

Inheritance

Long Answer Questions

Q.1 Define the following terms:

Genetics, inheritance, traits and genes

Ans.

Genetics

It is a branch of biology in which we study inheritance.

OR

The branch of biology which describes that how traits and characteristics are transferred from parents to offspring is called genetics.

Inheritance

It means the transmission of characteristics from parents to offspring.

Traits

Characteristics which are transmitted from parents to offspring are called traits. e.g., in man height, colour of the eyes, intelligence etc.

Genes

The chromosomes carry the biological units of inheritance called the genes.

Q.2 What are chromosomes and genes. Describe the structure of chromosomes.

Ans. Genes

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

Or

Units of inheritance, located on chromosomes are called genes.

Chromosomes

(a) Introduction

Hereditary material found in the nucleus of every cell is called chromosomes.

(b) Constant number

Body cells have a constant number of paired chromosomes.

(c) Homologous chromosomes

The two chromosomes of a pair are known as homologous chromosomes. In human body cells, there are 23 pairs for a total of 46 chromosomes.

(d) Chemical composition

They are made of chromatin material (chromatin). Chromatin is a complex material, made of DNA and proteins (histone).

(e) Nucleosomes

DNA wraps around histone proteins and forms round structures, called nucleosomes. DNA is also present between nucleosomes.

Beads on a string

The nucleosomes and the DNA between them look like beads on a string.

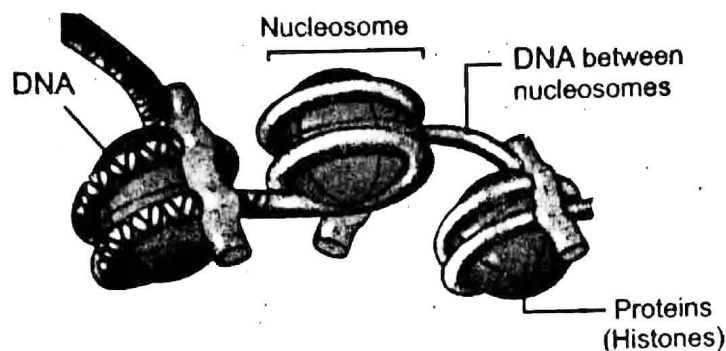


Figure 15.1: Chemical composition of chromosome

Chromosomes

The fibers consisting of nucleosomes condense into compact forms and get the structure of chromosomes.

Q.3 Describe structure of DNA.

Ans. James Watson and Francis Crick

In 1953, James Watson and Francis Crick proposed structure for DNA.

Double Helix

According to the Watson-Crick model, a DNA molecule consists of two polynucleotide strands which are coiled around each other in the form of a double helix.

Sugar-phosphate Backbone

There is a phosphate-sugar backbone on the outside of the double helix.

Nitrogenous Bases

Nitrogenous bases are present on the inside of the double helix.

Base Pairing

In the double helix, the nitrogenous bases of opposite nucleotides form pairs through hydrogen bonds.

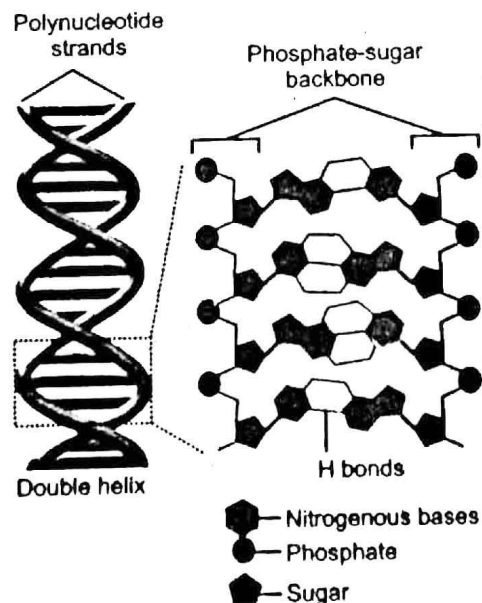


Figure 15.2: The Watson and Crick model of DNA

Specificity in Base pairing

Pairing is very specific. The nitrogenous base Adenine of one nucleotide forms pair with Thymine of opposing nucleotide while Cytosine forms pair with Guanine.

Hydrogen Bonding

There are two hydrogen bonds between Adenine and Thymine while there are three hydrogen bonds between Cytosine and Guanine.

Q.4 Describe DNA Replication.

Ans. Definition

It is a process in which one parental DNA is divided into two genetically identical daughter DNA molecules. DNA replication takes place before cell division.

Purpose

It is done to make the copies of chromatids of chromosomes.

Unwinding of DNA strands

First step in DNA replication is unwinding of DNA: As a result, two strands are separated, much like two sides of zipper.

Template strands

Each strand of parental DNA acts as a template.

Complimentary strands

New strands are called as complimentary strands.

Base pairing

Nitrogenous bases of nucleotides in template strands make pair with nitrogenous bases of nucleotides in complimentary strands.

New (Daughter) DNA Double helix

One template and one complimentary strands together form a new DNA double helix, genetically identical to parents.

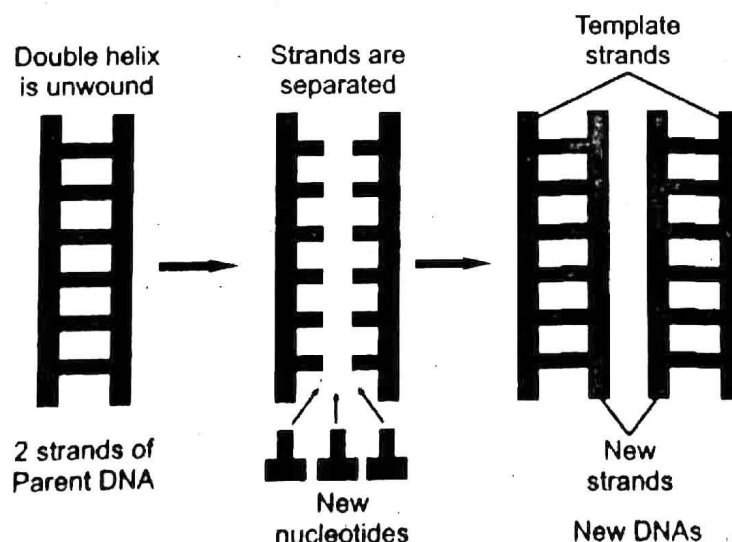


Figure 15.3: How does DNA replicate?

Q.5 How does DNA of chromosome work?

(Board 2014)

Ans: DNA

DNA is the genetic material. It performs its role by giving instructions for synthesis of specific proteins. Cell is actually controlled by its DNA. It is the DNA which makes characteristics or traits of cell or organism.

Roles of proteins

Proteins may have different roles. Some perform structural roles e.g. Keratin while other acts as enzymes to control all bio-chemical reactions of cells.

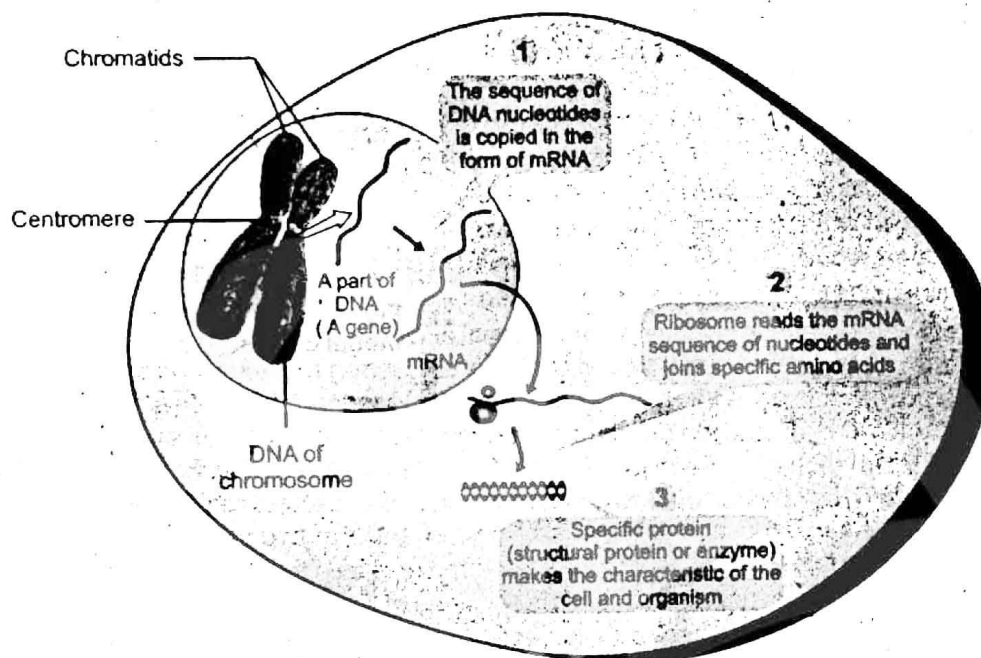


Figure 15.4: Working of DNA (also called the central Dogma)

Traits

Traits are made by specific proteins.

Sequence of Amino acids

Sequence of amino acids is controlled by specific sequence of nucleotides in DNA.

Protein Synthesis

Protein synthesis takes place in two steps:

- (i) Transcription (ii) Translation

Transcription

It is a process in which specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA) nucleotides.

Translation

The mRNA carries sequence of its nucleotides to ribosomes. The ribosome reads this sequence and joins specific amino acids, accordingly to it, to form protein. This is called as translation.

Q.6 Describe role of genes and alleles.

Ans. Gene

The part of DNA (sequence of nucleotides) that contains the instructions for the synthesis of a particular protein is known as a gene.

Gene Loci

DNA of each chromosome contains thousand of genes which are in pairs, one on each homologous chromosome. The locations or positions of genes on chromosomes are known as loci.

Role of Gene

Each gene determines a particular trait in an organism. Each individual carries at least one pair of genes for each trait.

Representation of gene pairs

Pairs of genes are represented by a letter or symbol. Both members of a gene pair may be the same like 'AA' or 'aa' or 'BB' and different in others like 'Aa' or 'Bb'. It means that a gene exists in more than one alternate forms of genes.

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. Both alleles are located on the one member separately of the homologous pair.

Separation of Alleles

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 receives one allele from each parent.



Figure 15.5: Location of alleles on chromosomes

Q.7 What is Genotype? Explain its different types. (Board 2013)

Ans: Genotype

The specific combination of genes in an individual is known as the genotype of that individual. It is of two types:-

- (i) Homozygous
- (ii) Heterozygous

(i) Homozygous Genotype

The genotype in which the gene pair contains two identical alleles (AA or aa) is called as homozygous genotype.

(ii) Heterozygous genotype

The genotype in which the gene pair contains two different alleles (Aa) is called as heterozygous genotype.

Explanation with example

Albinism

It is a condition in which normal body pigments are absent. Like other traits, it is also controlled by one pair of genes.

Recessive trait

Albinism is recessive trait i.e., it is produced when both recessive alleles are present in an organism.

Alleles for a trait

Two alleles for a gene pair are represented as 'A' and 'a'. Allele 'A' produces normal body pigments while allele 'a' does not produce pigments.

Three combinations

Three combinations i.e. genotypes are possible for these two alleles.

(i) AA (ii) Aa (iii) aa

Dominant allele

In heterozygous condition one allele masks or prevents the expression of other. It is called as dominant allele and it is represented by capital letter.

Recessive allele

In heterozygous condition, one allele is not expressed, it is called as recessive allele. It is always represented by lower case letters.

Genotype AA or Aa

If genotype is 'AA' or 'Aa', the individual will produce pigments.

Genotype aa

If genotype is 'aa', no pigments will be produced and individual will be albino.

Conclusion

So it is concluded that allele 'A' dominates allele 'a' because in 'Aa' individual pigments are produced and the effect of 'a' is suppressed by 'A'.

Phenotype

The expression of genotype in the form of trait (in albinism, being albino or having normal pigmentation) is known as phenotype.

Q.8 What do you know about Gregor Mendel? Why he selected pea plant for his genetic experiments?

Ans: Gregor Mendel

Gregor Mendel was monk (priest) in Austria. He developed the fundamental principles of genetics.

Special factors

Mendel proposed that there are "special factors" in organisms which control expression of traits and their transmission to next generations. These factors were eventually termed as genes.



Mendel used 28,000 pea plants in his experiments.

Pea Plant (*Pisum sativum*)

Mendel selected pea plant to carry out large number of genetic experiments. He argued that an organism for genetic experiments should have the following features:

1. There should be a number of different traits that can be studied.
2. 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.
3. The organism (if it is a plant) should be self-fertilizing but cross fertilization should also be possible.
4. The organism should have short but fast life cycle.

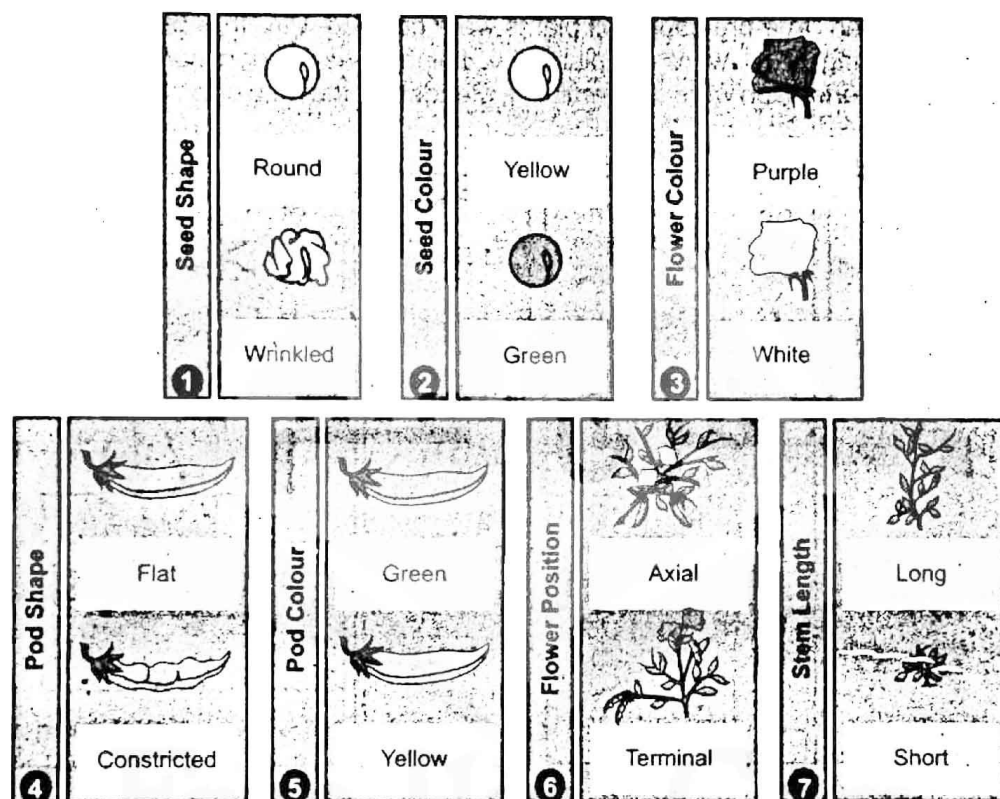


Figure 15.6: Traits in pea plant studied by Mendel

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.

Q.9 Define and Explain Mendel's law of segregation.

Ans: Definition

In each organism, genes are present in pairs. During gamete formation the genes (alleles) of each pair segregate from each other and each gamete receives one gene from the pair. When gametes of male and female parents unite, the resulting offspring again gets the genes in pairs. This is called as Mendel's law of segregation.

Explanation

Seed shape

Mendel studied the inheritance of seed shape first. Seed shape is a trait, like other traits in pea plant, which has two distinct forms:

1. Round seed shape
2. Wrinkled seed shape

Monohybrid cross

A cross in which only one trait is studied at a time is called as monohybrid cross.

P1 Generation

The parental generation is denoted as P1 generation. Mendel crossed true breeding round seeded plant with true breeding wrinkled seeded plant.

F1 Generation

The offspring of P1 generation are called as F1 generation (first filial).

Dominant trait

The trait which appear in F1 generation is called as dominant trait.

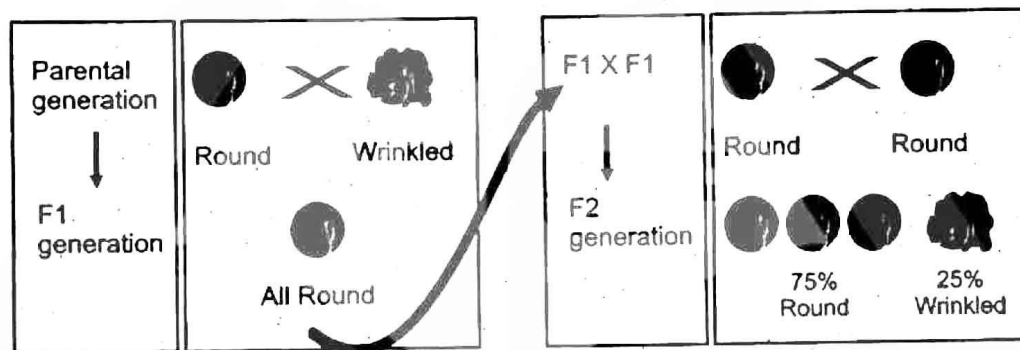
Recessive trait

The trait which does not appear in F1 generation is called as recessive trait.

So Mendel declared the trait round seeds as dominant while wrinkled seeds as recessive trait.

Self-fertilization / F2 Generation

The offspring of P1 generation are called as F1 generation. Later on, Mendel planted F1 seeds and allowed new plants to self-fertilize. As a result, he got 7324 seeds out of which 5474 round and 1850 wrinkled.



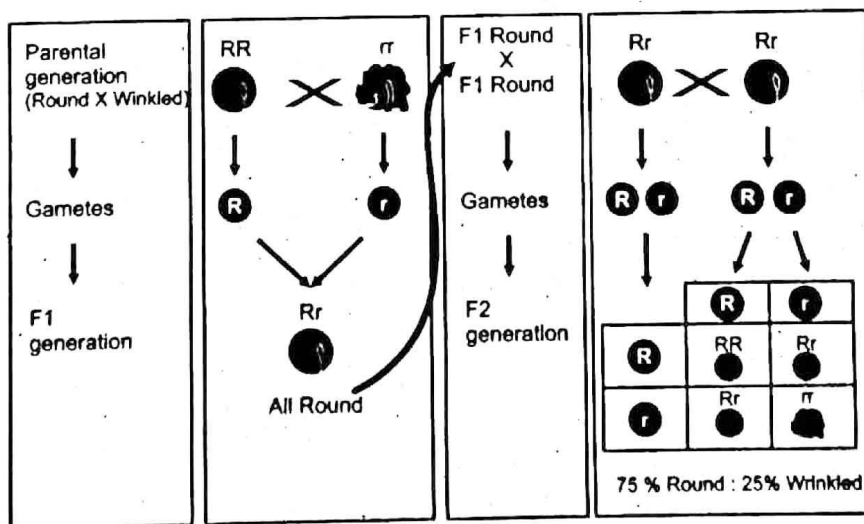
Phenotypic Ratio

In F2 seeds, phenotypic ratio would be 3 round: 1 wrinkled

Height

Mendel also studied inheritance of height in pea plant and he got same results.

When true breeding tall plants were crossed with true breeding short plants, all offsprings of F1 generation were tall i.e. Tallness is dominant trait. When members of F1 generation were self-fertilized, Mendel got ratio of tall to short plants in F2 as 3:1.



Discrete factors

Mendel concluded that the traits under study were controlled by discrete factors which are now called as genes.

Q.10 Define and Explain Mendel's Law of Independent Assortment. (Board 2013)

Ans: Definition

Alleles of a gene pair segregate (get separated and distributed to gametes) independently from the alleles of other gene pair. This is called as law of independent assortment.

Dihybrid Cross

It is a cross in which two contrasting traits are studied at a time.
In next crosses, Mendel studied dihybrid crosses.

Traits

Traits under study were as follows:-

Seed shape

It has two distinct forms:-

- (a) Round
- (b) Wrinkled

Seed Colour

It has also two distinct forms:-

- (a) Yellow
- (b) Green

Dominance

The trait of round seed was dominant over wrinkled, similarly yellow seed colour was dominant over green.

Alleles controlling traits

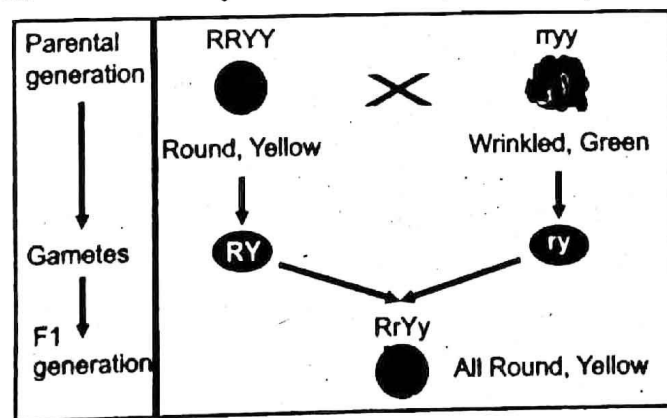
Round seed shape is controlled by 'R' and wrinkled by 'r', similarly yellow seed colour is controlled by 'Y' and green by 'y'.

P1 Generation

Mendel crossed the true breeding plant that had Round yellow seeds with true breeding wrinkled green seeds.

F1 Generation

All seeds in F1 generation were round yellow.



F2 generation

When F1 seeds grow into plants they were self fertilized. This cross produced seeds with four phenotypes. There were 315 round yellow seeds, 108 round green seeds, 101 wrinkled yellow seeds and 32 wrinkled green seeds.

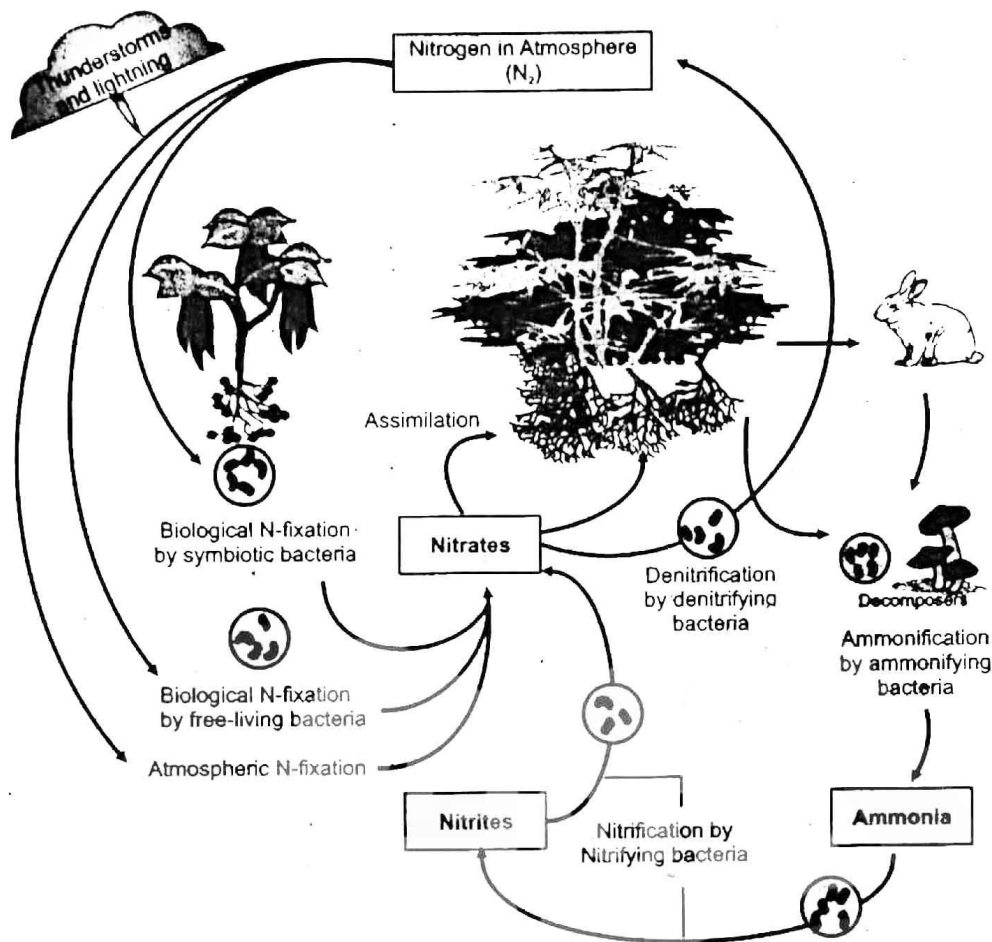


Figure 16.8: Nitrogen Cycle

Q 8 Explain various types of interactions in an ecosystem.

Ans: In all ecosystems, there are many kinds of interaction among living organisms.

(i) Intraspecific interactions

The interactions between the members of the same species are called intraspecific interactions

(ii) Interspecific interactions

The interactions between the members of different species are called interspecific interactions.

Some important interactions among living organisms in ecosystem are given below:

1. Competition
2. Predation
3. Symbiosis

1) Competition

In ecosystems, the natural resources e.g. nutrients, space etc. are usually in short supply. So, there is competition among the organisms of ecosystem for the utilization of resources. The competition may be intraspecific or interspecific.

Intraspecific competition is always stronger and more severe than the interspecific competition. Competition helps in maintaining a balance between the available resources and the number of individuals of a species.

2) Predation

Definition

It is an interaction between two animals of different species or between a plant and an animal. In predation, one organism (the predator) attacks, kills and feeds on other organism (the prey). All carnivore animals are predators. Some examples of predation are given below:-

Genotype	Antigen produced	Phenotype	Relationship between alleles
$I^A I^A$ or $I^A i$	Antigen A	Blood group A	Allele I^A is dominant over i
$I^B I^B$ or $I^B i$	Antigen B	Blood group B	Allele I^B is dominant over i
ii	No Antigen	Blood group O	Allele i is recessive
$I^A I^B$	Antigen A & Antigen B	Blood group AB	Alleles I^A and I^B are co-dominant

Allele i

Allele i does not produce any antigen and the phenotype is blood group O.

Complete Dominance

Allele I^A and I^B are completely dominant over allele i .

Genotype $I^A I^B$

In heterozygous genotype $I^A I^B$, each of the two alleles produces the respective antigens and neither of them dominates over the other. So blood group will be AB.

Incomplete Dominance

It is a situation where in heterozygous genotypes, both the alleles express as a blend (mixture) and neither allele is dominant over the other. As a result of this blending, an intermediate phenotype is expressed.

In Four O Clock plants, the 3 flower colours are red, pink and white. There is no specific gene responsible for producing pink flowers.



Four O Clock plant

Flower colour

The trait of flower colour is controlled by two alleles i.e. 'R' and 'r'.

Allele 'R'

Allele 'R' is responsible for giving red colour to flower.

Allele 'r'

Allele 'r' is responsible for giving white colour to flowers.

True Breeding Plants

True breeding plants 'RR' and 'rr' have red and white coloured flowers respectively.

Heterozygous plants of F1 Generation

When homozygous red flowered plant (RR) is crossed with homozygous white flowered plant (rr), the heterozygous (Rr) plants of F1 generation produce pink flowers.

Blending

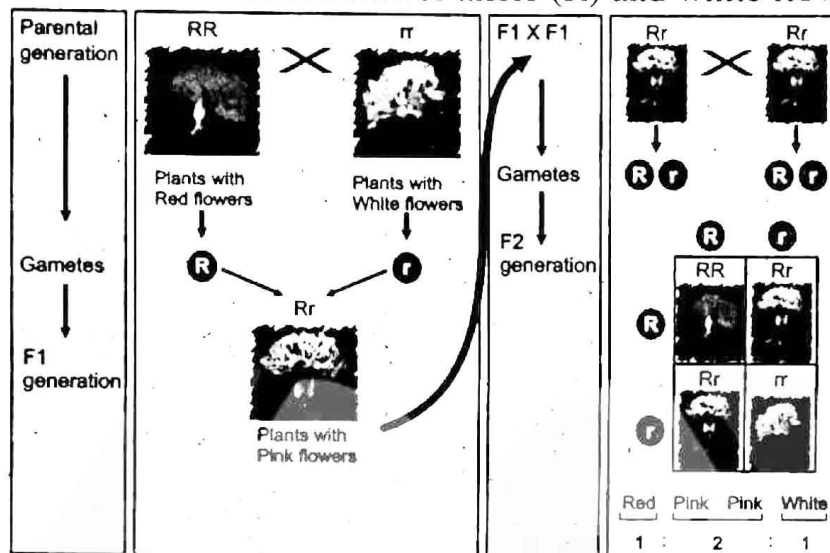
Pink colour is blend of red and white colours.

F2 Generation

When two heterozygous plants with pink flowers (Rr) are crossed, F₂ generation show phenotype of red, pink and white flowers in the ratio 1:2:1.

Conclusion

Thus, it is concluded that neither of red flower allele (R) and white flower allele (r) is dominant.



Q.12 Define variations. Discuss their sources and types.

Ans. Definition

Differences shown by the individual of same species are called as variations.

Sources of variations

(a) Genetic Recombination

The genetic recombination produced through crossing over results in gametes with variations.

(b) Mutation

Mutation (changes in DNA) are important source of variations.

(c) Combination of Sperm with egg

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.

(d) Gene Flow

Movement of genes from one population to another is also an important source of variations.

(e) Combination of Chromosomes

Variations are also caused by different combinations of chromosomes in gametes and then in zygote.

Types of Variations

(i) Continuous variations

In continuous variations, the phenotypes show a complete range of measurements from one extreme to the other.

Such variations are controlled by many genes and also affected by environmental factors.

Examples

Height in Man

Weight in Man

Feet size in Man

Intelligence in Man

Height in Man

In every human population, the individuals have range of heights (from very small to tall). No population can show only two or three distinct heights.

(ii) Discontinuous variations

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

Discontinuous variations are controlled by the allele of a single gene pair. Environment has no effect on such variations.

Example

Blood groups in Man

In human population, an individual has one of the four distinct phenotypes (blood groups) and cannot have in between.

Q.13 What is Biological or Organic Evolution? Explain with the help of Darwin's theory of natural selection.

Ans: Biological/Organic Evolution

It is a change in the characteristics of a population or species of organisms over the course of generations.

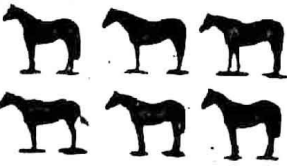
The changes in an individual are not considered as evolution because evolution refers to populations and not to individuals.

Processes

Organic evolution includes two major processes:-

- Alteration in genetic characteristics (traits) of a type of organism over time.
- Creation of new types of organisms from a single type.

Variations
Continuous or Discontinuous?

 Variations in human skin colour Discontinuous ☐ Continuous ☐	 Variations in human body weight Discontinuous ☐ Continuous ☐
 Variations in horse skin colour Discontinuous ☐ Continuous ☐	 Variations in rose flower colour Discontinuous ☐ Continuous ☐



Buffon



Lamarck

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.

Theory of Natural Selection

Charles Darwin (1809 – 1882) proposed the mechanism of organic evolution in 1838. It was called as “The theory of natural selection”. “Darwin proposed after his 5-year voyage on HMS (His Majesty’s Ship) Beagle. He also published a book “On the Origin of Species by means of Natural Selection” in 1859.

Early response to Darwin’s theory

Darwin theory of evolution was not widely accepted because of lack of sufficient evidence. Modern evolutionary theory began in the late 1920’s and early 1930s.

Some scientists proved that the theory of natural selection and Mendelian genetics are the same ideas just as Darwin has proposed.

Importance of study of evolution

It determines the ancestry and relationships among different kinds of organisms.

Theory of special creation

The anti-evolution ideas support that all living things had been created in their current form only a few thousand years ago. It is known as the “theory of special creation.”

MECHANISM OF EVOLUTION

Natural selection

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

Variations in population

Almost every population contains several variations for the characteristics of its members. These variations are of two types:

- (i) Morphological Variations
- (ii) Physiological Variations

Evolutionary Fitness of Organism

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.

Struggle for survival

These conditions produce struggle for survival among the organisms of a population.

Favourable variations

The Organisms with favourable variations are able to reproduce and pass these variations to their next generations.

Unfavourable Variations

On the other hand, rate of the transmission of unfavourable variations to next generations is low. It means that unfavourable variations are selected against their transmission to next generations.

Examples

Skin colour in Mouse

There are three variations in skin colour of mouse population:-

- Light coloured
- Medium coloured
- Dark coloured

Cat preys upon light and medium coloured mouse.

First Generation

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

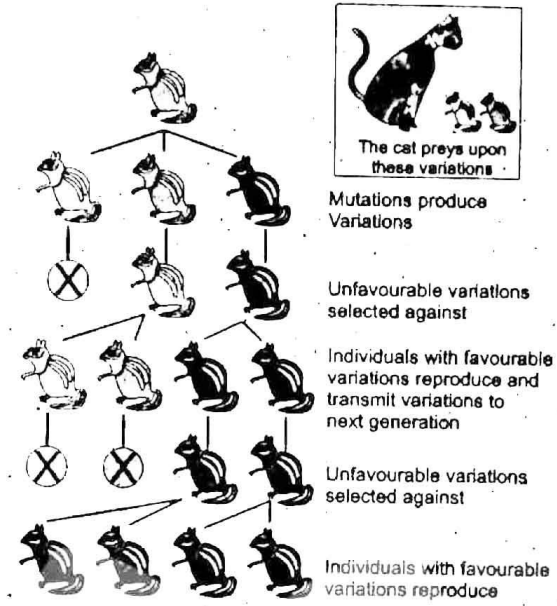


Figure 15.7: The concept of natural selection

Next Generation

In next generation, population again contains light, medium and dark coloured mouse. Cat preys upon the light and medium coloured mouse. Now only dark coloured mouse make new generation.

Favourable Variations

It happens in many generations, we will see only the dark coloured mouse in the population.

Natural selection

As a result of natural selection, the alleles that give more fitness of characteristics (favourable variations) than other alleles become more common within population.

Colour Variations in Moth

In England, moths had two variations i.e.,

- (i) Dark coloured moth
- (ii) White coloured moth

Light coloured tree trunk

The moths used to rest on the light coloured tree trunks (on which white lichens had grown).

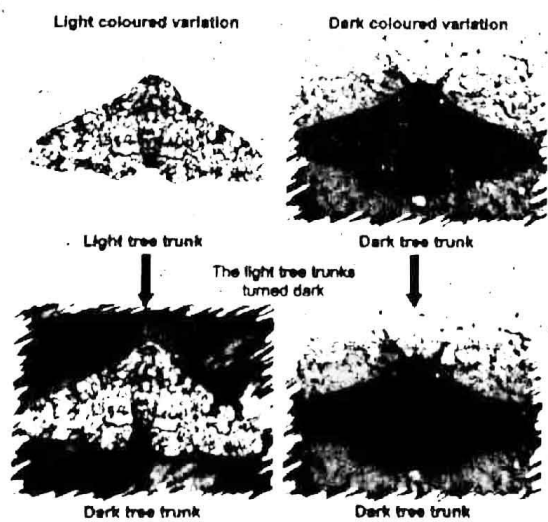


Figure 15.8: White and dark coloured moths

Favourable variations

In those days, light colour was favourable variation as they were invisible to predatory birds while resting on light coloured tree trunks.

Industrial Revolution

After industrial revolution in England, the lichens on tree trunks died due to polluted air and naked tree trunks turned dark.

The Unfavourable variation

Now the white moth variation became unfavourable or harmful because a white moth resting on dark tree trunk was easily visible to predatory birds.

Natural Selection

The natural selection selected dark moths to reproduce. In this way, dark coloured moth became more common and at last white moths disappeared from population. In this case, the dark colour variation in moth may be considered an adaptation to environment.

Conclusion

So it is concluded that individuals with favourable variations become major part of population while individuals with harmful or unfavourable variations become rare.

Q.14 What is artificial selection? Explain it. (Board 2014)

Ans. Definition

Artificial selection (or selective breeding) means intentional breeding between individuals for certain traits or combination of traits.

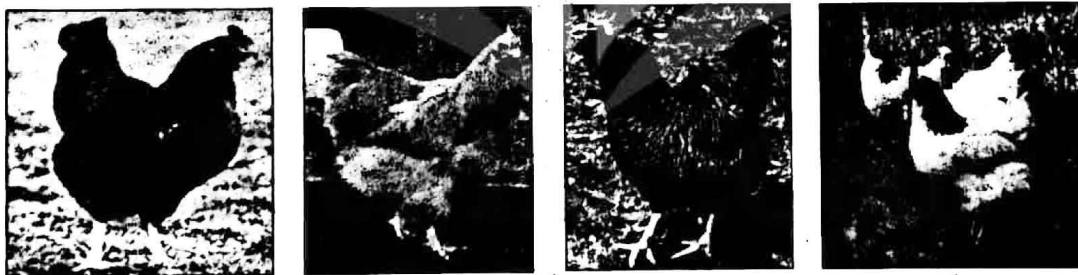


Figure 15.9: Breeds of hen produced through artificial selection

Historical Background

(a) Abu Rayhan Biruni

The term artificial selection was expressed by the Persian scientist Abu Rayhan Biruni in the 11th century.

(b) Charles Darwin

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:

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

Desirable characteristics

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

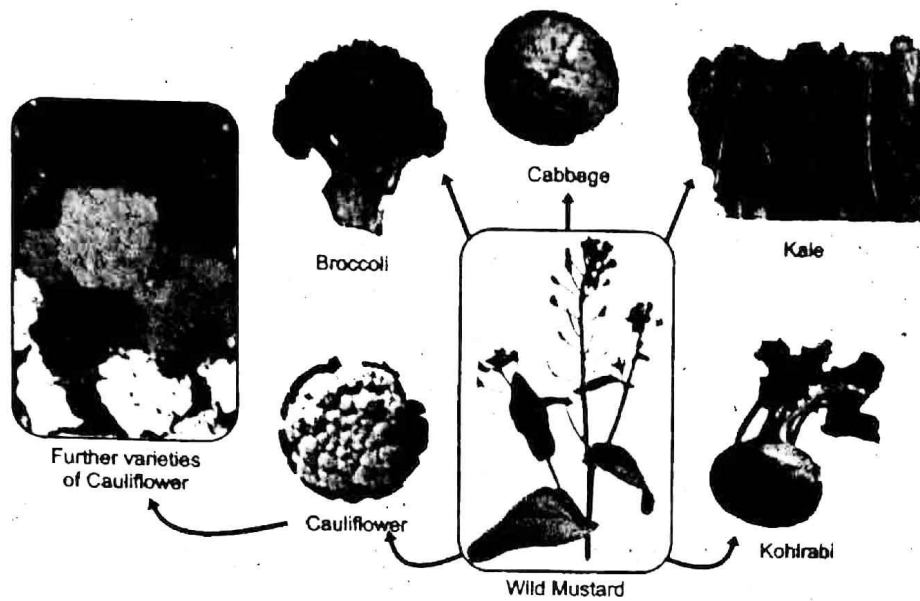


Figure 15.10: Plant varieties produced through artificial selection in wild mustard

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.

Examples

- (i) Numerous breeds of sheep, goat, cow, hen etc have been produced by artificial selection to increase the production of wool, meat, milk, eggs etc.
- (ii) Similarly, varieties of plants have been produced for better quantity and quality of cereals, fruits and vegetables.

Multiple Choice Questions

1. An organism's expressed physical trait, such as seed colour or pod shape, is called its:
(a) Genotype (b) Phenotype
(c) Karyotype (d) Physical type
2. An organism has two different alleles for a single trait. Its genotype is said to be;
(a) Homozygous (b) Heterozygous
(c) Hemizygous (d) Homologous
3. In the cross-pollination between a true-breeding yellow pod plant and a true-breeding green pod plant, where green pod colour is dominant, the resulting offsprings (F1 generation) will be;
(a) $\frac{1}{4}$ green, $\frac{3}{4}$ yellow
(b) All yellow
(c) $\frac{1}{4}$ yellow, $\frac{3}{4}$ green
(d) All green
4. How many genetically different kinds of gametes an individual with genotype AAbb can produce? (B-2014)
(a) 1 (b) 2
(c) 4 (d) 8
5. Which of the following statements regarding genes is FALSE?
(a) Genes are located on chromosomes
(b) Genes consist of a long sequence of DNA
(c) A gene contains information for the production of a protein
(d) Each cell contains a single copy of every gene
6. Mendel's primary contribution to our understanding of inheritance was;
(a) The idea that genes are found on chromosomes
(b) Explanation of the patterns of inheritance
(c) The discovery of alleles
(d) Determining that informations contained in DNA are for protein synthesis
7. A purple-flowered pea plant has the genotype PP. Which of the following statements about this plant is FALSE?
(a) Its phenotype will be white flowers
(b) It has a homozygous dominant genotype
(c) When bred to a white-flowered plant, all offspring will be purple flowered
(d) All the gametes produced will have the same flower colour allele
8. Charles Darwin proposed that organisms produce many more offspring than can possible survive on the limited amount of resources available to them. According to Darwin, the offspring that are most likely to survive are those that;
(a) Are born first and grow fastest
(b) Are largest and most aggressive
(c) Have no natural predators
(d) Are best adapted to the environment
9. Branch of biology that deals with the study of inheritance is called as;
(a) Artificial selection
(b) Natural selection
(c) Genetics
(d) Histology
10. Transmission of characteristics from parents to offsprings is called as;
(a) Replication (b) Inheritance
(c) Co-dominance (d) Mutation

11. Chromosomes carry units of inheritance called as;
(a) Chromatin (b) DNA
(c) genes (d) None of these
12. Genes contain instructions for the synthesis of;
(a) Fats (b) Carbohydrates
(c) Vitamins (d) Proteins
13. How many pairs of homologous chromosomes are there in human body cell?
(a) 22 (b) 23
(c) 40 (d) 46
14. Chromatin is made up of;
(a) DNA
(b) Protein
(c) DNA + protein
(d) None of these
15. DNA wraps around histone protein and forms rounded structures called as;
(a) Nucleosomes (b) Ribosomes
(c) Lysosomes (d) mRNA
16. In _____ James Watson and Francis Crick proposed the structure of DNA.
(a) 1951 (b) 1953
(c) 1955 (d) 1957
17. In 1953, _____ proposed the structure of DNA.
(a) James Watson
(b) Francis Crick
(c) Both a and b
(d) None of these
18. A DNA molecule consists of _____ polynucleotide strands.
(a) 2 (b) 3
(c) 4 (d) 5
19. Outside backbone of double helix is made up of;
(a) Sugar
(b) Phosphate
(c) Sugar-phosphate
(d) None of these
20. Inside of double helix consists of;
(a) Nitrogenous bases
(b) Sugar
(c) Sugar-phosphate
(d) Phosphate
21. Adenine always pairs with;
(a) Guanine (b) Cytosine
(c) Uracil (d) Thymine
22. Cytosine always pairs with;
(a) Guanine (b) Adenine
(c) Uracil (d) Thymine
23. How many hydrogen bonds are formed between adenine and thymine?
(a) 1 (b) 2
(c) 3 (d) 4
24. How many hydrogen bonds are formed between cytosine and guanine?
(a) 1 (b) 2
(c) 3 (d) 4
25. Copies of chromatids of chromosomes are made through the process called;
(a) Inheritance
(b) Transcription
(c) Translation
(d) Replication
26. Specific proteins have specific number and sequence of;
(a) Enzymes
(b) Amino Acids
(c) Loci
(d) Allele
27. Sequence of amino acids in a protein is controlled by sequence of ---- in DNA.
(a) Genes (b) Loci
(c) Nucleotides (d) alleles
28. Specific sequence of DNA nucleotides is copied in the form of mRNA in a process;
(a) Replication
(b) Translation
(c) Inheritance
(d) Transcription

29. Ribosome reads the sequence of mRNA nucleotides and joins specific amino acids to form proteins. This step is known as; (Board 2013)
- (a) Combination
 - (b) Transcription
 - (c) Translation
 - (d) Replication
30. The position of gene on chromosome is known as;
- (a) Locus
 - (b) Allele
 - (c) Genotype
 - (d) Genome
31. In which part of cell, transcription takes place?
- (a) Cytoplasm
 - (b) Nucleus
 - (c) Ribosome
 - (d) Golgi Apparatus
32. Which component of cell is involved in translation?
- (a) Ribosome
 - (b) Mitochondria
 - (c) Golgi apparatus
 - (d) Nucleus
33. The alternate forms of a gene are called as;
- (a) Genome
 - (b) Genotype
 - (c) Alleles
 - (d) None of these
34. The Specific combinations of genes in an individual is known as; (Board 2013)
- (a) Phenotype
 - (b) Genotype
 - (c) Karyotype
 - (d) Phenocopy
35. It is a condition in which normal body pigments are absent;
- (a) Colour blindness
 - (b) Albinism
 - (c) Diabetes
 - (d) Sickle cell anaemia

36. Dominant alleles are represented by _____ letter and recessive alleles by _____ letters.
- (a) Capital, lowercase
 - (b) Lowercase, capital
 - (c) Lower case, lowercase
 - (d) Capital, capital
37. Expression of genotype in the form of trait is:
- (a) Genome
 - (b) Phenotype
 - (c) Complete dominance
 - (d) Incomplete dominance
38. Who developed fundamental Principles of genetics?
- (a) Lamark
 - (b) Gregor Mendel
 - (c) Charles Lyll
 - (d) Charles Darwin
39. *Pisum sativum* is scientific name of;
- (a) Onion
 - (b) Frog
 - (c) Mustard plant
 - (d) Pea plant
40. Each trait studied in Pea plant had _____ distinct form.
- (a) 1
 - (b) 2
 - (c) 4
 - (d) 6
41. It is situation where two different alleles of a gene pair express themselves completely, instead of showing a dominant- recessive relationship is called;
- (a) Incomplete dominance
 - (b) Co-dominance
 - (c) Complete dominance
 - (d) None of these
42. Among following which is an example of co-dominance?
- (a) Blood group A
 - (b) Blood group B
 - (c) Blood group AB
 - (d) Blood group O

43. Among following, which is the genotype of blood group O?
- (a) $I^A i$ (b) $I^B i$
(c) $I^A I^B$ (d) ii
44. It is a situation where in heterozygous genotypes, both the alleles express as a blend and neither allele is dominant over the other;
- (a) Incomplete dominance
(b) Co-dominance
(c) Complete dominance
(d) None of these
45. Pink Flowered Four O Clock plant is an example of;
- (a) Incomplete dominance
(b) Co-dominance
(c) Complete dominance
(d) None of these
46. How many types of differences shown by individuals of same species?
- (a) 1 (b) 2
(c) 4 (d) 6
47. Among following, which is the source of variations?
- (a) Mutation
(b) Crossing over
(c) Gene flow
(d) All of these
48. Which variations show distinct phenotypes and phenotypes of such variations cannot be measured?
- (a) Discontinuous variations
(b) Continuous variations
(c) Both a and b
(d) None of these
49. Example of discontinuous variation is;
- (a) Blood group
(b) Height in Man
(c) Intelligence
(d) None of these
50. In which type of variations, the phenotypes show a complete range of measurements from one extreme to the other is;
- (a) Discontinuous
(b) Continuous
(c) Both a and b
(d) None of these
51. It is change in characteristics of a population or species of organisms over the course of generations;
- (a) Replication
(b) Transcription
(c) Evolution
(d) Translation
52. All living things had been created in their current form only a few thousand years ago. This idea is known as;
- (a) Theory of special creation
(b) Evolution
(c) Variations
(d) None of these
53. Who proposed the mechanism of organic evolution in 1838?
- (a) Charles Darwin
(b) Charles Lyll
(c) Lamark
(d) Gregor Mendel
54. Charles Darwin published a book "On the Origin of Species by means of Natural selection" in;
- (a) 1858 (b) 1859
(c) 1869 (d) 1870
55. It is the process by which the better genetic variations become more common in successive generations of population;
- (a) Variation
(b) Artificial selection
(c) Selective breeding
(d) Natural selection

56. Variations selected for their transmission to next generation are;
- Favourable
 - Continuous
 - Discontinuous
 - None of these
57. In which part of cell, transcription takes place?
- Cytoplasm
 - Nucleus
 - Ribosomes
 - Golgi Appartus
58. Which is favourable variation in moths before industrial revolution?
- Light colour
 - Dark colour
 - Medium colour
 - None of these
59. Which is favourable variation in moths after industrial revolution?
- Light colour
 - Medium colour
 - Dark colour
 - None of these
60. Intentional breeding between individuals for certain traits, or combination of traits is called as:
- Variations
 - Evolution
 - Natural selection
 - Artificial selection
61. A dominant allele only supresses the expression of recessive allele, it does not affect its:
- Length
 - Working
 - Nature
 - Position
62. Mendel used _____ pea plants in his experiments.
- 2800
 - 28000
 - 28,0000
 - 28,00000
63. True breeding means:
- Homozygous
 - Hetrozygous
 - Both homozygous and hetrozygous
 - None
64. The possible number of chromosomal combinations are:
- 70 millions
 - 70 billion
 - 70 trillion
 - 80 trillion
65. _____ gave the first hint at evolution?
- Charles Darwin
 - Lamarck
 - C.de Buffon
 - R. C. Punnett
66. mRNA is synthesized by:
- DNA Polymerase
 - RNA Polymerase
 - RNA Ligase
 - Ribosomes
67. Feet size in Man is an example of:
- Continuous variations
 - Discontinuous variations
 - Gene flow
 - Heredity variations
68. In artificial selection, bred plants are known as:
- Breeds
 - Cultivars
 - Varieties
 - Cultivars and varieties
69. What is the Diploid (2n) number of humans?
- 23
 - 16
 - 26
 - 46
70. What condenses into a chromosome?
- Nucleoplasm
 - Nucleolus
 - Chromatin material
 - Cytoplasm
71. What make the backbone of DNA molecule?
- Phosphate
 - Deoxyribose
 - Nitrogenous bases
 - Phosphate + Deoxyribose
72. The first filial generation is denoted by
- P1
 - P2
 - F1
 - F2
73. Physical appearance or colour of an organism is called: (Board 2014)
- Genotype
 - Karyotype
 - Phenotype
 - Physical power

74. What will be the colour of flowers produced as a result of cross between red and white flowered 4'O Clock plants? (Board 2014)

- (a) Pink (b) Red
(c) White (d) Purple

75. Which of the following genes will be termed as Homozygous Recessive, (Board 2014)

- (a) RRYy (b) RrYy
(c) RrYY (d) rryy

Answer Key

1	b	2	b	3	d	4	a	5	b
6	b	7	a	8	d	9	c	10	b
11	c	12	d	13	b	14	c	15	a
16	b	17	c	18	a	19	c	20	a
21	d	22	a	23	b	24	c	25	d
26	b	27	c	28	d	29	c	30	a
31	b	32	a	33	c	34	b	35	b
36	a	37	b	38	b	39	d	40	b
41	b	42	c	43	d	44	a	45	a
46	b	47	d	48	a	49	a	50	b
51	c	52	a	53	a	54	b	55	d
56	a	57	b	58	a	59	c	60	d
61	c	62	b	63	a	64	c	65	c
66	b	67	a	68	d	69	d	70	c
71	d	72	c	73	c	74	a	75	d

Short Answer Questions

Q.1 Define Genetics.

Ans. It is a branch of biology which deals with the study of inheritance.

Q.2 Define Inheritance.

Ans: Inheritance means the transmission of characteristics from parents to offspring.

Q.3 What are traits? Write two human traits. (Board 2014)

Ans. Characters which are transmitted from parents to offspring are called traits. In man, height, eye colour etc are examples of traits and are inheritable.

Q.4 What are Genes?

Ans. Genes are segments of DNA. Each specific gene contains instructions for the synthesis of specific protein.

Q.5 What are homologous chromosomes? (Board 2013) OR / What are Homologous chromosomes? How many of these exist in man? (Board 2014)

Ans. The body cells have constant number of paired chromosomes. The two chromosomes of a pair are called as homologous chromosomes. For example, in human body cells, there are 23 pairs of homologous chromosomes for a total of 46 chromosomes.

Q.6 How is chromatin/ chromosome made up of?

Ans. Chromatin or chromosome is made up of DNA and protein.

Q.7 What is nucleosome?

Ans. In chromatin, DNA wraps around histone proteins and form round structure called as nucleosome. DNA is also present between nucleosomes. In this way, nucleosomes and DNA between them look like beads on string.

Q.8 Define Double helix.

Ans. DNA consists of two polynucleotide strands which are coiled around each other in the form of Double helix. There is phosphate-sugar backbone on outside, while nitrogenous bases are on inside of double helix.

Q.9 Define DNA replication.

Ans. It is a process in which one parental DNA is divided into two genetically identical daughter DNA molecules.

Q.10 What is the purpose of DNA replication?

Ans. DNA replication is done to make the copies of chromatids of chromosomes.

Q.11 How does DNA work?

Ans. DNA is genetic material. It performs its role by giving instructions for the synthesis of specific proteins. Some proteins perform structural role while others act as enzymes to control all bio-chemical reactions of cells.

Q.12 Differentiate between transcription and translation.

Ans. i. Transcription

It is a process in which specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA).

ii. Translation

The mRNA carries the sequence of its nucleotides to ribosomes. Ribosomes read this sequence and joins specific amino acids, according to it proteins are synthesized.

Q.13 Define a Gene. Write symbols of Genes for any two traits. (Board 2014)

Ans. Definition

Particular segment of DNA that contains instructions for synthesis of particular protein is called as gene.

OR

Particular sequence of nucleotides that contains instructions for synthesis of particular protein is called as gene.

Symbols of Genes

The trait of round seeds (controlled by allele R) was dominant over wrinkled (controlled by allele r) seeds. Similarly yellow seed (controlled by Y) was dominant over green (controlled by y).

Q.14 Define Allele.

Ans. Genes occur in pairs on homologous chromosomes. Each member of gene pair is called as allele. The alternative forms of a gene are called as alleles e.g. 'A' and 'a' are two alternative forms of a gene or 'B' and 'b' are two another alternative forms of a gene.

Q.15 Define Locus.

Ans. Location or position of gene on chromosome is called as its locus.

Q.16 What is genotype? Describe its Types.

Ans. The specific combinations of genes in an individual is known as genotype. It has two types i.e. Homozygous and Heterozygous

(i) Homozygous Genotypes

The genotype in which gene pair contains two identical alleles (AA,aa) is called as homozygous genotype.

(ii) Heterozygous genotype

The genotype in which gene pair contains two different alleles (Aa) is called as heterozygous genotype.

Q.17 Define Albinism

Ans. It is a condition in which normal body pigments are absent.

Q.18 Differentiate between dominant alleles and recessive allele.

Ans. i. Dominant Allele

In the heterozygous condition, one allele masks or prevents the expression of the other, such allele is called as dominant allele. Dominant alleles are represented by capital letters e.g., $I^A I^B$

ii. Recessive Allele

The allele which is not expressed is called as recessive allele. Recessive alleles are represented by lower case letters e.g., ii.

Q.19 What features should be present in an organism used for genetic experiments?

Ans. Organism used in genetic experiments should have following features:-

- There should be number of different traits that can be studied.
- 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.

- The organisms (if it is plant) should be self-fertilizing but cross fertilization should also be possible.
- The organism should have a short but fast life cycle.

Q.20 Differentiate between monohybrid cross and dihybrid cross. OR Define monohybrid and dihybrid cross.

(Broad 2014)

Ans. A cross in which only one trait is studied at a time is called as monohybrid cross e.g. cross between true-breeding round seeded plant and true breeding wrinkled seeded plant. In this case one trait i.e seed shape is under study.

A cross in which two traits are studied at a time is called as dihybrid cross e.g. cross between true breeding round yellow seeded plants and wrinkled green seeded plants. In this case, two traits i.e. seed shape and seed colour are under study.

Q.21 What is meant by P_1 , F_1 and F_2 generations?

Ans. P_1 generation

First parental generation is known as P_1 generation.

F_1 generation

Means first filial. The offspring of P_1 generation are called as F_1 generation.

F_2 Generation

Means second filial. The offspring of F_1 generation are called as F_2 Generation.

Q.22 Define Law of Segregation.

(Board 2013)

Ans. This law states that during gamete formation, the genes (alleles) of each pair segregate from each other and each gamete receives one gene from the pair when the gametes of male and female parents unite, the resulting offspring again gets the genes in pairs.

Q.23 Define Mendel's Law of independent assortment.

Ans. This law states that the alleles of a gene pair segregate (get separated and distributed to gametes) independently from the alleles of other gene pairs.

Q.24 Define co-dominance. Give an example.

(Broad 2014)

Ans. It is a situation in which two different alleles of a gene pair express themselves completely, instead of showing a dominant-recessive relationship. As a result, heterozygous organisms shows a phenotype that is different from both homozygous parents.

For example human blood group AB.

Q.25 Define incomplete dominance. Give example.

Ans. It is a situation in which phenotypic expression of heterozygous organism is intermediate to phenotype expressions shown by both homozygous organisms. Both alleles in heterozygous organisms express this blend (mixture) and neither allele is dominant over the other.

For example pink flowered four o'clock plant.

Q.26 Define variation. Give sources of variations.

Ans. Differences shown by individuals of same species are called variations. Important sources of variations are as following:-

- | | |
|----------------------------|----------------|
| (i) Crossing Over | (ii) Mutation |
| (iii) Random Fertilization | (iv) Gene flow |

Q.27 Define Gene flow.

Ans. Movement of genes from one population to other population is called gene flow.

Q.28 Describe types of variations with examples.

Ans. There are two types of variations:

1. Continuous variations

Those variations in which phenotypes show a complete range of measurements from one extreme to other are called as continuous variations.

Height, weight, feet size, intelligence etc. are examples of continuous variations. In every human population, the individuals have a range of heights. No populations can show only two or three distinct heights. Continuous variations are controlled by many genes and are then affected by environmental factors.

2. Discontinuous variations

These are the variations which show distinct phenotypes which can be easily distinguished from each other. The phenotypes of such variations cannot be measured.

Blood groups are good examples of discontinuous variations. In human population, an individual has one of the four distinct blood groups and cannot have in between. Such variations are controlled by alleles of single gene. The environment has little effect on this type of variations.

Q.29 Define Organic or Biological Evolution.

Ans. Organic or Biological evolution is change in characteristics of population or species of organisms over the course of generations.

The changes in an individual are not considered as evolution because evolution refers to populations, not to the individuals.

Q.30 What processes are involved in Organic evolution.

Ans. There are two major processes involved in organic evolution.

- Alteration in genetic characteristics (traits) of a type of organisms over time.
- Creation of new types of organisms from a single type.

Q.31 What is anti-evolution or theory of special creation? (Board 2013)

Ans. The anti-evolution idea supports that all living things had been created in their current form only a few thousand years ago. It is also known as theory of special creation.

Q.32 Define Natural selection.

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

Q.33 Define Artificial selection/selective breeding

Ans. Artificial selection (selective breeding) means intentional breeding between individuals for certain traits or combination of traits.

Q.34 Differentiate between breeds and varieties or cultivars.

Ans. In artificial selection, the bred animals are known as breeds, while bred plants are known as varieties or cultivars.

Q.35 Define genotype and phenotype. (Board 2013)

Ans. Genotype

The specific combination of genes in an individual is known as genotype.

Phenotype

The expression of genotype in the form of trait is known as phenotype.

Q.36. What is template strand?

Ans. The strand of DNA to which new strand is formed called template strand.

Q.37. Define Punnett Square?

Ans. It is a diagram used to predict an outcome of a particular cross or breeding experiment. The gametes of both parents having all possible genetic make-up (set-ups) are determined.

Q.38. What will be Genotype of plants produced as a result of cross between two plants having Genotype Rr? (Board 2014)

Ans. When two heterozygous plants with pink flowers (Rr) are crossed, F₂ generation shows phenotypes of red, pink and white flowers in ratio 1 : 2 : 1.