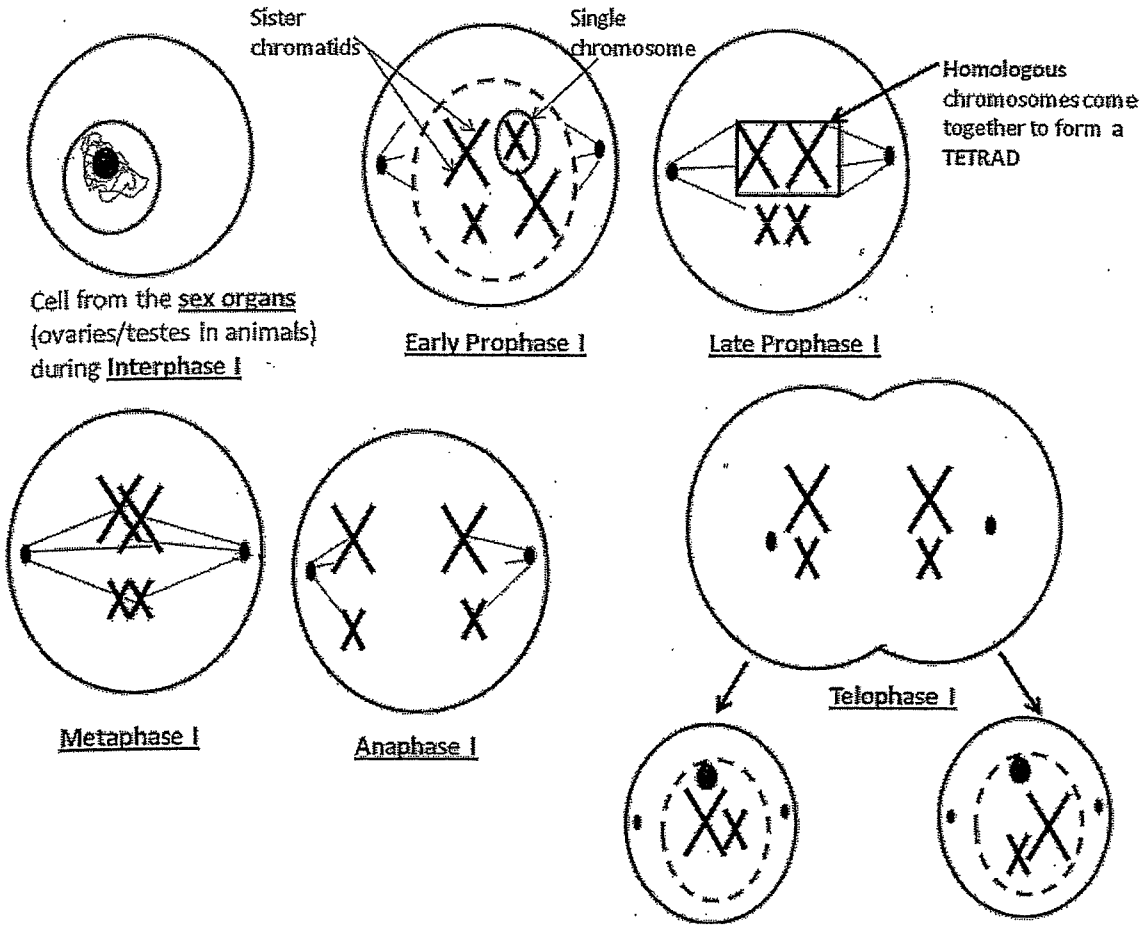
MEIOSIS

How does sexual reproduction lead to genetic variation?

Why?

Cells reproduce through mitosis to make exact copies of the original cell. This is done for growth and repair. Sexually-reproducing organisms have a second form of cell division that produces reproductive cells with half the number of chromosomes. This process is called **meiosis**, and without it, humans, oak trees, beetles, and all other sexually-reproducing organisms would not be what they are today.

Model 1 – Meiosis I



1. What organs do the cells that enter meiosis I come from?

2. Considering what you already know about mitosis in cells, what event must take place during interphase before a cell proceeds to division?
3. What two structures make up a single chromosome?

4. How many **single** chromosomes does the cell in prophase contain?

Read This!

Alleles are alternative forms of the same gene. For example a gene A may contain the information for hair color. One allele "A" may result in blond hair, while the alternative allele "a" may result in black hair. **Homologous chromosomes** are chromosomes that contain the same genes although each chromosome in the homologous pair **may** have different alleles.

5. At which stage in meiosis I do the homologous pairs come together?

6. Once the chromosomes have formed a pair, what are they now called?

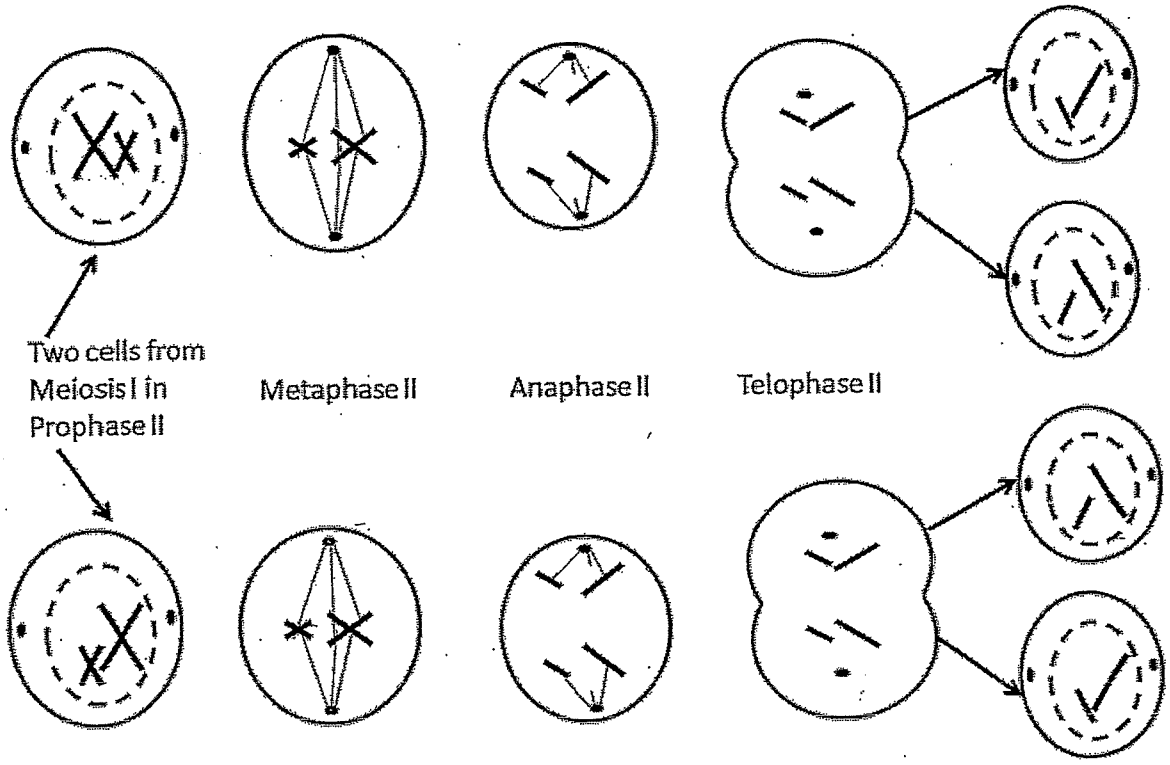
7. At the end of meiosis I, two cells have been produced. How many **single** chromosomes are there in each of these cells?

8. Cells with a full set of chromosomes are referred to as **Diploid or 2n**, whereas cells with half the chromosomes number are **Haploid or n**. At which stage(s) of meiosis I are the cells diploid and at which stage(s) are they haploid?

9. Considering the genetic makeup of the homologous pairs, will the cells at the end of telophase I be genetically identical to each other? Explain your answer fully, using *homologous pairs* and other terminology from the previous questions.

10. How do the cells at the end of meiosis I differ from the parent cells?

Model 2 – Meiosis II



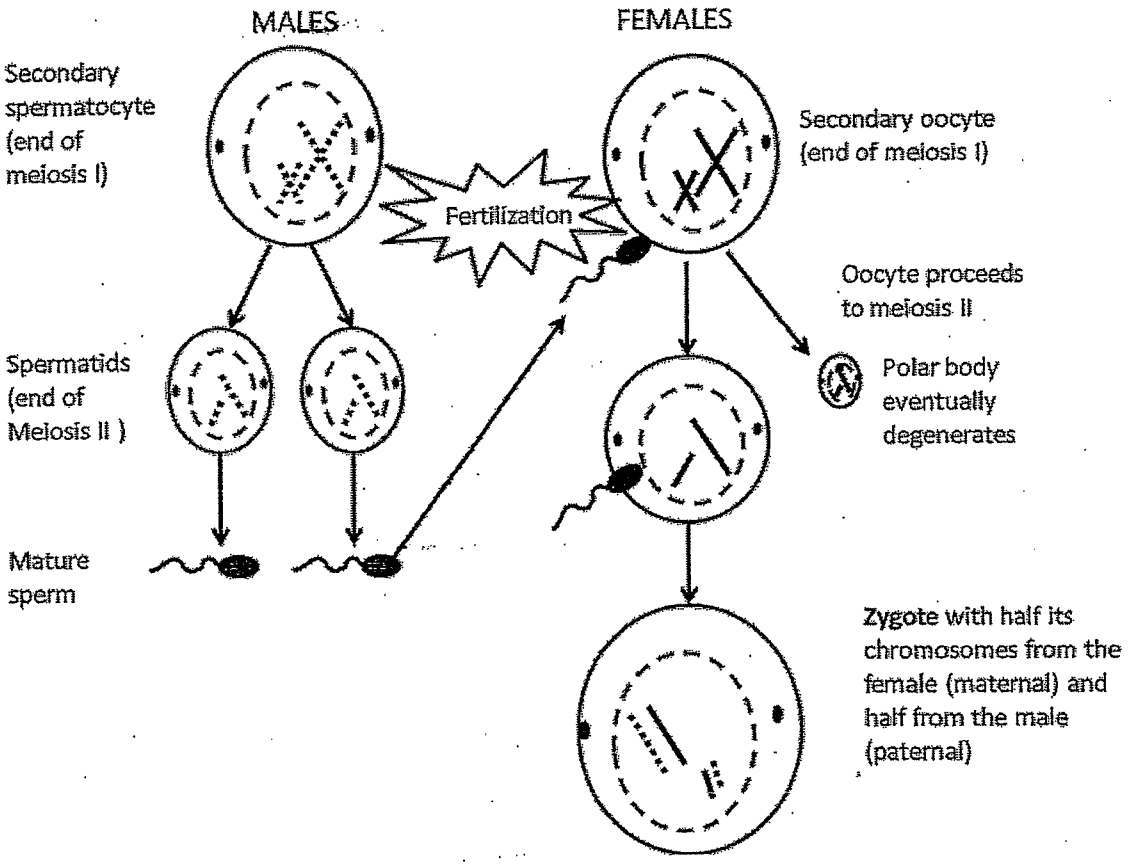
11. Where did each of the cells come from that started meiosis II?

12. In meiosis I, during anaphase I, did homologous chromosomes separate or did sister chromatids separate?

13. In meiosis II, during anaphase II, did homologous chromosomes separate or did sister chromatids separate?

14. At the end of the meiosis II there are four **daughter cells**. Are they haploid or diploid? Explain your answer in a complete sentence.

Model 3 – Gametogenesis & Fertilization



15. What is the name given to the cells produced at the end of meiosis I in males?

16. What is the name given to the cells produced at the end of meiosis I in females?

17. At the end of meiosis II in males, what cells are produced?

18. What do these cells (from the previous question) eventually become?

19. During fertilization which two cells come together? Be specific in your answer.

20. After fertilization what happens to the secondary oocyte?

21. During meiosis II the secondary oocyte divides unevenly, with one cell (the ovum) receiving half of the chromosomes and nearly all the cytoplasm and organelles, while the other cell, the polar body, is much smaller and eventually degenerates. With your group develop a hypothesis to explain why the secondary oocyte divides in this way.

22. What is the ploidy of the zygote produced by fertilization: haploid or diploid?

23. What would the ploidy of the zygote be if egg and sperm were produced by mitosis rather than meiosis? How would this affect the ploidy of each successive generation?

24. With your group write a statement to explain the origin of the chromosomes found in the zygote. Your statement must include the term *homologous pair*.

Model 4 – Genetic Variation

Diagram A

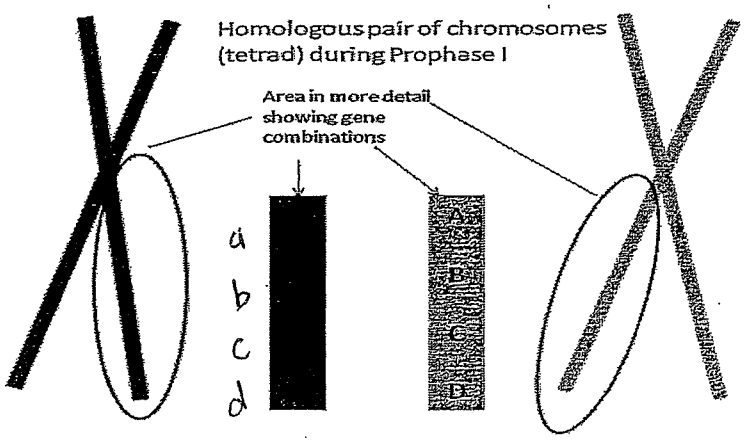


Diagram B

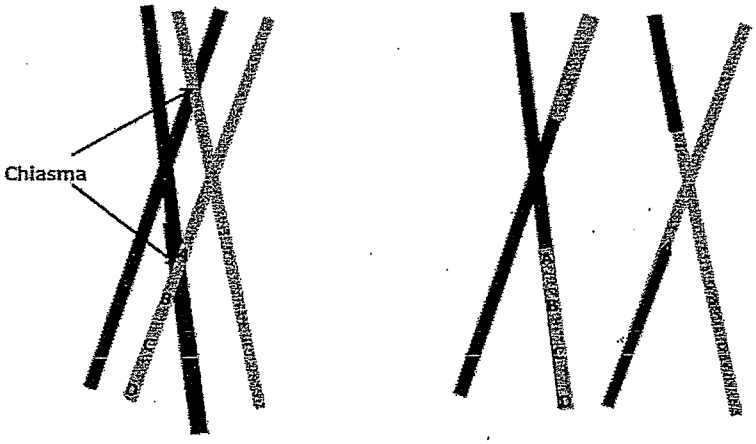


Diagram C

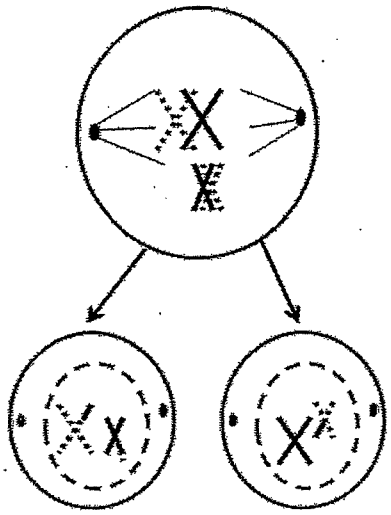
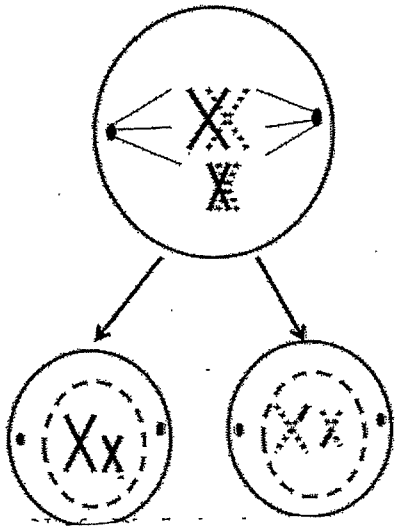


Diagram D



25. At which stage of meiosis are the chromosomes in diagram A?

26. What word describes the two chromosomes?

27. What do the letters A-D represent?

28. Are the letters exactly the same on each homologous chromosome? Be specific in your answer.

29. Using information from the previous models, what is the origin of each of the homologous chromosomes?

30. When the chromosomes come together as homologous pairs, the arms of the sister chromatids may cross over. What are these cross-over points called?

31. When the homologous pairs separate during anaphase I do the homologous chromosomes still contain the same type of genes? Explain your answer fully.

32. When the homologous pairs separate during anaphase I do the homologous chromosomes still contain the same type of alleles?

33. What phrase is used to describe the chromatids after separation of the homologous chromosomes?

34. In diagram C, describe the arrangement of the chromosomes during metaphase. Be specific in your answer as you describe the location of each homolog in relation to each other.

35. What is different about the arrangement of the chromosomes in diagram D?

36. What effect does the orientation of the homologous pairs have on the end products of meiosis I?

Read This!

When homologous chromosome pairs align on the spindle during metaphase I the orientation of one pair is independent of the orientation of any other pair. This is known as **Independent Assortment.** Humans have 46 chromosomes, arranged as 23 pairs. During metaphase I each pair lines up independently, which results in 2^{23} **possible combinations.**

37. With your group, calculate how many possible genetic combinations there are due to independent assortment.

38. Meiosis and sexual reproduction each lead to variation. With your group, explain how events that occur during meiosis, as well as the random fertilization of eggs and sperm, together lead to variation in the genetic make-up of every person.