

CLASS 12 BIOLOGY – SUPER STUDY GUIDE

UNIT: Genetics, Molecular Biology & Evolution

CHAPTER 1: PRINCIPLES OF INHERITANCE & VARIATION

(Genetics: Mendel → Chromosomes → Disorders → Pedigree → Variations)

1. THEORY IN SIMPLE WORDS + VISUALS

1.1 Mendel's Experiments (Easy Explanation)

Think of genes like "instruction cards" inside your body.
Each person gets **one card from mom + one from dad.**

Mendel used **pea plants** because they grow fast and have clear traits.

Mental Image:

Pea plant as a **vending machine** that gives 2 "gene coins" → 1 from each parent.

1.2 Key Terms (Super Simple)

Term	Meaning (Easy)	Visual Trick
Gene	A trait unit	"Recipe step" in a cookbook
Allele	Different versions of a gene	Same ice-cream, different flavors
Homozygous	Same alleles (RR, rr)	Two same-colored socks
Heterozygous	Different alleles (Rr)	One red + one blue sock
Phenotype	Visible trait	What you see
Genotype	Gene combination	What's written inside

1.3 Mendel's Laws (Flowchart)

→ Law of Dominance

Dominant allele hides recessive.

Rr → R shows

→ Law of Segregation

Alleles separate during gametes.

(Rr → R or r)

→ Law of Independent Assortment

Alleles of different traits mix independently.

1.4 Types of Inheritance

Heart 1. Incomplete Dominance:

Neither allele is fully dominant → mixed phenotype

Example: Snapdragon → Red × White = Pink

Heart 2. Codominance:

Both alleles show → both traits visible

Example: AB Blood Group

Heart 3. Multiple Alleles:

More than 2 alleles in population

Example: ABO Blood Group (IA, IB, i)

Heart 4. Polygenic Inheritance:

Many genes controlling 1 trait

Examples: height, skin color

Mental image: Several "color pencils" together create final shade.

1.5 Chromosomal Basis of Inheritance

Concept

Simple Meaning

Gene → located on → Chromosome

Chromosome → two alleles

like 2 stripes on a belt

Sex determination

XX (female), XY (male)

1.6 Genetic Disorders (Simple Table)

Disorder	Type	Cause	Symptoms
Color blindness	Sex-linked	X-chromosome	Cannot differentiate colors

Disorder	Type	Cause	Symptoms
Haemophilia	Sex-linked	X-chromosome	Excessive bleeding
Thalassemia	Autosomal	Defective Hb	Anemia
Sickle cell anemia	Autosomal	Point mutation	RBC sickle shape
Down's syndrome	Chromosomal	Trisomy 21	Mental retardation

★ CHAPTER 2: MOLECULAR BASIS OF INHERITANCE

(DNA → Replication → Transcription → Translation → Genetic Code → Regulation)

2. THEORY IN SIMPLE WORDS + VISUALS

💡 2.1 DNA Structure (Kid-Friendly)

Imagine DNA as a **twisted ladder**:

- Sugar–phosphate = ladder sides
- Bases (A, T, G, C) = rungs

Base pairing rule:

A ↔ T (2 H-bonds)

G ↔ C (3 H-bonds)

🧠 *Memory trick:*

AT → 2 lines (2 bonds)

GC → looks like 3 lines (3 bonds)

💡 2.2 DNA Replication (Flowchart)

Goal: Copy entire DNA before cell divides.

1. Helicase → **unzips** DNA
2. Primase → adds **RNA primer**
3. DNA polymerase → builds new strand
4. Ligase → **glues** Okazaki fragments

🧠 *Analogy:*

Replication is like **unzipping a jacket** → stitching 2 new jackets from it.

💡 2.3 Transcription

DNA → mRNA

Think of DNA as a **master book**, mRNA as a **photocopy of one chapter**.

💡 2.4 Translation

mRNA → Protein

Steps:

1. Initiation
2. Elongation
3. Termination

👉 *Visual:*

Ribosome = **protein factory machine**

tRNA = **delivery trucks carrying amino acids.**

💡 2.5 Genetic Code (Table)

Feature	Meaning
Triplet codon	3 bases = 1 amino acid
Degenerate	Many codons for 1 amino acid
Universal	Same in almost all organisms
Start codon	AUG
Stop codons	UAA, UGA, UAG

⭐ CHAPTER 3: EVOLUTION

(Evidence → Darwin → Hardy-Weinberg → Speciation)

3. THEORY + VISUALS

⌚ 3.1 Evidence of Evolution

Evidence	Example	Visual
Fossils	Dinosaurs	Old photos

Evidence	Example	Visual
Homologous organs	Forelimbs of humans/whales	Same design, diff use
Analogous organs	Wings of insects/birds	Diff design, same use
Biochemical	DNA similarity	Matching barcodes

3.2 Darwin's Natural Selection (Easy)

Nature chooses the **fittest** like a game where strongest characters survive.

Steps:

1. Variation
2. Competition
3. Survival of fittest
4. Descent with modification

3.3 Hardy–Weinberg Principle (Formula)

Population is genetically stable if:

$$\begin{aligned} p^2 + 2pq + q^2 &= 1 \\ p + q &= 1 \end{aligned}$$

Where:

p = frequency of dominant allele

q = frequency of recessive allele

SOLVED NUMERICAL PROBLEMS

1. Monohybrid Cross

Q: Tall (Tt) × Tall (Tt)

Find phenotype ratio.

Solution:

Punnett square → TT, Tt, Tt, tt

Phenotype: 3 Tall : 1 Dwarf

2. Hardy–Weinberg Numericals

Q: If $q = 0.2$, find p .

$$p + q = 1$$

$$p = 1 - 0.2 = 0.8$$



PREVIOUS YEARS' QUESTIONS (Solved)

1. Define codominance.

Ans: Both alleles express equally. Example: AB blood group.

2. What is Okazaki fragment?

Ans: Short DNA fragments formed on lagging strand during replication.

3. Difference between homologous and analogous organs.

Homologous → same origin

Analogous → same function

⚡ QUICK REVISION NOTES (1-PAGE)

Principles of Inheritance

- Law of dominance
- Law of segregation
- Law of independent assortment
- Monohybrid 3:1, Dihybrid 9:3:3:1
- Sex-linked diseases
- Pedigree symbols

Molecular Biology

- DNA structure
- Replication enzymes
- Transcription steps
- Translation steps
- Genetic code features

Evolution

- Homologous vs Analogous
 - Natural selection
 - Hardy–Weinberg formulas
 - Types of evolution
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PREDICTED QUESTIONS (HIGH-YIELD)

Short Answer

- Explain incomplete dominance with example.
- Draw DNA double helix diagram.
- What is a codon?

Long Answer

- Describe DNA replication.
- Explain Darwin's theory with examples.
- Hardy-Weinberg principle: conditions + numericals.

Diagram-Based

- Pedigree chart
 - tRNA structure
 - DNA replication fork
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EXAM TIPS & TRICKS

Genetics

- ✓ Always write genotype **first**, phenotype **second**
- ✓ For dihybrid: use **FOIL method**
- ✓ Write **Punnett squares cleanly** → fetches marks

Molecular Biology

- ✓ Label diagrams (DNA, transcription unit)
- ✓ Write **enzymes in sequence**
- ✓ Learn codons: **AUG start, UAA/UGA/UAG stop**

Evolution

- ✓ Always differentiate homologous vs analogous
 - ✓ Use examples (whale flipper = homologous)
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FUN VISUAL MEMORY TRICKS

- **DNA ladder:** A-T = "Apple-Tree", G-C = "Girl-Couch"
- **Evolution Pillow:** HOMO-logous = "HOME design same"
- **Genetic code:** AUG = "*August starts school*" → *Start codon*