Recombinant DNA technology

What is recombinant DNA technology?

Recombinant DNA technology, joining together of DNA molecules from two different species that are inserted into a host organism to produce new genetic combinations that are of value to science, medicine, agriculture, and industry. Since the focus of all genetics is the gene, the fundamental goal of laboratory geneticists is to isolate, characterize, and manipulate genes. Although it is relatively easy to isolate a sample of DNA from a collection of cells, finding a specific gene within this DNA sample can be compared to finding a needle in a haystack. Consider the fact that each human cell contains approximately 2 metres (6 feet) of DNA. Therefore, a small tissue sample will contain many kilometres of DNA. However, recombinant DNA technology has made it possible to isolate one gene or any other segment of DNA, enabling researchers to determine its nucleotide sequence, study its transcripts, mutate it in highly specific ways, and reinsert the modified sequence into a living organism. Recombinant DNA technology is based primarily on two other technologies, cloning and DNA sequencing. Cloning is undertaken in order to obtain the clone of one particular gene or DNA sequence of interest. The next step after cloning is to find and isolate that clone among other members of the library (a large collection of clones). Once a segment of DNA has been cloned, its nucleotide sequence can be determined. Knowledge of the sequence of a DNA segment has many uses.

When was recombinant DNA technology first invented?

The possibility for recombinant DNA technology emerged with the discovery of restriction enzymes in 1968 by Swiss microbiologist Werner Arber. The following year American microbiologist Hamilton O. Smith purified so-called type II restriction enzymes, which were found to be essential to genetic engineering for their ability to cleave at a specific site within the DNA (as opposed to type I restriction enzymes, which cleave DNA at random sites). Drawing on Smith's work, American molecular biologist Daniel Nathans helped advance the technique of DNA recombination in 1970–71 and demonstrated that type II enzymes could be useful in genetic studies. About the same time, American biochemist Paul Berg developed methods for splitting DNA molecules at selected sites and attaching segments of the molecule to the DNA of a virus or plasmid, which could then enter bacterial or animal cells. In 1973 American biochemists Stanley N. Cohen and Herbert W. Boyer became the first to insert recombined genes into bacterial cells, which then reproduced.

How is recombinant DNA technology useful?

Through recombinant DNA techniques, bacteria have been created that are capable of synthesizing human insulin, human growth hormone, alpha interferon, hepatitis B vaccine, and other medically useful substances. Recombinant DNA technology also can be used for gene therapy, in which a normal gene is introduced into an individual's genome in order to repair a mutation that causes a genetic disease. The ability to obtain specific DNA clones using

recombinant DNA technology has also made it possible to add the DNA of one organism to the genome of another. The added gene is called a transgene, which can be passed to progeny as a new component of the genome. The resulting organism carrying the transgene is called a transgenic organism or a genetically modified organism (GMO). In this way a "designer organism" is made that contains some specific change required for an experiment in basic genetics or for improvement of some commercial strain.

What is Gene therapy and how is it used?

Gene therapy, also called **gene transfer therapy**, introduction of a normal gene into an individual's genome in order to repair a mutation that causes a genetic disease. When a normal gene is inserted into the nucleus of a mutant cell, the gene most likely will integrate into a chromosomal site different from the defective allele; although that may repair the mutation, a new mutation may result if the normal gene integrates into another functional gene.

DNA Cloning

In biology a clone is a group of individual cells or organisms descended from one progenitor. This means that the members of a clone are genetically identical, because cell replication produces identical daughter cells each time. The use of the word *clone* has been extended to recombinant DNA technology, which has provided scientists with the ability to produce many copies of a single fragment of DNA, such as a gene, creating identical copies that constitute a DNA clone. In practice the procedure is carried out by inserting a DNA fragment into a small DNA molecule and then allowing this molecule to replicate inside a simple living cell such as a bacterium. The small replicating molecule is called a DNA vector (carrier). The most commonly used vectors are plasmids(circular DNA molecules that originated from bacteria), viruses, and yeast cells. Plasmids are not a part of the main cellular genome, but they can carry genes that provide the host cell with useful properties, such as drug resistance, mating ability, and toxin production. In order to insert a human gene into a plasmid, both must have identical DNA sequences. They are small enough to be conveniently manipulated experimentally, and, furthermore, they will carry extra DNA that is spliced into them. Look at the example below.