The Arizona DPS Rapid DNA Program

Vince Figarelli, Superintendent
Arizona Department of Public Safety Crime Laboratory
vfigarelli@azdps.gov
The Arizona DPS Rapid DNA Program

- Lots of questions....
  - What the $#%#! are you doing ?!?!
The Arizona DPS Rapid DNA Program

- Lots of questions....
  - What the $*#%! Are you doing ?!?!?
  - Does the FBI know about this?
# Two Phases of AZ Rapid DNA Program

## External
- Officers Trained to operate the RapidHit 200
- Officers Analyze samples for direct comparison or search against AZ DNA Database (AZ DB)

## Internal
- Database Unit Hit Confirmations
- Database analysis of Arrestee and Convicted Offender Samples
- Forensic Casework Knowns
The Arizona DPS Rapid DNA Program

- What this talk is....
  - Overview of the External Program
    - Training and network setup
The Arizona DPS Rapid DNA Program

- What this talk is....
  - Overview of the External Program
    - Training and network setup
- What this talk isn’t....
  - Cost Benefit Analysis
  - Review of the validation
Rapid DNA External Uses

- Upload of Arrestee and Convicted Offender profiles at intake to a database (CODIS or other database)
- Provide Investigative Leads to Law Enforcement from forensic samples
- Identification of Victims
- Identification of apprehended individuals (comparison to forensic unknowns)
Rapid DNA External Uses

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Arizona DNA Database Network

Why?

- Quickly provide IL’s to Law Enforcement
- Large number of backlogged DNA cases
  - >4,000 Property Crimes
- If we didn’t do it, someone else (LEA’s) would
Arizona DNA Database Network

- IntegenX RapidHit 200’s in three AZDPS locations
  - Colocated with Phoenix, Tucson, and Flagstaff Laboratories
  - Accessible to officers
- Connected to the AZ DB secure, closed network
- SmallPond software housing the AZ DB
- Synchronized with AZ SDIS
1. AZDPS will be periodically export CODIS Offender, CODIS Evidence, Suspect and Staff profiles. These will be used to keep the SmallPond Ponds synchronized with the CODIS database.

2. The SmallPond Import Agent will be configured to monitor the 5 network folders and import profiles into their respective Ponds.

3. SmallPond automatically matches profiles within a Pond

4. SmallPond automatically cross-matches all Ponds in a Pool

5. SmallPond automatically generates match notifications.
Arizona DNA Database Network

- RH200 profiles are placed in the Law Enforcement Pond
- Samples in all “Pooled” ponds are searched against each other as profiles are added
- Profiles do not get copied or moved between ponds
Arizona DNA Database Network

- Flexible search control
- Additional ponds can be added to the same pool or a different pool can be established
- Can Link to other external ponds
  - MOU required
Arizona DNA Database Network

- Instrument & Software
  - IntegenX RapidHit 200
  - SmallPond Software
  - Custom search interface for IL information
RapidHit 200 Instrument
RapidHit 200 Instrument

- Cost
  - $270,000 for the RapidHit 200
  - $1,750 for each set of cartridges
  - $350 per sample for 5 samples
RapidHit 200 Instrument
RapidHit 200 Instrument

- SAMPLE CARTRIDGE
  - 4 samples
  - Reagent reservoirs
  - PCR premix
  - Reaction chambers
RapidHit 200 Instrument

CONTROL CARTRIDGE

- 1 sample
- 1 allelic ladder
- 1 positive control
- 1 negative control

Reagent reservoirs

PCR premix

Reaction chambers
DNA Extraction from sample swabs

- Extraction solution in the reservoirs is MOVe’d to sample swabs and agitated with air

- Lysed cells are pumped from the sample wells through the chip to the bead chamber, which is pre-loaded with paramagnetic beads
RapidHit 200 Instrument

DNA extraction processes

DNA capture on magnetic beads

- Bead chambers are pre-packed with beads
- Lysis solution is mixed with the beads
- Beads/DNA are engaged by magnets
- Lysis solution is transferred to waste receptacle

Two bead washes with ethanol

- Ethanol pumped into bead chamber from each of two reservoirs
- Agitation by air
- Wash solution dumped to waste receptacle
RapidHit 200 Instrument

DNA extraction processes

PCR reaction preparation
- Washed DNA is transferred to the PCR reaction chamber on beads
- PCR premix is added to the reaction chamber

PCR amplification
- Thermal cyclers engage
- Amplification 30 cycles, approx 15 minutes
RapidHit 200 Instrument

Rapid DNA – a comprehensive microfluidic solution

Electrophoresis
- Diluted reaction fills the cathode, stops for a 15 second electroinjection at 4 kV, and quickly gets flushed with copious amounts of buffer
- Electrophoresis occurs at 9 kV for approximately 20 minutes
- Capillary length is 26 cm to the detection window
### Ponds

**Knowns**
- This pond holds statewide knowns.
- Processed Profiles: 522,041
- Unprocessed Profiles: 0
- Comparisons: 136,263,141,820
- Matches: 0

**Suspects**
- This pond holds statewide suspect profiles.
- Processed Profiles: 10,028
- Unprocessed Profiles: 0
- Comparisons: 50,275,378
- Matches: 0

**Rapid DNA**
- This pond holds Rapid DNA samples.
- Processed Profiles: 0
- Unprocessed Profiles: 0
- Comparisons: 0
- Matches: 0
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<thead>
<tr>
<th>Case Id</th>
<th>Status</th>
<th>Entry Date</th>
<th>Criminal Offense</th>
<th>Total</th>
<th>Not Yet Sent</th>
<th>In Lab</th>
<th>No Hit</th>
<th>Hit</th>
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<td>05/02/2014</td>
<td>14-54. Breaking or entering buildings</td>
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**Items per page:** 20
# Matches

You can review all matches that have been found for your Pond on this page.

The system will automatically search for a match whenever a new DNA Profile is added. It uses the Pond's Match Stringency parameters when performing the match. Notifications are automatically sent when new matches are made.

<table>
<thead>
<tr>
<th>Match Date/Time</th>
<th>Searched Profile</th>
<th>Found Pond</th>
<th>Found Profile</th>
<th>Exact Match?</th>
<th>RMP</th>
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<td>4/24/2014 4:33:51 PM</td>
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## Match Detail

### Match Statistics

<table>
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<tr>
<th>Field</th>
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<tr>
<td>Pond Name:</td>
<td>Rapid DNA</td>
<td>Rapid DNA</td>
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<tr>
<td>Profile ID:</td>
<td>3065967</td>
<td>3064828</td>
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<td>Specimen ID:</td>
<td>2014-05-02-0001</td>
<td>9712e2f-0399-4df7-a2db-8ca93a822b7d</td>
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<tr>
<td>Specimen Source Known?</td>
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<td>☐</td>
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<tr>
<td>Locus Data Partial?</td>
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<td>☐</td>
</tr>
<tr>
<td>Is Mixture?</td>
<td>☐</td>
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### Locus Data:

<table>
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<th>Locus</th>
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Arizona DNA Identification System
Specimen Lookup

Specimen ID: [Redacted]

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<tr>
<th>First Name</th>
<th>Middle</th>
<th>Last Name</th>
<th>Gender</th>
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<tr>
<th>DOB</th>
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Back to the Search Page
Arizona DNA Database Network

Officer Training
Arizona DNA Database Network

Officer Training

- 10 officers
- 3 RH200 Instruments
- Four day training class
Arizona DNA Database Network

Officer Training

- Presumed single source samples
  - Blood
  - Saliva
- Must be enough sample for follow up analysis in the lab
1. Officer collects sample (saliva/blood from known or presumed known).

2. Officer adds Specimen (and Case) to SmallPond. Specimen ID must be unique.

3. Officer adds Specimen to RapidHIT. Specimen ID must match used in step 2.

4. RapidHIT processes Specimen and generates a Profile file in the output directory. (90 minutes)

5. SmallPond monitors RapidHIT Profile generated by RapidHIT and automatically adds the new profile to the SmallPond RapidHIT Results Pond.

6. SmallPond matches the newly added profile against the profiles in the CODIS Offender CODIS evidence and RapidHIT Results Pond and generates match notifications if a match is found.

7. Officer reviews SmallPond My Cases page to see Hit/Ne Hit status of Specimen.

8. Officer uses StaCS to get name of offender.

9. E-Mail/Text Notification is sent to officer.

10. 90 minutes.
Performance Objectives

At the completion of this course the student will demonstrate:

- An understanding of basic biology
- An understanding of basic DNA analysis
- An understanding of identification of appropriate samples for analysis on the RapidHit 200 instrument
Final Outcome of Course

Students successfully completing the course will be qualified to use the RapidHit 200 instrument and SmallPond database as an investigative tool to develop potential ILs.
PO 1 – Basic Biology

- Structure of cells
  - Protected by cell membrane
  - Filled with cytoplasm
  - Made up of numerous organelles with specific functions
  - Two specific organelles important for DNA analysis
    - Nucleus
    - Mitochondria
PO 1 – Basic Biology

Cell Structure

- Cilia
- Lysosome
- Centrioles
- Microtubules
- Golgi apparatus
- Smooth endoplasmic reticulum
- Mitochondrion
- Rough endoplasmic reticulum
- Cell membrane
- Cytoplasm
- Nucleolus
- Chromatin
- Ribosomes
- Nuclear membrane
PO 5 – DNA Databases

- CODIS
  - Major Indices
    - Offender – sample collected from someone that has committed a felony, is on parole, or is required by law to give one
    - Forensic – sample attributed to a crime scene
    - Arrestee – sample collected from a person arrested for a qualifying crime
The Arizona DPS Rapid DNA Program

- First Case
  - One vehicle accident with two unrestrained passengers
  - Blood on airbag
Airbag
Airbag
The Arizona DPS Rapid DNA Program

- Future Plans....
  - Additional Training Classes
  - Test Case
  - Familial Searching (SmallPond)
The Arizona DPS Rapid DNA Program

Acknowledgements

- Scott Rex, DNA Lab Manager
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- Jennifer Kochanski, DNA Property Crimes Supervisor
- Mark Smith, Lab Information Systems Administrator
- Randy Johnson, Assistant Superintendent
- Dave Duplissa, DNA Database Supervisor/Tech Lead
- Lt. Col. Jeff Raynor, Assistant Director DPS (my boss)