Evolution of Forensic DNA

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Life Technologies
DNA’S SCIENTIFIC
PATH FORWARD

1953
DNA discovered by James Watson and Francis Crick
Watson, Crick and Wilkins win Nobel Prize in 1962

1984
Sir Alec Jeffries develops methods of the DNA fingerprinting and DNA profiling
Jeffries knighted by Queen Elizabeth II in 1994

Early 1990’s
STR testing begins to replace RFLP testing methods. STR testing is quicker, and is better with degraded and small samples – BIRTH OF DNA DATABASES

Dr. Paul Ferrara in Virginia leads the way for DNA database programs in US
A look back... 10 years ago

- 9/11 WTC Attacks
- CSI only in 2\textsuperscript{nd} Season, but surging in popularity
A look back... 10 years ago

- Fragmented, Inefficient Forensic DNA Workflow
  - Manual Processes
  - Quantiblot
  - GeneScan®/Genotyper® Software

- Minimal Use of Y-STRs

- Limited options for analyzing heavily degraded samples

- Global DNA Databases in their infancy (except for the UK)
Common beliefs I encountered...

- “Automation cannot work for forensic DNA casework.”
- “Manual Organic Extraction is the only trusted method for casework.”
- “Automated data analysis with advanced software (e.g. expert systems) is impossible.”
- “Analysis of lesser felonies i.e. property crimes is not practical.”
- “Large STR multiplexes are not well suited for casework. Sensitivity and robustness can suffer with the addition of more loci.”
Increased Discrimination and Sensitivity/Robustness

\( \sim 1 \text{ in } 10^{18} \) (quintillion)

Bone sample amplified using the Identifiler\textsuperscript{®} Kit

Bone sample amplified using the NGM\textsuperscript{™} Kit

Mean Peak Height (RFU)
Today

Increased Integration and Efficiency......

Ease of Use  Success with Difficult Samples  Simplified Interpretation  Higher Throughput  Streamlined Workflow
Streamlined Workflows for Single Source Samples

A COMPLETE SET OF DIRECT AMPLIFICATION WORKFLOWS

**COLLECT SAMPLES**

**Treated Paper**
- Punch 1.2 mm Disc
- Add PCR Reagents

**Untreated Paper**
- Add Prep-n-Go™ Buffer
- Punch 1.2 mm Disc
- Add PCR Reagents

**Buccal Swabs**
- Lyse Swab in Prep-n-Go™ Buffer
- Transfer lysate into well containing PCR Reagents

**AMPLIFY**

**ELECTROPHORESE**

**Prep-n-Go™ Buffer**
Improved Efficiency for Casework Samples

Sample Preparation | Quantitation/Normalization | Amplification | Detection | Analysis

Time to Result (hrs/per 13 samples)

1-3 | 2 | 1.5 | 0.55 | 1-2

Total Time to Result = ~6-9 hrs
Evolution of STR Technology

1996 | AmpF™STR® PCR Amplification Kits | 2012
---|---|---
Triplexes | Larger Multiplexes | Enhanced Capability | Optimized for Application
Blue | Profiler® | SEfiler™ Plus | NGM™
Green | Profiler Plus® | Yfiler® | NGM SElect™
| Profiler Plus® ID | MiniFiler® | NGM SElect™ Express
| COfiler® | | | Identifiler® Plus
| SGM Plus® | | | Identifiler® Direct
| Identifiler® | | | 
| SEfiler™ | | | 

A comprehensive product portfolio, developed, validated and manufactured according to stringent performance standards specifically for use on forensic samples
UNITED STATES LEGISLATIVE WAVE

ALL CONVICTED OFFENDER LEGISLATION
1999 – 5 states
2003 – 27 states
2008 – 42 states
2011 – 50 states

ARRESTEE LEGISLATION
1999 – 1 state
2006 – 7 states
2011 – 26 states
THE WORLD ADOPTS DATABASING
44 COUNTRIES, OVER 40 MILLION OFFENDER SAMPLES

Australia
Austria
Barbados
Belarus
Belgium
Brazil
Canada
Chile
China
Croatia
Cyprus
Denmark
Estonia
Finland
France
Germany
Hong Kong
Hungary
Iceland
Israel
Japan
Jordan
Kuwait
Latvia
Netherlands
New Zealand
Macedonia
Norway
Panama
Poland
Portugal
Qatar
Russia
Slovenia
Slovakia
Singapore
South Korea
Spain
Sweden
Switzerland
Taiwan
United Arab Emirates
United Kingdom
United States
INTERPOL HIT EXEMPLIFIES FUTURE OF INTERNATIONAL MATCHING

3 rapes in 2004 linked by COJ CODIS
Suspect identified – flees country – alias assumed
Profile sent to Interpol in 2009

Suspect arrested for rape in 2009 in Austria
DNA profile sent to Interpol Gateway and matches profile in CODIS

Ali Achekzai extradited to California
Convicted on all counts
# Global Databases: Locus Overview

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Loci in **bold** contained in either the Identifiler® or NGM SElect™ Kits.
The World Is Positioning For Explosive Growth of DNA Databases

“Currently there are about 35 trained analysts for DNA profiling [in all of India]. The country will need about 1,100 analysts [over the next 10 years].”

✓ INDIA
✓ INDONESIA
✓ BRAZIL (LEG. PASSED)
✓ PAKISTAN
✓ NIGERIA
✓ RUSSIA (LEG. PASSED)
✓ MEXICO
✓ VIETNAM
✓ TURKEY
✓ THAILAND
✓ ITALY (LEG. PASSED)
✓ SOUTH AFRICA
✓ COLOMBIA
✓ ARGENTINA
✓ KENYA
✓ PERU
✓ SAUDI ARABIA
✓ MALAYSIA (LEG. PASSED)
Increasing Casework Backlogs

- Backlogs increasing with increased submissions
- Samples increasing in complexity
- Shortage of trained analysts
- Validation and implementation barriers

To help address these and other challenges, we want to provide more than just core technologies

HID Service Solutions

- **HID Professional Services Program (HPS)**
  - Delivery of internal validation programs and/or performance checks on any Applied Biosystems HID product
  - Robotic Validation/Implementation Support

- **“HID University” Training Programs**
  - Comprehensive suite of training courses designed to provide continuing education to forensic DNA analysts

- **LIFE Center for Forensic Excellence at UNTHSC**
  - Helps developing nations to rapidly establish world-class database laboratories through a unique certificate training program

Advisory Consulting  Complete Laboratory Integration and Validation  Analyst Training Programs  On-site Support and Training
Looking ahead...
Potential PGM™ Human Identification Applications

Mitochondrial DNA Sequencing
Missing Persons, DVI

Phenotypic SNPs for Investigative Leads
Eye Color
Hair Color
Facial Reconstruction

SNP Genotyping
Paternity, Mixtures, Missing Persons, DVI
Upcoming Life Technologies Webinar hosted by Forensic Magazine

Ion Torrent™ Semiconductor Sequencing for Forensic Applications
(Thurs, Feb 14th)

Next Generation Sequencing (NGS) has the potential to vastly expand the capabilities of human identification laboratories, enabling simultaneous analysis of a wide range of forensically relevant genetic markers to aid in resolution of challenging cases.

The Ion Personal Genome Machine® (PGM™) Sequencer is an integrated semiconductor device enabling high throughput non-optical genome sequencing. It delivers the fastest run times, at the most affordable price, of any next-generation sequencer. High accuracy and low reagents put the Ion PGM™ Sequencer in a class of its own and makes next-generation sequencing more accessible to scientists around the world.

Join this webinar for an overview of this exciting technology as well as the latest human identification studies and protocol development underway at Life Technologies and collaborators sites. In addition, Dr. Walther Parson from the Institute of Legal Medicine in Innsbruck, Austria will share results from his laboratory’s recent work sequencing whole mitochondrial genomes using the Ion PGM Sequencer.

Lisa Calandro
Director of Product Management
Life Technologies

Dr. Walther Parson
Institute of Legal Medicine
University of Innsbruck, Austria

Click to Register
What technology developments will have the most impact on our field over next 5-10 years?

A. Integration & efficiency improvements to current STR/CE workflow
   - improved data recovery in much less time

B. Improved mixture interpretation capability
   - via software, analysis platform or both

C. Application of next gen sequencing
   - additional information from forensic samples

D. Rapid, “field deployable” testing systems
   - DNA results generated outside the crime lab

E. Integration of DNA profiling with other biometrics (i.e. fingerprints)
   - creation of more powerful intelligence databases
21st Century Crime Fighting...

DNA profiles of all felony arrestees loaded to an investigative database.

DNA used to investigate all types of evidence.

Rapid turnaround time of DNA evidence.

Data shared globally across national databases.
Our Role

Enable Forensic Labs to Do More with Less

• Increase efficiency with next-gen products and workflow integration (more info, less time)

• Improve performance on difficult and compromised samples (more info, less sample)

• Be a true systems integration partner (leveraging HID Professional Services)

• Enable use of latest technologies for forensic and biometric applications
Thank You

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