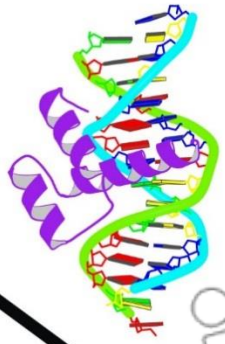


CH# 15 INHERITANCE

15.1 INTRODUCTION TO GENETICS

15.2 CHROMOSOMES AND GENES

LONG QUESTIONS

Q.1 Describe structure of DNA. ***(K.B)*** **(Understanding the Concept Q.1)**

OR

Describe the structure of chromatin.

Ans:

STRUCTURE OF DNA

Introduction:

In **1953**, **James Watson** and **Francis Crick** proposed the structure for DNA that is why it is called, **Watson - Crick Model of DNA**.

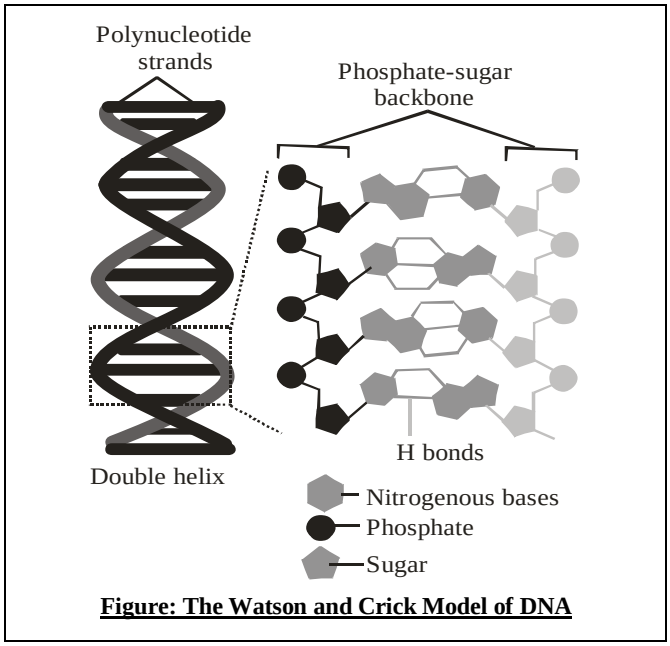


Figure: The Watson and Crick Model of DNA

Double Helix Structure:

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

Backbone:

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

Nitrogenous Bases:

The **nitrogenous bases** are on the inside of the **double helix**. In double **helix**, the nitrogenous bases of opposite **nucleotides** form pairs through **hydrogen bonds**.

Specific Nucleotides Pairing:

The **pairing** of nucleotides is **highly specific**. The nitrogenous base **adenine** of one nucleotide forms pair with the **thymine** of opposing nucleotide, while **cytosine** forms pair with **guanine**.

Hydrogen Bonds:

There are two hydrogen bonds between adenine and thymine while there are three hydrogen bonds between cytosine and guanine.

Q.2 Describe DNA replication. ***(K.B)*** **(GRW 2016, DGK 2015)**

Ans:

DNA REPLICATION

Introduction:

Before a cell divides, its DNA is replicated (duplicated). It is done to **make the copies** of the chromatids of chromosomes.

MECHANISM OF REPLICATION

Uncoiling of DNA:

During replication, the DNA double helix is **unwound** and the **two strands are separated**, much like the two sides of a zipper.

Templates:
Each strand acts as a template to produce another strand.

Pairing of Nucleotides:
The DNA template nitrogenous bases make pairs with the nitrogenous bases of new nucleotides. In this way, both **template strands make new polynucleotide strands** in front of them.

New DNA Molecule:
Each template and its new strand together then form a new DNA double helix, identical to the original.

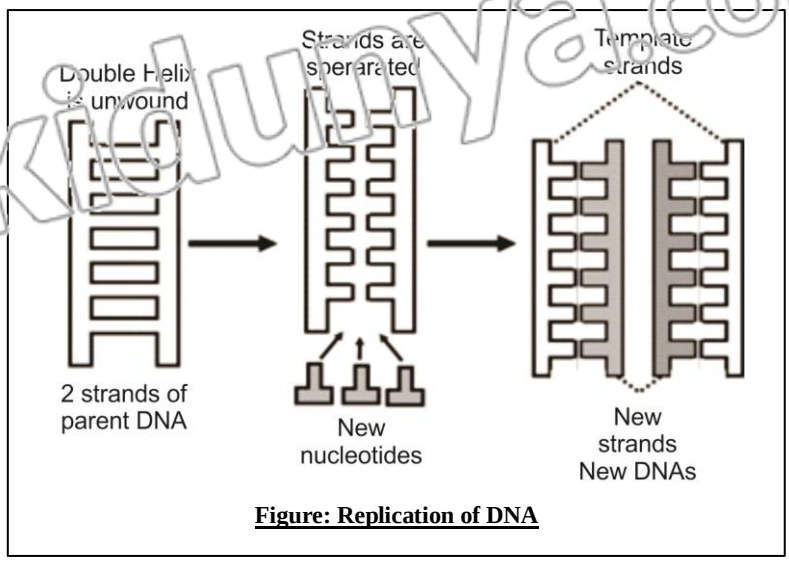


Figure: Replication of DNA

Q.3 Explain how does DNA of chromosome work? *(U.B)* **(LHR 2014)**

Ans:

WORKING OF DNA CHROMOSEMS

Genetic Material:
DNA is the genetic material. It contains the instructions to direct all the functions of cells. It performs its role by **giving instructions** for the **synthesis of specific proteins**.
Some proteins perform structural roles while the others act as enzymes to control all biochemical reactions of cells.

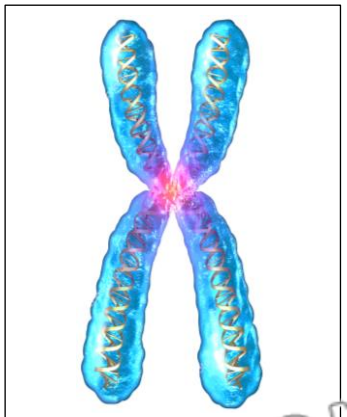


Figure: Location of Genes on Chromosomes

DNA Control:
In this way, **whatever a cell does is actually controlled by its DNA**. In other words, DNA makes the characteristic or trait of cell or organism.

Expression of Trait:
The **traits are made by specific proteins**. Specific proteins have specific **number and sequence of their amino acids**. DNA controls this sequence of amino acids by the sequence of its nucleotides. During protein synthesis, the sequence of DNA nucleotides decides that what will be the sequence of amino acids

Transcription:
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 ribosome. The ribosome reads this sequence and **joins specific amino acids**, according to it, to form protein. This step is known as translation.
The part of DNA (sequence of nucleotides) that contains the instructions for the synthesis of a particular protein is known as a gene, each chromosome contains thousands of genes.

Gene-Trait Relationship:
The part of DNA (sequence of nucleotides) that contains the instructions for the synthesis of particular protein is known as gene. DNA of each chromosome contains thousands of genes.

Like chromosomes, genes also occur in pairs, one on each homologous chromosome. The **locations or positions** of genes on chromosomes are known **as loci** (*Singular*. locus).
Each gene determines a particular trait in an organism. Each individual carries at least one pair of genes for each trait.

Representation:

For convenience, pairs of genes are **represented by a letter or symbol.**
Both members of a gene pair may be the same in some individuals (a condition which we may represent as AA or aa or BB) and different in others (Aa or Bb).

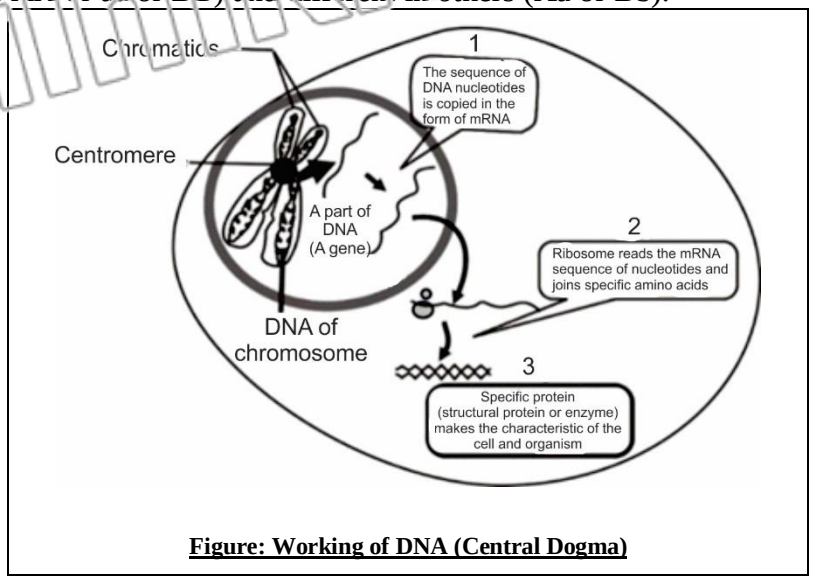


Figure: Working of DNA (Central Dogma)

15.1 SHORT QUESTIONS

Q.1 Define genetics. ***(K.B)*** **(GRW 2016)**

Ans:

GENETICS

Definition:

"Genetics is the branch of biology in which we study inheritance".

Q.2 Define inheritance. ***(K.B)*** **(LHR 2017)**

Ans:

INHERITANCE

Definition:

Inheritance means the transmission of characteristics from parents to offspring

Q.3 What are traits? Give some examples of traits in human. ***(K.B)*** **(GRW 2016)**

Ans:

TRAITS

Definition:

"Inheritable characteristics are called traits".

Example:

In human, some inheritable characteristics are given below.

- Height
- Colour of eyes
- Intelligence

Q.4 What is chromatin? ***(K.B)***

Ans:

CHROMATIN

Chromosome is made of chromatin material (simply as chromatin). Chromatin is a complex material, made of DNA and proteins (mainly histone proteins).

Q.5 Define genes? ***(K.B)***

Ans:

GENES

Definition:

Parents pass characteristics to their young through gene transmission. Equal numbers of chromosomes from each parent are combined during fertilization. The chromosomes carry the units of inheritance called the genes.

Q.6 What are homologous chromosomes? How many homologous chromosomes are present in human body cells? *(U.B)* **(LHR 2014)**

Ans:

HOMOLOGOUS CHROMOSOMES

Pairs of chromosomes in a diploid cell are known as homologous chromosomes.

Example of Human:

In human body cells, there are 23 pairs of homologous chromosomes for a total of 46 chromosomes.

Q.7 Define nucleosomes *(K.B)* **(BWP2015, LHR 2016, 17)**

Ans:

NUCLEOSOMES

Definition:

DNA wraps around histone proteins and forms round structures called nucleosomes. DNA is also present between nucleosomes. In this way the nucleosomes and the DNA between them look "beads on a string".

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

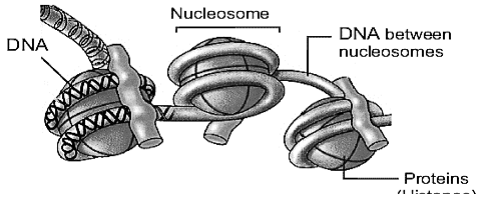


Figure: Chemical Composition of Chromosome

Q.8 Define transcription and translation. *(K.B)* **LHR 2016**

Ans: Page no 168.

Q.9 Name nitrogenous bases found in DNA molecule. *(K.B)* **LHR 2017**

Ans: Page no 168.

Q.10 Describe two major processes of organic evolution. *(K.B)* **LHR 2017**

Ans: Page no 186.

Q.11 Differentiate between transcription and translation. *(K.B)* **(LHR 2016)**

OR

What is meant by transcription? *(A.B)* **(GRW 2016)**

OR

What is meant by translation? *(A.B)* **(GRW 2016)**

Ans:

DIFFERENTIATION

The difference between transcription and translation is as follows:

Transcription	Translation
• The specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA) nucleotides. This process is called transcription. **DNA→mRNA**	• The mRNA carries the sequence of its nucleotides to ribosome. The ribosome read this sequence and joins specific amino acids, accordingly to it, to form protein. This step is known as translation. **mRNA→Protein**

Q.12 Define central dogma? (U.B)

Ans: Page no

Q.13 Differentiate between gene and alleles. (K.B) **(LHR 2014, 16 MTN 2015, SWL 2015, DGK 2015)**

Ans:

DIFFERENTIATION

The differences between gene and alleles are as follows:

Gene	Alleles
Definition	
• The part of DNA (sequence of nucleotides) that contains the instructions for the synthesis of a particular protein is known as a gene.	• The alternate forms of a gene are called alleles.
Example	
• Gene for Height	• "A" and "a" are the two

• Gene for Intelligence	alternate forms of a gene and B and b are the alternate forms of another gene.

Q.14 Differentiate between genotype and phenotype? (K.B) **(LHR 2015)**

OR

What do you know about genotype? (U.B) **(GRW 2016)**

Ans:

DIFFERENTIATION

The differences between genotype and phenotype are as follows:

Genotype	Phenotype
• The specific combination of gene in an individual is known as genotype. It is of two types. • Homozygous Genotype • Heterozygous Genotype	• The expression of the genotype in the form of trait (in our example, being albino or having normal pigmentation) is known as the phenotype.

Q.15 What are homozygous and heterozygous genotype? (K.B)

Ans:

DIFFERENTIATION

The difference between homozygous and heterozygous genotype is as follows:

Homozygous genotype	Heterozygous genotype
• The genotype in which the gene pair contains two identical alleles (AA) is called homozygous genotype.	• The genotype in which the gene pair contains two different alleles (Aa) is called the Heterozygous genotype.

Q.16 What are dominant and recessive alleles? (U.B) **(SWL 2015)**

Ans:

DIFFERENTIATION

The differences between dominant and recessive alleles are as follows:

Dominant allele	Recessive allele
Definition	
• When in the heterozygous condition one allele masks or prevents the expression of the other, it is called the dominant allele.	• The allele which is not expressed is called recessive allele.
Example	
• "R" allele is dominant over "r" allele for the shape of seed.	• "r" allele is recessive for the shape of seed.
Representation	
• The dominant alleles are represented by capital letters.	• Recessive alleles are represented by lower case.

Q.17 Can dominant allele effect the nature of recessive allele? (U.B)

Ans:

EXPRESSION

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

Q.18 What is albinism? Write its genotype? (A.B)

Ans:

ALBINISM

Condition in which normal body pigments are absent.

Genotype:

It is also controlled by one pair of genes. "aa" is a genotype of albinisim because it's a recessive trait in hum

15.1 MULTIPLE CHOICE QUESTIONS

1. The idea of transmission of characteristic to off spring was 1st explained by: (K.B)
(A) Greger Mandel (B) James Watson
(C) Fransis crick (D) Jan Bepist De Lamark

2. The branch of Biology that deals with inheritance. (K.B) (DGK 2014, LHR 2015, SWL 2015)
(A) Physiology (B) Ecology
(C) Pharmacology (D) Genetics

3. Which of the following is an example of inheritable traits (U.B)
(A) Height (B) Colour of eye
(C) Intelligence (D) All

4. The chromosomes carry the units of inheritance called_____. (K.B)
(A) Genes (B) Traits
(C) Alleles (D) Genetics

5. Genes contains the specific instructions for the synthesis of: (K.B)
(A) Carbohydrates (B) Vitamins
(C) Lipids (D) Proteins

6. Which of the following statements regarding genes is false? (U.B) (LHR 2013)
(A) Genes are located an 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

7. In humans, pairs of homologous chromosomes are: (K.B) (DGK 2015)
(A) 21 (B) 22
(C) 23 (D) 24

8. DNA wraps around histone proteins and forms round structures, called: (U.B) (BWP 2014)
(A) Chromatin (B) Chromosome
(C) Nucleolus (D) Nucleosomes

9. Watson and Crick proposed the DNA model in: (K.B) (MTN 2015)
(A) 1951 (B) 1953
(C) 1955 (D) 1957

10. According to Watson and crick model of DNA the backbone of DNA is formed of (U.B)
(A) Sugar-N-Bases (B) Phosphate-Sugar
(C) N-Base-Phosphate (D) N-Base-Sugar –Phosphate

11. In DNA molecule, adenine always pairs with: (K.B)
(A) Guanine (B) Cytosine
(C) Thymine (D) Uracil

12. How many hydrogen bonds are present between cytosine and guanine? (K.B)
(A) One (B) Two
(C) Three (D) Four

13. The inside of helix is formed of (K.B)

(A) N-Base (B) Phosphates

(C) Ribose (D) Deoxyribose

14. The locations or positions of genes on chromosomes: (K.B)

(A) Loci (B) Traits

(C) Inheritance (D) Nucleotides

15. How many types of nucleotides are present in DNA? (K.B)

(A) 1 (B) 2

(C) 3 (D) 4

16. Ribosome reads the sequence of mRNA nucleotides and joins specific amino acids to form proteins. This step is known as: (U.B) **(LHR 2013**

(A) Combination (B) Replication

(C) Transcription (D) Translation

17. Which of the following statement is incorrect regarding to the process of DNA replication (U.B)

(A) Replication results into formation of two identical helixas of DNA from single Bond

(B) Both strands of Double helix in replication act as template

(C) Replication occurs during mitosis

(D) Replication means the creation of copies of the chromatids of chromosomes

18. A specific combination of genes in an individual is called: (K.B) **(GRW 2013)**

(A) Genotype (B) Phenotype

(C) Dominance (D) Recessive

19. Three possible combinations of pair (A and a) of genes (genotypes): (K.B)

(A) AA, Aa, aa (B) AA, AA, aa

(C) AA, BB, aa (D) AA, Bb, aa

20. Cytosine always make pair with: (K.B) **(LHR 2016, DGK 2014)**

(A) Guanine (B) Hydrogen

(C) Adenine (D) Thymine

21. Genotype in which gene pair contains two identical alleles is called: (U.B) **(LHR 2015, GRW 2016)**

(A) Homozygous (B) Heterozygous

(C) Hemizygous (D) Homologous

22. If organisms have genotype of AAbb, how many types of gametes can it produce? (U.B) **(LHR 2014)**

(A) 3 (B) 2

(C) 1 (D) 4

23. The specific combination of gene in an individual is known as: (K.B)

(A) Genotype (B) Phenotype

(C) Gene (D) Allele

24. The specific sequence of DNA nucleotide is copied in the form of messengers RNA nucleotide, this process is called: (U.B)

(A) Translation (B) Transcription
(C) Transmission (D) None

25. In DNA molecule, guanine always pairs with: (K.B)
(A) Adenine (B) Cytosine
(C) Thymine (D) Uracil

26. A DNA molecule consists of _____ polynucleotide strands. (K.B)
(A) Two (B) Four
(C) Three (D) One

27. Alternate form of gene is called: (U.B) **(LHR 2016, 17)**
(A) DNA (B) Gamete
(C) Chromosomes (D) Allele

28. Transmission of characters (triats) from parent to offspring is called: (K.B)
(A) Inheritance (B) Mutation
(C) Regeneration (D) Reproduction

29. These are the unit of inheritance: (K.B) **(GRW 2017)**
(A) Genes (B) Alleles
(C) Phenotype (D) Genotype

30. Align the given events w.r.t the synthesis of protein

DNA→protein (nucleus)
DNA→mRNA (nucleus)
mRNA→protein (cytoplasm) (U.B)

(A) 1&3 (B) 2&7
(C) 2&3 (D) 3&2

15.3 MENDEL'S LAWS OF INHERITANCE

LONG QUESTIONS

Q.1 Why did Mendel select pea plant? (A.B)

Ans:

SELECTION OF PEA PLANT

Introduction:

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

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**.

Pea Plant:

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

Different Traits:

There should be a **number** of **different traits** that can be studied.

Contrasting Traits:

The organism should have **contrasting traits**. Each trait studied in pea plant had two distinct forms.

Example:

The trait of height there should be only two very different phenotypes i.e. tallness and dwarfness.

DIFFERENT TRAITS AND THEIR PHENOTYPES STUDIED BY MENDEL

Traits	Phenotypes
Seed Shape	Round and Wrinkled
Seed Colour	Yellow and Green
Flower Colour	Purple and White
Pod Shape	Flat and Constricted
Pod Colour	Green and Yellow
Flower position	Axial and Terminal
Stem Length	Long and Short

Self-Fertilizing Plant:

The organism (if it is a plant) should be **self-fertilizing** but **cross fertilization** should also be possible.

Life Span:

The organism should have a **short** but **fast life cycle.**

Cross Fertilization:

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.

Mendel's Success:

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).

Q.2 State and explain Mendel's Law of Segregation. (Understanding the Concept Q.3) (K.B) (LHR 2016)

Ans:

MENDEL'S LAW OF SEGREGATION

Statement:

"In each **organism**, the **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 the **gametes** of male and female parents **unite**, the resulting **offspring** again gets the **genes in pairs**".

Introduction:

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

Selection of Plant:

Mendel **selected pea plant** (Pisum sativum) to carry out a large number of experiments.

Selection of Phenotype:

Mendel studied the **inheritance** of **seed shape** first.

Monohybrid Cross:

He crossed two plants having **one contrasting trait** i.e. seed shape. A **cross**, in which only **one** trait is studied at a time, is called as a **monohybrid cross**.

Cross Fertilization of True Breeding:

Mendel crossed a true-breeding **round-seeded** plant with a **true-breeding wrinkled seeded** plant.

P1 and F1 Generation:

The **parental generation** is denoted as P1 generation. The **offspring** of **P1 generation** are **F1 generation** (first filial).

Result:

All **resulting seeds** of the next generation were **round**.

Conclusion:

Mendel declared the trait "**round Seeds**" as **dominant**, while "**wrinkled seeds**" as **recessive**.

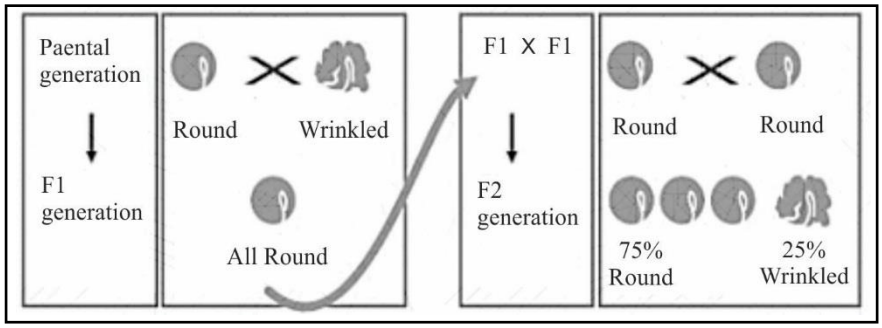
Self-Fertilization of F1:

The following year, Mendel planted these seeds and allowed the **new plants** to **self-fertilize**. The cross in **F1 generation produces F2 generation** (second filial).

Results:

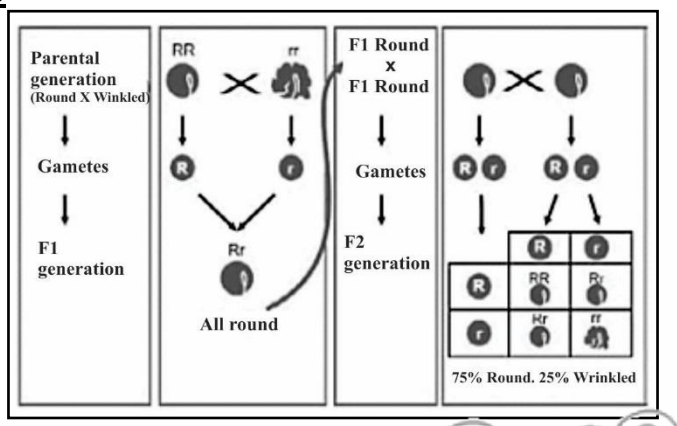
As a result, he got obtained.

Total seeds = 7324
Round seeds = 5474
Wrinkled seeds = 1850
Ratio= Round : Wrinkled
3 : 1



Experiments on Tall and Short Plants:

Similarly, when "**true-breeding**" tall **plants** were crossed with "**true-breeding**" **short plants**, all offspring of **F1** were **tall plants** i.e. tallness was a **dominant trait**. When members of F1 generation were **self-fertilized**, Mendel got the ratio of tall to short plants in F2 as 3:1.



Conclusion:

Mendel concluded that the traits under study were **controlled** by **discrete** (separable) **factors** or genes.

Q.3 State and explain Mendel's Law of Independent Assortment. (K.B) **(DGK 2014)**

OR

Explain how Mendel proved the law of independent assortment. (U.B)

(Understanding the Concept Q.3)

Ans: **MENDEL'S LAW OF INDEPENDENT ASSORTMENT**

Statement:

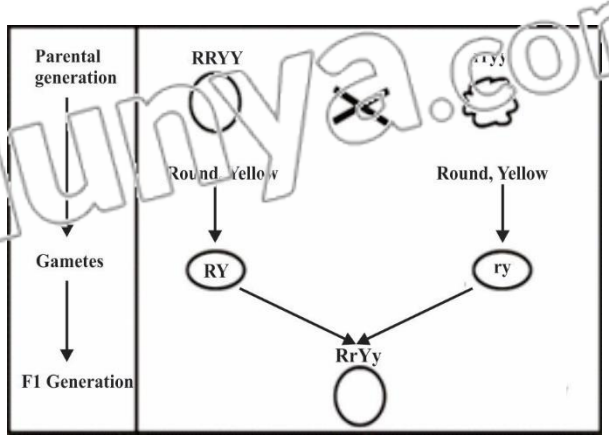
"The **alleles** of a **gene pair segregate** (get separated and distributed to gametes) **independently** from the **alleles** of **other gene pairs**".

Introduction:

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

Selection of Plant:

Mendel **selected** pea **plant** (Pisum sativum) to carry out a large number of experiments.



Dihybrid Cross:

Mendel **studied two contrasting traits** at a time. Such crosses are called dihybrid crosses.

Selection of Phenotypes:

He performed experiments on **two seed traits**:

Seed Shape:

The trait of **round seeds**, (controlled by allele R), was **parental dominant** over **wrinkled** controlled by allele r) **seeds**.

Seed Colour:

Yellow seed colour (controlled by Y) was **dominant** over **green controlled** by y.

Cross Fertilization of True Breeding:

Mendel **crossed** a **true- breeding** plant-that had **round yellow seeds** (RRYY) with a **true breeding** plant having **wrinkled green** seeds (rryy).

Results:

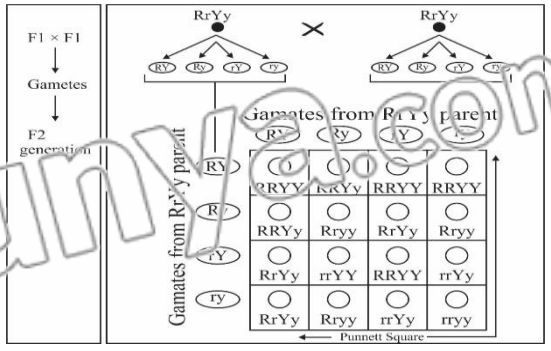
All seeds in **F1 generation** were **round yellow**.

Self-Fertilization of F1:

When **F1** seeds **grew** into plants, they were **self-fertilized**.

Results:

This **cross** produced seeds with **four phenotypes**.



Round yellow seeds = 315.

Round green seeds = 108

Wrinkled yellow seeds = 101

Wrinkled green seeds = 32

Phenotypic Ratio:

The ratio of these **phenotypes** was **9:3:3:1.**

Conclusion:

Mendel **concluded** that the **two traits** i.e. seed shape and seed colour, are **not tied** with **each other**. The segregation of 'R' and 'r' alleles happens independently of the segregation of 'Y' and 'y' alleles. From this, Mendel concluded that different traits are inherited independently of one another.

15.3 SHORT QUESTIONS

Q.1 Differentiate between monohybrid and dihybrid cross? (K.B)
(LHR 2014, SWL 2015, DGK 2015)

Ans: **DIFFERENTIATION**

The differences between monohybrid and dihybrid cross are as follows:

Monohybrid Cross	Dihybrid Cross
Definition	
A cross, in which only one trait is studied at a time, is called as a monohybrid cross.	A cross, in which two traits are studied at a time, is called as a dihybrid cross.
Example	
In law of segregation, Mendel chose only shapes of seed to check his results. (Round seeded and wrinkled seeded plants)	In law of independent assortment, Mendel chose shapes and colour of seeds to check his results. (Round+Yellow seed and wrinkled+Green seed plants)

Q.2 Define transcription. (K.B) **GRW 2017**

Ans: Page no 168.

Q.3 What are the total contrasting traits observed by Mendel in his experiment? (K.B)
(DGK 2014)

Ans: **CONTRASTING TRAITS**

There are seven contrasting trait observed by Mendel in his experiment are as follows:

- Seed Shape ⇒ Round, Wrinkled
- Seed Color ⇒ Yellow, green
- Flower Color ⇒ Purple, white
- Pod Shape ⇒ Flat, Constricted
- Pod Colour ⇒ Green, Yellow
- Flower Position ⇒ Axial, Terminal
- Stem Length ⇒ Long, Short

Q.4 State Mendel's law of segregation. (K.B) **(LHR 2015, 17, GRW 2016, 17)**

Ans: Page no 157.

Q.5 Differentiate between Punnett square and checker board? (K.B) **(DGK 2015, LHR 2016)**

Ans: **DIFFERENTIATION**

The difference between Punnett square and checker board is as follows:

Punnett Square	Checker Board
• The Punnett square is a diagram that is used to predict an outcome of a particular cross or breeding experiment. If is named after R.C Punnett (an English mathematician). The gametes of both parents having all possible genetics setups 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 offspring.

Q.6 State Mendel's law of independent assortment. (K.B)

Ans: Page no 176.

Q.7 Differentiate between self and cross fertilization. (K.B)

Ans: Page no 175.

15.3 MULTIPLE CHOICE QUESTIONS

1. How many plants were used by Mendel in his experiments? (K.B)
(A) 26,000 (B) 28,000
(C) 30,000 (D) 32,000

2. The term true breeder means. (K.B)
(A) Heterozygous (B) Genotype
(C) Phenotype (D) Homozygous

3. Mendel obtained how many round seeds in monohybrid cross? (A.B)
(A) 4784 (B) 5474
(C) 7454 (D) 4555

4. Which of the following genes will be termed as homozygous recessive: (K.B) **(LHR 2014)**
(A) RRYY (B) RrYy
(C) RrYY (D) rryy

5. Phenotypic ratio of monohybrid cross: (K.B)
(A) 3:1 (B) 2:1
(C) 9:3:3:1 (D) 1:2:1

6. Genotypic ratio of monohybrid cross: (K.B)
(A) 3:1 (B) 2:1
(C) 9:3:3:1 (D) 1:2:1

7. Phenotypic ratio of dihybrid cross: (K.B)
(A) 3:1 (B) 2:1
(C) 9:3:3:1 (D) 1:2:1

8. Number of round yellow seeds obtained in dihybrid cross: (K.B)
(A) 32 (B) 108
(C) 101 (D) 315

9. Number of round green seeds obtained in dihybrid cross: (K.B)
(A) 32 (B) 108
(C) 101 (D) 315

10. Number of wrinkled yellow seeds obtained in dihybrid cross: (K.B)
(A) 32 (B) 108
(C) 101 (D) 315

11. Number of wrinkled green seeds obtained in dihybrid cross: (K.B)
(A) 32 (B) 108
(C) 101 (D) 315

12. A couple can produced more than _____ genetically different children. (A.B)
(A) 60 trillion (B) 40 trillion
(C) 70 trillion (D) 100 trillion

13. A cross in which one character is studied at a time is called: (K.B) **(GRW 2016)**
(A) Monohybrid cross (B) Dihybrid cross
(C) Text cross (D) Back cross

14. When both the alleles of a gene pair in an organism are same the organism would be for that gene (U.B) **(GRW 2016)**
(A) homozygote (B) heterozygote
(C) homozygous (D) heterozygous

15. If a homozygous tall (TT) is crossed with a homozygous short (tt), the F1 plants would be (U.B)

(A) all tall (B) 50% tall and 50% short
(C) all short (D) 75% tall and 25% short

16. If a tall heterozygote (Tt) is crossed with a short homozygote (tt), the F1 offspring would comprise of (U.B)

(A) all tall (B) 50% tall and 50% short
(C) all short (D) 75% tall and 25% short

17. A possible method used to predict an outcome of a particular cross or breeding experiment is (K.B)

(A) Punnett square (B) monohybrid cross
(C) dihybrid cross (D) test cross

18. The trait that appears in F1 after a cross is made between two true breeding plants is called (K.B)

(A) dominant (B) recessive
(C) Monohybrid (D) dihybrid

19. Mendel formulated Law of Independent Assortment with the help of (K.B)

(A) monohybrid cross (B) dihybrid cross
(C) test cross (D) all of these

15.4 CO-DOMINANCE AND INCOMPLETE DOMINANCE

LONG QUESTIONS

Q.1 Write a note on co-dominance. (K.B)

OR

What do you mean by co-dominance? Give an example. (Understanding the Concept Q.6)

Ans:

DOMINANCE

Definition:

"**Dominance** is a **physiological effect** of an **allele over its partner allele** on the **same gene locus**".

Example:

Round seed shape is dominant over wrinkled seed shape in cross fertilization.

Explanation:

After the **discovery** of **Mendel's work**, scientists began **experiments** on the genetics of various organisms. These experiments **proved** that all the traits in organisms **do not follow Mendel's laws**. For example, it was found that there are many traits which are **controlled by more than one pair of genes**. Similarly for many traits there are more than **two alleles** in a **gene pair**.

Types of Dominance:

There are **two types** of dominance relationships.

- Co-Dominance
- In-Complete Dominance

Co-Dominance:

"The situation where **two different alleles** of a gene pair **express themselves completely**, **instead** of showing a **dominant-recessive relationship** is called co-dominance".

Phenotype of Heterozygous:

As a result, the **heterozygous organism** shows a **phenotype** that is **different** from both **homozygous parents**.

Example:

Expression of human **blood group AB**:

The **ABO blood group** system is **controlled** by the **gene** I. This gene has three alleles:

- I^A
- I^B
- i

Blood Group A:

The **allele I^A** produces **antigen A** in blood and the **phenotype** is **blood group** A.

Blood Group B:

The **allele I^B** produces **antigen B** in blood and the **phenotype** is blood group B.

Blood Group O:

The **allele i does not produce any antigen** and the **phenotype** is **blood group O.**

Blood Group AB:

The **alleles I^A and I^B** are **dominant over i**. When there is a **heterozygous genotype** of I^A I^B, each of the **two alleles** produces the **respective antigen** and **neither** of them **dominates** over the other.

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

Q.2 Write a note on incomplete dominance. (K.B)

OR

Explain the phenomena of incomplete dominance with the help of example.

(Understanding the Concept Q.5)

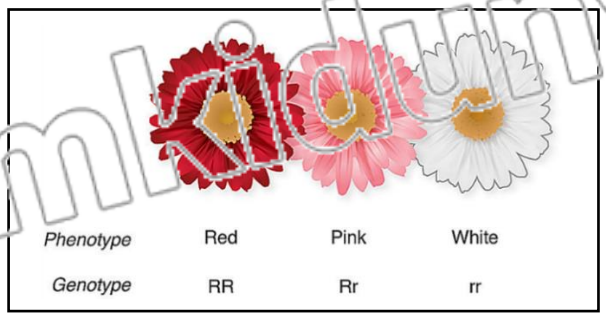
Ans: **INCOMPLETE DOMINANCE**

Definition:

"The situation where, in **heterozygous genotypes**, both the **alleles express as a blend** (mixture) and **neither** allele is **dominant** over the other, is called incomplete dominance".

Intermediate Phenotype:

As a **result** of this **blending**, an **intermediate phenotype** is **expressed**.



Example:

In **Four 0 Clock plants**, there are three flower colours:

- **Red**
- **Pink**
- **White**

There is **no specific gene** responsible for **producing pink flowers.**

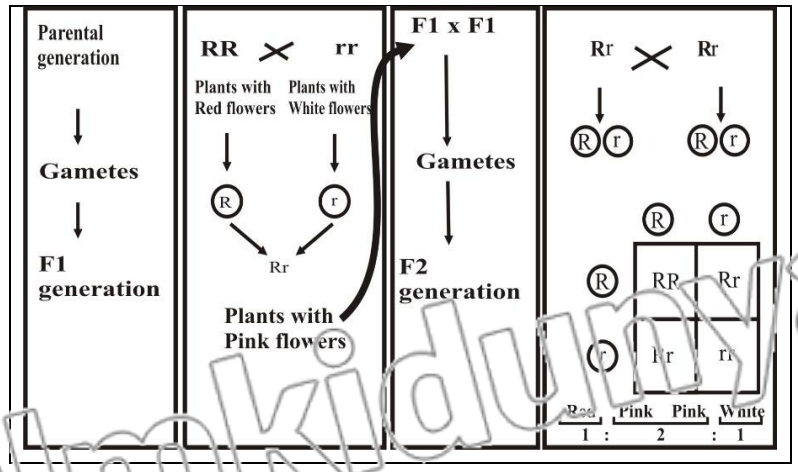
Explanation:

In four O clock plant, the trait of flower colour is **controlled** by two alleles 'R and r'.

- The **true breeding red flower** plants have RR alleles.
- The **true breeding white flower** plants have rr alleles.

Cross Fertilization of True Breeding:

A **homozygous red flowered** plant (RR) is **crossed** with **homozygous white flowered** plant (rr).



Result:

The **heterozygous** (Rr) plants of **F1 generation** produce **pink flowers**.

Conclusion:

Pink is a **blend** of red and white colours. This result clearly indicates that **neither** of the red **flower** allele (R) and **white flower** allele (r) is **dominant**.

Self-Fertilization of F1:

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

15.4 SHORT QUESTIONS

Q.1 How co-dominance is difference form incomplete dominance? (K.B) (GRW 2017)

OR

What is co-dominance? Give an example (LHR 2014, GRW 2017, MTN 2015)

OR

Define in-complete dominance. (MTN 2015, DGK 2015)

Ans:

DIFFERENTIATION

The differences between co-dominance and incomplete dominance are as follows:

Co-Dominance	In-Complete Dominance
Definition	
• Co-dominance is the situation where two different alleles of a gene pair express themselves completely, instead of showing a dominant-recessive relationship. • The heterozygous organisms show a phenotype that is different from both homozygous parents.	• In-complete dominance is the situation where in heterozygous genotypes, both the alleles express as a blend (mixture) and neither allele is dominant over the other. • This blending an intermediate phenotype is expressed.
Example	

• Human blood group AB	• In Four 0 Clock plants, there are three flower colours:
	  • Red
	  • White
	  • Pink (In-complete Dominance)
	There is no specific gene responsible for producing pink flowers

Q.2 Write the genetic bases of blood group "O" (U.B)

Ans: Page no 181.

Q.3 Blood AB is a example of co-dominaie explain (U.B)

Ans: Page no 181.

Q.4 Blood groups A&B are example of complete dominance explain. (U.B)

Ans: Page no 181.

15.4 MULTIPLE CHOICE QUESTIONS

1. The situation where two different alleles of a gene pair express themselves completely is called: (K.B)

(A) Co-dominance (B) Over dominance
(C) Incomplete dominance (D) Dominance

2. Which genotype represents blood group A? (K.B)

(A) I^AI^b (B) I^Ai
(C) I^AI^A, I^Ai (D) I^bi

3. Genotype of blood group B: (K.B)

(A) I^AI^A (B) I^Ai
(C) I^BI^B (D) AB

4. Person with genotype-ii has blood group: (K.B) **(LHR 20**

(A) AB (B) B
(C) O (D) A

5. What will be the colour of flowers produced as a result of cross between red and white flowered 4 o'clock plants: (K.B) **(SWL 2015)**

(A) Pink (B) Red
(C) White (D) Purple

6. Example of co-dominance is: (K.B) **(LHR 2017)**

(A) Blood group B (B) Blood group A
(C) Blood group AB (D) Blood group O

7. Phenotype ratio in incomplete dominance is: (K.B) **(LHR 2017)**

(A) 1 : 3 : 3 (B) 3 : 1
(C) 1 : 3 (D) 1 : 2 : 1

8. The pink coloured flowers in Four O' clock is an example of

(A) co-dominance (B) complete dominance
(C) in-complete dominance (D) Law of Independent Assortment

9. The situation in which heterozygous genotypes both the alleles express as a blend and neither allele is dominant over the other is called

(A) in-complete dominance (B) co-dominance
(C) non-disjunction (D) miss-match crosses

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

(A) co-dominance (B) in complete dominance
(C) complete dominance (D) non-disjunction

15.5 VARIATIONS AND EVOLUTION

LONG QUESTIONS

Q.1 Define variations. Discuss sources of variations. (A,B)

Ans:

VARIATIONS

Definition:

"The **differences among the individuals** of the **same species** are called variations".

Examples:

- Variations in human heights
- Variations in skin colour of rats

Explanation

Sexual reproduction produces variations in the next generation. **No two individuals** resulting from **separate fertilizations** are genetically **identical.**

SOURCES OF VARIATIONS

The **main sources** of variations in sexually reproducing populations are as follow:

Genetic Recombination:

The **genetic recombination** produced through **crossing over** occurring during **meiosis** results in **gametes** with **variations**.

Mutations:

Mutations which are the **sudden changes in the structure of DNA** are important source of **variations**. Mutations also **happen** during **gametes** formation through **meiosis**.

Random Fertilization of Gametes:

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**. .

Gene Flow:

The **movement of genes** from one **population to another** is called as **gene flow**. It is also an important **source** of **variations**.

Different Combinations of Chromosomes:

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** genetically **different children**.

> 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 genetically different children.

Q.2 Differentiate between discontinuous and continuous variations. (K.B) **(BWP 2015)**

Ans:

DIFFERENTIATION

The differences between discontinuous and continuous variations are as follows:

Discontinuous Variations	Continuous Variations
Phenotypes	
• The **individuals** of a population **either** have **distinct phenotypes**, which can be **easily distinguished** from each other.	• In continuous variations, the **phenotypes** show a **complete range** of **measurements** from one **extreme** to the other.
Genes	
• Discontinuous variations are **controlled** by the **alleles** of a **single gene pair**.	• Continuous variations are **controlled** by **many genes**.
Environmental Effect	
• The environment has **little effect** on this type of variations.	• Continuous variations are **often affected** by environmental factors.
Example	
• Blood Groups. In human population, an individual has one of the four distinct phenotypes of blood groups (A, B, AB or O) and cannot have in between.	• **Height**: 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.
Other Examples	
• **Tongue rolling** • **Person with six fingers** of hand or foot	• **Weight** • **Feet size** • **Intelligence**

Q.3 Prove that variations lead evolution.

OR

How would you prove that variations lead to evolution? (A.B) (Understanding the Concept Q.4)

Ans:

VARIATIONS LEAD TO EVOLUATION

Evolution:

"**Organic evolution** (biological evolution) is the **change** in the **characteristics** of a population or **species** of organisms **over the course** of **generations**".

Evolutionary Changes:

The **evolutionary changes** are always **inheritable**. The **changes** in an individual are **not** considered as evolution, because **evolution refers** to **populations** and **not** to **individuals**.

Process of Organic Evolution:

Organic evolution includes two major processes.

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

Theories:

The study of **evolution** determines the **ancestry** and **relationships** among **different kinds** of **organisms**. Following are the **two theories** related to the **creation** of **living organisms**.

- **Theory of Special Creation**
- **Theory of Evolution**

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**".

Theory of Evolution:

But the scientific work in **eighteenth century** led to the idea that "**living things might change as well**".

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

Limitations of Darwin's Theory of Evolution:

Darwin's theory of evolution was **not widely accepted** because of **lack of sufficient evidence**.

Modern Evolutionary Theory:

Modern evolutionary **theory** began in the late **1920s** and early **1930s.** Some scientist proved that the theory of **natural selection** and **Mendelian genetics** are the **same ideas** just as **Darwin** had **proposed**.

Mechanism of Evolution:

Almost every **population** contains **several variations** for the characteristics of its members. In other words, there are **morphological** and **physiological variations** in all populations.

Different populations face different environments and they have to adapt to different conditions.

Natural Selection:

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

Survival for the Fittest:

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**.

Selection of Variations:

The **favorable variations** are "selected for" their **transmission** to next generations, while the unfavorable variations are "**selected against**" their **transmission** to next generations.

First Example:

Natural Selection in Rats:

A mouse population with variations in skin colour.

- Light coloured
- Medium coloured
- Dark coloured

Favourable and Unfavourable Variations:

Cat preys upon light and medium coloured mouse. In first generation, light 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, the dark coloured (favourable variation) mouse in the population.

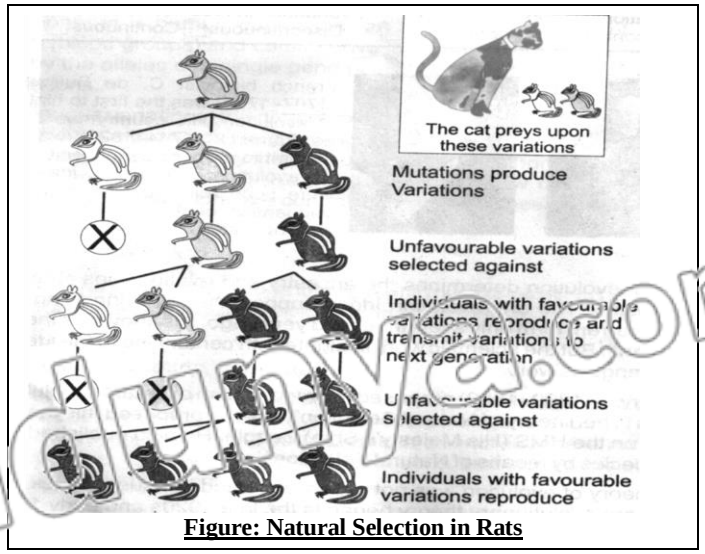


Figure: Natural Selection in Rats

Results of Natural Selection:

As a result of natural selection, the allele that gives more fitness of characteristics (favourable variations) than other alleles becomes more common within population. So, the individuals

with favourable variations become a major part of population while the individuals with harmful or unfavourable variations become rarer.

Second Example:

Natural Selection In Moths:

In England, the moths had two variations:

- Dark coloured moths
- White coloured moths

Favourable and Unfavourable Variations:

The moths used to rest on the light coloured tree trunks on which white lichens had grown. In the 19th 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 moth became more common and at last the white moths disappeared from population. In this case, the dark colour variation in moth may be considered an adaptation to environment.

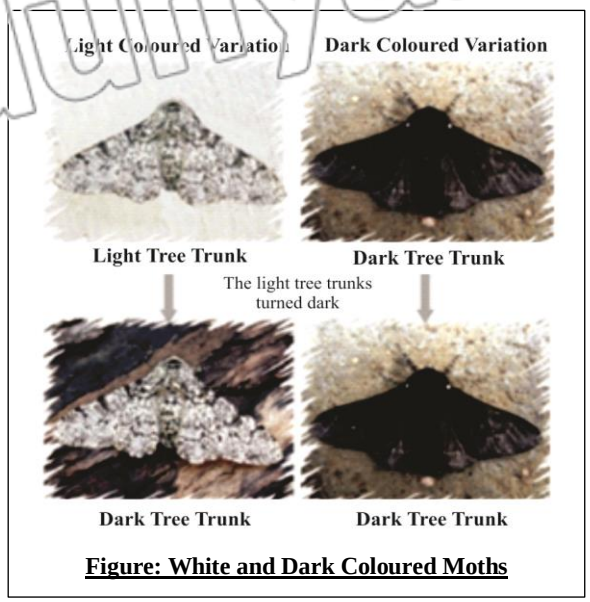


Figure: White and Dark Coloured Moths

15.5 SHORT QUESTIONS

Q.1 What is Theory of Special Creation? (K.B) **(LHR 2017)**

Ans: Page no 186.

Q.2 State Darwin's theory of evolution. (K.B)

Ans: Page no 186.

Q.3 Write limitation of Darwin's theory of evolution. (K.B)

Ans: Page no 186.

Q.4 When the work of modern evolutionary theory was started? (K.B)

Ans: Page no 186.

Q.5 Define organic evolution? (K.B)

Ans: **ORGANIC EVOLUTION**

Definition:

"Organic evolution (biological evolution) is the change in the characteristics of a population or species of organisms over the course of generations".

Q.6 What are the two major processes of organic evolution? (A.B) **(LHR 2017, MTN 2015)**

Ans: **MAJOR PROCESSES OF ORGANIC EVOLUTION**

Organic evolution includes two major processes.

- Alteration in genetic characteristics (traits) of a type of organism over time

- Creation of new types of organism from a single type.

Q.7 Define gene flow. (K.B) **(LHR 2016)**

Ans:

GENE FLOW

Definition:

"Gene flow is the movement of gene from one population to another".

Q.8 What are the findings of C.de Buffoon and J. de Lamarck in evolution? (K.B)

Ans:

C. DE BUFFOON AND J.DE 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.

Q.9 Define natural selection. (A.B)

Ans: Page no 186.

Q.10 Differentiate between contenous and Discontenous variation.

Ans: Page no 185.

Q.11 Explain Anti-Evolutiony idea or theory. **(MTN 2015)**

Ans: Page no 186.

15.5 MULTIPLE CHOICE QUESTIONS

1. Year of death of Charles Darwin: (K.B)

(A) 1880 (B) 1882
(C) 1884 (D) 1886

2. Year of death of C. de Buffon: (K.B)

(A) 1780 (B) 1784
(C) 1788 (D) 1790

3. In humans, possible number of chromosomal combinations at fertilization is: (K.B)

(A) 70,368,744,177,664 (B) 75,364,644,177,664
(C) 71,368,744,177,664 (D) 73,368,744,177,664

4. Which one is an example of discontinuous variation? (K.B)

(A) Height (B) Weight
(C) Intelligence (D) Blood group

5. Which one is not an example of continuous variation? (K.B)

(A) Height (B) Weight
(C) Intelligence (D) Blood group

6. Darwin published his book in: (K.B)

(A) 1853 (B) 1855
(C) 1857 (D) 1859

7. Modern evolutionary theory began in late: (K.B)

(A) 1920 (B) Early 1930
(C) 1940 (D) 1920, early 1930

8. Charles Darwin proposed the mechanism of organic evolution in: (K.B)
(A) 1937 (B) 1838
(C) 1824 (D) 1939

9. The anti-evolution ideas support the theory of: (K.B)
(A) Special creation (B) Organic evolution
(C) Natural selection (D) Evolution

10. Variation in human skin color is: (K.B)
(A) Discontinuous (B) Continues
(C) Variable (D) None

11. Discontinuous variations are controlled by: (K.B)
(A) Single gene pair (B) Multiple gene
(C) Many gene (D) No any gene

12. Continuous variation are controlled by: (K.B)
(A) Single gene pair (B) Many gene pair
(C) No gene (D) Two genes

15.5.2 ARTIFICIAL SELECTION

LONG QUESTION

Q.1 Describe artificial selection. (K.B) **(LHR 2016)**

Ans:

ARTIFICIAL SELECTION

Definition:

"The **intentional breeding** between **individuals** for **certain traits** or **combination** of traits is called **artificial** selection or **selective breeding**".

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.

Darwin's Observations:

Darwin 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**

In **artificial selection**, **humans favor specific** variations for selection while in **natural selection** the environment selects or **rejects** variations.

Advantages of Selective Breading:

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:

The bred **animals** are as **breeds** in **artificial selection** are called breeds.

Cultivars:

The **bred plants** in **artificial selection** are known as **varieties or cultivars**.

Examples:

Numerous breeds of the following animals have been produced by artificial selection:

- **Sheep for wool**
- **Goat for meat**
- **Cow for milk**
- **Hen for eggs**

Plant Varieties:

Similarly many **plant varieties** (cultivars) have been **produced** for **better quantity** and **quality** of:

- **Cereals**
- **Fruits**
- **Vegetables**

Plants Varieties of Wild Mustard:

- **Kohlrabi**
- **Kale**
- **Cabbage**
- **Broccoli**
- **Cauliflower**

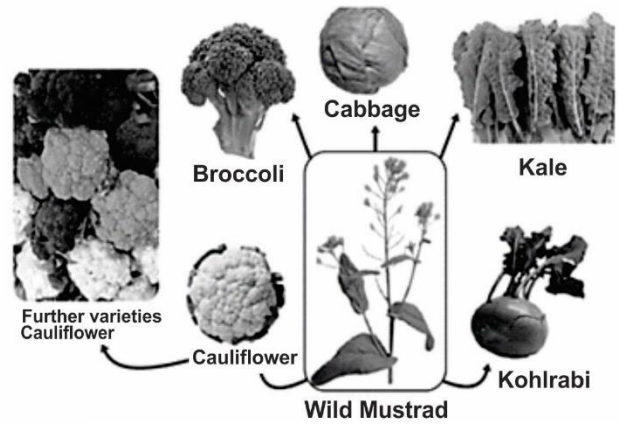


Figure: Plant Varieties Produced through Artificial Selection in Wild Mustard

15.5.2 SHORT QUESTIONS

Q.1 Define artificial selection. Give an example. (K.B) **(MTN 2015, GRW 2017)**

Ans: Page no 190.

Q.2 What are breed and cultivars? Give examples. (K.B)

OR

Differentiate between breed and cultivars. **(LHR 2016)**

Ans: Page no 190.

Q.3 Name three different plant varieties produced through artificial selection of wild mustard? (A.B)

Ans: Page no 191.

15.5.2 MULTIPLE CHOICE QUESTIONS

1. The term artificial selection was expressed by: (K.B)

(A) Abu Rayhan Biruni (B) Ali Ibn-e-Isa

(C) Jabir Bin Hayan (D) Musa Bin Nasir

2. Abu Rayhan Biruni introduced term artificial selection in: (K.B)

(A) 10^{th} century (B) 11^{th} century

(C) 12^{th} century (D) 13^{th} century

3. The bred animals are known as: (K.B)

(A) Cultivars (B) Varieties

(C) Breed (D) Recominant organism

4. The bred plants are known as: (K.B)

(A) Breed (B) Cultivars

(C) Recombinant organism (D) Sheeps

5. Plant varieties produced through artificial selection in wild mustard are: (K.B)

(A) Broccoli (B) Cauliflower

(C) Broccoli, Cauliflower (D) Milk

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

15.1 INTRODUCTION TO GENETICS

15.2 CHROMOSOMES AND GENES

1	A	**2**	A	**3**	D	**4**	A	**5**	D	**6**	D
7	C	**8**	D	**9**	B	**10**	B	**11**	C	**12**	C
13	A	**14**	A	**15**	D	**16**	D	**17**	A	**18**	A
19	A	**20**	A	**21**	A	**22**	C	**23**	A	**24**	B
25	B	**26**	A	**27**	D	**28**	A	**29**	A	**30**	C

15.3 MEDEL'S LAWS OF INHERITANCE

1	B	**2**	D	**3**	B	**4**	D	**5**	A	**6**	A
7	C	**8**	D	**9**	B	**10**	C	**11**	A	**12**	C
13	A	14	A	15	A	16	B	17	D	18	C
19	B										

15.4 CO-DOMINANCE AND INCOMPLETE DOMINANCE

1	A	**2**	C	**3**	C	**4**	C	**5**	A	**6**	C	**7**	D
8	C	**9**	A	10	A								

15.5 VARIATIONS AND EVOLUTION

1	B	**2**	C	**3**	A	**4**	D	**5**	D	**6**	D
7	D	**8**	B	**9**	A	**10**	B	**11**	A	**12**	B

15.5.2 ARTIFICIAL SELECTION

1	A	**2**	B	**3**	C	**4**	B	**5**	C

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. An organism's expressed physical trait, such as seed colour or pod shape, is called its;
(K.B) **(GRW 2017)**
(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: (U.B)
(a) Homozygous (b) Heterozygous
(c) Hemizygous (d) Homologous

3. In the cross-pollination between a true-breeding yellow pod plant and true-breeding green pod plant, where green pod colour is dominant, the resulting offspring (F1 generation) will be: (U.B)
(a) ¼ green, ¾ yellow (b) All yellow
(c) ¼ yellow, ¾ green (d) all green

4. How many genetically different kinds of gametes an individual with genotype AAbb can produce? (U.B)
(a) 1 (b) 2
(c) 4 (d) 8

5. Which of the following statements regarding genes is FALSE? (K.B)
(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: (U.B)
(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? (K.B)
(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 organism 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

ANSWER KEY

1	b	2	b	3	d	4	a	5	d	6	b	7	a	8	d

SHORT QUESTIONS

1. Define genotype and phenotype. (K.B)

Ans:

GENOTYPE AND PHENOTYPE

Genotype:

The specific combination of gene in an individual is known as genotype. It is of two types.

- Homozygous Genotype
- Heterozygous Genotype

Phenotype:

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

2. What do you mean by dominant and recessive alleles? (K.B)

Ans:

DOMINANT AND RECESSIVE ALLELES

Dominant Alleles:

When in the heterozygous condition one allele masks or prevents the expression of the other, it is called the dominant allele.

Example:

- "R" allele is dominant over "r" allele for the shape of seed.

Recessive Alleles:

The allele which is not expressed is called recessive allele.

Example:

"r" allele is recessive for the shape of seed.

3. What are the homozygous and heterozygous genotypes? (K.B)

Ans:

HOMOZYGOUS AND HETEROZYGOUS GENOTYPES

Homozygous Genotype:

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

Heterozygous Genotype:

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

4. Differentiate between natural and artificial selection. (K.B)

Ans:

DIFFERENTIATION

The differences between natural selection and artificial selection are as follows:

Natural Selection	Artificial Selection
• Natural selection is the process by which the better genetic variations become more common in successive generations of a population.	• Artificial selection or selective breeding means intentional breeding between individuals for certain traits, or combination of traits.
• Natural selection is necessary for evolutionary process.	• Artificial selection is intentional breeding among individuals with desirable characteristics.

UNDERSTANDING THE CONCEPT

Q.1 Describe the structure of chromatin. (K.B)

Ans. See LQ.1 (Topic 15.1, 15.2)

Q.2 Describe Mendel's law of segregation. (K.B)

Ans: See LQ.2 (Topic 15.3)

Q.3 Explain how Model proved the law of independent assortment. (U.B)

Ans: See LQ.3 (Topic 15.3)

Q.4 How would you prove that variations lead to evolution? (U.B)

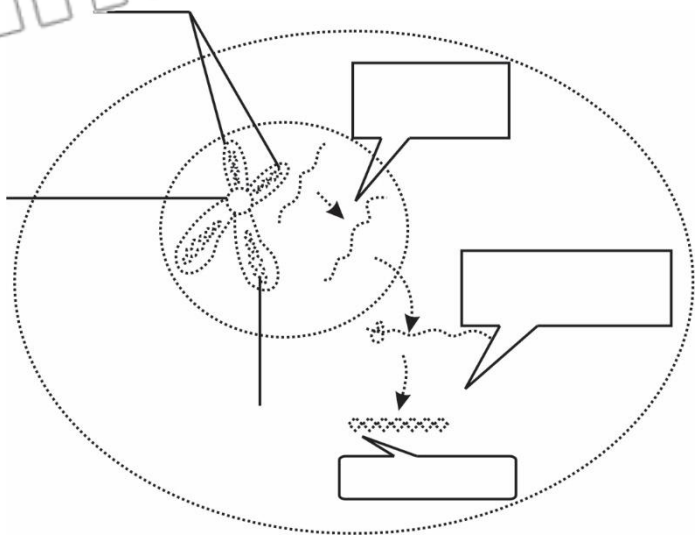
Ans: See LQ.3 (Topic 15.5)

Q.5 Explain the phenomenon of incomplete dominance with the help of example. (K.B)
Ans: See the Q.2 of (Topic 15.4)
Q.6 What do you mean by co-dominance? Give an example. (K.B)
Ans See the Q.1 of (Topic 15.4)

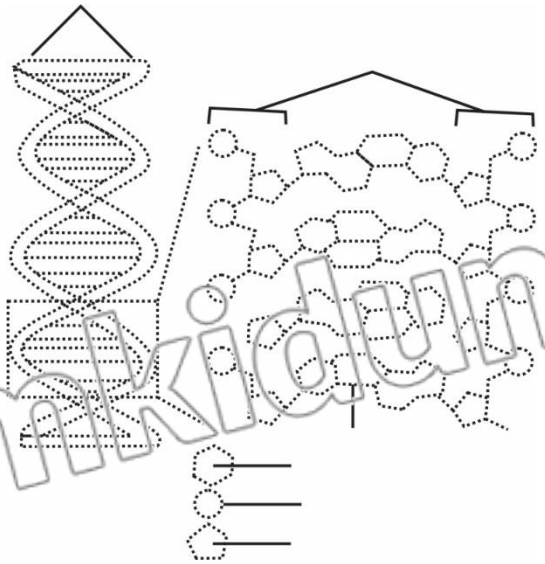
KIPS ASSIGNMENT

PRACTICE DIAGRAM & LABEL

WORKING OF DNA



THE WATSON AND CRICK MODEL OF DNA



CUT HERE

SELF TEST

Time: 40 min **Marks: 25**

Q.1 Four possible answers A, B, C and D to each question are given, mark the correct answer. **(6×1=6)**

1. How many types of nucleotides are present in DNA? (K.B)

(A) 1 **(B)** 2

(C) 3 **(D)** 4

2. The term true breed means: (K.B)

(A) Heterozygous **(B)** Genotype

(C) Phenotype **(D)** Homozygous

3. Genotype of blood group B: (U.B)

(A) I^AI^A **(B)** I^Ai

(C) I^BI^B **(D)** AB

4. The specific combination of gene in an individual is known as: (K.B)

(A) Phenotype **(B)** Genotype

(C) Gene **(D)** Allele

5. The anti-evolution ideas support the theory of: (K.B)

(A) Special creation **(B)** Organic evolution

(C) Natural selection **(D)** Evolution

6. An organism's expressed physical trait, such as seed colour or pod shape, is called its: (K.B)

(A) Genotype **(B)** Phenotype

(C) Karyotype **(D)** Physical type

Q.2 Give short answers to following questions. **(5×2=10)**

(i) What is P1 generation and F1 and F2 generation? **(K.B)**

(ii) What is albinism and its genotype? **(A.B)**

(iii) Give some example of traits in human. **(K.B)**

(iv) Define in-complete dominance. **(K.B)**

(v) What is the theory of special creation? **(K.B)**

Q.3 Answer the following questions in detail. **(5+4=9)**

(a) Describe Watson and Crick model of DNA. **(K.B)**

(b) Why did Mendel select pea plant**? (A.B)**

NOTE: Parents or guardians can conduct this test in their supervision in order to check the skill of the students.