

Recombination, a repair system and much, much more

I. Definitions of recombination

- A. In broadest terms, any process that changes the physical linkage of genes; any process by which genetic information is rearranged to form new associations
- B. At the molecular level, recombination is the incorporation of one DNA sequence into another
- C. Initial observation of recombination--independent assortment of chromosomes versus genetic linkage

II. Significance of recombination

- A. Driving force in evolution, as a source of genetic diversity by shuffling of the gene pool, and as a source of gene duplication leading to the evolution of new genes
- B. Essential repair mechanism
- C. Essential for proper disjunction of homologues during meiosis
- D. Tool for molecular biology and genetics--mapping chromosomes, replacing genes

III. Genetics of recombination

- A. Meiosis, mitosis and recombination
- B. Analysis of meiotic recombination, three factor crosses and genetic mapping

IV. The Holliday recombination intermediate

- A. strand breakage, strand transfer (invasion), branch migration, and resolution.
- B. The double strand break repair model and gene conversion

VI. Biochemistry of homologous (general) recombination in *E. coli*

- A. Rec A--ATP-dependent strand exchange, the initial steps in the Holliday model
- B. Ruv ABC--branch migration and resolution of the Holliday intermediate

<http://www.sdsc.edu/journals/mbb/ruva.html>

- C. Rec BCD--conjugation and repair

D. Eukaryotic homologs of E. coli recombination proteins

VII. Other types of recombination

A. Site-specific recombination

B. Nonhomologous (illegitimate) recombination - end-joining

C. Mixture of A and B - immunoglobulin gene segment rearrangement,

1. Structure of immunoglobulin genes- variable and constant regions
2. Variable regions result from directed rearrangements of several gene segments
3. Proteins involved in rearrangement
 - a. RAG1 and RAG2 (site-specific factors)
 - b. DNA-dependent protein kinase complex: DNA-PKCS, Ku70, Ku80,
 - c. DNA ligase

Readings:

Watson, Chapter 1, pp. 6 - 13
Chapter 9, pp. 253-254
Chapter 10, pp 259-279, 282-284, 288-291
Chapter 11, pp. 337-341