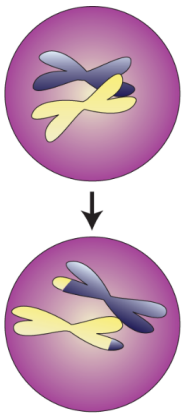
Variation of Traits during Meiosis

Activity



If you look around your classroom, you will notice in other faces many differences from the way you look. Even your brother or sister may look completely different from you even though you have the same parents. Part of the reason for this is a process that takes place during meiosis called crossing over. This happens when the paternal and maternal homologous chromosomes exchange different sections of their chromosomes as shown in the picture to the right.

Procedure Part I:

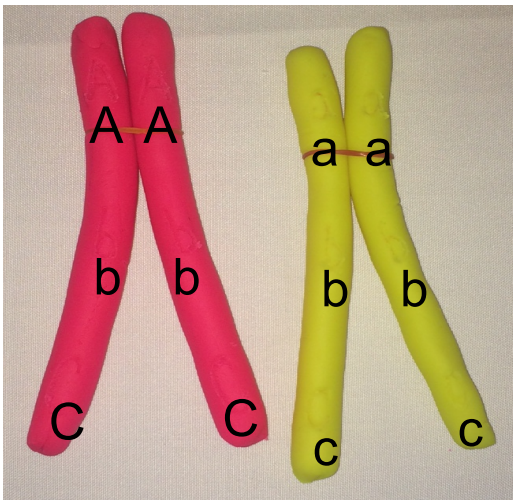
Follow the steps below to model the process of crossing over, and then answer the questions that follow.

1. Obtain a ball of clay from your teacher and roll it out into two 8-cm long strands of clay. Using a twist tie or rubber band, connect the two pieces about 2 cm down.

2. With a pencil, sketch in an “A” above the twist tie on each strand of clay, and a “b” and “C” below the twist tie. (Use the picture as a guide.)

3. Obtain a different color ball of clay from your teacher. Roll it out into two 8-cm long strands of clay and connect the two pieces with a twist tie 2 cm down.

4. With a pencil, sketch in an “a” above the twist tie on each strand of clay, and a “b” and “c” below the twist tie. (Use the picture as a guide.) Each set of paired clay strands represent a chromosome, each with two chromatids. The two sets of chromosomes are considered homologous chromosomes. Note that this represents chromosomes after replication.



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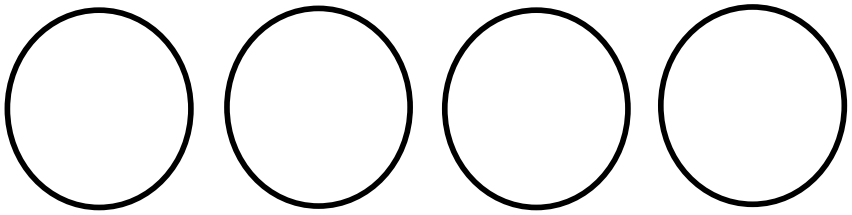
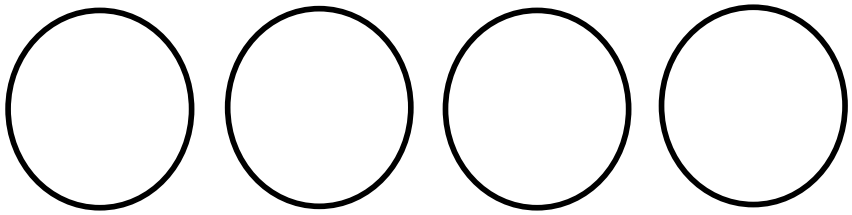
Activity, continued

Procedure Part I, continued

5. In the table below, draw what the daughter cells would look like if meiosis took place without any crossing over.

6. With your set of clay homologous chromosomes, model crossing over between gene B and C. You can remove and rearrange the pieces of clay if needed.

7. In the table below, draw what the daughter cells would look like if meiosis took place after this crossing over.

Picture of gametes with no crossing over	
Picture of gametes with crossing over	

1. What are gametes? _____
_____

2. Explain the difference between the gametes that are formed with crossing over and the gametes that formed without crossing over.
_____
_____

3. Can any of the gametes be identical to each other after crossing over took place? Why?
_____
_____
_____

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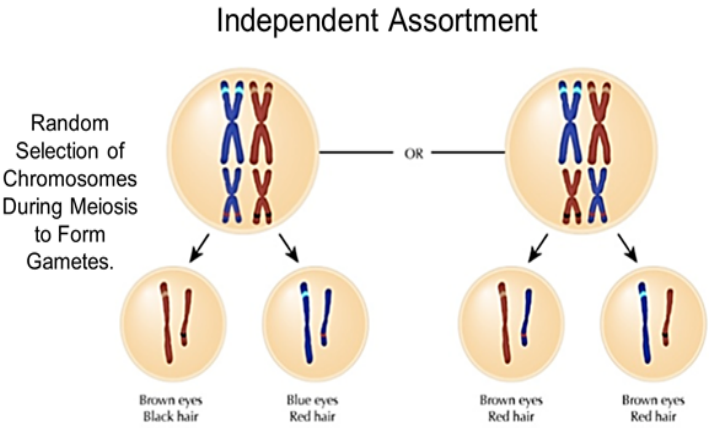
Activity, continued

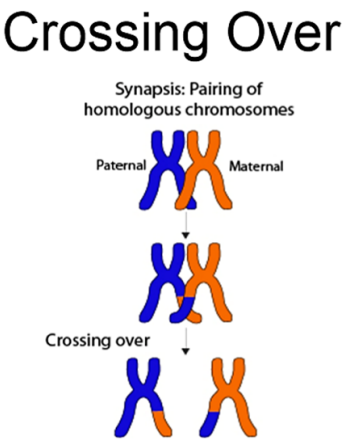
Part II: Causes of Genetic Variation

Random Assortment: After meiosis, the daughter cells that are created are all genetically different from each other. One reason for this is the fact from the chromosomes randomly sort into the four different daughter cells. For example, if one daughter cell has the maternal chromosome that codes for blue eyes, it does not mean it also has the maternal chromosome that would code for the shortness trait. This is why siblings do not look identical even though they have the same parents.



Crossing Over: Another factor that increases genetic variation within organisms is crossing over. During prophase I of meiosis, the replicated paternal and maternal homologous chromosomes intertwine and exchange different sections of their chromosomes, i.e. swap genetic information. The sections that are exchanged contain genes that hold the instructions to code for different traits. The resulting chromosomes that are segregated into daughter cells will contain chromosomes that contain part maternal and paternal genes. This crossing over of homologous chromosomes during meiosis generates many new combinations of alleles in the gametes (sperm & egg cell).

The process is analogous to receiving a full deck of cards from each parent, shuffling the cards together, and then giving one full deck composed of cards from both of the parental decks to an offspring; if the process is repeated for every offspring, then each offspring will have a different combination of cards from the two parental decks. The offspring will also receive a similarly shuffled and recombined deck from its other parent. Independent assortment and genetic recombination result in a huge increase in the number of different allele combinations, i.e. genetic variation, within the population.



The exchange of genetic material between homologous chromosomes during meiosis; contributes to genetic variation.

Variation of Traits

Do

Variation of Traits during Meiosis

Activity, continued

Part II: Causes of Genetic Variation, continued

1. Explain two processes that take place during meiosis that lead to genetic variation.

2. How is crossing over analogous to shuffling a deck of cards?