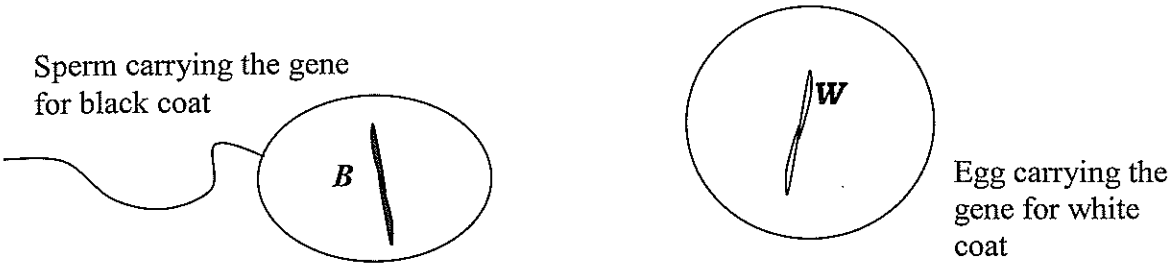
Activity 16: Inheritance

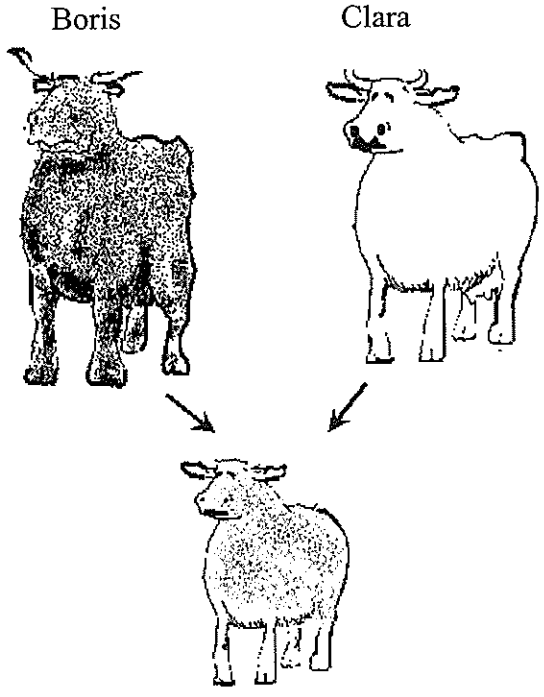
Characteristics like those investigated in Activity 16 are controlled by genes and are said to be inherited.

The chromosomes of every cell of a person's body contain a chemical called DNA. Sections of this DNA act as 'genes' for each characteristic of that person. A different gene controls each one of our characteristics. As the chromosomes are in pairs, this would mean that a person has two genes for every characteristic, ONE FROM HIS MOTHER AND ONE FROM HIS FATHER.



For every gene carried by one chromosome, there is another gene on the other chromosome of the pair. The two genes carried by a pair of chromosomes may both be the same or different. Let's see how this works by looking at this example.

Suppose that in cattle, two genes determine coat colour, one that controls black coat colour and the other controlling white coat colour.



Each parent gave one gene for the coat colour characteristic, yet Bertie the calf has a grey coat colour. This can be explained by thinking about the genes involved.

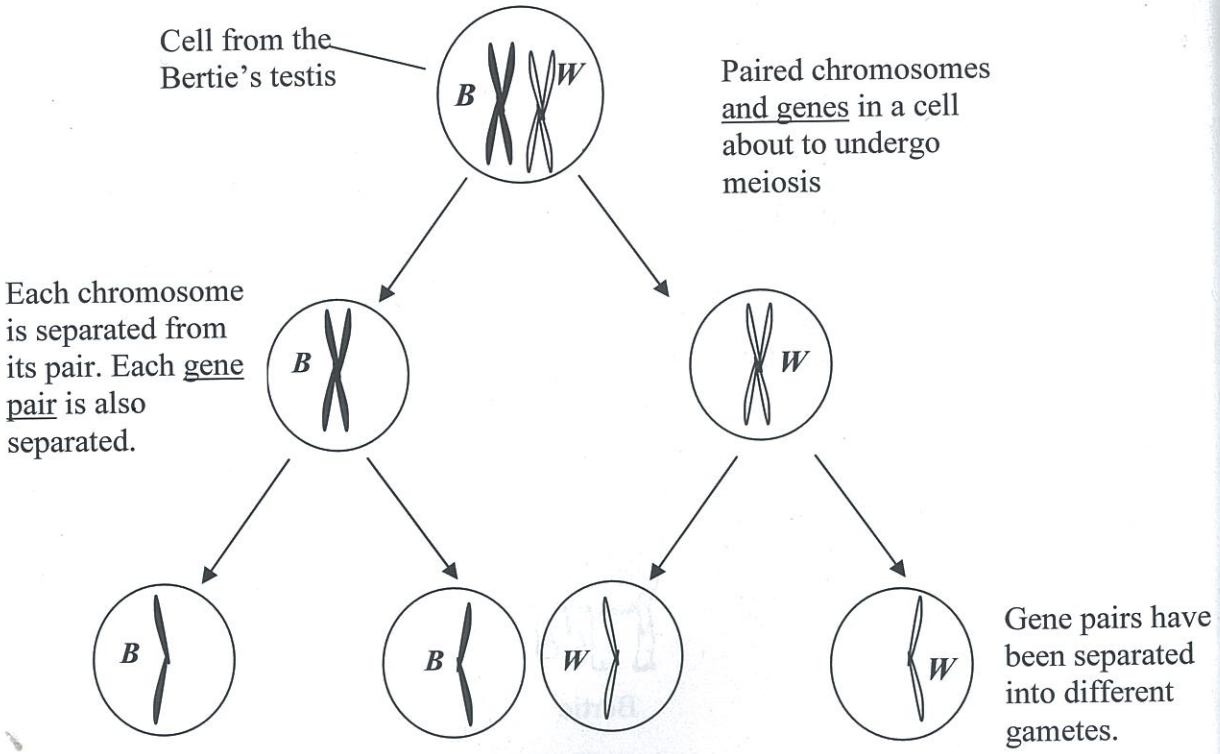
Let ***B*** represent the gene for black coat colour and

W represent the gene for white coat.

1. Write down the genes that Bertie the calf must have received from his father and his mother.
2. Write down the genes that each of the parents must have had to be able to have produced the grey calf.
3. Suggest why neither parent showed the grey coat characteristic.
4. If Boris and Clara were to have further calves, predict the coat colour of these calves.

BACK TO MEIOSIS

Earlier we looked at the behaviour of chromosomes during the division process called meiosis that gives rise to egg and sperm cells. We have seen that a cell about to undergo meiosis has paired chromosomes. The cell divides producing gametes that have half the number of chromosomes as the original cell.
Now we know more about genes, let us see if we can show what happens to genes as sperm are formed in testes. From the previous question you should have found out that Bertie, the grey calf, must have two types of gene instruction for coat colour in each of its normal body cells, both ***B*** for black coat and ***W*** for white coat. Let us see what happens when Bertie matures to become a grey bull and forms his own sperm cells.



NOTE: Meiosis separates a. chromosome pairs
b. gene pairs into different gametes.

Supposing Bertie is mated with a grey cow called Sadie. A similar process would occur in forming the eggs in a grey cow. Eggs would carry the gene ***B*** or ***W***, not both.

This can be shown more simply in this way:

Parent	**Bertie: Grey Bull**	**Sadie: Grey Cow**
Genes present	*B/W*	*B/W*
Genes present in gametes	*B* or *W*	*B* or *W*
Genes present in the young	*B/B*, *W/B*, *B/W*, *W/W*	

The genetic make up of an organism is its **genotype.**

The physical expression of the genes in an organism is called its **phenotype**.

From this diagram:

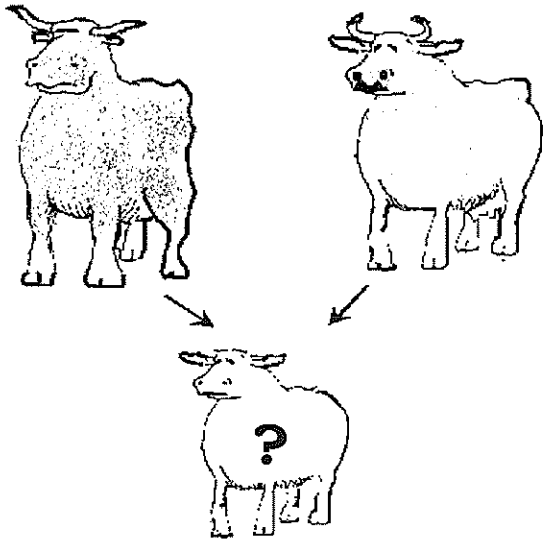
1. How many different genotypes are possible amongst the offspring?
   Note: the order of the genes B/W or W/B is not important.
2. What are the possible coat colours for any young born to these grey parents?
3. How many different phenotypes are possible amongst the offspring?

The pattern of inheritance displayed in this example is called **INTERMEDIATE INHERITANCE**.

In this type of inheritance both the genes inherited from each parent show through in the young so that there is a kind of blending of the parent's characteristics amongst the new generation of offspring (called the F1).

PROBLEM

What colour/s would you expect any young to show if a grey bull was mated with a white cow?



QUESTIONS:

1. Write down your prediction after discussing your ideas with your group.
2. What genes would each of these calves inherit to produce these coat colours?

Another Example of the Intermediate Inheritance Pattern

White snapdragon flowers can be crossed with red snapdragon flowers by taking the pollen from one flower and dusting it on the stigma of the other. New seeds are formed, and when these germinate they grow into plants which all form pink flowers.

However, if some of these pink flowers are pollinated from other pink flowers, the next generation shows a variety of colours – pink again, but also red and white. This time, there seems to be some unblending! The colours of the grandparents have reappeared.

When this self-cross is done with a large number or pink flowers, a definite pattern emerges in the F2 generation. For example, in 1000 flowers the following count was made:

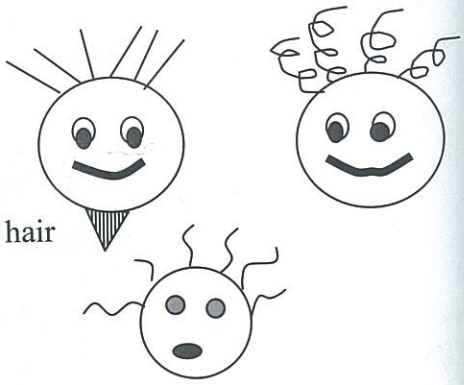
502 pink,
251 white, and
247 red flowering plants.

Notice the pattern is roughly two pink for every one red and one white.

QUESTIONS:

1. Using the symbols ***R*** for red flowers and ***W*** for white flowers, write down the genotype of each of the
   i. pink,
   ii. red and
   iii. white snapdragon plants.

2. A case of intermediate inheritance also occurs in humans when one parent has curly hair, and the other parent has straight hair. All their children are likely to have wavy hair, intermediate between curly and straight.



   a. Using the symbols ***S*** for straight hair and ***C*** for curly hair write down the genotypes of
      i. the father
      ii. the mother
      iii. the children

   b. What would be the hair type/s expected if a two wavy haired people had children.

3. When a white mouse was crossed with a black mouse all the F1 offspring were found to be grey in colour. When two of these grey mice were mated, black, white and grey offspring were produced in the F2.

   a. What name is given to this type of inheritance pattern?

   b. In the F1 what was the chance of a black mouse appearing amongst the offspring?

   c. In the F2 what was the chance of a mouse being born having a grey coat?

   d. If a black mouse was mated with another black mouse what colour would the offspring be?

4. Suppose that radishes have two genes for shape - ***L*** (for long) and ***R*** (for round). When long radishes are crossed with round radishes, all the offspring are oval.

   a. What is the genotype of a long radish?

   b. What is the genotype of a round radish?

   c. What is the phenotype of a radish with a ***L/R*** genotype?

   d. What genotypes could be expected in the offspring of a cross between two oval radishes?

   e. If a plant with oval radishes was crossed with a plant bearing long radishes, what would the F1 be like?