The Conference and Event Center
NIAGARA FALLS

October 17th-21st
2022

The Sheraton
NIAGARA FALLS

NEAFS.ORG/NEAFS-ANNUAL-MEETING

NORTHEASTERN ASSOCIATION OF FORENSIC SCIENTISTS

2022 ANNUAL MEETING

Table of Contents: NEAFS 2022

cfsre The Center for Forensic Science Research & Education

CONTINUING EDUCATION

Practitioners, educators, law enforcement personnel, and the legal community require continuing education in the constantly evolving field of forensic science. Take advantage of our expert faculty to enhance your—and your lab's—skill sets and knowledge base to stay abreast of new developments.

To receive a $150.00 discount on one course, use Promo Code:
NEAFS2022

GRADUATE PROGRAMS

The CFSRE offers Master of Science degrees in forensic disciplines in conjunction with leading university partners (Arcadia and Thomas Jefferson University) as well as advanced certificate programs. With a commitment to supplementing didactic education with real-world casework experiences, the CFSRE facilitates a network of highly qualified practitioners, access to our state-of-the-art facilities for laboratory coursework, the opportunity to engage in grant funded research initiatives, comprehensive hands-on training in our internship programs, and invaluable links to the forensic science community.

PREP COURSES

The **Forensic Criminalistics Board Certification Preparation Course** is a 16 module on-demand online course taught by professionals in the field that are certified in their area of study. The courses are taught by experienced criminalists with a collective practical perspective on forensic materials/trace analysis, drug chemistry, and serology/forensic biology. The course is designed for forensic criminalists who are preparing to take a board certification exam in drug analysis.

Forensic Toxicology – ABFT Prep is a 17 Module On-Demand online course that consists of a combination of in-depth lectures, self-study, and practice exams covering all areas of the study curriculum that would comprise a forensic toxicology certification examination. Each module is provided to you by experts in their respective fields. Topics covered include drug and alcohol effects, pharmacokinetics, analytical techniques, quality assurance, and interpretation of drug findings. This course ensures mastery of the presented material and guides future learning efforts.

LEARN MORE AT: CFSRE.ORG/EDUCATION

President's Welcome

Dear Members of the NEAFS Community-

Welcome to the 48th Annual Meeting of the Northeastern Association of Forensic Scientists (NEAFS)! Thank you all for making the trip to beautiful Niagara Falls, New York. As President of NEAFS I would like to extend my sincerest appreciation to Betsy Duval, President-Elect for her tireless efforts in planning this year's meeting. If you see her running around this week (and I'm sure you will!) please say "Thanks". Having planned last year's meeting in Newport, RI I can attest that it's no small feat. To be honest, as much as I enjoyed it, it has been a breath of fresh air to not plan this year's meeting. I could relax knowing that with all the numerous preparations, Betsy Duval was up for the challenge! I'm very excited to begin this year's meeting. It takes a village to plan one of these meetings. Janine Kishbaugh, Beth Saucier Goodspeed, Keri LaBelle, Matthew Marino, and many others deserve special recognition for their amazing work in helping us to make this a successful meeting.

As weeks turn to months, seasons go by and the crisp fall air is now upon us, I'm reminded once again how quickly time passes. In fact, it reminds me of a short story by Stephen King entitled *My Pretty Pony*. You should read it sometime, its only 100 pages! As King eluded, the passage of time does not appear to be linear throughout our lives. As a child I recall saying that I was "bored". I cannot honestly remember the last time I used that word. What felt like an eternity as a child or young adult now feels like a brief moment in time.

Over the past year I have been honored to serve as your President and I promise to depart when it's my time to go! I've been coming to NEAFS Meetings for the past 20 years and distinctly recall wondering what someone must have accomplished in their career to serve as the President of a regional forensic science organization with a history as rich as NEAFS. Through the passage of time and contributions made to NEAFS, I started to meet many people and learned more about how the organization operated. In 2016, I was invited to join the Board of Directors thanks in large part to Andrea Belec LaJoy and Vinny Desiderio, two fantastic individuals I met through NEAFS many years ago whom I admire immensely to this day. For the past six years, before Covid and throughout its associated challenges, I have been proud to serve the NEAFS community. I've grown both personally and professionally as a result. If you're passionate about forensic science and want to leave your mark, please speak with us about how you can become involved. Last year during the 47th Annual Meeting in Newport, RI I stated, "In a field of evidential traces, how will you leave your mark?" I strongly encourage you to contribute to NEAFS, and one day you will be writing this message with the pride and honor that I am today.

Be well and stay safe. This week will most certainly be one of the best NEAFS Meetings to date!

An extra special thanks goes out to my wife, Kathryne, and boys, Connor, Jameson and Emmett Hall for putting up with me during times when I overcommit myself professionally and for being by my side throughout it all.

Please do not hesitate to contact me for any reason: president@neafs.org

Respectfully Submitted,

Adam B. Hall, Ph.D., ABC-FD
President, Northeastern Association of Forensic Scientists
Assistant Professor, Biomedical Forensic Sciences Program
Boston University School of Medicine

Program Chair's Welcome & Acknowledgements

HOWDY! I would like to extend a warm welcome to everyone for the 48th Annual Northeastern Association of Forensic Scientists Meeting in Niagara Falls, NY. I hope ya'll enjoy all that has been wonderfully put together for you by the village (family) we call NEAFS!

Our field is a very special one. We live at the juncture of science and law and get the singular opportunity to work within both worlds. As scientists we discover and deliver the truth while educating the community we serve. We must also continually adapt to the ever-changing landscape of forensic science both from changes in the criminal justice system and technological advancements within the field. This year's program was created to hopefully highlight that growth and change.

There are fabulous workshops being offered by leaders in the field that aid in our continual evolution as scientists and participants in the criminal justice community. There are forward thinking scientific sessions to attend which keep science in the forefront of what we do.

You will experience two excellent case presentations, one at Wednesday night's Evening Session and the other given during the Annual Luncheon. The speakers will present different cases that employed both investigative tenacity and the use of developing forensic technologies that helped to solve horrific crimes, bring justice and closure to victims and/or their families, and even exonerate the innocent.

Thursday's morning and afternoon sessions will be the springboard for addressing the changes we have already and will continue to encounter. The morning session presented by a panel of experts, will address from different perspectives where we have come from, where we are now, where we are headed and most importantly WHY. Thursday's afternoon session presented by John Collins will address HOW, when change happens, we learn to navigate and grow, even when it's hard.

In addition, there are two welcome receptions to enjoy both outdoors and indoors, numerous vendors to meet and engage with (they are fundamental to the longevity of these meetings) and fun to be had just relaxing and exploring the natural beauty of the Falls. It's only fitting as scientists to be near such a marvel of scientific ingenuity in harnessing a natural power. Thank you, Mr. Tesla!

I'd like to give a special shoutout to this year's T-shirt design winner Emily Despres, who hails from our DNA Unit at the MSPCL. Great job Emily!

And let's not forget the party! Halloween is my favorite holiday!! I do hope you enjoy the festivities and come dressed to impress (or at least leave a lasting impression…get it, impression) …

Planning this meeting, for me as a mom, has oftentimes felt like having and raising a child. You're excited, overjoyed, protective, overly cautious, worried because you want to do your best and half the time have no clue what you are doing and scared that you're going to make mistakes (and you will). Ultimately it doesn't matter because you wouldn't change any of it. And at some point, you let go and send it out into the world hoping that what has been done is good enough and that its success is reflected in the change it inspires.

Last but certainly not least - I could not have done any of this without the support and selfless hard work from all of those who helped make this a reality. I'm inspired and in complete awe of the sheer dedication these folks have shown to NEAFS. It's really not my meeting it's Janine's, Keri's, Brandi's, Steph's, Beth's, Matt's, Eric's, Amanda's, Danielle's, Sandra's, Pete's, Anisha's, Tiff's, Alanna's, Joe's, Adrian's, Amy's, Season's, Sabra's, Roberta's, John's, Melissa's, and Adam's (thank you Mr. President) to name a few. But most importantly this meeting is YOURS.

I cannot tell you how very proud and humbling it is to belong to such a supportive and wonderful family. This has been a labor of love for me, and I hope that I have 'done you proud' as those of us from the South would say.

As I've said before, it does take a village(family), but what a wonderful village to be a part of.

- Betsy

Elizabeth Duval
2022 NEAFS President-Elect

2022 Program Team

Program Chairperson	Elizabeth Duval Massachusetts State Police Crime Laboratory
Site Chairperson	Janine Kishbaugh Cedar Crest College, PA
Exhibits Chair/Corporate Liaison	Keri LaBelle Massachusetts State Police Crime Laboratory
Registration Chairperson	Beth Saucier Goodspeed Massachusetts State Police Crime Laboratory
Workshop Coordinator	Eric Sorrentino Suffolk County Crime Laboratory
Workshop Co-Coordinator/ Meeting Booklet	Amanda White New York State Police: Mid-Hudson Satellite Crime Laboratory, NY
Awards Chairperson	Danielle Malone New York City, Office of the Chief Medical Examiner
Scientific Sessions Coordinator	Matthew Marino New Jersey State Police East Regional Laboratory, NJ
Crim Session Chairperson	Amy Brodeur Boston University School of Medicine
Crim Session Co-Chair	Season Seferyn Onondaga County Center for Forensic Sciences
Drug Chemistry Session Chairperson	Tiffany Ribadeneyra Nassau County Medical Examiner Office
Biology/DNA Session Chairperson	Alanna Laureano Westchester County Department of Labs & Research
Biology/DNA Session Co-Chair	Melissa Balogh New Jersey State Police
Toxicology Session Chairperson	Sabra Botch Jones National Highway Traffic Safety Administration Region 5
Trace/Arson & Explosives	Roberta Westerman

Session Chairperson	Massachusetts State Police Crime Laboratory
Trace/Arson & Explosives Session Co-Chair	John Biello Massachusetts State Police Crime Laboratory
Educator's Forum Session Chairperson	Sandra Haddad Bay Path University, MA
Evening Session Chairperson	Tiffany Ribadeneyra Nassau County Medical Examiner Office, NY
Plenary Sessions Chairperson	Elizabeth Duval Massachusetts State Police Crime Laboratory
Peter R. De Forest Student Research Award Chairperson	Adrian Garcia Sega PerkinElmer, CT
Peter R. De Forest Student Research Award Judges	Alyssa Berthiaume John Biello Sandra Haddad Peter Murphy Anisha Paul Jamie Foss Scott Rubins Lynn Schneeweis Alanna Laureano Beth Saucier-Goodspeed
Poster Session Chairperson	Keri LaBelle Massachusetts State Police Crime Laboratory
Social Media & Merchandise Coordinator	Alyssa Berthiaume Massachusetts State Police Crime Laboratory
Publications/Meeting Booklet	Brandi Clark Westchester County Department of Labs and Research, Division of Forensic Sciences, NY
Audio/Visual Coordinator	Adrian Garcia Sega PerkinElmer, CT

2022 NEAFS Board of Directors & Staff

President	Adam Hall

	Boston University School of Medicine Biomedical Forensic Sciences Program
President-Elect	Elizabeth Duval Massachusetts State Police Crime Laboratory
Treasurer	Stephanie Minero Nassau County Office of the Medical Examiner, NY
Secretary	Alanna Laureano Westchester County Department of Labs and Research
Director	Matthew Marino New Jersey State Police East Regional Laboratory, NJ
Director	Amanda White New York State Police: Mid-Hudson Satellite Crime Laboratory, NY
Director	Anisha Paul Vermont Forensic Laboratory, Department of Public Safety, VT
Past President	Angela Vialotti Connecticut Department of Emergency Services and Public Protection
Publications Chairperson	Brandi Clark Westchester County Department of Labs and Research, Division of Forensic Sciences, NY
Executive Secretary	Sarah Roseman Nassau County Office of the Medical Examiner, NY
Awards Chairperson	Danielle Malone New York City, Office of the Chief Medical Examiner, New York, NY
Education Chairperson	Sandra Haddad Bay Path University, MA
Ethics Chairperson	Tiffany Ribadeneyra Nassau County Office of the Medical Examiner, Division of Forensic Services, NY

Registration Chairperson	Beth Saucier Goodspeed Massachusetts State Police Crime Laboratory, MA
Corporate Liaison	Keri LaBelle Massachusetts State Police Crime Laboratory
Membership Chairperson	Joseph Phillips Westchester County Department of Labs and Research, Division of Forensic Sciences, NY
Membership Dues Contacts	Angelina Pollen Westchester County Department of Labs and Research, Division of Forensic Sciences, NY
Social Media Coordinator & Merchandise Chairperson	Alyssa Berthiaume Massachusetts State Police Crime Laboratory, MA
Certification Chairperson	Peter Diaczuk John Jay College, Department of Sciences, NY
Site Chairperson	Janine Kishbaugh Cedar Crest College, PA
Regional Associations	Lynn Schneeweis Committee Representative Massachusetts State Police Crime Laboratory

NEAFS Past Presidents

1975 (Organizational Meeting)	New York, NY	**1999** Mary Beth Raffin	Hyannis, MA
1976 Dr. Angelo Fatta	New York, NY	**2000** Ted Schwartz	Saratoga Springs, NY
1977 Vincent Crispino	Mineola, NY	**2001** Chris Montagna	Mt. Snow, VT

1978	Thomas Kubic	Storrs, CT	**2002**	Mary Eustace	Atlantic City, NJ
1979	Dr. John Reffner	Albany, NY	**2003**	Christopher Huber	Pittsfield, MA
1980	Mark Lewis	Morristown, NJ	**2004**	Jennifer Limoges	Mystic, CT
1981	George Neighbor	Allentown, PA	**2005**	Tammi Jacobs Shulman	Newport, RI
1982	Alexander Stirton	Albany, NY	**2006**	Dennis Hilliard	Rye Brook, NY
1983	Robert Herrmann	Hasbrouck Heights, NJ	**2007**	Elayne Schwartz	Bolton Landing, NY
1984	Patricia Prusak	Uniondale, NY	**2008**	Adrian Krawczeniuk	White Plains, NY
1985	Jeffrey Weber	Uniondale, NY	**2009**	Dr. David San Pietro	Long Branch, NJ
1986	Heljena McKenney	Peabody, MA	**2010**	Laura Tramontin	Manchester, VT
1987	Ann Giesendorfer	Princeton, NJ	**2011**	Dr. Peter Diaczuk	Newport, RI
1988	Robert Genna	Mystic, CT	**2012**	Vincent Desiderio	Saratoga Springs, NY
1989	Steven Sotolano	Albany, NY	**2013**	Andrea Belec	Cromwell, CT
1990	Elaine Pagliaro	Providence, RI	**2014**	Kevin MacLaren	Hershey, PA
1991	Kirby Martir	Huntington, NY	**2015**	Dr. Lawrence Quarino	Hyannis, MA
1992	Dr. Peter Pizzola	Atlantic City, NJ	**2016**	Erica Nadeau	Atlantic City, NJ
1993	Robert Adamo	Springfield, MA	**2017**	Beth Saucier Goodspeed	Pocono Manor, PA
1994	Karolyn LeClaire Tontarski	New York, NY	**2018**	Melissa Balogh	Bolton Landing, NY
1995	Jeffrey Luber	Mystic, CT	**2019**	Tiffany Ribadeneyra	Lancaster, PA
1996	Donald Doller	Pocono Manor, PA	**2020**	Maria Tsocanos	Virtually Everywhere!
1997	George W. Chin	White Plains, NY	**2021**	Angela Vialotti	Newport, RI
1998	Joseph Galdi	Newport, RI	**2022**	Adam Hall	Niagara Falls, NY

NEAFS Life Members

Dr. Peter R. De Forest
Mr. Robert E. Genna
Mr. Kirby Martir
Dr. Robert Gaensslen
Ms. Joy Reho
Dr. Thomas Kubic
Ms. Elaine Pagliaro

FORENSIC & NATIONAL SECURITY SCIENCES INSTITUTE

College of Arts and Sciences

thecollege.syr.edu/fnssi

Proudly supported by Syracuse University

2022 NEAFS Exhibitors and Sponsors

NEAFS graciously acknowledges the support of our 2022 Corporate Sponsors

NEAFS would like to recognize sponsorship from PerkinElmer for the Dr. Peter R. De Forest Student Research Competition for the top undergraduate and graduate research awards for poster and oral presentations at the 48th Annual NEAFS Meeting!

ABC: The American Board of Criminalistics (ABC) is composed of regional and national organizations which represent forensic scientists. The ABC offers certification examinations in different disciplines within the broad scope of forensic science. Certification is a voluntary process

of peer review by which a practitioner is recognized as having attained the professional qualifications necessary to practice in one or more disciplines of criminalistics. www.criminalistics.com

Activated Research Company: ARC is an innovative award-winning product development company with expertise in microreactor design, heterogeneous catalysis, and separations. Our goal: To improve gas and liquid chromatography. www.activatedresearch.com

Adam Equipment: Adam Equipment designs and manufactures precision weighing equipment for professionals worldwide. Its global distribution network serves markets including laboratory, education, industrial, food and legal cannabis. www.adamequipment.com

Agilent: Agilent is your global partner for sample preparation, chromatography, mass spectrometry, elemental analysis, molecular spectroscopy, laboratory software, support, service, and supplies. www.agilent.com

Bode Technology: Bode provides accredited forensic DNA testing services of backlogged and current cases. Bode also offers Forensic Genetic Genealogy Services, Comprehensive Rapid DNA Support and more. www.bodetech.com

Bone Clones: Bone Clones, Inc. manufactures detailed, high-quality osteological reproductions of skeletal elements. In addition to an extensive range of skulls and skeletons providing age (from pre-natal to elderly), sex, and ancestry differences, we have a Forensic Collection of specimens exhibiting trauma (blunt, sharp, and firearms injuries) and pathology (arthritis, scoliosis, hyperostosis, achondroplasia). Our durable replicas obviate the need for a dedicated teaching collection of real human remains. www.boneclones.com

Bruker Nano Analytics: Bruker's specialized equipment can detect evidence long after it is no longer visible to the human eye, GunShot residue to Glass analysis and more. www.bruker.com

Crime Sciences: Leading supplier of forensic alternate light sources, including forensic laser lights, as well as our LIZQ360 3DVIRTUAL crime scene recording system. crimesciences.com

EDAX: EDAX is the global leader in EDS, EBSD, WDS, and XRF systems. www.edax.com

GenTech Scientific: Since 1996, GenTech Scientific has been a leading full solutions provider in refurbished GC, MS, HPLC, GC-MS & LC-MS along with expert service and support. www.GenTechScientific.com

GERSTEL: GERSTEL Inc. develops and produces systems for chemical analysis focusing on automated sample preparation and introduction for Gas Chromatography-Mass Spectrometry and Liquid Chromatography-Mass Spectrometry. www.gerstelus.com

iMiller Microscopes: I. Miller Microscopes is a family-owned and operated Microscope Sales & Service Company, in business since 1936. imillermicroscopes.com

Indigo BioAutomation: Indigo BioAutomation is an established leader in software automation for the applied and health sciences. Indigo's systems provide laboratory collaboration support. www.indigobio.com

InnoGenomics Technologies: InnoGenomics Technologies is dedicated to the development of innovative genetic testing solutions that solve crimes and save lives. www.innogenomics.com

InVita Healthcare Technologies: InVita provides chain of custody software technologies for complex medical, forensic and community care environments. www.invitahealth.com

ionBench: ionBench is internationally recognized as the leading expert in standard and custom designed mass spectrometry laboratory furniture. Our products are manufactured to ease the day-to-day use of your LC/GC/ICP/MS systems. We provide many features and accessories that greatly improve working environments. ionBench products are compatible with all major Mass Spectrometry original equipment manufacturers. www.ionbench.com

JEOL USA: JEOL is a world leader in instrumentation for high-end scientific and industrial research and development. Core product groups include analytical instruments (mass spectrometers, NMRs and ESRs) and electron microscopes (SEMs and TEMs). JEOL equipment enables forensic techniques like trace evidence analysis, toxicology, and gunshot residue analysis. For more information about JEOL USA, Inc. or any JEOL products, call 978-535-5900 or visit www.jeolusa.com

Justice Trax: Since 1995 providing forensic laboratories with comprehensive case management software, outstanding customer support, software development and integration. Offering LIMS-plus and LIMS-plus DNA to manage sample work flow, including data upload and download to instrumentation. These systems are now available in the *JusticeTrax Cloud*. www.JusticeTrax.com

Leeds Forensic Systems: Leeds manufactures firearms, tool marks, & trace evidence comparison microscopes; the LCF3, Discovery, LCT, & Trace-Z. Leeds is the exclusive Evofinder® distributor in North America. www.leedsmicro.com

Lipomed: Lipomed is a leading manufacturer and global supplier of certified reference materials and analytical reference standards for mass spectrometry and other analytical techniques. All Lipomed products are developed in-house at our headquarters in Switzerland under ISO 17034 and ISO/IEC 17025 accreditations. lipomed-usa.com

MetaSystems: MetaSystems is a leading manufacturer of automated imaging slide scanning systems that combines artificial intelligence to provide enhanced microscopy workflows in forensics, and more. www.metasystems.org

Mettler Toledo: METTLER TOLEDO is the world's largest manufacturer and marketer of weighing instruments for use in laboratory, industrial and food retailing applications. www.mt.com

NEAFS Merchandise: Visit the NEAFS merchandise booth to see our selection of T-shirts and mugs! www.cafepress.com/neafs, www.neafs.qbstores.com

Perkin Elmer: Leading, global provider of end-to-end analytical technology solutions that help scientists and researchers with applied analysis excellence. www.perkinelmer.com

Promega: Promega is a global leader in the development, distribution, and sale of products for human identification. Promega offers flexible, reliable solutions for all stages in the DNA laboratory workflow, from pre-processing through STR analysis. www.promega.com

Randox Toxicology: Randox Toxicology is dedicated to advancing forensic, clinical and workplace toxicology globally; minimizing laboratory workflow constraints whilst maximizing the scope of quality drug detection. www.randoxtoxicology.com

Sangali: Sangali provides psychoactive plant and "legal-high" sample identification services. Requiring minimal amounts of material for analysis, Sangali delivers precise, fast, affordable and high-throughput screening. www.sangali.org

SCIEX: SCIEX offers expertise, LC-MS/MS technology and comprehensive forensic solutions designed to push the limits of usability, speed, and sensitivity for both quantitative and qualitative analyses. www.SCIEX.com

Shimadzu: Shimadzu provides a broad range of analytical instruments indispensable for research, development, and quality control in a variety of fields. www.ssi.shimadzu.com

Spider Thermo: Cutting edge wireless sensors connect to remote cloud monitoring software, logging vital information in real time. www.spiderthermo.com

Syracuse University: Syracuse University's Forensic Science and National Security Science Institute offers educating the next generation of forensic scientists by gaining practical knowledge and hands-on experience taught by current or former forensic practitioners. Over 90% of FNSSI employed graduates are working in crime laboratories, medical examiner's, and federal agencies in over 25 states. forensics.syr.edu

Teledyne FLIR: Teledyne FLIR's Detection division safeguards people and property by providing tools that see and sense harmful chemical, biological, radiological, nuclear, and explosives (CBRNE) substances. teledyneflir.com

TESCAN: TESCAN develops state-of-the-art SEMs, FIB-SEMs, and micro-CTs instruments that can provide valuable insights into a broad range of scientific disciplines. www.tescan.com

The Center for Forensic Science Research and Education: The CFSRE conducts research, development, and new technology assessment, and delivers educational and training services for the forensic science community and beyond. www.cfsre.org

Thermo Fisher Scientific - Molecular Spectroscopy: Visit Thermo Scientific for the world's largest portfolio of analytical instruments, laboratory consumables/equipment, and services. We keep your laboratory at peak performance. www.thermofisher.com/ftir

2022 Meeting Schedule

Monday October 17, 2022

3:30pm – 5:30pm	Board of Directors/Staff Outing	NF State Park
3:00pm – 6:00pm	Part One: Facial Approximation Workshop	Whitney
7:00pm – 10:00pm	BOD/Staff Dinner	

Tuesday October 18, 2022

7:00am – 8:30am	Registration	Registration Area
7:00am – 8:30am	Breakfast	Grand Foyer
8:00am – 4:30pm	PART Two: Facial Reconstruction Workshop	Whitney
8:00am – 4:30pm	ThermoFisher Sponsored DNA Workshop: "Advanced Topics in Forensic DNA and Biology Analysis"	Porter
8:00am – 4:30pm	Field Analytical Detection Tech. Workshop	DeVeaux
8:00am – 4:30pm	Agilent Sponsored Workshop: "GCMS Fundamentals of Troubleshooting and Maintenance"	Red Jacket
8:00am – 12:00pm	Ethics in Forensic Science Workshop	Schoellkopf
10:00am – 10:15am	Break	Grand Foyer
12:00pm – 1:00pm	Lunch	
12:30pm – 1:30pm	Registration	Registration Area
1:00pm – 4:30pm	Student Workshop	Schoellkopf
2:30pm – 5:30pm	Exhibitor Set-up	Event Center
3:00pm – 3:15pm	Break	Grand Foyer
4:00pm – 7:00pm	Pre-Welcome Reception (Food Trucks/Games)	Old Falls Street
7:00pm – 9:00pm	Registration	Registration Area
3:00pm – 9:00pm	Silent Auction	Ticket Booth Area

Wednesday October 19, 2022

7:30am – 9:30am	Registration	Registration Area
7:30am – 9:00am	Breakfast	Event Center
8:00am – 8:00pm	Exhibits	Event Center
9:00am – 5:00pm	Forensic Biology/DNA	Cascade II
9:00am – 5:00pm	Criminalistics/Crime Scene & Digital Evidence	Red Jacket
9:00am – 5:00pm	Forensic Drug Chemistry	Poter-DeVeaux
9:00am – 12:00pm	Forensic Toxicology	Cataract
10:00am – 10:15am	Break	Event Center
12:00pm – 1:30pm	Annual Business Lunch**	Cascade II
1:00pm – 5:00 pm	Trace Evidence/Fire Debris & Explosives	Cataract
3:00pm – 3:15pm	Break	Event Center
5:30pm – 7:30pm	Welcome Reception & Poster Session	Event Center
7:00pm – 8:00pm	Registration	Registration Area

8:00pm – 10:30pm	Evening Session	Cascade II
9:15pm – 9:30pm	Break	Grand Foyer
7:30am – 9:00pm	Silent Auction	Ticket Booth Area

Thursday October 20, 2022

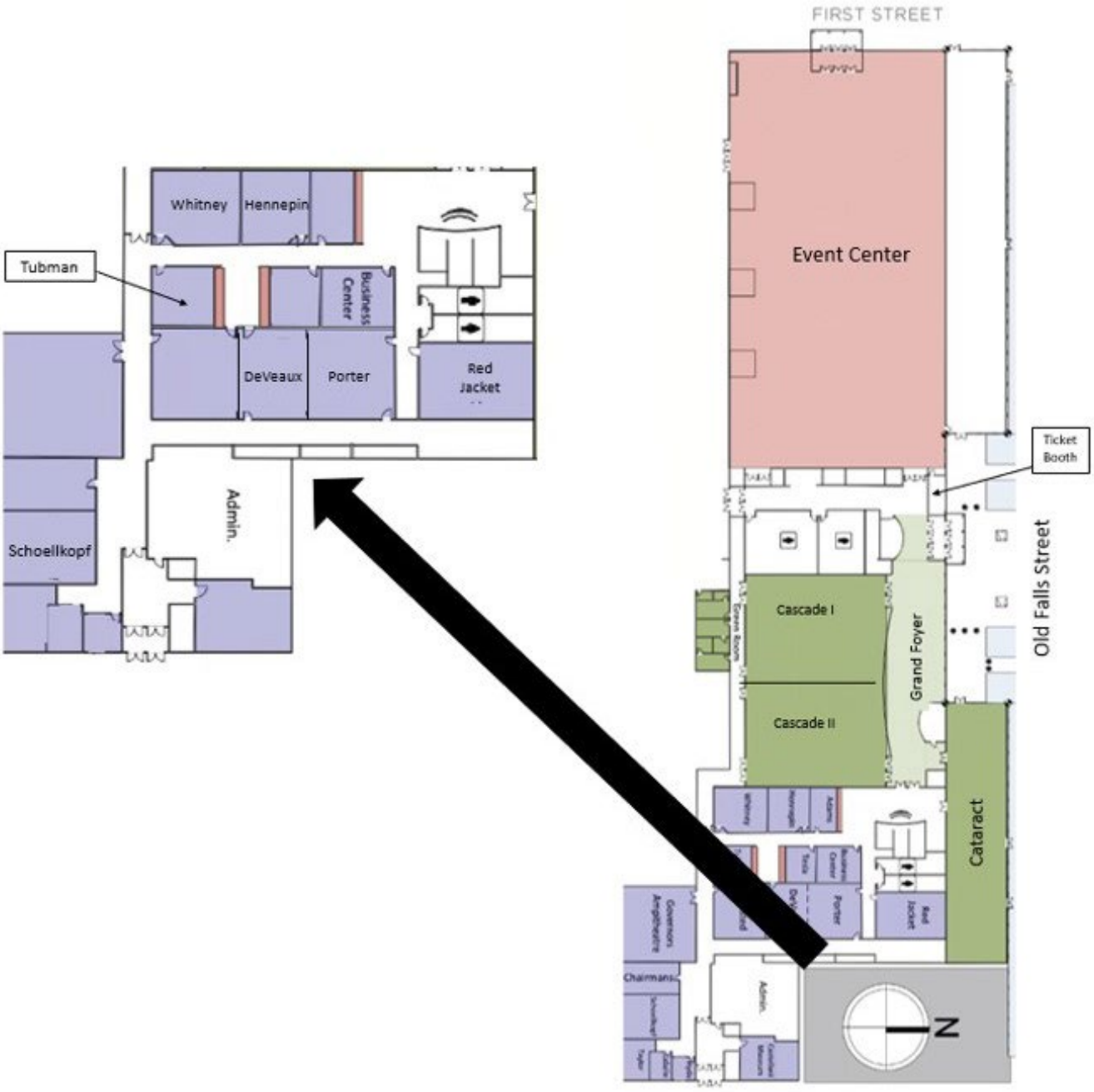
7:00am – 9:30am	Registration	Registration Area
7:30am – 9:00am	Breakfast	Event Center
8:00am – 11:00am	Exhibits	Event Center
730am – 12:00pm	Silent Auction	Ticket Booth Area
9:00am – 12:00pm	Morning General Session	Cascade II
10:00am – 10:15am	Break	Event Center
12:00pm – 2:00pm	Annual Luncheon & Awards Ceremony**	Cascade I
2:15pm – 5:15pm	Afternoon General Plenary Session	Cascade II
3:45pm – 4:00pm	Break	Grand Foyer
6:30pm – 11:30pm	President's Reception (Halloween themed)	Cascade I

Friday October 21, 2022

8:00am – 9:30am	Breakfast	Grand Foyer
8:00am – 9:00am	Registration	Registration Area
9:00am – 11:00am	Educators Forum	Porter
11:00am – 12:00pm	George W. Chin Cup Competition	Red Jacket
9:00am – 5:00pm	ABC Exams	Tubman

***Requires a ticket for entry*

Convention Center Map


FIRST STREET
Event Center
Whitney
Hennepin
Tubman
Business Center
DeVeaux
Porter
Red Jacket
Admin.
Schoellkopf
Ticket Booth
Old Falls Street
Cascade I
Cascade II
Grand Foyer
Cataract
Chairmans
N

Niagara Falls Area Map

NIAGARA FALLS STATE PARK

- **N1** Cave of the Winds | The World Changed Here Pavilion
- **N2** Goat Island
- **N3** Luna Island*
- **N4** Maid of the Mist Boat Tour* | Observation Tower
- **N5** Niagara Gorge Trailhead Building*
- **N6** Prospect Point
- **N7** Schoellkopf Power Plant Ruins*
- **N8** Terrapin Point*
- **N9** Three Sisters Islands

ATTRACTIONS

- **A1** Aquarium of Niagara
- **A2** Art Alley NF
- **A3** At the Falls Arcade
- **H14** Bella Rose Winery Tasting Room
- **A4** The Great American Arcade
- **A5** Haunted House of Wax*
- **A6** Niagara Adventure Theater | Mindgames Niagara Falls
- **A7** Niagara Falls Convention Center | Castellani Satellite Gallery
- **A8** Niagara Falls Culinary Institute | Marjim at the Falls
- **A9** Niagara's Wax Museum of History*
- **G4** One Niagara Welcome Center: The Links Golf & Tap
- **A10** The Panic Room
- **A11** Rainbow Air, Inc. Helicopter Tours*
- **A12** Seneca Niagara Resort & Casino

GIFTS & RETAIL

- Niagara Falls USA Official Visitor Center
- **A6** JD Gifts
- **A8** Niagara Falls Culinary Institute: Barnes & Noble
- **G1** Duty Free Americas
- **G2** Honeymoon Capital Souvenirs*
- **G3** Maid of the Mist Gift Shop*
- **G4** One Niagara Welcome Center | Made in America Store* | Luvmore Wines
- **G5** Third Street Liquors & Wines
- **G6** Top of the Falls Gift Shop*

DINING

- **H8** Anchor Bar (Holiday Inn Niagara Falls)
- **D1** Ashker's Fresh Market
- **H9** Cantina by F Bites | Cataract House
- **D2** The Craft Kitchen & Bar
- **D3** Donatello's
- **D4** Dunkin'
- **D5** F Bites Coffee & Kitchen
- **D6** Flip Burger* | Sweet Spot*
- **D7** The GoldBar
- **D8** Hard Rock Cafe Niagara Falls USA
- **D9** Indian Kitchen King (Indian)
- **D10** International Buffet* (Indian)
- **H10** La Cucina Di Mamma* (Italian; Kalika Hotel)
- **D11** Mackinali's Café & Bake Shop
- **D12** Mario's NY Pizza*
- **D13** Misty Dog* | Twist of the Mist*
- **D14** Niagara Curry House
- **A8** Niagara Falls Culinary Institute: La Patisserie | Savor
- **G4** One Niagara Welcome Center: Food Court | The Links Golf & Tap
- **H12** Papa John's | Legend's Bar | Old Falls Street Burgers (Quality Hotel & Suites At The Falls)
- **H4** Parkway Prime Steakhouse & Lounge (DoubleTree by Hilton Niagara Falls)
- **D15** Power City Eatery
- **D16** Punjabi Hut (Indian)
- **H13** Red Coach Inn
- **H9** Royal Dragon Noodle Bar & Grill (Chinese)
- **A12** Seneca Niagara Resort & Casino: Blues Burger Bar | Koi | Morrie's Express | Slice-N-Dice | Three Sisters Café | Tim Horton's | Western Door Steakhouse
- **H1** SEVA Tapas Bar & Lounge
- **H14** Sheraton Niagara Falls: The Corner Deli | Rainforest Cafe | Starbucks | Torrent
- **D17** Spot Coffee
- **D18** Taste of Nepal (Nepalese)
- **D19** Third Street Retreat Eatery & Pub*
- **D20** Top of the Falls Restaurant*
- **D21** Wine on Third
- **D22** Zaika Indian Cuisine (Indian)

Variety of food carts available on Old Falls Street, USA and surrounding areas.

HOTELS

- **H1** The Cadence
- **H2** Comfort Inn "The Pointe"
- **H3** Courtyard by Marriott Niagara Falls USA
- **H4** DoubleTree by Hilton Niagara Falls
- **H5** Fairfield by Marriott
- **H6** The Giacomo
- **H7** Hampton Inn Niagara Falls
- **H8** Holiday Inn Niagara Falls
- **H9** Hyatt Place Niagara Falls
- **H10** Kalika Hotel
- **H11** Passport Inn
- **H12** Quality Hotel & Suites At The Falls
- **H13** Red Coach Inn
- **A12** Seneca Niagara Resort & Casino
- **H14** Sheraton Niagara Falls
- **H15** Wingate by Wyndham Niagara Falls
- **H16** Wyndham Garden At Niagara Falls

BED & BREAKFASTS

- **B1** Butler House
- **B2** Hanover House
- **B3** Marshall House
- **B4** Rainbow House

HOSTELS

- **HS1** Gorge View*
- **HS2** Wanderfalls Guesthouse & Hostel

*Please note, some businesses are seasonal. It is recommended to call ahead and confirm hours of operation.

Niagara Falls, NY – Area Attractions, Bars & Restaurants

Niagara Falls Fireworks & Illumination

A new nightly illumination display, "Inspired by Nature," will showcase colors and movements found in nature, including sunrise, aurora borealis, rainbow and sunset; this is part of the regular nightly illumination of the Falls. The five-minute lighting display will play three times on the half hour, beginning at 9:30 each evening, with additional displays at 10:30, 11:30, and 12:30 a.m. https://www.niagarafallsusa.com/niagara-falls-state-park/illumination-fireworks/

Maid of the mist

A favorite Niagara Falls State Park attraction for more than 150 years, the Maid of the Mist journey begins at the Observation Tower, where guests are given a souvenir rain poncho to wear and board the double-deck Maid of the Mist tour boat. From there, the boat ferries past the base of the American Falls, and onto the basin of Horseshoe Falls--the dramatic passage leading you through the roiling waterfall whitewater and massive rock formations. The Maid of the Mist returns guests to shore with newfound appreciation of the power and grandeur of Niagara Falls. https://www.maidofthemist.com/

Butterfly Conservatory

Step inside one of the largest glass-enclosed butterfly conservatories in North America and discover a tropical garden oasis. The Niagara Parks Butterfly Conservatory features over 2,000 vibrantly coloured butterflies fluttering freely throughout winding pathways adorned with lush vegetation and trickling waterfalls. Make your way through 180 metres of meandering pathways surrounded by towering tropical plants and gorgeous blooms. This tropical oasis is yours to explore! You'll find feeding trays where butterflies gather for an up-close look, specially curated blooms that attract these fascinating creatures, and a picturesque waterfall creating a virtual rain forest atmosphere. Located on the Canadian side of the Falls!https://www.niagaraparks.com/visit/attractions/butterfly-conservatory/

The Bear's Den

Located inside of the Seneca Niagra casino the Bear's Den is an amazing venue for live entertainment! They feature the best in Niagara Falls entertainment with world-famous performers, jaw-dropping shows, must-see concerts, and the region's best live bands. Visit https://senecaniagaracasino.com/entertainment/ for upcoming events!

Niagara Falls State Park

America's oldest state park, open 365 days a year, 24 hours a day, brings you closer than you ever thought possible to the grandeur of the Falls. Changing leaves, long walks and hiking trails galore conspire to make fall a stunning time to visit Niagara Falls, New York. Ride the Niagara Scenic Trolley for a historical overview of this Frederick Law Olmsted-designed park or explore its scenic terrain and stunning views by foot. All trails are flat and accessible for beginners, with self-guided tours and professionally led outings offering many choices. A helicopter ride provides an incredible aerial view of the Falls and the park's foliage. https://www.niagarafallsstatepark.com/

Cave of the Winds & The World Changed Here Pavilion	Learn how Nikola Tesla harnessed the power of the Falls to create alternating current, experience what Niagara Falls looked like before it was a park and witness why people from around the globe have been drawn to the edge of the Falls for hundreds of years as you travel through The World Changed Here Pavilion. Then check out the "Hurricane Deck" where you are within feet of the crashing Bridal Veil Falls and surrounded by tropical storm like conditions-even on the calmest of days. Don't worry they dress you for the occasion! https://www.niagarafallsstatepark.com/attractions-and-tours
Rainbow Air Inc.	Helicopter tours above and around the American and Canadian Falls. View the majestic power and beauty of the Falls from the air! Rainbow Air is proud to have served the Niagara Region since 1995. Located conveniently downtown, within walking distance to the Niagara Falls State Park. https://rainbowairinc.com/
Seneca Niagara Casino	Guests staying at the Sheraton Niagara Falls receive exclusive access to a tunnel straight into the casino! With ten restaurants, seven shops, more than 2,500 slots, and over 80 table games, live poker, keno, a full-service spa, superstar entertainment, and exciting nightlife, Seneca Niagara is consistently rated as a must-see Niagara Falls casino. https://senecaniagaracasino.com/
Fort Niagara	Old Fort Niagara offers you a chance to step back in time to an era when great empires struggled for control of North America. You'll visit original 18th century buildings, enjoy incredible views and take part in exciting living history programs. The Fort's Visitor Center offers you introductory exhibits filled with original artifacts and an award-winning 16-minute orientation film. Don't miss the Fort's original War of 1812 Flag. Inside the Fort, you'll tour original buildings where Native American, French, British and American soldiers lived and worked from the 18th to the 20th centuries. During the summer months you'll witness musket and artillery firing demonstrations, go on a guided tour, see artisans at work and learn about life on the Niagara Frontier during the 18th and early 19th centuries. https://www.oldfortniagara.org/
The Panic Room-Niagara	Up for a challenge? Try one of the many escape rooms at The Panic Room In each game, your team has 60 minutes to escape. before the the game starts, you'll be provided with everything you need to know so don't panic! Only $27 per person! https://thepanicroomniagara.com/
Breweries & Wineries	The Sheraton Niagara is in the middle of the Niagara Wine Trail and such is close to several wineries and breweries too! For a list of local breweries visit https://www.niagarafallsusa.com/restaurants/niagara-breweries-cideries/
Bella Rose Vineyard Tasting Room	Bella Rose Vineyard & Winery now has a tasting room located on Old Falls Street in Downtown Niagara Falls. As a sister store to the main location in Lewiston, the tasting room invites all who share a love and passion for the different varieties of locally grown, produced, and bottled wines to come taste the very best the region has to offer. The tasting room is located on Old Falls Street and the corner of 3rd Street between Starbucks and RainForest Cafe in Niagara Falls, USA. http://bellarosewinery.com/

2023 Annual Meeting Announcement

SILENT AUCTION

Tuesday, October 18th
3pm – 9pm
Wednesday, October 19th
730am– 9pm
Thursday, October 20th
730am – 12pm

Place your bids across from Registration
Winners announced at Annual Luncheon

PRE-WELCOME RECEPTION

Tuesday October 18th 2022

4:00PM-7:00PM

Sweet Melody's
Artisan-Crafted Gelato

DIRTY BIRD
CHICKEN-N-WAFFLES
LLC

Join us outside on Old Falls Street

-FOOD TRUCKS - GAMES - CASH BAR-

2022 NEAFS Workshops

Constructing a Face: Forensic Facial Reconstruction

Monday, October 17th 3:00pm – 6:00pm &
Tuesday, October 18th 8:00am - 4:30pm
Location: Whitney

Instructor: **Jenny Kenyon,** Federal Bureau of Investigation
Forensic & Theatrical Artist
jennykenyon.wixsite.com/jenny-kenyon

Join Forensic Artist Jenny Kenyon for a multi-day workshop in Forensic Facial Approximation. This workshop will be broken down into two parts. On Monday, we will meet for 3 hours to cover anthropological assessments of gender, age, ancestry and build using a 3D print of a skull. We will also cover the differences between the Manchester, Russian and American methods of facial approximation. On Tuesday, we will work on creating the muscles out of clay, fitting it to the architecture of the skull and adding skin and soft tissues to reconstruct/approximate the individual over the course of the day.

The Manchester/British method was developed by Richard Neave in 1977 and is the most accepted method for facial reconstruction/approximation today. This method has been used in many famous reconstructions including Phillip II of Macedon, Johann Sebastian Bach, Saint Nicholas, Robert the Bruce, and King Richard III.

Supplies and tools will be provided, and no prior facial reconstruction experience or art skill is needed.

Instructor Biography

Jenny Kenyon is both a Forensic Artist and Costume & Scenic Designer for Theatre. She received her BFA in Studio Art from SAIC, an MFA in Theatre Design from Brandeis University, and a MSc in Forensic Art from University of Dundee, Scotland. Her specialties include virtual and clay 3D Facial Reconstructions from skeletal remains and CAD based 3D reconstructions of Heritage and burial sites. Her other skills include Age Progression & Regression, Witness Interviewing Techniques, Composite Sketching, Forensic Photography, and Cranio-Facial Superimposition. Her archaeological facial reconstructions have been featured in exhibits in Europe, the UK and the US. She also works creating illustrations for scientific research, with police departments providing faces for unidentified human remains, and teaching forensic art & photography at Penn State University. She has recently started working at the FBI Lab in Quantico Virginia and is creating facial approximations, age progressions, and court presentations for the FBI.

Advanced Topics in Forensic Biology and DNA

Tuesday, October 18th 8:00am – 4:30pm

Location: Porter

ThermoFisher SCIENTIFIC

Presenters: **Chery Carreiro,** ThermoFisher
Jonathan Kui, OCME NYC
Dr. Claire Glynn, University of New Haven
Ryan Gallagher, Philadelphia Police Department's Office of Forensic Science
Carlos Riera Ruiz, University of Nebraska-Lincoln

The Development & Implementation of Best Practices and Standards for using Forensic Genetic Genealogy in Criminal Investigations *Dr. Claire Glynn*

Since its inception in 2018, Forensic Genetic Genealogy (FGG) has become one of the fastest-growing new investigatory tools to be implemented into criminal investigations. The speed of this implementation has been alarming, yet its success and impact in resolving cold cases cannot be denied. As with all new methods, tools, and techniques, it is critical that robust procedures, best practices, and standards for their use are developed and implemented. With FGG, its use has become widespread across the United States, yet there exists only minimal guidance and policy surrounding it. Critics of the use of FGG have raised concerns over genetic privacy, individual privacy, and informed consent, to name a few. Members of the law enforcement/forensic science community that have been hesitant to embrace this new tool have cited the lack of guidance, understanding of legal implications, and defined set of procedures for using it as a concern. Therefore, it is necessary that robust best practices and standards are developed for using this investigatory tool, with a focus on balancing the best interests of the public in terms of both protecting their safety and protecting their privacy. It is essential that all stakeholders are given the opportunity to provide input in the development of national best practices and standards, which must include not only legal experts and policymakers, but also ethics and privacy experts, forensic practitioners, and those with in-depth knowledge and expertise in carrying out the many steps involved in a thorough FGG investigation. Over the last 30+ years, Forensic DNA (STR) analysis has become the gold standard of forensic science. This was and still is, achieved through methodical diligence, robust practices, and constant revision and oversight. The same is now required for FGG in order to cement its credibility within the industry, and also to sustain, even grow, its use in investigations. This workshop will discuss a comprehensive set of recommendations for best practices and standards for the use of FGG in criminal investigations, with a proposed mechanism for their implementation.

Analyzing Workflow Changes to Incorporate New Technology *Ryan Gallagher*

An Overview of the Connecticut Rapid DNA Program *Chery Carreiro*

Application of the Human Virome to Touch Objects and Hair Shafts *Carlos Riera-Ruiz*
The Validation of Massively Parallel Sequencing for Mitochondrial Casework (mitoMPS) at NYC OCME *Jonathan S. Kui*

Validation of a new technology for casework is an involved process that often does not follow expected paths. While the framework of requirements for validation are readily available, there are often unforeseen challenges. We will review the process of validation for mitochondrial massively parallel sequencing (MPS) used by the NYC Office of Chief Medical Officer to highlight different approaches, and offer recommendations to other labs considering validation of a new technology.

Presenter Biographies

Chery Carreiro began her forensic career at the Connecticut Division of Scientific Services in 2007. In addition to overseeing the laboratory operation, as the Assistant Director of the Forensic Science Laboratory, Cheryl oversees grants, contracts, and a very busy Rapid DNA program. With nearly 14 years of casework experience as a DNA analyst, Cheryl co-developed Connecticut's first Rapid DNA program for use on crime scene samples. Cheryl holds a B.S in Biology, minor Chemistry from Fairfield University and a M.S. in Forensic Science with a concentration in Criminalistics from the University of New Haven

Jonathan S. Kui is currently the Laboratory Director of the forthcoming DNA Laboratory of the Office of the Hudson County Prosecutor. Previously, Jonathan was a Criminalist IV at the NYC Office of Chief Medical Examiner, in the Department of Forensic Biology. He was a post-conviction case coordinator for the laboratory, and was a Validation Lead for mitochondrial massively parallel sequencing (MPS). He had been a casework analyst since joining the laboratory in 2008, and a supervisor since 2014.

Dr. Glynn previously worked as a forensic scientist at Eurofins Forensic Services (formerly named LGC Forensics) in Oxfordshire, England. Eurofins Forensic Services is one of the United Kingdom's leading forensic science providers for the UK's police forces. Dr. Glynn worked in the forensic biology department, within the homicide and sexual assaults team, which has investigated some of the UK's most high-profile crimes. Dr. Glynn, who joined the University of New Haven in 2014, teaches both undergraduate and graduate courses in forensic science, focused on forensic biology, forensic DNA analysis, and Forensic Genetic Genealogy (FGG). Her research interests are focused on FGG, and a broad range of applications for this novel investigatory tool. This includes investigating the effects of degraded samples and novel technologies, establishing best practices, the international feasibility of this tool, historical applications, and ethical considerations, to name just a few. Her other research interests include Rapid DNA analysis, RNA (mRNA and miRNA) analysis, Single Nucleotide Polymorphism (SNPs) applications, and DNA Methylation markers. Dr. Glynn is the founding Director of the University of New Haven's online Graduate Certificate in Forensic Genetic Genealogy, and she actively consults and provides subject matter expertise on the topic to law enforcement agencies, both nationally and internationally.

Ryan Gallagher is the Criminalistics Unit Manager at the Philadelphia Police Department's Office of Forensic Science, where he is responsible for the daily operations of the laboratory that processes all of the DNA cases for the City of Philadelphia. He earned a bachelor's degree in Molecular Biology from Temple University and a master's degree in Forensic Science from Arcadia University. He began his career in forensics with the Philadelphia Police Department in 2006. For more than ten years, he worked in the Criminalistics Unit processing hundreds of cases that involved the identification of

biological fluids and/or ignitable liquids. For the past five years, Mr. Gallagher has overseen the operations of the Criminalistics Unit

Carlos Riera-Ruiz is originally from Ecuador where he received his bachelor's degree in Agricultural and Biological Sciences and a professional MS in Project Management. In Ecuador he was a research assistant in the Biotechnology Research Center (CIBE), one of the most prestigious Universities in Ecuador, Escuela Superior Politécnica del Litoral. There he studied plant pathogens of rice and published his work in high impact journals. This experience led him decide to pursue graduate studies and a career in science. He came to the US with a Fulbright scholarship and got his MS in Biology at the University of Nebraska-Lincoln. He is currently pursuing a PhD in Complex Biosystems in which he is applying microbial systems ecology, data science and "-omics" tools for forensics applications. He likes writing scripts in Python, R and Shell Script to automatize his computational workflows. In his free time, he is a tennis and volleyball enthusiast and a not-very-good guitar player. Find him in Google Scholar and LinkedIn as Carlos Riera-Ruiz or in Twitter as @carlosriera90.


Annual Meeting T-Shirt!
T Shirt Design Winner: Emily Despres
Emily DNA Despres is a Forensic Scientist for the Massachusetts State Police Crime Lab in the DNA Unit. Prior to joining the Crime Lab in 2011, she served in the United States Marine Corp and attended UMass Amherts
NEAFS
FALL INTO FORENSICS
Niagara Falls, NY
Northeastern Association of Forensic Scientists
1976
Be sure to check out the NEAFS Merchandise Booth and neafs.org!

SPIDER THERMO

ENVIRONMENTAL MONITORING SYSTEMS

SENSOR TYPES:

Temperature
Humidity
Differential Air Pressure
Oxygen
Water
Customized Sensors Available

Calibration Services:

NIST Certification
SP/IEC 17025
ANSI/NCSL Z450.1
ANSI/NCSL Z450.3 through A2LA

The Next Generation in Wireless Sensing Technology

Sales@Spiderthermo.com **(856) 900-8342 Ext. 204**

Fieldable Analytical Detection & Identification Technologies: FTIR, Raman, HP-MS and GC-MS

Tuesday, October 18th 8:00am - 4:30pm

Location: DeVeaux

Instructors: **David Godin,** 908 Devices
Jessamyn Chmura, 908 Devices
Dave Schiering, Redwave Technology
Luisa Profta, PH.D, PMP, Rigaku Analytical Devices
Dr. Mike Hargreaves, Rigaku Analytical Devices
Kevin Jarboe, Teledyne FLIR
Rakesh Patel, Teledyne FLIR

Advancements in miniaturizing technology has brought traditional chemical instrumentation used for forensic analyses from the crime lab and into the hands of first responders and law enforcement professionals. Techniques such as colorimetric tests, Raman, infrared spectroscopy, and mass spectrometry are being ruggedized, miniaturized, and simplified so non-scientists can perform preliminary analyses on-scene. When utilized effectively, field detection reduces exposures to harmful materials, identifies probative samples, thus reducing backlogs, and provides real-time intelligence to focus investigative resources. In the laboratory, these devices are being used perform rapid screens to help guide analysis.

It's important for case-working analysts to become familiar with tools used by officers in the field to help guide and validate their use and have a firm understanding of the capabilities and limitations of field analysis tools. This workshop will introduce devices used by law enforcement to screen for controlled substances, explosives, and other harmful materials. Attendees will learn about the technological advances that allowed for the miniaturization of instrumentation, and how they're used in the field through a mixture of case studies, hands-on interaction, and demonstrations.

Portable FTIR Spectroscopy for In-Field Forensics

Key learning points:

- Introduction to portable FTIR spectroscopy instrumentation and methods
- Where does FTIR spectroscopy fit in the overall threat response?
- What are the strengths and weaknesses of FTIR spectroscopy for in-field forensics?
- The chemical threat space – the 'sweet spots' for FTIR spectroscopic analyses
- Application of FTIR Spectroscopy in the identification of chemicals - drugs, explosives, toxics - in the field

Key Takeaways from the talk:

- The specificity of IR absorption spectroscopy makes FTIR an indispensable method for in-field chemical analyses.
- The reduction of size, weight, and power and the hardening of FTIR spectrometers have made FTIR spectroscopy well suited for use austere environments.
- Technological advances in electronics, optics, and materials have made portable FTIR spectroscopy possible and have altered the trajectory of laboratory instrumentation as well.
- Advances in software and methods have made FTIR spectroscopy useful to responders in the field.

- FTIR spectroscopy can provide threat assessments on samples in any physical state – solid, liquid, and vapor.
- Sample preparation methods can extend the FTIR limit of identification into the trace regime.

Key learning points (complimentary to other presentations):

- Introduction to handheld Raman spectroscopy instrumentation
- Where does Raman spectroscopy fit in the toolbox and how does it compare vs other technologies
    - What are the strengths and weaknesses of Raman spectroscopy?
- Application of Raman Spectroscopy to the identification of chemicals - drugs, explosives, etc in the field

Using Portable GCMS for In-Field Chemical Identification

Key learning points:

- Introduction to GCMS instrumentation and methodology
- Where does GCMS fit in responder's toolbox / comparison to other portable analytical instrumentation?
- What are the strengths and weaknesses of portable GCMS?
- Applications of mobile GCMS in the identification of drugs/narcotics, CWAs, TICS, etc.

Key Takeaways from the talk:

- The specificity of GCMS combined with the power of NIST makes "gold standard" laboratory quality data possible in the field.
- The reduction of size, weight, power and advancements in computing have made portable GCMS well suited to mobile applications.
- GCMS can provide class-leading assessment of complex mixtures in any phase of matter (i.e., solid, liquid or air).
- Various sample preparation methods can further enhance end-user flexibility on how to introduce samples for analysis.

Field Applications of High Pressure Mass Spectrometry (HPMS)

Key learning points:

- Introduction to HPMS instrumentation and technology
- Algorithmic detection of fentanyl analogs using mass spec
- The application of "trace chemical evidence" to the investigatory process
- Field analysis of controlled substance case studies.

Key Takeaways from the talk:

- Advances in high pressure mass spectrometry allow for the operation of ion traps at nearly atmospheric pressure
- Reduction in size, weight, and power requirement allow for mass spec to be leveraged in the field for real time analysis.
- Utilizing a combination of analytical techniques at point of contact with unknown materials provides responders and law enforcement real time, actionable intelligence to conduct operations safely and efficiently.

Instructor Biographies

Dr. David W. Schiering is a founder and the Chief Technology Officer of RedWave Technology, a private company that develops and markets vibrational spectroscopy products for in-field chemical defense. Dr. Schiering has many years of experience in the chemical instrumentation field. He has held numerous scientific and management roles in technology and product development and has been previously employed by Smiths Detection, SensIR Technologies, Thermo Electron Corp., and Perkin Elmer. Dr. Schiering has written many publications on various aspects of vibrational spectroscopy. He earned a PhD in analytical chemistry from Miami University, where he is also an adjunct Assistant Professor of Chemistry. Dr. Schiering has served the Coblentz Society as a member of the Board of Managers and as secretary from 1991 to 2010. In 2011, Dr. Schiering was made an Honorary Member of the Coblentz Society and in 2018 received a Society of Applied Spectroscopy Fellows award.

Luisa Profeta, Ph.D., PMP, has been actively engaged in the defense and security industry, specializing in customer education and utilization of spectroscopic solutions for field analysis. Most of her past customers include various government agencies including, but not limited to, RDECOM, CTTSO and DTRA. Dr. Profeta has also led customer efforts on Reachback analysis, with 365/24/7 rapid turnaround time for critical customer data analysis, orchestrating the building of extensive libraries for customer fielded equipment for SSE, and taking emerging technologies and adapting them to fieldable demands.

Dr. Michael Hargreaves is currently VP Engineering at Rigaku Analytical Devices, a company that develops handheld Raman devices, used for chemical identification applications. He has over 15 years' experience in developing chemical identification devices. He has held several scientific and management roles in technology and product development and has previously worked for Cobalt (now Agilent), Ahura Scientific and Thermo Scientific. He has travelled extensively, working with many different end-users to refine and develop new capabilities. He has written many papers and several book chapters on the field of chemical identification using Raman & FTIR. He earned a Ph.D. from Nottingham University and holds chartered Chemist & Scientist status in the UK.

Kevin Jarboe is a Technical Account Manager for Teledyne FLIR supporting customer's CBRNE detection needs. He has over 12 years direct field experience with various detection equipment including GCMS, FTIR, PCR, radiological / isotope monitoring, etc. Over the years, Kevin has worked as an SME for numerous environmental response groups supporting first responders and federal agencies tasked with the identification of unknown substances (i.e., white powders, etc.) both inside and outside of the laboratory setting. He also specializes in critical infrastructure protection using portable and traditional benchtop type instrumentation. Kevin earned a BS in chemistry from George Mason University and an MS in biochemistry from the University of Maryland. During his time at Lockheed Martin, he also gained a lean-sigma six greenbelt that enabled him to streamline deployment processes for CBRNE instrumentation. Throughout his time with Leidos, Lockheed Martin and CSC (now GDIT), Kevin supported many government programs / customers including DoD, EPA and DoE (Oakridge National Laboratory) in addition to state and local agencies. With most of his career being a hands-on "end user", Kevin has a deep understanding and appreciation of real-world customer needs as it relates to CBRNE detection and protection.

Rakesh Patel is the Product Manager for Detection at Teledyne FLIR. Rakesh is based out of West Lafayette, IN. He has over 20 years of experience working with GC/MS instrumentation. Rakesh started his career in 1999 at the Office of Indiana State Chemist (OISC) which is located on the campus of Purdue University. He was there for 10 years where he worked with feed and fertilizer analysis for 5 years. He then moved into the Pesticide Residue lab which used GC/MS instrumentation for the analysis of pesticides in soil, vegetation, and other media. In 2011, an opportunity came up to work at FLIR in the R&D group using his GC/MS experience, for explosives detection. After about 6 years in the R&D group he was offered a position in the

service group as a Field Service Support/Engineer. He supported the G510 and was the primary trainer for the Griffin line of instruments. 2 ½ years later he was offered the role of Product manager for detection.

David A. Godin is the Director of Field Forensic Applications for 908 Devices in Boston, Massachusetts. He holds a Masters of Forensic Sciences Degree from Boston University, and a B.S. degree in Chemistry from the United States Military Academy. Mr. Godin served five years as a US Army Chemical Officer in the 110th Chemical Battalion, Technical Escort. During that time, he served as Chemical Analyst and Officer in Charge of the Combined Explosive Exploitation Cell-North in support of Operation Iraqi Freedom. He has trained hundreds of Emergency Response personnel in the field analysis of controlled substances, HAZMAT Operations, and CBRNE Response.

Jessamyn W. Chmura, ABC-CC, is the Lead Forensic Chemist with 908 Devices in Boston, MA. Ms. Chmura obtained her Masters of Science in Biomedical Forensic Sciences from Boston University and her Bachelors of Science in Biochemistry from Central Connecticut State University. Jessamyn began her career in forensics in the Boston Police Crime Lab in the Criminalist and Trace Evidence Sections. As an Applications Scientist with 908 Devices, she supports operations and investigations across the world with real-time data analysis and technical expertise.

Solutions for Forensic Toxicology

Reduce turnaround time and lower cost

Speed and comprehensive coverage of drugs are key to today's forensic toxicology lab. SCIEX has been a leader in high-speed screening technologies for the forensic community for many years. The technology offers the best in high speed, accurate LC-MS/MS screening.

- Increase accuracy with gold standard technology
- Reduce turnaround time to results
- Bring send outs in-house
- Offer better coverage, including synthetics
- Replace outdated antibody-based and GC/MS technologies for faster, more comprehensive results

Experience the power of SCIEX QTRAP® and QTOF technology

SCIEX is the innovator in LC-MS/MS solutions for screening and confirmation. Whether you need the quantitative speed and coverage of the QTRAP functionary or the unknown identification of the X500R QTOF, SCIEX offers technology and workflows to fit your needs. The speed and accuracy of either technology can switch between screening and quantitation mode in milliseconds.

Learn everything you need to know about mass spectrometry

SCIEX is your partner in training and continuing education. Use this page as your knowledge hub for mass spectrometry, capillary electrophoresis and related liquid chromatography technologies. And find out how advanced detection can benefit your lab.

Choose from:

- Classroom based training
- e-Learning
- On-site-training

Visit https://sciex.com/support/training to enroll

GCMS Fundamentals of Troubleshooting and Maintenance

Tuesday, October 18th 8:00am – 4:30pm

Location: Red Jacket

Instructors: **Agilent Technologies**
Kirk Lokits, GCMS Applications Scientist
Alexis Willey, Pre-Sales GCMS Chemist

The GCMS workshop will focus on the fundamental aspects of operational theory, troubleshooting, and maintenance of GC (Split/Splitless) inlets, FID detectors, and MS EI sources. Column selection and inlet and flow path troubleshooting, and maintenance will be discussed. The workshop format will be PowerPoint based but will have hands on labs involving split/splitless inlet modules, FID modules, and MS EI sources.

Gas Chromatography Basics

- Column Science
- How a GC column separates mixtures

Inlet and Detector Designs

- Split/Splitless (S/S)
- Septum and Inlet Liners
- Flame Ionization (FID) optional-class dependent

Mass Spectrometry Basics

- Theory of Quadrupole applied to Single Quadrupole, Triple Quadrupole, and Time-of-Flight
- Tuning and Evaluating a Single Quadrupole System
- Acquisition Parameters (optimizing your data quality)

Maintenance and Troubleshooting

Agenda
GC Basics, Inlet & Detector Designs (Lecture)
Hands-on Inlet Maintenance Lab
Hands-on FID Detector Maintenance Lab
Mass Spectrometry Basics (Lecture)
Hands-on Source Maintenance Lab

Instructor Biographies

Kirk E. Lokits
Agilent Technologies, GCMS Applications Scientist
Kirk received his B.S. in Forensic Science and Chemistry from Eastern Kentucky University, under Dr. Robert Fraas and began working as a Forensic Drug Chemist in the Miami Valley Regional Crime Laboratory in Dayton, Ohio. He then moved to Orlando, Florida where he worked as a Forensic Toxicologist for the Florida Department of Law Enforcement in the Orlando Regional Crime Laboratory and later as Crime Analyst Supervisor in the Pensacola Regional Crime Laboratory. Kirk left the forensic realm and began his tenure with Hewlett Packard/Agilent Technologies, working as a Customer Service Engineer (CE) supporting the LC, GC, LCMS, GCMS, and ICPMS products. While working for HP Kirk earned his M.S. in Analytical Chemistry from Middle Tennessee State University, under Dr. Gale Clark and in 2005 Kirk left Agilent Technologies to attend the University of Cincinnati and earned his Ph.D. in Analytical Chemistry under Dr. Joseph A. Caruso. After receiving his PhD., Kirk worked for the Midwest Research Institute (MRIGlobal) in Kansas City, MO where he worked as a Principal Chemist and Sr. Program Manager on Department of Defense projects, staffing, designing, and building remote laboratories for placement throughout the world. In 2014, Kirk re-joined Agilent Technologies as a GCMS Applications Scientist focusing on forensic applications within the GCMS product line.

Alexis Willey
Agilent Technologies, Pre-Sales GCMS Chemist
Alexis started with Agilent in 2017 as a Field Service Engineer supporting GC/GCMS products and Markes Thermal Desorption. She has taught GC courses internally for incoming engineers as well as participated in Fear Factor seminars and Lunch & Learns around her district to customers. Prior to joining Agilent, Alexis worked 7 years at DuPont/Chemours as an applications chemist responsible for GC, GC/MS, IC, SFC and LC/MS/MS method development and transfer to manufacturing labs for fluorochemicals and environmental pollutants. Previously, she was a GCMS lab technician for the industrial hygiene lab at EMSL Analytical from 5 years, a contract environmental lab in New Jersey, testing for air quality and drug screening.

Ethics in Forensic Science
Tuesday, October 18th 8:00am – 12:00pm
Location: Schoellkopf

Instructor: **Dr. Robin Bowen,** West Virginia University

Ethics is an understudied, yet significant topic when it comes to the field of forensic science. Although people may think of ethics as a personal matter, it also includes professional and public issues. Proper ethical behavior is required by scientists making complex decisions about the interpretation of data, about which problems to pursue, and about when to conclude an experiment, all which help to improve the quality of forensic science.

While the workshop includes many "basics," the course relates those ideas to the forensic science profession. To understand forensic-specific ethics, it is important to look at the interactions between the cultures of science, law, research, and law enforcement.

Upon completion of this course, the student will be able to:

- Demonstrate the relationship between science, technology, and society in ethics
- Examine the various types of conflicts and the problems they may create
- Analyze what ethical standards are in place for forensic scientists and related professions
- Evaluate how codes of ethics in science may contradict other professions
- Defend how and why unethical situations occur
- Analyze when and how to report misconduct and associated consequences

Attendees are given the opportunity to interact and discuss ethical situations that have taken place within the forensic science community. Attendees will be presented with scenarios and the ethical considerations involved with each. The attendees will provide insight from their work environments and represent the "real-world" of ethics in forensic science. Participants should be open to discuss and debate, while keeping an open-mind and a positive environment.

Instructor Biography

Robin Bowen is a Teaching Assistant Professor and FIS Minor Coordinator with the Department of Forensic Science at West Virginia University. Bowen is the author of Ethics and the Practice of Forensic Science, The Significance of Ethical Practices in Forensic Science in the Encyclopedia of Forensic Sciences, and various chapters on ethics in forensic science. She has participated as an advisory member of the Outreach and Communication Interagency Working Group (IWG) under the National Science and Technology Council Subcommittee (NSTC) on Forensic Science and as a member of the Editorial Advisory Board for the revised edition of Encyclopedia of Forensic Sciences. Bowen is the primary developer of the Forensic Educational Alliance, an initiative to offer a variety of forensic science continuing education online courses. She has an undergraduate degree in Forensic and Investigative Sciences, a graduate degree in Secondary Science Education, and a doctorate in Instructional Design and Technology.

Student Workshop
Tuesday, October 18th 1:00pm – 4:30pm
Location: Schoellkopf

Instructors: **Anisha Paul,** Vermont Forensic Laboratory Department of Public Safety
Andrea Belec-LaJoy, Champlain Toxicology Laboratory
Chris Chany, Texas Department of Public Safety, Crime Lab Division, Austin Laboratory

"The Real World"
You're in the home stretch of all these years of classes, studying and research and on the cusp of getting your degree and getting that "real job." How do we do that? What's the best way to interview? What are the right questions to ask? Am I expecting too much? Am I expecting too little? What if there's a hiring freeze at my dream agency – do I flip burgers until I get my dream job? Once I have that "perfect" job – how do I stay current and competitive as the person with the least seniority? Join Chris, Andrea, and Anisha as they discuss the ins and outs of interviewing, getting the right job, keeping the right job and deciding if and when it is best to move onto another opportunity. Topics to be discussed include: job requirements and descriptions, civil service rules and salaries, internships, resumes, interviewing skills. They'll also compare and contrast the differences between working in the public and private sectors. Bring your resume and your questions!

Instructor Biographies

Anisha Paul works in the Toxicology division of the Vermont Forensic Laboratory. She graduated with a Master's of Science in Forensic Science from Arcadia University and received a Bachelor's of Science degree in Biochemistry, Chemistry, and Microbiology from Osmania University in India. She also holds board certification as a Diplomate of the American Board of Forensic Toxicology (D-ABFT-FT). At the Vermont Forensic Laboratory her primary responsibilities include analyzing blood samples for alcohol and impairing drugs, performing method validations, and providing expert testimony on alcohol and drug physiology and pharmacology. Outside of the lab, she is an adjunct professor at Champlain College and is an active member of the National Safety Council-Alcohol Drugs and Impairment division (NSC-ADID), Society of Forensic Toxicologists (SOFT), International Alliance of Clinical and Forensic Toxicologists (IACFT), Council of Forensic Science Educators (COFSE), and North Eastern Association of Forensic Scientists (NEAFS), where she currently serves on the Board of Directors. When Anisha isn't working you will find her hanging out with her two cats, dog, and turtle. She loves a good beer and is still working on truly enjoying life in the tundra!

Andrea Belec LaJoy is currently working as the Lab Operations Director for Champlain Toxicology Lab in Plattsburgh, NY. With over thirty years of experience in analytical chemistry, she received her introduction to forensic toxicology while working with laboratory automation and sample prep applications for Zymark Corporation. Andrea further developed her skills with Sciex and later Waters Corporation. In 2003, she took the plunge leaving industry and spent nearly a decade at the New York State Police Forensic Investigation Center's Toxicology Unit in Albany, NY. In late 2012, Andrea was offered an opportunity to build a startup drug screening lab in Burlington, VT into a full-service urine toxicology lab. Over the course of four years, she built it from a five-person screening

lab to a company of 180 employees, fifty-five of whom were in the lab. Andrea left Burlington Labs in 2016 to transform a two-person Physician Office Lab in Plattsburgh, NY into an accredited urine toxicology reference lab. Champlain Toxicology has a strong client base in Pain Management and Addiction/Recovery testing and serves as the toxicology lab for the largest hospital system in northern NY and Vermont. A native of Long Island, Andrea is a former NEAFS President and also a member of the Society of Forensic Toxicologists. She resides in northern Vermont on an island in the middle of Lake Champlain with her husband, Scott, their dog and two cats who think they are dogs. Andrea can be found camping (ok, really glamping) from May through October with a knitting project always nearby.

Chris Chany started at the Westchester Co Forensic Lab on October 3, 1977, as a Drug chemist, Chris spent 29 1/2 years performing chemical analyses on Drugs, fire debris, gunshot residue distance determination, gunshot primer residue, paint, tear gas, explosives, and general unknowns. In March of 2007 he became Lab Director of the Yonkers PD Forensic Science Lab. After overseeing their transition from ASCLD-LAB Legacy to International (ISO 17025) accreditation, he retired and moved to Texas where he started his second career as a Gunshot Primer Residue analyst for the Texas Department of Public Safety Crime Laboratory in Austin, Texas. He, along with the late George W. Chin, started the student forum at the 2004 Annual Meeting in Mystic, CT.

Scientific Sessions:
Forensic Toxicology

Wednesday, October 19th 9:00am – 12:00pm
Location: Cataract

Chair: Sabra Jones, National Highway Traffic Safety Administration

9:00am – 9:05am	**Opening Remarks**
9:05am – 9:20am	**Standardization, Impaired Driving, and the Regional Toxicology Liaison Demonstration Project** Sabra Jones[1], Chris Hearsill[1], Kristen Burke[1], and Amy Miles[1,2], [1]Regional Toxicology Liaisons NHTSA Regions 5, 7, 9, [2]Wisconsin State Laboratory of Hygiene, Madison, WI
9:20am – 9:35am	**Antihistamines in Driving Under the Influence of Drugs Investigations** Jolene Bierly, NMS Labs
9:25am – 10:00am	**Validation of Drugs in Umbilical Cord Tissue by LCMSMS** Andrea Belec, Champlain Toxicology Lab
10:00am – 10:15am	**Break**
10:15am – 10:45am	**Review of a Drug Facilitated Crime Involving Zolpidem** Celeste Wareing, Boston University School of Medicine, Biomedical Forensic Sciences
10:45am – 11:00am	***Chiral Analysis of Methamphetamine in Hair Samples** Kristen Payes, Damon Borg, PhD, Richard Stripp, PhD, and Marta Concheiro-Guisan, PhD, John Jay College of Criminal Justice and Cordant Health Solutions
11:00am – 11:20am	**Enhancing High-Resolution Mass Spectrometry Performance for NPS Analysis with Improved Sensitivity and Characterization** Joe Doktorksi and Pierre Negri, PhD, SCIEX
11:20am – 11:50am	**Panel Discussion: Addressing the Challenges Toxicology Laboratories Face**
11:50am – 12:00pm	**Closing Remarks and Toxicology Session Wrap Up**
12:00pm – 1:30pm	**Annual Business Lunch** (*requires ticket)*

***Denotes Peter R. De Forest Collegiate Competition Participant**

Toxicology

Abstracts

Standardization, Impaired Driving, and the Regional Toxicology Liaison Demonstration Project

Sabra Jones[1], Chris Hearsill[1], Kristen Burke[1], and Amy Miles[1,2], [1]Regional Toxicology Liaison Project and [2]Wisconsin State Laboratory of Hygiene

Background/Introduction: There has been a sharp increase in drug-impaired driving across the country. A recent National Highway Traffic Safety Administration report on 2020 Traffic Fatality Data found 38,824 people died on US roadways, with a 6.8% increase in fatal crashes. Of that, 45% of fatal crashes involve risky behavior such as driving impaired by alcohol, speeding, or not wearing a seatbelt. Alarmingly, alcohol-impaired fatalities increased by 14% compared to 2019 data, even with an 11% decline in vehicle miles traveled. The National Safety Council recently published that the traffic death rates in 2021 exceeded the rate of 2019 by 19%.

Objectives: To more fully understand and address the issue of drug-impaired driving, the Regional Toxicology Liaison (RTL) Demonstration Project aims to benefit state toxicology programs through increased support, communications, resources, and criminal justice system coordination; decreased processing time of toxicology samples; and better data reporting. In 2022, the Project established Toxicology Liaisons that support states in NHTSA regions 5, 7, and 9 (https://www.nhtsa.gov/about-nhtsa), to assist with training, collaboration, and the standardization of testing across state laboratories as well as improving the reporting of data to understand the scope of the drug-impaired driving problem.

Methods: The Regional Toxicology Liaisons work within and collaborate between their respective regions identifying stakeholders within each state, laboratory engagement, collaboration, and evaluation of training requests. The RTLs work together to ensure consistency within the program and share information and resources. Additionally, the Project provides a quarterly report to the SOFT Board of Directors and periodic updates regarding activities, progress, and needs assessments.

Results: Through SOFT, Regional Toxicology Liaisons are involved in various committees to understand current trends in drugged driving, laboratory testing, and laboratory needs. The RTLs are engaged in meetings with stakeholders in each state, including NHTSA regional offices, State Impaired Driving Task Forces, State Traffic Safety Resource Prosecutors, and other regional liaisons, including Judicial Outreach Liaisons and Law Enforcement Liaisons.

Conclusion/Discussion: This presentation will provide an overview of the Project and activities accomplished within the first ten months of the program.

Antihistamines in Driving Under the Influence of Drugs Investigations

Jolene Bierly, NMS Labs

Intro: First generation-antihistamines with H1-antagonist action are known to produce CNS depressant side effects, such as drowsiness and fatigue. While these side effects are known to be incompatible with safe driving, few publications are available regarding the impacts of these drugs in DUID investigations. This study was performed to investigate the prevalence of first-generation antihistamines in the driving population and to provide case histories demonstrating their effects on driving.

Methods: First-generation antihistamines are included in the scope of Tier II DUID testing at NMS Labs. Diphenhydramine, hydroxyzine, chlorpheniramine, doxylamine, and promethazine are screened via LC-TOF/MS and confirmed via LC-MS/MS or GC-NPD at the reporting limits listed in Table I. Antemortem blood specimens requesting the Tier II DUID expanded panel submitted between January 1, 2017 and May 31, 2022 were reviewed.

Table I. Screening and Confirmation Reporting Limits and Confirmation Instrumentation for First-Generation Antihistamines

Antihistamine	Screening Reporting Limit (ng/mL)	Confirmation Reporting Limit (ng/mL)	Confirmation Instrumentation
Diphenhydramine	50	50	LC-MS/MS
Hydroxyzine	25	5	LC-MS/MS
Promethazine	5	5	LC-MS/MS
Chlorpheniramine	10	10	LC-MS/MS
Doxylamine	50	100	GC-NPD

Results: More than 10,500 Tier II expanded panels were ordered during the study period. Positivity and concentration information for each antihistamine in the Tier II panel is provided below (Table II).

Table II. Summary of First-Generation Antihistamine Positivity from DUID Casework, 2017 to 2022

Antihistamine	Percent Positivity	Number of Positive Confirmations	Mean ± SD (ng/mL)	Median (ng/mL)	Concentration Range (ng/mL)
Diphenhydramine	2.2	232	303 ± 410	135	50 – 3200
Hydroxyzine	2.1	232	70 ± 85	47	7.9 - 600
Promethazine	0.5	66	34 ± 50	20	5.8 - 280
Chlorpheniramine	0.4	47	162 ± 151	110	10 - 580
Doxylamine	0.3	16	223 ± 66	195	100 - 500

Diphenhydramine and hydroxyzine were the most prevalent antihistamines (78%). Polypharmacy was common with 94% of all antihistamine cases involving other drugs. Common drug combinations included antihistamines with benzodiazepines, opioids, and antidepressants. There were 13 cases where diphenhydramine was the only drug indicated and an additional 6 hydroxyzine only cases. Means ± SD, medians, and ranges for these cases were 772 ± 957 ng/mL, 320 ng/mL, (59 – 3200 ng/mL) and 30 ± 23 ng/mL, 19 ng/mL, (10-78 ng/mL), respectively. One case history

involved a 27-year-old male who ran a stop sign. CNS depressant effects, such as swaying, inability to follow instructions, and poor balance were observed by law enforcement. Toxicology testing confirmed the presence of hydroxyzine at 16 ± 4 ng/mL with no other significant findings.

Conclusion: This review found the overall positivity of first-generation antihistamines in DUID cases to be <3% for each drug included in the scope. Most antihistamine confirmations involved diphenhydramine and hydroxyzine (78%). Significant impairment to driving and human performance was observed in case histories involving first-generation antihistamines. Approximately 94% of the cases involved antihistamines in combination with other drugs.

Validation of Drugs in Umbilical Cord Tissue by LCMSMS

Andrea Belec, Champlain Toxicology Lab

With the opiate epidemic still raging, the most helpless victims are infants born to mothers struggling with Substance Use Disorder. Depending on what specific drugs were being taken by the mother, infants may not show signs of withdrawal until five to ten days after their birth. The wide majority of babies are home and not under direct medical supervision when withdrawal symptoms begin. Drugs can deposit into umbilical cord tissue up to 20 weeks back in a pregnancy so the "look back" is dramatically longer when compared to other matrices. By identifying drugs in umbilical cord tissue within hours of their birth, hospitals can clinically manage these little patients and work to minimize effects. This presentation will discuss all aspects of validation and include detailed discussion of sample preparation challenges with this matrix compared to other matrices, the specific solid phase extraction process that was performed and the subsequent LCMSMS analysis.

Review of a Drug Facilitated Crime Involving Zolpidem

Celeste Wareing, MS, Boston University School of Medicine, Biomedical Forensic Sciences

The sedative-hypnotic and amnesic effects of Zolpidem make it an attractive drug used in drug facilitated crimes. This case involves a young female exchange student that was allegedly dosed with zolpidem by her host father under the guise of it being aspirin. Both blood and urine were collected during a sexual assault examination the morning after the alleged assault. Toxicological analysis showed the presence of zolpidem in both samples.

***Chiral Analysis of Methamphetamine in Hair Samples**

Kristen Payes[1], Damon Borg[1,2], Richard Stripp[1,2], Marta Concheiro-Guisan[1], [1]John Jay College of Criminal Justice, [2]Cordant Health Solutions

Methamphetamine (MAMP) is a highly addictive illicit drug typically abused for its nervous system stimulating effects. Conversely, methamphetamine has therapeutic use treating attention deficit hyperactivity disorder, controlling appetite and assisting with weight loss, and is available as the pure l- isomer in over-the-counter (OTC) nasal inhalers due to its decongestant activity. Because l-methamphetamine (l-MAMP) is available in OTC form, forensic guidelines require a sample to contain greater than 20% d-methamphetamine (d-MAMP) when classifying results as consistent

with illicit MAMP use. Chiral chromatographic analysis is capable of distinguishing between l-MAMP and d-MAMP. This study was designed to develop and validate a method for the detection of d/l-MAMP in hair. Reverse phase liquid chromatography with tandem mass spectrometry (LC/MSMS) and a chiral derivatizing agent were used in this study. MAMP was extracted from hair specimens using mixed mode cation exchange solid phase extraction cartridges and extracts derivatized with Marfey's reagent. Chromatographic separation of the isomers was achieved using a standard reverse phase (C18) LC column. Linearity, accuracy and precision were all within acceptable criteria. Intraday accuracy ranged from 96.76% to 102.62% and a precision 0.31 to 2.80%. Previously tested hair samples that resulted in a positive result for methamphetamine using non-chiral analysis were analyzed using this validated method. It was found that 100% of all samples (n = 20) tested positive for d-MAMP at greater than 20%.

Keywords: l-methamphetamine, d-methamphetamine, hair, Marfey's Reagent, LC/MSMS

Enhancing High-Resolution Mass Spectrometry Performance for NPS Analysis With Improved Sensitivity and Characterization

Joe Doktorski and Pierre Negri, PhD, SCIEX

Short Abstract

The technology advancements of the ZenoTOF 7600 system provides the ability to confidently characterize and identify novel psychoactive substances (NPS) present in authentic case samples. at trace levels that were not previously achievable.

Extended Abstract

This presentation will showcase how the benefits of the new technological features introduced on the ZenoTOF 7600 system provide a high degree of sensitivity, selectivity, and confidence for sensitive novel psychoactive substances (NPS) detection and characterization. The addition of a Zeno trap (which improves MS/MS duty cycle) in combination with the use of a hybrid collision cell (which offers an alternative fragmentation capabilities) are leveraged to significantly improve MS/MS sensitivity and provide richer fragmentation for improved structural information, respectively. These technological advancements were investigated for the characterization and identification of NPS, and more specifically novel synthetic opioids (NSO) in a series of authentic case samples. The depth of information extracted from the unique fragmentation capabilities of electron-activated dissociation (EAD) enabled differentiation of structurally related isomeric species that were not previously discernable using convention collision-induced dissociation (CID). In addition, the improved MS/MS sensitivity resulted in confident identification of key drugs and metabolites at trace levels that were not previously achievable. Overall, the use of the ZenoTOF 7600 system provided a means to characterize and monitor low-levels of ultra-potent NSO in poly-drug intake scenarios. These advancements are shown to support the case of combined opioid drug toxicity leading to death, which offers a clearer picture for help in determining the cause of death.

Learning Objectives:
After having attended this presentation, one will:

a) Learn the instrument features on the ZenoTOF 7600 system that provide qualitative flexibility combined with quantitative power for NPS detection and characterization
b) Understand how the depth of information extracted from EAD-based MS/MS spectra combined with the improved MS/MS sensitivity can be leveraged for characterization of structurally related isomeric species present at low levels in authentic case samples
c) Learn how these new technological advancements on the ZenoTOF 7600 are leveraged to provide more confidence in the quantified amounts of drugs and metabolites detected in authentic case samples which is critical when determining the cause of death following an accidental overdose

***Denotes Peter R. De Forest Collegiate Competition Participant**

Scientific Sessions:
Trace Evidence/Fire Debris & Explosives
Wednesday, October 19th 1:00pm – 5:00pm
Location: Cataract

Chair: Roberta Westerman, Massachusetts State Police Crime Laboratory, MA
Co-Chair: John Biello, Massachusetts State Police Crime Laboratory, MA

1:30pm – 2:00pm	**Understanding the Science and Concerns Behind the Possible Conversion of Helium to Hydrogen Carrier Gas for EI GCMS Systems** Kirk Lokits, PhD, GCMS Applications Chemist, Agilent Technologies
2:00pm – 2:20pm	**Automation Possibilities for Fire Debris Analysis using ChemStation Macros** Euguene Zegocki, Monroe County Crime Laboratory
2:20pm – 2:35pm	***Determining the Variability in Color in Human Head Hair** Emma Redman, and Lawrence Quarino, PhD, ABC-GKE, Cedar Crest College
2:35pm – 3:00pm	**Ghost Guns** Pete Diaczuk, PhD, John Jay College
3:00pm – 3:15pm	**Break**
3:15pm – 3:35pm	***Elemental Profiling of Gunshot Residue with Multiple X-ray Fluorescence Spectroscopic Techniques** Samantha Gong, BS, Nicole Homburger, BS, and Ling Huang, PhD Hofstra University, Hempstead, NY
3:35pm – 3:50pm	***Optimization in the Identification of Inorganic Ions Found in Home-Made Explosives Using Microcrystalline Tests and Raman Microspectroscopy** Krystal Sears, and Lawrence Quarino, PhD, ABC-GKE, Cedar Crest College
3:50pm – 4:10pm	**Fluorescence in Forensic Fiber Examinations** Michelle Mercer, Monroe County Crime Laboratory
4:10pm – 5:00pm	**ATF – National Response Team** John Pijaca, SACFI, IAAI-CFI, ATF, retired

***Denotes Peter R. De Forest Collegiate Competition Participant**

Trace, Arson & Explosives Abstracts

Understanding the Science and Concerns Behind the Possible Conversion of Helium to Hydrogen Carrier Gas for EI GCMS systems
Kirk Lokits, PhD, GCMS Applications Chemist, Agilent Technologies

Helium has historically, with valid scientific reasons, been the preferred carrier gas for GCMS and the majority of GC analysis. Within the last decade there has been an increase in the difficulties to procure UHP helium in the quantities required for full laboratory operations and or a drastic increase in the overall cost of UHP helium tanks. Due to its chemical and physical characteristics, high resolution chromatographic separations can be achieved with minimal analyte interactions. GCs with atmospheric detectors often utilize alternative carrier gases such as nitrogen, argon, and hydrogen. However, when the GC is coupled to a mass spectrometer under high vacuum, parameters based on a mean free pathway of ion molecules, vacuum, low background, and high sensitivity come into play. Based on these parameter limitations, of the previously mentioned carrier gases, hydrogen is the practical alternative. Nonetheless, hydrogen does have disadvantages that may cause a GCMS analyst to re-evaluate the urgency to convert to hydrogen carrier based on its reactivity with some analytes, reduced sensitivity, increased peak tailing, and reduced spectral fidelity when compared to helium generated reference spectra.

Ultimately, helium is the preferred carrier gas choice, but if not available, hydrogen may be considered. The purpose of this presentation is to help analysts determine if hydrogen can be used as a carrier gas for their specific analysis. Furthermore, the illustration of best practices, specific MS source configurations, forensic drug data examples, and the acquisition parameters necessary to help determine if the transition of a specific application is or is not compatible for hydrogen carrier gas on a GCMS system, will be discussed.

Automation Possibilities for Fire Debris Analysis using ChemStation Macros
Eugene Zegocki, Monroe County Crime Laboratory

ChemStation macro language provides ample possibilities for automation tasks. Using macros, it is possible to automate screening, pattern recognition, identification and documentation of GC/MS instrument results. The author designed and tested a set of macros for Agilent GC/MS instruments using ChemStation software for Fire Debris analysis.

A set of macros automatically process sequences containing samples for one or several cases. The program screens GC/MS data and identifies ignitable liquids. In certain cases, the program only indicates ignitable liquids and those should be cleared by analyst. If analyst does not agree with the automated identification results, he/she could change suggested results or references manually prior to printout. There are embedded tools for comparison of patterns and peaks, MS library search and searches in folders containing GC/MS data of previously run samples, for example, NCFS samples helping an analyst to confirm or reject suggested result.

There is a predefined directory containing references (previously run ignitable liquids). If an ignitable liquid is identified, the program selects appropriate reference(s), automatically makes extracted ion profiles and/or peak RT and mass spectra comparisons. In the case of low intensity peaks the background could be subtracted, thus making better library hits.

Results are produced in PDF format for final review. The printout includes total ion chromatograms of ASTM test mixture, blanks, items in the case, library searches, extracted ion profiles for identified ignitable liquids and appropriate references and might include all additional manual comparisons.

Data is combined in one PDF file, which is easy to use in a paperless workflow process. Printout could be automatically paginated. Also, obtained results could be automatically inserted into pdf form notes, if analyst use those.

***Determining the Variability in Color in Human Head Hair**
Emma Redman and Lawrence Quarino PhD, ABC-GKE, Cedar Crest College

Color has often been used as a parameter in human head hair microscopic comparative analysis [1]. What is not known is the extent of variation of naturally colored hair within an individual and between individuals with the same shade of hair. This study is designed to measure the extent of the variability and to determine if color can be reliably used as a parameter in microscopic hair examination. Fifty head hairs were collected from several Caucasian women displaying the same shade of brown hair. Each hair was mounted on glass slides with DPX mounting media (nD - 1.521) and examined at 200x using an Olympus BX53 polarizing light microscope under Kohler illumination. Color measurements in the RGB system (red, green, blue) was performed using CellSens® software. Color measurements were taken at defined points in the cortex, 100-300mm from the edge of the root. This area was chosen since it was found to show the most consistency in terms of color. Median RGB values for each participant were grouped together and compared using principal component analysis (PCA) and linear discriminant analysis (LDA). Results showed significant data overlap between individuals with little to no discriminate value. Similarly, significant overlap between individuals was observed qualitatively using color charts based on median hair values. In addition, a randomly selected hair was compared to the other forty-nine hairs removed from one participant by calculating a delta E value between RGB values. Only one comparison yielded a delta E value below the threshold of minimal color difference, two comparisons provided values consistent with more subtle but distinct difference, while forty-seven yielded values showing notable differences in color. This implies that the intrapersonal variability of hair color is high. Given the data generated both qualitatively and quantitatively in this study, color may have limited utility in microscopic hair comparisons.

[1]. Robertson J., Brooks E. A Practical Guide to the Forensic Examination of Hair From Crime Scene to Court, 2st Edition, 2021.

Ghost Guns

Pete Diaczuk, PhD, John Jay College

Ghost guns, now classified as Privately Manufactured Firearms, or PMFs, are guns without serial numbers. Not too long ago, these were identified as an issue due to the low rate of traceability (less than one percent) with increased use in crimes. According to the Bureau of Alcohol, Tobacco, and Firearms (BATF), "approximately 45,000 reports of suspected privately made firearms (PMFs) were recovered by law enforcement in criminal investigations — including 692 used in homicides or attempted homicides" --- from January 2016 to December 2021. This presentation will explore the concept of ghost guns in comparison with their legitimate counterparts, including unserialized firearms in general.

***Elemental Profiling of Gunshot Residue with Multiple X-ray Fluorescence Spectroscopic Techniques** Samantha A. Gong, BS, Nicole Homburger, BS, and Ling Huang, PhD Hofstra University, Hempstead, NY

Gunshot residue (GSR) is the material from firearm ammunition cartridges that is dispersed into to the surrounding environment during and after the discharge of a firearm. GSR is made up of various organic and inorganic compounds that originate primarily from propellant powder, primer material, and the body of the bullet within the cartridge [1]. In this project, GSR was analyzed using paired scanning electron microscope with energy dispersive X-ray fluorescence spectroscopy (SEM-EDS), portable X-ray fluorescence spectroscopy (p-XRF), and total reflection X-ray fluorescence spectrometry (TXRF). The results of the three analyses were compared and contrasted to evaluate each type of XRF technique for their unique capabilities and weakness.

In crime laboratories, the most important aspect of GSR analysis is to determine if the evidence collected is indeed GSR. The most commonly used instrumentation for the elemental analysis of gunshot residue is SEM-EDS [2]. SEM-EDS is used to analyze a sample of presumed GSR material to determine if a suspect has recently handled a firearm [3]. SEM-EDS searches collected material for particles containing a tri-element composition of lead, barium, and antimony that is characteristic to GSR [3]. SEM has the ability to scan and visualize the microscopic GSR particles and analysts generally look for spherical, flattened, or partially splattered particles to focus on. EDS, a type of X-ray fluorescence (XRF) spectroscopy that is coupled with SEM. After locating a scanning area on SEM, EDS has the ability to determine the elemental composition of these particles and determine if they are consistent with the known makeup of GSR.

SEM-EDS analysis focuses on the materials found on the suspect's hands. There is additional information to be found, though, on the impact site of the projectile. GSR collected on a fabric target from a short-range was found to collect residues from most if not all of the sources of GSR. In a previous study, this collection of GSR was analyzed using TXRF [4]. Samples collected in the same method as the TXRF study could be used for analysis by SEM-EDS to look for the same information as traditional GSR analysis. Additionally, a p-XRF instrument could be used to analyze the same samples and as such was added to the comparison.

Through these analyses, different types of ammunition were found to consistently produce distinct elemental profiles from the GSR. Lead, as the main element composing the bullet, was the primary

element of interest. The analyses also extended to copper, barium, antimony, iron, and zinc. Each XRF analysis had unique information to present about the elemental makeup of GSR. For practical forensic uses, the information obtained from these XRF techniques could be used as the basis of a predictive tool to associate ammunition types and the GSR on the targets of close-range shootings. The project, furthermore, shows various pros and cons of each instrument. The findings of the instrumental comparison could then assist GSR analysts in deciding which type of XRF instrument is suitable for their own investigation.

References (1) Dalby, O.; Butler, D.; Birkett, J. W. Analysis of Gunshot Residue and Associated Materials—A Review. Journal of Forensic Sciences 2010, 55 (4), 924–943. https://doi.org/10.1111/j.1556- 4029.2010.01370.x. (2) Guide for Primer Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry, SWGGSR, 2011. https://www.swggsr.org/publications (accessed March 26, 2021). (3) Blakey, L. S.; Sharples, G. P.; Chana, K.; Birkett, J. W. Fate and Behavior of Gunshot Residue-A Review. J. Forensic Sci. 2018, 63 (1), 9–19. https://doi.org/10.1111/1556-4029.13555. (4) Gong, S. A.; Homburger, N.; Huang, L.; Elemental profiling of total gunshot residue using total reflection X-ray fluorescence spectroscopy. J. Forensic Sci. 2022, 67(3), 1198-1207. https://doi.org/10.1111/1556-4029.14988

***Optimization in the Identification of Inorganic Ions Found in Home-Made Explosives Using Microcrystalline Tests and Raman Microspectroscopy**

Krystal Sears and Lawrence Quarino, PhD, ABC-GKE, Cedar Crest College

Identifying inorganic ions commonly found in homemade explosives provides examiners a strong starting point for the scientific investigation of explosive debris. Common methods of analyzing explosive debris typically require extensive sample preparation, multiple types of instrumentation, and are time consuming and expensive. This presentation is a continuation of a study designed to introduce an efficient and cost-effective method to screen for specific inorganic ions indicative of explosive residue utilizing the Raman microscope. Ions found in firework, fertilizer, and bleach were chosen for examination. Microcrystalline tests were performed on aqueous solutions of inorganic compounds containing the anions and cations of interest using nitron, silver nitrate, and squaric acid. Raman spectra were then generated from microcrystals at 200x using the Raman microscope and corrected for baseline, fluorescence, and smooth. Parameters including type of slide, number of scans, power of laser, scanning range, and aperture were determined for each ion. Often the parameters for each ion were different. Optimization of parameters resulted in noticeable and distinguishable Raman spectra for each ion tested. Combined with the morphology and habit of the microcrystal generated, the differentiation of seven cations (ammonium, barium, calcium, potassium, silver, sodium, and strontium) and nine anions (acetate, chlorate, chloride, nitrite, nitrate, perchlorate, phosphate, sulfate, and tartrate) was achieved. The generation of microcrystals using the three reagents with subsequent examination by Raman microspectroscopy can normally by achieved in less than ten minutes demonstrating the efficiency of the method making it suitable for application in a crime lab.

Fluorescence in Forensic Fiber Examinations

Michelle Mercer, Trace Evidence/Fire Debris Examiner at the Monroe County Crime Laboratory in Rochester, NY. ASTEE member and current OSAC Trace Materials Subcommittee Fiber Task Group Chair.

The 2021 Collaborative Testing Services, Inc. (CTS) fiber proficiency test had a larger number of labs not reaching the expected answer. It was determined that fluorescence was the primary discriminating property that enabled the majority to correctly exclude a fiber pair. Additional issues were found with the instrumentation that was used among some laboratories, specifically with older fluorescence light microscopes and/or filter cubes with limited ranges.

What began as an informal ASTEE forum discussion became a project for the OSAC Fiber Task Group to investigate further. A meeting with representatives from CTS then led to a survey sent out to the ASTEE membership. The purpose of the survey was to capture the experiences of participating laboratories with the PT, as well as how they use fluorescence in general for fiber examinations. The survey data collected includes: brands of microscopes, types of filter cubes, and mounting medium utilized; discriminating power of specific filter cubes/wavelength range; value of fluorescence microscopy for certain fiber types/colors; and selection of representative samples for testing.

This presentation will give an overview of the 2021 fiber proficiency test, the results of the ASTEE survey, and current recommendations for the use of fluorescence in fiber examinations. Discussion and feedback received will assist the Fiber Task Group to evaluate whether there is a need to write a guidance document specifically on fluorescence.

ATF – National Response Team
John Pijaca, SACFI, IAAI-CFI, ATF, retired

This presentation will touch on the similarities and diversities with transitioning as an ATF Agent within the field of
fire investigations to the private sector as an independent contractor.

***Denotes Peter R. De Forest Collegiate Competition Participant**

Scientific Sessions:
Criminalistics/Crime Scene & Digital Evidence
Wednesday, October 19th 9:00am – 5:00pm
Location: Red Jacket

Chair: Amy Brodeur, Boston University School of Medicine, Biomedical Forensic Sciences
Co-Chair: Season Seferyn, Onondaga County Center for Forensic Sciences

9:00am – 9:05am **Opening Remarks**

9:05am – 9:20am **Changes in the Bacteroidetes: Firmicutes Ratio of the Thanatomicrobiota in Substance Abuse Disorders**
Gulnaz Javan, Alabama State University

9:20am – 9:55am **Gun-Shot**
Peter Diaczuk, PhD, John Jay College of Criminal Justice

10:00am – 10:15am **Break**

10:20am – 10:40am ***The Study of Hyoid Bone Fracture Patterns**
Grace Stockmal, Roger Sherman, MS, Jennifer Hammers, DO, John Viator, PhD and Pamela Marshall, PhD, Duquesne University

10:40am – 11:00am ***The Twig Is Up: Forensic Identification of Endangered Wood Species by DART-HRMS and Multivariate Statistical Analysis to Combat Illegal Logging**
Mónica Ventura, Samira Beyramysoltan, PhD, Benedetta Garosi, Meghan Appley, and Rabi Musah, PhD, University at Albany; Edgard Espinoza, PhD, National Fish and Wildlife Forensic Lab

11:00am – 11:20am **Fly Curious: A Non-Destructive Approach to Entomotoxicology Through Direct Analysis in Real Time-High Resolution Mass Spectrometry (DART-HRMS) Examination of Insect-Ethanol Suspensions**
Amy Osborne and Rabi A. Musah, PhD, University at Albany; Jennifer Y. Rosati, PhD, John Jay College of Criminal Justice

11:20am-11:40am ***Footwear Image Quality Classification: Using Expert Assessments and Image Metrics to Predict Impression Quality**
En-Tni (Lily) Lin, West Virginia University

12:00pm – 1:30pm **Lunch** (*requires ticket)*

1:45pm – 2:00pm **Analysis of Distortion in BVDA Gel Lift Method of Obtaining Footwear Impressions in Relation to Time of Rest Before Evidence Application**

Shian Valles and Wade Knapp, University of Toronto; Amanda Lowe, Ontario Provincial Police

2:00pm-2:20pm ***Estimate of the Random Match Frequency of Acquired Characteristics in a Forensic Footwear Database**
Alyssa Smale, MPS and Jaqueline Speir, PhD, West Virginia University

2:20pm- 2:40pm **A Cold Case Homicide Solved After 37 Years**
Beth Saucier Goodspeed, Massachusetts State Police Crime Laboratory

2:40pm-2:45pm **Closing Remarks**

3:00pm – 3:15pm **Break**

***Denotes Peter R. De Forest Collegiate Competition Participant**

Criminalistics, Crime Scene & Digital Evidence Abstracts

Changes in the Bacteroidetes: Firmicutes Ratio of the Thanatomicrobiota in Substance Abuse Disorders

Gulnaz Javan, Alabama State University

The microbiota gut-brain-axis is a bidirectional circuit that links the neural, endocrine, and immunological systems with gut microbial communities. The gut microbiome plays significant roles in human mind and behavior, specifically pain perception, learning capacity, memory, and temperament. Studies have shown that disruptions in the gut microbiota have been associated with substance use disorders. The interplay of gut microbiota in substance abuse disorders has not been elucidated; however, postmortem microbiome profiles may produce promising avenues for future forensic investigations. The goal of the current study was to determine gut microbiome composition in substance abuse disorder cases using transverse colon tissues of 21 overdose criminal cases versus 19 non-overdose-related cases. We hypothesized that postmortem samples of the same cause of death will reveal similar taxonomic relationships. A heatmap was generated of the relative abundances of the 30 most prevalent bacteria per case and their associated substance profile. The results revealed that samples of the same cause of death cluster together, showing a high degree of similarity between samples and a low degree of similarity among samples of different causes of death. Our examination of human transverse colon microflora in decomposing cadavers extends emerging literature on postmortem microbial communities, which will ultimately contribute to advanced knowledge of human putrefaction.

Gun-Shot

Peter Diaczuk, PhD, John Jay College of Criminal Justice

A felon who was carrying a concealed firearm was spotted by law enforcement. The felon turned and fled, and while being pursued on foot, the felon was fired upon. One shot hit the fleeing man, who collapsed about 50 yards later and was pronounced at the scene. Upon being searched, no firearm was recovered from the decedent. Months later, a homeowner who lived along the route taken by the fleeing man found a firearm in his garden. It was turned over to the police immediately thereafter. The question to be answered was whether the recovered firearm could be connected to the felon. Laboratory analysts tested the function and assessed the operability of the firearm, which was then test fired. No shots were fired by the man during this altercation, so traditional firearm examination techniques were not probative. Biological traces were long gone; neither hairs nor fibers were present on the recovered firearm. There was however a subtle imperfection in the grip on one side of the firearm, and a missing piece of plastic on the other. Perhaps this damage was the result of tossing the firearm while on the run, or perhaps it was the result of something else.

***Open Fire**

Abigail Wilson, Peter Diaczuk, PhD, John Jay College of Criminal Justice

Bullets used in ammunition manufacture can be broadly divided into two categories, full metal jacketed and jacketed hollow points. These can be further divided into numerous subsets within each group, including some specialty groups, such as frangible. This research examines a representative brand of jacketed hollow point bullets used in a common caliber cartridge, the 9mm Luger. A jacketed hollow point bullet is designed to open or expand when it comes into contact with a viscous medium such as water, tissue, or ballistic gelatin. This research used ballistic gelatin as a tissue simulant with a chamois overlay as a substitute for skin. The 9mm Luger caliber jacketed hollow point bullets were fired and subsequently recovered from cotton waste. Cotton waste was used as the recovery medium so any bullet expansion, or lack thereof, would not take place post-gelatin. After recovery from the cotton waste, the bullets were carefully weighed, and their expansion measured. As a positive and negative control, a series of bullets were fired into a full-size block of gelatin to achieve complete expansion and into just cotton waste to resist expansion. There are six petals that compose the tip and ogive of the hollow point bullet used in these tests. The distance between all of the opposing petals of each bullet were measured, resulting in three measurements per bullet. There were five bullets fired for gelatin thicknesses of 3 inches, 2 inches, 1.5 inches, 1 inch, and 0.5 inches, as well as for the negative and positive controls. The positive control averaged 12.97 mm and the negative control averaged 6.24 mm at maximum width. Bullet expansion through the respective gelatin slices averaged 12.47 mm for 3 inches, 12.23 mm for 2 inches, 11.83 mm for 1.5 inches, 11.84 mm for 1 inch, and 11.49 mm for 0.5 inches. The differences between the average distances of the expanded petals can be explained by the differences in the thickness of the gelatins. As the gelatin slices get thinner, the width of the expanded bullets gets narrower. Velocity data was collected both from the muzzle of the firearm and as the bullets left the varying thicknesses of the chamois-covered ballistic gelatin. The velocity loss decreased as the gel thickness decreased. This research is intended to provide an understanding of how hollow point bullets behave and make it common knowledge to those who are not familiar with wound ballistics.

***The Study of Hyoid Bone Fracture Patterns**

Grace Stockmal, Roger Sherman, MS, Jennifer Hammers, DO, John Viator, PhD and Pamela Marshall, PhD, Duquesne University

Commonly referred to as the "Hangman's Fracture", the hyoid bone in the neck has been observed to partially or completely break when compressed by a ligature in suicidal hangings and homicidal strangulations. Hyoid bones need to be studied to determine if they fracture differently between these two manners of death. Previous studies have determined differences in neck damage and frequency of thyrohyoid fractures, but scientists need to develop effective comparisons between the manners of death and patterns of fracture within the hyoid bone. It is proposed that homicidal strangulations by ligature will require more force and will result in higher frequencies of fractures to the body than the greater horns of the hyoid than in a suicidal hanging. To test this proposal, hyoid bones were collected from deceased patients, cleaned using an Oxi-Clean solution, and models were created by 3D-printing utilizing FibreTuff polymer. The Torbal FT Odyssey force gauge was used to measure the Newtons required to partially fracture these models and allowed observation of fracture patterns. Ligatures and ballistic head models with inserted 3D model hyoids were used to simulate suicidal hangings and homicidal strangulation methods. Future autopsies with unidentified manners of death involving asphyxiation and abrasive damage to the neck can investigate the hyoid bone for patterns of fracture that correlate to either suicide or homicide. Future cases like Jeffrey Epstein would have further investigation of the hyoid bone to determine a manner of death.

Key words: hyoid bone, fracture, suicidal hanging, homicidal ligature strangulation

***The Twig Is Up: Forensic Identification of Endangered Wood Species by DART-HRMS and Multivariate Statistical Analysis to Combat Illegal Logging**

Mónica Ventura, Samira Beyramysoltan, PhD, Benedetta Garosi, and Meghan Appley, University at Albany, Edgard Espinoza, PhD, National Fish and Wildlife Forensic Lab and Rabi Musah, PhD, University at Albany

One of the recent trends in forensics is wildlife, with the concern being identification of illegally traded endangered species. While trade in fauna, including elephant parts (such as tusks), rhinoceros horns, and pangolin scales, are well-known examples of wildlife crimes, there are a host of flora that are heavily trafficked, including trees. Illegal trade of endangered wood is common because it is highly prized for making exclusive furniture, cabinetry, musical instruments, and construction materials. This causes environmental and economic damage because it leads to forest degradation and deforestation and deprives countries of billions of dollars in revenue. Illegal logging is one of the most lucrative natural resource crimes and is valued at $52 billion to $157 billion per year, which is a magnet to some of the world's largest organized crime groups. The Convention on International Trade of Endangered Species (CITES) was created to address the conservation of imperiled wildlife by controlling their trade. Regulation status is defined by appendices: CITES Appendix I species are threatened with extinction, and trade of any kind is illegal; CITES Appendix II species are threatened in the wild and international trade is controlled to aide in their survival; and CITES Appendix III species are regulated by a particular nation. Therefore, depending on the species, trade is either totally or heavily restricted. Moreover, when specimens are intercepted by law enforcement, it is extremely challenging to identify the evidence as either legal or illegal, because many of the species that are illegal to trade have an appearance that is similar to species that are not restricted. A current technique used by law enforcement to differentiate species of wood is direct analysis in real time-high resolution mass spectrometry (DART-HRMS), coupled with multivariate statistical analysis. Here, the added dimension of wood headspace analysis featuring solid phase microextraction (SPME) was used to generate data to complement that acquired using the conventional wood analysis technique. This could facilitate the development of "stand-off" approaches to the differentiation of wood species based on their volatiles profiles. Eight genera, including *Dalbergia*, *Swietenia*, *Pericopsis*, *Araucaria*, *Pterocarpus*, *Cedrela*, *Diospyros*, and *Millettia* were provided by the U.S. Fish & Wildlife Forensic Lab, all of which are listed as CITES Appendices I-III. The headspace volatiles of the wood samples were concentrated on SPME fibers for thirty minutes and analyzed by DART-HRMS. Multivariate statistical analysis processing of the DART-HRMS data revealed intra-genus similarities and inter-genus differences that resulted in the ability to assign genus attribution to the chemical signatures. The classification model that was developed could therefore be used for rapid forensic identification of species based on simple analysis of the headspace of the wood. The results show that this approach can contribute to the enhancement of techniques that enable law enforcement to distinguish between endangered wood at crime scenes.

Fly Curious: A Non-Destructive Approach to Entomotoxicology Through Direct Analysis in Real Time-High Resolution Mass Spectrometry (DART-HRMS) Examination of Insect-Ethanol Suspensions

Amy Osborne and Rabi A. Musah, PhD, University at Albany; Jennifer Y. Rosati, PhD, John Jay College of Criminal Justice

Entomological evidence is well-known in a forensic context as a means by which to estimate the minimum postmortem interval (PMI) in death investigations. This is particularly important in cases where decomposition has advanced to a degree that conventional techniques for PMI estimation cannot be used. However, difficulty in establishing the PMI is not the only challenge associated with remains found in advanced stages of decomposition. When blood, urine, and internal organs no longer remain, toxicological information which may have relevance to the cause of death can be lost or become irretrievable. In these circumstances investigators may turn to less conventional methodologies. One resource that may be utilized is the maggots which have fed on the decomposing remains, which ingest tissue along with any drugs or chemical toxins that are contained therein. To the extent that these chemical compounds and/or their metabolites remain within the flies, their presence can serve as a historical record of the factors that may have led to the cause of death.

The majority of research in forensic entomotoxicology has focused on applying traditional toxicological analyses and drug detection methods to insects. These techniques can involve long, complicated sample preparation that requires the complete destruction of the collected insect evidence. It was previously demonstrated that Direct Analysis in Real Time-High Resolution Mass Spectrometry (DART-HRMS) could serve as a means to extract toxicological information from insects without lengthy sample preparation. It is now further reported that DART-HRMS analysis of the aqueous ethanol solution used to preserve insect specimens collected from remains provides a non-destructive means to screen blowflies for drug or toxin contamination. For this study, *L. sericata* were fed beef liver laced with fentanyl derivatives at physiologically relevant concentrations, and the life stages of the flies following emergence of the maggots from eggs were collected through to the appearance of adult flies from pupal casings. Following standard insect evidence collection procedures, all specimens were stored in 70% aqueous ethanol prior to further analysis. DART-HRMS was then utilized to generate insect metabolome profiles through both the direct investigation of the individual insect specimens as well as through the aqueous ethanol preservative solution. These profiles were subjected to multivariate statistical analyses including kernel discriminant analysis (KDA), discriminant analysis of principal components (DAPC), and support vector machines (SVM), in order to determine whether the profiles of the liver control (no drug) and the drug-laced liver could be differentiated through pattern recognition techniques. While the results showed strong differences in the metabolome profiles of drug versus control samples for the analysis of the whole specimens, there were also significant differences exhibited in the metabolome profiles obtained solely from the ethanol solutions. These differences are especially pronounced in the metabolome profiles belonging to the ethanol solutions which preserved the pupae and the adults, and pupal casings. These findings provide a new avenue by which to access toxicological information of potential relevance to death investigators while circumventing many of the challenges encountered when using conventional techniques for the toxicological analysis of insects.

***Footwear Image Quality Classification: Using Expert Assessments and Image Metrics to Predict Impression Quality**

En-Tni (Lily) Lin, West Virginia University

Shoeprints deposited during the commission of a crime vary in quality as a function of numerous factors, including substrates, media, and the physical activities carried out by perpetrators. This variability impacts the value and quantity of information available in questioned crime scene impressions, and therefore the strength of an examiner's opinion concerning source attribution. To date, limited research has been conducted to quantify footwear image quality. In response, this research aims to develop definitions of footwear image quality as a function of image factors, including totality, noise, contrast, sharpness, and complexity. Modeling is then proposed to combine these factors, and using human assessments as a guide, predict footwear image quality.

The methodology used to achieve this goal is based on a five-pronged approach, of which the first three phases have already been completed. First, a footwear database was created containing nearly 600 images, with variations in media (blood, dust), substrate (vinyl, ceramic, paper), collection method (electrostatic lifter, gelatin lifter, Stat-Lift), and enhancement technique (digital, chemical). Second, automated image processing tools, such as wavelet coefficients and gray-level co-occurrence matrices (GLCM), were employed for feature extraction. Next, online surveys were designed using a R Shiny application that presents impressions to human raters to elicit quality and value assessments. As soon as expert opinions are collected, the fourth step is to relate subjective ratings and image features through an ordinal logistic regression model. Finally, the regression coefficients generated from this model will be evaluated.

During this presentation, pilot study data will be presented, including proposed measures of intra-rater inconsistency and inter-rater reliability, the use of matrix completion for data expansion, and preliminary correlation estimates between human assessments and image factors of sharpness (0.56), noise (0.73), contrast (0.48), and complexity (0.45). Although separately, each correlation coefficient is (at most) modest in magnitude (<0.75), the results are better than anticipated based on how challenging it is to describe footwear image quality using traditional image analysis methods, and given that no single metric can capture all variability. Instead, individual image features demonstrating reasonable correlation coefficient values will be used in combination via regression, which is anticipated to improve overall prediction. Moreover, this preliminary data can be used to inform deep learning methods to explore the use of patent versus latent image features. Once the entire project is completed, it is expected to provide insight into which image features drive human quality and value ratings, thereby ultimately advancing the body of work concerning footwear impression quality.

Analysis of Distortion in BVDA Gel Lift Method of Obtaining Footwear Impressions in Relation to Time of Rest Before Evidence Application

Shian Valles and Wade Knapp, University of Toronto; Amanda Lowe, Ontario Provincial Police

Purpose: The focus of this project will be to determine whether there is significant distortion among impressions lifted using Bureau Voor Dactyloscopische Artikelen Gel-lifters, and to establish whether the duration the gelatin sheet is left to rest before application contributes to distortion. This will be done by performing measurements on gel-lifted footwear impressions using various lifting times and comparing these measurements to the test impression of the shoe, with an accepted standard difference of <1mm. This research will help establish the ideal time to allow the gelatin sheet to rest before application, as an effort to reduce significant distortion in lifted impressions. Providing the ideal time of rest before application can enable shoe characteristics to be properly analyzed without having to account for possible deviations due to distortion. This will prevent issues relating to distortion from being raised at court trials, which may result in footwear evidence being

deemed inadmissible. Reducing distortion may also help avoid wrongful identification and the dissipation of time and resources due to incorrect interpretations of distorted shoe characteristics.

Background: The gel-lift method targets two-dimensional impressions on porous and non-porous surfaces (1, 2, 3). Gelatin sheets are available in black, white and transparent colors which are selected depending on the print matrix (2, 3, 4, 5). Black gelatin sheets target impressions in soil, dust and developed latent impressions (2, 3, 4, 5). Gelatin sheets are composed of a transparent cover, a gelatin layer and a rubberized linen backing (2, 3, 4, 5). High-quality Impressions of black gelatin sheets are obtained using the BVDA scanning machine, which incorporates oblique lighting and vacuum settings that are adjustable depending on the strength of the impression (2).

Methodology: The total sample size consists of 80 impressions, which include 20 impressions per shoe type, which is further subdivided into four impressions per rest time. The time variables used include 30 seconds, 1 minute, 2 minutes, 5 minutes and 10 minutes. Latent impressions were created on a tile surface, and further developed using white granular fingerprint powder. After allowing the gelatin sheet to rest for the time variable of interest, it would then be applied to the impression using a roller and lifted immediately after application. The subsequent impression would then be placed into the BVDA machine for scanning. Scanning parameters included a 13 x 36 cm image, with a single light source for strong impressions. Measurements of the lifted impression were obtained in Adobe Photoshop using calibration of the built-in scale from the scanned image in conjunction with the ruler tool.

Results: This is a preliminary report as there are statistical results that are still needed. Full statistical analyses of these results are pending.

Keywords: forensic science, forensic identification, BVDA gel-lifter, distortion, gelatin lift, impression evidence, time before application, two-dimensional footwear impression

References:
1). Taylor, K. M., Krosch, M. N., Chaseling, J., & Wright, K. A comparison of three shoe sole impression lifting methods at high substrate temperatures. Journal of Forensic Sciences, 2020;66(1):303–314.
2). BVDA Gellifter Manual Bvda.com. BVDA - BVDA Gellifters. [online] Available at: <https://www.bvda.com/en/gellifters> [Accessed 22 September 2021].
3). Hammell, L., Deacon, P., & Farrugia, K. J. Chemical enhancement of soil-based marks on nonporous surfaces followed by gelatin lifting. Journal of Forensic Identification, 2014;64(6): 583-608.
4). Wiesner, S., Tsach, T., Belser, C., & Shor, Y. A comparative research of two lifting methods: Electrostatic lifter and gelatin lifter. Journal of Forensic Sciences: https://doi.org/10.1111/j.1556-4029.2010.01617.x. Epub 2010
5). Davis, R. J A systematic approach to the enhancement of footwear marks. Canadian Society of Forensic Science Journal, 1988;21(3):98–105.

***Estimate of the Random Match Frequency of Acquired Characteristics in a Forensic Footwear Database**

Alyssa Smale, MPS and Jacqueline Speir, PhD, West Virginia University

When analyzing footwear impression evidence, one of the goals of an examiner is to determine if an exemplar shoe could be the source of a questioned impression. In order to form an opinion regarding the possible source, examiners evaluate the similarity of class and individualizing characteristics between impressions, typically using individualizing characteristics as the basis to reach the highest degree of source association. Opinions regarding the strength of the association are based upon the quantity and quality of the observed characteristics, but specific descriptions of what is considered sufficient quantity and quality are not well-defined. Instead, these criteria are developed through training and experience. Due to the purported subjective nature of the interpretation of this evidence, the opinions formed regarding footwear evidence can be misunderstood and undervalued. One way to mitigate this criticism is to complement casework with research that includes numerical analyses. This has been successfully accomplished within the discipline of DNA, wherein the term random match probability (RMP) is commonly used to provide an estimate of the chance of randomly selecting a person from a population and observing a predefined DNA profile of interest. This research aims to perform a similar evaluation within a footwear research database comprised of 1,300 outsoles in order to estimate random match frequency (RMF) for randomly acquired characteristics (or RAC-RMF). To accomplish this goal, this study re-analyzes and expands upon previously evaluated/published data, including RAC comparisons performed using a combination of visual comparisons (> 91,000) and mathematical predictions (> 3.2 million). Through visual comparison, 2,182 indistinguishable RAC pairs were previously identified. For the remaining pairs, a mathematical model predicted the conditional probability of indistinguishability based on the degree of geometric similarity between the features on unrelated outsoles, as assessed via overlap in size, shape, and orientation. Re-analysis of the data for the purposes of RAC-RMF indicated that approximately 95% of RAC pairs with positional co-occurrence were distinguishable with a probability of 0.99 based on shape characteristics. Moreover, only 0.2% of non-mated shoe pairs in this database (2,072 out of 844,350 pairwise comparisons) shared at least one indistinguishable RAC pair, with a maximum of four observed on four different outsole pairs. RAC-RMF was estimated for each shoe by determining the number of unrelated outsoles that contained one or more RACs with positional and geometric similarity. The minimum RAC-RMF of 0 out of 1,299 was observed for 32% of the outsoles in the database, with an additional 19% having a RAC-RMF of 1 out of 1,299. Approximately 77% of values were less than 5 out of 1,299, and the maximum RAC-RMF of 49 out of 1,299 was observed for a single outsole. This research demonstrated that, while repetition of RAC features did occur on unrelated outsoles in this database and RAC-RMF values near 1 in 1,000 exist, the majority of RAC pairs were distinguishable from each other and the indistinguishable features were often small RACs that did not possess remarkable attributes.

A Cold Case Homicide Solved After 37 Years

Beth Saucier Goodspeed, Massachusetts State Police Crime Laboratory

Key Words: Cold Case Homicide, Case Study, Genetic Genealogy

Learning Objective: By attending this presentation, the attendees will obtain knowledge about the circumstances and the steps taken to solve a homicide that occurred in 1984. The case involved police investigations, forensic science, genetic genealogy, as well as a "death bed" confession.

Impact Statement: This presentation will provide the forensic community actual case information and discussion on the challenges encountered and new technology utilized during the processing of the evidence in this cold case. Interesting case facts will also be discussed, and questions will be addressed.

Abstract: On February 13, 1984, a 64-year-old woman was brutally stabbed multiple times, strangled, and beaten in a small town in Massachusetts. The suspect then remained in her home, ate her food, and took her car out for a joy ride. Several items of evidence were left behind at the scene that contained blood and skin cells. The case was assigned to the author on August 15, 2004, during her work as a Criminalist at the Massachusetts State Police Crime Laboratory. The assignment included giving the case a second look with fresh eyes and updated technology. Numerous items were examined, and DNA processing was completed. DNA profiles were obtained, and some were entered into CODIS. Years went by without a CODIS hit. Additional DNA work was performed but the case remained unsolved. Fast forward to April 2019 – a Y-STR profile from the crime scene was sent to a private company for comparison to genealogical haplotype databases with the goal of developing a potential surname for the suspect. This provided some leads but did not result in the identification of a suspect. In December 2019, a crime scene sample was sent out for forensic genetic genealogy (FGG). This sample did not contain enough genetic material to produce searchable SNP data. Another sample was sent for FGG in September of 2020 and resulted in the identification of an individual who was eliminated as a potential suspect. In February 2020, police were contacted by a lawyer's office; someone had come forward with information about the case. This information led to the discovery of a "new" crime scene that was processed in June of 2020. New evidence was collected and tested in the Criminalistics Unit by another analyst. In March 2021, the District Attorney's office made a televised announcement of a "death bed" confession that was brought forward and verified by forensic science. A suspect had been identified and his involvement in the crime was confirmed with DNA analysis. Finally, this cold case homicide was brought to a close.

***Denotes Peter R. De Forest Collegiate Competition Participant**

Scientific Sessions:
Drug Chemistry
Wednesday, October 19th 9:00am – 5:00pm
Location Porter-DeVeaux

Chair: Tiffany A. Ribadeneyra, Nassau County Medical Examiner Office

9:00am – 9:10am	**Opening Remarks**
9:10am – 9:25am	**Optimal Extraction for the Identification of Components in Complex Mixtures** Samantha Jarvis, M.P.S., Alexandra Rothaar, B.S., Victoria DePrimo, M.S., New York City Police Department Police Laboratory
9:25am – 9:40am	***Improved Quantitation for 15 Benzodiazepines using LC-MS/MS with a 1.5 mm Internal Diameter Column** Taylor Maslin, William Campbell, Ph.D., The Pennsylvania State University
9:40am – 9:55am	**Waters RADIAN™ ASAP Direct Mass Detector – An Alternative Seized Drug Screening Technique** Nicholas Ciccone, M.S., Marisa McNamara, Nassau County Office of the Medical Examiner, Division of Forensic Services
9:55am – 10:00am	**Panel Discussion / Q & A**
10:00am – 10:15am	**Break**
10:15am – 10:30am	**Qualitative Analysis of Fentanyl Laced Marijuana** Matthew J. Marino, B.S., New Jersey State Police Office of Forensic Sciences
10:30am – 10:50am	***Trick or Weed – Application of Ambient Mass Spectrometry for the Detection and Quantification of Cannabinoids in Complex Matrices** Benedetta Garosi, Megan I. Chambers, B.S., Rabi A. Musah, Ph.D., State University of New York at Albany
10:50am – 11:20am	**Understanding the Science and Concerns Behind the *Possible* Conversion of Helium to Hydrogen Carrier Gas for EI GCMS systems** Kirk Lokits, Ph.D., Agilent Technologies
11:20am – 11:40am	**Development of an Analytical Platform for the Rapid Testing of Drug Paraphernalia Residue** Meghan G. Appley, Ph.D., Elizabeth L. Robinson, Edward Sisco, National Institute of Standards and Technology

11:40am – 11:55am	**Separation of Geometric Isomers (±)-11-nor-9-Carboxy-Δ9-THC and (±)-11-nor-9-Carboxy-Δ8-THC by LC-MS-MS** Paola Roldán-Arroyo, William Campbell, Ph.D., The Pennsylvania State University
11:55am – 12:00pm	**Panel Discussion / Q & A**
12:00pm – 1:30pm	**Lunch** *(requires ticket)*
1:30pm – 1:50pm	**Things WE'ED Like to Know – How to Differentiate Hemp and Marijuana Varieties of Cannabis sativa with a Combined Ambient Mass Spectrometric and Chemometric Approach** Megan I. Chambers, Samira Beyramysoltan, Ph.D., Benedetta Garosi, and Rabi A. Musah, Ph.D., State University of New York at Albany
1:50pm – 2:05pm	***Distinction of cathinone isomers and fentanyl isomers based on statistical comparison of mass spectra** Andrew Sacha, Forensic Science Program, School of Criminal Justice, Michigan State University, Victoria L. McGuffin, Ruth Waddell Smith, Ph.D., Department of Chemistry, Michigan State University
2:05pm – 2:25pm	**Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Update** Tiffany A. Ribadeneyra, M.S., ABC-CC, Nassau County Office of the Medical Examiner, Division of Forensic Services, Sandra E. Rodriguez-Cruz, Ph.D., ABC-DA, DEA Special Testing & Research Laboratory
2:25pm – 2:45pm	**Introducing the "Database of Psychoactive Plants" aka "DoPP": A Graphical User-friendly Application for the Rapid Forensic Identification of Psychoactive Plant Materials** Rabi A. Musah, Ph.D., Samira Beyramysoltan, Ph.D.; Megan I. Chambers; Amy M. Osborne; Mónica I. Ventura, State University of New York at Albany
2:45pm – 2:50pm	**Panel Discussion / Q & A**
2:50pm – 3:00pm	**Closing Remarks**
3:00pm – 3:15pm	**Break**

***Denotes Peter R. De Forest Collegiate Competition Participant**

Drug Chemistry
Abstracts

Optimal Extraction for the Identification of Components in Complex Mixtures
Samantha Jarvis, M.P.S., Alexandra Rothaar, B.S., Victoria DePrimo, M.S., New York City Police Department Police Laboratory

When preparing complex mixtures for the identification of controlled substances at the NYPD Police Laboratory, one sample can potentially be prepared up to four times to identify all components present. This is especially true for mixtures that include heroin, fentanyl, and fentanyl-related compounds. Using current laboratory procedures, some controlled substances can be identified in methanol, while others may require a basic extraction with sodium hydroxide (pH 14) for identification. The extraction process allows for identification criteria to be met for all remaining components of complex mixtures. An optimal extraction for these compounds should be utilized in order to reduce the number of preparations, promote timeliness, and consume less resources. This study aims to determine the ideal solvent and pH for the recovery of all controlled substances in complex mixtures when using Gas Chromatography/Mass Spectrometry (GC/MS) analysis. Based on the literature, a lower extraction pH may be optimal for the recovery of fentanyl and related compounds. Research was conducted using chloroform basic extractions with sodium hydroxide at a lower pH, as well as using ammonium hydroxide as an alternative base. Preliminary results showed that ammonium hydroxide was not optimal for extraction due to its possible assistance of de-acetylation of heroin to 6-monoacetylmorphine. Extractions using sodium hydroxide at a lower pH showed variable results when utilizing mixtures made with standards of fentanyl, quinine, and procaine. The variability may be attributed to the fact that the standards used were not representative of clandestinely manufactured street samples. Future research will be conducted on previously analyzed casework samples to accurately assess if a lower pH yields a more optimal extraction for the identification of these compounds.

***Improved Quantitation for 15 Benzodiazepines using LC-MS/MS with a 1.5 mm Internal Diameter Column**
Taylor Maslin, William Campbell, Ph.D., The Pennsylvania State University

Benzodiazepines are a well-known class of drugs used to treat a variety of conditions including anxiety, insomnia, and muscle tension. These drugs are often also used to facilitate crimes including sexual assault and robbery due to their ability to sedate and or compromise the memory of the victim. In addition, benzodiazepines are abused by individuals seeking to mediate withdrawal symptoms of other drugs. There are currently numerous variations in the core structure of benzodiazepines which result in various analogues. In this study, a method for the separation and identification of fifteen different benzodiazepines was developed for LC-MS/MS analysis. This study specifically compared the peak area intensities using a column with an internal diameter of 2.1 mm versus a column with an internal diameter of 1.5 mm. At 1.5 mm, the internal volume of the column is roughly half of the internal volume of a 2.1 mm column of the same length. This reduced system volume effectively doubles the concentration of analytes as they elute from the column assuming equivalent mass load. In addition, columns with an internal diameter of 1.5 mm utilize a slower elution flow rate as compared to the 2.1 mm column. The slower flow rate results in a

smaller volume of mobile phase being used. As a sample is introduced to the mass spectrometer with a smaller volume of mobile phase there is a higher concentration of ions in the sample introduced due to the decrease in the amount of solvent needing to be stripped away upon exiting the ions source in atmospheric ionization instruments. This means that at the same initial mass load of the sample, the 1.5 mm column will provide increased peak sensitivity when compared to the 2.1 mm column. This study's results demonstrate that there was a twofold or better increase in peak areas for each of the drugs when using the 1.5 mm internal diameter column.

Waters RADIAN™ ASAP Direct Mass Detector – An Alternative Seized Drug Screening Technique Nicholas Ciccone, M.S., Marisa McNamara, Nassau County Office of the Medical Examiner, Division of Forensic Services

The recent helium shortage has severely affected crime laboratories across the country as most forensic drug chemistry laboratories utilize Gas Chromatography/Mass Spectrometry instrumentation. To combat this, forensic laboratories are exploring alternative techniques to detect and identify controlled substances in drug seized drug evidence. The Nassau County Office of the Medical Examiner, Division of Forensic Services Controlled Substance Section had the opportunity to serve as a beta testing site for a novel chemical and materials testing technique, the RADIAN™ ASAP with LiveID.

The RADIAN™ ASAP is Waters latest development for rapid preliminary detection of controlled substances. Utilizing technology similar to Direct Analysis Real-Time Mass Spectrometry (DART-MS), the RADIAN™ ASAP is a direct analysis system using a robust single quadrupole mass spectrometer combined with an Atmospheric Pressure Solids Analysis Probe (ASAP). The single quadrupole mass detector provides high quality mass spectral data that is delivered in real-time using the LiveID software. This ensures a quick preliminary identification of the unknown sample against a library of known compounds of commonly seen controlled substances analysis without the use of helium.

This presentation will give an overview of the RADIAN ™ ASAP including instrumental operation and sample preparation. Specific performance characteristics evaluated during this beta test period include selectivity, repeatability, interference, and analyte concentration. Recommendations for integration of the RADIAN™ ASAP into a typical drug chemistry laboratory workflow and overall utility for controlled substance analysis will also be included in the presentation.

Qualitative Analysis of Fentanyl Laced Marijuana
Matthew J. Marino, B.S., New Jersey State Police Office of Forensic Sciences

The Connecticut Overdose Response Strategy and the Connecticut Department of Public Health, Office of Emergency Medical Services recently received numerous reports of suspected opioid overdose cases that required naloxone for revival and where no opioid use was acknowledged. 39 such incidents were reported. In each, the patients solely reported the use of marijuana. At one of the overdose scenes, the Plymouth Police Department confiscated a vegetation sample for laboratory testing. The results indicated the presence of both marijuana and fentanyl. Mixtures of marijuana and fentanyl within the illicit drug market could have a significant impact on the quantity

of reported overdoses within the Northeast. The New Jersey State Police Drug Monitoring Initiative (DMI) of the Regional Operations and Intelligence Center (ROIC) identified this as a public health concern and established a joint effort between the New Jersey State Police Office of Forensic Sciences (OFS) and the Hazardous Materials Response Unit (HMRU) to aid in the detection of such mixtures. This research project tested the reliability of several screening and confirmatory drug analytical techniques with identifying sample mixtures of fentanyl on vegetation or paper. The expectation was that a laboratory practitioner would not encounter any issues in confirming fentanyl. However, police officers and first responders often have limited techniques that can be used to presumptively identify fentanyl in the field. Solutions of multiple concentrations of fentanyl in acetone and isopropanol were sprayed onto marijuana and paper and tested using an analytical scheme of Modified Duquenois color test (on marijuana only), Marquis color test, BTNX Rapid Response Fentanyl Forensic Test Kits immunoassay and Gas Chromatography/Mass Spectrometry (GC/MS).

The research project confirmed the ineffectiveness of using the Marquis color test on fentanyl laced marijuana samples, as the marijuana control sample resulted in a false positive orange/brown color change. This is significant, as it is the most commonly used narcotic presumptive test by police officers in the field. As expected, the GC/MS was the most effective analytical tool utilized in identifying fentanyl laced samples. The results also verified the effectiveness of BTNX Test Kits on fentanyl laced paper samples and solid fentanyl powder, marijuana mixtures. However, they were not an acceptable presumptive test for the liquid fentanyl laced marijuana samples within this research project. Further study is necessary to determine whether the BTNX Test Kits would be an effective screening test for higher concentration fentanyl mixtures. This would verify BTNX Test Kits as an efficient screening method for law enforcement to determine the likelihood of fentanyl mixtures at crime scenes.

***Trick or Weed – Application of Ambient Mass Spectrometry for the Detection and Quantification of Cannabinoids in Complex Matrices**

Benedetta Garosi, Megan I. Chambers, B.S., Rabi A. Musah, Ph.D., State University of New York at Albany

With the increased legalization and decriminalization of marijuana in the U.S., recreational use of Cannabis sativa, as well as the myriad of products derived from Cannabis or prepared with cannabinoids, has increased exponentially. This rise in Cannabis, CBD (cannabidiol)- and THC (Δ9-tetrahydrocannabinol)-infused products has imposed major challenges related to the analysis of cannabinoid content (i.e., THC/CBD detection and quantification), because highly specialized methods must be developed for each type of complex matrix that is encountered. When applied to complex materials, conventional methods used in current forensic science practices in the U.S generally are resource-intensive, time-consuming, require extensive sample preparation, and involve complex data analysis. To address some of these difficulties, this study focused on the application of direct analysis in real time – high-resolution mass spectrometry (DART-HRMS) for the rapid analysis of CBD and THC in edible and non-edible complex matrix samples for detection, differentiation, and quantification purposes.

Of importance to this approach is the necessity of devising a means by which to differentiate between THC (scheduled) and CBD (unscheduled), and which, when analyzed by mass

spectrometry under soft ionization conditions, are indistinguishable because they are isomers with a molecular formula of C21H30¬¬¬O2 and a protonated monoisotopic mass of 315.232. Previous results demonstrated that the presence of the two compounds within a complex matrix such as candies, could be revealed by derivatization using N-Methyl-N-(trimethylsilyl)trifluoroacetamide (MSTFA). Engagement of the one -OH group in THC and the two -OH groups in CBD with the derivatizing agent results in the differentiation of the two cannabinoids due to the mass [M+H]+ disparities of the protonated adducts formed (m/z 387.272 and 459.312 for THC and CBD, respectively). Thus, derivatization is an important step in the process of differentiating between CBD and THC by DART-HRMS.

While the process proved successful with edible matrices, it remained to be seen whether it could be applied to other types of complex materials such as commercial topicals (i.e., balms). Therefore, CBD-infused balms were treated with MSTFA to reveal the cannabinoid content of these products. The approach was also applied to extracts, the generation of which are essential to the ability to quantify compounds of interest such as THC. The success of this method was demonstrated with gummy candies, chocolates, and marshmallows. In the course of these investigations, it was discovered that the use as internal standards of the deuterated counterparts of analytes of interest was not optimal for the quantification of derivatized cannabinoids by DART-HRMS. Alternative compounds are under investigation (e.g., synthetic cannabinoids) for the development of validated quantification protocols. Development and optimization of these procedures will aid in the investigation of Cannabis sativa evidence in forensic laboratory settings.

Understanding the Science and Concerns Behind the *Possible* Conversion of Helium to Hydrogen Carrier Gas for EI GCMS systems

Kirk Lokits, Ph.D., Agilent Technologies

Helium has historically, with valid scientific reasons, been the preferred carrier gas for GCMS and the majority of GC analysis. Within the last decade there has been an increase in the difficulties to procure UHP helium in the quantities required for full laboratory operations and or a drastic increase in the overall cost of UHP helium tanks. Due to its chemical and physical characteristics, high resolution chromatographic separations can be achieved with minimal analyte interactions. GCs with atmospheric detectors often utilize alternative carrier gases such as nitrogen, argon, and hydrogen. However, when the GC is coupled to a mass spectrometer under high vacuum, parameters based on a mean free pathway of ion molecules, vacuum, low background, and high sensitivity come into play. Based on these parameter limitations, of the previously mentioned carrier gases, hydrogen is the practical alternative. Nonetheless, hydrogen does have disadvantages that may cause a GCMS analyst to re-evaluate the urgency to convert to hydrogen carrier based on its reactivity with some analytes, reduced sensitivity, increased peak tailing, and reduced spectral fidelity when compared to helium generated reference spectra.

Ultimately, helium is the preferred carrier gas choice, but if not available, hydrogen may be considered. The purpose of this presentation is to help analysts determine if hydrogen can be used as a carrier gas for their specific analysis. Furthermore, the illustration of best practices, specific MS source configurations, forensic drug data examples, and the acquisition parameters necessary to help determine if the transition of a specific application is or is not compatible for hydrogen carrier gas on a GCMS system, will be discussed.

Development of an Analytical Platform for the Rapid Testing of Drug Paraphernalia Residue Meghan G. Appley, Ph.D., Elizabeth L. Robinson, Edward Sisco, National Institute of Standards and Technology

To better initiate public health and public safety responses related to drug overdoses requires the ability to capture real-time tracking of drug trends to identify new substances and poly-drug mixtures as they hit the streets. This type of information is typically gathered using spectroscopic or immunoassay-based techniques which present several limitations. To capture the drug landscape more completely, begin monitoring the presence of cutting agents and adulterants, and minimize the need to handle bulk drug powders, the use of ambient ionization mass spectrometry techniques, specifically direct analysis in real-time – mass spectrometry (DART-MS), for analysis of trace residue from drug paraphernalia was proposed. To evaluate the feasibility of this approach, wipes of trace residue samples from over 500 pieces of used drug paraphernalia were collected from multiple syringe service programs throughout the state of Maryland. The wipes were mailed to the laboratory for analysis by DART-MS where the resulting spectra were analyzed for the presence of drugs and other compounds of interest using the NIST/NIJ Data Interpretation Tool (DIT) and NIST DART-MS Forensics Database. The entire process produced near complete chemical profiles of the drug residue within minutes with little sample preparation and no bulk material handling. As valuable and efficient as DART-MS was, additional testing with more targeted mass spectrometric techniques (DART-MS/MS and liquid chromatography-MS/MS) was needed to provide supplementary information for a small subset of samples. When new substances or substances not well differentiated by the screening approach of DART-MS (e.g., isomers) the targeted approaches of DART-MS/MS and LC-MS/MS were used to provide confirmation of the presence or absence of a compound identified. By using the combination of different techniques, DART-MS can rapidly identify possible compounds so that public health and law enforcement officials can quickly inform the public, while confirmatory testing can provide specific information that is necessary for the tracking of new compounds and drug trends. This presentation will discuss the successful development of this analytical platform created to provide near-real time results to help map the drug landscape within the state of Maryland. In addition, the limitations of the techniques, data obtained from the ongoing pilot study, and the future goals of this project will also be presented.

Separation of Geometric Isomers (±)-11-nor-9-Carboxy-Δ9-THC and (±)-11-nor-9-Carboxy-Δ8-THC by LC-MS-MS
Paola Roldán-Arroyo, William Campbell, Ph.D., The Pennsylvania State University

The separation and identification of the geometric isomers, (±)-11-nor-9-CarboxyΔ^9 -THC and (±)-11-nor-9-Carboxy-Δ^8 -THC are important in clinical and forensic drug testing due to the variation in legal status of the delta 9 and delta 8 variants of THC in multiple states. The compounds in question are metabolites of THC and it is the metabolites that are analyzed in drug screens and other testing. Many laboratories cannot distinguish these isomers since both compounds have the same molecular weight and have similar chromatographic behavior. Baseline separation is essential for LC/MS/MS analysis. Analysis will depend on both retention characteristics and MS/MS transitions, since transitions for both compounds are the same. In this study, a method for

separation of these metabolites was developed using LC/MS/MS. Furthermore, this method was developed for the inclusion of a larger panel of drugs if so desired. Additionally, we evaluated the Halo® C18 column technology comparing a 2.1 mm ID column with a 1.5 mm ID column. Baseline resolution greater than 5% was achieved using both columns. We wanted to explore the advantage of using the 1.5 mm column. The smaller column geometry provides elution of equivalent mass load of the desired drug but into a smaller volume giving a higher average concentration across the eluted peak. This results in at least a two-fold improvement in sensitivity. Further, using a lower flow rate provides enhanced ionization from the atmospheric pressure ion source in our system. We will provide quantitative data for these compounds and hope to transfer this method to analysis of biological fluids.

Things WE'ED Like to Know – How to Differentiate Hemp and Marijuana Varieties of Cannabis sativa with a Combined Ambient Mass Spectrometric and Chemometric Approach

Megan I. Chambers, Samira Beyramysoltan, Ph.D., Benedetta Garosi, and Rabi A. Musah, Ph.D., State University of New York at Albany

Hemp and marijuana are two major varieties of Cannabis sativa, both of which contain Δ9-tetrahydrocannabinol (THC), the primary psychoactive component of the plant. However, these two varieties differ in the amount of this active ingredient that is present. Federal law currently stipulates that C. sativa that contains greater than 0.3% THC is the drug-type (marijuana), while plant material that contains less than or equal to 0.3% THC is the fiber-type (hemp). The differentiation of hemp and marijuana has become a challenging aspect of analyzing Cannabis evidence in a forensic laboratory setting because of the increased workload that arises from the need to analyze and quantify the THC content of all C. sativa samples to enable proper designation of seized materials. This project aimed to develop a combined direct analysis in real time – high-resolution mass spectrometry (DART-HRMS) and chemometric approach for the rapid differentiation of hemp and marijuana plant materials.

Commercial hemp products from multiple vendors were purchased. Marijuana plant material was obtained from two DEA-registered suppliers. Furthermore, DART-HRMS data from analysis of recreational marijuana strains was provided by an industrial collaborator. All plant materials were analyzed by DART-HRMS with no sample pretreatment in both positive- and negative-ion modes at a range of orifice 1 voltages, including +/- 20, 30, 60, and 90 V. The application of preliminary statistical analysis methods to the chemical profiles revealed the potential for differentiating hemp and marijuana by DART-HRMS. These results prompted the use of advanced multivariate data analysis (e.g., principal component analysis (PCA), Random Forest) for the optimized differentiation of the two C. sativa varieties with a high level of certainty. In addition to developing the model and performing external validations (i.e., test samples), several m/z values were identified as diagnostic for distinguishing between the hemp and marijuana materials in the model. The identities of m/z values that were determined to be important for the optimal differentiation of hemp and marijuana are currently under investigation by thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS) and DART-HRMS. Using these methods, several markers appear to correspond to cannabinoids and terpenes known to exist in Cannabis. Fragments of these major molecules are also formed during analysis under ambient conditions. This combined mass

spectrometric and chemometric approach would significantly aid in the investigation of C. sativa plant materials in a forensic setting, prior to launching confirmatory analysis testing.

***Distinction of cathinone isomers and fentanyl isomers based on statistical comparison of mass spectra**

Andrew Sacha, Forensic Science Program, School of Criminal Justice, Michigan State University, Victoria L. McGuffin, Ruth Waddell Smith, Ph.D., Department of Chemistry, Michigan State University

In this presentation, a method to statistically compare electron-ionization mass spectra will be discussed, with particular emphasis on the distinction of structurally similar synthetic cathinones and fentanyl analogs. The method uses the unequal variance t-test to compare the intensity of corresponding ions in the two spectra. The null hypothesis (H0) states that the difference in intensity is equal to zero, whereas the alternative hypothesis (Ha) states that the difference in intensity is not equal to zero. If H0 is accepted for all corresponding ions, the two spectra are statistically indistinguishable at the specified confidence level. In contrast, if H0 is not accepted for at least one ion, the two spectra are statistically distinct. In these cases, the number and m/z value of the ions responsible for discrimination are determined.

Previous work in our group demonstrated the ability to distinguish spectra of positional isomers of ethylmethcathinone and fluoromethamphetamine at the 99.9% and 99% confidence levels, respectively. In the current work, the robustness of the comparison method is evaluated, specifically addressing the effects of inherent instrument variation and compound concentration. A set of synthetic cathinone structural isomers (dibutylone, eutylone, propylone, and pentylone) and a set of fentanyl positional isomers (isovaleryl, valeryl, and pivaloyl fentanyl) were analyzed by GC-MS multiple times over a 12-month period. The resulting mass spectra were statistically compared to evaluate association of corresponding compounds and discrimination from other compounds in the set.

At the 99.9% confidence level, spectra of corresponding cathinones were associated across the collection period. Each cathinone was readily distinguished from the other three cathinones, with 9 – 33 ions responsible for discrimination. As concentration was decreased, discrimination was maintained albeit with fewer ions (2 – 10 ions) responsible for discrimination. Similar trends were observed for the fentanyl analogs, with discrimination among the three compounds achieved at the 99.9% confidence level, with 3 – 6 ions responsible for discrimination. However, as concentration was decreased to 0.1 mg/mL, discrimination of isovaleryl fentanyl and valeryl fentanyl was not possible at 99.9% confidence level but was achieved at lower confidence levels.

This presentation will discuss the statistical comparisons in more detail and will highlight ions that are consistent and, therefore, reliable for discrimination of the synthetic cathinones and fentanyl analogs.

Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Update

Tiffany A. Ribadeneyra, M.S., ABC-CC, Nassau County Office of the Medical Examiner, Division of Forensic Services, Sandra E. Rodriguez-Cruz, Ph.D., ABC-DA, DEA Special Testing & Research Laboratory

The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) was formed in 1997 in a joint effort between the U.S. Drug Enforcement Administration (DEA) Office of Forensic Sciences and the Office of National Drug Control Policy (ONDCP). Historically, SWGDRUG recommended minimum standards for the forensic examination of seized drugs and sought their international acceptance. Considering the formation of the Organization of Scientific Area Committees (OSAC), SWGDRUG continues to work as part of the international community to improve the quality of the forensic examination of seized drugs. In addition, the extensively utilized resources provided on the SWGDRUG website will continue to be updated and available including free spectra libraries and monographs.

This presentation will provide attendees with an update on SWGDRUG activities during the year 2020 and currently in 2022. Upcoming publications will include revisions to Part IVA of the SWGDRUG Recommendations: Quality Assurance/General Practices and Supplemental Document SD-5: Reporting Examples. Recent activities include revising Parts IVB of the SWGDRUG Recommendations: Quality Assurance/Validation of Analytical Methods, revising Supplemental Document SD-2: Validation of Analytical Methods and the formation of an outreach and training subcommittee. Lastly, the current state of SWGDRUG as well as future initiatives will be reviewed.

Introducing the "Database of Psychoactive Plants" aka "DoPP": A Graphical User-friendly Application for the Rapid Forensic Identification of Psychoactive Plant Materials

Rabi A. Musah, Ph.D., Samira Beyramysoltan, Ph.D.; Megan I. Chambers; Amy M. Osborne; Mónica I. Ventura, State University of New York at Albany

The abuse of "legal high" psychoactive plants is a world-wide public health concern that exposes users to dangerous health consequences and even death. A major challenge for law enforcement in regulating widespread abuse of these plants is the paucity of methods by which to identify them. In general, identification of psychoactive plants is limited to only a few species using methods such as color tests, visual examination, chemical/biochemical methods, and DNA. While DNA analysis is the gold standard, the genomes for most of the relevant psychoactive plants have not been mapped, and therefore, this approach cannot be used. By and large, the other tests are presumptive, and definitive identification is laborious and time-consuming, rendering cases involving these substances un-prosecuted. Development of accurate, fast, efficient and cost-effective techniques for forensic identification of psychoactive plant materials is crucial. Direct Analysis in Real Time-High Resolution Mass Spectrometry (DART-HRMS) was investigated as an approach for building a species-specific chemical signature database that could be mathematically interrogated to reveal differentiation between and identification of psychoactive plants species. The rapid acquisition of DART-HRMS mass spectra (i.e. a few seconds per analysis) and the ability to analyze the materials in their native form without pre-treatment steps, enabled the generation of the vast number of spectral replicates required for database construction. A machine learning based workflow was implemented in Python for the generation of a discrimination model and identification of plant unknowns. An interactive graphical user interface named "database of psychoactive plants" or

"DoPP" was also developed to simplify the workflow for identification of plant materials for end users.

To create the database, 57 psychoactive species including plants such as Mitragyna speciosa (aka Kratom), and Salvia divinorum (aka diviner's sage) representing a range of sample types including flowers, stems, seeds, leaves, roots, extracts and brews, were analyzed by DART-HRMS in multiple replicates. A DART-SVP ion source coupled with a JEOL AccuTOF high-resolution time-of-flight mass spectrometer (JEOL USA) operating in positive ion mode was used to collect soft-ionization mass spectra in the m/z 40-800 range. The spectra were corrected for background and mass shifts and aligned along common m/z values for further multivariate analysis. A three-level hierarchical classification tree was designed (i.e., family, genus and species) based on the taxonomic relationships between the plant species, to reduce the 57 multi-class problem into several simplified multi-class problems. Within each node of the tree, the supervised classifiers support vector machine (SVM), Random forest (RR), and k-nearest neighbor (KNN) were used to train the discrimination models, and their outputs were then fused for sample prediction. Performance analysis using 5-fold cross validation revealed the hierarchical classifier to have 95% prediction accuracy. Therefore, the workflow enabled prediction of plant species identity from the raw DART mass spectra of unknowns, despite the complexity of their matrices and the absence of sample pretreatment. The developed screening tool can be readily utilized by crime labs and forensic scientists and does not require sample preparation steps or knowledge of botany.

***Denotes Peter R. De Forest Collegiate Competition Participant**

Scientific Sessions:
Forensic Biology/DNA

Wednesday, October 19th 9:00am – 5:00pm
Location: Cascade II

Chair: Alanna Laureano, Westchester County, Division of Forensic Sciences, NY
Co-Chair: Melissa Balogh, New Jersey State Police Office of Forensic Sciences, NJ

9:00am – 9:05am	**Opening Remarks**
9:05am – 9:20am	***Rapid identification of semen using STK Sperm Tracker Spray** Taylor Zekri, Michael A. Marciano, Jessica Haresign, Elise McInnis, Syracuse University
9:25am – 10:00am	**Validation and Implementation of Three Next Generation Sequencing Systems** Rachel Oefelein, DNA Labs International
10:00am – 10:15am	**Break**
10:15am – 11:15am	**Using Genetic Genealogy to Overcome a Non-Paternity Event and Solve an Unknown Parentage Case** Tobi Kirschmann, Nora Cheek, Don Carola, and Kevin Sullivan, DNA Investigations, LLC
11:15am – 11:35am	**Extraction of Challenging Forensic Samples Using the MicroGEM DNA Extraction Kit** Lauren Chwatt, Pace University, Falyn Vega, John Jay College of Criminal Justice, James Prinston & Andrew Schweighardt, NYC Office of Chief Medical Examiner
11:35am – 12:00pm	**New Standards and Best Practice Recommendations for Forensic DNA Testing** Charlotte Word Ph.D., Consultant
12:00pm – 1:30pm	**Lunch** (*requires ticket)*
1:30pm – 1:45pm	***Examination of Saliva for Determination of a Confirmatory Test** Sierra Soletsky, Claire Glynn Ph.D., University of New Haven
1:45pm – 2:05pm	**DNA Mixture via Transplantation** Jennifer Thayer, New Jersey State Police Office of Forensic Sciences

2:05pm – 2:30pm **Applying complex trait and statistical genetics concepts to forensically relevant phenotypes**
Frank Wendt Ph.D., Brendan Newton, University of Toronto, Andrea Quintero Reis, American University of Antigua College of Medicine

2:30pm – 2:45pm ***Application of K-means clustering to Images of Immunochromatographic Test Strips for Saliva Detection**
Katelyn Rivera, Lasell University, Frank Wendt Ph.D., University of Toronto

2:45pm – 3:00pm **Utilizing Y-SNPs for samples containing low amounts of nuclear DNA**
Elise Anderson, Arwin Ralf, Manfred Kayser, Charla Marshall, Kimberly Sturk-Andreaggi, AFMES-AFDIL

3:00pm – 3:15pm **Break**

3:15pm – 3:40pm **Post-Conviction Testing: A Case Study**
Devora Goldberg, New York City Office of Chief Medical Examiner, Jonathan S. Kui, Office of the Hudson County Prosecutor

3:40pm – 4:00pm **SupreMEtric: A commercialization effort for a body fluid identification test for forensic laboratories**
Alexis Weber, SupreMEtric LLC, Igor K. Lednev, Ph.D., University at Albany, SUNY

4:00pm – 4:15pm ***Trace DNA Detection Using Diamond Dye: A Recovery Technique to Yield More DNA**
Leah Davis, Heather Coyle Ph.D., University of New Haven

4:15pm – 4:40pm **Forensic Investigative Genetic Genealogy (FIGG): A Cautionary Tale and a Call to Action**
Claire Glynn Ph.D., University of New Haven

4:40pm – 4:55pm **The Impact of Manually Degraded SNP Microarray Data on GEDmatch Top Genetic Matches for Forensic Genetic Genealogy Purposes**
Justin Rivera, Claire Glynn Ph.D., University of New Haven

4:55pm – 5:00pm **Closing Remarks**

***Denotes Peter R. De Forest Collegiate Competition Participant**

Biology/DNA
Abstracts

***Rapid identification of semen using STK Sperm Tracker Spray**
Taylor Zekri, Michael A. Marciano, Jessica Haresign, Elise McInnis, Syracuse University

The identification and confirmation of semen stains on items of evidence can be a critical step toward corroborating stories and obtaining a profile suitable for comparison. An alternative light source (ALS) is one of the most common methods to screen for the presence of body fluids, which then leads to presumptive or confirmatory testing. Although most semen stains will be identified on clothing it is not uncommon to identify semen stains on other items at a scene, for example, items or surfaces in a bathroom. These larger items or surfaces may not be easily transported to a lab or may be time-consuming to screen at the scene. This study examines the use of STK Sperm Tracker™ Spray, used in conjunction with ALS, for the identification of semen stains. The STK Sperm Tracker™ is specific to seminal acid phosphatase and uses reagents that cause the stain to fluoresce more brightly under ALS making detection faster and more efficient. The aim of this study is to (1) compare the accuracy and precision of semen identification with STK Sperm Tracker™ Spray and ALS compared to the ALS in isolation, (2) determine the sensitivity of the spray, and (3) test the specificity of the spray. Bathroom surfaces and structures were stained with dilutions of semen, blood, urine, and mixtures of these fluids. Items were screened with the Vilber ALS at 365nm and Rofin Polilight Flare 2 ALS at 365nm to compare efficiency. Preliminary testing indicates that the STK Sperm Tracker™ Spray enhances the brightness of the semen stains, thus making it easier and faster to identify potentially probative evidence. Downstream analysis will be conducted on stains observed with STK Spray to determine whether the product interferes with the ability to obtain DNA profiles.

Validation and Implementation of Three Next Generation Sequencing Systems
Rachel Oefelein, DNA Labs International

Next Generation Sequencing (NGS) technology has been available for quite some time; however, the forensic science community, up until this point, has been slow to adapt. In 2021, going in to 2022, the tides have turned. Over 6 major government laboratories and multiple private laboratories have begun to adopt NGS workflows. This presentation will go over the validation and implementation process of three ForenSeq NGS systems; whole genome mtDNA, Signature Prep Primer Set B, and Kintelligence for forensic genetic genealogy. Challenges and lessons learned regarding validation, automation, protocol drafting, report templates, scope of accreditation changes, and training will be highlighted. Finally, a successful case using NGS technology will be highlighted.

Using Genetic Genealogy to Overcome a Non-Paternity Event and Solve an Unknown Parentage Case
Tobi Kirschmann, Nora Cheek, Don Carola, and Kevin Sullivan, DNA Investigations LLC

Genetic Genealogy (GG) is a human identification technique that places a person's sequenced DNA file into a genealogy database for comparison amongst relatives and combines that information with traditional genealogy research methods. This technique can solve family mysteries and deliver suspect leads for law enforcement. A common obstacle in GG cases is the non-paternity event (NPE), arising when genetic data and genealogical records conflict. Although problematic, an NPE can be overcome with thorough genealogical analysis and target DNA testing. Using an example of an unknown paternity case, the identification and resolution of an NPE is described, and the steps taken for target DNA testing are reviewed. When the target DNA matches the starting DNA in the predicted way, the NPE is confirmed, and the true genetic lineage is identified.

Extraction of Challenging Forensic Samples Using the MicroGEM DNA Extraction Kit

Lauren Chwatt, Pace University, Falyn Vega, John Jay College of Criminal Justice, James Prinston & Andrew Schweighardt, NYC Office of Chief Medical Examiner

DNA extraction is an essential but sometimes tedious process in forensic investigation that may require a significant investment of time and resources. Proteinase K has been an industry standard for DNA extraction for several decades due to its reliability of protein denaturation when performing an extraction. Some of the drawbacks of proteinase K are that its use requires multiple ionic detergents and washing steps, while only being active above 65℃. Here, we analyze the potential of a new enzyme being used in DNA extraction known as forensicGEM by the manufacturer MicroGEM. This novel enzyme is temperature-dependent, which enables it to be compatible with mesophilic enzymes. The forensicGEM protocol offers complete DNA extraction in about 20 minutes in a single tube, thus limiting contamination, loss of sample, and working time -- ultimately increasing efficiency. One of the main attractions of forensicGEM is its ability to extract DNA from highly degraded samples, potentially leading to more complete STR profiles in samples where a profile may have previously been poor or unattainable by conventional extraction procedures. To assess the efficiency and potential uses of forensicGEM, we collected highly degraded tissue and bone samples and extracted DNA using the MicroGEM kit, altering different parameters such as incubation times, enzyme amount, bone preparation method, and post-extraction purification. We then compared the results of samples extracted with MicroGEM to the results of the same samples extracted with a standard organic extraction to assess whether this new technology could be utilized routinely on highly degraded samples. Half of the degraded samples extracted with MicroGEM had detectable DNA. The highest success rate was observed for bone samples. One tissue sample in particular yielded higher average peak heights when extracted with MicroGEM. No statistically significant pattern was apparent with respect to identifying superior MicroGEM optimization parameters. Success with bone profiling was notable given that there was much less sample input for MicroGEM (10 mg) compared to the organic extraction (2 g). An ancillary finding of this study is that the bone reparation method of scraping yielded higher DNA quantities and better quality profiles compared to samples treated with the standard method of milling. Since the initial results were promising, this new technology was utilized on remains from the 9/11 World Trade Center attacks from which no detectable DNA had been previously extracted. Ultimately, MicroGEM was able to yield a 22-locus and a 15-locus profile on two of these highly degraded samples. Future work will focus on further investigation of the bone scraping method for universal application, and continued optimization of experimental parameters in the MicroGEM extraction protocol.

New Standards and Best Practice Recommendations for Forensic DNA Testing
Charlotte Word Ph.D., Consultant
Since its inception in 2014, the Organization of Scientific Area Committees for Forensic Science (OSAC) has facilitated the drafting of many new Standards and Best Practice Recommendations for forensic science service providers in multiple disciplines. Many of these documents are now published and available for implementation having been further developed by various Standards Developing Organizations (SDOs), such as the American Academy of Forensic Sciences Academy Standards Board (ASB), and are also available on the OSAC Registry. Currently thirteen Standards and Best Practice Recommendations for forensic DNA testing laboratories have been published and/or listed on the OSAC Registry, and many others are in various stages of the drafting or development process. These documents cover various aspects of analyst training as well as DNA laboratory testing processes, including DNA mixture interpretation, probabilistic genotyping software and serological testing method validation and protocol development. Other documents address contamination prevention, monitoring and mitigation including the use of elimination databases as well as the reporting of profiles impacted by contamination or failed controls. This presentation will provide a brief summary of the thirteen Standards and Best Practice Recommendations available for implementation in forensic DNA testing laboratories along with a preview of other documents currently in progress. Information regarding how individuals can get involved and participate in the standard development process and the resources available to assist with implementation by laboratories will also be presented.

***Examination of Saliva for Determination of a Confirmatory Test**
Sierra Soletsky, Claire Glynn Ph.D., University of New Haven
Saliva can be very important in criminal cases for confirming activities claimed took place or victims or suspects were involved in the crime. The way saliva is identified in forensic cases is through the use of three tests: SALIgAE®, RSID™ Saliva, and Phadebas® Amylase Test. These tests work to identify salivary a-amylase which is an enzyme that is present in saliva. However, there is no general consensus across laboratories on if these are all presumptive or if any can be used as confirmatory. This is due to amylase also being present in small quantities in other bodily fluids like vaginal fluid, semen, and breast milk. It is also present in plants and animals. These items can cause false positives in the tests along with even household items like laundry detergent causing false positives in some studies. These false positives lead to these tests not being selective enough to be considered confirmatory by all labs, yet still some labs believe RSID™ saliva is selective enough to be considered confirmatory. This study examined the selectivity and the sensitivity of these three tests to see if RSID™ saliva should be considered confirmatory by all labs, or if there were too many false positives possible that RSID™ saliva and the other two tests interact with, to display that all should be solely presumptive. This study used citrus fruits and laundry detergents which are known to have forms of amylase in them. This study confirmed that citrus fruits is a false positive that interacted with RSID™ saliva and laundry detergents are false positives that interacted with Phadebas® Amylase Test. This proves that Phadebas® Amylase Test and RSID™ saliva are solely presumptive tests since false positives were easily obtained by these tests. SALIgAE®

was the only test to not react positively to the laundry detergent or the citrus fruits showing it had higher selectivity than the other two tests, but further research must be done on possible false positives and the sensitivity to these false positives before it can be fully considered confirmatory by all labs.

DNA Mixture via Transplantation

Jennifer Thayer, New Jersey State Police Office of Forensic Sciences

Y-STR DNA profiles obtained in a sexual assault case were originally described as 2-person mixtures; however after a suspect reference was submitted it was theorized that he was, in fact, a chimera. This presentation describes the DNA results for the case, the subsequent retesting of reference samples, the potential causes of a chimera, and the final reporting for the case.

Applying complex trait and statistical genetics concepts to forensically relevant phenotypes

Frank Wendt Ph.D., Brendan Newton, University of Toronto, Andrea Quintero Reis, American University of Antigua College of Medicine

DNA can be used in a forensic science context to make inferences about the source of biological material collected from an event. Short tandem repeats (STRs) and single nucleotide polymorphisms (SNPs) also may be aggregated into "profiles" that may predict eye color, hair color, skin color, hair balding patterns, etc. Collectively, these forensically relevant phenotypes have garnered considerable attention for generation of investigative leads in criminal casework. Commercially available kits to predict such phenotypes rely heavily on whether the unknown profile matches some reference profile(s). As all humans are a mosaic of genetic information blended from ancestral populations, the appropriate consideration of admixture is not appropriately addressed in these predictive algorithms. This talk will describe a series of investigations into (i) the population genetic features of DNA phenotyping SNPs across diverse global populations, (ii) the relationship between these loci and potentially probative features of the human phenome, (iii) overcoming statistical challenges to pattern-matching algorithms in forensic DNA phenotyping, and (iv) an example use of statistical genetics investigation of various definitions of suicidal thoughts and behaviors. Collectively, this talk is designed to shed light on the power of complex trait genetics, statistical genetics, and genetic epidemiology to rapidly advance the forensic science field with rigorous and statistically powerful computational investigation of traits routinely investigated in the legal system. Furthermore, this talk will emphasize one major weakness of the forensic DNA community related to the inclusion and appropriate adjustment for measures of population stratification in genetic studies.

***Application of K-means clustering to Images of Immunochromatographic Test Strips for Saliva Detection**

Katelyn Rivera, Lasell University, Frank Wendt Ph.D., University of Toronto

The identification of body fluids on evidentiary items is an essential presumptive step in forensic casework. Lateral flow immunochromatographic tests are regularly used as a confirmatory test for the detection of human saliva, seminal fluid, and/or blood and determines whether or not these tested items will be submitted for DNA extraction. The positive and negative results of these test strips rely on visual recognition of a colored band, making the results highly subjective from analyst to analyst. We hypothesized that machine learning analysis of image data can accurately discriminate between negative and positive detection of saliva from immunochromatographic assays. As a proof of concept, we used a total of 10 images of saliva test strips from Old, et al. Each image showed a control line indicating a reliable test result and a test line resulting from various volumes of saliva: 0.5nl, 0nl, 5nl, 10nl, 25nl, 50nl, 250nl, 500nl, 1250nl, and 2500nl. Image colorization was performed with custom K-means clustering algorithms written in R studio. Control lines from each test strip were analyzed to determine the most appropriate K (i.e., the number of clusters of data points in the images) using three methods: (i) within sum of squares (WSS), (ii) average silhouette coefficients ("silhouette"), and (iii) gap statistics. We decomposed the test lines into red, green, and blue color spectra and projected these values onto the two- dimensional feature space of the spectra from control lines. Pixels were assigned to a reference cluster (e.g., "Background, "Test Line," and "Unclustered") based on their relative position to the centroid of the reference clusters. Any data point within the 95% confidence interval of the reference cluster centroid position was considered a member. Control line analyses support K=2 as the most appropriate number of clusters in the data (mean WSS=7.99±1.32; mean silhouette coefficient=0.856±0.010; mean gap statistic=0.780±0.030). At K=2, image colorization was able to detect 500nl of saliva with approximately 6.7% of data points assigned to the test line. Some immunochromatographic card images supported K=3 with some of the clustering algorithms; however, across all cards, K=3 was less well supported than K=2 by all model fit metrics (K=3 mean WSS=3.59± 0.483; mean silhouette coefficient=0.798±0.020; mean gap statistic=0.766±0.047). Our work has established one workflow to assess images of RSID Saliva cards for the presence of positive test lines. Based on these findings, future work includes collection camera setting parameterization, cross-card compatibility, and cross-substrate portability. We are actively collecting high-quality immunochromatographic card images and assessing cross-tissue portability of the algorithm.

Utilizing Y-SNPs for samples containing low amounts of nuclear DNA

Elise Anderson, Arwin Ralf, Manfred Kayser, Charla Marshall, Kimberly Sturk- Andreaggi, AFMES-AFDIL

Y-chromosomal single nucleotide polymorphisms (Y-SNPs) can provide paternal lineage identification and paternal ancestry prediction in cases with samples of limited nuclear DNA, such as aged skeletal remains in missing persons cases. Additionally, due to reduced amplicon size, Y-SNPs can be recovered from poor quality samples when typical Y-chromosomal short tandem repeat (STR) testing fails to yield a useful profile. The Ion AmpliSeq HID Y-SNP Research Panel was designed for Ion sequencing to detect 884 Y-SNPs and allow the interference of 640 Y-haplogroups. The assay includes ~600 amplification targets multiplexed into a single primer pool, with amplicons averaging 120 bps (65 to 250 bps). To assess this kit for the application to forensic-type samples, the assay was tested on blood serum samples from diverse U.S. populations. Serum contains minimal quantities of high-quality nuclear DNA, which limit Y-STR recovery. Furthermore, this study evaluated the ability to generate Illumina data with the AmpliSeq HID Y-SNP panel. The Y-SNP targets were amplified with Qiagen Multiplex

MasterMix followed by automated half-volume library preparation using the KAPA Hyper Prep kit. Data was analyzed with the Yleaf software and a custom CLC Genomics Workbench workflow. Based on Yleaf results, a total of 202 samples produced a refined Y-haplogroup consisting of 102 unique haplogroups. These samples generated an average of 789 Y-SNPs (426 to 877 Y-SNPS) with a coverage of at least 10X. There were 13 male samples that produced more than 300 Y-SNPs, but Y-haplogroup assignment was not possible due to missing diagnostic markers. This presentation will describe these results in more detail, including the correlation between DNA quantitation and Y-SNP recovery as well as improved sample success compared to Y-STRs.

Disclaimer: The opinions or assertions presented hereafter are the private views of the speaker(s) and should not be construed as official or as reflecting the views of the Department of Defense, its branches, the Defense Health Agency, or the Armed Forces Medical Examiner System.

Post-Conviction Testing: A Case Study

Devora Goldberg, New York City Office of Chief Medical Examiner, Jonathan S. Kui, Office of the Hudson County Prosecutor

The New York City Office of Chief Medical Examiner's Department of Forensic Biology is an accredited laboratory with approximately 170 analysts who process over 20,000 cases per year. In addition to homicides, assaults, robberies, firearms and property crimes under active investigation, and cold cases and missing persons identifications, the laboratory also tests evidence requested in post-conviction contexts, where testing may yield results that would support exoneration. The laboratory tests a wide variety of evidence types in post-conviction inquiries, as the use of modern techniques may represent one of the last remaining options in uncovering elusive answers in these enduring cases. Here we present a post-conviction case study on a violent 1996 kidnapping and sexual assault by three perpetrators. Three suspects were convicted at trial in 1997, though the DNA testing at the time had only shown possible associations to two of the three suspects. A 2015 request for post- conviction testing sought to explore remaining 1996 evidence to assess any contribution/exclusion of the third suspect. The results of two years of testing efforts from 2017-2019 demonstrates the process and challenges involved in post-conviction testing at OCME.

SupreMEtric: A commercialization effort for a body fluid identification test for forensic laboratories

Alexis Weber, SupreMEtric LLC, Igor K. Lednev, Ph.D., University at Albany, SUNY

The ability to identify body fluid traces at crime scenes, while preserving any DNA present, is critically important in forensic science. Currently in forensic science laboratories, the identification can be difficult and many of the current techniques are specific to one body fluid. Additionally, typical biochemical methods are destructive – preventing any further analysis. When there is a problem within the scientific field, research laboratories are the main group to solve this problem. After conducting research in the laboratory, the next step in the process is to commercialize the research. Commercialization is bringing a product to market and selling it for financial gain. Within the Lendev Laboratory, in order to develop a universal, confirmatory, nondestructive, approach that can be used to differentiate and identify body fluids, the specificity of Raman spectroscopy was combined with the analytical power of statistical modeling. All six forensically relevant body fluids (blood, semen, saliva, sweat, urine, and vaginal fluid) were successfully discriminated by coupling Raman spectroscopy and chemometrics. This technique is both reliable and nondestructive, offering substantial advantages over the current techniques used to identify body fluids. This development of this product has occurred over several years to prepare it for sale, with the culmination of this being the creation of the start-up company SupreMEtric LLC. SupreMEtric's mission is to streamline the forensic analysis of biological stains by creating a universal nondestructive method for the identification of all main body fluids. This presentation covers the process from research to commercialization process of this technology.

***Trace DNA Detection Using Diamond Dye: A Recovery Technique to Yield More DNA**
Leah Davis, Heather Coyle Ph.D., University of New Haven
The current approach to the recovery of trace DNA on larger pieces of evidence is blind swabbing in an area where there may be a source of DNA. When using this technique, the chance of missing the area that does contain trace DNA increases which could lead to retaining a partial DNA profile or no profile in general. This study aspired to find a new approach to trace DNA recovery techniques to yield a higher quantity of trace DNA from larger items of evidence. It took the path of visualizing trace DNA on items of evidence with potential DNA so analysts can swab a more localized area rather than through the general swabbing technique currently used for touch DNA recovery. Specifically, the use of Diamond Nucleic Acid Dye in a spraying mechanism was used to distribute the Diamond Dye solution (Young & Linacre, 2020) . The first part consisted of the solution being tested on porous and non-porous surfaces to investigate the appearance of the dye on different materials when being excited by a mini crimescope at different light wavelengths (Kanokwongnuwut, Kirkbride, & Linacre, 2018) . These tests helped to access the amount of dye that needed to be distributed from the spraying mechanism to ensure the retention of DNA was possible. Images were captured to display the effects of the dye on the different materials. The next part of the experiment involved Diamond Dye being sprayed onto brand new and laundered brassieres that had touch DNA placed by donors on the porous cup area and the non-porous clasp area to replicate potential evidence from an assault. The stained brassieres were visually analyzed using a Dino-Lite magnifier to locate areas that fluoresced, meaning that touch DNA is present, and images were captured to display the effects on the mock evidence. The final part of the study consisted of double swabbing of laundered brassieres using the general blind and localized Diamond Dye swabbing techniques and analyzing the swabs for the quantity of DNA present. Donors placed trace DNA on the cup and clasp areas of laundered brassieres that were used for either swabbing technique. General blind swabs of randomly selected brassieres were collected. The other brassieres were

first sprayed with the Diamond Dye solution and placed under the mini crimescope at multiple wavelengths in order to excite the dye for locating the trace DNA present and swab fluorescing areas of the brassieres. The swabs are currently being put through DNA extraction and quantification using the Qiagen QIAmp DNA Investigator Kit and the Quantifiler Trio DNA Quantification Kit in order to quantify the amount of DNA was recovered from each area of the brassiere. The quantified data can then be input into charts in order to compare recovery quantities between the two techniques in both porous and non-porous materials of mock evidence items and determine if there's a statistical difference in the quantity of DNA being yielded between the two techniques.

Forensic Investigative Genetic Genealogy (FIGG): A Cautionary Tale and a Call to Action

Claire Glynn Ph.D., University of New Haven

The use of Forensic Investigative Genetic Genealogy (FIGG) has rapidly increased across the United States since early 2018. It is estimated that at least 500 cases within the US alone have been resolved using FIGG in just a few short years. However, the number of cases solved is not the same metric, nor is it as informative, as the clearance rate of FIGG cases. As there is no required reporting of the use of FIGG in criminal investigations to any governing body, there exist many questions regarding the number of cases FIGG was not successful in resolving, and why. While several law enforcement agencies have established their own in-house FIGG investigation units, it remains that the majority of cases are outsourced to private FIGG providers and/or vendor laboratories. Some FIGG providers/vendors are cognizant of forensic standards and adhere to robust quality assurance and quality control practices. It is critical however that all FIGG providers and vendor labs do the same. This presentation will highlight some of the risk factors that can compromise the integrity of a case and will offer some recommendations to safeguard the use of FIGG in the future.

The Impact of Manually Degraded SNP Microarray Data on GEDmatch Top Genetic Matches for Forensic Genetic Genealogy Purposes

Justin Rivera, Claire Glynn Ph.D., University of New Haven

Forensic Genetic Genealogy (FGG) has recently become a valuable tool in the forensic science community and is having a great impact on the resolution of unresolved cases, including homicides, sexual assaults, and Unidentified Human Remains (UHRs) cases. In forensic investigations, following traditional Forensic DNA (STR) analysis and CODIS upload (within the United States), and failure to produce a candidate match in CODIS, FGG could produce investigative leads to identify an unknown individual. FGG employs SNP sequence data uploaded to genetic genealogy databases (i.e., FamilyTreeDNA® and GEDmatch PRO®) to identify genetic relatives (i.e., genetic matches) of the unknown individual. Family tree(s) are then constructed using the genetic matches to reach a possible candidate identity of the unknown individual. SNP sequencing (i.e., SNP microarray) typically requires high-quality/high-quantity DNA samples. Degraded DNA samples however are regularly encountered in forensic investigations. Therefore, a critical analysis of the impact of degraded DNA/SNP data is necessary to investigate the downstream effects this may have on the subsequent FGG analysis within the genetic genealogy databases. Addressing this potential issue, this study investigates how manually degraded SNP DNA data files affect the top ten genetic matches generated in GEDmatch. Following informed consent, three volunteers provided their own downloaded raw DNA SNP microarray data. Once received by the principal investigator, the data files were anonymized and subjected to a randomized manual deletion protocol using

Microsoft Excel. This process is composed of increasing increments of deletion percentages from the overall SNP data profile with a total of nine modified files for each donor (minus 5%,10%, 15%, 20%,25%, 30%,- 50 deletion), each file was uploaded to GEDmatch as "Research Files", and a list of the top ten genetic matches based on shared DNA (total shared cM value) was produced. Each modified file was examined using autosomal One-to-Many matching, autosomal One-to-One Q-Matching, and Segment Searching, to investigate how values and top matches were altered with increased deletion of data. Currently, this specific protocol and analysis is being completed for SNP profiles generated through whole genome sequencing (WGS), which has been valuable in FGG. The results highlight various changes among top matches, including, but not limited to; matches that decrease/increase in total shared cM value, decrease/increase in quality scores of matching segments on a one-to-one basis, and changes to percentage confidence in predicted relationships. Additionally, the ranking of each donor's top ten genetic matches became altered with increasing deleted percentages, with some moving up in rank, some moving down in rank, and some lost completely (from the top ten list) when compared to the original full DNA SNP data file. Practically, these findings highlight potential issues for match assessment as typically the top ten genetic matches are the most valuable starting point in an FGG investigation. As FGG use grows, it is important to understand how to assess the information coming from a subject's matches, particularly when dealing with degraded DNA samples. Overall, this research emphasizes the need for further empirical research to assess the impact of degraded DNA samples in FGG investigations.

***Denotes Peter R. De Forest Collegiate Competition Participant**

NEAFS Welcome Reception
Poster Session
Wednesday, October 19th 5:30pm – 8:00pm
Event Center

Chair: Keri LaBelle, Massachusetts State Police Crime Laboratory, MA

P1. Getting Confident Answers to Serious Questions via "Classical & Searchable EI Spectra" in Under a Minute using Agilent's QuickProbeTM Technology on an existing GCMS System Kirk Lokits, Agilent Technologies

P2. Increased Accuracy and Precision in the Detection and Identification of Human Semen Stains on Clothing Fabrics using the STK ™ Sperm Tracker STK Lab Jessica Haresign, Syracuse University; Elise McInnis, Taylor Zekri, Michael Marciano, Forensic and National Security Institute at Syracuse University

P3. Increasing the Precision and Accuracy of the Detection of Semen Stains on Household and Vehicle Fabrics Using STK Sperm Tracker Lab Elise McInnis, Syracuse University; Taylor Zekri, Jessica Haresing, Michael Marciano, Forensic and National Security Institute at Syracuse University

***P4. What Came First, the Crime or The Egg? Analyzing Necrophagous Insect Eggs by DART-HRMS for Species Identification** Alexa Figueroa, University at Albany, SUNY; Jennifer Y. Rosati, Ph.D., John Jay College of Criminal Justice; Rabi A. Musah, Ph.D., University at Albany, SUNY

***P5. Manifestation of TASER drive stun burn marks on fabric** Hannah Ruffo, University of Toronto, Mississauga; Eugene Liscio, Wanying Cao, Yu Ran Zhou, Corrin Doucette, University of Toronto, Mississauga

P6. Development of a spectroscopic screening tool to determine optimal sampling sites for DNA recovery from human skeletal remains Kathleen Smith, University of New Haven; Cody Silverman, University at Albany, SUNY.

***P7. Investigation and Quantitation Using Ultraviolet-Visible Spectrophotometry of the Products of the 4-Aminophenol Reaction with Cannabinoids** Juliet Pearsall, Cedar Crest College; Marianne Staretz, Ph.D., Cedar Crest College; Matthew Wood, Ph.D., ABC-GKE, Ocean County Sheriff's Department; Jeanne Berk, Ph.D., Cedar Crest College

***P8. The Importance of a Comprehensive Raman Spectral Library for the Identification of Minerals in Soil** Chase Notari, University of New Haven; Dr. Brooke Kammrath, Henry C. Lee Institute of Forensic Science, University of New Haven

***P9. Analysis of Kratom using High Performance Thin Layer Chromatography Coupled with Surface Enhanced Raman Spectroscopy** Ana Monogan, Cedar Crest College; Marianne Staretz,, Cedar Crest College

P10. The Effect of Degradation on IrisPlex SNPs Maria Gruber, University of New Haven; Dr. Heather Coyle, University of New Haven

P11. Forensic Analysis of 3D Printed Polymers Using Direct Analysis in Real-Time Mass Spectrometry (DART®-MS) Jenna Covey, University of New Haven; Dr. Brooke Kammrath, University of New Haven; Dr. Brian Musselman, Ionsense, Inc.; Dr. Maria-Isabel Carnasciali, University of New Haven

***P12. Evaluation of successive DNA extractions from different types of swabs** Ella Pickell, Hofstra University; Charlotte Arsenault, Department of Arts and Sciences, Western New England University; Georgiana Gibson-Daw, Department of Arts and Sciences, Western New England University; Deborah S.B.S. Silva, Chemistry Department, Hofstra University

P13. The Detection of Backspatter Bloodstains on Horizontal Surfaces at Different Heights Nicole Millis, University of New Haven; Dr. Peter Valentin, University of New Haven

P14. Rapid quantification of 65 drugs in biological fluids by QSight UHPLC/MS/MS Jacob Jalali, Perkin Elmer; Cole Strattman, Marc Elie, Perkin Elmer

***P15. Automated Sperm Identification Using MetaSystems Metafer Imaging System** Itunu Alao, Boston University; Boston University; MetaSystems; Caitlyn Taveira; Amy N. Brodeur

P16. Enzymatic Assay Development for SAM-dependent Phenylethanolamine N-Methyl transferase activity in Human S9 cytosol fraction Mackenzie Pavlik, Department of Forensic Science, University of New Haven; Abby Veeser, Department of Forensic Science, University of New Haven; Robert H. Powers, Ph.D. Department of Forensic Science, University of New Haven

***P17. Differentiating Human and Canine Saliva through the Genetic Expression of AMY1 and AMY2** Nancy Lay, Cedar Crest College; Lawrence Quarino, K. Joy Karnas, Cedar Crest College

***P18. Open Fire** Abigail Wilson, Peter Diaczuk, PhD, John Jay College of Criminal Justice

***Denotes Peter R. De Forest Collegiate Competition Participant**

NEAFS Welcome Reception
Poster Session
Wednesday, October 19th, 5:30pm
Event Center

Chairperson: Keri LaBelle

P1. Getting Confident Answers to Serious Questions via "Classical & Searchable EI Spectra" in Under a Minute using Agilent's QuickProbeTM Technology on an existing GCMS System
Kirk Lokits, Agilent Technologies

Routine analysis of unknown powders, tablets, and liquids by forensic drug chemist, has routinely utilized capillary chromatography with mass selective detectors (MSD). However, this usually requires some sample preparation and or acid/base extraction and includes runtimes routinely from 10 to 30 minutes for general sample screenings. QuickProbe analysis can produce "classical EI" spectral identification of compounds in a variety of sample matrices with minimal to no sample prep. The purpose of the research is to demonstrate the ability of QuickProbe™ to be successfully incorporated into the current forensic workflow on existing GCMS systems. This work illustrates how the technique can be configured on existing 5977B/7890B or 8890 GCs in 3 different configurations, while maintaining the current conventional capillary GCMS capabilities. QuickProbe is controlled by Agilent MassHunter software with access to acquisition control, qualitative analysis, unknowns' deconvolution, and reporting templates.

P2. Increased Accuracy and Precision in the Detection and Identification of Human Semen Stains on Clothing Fabrics using the STK ™ Sperm Tracker STK Lab Jessica Haresing, Syracuse University; Elise McInnis, Taylor Zekri, Michael Marciano, Forensic and National Security Institute at Syracuse University

The detection and identification of seminal fluid is many times a critical step in forensic analyses, where these stains can be present on items collected at a crime scene or from a sexual assault evidence collection kit. The alternate light source, or ALS, is the first analytical tool that is used to screen evidence for the presence of body fluids, primarily used for the identification of semen. However, this is not specific, as other types of body fluids and chemical reagents can fluoresce under ALS, making the search and identification of semen stains potentially difficult
and time-consuming. Additionally, diluted semen or semen mixed with other bodily fluids can go unnoticed even with the use of an ALS. STK Sperm Tracker - STK Lab paper has been developed allowing for a more sensitive and specific means of quickly screening evidence for the presence of semen on porous items such as clothing fabrics. This product has chemical reagents impregnated onto one side of the paper that reacts with human seminal acid phosphatase, producing a bright fluorescence when viewed under a 365nm UV light. This study investigates the sensitivity of the STK Sperm Tracker - STK Lab paper on clothing made from a diverse array of fabric types, such as cotton, polyester, and wool. The speed and sensitivity of identifying semen stains using the STK Lab paper was compared to an ALS, (Arrowhead Forensics 455nm), and the resulting evaluation of semen positive STK Lab paper will be compared using the two different 365nm ALS, the Vilber VL- 6.L and Rofin Polilight Flare + 2 UV. Preliminary studies have shown that semen stains fluoresce brighter

with the STK Lab with ALS versus the 455nm ALS by itself. Also, it is evident that Vilber VL-6.L (365nm) increases the fluorescence of the semen stains with STK Lab compared to the Rofin Polilight Flare + 2 UV (365nm). Further studies will analyze how accurate and how rapid the STK Lab is when identifying semen stains on clothing fabrics with varying thicknesses, compositions, and colors.

P3. Increasing the Precision and Accuracy of the Detection of Semen Stains on Household and Vehicle Fabrics Using STK Sperm Tracker Lab Elise McInnis, Syracuse University; Taylor Zekri, Jessica Haresing,_Michael Marciano, Forensic and National Security Institute at Syracuse University

Initial efforts in searching for the presence of semen involve the use of an alternative light source (ALS). There are many types of fabrics on which semen stains may be deposited, some types may be more difficult to detect stains using this method. This study uses STK® Sperm Tracker Lab, a new product to be used along with ALS as a presumptive test for human semen. STK Lab is a paper impregnated with reagents that react with seminal acid phosphatase, making it highly sensitive and specific to semen. The reaction results in greater fluorescence of the semen stain under ALS, including for diluted semen stains and stains mixed with other body fluids. Greater fluorescence allows for greater efficiency when searching for the presence of semen and greater sensitivity. This study aimed to compare the accuracy and precision of semen identification using STK Lab and ALS compared to ALS alone. To achieve this, various household and vehicle fabrics were stained with semen dilutions, blood, and a mixture of semen and blood to simulate evidence in a real scenario. Fluorescence with the ALS was compared on items using Arrowhead 455 nm and Vilber VL-6.L 365 nm before using the STK Lab. Following the use of STK Lab, fluorescence was compared on items using Vilber VL-6.L 365 nm and Polilight® Flare + 2 365 nm ALS. Preliminary testing has found the STK Lab increases the ability to identify the stain including showing a more precise size and shape of the stain and increasing the ease of identifying mixed stains of semen and blood.

P4. What Came First, the Crime or The Egg? Analyzing Necrophagous Insect Eggs by DART-HRMS for Species Identification* Alexa Figueroa, University at Albany, SUNY; Jennifer Y. Rosati, Ph.D., John Jay College of Criminal Justice; Rabi A. Musah, Ph.D., University at Albany, SUNY

Forensic entomology focuses on the use of necrophagous insects to inform investigators of the time elapsed since death, or post-mortem interval (PMI). Blowflies are often used to determine the PMI since they are typically the earliest arrivers and due to the well-known correlation of their colonization of human remains to the various stages of decomposition. It is crucial that the insect species are accurately identified to correctly utilize their lifecycle for this prediction. This is challenging and laborious because species identification of juvenile fly life stages is difficult due to the fact that multiple species have similar appearances. For this reason, it is common practice to identify species by rearing the juvenile life stages to adulthood in order to base the assessment on the gross morphological feature characteristics of the adult specimens. This is time consuming, requires specialty laboratory resources and entomological expertise.

Described here is the development of a method for determination of the species identity of blow fly eggs based on their chemical fingerprints attained by direct analysis in real time-high resolution mass spectrometry (DART-HRMS). Eggs from various species within the blowfly Calliphoridae family, such as Calliphora vicina, Lucillia illustris, and Cyonoma cadaverina were collected and suspended in aqueous ethanol. The suspensions were analyzed via DART-HRMS, producing unique chemical profiles. The chemometric processing of the ethanol suspensions revealed interspecies differences and intraspecies similarities amongst the samples. The application of Kernal Discriminant Analysis (KDA) to the DART-HRMS data enabled species identification with an accuracy of 99.18%. Subsequent research aims to create a database of DART-HRMS chemical profiles for blowfly species eggs that can be utilized by law enforcement for species identification of entomological evidence, thereby increasing the evidentiary value of this underutilized insect life stage.

P5. Manifestation of TASER drive stun burn marks on fabric* Hannah Rufo, University of Toronto, Mississauga; Eugene Liscio, Wanying Cao, Yu Ran Zhou, Corrin Doucette, University of Toronto, Mississauga

The TASER® is a type of conducted energy weapon (CEW) used with increasing frequency by law enforcement to subdue subjects in circumstances where compliance is necessary. When operated in the drive stun method of deployment, the electrodes at the head of this CEW are intended to make direct contact with a surface, generating heat and light which may result in burn marks as a by-product of the electrical discharge that occurs. This research aims to tackle a crucial gap in CEW research that fails to address the appearance of burn marks on fabrics. A drive stun duration (DSD) of 1, 3, and 5 seconds was used with three TASER models (X26P, X2, & TASER 7) on three fabrics (white 100% cotton, 100% polyester, 35:65 cotton-polyester blend) with an underlying backing of pork hock. Using a Keyence VHX-6000 confocal microscope, high magnification images were taken to observe any qualitative changes to the fabric. On polyester fabric, with increasing DSD, darker brown discolouration occurred. Additionally, on polyester fabric, the spatial orientation of the burn marks corresponded with that of the electrodes at the muzzle of each TASER model. These features enabled the correct identification of the TASER model and DSD on polyester fabric in the blind tests performed. Evidence of burn marks on cotton and blend fabrics were both limited and inconsistent such that no features were sufficiently unique to link them to any TASER model or DSD.

P6. Development of a spectroscopic screening tool to determine optimal sampling sites for DNA recovery from human skeletal remains Kathleen Smith, University of New Haven; Cody Silverman, University at Albany, SUNY.

Forensic experts estimate the number of unidentified dead in the United States to be between 40,000 and 60,000. Numerous challenges exist with forensic genetic testing of human skeletal remains due to diagenesis patterns in bone microstructure, DNA degradation, and the presence of PCR inhibitors. Diagenesis is the microscopic breakdown of the bone matrix, which consists primarily of mineralized calcium hydroxyapatite and collagen. The process of diagenesis occurs in a heterogeneous, non-uniform manner along the diaphysis of a long bone, and determining the region with the most intact bone microstructure is not possible with the naked eye. Therefore, taking cuttings from the diaphysis for DNA testing is a blind process, and decades of research and casework have demonstrated that differences in DNA recovery do exist between cuttings along the shaft of the same long bone. An

additional consideration is that forensic genetic testing of bones is a time-consuming and labor-intensive process. Development of an effective screening method to determine the optimal sampling site(s) on the diaphysis could reduce time, labor, costs, and the degree of destructive sampling to obtain a DNA profile. This approach could help maximize DNA recovery and improve success rates in unidentified human remains (UHR) investigations.

Non-destructive Raman spectroscopy could serve as a reliable screening tool to obtain information about bone microstructure and stage of diagenesis which, according to previous research, often correlates to the quantity and quality of endogenous DNA within that region of bone. In the first phase of this research, Raman spectroscopy was evaluated for its effects on known quantities of human DNA extracted from buccal swabs. This step was implemented to determine if exposure to the Raman laser would damage endogenous DNA, which would preclude the use of spectroscopy in genetic casework involving human skeletal remains. Additionally, a fresh non-human (mammal) bone was scanned to serve as a reference for high quality (non-degraded) bone microstructure. In the second phase of this research, Raman spectroscopy was used to scan various pre-marked sections of the diaphysis of long bones from three sets of human skeletal remains with varying post-mortem intervals (9 months, 5 years, 50 years). Compositional analysis of each scanned section provided information about degree of diagenesis within the bone microstructure. The scanned regions of each long bone diaphysis were subsequently sectioned with an autopsy saw (Mopec), pulverized into fine powder using liquid nitrogen and a SPEX SamplePrep 6770 Freezer/Mill, and the associated bone powder fractions were then extracted for DNA. DNA extraction from buccal swabs and bone powder were performed using the QIAamp™ DNA Investigator Kit (Promega) and a modified organic extraction method, respectively. Total DNA recovery and a Degradation Index (DI) were determined using the Quantifiler™ Trio Human DNA Quantification Kit and the QuantStudio™ 5 Real-time PCR System (Thermo Fisher Scientific). Data on both DNA quantity and quality were compared to the Raman spectroscopy data to evaluate the correlation between bone diagenesis and DNA recovery.

P7. Investigation and Quantitation Using Ultraviolet-Visible Spectrophotometry of the Products of the 4-Aminophenol Reaction with Cannabinoids* Juliet Pearsall, Cedar Crest College; Marianne Staretz, Ph.D., Cedar Crest College; Matthew Wood, Ph.D., ABC-GKE, Ocean County Sheriff's Department; Jeanne Berk, Ph.D., Cedar Crest College

Delta-9 tetrahydrocannabinol (THC) and cannabidiol (CBD) are two major cannabinoids often derived from the plant Cannabis sativa L. Uses of cannabinoids range from recreational drug use to medical uses. A new test being utilized by law enforcement and forensic science analysts is the "Swiss test" or the 4-aminophenol (4-AP) test which is a presumptive color test used to determine if a sample potentially contains THC or CBD which is important in distinguishing a legal hemp sample from a marijuana sample. In the current study, a visible spectrophotometric analysis of the products of various cannabinoids with 4-aminophenol was performed. The wavelength maxima for the products of the 4-AP reaction with delta-9 THC, CBD, cannabinol (CBN), delta-8 THC were 650 nm, 525 nm, 685 nm, and 650 nm, respectively. The kinetics of the reaction was studied at a THC concentration of 159.0 μM and the time required for maximum formation of product was observed to be 15 minutes. Most of the other cannabinoids had a similar kinetic profile. The formation of products was found to be linear with increasing concentration of starting cannabinoid for all cannabinoids. Standard curves were generated using the absorbance of the 4-AP reaction products

at the respective maximal wavelengths using a concentration range of 1.590 μM to 159.0 μM for CBD, 1.590 μM to 119.2 μM for both delta-8 and delta-9 THC, and 1.611 μM to 80.54 μM for CBN. The ability to quantify THC in the presence of CBD using visible spectrophotometric analysis of the 4-AP product was also investigated. Delta-9 THC and CBD were combined at the following ratios (THC: CBD) 1:1, 1:2, 1:3, 1:4, 1:5, 1:6, 1:7, 1:8, 1:9, and 1:10. THC was effectively quantitated at each ratio using the maximum absorbance of the THC/4-AP product with biases ranging between -7% and 22%.

Keywords: Cannabinoids, 4-Aminophenol, Ultraviolet-Visible Spectrophotometry

P8. The Importance of a Comprehensive Raman Spectral Library for the Identification of Minerals in Soil* Chase Notari, University of New Haven; Dr. Brooke Kammrath, Henry C. Lee Institute of Forensic Science, University of New Haven

Raman spectroscopy is a valuable tool for elucidating the chemical structure and more of an unknown sample. A comprehensive collection, or library, is required for the proper identification of any material. Searchable spectral libraries have demonstrated value for the identification of a plethora of forensic samples, such as drugs, organic pigments and polymers. Mineral analysis is another opportunity where a comprehensive searchable Raman spectral library could aid in the identification of samples for both geological and forensic purposes. However, while there have been several collections of mineral spectra created, there remains to be one comprehensive searchable Raman spectral library. Programs like KnowItAll currently only have a few hundred profiles, and other databases like RRUFF do not have a capability to compare an unknown sample to the library, thus a comprehensive database is required. Another important consideration is the challenge associated with the natural variations within a mineral variety which can cause spectral differences. This research aims to create a comprehensive spectral library of minerals that addresses these issues and also is evaluated for its ability to accurately identify samples from a known set of 60 common soil minerals.

P9. Analysis of Kratom using High Performance Thin Layer Chromatography Coupled with Surface Enhanced Raman Spectroscopy* Ana Monogan, Cedar Crest College; Marianne Staretz,, Cedar Crest College

Kratom is an herbal substance, derived from the leaves of the tree Mitragyna speciosa, which can produce opioid-like effects and is currently legal in the United States. Given the increasing use of Kratom products, there is a growing need for methods that can be used in the analysis of these products. Thin layer chromatography (TLC) has often been applied to the screening of substances of abuse with high performance TLC (HPTLC) offering improved resolution, reproducibility, and automation over traditional TLC methods. Raman spectroscopy has also been used to aid in the identification of substances of abuse. Surface-enhanced Raman spectroscopy enhances the Raman scattering of molecules on particular surfaces leading to greater sensitivity. The current research investigates the use of HPTLC in combination with surface enhanced Raman spectroscopy for the analysis of Kratom samples. Kratom components were separated by HPTLC, sprayed with a gold colloid solution, and then Raman spectra were collected and compared to standards. The HPTLC separation was performed using a 95:5 acetone:methanol solvent system. The gold colloid solution was synthesized by adding 48.5mg gold (II) chloride hydrate ($HAuCl_4$) in 100mL of ultrapure water,

heating to 85°C, and adding 10mL of a 1% trisodium citrate solution. The reaction was stirred until the solution turned from spring yellow to wine-red. The reaction was then removed from heat and placed in an
ice water bath. Standard Raman spectra were created by running standard 1 mg/mL solutions of the five main components of Kratom (mitragynine, 7- hydroxymitragynine, speciociliatine, speciogynine, and paynanthenine) on the same type of HPTLC plate used for separation. This combination of HPTLC and SERS shows promise in the identification of Kratom products.

P10. The Effect of Degradation on IrisPlex SNPs Maria Gruber, University of New Haven; Dr. Heather Coyle, University of New Haven

The information from short tandem repeats (STRs), the current standard forensic DNA typing technology, does not always result in identification. In these cases, there are other informative markers in DNA that can be used to help generate investigative leads, one of which is single nucleotide polymorphisms (SNPs). One of the uses of SNPs is for phenotype determination. Among the phenotypic characteristics that can be predicted is eye color. A commonly used tool for eye color prediction is the free, online statistical prediction model IrisPlex, which includes 6 SNPs known to control eye color.

While SNPs can be useful, they, like all DNA, are susceptible to degradation. Research on the effect of degradation on SNPs has already been done, but much of it uses massively parallel sequencing (MPS), which is not currently feasible for most crime labs. A stronger consensus is needed regarding the value of SNPs with instrumentation and techniques currently available to crime labs, such as real-time PCR. The ultimate goal is to test IrisPlex SNPs on teeth samples and ancient human remains from the Gobi Desert.

Because SNPs are such small fragments, they will be highly resistant to the effects of degradation. Buccal swabs from 3 donors were degraded using two methods: UV exposure and burial in soil. For the UV exposure samples, swabs were put in a UV crosslinker with an energy level of 120 μJ/cm 2 for 1 min, 5 mins, 10 mins, 15 mins, 20 mins, and 30 mins. For the soil burial samples, swabs were buried 2 inches deep in individual containers of potting soil. Temperature was recorded and a controlled amount of water was added each week. The soil pH was kept within 1 unit of the original soil pH. Samples were buried for 7 days, 14 days, 30 days, 60 days, and 90 days. The DNA was extracted and quantified, and the degradation index (DI) was assessed. So far, the UV exposure samples follow the expected pattern of decreasing DNA quantity and increasing DI with longer exposure times. The DI roughly doubled with every 5 min increase between 5-20 mins. The soil samples show sharply decreasing DNA quantity with increasing time, compared to untreated control swabs.

The current sample extracts are being used with custom SNP assays to generate allele data for all 6 IrisPlex SNPs. For the UV exposed samples, the allele calls were consistent throughout the 0-30 min exposure times for the OCA2 and LOC105370627 SNPs. The SNP assays were not hindered by the degradation caused by UV exposure for these time intervals. The additional SNP assays are in progress.

The resulting SNP data will be input into IrisPlex to generate predictive eye color estimates, which will be assessed for accuracy and compared within each degradation method and between similar degradation indices. Ultimately, the goal is to develop a predictive strategy at the quantitation step for success in SNP assays for extreme samples such as those recovered from human remains.

P11. Forensic Analysis of 3D Printed Polymers Using Direct Analysis in Real-Time Mass Spectrometry (DART®-MS) Jenna Covey, University of New Haven; Dr. Brooke Kammrath, University of New Haven; Dr. Brian Musselman, Ionsense, Inc.; Dr. Maria-Isabel Carnasciali, University of New Haven

Additive manufacturing, or 3D printing, is a burgeoning industry with examples of its products existing in all aspects of everyday life including automotive and other mechanical parts, house and bridge construction, medical and emergency equipment, food and pharmaceuticals, and items of aesthetic value (e.g., jewelry, clothing, and shoes). As 3D printer technologies continue to evolve with concerted improvements in quality and decreased costs, its ease of access for providing parts for nefarious endeavors has been exploited. A variety of 3D printed parts have been used in criminal activities, including firearm components, knuckle dusters, pipe bomb components and ATM skimmers. In order to assess the evidentiary significance of 3D printed materials, the nature and variability of polymer materials used in their assembly must be investigated and understood.

The goal of this research was to evaluate the ability of Direct Analysis in Real Time-Mass Spectrometry (DART®-MS) for the source identification and discrimination of polymers used in the manufacturing of 3D printed objects. DART®-MS is a rapid, non-contact and non- destructive ambient ionization technique which enables near instantaneous determination of sample composition when paired with a mass spectrometer. DART®-MS is a proven technique for the identification of a range of samples of forensic interest, such as explosives and drugs. There is also concerted interest in evaluating its utility for the identification and discrimination of other materials, including ink, paint and polymer fibers. DART®-MS has been demonstrated to differentiate polymers from different manufacturers due to its ability to detect a diversity of its complex components. A variety of chemical additives (e.g., dyes, pigments, UV absorbers and plasticizers) may be added to a polymer product in order to produce a certain chemical or physical property of the final material. Although it is known that differences in chemical components of polymers exists between manufacturers, analytical techniques which may be uses for their discrimination need to be evaluated. In particular, this research focused on understanding the advantages and limitations of DART®-MS as it applies to the brand classification and source identification of 3D printed objects made using polylactic acid (PLA). PLA filament spools of different colors within the same brand and also different brands were analyzed using DART®-MS. Intra-sample variability was assessed for pre-manufactured samples through analysis at several locations along the filament. To evaluate brand classification and source identification, seven different colors of PLA filament from three different manufacturers were analyzed by DART®-MS. Last, the ability to associate a 3D printed part to an unused spool of polymer was assessed through a comparison of the DART-MS analysis of a PLA polymer filament and its post-3D printed part. It was ultimately concluded that DART-MS is a rapid and reliable tool for the forensic analysis of 3D printed PLA polymers which provides chemical information that can be used for its classification and discrimination.

[1] Sisco, E., & Forbes, T. P. (2021). Forensic applications of DART-MS: A review of recent

literature. Forensic Chemistry, 22, 100294.

P12. Evaluation of successive DNA extractions from different types of swabs* Ella Pickell, Hofstra University; Charlotte Arsenault, Department of Arts and Sciences, Western New England University; Georgiana Gibson-Daw, Department of Arts and Sciences, Western New England University; Deborah S.B.S. Silva, Chemistry Department, Hofstra University

DNA evidence has been incredibly useful to law enforcement for the identification and conviction of criminals as well as the innocence of others. Many cases rest on the ability of the DNA evidence to clearly and decisively determine to whom the DNA belongs to. Samples at crime scenes can be collected in different ways, and the use of swabs to collect biological samples for DNA analysis is a current practice. For decades, the cotton swab has been an important device for collecting biological samples since they are inexpensive and can be applied on several items and surfaces. Alternative swab types, such as nylon-flocked swabs, have been developed and applied for DNA sampling. Comparisons of the recovery efficiencies of different swab materials have shown diverging results depending on the sample and on the surface or item. But independently of the type of swab chosen for sample collection, crime labs face a challenge in regards to swab storage or swab discard after DNA extraction. In many crimes, only one or a couple of swabs are collected due to the lack of biological material available for collection at the crime scene. Once a sample is collected, the DNA is extracted and it can often yield low DNA amounts, which may not be enough for use in different DNA tests done at the crime lab. In order to increase the DNA yield of a swab and subsequently increase the probability of there being enough DNA for all the necessary tests, the swab should go through the extraction process multiple times. The goal of this study was to investigate the success rate of obtaining good DNA yields from previously extracted swabs. Buccal cells were collected from volunteers using cotton and flocked swabs. To mimic case-type samples, two volunteers drank from the same type of coffee cup and the cups were swabbed with different types of swabs. Genomic DNA was extracted from samples using only the QIAamp® DNA Investigator Kit (Qiagen, CA), or using this kit in combination with the Investigator Lyse&Spin Basket Kit (Qiagen, CA). Each swab went through the process of extraction four different times. DNA samples were amplified using the GlobalFilerTM PCR Amplification Kit (ThermoFisher Scientific, MA) and the amplification products were separated on a SeqStudio Genetic Analyzer (ThermoFisher Scientific, MA). According to the results, both types of swabs were able to produce complete DNA profiles for buccal swab samples up to the third extraction, and for some even up to the fourth extraction, independently of the type of extraction method used. As for case-type samples, both flocked and cotton swabs generated complete DNA profiles up to the second extraction, and most up to the third extraction. Our results showed that it is possible to obtain complete profiles from multiple extractions of the same swab, and that this technique is incredibly advantageous for forensic scientists since it increases the amount of DNA evidence obtained from swabs and that is available for multiple genetic tests.

Keywords: Cotton swab, Flocked swab, DNA extraction, DNA profiling

P13. The Detection of Backspatter Bloodstains on Horizontal Surfaces at Different Heights Nicole Millis, University of New Haven; Dr. Peter Valentin, University of New Haven

Bloodstain pattern analysis (BPA) is the interpretation of the shape, size, distribution, location, and appearance of bloodstains. BPA can provide information on the location of blood sources at the time of events at a scene, which can assist in crime scene reconstruction. There is an inverse relationship between the energy in a bloodletting event and the size of the droplets produced during that event. The blood is broken into many sub-millimeter droplets in high- energy events, such as gunshot wounds. While the diameter of the droplets can indicate the force used in the event, the location can provide information about the position of the person when they were shot.
Two types of spatter stains that can be produced from a bullet striking a person are forward and back spatter. Backspatter travels in the opposite direction of the bullet and originates from the entrance wound. Forward spatter, which travels in the same direction as the bullet, only occurs when there is an exit wound, so it is not always produced.

The sub-millimeter size of these droplets cannot travel far and, generally, can only be seen when there is a surface near the injury for the droplet to land on. But what if the shooting occurs in a location with no surface close enough to the wound for the blood to deposit?

This research examines whether it is possible to locate these characteristic bloodstains land on the floor by being visualized with blood-detecting reagents. If so, can the blood be visualized while preserving its characteristic size and shape so it can be recognized as back or forward spatter stains and not the other types of bloodstains that might be seen on the floor at the scene of a shooting? If the research yields useful results, we hypothesize that the visualization of these characteristic spatter stains could be used to indicate the position of a shooting victim in a scene.

P14. Rapid quantification of 65 drugs in biological fluids by QSight UHPLC/MS/MS Jacob Jalali, Perkin Elmer; Cole Strattman, Marc Elie, Perkin Elmer

The main objectives of this work were to develop a rapid LC/MS/MS method for the separation and detection of 65 drugs in urine and blood, and to evaluate the selectivity, linearity, and sensitivity of the QSight® 420 LC/MS/MS system. In this work different categories of drugs such as opiates, benzodiazepines, barbiturates, THCs, amphetamines, antidepressants, stimulants, and their metabolites were determined. Analysis of drugs has always been a challenge due to the number of target analytes, matrix effects and heavy ion suppression. Achieving proper detection limit, quantitation limit, recovery, accuracy, precision, stability of analytes and being able to hit the regulation's LOQs in matrix, are some of the analytical challenges in the analysis of drugs in biological fluids. In this study, blank urine and blood were spiked with all the drugs and deuterated internal standards. Urine samples were then diluted 25-fold with LCMS grade water and blood samples went through a simple protein precipitation using 1/10 Acetonitrile then transferred to HPLC vial for LC/MS/MS analysis. A mix of 20 deuterated internal standards were used across the run for correction of any matrix effect. PerkinElmer SPP Biphenyl HPLC column (50x2.1mm, 2.6um) was used for separation of the drugs. Ionization on Mass spectrometer is achieved with Electrospray ionization. Standards used for this analysis were from Cerilliant. Mobile phases used for this method were 0.1% formic acid & 5mM ammonium acetate in water for A and Acetonitrile for B channel.

P15. Automated Sperm Identification Using MetaSystems Metafer Imaging System* Itunu Alao, Boston University; Boston University; MetaSystems; Caitlyn Taveira; Amy N. Brodeur

Many crime laboratories across the country face a backlog of sexual assault cases awaiting to be processed. Microscopic visualization of sperm cells is a time consuming but important part of sexual assault evidence examination. This study evaluated an automated scanning, imaging and analysis system for its ability to recognize spermatozoa. The Metafer system (MetaSystems Medford, MA) includes a compound microscope with a motorized stage, high resolution digital camera and a software platform that uses specialized algorithms (classifiers) to recognize and group objects of interest.

Slides were prepared using dilutions of human semen and various combinations of buccal cells, yeast, bacteria, mold spores and soil particles. Contaminants were included to mimic difficult casework samples and challenge the limits of the software. Two microscopic staining techniques (Christmas Tree stain and Hematoxylin and Eosin) were applied to each sample type prior to examination. Up to 8 slides were scanned and analyzed at a time. All objects identified by the software as a possible sperm candidate appeared as thumbnail images that included a quantitative value correlating to the relative strength of the classification. A subset of the images was reviewed by the researcher to assess accuracy of the classifier. The slides were subsequently examined using traditional microscopy while blinded to the contents of each sample to compare hands-on time for the user with each technique as well as the occurrence, if any, of false negative results.

Results showed that an artificial intelligence-driven forensic sperm cell detection microscope can significantly reduce the time it takes to find sperm cells and estimate sperm cell quantity compared to a lengthier and more tedious manual search. This method also allows an accurate quantification of the number of sperm cells present in a sample, which can inform downstream DNA testing. Additionally, the Metafer system was successful in sperm cell identification amid different cell types and contaminants which often causes difficulties during a manual search.

P16. Enzymatic Assay Development for SAM-dependent Phenylethanolamine N-Methyl transferase activity in Human S9 cytosol fraction Mackenzie Pavlik, Department of Forensic Science, University of New Haven; Abby Veeser, Department of Forensic Science, University of New Haven; Robert H. Powers, Ph.D. Department of Forensic Science, University of New Haven

The N-methylation of amphetamine (AMP) yielding methamphetamine (MAMP), is chemically analogous to the N-methylation of norephedrine, a biosynthetic step in the formation of ephedrine, catalyzed by phenylethyanolamine N-methyltransferase (PMT) with S-adenosyl methionine (SAM) as the methyl donor. This enzyme was shown to be functional with a number of neurotransmitters and analogue substrates (e.g. AMP) by Axelrod in 1962. However, the methylation of AMP to MAMP is not generally thought to play a significant role in the metabolism of AMP, for which the primary metabolic pathways involve either ring or C1 hydroxylation, or oxidative deamination, yielding 4-hydroxyamphetamine, norephedrine, or phenylacetone, respectively.

Methamphetamine (MAMP) is relatively rapidly metabolized in the body via N-demethylation, yielding amphetamine (AMP). This pathway is well recognized as the basis for the appearance of AMP in biological fluid and hair samples of individuals using MAMP as a recreational drug, and AMP is an expected finding in such cases. In contrast, there is no expectation that individuals either abusing, or receiving AMP for therapeutic purposes (e.g. as treatment for ADHD) will generate any

significant levels of MAMP, and the appearance of that species in drug abuse monitoring samples is routinely presumed to reflect MAMP abuse, often with significant medical or legal consequences. We have hypothesized however, that some individuals receiving therapeutic AMP (e.g. Adderall) may generate low levels of MAMP, as a function of an equilibrium between formation from AMP via PMT, and the reverse demethylation reaction. We expect the equilibrium between AMP and MAMP is determined by both the steady-state concentration of AMP, and product inhibition of PMT by MAMP.

As an initial step in exploring the relationship between the N-methyl and -demethylation reactions, we have developed a method for the n-methylation of AMP analogs in human S9 based on Axelrod's 1962 study on Serotonin. We chose to utilize norephedrine, the C1-hydroxy analogue of amphetamine, as the basis our experiments.

Enzyme assays were completed in 1mL aliquots with a 200mM Trizma buffer at pH 7.6 and consisted of 200L S9 (Sigma), 15L 20mg/mL norephedrine, and 350L 55mM s-adenosylmethionine (SAM; Sigma). Enzyme incubations were performed at 37°C and were stopped at 0 and 60 minutes via the addition of 300 L 1M pH 9.0 Trizma buffer and 100 L 0.5g/mL KF. The solution was then extracted 3 x with 0.5mL EtOAc. The mixture was centrifuged, and the supernatant organic phases were combined and evaporated to ~ 100 L under N2 and analyzed by GC/MS for ephedrine. Our result indicated that N- methyl transferase from human S9, normally functional in neurotransmitter synthetic pathways, is capable of generating MAMP from AMP in this incubation system.

Axelrod, J. (1962). The Enzymatic N-Methylation of Serotonin and Other Amines. Journal of Pharmacology and Experimental Therapeutics, 138(1), 28–33.

P17. Differentiating Human and Canine Saliva through the Genetic Expression of AMY1 and AMY2* Nancy Lay, Cedar Crest College; Lawrence Quarino, K. Joy Karnas, Cedar Crest College

Body fluid identification provides crucial context to crime scene reconstruction. Saliva is often found in criminal investigations and its presence can be used to corroborate witness or victim statements. As a biological fluid, saliva is also likely to contain DNA that can be analyzed to potentially generate a DNA profile. Non-human biological material is forensically relevant due to canine bite-related cases, the transfer of pet or wildlife biological material, and crimes involving animals. At least in some cases, bitemark analysis may not be able to reliably differentiate human from canine bitemarks using morphological analysis. Most methods for saliva identification rely on the detection of amylase, an enzyme involved in digestion. There are two forms of amylase that exist: salivary amylase and pancreatic
amylase. Salivary amylase is expressed in human saliva, but this enzyme is not observed in canine saliva. However, both humans and canines express pancreatic amylase. AMY1 and AMY2 are the genes that code for salivary amylase and pancreatic amylase, respectively. No DNA-based method currently exists to differentiate canine saliva from human saliva, despite the potential of encountering non-human biological fluids in a forensic setting. A DNA-based method would offer advantages over current protein- based saliva tests due to the fact that DNA is more stable than proteins, which is critical when it comes to the degradation of biological material at a crime scene. False negatives may occur because of the inability to detect a degraded enzyme, and not due to the actual absence of saliva itself. A DNA-based method also offers the potential for multiplex PCR. In this preliminary study,

the sequences of each amylase gene were aligned between the two different species in order to identify regions of interest to target when designing primers. Primers were designed using information obtained from literature searches, as well as from the data generated by the sequence alignments of AMY1 and AMY2 for canines and humans. Differences in the amplicon sizes of the PCR products generated from these designed primer sets were used to distinguish saliva between the two species of interest.

***Denotes Peter R. De Forest Collegiate Competition Participant**

EVENING SESSION

Wednesday, October 19th 8PM-10:30PM
Location: Cascade II

Guest Speaker:

Sergeant Matthew Koehler

Sergeant Matthew Koehler has a Bachelor of Science degree from the University of New Hampshire. He has over 22 years of investigative experience with the New Hampshire State Police and has been a member of the Major Crime Unit since 2011. He has worked on a multitude of active and historic homicides throughout his career. He was assigned as Commander of the NH Cold Case Unit in 2018, and manages the 130 unsolved homicide, and missing person cases, designated by the New Hampshire Attorney General's Office.

Using Forensic Science to solve the 'Allenstown Four' Homicide Over 35 years of investigation from New Hampshire to California

Presenting with Sergeant Matthew Koehler is Detective Chris Elphick. Chris Elphick is a Detective with the New Hampshire State Police Cold Case Unit. He was hired by the New Hampshire State Police in 2013 after serving as a local police officer in New Hampshire for several years. He moved into the Major Crime Unit as a Detective in 2018, investigating homicides and officer-involved shootings prior to being assigned to the Cold Case Unit.

Guest Speaker:

Detective Chris Elphick

MORNING GENERAL
PLENARY SESSION

Thursday October 20th 9:00AM-12:00PM
Location: Cascade II

Guest Speakers

Robin W. Cotton, Ph.D.
Lisa M. Kavanaugh, J.D.
Lynn Schneeweis, MS

Perspectives on Progress: Forensic Science and the Criminal Justice System in 2022

Robin W. Cotton, Ph.D.
Dr. Cotton has B.S. and M.S. degrees in Biology from Southern Methodist University in Dallas, Texas, and a Ph.D. in Molecular Biology and Biochemistry from the University of California at Irvine. Additionally, she did post-doctoral research at the University of Iowa and at the National Institutes of Health in Bethesda, Maryland.

Dr. Cotton's experience in the forensic application of DNA analysis began at Cellmark Diagnostics in Germantown, MD in 1988. She subsequently served as Laboratory Director and Technical leader of the Cellmark Laboratory from 1994 to 2005. As Director and Technical Leader, Dr. Cotton was responsible for overseeing the development and implementation of new technology as well as participating in technical review of forensic casework and providing testimony in admissibility hearings and trials. She has testified as an expert witness in over 250 criminal cases in 35 states.

In October of 2006, Dr. Cotton joined the faculty at the Boston University School of Medicine where she is the Director of the M.S. Program in Biomedical Forensic Sciences which is a FEPAC accredited program. Her primary research interests focus on the development of improved and/or new methods of DNA extraction. Dr. Cotton has served on the ASCLD/LAB Board of Directors and is currently a member of the Forensic Science Oversight Board for the State of Massachusetts.

Lynn Schneeweis, MS
Lynn Schneeweis received a Bachelor's Degree in Biology from Western New England College, and a Master's Degree in Forensic Science from the University of New Haven. Lynn currently serves as the Deputy Chief Science Officer/Assistant Laboratory Director for the Massachusetts State Police Crime Laboratory. She has been with the laboratory since 2003 and has held prior positions in both the DNA Unit and the Crime Scene Response Unit.

Lisa M. Kavanaugh, J.D.

Lisa M. Kavanaugh is the director of the Committee for Public Counsel Services (CPCS) Innocence Program, a unit of the Massachusetts statewide public defender agency that identifies innocence cases and provides litigation support and funding for the investigation and expert resources needed to successfully litigate these cases. Ms. Kavanaugh has played an instrumental role in overturning several wrongful convictions, including Raymond Champagne, Frederick Clay, Shaun Jenkins, Darrell Jones and Victor Rosario. She is also actively involved in developing statewide training programs on flawed forensic evidence and other leading causes of wrongful convictions, as well as skills-based trainings for post-conviction lawyers. In 2013, she formed a multi-agency Working Group of criminal justice leaders to improve access to post-conviction DNA analysis, reform evidence handling practices, and initiate a collaborative review of cases involving microscopic hair comparison evidence. Ms. Kavanaugh first joined CPCS in 2002 as a staff attorney in the Somerville Superior Court trial unit. From 2007-2009, she worked in the Appeals Unit and litigated numerous felony appeals. She is a 1996 graduate of Yale University and a 2000 graduate of Harvard Law School. A frequent lecturer at local and national CLE training programs, she has also served as a Visiting Lecturer of Law at Harvard Law School and an Adjunct Professor with the Boston College Law School Innocence Clinic. She presently serves as a member of the Massachusetts Forensic Science Oversight Board and as co-chair of the Massachusetts Bar Association's Task Force on Conviction Integrity.

PRESIDENT'S LUNCHEON

Thursday October 20th 12PM-2PM
Location: Cascade I

Guest Speaker:

Steven A. Nigrelli
First Deputy Superintendent
New York State Police

The Bike Path Rapist/Killer and how tenacity and technology ended his reign of terror.

Steven A. Nigrelli is a 32-year veteran of the New York State Police and currently holds the position of First Deputy Superintendent. In this position, he assists the Superintendent with the performance of his official functions and serves as the Superintendent in his absence. He is Chairman of the Executive Committee, assisting with the development and implementation of major policy decisions and agency initiatives. He coordinates statewide deployment of personnel and administers the agency's disciplinary system. He oversees the operations of the offices of Field Command, Professional Standards and Administration. Superintendent Nigrelli is second in command of the agency.

Superintendent Nigrelli joined the State Police on October 1, 1990, after briefly working with the Buffalo Housing Police. He was initially assigned to patrol duties in the Central New York region, and went on to work undercover for over five years with the Community Narcotics Enforcement Team before serving several years in various roles as a member of the Bureau of Criminal Investigation. Over the years, Superintendent Nigrelli obtained and served in numerous ranks and positions, including Investigator, Sergeant, Lieutenant, Captain, Major, Staff Inspector, Lieutenant Colonel, and Colonel. As Colonel, he served as the Deputy Superintendent in Field Command. As the Field Commander, he oversaw the statewide operations of the Uniform Force, the Bureau of Criminal Investigation, the New York State Intelligence Center, the Office of Counter Terrorism, and the associated special details of these units.

Throughout his career, Superintendent Nigrelli has had the opportunity to work on or be in command of several high-profile cases and events, including numerous homicides, the Bike Path Rapist-Serial Killer Task Force, the nationwide Ralph "Bucky" Phillips manhunt, the Clinton Correctional Escape of two murderers, and was Scene Commander of the crash of Continental Flight #3407 in which 50 people were tragically killed.

Superintendent Nigrelli has received numerous awards and commendations over his career; of the most prominent were being recognized by the Buffalo News as one of the "2007 Citizens of the Year," and being named New York State's "2007 Top Cop" for his work on the Bike Path Rapist-Serial Killer Task Force. He is also a two-time recipient of the prestigious Superintendent's Commendation Award.

Superintendent Nigrelli holds Bachelor of Science Degrees in Business Studies and in Economics from the State of New York College at Buffalo.

PLENARY SESSION

Thursday October 20th 2:15PM-5:15PM
Location: Cascade II

Guest Speaker: John Collins

John Collins is an executive leadership coach specializing in working with people, teams, and organizations in positions of public trust. He started his private practice in 2013 after retiring his award-winning, 20-year career in forensic science, having served as the director of forensic science for the State of Michigan. He is also the author of three books on leadership, professionalism, and public policy in forensic science. As a facilitator, John's range of experience is unmatched, having facilitated corporate strategy retreats, as well as highly sensitive domestic and international meetings on behalf of the United States Government. John's career highlights include his part in the forensic investigation of the Atlanta serial bombings, which included the bombing of the 1996 Olympics in Atlanta (for which he received a commendation from the Department of the Treasury), as well as his 2013 participation in a historic meeting with Attorney General Eric Holder and other experts to discuss solutions to gun violence following the Sandy Hook Elementary School shooting.

In his practice, John combines principles of executive coaching and leadership education with forensic analytical methods that quickly and accurately identify opportunities for his clients to improve their professional effectiveness. John has a master's degree in Organizational Management and is formally certified as a senior HR professional by the Society for Human Resource Management (SHRM). In 2012, John was trained as a professional coach by the College of Executive Coaching, and he became certified as a Gallup Strengths Coach in 2022. He lives and works near Detroit.

"Navigating the Complexities of High-Stakes Change"

How do you deal with the unexpected when it comes at the expense of your laboratory and your team? Unfunded mandates, legislation promising quick turnaround times, and other kinds of workplace demands that seem beyond the reach of what's possible often crash upon our shoulders when we least expect them. John Collins, host of the semi-monthly Crime Lab COACH Cast and a trained and practicing executive coach working with forensic science clients all over the United States and overseas is going to explain how you can turn the impossible into some of the best opportunities that your laboratory will ever have to showcase its talents and expertise. By utilizing some basic principles of human psychology and professional performance, your team can not only respond more effectively to the craziest of demands, but also turn those demands into long-term gains that reinforce the stature of your laboratory in whatever criminal jurisdiction you serve.

Educators' Forum
Friday, October 21st 9:00am – 11:00am
Location: Porter

Chair: Sandra Haddad, Bay Path University

9:00am – 9:10am **Welcoming Remarks**

9:10am – 9:20am **ForensicXR: Creating a Virtual Lab**
Kamil Arif, Margarita Vinnikov, PhD, David Fisher, PhD, Kevin Parmelee, PhD, Josue Benavides, JongHyun Choi, Michael Kehoe, New Jersey Institute of Technology

9:20am – 9:35am **Visual Communication in Undergraduate Forensic Science Courses**
Taylor Hopkins, Duquesne University, Kelly Martin, PhD, Rochester Institute of Technology

9:35am – 9:50am
Scientific Criminal Investigation Education for Law Enforcement Officers
Dennis Hilliard, RI State Crime Laboratory, University of Rhode Island

9:50am – 10:00am **Break**

10:00am – 11:00am **Being Learner-Centered: Moving Toward Equity in the Classroom**
Yadilette Rivera-Colon, Ph.D., Bay Path University

Educators' Forum
Abstracts

ForensicXR: Creating a Virtual Lab
Kamil Arif, Margarita Vinnikov, PhD, David Fisher, PhD, Kevin Parmelee, PhD, Josue Benavides, JongHyun Choi, Michael Kehoe, New Jersey Institute of Technology

Recreating a crime scene can be very challenging as every single detail can be important in understanding what took place. Hence investigators take many pictures and make very detailed notes. However, no matter how detailed the recreation, it can never replace the actual experience of being in a real scene. However, it is still important to come as close as possible to recreating that experience in a safe environment. For investigators and jurors, this allows them to explore the crime scene without worrying about accidentally altering it. For students and educators, the repeatability and lessons that can be learned are vital for providing a consistent and complete education. However, in many cases, it is difficult to recreate a scene in such a manner, oftentimes due to a lack of space, time, or human resources, even more if the organization intends to create several mock crime scenes. To solve these issues, our team has developed an extended reality application - ForensicXR. ForensicXR is an educational platform that supports crime scene processing in virtual or augmented reality environments. Both options provide a consistent and repeatable view of a recreated crime scene. The scene is either a 3d-scanned scene or a scene recreated using accurate measurements from a 3D scan. These scenes can either be viewed in virtual reality, which entirely replaces the surroundings with the recreated scene, or in augmented reality, which overlays virtual objects and interactions over the existing surroundings. The application mirrors many of the actions that take place in a real investigation: taking pictures of the scene, lifting fingerprints, collecting and labeling evidence, and communicating with other departments and labs via a virtual tablet interface. Each scene contains a briefing and debriefing, which is stored on a database alongside the scene, allowing the application to scale and accommodate a variety of different scenarios. The system is a work in progress as we are still developing the tools required for scene processing, the database structure required to support each scene, and the educational components required to support efficient and successful learning for future investigators. In the future, we plan to perform a series of usability studies to help develop an effective and successful extended reality application. These usability studies will cover, among other things, how to best train people in using the application, and how well different types of scenes (car crash, arson, theft, murder, etc) can be represented in VR and AR formats.

Visual Communication in Undergraduate Forensic Science Courses
Taylor Hopkins, Duquesne University, Kelly Martin, PhD, Rochester Institute of Technology

Educators are tasked with creating a curriculum that uses effective strategies to promote student engagement and learning to prepare them for the workforce and beyond. The use of visual communication in higher education is crucial to ensure instructors are conveying information that students can effectively and efficiently comprehend by offering a variety of learning formats. Education in STEM disciplines, including forensic science, often follow lecture-style classes and laboratory courses that may use slideshows and procedural handouts to relay information. However, visual communication goes beyond including images in a lecture or handout. The goal of this multi-part project was to discover innovative ways that visual communication was being utilized in

pedagogical decisions by undergraduate educators. For this portion of the project, instructors from the forensic science discipline were solicited via email to share visual teaching practices and assignments used in their courses. Data was collected through two different methods: by virtual interview or completion of a survey form, with participants choosing their preferred method of data collection. Both formats asked instructors to describe their teaching practice or assignment, the motivation behind its development and implementation, and how they felt it has been beneficial to their students. The data presented common themes across the responses of the various educators that provided insight on how visual communication can be implemented at the undergraduate level. Ultimately, this project will contribute to a multi-disciplinary guidebook for university educators to showcase unique visual techniques to encourage continued innovation in higher education courses.

Scientific Criminal Investigation Education for Law Enforcement Officers
Dennis Hilliard, RI State Crime Laboratory, University of Rhode Island

The Rhode Island State Crime Laboratory in conjunction with the University of Rhode Island's Feinstein College's Office of Strategic Initiatives, has been diligent in providing training opportunities to the Forensic Science, Law Enforcement and Public Safety Communities. The training includes: crime scene processing, blood spatter interpretation, trace evidence collection, latent print processing, firearms examination, and crime scene reconstruction. It is important to the criminal justice community that opportunities for professional development in these areas are continuously being offered.

The primary training opportunity for Law Enforcement Officers is a program that started nearly seventy years ago within the University's Department of Chemistry through the efforts of Harold C. Harrison, Ph.D. a professor of Chemistry and the director of the Laboratories for Scientific Criminal Investigations, which eventually became the RI State Crime Laboratory.

The presentation will explore the genesis of this course offered by the State Crime Laboratory at the University of Rhode Island; its development over the course of the past seventy years; and how it is presented currently as a credited undergraduate two semester course. It will discuss how the elements of the current course were designed to meet the requirements for applying for and qualifying for the basic Crime Scene Investigator Certification (CCSI) offered by the International Association for Identification (TheIAI.org).

Being Learner-Centered: Moving Toward Equity in the Classroom
Yadilette Rivera-Colon, Ph.D., Bay Path University

Diversity, equity, inclusion and belonging (DEIB) work is essential in all fields. In education, making physical and remote classes accessible to all students leads to greater success in achieving learning outcomes. Moving from awareness to action is a difficult but necessary step. Steps toward action may not only be challenging, but also confusing. In this session, participants will learn about the use of equity audits to reveal areas of inequity and how to plan for improvements as a next step in the DEIB road. We will discuss how to apply equity audits in education and how these findings can lead to programmatic equity, quality equity and ultimately move us closer to learner-centered practices.

American Board of Criminalistics Examination

Friday, October 21st
Location: Tubman

Drug Analysis:
Registration at 8:00am Exam: 8:15 to 11:15 (3 hours)

Biological Evidence Screening:
Registration at 12:00 Exam: 12:15 to 1:45 (90 minutes)

Forensic DNA Analysis:
Registration at 2:15 Exam 2:30 to 4:45 (2 hours and 15 minutes)

The Chin Cup

Friday, October 21st 11:00am - 12:00pm
Location: Red Jacket

GEORGE W. CHIN COLLEGIATE CUP

In 2004 NEAFS instituted the collegiate competition. Each school submitted one paper for judging. However, with students submitting so many great papers it was felt that the competition should be open to all the student papers. So, the collegiate competition became an individual award and not a school award. In order to resume the collegiate competition Dr. Quarino instituted the "Kirk" Cup at the 2014 Annual Meeting. In 2016 the competition was renamed in honor of George W. Chin, long time moderator of the student forum.

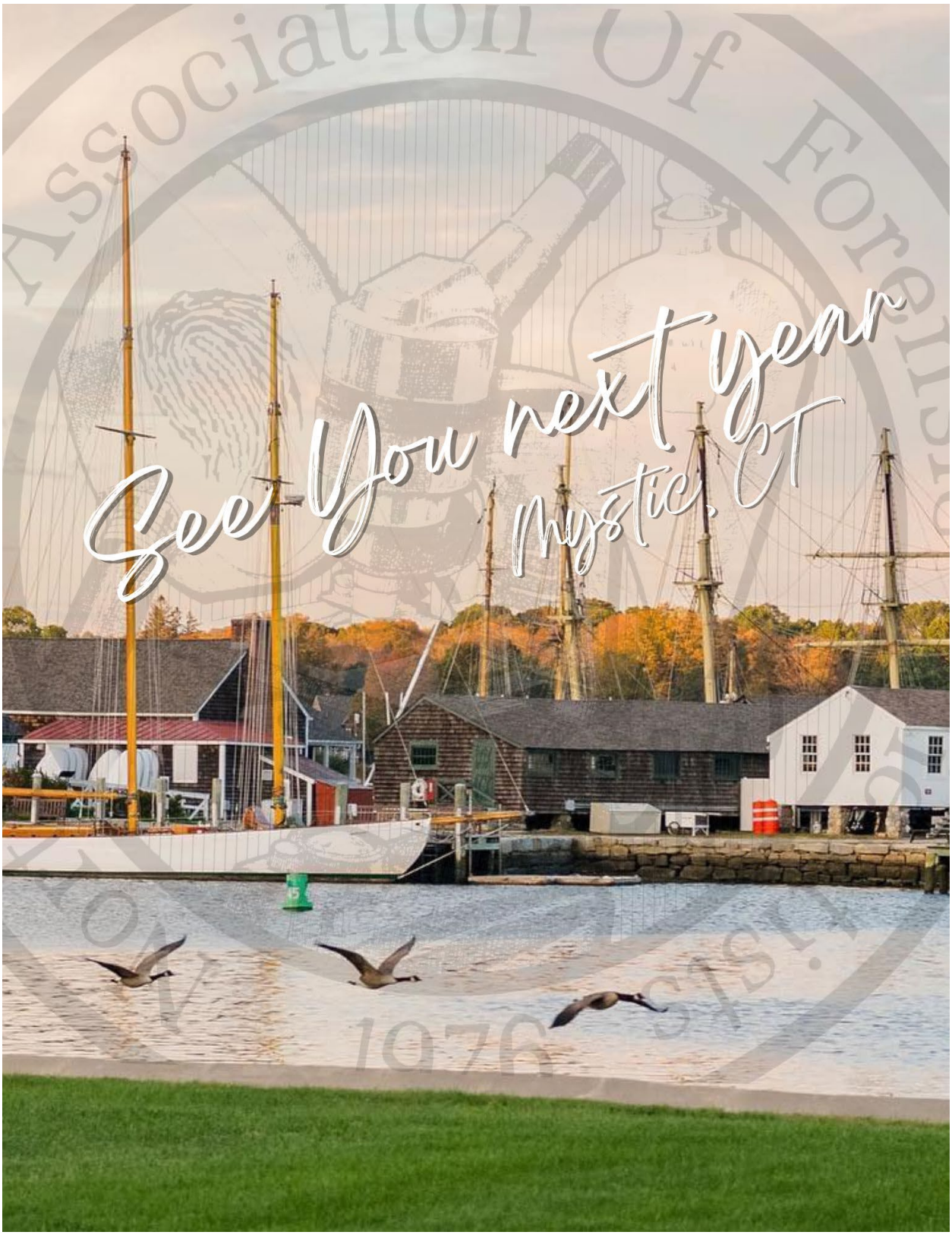
GET YOUR TEAM READY

On September 22, 2016, NEAFS lost one of the pioneers of the Association. George had a passion for forensic science and as a self-appointed "God of Trace Evidence", he liked to share his knowledge and mentor the younger generation. George was one of the co-founders of the Student Forum at NEAFS, where he would teach students about the realities of a job in forensic science. In addition to NEAFS, he was also a life member of the New Jersey Association of Forensic Scientists (NJAFS), a charter member of the American Society of Trace Evidence

A graduate of John Jay College of Criminal Justice – City University of New York (CUNY), his professional career spanned 36 years with the New Jersey State Police. When George first started in March of 1980, he was briefly assigned to the Equine Laboratory at the Meadowlands, but quickly transitioned to a position at the North Regional Laboratory, where he was able to grow his love for all things Trace Evidence. George loved his work and helped to educate students about our field. He would routinely take his own time to go and lecture to high schools and attend their career fairs. In addition, George has mentored numerous interns over the course of his career, many of whom have him to thank for their current employment! George's graciousness was felt by all who came into contact with him and his passing leaves a huge void in the forensic community and in our hearts

FRIDAY
10/21
11AM-12PM

LOCATION:
RED JACKET


See You next year
Mystic, CT