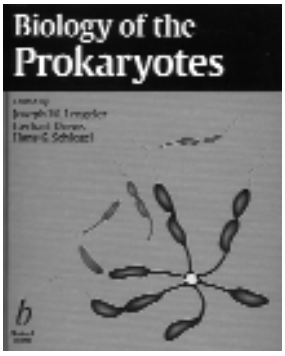
INTERNATL MICROBIOL (1999) 2:125–130



Biology of the Prokaryotes

JOSEPH W. LENGELER, GERHART DREWS, HANS G. SCHLEGEL (eds.)

1999. Blackwell Science, Oxford.

328 pp. 24.5 × 20 cm.
Price: £ 39.50
ISBN 0-632-05357-7

Two years ago we commented on a small—yet great—book on microbiology by one of the editors of *Biology of the Prokaryotes*. It was the Spanish translation of the German 7th edition of *Allgemeine Mikrobiologie* by Hans G. Schlegel (see *Microbiología SEM*, 12:109–110, 1997). *Biology of the Prokaryotes* might be considered a grown up sibling—or even better a strong step brother or sister—of that already classical manual on general microbiology. Schlegel along with Joseph W. Lengeler and Gerhart Drews have edited a new book on microbiology now restricted to prokaryotic organisms and devoted mainly to their biochemical pathways and regulatory processes. The book, in fact, could have been subtitled *Biochemistry and Regulation in Prokaryotes*. The editors have gathered more than forty specialists to write the different chapters, and they themselves have authored some. Besides, each of the nine Sections into which the book is divided has its own editor, an expert on the topic dealt with there. In the Preface, the editors tell us why this textbook is restricted to the biology of prokaryotes. They think that their separated treatment is justified because of prokaryotes' tremendous physiological diversity and adaptability, together with their fundamental role in environmental, biotechnological, and medical research and application.

Prokaryotes are ubiquitous, numerous organisms that have adapted to every kind of environment. Their ordinary metabolism, itself a sign of their maintenance and growth, produces and removes atmospheric gases, as well as most of the chemical compounds found in the cycles of the major elements. By interacting strongly with solar radiation, phototrophic bacteria alter the solar radiative properties of their environments. They also produce and release many organic acids and oxidize sulfur and nitrogen, generating sulfuric, nitric, and other acids. Although bacteria are autonomous cells and complete organisms, their biology cannot be fully understood if they are considered as single cells. One of their most outstanding capabilities is their extended horizontal gene transfer under natural conditions. A bacterium has access to any useful gene of any other strain and the sum of all the genes of all the organisms of a community constitutes a large collective genome. Speciation is not so obvious in prokaryotes as it is in eukaryotes, which show strict genetic isolation. Those and other relevant reasons such as the tremendous physiological diversity and adaptability of prokaryotes have led the editors to call for the contribution of so many authors, known for their expertise in their own fields. The result is a modern textbook on the biology and the biochemistry of prokaryotes, which has the ingredients to become a classic and find its own niche among other excellent books on general microbiology.

Simplicity and clarity are two outstanding features of *Biology of the Prokaryotes*. Like the above mentioned *Allgemeine Mikrobiologie*, it is printed in two colors and has many figures and tables. Shaded areas help the reader to capture the essential conclusions in all chapters; boxes contain information on historical and outstanding experiments as well as the description of basic and new methods. Besides, titles such as "Membrane differentiation in facultatively phototrophic bacteria is regulated by shifts" or "Prokaryotes participate in all steps of the sulfur cycle" for the different parts of the chapters are usually a summary of their contents, and make it clear what the reader will find.

An Introduction by H. G. Schlegel and W. Köhler is a historical account that leads the reader from the beginnings of bacteriological research, with its roots in medicine, in plant physiology and in agricultural chemistry, to the concepts developed in the early 1960s. A useful table at the end of the Introduction shows the milestones in the development of microbiology over more than three centuries. Developments and breakthroughs which took place after 1962 will be discovered through the pages of the different chapters.

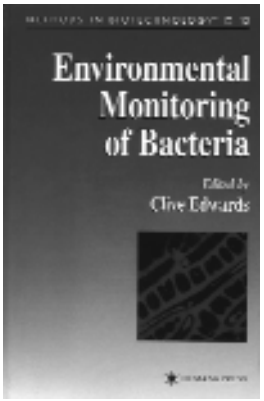
From the point of view of evolution, all cellular structures have evolved to fulfill functions, and that is the only context in which they can be understood. This is the conclusion of the first of the nine sections in which the book is distributed: Section I, "The Prokaryotic Cell", in which cellular and subcellular organization of the prokaryotes are considered jointly with their structural components and functions. Section II, "Basic Prerequisites for Cellular Life", turns to metabolism, stressing the basic unity of prokaryotic growth and nutrition. The principles of catabolism, nutrition, kinetics of growth are described as well as the biosynthesis of building blocks from simple growth substrates. The six chapters of Section III, "Diversity of Metabolic Pathways", offer a view of the impressive diversity of bacterial metabolism. This is a feature of prokaryotes usually neglected in textbooks on biochemistry, which tend to emphasize pathways operating in eukaryotes, especially in humans. There is a great variety of prokaryotes that make their living by oxidizing all kind of organic substrates. Behind the diversity of metabolic pathways, there is a unity of basic mechanisms. In Section IV, "The Genetics of the

Prokaryotes and Their Viruses", Friedrich and Lengeler call attention to the fact that the lack of nucleus, chromosomes and sexuality was for a long time considered to be a major difference between bacteria and eukaryotic cells. These ideas changed thanks to *Sexuality and the Genetics of Bacteria* published by F. Jacob and E. Wollman in 1961 and *The Genetics of Bacteria and Their Viruses*, by W. Hayes, 1964. Besides those historic events, the most updated knowledge about genetic information, recombinant DNA technology, genetic exchange between microorganisms, assembly of cellular surface structures, regulation of fermentation and respiration, among other topics, are discussed in this and the two following sections: V, "Gene Expression and Regulatory Mechanisms"; and VI, "Cell Growth and Differentiation".

With the recent application of molecular techniques, microbiologists have been able to assess the diversity of prokaryotes in environmental samples. In doing this, the difficulties to obtain axenic cultures for the subsequent characterization have been finally overcome. Besides ubiquitous, prokaryotes are ancient and also largely unknown; in fact, only a very small number of prokaryotic species have been described, all of them being Bacteria and Archaea. There is a long road in front of us. Step by step and with the support of knowledge, technology and ingenuity we will know more about those organisms that have inhabited our planet for more than 3,500 millions years and that are able to survive in the most extreme environments. Section VII, "Diversity and Systematics", emphasizes the enormous variety of the microbial world and shows how systematics lies on the work carried out by the early natural historians. The chapters of Section VIII, "Prokaryotes in the Biosphere", concentrate on general topics of ecological research. Conditions under which microorganisms live in natural environments, their contribution to the physical, chemical, and biological properties of their environment, taking into account the basic differences between the natural environments and laboratory conditions. Ecophysiology and ecological niches of prokaryotes, their habitats and global biogeochemical cycles are accurately described and discussed as a way to understand the ecological conditions under which evolution takes place. Finally, because it is worthwhile to think of the historical, practical applications of microbes, the last Section, IX, "Applied Microbiology", offers a brief view of the role of prokaryotes in the past and a more extensive description of their potential and real applications in present and future. Those applications refer to the fields of medicine, agriculture, industrial production, and environmental processes for bioremediation of soils, water and gas. In addition to bioremediation, special characteristics of bacterial enzymes, such as their ability to bind specific compounds, are used in the development of biosensors.

Biology of the Prokaryotes will be a most useful companion to advanced students and researchers on fundamental microbiology, to whom it will provide the central concepts of this subject especially regarding the biochemistry of prokaryotes. The book is also recommended to researchers that use prokaryotes as a tool for their work. In fact, basic microbiology is the foundation for the development of applied microbiology and modern techniques used in biotechnology. Undoubtedly, this book is an excellent representative of the Delft School of microbiological thought and another milestone in the brilliant path of microbiology textbooks initiated in 1957 by R. Stanier's *The Microbial World*.

Ricardo Guerrero
University of Barcelona



Environmental Monitoring of Bacteria

CLIVE EDWARDS (ed.)

1999. Humana Press, Totowa, New Jersey.
(Series: Methods in Biotechnology, vol. 12)

334 pp. 23.5 × 15.5 cm.
Price: $ 89.50
ISBN 0-89603-566-2

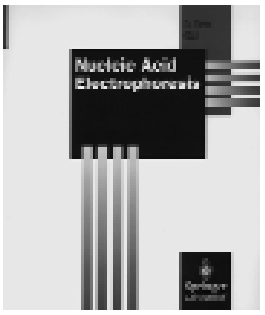
Environmental microbiologists currently assume that only 1% of existing strains in a given ecosystem could be cultured by traditional isolation techniques. This implies that until now a very low percentage of microbial species have been known, if we follow the traditional criteria of having axenic cultures for their characterization. New methods derived from molecular biology techniques are being applied to the analysis of microbial components of natural habitats. The detection, identification, and recovery of microorganisms from environmental samples is now possible by using molecular techniques which allow to gather direct information of the microbial community without having to isolate all microbial strains present. Moreover, nucleic acids (DNA, RNA) recovery and analysis from natural samples provide in-depth information of the individual genomes present and the possibility of single cell monitoring. This aspect is useful, for example, to monitor the fate and survival of genetically manipulated organisms.

This book deals with all these issues. It is aimed at environmental microbiologists, from undergraduate level upwards. It gathers all the main techniques to study microbial communities at the molecular level. Besides, it provides in-depth knowledge of all the factors involved in the technique. Each chapter starts with an introduction that discusses the specific technique used, and the theory on which it is based. Materials and methods follow, as two separate issues, and give many specifications for each technique. A lot of clarifying notes and references end each chapter.

The book follows the rationale of a full analysis and monitoring of the microbial community at a molecular level. Sampling of microbial ecosystems (sediment, soil, and water) is described in the first chapters. The chapters that follow deal with the separation techniques and the analysis of specific types of cells using flow cytometry and magnetic particle-based separation. DNA and RNA extraction methods from natural environments are described. Moreover, sequencing techniques and methods for sequence analysis are also detailed. The following special techniques are presented for monitoring and identifying bacterial strains: restriction fragments length polymorphism (RFLP) analysis using PCR, reporter gene expression, flow cytometry, membrane inlet mass spectometry and confocal laser scanning microscopy. The last two chapters deal with a new insight into the analysis and study of environmental processes in the lab: experimental biofilms.

With these two last chapters, the editor shows he is continuosly updated of new techniques. In fact, the book could be also named Manual of Ecogenetics since it gives an in-depth knowledge and immediate access to techniques to carry out the monitoring and analysis of benthic and planktonic microbial natural communities.

Jordi Mas-Castellà
University of Barcelona



Nucleic Acid Electrophoresis

DIETMAR TIETZ (ed.)

1998. Springer-Verlag, Heidelberg.

328 pp. 24 × 21 cm.
Price: DM 129
ISBN 3-540-63959-4

Modern descriptions of the history of science tend to point out that science and technology have developed separately for a long time. The example of the wheel is among the preferred by authors dealing with these two aspects of progress and culture. Although the wheel is considered one of the motors of western civilization, its invention had nothing to do with science. But that has not been the general rule in more recent times, at least as recent as the Greek times and since medieval ages. Usually, sciences and technology are quite interdependent and in most cases develop together. For instance, gel electrophoresis as a method of separating and analyzing DNA has had a significant role in the modern scientific revolution carried out by molecular biology over the last 20 years. Agarose gels have become the "workhorses" of the molecular biology laboratory for several reasons: they are easy to cast, quick to run and they are workable gel media. But they also have disadvantages such as the high cost of agarose and the appearance of fuzzy bands.

This Springer laboratory manual on *Nucleic Acid Electrophoresis* is the compendium of the most relevant electrophoretic techniques available nowadays, written by several experts in such a field. Although the manual does not cover exhaustively all possible aspects, the inclusion of a web site in the book provides the readers with useful and complementary information about news groups and the possibility of exchanging comments with the authors.

The book consists of 13 chapters, each one written by a different author or group; containing accurately describing explanations and procedures of several sophisticated techniques. Among those techniques are capillary and pulsed-field electrophoresis, fingerprinting with RFLP (restriction fragment length polymorphism) and RAPD (randomly amplified polymorphic DNA), mobility shift assay, DNA sequencing, and silver staining of nondenaturing polyacrylamide gels. Under the title "troubleshooting" problems associated with the routine maintenance and unexpected events in the preparation of the material are discussed. Advice to avoid those problems and to correct failures associated to them are also provided. A list of the suppliers of equipment and reagents as well as a complete set of references close each chapter, some of which being completed with Internet addresses of general interest for the users.

In several chapters, the reader will find historical introductions to the current protocols, before procedures and material for the lab work are described. The book clearly focuses on experimental procedures and on showing hidden technical details, which usually do not appear in traditional publications. Besides the general interest for technical training in basic research, two chapters are especially important in the field of applied medical research and practice; Chapter 8, *Rapid detection of hepatitis C virus in plasma and liver biopsies by capillary electrophoresis* and Chapter 9, *Electrophoresis in the field of forensic science*. Specific applications of the nucleic acid electrophoresis in legal medicine, microbiology, agriculture, and environmental sciences are discussed by leading experts in each area.

The aim of the book is to assist a wide range of readers by describing the most important experimental techniques based on nucleic acid electrophoresis. Since the manual deals with the appropriate equipment, preparation of probes, significance of results, and tricks for troubleshooting, its interest for the many kinds of professionals, scientists, technicians is obvious. Students interested in becoming familiar with this discipline, which in the editor's words, D. Tietz, is rapidly changing into a high-tech enterprise, will also find this book a most useful tool.

Carmina Rodríguez
Complutense University of Madrid

Introducción al análisis sensorial de los alimentos

J. SANCHO, E. BOTA, J. J. DE CASTRO

1999. Edicions de la Universitat de Barcelona, Barcelona.

336 pp. 24 × 17 cm.
Price: 3750 PTA
ISBN 84-8338-052-8

Although quite an automatic and individual practice, sensorial analyses of food as a matter of study are mostly unknown. But food industries are very interested in those analyses because they must know the preferences of consumers for the acceptance of their products. Besides the imperative safety control guarantees, commercial strategies are designed taking into account consumers' preferences. The importance of sensorial analyses as a tool in the industrial production of food has greatly increased over the last ten years; there is more specialized literature, more topics about the teaching of the food process and food technology. In this sense, the first part of the book offers an approach to the general concepts and theoretical basis of the sensorial analyses, with an extensive explanation about the function and mechanisms of the sense organs. A description of the physiology and biochemistry of the sensorial organs is also included.

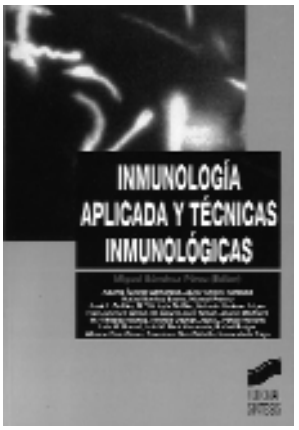
The second part deals in close detail with the different types of common use tests to determine the quality of food. Tests are classified into descriptive, discriminatory, acceptance, and capability tests. The kinds of food analyzed in the book are wine, water, cheese, pig derivatives, olive oil and honey. At the end there is some useful information for the readers: a complete list of references, an appendix with European rules, and a glossary of terms.

The global quality control in food includes the sensorial analysis as a tool to assess, analyze and control the manufacturing process and the product. While the aim of any quality control is to prevent defects in the final product, sensorial analyses are directed to the raw materials that will be transformed during the process. Physical, chemical and microbiological methods are the tools to guarantee that the ingredients agree with quality standards. In the food industry, smell, color, taste and the general organoleptic characters are the criteria tested to accept or reject the products.

Sensorial analyses consider three different types of taste: analytic, technical and hedonistic. Analytic taste is used to separate, classify and identify the dominant perceptions of the consumer. Technical taste is an objective test that tries to asses the commercial qualities of the product. Finally, hedonistic taste looks for the appreciation and the pleasure in eating or drinking a given food. Senses are the main characters in the sensorial analyses, but certain conditions and regulations must be used to guarantee the objectivity and liability of the tests. Therefore, it is important to know the physiology of the organs and the elements and mechanisms by which the stimuli reach the consumers. Mathematical elements such as statistics and other tools are also necessary to translate the perceptions into quantifiable data.

In summary, the book is of great interest to professionals of the food industry and to teachers and students of matters such as nutrition, dietetics, and food technology and instruments. Besides its interest as a professional and teaching tool, it is also a book that non-specialized people will enjoy. They can find out how to distinguish the qualities of a good wine, how to appreciate the finest olive oil and how to recognize the best texture of a cheese.

Jordi Mas-Castellà
University of Barcelona



Inmunología aplicada y técnicas inmunológicas

MIGUEL SÁNCHEZ-PÉREZ (ed.)

1998. Editorial Síntesis, Madrid.

368 pp. 24 × 17 cm.
Price: 3000 PTA
ISBN 84-7738-602-1

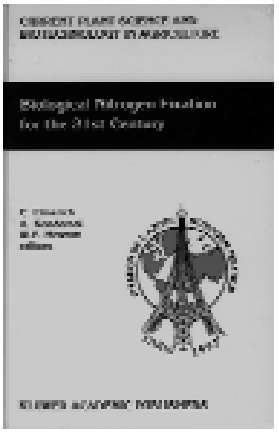
Inmunología aplicada y técnicas inmmunológicas is a new textbook edited by Miguel Sánchez-Pérez (Complutense University of Madrid), who has also coauthored two chapters. The book is a complement to the editor's previous work *Introducción a la Inmunología humana* (Ed. Síntesis, Madrid; see review in *Microbiología SEM* 13[4] pp. 533–534), which dealt mostly with the cellular and molecular bases of immune responses. In the book we comment on now, the authors have covered, among other issues, the study of both the role of the immune system in the defense of organisms and the pathological alterations of the system itself. Although the chapters are not separated into sections, they follow a logical distribution, starting from the principles of immunology, proceeding to the application of those principles on clinical medicine, and providing the bases of the techniques for such an application. The first three chapters are devoted to the study of the immune responses to microorganisms and to

animal parasites as well as to the tumor immunology. The authors have analyzed extensively these topics, emphasizing especially the mechanisms developed by pathogens for evading the control by the immune system. A first approach to the application of immunology to tumor therapy is presented, the technical aspects of such an application being described later in the book. Chapters 5 to 9 cover pathological alterations of the immune system such as autoimmunity, hypersensitivity (types I to IV), congenital and acquired immunodeficiencies—a whole chapter is devoted to AIDS—, and immunization and modification of the immune response. The part on clinical immunology finishes with an excellent overview on transplantation immunology (Chapter 9), enclosed to which is a brief, excellent appendix by J. Arroyo-Nombela that describes human leukocyte antigen (HLA) typing techniques such as the analysis of restriction fragment length polymorphism (RFLP), polymerase chain reaction (PCR) combined with sequence specific oligonucleotide analysis (SSO), PCR combined with RFLP, and DNA sequencing. In all these chapters, the authors have analyzed the functioning of the immune system in each syndrome, and have also described the clinical characteristics of related diseases and their possible therapeutic treatments. They have approached the study of the modifications and potentiation of the immune responses from therapeutic and prophylactic points of view, dealing with the different mechanisms of immunosuppression, immunopotentiation and both active and passive immunization, with an extensive review on currently used vaccines.

The last part of the book (Chapters 10, 11 and 12) describes techniques which had an introduction in the Appendix to Chapter 9. Besides the description of classical techniques for the obtaining and the characterization of monoclonal antibodies, Chapter 10 makes an introduction to more recent techniques, such as bifunctional antibodies, recombinant antibodies and catalytic antibodies. In Chapter 11, the authors review several serological techniques, including precipitation and agglutination as well as the immunological applications of immunohistochemical methods, such as immunofluorescence, and enzyme-linked immunosorbent assays (ELISA). They also provide the guidelines for the election of the most suitable diagnostic tests. A brief description of the technical basis of flow cytometry analysis and its possible applications in immunology closes the book.

Inmunología aplicada y técnicas inmunológicas is strongly recommended to students who already have a background in the different biomedical fields, but also to researchers and to those lecturing on immunology issues who look for a textbook which remarkably combines simplicity and conciseness with an excellent contents level. The book provides the readers with an accurate up-to-date understanding of the immune system. Each chapter contains recent bibliographical references which are further sources to explore the subject in depth. Moreover, excellent diagrams and figures illustrate the book, and boxed features separated from the main text provide additional information on relevant, hot topics such as defenses against virus, activation of cytolytic T lymphocytes (CTLs), vaccines for several infectious diseases and AIDS. These complements help to a better understanding of the text and contribute to the high level of this work.

Agustín G. Zapata
Complutense University of Madrid



Biological Nitrogen Fixation for the 21st Century

C. ELMERICH, A. KONDOROSI, E. NEWTON (eds)

1998. Kluwer Academic Publishers, Dordrecht.
(Series: Current Plant Science and Biotechnology in Agriculture, vol. 31)
708 pp. 24.5 × 16 cm.
Price: $ 285
ISBN 0-7923-4834-6

If somebody asks you as a microbiologist why microorganisms are important, what would you say? If somebody asks you to name the most important biological process carried out by microbes, which would you choose? If somebody still ignores that thanks to microbes there is life on Earth, how would you convince him or her? All these questions have a common answer: microbiological nitrogen fixation.

The book *Biological Nitrogen Fixation for the 21st Century* is the Proceedings of the 11th International Congress on Nitrogen Fixation, held at the Institut Pasteur in Paris from July 20 to 25, 1997. Since 1974, when the first edition was held in Pullman (WA, USA), a great progress has been made. The three-dimensional structures of the nitrogenase enzyme and its component proteins have been established during that time. The mechanisms controlling the expression of the nitrogen fixation genes have been elucidated at the molecular level. The *Rhizobium*-legume symbiosis has been detailed up to the chemical signals that induce the differentiation of a special nitrogen-fixing organ. Novel practices and improved management systems in the field of *Rhizobium* inoculants to improve crops yield have emerged.

The book compiles the keynote lectures and the parallel sessions held during the congress. It is obvious that all the present and updated knowledge about biological nitrogen fixation is in this book. The contents has been divided into several sections with the recent findings in the subject.

Chemistry and Biochemistry of Nitrogenase (section I) comprises the latest results with respect to the structure and function of nitrogenase and its components, i.e. Fe and MoFe proteins. In the section Genetics and Regulation (section II), two main topics are discussed. First, the nature of the metabolic signals that control biological nitrogen fixation. Second, the means by which metabolic signals are transduced to the proteins that control transcription of *nif* genes or modulate the activities of *nif* genes products. Papers presented in section III (Symbioses and Associations) cover the main aspects of the signaling in nodule organogenesis. They deal with the signal-exchange leading to nodule organogenesis; the relevance of rhizobial extracellular polysaccharides for nodule invasion; and the rhizobial signals and their evaluation by the host plant. The research on Environmental and Physiological Factors Controlling Nitrogen Fixation (section IV) has evolved rapidly with a great understanding of nodule functioning. However, the applicability of this research in agricultural systems has to be demonstrated by concentrating on host plant regulation rather than nodule functioning. Section V (Genome Structure, Taxonomy and Ecology), shows how the use of molecular techniques based on the genome of nitrogen fixers is changing the way researchers look at ecology and taxonomy. The application of molecular biology techniques has allowed to detect an increasing proportion of microorganisms never described before. The implications of such a new methodology affect also the knowledge of their ecology and taxonomy. To maintain a productive and sustainable agricultural system, it must be managed as an ecological system: ensuring biodiversity, providing it with a suitable energy flux and nutrient cycling. This is developed in section VI (Sustainable Agriculture and Forestry) with a special stress in the N limitation of crop productivity.

The book ends with section VII (Prospects for Agriculture) which comprises the debate held on a round table during the meeting. Probably, research on nitrogen fixing bacteria and plant-microbe interactions are some of the fields of research highly beneficious for the human population in the world. World demographic expectations (8 billion human population by the year 2020) have created a growing concern for the total world environment and have led to the realization that food production must be markedly increased over the next century. Here clearly, biotechnology must meet human needs, and the "green revolution" of the developing world must benefit from the most recent findings of disciplines such as biological nitrogen fixation.

Jordi Mas-Castellà
University of Barcelona

The Cell Wall of Prokaryotes. The cytoplasm of prokaryotic cells has a high concentration of dissolved solutes. Therefore, the osmotic pressure within the cell is relatively high. The cell wall is a protective layer that surrounds some cells and gives them shape and rigidity.Â Scientists at the NASA Astrobiology Institute and at the European Molecular Biology Laboratory collaborated to analyze the molecular evolution of 32 specific proteins common to 72 species of prokaryotes.1 The model they derived from their data indicates that three important groups of bacteriaâ€”Actinobacteria, Deinococcus, and Cyanobacteria (collectively called Terrabacteria by the authors)â€”were the first to colonize land. Study Guides. Biology. The Structure of Prokaryote and Eukaryote Cells. All Subjects. The Science of Biology.Â All prokaryote and eukaryote cells also have cytoplasm (or cytosol), a semiliquid substance that composes the volume of a cell. Essentially, cytoplasm is the gel-like material enclosed by the plasma membrane. Within the cytoplasm of eukaryote cells are a number of membrane-bound bodies called organelles (â€œlittle organsâ€) that provide a specialized function within the cell.Â Many kinds of prokaryotes and eukaryotes contain a structure outside the cell membrane called the cell wall. With only a few exceptions, all prokaryotes have thick, rigid cell walls that give them their shape. Among the eukaryotes, some protists, and all fungi and plants, have cell walls. Structure of Prokaryotes. Basic Structures of Prokaryotic Cells. Prokaryotes, found in both Domain Archaea and Bacteria, are unicellular organisms that lack membrane-bound organelles and a defined nucleus. Learning Objectives. Describe the basic structure of a typical prokaryote. Key Takeaways. Key Points. Prokaryotic cells lack a defined nucleus, but have a region in the cell, termed the nucleoid, in which a single chromosomal, circular, double-stranded DNA molecule is located. Archaeal membranes have replaced the fatty acids of bacterial membranes with isoprene; some archaeal membranes are m