Genetics

Principle of Inheritance & variation

Genetics – Branch of science which deal with study of inheritance & variation.

Inheritance – Transfer of character from one generation to another.

- Variation
  - Somatic – Non inheritable
  - Generic – Heritable
    - Continuous – Due to crossing over
    - Discontinuous – Due to mutation

- Continuous
  - Adventative – Variation in shape, size, colour
  - Meristic – Variation in number e.g Polydactyly

- Discontinuous
  - Adventative
  - Meristic

Genetics
- Classical
- Molecular

Terms:

1) Father of genetics: Mendel (Austria)
2) Genetics term: Bateson
3) Gene term: Johanson
4) Father of mutation: Hugo de Vries
5) Linkage – TH Morgan
6) Gene located on chromosome in linear fashion: Morgan
7) Chromosome theory – Sutton & Boveri

8) DNA is genetic material - Mac carthy & Mac licod
9) DNA helical modal - Watson & Crick
10) DNA replication is semi conservative - Measalson & Stahl
11) Operon concept - Jacob and Monad

History of Mendel

- 1822 - Mendel birth
- 1856-65 : Duration of experiment
- 1856 : Announcement of experiment
- 1865 : Publication of result
- 1884 : Mendel's death
- 1900 : Rediscovery
  - Correns (Germany)
  - Hugo de Vries (Holland)
  - Tschermak (Austria)

Q. Which of the following plant was ~~chose~~ choosed by Mendel for experiment?

a) Sweet pea
b) Cowpea
c) Pigeon pea
d) Garden pea (Pisum sativum)
↓
14 chromosomes

Q. Why Mendel selected pisum sativum?

Ans. Reasons:

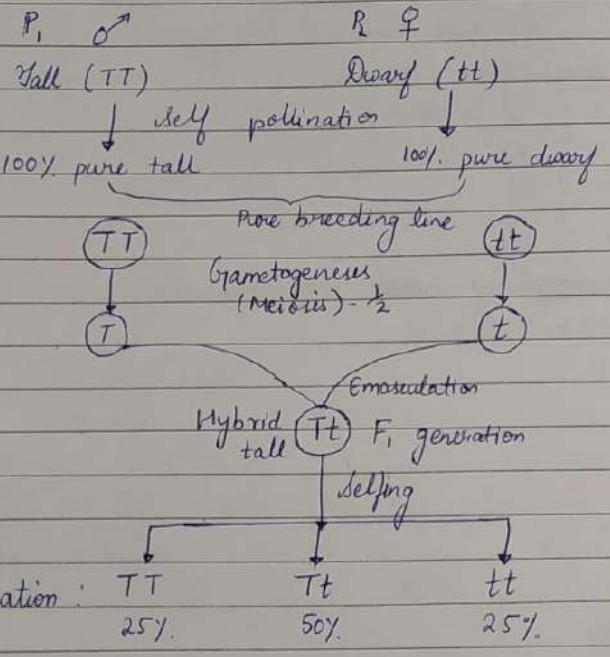
i) Short life cycle (life cycle complete in 3 months)
ii) Bisexual flower
iii) Self pollination occur but cross pollination also ~~possible~~ possible
iv) It consist of 7 pair of contrasting characters.

- 7 pair contrasting characters are present on no. 4 gene.

Euploidy - Failure of cytokinesis after karyokinesis
Aneuploidy - Non-disjunction of chromosome

Monohybrid cross

Selected one contrasting character



♀ \ ♂	T	t
T	TT	Tt
t	Tt	tt

Phenotypic ratio :- 3:1
(Morphological character)

Genotypic ration :- 1:2:1

Mendelian 3:1 ratio based on 5 hypothesis

1st hypothesis: Concepts of factor

a) Factor: Factor is hypothetical unit which control the character and transmit the character from one generation to other.

b) 1 character = 2 factor

Tall = TT

Dwarf = tt

2nd hypothesis: Concept of allele and non-allele

Allele: Contrast character

Allele	Non allele
• Character same	• Different character
• e.g Tall & dwarf (Height)	e.g Tall & red (Height, Colour)

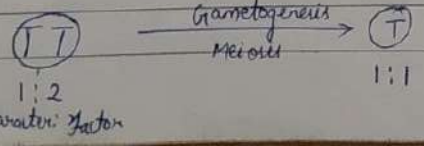
Types of allele

1) Homozygous - Similar gene pair e.g tt, RR
   - 100% pure

2) Heterozygous - Dissimilar gene pair e.g Tt, Rr
   - Impure

3) Hemizygous - Only one gene e.g T, A, a
   - 100% pure

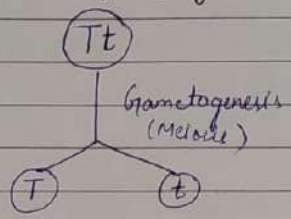
3rd hypothesis - First hypothesis are ~~or~~ exception during gametogenesis



2^n : no. of gametes & no. of phenotypic class
3^n : Genotypic class
n : no. of heterozygous

4th hypothesis : Concept of dominance
1 gene is dominant

5th hypothesis : Concept of segregation



∴ Physical separation of allele during gametogenesis.

Test cross and back cross

Back cross
Heterozygous × Either dominant or recessive parent

Heterozygous × Dominant

	T	t
T	TT	Tt
T	TT	Tt

All tall
No ratio

Heterozygous × recessive

	T	t
t	Tt	tt
t	Tt	tt

50% T & 50% dwarf
1:1

Monohybrid ~~test cross~~ progeny result 1:1
Dihybrid —"— 1:1:1:1
Trihybrid —"— 1:1:1:1:1:1:1:1

• Test cross is the example of back cross.

Test cross

Heterozygous × Recessive

Tt × tt

	T	t
t	Tt	tt
t	Tt	tt

50% Tall
50% Dwarf

Significance of test cross

1) Determine purity of gametes - either heterozygous or homozygous

Post Mendalian law

1) Co-dominance (Mosaic inheritance)
2) Intermediate dominance or incomplete dominance
3) Pseudo dominance
4) Multiple allele
5) Lethal gene

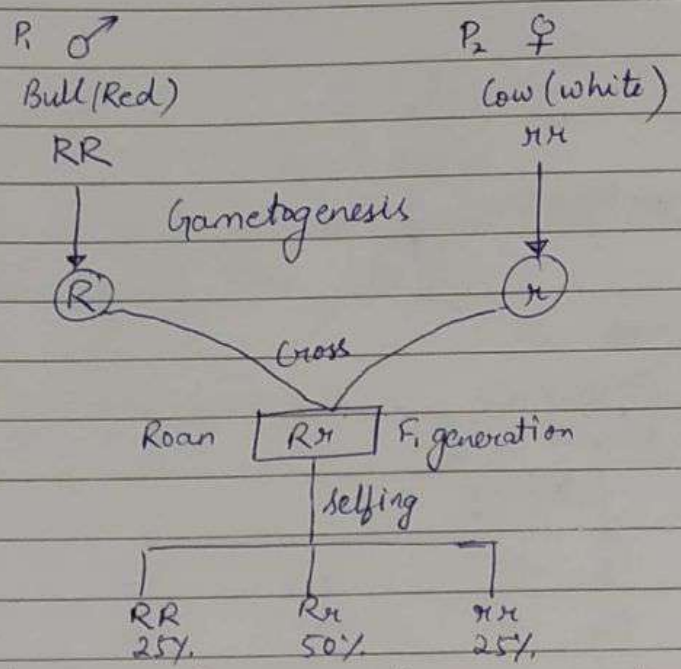
Dominance

(A) > (a)
Red — White
⇓ — 0% expression
100% expres

1) Co-dominance (Mosaic inheritance)

(B) = (b) = (Bb)
Red — white — Roan
⇓ — ⇓ — (Red & white patches)
50% — 50%

Explanation: Cattle colour



Q. Which of the following inheritance show similar phenotype & genotype?

a) Codominance
b) Intermediate dominance
c) Test cross
d) All of the above

F_2 generation

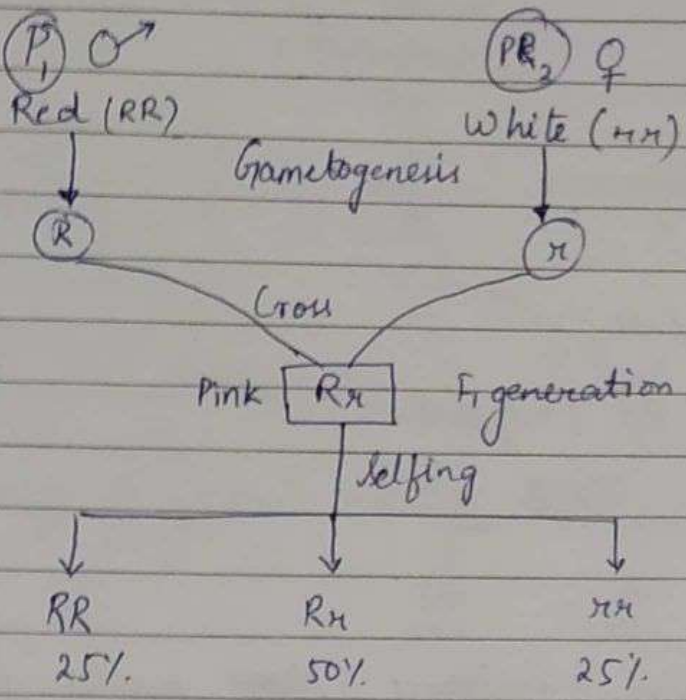
	R	r
R	RR	Rr Roan
r	Rr Roan	rr

Phenotypic ratio = 1 : 2 : 1
Genotypic ratio = 1 : 2 : 1

Intermediate or incomplete dominance

C + c = Cc
Red + White = Pink

Experiment on Mirabilas Jalapa (Four o' clock plant)
(Scientist - Bateson, Punnet & Saunder)

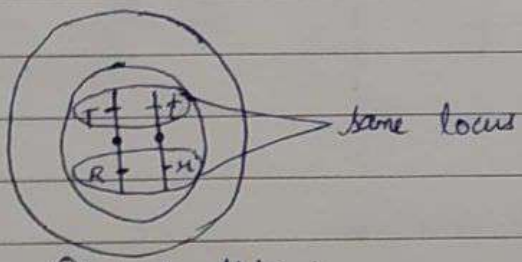


F_2 generation

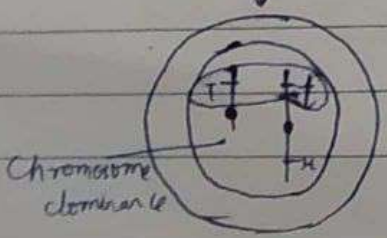
	R	r
R	RR	Rr
r	Rr	rr

Phenotypic ratio :- 1:2:1
Genotypic ratio : 1:2:1

Pseudo dominance



Diploid cell (2n)
x Ray | Mutation



Tall + white
↓
Here recessive expresses itself completely

The recessive gene express 100% due to absence of dominant gene.

Multiple allele

- More than 2 allele control single character
  - ⇒ E.g Blood group (ABO system)

Blood group	Antigen	Antibody
A	A	b
B	B	a
AB	AB	×
O	×	ab

$I_A = I_B > i$

$I_A = I_B$ → Codominant

$> i$ → Recessive

I_A or I_B → Dominant

I_A = Production of antigen A
I_B = Production of antigen B
i = No antigen production

Antigen - RBC
Antibody - Blood plasma

Genotype	Phenotype
$I^A I^A$	A
$I^A i$	A
$I^A I^B$	AB
$I^B I^B$	B
$I^B i$	B
ii	O

Q. Father A Mother B

Homozygous

	I_A	I_A
I_B	I_AI_B	I_AI_B
I_B	I_AI_B	I_AI_B

= AB

Heterozygote

	I_A	i
I_B	I_AI_B	I_Bi
I_B	I_AI_B	I_Bi

AB, B

	I_A	I_A
I_B	I_AI_B	I_AI_B
i	I_Ai	I_Ai

A, AB

If both heterozygous : A, B, AB, O

Q. Father O Mother AB

	i	i
I_A	I_Ai	I_Ai
I_B	I_Bi	I_Bi

A, B

Lethal gene

Any exceptional gene present inside the organism which can cause its death.

e.g - Sickle cell anaemia – Genetical, Inheritable

Sickle cell anaemia

⇓ RBC

Hb Hb Hb Hb ⇒ Normal

⇓ Mutation

⇒ Sickle cell anaemia

Haemoglobin — Iron Fe^{2+} — Protein

In Haemoglobin, iron is neither oxidised or reduced

Protein → Amino acid (500 chains)

- α chain (250 chains)
- β chain (250 chains)
  - → 6th position In sickle cell anaemia Glutamic acid → Valine

Genotype

1. $Hb^N Hb^N$ – Normal
2. $Hb^N Hb^S$ – Sickle cell trait
3. $Hb^S Hb^S$ – Sickle cell anaemia

Father $Hb^N Hb^S$ × Mother $Hb^N Hb^S$

	Hb^N	Hb^S
Hb^N	$Hb^N Hb^N$	$Hb^N Hb^S$
Hb^S	$Hb^N Hb^S$	$Hb^S Hb^S$

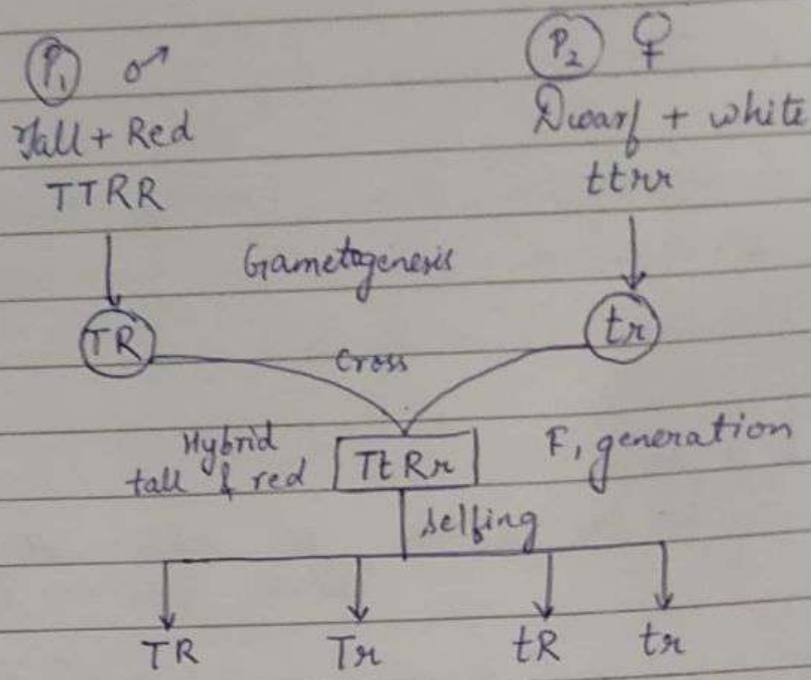
Ratio = 1 : 2 Recessive

Dominant = 2 : 1

Dihybrid cross

Mendel selected 2 contrast character

Character - Height + Colour



F_2 generation

♀ \ ♂	TR	Tr	tR	tr
TR	TTRR	TTRr	TtRR	TtRr
Tr	TTRr	TTrr	TtRr	Ttrr
tR	TtRR	TtRr	ttRR	ttRr
tr	TtRr	Ttrr	ttRr	ttrr

Explanation:
1) TTRR - 1 - Tall + Red
2) TTRr - 2 - Tall + Red
3) TtRR - 2 - Tall + Red
4) TtRr - 4 - Tall + Red
5) TTrr - 1 - Tall + White
6) Ttrr - 2 - Tall + White
7) ttRR - 1 - Dwarf + Red
8) ttRr - 2 - Dwarf + Red
9) ttrr - 1 - Dwarf + White

Phenotypic ratio = 9:3:3:1
Genotypic ratio = 1:2:2:4:1:2:1:2:1

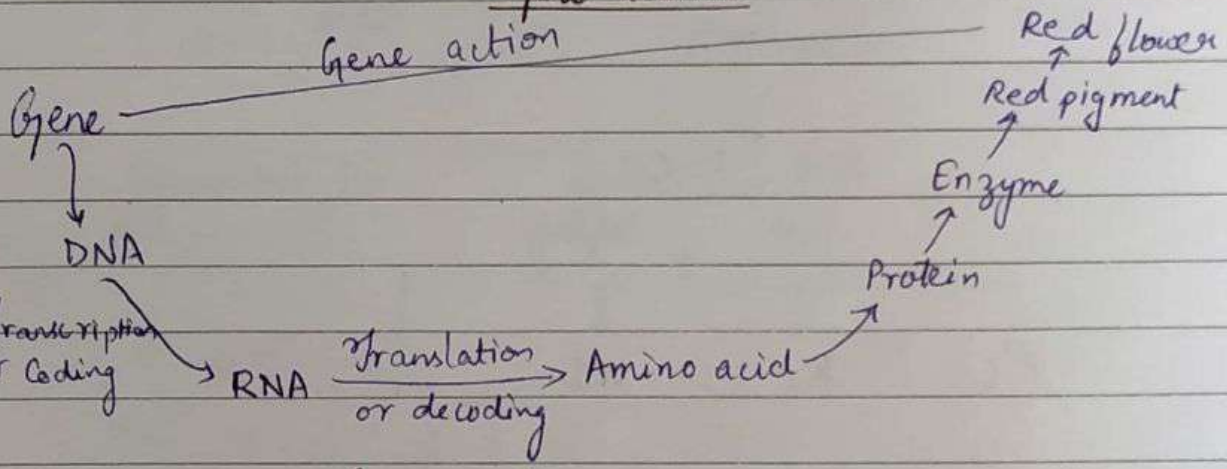
Trick

$(A+B)^2 = A^2 + 2AB + B^2$
or $(A+B)^2 = A^2 + AB + AB + B^2$

(Monohybrid ratio)^2 = Dihybrid ratio
(Monohybrid ratio)^3 = Trihybrid ratio

$(3+1)^2 = 9 + 3 + 3 + 1$

Gene action



Gene interaction

The different types of gene modify the phenotypic ratio of dihybrid ratio (9:3:3:1).

1) Complimentary gene - Cooperative
Ratio = 9:7

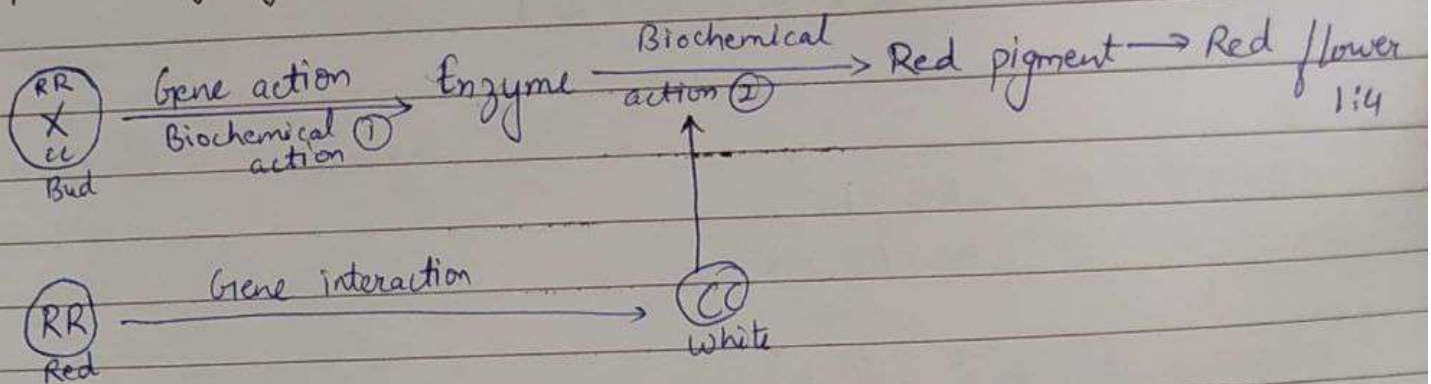
2) Inhibitory gene - Ratio = 13:3

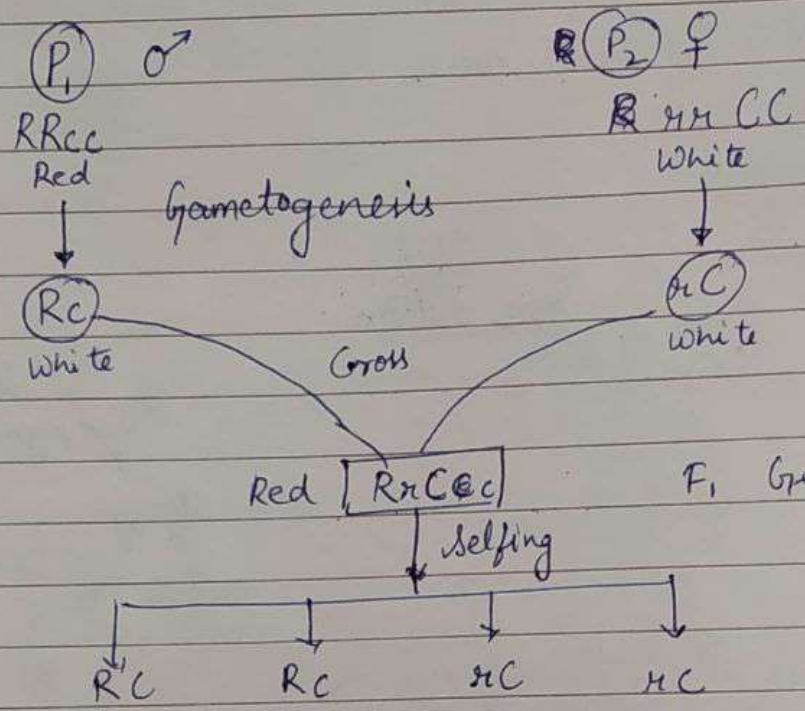
3) Epistasis (Modify the character) Ratio = 9:3:4

4) Duplicate : Ratio = 15:1

5) Additive gene : - Ratio = 9:6:1

Complimentary gene (9:7)

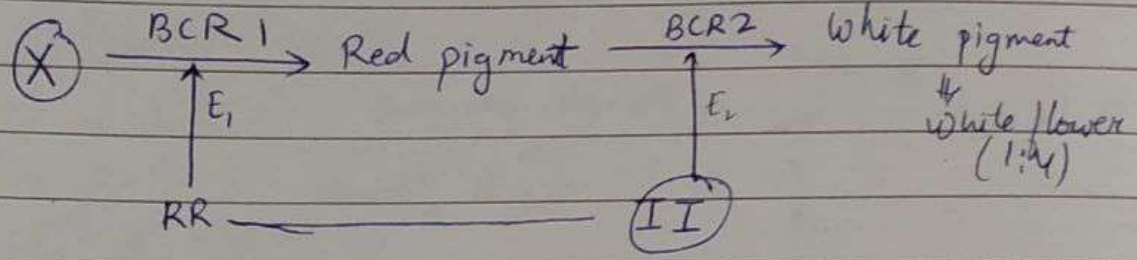


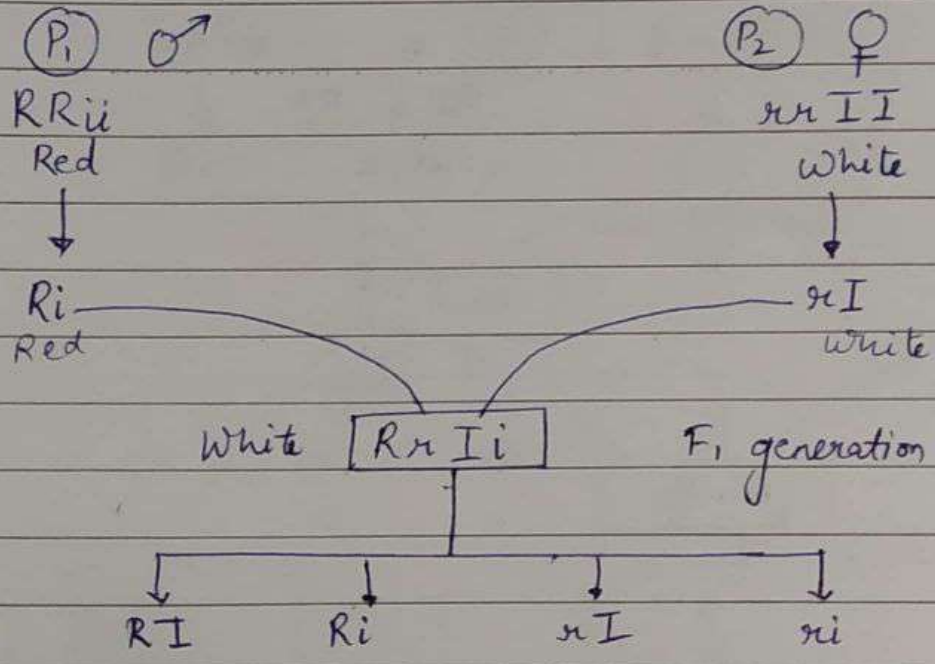


	RC	Rc	rC	rc
RC	Red	R	R	R
Rc	Red	White	R	W
rC	R	R	W	W
rc	R	White	W	W

- Seen in maize

Inhibitory gene (13:3)

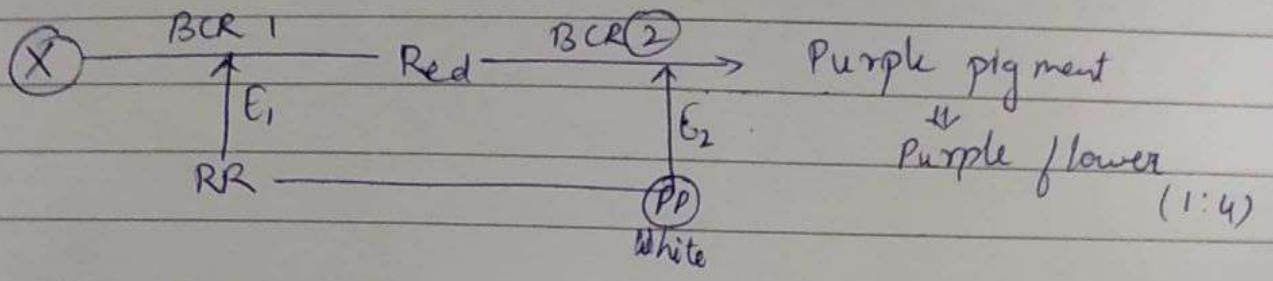


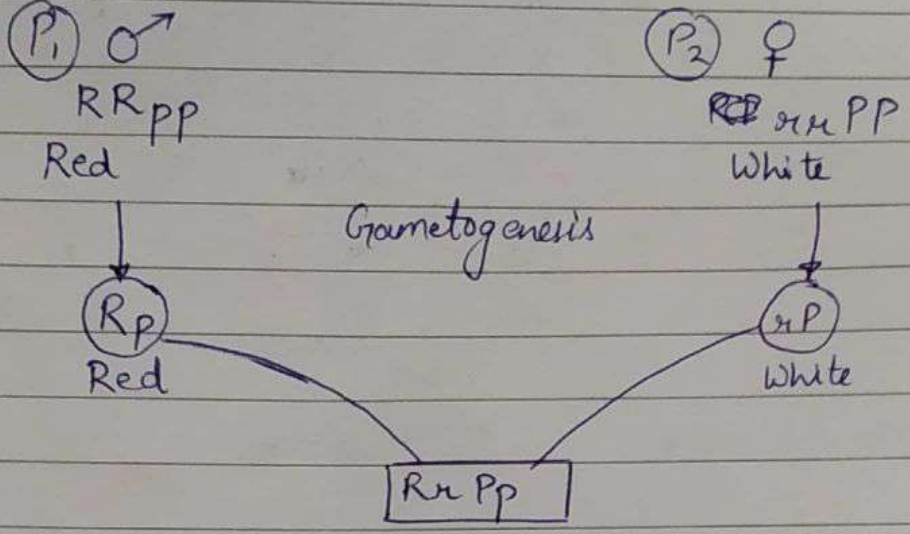


♀ \ ♂	RI	Ri	rI	ri
RI	W	W	W	W
Ri	W	R	W	R
rI	W	W	W	W
ri	W	R	W	W

Epistasis (9:3:4)

Modify the character





Q. Genotype AABB, AaBB, AaBb, aabb
$2^0=1$ $2^1=2$ $2^2=4$ $2^0=1$

Genotypic ratio

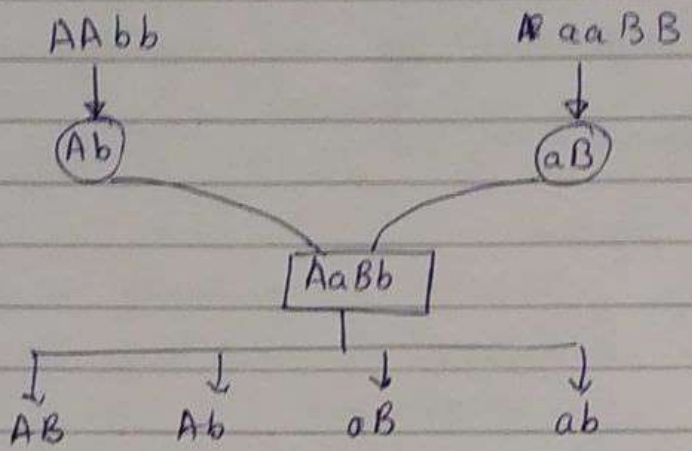
a) 1:1:1:1

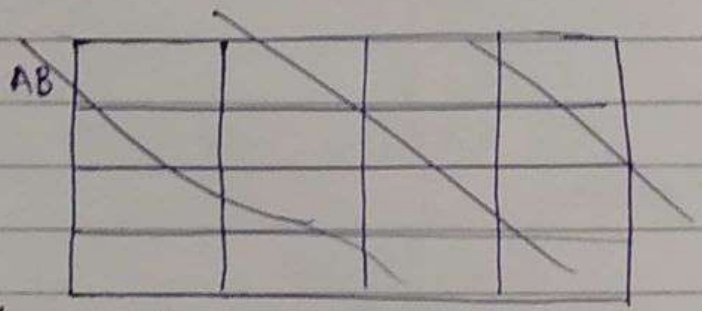
b) 1:2:2:1

c) 1:2:4:1

d) 1:1:2:1

Ans

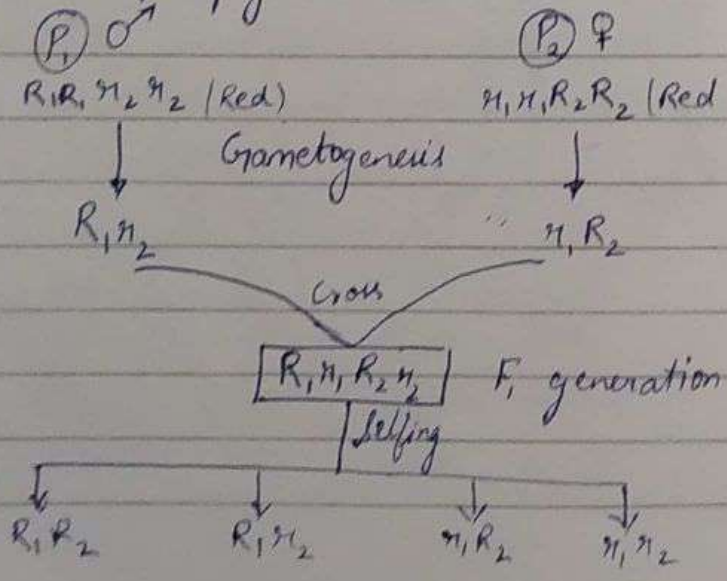




Duplicate gene (15:1)

1) R_1R_1 —BCR→ Red pigment

2) R_2R_2 —BCR→ Red pigment



R	R	R	R
R	R	R	R
R	R	R	R
R	R	R	W

Additive gene (9:6:1)

R_1R_1 —BCR→ Red pigment
Petal – 0.5mg

R_2R_2 —BCR→ Red pigment
Petal – 0.5mg

$R_1R_1 + R_2R_2$ —Solo action / BCR→ Dark red
1mg

(P1) ♂ $R_1R_1r_2r_2$ ↓ Gametogenesis → R_1r_2 Red

(P2) ♀ $r_1r_1R_2R_2$ ↓ → r_1R_2 Red

Cross

$R_1r_1R_2r_2$ Dark red

↓ selfing

R_1R_2 | R_1r_2 | r_1R_2 | r_1r_2

AABbCc

	R_1R_2	R_1r_2	r_1R_2	r_1r_2
R_1R_2	DR	DR	DR	DR
R_1r_2	DR	R	DR	R
r_1R_2	DR	DR	R	R
r_1r_2	DR	R	R	W

Q. How many different types of genetically different gametes will be produced by a heterozygous plant having genotype AABbCc
a) 2 b) 4 c) 6 d) None

Q On selfing a plant of F_1 generation with genotype AABbCC the genotypic ratio in F_2 generation will be
a) 13:1 b) 1:2:1 c) 9:3:3:1 d) 27:9:9:9:3:3:3:1

AABbCC

ABC ABC ABC ABC

Ratio = 2:2
= 1:1

Q. In a certain plant, red fruit (R) is dominant over yellow fruit (r) and tallness (T) is dominant over shortness (t). If a plant is RRTt genotype is crossed with a plant rrtt genotype. What will be the % of tall plant with red fruit in the progeny
a) 50% b) 100 c) 75 d) 25

	Rt	Rt	rT	rt
Rt	RRtt	RRtt	RrTt	Rrtt
Rt	RRtt	RRtt	RrTt	Rrtt
rT	RrTt	RrTt	rrTt	rrTt
rt	Rrtt	Rrtt	rrTt	rrtt

$\frac{4}{16} = \frac{1}{4}$

RRTt × rrtt

RT Rt rt

	RT	Rt
rt	RrTt	Rrtt

Q. In antirrhinum 2 plant with pink flower ~~where~~ were hybridised the F_1 plant produced red, pink & white flower in the ratio 2 pink, 1 white What would be the genotype of 2 plant used for hybridisation

Red flower ~~the~~ colour is determined ~~R~~ R

White flower rr

Rr Rr

Rr Rr RR rr

Q. If a colour blind man marries a woman who is homozygous for normal colour. . The ~~hom~~ probability of their son being colour blind.

a) 0.75 b) 1 c) 0 d) 0.5

c+ + c+ c+ + c

Q

c+ + c c+ + c+ & c+ c c+c c

c+ + c c+ + c

c+c+ c+c+ c+ c+ c+c c+c cc ~~cc~~ c+c cc

Q. In a population of 1000 individual. ~~30~~ 360 (50%) belong to genotype AA, 480 belong Aa & the remaining 160 to aa. Based on data, the frequency of allele A in the population is

a) 0.4 b) 0.5 c) 0.6 d) 0.7

$(A+B)^2$

$A^2 = 360$

480 / 1000

Q A normal vision man whose father was colour blind marries a woman whose father ~~was~~ colour blind, they have their first child as daughter. what are the chance that this child can be colour blind?

Ans $C^+ + \times C^+$ $\quad C^+ + \times + C$

$C^+C^+ \quad C^+C \quad C^+C \quad CC$

Ans 50%

Q A male human is heterozygous for autosomal gene ~~A & B~~ and is also hemizygous for haemophilic 'a' what proportion of his sperm will be AbBa

a) 1/8 b) 1/32 c) 1/16 d) 1/64

Ans trick $\left(\frac{1}{4}\right)^n$ where n is no. of gene

$\left(\frac{1}{4}\right)^2 = \frac{1}{16}$

A & B → autosomal gene
a → located on sex chromosome

Q At a particular locus, frequency of A allele is 0.6 and that of 'a' is 0.4. What would be the frequency of heterozygous in random mating

$2 \times \frac{4}{10} \times \frac{6}{10}$

$= 0.48$

Q In a dihybrid cross, AABB ♂ × aabb ♀. F_2 progeny of AABB, AABb, AaBb & AaBB occurs in the ratio

1:1:1:1 9:3:3:1 1:2:2:1 d) 1:2:2:4

Ab AAbb
Ab AAbb AaBb
aB
aB

Q R-G colour blindness in human is governed by sex linked recessive gene. A normal woman whose father was colour blind married a colour blind man. What proportion of their daughter is expected to be colour blind

a) 3:4 b) 1:2 c)

Ans 1/2

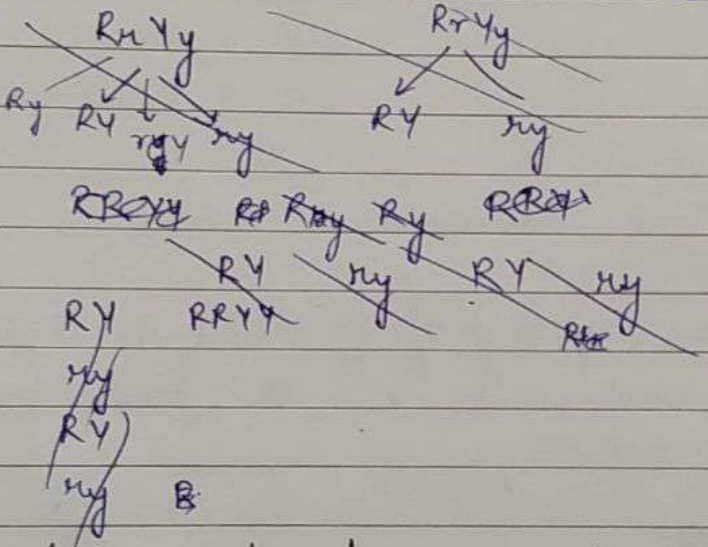
Q. Sickle cell anaemia disorder arises due to

a) duplication of a segment of gene

b) substitution of single base

Q. Heterozygous round & yellow seeded pea plant were selfed & total 800 seed are collected. What is total no. of seed with first dominant & second recessive.

a) 850 b) 300 c) 100 d) 150



$\frac{800}{50} \times \frac{3}{16} = 150$

Q. One of the parent of a cross has mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2 progeny, that mutation is found in

a) 1/3 of progeny b) None of progeny c) All of the progeny d) 50% of progeny

Q If 1 gamete in 5 carry a recessive allele. What must be the freqdency of homozygous recessive genotype in its population at Hardy-Weinberg equilibrium?

a) 4% b) 16% c) 20% d) 60% e) 80%

Ans $\frac{1}{5} = 0.2$ Frequency = $(0.2)^2 \times 100$

Special type of inheritance:

1) Sex linked inheritance
2) Sex limited —"—
3) Sex influenced "

Pedigree Analysis

Some symbol used to express different character

- □ → Normal male
- ▨ → Affected male
- ⊠ → Death
- ○ → Normal female
- ◎ → Carrier
- ● → Affected female
- ⌀ → death
- □—○ → Marriage between 2 different family ⇒ No blood relationship ⇓ Out breeding
- □═○ → Marriage between same family ⇓ with blood relationship ⇓ in breeding

Human being

Male : 44XX + XY

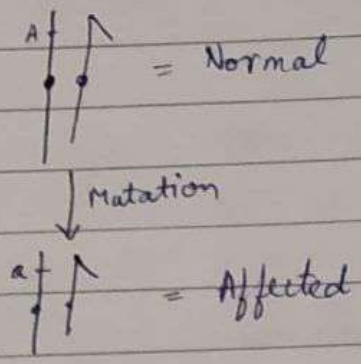
Female : 44 XX + XX

Chromosome

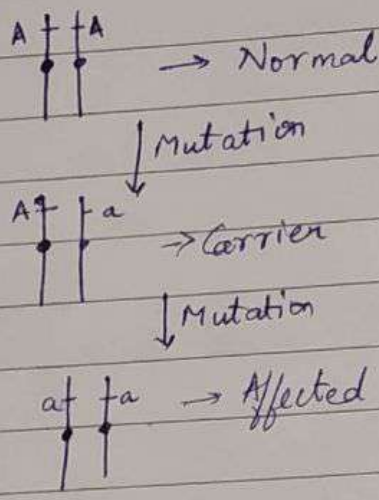
Somatic chromosome or Autosome
⇓
Always identicle
No. = 44 or 22 pair

Sex chromosome or Allosome
⇓
Different
⇓
1 pair

Male



Female



Sex linked inheritance

- Scientist Gate observed about more than 100 sex linked disease. e.g- Haemophilia, colour blindness, short sightedness (myopia), high sweating, cystic fibrosis.

Haemophilia

First observed in Queen Victoria.

- Continuous bleeding from certain part of body
- Blood clotting mechanism fails
- Due to deficiency of factor 8 C protein – Haemophilia A
  factor 9C – Haemophilia B
  (or Christmal disease)

Male

X^HY → Normal

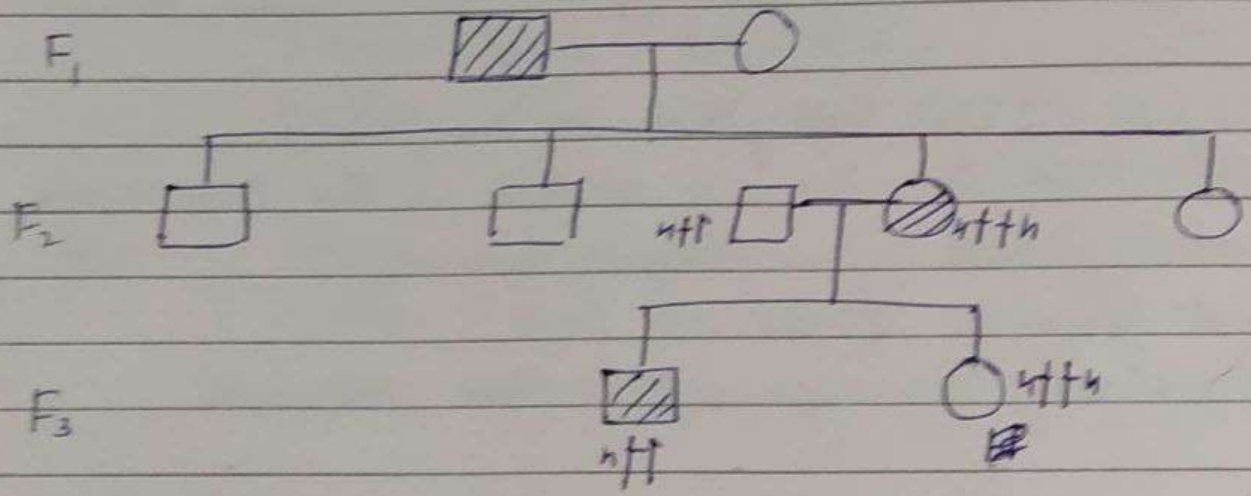
X^hY → Affected

Female

X^HX^H → Normal

X^HX^h → Carrier

X^hX^h → Affected



(skip 1 generation)

- Haemophilia expresses itself in alternate generations.
- Haemophilia is the x linked recessive inheritance.

- The haemophilic character located on the x chromosome. It is due to deficiency of factor 8C protein
- Absent Only maternal grandson affected.
- It is also called criss-cross inheritance.

Colour blindness

- Inability of a person to identify primary colour.
- Due to absence of iodopsin pigment.
- Defect in cone cell.

Male X^HY - Normal

X^hY - Colour Blind

♂ X^hY ♀ X^hX^h Ratio 1:2:1

	X^h	X^h
X^h	X^hX^h	X^hX^h
X^h	X^hY	X^hY

Progeny - 50%.
Son - 50%.
Daughter - 50%

Sex limited inheritance

Some time Y chromosome carries active gene called Holandric gene.

Eg Hypertrichoses (Extra hair growth on the pinna).

- The hypertrichosis character is located on the Y chromosome.
- Due to more secretion of androgen hormone.

Only paternal grandson effected.

Hypertrichosis character is expressed in ~~one~~ consecutive generation.

Sex influenced ~~inheritance~~ inheritance

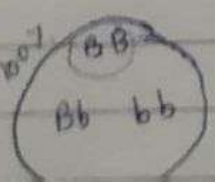
eg Baldness (Premature loss of hair from head)

- The baldness character is located on the x chromosome.
- It is due to less secretion of androgen hormone

About 66.66% express in male but 33.33% express in female.

Express in consecutive generation.

	Male phenotype	Genotype	Female phenotype	
1	25% Normal	BB	Normal	1
2	50% Half Bald	Bb	50% Normal	2, 3:1
3	25% Bald	bb	25% Bald	1

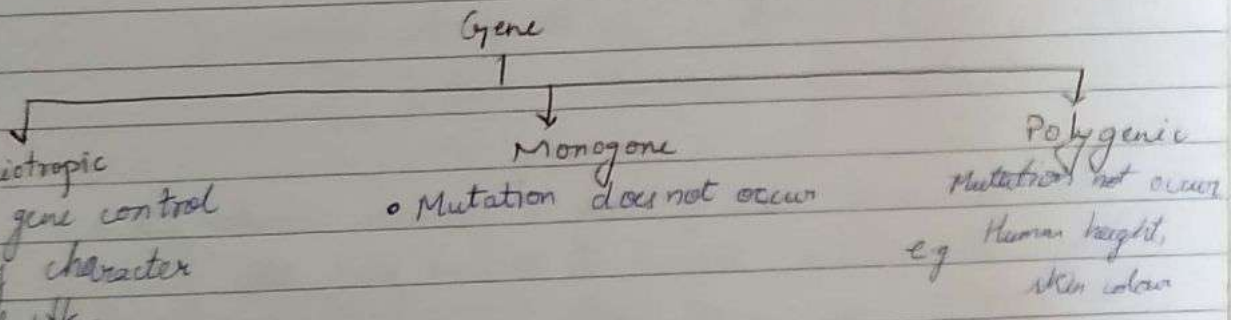


Male phenotype : 1 : 3
Female = 3 : 1

Gene

Scientist Benzer
↳ Gene - 3 component
- Muton - Unit of mutation - Change single base in DNA
- Recon - Change more than 2
- Cistron - Change whole length of DNA

Gene
- Monogene - Single gene control single character e.g monohybrid
- Pleiotropic - Single gene control many character e.g - sickle cell anaemia, brittle bone disease, part of Drosophila, vestigial wing
- Polygene - Many gene control 1 character e.g skin colour, height



Explanation of polygenic gene
e.g Human height - controlled by 7 pair different genes
They are both dominant & recessive (Heterozygous)
AbCdEfG

Q. Crossing AABB and aabb, the ratio of AaBb would be in F_2 generation?

a) 1/16 b) 8/16 c) 2/16 d) 4/16

Q. On crossing black & white flower plant. The ratio of black & white flower plant in F_2 generation was 120:40 then, on selfing the heterozygous black flower plant, the offspring would be as 144:48

b) 40:60

c) 52:48

c) 84:16

Bb Bb

Q. 120 plant are produced on crossing pure red & pure white flower. Ratio is BB Bb Bb bb

a) 90 red : 30 white b) 30 red : 90 white

c) 60 red : 60 white d) All of the above

Red colour is dominant on white

Q. From a single ear of corn, a farmer planted 200 kernel which produce 140 tall & 40 short plant. The genotype of the offspring are most likely

a) TT, Tt & tt b) TT, tt c) TT, Tt d) Tt, Tt

Q. A trihybrid cross is made between 2 plant with genotype AaBbCc. How many offspring of such cross will have genotype AABBCC → A/a B/b C/c

a) 1/64 b) 1/16 c) 1/4 d) 1/32

Scanned with CamScanner

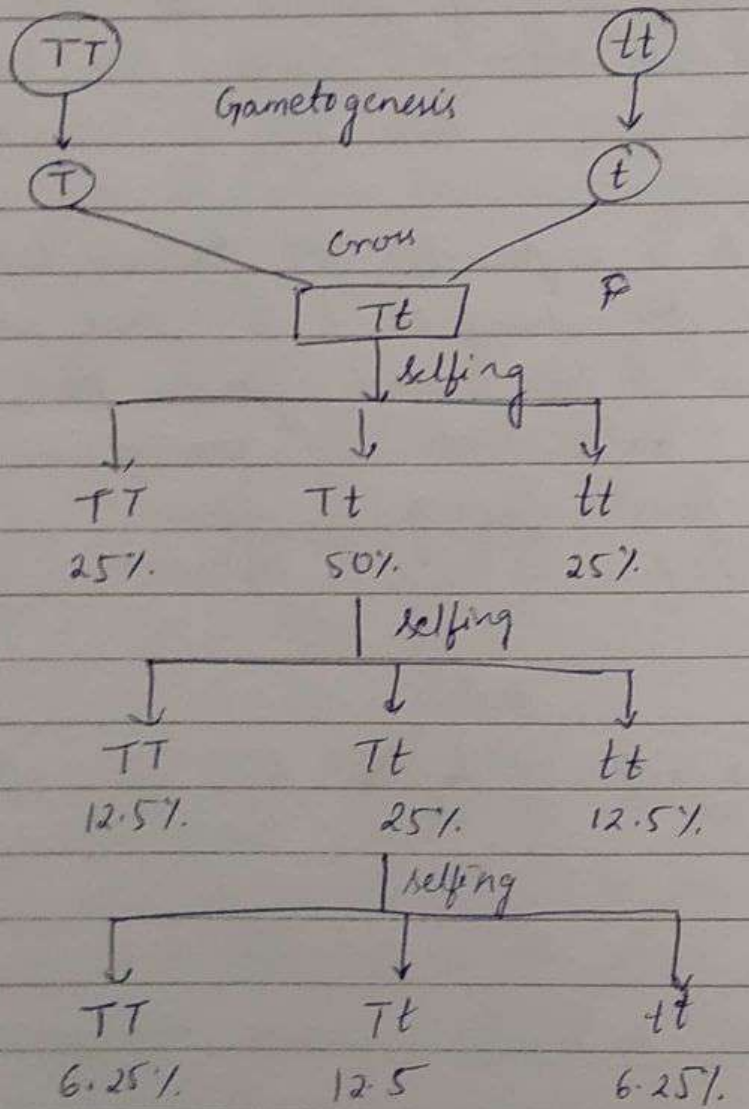
BBSS

Q In rabbit, black skin (B) is dominant over brown skin (b) & short hair (A) is dominant over long hair (a). In homozygous black short hair male is crossed with homozygous brown long haired female. All F_1 offspring are heterozygous black short hair. F_1 male crossed with F_1 female in F_2 generation what is the % of Black short hair?

a) 50% b) 25% c) 6.25%

Law of dominance

In single allele pair, the dominant gene express 100% character in next generation but recessive gene remain latent.



Law of segregation

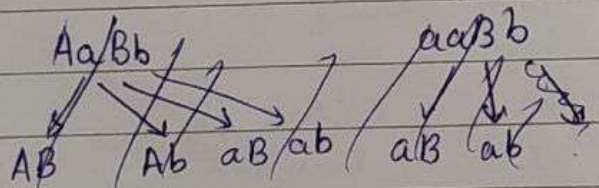
This law is very important value for farmer because hybrid seed in the field are always intercrossed and they will segregate in the ratio of 1:2:1. But, its production decreases to just half.

The mutant seed are good for farming because it produce carbon copy progeny.

Law of independent assortment

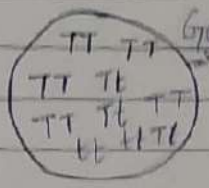
This law indicates that any gene of gamete can combine physically on the chromosome with each other. But, follow the law of crossing over.

Q. In a plant, gene A is responsible for tallness and its recessive allele a for dwarfness & B → red colour, b → white flower colour. A tall & red flower plant with AaBb crossed with aaBb. What is the percentage of dwarf white flower offspring of above
a) 50% b) 6.25% c) 12.5% d) 100%.



Drosophilla : 8 pair chromosome

AbCdEgH



Genetic population → Hardy Weinberg

Total population = 10
Total gene = 10 × 2 = 20
Total dominant gene = 13/20
Total recessive gene = 7/20

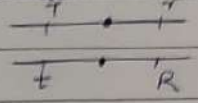
$$(p+q)^2 = p^2 + 2pq + q^2$$

$$\left(\frac{13}{20} + \frac{7}{20}\right)^2 = \left(\frac{13}{20}\right)^2 + 2 \times \frac{13}{20} \times \frac{7}{20} + \left(\frac{7}{20}\right)^2$$

Hardy-Weinberg Concept : Gene frequency = 1
Genotypic frequency = 1

Behaviour of gene with respect to chromosome

- If two gene located on the two different chromosome.



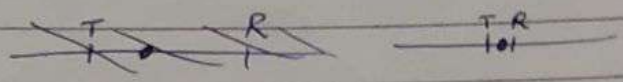
F_1 hybrid × Recessive

Data
- TR - 102 - Parental combination (PC)
- Tr - 101 } Recombinant
- tR - 103 }
- tr - 100 - PC

Objective
1. Crossing over takes place
2. Produce 1:1:1:1
3. 50% parental & 50% recombinant
4. Linkage does not take place

No of linkage group = Total no. of chromosomes / 2

- If two gene located on the same chromosome but closely placed



F_1 hybrid x Recessive

- TR - 101 - PC
- Tr - 00 } RC
- tR - 00 }
- tr - 102 - PC

- Only parental combination present.
- Recombinant class → 0
- No ratio
- Strong linkage

- If two gene located on same chromosome but distinctly placed

F_1 hybrid x Recessive

TR - 101 - PC

Tr - 10 } RC = 25 1:1:1:1

tR - 15 }

tr - 102 - PC

- No crossing over
- Weak linkage
- Partial form 1:1:1:1

Percentage recombinant class

$$\% RC = \frac{\text{Total recombinant class}}{\text{total population}} \times 100$$

Data

TR	101	
Tn	10	22
tR	12	
tn	102	
	225	

$= \frac{22}{225} \times 100 = 9.8 \approx 9\%$

1% RC = 1 morgan unit
Distance between T & n is 9 Morgan unit

Q A test cross of F_1 progeny $\frac{a+}{+b}$ produce the following offspring $\frac{a+}{ab} = 9$ $\frac{ab}{ab} = 9$, $\frac{+b}{ab} = 41$ $\frac{a+}{ab} = 41$

What will be distance between linked gene?
a) 82 cm b) 18 cm c) 20 cm d) 18 cm trans

Strong linkage - cis Weak linkage - trans

Q Their are 3 genes abc % of crossing over between a & b is 20%, b & c is 28% a & c is 8%. What is sequence of gene on chromosome
a) b a c b) a b c d) a c b

Q. In maize, coloured endosperm C is dominant over colourless c and full endosperm R is dominant over shrugged r. When a dihybrid of F_1 generation was test crossed it produced
Cr coloured & full 45%
cr c/o & s 5%
Cr colourless & full 4%
cr colourless & shrugged 46%
What would be the distance between 2 allelic gene?
Ans. 9

Top

Q. In a cross between individual homozygous for (a, b) & wild type (+,+) in this cross, 700 out of 1000 individual were of parental type. Distance between a & b is

Ans. 30

Q. The linkage map of x chromosome of fruitfly has 66 units with yellow body gene (Y) had one end & bobbed hair (b). The recombination frequency between Y & b is should be
a) 66%. b) greater than 50%. c) lesser or equal to 50%.
d) 100%.

Barr body - Only present in female, Klinefelter syndrome
↳ Type of heterochromaty
Barr body = No. of X chromosome - 1
Barr body determine gender

Linkage: Tendency of gene to inherit together in next generation.

Theory of linkage:
1) Coupling 2) Repulsion

1) Coupling - 2 gene coming from 2 different parent and tend to enter in different gamete but inherited together in next generation

2) Repulsion - 2 gene coming from 2 different parent but tend to enter in different gamete but inherited separately in next generation

Objective of linkage
1) Concerned gene located on the same chromosome.
2) Gene located on the chromosome in linear fashion
3) Very closely present gene show strong linkage.
4) It does not produce recombinant class but few recombinant class

produce (i) two concerned gene distinctly placed).

Types of linkage

1) Complete linkage
2) Incomplete linkage
3) Cis linkage
4) Trans linkage

Complete linkage - • 2 concerned gene present on the same chromosome but closely placed
• No recombinant class
• Strong linkage
• Generally cis

Incomplete linkage - Opp of complete linkage

Cis linkage - Either dominant or recessive gene located on the same chromosome.

Trans linkage - Both dominant & recessive located on the same chromosome.

No. of linkage group = ~~Half~~ $\frac{\text{Total no. of chromosomes}(N)}{2}$

Pedigree Analysis

Pedigree	Autosomal dominant	Autosomal Recessive	X linked dominant	X linked recessive
□	aa	AA / Aa	X^aY	X^AY
▨	Aa / AA	aa	X^AY	X^aY
○	aa	AA / Aa	X^aX^a	X^AX^A / X^AX^a
ⓘ	AA / Aa	aa	X^AX^A / X^AX^a	X^aX^a

- Autosomal dominant → Affected offspring should have affected parent
- Generally present is all generations.
- Autosomal recessive - Affected offspring not have affected parent.
  - Can skip the generation.
    - Character may be present or absent in same generation

Inheritance

All affected offspring have affected parent.

↓ Yes

⇒ Dominant
- All affected male have affected mother and all daughter of affected male are also affected

↓ No

⇒ Recessive

Dominant

↳ Statement

Yes → X linked dominant

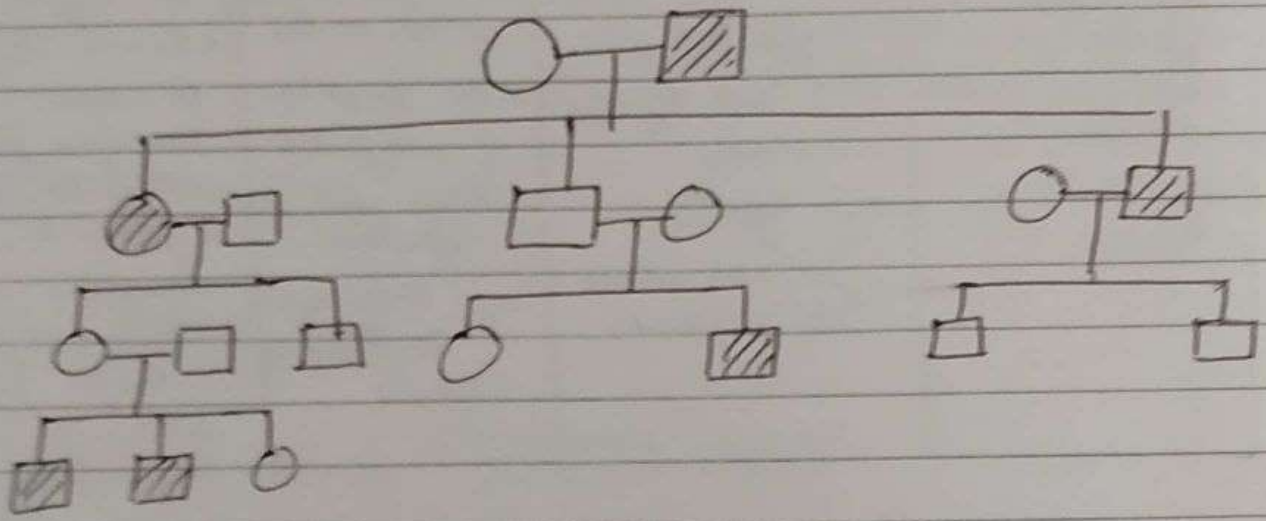
No → Autosomal dominant

Recessive

↳ All affected female have affected father and all her son are also affected

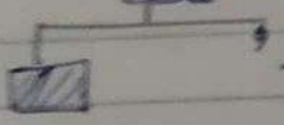
Yes → x linked recessive

No → Autosomal recessive

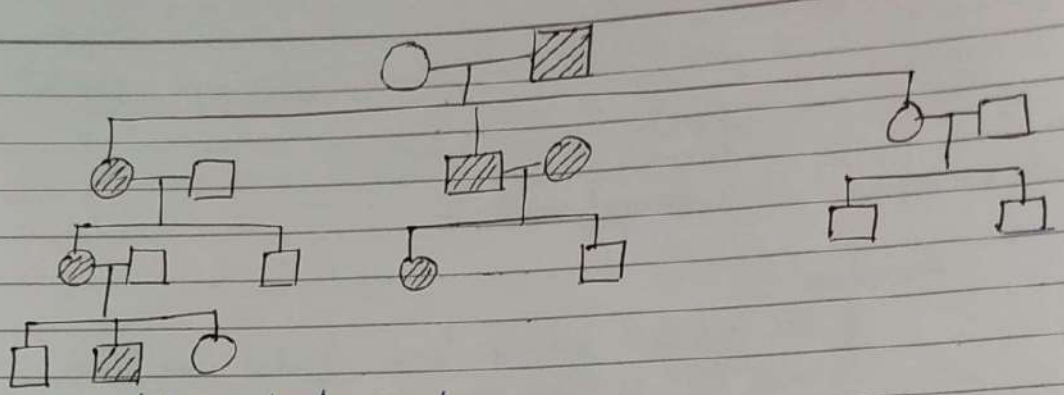


↳ Autosomal recessive

- Male ⟷ Male : Y linked
- Criss cross inheritance : x linked recessive
-  or ⊙



→ Recessive trait



→ Autosomal dominant

AD	AR	XLD	XLR
• Do not skip generation • Affected parent have unaffected children e.g - Hantigtons disease	• Skip generation • Unaffected parent can have affected children e.g - Cystic fibrosis, sickle cell anaemia	• It is never transferred from father to son • All daughter of unaffected father will be affected eg- Vitamin D deficiency rickets	• Male are more affected • Disease tend to ~~enter~~ transfer from mother to son & father to daughter • Disease never transfer from father to son e.g Haemophilia Colour blindness

Mutation

Father of mutation - Hugo de Vries
- Sudden change in genetic material.
- Structural and functional unit of mutation - muton

Mutation

Chromosomal mutation (Macro mutation)
- Morphological
- Numerical

(Micro mutation) Gene mutation or point mutation / DNA mutation
⇓
Position of gene fixed on the chromosome

Morphological → change in structure of chromosome
Numerical → change in no of chromosome

Morphological
- Deficiency
- Duplication
- Inversion
- Translocation

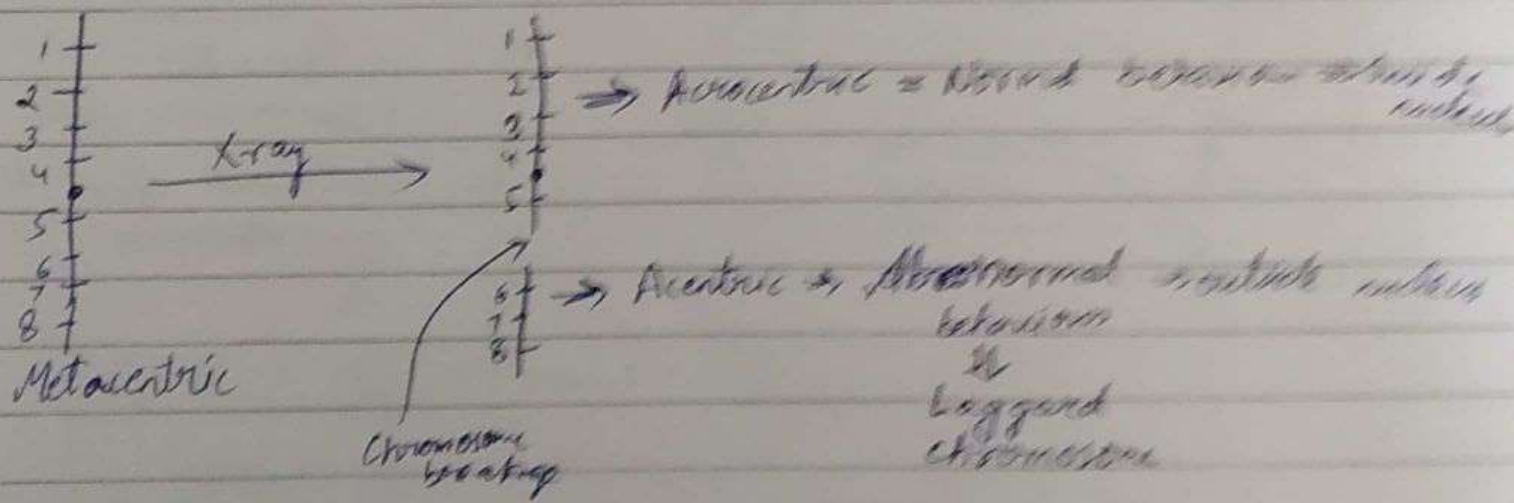
Numerical
- Aneuploidy
- Euploidy

Aneuploidy - Fractional change in chromosome no in diploid cell
Euploidy - Genomic change in chromosome no in diploid cell

Gene mutation
- Base pair substitution
  - Transition
  - Transversion
- Frame shift mutation
  - +ve
  - -ve
  - 0

Morphological change

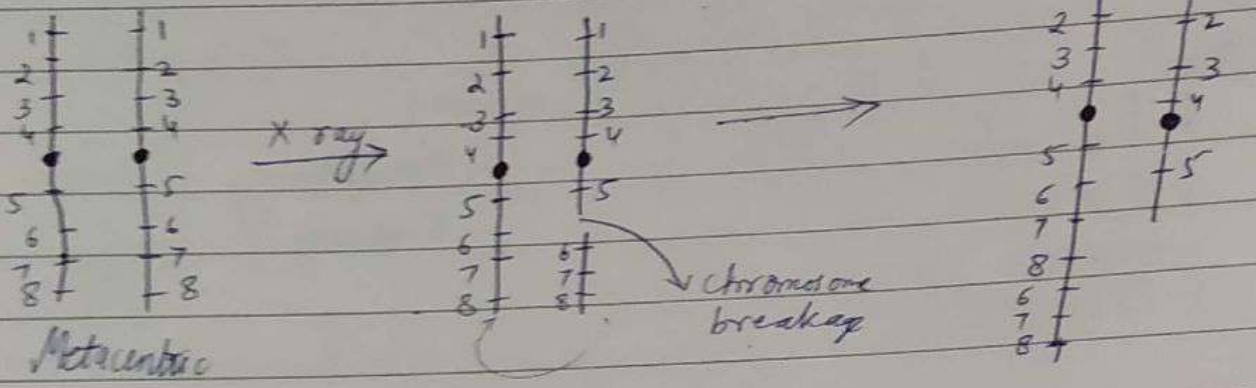
1. Deficiency → Loss of chromosome segment



Abnormal behaviour of nucleus

Abnormal mitotic anaphase behaviour
↓
Laggard chromosome

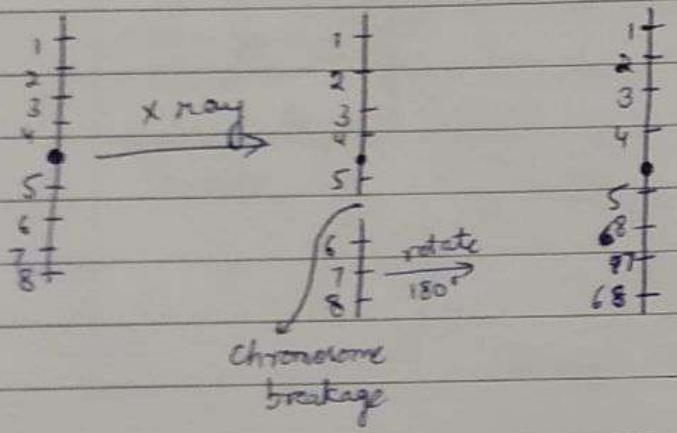
2) Duplication



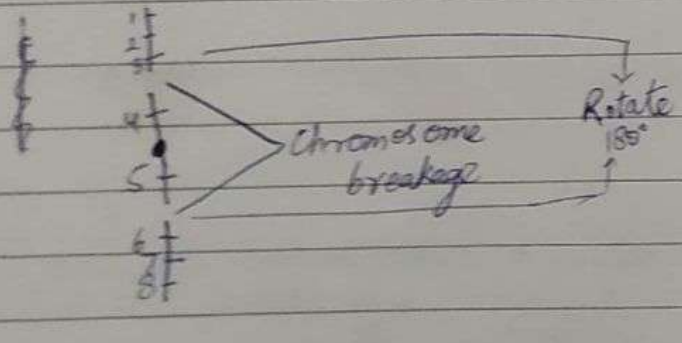
3) Addition of chromosome segment - Dosage effect

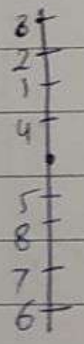
3) Inversion

Rearrangement of chromosome segment



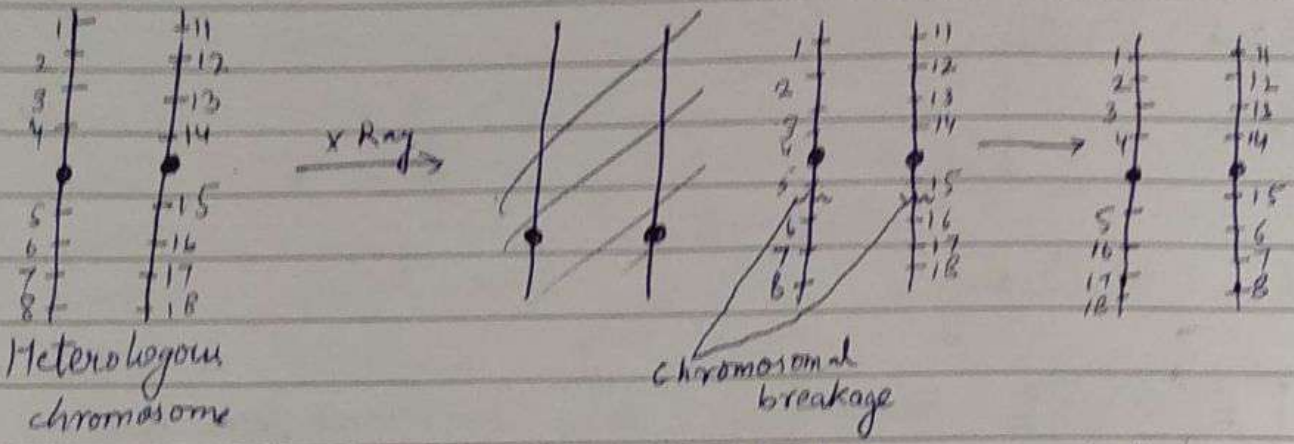
⇒ Paracentric (without centromere) type inversion chromosome split 1 side of centromere





Pericentric
Chromosome split both side of centromere

4) Translocation

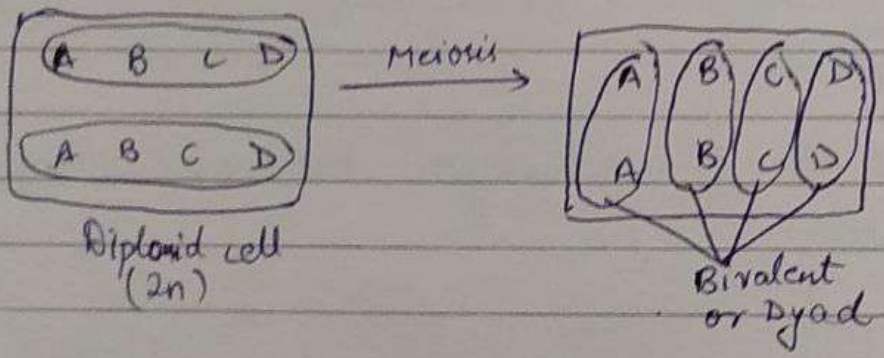


Exchange of chromosome segment between 2 heterologous chromosome.

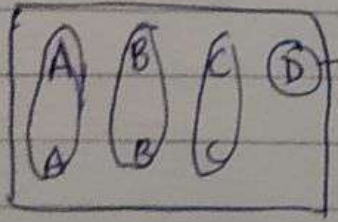
If 2 homologous - then crossing over

Numerical changing

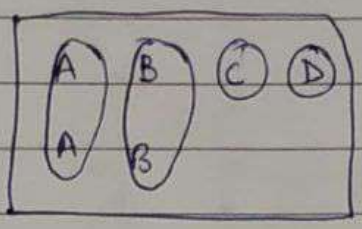
Change in no. of chromosome



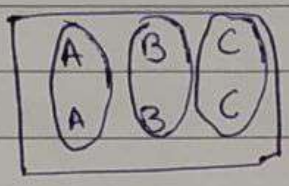
* First mutation (2n-1)
  → Monosomy



2nd mutation: 2n-1-1 (Double monosomy)

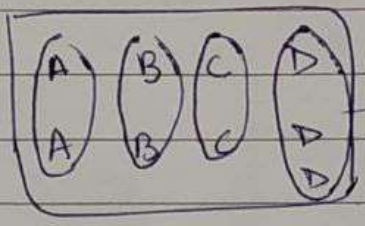


3) 2n-2 : Nullisomy



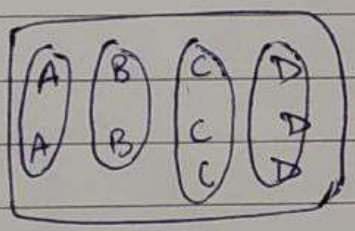
Removal of 2 ~~single~~ similar chromosome from diploid cell

4) 2n+1 : Trisomy



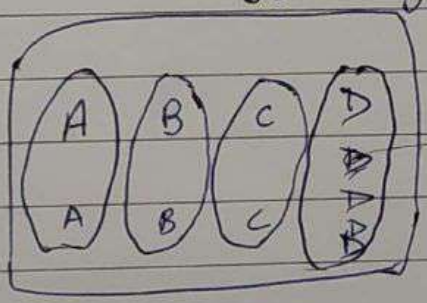
Trivalent → Addition of single chromosome in diploid cell

5) 2n+1+1 : Double trisomy



Addition of 2 heterologous chromosome in diploid cell

6) 2n+2 Tetrasomy



Tetravalent

Summary

1. $2n-1$ = Monosomy
2. $2n-1-1$ = Double monosomy
3. $2n-2$ = Nullisomy
4. $2n+1$ = Trisomy
5. $2n+1+1$ = Double trisomy
6. $2n+2$ = Tetrasomy

} Fractional changing Aneuploidy

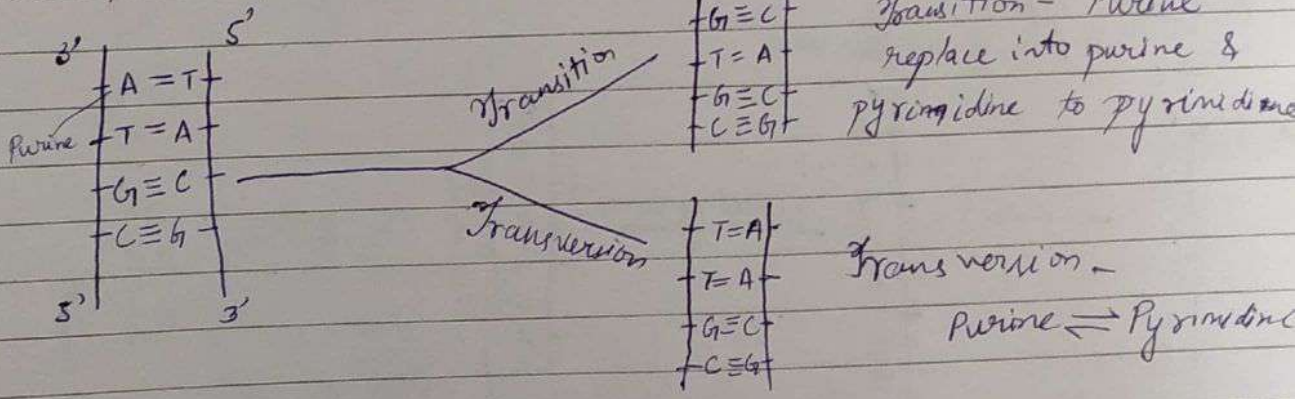
Euploidy : Genomic change

$2n + n = 3n$ (Triploid)
$3n+n = 4n$ (Tetraploid)
$4n+n = 5n$ (Pentaploid)
$5n+n = 6n$ (Hexaploid)

Triticera → $8n$

Micromutation

1. Base pair substitution

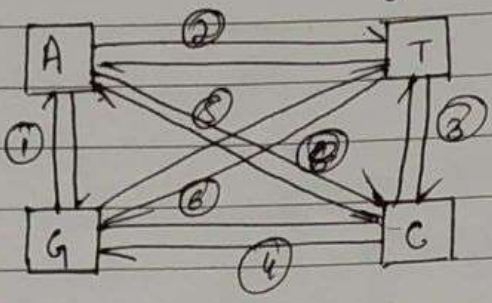


Transition - Purine replace into purine & pyrimidine to pyrimidine

Transversion -
Purine ⇌ Pyrimidine

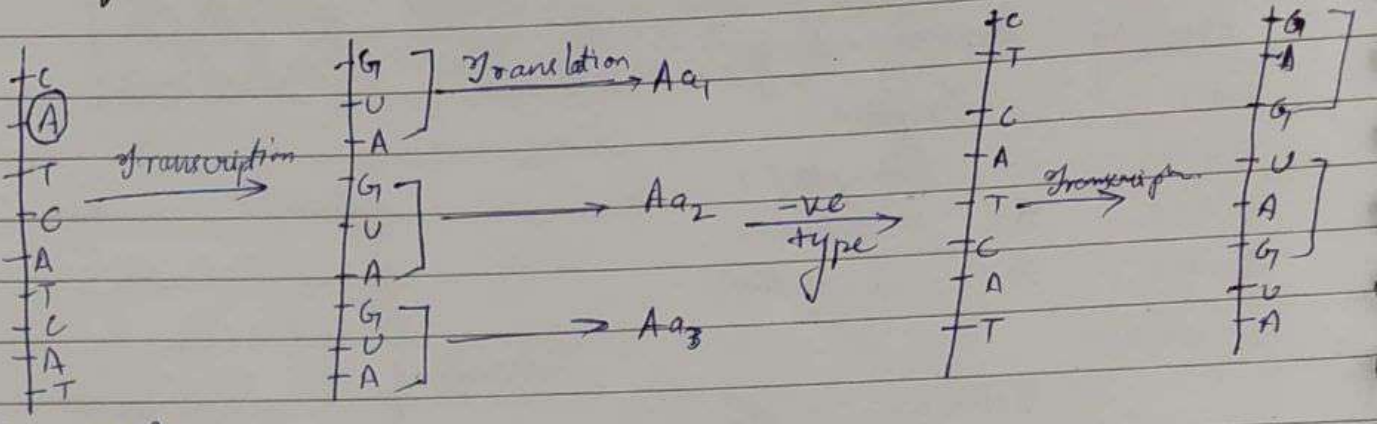
Does not divide due to absence of centromere

Purine — Pyrimidine



1 & 3 – transition
2, 4, 5, 6 – transversion

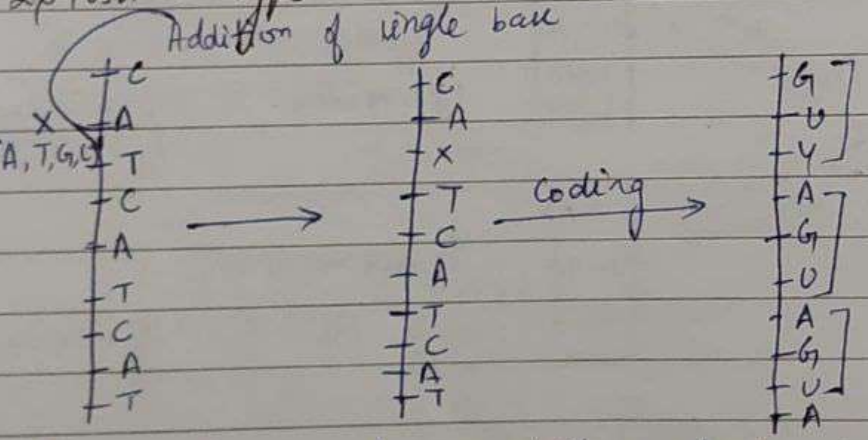
Frameshift mutation



Sense DNA

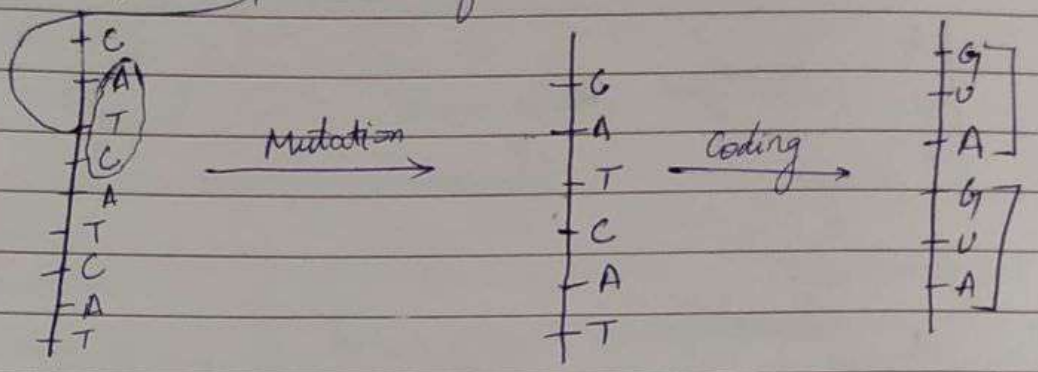
In -ve type frame shift mutation, the quality as well as quantity of codon change due to removal of single base from self sustained DNA.

2) Positive type



In +ve type frame shift mutation in which quality of codon do change but quantity remains same. It is due to addition of single base to self sustained DNA.

3) O type → Removal of more than 2 base

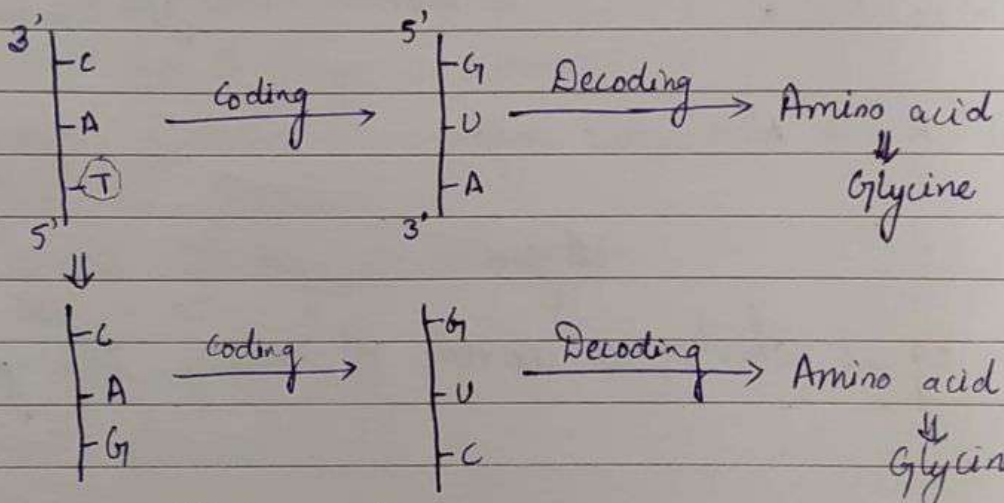


In O type frame shift mutation, in which the quantity of codon change but quality remain same.

Other type of mutation

1) Sense mutation
2) Mis-sense mutation
3) Nonsense mutation

1) Sense mutation



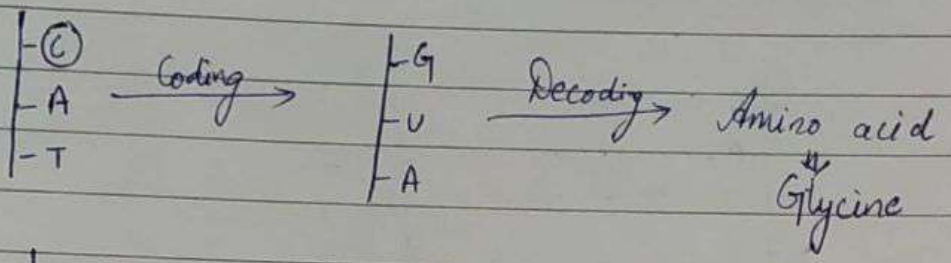
Silent mutation

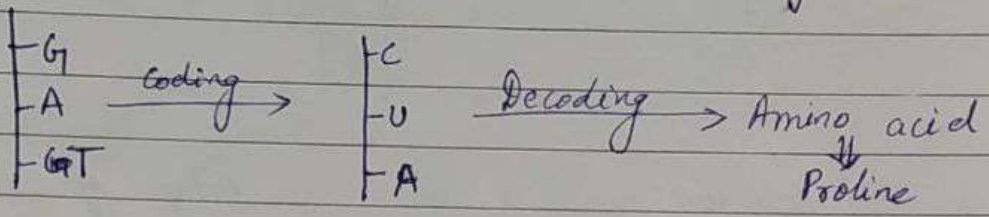
- In this type of mutation, the 3rd position of codon change now /or same amino acid.
- It is also called silent mutation.

Philadelphia chromosome: Mutation in 22nd chromosome

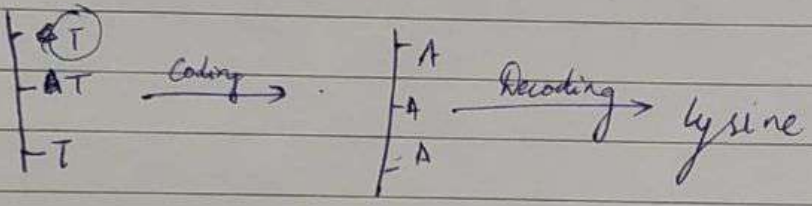
Super male: XYY

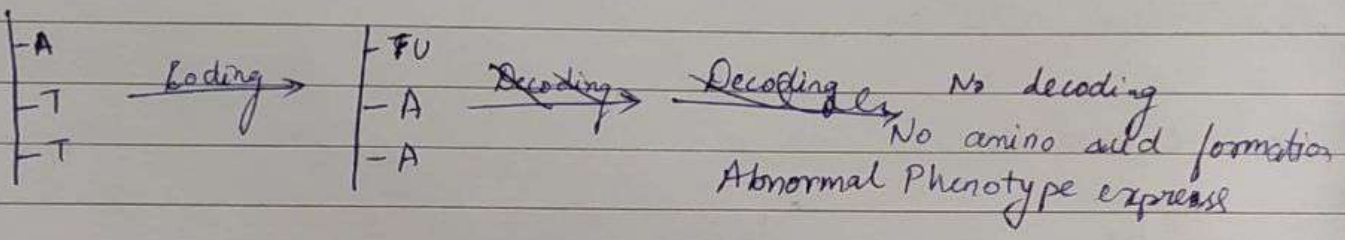
Missense mutation





Nonsense mutation





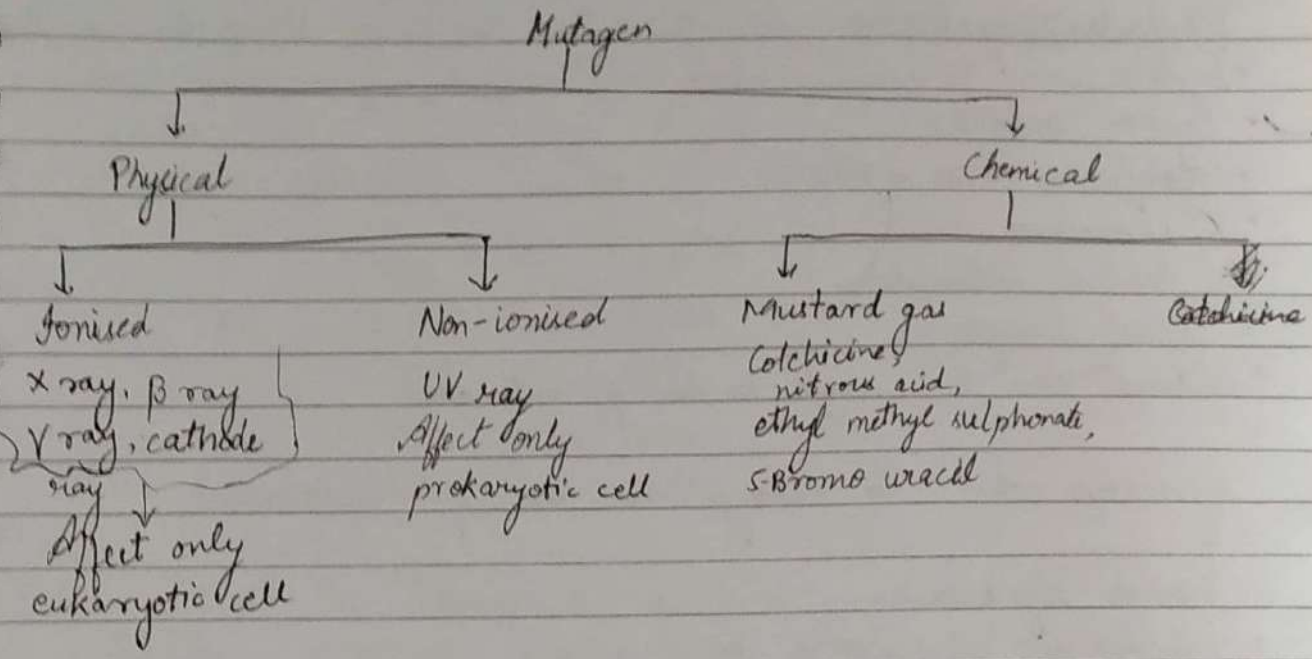
UAA, UAG, UGA → Non-sense codon

Mutagen

Any external agent which is capable of changing the genetic material.

- First physical mutagen → X ray
- First chemical mutagen → Mustard gas

X ray → Plant - Stedlar → Tobacco plant
Animal - Muller → Animal cell - Drosophila



Syndrome

Group of symptomes is called syndrome -

Abnormal change in no. of autosome or allosome result in abnormal expression of phenotype.

Syndrome due to change in allosome

1. Turner's syndrome
   - Affect only female
   - Monosomy condition
   - 44A + XO
   - 45 chromosomes
   - Short statured
   - Neck absent
   - Mental retarded
   - Finger blunt
   - Sexual immaturity

Klinefelter's syndrome

- In males
- Trisomy condition
- Genotype - 44AA + XXY
- 47 chromosomes
- Mental retardation
- Sexual immaturity
- ~~Syndrome due to change in no. of autosomes~~

Syndrome due to change in no. of autosomes

Down's syndrome

- Trisomy in chromosome 21

Edward syndrome

- 18th chromosome defect

Pataus syndrome

13th chromosome defect

Cat cry syndrome

9th chromosome defect

Q.

♀ \ ♂ gamete	AB	Ab	aB	ab
♀ female gamete	AaBB	Aa Bb	aaBB	aaBb

In Punett square ~~gv~~ given above the genotype of ~~m~~ female parent respectively is

AABb ~~A~~ aaBb

~~AaBb~~ ♂ aaBB Aa Bb aB aB aB aB

♂ AABB Aa Bb

♂ AaBB Aa Bb

♂ AaBb

Q. A dihybrid plant on self pollination, produce 400 phenotype with 9 types of genotype. How many seeds will have TtRr

a) 200 b) 100 c) 50 d) 150

	TR	Tr	tR	tr
TtRr	TTRR	TTRr	TtRR	TtRr
Tr	TTRr	TTrr	TtRr	Ttrr
tR	TtRR	TtRr	ttRR	ttRr
tr	TtRr	Ttrr	ttRr	ttrr

Q. In tomato, genotype aabbcc produce 100g of tomato AABBCC produce 160g tomato. What is the contribution of each polygene in the production of tomato?

a) 10g b) 20g c) 30g d) 40g

Ans. $\frac{\text{Difference of g values}}{\text{Total no. of genes}} = \frac{160-100}{6}$

$= 10g$

Heterosis or hybrid vigour

P1

AB CD E FG
ABC D E F G

⇒ Each gene expresse 5cm height

ABCDEFG

B

abcdefg
abcdefg

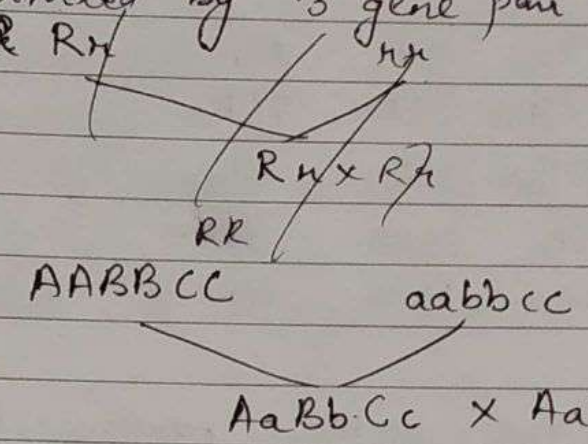
⇒ Each gene express 1cm height

abcdefg

AaBbCcDdEeFfGg

Dominant gene = 7×5 = 35cm
Recessive gene = 7×1 = 7cm
42cm

Q When a red grain variety of wheat is crossed with another white grain variety of, F_1 hybraid is produced. On selfing of this F_1 hybrid, how many % offspring of F_2 generation resemble phenotypically parent? (Red grain colour of wheat controlled by 3 gene pair



a) $\frac{2}{16}$ b) $\frac{20}{64}$ c) $\frac{15}{64}$ d) $\frac{2}{64}$

Q In a plant flower ~~clo~~ colour is an ~~ex~~ example of quantitative trait and ~~color~~ controlled by 1 gene pair ? How many plants show parental phenotopy

a) $\frac{2}{16}$ b) $\frac{2}{4}$ c) $\frac{2}{64}$ d) $\frac{2}{256}$

Q Grain colour in wheat is determined by 3 pair of polygene. Following cross AABBCC (Dark colour) X aabbcc (light) in F_2 genen, what proportion of progeny is likely to resemble either parent

a) None b) less than 5% c) $\frac{1}{2}$ d) $\frac{1}{3}$

$\frac{1}{32} \times 2 = 0.$

Q. If 2 person with AB blood group married marry and have sufficiently large no. of children, these children would be classified as
a) A : AB : B in 1:2:1 ratio. Modern technique of protein electrophoresis relates presence of both A & B type protein in AB blood group individual. This is the example of
Ans. codominance

Q Their are 2 allele (A_1 & A_2) out of which one (A_1) have nill abundance in the population than the abundance of 2nd allele (A_2) is
a) 0.25 c) 0.040
b) 1.00 d) 0.50

Q A tobaco plant heterozygous for albinism is self pollinated and 1200 seeds are subsequently germinated
How many seed are have parental genotype?

Aa × Aa
A a
A AA Aa
a Aa aa

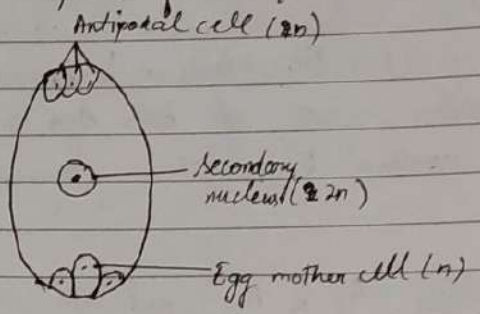
Ans. 600

Q Red → R, gene C → white, relation between them epistasis. Ratio?
Ans. 9:3:4

Q

Cross	Phenotypic	Genotypic
Co dominance	1:2:1	a) 1:2:1
Intermediate	b) 1:2:1	1:2:1
Lethal gene	1:2	c) 1:2
Compliment	9:7	d) 1:2:2:4:1:2:1:2:1
Epistasis	9:3:4	"

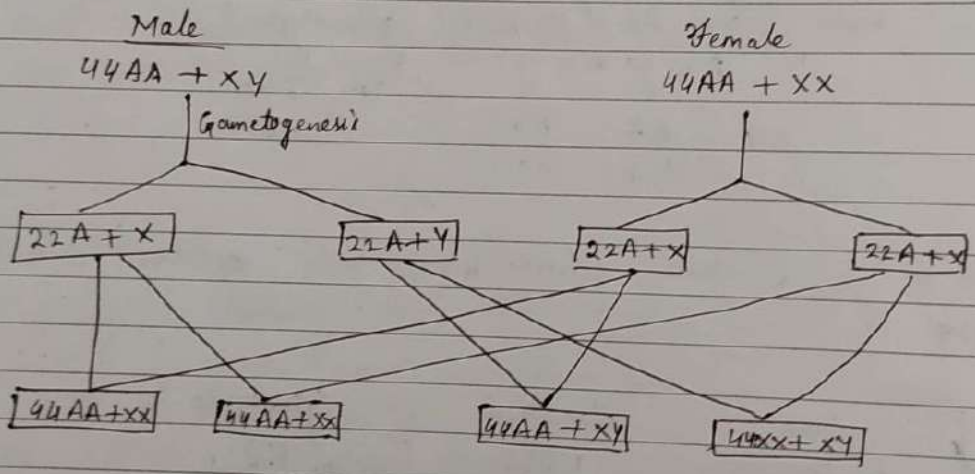
Q. How many correct ploidy present in endosperm when cross between tetraploid male plant & diploid female plant?



Trick: Ploidy of female plant = Ploidy of secondary nucleus

For ploidy of endosperm → Half of ploidy of male plant + ploidy of secondary nucleus

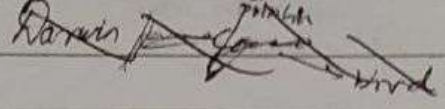
Sex determination



Types of sex determination

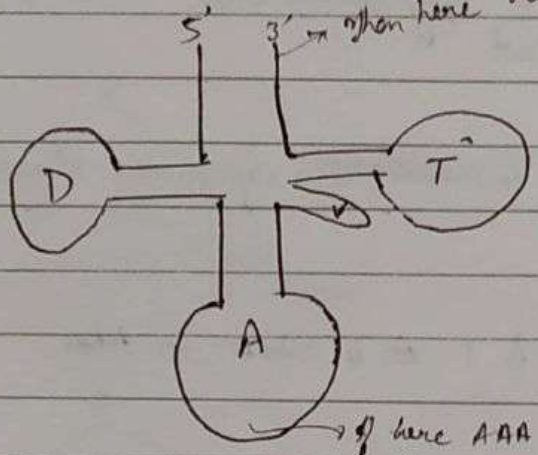
1) Male heterogamety
   eg Human being, Drosophila, cockroach, frog, grasshopper

2) Female heterogamety
   eg Birds, reptile and some insects like ~~grasshopper~~, moth, butterfly



Darwin finch (bird)

Human being: XY
Drosophila, Cockroach, frog - ~~XO~~ XY
Birds - ZW
Moth, butterfly - ZO



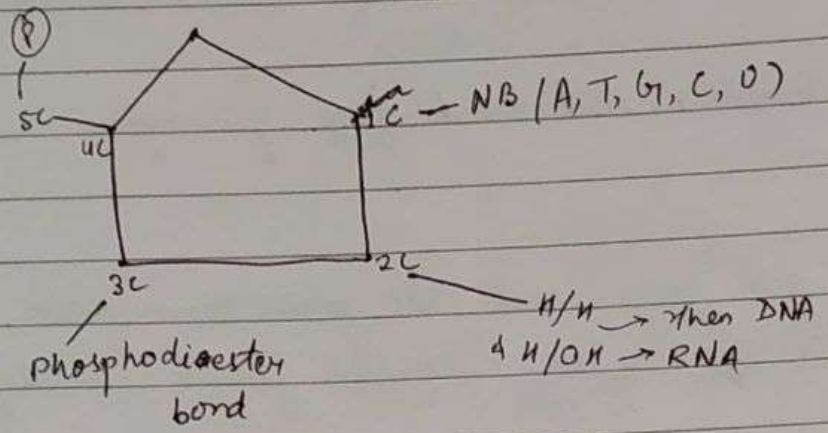
Nucleic acid

Mischer - First observed fragment like structure by breakdown of nucleus, thread like
↳ Nucleic acid is the polymer of nucleotide
• Repeating unit → nucleotide

Composition
→ 5C pentose sugar, N_2 base, phosphate (PO_4)

pH of DNA = 5 (Acidic)

5C pentose sugar



Bonding

1) Hydrogen bond (Between 2 N_2 base) A = T, C ≡ G
2) Pentose sugar & N_2 base → Glycosidic bond
3) 2 nucleotides – phosphodiester bond

Phosphodieter bond – Between 2 nucleotide of same strand of DNA

4) Phosphoester bond

Hydrogen bond between A & T is absent in RNA

Nitrogenous base

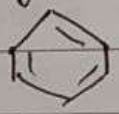
Purine

1)

2) Double ring orientation
3) 9 membered compound
4) Mol wt. – high
5) e.g. A, G

Pyrimidine

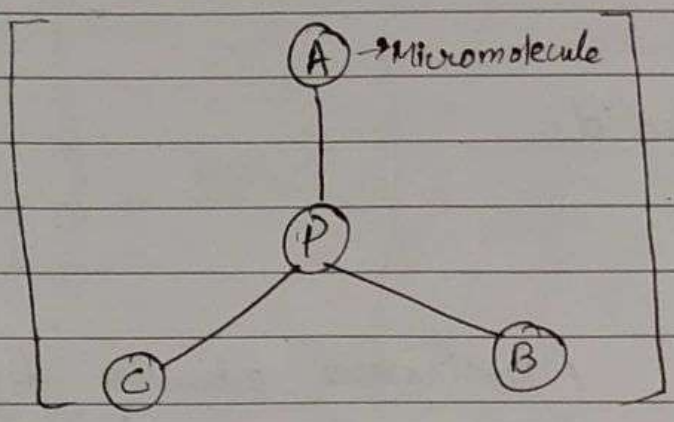
1)



2) Single ring orientation
3) 6 membered compound
4) Mol-wt – low
5) Eg- C, T, U

Phosphate

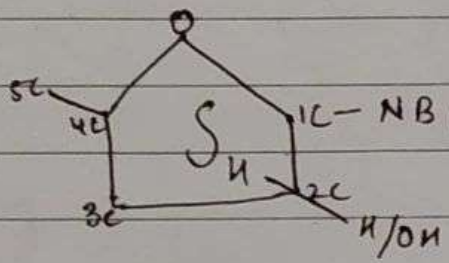
Phosphate act as linker molecule to connect different micromolecule to form macromolecule.



= Macromolecule

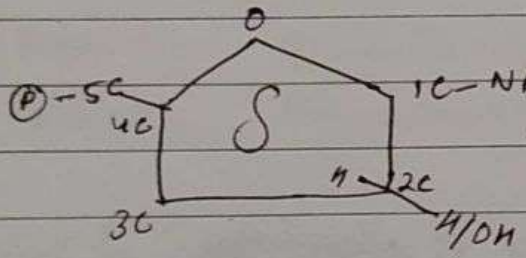
Changing

I}



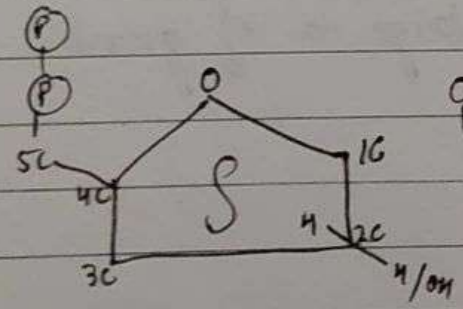
= Nucleoside (Adenosine)

II}

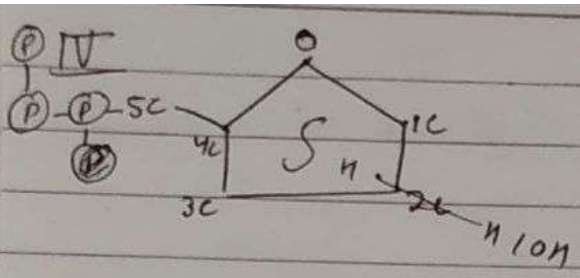


→ Nucleotide
Adenosine monophosphate (AMP)

III}

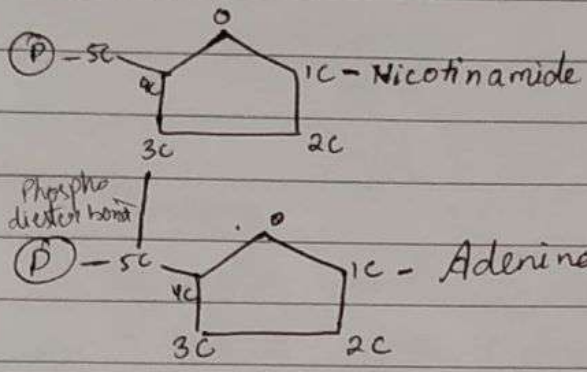


d- Adenosine diphosphate
↳ If H/H on 2nd carbon
d → deoxy



Adenosine triphosphate (ATP)

V Formation of dinucleotide



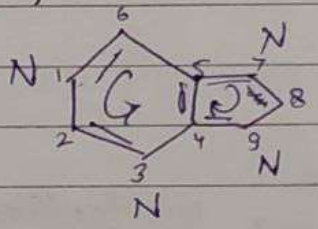
Nicotinamide adenosine diphosphate (NAD)

↓

Coenzyme

Q The position of nitrogen in purine is

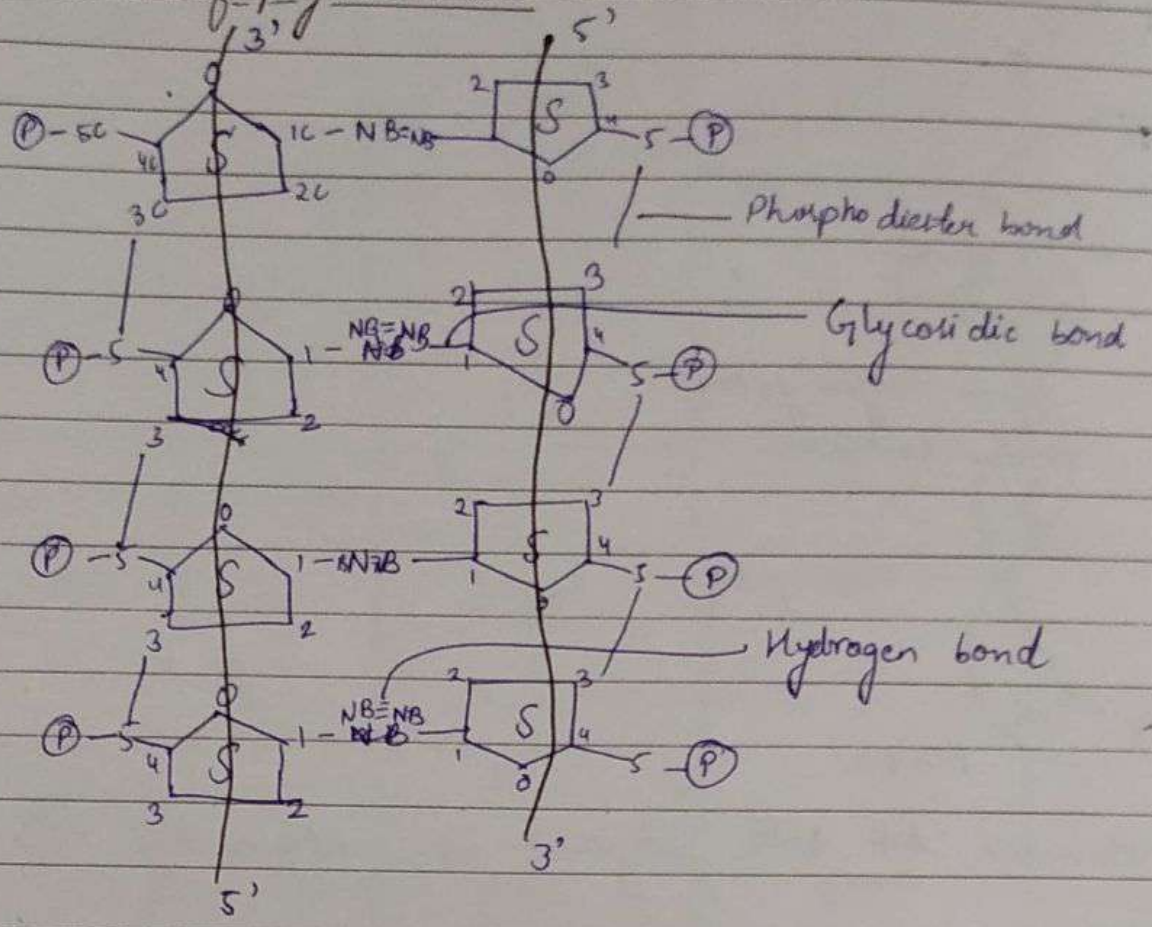
1) 1,3,7,9
2) 2,4,6,9
3) 1,5,7,9
4) 2,5,7,9



DNA - -ve charged due to presence of phosphorus

DNA is more stable than RNA due to large no. of guanine

Formation of polynucleotide



Summary:

S + NB: Nucleoside

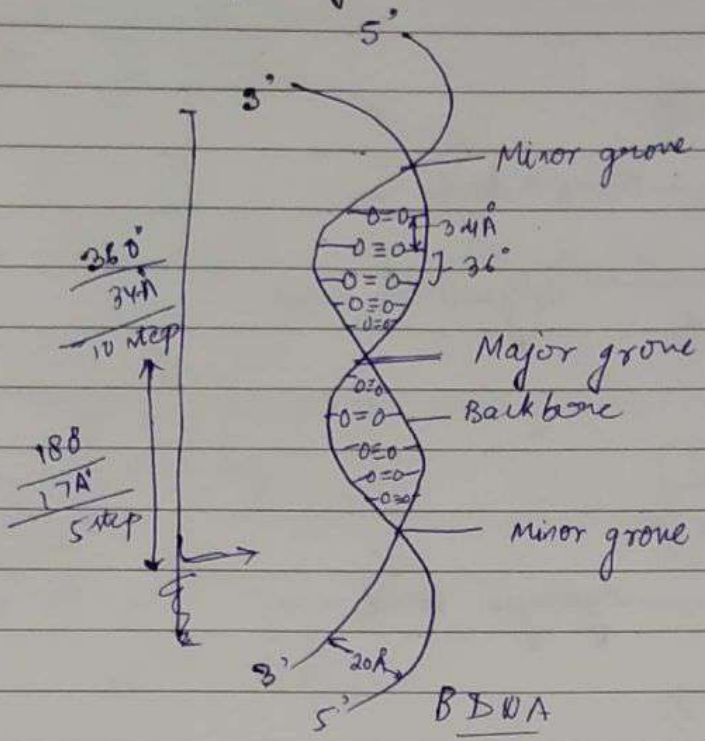
S + NB + P: Nucleotide

$(S+NB+P)_2$: Dinucleotide

$(S+NB+P)_n$: Polynucleotide

~~Watson & Crick model~~

Formation of polynucleoticle



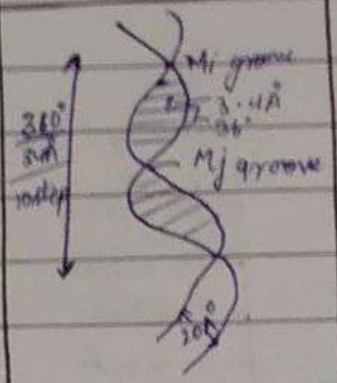
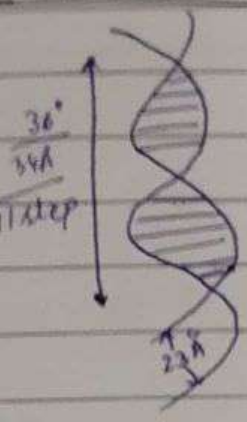
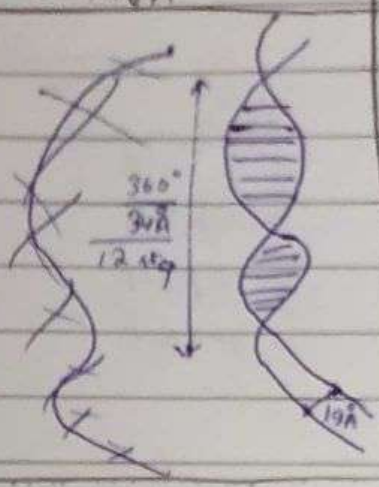
1) In double stranded DNA both polymer are antiparallel to each other.
2) The direction of 1 polymer is is 3' to 5' but other polymer is 5' to 3' of the same DNA.
3) Curvature distance in whole length of DNA = 360° But, straight distance on the same DNA is about 34Å
4) The diameter between 2 polymer is about 20 Å.
5) The backbone consist of alternate minor groove & major groove
6) The whole length of DNA consist 10 base pair.

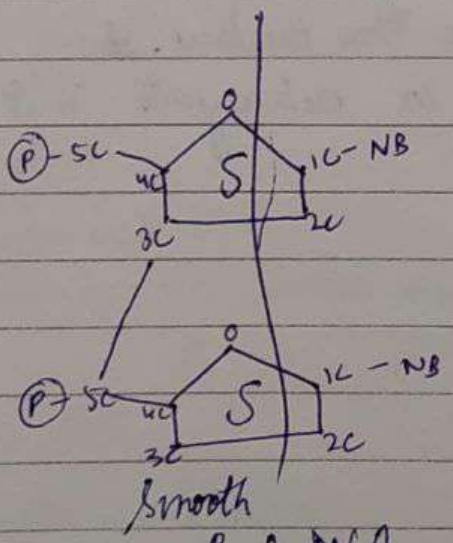
Types of DNA

1) B DNA - common
2) A DNA - rare
3) Z DNA - rare

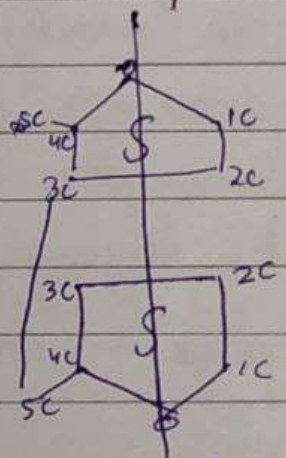
} Double stranded

4) C DNA - virus (complementary DNA) - Single stranded - Man made DNA
5) H DNA → Triple stranded

Character	B DNA	A DNA	Z DNA
1) Structure			
2) Coiling of backbone	Clockwise	Clockwise	Anticlockwise
3) Nature of helix	Smooth	Smooth	Rough
4) No. of step	10	11	12
5) Curvature distance between 2 strand	36°	32.7°	-30°
6) Straight distance between 2 step	3.4Å	3.09Å	2.8Å
7) Nature of groove	Well developed minor & major groove	Poorly developed minor & major groove	Groove are identical



Smooth
B, A DNA



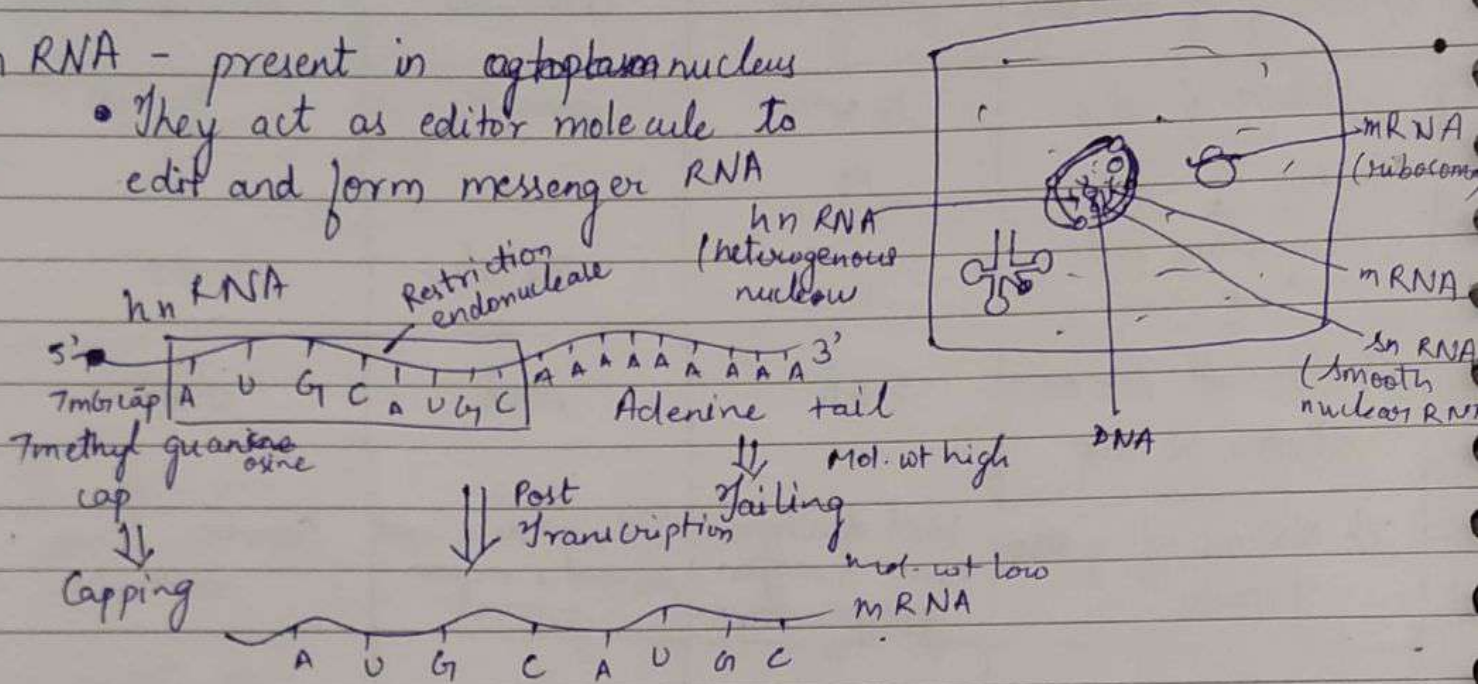
Rough, Z DNA

RNA

- Prokaryotes
  - mRNA
  - tRNA
  - rRNA
- Eukaryotes
  - hn RNA
  - m RNA
  - t RNA
  - r RNA
  - sn RNA

hn RNA - present in ~~cytoplasm~~ nucleus

- They act as editor molecule to edit and form messenger RNA



Messenger RNA (mRNA) :- Present inside the nucleus, ~~it~~

- It produced after post transcription in eukaryote but ~~not~~ transcription in prokaryot
- Use genetic language

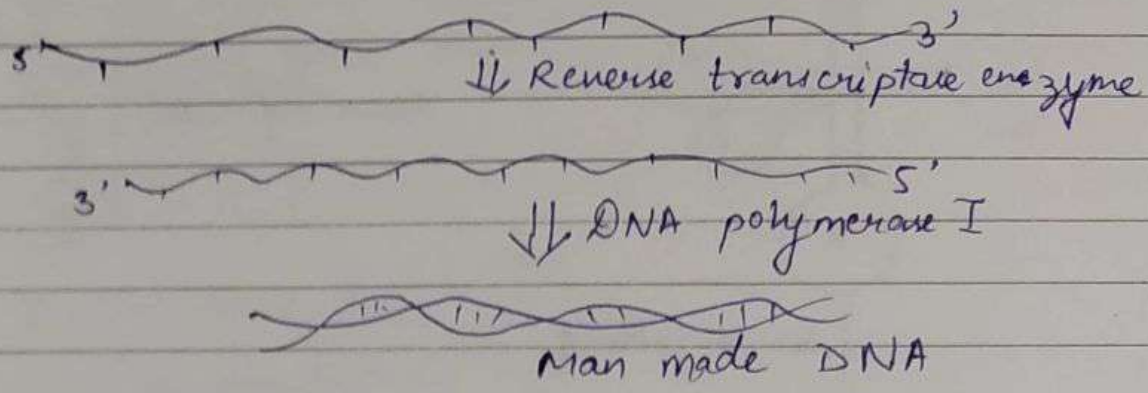
Language — Genetic code
⇓
Word
⇓
Letter
⇓
26

Codon
⇓
Nitrogenous base
(A, U, G, C)

C DNA

Man made

- Complimentary DNA
- Single strand
- Nitrogenous 8 base
- Discovered by Temin & Baltimore
- Teminism theory (Retrovirus contain RNA converted to CDNA)



RNA

- Ribose Nucleic acid
- Single strand
- Direction 5'-3'
- Ribo protein

- mRNA (contd.) - Transfer information related with protein synthesis from nucleus to small sub unit of ribosome

tRNA

- Smallest RNA
- It carry amino acid and to large ~~to~~ sub unit of ~~dogo~~ ribosome

Sn RNA

- Smooth nuclear RNA
- Present inside the nucleus
- They release outside nucleus without editing.

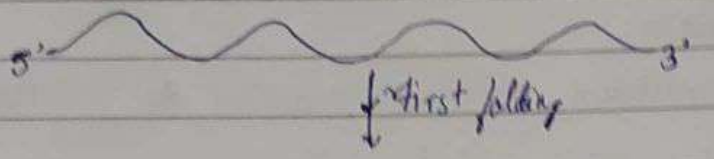
- NH grp : imino acid
- NH_2 grp : amino acid

In human body,
Amino acid - L form
Carbohydrate - D form

* All amino acids are optically active except glycine

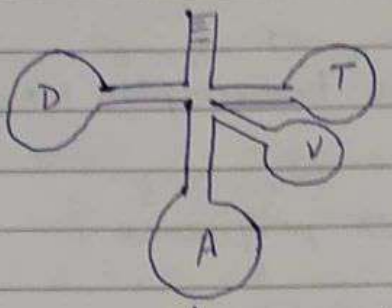
rRNA
Ribosomal RNA

- Lies on the ribosomal surface to help in protein synthesis.



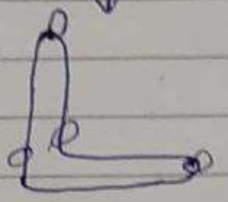
1-dimensional
mRNA
Linear

first folding



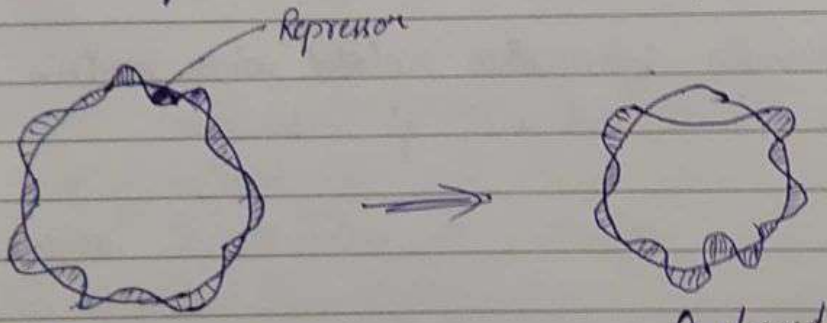
2-D tRNA
Clover leaf model

second folding



~~Three-D~~ 3-D
L shaped

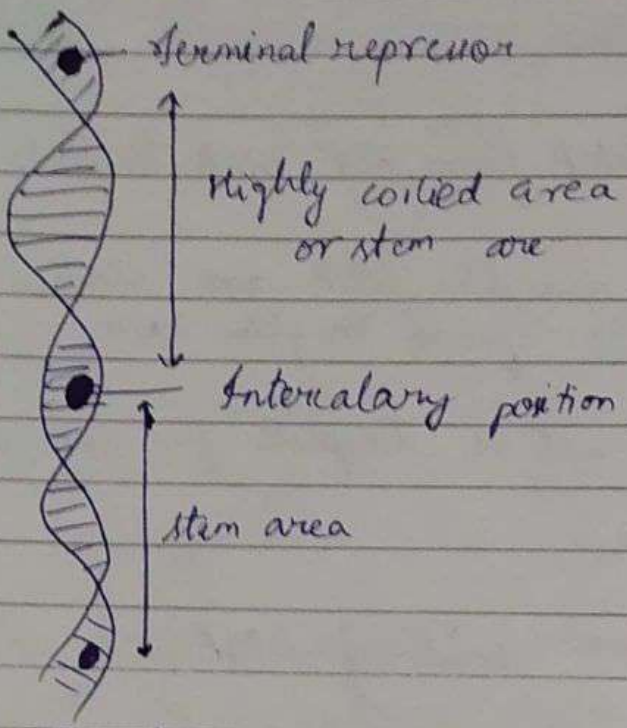
Structure of prokaryotic and eukaryotic DNA



→ Circular DNA,
double helix
~~circular~~ monorepliconic

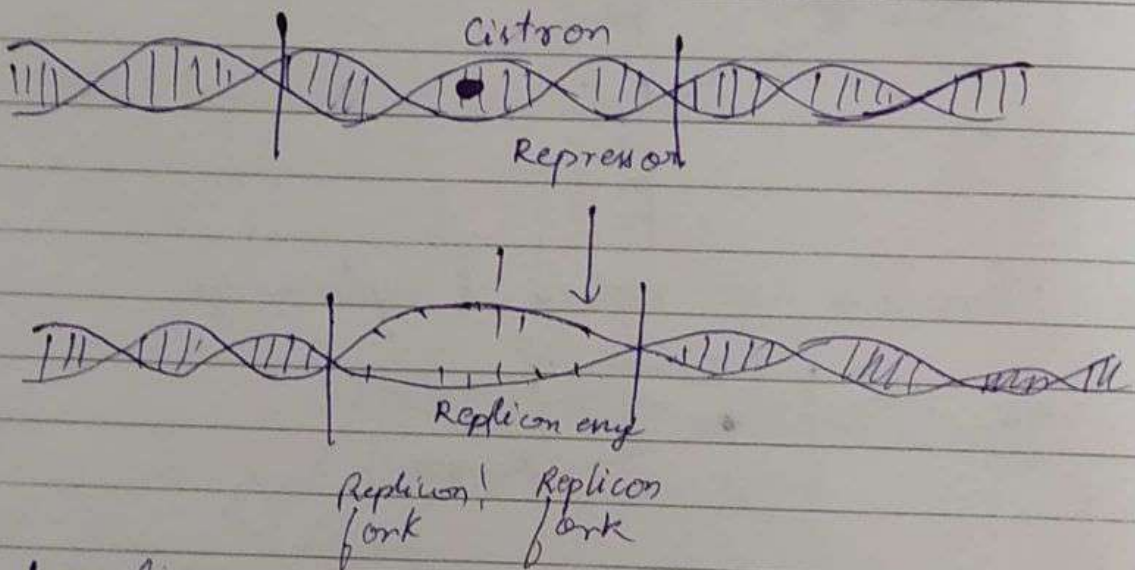
θ shaped

Guanosine tri phosphate (GTP), unwinding protein (UWP), Helix ~~de st~~ destabilising protein forms repressor.



Double strand, linear

Multirepliconic



1 replicon eye = 2 replicon fork

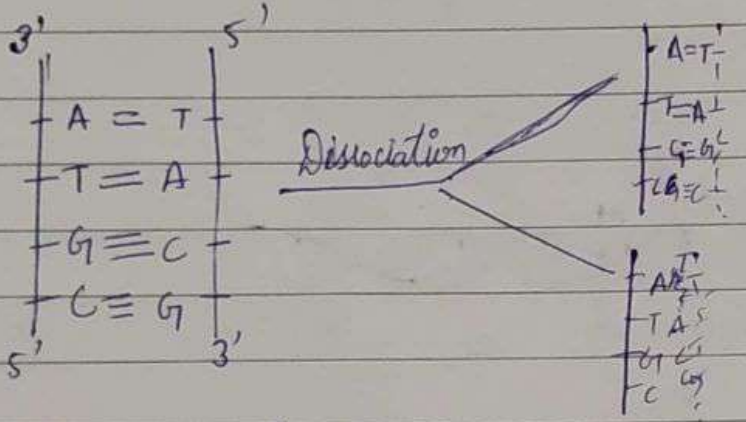
Mechanism of DNA replication

Replication-
Formation of new daughter DNA from old DNA template.

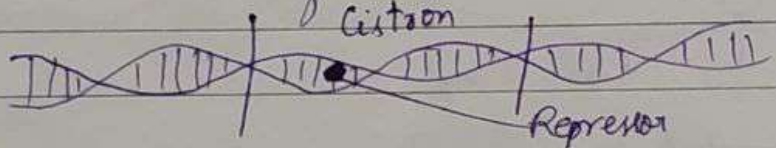
Replica - Formation of 2 new daughter DNA are similar to each other and also similar from Daughter DNA.

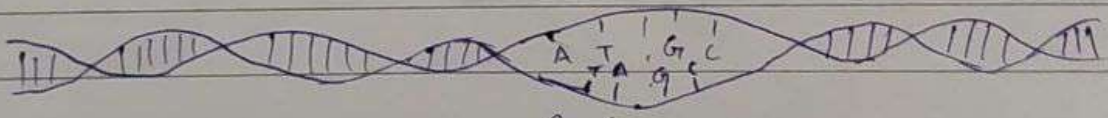
Template - The all DNA strand act as template for formation of new strand.

Cistron : Structural & functional unit of DNA.-



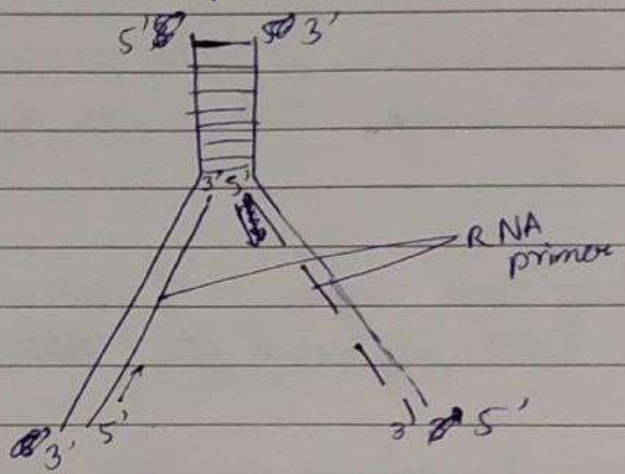
1st step - Formation of replica & replicon eye





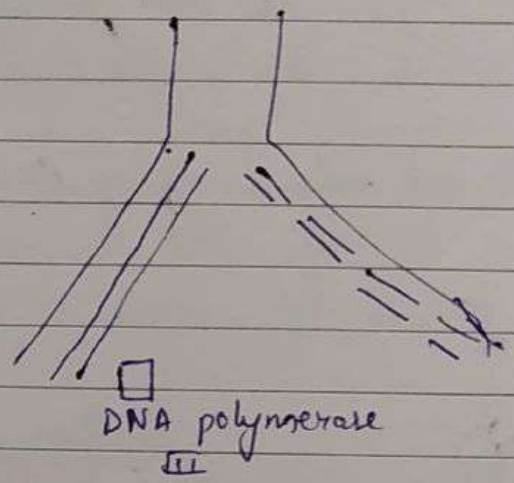
Replicon eye

2nd step - Formation of RNA primer



The RNA polymerase act on all DNA template in catalytic action, the deoxyribose containing nucleotide & ribose containing nucleotide join together by phosphodiester bond & hydrogen bond. The synthesis of RNA primer is 5' to 3'

3rd step - Formation of DNA primer



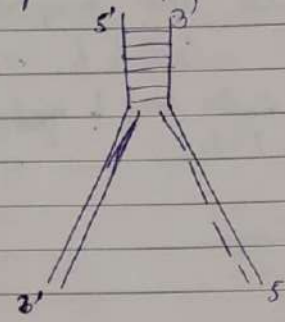
The DNA polymerase III act on the all DNA template is catalytic action. The ribose containing nucleotide and deoxyribose containing nucleotide are joined together by phospho-diester & H_2 bond. Catalytation of DNA primer & synthesis 5' → 3'

h step: Formation of leading & lagging strand

ading- continuous because formation of DNA primer or RNA primer require single DNA or RNA polymerase
Diraction 5' → 3'

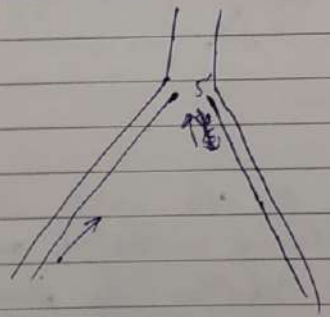
gging- Discontinuous bcoz each segment of DNA or RNA primer require independent DNA polymerase III & RNA polymerase

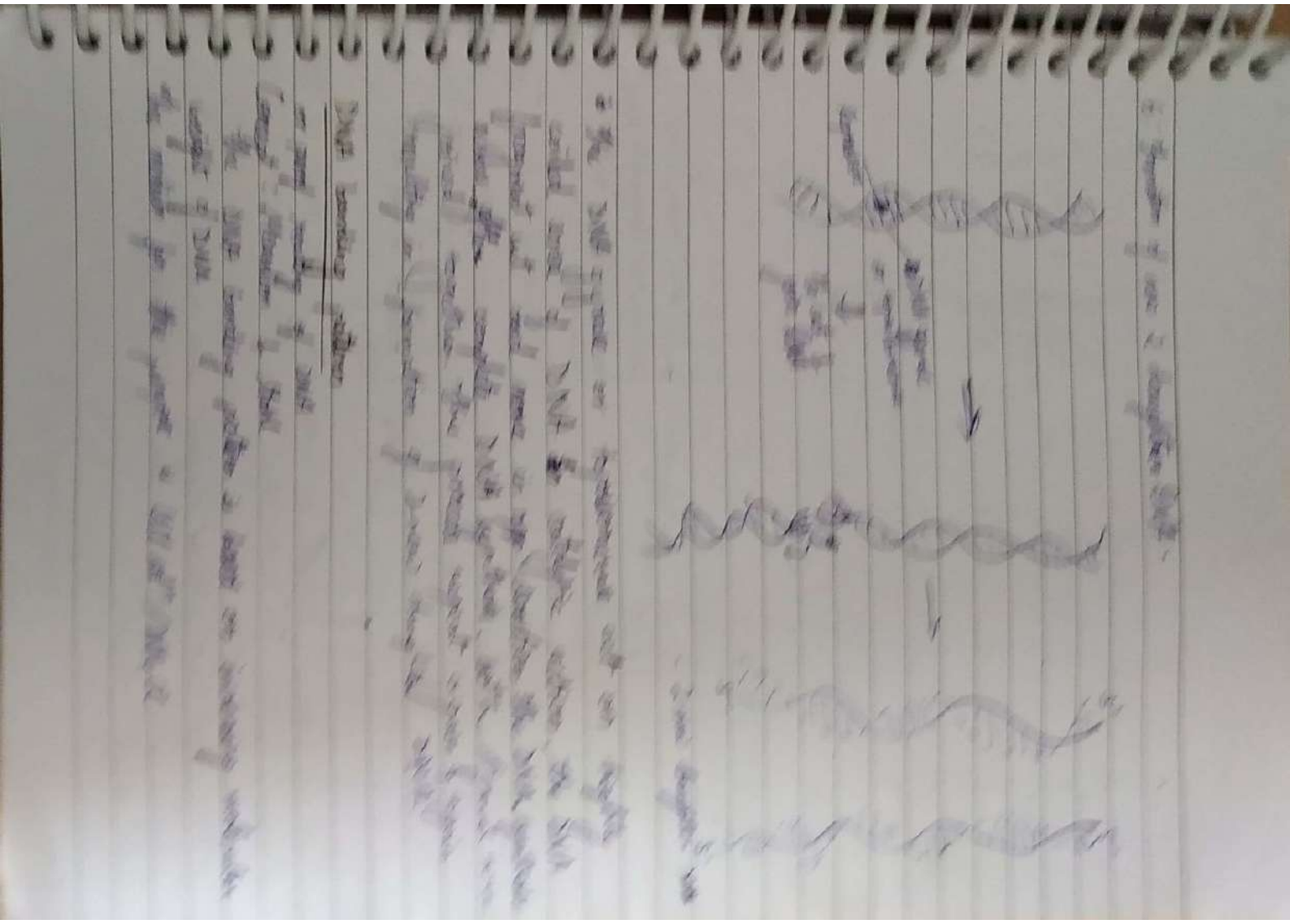
Removal of RNA primer & addition of DNA primer

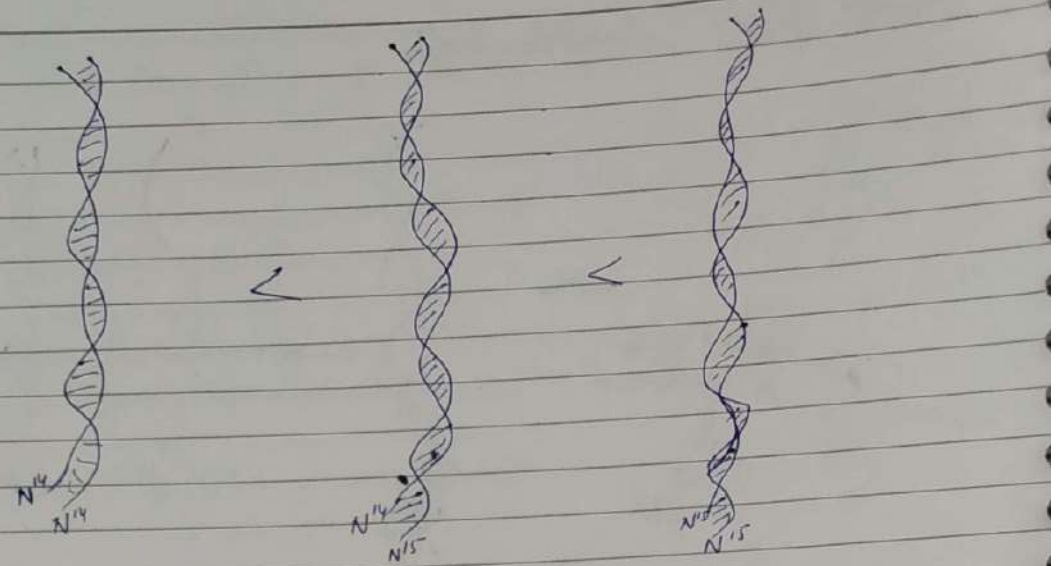


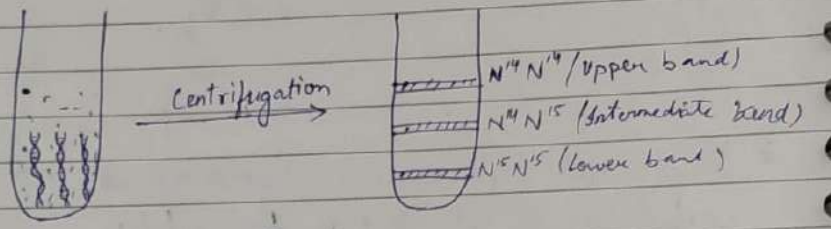
The DNA polymerase I act on the DNA template in catalytic action the RNA primer removed by breaking phosphodiester bond and hydrogen bond and also add DNA primer by addition of by phosphodiester bond.

The DNA ligase act on only lagging strand and become continuous and reverse

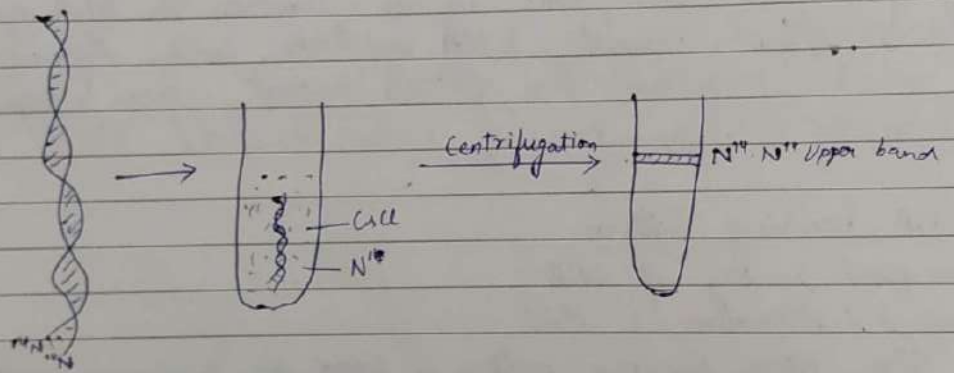




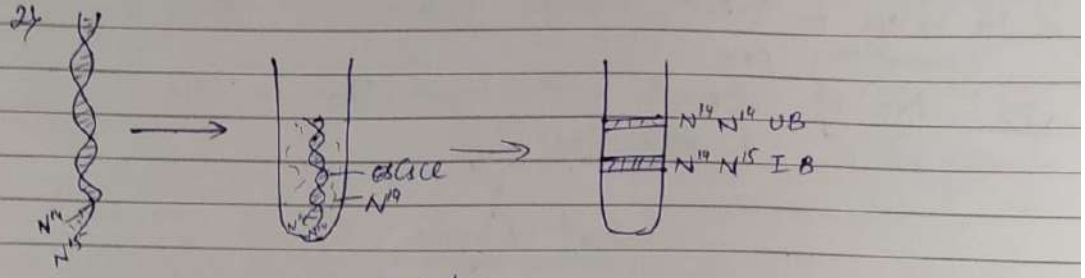




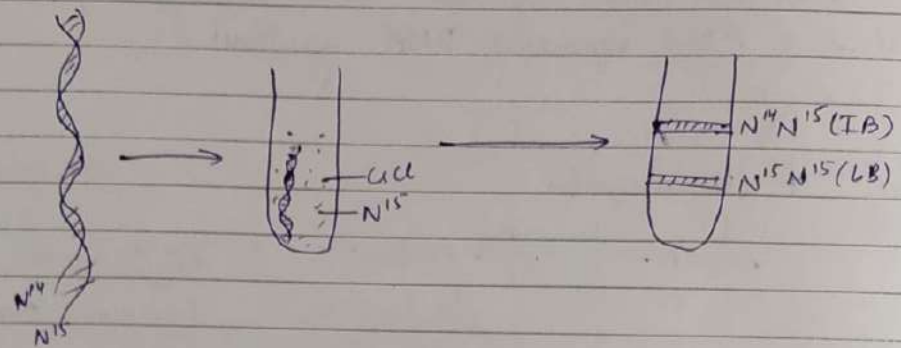
II)



Only upper band produced ,confirm which consist of $N^{14}N^{14}$ isotope which confirm the presence of N^{14} isotope assemble on the all DNA template



Both upper band & ~~lower~~ intermediate band produce due to presence of culture medium in N^{14}



Both intermediate & lower band produced in the test tube. It is possible due to presence of ~~test~~ culture medium N^{15}. The regular replication of DNA inside the culture medium containing N^{15} isotope which confirm the new daughter DNA produced due to presence of culture medium.

Q The double strand DNA consist N^{14} isotope that replicate in the culture medium containing N^{15} isotope. Find out no. of daughter DNA ~~out~~ ~~with~~ which contain N^{15} isotope after three generation.

(8)

$N^{14}N^{15}$
$N^{14}N^{15}$
$N^{14}N^{15}$
$N^{15}N^{15}$

$\Rightarrow$ $N^{14}N^{15}$ $N^{14}N^{15}$ $N^{15}N^{15}$ $N^{14}N^{15}$

$N^{15}N^{15}$ $N^{15}N^{15}$ $N^{14}N^{15}$ $N^{15}N^{15}$

$N^{15}N^{15}$ $N^{15}N^{15}$ $N^{14}N^{15}$ $N^{15}N^{15}$

$N^{15}N^{15}$ $N^{15}N^{15}$ $N^{15}N^{15}$ $N^{15}N^{15}$

(2) (6) Intermediate N^{15}

In all generations parental type 2 only

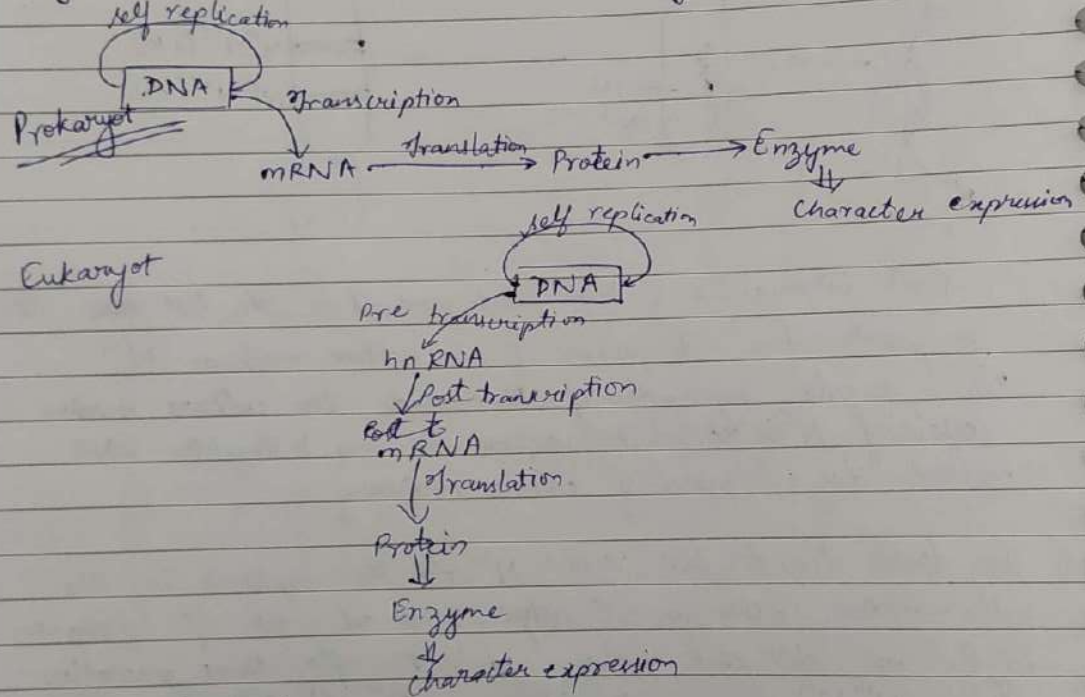
Q No. isotope on DNA, culture medium N^{15}. After 3 generation, N_{15}

Ans No. of strand containing N_{15} – 14
2- parental type

Central Dogma

DNA ⇌ RNA ⟶ Protein

Central dogma is bidirectional flow of information in which DNA dependent RNA synthesis, RNA dependent protein synthesis and RNA dependent DNA synthesis

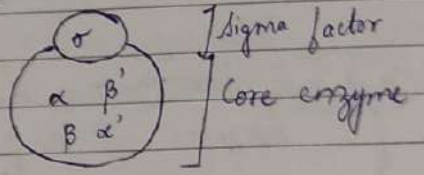


Transcription

DNA dependent RNA synthesis

Requirement : 1) Site - Cistron - Site of DNA where all the metabolic activity. Lies between p site & t site

2) Catalyst - RNA polymerase



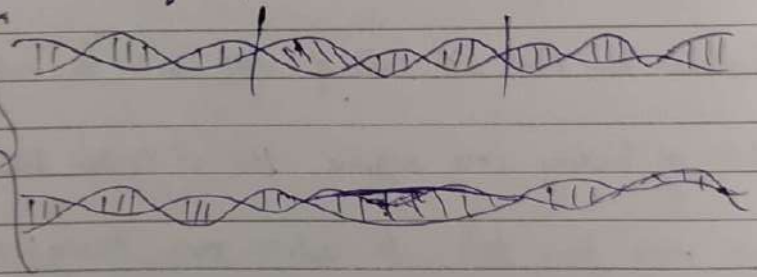
Sigma factor - It consist of single amino acid
Molecular wt. low

It ~~Attach~~ ~~core enzym~~ bind the core enzyme with p site of DNA & then become free.

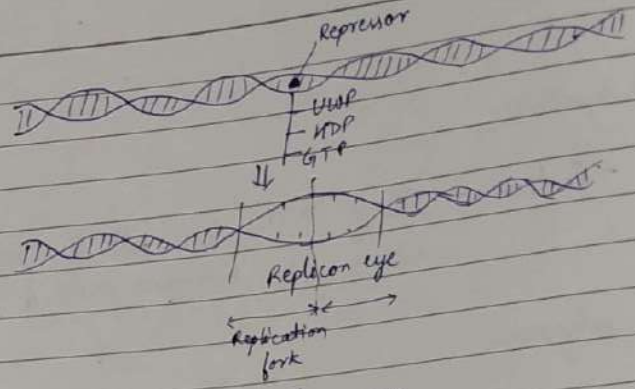
Core enzyme - Contain 4 amino acids arranged in α, β', β, α'

It form RNA primer on the cistron area

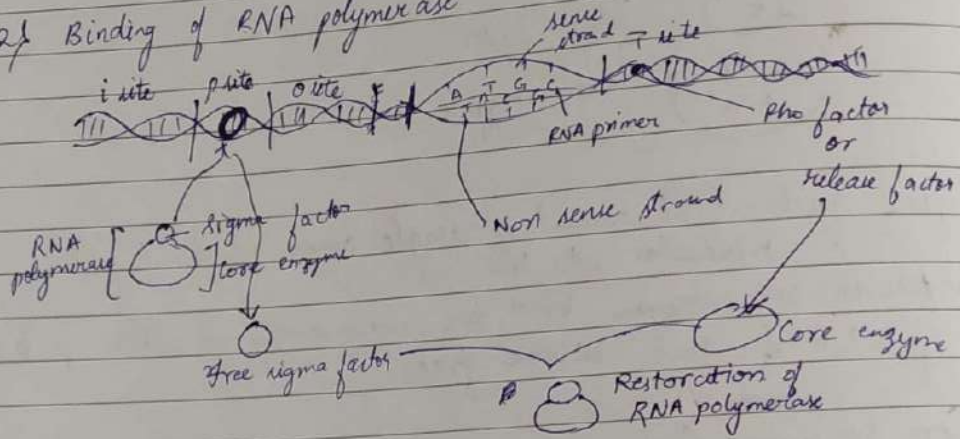
3) Formation of repressor & replication eye



During DNA replication, energy provider is GTP.



2) Binding of RNA polymerase



i) First of all, replicon eye produced by the presence of unwinding protein, HDP & GTP.

ii) Only 1 strand of DNA act as template for synthesis of RNA prithen for sense stranding and other strand is called nonsense strand.

iii) The RNA polymerase ~~bon~~ bind with t site of DNA with the help of σ factor.

iv) After completion of binding core enzyme, the σ factor later becom free.

v) The core enzyme move from t site to cistron area through o site and start synthesis of RNA primer.

- After complete primer synthesis, the core enzyme released outside DNA surface through release factor or rho factor from the t site. The free core enzyme and free sigma factor bind together resulting in restoration of RNA polymer.
- The synthesised RNA primer further transfer on the riborome surface.
- After transfer of RNA primer, both strand of DNA further bind together resulting in restoration of ostron.

Translation

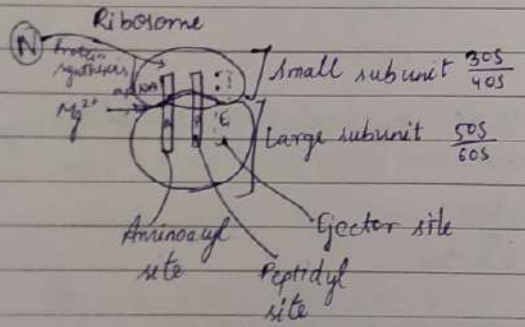
RNA dependent protein synthesis.

1) Site – Riborome

2) Raw material - Amino acid, ~~mRNA~~, tRNA

3) ~~30~~ mRNA

4) tRNA



Mg^{2+} conc^{n} in Cytoplasm

- = 0.001 Both sub unit attached together
- < 0.001 separate
- > 0.001 formation of dimer

2) Raw material

Amino acid

$$NH_2 - \underset{\underset{R}{|}}{\overset{H}{\overset{|}{C}}} - COOH$$

Q Which of the following amino acid enter first inside the ribosome surface

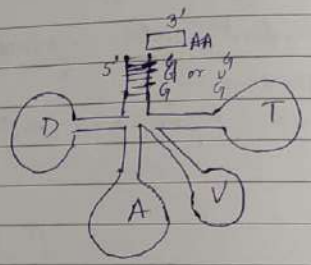
Methionine - Start codon (Initiator codon)

mRNA
- Linear, 1 dimensional
- Direction 5' to 3'

5' ~~~~~ 3'

Function : 1) Codon formation
2) Carry msg from nucleus to small sub unit of ribosome

tRNA
- Clover leaf model
- 2 dimensional
- Lobulated
- Smallest RNA
- Direction 5' to 3'
- Amino acid bind at 3' end
- Present in the cell cytoplasm.



D loop - Consist single unusual base i.e. Dihydrouridine

A loop - Formation of anticodon
↓
3 letter

V loop (Variable loop) : Consist different types of nitrogenous base

T loop : Consist only thymine base

Codon

- Triplet structure
- Produced on the mRNA
- Total no. of codon = x^y

where x is no. of nitrogenous base available = 4

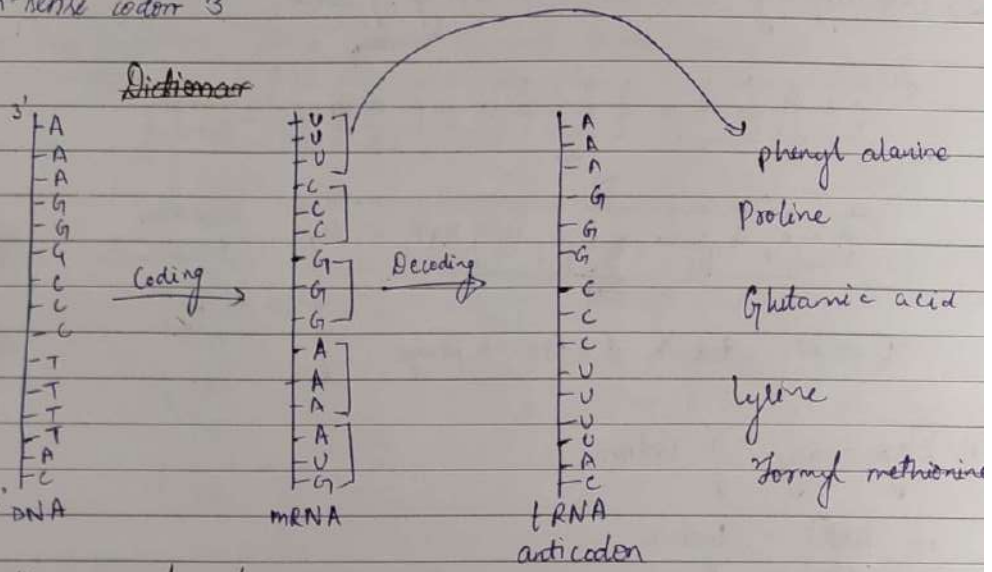
y = no. of nitrogenous base used = 3

Total no. of codon = $4^3 = 64$

Sense codon - 61

Non-sense codon 3

~~Dictionar~~



Dictionary of codon

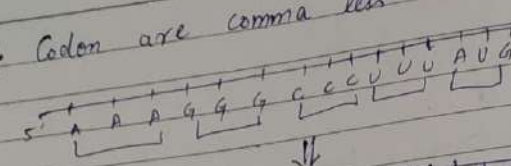
1) Sense & non-sense codon

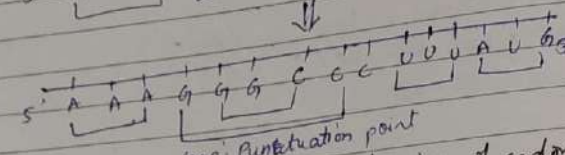
Sense codon: it form amino acid
No. - 61

Nonsense codon: Not form amino acid
No 3 (UAA, UAG, UGA)

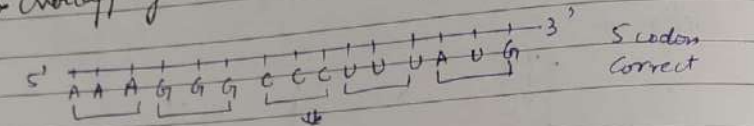
Significance: Determine the no. of amino acid

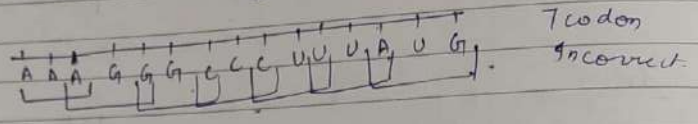
2) Codon are comma less





3) Overlapping and non overlapping of codon





Except ~~fx A~~ ϕx174, λ phage

4) Degeneracy of codon

1) AAA - Lysine
2) AAG - "
3) AAC - "
4) AAU - "

wobble position ⇒ 3rd position doesn't ~~not~~ matter if 1st & 2nd positions are same

⇓

Gave by Crick

- The 3rd base of codon change but expression of same amino acid

5. Codon are universal

AUG → Formyl methionine

GUG → "

UUG → "

CUG → "

- Any live form, the AUG codon express same phenotype.

	A	U	G	C	
A	AAA	AUA	AGA	ACA	A
	AAU	AUU	AGU	ACU	
	AAG	AUG	AGG	ACG	
	AAC	AUC	AGC	ACC	
U	UAA	UUA	UGA	UCA	U
	UAU	UUU	UGU	UCU	
	UAG	UUG	UGG	UCG	
	UAC	UUC	UGC	UCC	
G	GAA	GUA	GGA	GCA	G
	GAU	GUU	GGU	GCU	
	GAG	GUG	GGG	GCG	
	GAC	GUC	GGC	GCC	
C	CAA	CUA	CGA	CCA	C
	CAU	CUU	CGU	CCU	
	CAG	GUG	CGG	CCG	
	CAC	CUC	CGC	CCC	

Q RNA containing 200 codon, 5th position consist initiation codon & 194th consist terminator codon. Find out total no. of codon amino acids formed

Ans 189 189

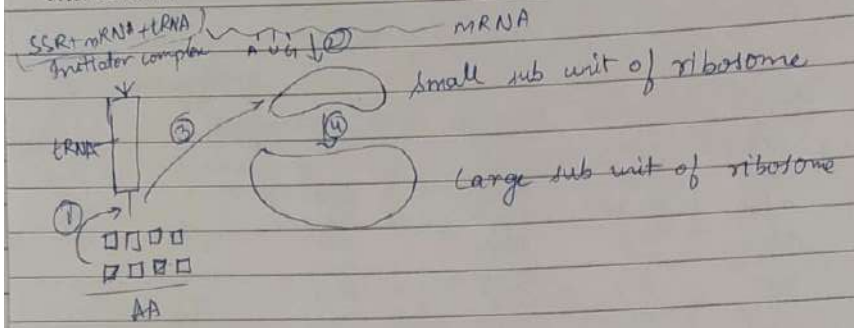
Eukaryot - initiation codon - AUG

Prokaryot - initiator codon - GUG

Protein synthesis

1. Initiation
2. Elongation
3. Termination

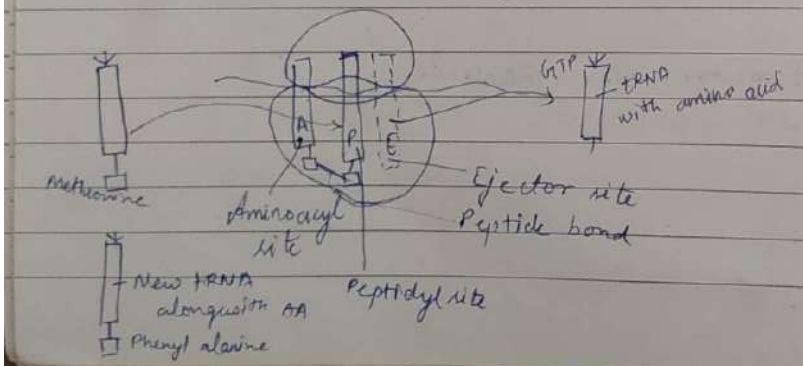
Initiation:

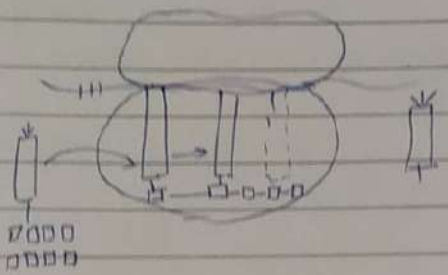


1. During initiation, first of all the tRNA search the amino acid inside the cytoplasm and then bind together.
2. mRNA bind with small subunit of ribosome
3. tRNA along with amino acid bind with small subunit of ribosome to form initiation complex.
4. Initiation complex bind with large subunit of ribosome

Elongation

- Formation of long polypeptide chain





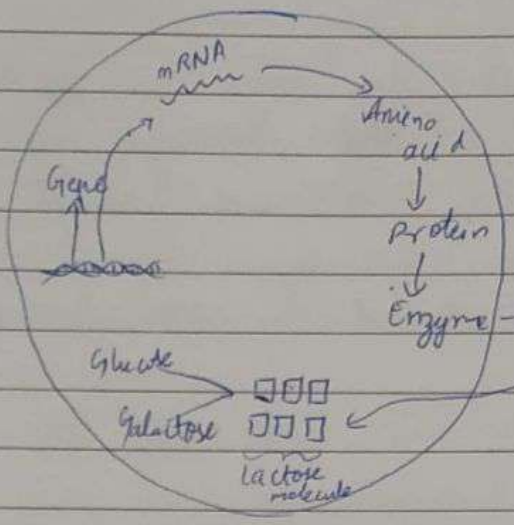
- Elongation is the formation of long polypeptide chain.
- tRNA along with AA
- Methionine gets attached to the peptidyl site of ribosomes.
- Then, new tRNA along with amino acid phenyl analine goes to aminoacyl site of ribosome.
- Both the amino acids are attached to each linked by peptide bond.

- First of all, tRNA along with amino acid like formyl methionine directly enter p site of ribosome.
- The new tRNA along with amino acid are attached with A site of ribosome.
- Due to blockage of both A & P site, the new tRNA along with amino acid not enter inside the ribosome.
- The p site tRNA transfer on the ejector site and A site tRNA transfer on the P site and A site become vacant.
- The new tRNA along with amino acid enter & bind with A site of ribosome.
- The formation of peptide bond between 2 AA.
- This process repeat again and again resulting in formation of polypeptide chain.
- The tRNA ejected or release from E site without amino acid with the help of GTP.

Termination

Any non-sense codon (UAA, UAG, UGA) produced on the mRNA to suddenly terminate the protein synthesis.

Gene expression



Operon concept

Operon concept

Operon is a special type of gene which control all metabolic activities going inside the living gene.

Lac operon
(lactose)

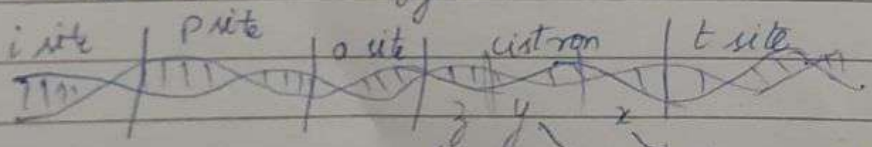
↳ Inducer operon

His operon
(histidine)

• Replicable operon

Lac operon

ON — lac present - enzyme
OFF - Lac absent - no enzyme



z, y, a → 3 structural gene

i site - regulator site
↳ it forms protein repressor

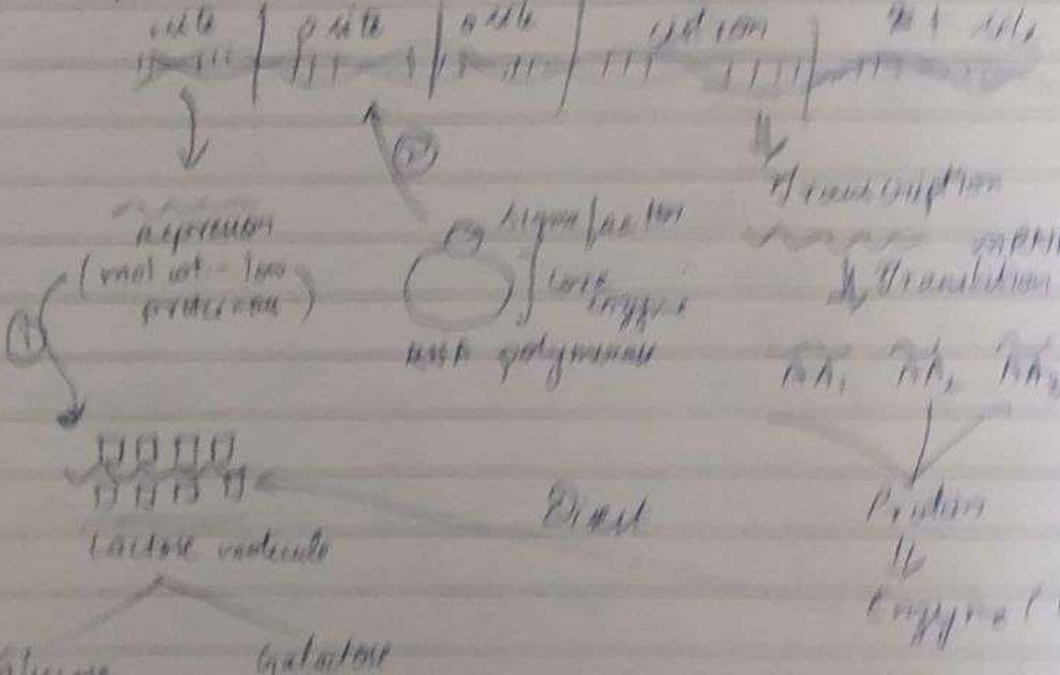
p site = promoter site
↳ binding site of RNA polymerase

O site = operator site
↳ allows movement of RNA polymerase from p site to structural area.

Cistron = Unit between p site & t site.
↳ structural & functional unit of DNA

t site = terminator site
Consist of ρ and release factor

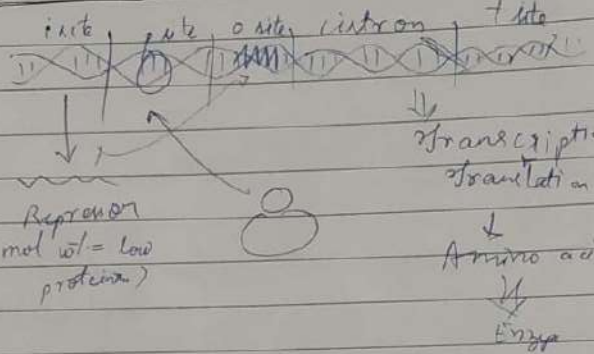
It release RNA polymerase after functioning
↳ last operon on mechanism



- If the inducer protein repressor also to present of lactose molecule, the protein repressor bind & become inactive, the RNA polymerase bind with p site of DNA with the help of sigma factor

- The free o site allow movement of core enzyme from the cistron area and start transcription & translation.
- After transcription & translation, they produce mRNA, amino acid, protein & equivalent enzyme like lactase.
- The lactase digest lactose molecule & form 1 molecule glucose & 1 molecule galactose.
- The lactose molecule act as inducer therfore, lac operon is also called inducible operon.

Off mechanism

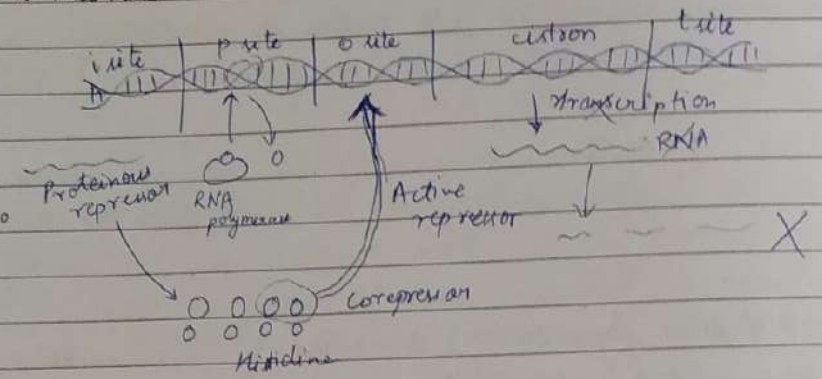


- The i site produce proteinous repressor
- Due to absence of lactose molecule, the proteinous repressor bind with o site of DNA.
- Due to blockage of o site, the core enzyme not move on the cistron area.
- Their are no transcription & translation process resulting no RNA, amino acid, protein & enzyme synthesis.

Q Which is incorrect
a) i gene codes for repressor of lac operon
b) z gene —— galactosidase
c) y gene —— transacetylase

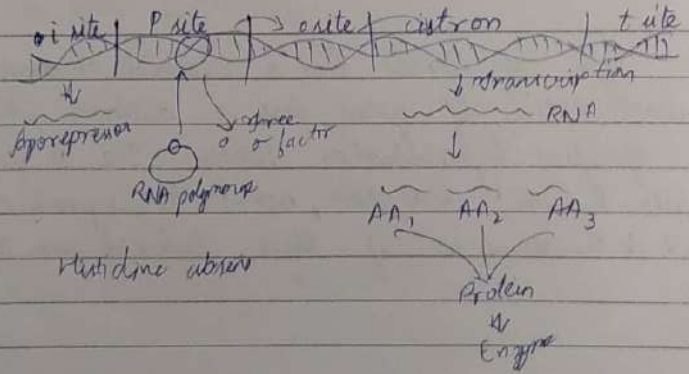
His operon

ON mechanism



- The i site produce apo repressor.
- Due to presence of histidine molecule
- The corepressor bind with o site of DNA.
- The RNA polymerase bind with p site of DNA with the help of σ factor.
- Due to blockage of o site, the RNA enzyme not move on the cistron area, resulting in no transcription & translation. result is no RNA, no amino acid, no protein, no equivalent enzyme.
- Histidine operon is also called repressable operon.

OFF mechanism



- i site produce aporepressor.
- The corepressor bind with p site of DNA
- Their is no corepressor due to absence of histidine.
- RNA polymerase bind with p site of DNA with the help of σ factor.
- Due to absence of ~~abstract~~ corepressor, the ~~enzyme~~ factor moved through the site of ~~six~~ cistron & undergoes transcription & translation.

Q Albinism (lack of skin pigmentation) is caused by a recessive autosomal. A man and a woman, both normal, have an albino child together, the couple then have a 2nd child. What is the probability that the second child will be albino
a) 0% b) 25% c) 50% d) 75%.

QQ DNA was isolated from wild type (galactose +ve) and mutant (galactose -ve). E.coli is separated by density gradient centrifugation technique. DNA from gal -ve strain acquire a lower position. This indicate ~~that~~ that the mutation is caused by
a) Deletion b) Insertion c) Missense mutation
d) point mutation

Q A certain type of grass has a diploid chromosome no. of 8. A similar specie of grass has a diploid chromosome no. 10 inter specific hybridisation between the 2 species result in sterile hybrid that can, nonetheless, reproduce vegetatively. The diploid chromosome no. of this hybrid would be.
Ans 9

Q. 2 organism with a genotype of $Tt\ \frac{Gg}{Gg}$. T - Height G → Colour are mated with each other. What is the probability for the offspring to carry only 1 of the dominant character

a) $\frac{6}{16}$ b) $\frac{1}{16}$ c) $\frac{4}{16}$ d) $\frac{1}{4}$

Q. In a population that is in Hardy Weinberg equilibrium, the frequency of a recessive allele for a certain recessive trait 0.2. What percentage of the individual in nexet generation would be expected to show dominant trait

a) 8% b) 16% c) 32% d) 64% e) 96%

0.08 0.2 0.04

Q. How many meiotic divison required to form 100 seed plant

$n + \frac{n}{4} = 125$

Q. A segment of DNA has base sequence AAG, GAG, GAC, GAA, CCA. Which of the following sequence represent a frame shift mutation.

a) AAG, GAG, GAC, CAA, CCA
b) AGG, AGG, ACC, AAC, CAA
c) ACG, GAC, GAC, CAG, CCA
d) AAG, GCG, GAC, CCA, AGG

• Interferon - kill virus

Q A shell at telophase stage is observed by a student in plant ~~root~~ brought from the field. He tells his teacher that this shell is not like other shell at telophase stage. There is no formation of cell plate & thus the cell is containing more no. of chromosome as compared to other dividing shell. This could result in

a) Aneuploidy b) Polyploidy c) Somaclonal variation
d) Polytany

Somaclonal variation

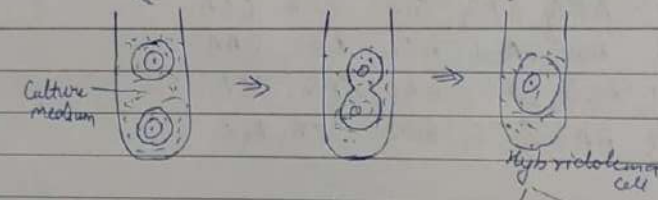
eg: Hybridoma cell

Lymphocyte cell
Human being

• Production of antibody
• Slow growth in culture medium

Myeloma cell
Mouse

• No antibody production
• Fast growth in culture medium



Q Out of 8 ascospore ~~arrangement~~ form in Neurospora the arrangement 2a : 4a : 2a showing

a) No crossing over
b) Meiosis
c) 2nd generation division
d) 1st ——"——

Southern - DNA
Northern - RNA
Eastern - Protein

Q Out of 64 codon, 61 codon a codon code for 20 types of amino acid. It is also called
a degeneracy of secondary codon
b overlapping of gene
c wobbling of codon - 3rd base position not changes the amino acid
d Universal of codon

Wobble hypothesis - Crick

Q During transcription, RNA polymerase holoenzyme bind to a gene promotor and assume a saddle like structure. Wh is its DNA binding sequence
a AATT
b GACC
c TATA

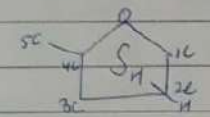
Q What would be the no. of chromosome of the aleuro cell of a plant with 42 chromosome in its root tip ce
a 42 c 64
b 63 d 21

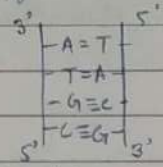
Aleurone - Part of endosperm
3n
n=21

Flowering → Gibberalin

Vernalisation: Treatment through low temp.
Temp → Vernalin - Vernalisation
Light → Florogen - Photoperiodism

DNA

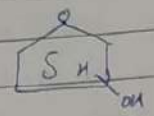
- Deoxy ribonucleic acid
- 
- DNA - double stranded
  exception - $\phi x 174$
- N_2 base: A, T, G, C
- Chargaff's rule applicable



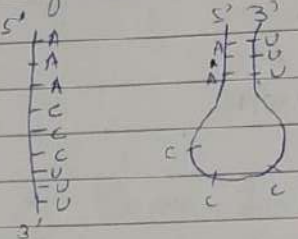
- DNA Felgeon +ve

RNA

- Ribonucleic acid



- Single strand
  exception - Rheo virus
- N_2 base: A, U, G, C
- Not applicable but
  partially applicable
  in folded structure



~~Linear fashion~~
No base pairing

- RNA Felgeon -ve

Palindrome sequence

It is special type of ~~DNA~~ sequence of nitrogenous base present in DNA. It is also called ~~malayalam~~ malayalam DNA.

Palindrome sequence correct the ~~to~~ sequence of N_2 base by the ~~use~~ presence of ~~N_2 base and~~ enzyme like restriction endonuclease and DNA ligase.

Nuclease

Nuclease

- **Exonuclease**
  - % cut DNA at terminal position
- **Endonuclease**
  - % cut DNA at intercalary position
- **Restriction endonuclease**
  - % cut DNA at specific sequence of intercalary position of DNA
  - Cut pallindrome sequence

E. coli

- 6 base cutter - GAATTC

Q E.coli with completely radioactive DNA was allowed to replicate in non-radioactive medium for 2 generation. % of bacteria with radioactive DNA is
a) 100% b) 50% c) 25% d) 12.5%

Q Which of the following statements are incorrect for photorespiration
a) It produce ATP b) It produce amino acid c) occurs in chloroplast, peroxisome & mitochondria
d) Formation of H_2O_2

Q Which of the following acid is partner of phosphoglyceric acid during C_2 cycle?
a) Glycolic acid b) phosphoglycolic acid c) oxaloacetic acid
d) pyruvic acid

Q Which of the following is non-human model of organism?
a) Bacteria
b) Yeast
c) Caenorhaptitis
d) All of the above

Q Which of the following non-human modern organism is non-pathogenic?

a) Bacteria
b) Yeast
c) Caenorhaptition
d) Drosophila

BAC (Bacterial Artificial Chromosome) - Vector
YAC (Yeast Artificial chromosome) - Vector

EST, Sequence Annotation - coding & non coding sequence

P

RNA polymerase

RNA polymerase I	RNA polymerase II	RNA polymerase III
Transcript rRNA (28S, 80S, 5.8S)	• Precursor of mRNA and mRNA	• tRNA, 5S rRNA & snRNA
Traffic junction -	Non equilibrium state	