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Question: Explain the applications of DNA fingerprinting in medical biotechnology.

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

In 1984, Alec Jeffrey's, 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.

Importance of genetic research

- Genetic research generates knowledge with the potential to improve individual and community health.
- Research can also reveal information about an individual's susceptibility to disease and about the individual's future health. Such information may be of

interest and benefit to research participants especially if preventive strategies exist.

The role of genetic research is indispensable in the ever challenging fields of diagnosis and treatment of genetic disorders, infectious diseases and non communicable diseases. Main areas of genetic research include:

- genetic testing
- gene therapy
- reproductive genomics
- genetic databanks and pharmacogenomics

Researchers and policy makers alike are continuously assessing the value of this research in terms of its utility and cost-effectiveness for public health.

To provide information on genetic research, this section includes online articles from journals that address recent discoveries, advanced technologies, and current treatment options in the area of genetic.

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. Each person's genetic fingerprint is unique—a fact that makes this type of testing so reliable. A biological child shares 50% of their DNA with the biological father and 50% with the biological mother. A DNA paternity test compares a DNA sample from an alleged father and a DNA sample from a child (minor or adult) to determine whether the two individuals are likely to share or not share a father/child biological relationship. With

the exception of any mutations— which are taken into account by geneticists when determining probability of paternity–the man being tested must match the child's data at every marker tested in order to be considered the biological father.

What a DNA paternity test can't determine

- Proof of relationship for possible biological connections other than paternal (aunt/uncle/sibling/grandparent)
- Information about ancestry
- Age of participants
- Race of participants

Genetic Forensics

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.

Collecting DNA samples

DNA can be isolated from a wide range of evidence left at a crime scene – from skin, hair and semen samples to bacteria in dirt.

Forensic scientists, for example those who work at Environmental Science and Research, are required to collect biological material from a crime scene. Blood is an excellent source of DNA. It is collected from the white blood cells (mature red blood cells do not contain DNA). DNA can also be obtained from the heads of individual sperm cells, from hair follicles or from any other cellular tissue.

For example, imagine someone has broken into the school office where exam records are kept. Perhaps some hairs dropped off without the person realizing, or maybe the person cut their arm on the broken window when they entered, leaving a small trace of blood. It would be up to the forensics team to find these samples and collect them for analysis in the lab.

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. Plant DNA fingerprinting is intricate since it deals with populations and often more than one species. In less than a decade, plant DNA fingerprinting has taken off as a result of substantial achievements in marker isolation and protocol optimization. Nevertheless, commercial imperatives demand that plant DNA fingerprinting accomplishes more than just technological advances. Scientists involved in plant DNA fingerprinting require constant interaction with breeders, biometricians, computer analysts, legal experts and policy makers. International consensus is being reached on general guidelines for employing plant DNA fingerprints as legal evidence.