

The Polymerase Chain Reaction

During the last 4 years, the technique of polymerase chain reaction (PCR) has revolutionized the way in which molecular genetics is done. PCR is a relatively simple method to amplify or increase the number of copies of a specific segment of DNA, to obtain sufficient DNA for further evaluation. The segment of DNA to be amplified may come from many sources or from DNA in an intact cell. It is possible to amplify a short segment, 50 to over 2,000 base pairs in length, to more than a million copies in just a few hours. Furthermore, the process has been automated and is presently being used for detecting DNA on fixed pathologic specimens, from single cells (lymphocytes, sperm cells, skin cells, etc), from forensic material such as hairs or blood cells, from ancient archeological specimens,

and for many molecular genetic studies and diagnostic tests.

The basis of the technique, developed by the Cetus Corp, lies in targeting the DNA segment to be amplified by identifying its boundaries with 2 single-stranded oligonucleotide primers. A heat-stable DNA polymerase is used to catalyze the duplication reaction. The native double-stranded DNA to be amplified is denatured by heat, and once the DNA has been liberated as single strands it can then be duplicated by the polymerase using the primers. Thus, the process moves very rapidly as new copies become templates for more copies. By rapidly alternating the temperature—causing separation of the double strand, allowing duplication—large amounts of double-stranded DNA of the specific short segment

are produced.

The technique has endless research applications, including the study of specific mutations, use in genomic cloning, analysis of protein-DNA interactions, a variety of genetic therapies, rapid diagnosis (both prenatal and prior to implantation), unique identification of tissues, diagnosis of infectious states such as HIV, etc; and there will undoubtedly be additional major applications in the years to come.

Eisenstein Bl. *N Engl J Med* 1990; 332:178-183.

Editor's Comment—*This is an excellent review. All individuals in medicine should understand the PCR technique; if you don't, read the article!*

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