

Introduction to Bioorganic Chemistry and Chemical Biology

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Detailed Contents

Chapter 1

The Fundamentals of Chemical Biology

Why organize a book on chemical biology around biooligomers?

1.1 THE CENTRAL DOGMA OF MOLECULAR BIOLOGY

The central dogma of molecular biology is an organizing principle for chemical biology

1.2 GENES

A gene is made up of a promoter and a transcribed sequence

1.3 GENOMES

We have sequenced the human genome and many others. Now what?

We are far from understanding cells that we understand the best—*Escherichia coli*

We are even farther from understanding human cells

You cannot judge a cell by its genome

The observable phenotype belies the hidden genotype

1.4 SOURCES OF DIVERSITY BEYOND GENOMES

The transcriptome is the collection of all of the RNA transcripts in a cell

RNA splicing amplifies the diversity of the transcriptome

Post-translational modification of proteins amplifies the diversity of the proteome

Beyond template-directed synthesis of biooligomers

1.5 COMBINATORIAL ASSEMBLY GENERATES DIVERSITY

Combinatorial assembly of linear biooligomers can generate massive diversity

Combinatorial synthesis can be used to synthesize DNA libraries

Modular architecture lends itself to the synthesis of non-natural chemical libraries

The human immune system uses combinatorial biosynthesis

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1.6 SOME COMMON TOOLS OF CHEMICAL BIOLOGY

Chromophores reveal invisible molecules

Assays connect molecular entities to readily visible phenomena

Powerful microbiological screens reveal interesting chemical phenomena

Viruses deliver genes efficiently

Vast libraries of proteins can be screened *in vitro* using bacteriophages

In vitro screens of DNA and RNA push the limits of library diversity

Small molecules take control

Short RNA molecules silence gene expression

Monoclonal antibodies bind specifically

Immortal cancer cell lines serve as mimics of human organs

Human stem cells are highly valuable tools for research and medicine

Model organisms teach us about humans

1.7 SUMMARY

PROBLEMS

Chapter 2

The Chemical Origins of Biology

2.1 MECHANISTIC ARROW-PUSHING IS AN

EXPRESSION OF MOLECULAR ORBITAL THEORY

Three properties control chemical reactivity

Perturbational molecular orbital theory connects arrow-pushing with quantum mechanics

Six canonical frontier orbitals can be used to predict reactivity

Electronegativity affects both frontier orbitals and Coulombic interactions

Curved mechanistic arrows depict the interaction of filled orbitals with unfilled orbitals

There are three basic rules for mechanistic arrow-pushing

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