FREE NOTES · NCERT + NEET LEVEL

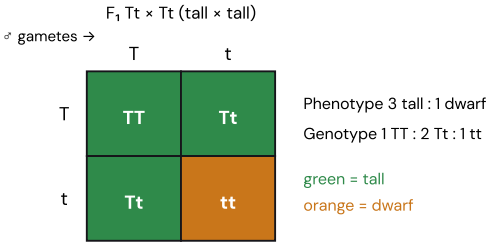
Principles of Inheritance & Variation

Mendel ke experiments aur laws, monohybrid aur dihybrid cross, incomplete dominance, co-dominance, multiple alleles, pleiotropy, polygenic inheritance, chromosomal theory, linkage, sex determination, mutation, pedigree analysis, Mendelian aur chromosomal disorders.

01 Mendel aur unke laws
02 Dihybrid cross aur apvaad
03 Polygenic inheritance aur chromosomal theory
04 Sex determination
05 Mutation aur pedigree analysis
06 Genetic disorders
07 Extra + tricks
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Mendel aur unke laws

- Gregor Mendel (1856–1863) matar (*Pisum sativum*) pe: 7 jode virodhi gun (stem lambai, phool ka rang, phool ki jagah, pod shape, pod rang, beej shape, beej rang). True-breeding lines aur statistics.
- Factors (ab genes) jode me; alleles = alag roop. Dominant, recessive. Genotype vs phenotype.
- **Law of dominance**: alag jode me ek factor haavi. **Law of segregation**: gamete bante samay alleles alag (gametes hamesha shuddh).
- **Test cross**: F_1 × recessive parent; 1:1 ⇒ heterozygous.
- Monohybrid F_2: phenotype 3:1, genotype 1:2:1.



Monohybrid cross ka Punnett square

02 Dihybrid cross aur apvaad

- Dihybrid (round yellow RRYY × wrinkled green rryy): F_2 **9:3:3:1**. **Law of independent assortment**: ek jode ka alag hona doosre se independent.
- Mendel ka kaam 1865 me chhapa, 1900 me de Vries, Correns, von Tschermak ne dobara khoja.
- **Incomplete dominance**: snapdragon/dog flower (*Antirrhinum*): laal × safed ⇒ gulabi F_1; F_2 1 laal : 2 gulabi : 1 safed.
- **Co-dominance**: ABO blood groups (gene I, alleles I^A, I^B, i): AB me I^A aur I^B dono. **Multiple alleles** ka bhi example (3 alleles, 6 genotypes, 4 phenotypes).
- **Pleiotropy**: ek gene, kai asar: phenylketonuria; matar me starch gene (bade/chhote starch grains aur round/wrinkled beej).
- Dominance product pe nirbhar: matar me B enzyme sugar ko starch banata.

03 Polygenic inheritance aur chromosomal theory

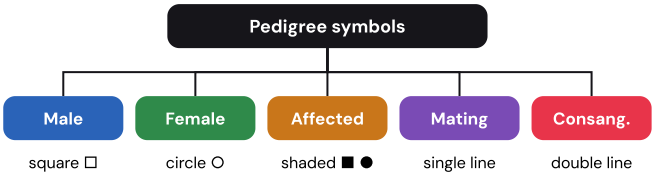
- **Polygenic**: 3 ya zyada genes, har ek ka jud-ne wala asar; jaise insaan ki skin ka rang, lambai. Lagataar range (bell curve).
- **Chromosomal theory of inheritance**: Sutton aur Boveri (1902): chromosomes ki chaal Mendel ke laws samjhaati.
- **T.H. Morgan** *Drosophila melanogaster* pe (fruit fly: 2 hafte me life cycle, bahut bachche, aasaani se paalna, male/female saaf, kai dikhne wale variations).
- **Linkage**: ek chromosome ke genes saath jaate. **Recombination**: naye combinations. Kaske jude genes: kam recombination (white/yellow: 1.3%); dheele: zyada (white/miniature: 37.2%).
- **Sturtevant** ne recombination frequency se genes ka map banaya.

04 Sex determination

System	Female	Male	Example
XX–XO	XX	XO (male heterogametic)	Tiddda, kai insects
XX–XY	XX	XY (male heterogametic)	Insaan, *Drosophila*
ZW–ZZ	ZW (female heterogametic)	ZZ	Birds
Haplodiploidy	Diploid (fertilised egg)	Haploid (unfertilised egg, parthenogenesis)	Madhumakkhi

Henking (1891) ne insects me "X body" dekha. Insaan me har pregnancy me ladka ya ladki 50% chance; ling pita ka sperm tay karta.

05 Mutation aur pedigree analysis



Pedigree charts ke aam symbols

- **Mutation**: DNA sequence me badlav ⇒ genotype aur phenotype badalta. Chromosomal aberrations (deletion, insertion, duplication) aksar cancer cells me. **Point mutation**: ek base badalna (sickle-cell anaemia). Frameshift: bases ka hatna/judna. Mutagens: UV, chemicals.
- **Pedigree analysis**: family tree me peedhi-dar-peedhi gun ka adhyayan; disorders ki virasat (autosomal ya sex-linked, dominant ya recessive) pata karne me.

06 Genetic disorders

Disorder	Type	Key feature
Haemophilia	Sex-linked recessive	Clotting protein defect; small cut ⇒ non-stop bleeding; carrier females transmit to sons; royal family of Queen Victoria
Sickle-cell anaemia	Autosomal recessive	Glu → Val at 6th position of β-globin (GAG → GUG); Hb^sHb^s affected; RBCs sickle-shaped at low O_2
Phenylketonuria	Autosomal recessive (inborn error)	Lacks enzyme converting phenylalanine to tyrosine; mental retardation; phenylpyruvic acid in urine
Colour blindness	Sex-linked recessive	Red/green cones defective; ~8% males, 0.4% females
Thalassaemia	Autosomal recessive	Reduced synthesis of α (α-thal, genes HBA1, HBA2 on chr 16) or β globin (β-thal, HBB on chr 11); quantitative problem (sickle cell = qualitative)
Down's syndrome	Trisomy 21	Short stature, small round head, furrowed tongue, partially open mouth, palm crease, retarded development (Langdon Down, 1866)
Klinefelter's	47, XXY	Male, gynaecomastia, sterile, overall masculine development
Turner's	45, XO	Female, sterile (rudimentary ovaries), lack secondary sexual characters

Aneuploidy from failure of chromatid segregation; polyploidy (common in plants) from failure of cytokinesis.

07 Extra + tricks

Syndrome	Kaaran
Patau	Trisomy 13
Edwards	Trisomy 18
Down	Trisomy 21
Cri-du-chat	Chromosome 5 pe deletion (billi jaisi awaaz)
Klinefelter	47, XXY
Turner	45, XO
Cystic fibrosis	Autosomal recessive; lungs, aant me gaadha mucus

- Gamete types = $\mathbf{2^n}$ (n = heterozygous jode); F_2 genotypes = 3^n; F_2 phenotypes (complete dominance) = 2^n.
- *Drosophila* me X:A ratio: 1 = female, 0.5 = male, >1 = super female, <0.5 = super male, beech me = intersex.
- Pedigree tricks: swasth parents ka bimaar bachcha ⇒ **recessive**; har peedhi me ⇒ aksar **dominant**; zyada purush + carrier maa se ⇒ **X-linked recessive**.

- Haemophilia A = factor VIII; B = factor IX (Christmas disease).

08 Important Q&A

Q1. Blood group A ka purush aur B ki mahila; bachcha O. Parents ke genotype?

Pita I^Ai, maa I^Bi (dono heterozygous); bachcha ii.

Q2. Snapdragon F_2 me 1:2:1 phenotype kyun?

Incomplete dominance: heterozygote (Rr) gulabi, beech wala, isliye har genotype ka alag phenotype.

Q3. Haemophilia purushon me zyada kyun?

X-linked recessive; purush me ek X, ek kharab allele kaafi; mahila ko do chahiye.

09 Common mistakes

- ABO ko sirf co-dominance kehna (multiple alleles bhi).
- Dihybrid test cross ratio 9:3:3:1 likhna (1:1:1:1 hai).
- Kehna ki insaan me female heterogametic.
- Thalassaemia (matra) aur sickle-cell (gunvatta) mix karna.

10 Practice (NEET style)

1. Dihybrid ka F_2 ratio?
2. Turner's ka karyotype?
3. Morgan ka organism?
4. Birds me sex determination?
5. Trisomy 21 se?

ANSWERS

1) 9:3:3:1 · 2) 45, XO · 3) *Drosophila* · 4) ZW female, ZZ male · 5) Down's syndrome

11 Quick revision: exam se 5 minute pehle

MENDEL

- 3:1, 1:2:1
- 9:3:3:1
- Test cross 1:1

BEYOND MENDEL

- Snapdragon incomplete
- ABO co-dominant, multiple alleles
- Skin colour polygenic

CHROMOSOMES

- Sutton–Boveri theory
- Morgan linkage
- XO tidda, ZW birds

DISORDERS

- Haemophilia, colour blindness X-linked
- Sickle GAG→GUG
- Down 21, Klinefelter XXY, Turner XO

Koi doubt? padhaiadda.netlify.app pe AI Doubt Solver se poocho, ya is chapter ka mock test do.