Recombination Encyclopedia Article

Recombination

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Recombination

Recombination, is a process during which genetic material is shuffled during reproduction to form new combinations. This mixing is important from an evolutionary standpoint because it allows the expression of different traits between generations. The process involves a physical exchange of nucleotides between duplicate strands of **deoxyribonucleic acid** (**DNA**).

There are three types of recombination; homologous recombination, specific recombination and **transposition**. Each type occurs under different circumstances. Homologous recombination occurs in **eukaryotes**, typically during the first phase of the meiotic cell division cycle. In most eukaryotic cells, genetic material is organized as **chromosomes** in the **nucleus**. A nick is made on the chromosomal DNA of corresponding strands and the broken strands cross over, or exchange, with each other. The recombinant region is extended until a whole **gene** is transferred. At this point, further recombination can occur or be stopped. Both processes require the creation of another break in the DNA strand and subsequent sealing of the nicks by special **enzymes**.

Site specific recombination typically occurs in prokaryotes. It is the mechanism by which viral genetic material is incorporated into bacterial chromosomes. The event is site-specific, as the incorporation (integration) of viral genetic material occurs at a specific location on the bacterial genome, called the attachment site, which is homologous with the phage genome. Under appropriate conditions alignment and merging of the viral and bacterial genomes occurs.

Transposition is a third type of recombination. It involves transposable elements called **transposons**. These are short segments of DNA found in both prokaryotes and eukaryotes, which contain the information enabling their movement from one genome to another, as well as genes encoding other functions. The movement of a transposon, a process of transposition, is initiated when an enzyme cuts DNA at a target site. This leaves a section that has unpaired nucleotides. Another enzyme called transposase facilitates insertion of the transposon at this site. Transposition is important in genetic engineering, as other genes can be relocated along with the transposon DNA. As well, transposition is of natural significance. For example, the rapid reshuffling of genetic information possible with transposition enables immunocytes to manufacture the millions of different antibodies required to protect eukaryotes from infection.