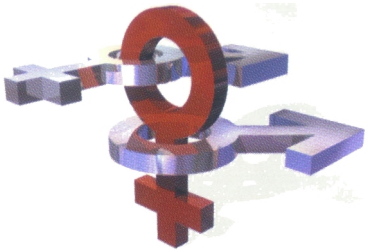
Creating Chromosomes



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This visual exercise helps students understand the concepts of homologous chromosomes, non-homologous chromosomes, crossing over, and deletion.

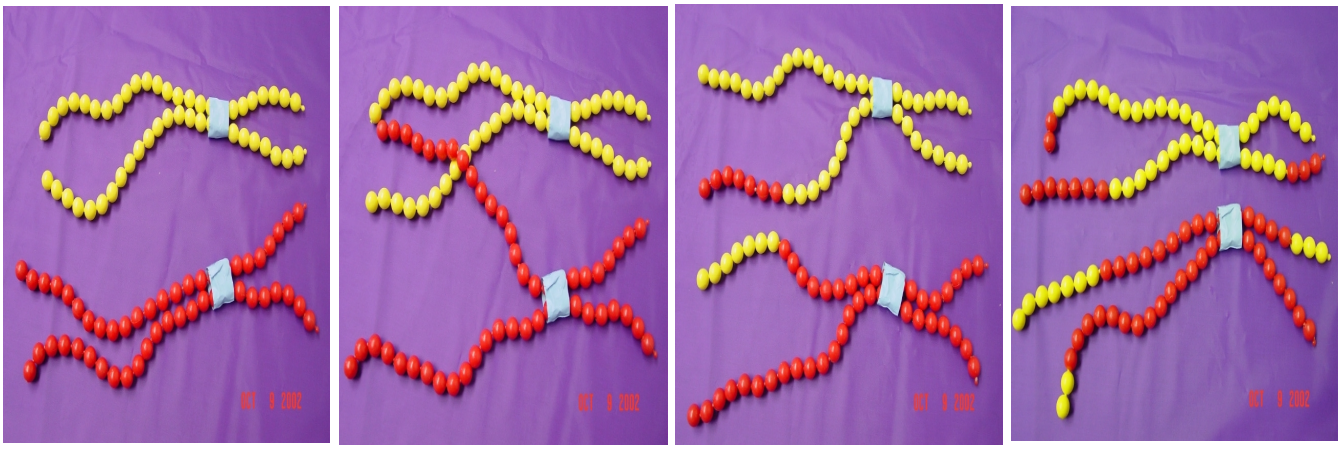
1. Make a pair of homologous chromosomes.

Materials: 2 different colors of "Pop-It" beads

Procedure: Make 2 strands of the same length but different colors.

Discussion: Once the homologous chromosomes are created, remind students that the autosomes pair (and 2 X's in the case of a female will pair).

Discuss the prefix "homo". Have the students name as many words as they can with the prefix "homo" (homogenous, homosexual, homologous, etc.) What does it mean for two chromosomes to be homologous? They are ALIKE…morphologically (physically) they are alike and they carry similar genetic traits.



If Pop-its are not available you can use 2 pieces of string of the same length with various beads (pairs of "like" beads that are the same size and shape but come in different colors- the different colors will represent different alleles [versions for that gene]) Remember the beads represent alleles (versions of genes) so the students may choose the same colors or have different colors for that particular gene. String "like" beads, placing one of each "like" pair on each piece of string in the same order.

2. Use the homologous chromosomes to discuss linked genes and how crossing over may occur.
Procedure: (if different colored beads are used) Ask students to closely observe each chromosome of their homologous chromosome pair and for each chromosome, write down the color sequence of beads that are present.

Discussion: Remind students that those genes (beads) located on the same chromosome tend to be inherited together and are said to be linked.

Procedure: Ask students to line up the chromosomes of the homologous pair close together. Select a segment of some number of beads from each chromosome, being careful to keep the selected sequence in order (if different colored beads are used), and exchange the segments between the two chromosomes by taking a sequence of beads from one chromosome and replacing the sequence with the selected sequence from the other chromosome. Now, for each new, recombined chromosome write down the color sequence of beads found on the chromosome.

Discussion: Crossing-over occurs during meiosis when the homologous chromosomes come together and pair-up and exchange segments of DNA. This genetic swapping results in recombinant (recombined, mixed) chromosomes. When this occurs, genes that were linked are no longer linked and are not necessarily inherited together. This increases genetic variation and contributes to genetic variation in eggs and sperm cells and that genetic variation leads to variation in offspring. This helps explain why you may look a great deal like your brother or sister because you share genetic material in common but you are different because you also possess a unique combination of genetic material.

3. Create an X and a Y sex chromosome.
Procedure: Change the homologous chromosome pair into a non-homologous pair of sex chromosomes (X and Y). Select one chromosome to be the Y chromosome and let the other chromosome be the X chromosome. In order to make your string model resemble a Y chromosome, remove 2/3 of the beads (genes) present on the chromosome. Line the Y chromosome up with the X chromosome and observe the size differences between the two sex chromosomes.
Discussion: Discuss size differences between the two different sex chromosomes. Explain the inability of these 2 non-homologous chromosomes to exchange segments.

4. Use the Y chromosome string model to demonstrate a deletion mutation.
Procedure: Remove 1-2 beads (genes) from the Y chromosome.
Discussion: The genes that control maleness (gonad differentiation, sperm production, and secondary sex characteristics) are located on the Y chromosome. Beads that were removed from the Y chromosome model represent genes that are deleted (lost) from the chromosome. These deleted genes are often important genes necessary for male fertility. Without these genes men are infertile.