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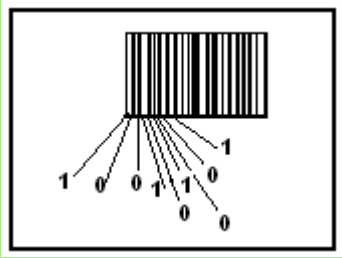
Biological barcodes

Grocery store labeling methods are finding application in identifying the world's living species, says S.Ananthanaryanan.

We are familiar with the patterns of dark and white lines that mark food packets and cosmetic items or even library books. These help check-out counter-persons identify the articles and make bills or loan entries in a trice, using computers. The world of biological species now needs a speedy and reliable method to identify living samples. Scientists at the Smithsonian Institution National Museum of Natural History in Washington have developed a similar system to identify living species, using a coding system that is built into the organism's genetic record.

The barcode

	This is a pattern of dark and light lines that represent the digit '0' or '1'. The series of '0's and '1's represent binary numbers and even a modest set of such lines can code for very large numbers. It is easy to see that each space for a line represents a choice between 2 possibilities – dark or light, or '0' or '1'. Two such places then can be printed in 2x2=4 ways, like this: 00, 10, 01, 11.

Three places can take 2x2x2=8 forms, like this: 000,001,010,011,100,101,110,111. It can be shown that number of ways the lines can code is 2 multiplied by itself as many times as there are lines. With 10 lines, for instance, there are 1024 ways, with 20 lines, 1024x1024=1,048,576 (this is over a million) ways.

20 dark and light lines, which occupy just 2 cm, can then uniquely code a million books in a library. The advantage of lines like this is that they are readily read by a hand-held scanner and a computer instantly identifies the thing marked with the barcode. The computer could then look up the price, the discount, the taxes, for instance, and everything else and out with the bill with accuracy and in a fraction of the time it would normally take.

Biological species

There is similar need for quickly identifying the staggering diversity of living things. There are thousands of varieties, for instance, of each of thousands of common disease carrying insects. But only a few of these are the ones to look out for. A swift and reliable method to identify the species would allow for very quick reaction time for prophylaxis in case of an outbreak. It happens, for instance, that pesticides are heaped on harmless species, while the deadly ones frolic and thrive.

There are other areas too, where quick identification is important. Monitoring of food products for quality and health, monitoring biodiversity in rain forests, commercial applications of verifying correct delivery of organic merchandise, medical and public health applications and so on. They all need to be able to use the equivalent of a hand-held scanner and exactly identify living things.

DNA barcoding

But how does one painstakingly track down every living thing, identify the species and then mark it with a barcode for later reference? Fortunately this is not necessary, as each species has a built in marker, the DNA, or the genetic code in each of its cells. And again, it is not the entire DNA that needs to be read, but only a limited portion,

It is found that a short part of the DNA that resides outside the cell's nucleus is highly variable between even closely related species and serves as a reliable marker. The parts of DNA consist of units called ***base pairs*** **(bp)**, each of which is one of 4 possible kinds. The part of DNA that is used has 648 base pairs and this can, in theory, occur in 4^{648} (4 to the power of 648) forms. This number is more than a billion billion billion…40 times. The marker can clearly code for a large number of species (the world has about 1.8 million).

Scientists from the world over are meeting this month (Sep 2007) in Taiwan for the Second International Barcode of Life Conference to discuss the areas, like food safety, disease prevention, environment monitoring, where barcoding could help. There are now more than 2,80,000 biological barcode records, representing about 31,000 species. When vast records are collected, any living thing can be identified in minutes, from very scant samples, like larval forms to tissue samples.