
Preface

Genetic recombination, in the broadest sense, can be defined as any process in which DNA sequences interact and undergo a transfer of information, producing new “recombinant” sequences that contain information from each of the original molecules. All organisms have the ability to carry out recombination, and this striking universality speaks to the essential role recombination plays in a variety of biological processes fundamentally important to the maintenance of life. Such processes include DNA repair, regulation of gene expression, disease etiology, meiotic chromosome segregation, and evolution.

One important aspect of recombination is that it typically occurs only between sequences that display a high degree of sequence identity. The stringent requirement for homology helps to ensure that, under normal circumstances, a cell is protected from deleterious rearrangements since a swap of genetic information between two nearly identical sequences is not expected to dramatically alter a genome. Recombination between dissimilar sequences, which does happen on occasion, may have such harmful consequences as chromosomal translocations, deletions, or inversions. For many organisms, it is also important that recombination rates are not too high lest the genome become destabilized. Curiously, certain organisms, such as the trypanosome parasite, actually use a high rate of recombination at a particular locus in order to switch antigen expression continually and evade the host immune system effectively. Whether or not a particular recombination event is a “good thing” or a “bad thing,” recombination is indeed a double-edged sword with a prominent position in life as we know it. There is thus ample reason to gain a better understanding of this essential process and how it is regulated.

To gain such an understanding requires the appropriate tools. Part I of *Genetic Recombination: Reviews and Protocols* outlines approaches and model systems for studying several aspects of recombination in a variety of eukaryotic organisms and in a mammalian parasite. Since a good collection of mutants is often the starting point for dissecting pathways, a chapter on the isolation of recombination mutants in mice is included.

Just as a properly regulated recombination pathway can help ensure genetic stability, so can an alteration in recombination serve as a sign of genomic instability. Part II describes approaches for using recombination as a reporter of genomic instability in lower and higher eukaryotes. These experimental

systems can be put to use to identify chemical or environmental agents or genetic mutations that may increase the risk of cancer or other diseases associated with genomic instability.

Recombination normally involves interactions between sequences displaying a high degree of sequence identity. The homology recognition machinery that is such a central part of normal recombination also provides the potential for putting recombination to practical use in order to bring about highly specific genomic changes. Over the past several years, investigators have developed methodologies for using recombination, or recombination-related processes, as a tool for producing targeted genetic modification. New methods continue to be developed. Part III discusses various methods and approaches for targeted genomic manipulation in higher and lower eukaryotes.

To understand fully any cellular process in terms of basic biology or for the rational design of potential applications, it is ultimately important to study the process on a biochemical level. Part IV presents two types of biochemical analyses useful for furthering the understanding of recombination mechanisms.

In summary, *Genetic Recombination: Reviews and Protocols* should be of significant value to both the novice and the established researcher in the field of recombination. Although this is indeed a collection of protocols and methods, contained within the various chapters is a wealth of more general information about recombination. Our hope is that this book will inspire further advances in this vital field.

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