



Ultra-Conserved Elements

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Why in News?

A study found that **Ultra-Conserved Elements (UCEs)** in the **Tra2b (Transformer-2 beta) gene** have remained unchanged for **80 million years** due to their role in **preventing infertility** by regulating protein levels.

What are Key Findings of the Study on Ultra-Conserved Elements?

- **Findings of the Study:** Deleting the UCE in mouse testes caused excess Tra2 β protein, sperm cell death, and infertility.
 - A UCE in the *Tra2b* gene regulates Tra2 β protein production by acting as a **poison exon**.
 - When **Tra2 β protein** levels are too high, the **UCE triggers an extra exon** in the gene's RNA, introducing a **stop codon** that halts protein synthesis, preventing overproduction.
 - Mutations disrupting **UCE's protein-limiting function** cause **infertility**, preventing inheritance. Thus [Natural selection](#) has preserved UCEs across species for **millions of years**.
- **Ultra-Conserved Elements: UCEs** are [Deoxyribonucleic acid \(DNA\)](#) sequences of at least 200 base-pairs that have remained **completely unchanged** across multiple species for **80 million years or more**.
 - These sequences are found in humans, mice, rats, chickens, and even fish, indicating their **critical biological importance**.
 - Across the human **genome** (an entire set of DNA instructions found in a cell), there are nearly **500 UCEs**.
 - **Characteristics of UCEs:** UCEs exhibit nearly **identical DNA sequences across diverse species**, even those that are evolutionarily distant.
 - **Functions of UCEs:** They do not usually **code for proteins** but are involved in gene regulation.

DNA to Protein Conversion

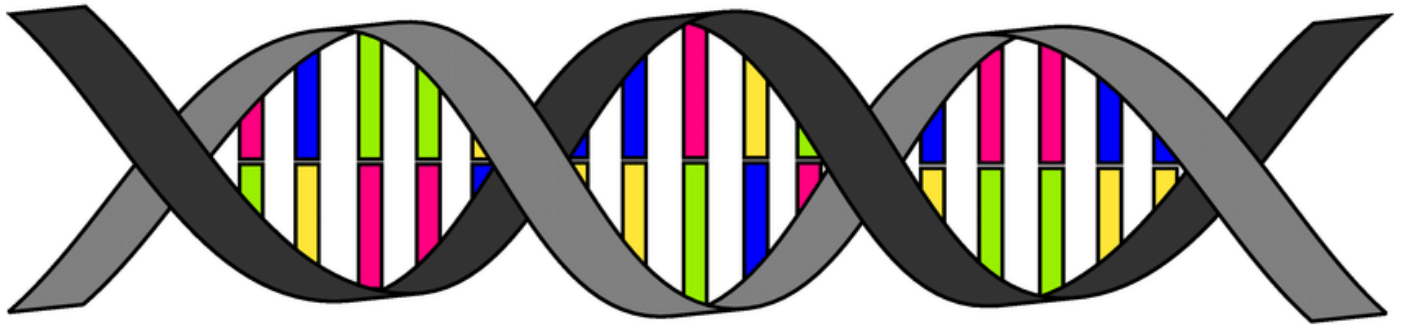
- **DNA Structure:** DNA is a **double-helix molecule**, with each strand consisting of four bases that pair up to hold the strands together.
- **Gene:** A gene is a **short segment of DNA**, typically a few thousand base-pairs long, that carries instructions for making proteins.
- **Transcription:** When a gene is **expressed** (information encoded in a gene is turned into a function), the cell **transcribes** its DNA sequence into **messenger RNA (mRNA)**.
 - **Ribosomes** read the **mRNA sequence** and assemble **amino acids** to form a protein (**Protein Synthesis**). The process **halts at a stop codon**, signaling the completion of protein synthesis.

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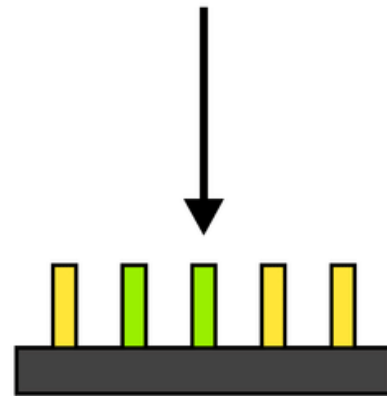
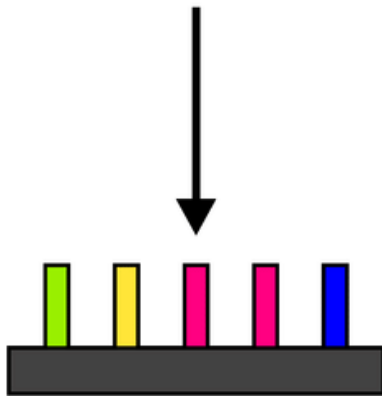
DNA

┌ Gene ─┐

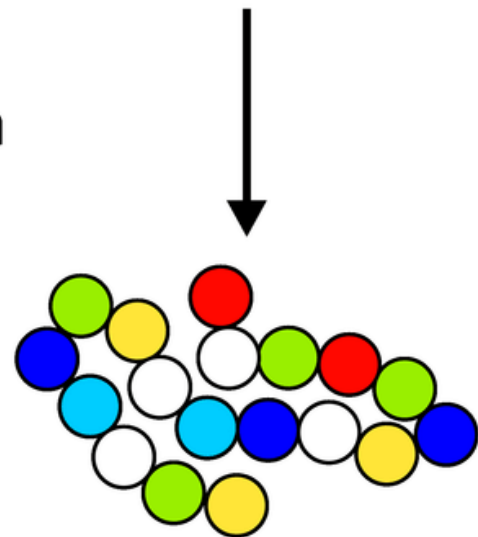
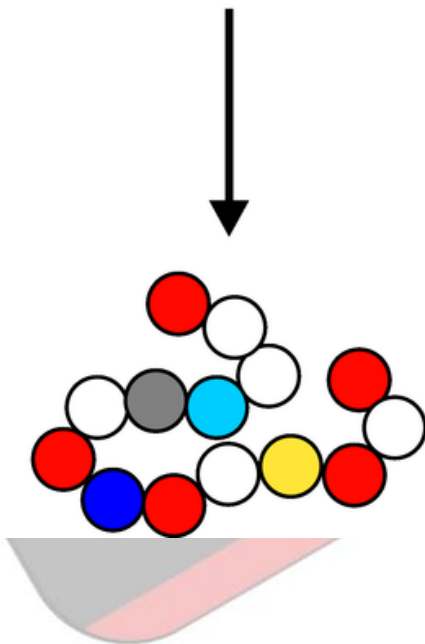
┌ Gene ─┐



mRNA



Protein



UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. What is Cas9 protein that is often mentioned in news? (2019)

(a) A molecular scissors used in targeted gene editing

(b) A biosensor used in the accurate detection of pathogens in patients

(c) A gene that makes plants pest-resistant

(d) A herbicidal substance synthesised in genetically modified crops

Ans: (a)

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