Osaro Evelyn princess

18/mhs07/046

What are Specific Biotechnology Applications

DNA fingerprinting is based on the distribution of small repetitive elements called "minisatellites" that are contained in the cellular DNA, or deoxyribonucleic acid, of an organism. The technique is also known as DNA profiling, DNA typing or genetic fingerprinting. Since each cell of an organism contains the same DNA, the technique can be used to identify individuals. Several techniques are available to visualize the distribution pattern of mini-satellites with applications in genetic research, paternity testing, family genealogy, agriculture and forensic genetics for crime investigation.

Genetic Research

DNA fingerprinting is often used to identify genetic disorders.

In 1984, Alec Jeffreys, a British geneticist, identified the presence of minisatellites within the boundaries of genes. These minisatellites do not contribute to the functioning of genes and are distributed throughout the cellular DNA of an organism in a unique and inheritable pattern. The DNA fingerprint can be revealed by processing cells collected from individuals through one of several different techniques. These different techniques for genetic fingerprinting have been applied to identify and isolate disease genes, develop cures for diseased genes, and diagnose genetic diseases.

Paternity Testing

Testing paternity samples requires the collection of cells and comparison of DNA fingerprints from and between children and potential parents. Children will have a mix of DNA fingerprints inherited from each parent. When a child is conceived, each parent provides half of the genetic information. Most often the test is performed when the mother of the child is known but the father is in question. Since it is highly unlikely that any two people will have the same genetic fingerprint, paternity testing using DNA fingerprints is a reliable way to determine the parentage of a child.

Genetic Forensics

Crime scenes and evidence can be a source of biological samples.

A crime scene can contain biological samples, including blood, semen, saliva, skin, urine and hair, from perpetrators, victims and bystanders that can be processed to provide DNA fingerprints. The DNA fingerprints obtained are used to search existing databases for matches and to identify victims or suspects. The biological evidence and the DNA fingerprints can be used in trials to help prove guilt or innocence. The United States military has been storing DNA fingerprints of all military personnel for identification of casualties and those missing in action. The military has found the technology to be superior to identification methods used previously.

Plants and Animals

DNA fingerprinting of plants and animals is performed for food security, food safety, identification and parentage. In food animals, DNA fingerprinting can be used to trace meat to the source animal. The technique can be used to identify endangered and non-endangered fish species, while the sources of plants can be verified to prevent counterfeiting of seeds and stock. Pathogenic food organisms can be quickly identified by their DNA fingerprints, allowing doctors to provide timely, targeted treatment.

What Is Recombinant DNA?

Recombinant DNA is a DNA sequence that has been artificially created in the lab. DNA is the template cells use to produce the proteins that make up living organisms, and the arrangement of nitrogen bases along a strand of DNA determines which proteins are formed. By isolating chunks of DNA and recombining them with other sequences, researchers are able to clone DNA within bacteria or other host cells and produce useful proteins, such as insulin. Cloning allows for much easier study of particular DNA sequences, since it produces a large amount of DNA that can then be modified and analyzed.

Methods of Constructing Recombinant DNA

Transformation is a process by which a segment of DNA is inserted into a plasmid--a small self-replicating circle of DNA. The DNA is cut using restriction enzymes. These enzymes are produced in bacterial cells as a defensive mechanism, and they target particular sites on a DNA molecule and chop it apart. Restriction enzymes are particularly useful because they create "sticky ends" on the segments of DNA. Like Velcro, these sticky ends allow the DNA to join easily with complementary segments.

The gene of interest and the plasmids are both exposed to the same restriction enzyme. This creates many different molecules. Some are plasmids containing the gene of interest, some are plasmids containing other genes, some are two plasmids together. The plasmids are then reintroduced to bacterial cells, where they replicate, and the sought-after recombinant DNA molecule is identified through different types of analysis. For example, if the plasmid is sliced apart at a particular gene, scientists can look for cells failing to express that gene and thus identify successful recombination.

Non-bacterial transformation is essentially the same process but uses non-bacterial cells as hosts. DNA can be injected directly into the nucleus of a host cell. Researchers also may barrage a cell with microscopic metal particles that have been coated with DNA.

Transfection is very similar to transformation, but phages are used instead of plasmids. A phage is a virus that infects bacteria. Both phages and plasmids are ideal for this process since they will replicate quickly within a bacterial cell.

Cloning and Using Recombinant DNA Sequences

Once researchers have identified the particular bacterial cells containing the recombinant sequence, they can grow those cells in a culture and generate large amounts of the gene. It is difficult to get bacterial cells to actually generate a protein from a human or animal host cell, but there are ways of tweaking gene expression to make such production easier. If nucleated cells are used as the host cells (as in nonbacterial transformation), the cells will have fewer problems expressing the recombinant gene.

Once genes are cloned in large numbers, they can then be stored in DNA libraries, sequenced and studied. Recombinant DNA technology has enabled many important discoveries in forensics, the study of genetic diseases, agriculture and pharmaceuticals.