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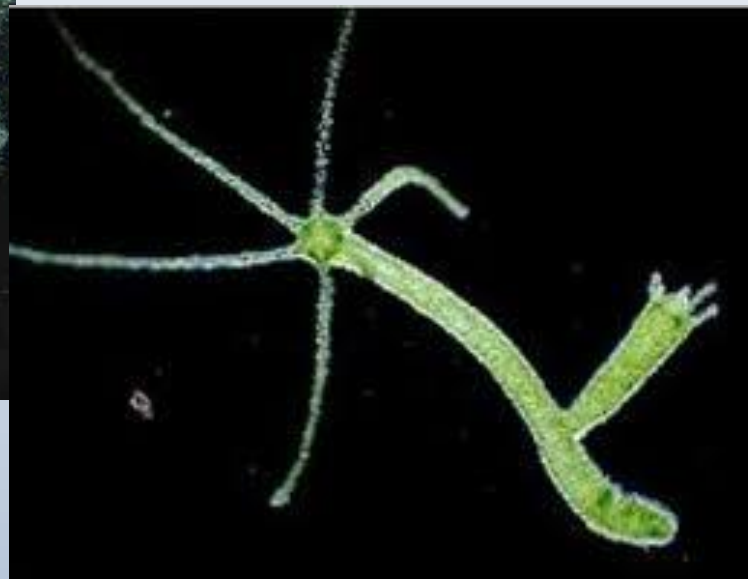
Asexual Reproduction

Offspring are produced by only one parent.

Each parent passes ALL of its genes to the offspring.



Asexual Reproduction

Advantages

- It is faster
- Large numbers of offspring are produced.
- The parent does not have to find a mate.

Disadvantages

- All of the offspring are exactly alike. There is no variation.
- The ability to adapt to a changing environment is greatly reduced.

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.

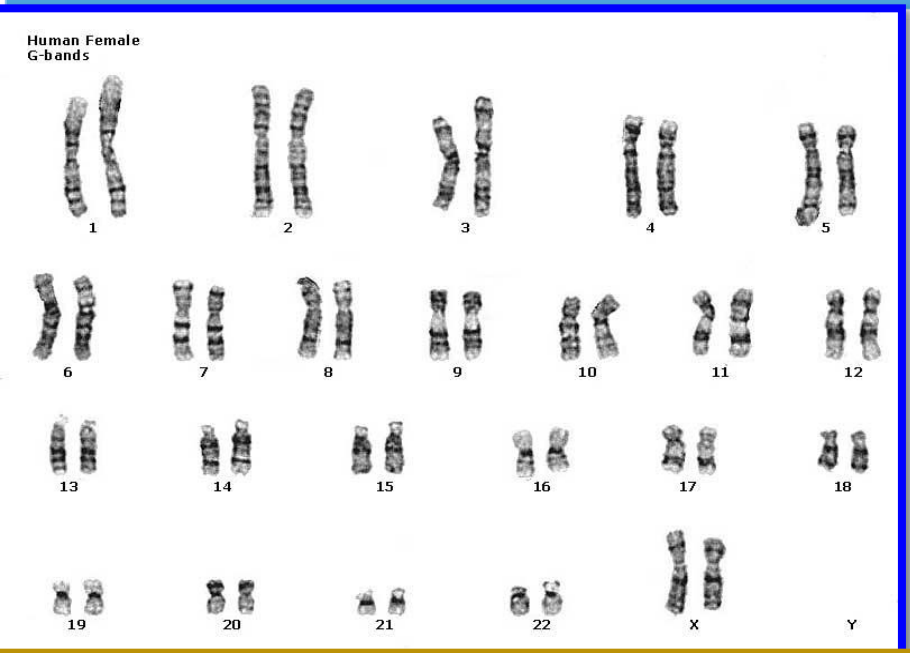
Sexual Reproduction involves:

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.

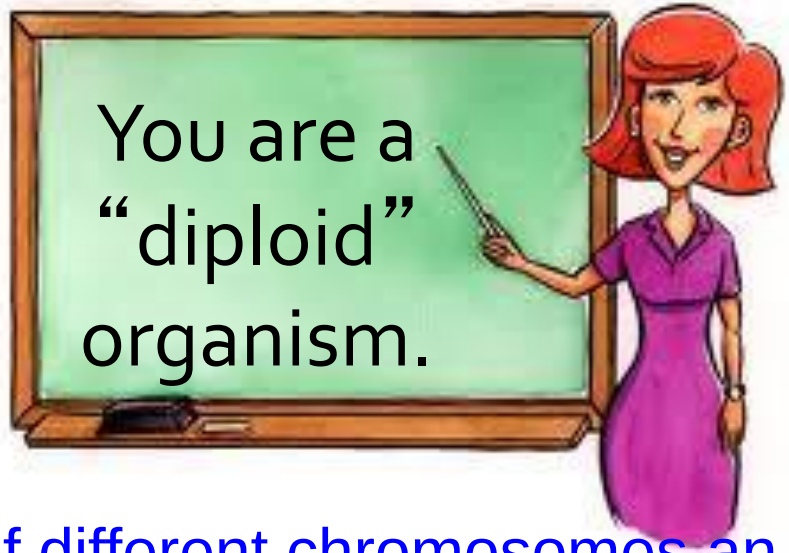
Homologous chromosomes are the two copies of each chromosome, one coming from the mother and one coming from the father.

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

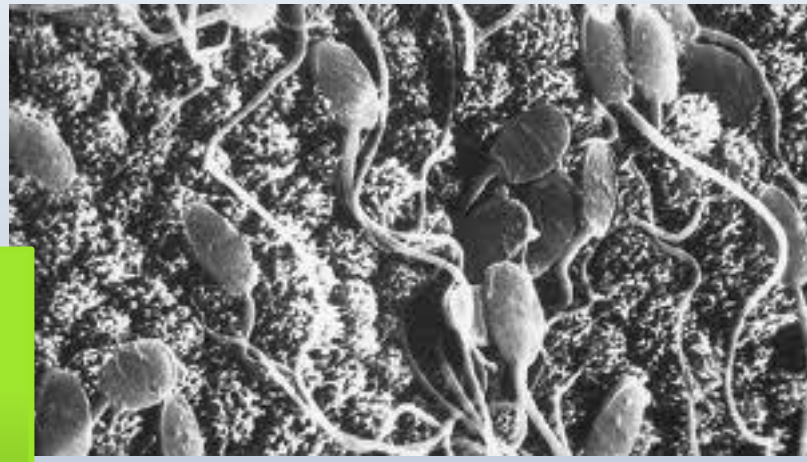
Egg and sperm cells must have half the number of chromosomes so that when added together, the zygote will have the proper number.

Human egg cell

Example: Gametes of the Human Body

Egg (23) + sperm (23) → zygote (46)

1N + 1N → 2N



Human sperm cells

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

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.

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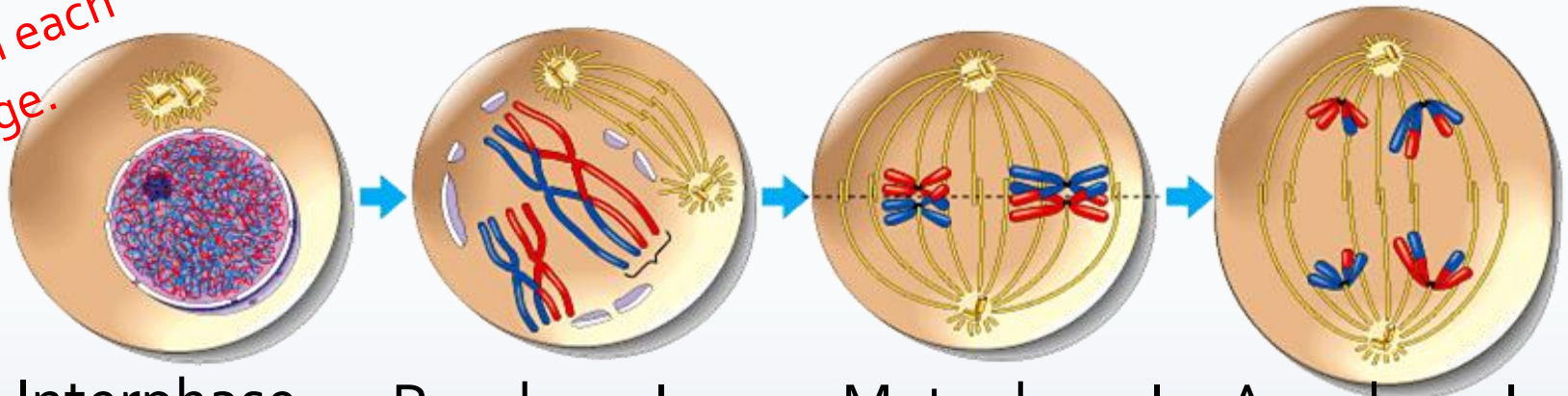
The stages of meiosis I and II

Let's first label each stage.

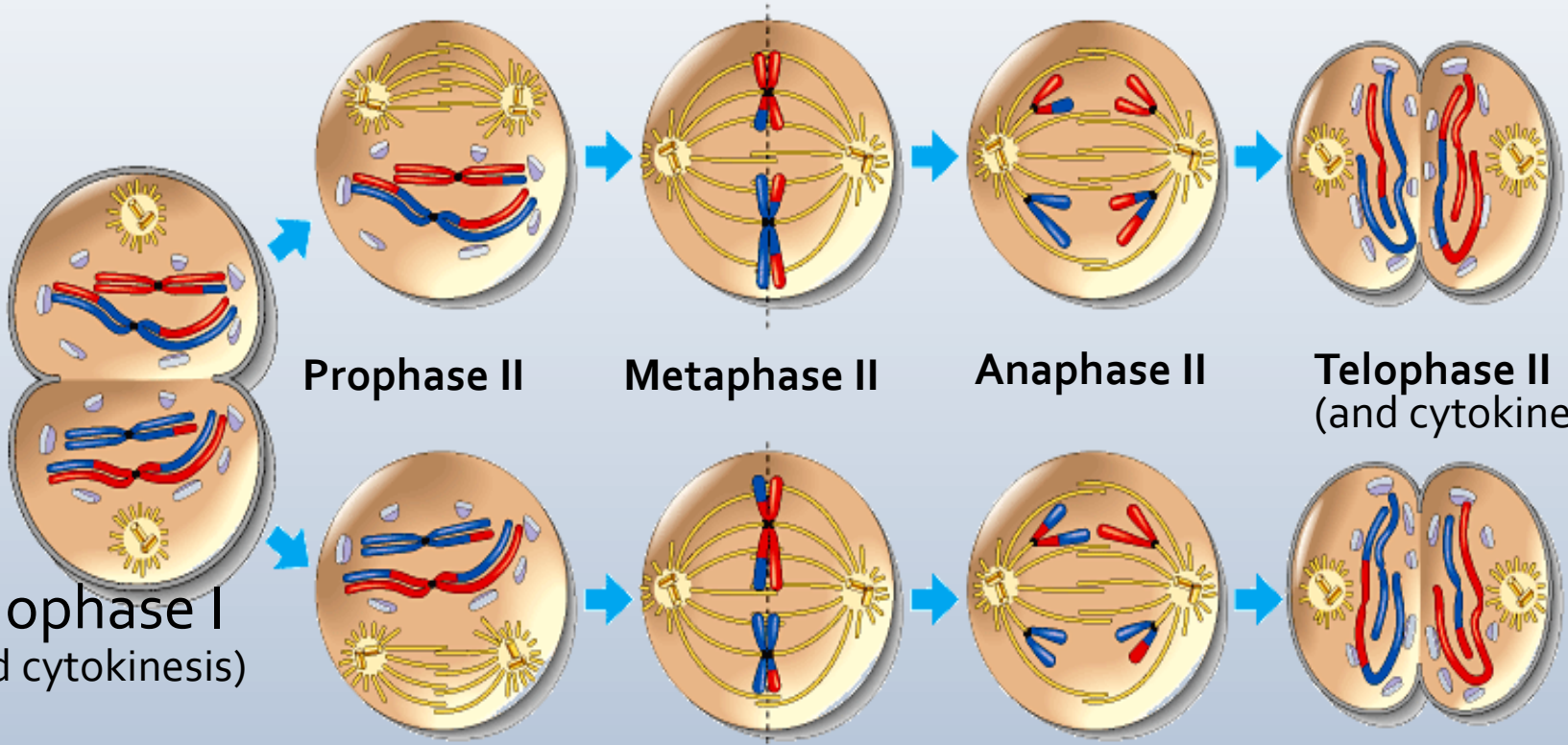


Interphase

Prophase I

Metaphase I

Anaphase I



Prophase II

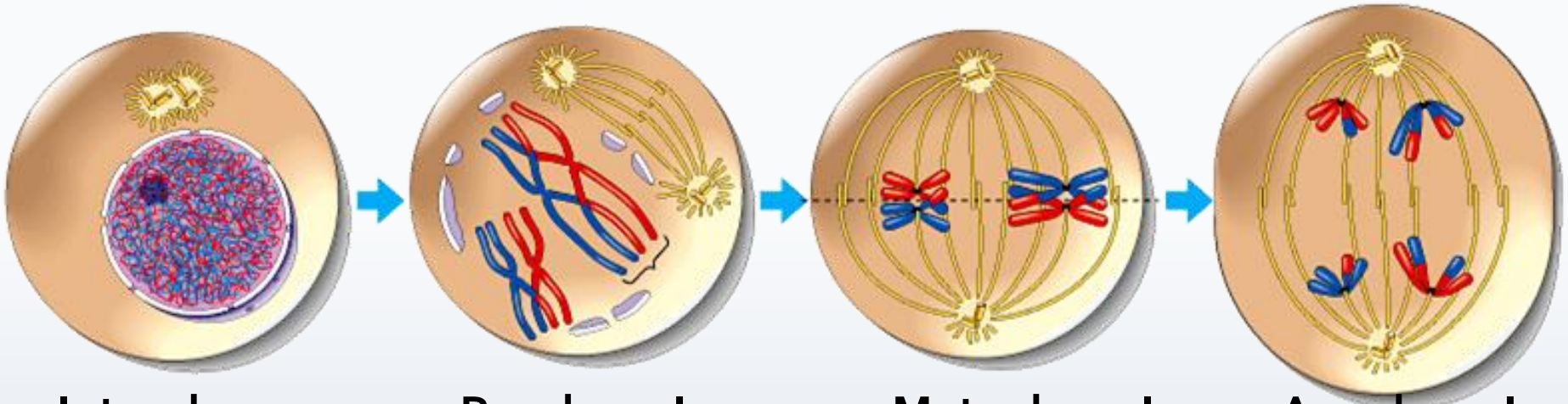
Metaphase II

Anaphase II

Telophase II
(and cytokinesis)

Telophase I
(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.

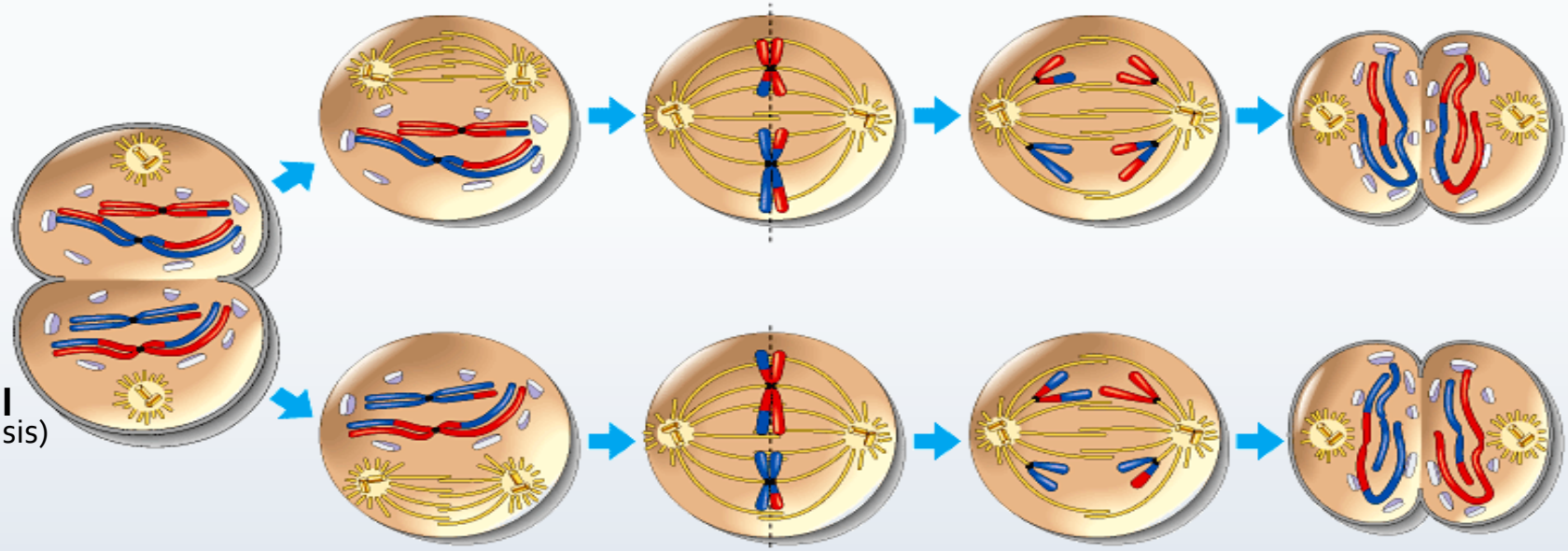
Metaphase I

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.

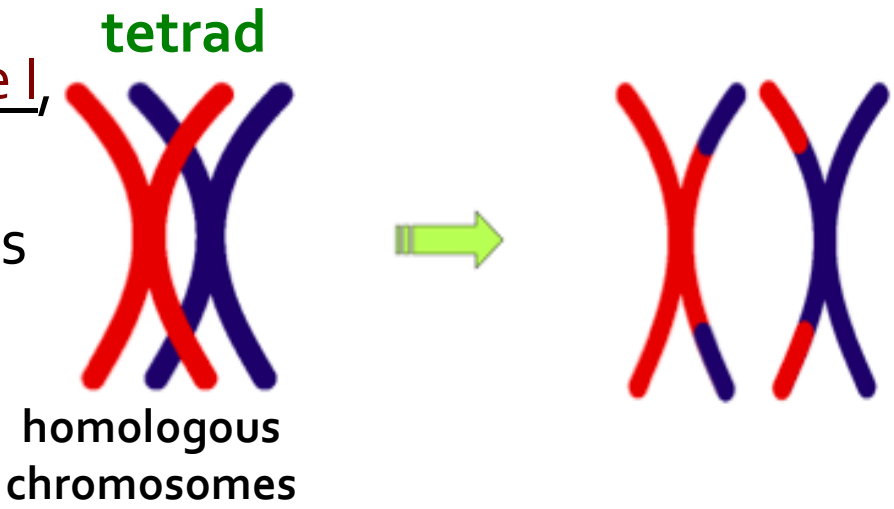
The Importance of Meiosis

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.

"Crossing Over" During Meiosis

During prophase I, each pair of chromatids lines up next to its homologue.



This process is called "crossing over"

This pairing of homologous chromosomes produces tetrads.

A tetrad consists of 4 chromatids.

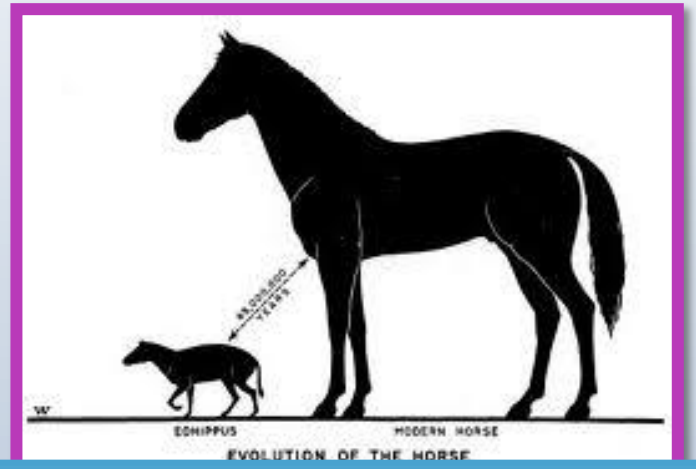
It is possible for the chromatids within a homologous pair to twist around one another. Portions of the chromatids may break off and attach to adjacent chromatids.

"Crossing over" is the exchange of genetic information (genes) between segments of homologous chromosomes during meiosis.

The result is that the offspring will receive a new combination of genetic information. This leads to variation in the offspring.

Variation leads to adaptation and change. These variations will cause some of the offspring to be better suited for their particular environment. If they are better suited for their environment, it is more likely that they will survive to reproductive age and pass these favorable variations on to their offspring.

If the result of crossing over causes the offspring to be less suited for its environment, it may not survive. Or, if the offspring does survive, it may not be reproductively competitive. This means that it may not be able to secure a mate. These "unfavorable" genes are not likely to be passed on to the offspring.



Crossing over leads to Evolution!

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.

Comparison of Mitosis and Meiosis

Mitosis occurs in all cells of the body except egg and sperm.

Meiosis only occurs in the formation of egg and sperm.

Comparison of Mitosis and Meiosis

In meiosis, each diploid cell divides twice to produce a total of 4 cells.

In mitosis each diploid cell divides once to form 2 cells.

Comparison of Mitosis and Meiosis

In meiosis, each of the four cells contains half the number of chromosomes as the parent cell.

In mitosis, each new cell contains the same number of chromosomes as the original cell.

Comparison of Mitosis and Meiosis

In mitosis, the homologous pairs do not come together to form tetrads.

In meiosis, the homologous pairs do come together to form tetrads. While the chromosomes are in tetrads, crossing over may occur. There will be no crossing over in mitosis.

Comparison of Mitosis and Meiosis

In meiosis, the four haploid cells contain different combinations of chromosomes from each other.

In mitosis, the new cells contain identical copies.