Introduction to Bioinformatics

Basic Genome Biology

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What is Bioinformatics

Wikipedia:

> **Bioinformatics** /ˌbaɪ.oʊˌɪnfərˈmætɪks/ is an interdisciplinary field that develops methods and software tools for understanding biological data. As an interdisciplinary field of science, **bioinformatics** combines computer science, statistics, mathematics, and engineering to analyze and interpret biological data.

- Measurement theory
- Computer Science
- Engineering
- Biology

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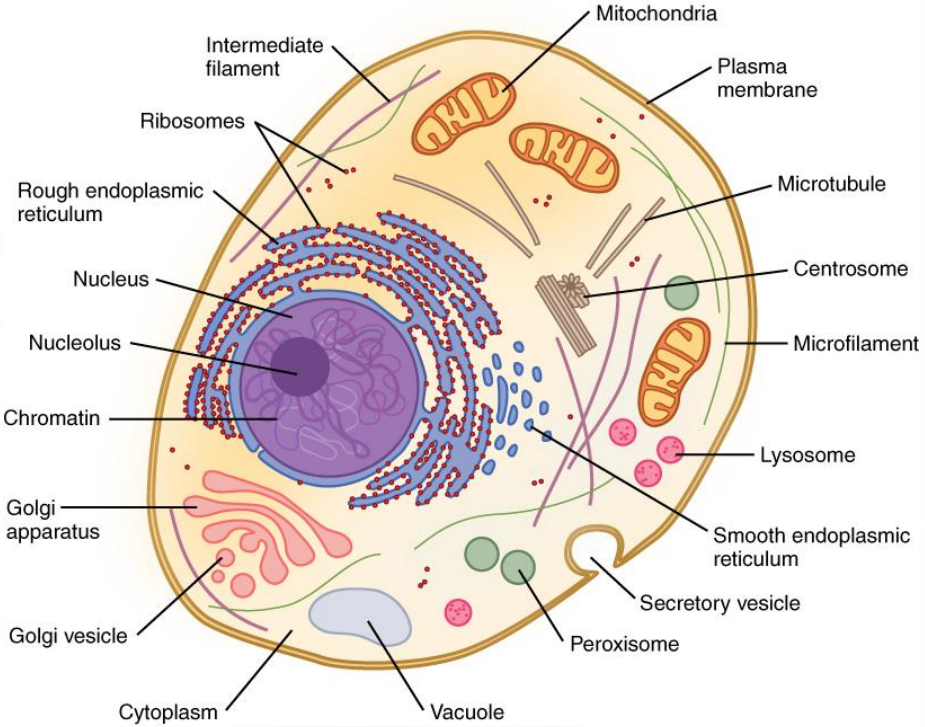
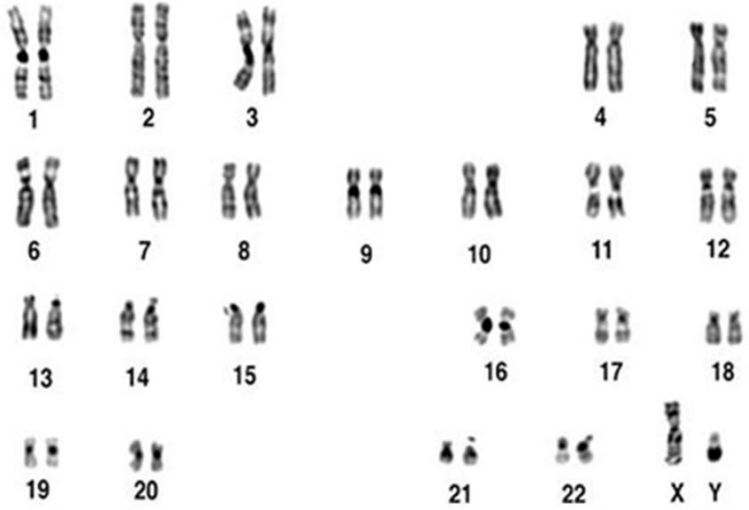
Why Genome Biology?

- Understanding what is being measured
- Interpreting errors
- Interpreting results
- For fun

DNA Structure and Properties

The Cell





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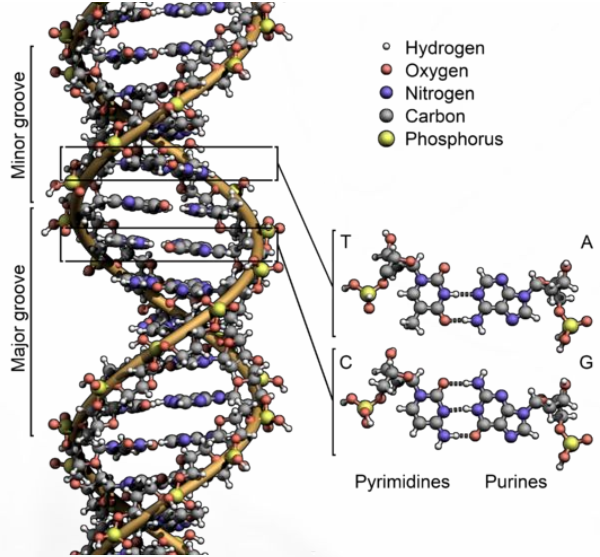
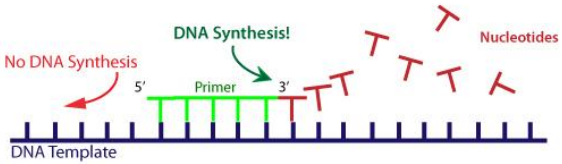
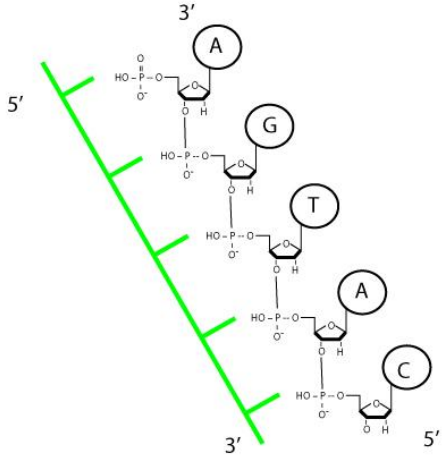
DNA - Structure

5'ATGACGTGGGGA3'
3'TACTGCACCCCT5'







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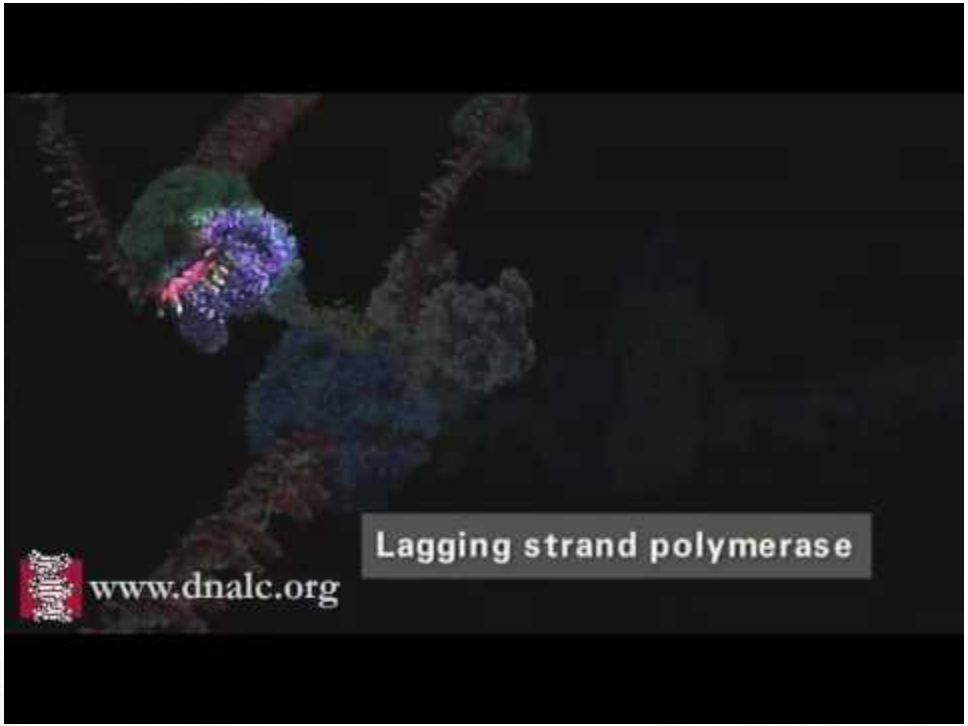
DNA Directionality Complications



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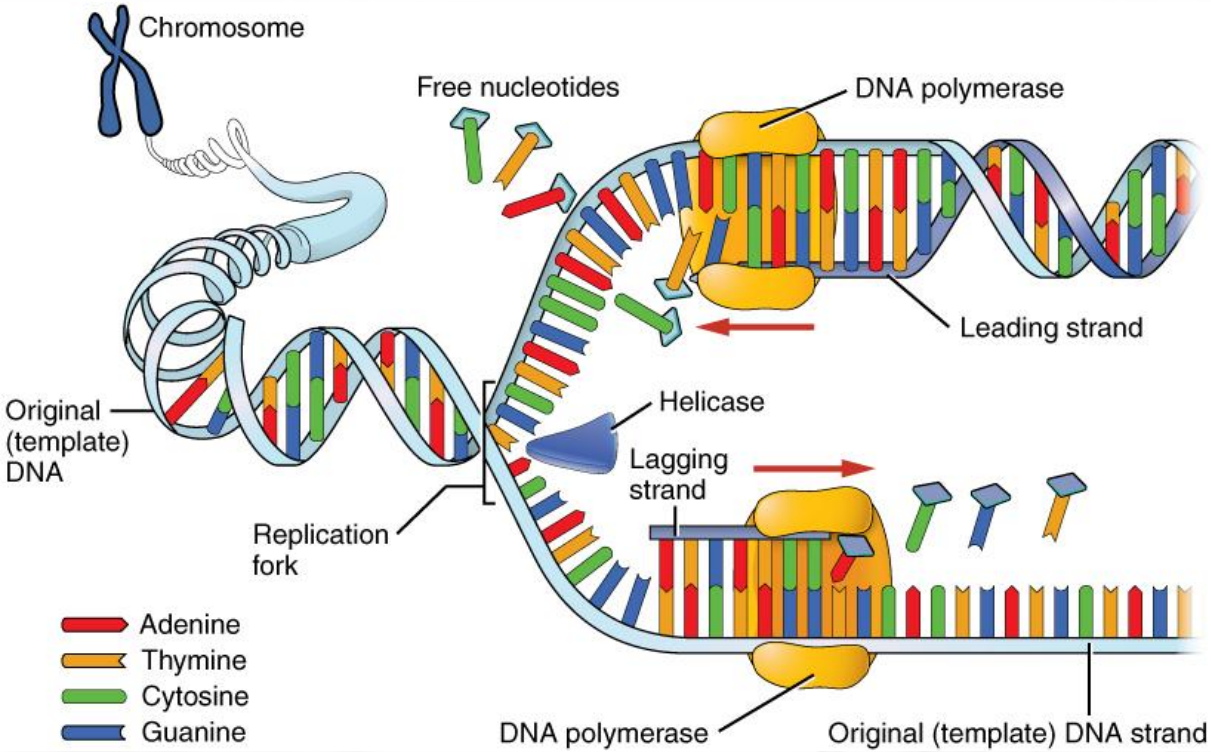
DNA Directionality Complications



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DNA - Packaging

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The Central Dogma of Molecular Biology

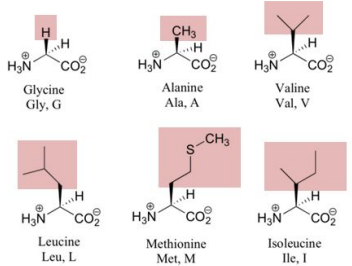
DNA makes RNA makes Protein

Proteins

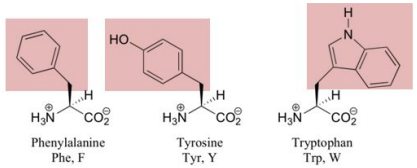
- Provide cell structure
- Do most of the cells work
- Made of 1D strings of amino acids connected by peptide bonds (polypeptides)
- Folded into 3D structure which enables useful function

Amino Acids & Protein folding

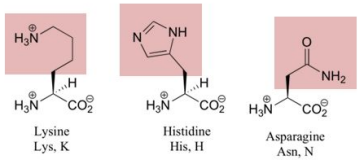
Nonpolar, aliphatic side groups



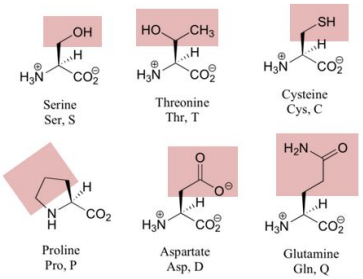
Aromatic side groups



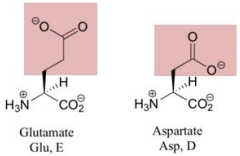
Positively charged side groups

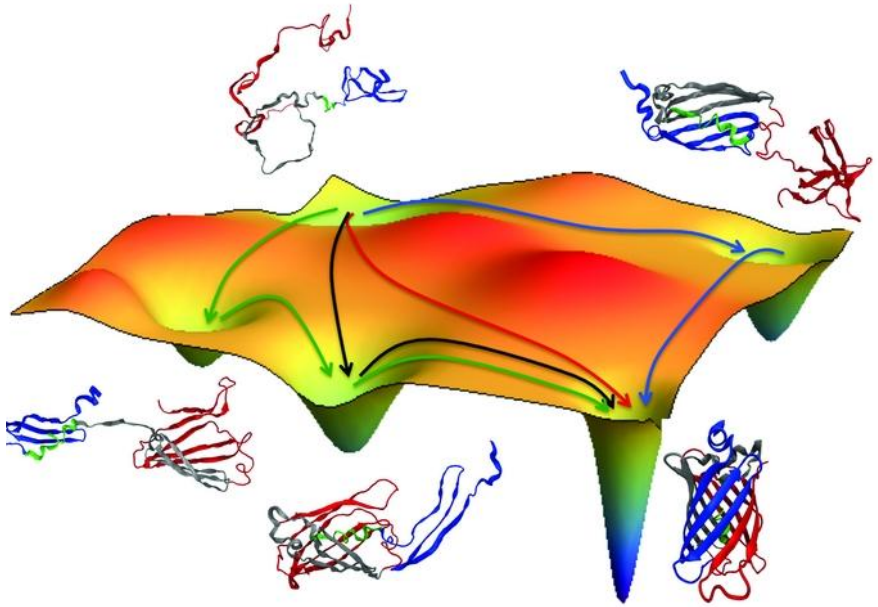


Polar, uncharged side groups



Negatively charged side groups





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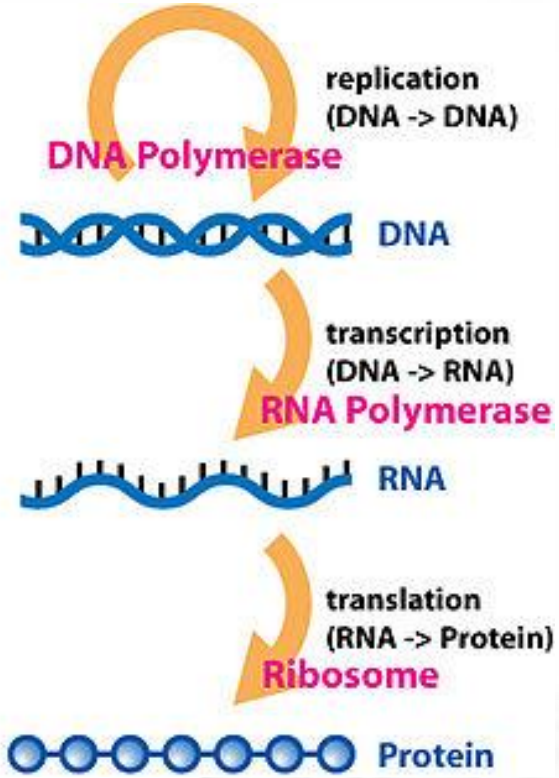
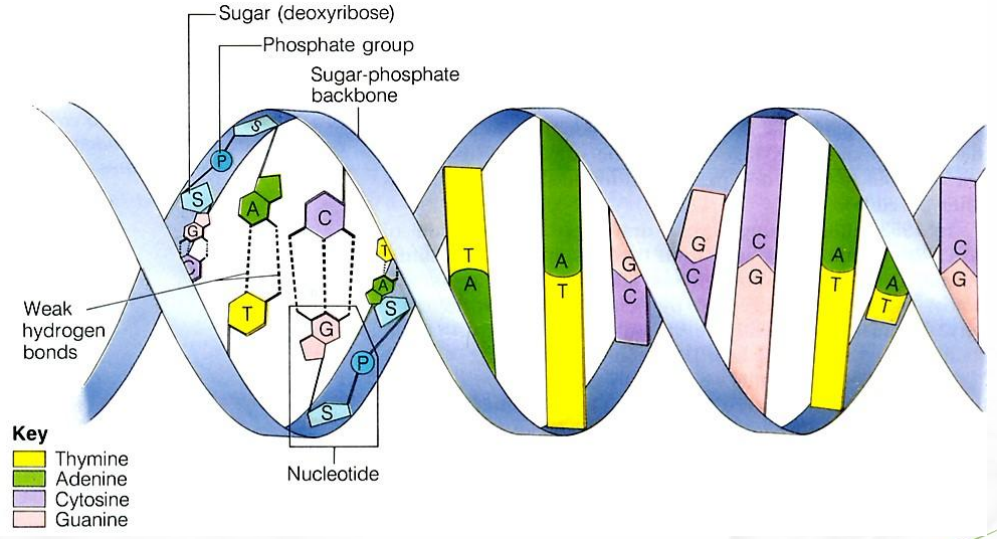
Central Dogma

- Flow of genetic information within a biological system - DNA makes RNA, and RNA makes protein



Central Dogma

- DNA (deoxyribonucleic acid) - double stranded molecule
- More stable, redundant information - complementary chain
- Nucleobases (T, A, C, G) encode for proteins



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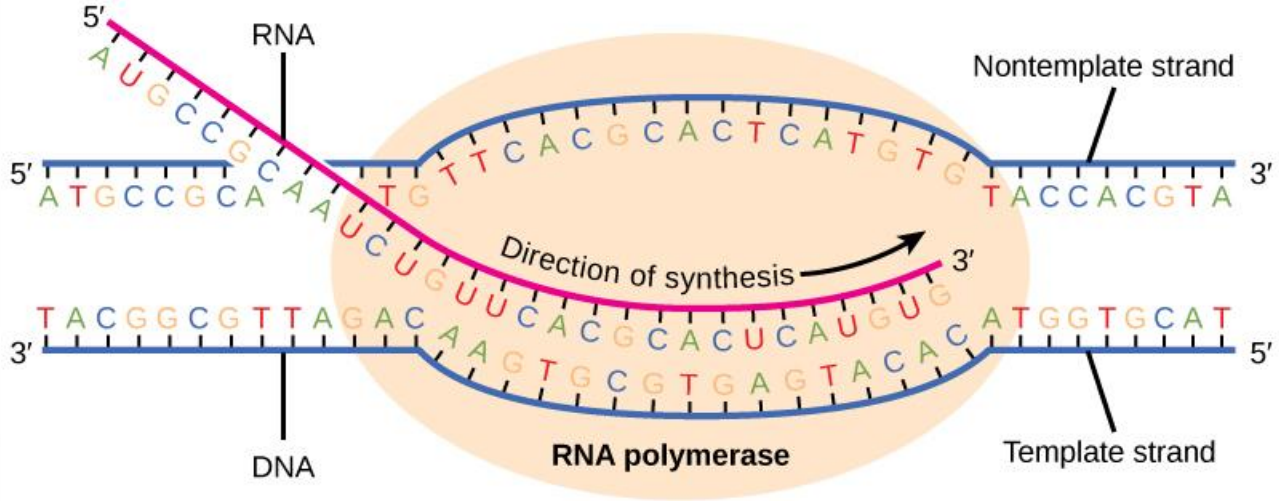
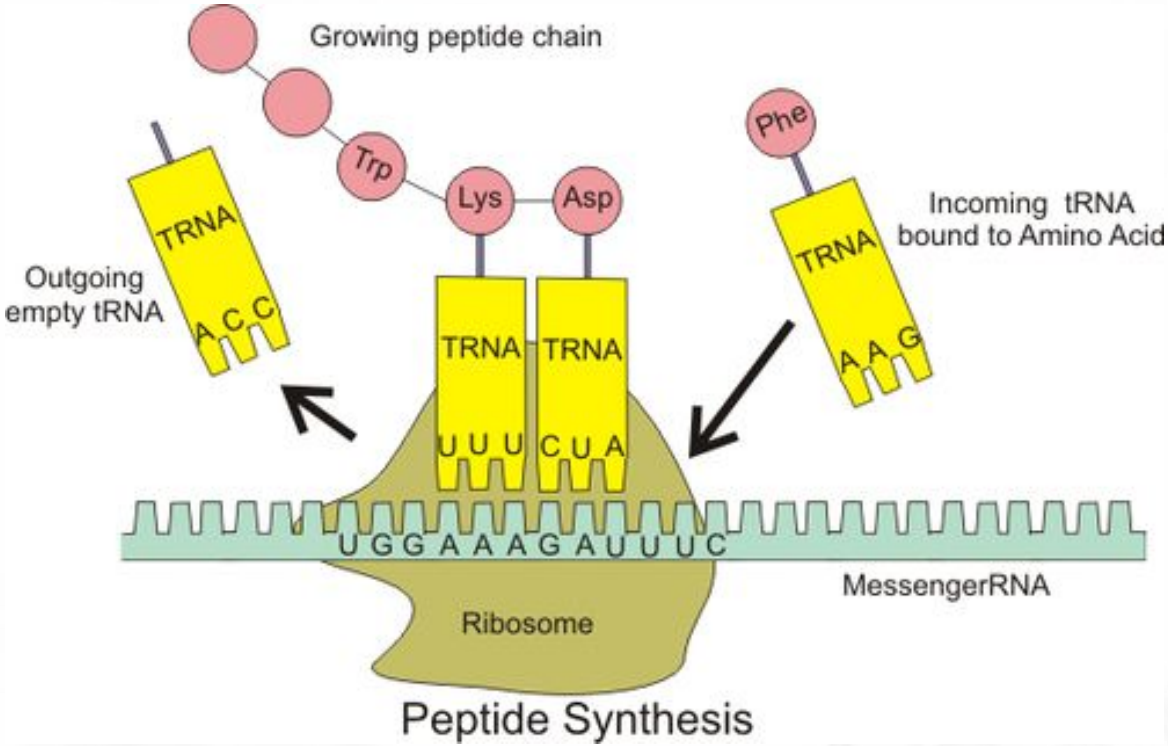
Central Dogma

- RNA (ribonucleic acid) - single stranded molecule
- Less stable, no redundant information
- Nucleobases (U, A, C, G) encode for proteins



Central Dogma



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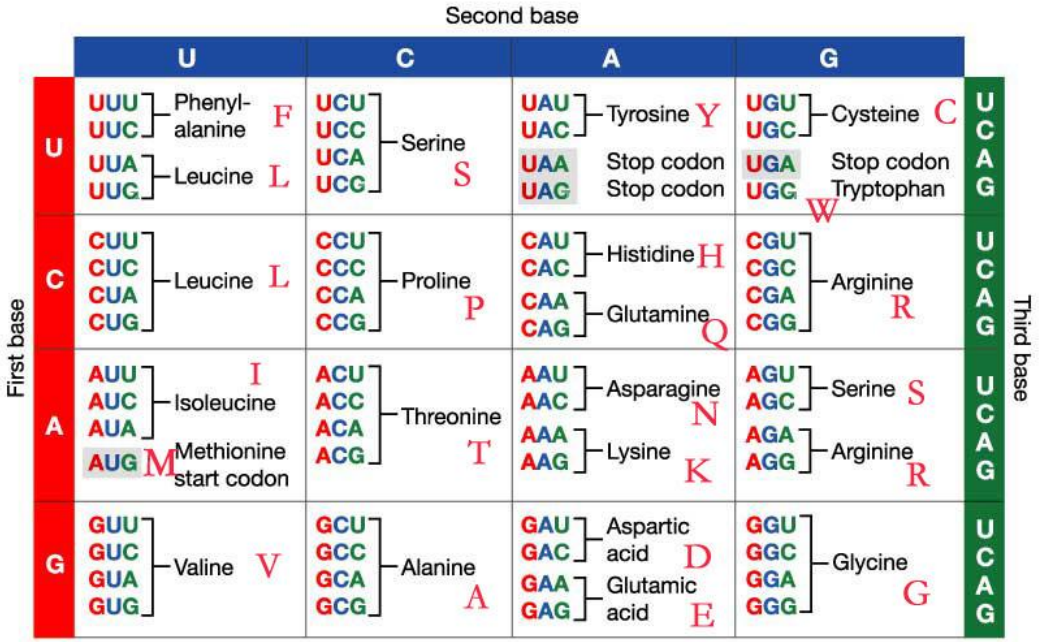
Amino Acid Codons



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Genes and Alleles

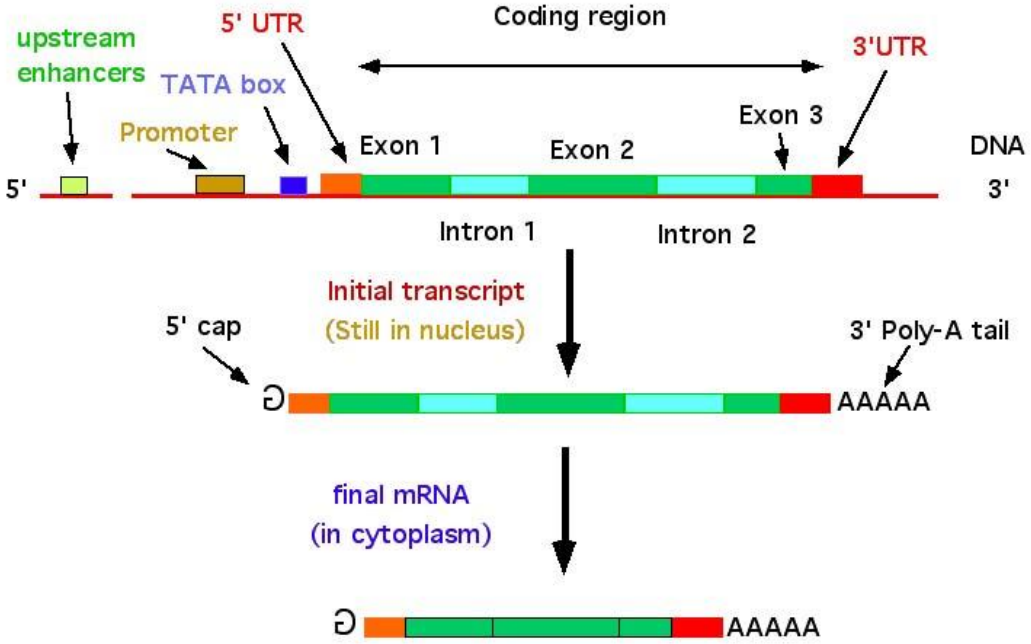
Wikipedia on Gene:

A **gene** is a locus (or region) of DNA that encodes a functional RNA or protein product, and is the molecular unit of heredity.[1][2]:Glossary The transmission of genes to an organism's offspring is the basis of the inheritance of phenotypic traits. Most biological traits are under the influence of polygenes (many different genes) as well as the gene–environment interactions. Some genetic traits are instantly visible, such as eye colour or number of limbs, and some are not, such as blood type, risk for specific diseases, or the thousands of basic biochemical processes that comprise life.

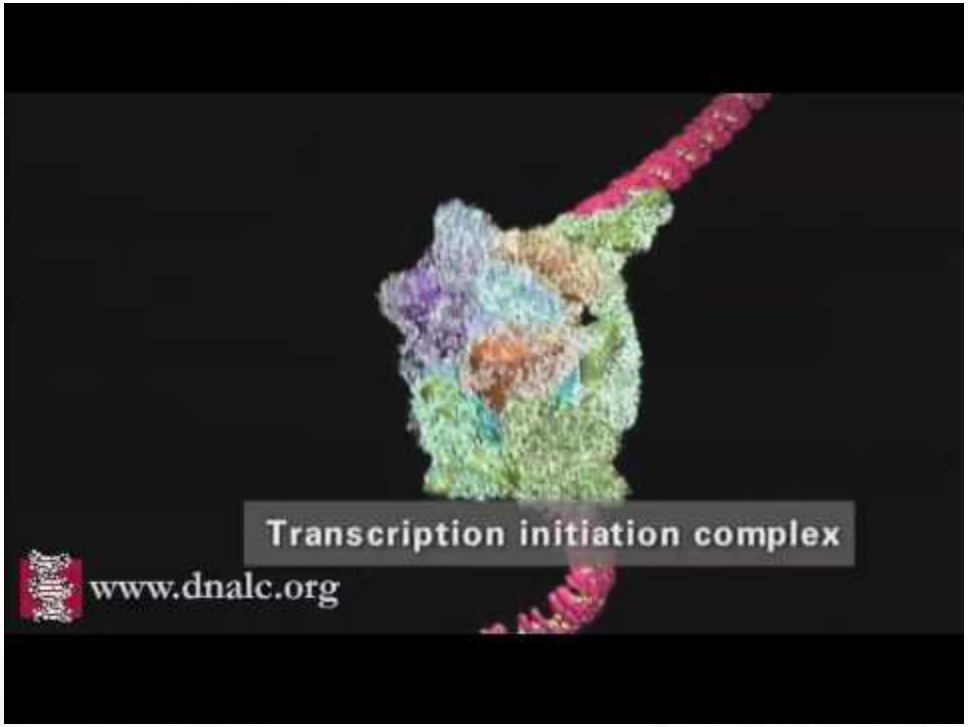
Wikipedia on Allele:

An **allele** (UK /ˈæliːl/ or US /əˈliːl/), or **allel**, is one of a number of alternative forms of the same gene or same genetic locus.[1][2] Sometimes, different alleles can result in different observable phenotypic traits, such as different pigmentation. However, most genetic variations result in little or no observable variation.

Gene Structure



DNA Transcription (to RNA)



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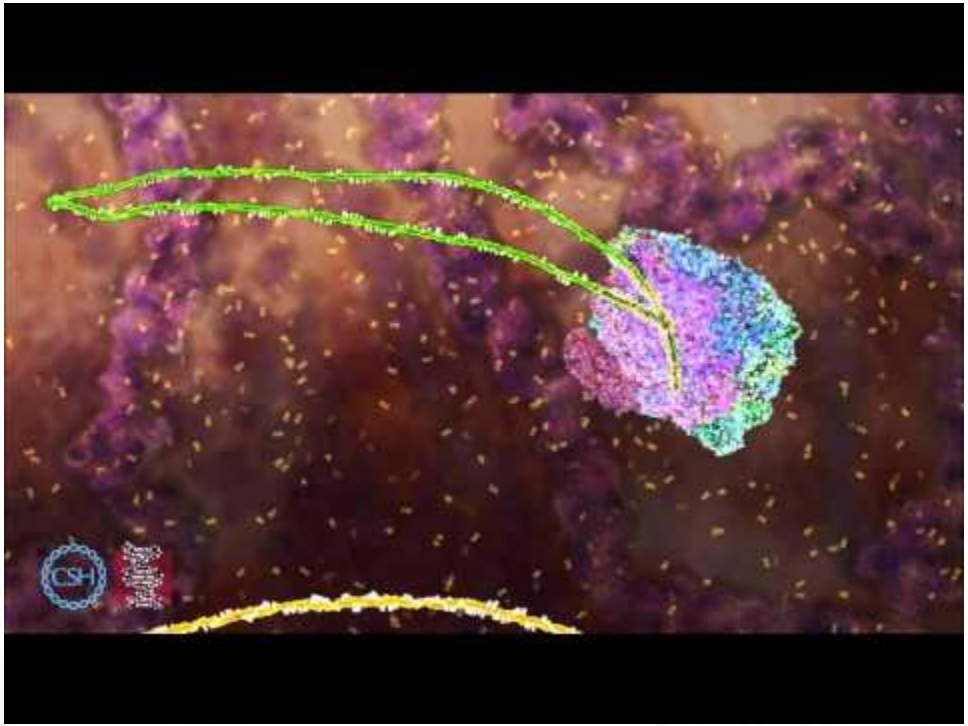
RNA Splicing



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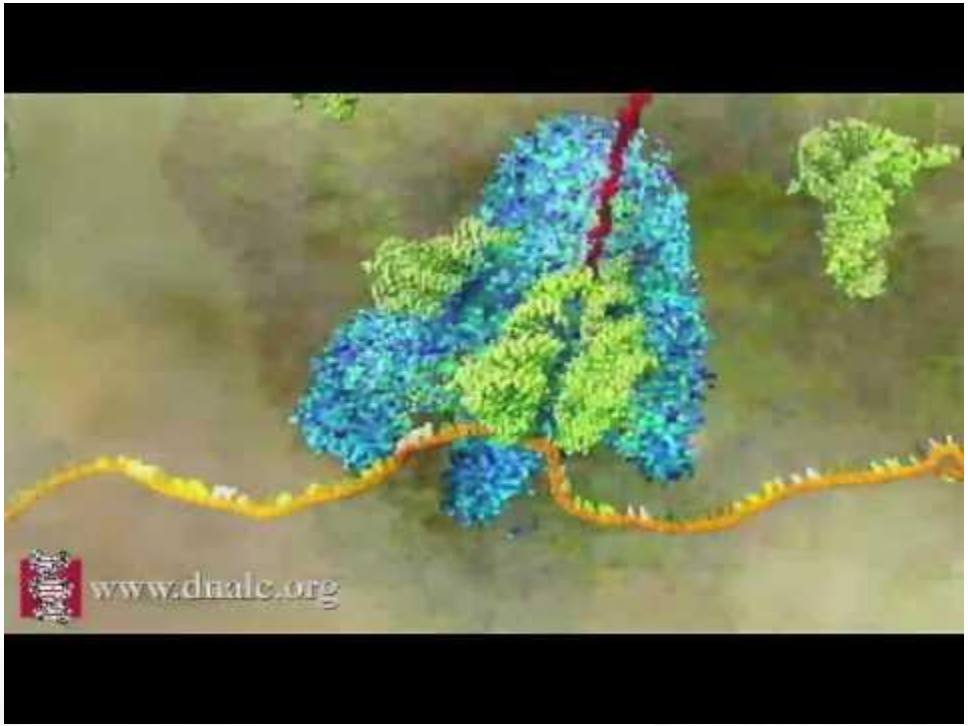
RNA Translation (to Protein)



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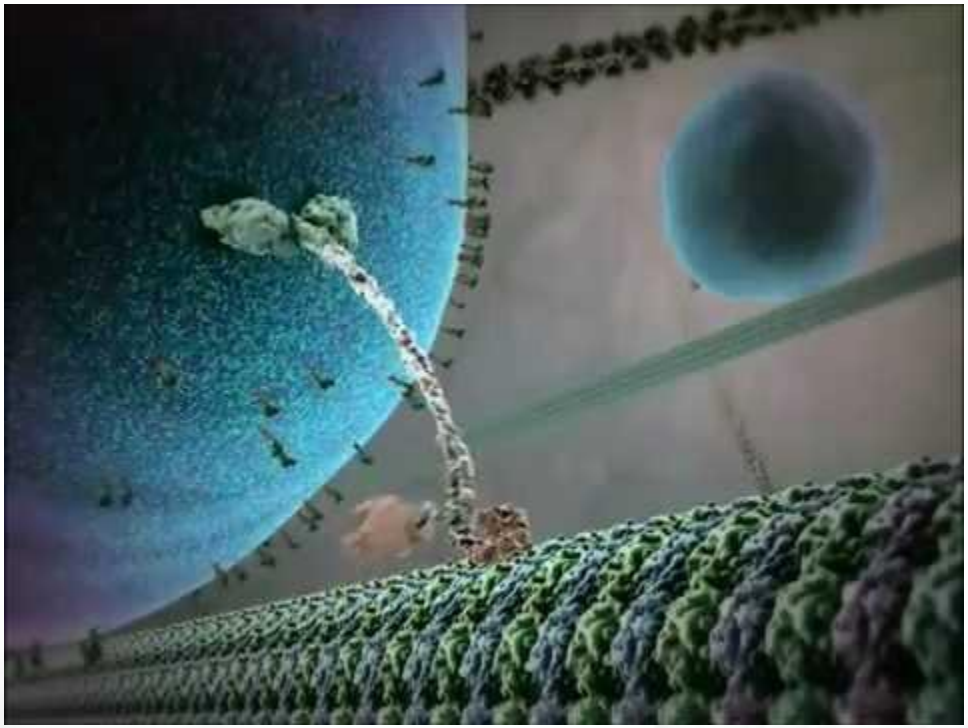
Examples of Protein Complexes

Kinesin - Motor Protein



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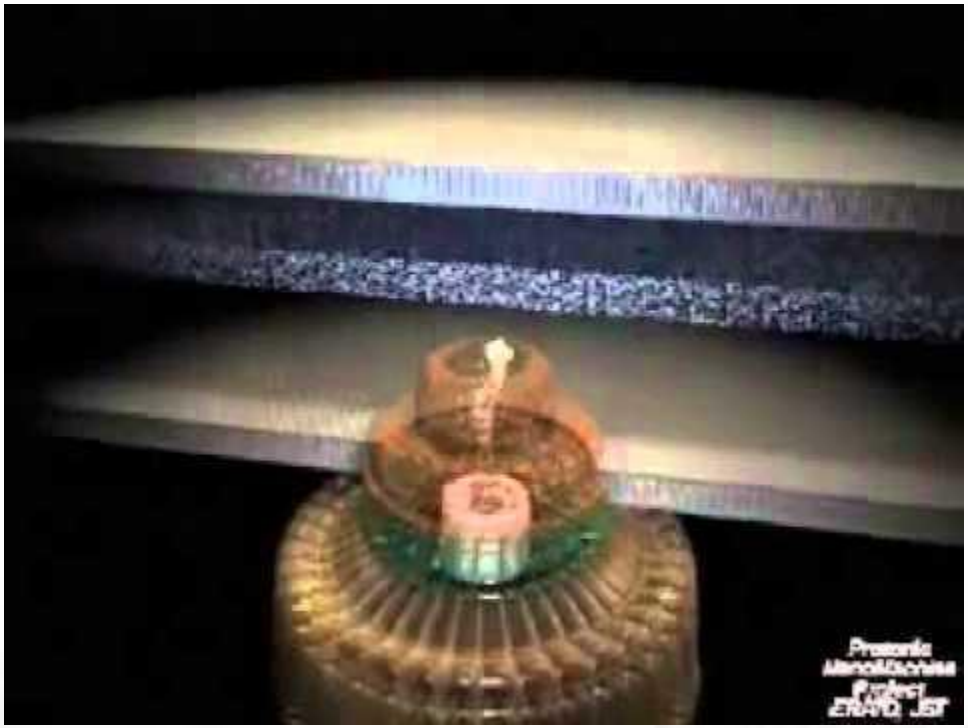
Bacterial Flagellum - Motility Protein



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