CHAPTER 8

Variations in Populations

Introduction

The differences in traits, structure or behaviour among living organisms are called variations.

A population is a group of organisms of the same species living in a specified area within a given period of time. In any population, one is able to differentiate an organism from another due to these variations. Variations found in or among organisms could be physical **(morphological)** or behavioural **(physiological).**

No two organisms in any population look alike physically or behaviourally because each organism has a unique genetic make-up, though some times some physical features help us to group some organisms together.

An example is the variations noticed between a rat and a goat. Some physical features of a rat are, long tails, whiskers, small ears, bent fore and hind-limbs. Goats are characterised by a short tail, absence of whiskers, larger ears, upright fore-and hind limbs. A rat and a goat also exhibit differences in their mode of feeding, movement and gestation.

Human beings are no exception. Twins that look alike possess some physical differences. One might be slightly darker or fairer than the other in complexion, or a bit taller or shorter The colour of the eyes might also differ. They also have different interests to life.

The environment, in which an organism lives also brings about variations. For example, if some maize grains are planted in a sandy soil and another set (obtained from the same cob) are planted in a loamy soil, it would be observed that the one planted in loamy soil would grow better than those planted in sandy soil. Variations are also found in plants of the same species grown under the same conditions. When identical twins, with very similar hereditary characteristics, are bred in different environments, they show marked differences in physical and intellectual development.

Morphological variations

The variations noticeable in the physical appearance of individuals of the same species such as size, height, weight, colour of hair and eyes, shape of the face, colour of the skin, and fingerprints are called **morphological variations.**

If you measure the heights of all the students in your class, that are of the same age, you will likely find out that there is a steady graduation from the students who are very short to those who are very tall. This is also true of weight, hair colour, intelligence and many other features. This type of variation in physical features among members of the same species, where there is a gradual transition from one extreme to the other, is called **continuous variation** (see Fig. 8.1).

Examples of continuous variations among plants of the same species are height, shape of body parts, leaf size, root size, size of petals, sepals and internodes.

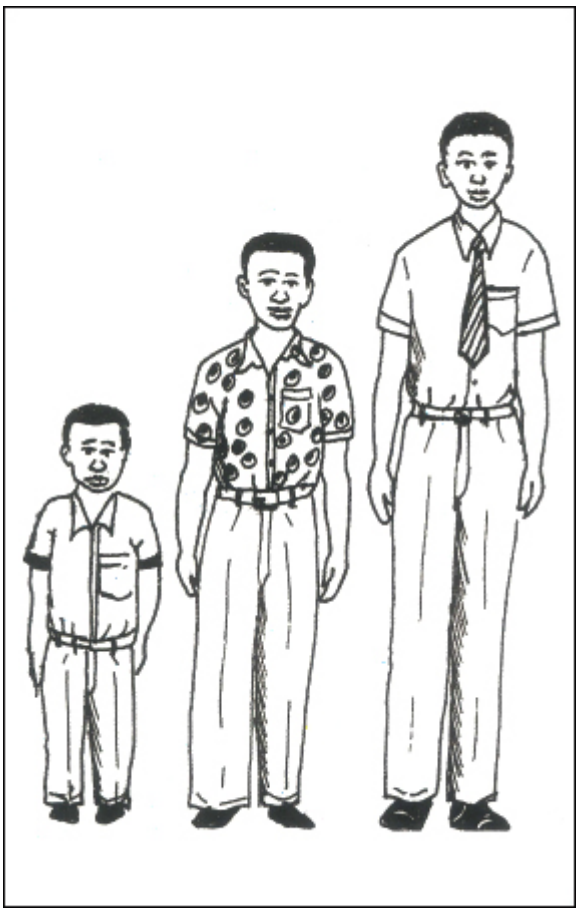

Fig. 8.1 Continuous variation in human height.

In general, variations among the members of a species are not usually very pronounced. Variations between species are more pronounced than within a specie. For instance, rice plants can always be easily distinguished from bean plants. Likewise, we can always differentiate scorpions from insects.

Commonly, variations within and between species are inherited by offsprings from their parents.

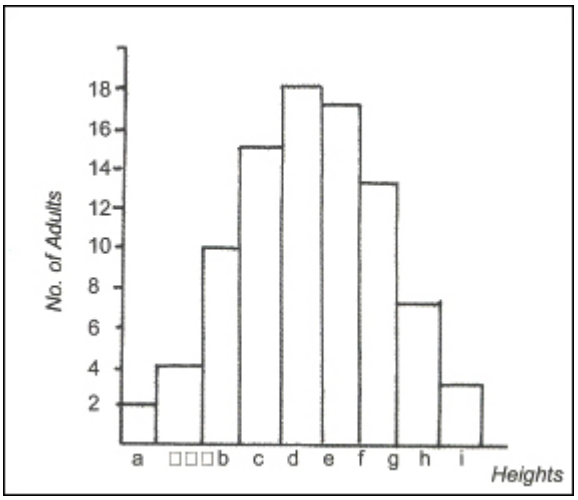

Fig. 8.2 Histogram of heights in an adult human population. The letters represent the classes of heights. The size of each block represents the number of individuals falling into a particular class (i.e. height).

Physiological variations

Physiological variations are the differences in the ways members of the same species behave or react to certain things or conditions in their environment. Differences or variations in behaviour by which organisms can be grouped into two or more classes within a population, without any gradation among them, are called **discontinuous variations.**

Examples of discontinuous variations in human population include the following:

1. Some people can perceive smell while others cannot.
2. Some people can detect the taste of certain substances even at very low concentration, while others can only do so at very high concentration. For example, if members of your class are allowed to taste the bitter chemical called phenylthiocarbamide (PTC) in dilute solution, you will discover that your class will be divided into two groups; those who can detect the taste of PTC at high concentration, and those who can at low concentration. There will be no non-tasters.
3. Some people (tasters) may be able to detect the taste of certain materials like bitter leaf, while others (non-tasters) cannot.
4. A few people can roll their tongues (tongue rollers, see Fig. 8.3) while many cannot (non-rollers). There are no â€˜in-betweens (intermediates).
5. Every human being possess one of the four blood groups called A, B, AB and O.
6. Every human being possesses one of the four main categories of fingerprints called arches, compounds, loops and whorls. See Fig. 8.4.
7. As mentioned earlier, some organisms display different behaviours.

A butterflyâ€™s behaviour when it sees food, is different from that of a cockroach. Even among the different species of butterflies, their behaviour towards the sight of food differ.

8. Examples of discontinuous variations in plants of the same species are:
   (a) colour of flowers
   (b) colour of fruits
   (c) colour of seeds
   (d) shape of seeds and fruits.

Fig. 8.3 Tongue rolling is a discontinuous variation.

Application of variations

The knowledge of variations in human population is applied in many ways including the following:

Fig. 8.4 Four major types of human fingerprints

1. Crime detection

Detectives use fingerprints in identifying people suspected to have committed certain crimes. This is based on the assumption that no two persons possess exactly the same fingerprints and that human fingerprints remain the same throughout oneâ€™s life span. Hence, if the fingerprint of a suspect are exactly like those at the scene of a crime, the suspect might be held as being responsible for the crime.

2. Classification of the human race

Variations in physical characteristics (e.g. skin colour) among human population, have been used to classify the human race into four major groupings.

(i) *Caucasoid* Light-skinned (â€˜whiteâ€™ skin) people with narrow nose and wavy hair, e.g. Europeans and people of European descent such as the â€˜whiteâ€™ Americans.

(ii) *Negroid* (negroes) Dark-skinned people with woolly hair, and broad nose, e.g. black Africans and people of African descent such as the Afro-Americans.

(iii) *Mongoloid* Yellowish-brown-skinned people with straight hair and moderately broad nose, e.g. Chinese and Japanese.

(iv) *Australoid* Brown-skinned people with curly hair and moderately broad nose, e.g. the Australian Aborigines.

3. Blood groups

Every human being belongs to any of the four blood groups, A, B, AB or O. The knowledge of human blood groups is used as follows.

(a) *Blood transfusion*

Blood group knowledge is used in blood transfusion. This is done

when it is necessary to pass blood from a healthy person to another person who needs more blood either due to the loss of blood from injuries sustained in an accident or due to illness. Before blood transfusion is undertaken, the doctor usually ensures that blood from the donor (the person who donates blood) is matchable or **compatible** with that of the recipient (i.e. the person who receives the blood). If the transfered blood does not match that of the recipient, the recipientâ€™s blood will clump or **agglutinate.** Death, within minutes, can result from the agglutination.

Table 8.1 shows the blood groups that will clump or agglutinate and those that will not during blood transfusion.

Table 8.1: Compatible and incompatible human blood groups

Blood Group	Compatible Donor	Incomplete Donor
A	A or O	B or AB
B	B or O	A or AB
AB	All	None
O	O	All

Note that people in blood group O can donate blood to people in all other groups. Hence, they are called **universal donors.** People in blood group AB can receive blood from people in the other groups. Thus they are called **universal recipients.**

(b) *Crime detection*
When blood stains got from the scene of a crime is analyzed, the result can be used by detectives to identify arrested suspects and hence, detect the actual criminals. For example, if the blood group of a suspect is exactly the same as the one in the blood stains got from the crime scene, the suspect might be regarded as the actual criminal.

(c) *Determination of paternity*
When there is a dispute as to the actual father of a baby, the knowledge of blood groups can be used to prove the paternity of the child. For example, if the babyâ€™s blood falls under blood group AB and its mother is in blood group A, the babyâ€™s genotype (see chapter 10), will be I^AI^B, and the mother I^Ai or I^AI^A. Certainly, the I^B gene of the baby must have been inherited from the father. Supposing the alleged father is in blood group O, it is not likely that the baby belongs to him. If he is the real father, the babyâ€™s genotype ought to be I^Ai.

Suggested Practicals

1. *Study of continuous variation*

   (a) Ask your partner to measure your height with a metre rule or

from a scale made on the wall. Record the measurement against your name.

(b) Measure the height of your partner in turn and record the measurement against his name.

(c) Collect the measurements of height from the remaining students in your class and record them against their names as in Table 8.2

Table 8.2 Studentsâ€™ heights

Name of Student	Height of student (in cm)
1.	
2.	

(d) Draw a graph of the number of students against height variations to 5cm intervals

(e) What kind of graph did you obtain? What is the mean height of the entire class?

(f) What is the range of heights for the entire class?

2. *Identification of tongue rollers*

(a) Try to roll your tongue (as shown in Fig. 8.4) and record your observations in the correct column as in Table 8.3.

(b) Collect the results from the other students and record as before.

(c) How many rollers and non-rollers are in your class? What are the percentages of non-rollers and rollers?

Table 8.3 Tongue rollers and non-rollers

Name of student	*Rollers*	
	Yes	*No*
1.		
2.		
3.		

3. (a) Observe the skin colour of your partner. What is your own skin colour. Are they the same?

(b) What is the colour of the following plants you collected: maize cob, leaves of mango, hibiscus flower, cassava, apple, cashew etc.

(c) Visit a slaughter house, observe and record the different skin colours of the cows you see.

4. Make a table for recording your different fingerprints. Write the name of each fingerprintâ€™s bearer. Work in fives. You can use ink pad to press to your thumb

5. Visit a hospital, carry out a blood test and find out which blood group you belong to.

Summary

1. Variations are the differences in certain features among members of the same species.
2. Variations in the physical features of organisms of the same species are said to be morphological, while variations in their behaviour are said to be physiological.
3. The main sources of variations are heredity and environment.
4. Variations are either continuous or discontinuous.
5. In continuous variations, there is a graduation of differences from one extreme to the other, e.g. height, shape and colour of skin.
6. In discontinuous variations, there are no graduations or in-betweens. The differences enable organisms within a population to fall into two or more groups, e.g. those who can smell and those who cannot, tongue-rollers and non-rollers.
7. On the basis of colour, human beings have been classified into four main races, caucasoid, negroid, mongoloid and australoid.
8. The applications of variation include, the use of blood groups and fingerprints in crime detection, the use of the knowledge of blood groups in blood transfusion, as well as in the determination of the paternity of a child.

Objective Questions

1. Which of these statements about variation is **false?**
   A. It is the difference found among members of the same species.
   B. Variations among members of the same species are usually great.
   C. Variations can be inherited.
   D. Variations can be continuous or discontinuous.
   E. The environment partly brings about variations in organisms.
2. Which of the following is **not** a continuous variation?
   A. Height
   B. Weight
   C. Skin colour
   D. Ability to smell
   E. Hair colour
3. All the following are discontinuous variations **except**
   A. tongue rolling
   B. left-handedness

C. ability to taste
D. eye colour
E. ability to smell

4. Which of the following is **not** one of the applications of the knowledge of variation?
   A. Determination of paternity.
   B. Crime detection.
   C. Blood transfusion.
   D. Determination of genotype
   E. Human race classification.
5. Which of the following is a discontinuous variation in plants?
   A. Height
   B. Shape of body parts
   C. Root size
   D. Size of petals
   E. Colour of flowers

Essay Questions

1. (a) What is variation?
   (b) Distinguish between morphological and physiological variations.
2. (a) What is the main difference between continuous and discontinuous variations?
   (b) Explain two possible causes of variations.
3. (a) State five examples of continuous variations in (i) humans (ii) plants.
   (b) State five examples of discontinuous variations in (i) humans (ii) plants
4. In what ways is the knowledge of variation in human populations useful to us?