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Bill Nye - Genes



Dec 3

What is DNA Fingerprinting?

The chemical structure of everyone's DNA is the same. The only difference between people (or any animal) is the order of the base pairs. There are so many millions of base pairs in each person's DNA that every person has a different sequence. (Order of A, T, C, G)

Using these sequences, every person could be identified solely by the sequence of their base pairs. However, because there are so many millions of base pairs, the task would be very time-consuming. Instead, scientists are able to use a shorter method, because of repeating patterns in DNA.

These patterns do not, however, give an individual "fingerprint," but they are able to determine whether two DNA samples are from the same person, related people, or non-related people. Scientists use a small number of sequences of DNA that are known to vary among individuals a great deal, and analyze those to get a certain probability of a match.

DNA fingerprints

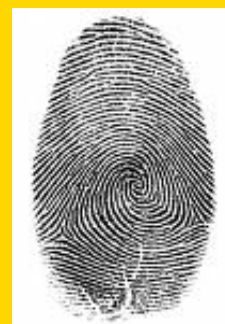
Every person has unique DNA. Identical twins are the only people who would have the same DNA.

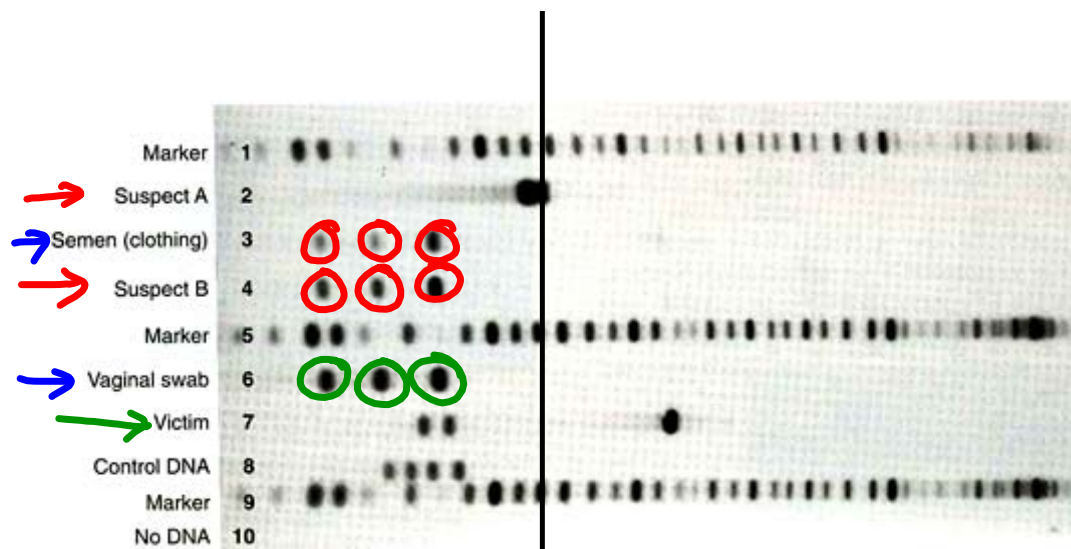
Allan Legere case was the first case in Canada that used DNA fingerprinting.

<http://fig.cox.miami.edu/~cmallery/150/gene/DNA.forensics.jpg>



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Use of DNA typing to help identify a rapist. Two suspects have been accused of attacking and raping a young woman. DNA analyses have been performed on various samples from the suspects and the woman. Lanes 1, 5, and 9 contain marker DNAs. Lane 2 contains DNA from the blood cells of suspect A. Lane 3 contains DNA from a semen sample found on the woman's clothing. Lane 4 contains DNA from the blood cells of suspect B. Lane 6 contains DNA obtained by swabbing the woman's vaginal canal. (Too

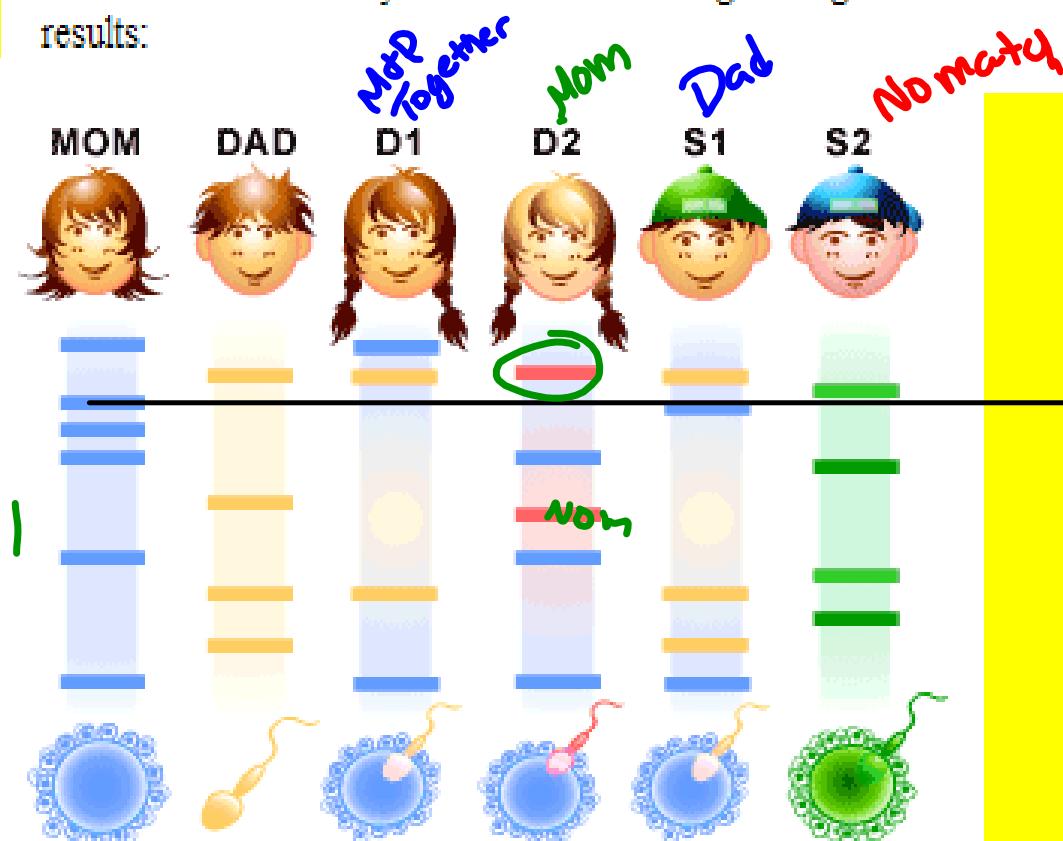
little of the victim's own DNA was present to detect.) Lane 7 contains DNA from the woman's blood cells. Lane 8 contains a control DNA. Lane 10 is a control containing no DNA. Partly on the basis of this evidence, suspect B was found guilty of the crime. Note how his DNA fragments in lane 4 match the DNA fragments from the semen in lane 3 and the vaginal swab in lane 6. (Source: Courtesy Lifecodes Corporation, Stamford, CT.)

DNA fingerprinting can be used to identify a child's parents. Each child inherits one set of chromosomes from each parent. This is why children resemble both of their parents.

A child who has a mom with brown hair and blue eyes and a dad with blond hair and brown eyes might end up with brown hair from his mom and brown eyes from his dad. RFLPs are inherited in the same way, some from the mother and some from the father.

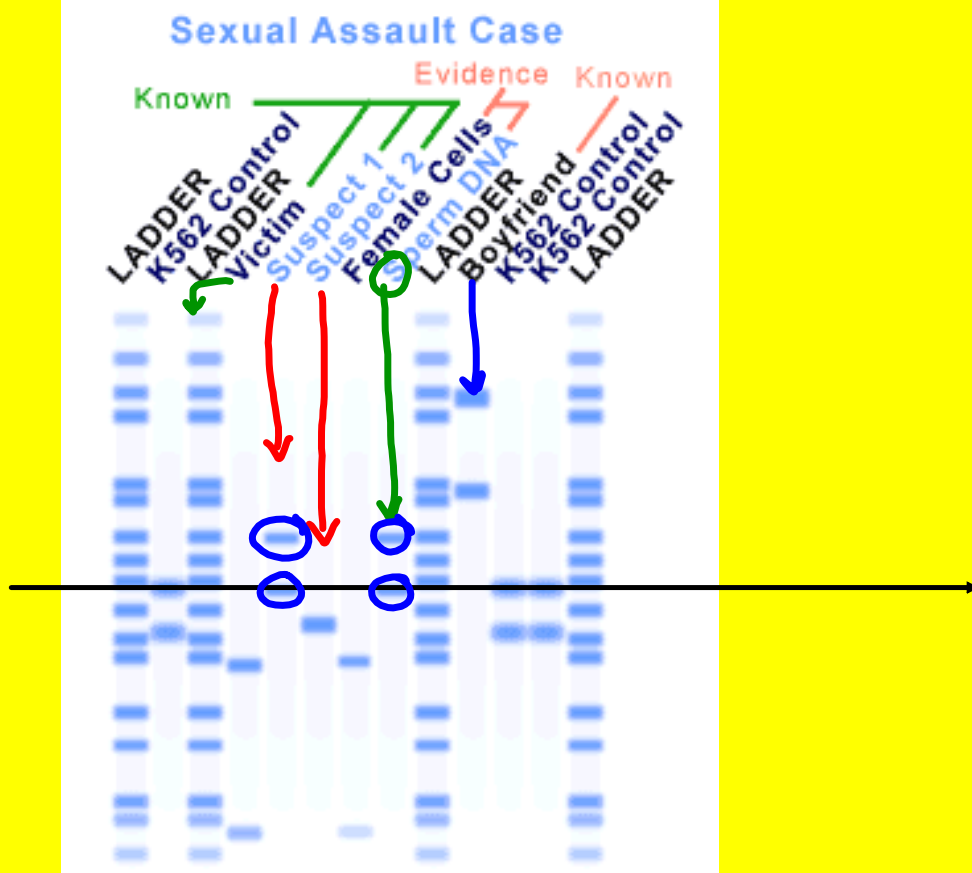
RFLP-restriction fragment length polymorphism

In this example, a family consists of a mom and dad, two daughters and two sons. The parents have one daughter and one son together, one daughter is from the mother's previous marriage, and one son is adopted, sharing no genetic material with either parent. After amplifying the VNTR DNA from each member of the family, it is cut with a restriction enzyme and run on an agarose gel. Here are the results:



It is easy to see in this example that daughter 2 is the child from the mother's previous marriage and son 2 is adopted. You can see that both daughter 1 and son 1 share RFLPs with both the mom and dad (coloured blue and yellow respectively), while daughter 2 has RFLPs of the mom but not the dad, and son 2 does not have RFLPs from either parent.

The next example shows how DNA fingerprinting can point to a criminal. DNA samples were taken from a crime scene, the female victim and two suspects in a sexual assault case. The victim's boyfriend was also tested. The DNA ladders are used to judge the sizes of the DNA fragments. Control samples are also run, to ensure that the experiment is done correctly. Can you determine which suspect is likely the criminal?



The DNA fingerprint from suspect 1 matches up with the fingerprint of the sperm DNA from the crime scene. You can also see that the female cells from the scene match the victim's DNA.



Identical twins, formed when one fertilized egg splits, are the only people in the world with identical DNA.

Fraternal twins, on the other hand, are formed when two different eggs are fertilized.

Genetically speaking, fraternal twins are no closer than normal siblings, sharing only about 50% of their genes.

Although identical twins have the same genotype, or DNA, they have different phenotypes, meaning that the same DNA is expressed in different ways.

Traits determined by phenotype, such as fingerprints and physical appearance, are the result of "the interaction of the individuals genes and the developmental environment in the uterus." Thus, a DNA test can't determine the difference between identical twins, while a simple fingerprint can.

New Brunswick twins identical DNA made for difficult conviction in deadly home invasion



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Police investigating a deadly home invasion in New Brunswick found key evidence on gloves and a mask linked to the crime — DNA that can pinpoint a culprit with scientific certainty; except in this case, where it led to twin brothers with identical DNA, prompting a courtroom conundrum where science could not reveal which brother it came from.

A Saint John jury decided the fate of Brandon and Bradley Saia Wednesday, knowing the hallowed science they might have seen on TV had failed them.

The Saia brothers, both 22, sat side by side in the prisoner's dock for more than a week. They have the same haircut, same style of facial hair and, although Brandon's face is a bit thinner and he stands an inch shorter than his brother, the pair have the unmistakable sameness of twins.

The jury could see their physical similarities, but also heard of their genetic closeness as well, making for a case that might forge legal precedence on the issue of genetic identity.

“The DNA is not of any assistance here because it is uncertain if it was from one brother or the other — or from both. They can't tell from the DNA who did what,” said Peter Corey, a lawyer representing Bradley Saia.

“These two really are truly identical. They look the same, have the same build, same facial features and their DNA is the same. I was told this was the first case like it in Canada.”

Court heard from DNA experts that genetic testing on blood samples of the brothers ~~could not tell them apart.~~

Catherine MacEachern, an RCMP DNA analyst who worked on the DNA samples, testified that DNA found on a bandana and two sets of gloves matched both of the accused men, but tests could not determine whether it was from both brothers or only one, nor which one that might be.

“They don’t have the technology to get deep enough to tell them apart. Maybe some day they will, but not now,” said Mr. Corey, on the prospect of Canadian forensic laboratories differentiating between genetic profiles of monozygotic twins, typically called identical twins.

Despite the unusual circumstances, the case did not rest entirely on DNA evidence; other evidence, including eyewitness accounts, was also presented.

Crown prosecutor Jill Knee told court that a brother’s presence at the scene was not necessary for a conviction since witnesses said both brothers were involved in the planning.

The trial stemmed from a nasty home invasion in Saint John last November.

Court heard that five men burst into an apartment wearing masks and gloves. During the attack, the victim stabbed one of the attackers to death. Police arrested four suspects; two have pleaded guilty. The Saia brothers were the remaining two accused.

Police found items that witnesses linked to the crime at someone else’s home and from them drew the DNA that was supposed to be compelling evidence at trial.

Despite the scientific uncertainty, both men were charged with theft with a weapon, forcible entry and having their faces masked while committing an indictable offence.

The case highlighted the often-mentioned but largely theoretical situation that has become a standard caveat at trials dealing with the science of identifying suspects based on DNA; experts and judges routinely say that, “except for identical twins,” no two people have the same DNA.

In some criminal trials, an accused's mother has been called to the stand solely to testify that the person on trial did not have an identical twin.

In this case, such evidence wasn't needed. The two men do not seem to try hard to look different from the other.

"Identification was a problem for eyewitnesses as well," said Mr. Corey.

On Wednesday, a jury heard its final instructions from the judge and, after a day of private deliberations, returned in the evening with a guilty verdict for both of the twins.

Legal scholars will be studying the decision.

"It is a rare occurrence," said Ricardo Federico, a defence lawyer in Toronto and adjunct professor of forensic evidence at Osgoode Hall Law School. "Can it raise reasonable doubt? The issue of identity is crucial at trial. A person's identity must be proven beyond a reasonable doubt."

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He said prosecutors sometimes joke that DNA stands for Do Not Acquit because of the sense of scientific certainty it hands a jury. A case such as this makes Mr. Federico retort that a better acronym might be Do Not Assume, he said.

While the DNA of twins causing confusion in criminal cases is rare, the prospect is not unique.

Earlier this year, police in France hunting a serial rapist used DNA evidence to arrest two men, but were unable to say which was the culprit because both of them were a genetic match.

In Alberta, a pair of twins named Karl and Kyle Strongman stood in for one another at court appearances, even entering pleas on behalf of a sibling before unwitting judges. Karl was eventually convicted of manslaughter in 2007, assuming the right one was sent to jail.

Identical twins in Germany escaped charges in a jewellery heist when police could not determine which brother's DNA was found in a latex glove at the scene.

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