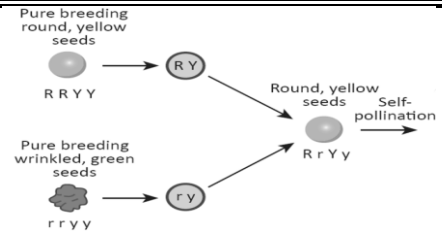


UNIT - 18

GENETICS



I. Choose the correct answer

- According to Mendel alleles have the following character
 - Pair of genes
 - Responsible for character**
 - Production of gametes
 - Recessive factors
- 9 : 3 : 3 : 1 ratio is due to
 - Segregation
 - Crossing over
 - Independent assortment**
 - Recessiveness
- The region of the chromosome where the spindle fibres get attached during cell division
 - Chromomere
 - Centrosome
 - Centromere**
 - Chromonema
- The centromere is found at the centre of the _____ chromosome.
 - Telocentric
 - Metacentric**
 - Sub-metacentric
 - Acrocentric
- The _____ units form the backbone of the DNA.
 - 5 carbon sugar
 - Phosphate
 - Nitrogenous bases
 - Sugar phosphate**
- Okasaki fragments are joined together by _____.
 - Helicase
 - DNA polymerase
 - RNA primer
 - DNA ligase**
- The number of chromosomes found in human beings are _____.
 - 22 pairs of autosomes and 1 pair of allosomes**
 - 22 autosomes and 1 allosome
 - 46 autosomes
 - 46 pairs autosomes and 1 pair of allosomes
- The loss of one or more chromosome in a ploidy is called _____.
 - Tetraploidy
 - Aneuploidy**
 - Euploidy
 - polyploidy

II. Fill in the blanks

- The pairs of contrasting character (traits) of Mendel are called **alleles (or) allelomorphs**.
- Physical expression of a gene is called **phenotype**.
- The thin thread like structures found in the nucleus of each cell are called **chromosomes**.
- DNA consists of two **polynucleotide** chains.
- An inheritable change in the amount or the structure of a gene or a chromosome is called **mutation**.

III. True or False: (if false give the correct statement)

- A typical Mendelian dihybrid ratio of F₂ generation is 3:1. [False]

*A typical Mendelian **monohybrid** ratio of F₂ generation is 3:1.
- A recessive factor is altered by the presence of a dominant factor. [False]

*A recessive factor is **masked** by the presence of a dominant factor.
- Each gamete has only one allele of a gene. [True]
- Hybrid is an offspring from a cross between genetically different parent. [True]

5. Some of the chromosomes have an elongated knob-like appendages known as telomere. [False]

**Some of the chromosomes have an elongated knob-like appendages known as satellite.*

6. New nucleotides are added and new complementary strand of DNA is formed with the help of enzyme DNA polymerase. [True]

7. Down's syndrome is the genetic condition with 45 chromosomes. [False]

**Down's syndrome is the genetic condition with 47 chromosomes (23 pairs(46) +1 extra chromosome).*

IV. Match the following

Column I	Column II	Answer
1. Autosomes	Trisomy 21	1. 22 pair of chromosome
2. Diploid condition	9:3:3:1	2. 2n
3. Allosome	22 pair of chromosome	3. 23 rd pair of chromosome
4. Down's syndrome	2n	4. Trisomy 21
5. Dihybrid ratio	23 rd pair of chromosome	5. 9:3:3:1

V. Answer in a sentence

1. What is a cross in which inheritance of two pairs of contrasting characters are studied?	Dihybrid cross
2. Name the condition when both the alleles are identical?	Homozygous condition.
3. A garden pea plant produces axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant trait.	axial white flowers
4. What is the name given to the segments of DNA, which are responsible for the inheritance of a particular character?	Genes
5. Name the bond which binds the nucleotides in a DNA.	Phosphodiester bonds

VI. Short answer questions

- Why did Mendel select pea plant for his experiments? [MAY - 2022]
 - ❖ It is naturally self pollinating and easy to cross-pollinate
 - ❖ It has short life span. We can follow several generations.
 - ❖ It has deeply defined contrasting characters.
 - ❖ Flowers are bisexual.
- What do you understand by the term phenotype and genotype? [AUG – 2022]
 - ❖ Phenotype – It is the external expression of a particular trait.
 - ❖ Genotype – It is the genetic expression of an organisms.
- What are allosomes? (or) Define Sex-chromosomes. [PTA – 2]
 - ❖ Chromosomes which are responsible for determining the sex of an individual are called Allosomes (or) sex chromosomes (or) hetero-chromosomes.
 - ❖ Human male have XY chromosomes. Human female have XX chromosomes.

4. What are Okazaki fragments?

[PTA – 4]

Short segments of DNA which are synthesised by lagging strand are called Okazaki fragments.

5. Why is euploidy considered to be advantageous to both plants and animals? [PTA – 1]

Euploidy is advantageous to plants, as they give increased fruit and flower size.

Euploidy is not advantageous in animals. If it occurs, it creates diseases and abnormalities.

6. A pure tall plant (TT) is crossed with pure dwarf plant (tt), what would be the F₁ and F₂ generations? Explain. [PTA – 5]

F ₁ generation		F ₂ generation	
	T T		T t
t	Tt Tt	T	TT Tt
t	Tt Tt	t	Tt tt
Phenotypes : All are tall plants		Phenotypes : 3 tall and 1 dwarf plant = 3 : 1	
Genotypic ratio = All are Tt		Genotypic ratio = TT : Tt : tt = 1 : 2 : 1	

7. Explain the structure of a chromosome. [SEP–2021, PTA–6]

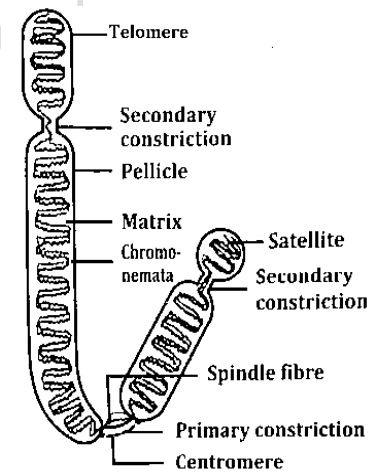
- ❖ Chromosomes are thin, long, thread like structures.
- ❖ It consists of two identical strands called sister chromatids.
- ❖ They are held together by centromere.
- ❖ They are made up of DNA, RNA, chromosomal proteins, etc.,
- ❖ Proteins provide structural support to the chromosome.
- ❖ A chromosome consists of the following regions.

i) **Primary constriction / centromere:** Two arms meet at this point.

ii) **Secondary constriction:** It occur at any point.

iii) **Telomere:** End of the chromosome. Provides stability.

iv) **Satellite:** Some have an elongated knob-like appendage.



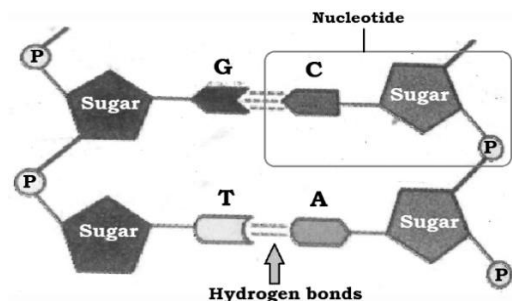
8. Label the parts of the DNA in the diagram given below. Explain the structure briefly.

The given figure is **Nucleotides in DNA**

- ❖ Each nucleotides consist of

- a) A sugar molecule - Deoxyribose sugar
- b) A nitrogenous base
 - Purines (Adenine and Guanine)
 - Pyrimidines (Cytosine and Thymine)
- c) A Phosphate group

- ❖ Adenine links thymine with two hydrogen bonds (A = T).
- ❖ Cytosine links guanine with three hydrogen bonds (C ≡ G).
- ❖ Nucleotides are joined by phosphodiester bonds.
- ❖ DNA consists of two polynucleotide chains.



A = Adenine
T = Thymine
C = Cytosine
G = Guanine

VII. Long answer questions

1. Explain with an example the inheritance of dihybrid cross. How is it different from monohybrid cross?

Experiment: Mendel Crossed round yellow seeded pea plants and wrinkled green seeded pea plants.

Observations:

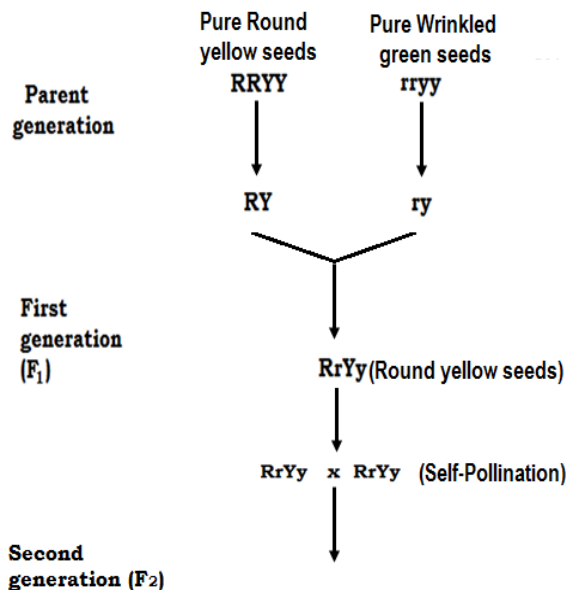
- * **First generation (F₁):** When pure seeds are crossed, only round yellow seeds were produced.
- * **Second generation (F₂):** When F₁ hybrids were crossed by self-pollination,

Conclusion: Factors for each trait is independent and maintain their identity in gametes and pass to the offsprings.

Results : Four types of plants.

- Round yellow – 9 plants – 2 Dominant traits
 - Round green – 3 plants
 - Wrinkled yellow – 3 plants
 - Wrinkle green – 1 Plant – 2 Recessive Traits
- } 1 Dominant &
} 1 Recessive

Phenotypic ratio – 9 : 3 : 3 : 1



	R Y	r Y	R y	r y
R Y	RRYY	RrYY	RRYy	RrYy
r Y	RrYY	rrYY	RrYy	rrYy
R y	RRYy	RrYy	RRyy	Rryy
r y	RrYy	rrYy	Rryy	rryy

Monohybrid cross	Dihybrid cross
1. Inheritance of one pair of contrasting characters	Inheritance of two pairs of contrasting characters
2. <i>Ex</i> : Tall Plant × Dwarf plant	<i>Ex</i> : Round yellow × Wrinkled green
3. F ₂ phenotypic ratio is 3:1	F ₂ phenotypic ratio is 9:3:3:1

2. How is the structure of DNA organised? What is the biological significance of DNA?

Structure of DNA – Watson and Crick Model:

- i) DNA molecule consists of two polynucleotide chains. They form double helix.
- ii) Nitrogenous bases in centre are linked to sugar-phosphate units.
- iii) It possess complementary base pairing between nitrogenous bases,
 - Adenine links Thymine with two hydrogen bonds (A = T)
 - Cytosine links Guanine with three hydrogen bonds (C ≡ G)
- iv) These hydrogen bonds make DNA molecule stable.
- v) Each turn of double helix is 34 Å°. There are ten base pairs in a turn.
- vi) Nucleotides in a helix are joined by phosphodiester bonds.

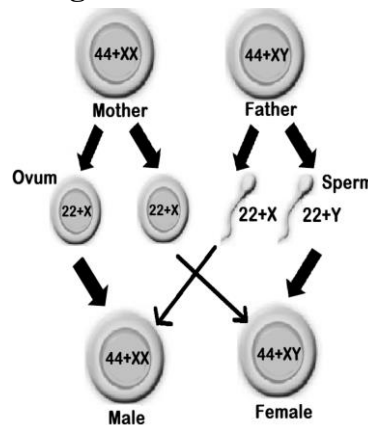
Significance of DNA:

[SEP – 2020]

- ❖ It transmits hereditary information from one generation to the next.
- ❖ It contains information for the formation of proteins.
- ❖ It controls developmental process and life activities.

3. The sex of the new born child is a matter of chance and neither of the parents may be considered responsible for it. What would be the possible fusion of gametes to determine the sex of the child?

- ❖ Human have 22 pairs of autosomes & one pair of allosomes.
- ❖ Female gametes are homogametic (22+XX).
- ❖ Male gametes are heterogametic (22+XY).
 - Sperm bearing (22 + X) chromosomes.
 - Sperm bearing (22 + Y) chromosomes.
- ❖ If egg is fused with X - bearing sperm (22+X) it produces a female child (44+XX).
- ❖ If egg is fused with Y - bearing sperm (22+Y) it produces a male child (44+XY).



VIII. Higher Order Thinking Skills (HOTS)

1. Flowers of the garden pea are bisexual and self-pollinated. Therefore, it is difficult to perform hybridization experiment by crossing a particular pistil with the specific pollen grains. How Mendel made it possible in his monohybrid and dihybrid crosses?

Mendel made this possible by following techniques

- **Emasculation:** Anthers are removed
- **Bagging :** Female flower is covered by polythene bag.

Pollen grains are collected from desired plant and dusted on the stigma in consideration.

2. Pure-bred tall pea plants are first crossed with pure-bred dwarf pea plants. The pea plants obtained in F₁ generation are then selfed to produce F₂ generation of pea plants. [MDL – 19]

a) What do the plants of F ₁ generation look like?	All are tall plants.
b) What is the ratio of tall plants to dwarf plants in F ₂ generation?	3:1
c) Which type of plants were missing in F ₁ generation but reappeared in F ₂ generation?	Dwarf plants

3. Kavitha gave birth to a female baby. Her family members say that she can give birth to only female babies because of her family history. Is the statement given by her family members true. Justify your answer.

- ❖ No, Kavitha is not responsible for the gender of her child. Father determines the sex.
- ❖ If egg is fused with X - bearing sperm (22+X) it produces a female child (44+XX).
- ❖ If egg is fused with Y - bearing sperm (22+Y) it produces a male child (44+XY).
- ❖ Thus, sperm of father, determines the sex. So, Kavitha and her family is not responsible.

IX. Value based question

1. Under which conditions does the law of independent assortment hold good and why?

Law of independent assortment holds good only if different gene pairs lie in different chromosome pairs, because chromosomes segregates during meiosis and not individual genes.