FREE NOTES · NCERT + NEET LEVEL

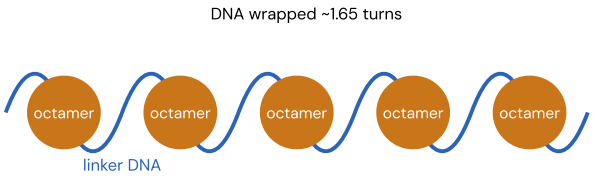
Molecular Basis of Inheritance

DNA structure aur packaging, genetic material ki khoj, RNA world, replication, transcription, genetic code, translation, regulation (lac operon), Human Genome Project aur DNA fingerprinting.

01 DNA structure aur packaging
02 Genetic material ki khoj
03 Replication
04 Transcription
05 Genetic code aur translation
06 Regulation, HGP, DNA fingerprinting
07 Extra + tricks
08 Important Q&A
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11 Quick revision

01 DNA structure aur packaging

- Polynucleotide: nitrogenous base + pentose (deoxyribose) + phosphate. N-glycosidic bond (base–sugar), phosphoester (sugar–phosphate), 3′–5′ phosphodiester (nucleotides ke beech). 5′ phosphate end aur 3′ OH end.
- Lambai: φ×174 phage 5386 nucleotides; λ phage 48,502 bp; *E. coli* 4.6×10^6 bp; human haploid 3.3×10^9 bp.
- Watson–Crick (1953) double helix, **Wilkins aur Franklin** ke X-ray data pe; **Chargaff's rule**: A = T, G = C. Right-handed, antiparallel; pitch 3.4 nm, turn me 10 bp, bp ke beech 0.34 nm. Insaan ka kul DNA ≈ 2.2 m.
- Prokaryotes: negative DNA positive proteins ke saath nucleoid me. Eukaryotes: **histones** (positive; lysine, arginine zyada) octamer; **nucleosome** = ~200 bp. Euchromatin (dheela, active), heterochromatin (ghana, inactive). Upar ki packaging ke liye NHC proteins.



Nucleosome: ~200 bp DNA around histone octamer (beads-on-string)

Nucleosomes: beads-on-string

02 Genetic material ki khoj

Experiment	Khoj
Griffith (1928), *Streptococcus pneumoniae*	S strain (capsule, zehreela) garam karke maara + zinda R strain ⇒ chuhe mare; R "transforming principle" se S bana
Avery, MacLeod, McCarty (1933–44)	Transforming principle DNA hai (DNase ne khatam kiya; protease, RNase ne nahi)
Hershey & Chase (1952)	^{32}P (DNA) aur ^{35}S (protein) wale bacteriophage: sirf ^{32}P bacteria me ⇒ **DNA genetic material**

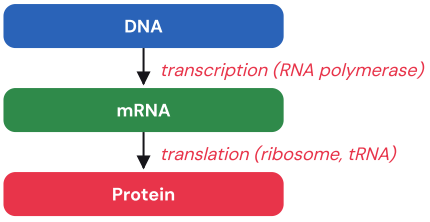
- Genetic material ki shartein: replication, chemical aur structural stability, dheere badlav (mutation) ki gunjaish, Mendelian gun ke roop me dikhna.
- DNA RNA se zyada stable (RNA ka 2′-OH reactive; uracil ki jagah thymine stability). **Pehla genetic material RNA tha** (RNA world): catalyst ban sakta (ribozymes); stability ke liye DNA RNA se bana.

03 Replication

- **Semi-conservative**: har naye DNA me ek purana, ek naya strand. **Meselson aur Stahl** (1958) ne *E. coli* me ^{15}N (bhaari) aur ^{14}N, CsCl density gradient se saabit kiya: 1 peedhi baad hybrid; 2 ke baad barabar hybrid aur light. Taylor ne *Vicia faba* me radioactive thymidine se.
- Enzyme: **DNA-dependent DNA polymerase**; sirf 5′→3′; bahut tez (*E. coli*: 4.6×10^6 bp ~18 min me, ~2000 bp/s) aur sahi. Energy deoxynucleoside triphosphates se.
- **Origin of replication** se shuru; replication fork. **Leading strand** lagataar; **lagging strand** tukdon me (Okazaki fragments), **DNA ligase** jodta.
- Eukaryotes: S phase me replication.

04 Transcription

- DNA se RNA copy; sirf ek strand use. **Template strand** (3′→5′); **coding strand** (5′→3′, RNA jaisa sequence, T ki jagah U; code nahi karta).
- Transcription unit: **promoter** (upstream, coding strand ke 5′ taraf), structural gene, **terminator** (downstream).
- Bacteria: ek RNA polymerase; shuruaat me σ (sigma), ant me ρ (rho) factor. Transcription aur translation saath (nuclear membrane nahi).
- Eukaryotes: RNA pol I (rRNA 28S, 18S, 5.8S), II (hnRNA = mRNA ka pehla roop), III (tRNA, 5S rRNA, snRNA). Processing: **splicing** (introns hatana, exons jodna), **capping** (5′ pe methyl guanosine triphosphate), **tailing** (3′ pe 200–300 adenylates).



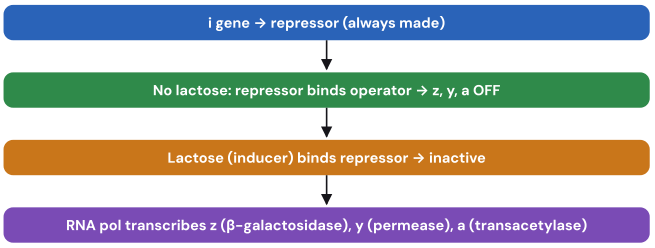
Central dogma (Crick)

05 Genetic code aur translation

- George Gamow: triplet code ($4^3 = 64$ codons). Nirenberg, Khorana (tay sequence wala RNA banana), Severo Ochoa (polynucleotide phosphorylase) ne samjhaya.
- Gun: triplet; 61 amino acids ke, 3 stop codons (UAA, UAG, UGA); ek codon = ek amino acid; **degenerate** (kuch amino acids ke kai codons); lagataar padha jaata; lagbhag **universal**; **AUG** = start codon, methionine.
- **tRNA** (adapter molecule, clover-leaf; 3D me ulta L): anticodon loop, amino acid acceptor end. **Charging** (aminoacylation) me ATP.
- Ribosome pe translation (bade aur chhote subunits; bacteria me 23S rRNA ribozyme, peptide bond banata). mRNA ke 5′ aur 3′ pe **UTRs**. AUG pe shuru, elongation, stop codon pe release factor se ant.

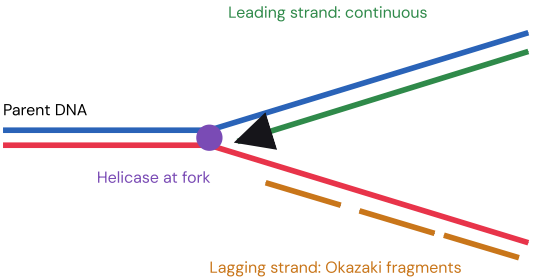
06 Regulation, HGP, DNA fingerprinting

- **Lac operon** (Jacob aur Monod): i (regulator), p, o, structural genes z, y, a. Lactose inducer. Regulation mainly transcription ki shuruaat pe; **negative regulation**.
- **Human Genome Project** (1990, poora 2003; ~13 saal, ~US$ 3 billion). Tareeke: Expressed Sequence Tags (ESTs) aur sequence annotation; BAC/YAC vectors; automated sequencers (Sanger).
- Nateeje: 3164.7 million bp; average gene 3000 bases (sabse bada: dystrophin 2.4 million); ~30,000 genes; sab logon me 99.9% bases same; 50% se zyada genes ka kaam pata nahi; <2% protein code; repeated sequences; ~14 lakh SNPs. Chromosome 1 me sabse zyada genes (2968), Y me sabse kam (231).
- **DNA fingerprinting** (Alec Jeffreys): **VNTRs** (satellite DNA, repetitive; polymorphism). Steps: DNA nikaalna, restriction enzymes, electrophoresis, Southern blotting, VNTR probe se hybridise, autoradiography. Forensics, paternity, population diversity me.



Lac operon: lactose se induction

07 Extra + tricks



Replication fork

Enzyme / protein	Replication me kaam
Helicase	DNA kholta (H-bonds todta)
Topoisomerase (bacteria me gyrase)	Fork ke aage ki uljhan (supercoiling) kam
SSB proteins	Strands alag rakhte
Primase	RNA primer banata
DNA polymerase III (bacteria)	Mukhya synthesis 5′→3′
DNA polymerase I	Primer hataata, gap bharta
DNA ligase	Okazaki fragments jodta

- Bacteria: **polycistronic** mRNA (ek mRNA, kai genes); eukaryotes: **monocistronic**.
- **Nirenberg aur Matthaei**: poly-U RNA se poly-phenylalanine ⇒ UUU = Phe (pehla codon).
- Retroviruses me reverse transcription (RNA → DNA): central dogma ka apvaad.

08 Important Q&A

Q1. DNA me 20% adenine ho to baaki bases?

A = T = 20%; G + C = 60% ⇒ G = C = 30%.

Q2. Coding strand 5′-ATGCATGC-3′ ka mRNA?

5′-AUGCAUGC-3′ (coding strand jaisa, T ki jagah U).

Q3. Hershey aur Chase ne ^{32}P aur ^{35}S kyun?

DNA me phosphorus par sulphur nahi; protein me sulphur par phosphorus nahi; isliye alag pehchaan.

09 Common mistakes

- Kehna ki template strand mRNA jaisa (coding strand hota).
- Code ko ambiguous kehna (unambiguous par degenerate).
- Kehna ki DNA polymerase 3′→5′ (5′→3′ jodta).
- Sochna ki paki mRNA me introns hote.

10 Practice (NEET style)

1. Semi-conservative kisne saabit kiya?
2. Lac operon ka inducer?
3. Start codon?
4. Okazaki fragments jodne wala?
5. DNA fingerprinting ka aadhar?

ANSWERS

1) Meselson and Stahl · 2) Lactose · 3) AUG · 4) DNA ligase · 5) VNTRs

11 Quick revision: exam se 5 minute pehle

DNA

- A=T, G≡C (Chargaff)
- 0.34 nm, 10 bp/turn
- Nucleosome 200 bp

EXPERIMENTS

- Griffith transformation
- Avery: DNA
- Hershey–Chase ^{32}P
- Meselson–Stahl ^{15}N

EXPRESSION

- Splicing, capping, tailing
- 64 codons, 3 stop
- AUG start

REGULATION/HGP

- Lac: z, y, a; lactose inducer
- ~30,000 genes, 99.9% same
- VNTR fingerprinting

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