Protein-DNA Interactions

Genes contain instructions for making proteins.

Proteins act alone or in complexes to perform many cellular functions.
The central dogma of biology
Genomic DNA
DNA packaging
DNA replication

DNA Replication Prior to Cell Division

Parent Strands

Complementary New Strand

A Adenine
T Thymine
G Guanine
C Cytosine

Complementary New Strand
DNA replication
The genetic code

DNA Genetic Code Dictates Amino Acid Identity and Order

DNA Sequence Is the Genetic Code.

GCA AGA GAT AAT TGT…

Ala Arg Asp Asn Cys… Growing Protein Chain

1 2 3 4 5
Translation of mRNA - Protein synthesis
DNA structure

(a) Minor groove
(b) Major groove
(c) 3.4 Å
(d) 36 Å
(e) 20 Å
DNA structure
DNA structure
Protein-DNA interactions
Minor & Major grooves- Recognition patterns

(a) Protein-DNA interactions

(b) Protein-DNA interactions

(c) Protein-DNA interactions

(d) Protein-DNA interactions

major groove

minor groove

KEY

= H-bond acceptor

= H-bond donor

= hydrogen atom

= methyl group

(a)

(b)
Protein-DNA interactions
Minor & Major grooves - Recognition patterns
Protein-DNA interactions
Minor & Major grooves- Recognition patterns
Protein-DNA interactions
Sequence specific vs. non-specific recognition

Diagram showing specific and non-specific complexes with labeled amino acids and nucleotides.
The RNA polymerase
The RNA polymerase
The RNA polymerase
RNA synthesis begins at promoter sites
The RNA polymerase
RNA synthesis begins at promoter sites
Gene regulation

Negative regulation

(Molecular signal causes dissociation of regulatory protein from DNA)

(Molecular signal causes binding of regulatory protein to DNA)
Gene regulation

Negative regulation

[Diagram showing gene regulation with emphasis on lactose repressor and its binding to regulatory sequences]
Gene regulation

Negative regulation

Lactose repressor
Gene regulation

Positive regulation

Positive regulation (bound activator facilitates transcription)

RNA polymerase

5' mRNA → 3'

5' mRNA → 3'
Gene regulation

Positive regulation

cAMP Receptor Protein (CRP)
Gene regulation

Positive regulation
Gene regulation
Positive regulation
Gene regulation

Positive regulation