
Preface

Despite long-standing assumptions, the work of many investigators over the past 10 years has demonstrated that the bacterial chromosome is highly organized. The precise dynamic organization of genes and domains has far reaching consequences for a wide range of biological processes from those required for the successful transmission of heredity, i.e., DNA replication and chromosome segregation in coordination with cell division, to processes ranging from gene regulation to pathogenicity. Bacterial chromosomes are condensed by several factors including molecular crowding of the cytoplasm, DNA supercoiling, nucleoid associated proteins, and condensins. These factors define layers of organization of different sizes such as plectonemic DNA loops (few kb), microdomains or chromosome interaction domains (CIDs) (few tens of kb), and macrodomains (hundreds of kb). Genetics and molecular biology methods have paved the way for the understanding of chromosome structuring and remain extremely powerful to reveal the molecular mechanisms involved in this structuring. During the last 15 years new approaches, technologies, and insights have revolutionized the field of chromosome folding. Imaging technologies have changed our perception of the nucleoid; they revealed the spatial organization of the chromosome, the dynamics of DNA and bacterial chromatin, and the coupling of nucleoid dynamics with cell architecture and cell cycle. Moreover these observations opened a door for quantitative analysis by biophysicists. More recently, super-resolution microscopy has been used to visualize previously unresolved structure essential to understanding the bacterial chromosome. From the sequencing perspective, ChIP-seq, capture of chromosome conformation (3C), and Hi-C, its deep-sequencing derivative, have enabled the capture of new types of structural information on a genomic scale. These techniques, combined with state-of-the-art genetic, genomic, molecular, and cell biology approaches, have provided a wealth of new information about the chromosome. Meanwhile polymer physics models and physical nanomanipulation of cells, protein, and DNA allow researchers to tackle questions that go far beyond the traditional biological description of chromosome structure. This issue of *Methods in Molecular Biology* will propose state-of-the-art protocols for these key experiments that have, over the last decade, revolutionized our understanding of the bacterial nucleoid.

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