

Bioinformatics – Lecture Notes

Class 2

Announcements

Clarification about Human Genome Funding

Computer access

Textbooks at off Campus Books 972-907-8398

1. Biological References

- *Molecular Biology of the Cell* by Bruce Alberts (1994)
- *Molecular Cell Biology* by Darnell, Lodish, and Baltimore (1995)

2. Cell structure

Cell membrane

Nucleus

Cytoplasm

Endoplasmic Reticulum – rough and smooth

Golgi Apparatus – received newly formed proteins from the ER and modifies them and directs them to final destination

Mitochondria – respiratory centers, have own circular DNA, bacterial origin

Chromosomes – chromatin, histones, centromeres and arms (2 pairs in eukaryotes)

Lysosomes – contain acid hydrolases – nucleases, proteases, glycosidases, lipases, phosphatases, sulfatases, phospholipases

Peroxisomes – use oxygen to remove hydrogen from substrates forming H₂O₂, abundant in kidney and liver –detoxification

Cytoskeleton

3. Cell types

Prokaryotes – no nuclear membrane, represented by cyanobacteria (blue-green algae) and common bacteria (*Escherichia coli*)

Eukaryotes – unicellular organisms such as yeast and multicellular organisms

Archaeobacteria – no nuclear membrane but similar to eukaryotes in transcription and translation mechanisms, discovered in deep sea thermal vents in 1982

4. Central Dogma

DNA RNA Protein
Deoxyribonucleic Acid
Ribonucleic Acid

5. Gene Coding and Replication

Double helix

Nitrogenous bases A,T,G,C

Sugar-Phosphate backbone

Nucleotide – sugar + base + phosphate group

Nucleoside – sugar + base

Purines – adenine, guanine

Pyrimidines – cytosine, thymine

A-T – 2 H bonds, G-C – 3 H bonds

5' end contains a phosphate group

3' end is free

DNA extended from 5' to 3'

Gene is a segment of DNA that codes for a specific protein

Exons are coding regions of the DNA

Introns are 'in between' regions, found in eukaryotes

Codons

Reading frame

Consensus sequences are conserved regions found in a particular type of regulatory region

6. Gene Transcription or DNA transcription

RNA molecules synthesized by *RNA polymerase*

RNA polymerase found in free and bound form

RNA polymerase binds very tightly to *promoter* region on DNA

Promoter region contains *start site*

Transcription ends at *termination signal* site.

Primary transcript – direct coding of RNA from DNA

RNA splicing – introns removed to make the mRNA

mRNA – contains the sequence of *codons* that code for a protein

uracil replaces thymine

splicing and alternative splicing

7. Gene Translation

tRNA – links an amino acid to the codon on the mRNA via the *anti-codon*

rRNA – RNA found in ribosomes

ribosomes – large and small subunit, made of protein and rRNA

initiator tRNA always carries methionine

initiation factors – proteins that catalyze the start of transcription

stop codon

Endoplasmic Reticulum

Posttranscriptional modification

8. Protein Folding

Primary structure – amino acid sequence

Secondary structure – local structure such as α helix and β sheets

Tertiary structure – 3-dimensional structure of a protein monomer

Quarternary structure – 3-dimensional structure of a fully functional protein (protein complexes).

9. Cell Signaling and Biochemical Pathways

Surface receptors

G-proteins, kinases, etc

Transcription factors

Other biochemical reactions – glycolysis, citric acid cycle, etc.