once was. Why do cells devote resources to altering the meaning of the nucleotide sequences originally specified in their genomes? While not providing a simple answer to this question, Öhman and Bass succeed in imposing a logical framework on this rapidly developing field with a clear text and well-chosen illustrations. A variety of mRNA degradation pathways serve to control mRNA abundance and prevent translation of aberrant transcripts. The chapter on mRNA degradation by Tharun and Parker focuses on the *cis*-acting sequences and protein factors in the major deadenylation-dependent degradation pathway in yeast. Regulated mRNA degradation initiated by sequence-specific endonucleases also is covered briefly. In his chapter on plant viroid RNAs, Symons demonstrates how sequence organization and the role of RNA self-cleavage and ligation reactions in the rolling circle replication cycle are becoming better understood for some viroid subgroups. On the other hand, host-range determinants and mechanisms of pathogenicity remain largely mysterious for these small, circular noncoding RNAs.

RNase P, the enzyme responsible for 5′ end formation of tRNAs, is the only RNA enzyme treated to its own chapter, prepared by Vioque and Altman. Strauss-Soukup and Strobel present an overview of the structures and the kinetic and catalytic mechanisms of the self-splicing and self-cleaving ribozymes found in nature and several ribozymes that have been identified through in vitro selection. Together, these chapters provide a thorough review of the RNA enzymology literature through about 1998, emphasizing the role of metal cation cofactors in catalysis. Recent high resolution views of RNA active sites devoid of metal cations (Ferré-D'Amaré et al., Nature *395*, 567–574, 1998; Nissen et al., Science *289*, 920–930, 2000; Rupert and Ferré-D'Amaré, Nature *410*, 780–786, 2001) support the notion that RNA nucleobases can participate directly in catalytic chemistry (Wadkins and Been, Cell. Mol. Life Sci. *59*, 112–125, 2002). Ellington and Robertson present a clear, comprehensive discussion of ribozyme selection, beginning with the methods used to create random RNA sequence libraries and selection of functional RNAs to the application of in vitro selection to create artificial phylogenies for RNA secondary structure modeling and the isolation of nucleic acid enzymes with catalytic activities not found in nature. This chapter concludes with a discussion of what has been learned from this approach about the evolution of catalytic power and the plausibility of a prebiotic RNA World. A final chapter by Taira and colleagues explains the development of ribozymes as therapeutic reagents for gene therapy applications. This chapter begins with a general introduction to hammerhead ribozymes and ribozyme expression systems and places special emphasis on the recent development of hammerhead ribozyme variants for specific and efficient inactivation of oncogene products that were carried out in the authors' laboratories.

RNA will provide a rigorous but accessible introduction to RNA biochemistry for beginning investigators and a useful reference for established scientists. Some chapters, especially those devoted to RNA structure and dynamics, are written at a level that is sufficiently basic to serve as an introduction to the primary literature for advanced undergraduates or graduate students in biochemistry. Many of these chapters are written from a broad historical perspective that is not accessible through the primary literature. The level of detail in some chapters might be more than is appropriate for undergraduate or graduate coursework. Reference lists appear to be complete through about 1998. Given the rapid pace of developments in RNA biochemistry, portions of any book on this subject are bound to be out-of-date almost before publication. The annotated diagrams of nucleotide analogs and tertiary structure motifs and the tables of free energy parameters for RNA secondary structure formation along with the illustrations of splicing, editing, and degradation pathways will make this book an especially useful resource in RNA biochemistry and molecular biology laboratories.

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Exchanging DNA Here, There, and Everywhere

Lateral DNA Transfer: Mechanisms and Consequences
By Frederic Bushman
Cold Spring Harbor, NY: Cold Spring Harbor Press (2002). 448 pp. $59.00

Monsieur Jordan: Par ma foi! il y a plus de quarante ans que je dis de la prose sans que j'en susse rien, et je vous suis le plus obligé du monde de m'avoir appris cela.

—Molière, Le Bourgeois Gentilhomme

One of the most fascinating cases of naturally occurring genetic engineering is the bacteria-promoted crown gall disease of plants. This disease occurs when the soil bacterium *Agrobacterium tumefaciens* infects a wounded plant and introduces into its nuclear genome a DNA segment encoding proteins that promote the formation of swellings (i.e., the crown galls) that synthesize nutrients that can be used only by the infecting bacterial species. By incorporating foreign genes into the DNA segment transferred by *A. tumefaciens*, scientists can modify plant cells, which results in the development of crop plants exhibiting novel traits.

Two of the lessons that we have learned from the sequencing of whole genomes are the following: first, many of the characteristics that distinguish bacterial species, such as virulence potential and metabolic abilities, are encoded within species-specific regions of the genome. And second, in contrast to bacterial genomes, which devote approximately 90% of their content to coding regions, only 1.5% of the human genome is coding DNA, the remaining "junk" being made up of transposons and viruses. The extent to which different eukaryotic organisms have acquired such elements may help explain the C-value paradox—the observation that genome size does not necessarily correlate with organism complexity (for example, the human genome is 30 times bigger than that of baker's yeast, yet 20 times smaller than the genome of certain amoebas).

Numerous biological phenomena, including the development of tumors in animals and plants, the spread of antibiotic resistance determinants in bacteria, and the abnormalities resulting from certain types of crosses in insects, result from lateral DNA transfer. Also referred to as horizontal gene transfer, lateral DNA transfer is the movement of DNA from one organism to another in which it becomes stably incorporated. The widespread nature of lateral DNA transfer and the realization that DNA can move from one location to another within an organism lead to the view that genomes are in a state of flux. However, this view was not readily accepted as Barbara McClintock was not awarded the Nobel Prize for her discovery of "mobile genetic elements" in plants until 1983, a belated recognition of work she had conducted in the 1940s which was fully appreciated only when transposable elements were rediscovered in bacteria. Coincidentally, 1983 also marked the publication of *Mobile Genetic Elements*, the first comprehensive discussion of DNA movement within and among organisms, which was written by several experts and superbly edited by Jim Shapiro.

The scope and consequences of lateral DNA transfer have been increasingly appreciated since the publication of *Mobile Genetic Elements*. Thus, it was comforting to read Frederic Bushman's marvelous new book, *Lateral DNA Transfer: Mechanisms and Consequences*. Bushman uses less than 450 pages to teach us not only about the molecular bases for many of the genetic discoveries of the 1980s and 1990s, but also about the impact of lateral DNA transfer in infectious diseases, bacterial speciation, and the evolution of eukaryotic organisms. *Lateral DNA Transfer* discusses several additional topics, including the different families of transposons and mechanisms of transposition, the molecular evidence for the endosymbiotic theory, and the hypothesis of a transposon being the progenitor of the vertebrate immune system.

Bushman's book is organized in 14 chapters, beginning with an introduction and a brief crash course on molecular biology, and concluding with the general principles governing lateral DNA transfer and its evolutionary implications. Three chapters are devoted to horizontal gene transfer in prokaryotes, including a genomic-based one analyzing rates of transfer, discussing why bacterial genes are organized in operons, and raising issues pertaining to bacterial phylogeny. Six chapters analyze DNA transfer in eukaryotes, emphasizing retroviruses and the use of genomic data to infer transfer frequencies in different organisms. The two remaining chapters cover gene exchange across domains of life and the regulatory mechanisms governing DNA transfer. Each chapter begins with a discussion of the biological context of the topic, includes excellent illustrations, provides current references from the primary literature, and concludes with a brief summary. Most importantly, the writing is clear and to the point, allowing reading of the chapters (or sections of them) without following the original order.

It has now become clear that lateral DNA transfer has played and continues to play a major role in shaping genomes. *Lateral DNA Transfer* constitutes a great effort to put under one umbrella a variety of topics pertaining to genome evolution. Moreover, it provides a molecular genetic framework to understand the current technological applications of gene transfer including gene therapy, crop improvement, and control of insect populations.

Most readers will find plenty of new information in *Lateral DNA Transfer*. For example, they will learn that the estimated frequency of gene transfer between organisms in the oceans is twenty billion times per second. On the other hand, many of the topics discussed by Bushman might not be new for other readers. Yet, these topics are presented with a different spin that makes us feel like a molecular biologist version of the bourgeois gentleman Monsieur Jordan: that we have been investigating/reading about/exploring lateral DNA transfer and we did not even know it.

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Mechanics of the Cell: Overcoming a Fear of Equations

Mechanics of the Cell
Edited by David Boal
New York: Cambridge University Press (2002).
406 pp. $45.00

Many of the critical aspects of biological functions can only be understood through a melding of the physics (often mechanics) and the biochemistry involved. From the morphological changes in gastrulation or the vascularization of cancerous tissue to the unfolding of DNA in transcription, biological functions rely upon an orchestrated feedback between mechanical forces and biochemical activities. In our attempts to better understand biological functions, a complete description of the proteins and enzymatic activities involved, although important, provide only a partial picture. Further, although many biological scientists have distaste for them, equations provide a concise way to describe and predict physical aspects of cell behavior. In addition, there is a dramatic increase of interest in biological questions among physicists who enjoy the mathematical description of cell functions. Thus, there is an urgent need to incorporate an understanding of the mechanics involved in the normal functioning of a cell, and the recent book by Boal speaks nicely to that issue.

Designed as a text for a one-semester course on cell mechanics, *Mechanics of the Cell* provides an excellent introduction to the basic mechanics of cytoskeletons and membranes (targeted for junior or senior undergraduate and beginning graduate students). It fills a unique