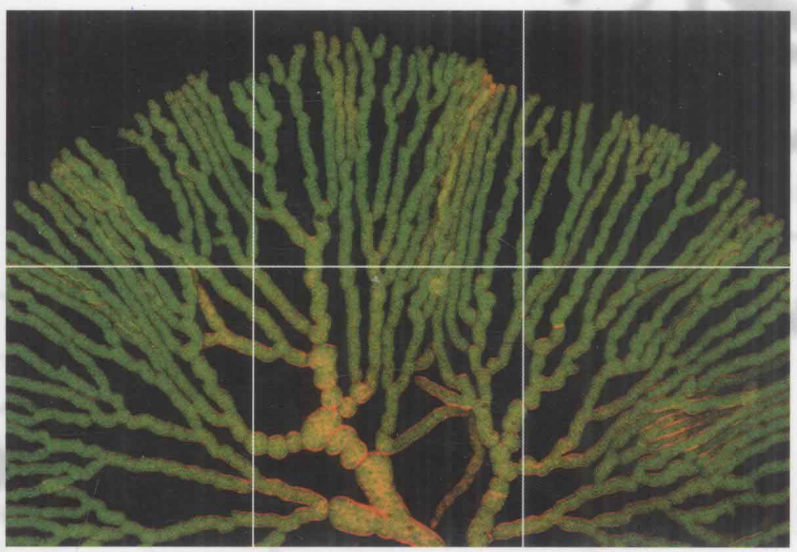
精要速览系列

Instant Notes

MICROBIOLOGY (THIRD EDITION)

微生物学（第三版）



·导读版·

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精要速览系列
Instant Notes in

Microbiology

Third Edition

微生物学

（第三版，导读版）

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内 容 简 介

“精要速览系列(Instant Notes Series)”丛书是国外教材“Best Seller”榜的上榜教材。该系列结构新颖,视角独特;重点明确,脉络分明;图表简明清晰;英文自然易懂,被国内多所重点院校选用作为双语教材。

本书第 3 版沿袭第 2 版的编写特点,但对全书进行了全面的修订。全书分为 12 个部分,包括微生物的细胞结构、分类、代谢、遗传、生态、感染和免疫以及真菌、藻类、原生生物和病毒等内容,增加了系统学、微生物学、RNA 代谢、细胞 DNA 和 RNA 操作、细菌生物武器、寄生性原生生物等章节。使第 3 版强化了普通微生物学部分,突出了细菌学内容,同时更加关注从分子生物学角度阐明微生物学相关知识,并将微生物学的理论知识与实验操作有机地结合在一起,既全面、重点地概括了微生物学的基本概念和原理,又突出介绍了本学科发展的前沿热点问题。

本书适合普通高等院校生命科学、医学、农学等相关专业使用,也可作为双语教学参考教材使用。

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导读编译者前言

微生物学是生命科学重要的基础学科，它在生命科学重大基础理论和现代生物技术的形成与发展中起着重要作用；同时微生物学又是应用性很强的学科，它与数理化和信息科学交叉渗透，与人类的经济发展、社会进步和日常生活特别是与人类目前面临的食品、健康、医药、能源和环境等热点问题息息相关。因此，微生物学是当代生命科学前沿中最具有活力和创造力的学科之一。使微生物学界引为自豪的是，在20世纪诺贝尔生理学或医学奖获得者中有超过1/3的获奖者是从事微生物学研究的学者。

随着教育部教学质量工程的建设，选用一流的国内外教材成为了教学环节中的重要组成部分。目前我国所引进的国外优秀微生物学教材多是美国版本，如 *Brock Biology of Microorganisms*（已有11th中译版）、Prescott/Harley/Klein's *Microbiology*（已有5th中译版）、*Microbiolgy*：*Principles and Explorations*（已有6th中译版）。这几本外文书的特点都是内容丰富、知识广泛、图表精美、更新迅速。但对于我们教师如何在有限的学时内，将这些丰富多彩的微生物学理论知识传授给学生，是一种极具挑战性的工作，需要我们根据授课对象的不同、学时的多少，有选择地取舍。

Instant Notes 系列图书是包括欧洲、北美在内全球畅销的优秀教材，是由英国著名大学具有丰富教学经验的一流教授编写的。科学出版社于2003年已将《微生物学》分册第2版以影印版发行，次年的9月，该版的中文版也面市。该书的编写与排版与我国多数教材和美国教材不同，其风格独特、简明扼要、通俗易懂、取材新颖、插图简洁、该书便于阅读、理解和记忆，各章节都有要点、相关主题和进一步阅读书目，重点突出、主线明确，国内许多高校将其作为双语对照教材，可以在学生快速掌握微生物学基础知识的同时也锻炼了英语阅读能力。因此，该书影印版、中文版累计印刷十余次，这在国内微生物学外文教材中是不多见的，足以看出广大读者对该教材的渴求与钟爱。

本书第3版沿袭第2版的编写特点，但对全书进行了全面的修订。全书分为12个部分，包括微生物的细胞结构、分类、代谢、遗传、生态、感染和免疫以及真菌、藻类、原生生物和病毒等内容，增加了系统学、微生物学、RNA代谢、细胞DNA和RNA操作、细菌生物武器、寄生性原生生物等章节。使第3版强化了普通微生物学部分，突出了细菌学内容，同时更加关注从分子生物学角度阐明微生物学相关知识，并将微生物学的理论知识与实验操作有机地结合在一起，既全面、重点地概括了微生物学的基本概念和原理，又突出介绍了本学科发展的前沿热点问题。

为了便于国内从事微生物学教学的教师扩展教学内容、搜寻教学参考资料，也为了使广大学习微生物学专业的学生增加知识、拓宽眼界，我们在林稚兰教授翻译的第二版基础上导读编译了 *Instant Notes Microbiology* 第三版，参加本书导读编译的人员有李国强（A，B，C，D部分）、蔡峻（E，F部分）、梁勇（G，H部分）、李明春（I，J，K，L部分），杨文博教授对全书做了校对和统稿。在整个翻译过程中得到了科学出版社编辑的热情帮助和支持。

在翻译中错误与疏漏在所难免，敬请广大读者批评指正，在此表示感谢。

李明春　杨文博

南开大学生命科学学院

2009年2月于天津

前　言

打开本书，您可以发现 *Instant Notes in Microbiology* 第三版包括普通微生物学、细菌学和相关分子生物学在内的许多章节已再一次进行了完全改写。新版更加关注分子方面的知识。有关细菌感染、真菌和原生生物的章节均已更新，并增加了新的一节——寄生性原生生物。病毒这一章虽然保留了其结构，但进行了修改。

本书中，作者采用细菌一词指的是细菌界的成员，而不是过去所说的非真核微生物。为此，我们使用了“原核生物”用以包括细菌和古生菌。虽然并不是所有的分类学家同意使用这个称谓，但是这些术语始终贯穿于这本书并且反映了当前对微生物学的认识——毫无疑问，今后第四版将会体现这种变化。

作者对编写这本书给予帮助的牛津大学地球科学系和英国萨里郡州（Surrey）艾普森赛马镇（Epsom）的ABgene有限公司表示感谢。我们还要感谢给予不懈支持的家人、同事以及给我们提出宝贵的反馈意见的第二版评审人。

PREFACE

The third edition of *Instant Notes in Microbiology* has once again seen a complete rewrite of many chapters. Those on general microbiology, bacteriology and the relevant molecular biology have been completely revised and now have a more molecular focus. The chapter on bacterial infections has been also been revised. The chapters on fungi and protists have been updated and a new section on parasitic protists has been added. The chapter dealing with the viruses retains its structure, but has been revised.

In this book, the authors have chosen to use the word Bacteria to mean those members of the Kingdom Bacteria, and not in its older usage to denote non-eukaryotic microbes. For this we have used "prokaryotes" to include both the Bacteria and the Archaea. While not all taxonomists will be happy with these definitions, the terms have been used consistently throughout the book and reflect current thinking within microbiology – though no doubt this will have changed by the publication of the fourth edition.

The authors would like to thank the Department of Earth Sciences, University of Oxford and ABgene Ltd., Epsom, Surrey for help in the preparation of this book. However, we would also like to thank our families for their continuing support, as well as to colleagues and the reviewers of the second edition, who all gave us valuable feedback.

缩 略 词

A	adenine	腺嘌呤
ABC	ATP-binding cassette	ATP 结合盒
ACP	acyl carrier protein	酰基载体蛋白
ADP	adenosine 5′-diphosphate	5′-腺苷二磷酸
Ala	alanine	丙氨酸
AMP	adenosine 5′-monophosphate	5′-腺苷[一磷]酸
A-site	amino-acyl site(ribosome)	氨酰基(A)位点(核糖体)
ATP	adenosine 5′-triphosphate	5′-腺苷三磷酸
ATPase	ATP synthase	腺苷三磷酸酶
BHK	baby hamster kidney	幼龄小鼠肾
Bp	base pair	碱基对
C	cytosine	胞嘧啶
C-phase	Chromosome replication phase(bacterial cell cycle)	染色体复制期(细菌细胞周期)
cAMP	cyclic adenosine 5′-monophosphate	环腺苷酸
CAP	catabolite activator protein	分解代谢物激活蛋白
CAT	chloramphenicol acetyl transferase	氯霉素乙酰转移酶
CFU	colony-forming unit	菌落形成单位
CMV	cytomegalovirus	巨细胞病毒
CNS	central nervous system	中枢神经系统
CoA	coenzyme A	辅酶 A
CPE	cytopathic effect	致细胞病变(效应),细胞致病作用
CRP	cAMP receptor protein	cAMP 受体蛋白
CTL	cytotoxic T lymphocyte	细胞毒性 T 淋巴细胞
Da	Dalton	道尔顿
d-Ala	D-alanine	D-丙氨酸
DAP	*meso*-diaminopimelic acid	内消旋二氨基庚二酸
D-Glu	D-glutamic acid	D-谷氨酸
DHA	dihydroxyacetone	二羟丙酮
DNA	deoxyribonucleic acid	脱氧核糖核酸
d-NTP	deoxyribonucleoside triphosphate	脱氧核糖核苷三磷酸
DOM	dissolved organic matter	溶解的有机质
D-phase	division phase(bacterial cell cycle)	分裂期(细菌细胞周期)
Ds	double-stranded	双链
EF	elongation factor	延伸因子
EM	electron microscopy	电镜术,电子显微镜术
ER	endoplasmic reticulum	内质网
FAD	flavin adenine dinucleotide(oxidized)	黄素腺嘌呤二核苷酸(氧化型)
FADH2	flavin adenine dinucleotide(reduced)	黄素腺嘌呤二核苷酸(还原型)

FMN	flavin mononucleotides	黄素腺嘌呤单核苷酸
G	guanine	鸟嘌呤
G-phase	gap phase(bacterial cell cycle)	间期(细菌细胞周期)
GTP	guanosine-5′-triphosphate	5′-鸟苷三磷酸
HA	hemagglutination	血细胞凝集
Hfr	high frequency recombination	高频重组
HMP	hexose monophosphate pathway	磷酸己糖途径,磷酸己糖支路
HSV	herpes simplex virus	单纯疱疹病毒
I	inosine	肌苷,次黄苷
ICNV	International Committee on Nomenclature of Viruses	国际病毒命名委员会
Ig	immunoglobulin	免疫球蛋白
IHF	integration host factor	整合宿主因子
Inc group	incompatible group(of plasmids)	不相容群(质粒的一种特性)
IS	insertion sequence	插入序列
kb	kilobase	千碱基,千碱基对
KDO	2-keto-3-deoxyoctonate	2-酮-3-脱氧辛糖酸[盐]
KDPE	2-keto-3-deoxy-6-phosphogluconate	2-酮-3-脱氧 6-磷酸葡萄糖酸[盐]
lac	lactose	乳糖
LBP	luciferin-binding protein	萤光素结合蛋白质
LPS	lipopolysaccharide	脂多糖
MAC	membrane-attack complex	攻膜复合体
MCP	methyl-accepting chemotaxis protein	甲基受体趋化蛋白
MEM	minimal essential medium	基本培养基
MHC	major histocompatibility complex	主要组织相容性复合体
m. o. i	multiplicity of infection	感染复数
mRNA	messenger ribonucleic acid	信使核糖核酸
MTOC	microtuble organizing centre	微管组织中心
NAD+	nicotinamide adenine dinucleotide(oxidized form)	烟酰胺腺嘌呤二核苷酸(氧化型),辅酶 I
NADH	nicotinamide adenine dincleotide(reduced form)	烟酰胺腺嘌呤二核苷酸(还原型),辅酶 I
NADP+	nicotinamide adenine dincleotide phosphate(oxidized form)	烟酰胺腺嘌呤二核苷酸磷酸(氧化型),辅酶 II
NADPH	nicotinamide adenine dincleotide phosphate (reduced form)	烟酰胺腺嘌呤二核苷酸磷酸(还原型),辅酶 II
NAG	*N*-acetyl glucosamine	乙酰氨基葡糖,*N*-乙酰葡糖胺
NAM	*N*-acetyl muramic acid	*N*-乙酰胞壁酸
NB	nutrient borth	营养肉汤
NTP	ribonucleoside triphosphate	核糖核苷三磷酸
O	operator	操纵子
OD	optical density	光密度
OmP	outer membrane protein	外膜蛋白
P	promoter	启动子
PCBs	polychlorinated biphenyls	多氯联苯
PCR	polymerase chain reaction	聚合酶链反应
PEP	phosphoenol pyruvate	磷酸烯醇式丙酮酸

pfu	plaque-forming unit	噬斑形成单位,蚀斑形成单位
PHB	poly-β-hydroxybutyrate	聚β-羟丁酸[盐]
Phe	phenylalanine	苯丙氨酸
P_i	inorganic phosphate	无机磷酸
PMF	proton motive force	质子动力,质子动势
PMN	polymorphonucleocyte	多形核白细胞
PP_i	inorganic pyrophosphate	无机焦磷酸
PPP	pentose phosphate pathway	戊糖磷酸途径
PS	photosystem	光(合)系统
PSⅠ和Ⅱ	photosystems Ⅰ and Ⅱ	光合系统Ⅰ和光合系统Ⅱ
P-site	peptidyl site(ribosome)	肽酰基(P)位点(核糖体)
R	resistance(plasmid)	抗性(质粒)
r	rho factor	ρ因子
RBC	red blood cell	红细胞
redox	reduction-oxidation	氧化-还原
RER	rough endoplasmic reticulum	粗面内质网,糙面内质网
RNA	ribonucleic acid	核糖核酸
rRNA	ribosomal RNA	核糖体 RNA
rubisco	ribulose bisphosphate carboxylase	核酮糖二磷酸羧化酶
S	Svedberg coefficient	沉降系数
snRNA	small nuclear ribonucleic acid	核内小 RNA
SPB	spindle pole bodies	纺锤极体
ss	single-stranded	单链
T	thymine	胸腺嘧啶
TCA	tricarboxylic acid	三羧酸
TCID	tissue culture infective dose	组织培养感染量
tRNA	transfer RNA	转移 RNA
Trp	tryptophan	色氨酸
TSB	tryptone soya broth	大豆胰蛋白胨肉汤
U	uracil	尿嘧啶
UL,US	unique long	单一长区(一串单核苷酸长链)
	unique short	单一短区(一串单核苷酸短链)
UDP	uridine diphosphate	尿苷二磷酸
UDPG	uridine diphosphate glucose	尿苷二磷酸葡萄糖
UV	ultraviolet light	紫外线

A 微生物世界

A1 微生物世界

要 点

微生物横跨生物界中的三个主要界：细菌、古生菌和真核生物。细胞核的存在是真核生物的重要标志，由于细菌和古生菌都不具有细胞核而被称为原核生物。除细胞核外，原核生物和真核生物在生理生化性质方面还存在着许多差异。

目　录

CONTENTS

A1 THE MICROBIAL WORLD

Key Note

Microorganisms are found in all three major kingdoms of life: the Bacteria, the Archaea and the Eukarya. The presence of a nucleus defines the eukaryotes, while both the Bacteria and Archaea can be defined as prokaryotes. Apart from the nucleus, there are many physiological and biochemical properties distinguishing the prokaryotes from the eukaryotes.

What are microbes?

Microbes are a diverse group of organisms that can be divided into the viruses, unicellular groups (Archaea, Eubacteria, protista, some fungi and some chlorophyta) and a small number of organisms with a simple multicellular structure (the larger fungi and chlorophyta). These larger microorganisms are characterized by having a filamentous, sheet like or parenchymous thallus that does not display true tissue differentiation. Most microbes cannot be seen without the aid of a microscope.

Microbiology

Microbiology is defined as the study of microorganisms. The discipline now includes their molecular biology and functional ecology as well as the traditional studies of structure and physiology. The discipline began in the late 17th century with Leeuwenhoek's discovery of bacteria using simple microscopy of mixed natural cultures. Through the 1850s and 60s, Louis Pasteur's simple experiments using sterilized beef broth finally refuted the long-held theory of spontaneous generation as an origin for microbes, and microbiology moved into mainstream science.

The early days were characterized by studying environments like soil and sediments, natural fermentations and infections, and it was not until Robert Koch developed techniques for pure culture in the late 19th century that the science moved to a reductionist phase, where microbes were isolated and characterized in the laboratory.

Through the 20th century microbiologists focused on the discovery and characterization of many different microorganisms, including a new kingdom of microorganisms the Archaea, new eubacterial pathogens including *Legionella* and MRSA (methicillin resistant *Staphylococcus aureus*), and the complex of pathogens associated with HIV (human immune deficiency virus) including the fungal pathogen Pneumocystis. The discovery of the unique communities found in extreme environments with their temperature tolerant DNA (deoxyribonucleic acid) polymerase enzymes has further opened up the new field of molecular biology.

The rapid advances of techniques in molecular biology have allowed microbiology to return to the natural environments. Techniques, such as DGGE (denaturing gradient gel electrophoresis) and SCCP (single stranded conformation polymorphism) DNA chips and *in situ* hybridization now give us the tools to study microbial community ecology at the molecular level. Microbiology has returned to its roots!

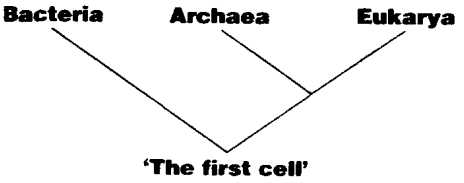

Fig. 1. The three cell lineages evolved from a common ancestor.

Bacteria, Archaea and Eukaryotes

The microbial world has three main cell lineages within it, all of which are thought to have evolved from a single progenitor (*Fig. 1*). The lineages are formally known as domains and were established from the DNA sequence of genes common to all organisms (see Section B3). The three domains are the Bacteria (previously called the Eubacteria), the Archaea (previously called the Archaeabacteria) and the Eukarya. The defining property of the Eukarya compared to the Archaea and Bacteria is the presence of a nucleus. It is frequently convenient to group the annucleate lineages (the Bacteria and Archaea) together as the prokaryotes. The prokaryotes are, with a very few exceptions (see Section C6), all microorganisms, but the Eukarya include not only microbial fungi, chlorophyta and protists (see Section I) but also the macroorganisms such as higher plants and animals.

Prokaryotic cell structure is characterized by the absence of a nucleus, but it also lacks energy-generating organelles such as mitochondria and chloroplasts. Instead, prokaryotes generate energy by cytoplasmic substrate-level phosphorylation and oxidative phosphorylation across their cell membranes (see Section E3). Apart from these major differences, there are a multitude of distinctive biochemical and physiological properties, the most important of which are listed in *Table 1*. The differences that exist between the Bacteria and the Archaea (see Section C6) are discussed elsewhere in more detail.

Summary of subjects covered in this volume

Systematics

Bacterial systematics allows the microbiologist to name, classify, and identify Bacteria and Archaea in a rational way. The importance of molecular biology to microbiology is emphasized by the prominence of 16S rRNA (ribosomal ribonucleic acid) sequencing in microbial phylogeny.

General microbiology

Microbiology as a science has a long and varied history, but we are only just beginning to appreciate the full ecological, biochemical, and genetic diversity of microbes. Sophisticated methods have been developed to measure the growth of many of these microbes in the laboratory. Our understanding of microorganisms has improved so that we can now appreciate the fine structure of the prokaryotic cell, rather than just considering it as a bag of enzymes. The understanding of microbial cell division and movement has also led to important breakthroughs in eukaryotic biology. Although the microbiology of human disease is well studied, we are beginning to find that microbes play an essential global role in the biogeochemical cycling of the elements.

Microbial growth

The way in which most prokaryotic cultures divide in batch and continuous culture can be modelled mathematically to reveal the limitations imposed by