Molecular Basis of Inheritance Class 12 Key Points

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

ChapterNotes

DNA Structure (Watson-Crick)

A=T (2 H-bonds) · G≡C (3 H-bonds)

Purines A,G (double ring) pair with pyrimidines T,C (single ring).

- Strands antiparallel: one 5'→3', other 3'→5'
- Backbone joined by 3'-5' phosphodiester bonds
- Right-handed helix, base + sugar = nucleoside; + phosphate = nucleotide

Helix Dimensions & Chargaff

0.34 nm/bp · 3.4 nm/turn · 10 bp/turn

Chargaff's rule: A = T and G = C, so A+G = T+C.

- Length = (number of bp) × 0.34 nm
- Turns = (number of bp) ÷ 10
- If C = 22% then G = 22%, so A = T = (100 – 44)/2 = 28%

Nucleosome & Chromatin

Nucleosome = ~200 bp DNA + histone octamer (2× H2A,H2B,H3,H4)

H1 is a linker histone, NOT part of the octamer. Human cell ~6.6×10^9 bp.

- Negative DNA wraps positive histones (rich in lysine & arginine)
- Beads-on-string → solenoid → chromatin fibre → chromosome
- Euchromatin = loose/active; Heterochromatin = dense/inactive

Search for Genetic Material

Hershey-Chase: ^{32}P → DNA · ^{35}S → protein

Only ^{32}P (DNA) entered bacteria; ^{35}S coat stayed outside.

- Griffith (1928): transforming principle in Streptococcus pneumoniae
- Avery-MacLeod-McCarty: transforming principle is DNA (DNase destroys it)
- Hershey-Chase (1952) used bacteriophages → DNA is genetic material

DNA Replication

DNA polymerase adds dNTPs only 5'→3' · needs RNA primer

Meselson-Stahl (1958): $^{15}N\rightarrow{}^{14}N$ in E. coli, hybrid DNA after 1 generation (CsCl).

- Leading strand continuous; lagging strand = Okazaki fragments joined by DNA ligase
- Starts at origin (ori); occurs in S phase in eukaryotes
- dNTPs supply both bases and energy; polymerase proofreads

Transcription

RNA = coding strand sequence with T → U

Template strand read 3'→5'; coding (sense) strand NOT copied.

- Transcription unit = promoter + structural gene + terminator
- Eukaryotes: Pol I → rRNA, Pol II → mRNA (hnRNA), Pol III → tRNA
- hnRNA processing: splicing (remove introns) + 5' cap + 3' poly-A tail

The Genetic Code

64 codons · AUG = start (Met) · UAA, UAG, UGA = stop

Degenerate (many codons→1 aa) but unambiguous, universal, comma-less.

- Triplet, non-overlapping, read continuously
- 3 stop codons code no amino acid
- Amino acids = (coding nucleotides ÷ 3) – 1 (for the stop codon)

Translation

tRNA = adaptor (anticodon ↔ codon) · rRNA = ribozyme

UTRs flank the coding region but are not translated.

- Initiation: ribosome assembles at start codon AUG
- Elongation: peptide bonds join amino acids as ribosome moves
- Termination: at a stop codon, polypeptide is released

lac Operon (Jacob & Monod)

Lactose = inducer → inactivates repressor → genes transcribed

Inducible system, negative regulation; lactose is substrate AND switch.

- Structural genes z (β-galactosidase), y (permease), a (transacetylase)
- i gene makes repressor that binds operator and blocks transcription
- Add lactose → repressor off → RNA polymerase transcribes the operon

HGP & DNA Fingerprinting

Human genome ~3×10^9 bp · ~2% codes protein · ~30,000 genes

DNA fingerprinting (Alec Jeffreys) compares VNTRs (minisatellites).

- HGP 1990-2003; Chromosome 1 most genes, Y fewest
- Methods: ESTs (expressed genes) and sequence annotation (whole genome)
- Fingerprinting steps: isolation → digestion → electrophoresis → blotting → probe → autoradiography

Quick revision

- DNA: double helix, antiparallel, A=T (2 H-bonds), G≡C (3 H-bonds), 3.4 nm pitch
- Replication: semiconservative (Meselson-Stahl); leading (continuous) + lagging (Okazaki fragments)
- Transcription: template 3'→5'; RNA Pol II makes mRNA in eukaryotes
- Genetic code: 64 codons (61 sense + 3 stop); AUG = start; degenerate, universal
- Translation: initiation (AUG) → elongation → termination (UAA/UAG/UGA)
- Lac operon: inducible; lactose = inducer; repressor blocks operator when no lactose
- HGP: 3.2 billion bp, about 30,000 genes (NCERT estimate), under 2% coding
- DNA fingerprinting: VNTRs, Southern blotting, used in forensics

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