, this replication is then followed by two divisions: meiosis I and meiosis II.

# The stages of meiosis I and II

Let's first label each stage.



Interphase Prophase I Metaphase I Anaphase I

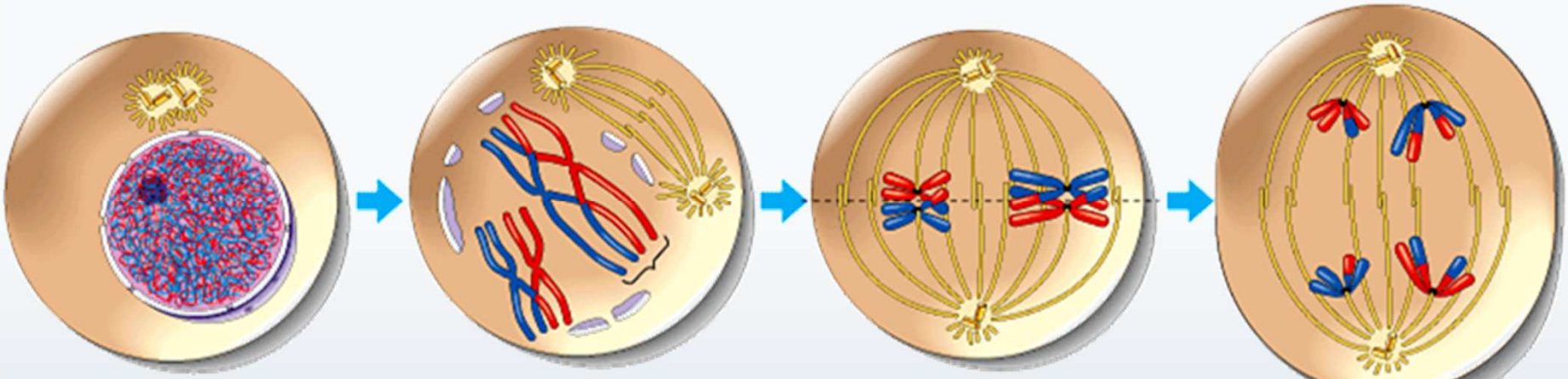


Telophase I
(and cytokinesis)

Prophase II Metaphase II Anaphase II

**Telophase II**
(and cytokinesis)

# The Stages of Meiosis I



## Interphase

The chromosomes replicate. It is similar to chromosome replication of mitosis. Two identical sister chromatids are held together by a centromere.

## Prophase I

Chromosomes shorten and thicken. Each chromosome pairs with its corresponding homologous chromosome to form a tetrad. There are 4 chromatids in a tetrad.

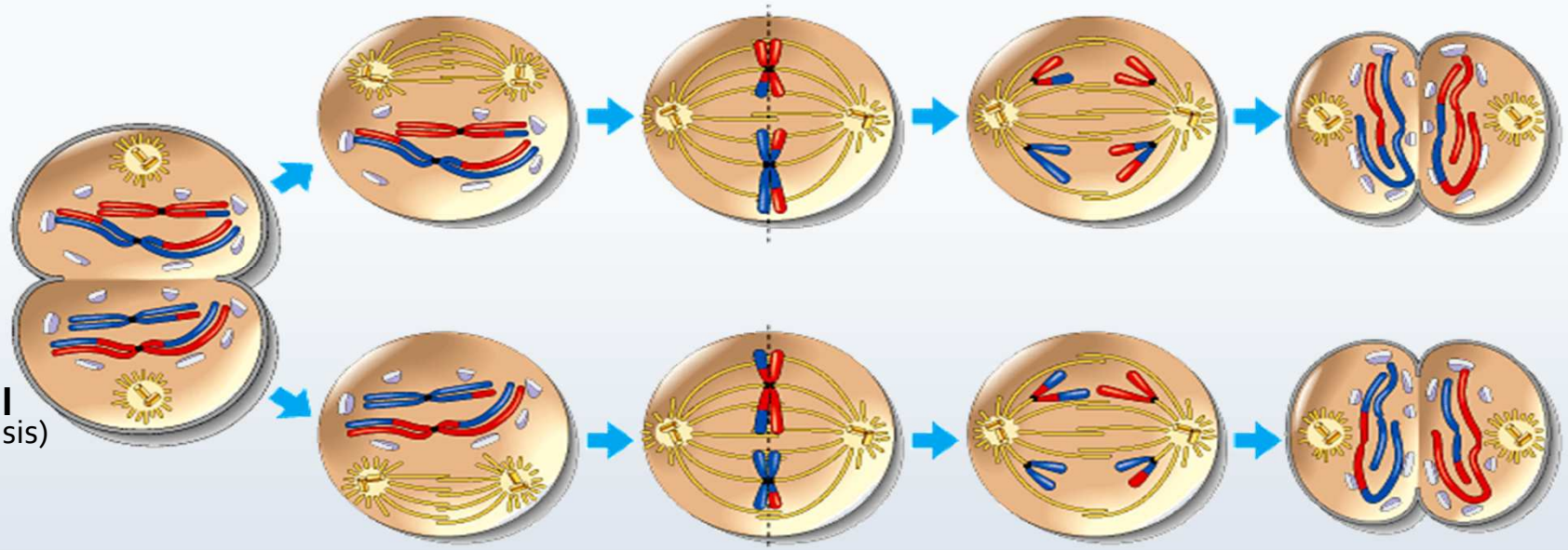
## Metaphase I

Tetrads line up at the center of the cell.

## Anaphase I

The tetrads break apart and the pairs move to opposite sides of the cell. Sister chromatids remain attached at their centromeres.

# The Stages of Meiosis II



**Telophase I**
(and cytokinesis)

The cell separates into two cells.

Meiosis I results in 2 haploid (1N) daughter cells

Each daughter cell has half the number of chromosomes as the original cell.

**Prophase II**

The pairs of sister chromatids start toward the center.

**Metaphase II**

Pairs of sister chromatids line up at the center.

**Anaphase II**

The pairs of sister chromatids separate and move to opposite sides of the cell.

**Telophase II**
(and cytokinesis)

Results in 4 new cells that are 1N.

# The Importance of Meiosis

1 (2N) cell -------> 4 (1N) cells

The chromosome number of the egg and sperm is cut in half to insure that the zygote will have the proper number of chromosomes.

# Gamete Formation

Meiosis produces four haploid cells that are different.

In males, meiosis results in 4 sperm cells.

In females, 4 cells are produced, but only one will become an egg cell. All of the cytoplasm and all of the organelles are put into one egg cell. The other three cells will never be functional.

# Left Side Activity

List all of the phases of meiosis and explain what occurs during each stage.