NIJ Forensic Science Technology Working Group Operational Requirements, 2013

Updated based on discussion at the Forensic Science TWG meeting held November 13-14, 2013

Technology Working Group Operational Requirements *Updated Fall 2013*	**Scientific Research**	**Technology Development**	**Policy**	**Assessment & Evaluation**	**Dissemination &/or Training**	**Other**	**Forensic Discipline**
Software tools for mixture interpretation of casework samples.				x	x		Forensic Biology/ DNA
Software tools for improving DNA data quality & enhancing analyst productivity (e.g. software to 'connect' & automate existing systems).						x	Forensic Biology/ DNA
Ability to differentiate, physically separate, and selectively analyze DNA and/or cells from multiple donors or multiple tissue/cell types contributing to mixtures.	x	x					Forensic Biology/ DNA
Better methods to physically separate sperm from epithelial cells.	x	x					Forensic Biology/ DNA
Ability to simultaneously detect location and identify type of biological materials/fluids with minimal destruction to evidence samples at crime scenes or from evidence taken from crime scenes.	x	x					Forensic Biology/ DNA
Ability to identify the original body fluid/cell type at the time of genetic analysis.	x	x					Forensic Biology/ DNA
Optimization of DNA evidence collection techniques and/or devices.	x	x		x			Forensic Biology/ DNA
Increased DNA recovery of elution and/or extraction methods.	x	x					Forensic Biology/ DNA
Ability to differentiate and "tag" a cell, identify and associate the biological source and other information, and follow the "tag" through to profile generation.	x						Forensic Biology/ DNA

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Better materials to reduce DNA loss during transfer/storage. Better understanding of stability during storage and compatibility of current/new consumables/reagents with downstream processing methods	x	x		x			Forensic Biology/ DNA
Better information sharing and understanding of what processes, protocols, and overall workflows are being used in the field.				x	x		Forensic Biology/ DNA
Alternate instrumental platform(s) to perform genetic typing.	x	x		x			Forensic Biology/ DNA
Better methods for quantitation.				x			Forensic Biology/ DNA
Preliminary differentiation to determine most probative sample(s) for DNA analysis.	x	x		x			Forensic Biology/ DNA
Ability to determine the age of a biological stain.	x						Forensic Biology/ DNA
Ability to successfully generate DNA profiles from forensic type samples in a fully automated sample-in-answer-out system.	x	x		x			Forensic Biology/ DNA
Automated test for definitive confirmation of presence of sperm/semen.	x	x		x			Forensic Biology/ DNA
Automated method(s) to concentrate DNA extracts and accurately and reliably transfer sample with minimal loss.	x	x		x			Forensic Biology/ DNA
Better understanding of how substrates and reagents used during crime scene investigations and/or upstream forensic analyses, affect downstream DNA analysis.				x			Forensic Biology/ DNA
Ability to identify biological material that is invisible to the eye (with or without aid of alternate light sources), in sufficient quantity for downstream DNA analysis.	x	x					Forensic Biology/ DNA

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Novel methods for DNA profiling (including non-PCR based methods for performing forensic DNA analysis).	x						Forensic Biology/ DNA
Method or device to remove contaminants from commercial products (consumables/reagents).						x	Forensic Biology/ DNA
Ability to identify and repair damaged DNA.	x	x		x			Forensic Biology/ DNA
Ability to isolate DNA with no or minimal destruction to the physical evidence item.	x	x		x			Forensic Biology/ DNA
Better understanding of the mechanisms involved in elements/metals that interfere with DNA analysis and development of methods to analyze DNA exposed to such elements/metals.	x						Forensic Biology/ DNA
Y-STR database coordination and management.			x				Forensic Biology/ DNA
Y-STR mixture interpretation and statistical analysis.		x					Forensic Biology/ DNA
The ability to determine physical characteristics from DNA evidence.	x	x					Forensic Biology/ DNA
Increase in success rate for generating DNA profiles from compromised (i.e. damaged) DNA evidence.	x	x		x			Forensic Biology/ DNA
Evaluation of Next Generation Sequencing technologies for forensic applications.			x	x			Forensic Biology/ DNA
Tools for mixture interpretation of data produced on non-standard genetic markers (e.g., mtDNA, Y chromosome markers, X chromosome markers, SNP markers, and other non-CODIS markers).	x	x					Forensic Biology/ DNA

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Improved sample processing time for DNA analysis of questioned samples.	x	x					Forensic Biology/ DNA
Increased discriminatory power using genomic information other than human DNA (e.g., microbiomes).	x	x					Forensic Biology/ DNA
Improved ability to identify distant relatives.	x	x					Forensic Biology/ DNA
Further investigation into the utility of SNP haploblocks.	x	x					Forensic Biology/ DNA
Multiplex kits for mitochondrial DNA analysis.	x	x					Forensic Biology/ DNA
X chromosome testing methods.		x		x			Forensic Biology/ DNA
Universal quant kit (methods to determine more quantitative information from biological evidence).		x		x			Forensic Biology/ DNA
Mitochondrial DNA population databases for whole mitochondrial genomes.		x	x				Forensic Biology/ DNA
Single Nucleotide Polymorphism (SNP) population database.				x			Forensic Biology/ DNA
Ability to differentiate identical twins.	x	x					Forensic Biology/ DNA
Automated sperm searching and identification.				x			Forensic Biology/ DNA
Species determination.				x			Forensic Biology/ DNA
Additional polymerases for improved PCR amplification.	x	x		x			Forensic Biology/ DNA

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Long term storage of DNA extracts.	x	x		x			Forensic Biology/ DNA
Single Cell DNA analysis (i.e. single cell PCR).	x	x					Forensic Biology/ DNA
Better understanding of the mechanisms involved with and development of methods for overcoming inhibition	x	x					Forensic Biology/ DNA
Better dissemination strategies for current research and technology, such as a centralized repository, especially of SOPs, to avoid duplication of effort in method development/problem solving and in house validation/verification.		x			x		Trace Evidence, Controlled Substances, Toxicology
Guidelines for: validation of methods, performance of SOPs, verification/validation of instruments.			x		x	x	Trace Evidence, Controlled Substances, Toxicology
Standards/new reference materials for use in forensic labs, especially standards for comparison (to include parent drugs and metabolites).			x		x		Trace Evidence, Controlled Substances, Toxicology
Clearly delineated cost benefit or other improvement of new technology or technology being repurposed for forensic use, including comparison of spectra between legacy and new technology/instruments or those being used for forensic purposes. Training on new instrumentation for laboratories.			x	x	x		Trace Evidence, Controlled Substances, Toxicology
Faster/easier way to separate isomers or metabolites of commonly encountered drugs on widely used instrumentation such as GC/MS, LC/MS and HPLC. Ability to differentiate similar drugs within a category/family (e.g. synthetic cannabinoids).	x						Controlled Substances, Toxicology
Forensically-relevant approaches for statistical interpretation of evidence (e.g. trace, postmortem toxicology levels). A better understanding of the value of the data.	x				x		Trace Evidence, Toxicology

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Effective , faster, more efficient streamlined processes in sample detection, collection, handling and analysis.	x	x					Trace Evidence, Controlled Substances, Toxicology
Support for examinations that require visual interpretation in conjunction with instrumentation. Methods of analysis using instrumentation for evaluation of evidence that is currently evaluated through visual inspection. Objective approach for interpretation of evidence to promote standardization across laboratories.	x	x					Trace Evidence
Better understanding within the rest of the criminal justice system, and further studies of the discrimination power, of microscopical exams used individually or in tandem with other scientific techniques/disciplines.	x				x		Trace Evidence
Construction of new and continuous updating of existing databases for new materials (eco-fibers) to make information available for trace analysts to make it easier for comparison and analysis.		x				x	Trace Evidence
Advancement of application/development pertaining to emerging instrumentation or current instrumentation being applied to method development (e.g., microspectrophotometer, using the second derivative, thermal analysis coupled with FTIR or GC-MS, Fast-GC and 2D-GC).		x		x	x		Trace Evidence, Controlled Substances, Toxicology
Improved discrimination of polymers and polymer products.	x						Trace Evidence
Increase understanding of how environmental factors can affect trace evidence.	x						Trace Evidence
Identification and development of best practices for material (e.g. drug, explosives, chemical) identification among emerging technologies. Evaluation of different instrument platforms for different commonly encountered materials.	x	x		x			Trace Evidence, Controlled Substances
Consistency in scheduling/legislation of emerging drugs.			x		x		Controlled Substances

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Unbiased evaluation of (evidential) Breath Alcohol Concentration instrument platforms for dissemination on a national scale. Guidelines for oversight, calibration, instrument performance, user proficiency/recertification, etc.				**x**	**x**		Toxicology
Sufficient qualified personnel trained on difficult/non-robust instrumentation. Guidelines for call for bids to include specifics of training.						**x**	Toxicology
Research studies on correlation of blood and oral fluid values, especially in regards to "driving under the influence of drugs" interpretation, including differences between point of contact devices and lab confirmation.	**x**						Toxicology
Further research studies to examine drug (esp. prescription drugs) levels pre and post-embalming. Assessing cause of death if toxicology not completed prior to embalming.	**x**						Toxicology
Studies on the recognition, selection, recovery and significance of evidence at crime scenes, to include studies of: a. Procedures b. Technologies c. Statistics (e.g. percentage hair recovery at a crime scene)	**x**	**x**	**x**	**x**			Crime Scene Examination
Further research studies to determine cause and manner of death in infants and children.	**x**						Forensic Pathology
Development of a system (or expansion of current data systems) with weighting capability for antemortem and postmortem comparisons with the goal of providing a ranked list of "best matches" in forensic anthropology casework.		**x**					Forensic Anthropology, Medicolegal Death Investigations
Further studies on capture and preservation of evidence on cadavers at or from the scene since probitive evidence may be lost during the handling, transport and alteration of the body from scene recovery to morgue.	**x**	**x**		**x**	**x**		Medicolegal Death Investigations

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Further development of effective biometric (e.g. fingerprints and facial recognition) capture techniques or devices for decedents, both at the scene and in the morgue.		**x**		**x**			Medicolegal Death Investigations
Further studies to update outdated anthropological morphometric and growth and development datasets, specifically applicable to assessment of biological profile.	**x**			**x**			Forensic Anthropology
Further research studies on force measurement and modeling of injuries, to include bone tissue and soft tissue; applicable to infants, children and adults.	**x**						Forensic Pathology
Further studies of innovative, useful and practical approaches for precise estimation of time since death.	**x**	**x**		**x**			Medicolegal Death Investigations
Further development of technologies, (e.g. UV, IR, chemical imaging), to visualize evidence and injuries on bodies, both living and deceased.		**x**					Crime Scene, Medicolegal Death Investigations, Forensic Pathology
Further research into the utility of advanced imaging technologies in postmortem examination, and assessing the cost-benefit of the imaging results with the financial burden of purchasing such technologies.	**x**			**x**		**x**	Forensic Pathology
Further studies to better understand bitemark analysis and techniques in bitemark interpretation and documentation.	**x**			**x**			Forensic Odontology
Further studies in geophysics (soil types, ground water) to determine best geophysical approach to locating clandestine graves.	**x**			**x**	**x**		Forensic Anthropology, Medicolegal Death Investigations

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Further studies to assess the impact of bias in forensic science (any type).	x						Multidisciplinary Forensic Disciplines
Further studies to better understand the toxicology values obtained from postmortem samples given the issues of postmortem redistribution, metabolism, degradation, temperature change, preservation.	x						Toxicology
Further research and development of rapid and inexpensive mass screening methods at autopsy of biological specimens for multiple drug classes to determine the necessity for confirmatory testing.	x	x					Toxicology
Further technological developments in interoperability and knowledge-sharing easily across distances.		x	x			x	Multidisciplinary Forensic Disciplines
Further research studies to investigate population frequencies of traits (e.g. anthropological, friction ridge, radiological, pathological, odontological) to quantify an identification.	x						Forensic Anthropology
Development of a mechanism to document and identify deceased undocumented border crossers within the United States.		x				x	Forensic Anthropology, Medicolegal Death Investigations
Technological developments that allow for rapid and accurate preliminary testing at a crime scene. Results of this testing have the capability to guide the direction of the investigation prior to traditional confirmatory laboratory testing.		x			x		Crime Scene Examination
Expansion of the use of current technologies (e.g. laser scanning, CT, 3-D printing, confocal microscopy, morphometric analysis) for the documentation and collection of 3D information to include crime scenes and evidentiary materials.		x		x			Crime Scene Examination

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Better understanding of the cognitive decision-making processes involved in pattern recognition, as applied to forensic identification.	x						Impression & Pattern
A foundational basis for assigning scientifically valid values and conclusions to particular comparisons (e.g., identification/exclusion).	x						Impression & Pattern
Better understanding of how the processes of evidence collection, examination, analysis, verification, and technical review contribute to overall error rate.	x		x	x			Impression & Pattern
Statistical data (e.g., frequency of class characteristics, rarity, permanence and reproducibility of pattern detail) to support qualified and definitive examiner conclusions.	x						Impression & Pattern
Adequate materials property data inputs that can be used for accurate computer fire models.	x			x			Fire & Arson Investigation
Statistical analyses of intra- and inter-person handwriting variation.	x						Questioned Documents
Establishment of a national footwear reference collection database of known outsoles and crime scene impressions.		x				x	Footwear
Better understanding of how blood interacts with fabrics to influence bloodstains.	x						Bloodstain Pattern Analysis
Improved techniques and devices for the collection and development of evidence, for lab or field use.	x	x					Impression & Pattern
Evaluation of the effects of sequential evidence processing on the integrity of downstream analysis (particularly DNA).	x		x	x			Impression & Pattern
Identification of best practices for the verification and technical review phases of examination.			x	x	x		Impression & Pattern

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Comparative evaluation of existing evidence processing reagents and techniques.			x	x			Impression & Pattern
Research to characterize the response of electrical systems to fire conditions, for aiding in the reconstruction of fire events.	x	x					Fire & Arson Investigation
Software to assist with the processing and categorization of elements in questioned document evidence.		x		x			Questioned Documents
Better understanding of the effects of pattern, directionality and surface treatments on the formation of bloodstain patterns on fabrics.	x						Bloodstain Pattern Analysis
Research on the kinematics of handwriting.	x						Questioned Documents
Studies of the variability of the shape of the foot and the resulting shoeless impression (barefoot and socked).	x						Footwear
Toolmarks research on the attribution of illicitly manufactured pharmaceutical tablets.	x						Toolmarks
Methods for linking questioned document evidence to printers (especially inkjet).	x	x					Questioned Documents