Principles of Inheritance and Variation Class 12 Key Points

CBSE Class 12 Biology · NCERT · for boards, NEET and JEE revision

ChapterNotes

Mendel & the Garden Pea

Pisum sativum · 7 pairs of contrasting traits · true-breeding lines

Pea chosen for easy self/cross-pollination and a short life cycle.

- Allele = an alternative form of a gene
- Homozygous (TT/tt) vs heterozygous (Tt)
- Dominant allele masks the recessive one in a heterozygote

Monohybrid Cross & First Two Laws

F_2 phenotype 3:1 · F_2 genotype 1:2:1

Law of Dominance + Law of Segregation (purity of gametes).

- Dominance: only the dominant allele shows in a heterozygote
- Segregation: the two alleles separate, so each gamete gets only one
- Alleles do not blend or contaminate each other

Dihybrid Cross & Independent Assortment

$F_2 = 9:3:3:1$ · gamete types $= 2^n$ · test cross = 1:1:1:1

9:3:3:1 is just (3:1) × (3:1) - each gene still 3:1.

- RrYy makes 4 gamete types: RY, Ry, rY, ry (equal)
- Independent assortment: one gene pair sorts independent of another
- RrYy × rryy test cross gives a 1:1:1:1 ratio

Incomplete Dominance & Codominance

Incomplete dom → 1:2:1 (RR red × rr white = Rr pink)

Antirrhinum/Mirabilis pink; here F_2 phenotype ratio = genotype ratio.

- Incomplete dominance: heterozygote is intermediate (pink)
- Codominance: both alleles fully expressed → blood group AB
- Codominant ABO alleles: I^A and I^B

ABO Blood Groups

Alleles I^A, I^B, i · I^A & I^B dominant over i

Gene codes a sugar-adding enzyme on the RBC surface.

- Group A = $I^A I^A$ or I^A i; Group B = $I^B I^B$ or I^B i
- Group AB = $I^A I^B$ (codominance); Group O = ii
- I^A vs i shows complete dominance, I^A vs I^B shows codominance

Epistasis, Pleiotropy & Polygeny

Epistasis: 12:3:1 · 9:3:4 · duplicate dominant 15:1

Epistatic gene masks; hypostatic gene is masked.

- Pleiotropy: one gene affects many traits (e.g. PKU)
- Polygeny: many genes add up → continuous variation (skin colour)
- Each affects the 9:3:3:1 dihybrid ratio differently

Linkage & Recombination

Map distance (cM) = (recombinants / total) × 100

1% recombination = 1 centimorgan (1 map unit); Morgan in Drosophila.

- Tightly linked genes → low recombination; loosely linked → high
- Recombination comes from crossing over in meiosis I
- Chromosomal Theory (Sutton & Boveri): genes lie on chromosomes

How Sex Is Decided

XX-XY (human) · XX-XO (grasshopper) · ZZ-ZW (birds)

In humans the father's sperm (X or Y) decides the child's sex.

- Human male is heterogametic (XY), female homogametic (XX)
- Grasshopper male is XO (one X, no Y)
- Birds: female is heterogametic (ZW), male is ZZ

Mendelian & Chromosomal Disorders

Sickle-cell: Glu → Val at 6th position of β-globin (HbS)

Down's, Klinefelter's, Turner's arise from non-disjunction.

- X-linked recessive: haemophilia, colour blindness
- Autosomal recessive: sickle-cell anaemia, PKU, thalassemia
- Down's = trisomy 21 · Klinefelter's = XXY · Turner's = XO

Quick revision

- Monohybrid F_2: 3:1 phenotype, 1:2:1 genotype. Dihybrid F_2: 9:3:3:1.
- Law of Segregation has no exception; Law of Independent Assortment applies only to unlinked genes.
- Incomplete dominance gives 1:2:1 phenotype; codominance shows both alleles (blood group AB).
- ABO blood group is an example of multiple alleles and codominance.
- Linked genes are inherited together; crossing over produces recombinants.
- Humans are XX-XY; the sperm decides sex. Birds are ZZ-ZW; honeybees use haplodiploidy.
- Down = trisomy 21, Klinefelter = XXY, Turner = X0. Haemophilia and colour blindness are X-linked recessive.

Full chapter notes with solved examples and practice questions: https://chapternotes.in/cbse/class-12-biology/principles-of-inheritance-and-variation-class-12-notes/