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Q1(e)

Gene expression.

UPSC Civil Services Mains 2023 · Anthropology GS 1 · 10 marks · The biological basis of Life

1.7 The biological basis of Life: The Cell, DNA structure and replication, Protein Synthesis, Gene, Mutation, Chromosomes, and Cell Division.

Core demand of the question

- Write a note on gene expression
- Keep the note to a 10-mark length of about 150 words

Revision summary

Expression is transcription plus translation under regulatory control.

Crick's **central dogma** names the default flow from DNA to protein.

Enhancers, chromatin, and splicing decide cell-specific products.

Lactase persistence and Tibetan **EPAS1** are anthropological examples of regulatory change.

Epigenetic marks link environment to expression without rewriting the DNA code.

Introduction

Gene expression is the turning of DNA sequence into RNA and protein at the right time and place. A genotype is not a finished trait until this switchboard has worked.

Body**The process**

- Transcription copies a gene into messenger RNA, and translation at the ribosome builds a polypeptide, which **Francis Crick** placed in the **central dogma** of molecular biology.
- Promoters, enhancers, transcription factors, and chromatin packing decide which loci are on in a liver cell and off in a neuron.
- Alternative splicing and RNA editing can make more than one product from one locus, so one-gene-one-trait talk is too crude for anthropology.

Why anthropologists need it

- **Lactase persistence** is a regulatory change near the lactase gene, not a new digestive organ, which is why dairying cultures and genotype must be read together, as in European and some African pastoral histories.
- High-altitude **EPAS1** regulation in Tibetans, and methylation changes under famine or stress, show expression and **epigenetics** as part of human adaptation.
- Disease risk, growth, and pigmentation are therefore expression profiles in environments, not a fixed racial essence.

Flow diagram

DNA -> Transcription
Transcription -> Translation
Translation -> Protein trait
Environment regulators -> Transcription

Conclusion

Gene expression is regulated transcription and translation, not the mere presence of a locus. Human variation in diet, altitude, and disease is often a story of when genes are on.

Facts & figures

Central dogma

Crick's statement that sequence information flows from DNA to RNA to protein as the ordinary cellular path.

Lactase persistence

Adult milk digestion tied to regulatory alleles near LCT, coevolving with dairying in some populations.

EPAS1

A hypoxia-related locus whose regulation is implicated in Tibetan high-altitude adaptation.

Epigenetics

Heritable or stable expression states, including methylation, that do not change the DNA base sequence.