

# Break

# Codon-substitution models

- In 1994, first tractable mechanistic evolutionary models for codon sequences were proposed by **Muse and Gaut** (MG94), and, independently, by **Goldman and Yang** (GY94) [in the same issue of MBE, back to back]
- Markov models of codon substitution provide a powerful framework for **estimating substitution rates** from coding sequence data, as they
  - *encode our mechanistic understanding of the evolutionary process,*
  - *enable one to compute the phylogenetic likelihood,*
  - *permit hypothesis testing or Bayesian inference,*
  - *systematically account for confounding processes (unequal base frequencies, nucleotide substitution biases, etc.),*
  - *afford many opportunities for extension and refinement (still happening today).*

**A likelihood approach for comparing synonymous and nonsynonymous nucleotide substitution rates, with application to the chloroplast genome**

**S. V. Muse and B. S. Gaut**  
Mol Biol Evol 11 715-724 (1994)

**~1000 citations**

**A codon-based model of nucleotide substitution for protein-coding DNA sequences.**

**N. Goldman and Z. Yang**  
Mol Biol Evol 11 725--736 (1994)

**~2250 citations**