

Since STRs are so small, they must be amplified by PCR. However, up to nine STRs can be amplified in a single reaction. The STRs are then separated electrophoretically and stained for visualization. The total loci of STRs are not currently known, but hundreds have been identified. CODIS, and FBI database, checks thirteen different STR loci. The probability of two people having the same profile with this database is about 1 to 1,000 trillion. There are only about one billion people alive on the planet. It suffices to say that if two samples exhibit the STR profile in CODIS, they are from the same individual (with the exception of identical twins).

The Y chromosome is passed directly from father to son. The analysis of genetic markers on the Y chromosome is especially useful for tracing relationships among males and for analyzing biological evidence involving multiple male contributors. Tests for STRs on the Y-chromosome are designed for comparing male descendants of a common male ancestor.

### **STR-At a Glance**

Within DNA patterns, there exist repeated patterns of bases. These exist even when the DNA has degraded into small fragments. STR allows us to compare specific repeated units of DNA within a sample. When paired with PCR, this type of testing may be performed on much smaller samples. For all practical purposes, a good STR profile is unique to an individual.

### **mtDNA (Mitochondrial DNA)**

Mitochondrial DNA analysis (mtDNA) may be used to examine samples that cannot be tested by RFLP or STR. RFLP, PCR, and STR all involve the use of DNA from the nucleus of a cell. However, mtDNA analysis uses DNA from a cellular organelle called a mitochondrion. Many older biological samples, such as hair and bones, lack nucleated cellular material. Therefore they cannot be analyzed by other methods. But, they may be tested for mtDNA. In the investigation of cases that have gone unsolved for many years, mtDNA has proven valuable.

Since the mitochondria of each new embryo come from the mother's egg, all mothers have the same mitochondrial DNA as their children. The father's sperm contributes only nuclear DNA. Comparing the mtDNA profile of unidentified remains with the profile of a potential maternal relative can be an important technique in missing person investigations. mtDNA provides valuable forensic DNA typing in certain circumstances. The high number of nucleotide polymorphisms or sequence variants in two portions of the non-coding region allows discrimination among individual samples.

The likelihood of recovering mtDNA in small or degraded biological samples is much greater compared to nuclear DNA. Nuclear DNA contains a complement of two copies per cell; mitochondria DNA molecules are present in thousands of copies per cell. Therefore, muscle, bone, hair, skin, blood and other body fluids, even if drastically degraded by environment or time, may still hold enough material for mtDNA typing. In addition, mtDNA is inherited from the mother only, so that in situations where a sample is not available from an individual, any maternal relative may provide a reference sample.

In contrast to mtDNA, nuclear DNA typing provides vastly superior discriminatory power. Therefore, mtDNA cannot provide the resolution of individuality that nuclear typing does. For this reason, it should be used only for cases where nuclear typing is not possible. Finally, it must be noted that mtDNA analyses are the most costly and time consuming. Laboratories performing these tests do well to conclude one case per month.

### mtDNA-At a Glance

Mitochondrial DNA analysis is conducted in a similar manner as nuclear DNA testing. The basic difference is the use of DNA from a different source: mitochondria. That is, the bases are found in a different part of the cell. In short, this test is not as precise as a standard STR profile, but it can be used on samples that are much older and/or degraded.

### DNA Testing-At a Glance

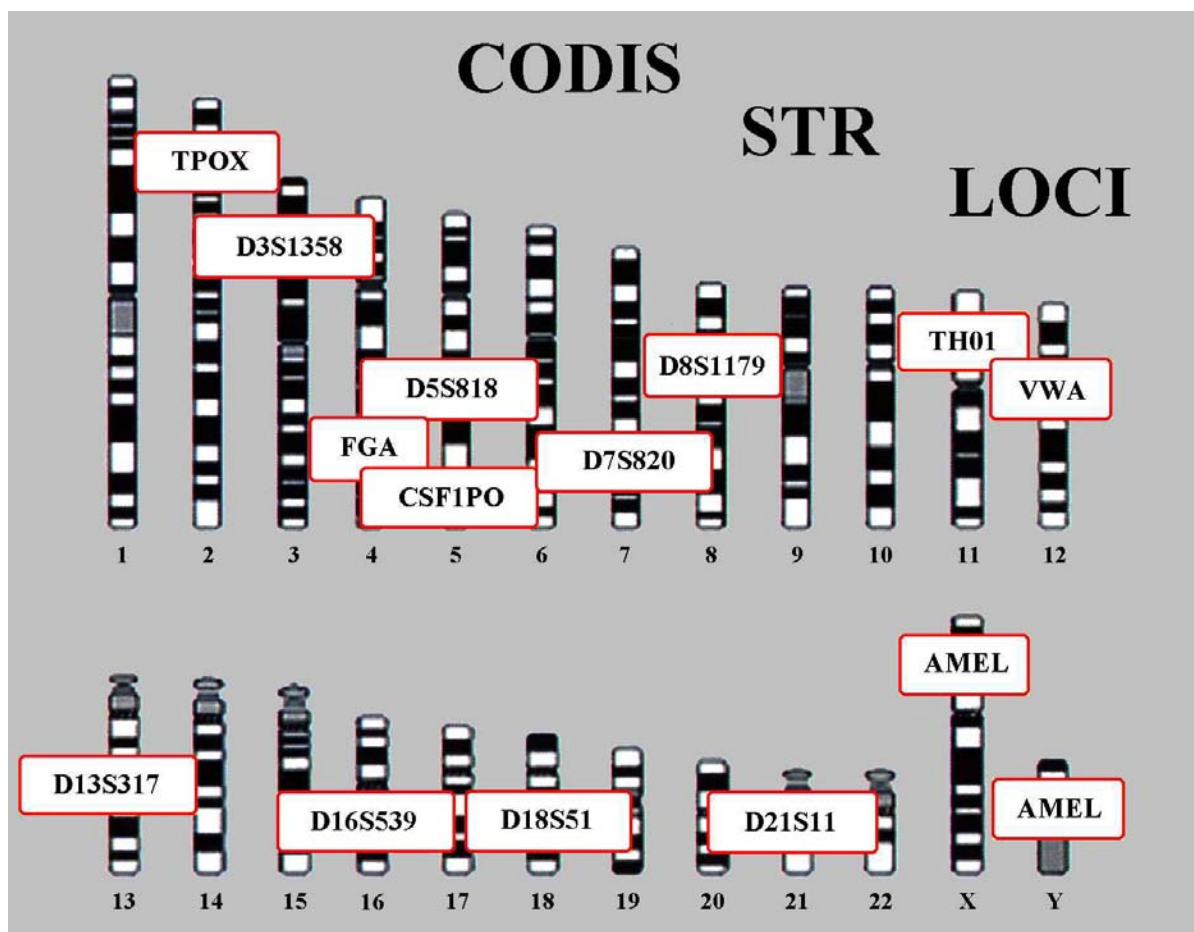
In its simplest form, DNA testing is basically chromatography on a much larger scale. Where thin layer chromatography uses a wicking motion and gravity to move solutes, DNA testing uses electric current and the polarity of molecules to move particular segments (VNTRs or STRs), of DNA. Larger molecules move slower than smaller ones. Considering that the average human being has approximately 3 billion base pairs, DNA testing is comparable to chromatography with a solution that could have billions of solutes.

### Where to Look for DNA

Evidence	Location of DNA	Source of DNA
Weapon	handle, end	sweat, skin, blood, tissue
Hat or Headdress	inside	sweat, hair, dandruff
Face Mask	inside	sweat, hair, dandruff, saliva
Eye/Sunglasses	nose, ear pieces, lens	sweat, skin
Dirty Laundry	surface area, pockets	blood, sweat, semen
Toothpick	tips	saliva, blood
Toothbrush	handle, bristles	saliva, blood
Hairbrush	handle, bristles	sweat, hair
Cigar or Cigarette	butt, shaft	saliva, sweat
Stamp or Envelope	licked area	saliva
Bottle, Can, or Glass	sides, mouthpiece	saliva, sweat
Used Condom	inside/outside surface	semen, vaginal or rectal fluids
Bed Linens	surface area	sweat, hair, semen, urine, saliva
Fired Bullet	outside surface	blood, tissue
Bite Mark	person's skin or clothing	saliva
Fingernail	scraping	blood, sweat, tissue

### CODIS

CODIS, (COmbined DNA Index System), is an electronic database of DNA profiles used to identify suspects and victims to link cases. Although this database is not yet as extensive as AFIS (Automated Fingerprint Identification System), it is constantly growing in size. Cost of retrieval and expediency are currently the only advantages fingerprints holds over DNA. Every state is now in the process of collecting and indexing DNA profiles for individuals convicted of crimes, such as rape, murder, and child abuse. Upon conviction, a criminal's DNA profile is entered into database. DNA profiles from a crime scene can be entered into CODIS in search of a suspect or link to another crime scene. CODIS enables law enforcement agencies to identify possible suspects when no prior suspect existed. The odds that two individuals will have the same 13-loci DNA profile are about one in one billion.



### Matching DNA Results

DNA is similar to fingerprint analysis in how matches are determined. When using DNA to identify a suspect, the results must be compared to known samples. If enough of the identifying features are the same, the DNA is determined to be a match. If, however, even one feature of the DNA is different, it is determined not to be from the same source.

### Reading DNA Tests

Here is a section of a DNA test which only shows one set of indicators on each sample. An observer only need pay attention to the vertical position of the indicators to see that there is a match. Although this test shows a match, it would not be enough to convict the suspect. However, this test would warrant a more detailed test, involving a much larger number of indicators.

