What is the mechanism behind sexual reproduction?

Sexual reproduction relies on the formation of egg and sperm; these structures are referred to as **gametes.** The egg and sperm unite during the process of fertilization to create a zygote with the full chromosome number for that species.

1. What are gametes?

Gametes are sex cells (egg and sperm)

2. How many chromosomes do humans have?
   46

3. If an adult human has 46 chromosomes, how many chromosomes were in the egg and the sperm that united to create them?

23 (egg) + 23 (sperm)→ 46 in zygote (fertilized egg)

How can gametes with half the number of chromosomes of that species be created? The answer is **meiosis** or meiotic cell division.

4. What is meiosis?

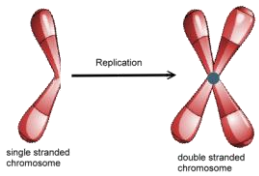
Meiosis is the process that creates gametes with half the number of chromosomes for that species.

5. Where in our bodies do you think meiosis takes place?
   Meiosis only takes place in the gonads (ovaries/testes)

6. Recall our discussion of mitosis, what must occur to the genetic material before mitotic cell division can occur?

The genetic material (chromosomes) must replicate prior to cell division.

As in mitosis, the chromosomes in the primary sex cells must also replicate prior to meiosis. When chromosomes replicate, they become double-stranded; once this occurs, the cell is ready to begin meiotic cell division.



7. What must occur prior to the start of meiotic cell division?
   The chromosomes must replicate prior to the start of meiotic cell division.

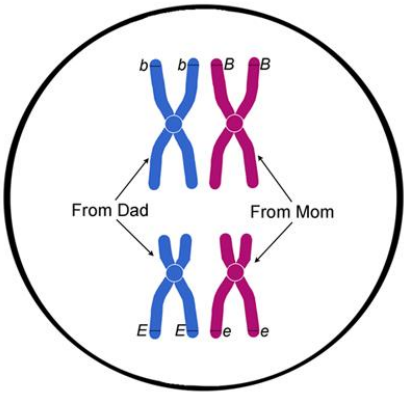
8. What evidence would we have that would indicate that a cell is ready to undergo meiosis?

   The chromosomes would be double-stranded if the cell is ready to undergo meiosis.

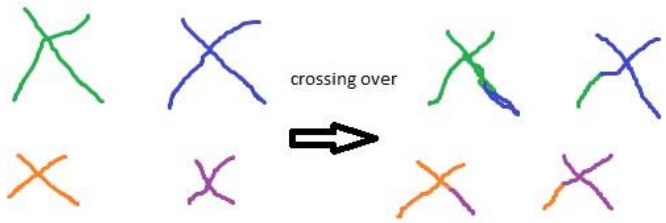
As previously discussed, humans have 46 chromosomes which really consist of 23 pairs of similar chromosomes. These pairs of chromosomes with genes for the same traits are referred to as **homologous pairs**.

9. Where have we seen the term homologous before?
   Homologous structures (same structure, different function)
10. What is a homologous pair?
    A homologous pair consists of chromosomes with genes for similar traits.

After the chromosomes have replicated in the nucleus, the double-stranded chromosomes try to find the other member of their homologous pair and they connect.



Once the homologous chromosomes have paired up, they may exchange pieces of adjacent chromatids with each other: (draw diagram using two different colors)



This process is referred to as **crossing over** and can only occur among homologous chromosomes during the first phase of meiosis.

11. Compare the chromosomes before and after crossing over. What has increased in the parts of the chromosomes that underwent crossing over?

Variety has increased in the chromosomes after crossing over.

12. Why would it be harmful to offspring if non-homologous chromosomes crossed over?

If non-homologous chromosomes crossed over, the resulting chromosomes could be missing genes.

Meiosis involves two sets of cell divisions; meiosis I and meiosis II. During **prophase** of meiosis I, **homologous chromosomes pair up and crossing over** may occur. The pairs then line up at the center of the cell during **metaphase I**. At this point the homologous pairs are pulled apart so that one complete set of chromosomes ends up at each pole of the parent cell (**anaphase I**). The parent cell starts to divide into two daughter cells, each with one full set of double-stranded chromosomes (**telophase I)**

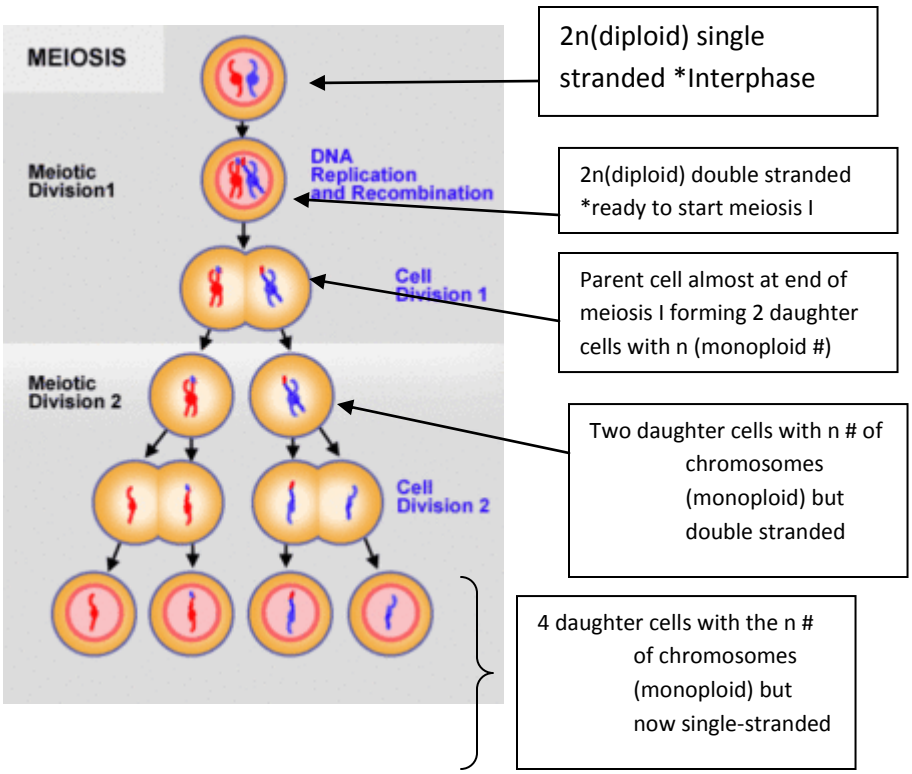
13. Explain what happens in each of the steps of meiosis I:
    a. Prophase- homologous chromosomes pair up and may do crossing over
    b. Metaphase- homologous pairs line up at the middle of the cell
    c. Anaphase- homologous pairs move apart into two separate sets
    d. Telophase – parent cell splits into two daughter cells with half the number of chromosomes (chromosomes are still double-stranded)

If the parent cell was that of a human, it would have 46 double-stranded chromosomes. This is referred to as **the diploid or 2n number** for the species, as it is the full number of chromosomes found in each body cell of that species.

14. How many double-stranded chromosomes would be found in each daughter cell at the end of meiosis I? This is considered **the monoploid or "n"** number for the species.

23 + 23

Chromosomes are only double-stranded during cell division; therefore the daughter cells at the end of meiosis I still have too much genetic material and must go through a second division. Meiosis II resembles mitosis in that double-stranded chromosomes line up single file at the center of the cell and are now separated into complete sets of single-stranded chromosomes.



Summing it all up:

15. How many daughter cells are produced at the end of meiosis?

Four daughter cells are produced at the end of meiosis (each with the monoploid number of single-stranded chromosomes)

16. How do these daughter cells compare to each other genetically?

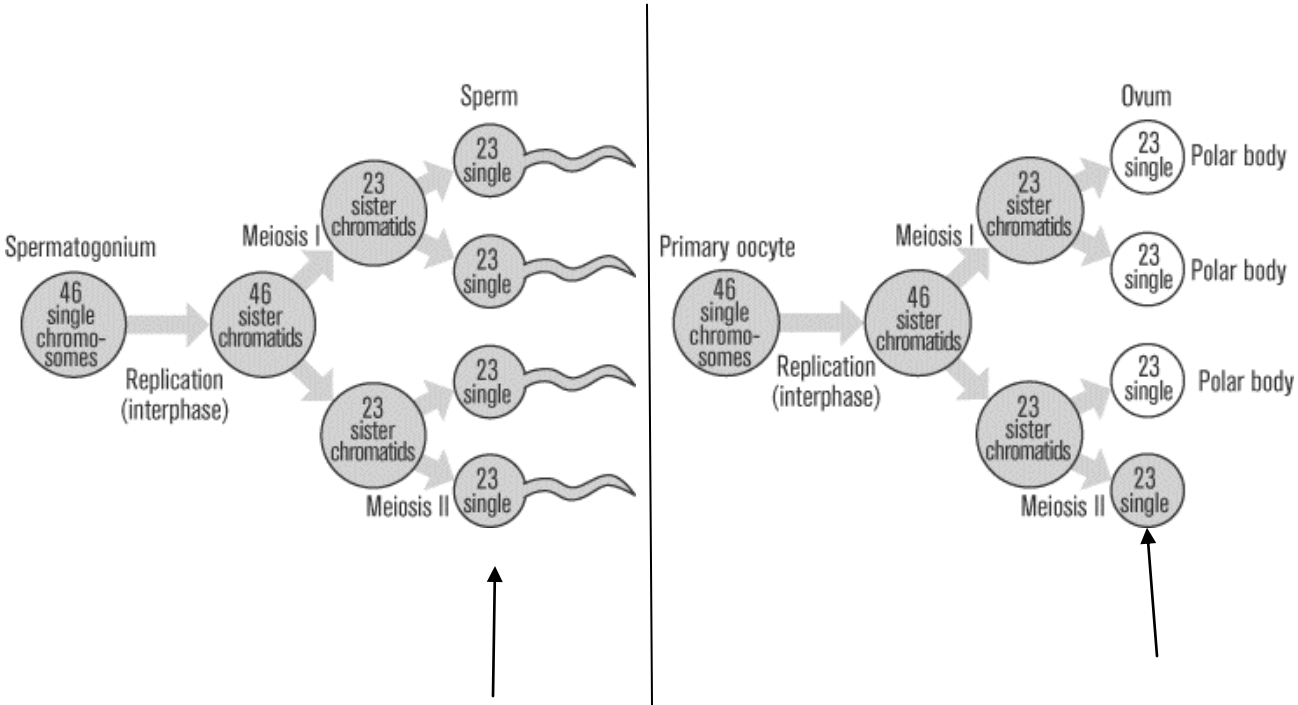
    These daughter cells are genetically similar to each other NOT genetically identical because of:

    1. Crossing over
    2. Recombination (which version of each chromosome number each daughter cell receives is random)

17. If these daughter cells are created in the ovaries or testes, what do you think they go on to become?

    These daughter cells become gametes (egg and sperm).

Spermatogenesis vs. Oogenesis



Four function sperm

one functional egg

Compare the number of functional sperm produced to that of functional eggs:

Four functional sperm are created during spermatogenesis, while only ONE functional egg is created during oogenesis.