MOLECULAR EVOLUTION: THE ROOTS OF OUR ROOTS

*Genetically, random variation is the result of **Random Mutations** which undergo **Non-Random Selection** and this collectively underpins the whole process of **Evolution** by **Natural Selection***

Fossils in Our Genes and Genomes

Distribution of fossils according to the geological layers of earth

Variable regions develop phylogenetic signals

ACAGCCCGGATACGCTGATG
ACAGCCCGGATACGGTGATG
ACAGCCCGGCTACGGTGATG
ATAGCCCGGCTACGGTGATG
ATAGCCCGGCTACGGTAATG
ATAGCCCGGCTTCGGTAATG
ATAGCCCTGCTTCGGTAATG
ATTGCCCTGCTTCGGTAATG

Molecular Phylogeny is based on comparison of DNA and/or Protein Sequences
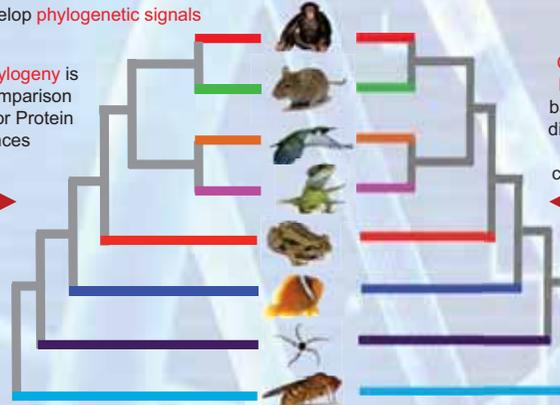
Conventional Phylogeny is based on fossil distribution and anatomical characteristics
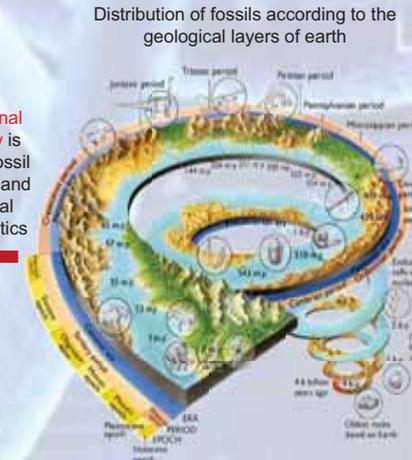
Conserved regions help identifying genes and potentially determine their core function(s)

Phylogeny based on molecular characteristics are broadly inline with the evolutionary tree based on morphological or anatomical characteristics

What is Mutation?

ATTGCCCTGCTTCGGTAATG

ATTGCCCTGCTTCGGTAATG
TAACGGGACGAAGCCATTAC

ATTGCCCTGCTTCGGTAATG
TAACAGGACGAAGCCATTAC

Human DNA polymerase tends to make 0.31 error (mutation) while copying DNA per cell division

Estimated 9 new mutations accumulated in every mature egg of human female

Estimated 124 new mutations accumulated in every mature spermatozoa of human male

Total 133 new mutations accumulated in every single progeny compared to parents

Think! how many mutations will accumulate in millions and billions of years of evolution?

So Little Yet So Big

CTG	ACT	CCT	GAG	GAG	AAG	TCT
Leu	Thr	Pro	Glu	Glu	Lys	Ser

Mutation in only 1 out of 441 bases

Mutation in only 1 out of 147 amino acids

CTG	ACT	CCT	GTG	GAG	AAG	TCT
Leu	Thr	Pro	Val	Glu	Lys	Ser

Normal Blood Cells

Sickle Cell Anemia
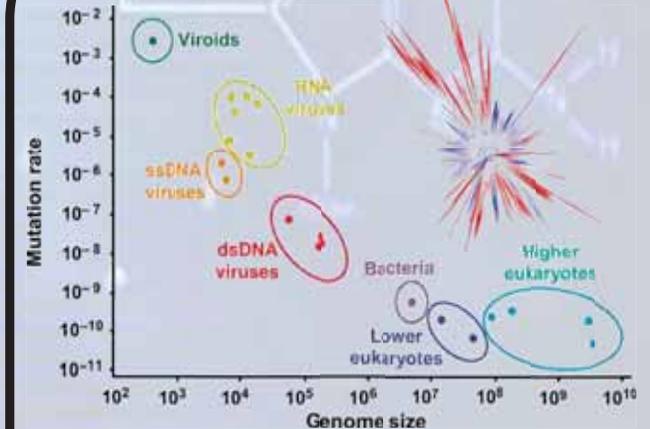
Sickle shaped RBCs tend to get aggregated at the branch point of blood vessels

Life expectancy reduced to 20-30 years

Its All About Race

Mutation rate vs Genome size (Viroids, RNA viruses, ssDNA viruses, dsDNA viruses, Bacteria, Lower eukaryotes, Higher eukaryotes)

Gago et al., 2009. Science. 323: 1308

Survival depends how fast organism evolves in response to its environment

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