

CHAPTER # 15

INHERITANCE

Q1. Define the following terms:

- i. Inheritance ii. Genetics iii. Genes**

Ans:

i. Inheritance:

The transmission of characteristics from parents to offspring is called inheritance

i. Genetics:

Genetics is the branch of biology Inheritance means the transmission of characteristics from parents to offspring These characteristics are called the traits.

ii. Genes:

The chromosomes carry the units of heritance called the genes

Q2. Write a note on the formation of Chromosomes and Genes.

Ans: Formation of Chromosomes:

The body cells have a constant number of paired chromosomes. The two chromosomes of a pair are known as homologous chromosomes. In humans body cells there are 23 pairs of homologous chromosomes for a total of 46 chromosomes. During meiosis the two members of each chromosome pair separate and each of them enters one gamete.

Formation of Genes:

Genes consist of DNA. They contain specific instructions for protein synthesis

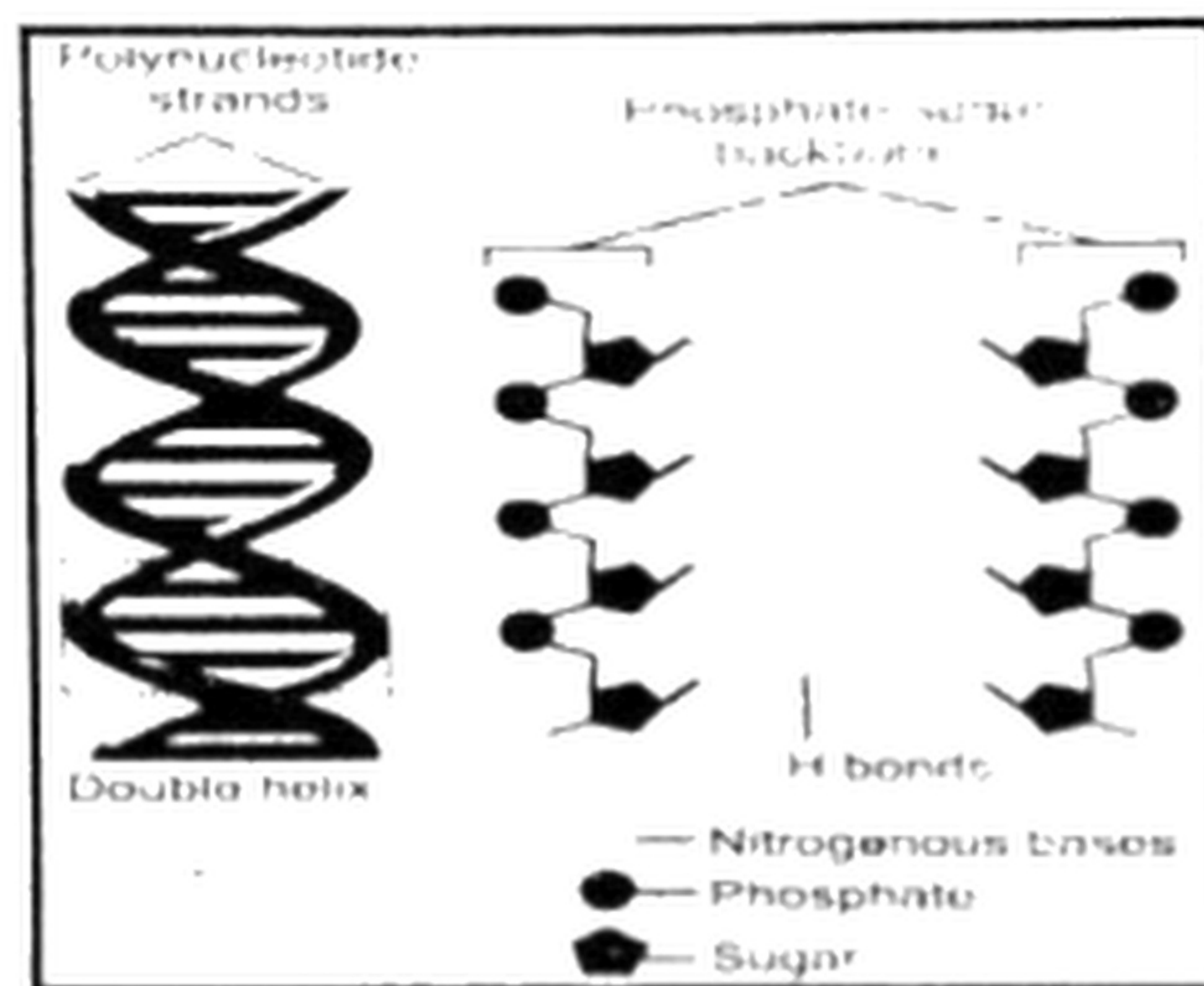
Q3. Describe the structure of chromatin.

Ans: See Q11 from Exercise (Understanding the Concept)

Q4. Briefly explain Watson-Crick Model of DNA.**Ans: Watson-Crick Model of DNA:**

In 1953 James Watson and Francis Crick proposed the structure for DNA. According to the Watson Crick model a DNA molecule consists of two polynucleotide strands. These strands are so led around each other in the form of a double helix. There is a phosphate-sugar backbone on the outside of double helix and the nitrogenous bases are on the inside.

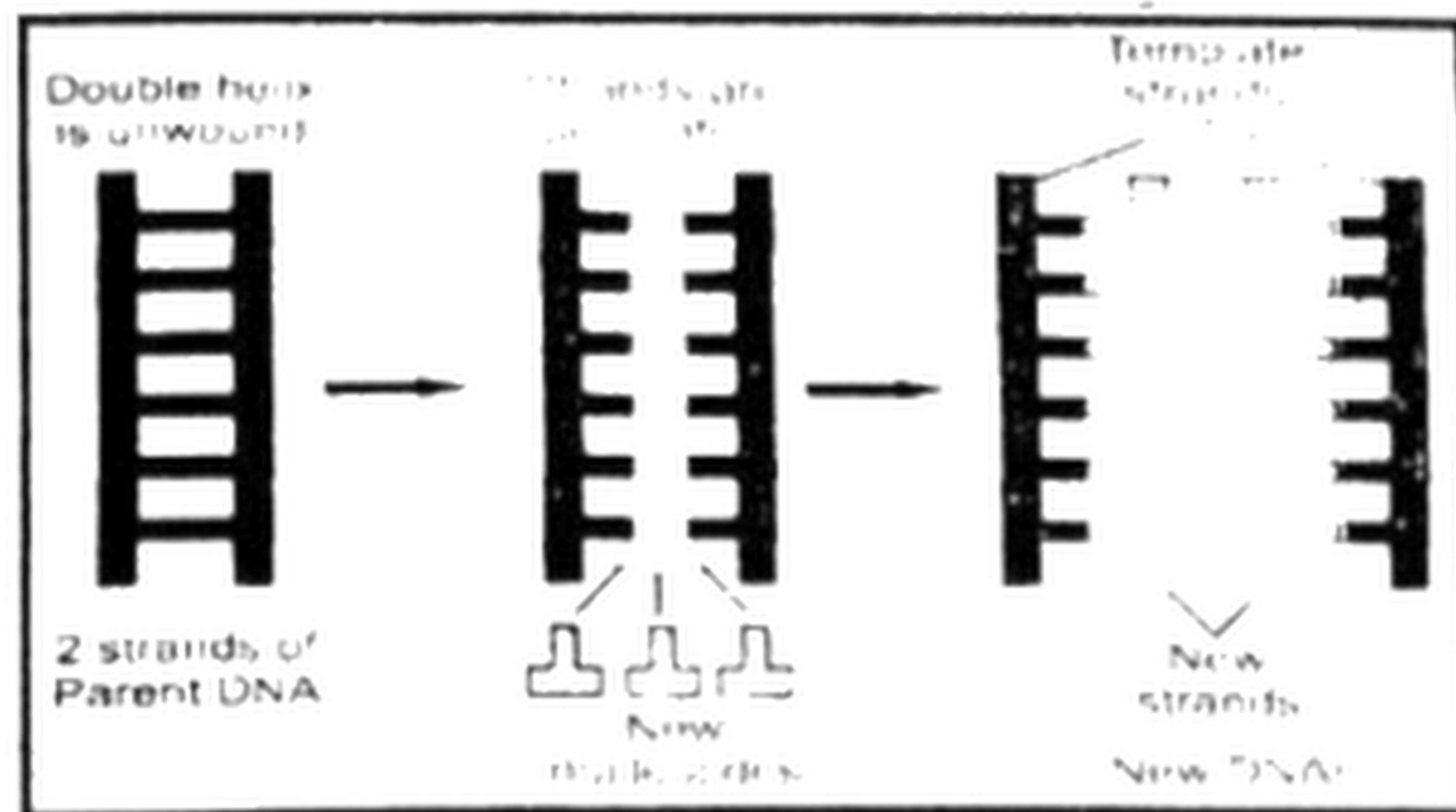
In double helix the nitrogenous bases of opposite nucleotides form pairs through nitrogen bonds. This pairing is very specific. The nitrogenous base accurate of one nucleotide forms pair with the thyme of opposing nucleotide while cytosine forms pair with guanine. There are two hydrogen bonds between adenine and thymine while there are three hydrogen bonds between cytosine and guanine.



The Watson and Crick model of DNA

Q5. What do you know about the replication of DNA?**Ans: Replication of DNA:**

Before a cell divides its DNA is replicated (duplicated) is done to make the copies of the chromatids of chromosomes. During replication, the DNA helix is unwound and the two strands are separated.....



how does dna replicate itself.

Q6. Write a note on the structure of DNA.

Ans: Function of DNA:

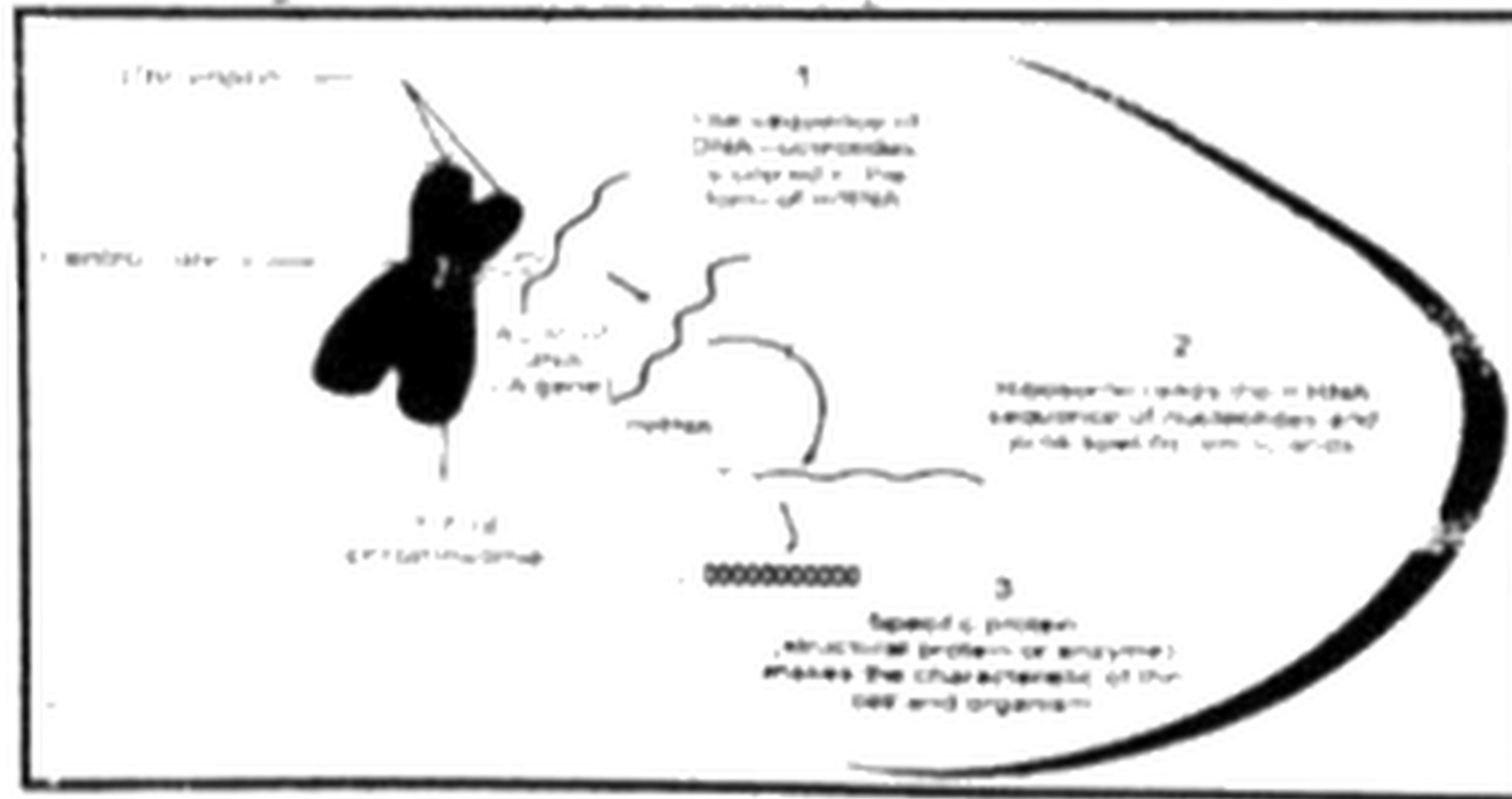
DNA is the genetic material it contains the instructions to direct all the functions of cell. It performs its role by giving instructions for the synthesis of specific protein. Some proteins perform structural roles while the others act as enzymes to control all biochemical reactions of cells. In this way, whatever a cell done is actually controlled by its DNA in other words. DNA makes the characteristic or trait of cell or organism.

Structure of DNA:

DNA is a right handed double helix. It is made up of nucleotides that are bound to each other by phosphodiester bonds. It consists of a phosphorous group and deoxyribose sugar and a base (Adenine, Guanine, Cytosine, Thymine) Adenine and Guanine are Purines, and the other two are Pyrimidines The bases are connected to each other by hydrogen bonding ATG C each colon represents the number of H-bonds.

Q7. How Does the DNA of Chromosome work?

Ans: Working of DNA Chromosome:



Working of DNA (also called the Central Dogma)

Traits are made by specific proteins. Specific proteins have specific number and sequence of their amino acid's. DNA controls this sequence of amino acids by the sequences of its nucleotides.



Transcription:

During protein synthesis the sequence of DNA nucleotides decides that what will be the sequence of amino acids. For this purpose, the specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA) nucleotides. This process is called transcription.

Translation:

The mRNA carries the sequence of its nucleotides to be some. The ribosome reads this sequence and joins specific amino acids according to form protein. This step is known as translation.

Gene:

The part of DNA sequence (of nucleotides) that contains the instructions for the synthesis of a particular protein is known as a gene. DNA of each chromosome contains thousands of genes. Like chromosomes, genes also occur in pairs, one on each homologous chromosome.

Loci:

The locations or positions of genes on chromosomes are known as loci (Singular locus). Some individuals have a condition which we may represent as AA or aa or BB) and different in others (Aa or Bb). It means that a gene exists in more than one alternate form. In the above example, A and 'a' are the two alternate forms of a gene, and 'B' and 'b' are the alternate forms of another gene.

Alleles:

The alternate forms of a gene are called alleles. If an individual has Aa gene pair, A and 'a' are the alleles of one another. In this individual, allele 'A' is located on one of the two homologous chromosomes, and the allele 'a' is on the other chromosome.

When chromosomes separate during meiosis, alleles also separate, and each gamete gets one of the two alleles. When gametes of both parents unite, the zygote (and the offspring also) receives one allele from each parent.

Q.8 Define genotype and phenotype.

Ans: See Q# 1 from Exercise (Short Questions)

Q9. What are the homozygous and heterozygous genotypes?

Ans: See Q-3 from Exercise (Short Questions)

Q10. What do you mean by dominant and recessive alleles?

Ans: See Q# 2 from Exercise (Short Questions)

Q11. What do you mean by albinism and albino? How pigment will produce?

Ans: Albinism:

Albinism is a recessive trait i.e. it is produced when both alleles are recessive. In humans allele A produces normal body pigments while allele 'a' does not produce pigments if genotype is AA or Aa the individual will produce pigments

Albino:

On the other hand if genotype is aa no pigments will be produced and the individual will be albino in this example you see that the allele A dominates Over 'a' because in Aa individual pigments are produced and the effect of 'a' is suppressed by 'A'. The expression of this genotype in the form of trait in our example, being albino or having normal Pigmentation) is known as the phenotype

Note:

A dominant allele only suppresses the expression of recessive allele It does not affect its nature.

Q1.2. Give introduction of Gregor Mendel.**Ans: Gregor Mendel:**

Gregor Mendel was a monk (priest) in Austria He developed the fundamental principles of genetics Mendel used 28,000 pea plants in his experiments.

Special factors

Mendel proposed that there are special factors" in organisms which control the expression of traits and their transmission to next generations. These factors were eventually termed genes. Mendel selected pea plant (*Pisum sativum*) to carry out a large number of experiments. In his writings he gave reasons for this selection.

Q13. How Mendel proposed special factors in organisms?**Ans: Special factors:**

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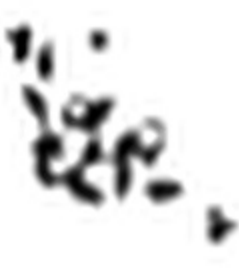

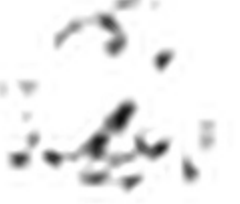





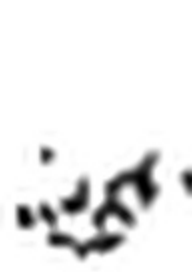
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Q14. Give the argue of Mendel for genetic experiments?

Ans: Mendel argued that an organism for genetic experiments should have the following features

- i. There should be a number of different traits that can be studied
- ii. The organism should have contrasting traits e.g. for the trait of height there should be only two very different phenotypes i.e. tallness and dwarfness
- iii. The organism is a plant) should be self-fertilizing but cross fertilization should also be possible
- iv. The organism should have a short but fast life cycle

Seed		Flower	Pod		Stem	
Form	Cotyledon	Color	Form	Color	Place	Size
						
Round	Yellow	White	Full	Green	Axial pods	Tall
						
Wrinkled	Green	Violet	Constricted	Yellow	Terminal pods	Short

Q19. Why Mendel selected the pea plant for his experiments?

Ans: Selection of Pea plant:

All these features are present in pea plant. Normally, the flowers of pea plant allow self pollination. Cross pollination can also be done by transferring the pollen grains from the flower on one plant to the flower on another plant. Each trait studied in pea plant had two distinct forms.

Q16. Why Mendel succeeded in his work?

Ans: Mendel's succeeded in his work not only because he selected the right organisms for his experiments but also because he analyzed the results by using the principles of statistics (ratios)

Q17. What is meant by the term "true-breeding"?

Ans: The term "true-breeding" means homozygous

Q18. Describe Mendel's law of segregation.

Ans: See Q #2 from Exercise (Understanding the Concept)

Q19. Explain how Mendel proved the law of independent assortment.

Ans: See Q# 3 from Exercise (Understanding the Concept)

Q20. What do you mean by Punnett square?

Ans: Punnett square:

The Punnett square is a diagram that is used to predict an outcome of a particular cross or breeding experiment. It is named after RC Punnett (an English mathematician).

The gametes of both parents having all possible genetic set-ups are determined. A checker board is used to cross all the possible gametes of one parent with all the gametes of other parent. In this way, a biologist can find all the possible genotypes of offsprings.

Q21. What do you mean by co-dominance? Give an example.

Ans: See Q# 6 from Exercise (Understanding the Concept)

Q22. Explain the phenomenon of incomplete dominance with the help of example.

Ans: See Q# 5 from Exercise Understanding the Concept)

Q23. What is the dominance relationship between blood group alleles I^A and I^B ?

Ans: Co-dominance

Q24. Describe the main sources of Variations.

Ans: Main sources of Variations:

The main sources of variations in sexually reproducing populations are

- i. The genetic recombination produced through crossing over (recall from previous studies that crossing over occurs during meiosis) results in gametes with variations.
- ii. Mutations (changes in DNA) are important source of variations. Mutations also happen during gametes formation through meiosis.
- iii. During fertilization one of the millions of sperms combines with a single egg. The chance involved in this combination also act as the source of variations
- iv. Gene flow i.e. movement of genes from one population to another is also an important source of variations.

Interesting Information

Variations are also caused by different combinations of chromosomes in gametes and then in zygote in the case of humans the possible number of chromosomal combinations at fertilization is $70,368,744,177,664$ In other words, a couple can produce more than 70 trillion (one trillion = 1000 Billions) genetically different children.

Q25. Differentiate between Discontinuous and Continuous Variations?**Ans: Discontinuous Variations:**

Discontinuous variations show distinct phenotypes. The phenotypes of such variations cannot be measured. The individuals of a population e phenotypes which can be easily distinguished from each other

Blood groups are a good example of such variations in a human population an individual has one of the four distinct phenotypes (blood groups) and cannot have in between Discontinuous variations are controlled by the alleles of a single gene pair. The environment has little effect on this type of variations

Continuous Variations:

In continuous variations the phenotypes show a complete range of measurements from one extreme to the other Height weight feet size, intelligence etc. are example of continuous variations.

In every human population, the individuals have a range of heights from very small to tall) No population can show only two or three distinct heights Continuous variations are controlled by many genes and are often affected by environmental factors.

Q26. How would you prove that variations lead to evolution?

Ans: See Q # 4 from Exercise (Understanding the Concept)

Q27. Give the introduction of C. de Buffon and J. de Lamarck.

Ans: French biologist C de Buffon (1707-1788) was the first to hint at evolution His countryman J de Lamarck (1744-1829) was the first to propose a mechanism of evolution Lamarck's ideas were soon rejected due to the vagueness of the mechanisms he proposed.

Q28. Differentiate between natural and artificial selection.

Ans: See Q# 4 from Exercise (Short Questions)

Q29. Explain the mechanism of evolution by Natural Selection.

Ans: Mechanism of evolution by Natural Selection:

Natural selection is the process by which the better genetic variations become more common in successive generations of a population

Explanation:

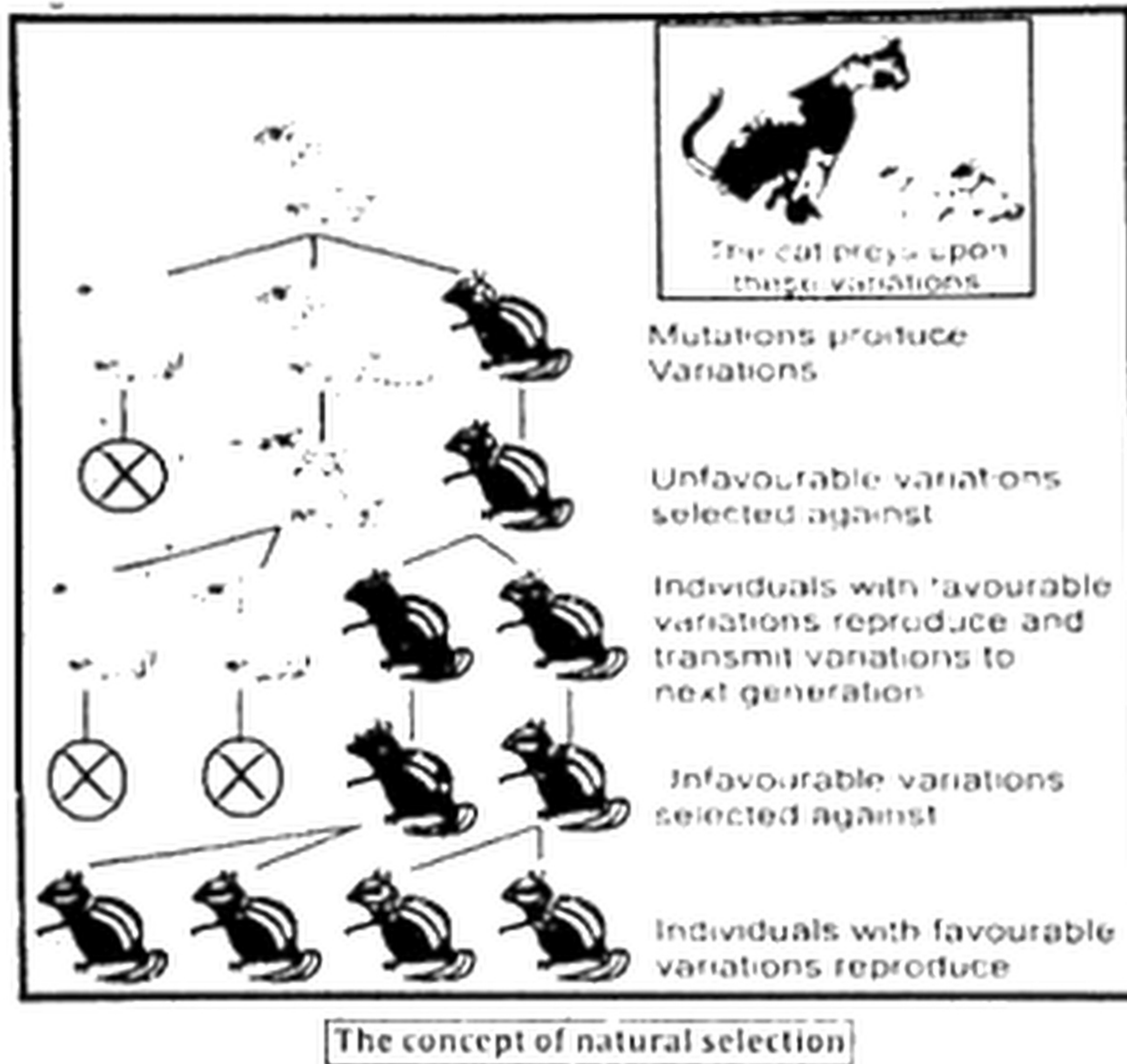
The central concept of natural selection is the evolutionary fitness of an organism. Fitness means an organism's ability to survive and reproduce. Organisms produce more offspring than can survive and these offspring vary in fitness. These conditions produce struggle for survival among the organisms of population. The organisms with favorable variations are able to reproduce and pass these variations to their next generations.

On the other hand, the rate of the transmission of unfavorable to next generations is low. We can say that the favorable variations are "selected for" their transmission to next generations, while the unfavorable variations are 'selected against' their transmission to next generations.

Q30 Explain the concept of Natural Selection with the help of examples.

Ans: Concept of Natural Selection:

We can see a mouse population with variations in skin colour. Cat preys upon light and medium coloured mouse.



In first generation, coloured mouse is preyed upon by cat Only medium and dark coloured mouse can make their next generations.

In next generation population again contains light medium and dark coloured mouse Cat preys upon the light and medium coloured mouse Now only the dark coloured mouse make new generation if this happens in many generations, we will see only the dark coloured (favorable variation) mouse in the population.

Conclusion:

As a result of natural selection, the allele that gives more fitness of characteristics (favorable variations) than other alleles become more common within population so the individuals with favorable variations become a major part of population while the individuals with harmful or unfavorable variations become rarer

Q31. Explain the concept of Natural Selection with the examples of white and dark coloured moths.

Ans: In England the moths had two variations i.e. dark and white coloured moths. The moths used to rest on the light coloured tree trunks (on which white lichens had grown) in the 19 century when industries were established in England the lichens on tree trunks died due to polluted air) and the naked tree trunks turned dark



Now the white moth variation became harmful because a white moth resting on a dark tree trunk was easily visible to the predatory birds. The natural selection selected dark moths to reproduce. In this way, dark coloured moths became more common and at last the white moths disappeared from the population. In this case, the dark colour variation in moths may be considered an adaptation to the environment.

Q32. Explain the concept of Artificial Selection with the examples.

Ans: Artificial Selection:

The term "artificial selection" was expressed by the Persian scientist Abu Rayhan Biruni in the 11th century. Charles Darwin also used this term in his work.

on natural selection. He noted that many domesticated animals and plants had special properties that were developed by

- i. Intentional breeding among individuals with desirable characteristics
- ii. Discouraging the breeding of individuals with less desirable characteristics

Importance of Artificial Selection:

Artificial selection (or selective breeding) means intentional breeding between individuals for certain traits, or combination of traits. Selective breeding has revolutionized agricultural and livestock production throughout the world.

Animals or plants having desirable characteristics are selected for breeding. In this way, many new generations with desirable characteristics are produced.

Breeds:

In artificial selection, the bred animals are known as breeds.

Varieties or cultivars:

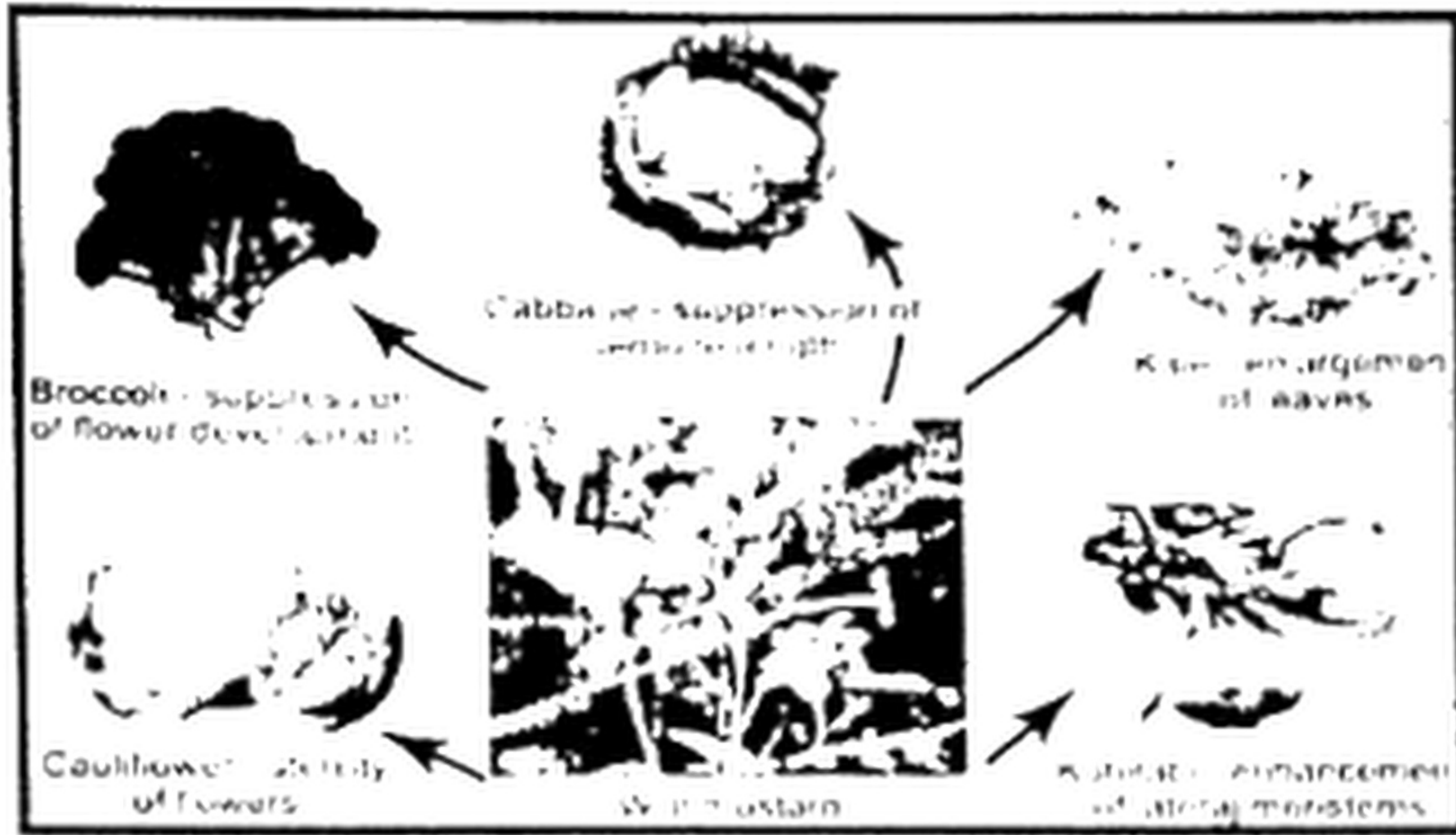
In artificial selection, bred plants are known as varieties or cultivars.

Advantages of Artificial Selection in animal:

Numerous breeds of sheep, goat, cow, hen etc have been produced by artificial selection to increase the production of wool, meat, milk, eggs etc.

Advantages of Artificial Selection in plants:

Similarly, many plant varieties (cultivars) have been produced for better quantity and quality of cereals, fruits and vegetables.



Plant variation produced through artificial selection in wild mustard

