

# MOLECULAR BIOLOGY

structure and dynamics of  
genomes and proteomes

Second Edition

Jordanka Zlatanova  
Kensal E. van Holde



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# Contents

<b>Preface</b>	<b>xvii</b>	Gregor Mendel developed the formal rules of genetics	<b>20</b>
<b>Acknowledgments</b>	<b>xix</b>	Mendel's laws have extensions and exceptions	<b>25</b>
<b>About the Authors</b>	<b>xxi</b>	Genes are arranged linearly on chromosomes and can be mapped	<b>26</b>
<b>Chapter 1: To the Cell and Beyond: The Realm of Molecular Biology</b>	<b>1</b>	The nature of genes and how they determine phenotypes was long a mystery	<b>27</b>
<b>1.1 INTRODUCTION</b>	<b>2</b>	<b>2.3 THE GREAT BREAKTHROUGH TO MOLECULAR GENETICS</b>	<b>27</b>
<b>1.2 THE VITAL ROLE OF MICROSCOPY IN BIOLOGY</b>	<b>2</b>	Bacteria and bacteriophage exhibit genetic behavior and serve as model systems	<b>27</b>
The light microscope led to the first revolution in biology	2	Transformation and transduction allow transfer of genetic information	<b>29</b>
Biochemistry led to the discovery of the importance of macromolecules in life's structure and processes	6	The Watson-Crick model of DNA structure provided the final key to molecular genetics	<b>30</b>
The electron microscope provided another order of resolution	6	<b>2.4 MODEL ORGANISMS</b>	<b>31</b>
<b>1.3 FINE STRUCTURE OF CELLS AND VIRUSES AS REVEALED BY MICROSCOPY</b>	<b>8</b>	<b>2.5 WHOLE GENOMES AND EVOLUTION</b>	<b>33</b>
<b>1.4 ULTRAHIGH RESOLUTION: BIOLOGY AT THE MOLECULAR LEVEL</b>	<b>10</b>	Evolutionary theory: From Darwin to the present day	<b>33</b>
Fluorescence techniques allow for one approach to ultra-resolution	10	Human-driven evolution: The story of Vavilov	<b>36</b>
Confocal fluorescence microscopy allows observation of the fluorescence emitted by a particular substance in a cell	10	The tree of life based on sequencing of thousands of species: Back to the two-domain tree of life	<b>36</b>
FIONA provides ultimate optical resolution by use of fluorescence	11	Key concepts	<b>36</b>
FRET allows distance measurements at the molecular level	12	Further reading	<b>37</b>
Single-molecule cryo-electron microscopy is a powerful new technique	12	Videos on the Internet	<b>37</b>
The atomic force microscope feels molecular structure	13	<b>Chapter 3: Proteins</b>	<b>39</b>
X-ray diffraction and nuclear magnetic resonance provide resolution to the atomic level	14	<b>3.1 INTRODUCTION</b>	<b>39</b>
Chemical imaging, the new powerful combination of imaging techniques	15	Proteins are macromolecules with enormous variety in size, structure, and function	<b>39</b>
<b>1.5 MOLECULAR GENETICS: ANOTHER FACE OF MOLECULAR BIOLOGY</b>	<b>15</b>	Proteins are essential for the structure and functioning of all organisms	<b>41</b>
Key concepts	15	<b>3.2 PROTEIN STRUCTURE</b>	<b>41</b>
Further reading	16	Proteins are homogeneous polypeptides and amino acids are their building blocks	<b>42</b>
Videos on the Internet	17	Fred Sanger and the sequence of insulin	<b>42</b>
<b>Chapter 2: From Classical Genetics to Molecular Genetics</b>	<b>19</b>	In proteins, amino acids are covalently connected to form polypeptides	<b>44</b>
<b>2.1 INTRODUCTION</b>	<b>19</b>	<b>3.3 LEVELS OF STRUCTURE IN THE POLYPEPTIDE CHAIN</b>	<b>46</b>
<b>2.2 CLASSICAL GENETICS AND THE RULES OF TRAIT INHERITANCE</b>	<b>20</b>	The primary structure of a protein is a unique sequence of amino acids	<b>46</b>
		A protein's secondary structure involves regions of regular folding stabilized by hydrogen bonds	<b>50</b>

Each protein has a unique three-dimensional tertiary structure  
 The tertiary structure of most proteins is divided into distinguishable folded domains  
 Algorithms are now used to identify and classify domains in proteins of known sequence  
 Some domains or proteins are intrinsically disordered  
 Quaternary structure involves associations between protein molecules to form aggregated structures

### 3.4 HOW DO PROTEINS FOLD?

Folding can be a problem  
 Chaperones help or allow proteins to fold

### 3.5 HOW ARE PROTEINS DESTROYED?

The proteasome is the general protein destruction system

### 3.6 THE PROTEOME AND PROTEIN INTERACTION NETWORKS

New technologies allow a census of an organism's proteins and their interactions  
 Key concepts  
 Further reading  
 Videos on the Internet

## Chapter 4: Nucleic Acids

### 4.1 INTRODUCTION

Protein sequences are dictated by nucleic acids

### 4.2 CHEMICAL STRUCTURE OF NUCLEIC ACIDS

DNA and RNA have similar but different chemical structures  
 Nucleic acids (polynucleotides) are polymers of nucleotides

### 4.3 PHYSICAL STRUCTURES OF DNA

Discovery of the B-DNA structure was a breakthrough in molecular biology  
 A number of alternative DNA structures exist  
 Although the double helix is quite rigid, it can be bent by bound proteins  
 DNA can also form folded tertiary structures  
 Closed DNA circles can be twisted into supercoils

### 4.4 PHYSICAL STRUCTURES OF RNA

RNA can adopt a variety of complex structures but not the B-form helix

### 4.5 ONE-WAY FLOW OF GENETIC INFORMATION

### 4.6 METHODS USED TO STUDY NUCLEIC ACIDS

Key concepts  
 Further reading  
 Videos on the Internet

## Chapter 5: Recombinant DNA: Principles and Applications

### 5.1 INTRODUCTION

Cloning of DNA involves several fundamental steps

### 5.2 CONSTRUCTION OF RECOMBINANT DNA MOLECULES

Restriction endonucleases and ligases are essential tools in cloning

### 5.3 VECTORS FOR CLONING

53 Genes coding for selectable markers are inserted into vectors during their construction 118  
 55 Bacterial plasmids were the first cloning vectors 121  
 Recombinant bacteriophages can serve as bacterial vectors 122  
 58 Cosmids and phagemids expand the repertoire of cloning vectors 125  
 62

### 5.4 ARTIFICIAL CHROMOSOMES AS VECTORS

64 Bacterial artificial chromosomes meet the need for cloning very large DNA fragments in bacteria 125  
 65 Eukaryotic artificial chromosomes provide proper maintenance and expression of very large DNA fragments in eukaryotic cells 125  
 66

### 5.5 EXPRESSION OF RECOMBINANT GENES

71 Expression vectors allow regulated and efficient expression of cloned genes 126  
 73 Shuttle vectors can replicate in more than one organism 128

### 5.6 INTRODUCING RECOMBINANT DNA INTO HOST CELLS

73 Numerous host-specific techniques are used to introduce recombinant DNA molecules into living cells 128  
 76

### 5.7 POLYMERASE CHAIN REACTION AND SITE-DIRECTED MUTAGENESIS

79 129

### 5.8 SEQUENCING OF ENTIRE GENOMES

80 Genomic libraries contain the entire genome of an organism as a collection of recombinant DNA molecules 131  
 80 There are two approaches for sequencing large genomes 132

### 5.9 MANIPULATING THE GENETIC CONTENT OF EUKARYOTIC ORGANISMS

82 Making a transgenic mouse involves numerous steps 133  
 83 To inactivate, replace, or otherwise modify a particular gene, the vector must be targeted for homologous recombination at that particular site 134  
 89

### 5.10 PRACTICAL APPLICATIONS OF RECOMBINANT DNA TECHNOLOGIES

91 Hundreds of pharmaceutical compounds are produced in recombinant bacteria 135  
 91 Plant genetic engineering is a huge but controversial industry 137  
 92 Gene therapy is a complex multistep process aiming to correct defective genes or gene functions that are responsible for disease 141  
 95 Delivering a gene into sufficient cells within a specific tissue and ensuring its subsequent long-term expression is a challenge 142  
 99 CRISPR, the new technology to change genomic DNA sequence at a predefined position 143  
 100 *Jurassic Park* or de-extinction 145  
 108 Cloning of whole animals by nuclear transfer 146  
 108 Key concepts 147  
 109 Further reading 148  
 Videos on the Internet 149

## Chapter 6: Protein–Nucleic Acid Interactions

### 6.1 INTRODUCTION

111 151

### 6.2 DNA-PROTEIN INTERACTIONS

112 DNA-protein binding occurs by many modes and mechanisms 152  
 112

Site-specific binding is the most widely used mode	154	DNA-bending proteins and DNA-bridging proteins help to pack bacterial DNA	201
Most recognition sites fall into a limited number of classes	155	<b>8.3 EUKARYOTIC CHROMATIN</b>	<b>201</b>
Most specific binding requires the insertion of protein into a DNA groove	156	Eukaryotic chromosomes are highly condensed	
Some proteins cause DNA looping	157	DNA-protein complexes segregated into a nucleus	201
There are a few major protein motifs of DNA-binding domains	158	The nucleosome is the basic repeating unit of eukaryotic chromatin	203
Helix-turn-helix motif interacts with the major groove	158	Histone nonallelic variants and postsynthetic modifications create a heterogeneous population of nucleosomes	206
Zinc fingers also probe the major groove	158	The nucleosome family is dynamic	211
Leucine zippers are especially suited for dimeric sites	159	Nucleosome assembly in vivo uses histone chaperones	212
<b>6.3 RNA-PROTEIN INTERACTIONS</b>	<b>159</b>	<b>8.4 HIGHER-ORDER CHROMATIN STRUCTURE</b>	<b>213</b>
<b>6.4 STUDYING PROTEIN-NUCLEIC ACID INTERACTIONS</b>	<b>162</b>	Nucleosomes along the DNA form a chromatin fiber	213
Key concepts	168	The chromatin fiber is folded, but its structure remains controversial	214
Further reading	168	The organization of chromosomes in the interphase nucleus is still obscure	216
Videos on the Internet	169	<b>8.5 MITOTIC CHROMOSOMES</b>	<b>217</b>
<b>Chapter 7: The Genetic Code, Genes, and Genomes</b>	<b>171</b>	Chromosomes condense and separate in mitosis	217
<b>7.1 GENES AS NUCLEIC ACID REPOSITORIES OF GENETIC INFORMATION</b>	<b>171</b>	A number of proteins are needed to form and maintain mitotic chromosomes	218
Our understanding of the nature of genes is constantly evolving	171	Centromeres and telomeres are chromosome regions with special functions	219
The central dogma states that information flows from DNA to protein	172	There are a number of models of mitotic chromosome structure	221
It was necessary to separate cellular RNAs to seek the adaptors	174	Key concepts	225
Messenger RNA, tRNA, and ribosomes constitute the protein factories of the cell	174	Further reading	225
<b>7.2 RELATING PROTEIN SEQUENCE TO DNA SEQUENCE IN THE GENETIC CODE</b>	<b>175</b>	Videos on the Internet	226
The first task was to define the nature of the code	175	<b>Chapter 9: Transcription in Bacteria</b>	<b>227</b>
<b>7.3 SURPRISES FROM THE EUKARYOTIC CELL: INTRONS AND SPLICING</b>	<b>179</b>	<b>9.1 INTRODUCTION</b>	<b>228</b>
Eukaryotic genes usually contain interspersed noncoding sequences	179	<b>9.2 OVERVIEW OF TRANSCRIPTION</b>	<b>228</b>
<b>7.4 GENES FROM A NEW AND BROADER PERSPECTIVE</b>	<b>180</b>	There are aspects of transcription common to all organisms	228
Protein-coding genes are complex	180	Transcription requires the participation of many proteins	229
Genome sequencing has revolutionized the gene concept	180	Transcription is rapid but is often interrupted by pauses	232
Mutations, pseudogenes, and alternative splicing all contribute to gene diversity	181	Transcription can be visualized by electron microscopy	233
<b>7.5 COMPARING WHOLE GENOMES AND NEW PERSPECTIVES ON EVOLUTION</b>	<b>182</b>	<b>9.3 RNA POLYMERASES AND TRANSCRIPTION CATALYSIS</b>	<b>235</b>
Genome sequencing reveals puzzling features of genomes	182	RNA polymerases are a large family of enzymes that produce RNA transcripts of polynucleotide templates	235
How are DNA sequence types and functions distributed in eukaryotes?	184	<b>9.4 MECHANICS OF TRANSCRIPTION IN BACTERIA</b>	<b>237</b>
Key concepts	188	Initiation requires a multisubunit polymerase complex, termed the holoenzyme	237
Further reading	189	The initiation phase of bacterial transcription is frequently aborted	241
Videos on the Internet	189	Elongation in bacteria must overcome topological problems	242
<b>Chapter 8: Physical Structure of the Genomic Material</b>	<b>191</b>	There are several mechanisms for transcription termination in bacteria	244
<b>8.1 INTRODUCTION</b>	<b>191</b>	Antisense transcription in bacteria is widespread and might have numerous functions	246
<b>8.2 CHROMOSOMES OF VIRUSES AND BACTERIA</b>	<b>192</b>	Understanding transcription in bacteria is useful in clinical practice	247
Generally, viruses are packages for minimal genomes	192	Key concepts	249
Bacterial chromosomes are organized structures in the cytoplasm	200	Further reading	250
		Videos on the Internet	250

## Contents

<b>Chapter 10: Transcription in Eukaryotes</b>	<b>251</b>
<b>10.1 INTRODUCTION</b>	<b>252</b>
Transcription in eukaryotes is a complex, highly regulated process	252
Eukaryotic cells contain multiple RNA polymerases, each specific for distinct functional subsets of genes	252
<b>10.2 TRANSCRIPTION BY RNA POLYMERASE II</b>	<b>253</b>
The yeast Pol II structure provides insights into transcriptional mechanisms	253
The structure of Pol II is more evolutionarily conserved than its sequence	255
Nucleotide addition during transcription elongation is cyclic	257
Transcription initiation depends on multisubunit protein complexes that assemble at core promoters	257
An additional protein complex is needed to connect Pol II to regulatory proteins	262
Termination of eukaryotic transcription is coupled to polyadenylation of the RNA transcript	262
<b>10.3 TRANSCRIPTION BY RNA POLYMERASE I</b>	<b>263</b>
<b>10.4 TRANSCRIPTION BY RNA POLYMERASE III</b>	<b>264</b>
RNA polymerase III specializes in transcription of small genes	264
<b>10.5 TRANSCRIPTION IN EUKARYOTES: PERVASIVE AND SPATIALLY ORGANIZED</b>	<b>265</b>
Most of the eukaryotic genome is transcribed	265
Transcription in eukaryotes is not uniform within the nucleus	269
Active and inactive genes are spatially separated in the nucleus	270
<b>10.6 METHODS FOR STUDYING EUKARYOTIC TRANSCRIPTION</b>	<b>271</b>
A battery of methods is available for the study of transcription	271
Key concepts	277
Further reading	277
Videos on the Internet	278
<b>Chapter 11: Regulation of Transcription in Bacteria</b>	<b>279</b>
<b>11.1 INTRODUCTION</b>	<b>280</b>
<b>11.2 GENERAL MODELS FOR REGULATION OF TRANSCRIPTION</b>	<b>280</b>
Regulation can occur via differences in promoter strength or use of alternative $\sigma$ factors	280
Regulation through ligand binding to RNA polymerase is called stringent control	281
<b>11.3 SPECIFIC REGULATION OF TRANSCRIPTION</b>	<b>282</b>
Regulation of specific genes occurs through <i>cis-trans</i> interactions with transcription factors	282
Transcription factors are activators and repressors whose own activity is regulated in a number of ways	284
Several transcription factors can act synergistically or in opposition to activate or repress transcription	285
<b>11.4 TRANSCRIPTIONAL REGULATION OF OPERONS IS IMPORTANT TO BACTERIAL PHYSIOLOGY</b>	<b>285</b>
The <i>lac</i> operon is controlled by a dissociable repressor and an activator	285
Control of the <i>trp</i> operon involves both repression and attenuation	291
The same protein can serve as an activator or a repressor: the <i>ara</i> operon	294
<b>11.5 OTHER MODES OF GENE REGULATION IN BACTERIA</b>	<b>295</b>
DNA supercoiling is involved in both global and local regulation of transcription	295
DNA methylation can provide specific regulation	296
<b>11.6 COORDINATION OF GENE EXPRESSION IN BACTERIA</b>	<b>297</b>
Networks of transcription factors form the basis of coordinated gene expression	298
Key concepts	299
Further reading	299
Videos on the Internet	300
<b>Chapter 12: Regulation of Transcription in Eukaryotes</b>	<b>301</b>
<b>12.1 INTRODUCTION</b>	<b>302</b>
<b>12.2 REGULATION OF TRANSCRIPTION INITIATION: REGULATORY REGIONS AND TRANSCRIPTION FACTORS</b>	<b>302</b>
Core and proximal promoters are needed for basal and regulated transcription	302
Enhancers, silencers, insulators, and locus control regions are all distal regulatory elements	303
Some eukaryotic transcription factors are activators, others are repressors, and still others can be either, depending on context	306
Regulation can use alternative components of the basal transcriptional machinery	307
Mutations in gene regulatory regions and in transcriptional machinery components lead to human diseases	308
<b>12.3 REGULATION OF TRANSCRIPTIONAL ELONGATION</b>	<b>308</b>
The polymerase may stall close to the promoter	308
Transcription elongation rate can be regulated by elongation factors	309
<b>12.4 TRANSCRIPTION REGULATION AND CHROMATIN STRUCTURE</b>	<b>309</b>
What happens to nucleosomes during transcription?	309
<b>12.5 REGULATION OF TRANSCRIPTION BY HISTONE MODIFICATIONS AND VARIANTS</b>	<b>311</b>
Modification of histones provides epigenetic control of transcription	311
Gene expression is often regulated by histone post-translational modifications	312
Readout of histone post-translational modification marks involves specialized protein molecules	313
Post-translational histone marks distinguish transcriptionally active and inactive chromatin regions	314
Some genes are specifically silenced by post-translational modification in some cell lines	315
Polycomb protein complexes silence genes through H3K27 trimethylation and H2AK119 ubiquitylation	316

Heterochromatin formation at telomeres in yeast silences genes through H4K16 deacetylation	318	The chromatin environment at regulatory elements and in gene bodies is also heterogeneous and asymmetric	346
HP1-mediated gene repression in the majority of eukaryotic organisms involves H3K9 methylation	318	<b>13.5 ENCODE INSIGHTS INTO GENE REGULATION</b>	<b>346</b>
Poly(ADP)ribosylation of proteins is involved in transcriptional regulation	319	Distal control elements are connected to promoters in a complex network	346
Histone variants H2A.Z, H3.3, and H2A.Bbd are present in active chromatin	319	Transcription factor binding defines the structure and function of regulatory regions	348
MacroH2A is a histone variant prevalent in inactive chromatin	321	Transcription factors interact in a huge network	349
Problems caused by chromatin structure can be fixed by remodeling	321	TF-binding sites and TF structure co-evolve	351
Endogenous metabolites can exert rheostat control of transcription	323	DNA methylation patterns show a complex relationship with transcription	352
<b>12.6 DNA METHYLATION</b>	<b>324</b>	<b>13.6 ENCODE OVERVIEW</b>	<b>353</b>
DNA methylation patterns in genomic DNA may participate in regulation of transcription	325	What have we learned from ENCODE, and where is it leading?	353
Carcinogenesis alters the pattern of CpG methylation	327	Certain methods are essential to ENCODE project studies	354
DNA methylation changes during embryonic development	327	<b>13.7 BEYOND THE ENCODE PROJECT</b>	<b>356</b>
DNA methylation is governed by complex enzymatic machinery	328	Key concepts	357
There are proteins that read the DNA methylation mark	328	Further reading	357
<b>12.7 LONG NONCODING RNAS IN TRANSCRIPTIONAL REGULATION</b>	<b>329</b>	Videos on the Internet	358
Noncoding RNAs play surprising roles in regulating transcription	329	<b>Chapter 14: RNA Processing</b>	<b>359</b>
The sizes and genomic locations of noncoding transcripts are remarkably diverse	330	<b>14.1 INTRODUCTION</b>	<b>360</b>
<b>12.8 METHODS FOR MEASURING THE ACTIVITY OF TRANSCRIPTIONAL REGULATORY ELEMENTS</b>	<b>333</b>	Most RNA molecules undergo post-transcriptional processing	360
Key concepts	334	There are four general categories of processing	360
Further reading	335	Eukaryotic RNAs exhibit much more processing than bacterial RNAs	360
Videos on the Internet	336	<b>14.2 PROCESSING OF TRNAS AND RRNAS</b>	<b>361</b>
<b>Chapter 13: Transcription Regulation in the Human Genome</b>	<b>339</b>	tRNA processing is similar in all organisms	361
<b>13.1 INTRODUCTION</b>	<b>340</b>	All three mature ribosomal RNA molecules are cleaved from a single long precursor RNA	361
Rapid full-genome sequencing allows deep analysis	340	<b>14.3 PROCESSING OF EUKARYOTIC MRNA: END MODIFICATIONS</b>	<b>364</b>
<b>13.2 BASIC CONCEPTS OF ENCODE</b>	<b>340</b>	Eukaryotic mRNA capping is co-transcriptional	364
ENCODE depends on high-throughput, massively processed sequencing and sophisticated computer algorithms for analysis	340	Polyadenylation at the 3'-end serves a number of functions	364
The ENCODE project integrates diverse data relevant to transcription in the human genome	342	Chemical modifications of eukaryotic RNAs and their roles	366
<b>13.3 REGULATORY DNA SEQUENCE ELEMENTS</b>	<b>342</b>	<b>14.4 PROCESSING OF EUKARYOTIC MRNA: SPLICING</b>	<b>368</b>
Seven classes of regulatory DNA sequence elements make up the transcriptional landscape	342	The splicing process is complex and requires great precision	368
<b>13.4 SPECIFIC FINDINGS CONCERNING CHROMATIN STRUCTURE FROM ENCODE</b>	<b>343</b>	Splicing is carried out by spliceosomes	368
Millions of DNase I-hypersensitive sites mark regions of accessible chromatin	343	Splicing can produce alternative mRNAs	369
DNase I signatures at promoters are asymmetric and stereotypic	344	Tandem chimerism links exons from separate genes	371
Nucleosome positioning at promoters and around TF-binding sites is highly heterogeneous	345	Trans-splicing combines exons residing in the two complementary DNA strands	376
		<b>14.5 REGULATION OF SPLICING AND ALTERNATIVE SPLICING</b>	<b>376</b>
		Splice sites differ in strength	376
		Exon-intron architecture affects splice-site usage	376
		Cis-trans interactions may stimulate or inhibit splicing	377
		RNA secondary structure can regulate alternative splicing	379
		Sometimes alternative splicing regulation needs no auxiliary regulators	379
		The rate of transcription and chromatin structure may help regulate splicing	379
		<b>14.6 SELF-SPLICING: INTRONS AND RIBOZYMES</b>	<b>381</b>
		A fraction of introns is excised by self-splicing RNA	381
		There are two classes of self-splicing introns	381



## 14.7 OVERVIEW: THE HISTORY OF AN MRNA MOLECULE

Proceeding from the primary transcript to a functioning mRNA requires a number of steps  
mRNA is exported from the nucleus to the cytoplasm through nuclear pore complexes  
RNA sequence can be edited by enzymatic modification even after transcription

## 14.8 RNA QUALITY CONTROL AND DEGRADATION

Bacteria, archaea, and eukaryotes all have mechanisms for RNA quality control  
Archaea and eukaryotes utilize specific pathways to deal with different RNA defects

## 14.9 BIOGENESIS AND FUNCTIONS OF SMALL SILENCING RNAS

All ssRNAs are produced by processing from larger precursors  
Key concepts  
Further reading  
Videos on the Internet

## Chapter 15: Translation: The Players

### 15.1 INTRODUCTION

### 15.2 A BRIEF OVERVIEW OF TRANSLATION

Three participants are needed for translation to occur

### 15.3 TRANSFER RNA

tRNA molecules fold into four-arm cloverleaf structures  
tRNAs are aminoacylated by a set of specific enzymes, aminoacyl-tRNA synthetases

Aminoacylation of tRNA is a two-step process

Quality control or proofreading occurs during the aminoacylation reaction

Insertion of noncanonical amino acids into polypeptide chains is guided by stop codons

### 15.4 MESSENGER RNA

The Shine-Dalgarno sequence in bacterial mRNAs aligns the message on the ribosome

Eukaryotic mRNAs do not have Shine-Dalgarno sequences but more complex 5'- and 3'-untranslated regions

Overall translation efficiency depends on a number of factors

### 15.5 RIBOSOMES

The ribosome is a two-subunit structure comprising rRNAs and numerous ribosomal proteins

Functional ribosomes require both subunits, with specific complements of RNA and protein molecules

The small subunit can accept mRNA but must join with the large subunit for peptide synthesis to occur

Ribosome assembly has been studied both *in vivo* and *in vitro*

The expanding "riboverse"

Key concepts

Further reading

Videos on the Internet

## Chapter 16: Translation: The Process

### 16.1 INTRODUCTION

### 16.2 AN OVERVIEW OF TRANSLATION: HOW FAST AND HOW ACCURATE?

### 16.3 ADVANCED METHODOLOGY FOR THE ANALYSIS OF TRANSLATION

Cryo-EM allows visualization of discrete kinetic states of ribosomes

X-ray crystallography provides the highest resolution

Single-pair fluorescence resonance energy transfer allows dynamic studies at the single-particle level

### 16.4 INITIATION OF TRANSLATION

Initiation of translation begins on a free small ribosomal subunit

Cryo-EM provides details of initiation complexes

Start site selection in eukaryotes is complex

### 16.5 TRANSLATIONAL ELONGATION

Decoding means matching the codon to the anticodon-carrying aminoacyl-tRNA

Accommodation denotes a relaxation of distorted tRNA to allow peptide bond formation

Peptide bond formation is accelerated by the ribosome

The formation of hybrid states is an essential part of translocation

Structural information on bacterial elongation factors provides insights into mechanisms

There is an exit tunnel for the peptide chain in the ribosome

Translation elongation in eukaryotes involves even more factors

Ribosome stalling during translation elongation

### 16.6 TERMINATION OF TRANSLATION

RF3 aids in removing RF1 and RF2

Ribosomes are recycled after termination

Our views of translation continue to evolve

Key concepts

Further reading

Videos on the Internet

## Chapter 17: Regulation of Translation

### 17.1 INTRODUCTION

### 17.2 REGULATION OF TRANSLATION BY CONTROLLING RIBOSOME NUMBER

Ribosome numbers in bacteria are responsive to the environment

Ribosome numbers in eukaryotes: Control and consequences of dysregulation

Synthesis of ribosomal components in bacteria is coordinated

Regulation of the synthesis of ribosomal components in eukaryotes involves chromatin structure

### 17.3 REGULATION OF TRANSLATION INITIATION

Regulation of translation initiation is ubiquitous and remarkably varied

Regulation may depend on protein factors binding to the 5'- or 3'-ends of mRNA

Cap-dependent regulation is the major pathway for controlling initiation

Initiation may utilize internal ribosome entry sites

5'-3'-UTR interactions provide a novel mechanism that regulates initiation in eukaryotes

Riboswitches are RNA sequence elements that regulate initiation in response to stimuli	457	Acetylation mainly modifies interactions	493
Repeat-associated non-AUG translation	459	Several classes of glycosylated proteins contain added sugar moieties	494
MicroRNAs can bind to mRNA, thereby regulating translation	460	Mechanisms of glycosylation depend on the type of modification	500
<b>17.4 REGULATION OF THE ELONGATION PROCESS</b>	<b>461</b>	Ubiquitylation adds single or multiple ubiquitin molecules to proteins through an enzymatic cascade	502
<b>17.5 mRNA STABILITY AND DECAY IN EUKARYOTES</b>	<b>463</b>	Specificity of ubiquitin targeting is determined by a special class of enzymes	504
The two major pathways of decay for nonfaulty mRNA molecules start with mRNA deadenylation	464	The structure of protein-ubiquitin conjugates determines the biological role of the modification	509
The 5' → 3' pathway is initiated by the activities of the decapping enzyme Dcp2	465	Polyubiquitin marks proteins for degradation by the proteasome	509
The 3' → 5' pathway uses the exosome, followed by a different decapping enzyme, DcpS	466	Sumoylation adds single or multiple SUMO molecules to proteins	510
There are additional pathways for mRNA degradation	468	<b>18.6 PROTEIN CO-TRANSLATIONAL FOLDING</b>	<b>512</b>
Unused mRNA is sequestered in P bodies and stress granules	468	<b>18.7 THE GENOMIC ORIGIN OF PROTEINS</b>	<b>513</b>
Cells have several mechanisms that destroy faulty mRNA molecules	471	Key concepts	513
mRNA molecules that contain premature stop codons are degraded through nonsense-mediated decay or NMD	472	Further reading	514
No-go decay (NGD) functions when the ribosome stalls during elongation	473	Videos on the Internet	515
Non-stop decay or NSD functions when mRNA does not contain a stop codon	473	<b>Chapter 19: DNA Replication in Bacteria</b>	<b>517</b>
<b>17.6 SUMMARY OF TRANSLATION REGULATION</b>	<b>474</b>	<b>19.1 INTRODUCTION</b>	<b>518</b>
Key concepts	474	<b>19.2 FEATURES OF DNA REPLICATION SHARED BY ALL ORGANISMS</b>	<b>518</b>
Further reading	474	Replication on both strands creates a replication fork	518
Videos on the Internet	476	Mechanistically, synthesis of new DNA chains requires a template, a polymerase, and a primer	520
<b>Chapter 18: Protein Processing and Modification</b>	<b>477</b>	DNA replication requires the simultaneous action of two DNA polymerases	520
<b>18.1 INTRODUCTION</b>	<b>478</b>	Other protein factors are obligatory at the replication fork	521
<b>18.2 STRUCTURE OF BIOLOGICAL MEMBRANES</b>	<b>478</b>	<b>19.3 DNA REPLICATION IN BACTERIA</b>	<b>523</b>
Biological membranes are protein-rich lipid bilayers	478	Bacterial chromosome replication is bidirectional, from a single origin of replication	523
Numerous proteins are associated with biomembranes	479	DNA polymerase III catalyzes replication in bacteria	523
<b>18.3 PROTEIN TRANSLOCATION THROUGH BIOLOGICAL MEMBRANES</b>	<b>479</b>	Sliding clamp $\beta$ , or processivity factor, is essential for processivity	523
Protein translocation can occur during or after translation	480	The clamp loader organizes the replisome	523
Membrane translocation in bacteria and archaea primarily functions for secretion	480	The full complement of proteins in the replisome is organized in a complex and dynamic way	524
Membrane translocation in eukaryotes serves a multitude of functions	481	DNA polymerase I is necessary for maturation of Okazaki fragments	528
Integral membrane proteins have special mechanisms for membrane insertion	482	<b>19.4 THE PROCESS OF BACTERIAL REPLICATION</b>	<b>530</b>
Vesicles transport proteins between compartments in eukaryotic cells	484	The replisome is a dynamic structure during elongation	530
<b>18.4 PROTEOLYTIC PROTEIN PROCESSING: CUTTING, SPLICING, AND DEGRADATION</b>	<b>485</b>	<b>19.5 INITIATION AND TERMINATION OF BACTERIAL REPLICATION</b>	<b>532</b>
Proteolytic cleavage is sometimes used to produce mature proteins from precursors	485	Initiation involves both specific DNA sequence elements and numerous proteins	532
Some proteases can catalyze protein splicing	486	Termination of replication also employs specific DNA sequences and protein factors that bind to them	534
Controlled proteolysis is also used to destroy proteins no longer needed	488	<b>19.6 DNA REPLICATION AND BACTERIAL CELL CYCLE</b>	<b>536</b>
<b>18.5 POST-TRANSLATIONAL CHEMICAL MODIFICATIONS OF SIDE CHAINS</b>	<b>489</b>	<b>19.7 BACTERIOPHAGE AND PLASMID REPLICATION</b>	<b>540</b>
Modification of side chains can affect protein structure and function	489	Rolling-circle replication is an alternative mechanism	542
Phosphorylation plays a major role in signaling	491	Phage replication can involve both bidirectional and rolling-circle mechanisms	543



Key concepts	543	Holliday junctions are the essential intermediary structures in HR	589
Further reading	546		
Videos on the Internet	547		
<b>Chapter 20: DNA Replication in Eukaryotes</b>	<b>549</b>		
<b>20.1 INTRODUCTION</b>	<b>550</b>	<b>21.4 HOMOLOGOUS RECOMBINATION IN EUKARYOTES</b>	<b>590</b>
<b>20.2 REPLICATION INITIATION IN EUKARYOTES</b>	<b>550</b>	Proteins involved in eukaryotic recombination resemble their bacterial counterparts	590
Replication initiation in eukaryotes proceeds from multiple origins	550	HR malfunction is connected with many human diseases	591
Eukaryotic origins of replication have diverse DNA and chromatin structure depending on the biological species	553	Meiotic recombination allows exchange of genetic information between homologous chromosomes in meiosis	593
There is a defined scenario for formation of initiation complexes	559	<b>21.5 NONHOMOLOGOUS RECOMBINATION</b>	<b>596</b>
Re-replication must be prevented	561	Transposable elements or transposons are mobile DNA sequences that change positions in the genome	596
Histone methylation regulates onset of replication licensing	561	Many transposons are transcribed but only a few have known functions	596
<b>20.3 REPLICATION ELONGATION IN EUKARYOTES</b>	<b>561</b>	There are several types of transposons	598
Eukaryotic replisomes both resemble and significantly differ from those of bacteria	561	DNA class II transposons can use either of two mechanisms to transpose themselves	601
Other components of the bacterial replisome have functional counterparts in eukaryotes	564	Retrotransposons, or class I transposons, require an RNA intermediate	602
Eukaryotic elongation has some special dynamic features	565	<b>21.6 SITE-SPECIFIC RECOMBINATION</b>	<b>602</b>
<b>20.4 REPLICATION OF CHROMATIN</b>	<b>565</b>	Bacteriophage $\lambda$ integrates into the bacterial genome by site-specific recombination	603
Chromatin structure is dynamic during replication	565	Immunoglobulin gene rearrangements also occur through site-specific recombination	603
Histone chaperones may play multiple roles in replication	566	Key concepts	616
Both old and newly synthesized histones are required in replication	567	Further reading	616
Epigenetic information in chromatin must also be replicated	568	Videos on the Internet	617
<b>20.5 THE DNA END-REPLICATION PROBLEM AND ITS RESOLUTION</b>	<b>570</b>	<b>Chapter 22: DNA Repair</b>	<b>619</b>
Telomerase solves the end-replication problem	570	<b>22.1 INTRODUCTION</b>	<b>620</b>
Alternative lengthening of telomeres pathway is active in telomerase-deficient cells	572	<b>22.2 TYPES OF LESIONS IN DNA</b>	<b>622</b>
<b>20.6 MITOCHONDRIAL DNA REPLICATION</b>	<b>573</b>	Natural agents, from both within and outside a cell, can change the information content of DNA	622
Are circular mitochondrial genomes myth or reality?	574	<b>22.3 PATHWAYS AND MECHANISMS OF DNA REPAIR</b>	<b>624</b>
Models of mitochondrial genome replication are contentious	574	DNA lesions are countered by a number of mechanisms of repair	624
<b>20.7 REPLICATION IN VIRUSES THAT INFECT EUKARYOTES</b>	<b>575</b>	Thymine dimers are directly repaired by DNA photolyase	626
Retroviruses use reverse transcriptase to copy RNA into DNA	575	The enzyme O <sup>6</sup> -alkylguanine alkyltransferase is involved in the repair of alkylated bases	628
Key concepts	578	Nucleotide excision repair is active on helix-distorting lesions	628
Further reading	579	The role of TFIIH in NER	629
Videos on the Internet	580	Base excision repair corrects damaged bases	630
<b>Chapter 21: DNA Recombination</b>	<b>581</b>	Mismatch repair corrects errors in base pairing	630
<b>21.1 INTRODUCTION</b>	<b>582</b>	Methyl-directed mismatch repair in bacteria uses methylation on adenines as a guide	631
<b>21.2 HOMOLOGOUS RECOMBINATION</b>	<b>582</b>	Mismatch repair pathways in eukaryotes may be directed by strand breaks during DNA replication	632
Homologous recombination plays a number of roles in bacteria	583	Repair of double-strand breaks can be error-free or error-prone	633
Homologous recombination has multiple roles in mitotic cells	584	Homologous recombination repairs double-strand breaks faithfully	633
Meiotic exchange is essential to eukaryotic evolution	584	Nonhomologous end-joining restores the continuity of the DNA double helix in an error-prone process	634
<b>21.3 HOMOLOGOUS RECOMBINATION IN BACTERIA</b>	<b>584</b>	<b>22.4 TRANSLESION SYNTHESIS</b>	<b>635</b>
End resection requires the RecBCD complex	585	Many repair pathways utilize RecQ helicases	637
Strand invasion and strand exchange both depend on RecA	586		
Much concerning homologous recombination is still not understood	587		

## Contents

<b>22.5 CHROMATIN AS AN ACTIVE PLAYER IN DNA REPAIR</b>	<b>637</b>	Key concepts	652
Histone variants and their post-translational modifications are specifically involved in DNA repair	638	Further reading	653
<b>22.6 SUMMARY OF DNA REPAIR</b>	<b>644</b>	Videos on the Internet	654
<b>22.7 OVERVIEW: THE ROLE OF DNA REPAIR IN LIFE</b>	<b>645</b>	<b>Glossary</b>	<b>655</b>
		<b>Index</b>	<b>695</b>