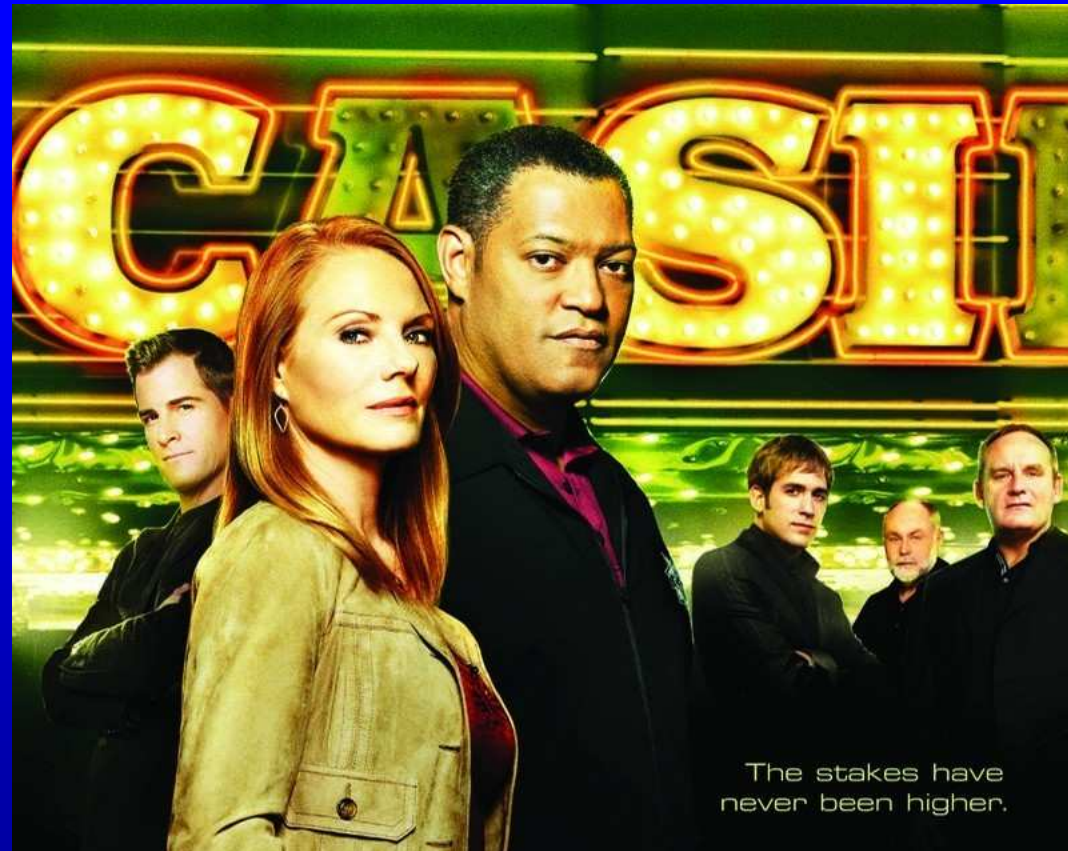


The Real CSI: Using DNA to Identify Criminals and Missing Persons



San Jose State University

May 2, 2012

Overview

- **Forensic DNA in the media – perceptions and reality**
- **The power and limitations of nuclear (STR) DNA testing**
- **Offender DNA Databasing**
- **Missing/Unidentified Persons**
 - **Kinship**
 - **Mitochondrial DNA**
- **Familial DNA Searching**
- **Ethical Issues**

Cold homicides thaw with high-tech help

■ DNA testing, though costly, and other advances have prompted Bay Area prosecutors to dust off many old case files for new tests

DNA 'cold hit' snares ex-con in Richmond sex murder

Berkeley lab helps make murder suspect, DNA match

Bay City News

NEWS RELEASE



Attorney General Bill Lockyer
California Department of Justice

"It (the arrest) validates what we're doing."
- Ana Marie Schubert, a Sacramento County deputy district attorney

Clearing DNA backlog tops Lockyer's priorities

How genetic code ID led to arrest in '94 case

STATE DNA DATABANK LINKS SUSPECT TO 1993 DOUBLE HOMICIDE

DNA: Case will affect rest of U.S., lawyer says

State's DNA database nabs first suspect

Parole violation led to DNA match DNA database leads to arrest

Suspect in '81 slaying makes court appearance today

DNA profile leads to arrest

Legal maneuver may be first in U.S.

Judge OKs use of DNA

Rape arrest came after time limit

DNA clues may solve 16-year-old murder

Convicted kid killer now on death row faces another trial in woman's slaying

DNA links convicted rapist to 1993 slaying of South Bay boys

ASSOCIATED PRESS March 21, 2001 SAN DIEGO

Unlocking evidence

Funding, expansion pushed for crime-solving DNA lab in Berkeley

Bay Area Man Charged in 5 Killings

Cops say DNA links him to 1992 Oklahoma case
Chronicle Staff and Wire Reports

THURSDAY, FEBRUARY 8, 2001

San Francisco Chronicle

THE VOICE OF THE WEST

EDITORIALS

Taking Felons to the Bank

DNA databanks

Friday, February 23, 2001 • The Sacramento Bee

► METRO/REGIONAL

DNA ties killer to '84 case

■ Man on death row for murdering a Yuba City boy now has been charged in the killing of an 18-year-old woman from San Leandro

Lockyer vows to expand DNA database
Attorney general addresses California police chiefs at Ontario convention.

DNA Ties Santa Rosa Parolee to Rape

By Charlie Goodyear
CONCORD STATE NEWS

DNA Links '70s Rapes to Serial Slaying Cases
Unknown Southern California killer was 'East Area Rapist'

Ein-Melissa, Charlie Goodyear, Chronicle Staff, Writers
Wednesday, April 4, 2001
100021 San Francisco Chronicle

DNA databanks

The more criminals we catalog, the more crimes we solve

Berkeley DNA lab

Inmate charged in '84 killing

Genetic match links suspect to death of Plumas County teen

DNA in the News: Gun Possession Proven



Music Mix

Albums, concerts, downloads, news, reviews, and more

[See Categories](#) [See Archive](#) [RSS](#)

OCT 22 2009
12:04 PM ET

Lil Wayne pleads guilty to gun possession, faces one-year prison sentence

by [Simon Vozick-Levinson](#)
Categories: [Lil Wayne](#), [News](#)

[b](#) [g+](#) [f](#)

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[Comments \(17\)](#)



Lil Wayne entered a guilty plea to felony gun possession in an NYC courthouse this morning, [MTV News reports](#). The rapper will likely be sentenced to one year in prison under the terms of his plea deal. He would have faced up to three and a half years behind bars if convicted.

The gun charges stemmed from a July 2007 incident in which police pulled over Wayne's tour bus after a concert. ([I was there in the audience earlier that night](#) — it was an unforgettable show.) They found a loaded .40 caliber semi-automatic pistol. While Wayne initially pleaded not guilty, the situation changed this month when prosecutors said they had DNA evidence linking him to the weapon.

October 22, 2009 - music-mix.ew.com

DNA in the News: the Innocent Released

October 26, 2009 11:26 AM

Dean Cage, An Innocent Man

Posted by Edecio Martinez

Font size

Print

E-mail

Share

4 comments



(Innocence Project)

Photo: Dean Cage.

NEW YORK (CBS/AP) Dean Cage once said "if you believe in something, fight for it."

Those hard-earned words rang out hours after the 41-year-old was released from prison more than a year ago after serving more than 12 years for a rape he didn't commit.

He was convicted in 1996 and sentenced to 40 years in prison for the rape of a 15-year-old girl, who, at the time, identified him as her attacker. But Cage always maintained his innocence and asked for DNA tests to prove it. He said his family had even tried to pay for it themselves.

October 26, 2009 - www.cbsnews.com

DNA in the News: From Strange Sources

Blood from leech nabs robber

Font size:   Email article:  Print article: 

NICK CLARK

October 20, 2009 07:08am

TASMANIA Police have used blood taken from a leech to match DNA eight years after an aggravated robbery.

In what is believed to have been a world first, police found the engorged leech about an hour after the crime.

Peter Alec Cannon, 54, of Lalla Rd, Karoola, north of Launceston, pleaded guilty in court yesterday to an aggravated armed robbery committed on September 28, 2001.

Detective Inspector Mick Johnston said he had never heard of a leech being involved in a crime scene before.

"It is the oddest way of convicting anyone I have ever been involved in," the 25-year police veteran said.

"I have not been able to find any similar cases anywhere in the world -- nothing like this at all."

Det-Insp Johnston said the leech was the only thing found during a full forensic investigation.

"It was the only evidence we found, and as there was no evidence of any leech bites from the victim or the police present we thought it was a good chance to have come from one of the offenders," he said.



Peter Alec Cannon outside court yesterday.

October 20, 2009 - www.themercury.com.au

DNA in the News: The CSI Effect?



12 year-old Leon Yates

CSI Bolton: Boy detective foils serial burglar after collecting DNA evidence from drink can

By JAMES TOZER

Last updated at 4:51 PM on 27th October 2009

[Comments \(51\)](#) | [Add to My Stories](#)

As a fan of crime-solving TV series CSI, schoolboy Leon Yates knew exactly what to do when his neighbour was burgled.

Although the terraced streets of his home town of Bolton are a long way from sun-drenched Florida, the 12-year-old proved he had been paying attention.

He had seen the suspect swigging lemonade before the break-in, and when he saw the empty can lying in the street outside he swept it into a plastic bag without touching it and handed it to police.

The budding detective's brainwave was rewarded after DNA tests unmasked the intruder as a serial burglar and he was sent to prison.

October 27, 2009 - www.dailymail.co.uk

DNA in the News: Controversy

DNA Profiling: You May Be Next

Mission Loc@l

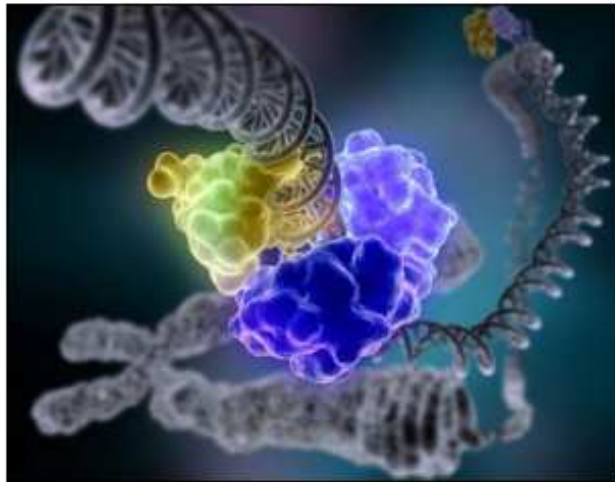


Photo by Tom Ellenberger via Wikimedia

Since its discovery a quarter century ago, the DNA fingerprint has been hailed as a pivotal tool in solving crimes and exonerating those wrongly convicted.

But as it celebrates its 25th anniversary, the question of how DNA evidence is being used and how samples are being extracted, have come under fire from civil rights activists and many criminal justice experts.

Proposition 69, passed in 2004, made California one of now 21 states that require DNA sampling for some arrestees. This voter-approved

initiative mandated that this extend to all felony arrestees by Jan. 1, 2009 -- and the legal backlash has already begun.

Earlier this month the American Civil Liberties Union of Northern California (ACLU-NC) filed a lawsuit against the state of California charging that the statute on DNA collection violates search and seizure laws under the Fourth Amendment, and due process under the 14th Amendment.

October 22, 2009 - www.sfgate.com

What is a Forensic Scientist?



Typical day in the lab...

Progress Is Minimal in Clearing DNA Cases



Ann Johansson for The New York Times

Stacy Vanderschaaf, of the Hertzberg-Davis Forensic Science Center in Los Angeles, where the Police Department has some 7,000 cases awaiting DNA analysis.

By SOLOMON MOORE

Published: October 24, 2008

LOS ANGELES — Local and state law enforcement agencies have made uneven progress in reducing a nationwide backlog of cases awaiting DNA analysis over the past four years, according to reports filed by more than 100 agencies with the National Institute of Justice.

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DNA

Pre-PCR



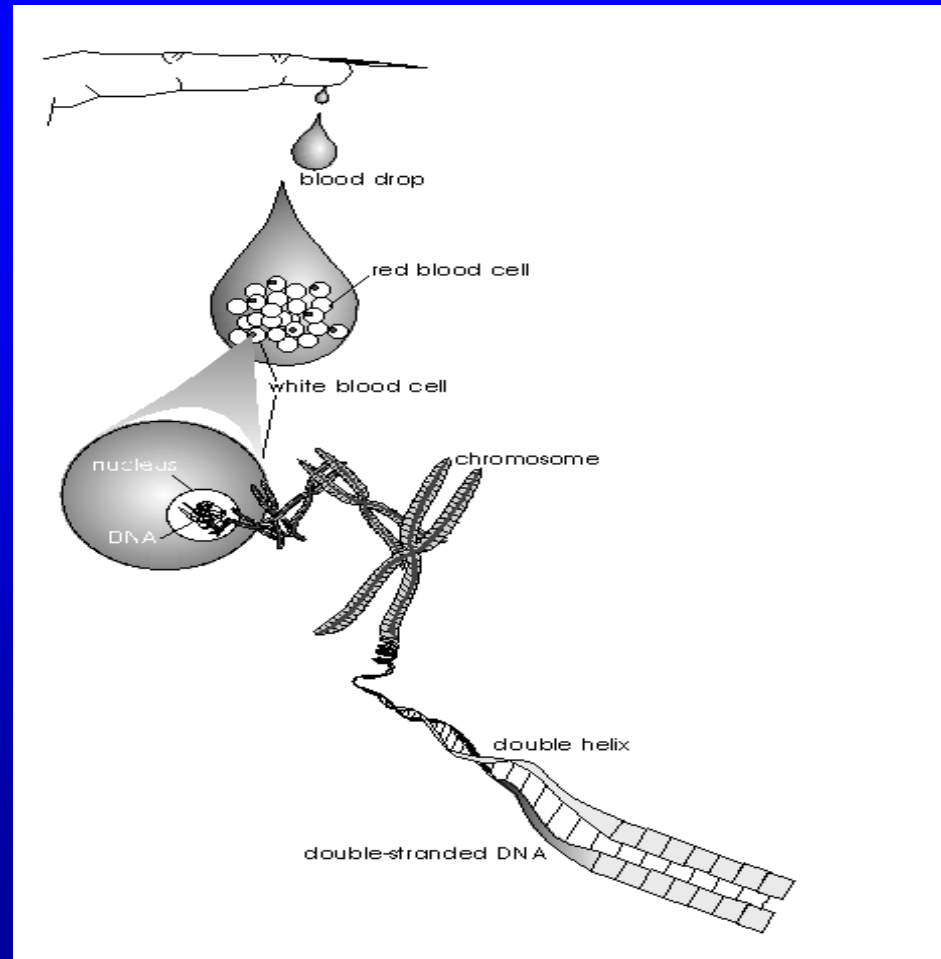
POST PCR



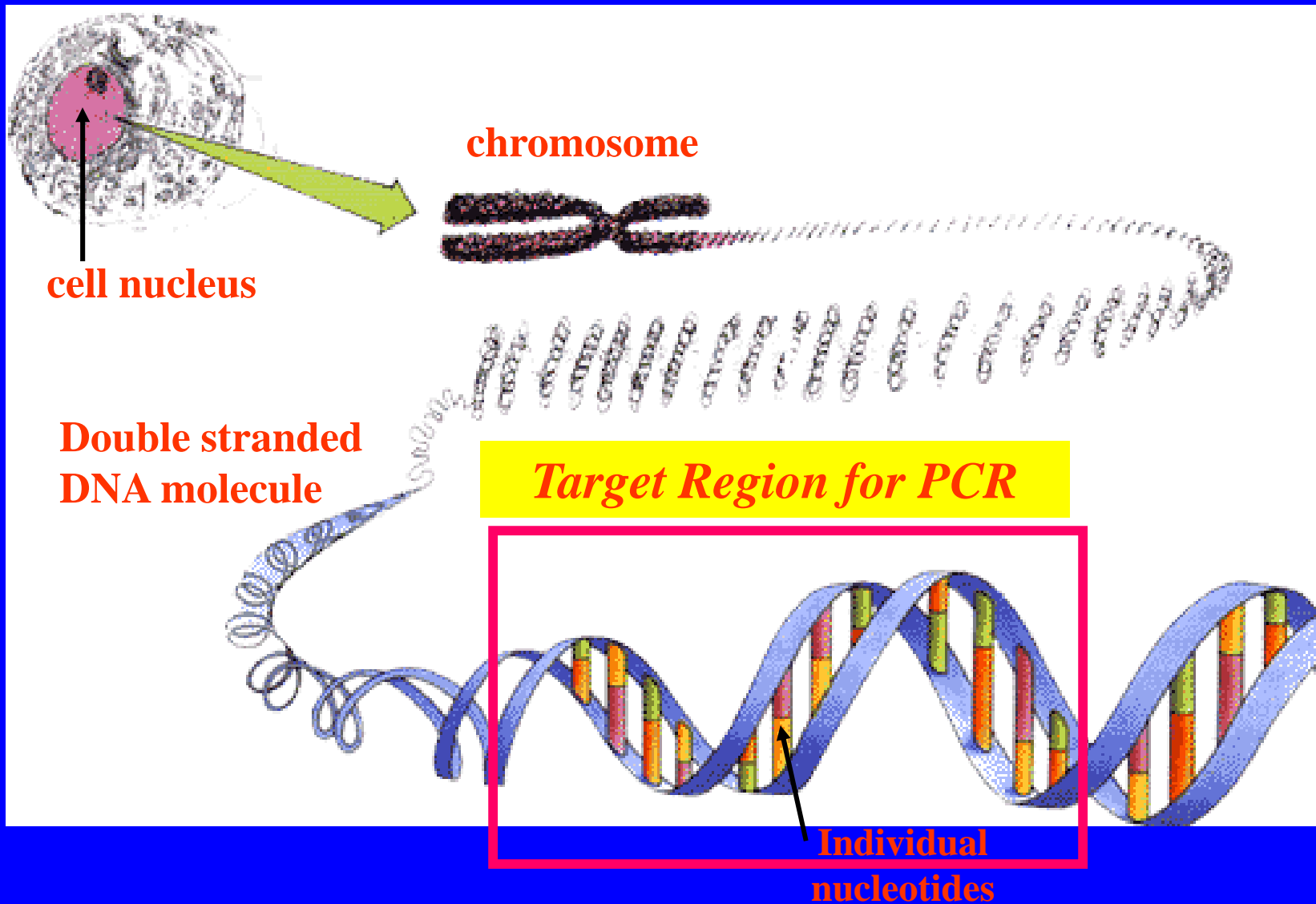
POST PCR



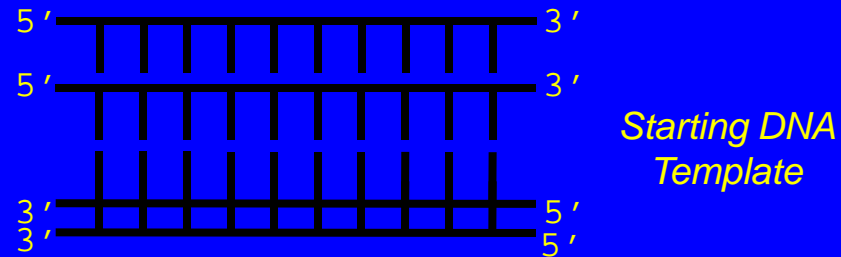
Forensic DNA



DNA in the Cell

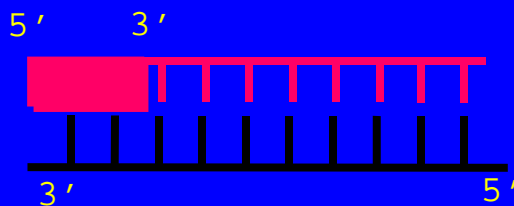


DNA Amplification with the Polymerase Chain Reaction (PCR)

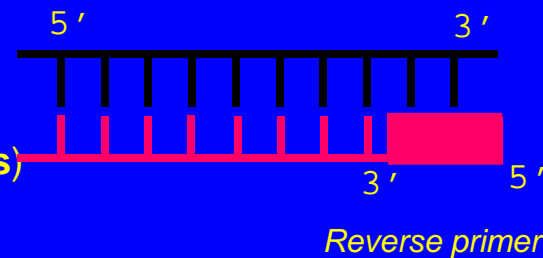


Separate strands
(denature)

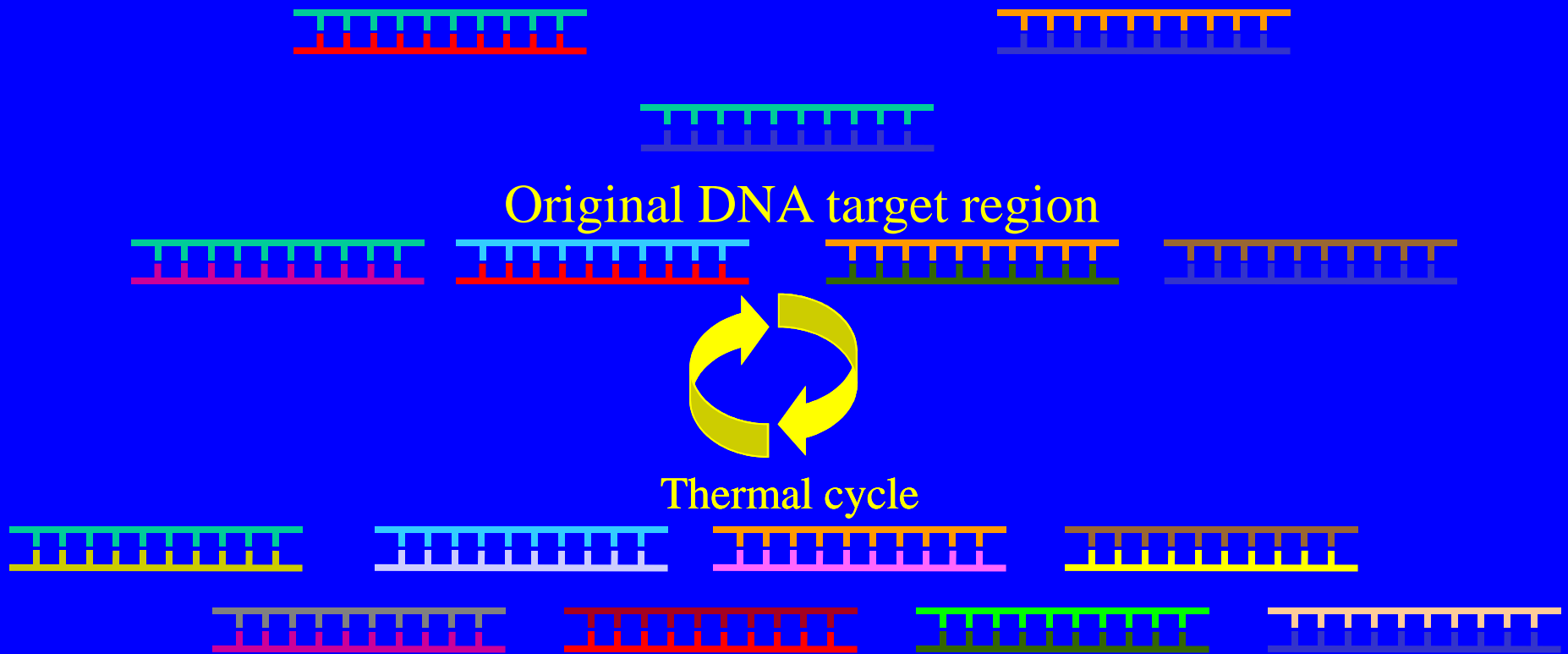
Forward primer



Make copies
Add primers
(extend primers)
(anneal)

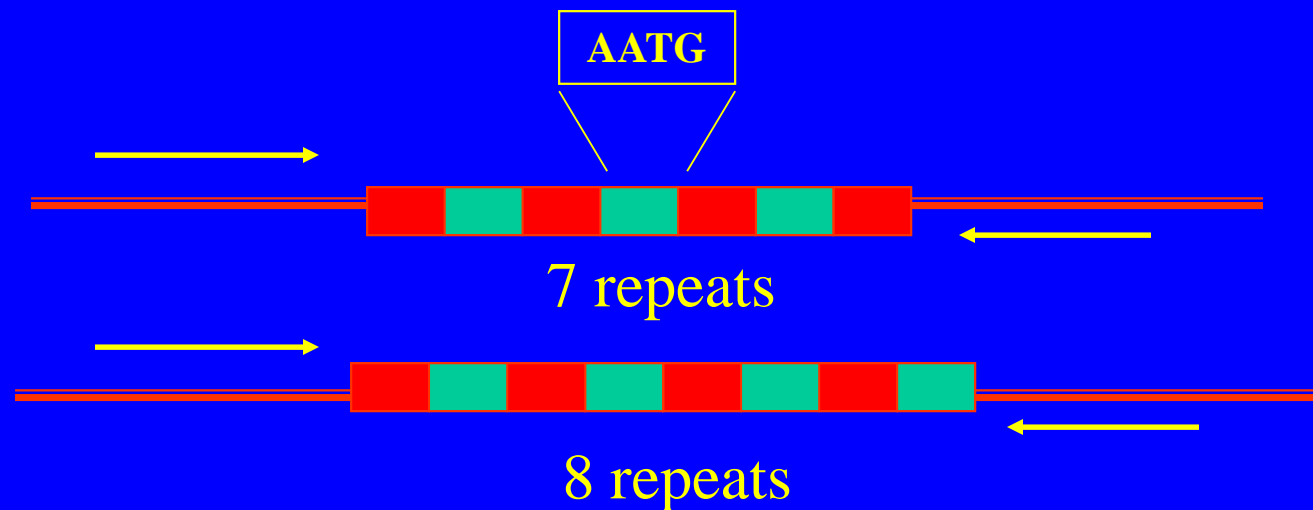


PCR Copies DNA Exponentially through Multiple Thermal Cycles



In 32 cycles at 100% efficiency, 1.07 billion copies of targeted DNA region are created

Short Tandem Repeats (STRs)



the repeat region is variable between samples while the flanking regions where PCR primers bind are constant

Homozygote = both alleles are the same length

Heterozygote = alleles differ and can be resolved from one another



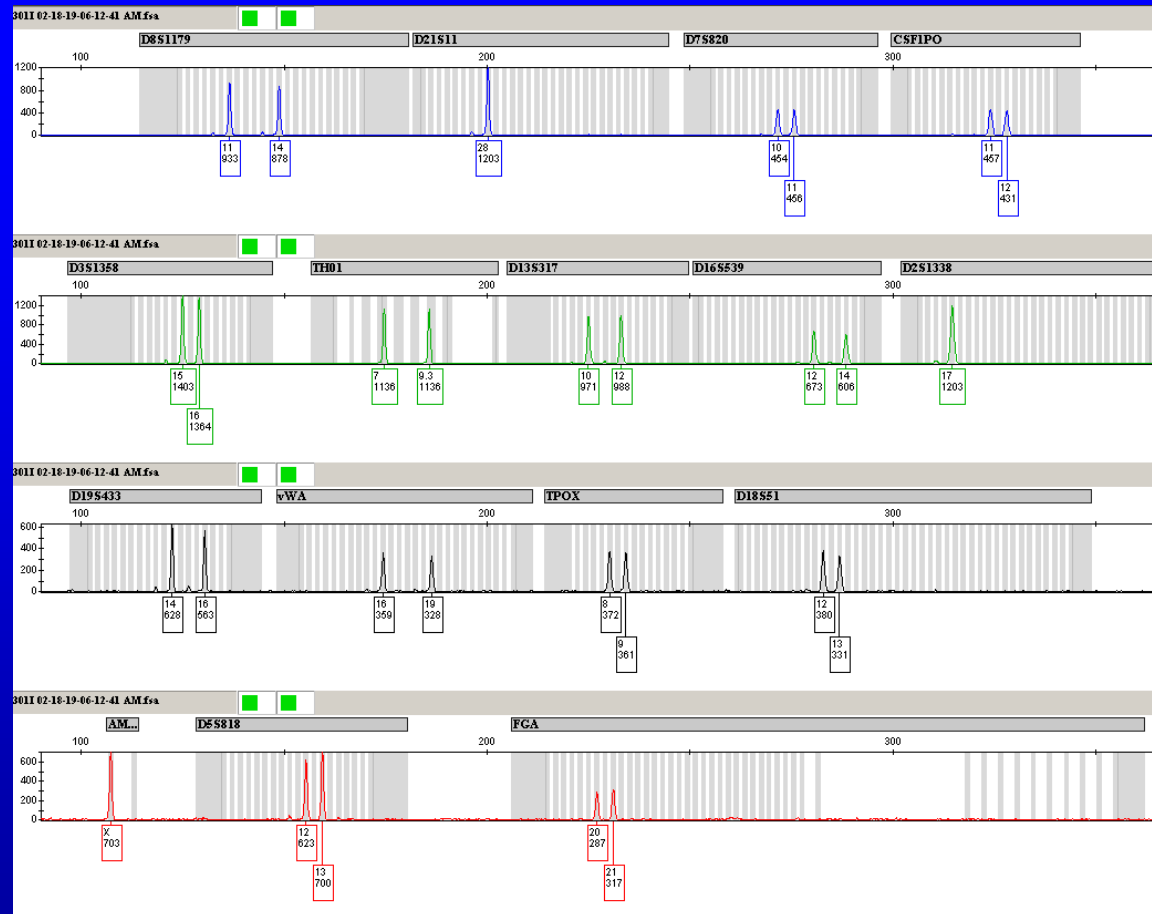
Multiplex PCR

- **Up to 16 Markers Can Be Copied at Once**
- **Sensitivities to levels less than 1 ng of DNA**
- **Ability to Handle Mixtures and Degraded Samples**
- **Different Fluorescent Dyes Used to Distinguish STR Alleles with Overlapping Size Ranges**

310/377/3100 Electrophoresis



A Sample STR DNA Profile:



The “Power” of STR typing

- **Statistical frequency**
- **Amplification from as little as a few cells**
- **Large databases for comparison**

How “rare” is a DNA profile?

- **15 STR markers (loci) in one amplification reaction**
- **Each locus is INDEPENDENT of all others**
- **Therefore, the overall frequency for a 15-locus profile is the product of the frequencies of each individual locus**
- **15 dice – what is the chance of rolling 15 sixes?**
- **2.1×10^{-12} or 1 in 4.7×10^{11}**

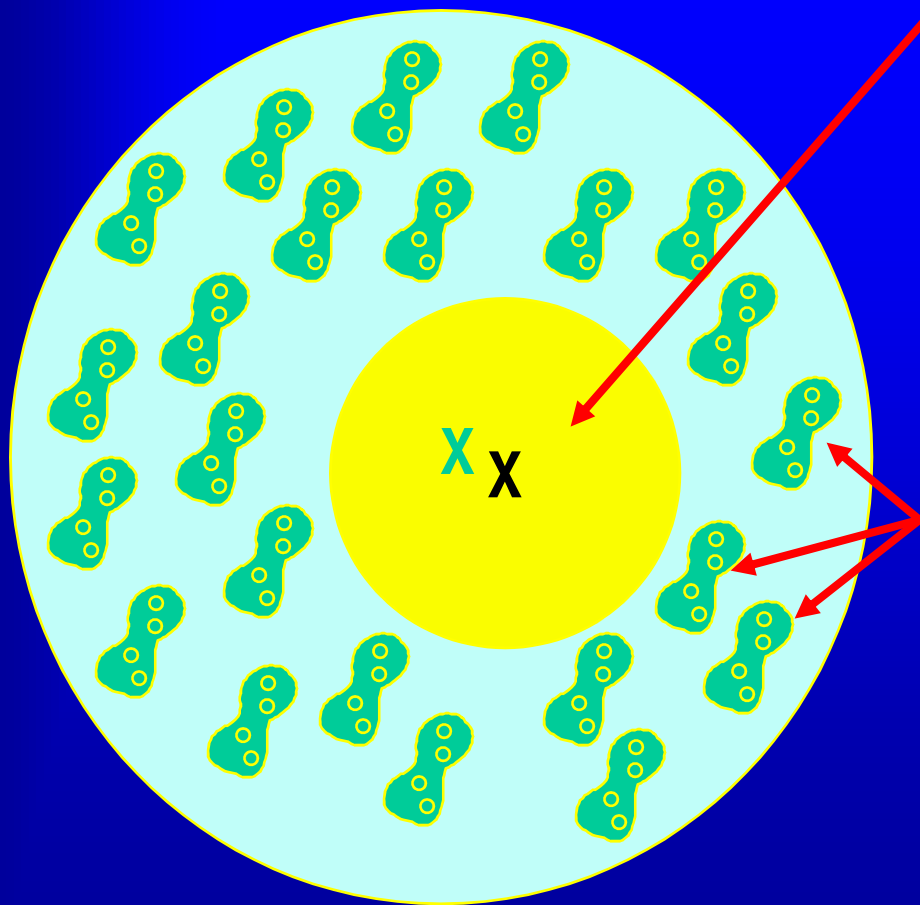
A Sample STR DNA Report:

AmpFISTR Identifiler Typing Results

ITEM # Description	QCA072 Blood
Locus	
D8S1179	11,14
D21S11	28,28
D7S820	10,11
CSF1PO	11,12
D3S1358	15,16
TH01	7,9,3
D13S317	10,12
D16S539	12,14
D2S1338	17,17
D19S433	14,16
VWA	16,19
TPOX	8,9
D18S51	12,13
Amelogenin	X,X
D5S818	12,13
FGA	20,21

- **STRs (autosomal) have a high power of discrimination. This profile is estimated to occur at random, among unrelated individuals, in approximately 1 in 9.3 quintillion (Caucasian) people .**

Types of DNA

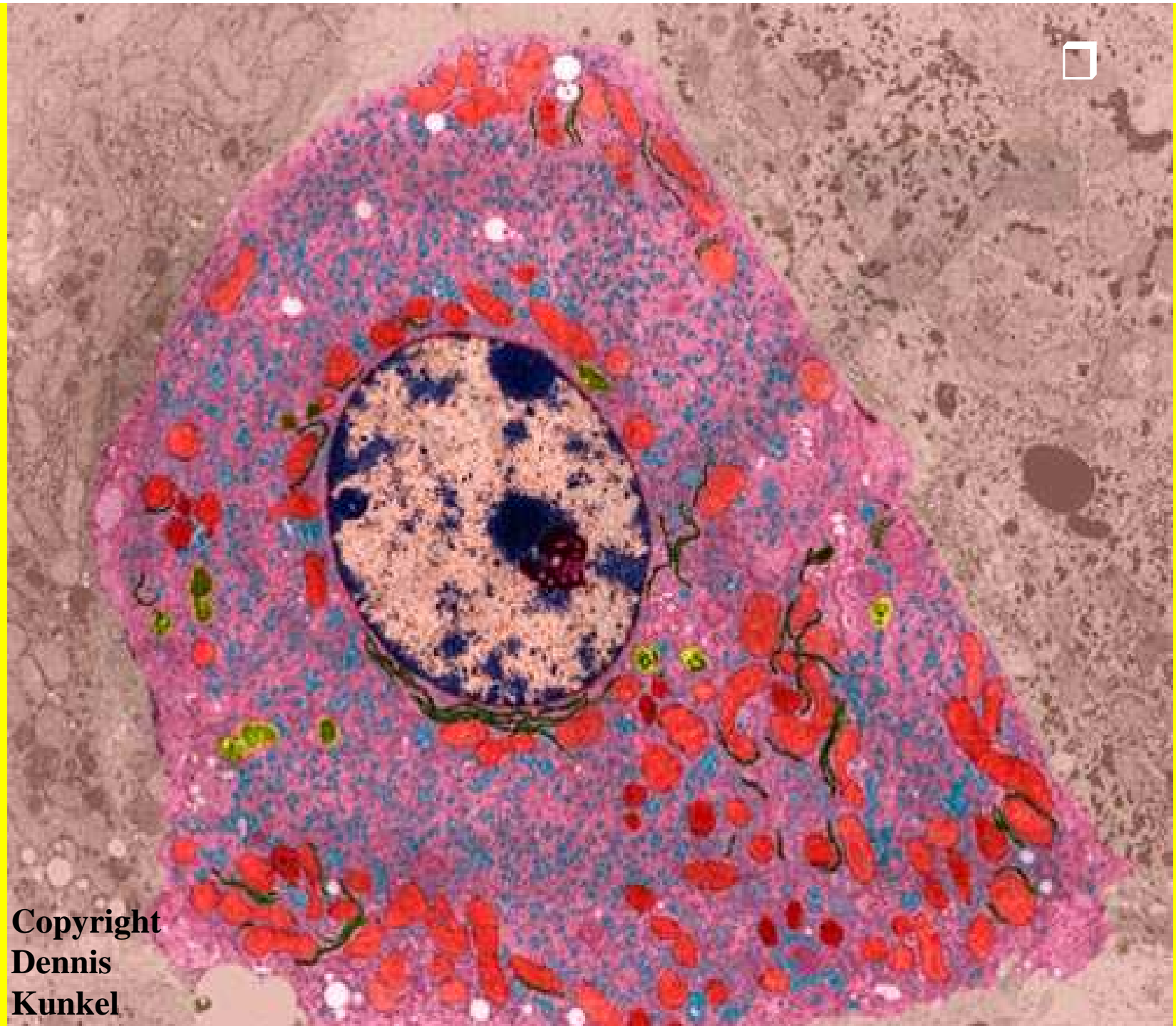


Nuclear

- 2 copies/cell
- inherited from both parents
- unique to individual

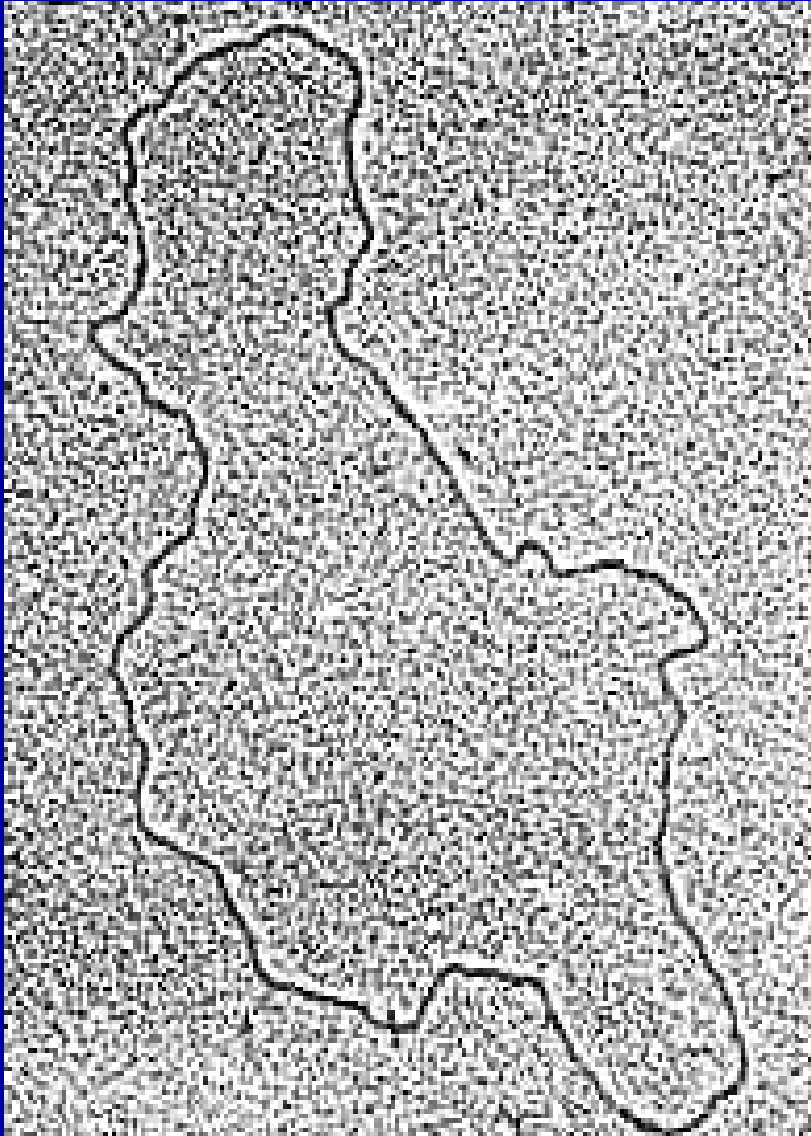
Mitochondrial

- >1000 copies/cell
- maternally inherited
- not unique to individual



Copyright
Dennis
Kunkel

Human Mitochondrial DNA □



Features of Mitochondrial DNA

- circular genome
- 1000's of copies per cell
- maternally inherited
- small genome: ~16,500 bp
- ~10% non-coding region
- maternally related
individuals share mtDNA type

Useful for analysis of samples
not amenable to nuclear analysis

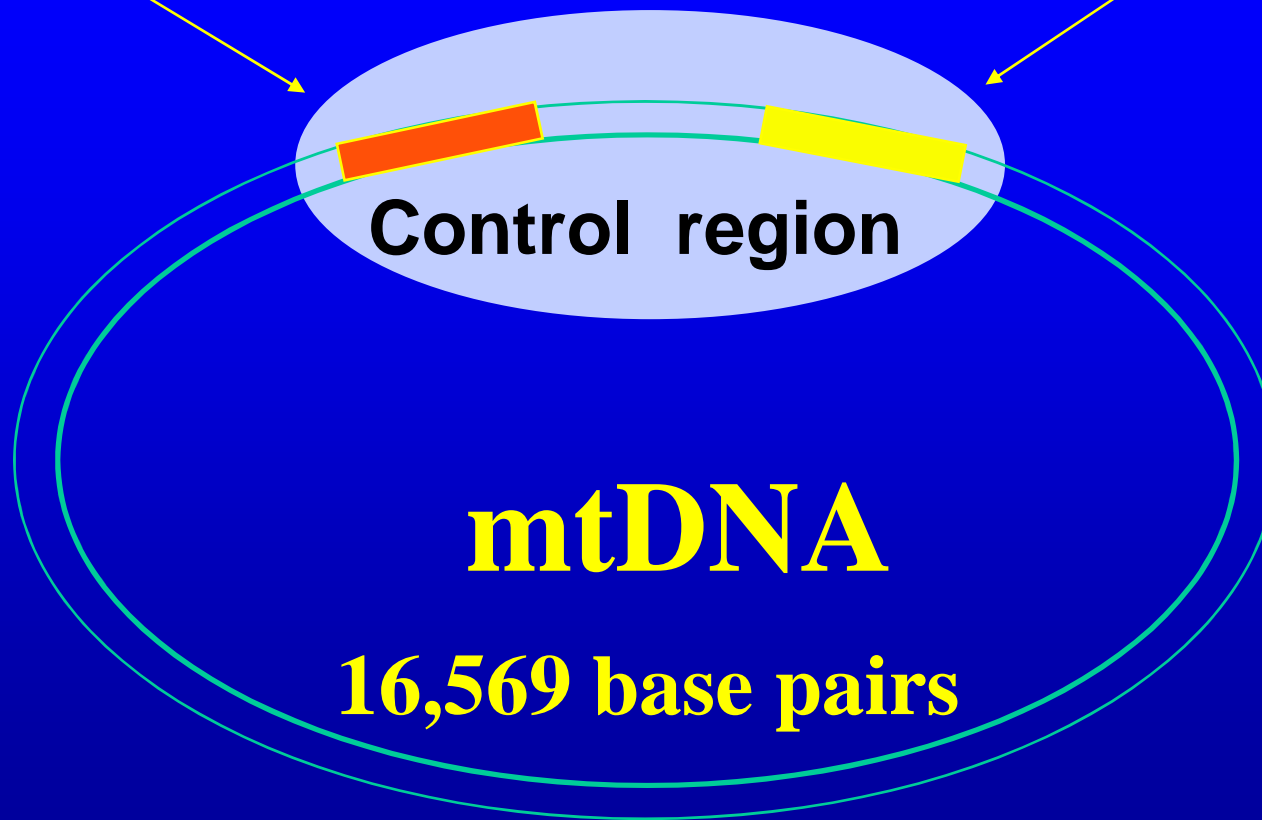
Organization of mtDNA

HV1

(hypervariable region 1)

HV2

(hypervariable region 2)



Control region

mtDNA

16,569 base pairs

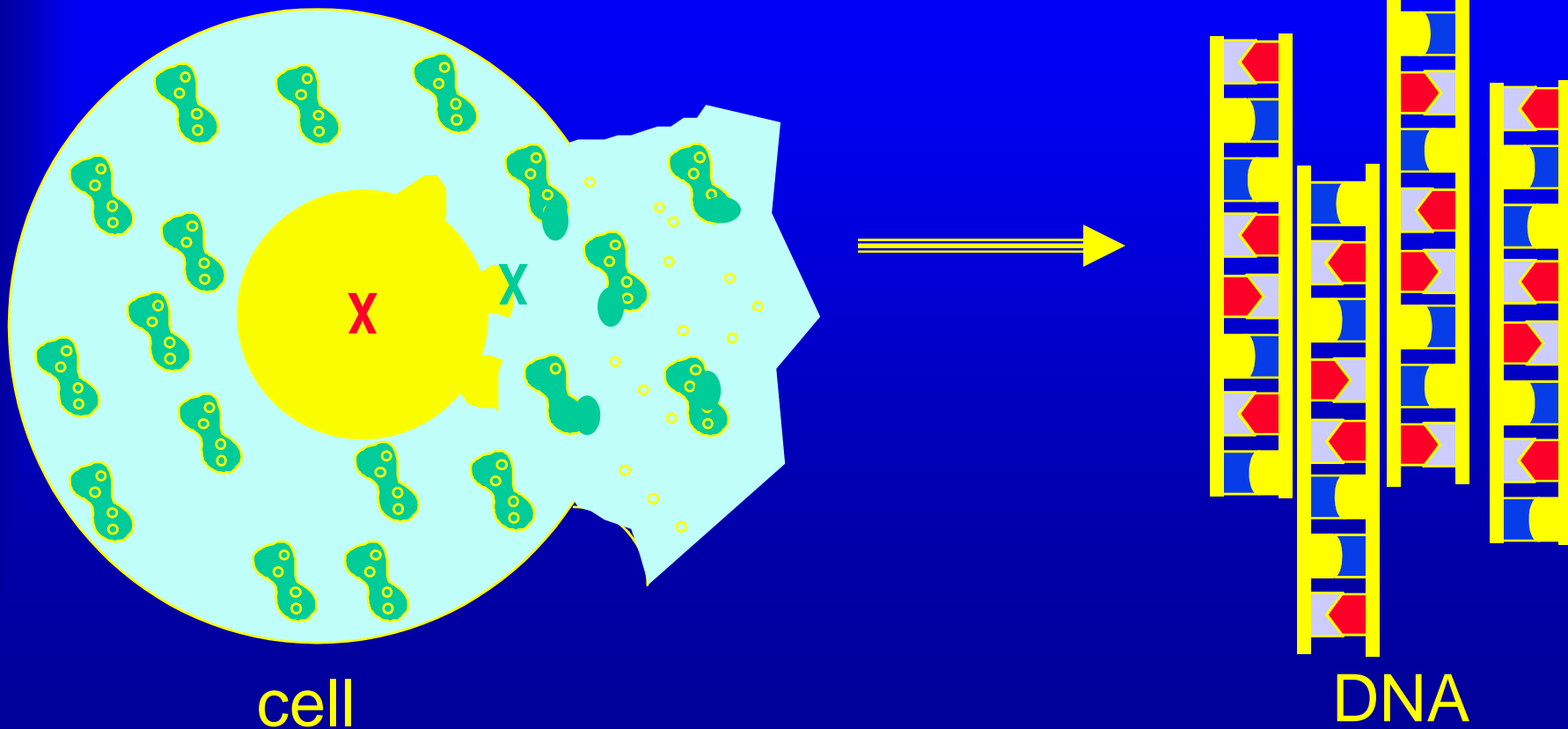
Advantages of mtDNA

- **High copy number**
limited sample
hair, teeth, bones
- **Less prone to degradation**
structure, location
- **Highly variable between individuals**
- **Maternal inheritance**
maternal relatives source of known
sample in missing persons cases

Steps in mtDNA analysis

1. Extraction

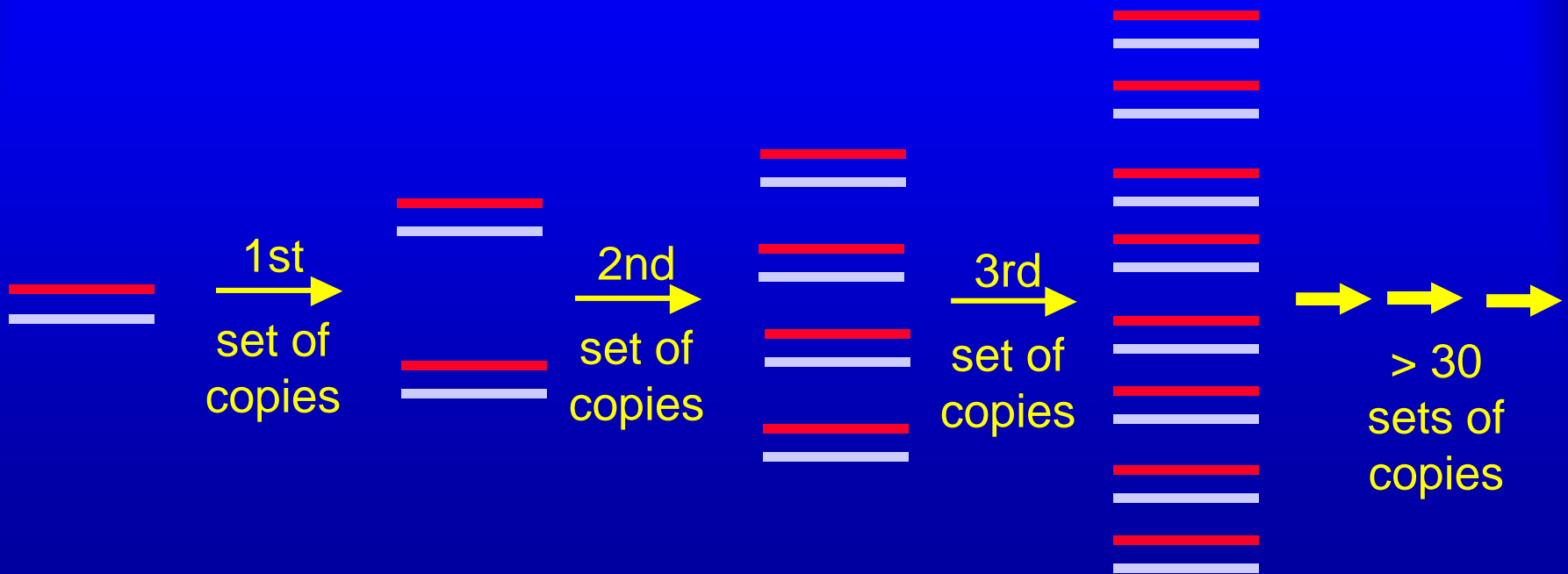
-removal of DNA from sample



Steps in mtDNA analysis

2. Amplification (Polymerase Chain Reaction)

-make many copies of specific regions of DNA



Steps in mtDNA analysis

3. Sequencing

-determine order of bases

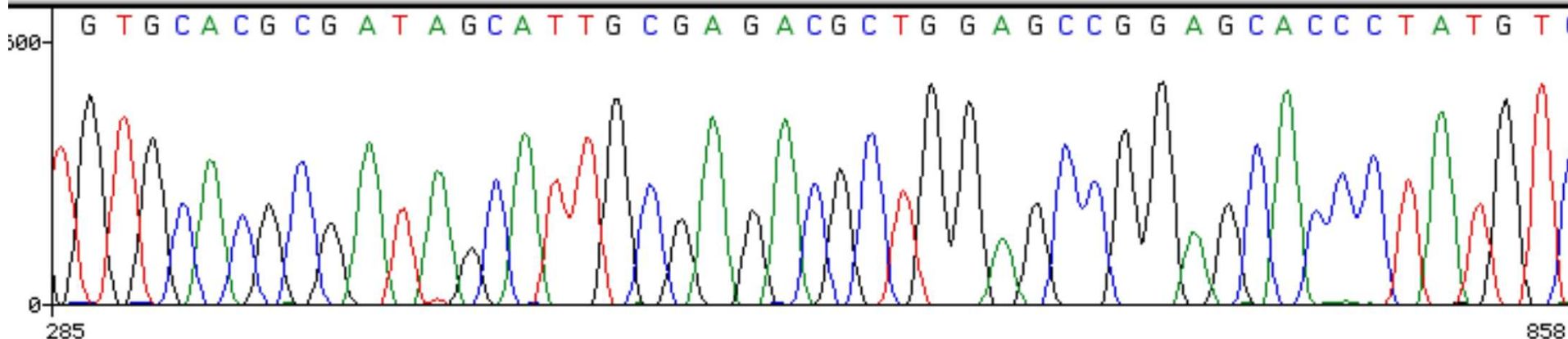
4. Sequence Comparison

	<u>Case #1</u>	<u>Case #2</u>
Q uestioned	GCA<u>T</u>ATT<u>G</u>CG<u>C</u>CTA	GCATATTGCGCCTA
K nown	GCAC<u>C</u>ATT<u>A</u>CG<u>T</u>CTA	GCATATTGCGCCTA
	EXCLUSION	CANNOT EXCLUDE

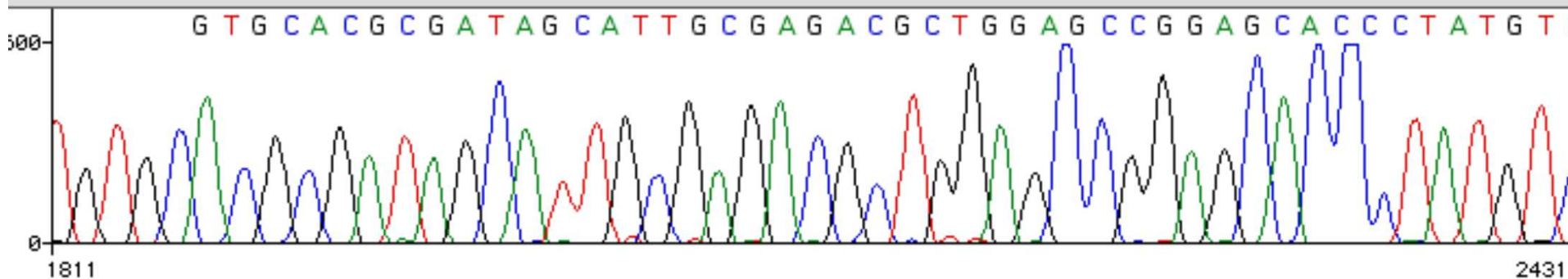
JT Hair Demo 9/21/00

	80	90	100	110	120	130
JT HAIR C1 6/9/00 06	GTGCACGC	GATAGCATTG	CGAGACGCTG	GAGCCGGAGC	ACCCTATGTC	GCAGTATCTG TC
JT HAIR D2 6/9/00 06	GTGCACGC	GATAGCATTG	CGAGACGCTG	GAGCCGGAGC	ACCCTATGTC	GCAGTATCTG TC
	*-----					
ANDERSON 73-340	ATGCACGC	GATAGCATTG	CGAGACGCTG	GAGCCGGAGC	ACCCTATGTC	GCAGTATCTG TC
	140	150	160	170	180	190
JT HAIR C1 6/9/00 06	TTTGATTTC	CTGCCTCATC	CTATTATTTA	TCGCACCTAC	GTTCAATATT	ACAGGCGAAC AT
JT HAIR D2 6/9/00 06	TTTGATTTC	CTGCCTCATC	CTATTATTTA	TCGCACCTAC	GTTCAATATT	ACAGGCGAAC AT

ANDERSON 73-340	TTTGATTTC	CTGCCTCATC	CTATTATTTA	TCGCACCTAC	GTTCAATATT	ACAGGCGAAC AT



2



Historic Identifications

- **Tsar Nicholas II (FSS, AFDIL, RAS)**
- **Anna Anderson Manahan - not Anastasia**
- **Jesse James (Melton/Stoneking)**
- **Vietnam Unknown Soldier (AFDIL)**

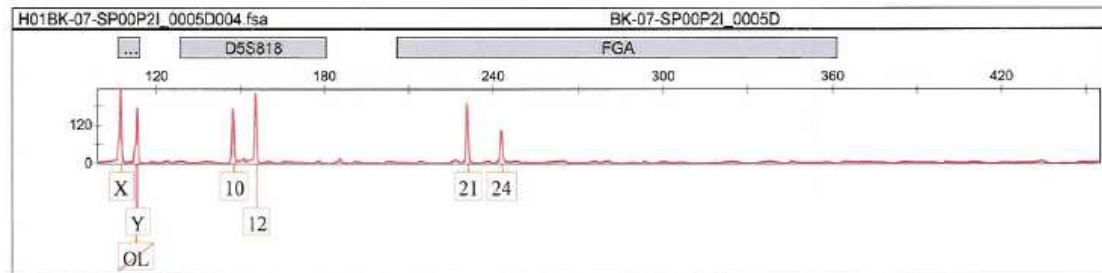
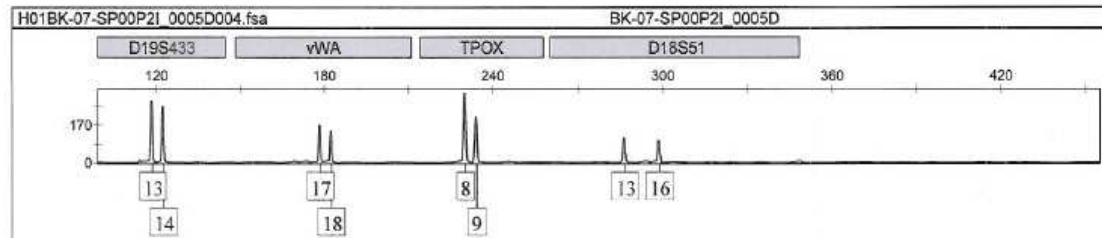
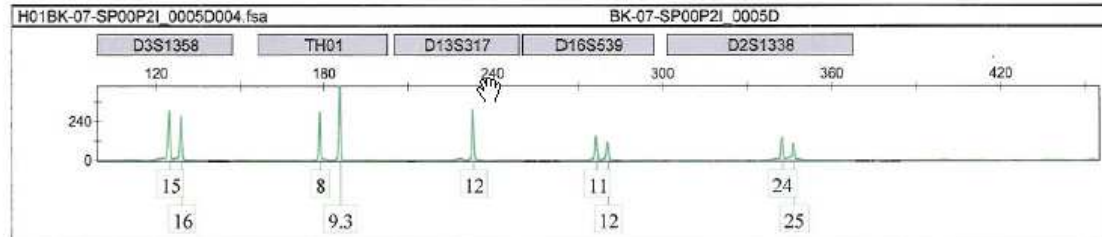
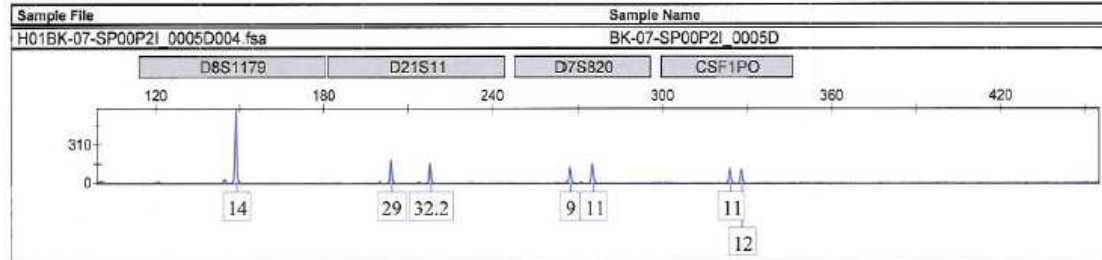
Limits of DNA Testing

- **DNA identifies donor - not necessarily the perpetrator**
- **DNA does not tell us when evidence was deposited at crime scene--only that it is there**
- **DNA does not tell us how evidence got there**
- **DNA does not tell us who else might have been present when DNA was deposited at scene**

DNA from Twin - RS

Applied Biosystems
GeneMapper ID v3.2.1

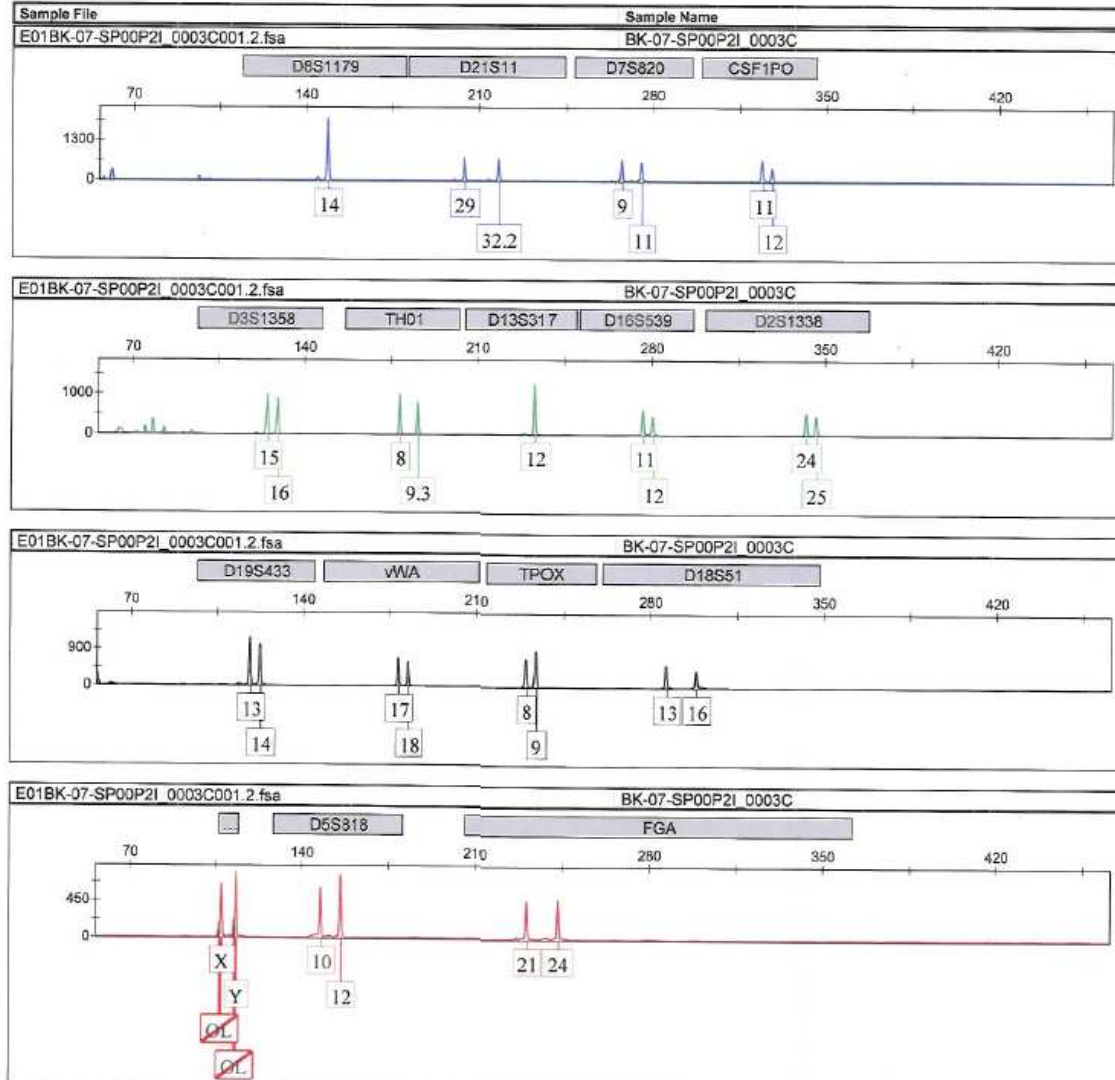
BK-07-SP00P11 GM 072407 SP -3



DNA from Twin - TS

Applied Biosystems
GeneMapper ID v3.2.1

BK-07-SP00P1I GM 072407 SP -3



The image shows the exterior of a modern, multi-story building with a light-colored facade. A large, circular, louvered vent is visible on the upper left. The building features a glass-enclosed entrance area with a dark frame. The number '1001' is visible on the glass above the entrance. There are several potted plants and a small tree in the foreground. The sky is bright and clear.

**California Department of
Justice**
Jan Bashinski DNA Laboratory



BFS DNA Lab Programs

- **Criminal Casework**
- **Convicted Felon DNA Data Bank**
- **COLD HIT Program**
- **Method Development and Training**
- **Post Conviction Testing**
- **Missing Persons DNA Program**
- **Mass Disasters**
- **Human Rights Violations**



Convicted Offender DNA Data Bank



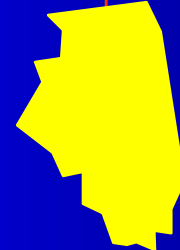
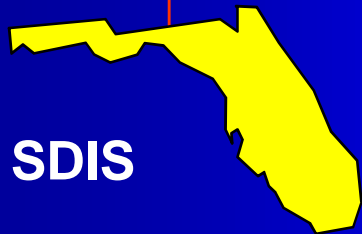
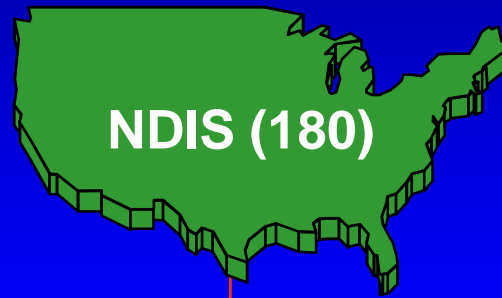
- Proposition 69 has greatly expanded pool of offenders
- At ~1,900,000 qualifying profiles – CA largest State Database
- Nationally, “CODIS” has
> 10 million offender profiles,
>400,000 crime scene profiles
- Familial searching

CODIS:



- **Combined DNA Index System**
- **Local, State and National databases tied together**
- **Various indices:
convicted offender, forensic unknown, unidentified remains,
family references...**

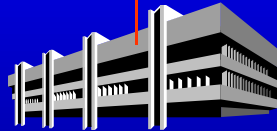
Levels of CODIS



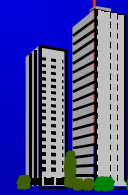
LDIS
22 in CA, i.e. :



Oakland PD



Fresno DOJ



LASD

Proposition 69

- **Passed by the California voters in the November 2004 election, effective 11/3/04**
- **Changed the primary DNA collection method to buccal samples**
- **Prior to Prop 69, the Databank had received a total of 343,000 samples since its inception in 1989.**
- **Over 1.5 million buccal samples collected since Proposition 69 passed.**



The life of a sample at the DOJ Databank



Kit Breakdown





Kit Breakdown cont.





Kit Breakdown cont.

