Activity 17

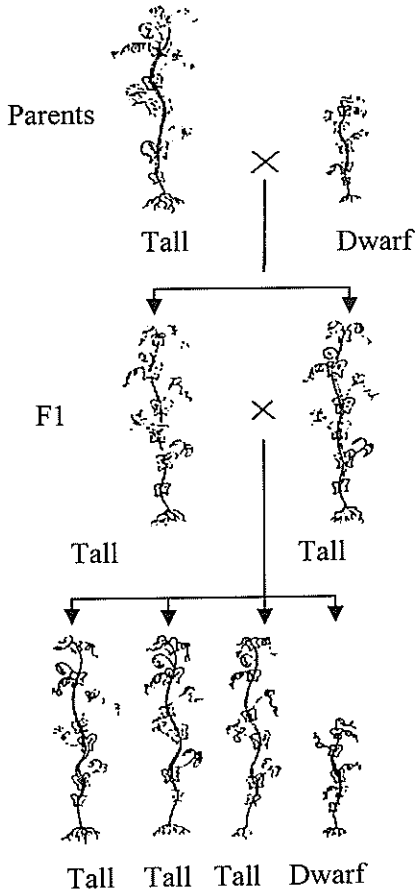
Dominant/recessive inheritance

Sometimes BOTH genes have an effect, and a person is **INTERMEDIATE** in characteristic between his mother and father. Sometimes one gene is **DOMINANT** and 'hides' the effect of the other gene for that characteristic.

The first person to discover this pattern of inheritance was an Austrian monk named Gregor Mendel.
He placed the pollen from tall pea plants onto the flowers of dwarf pea plants. When seeds formed he planted these out. When they were fully-grown he noticed that no dwarf pea plants were present amongst the offspring. All the offspring were tall.

How could this be?

He then self-fertilized flowers of these tall offspring and allowed more seed to form.
When this seed was grown he found most of the offspring were tall plants while some dwarf plants also grew.



Remembering that each pea plant has two genes for the characteristic of height how can this inheritance pattern be explained?

MENDEL'S EXPLANATION

Sometimes one gene may be hidden or recede for a generation only to reappear in a following generation. This happens because one is "stronger" than the gene for another characteristic. In this case, the gene for tallness completely masks the gene for dwarfness when they are together.

The "strong gene" is said to be **DOMINANT.**
The "weak gene" is said to be **RECESSIVE**

USING SYMBOLS

In genetics we use letters for the different genes controlling the different characteristics. Upper case letters are given to the dominant gene.
The same letter, but in lower case, is given to the recessive gene for that feature.

e.g. **If tall is dominant to dwarf we show the gene for tallness as *'T'***
and the gene for dwarfness as *'t'*

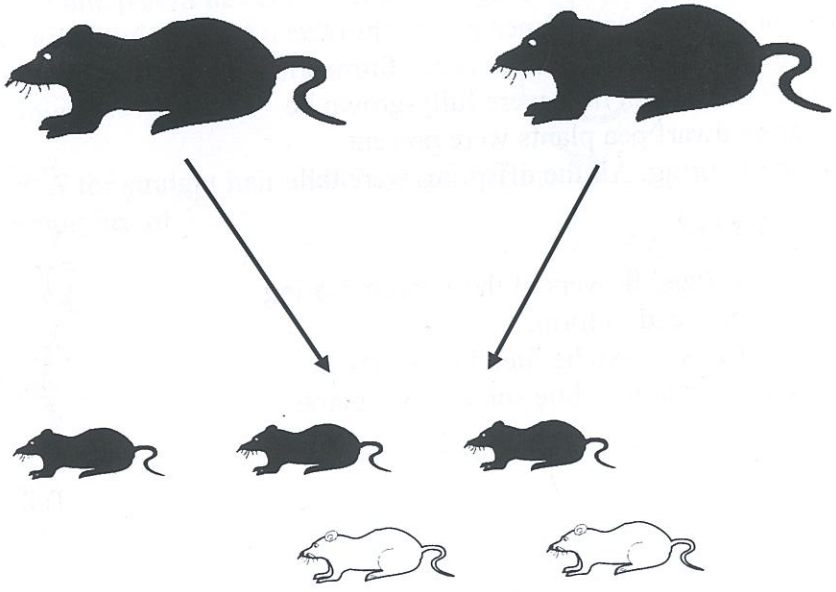
***'T'* and *'t'* are different forms of the same gene.**

QUESTIONS

1. Think about Mendel's peas. Which characteristic appears to be the dominant one?
2. Which characteristic is recessive?
3. All the F1 plants were hybrid. What do you think is meant be the word "hybrid"?
4. Why are the F1 plants tall, rather than medium sized or dwarf?

Here is another example of the dominant/recessive inheritance pattern:

Clarence bred rats as a hobby. When he mated two black rats he found that five of the seven offspring were black and two were white.



2. What was the genotype of each of the parents?
3. What are the two possible genotypes of the black offspring?
4. What is the genotype of the white offspring?

Activity 18

Using a punnet square

An easy way to predict the kinds of offspring to be obtained from a cross between the two rats is to use a grid known as a punnet square.

The grid below gives an easy way to show the offspring from the mating of these two black rats.

Male parent

Female parent

Sex cells	**B**	**b**
B	**B/B**	**B/b**
b	**B/b**	**b/b**

The grey section of the grid shows the types of offspring that can be formed from the cross. It also shows that for each white rat born, you can expect three black ones.

Geneticists often predict the number of genotypes expected for the offspring.
They write this as a **RATIO.**

From the table note there are three different genotypes: ***B/B***, ***B/b*** and ***b/b***
Out of the four genotypes, one of the four is ***B/B***, two of the four are ***B/b*** and one of the four is ***b/b.*** This is written as a "**genotypic ratio**"

¼ B/B : ½ B/b : ¼ b/b

From the table you can work out that all those having at least one ***B*** gene will be black in colour. Those without a ***B*** gene will appear white.
This means that the rats having the genotype ***B/B*** and ***B/b*** will look the same. Only rats having the genotype ***b/b*** will be white in colour.

The **appearance** of an offspring is called its "**phenotype**".
This means a second ratio can be written, the "**phenotypic ratio**", which shows the different types of offspring expected.

¾ Black : ¼ white

REVIEW

1. A **pure breeding strain** refers to plants or animals, which breed true to type, e.g. always showing dominant characteristics, or always showing recessive characteristics during breeding programs. They have only one type of gene for a given feature.

   e.g. A pea plant (***T/T***) and a rat (***b/b***) are both pure breeding.

2. A **hybrid** is an organism, which contains two different genes for the same characteristic.
   e.g. A pea plant having the genotype ***T/t*** or a bull having the genotype ***B/W***

3. Each parent supplies one gene towards the development of a single characteristic in an offspring.

4. When a characteristic controlled by a **recessive** gene is seen in offspring then each parent must also have had at least one of these genes to pass on to the offspring.

PROBLEMS

1. In guinea pigs, brown coloured fur ***(B)*** is dominant to white ***(b)*** coloured fur.
   Copy the following table into your notebook then complete the table by listing all the possible parents, their genotypes and the genotypes of their resulting offspring.
   List all the possible offspring, which can result from each of the crosses.

CROSS (PARENTS)	GENOTYPES OF PARENTS	GENOTYPES of OFFSPRING
1. Pure Brown x Pure White	***B/B*** x ***b/b***	All ***B/b***
2. Hybrid Brown x Hybrid Brown	***B/b*** x ***B/b***	***B/B, B/b, b/b***
3. x	***B/b*** x ***b/b***	
4. Pure Brown x Hybrid Brown	x	
5. x	x	All ***B/B***
6. x	***b/b*** x ***b/b***	

2. The correct word used for "pure breeding" is ***HOMOZYGOUS.***

   The correct term for "hybrid" is ***HETEROZYGOUS.***

   a. Write the meaning of these words in your notes and learn them.

   b. Write down the genotype of a homozygous (pure breeding) brown guinea pig.

   c. Write down the genotype of a heterozygous (hybrid) brown guinea pig.

Now try these crosses using a punnet square to help you. Each case involves the dominant/recessive pattern of inheritance.

3. A heterozygous (hybrid) black cow is mated with a red bull.

   a. Write down the ratio of different genotypes.

   The physical appearance of the offspring is called the phenotype.

   b. How many different phenotypes are there amongst the offspring?

   c. Write down a phenotypic ratio for this cross.

4. If two people with dimples have a child without dimples:

   a. What is the genotype of the child?

   b. What is the genotype of each parent?

   c. What is the chance that their next child will have

      i. no dimples?
      ii. dimples?

5. Two heterozygous (hybrid) organisms are mated. Both have the genes ***T*** and ***t***.
   T stands for tallness and is dominant to ***t***, which stands for short.
   Work out the possible genotypes and phenotypes of the offspring.

6. Some dogs bark when following a scent, others are silent. Barking (***B***) is dominant to non-barking (***b***). What would be the chance of a non-barking dog being born to two dogs, one a non-barker and the other heterozygous (hybrid) for the barking gene.