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Genetic engineer turns detective

The press has carried reports of DNA fingerprinting being used to decide paternity. S.Ananthanarayanan takes a look at how it is done.

So what is the DNA?

In the nucleus of every single cell of the body of living things is a bunch of complex, thread-like molecules called DNA. The structure of the DNA is a code that dictates what proteins the organism will produce. And the features of an organism, whether it is a man, chimpanzee or a bacterium, are decided by what proteins its cells produce – some proteins to build tissue, other proteins, the enzymes, to direct the function of various organs. Given one set of proteins, the organism may have brown hair, and given another set, it may grow a truck and become an elephant!

What is the code?

The DNA is like a string threaded with millions of beads, of four colours. Every consecutive ***triad***, or group of three beads, specifies one amino acid, a building block of proteins. The millions of proteins are all built from just twenty of these basic components. And just three beads, each one being one of four colours, can specify these twenty building blocks with space left over for duplicates, for safely. And humans have 23 sets of DNA, to deal with the myriads of features that make up each one of us.

And Paternity?

During reproduction, half this 'dictionary of individuality' is taken from each parent to create the genetic inheritance of the child. Specifically, half the DNA comes from one parent and half from the other. The combination makes a 'profile' that is unique to an individual, with common features among siblings or blood relatives.

If the profiles of a mother and child are compared, the features inherited from the mother can be identified. What is left must have come from the father. Check up the father's profile and we can make an assessment of whether the person was in fact the father.

How it is done

'Comparing' DNA profiles is easier said than done. The features that we are looking for are specific sequences of the 'beads of one of four colours', found in the DNA. This amounts to following the sequence at the scale of atoms along a string millions of atoms long! But techniques now exist to work this marvel in the laboratory.

A sample of DNA is first isolated, in a small smear from the body or even a bit of hair or skin, if we are dealing with the dead or traces left at the site of a crime. Now, there are enzymes and chemicals that can cut the DNA chain at specific points, like where a particular combination of the four ‘beads’ occurs. Once cut like this, particular bits of the DNA can be filtered out, often by using properties like the different speeds of seepage of different fragments of DNA.

It is something like using different sieves to separate pebbles of a particular size out of a mixture of stone, pebbles and sand.

In this way, just a particular part of the DNA, which needs to be compared with the same part from the suspected father, can be isolated. And the parts can then be tested, to see if they match. Matching a number of samples can lead to very reliable identification of the source of the DNA.

Fingerprints

The separated samples can be transferred to nylon bases and then stained by special reagents. When a number of typical ‘DNA clippings’ are viewed together, they become the unique ‘DNA print’, a lot like the bar code used by supermarkets.