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Q3(b)

Explain the genetic mechanisms of micro and macro evolution

UPSC Civil Services Mains 2021 · Anthropology GS 1 · 15 marks · Synthetic theory of evolution

(c) Synthetic theory of evolution; Brief outline of terms and concepts of evolutionary biology (Doll's rule, Cope's rule, Gause's rule, parallelism, convergence, adaptive radiation, and mosaic evolution).

Core demand of the question

- Discuss the genetic mechanisms of micro and macro evolution
- Write about 200 words for 15 marks

Revision summary

Microevolution is allele-frequency change in a population.

The forces are mutation, selection, drift, gene flow, and non-random mating.

Macroevolution is speciation and higher-level pattern in deep time.

Punctuated equilibrium and regulatory genes are debated extras, not magic.

Hominin splits and isolate drift show both scales in anthropology.

Introduction

Microevolution is change in allele frequencies within a breeding population. Macroevolution is the origin of higher taxa, species, and long-term trends. The same genetic mechanisms scale up, with debate about extra rules.

Body**Microevolutionary mechanisms**

- **Mutation** supplies new alleles. Most are neutral or harmful; a few are useful, as in lactase persistence.
- **Natural selection** changes frequencies by differential survival and fertility. **Sickle-cell** and malaria is the human classroom case.
- **Genetic drift**, including founder effect and bottleneck, is strong in small groups. **Andaman** and other island isolates illustrate drift and founder sampling.
- **Gene flow** mixes populations. Migration prevents full local fixation.
- **Non-random mating**, including inbreeding and assortative mating, changes genotype frequencies and can raise homozygosity.

To the macro scale

- **Speciation** is the hinge. Allopatric isolation, then reproductive barriers, turns micro change into new species. Hominin fossils show this as splitting lineages, not one file.
- **Macroevolution** adds origin of bauplans, mass extinction, and adaptive radiation. **Gould** and **Eldredge** argued punctuated equilibrium: long stasis, then geologically rapid change, still built from genetic processes.

- Chromosomal rearrangements and regulatory (Hox) shifts can produce larger morphological jumps than a single point mutation. They remain genetic mechanisms.

Unity and caution

- The Modern Synthesis treated macro as accumulated micro. Palaeontology adds time, extinction, and development. Anthropology uses both for fossils and living variation.

Flow diagram

Microevolution -> Mutation selection drift flow mating

Microevolution -> Speciation

Speciation -> Macroevolution taxa trends

Macroevolution taxa trends -> Fossil hominin splits

Conclusion

Mutation, selection, drift, flow, and mating rules drive microevolution. Speciation, radiation, and developmental-genetic change carry those mechanisms into macroevolution.

Facts & figures

Hardy-Weinberg

The null model of no change; violation names a microevolutionary force.

Mayr

Biological species concept and allopatric speciation linked genetics to the origin of taxa.

Eldredge and Gould

Punctuated equilibrium read the fossil record as stasis plus rapid branching.

Sickle cell

Selection at one locus as a micro process with large medical phenotype.