WELCOME TO THE 15th ANNUAL

FORENSIC SCIENCE RESEARCH DAY

Thursday, April 20th, 2023
- Regent Theatre -

OntarioTech UNIVERSITY

Photo by honours research thesis student Shaijieni Kannan

ONTARIO TECH FORENSIC SCIENCE RESEARCH DAY 2023

Program Schedule

8:30 a.m.	Registration	Stacey Sainte-Marie, M.Sc. *Forensic Science Laboratory Technician*
8:45 a.m.	Land Acknowledgement & Opening Remarks	Kimberly Nugent, M.Sc. *Associate Teaching Professor*
8:50 a.m.	Keynote Address	Dr. Cecilia Hageman *Undergraduate Program Director, Associate Teaching Professor*
9:10 a.m.	Session I	Chair: Jeff Ward, BFI *Program Instructor & Retired Staff Sergeant, DRPS*
10:00 a.m.	Session II	Chair: Dr. Theresa Stotesbury *Assistant Professor*
13:00 p.m.	Closing Remarks	Dr. Hélène LeBlanc *Associate Professor*
1:10 p.m.	Group Photo & Congrats!	Dr. Nelson Lafrenière & Dr. Jenna Comstock *Associate Teaching Professor & Forensic Science Laboratory Technician*

The research conducted by our fourth-year students would not have been possible without the support and mentorship of our supervisors and mentors!

THANK YOU!

Mission Statement

The Forensic Science program at Ontario Tech University strives to create an interdisciplinary learning environment dedicated to education in, research for, and contribution to the forensic community.

Specifically, the Forensic Science program at Ontario Tech University endeavours to:

- Advance the highest quality of knowledge, skills and abilities through excellence in teaching and a technologically-enhanced learning environment;
- Foster inquiry, critical thinking and scholarship in innovative research by providing access to state-of-the-art facilities and supervision by internationally recognized faculty and professional experts;
- Actively collaborate with industry to produce outstanding graduates who are consistently sought after and highly valued by professional partners and employers;
- Command next-generation leaders demonstrating integrity, ethical behaviour, and professional conduct in the field of forensic science;
- Contribute to society through community participation, leadership and outreach initiatives, with the goal of inspiring youth.

Forensic Science Program Accreditation

We are pleased to announce that our program was successful in obtaining re-Accreditation. It is the second such program in Canada granted this distinction by the American Academy of Forensic Sciences' Forensic Education Programs Accreditation Commission (FEPAC). Congrats!

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Schedule

8:45 **Welcome and Opening Remarks**
Kimberly Nugent, M.Sc.

8:50 **Keynote Address**
Dr. Cecilia Hageman

Dr. Cecilia Hageman is a BSc (Genetics), PhD (Plant Sciences) and LLB graduate of the University of Western Ontario in London. She is an associate member of the Law Society of Upper Canada (Call to Bar in 1991) and an LLM (Criminal Law) graduate of York University (Osgoode Hall). She was employed as a forensic biologist with the Centre of Forensic Sciences (MCSCS, Ontario) in Toronto beginning in 1991 and has been an expert witness in criminal proceedings in Ontario courts in the fields of body fluid identification, forensic DNA analysis and bloodstain pattern analysis. She was a member of CFS's Biology Section management team from 1998 to 2013. In July of 2013, she joined the Faculty of Science at the University of Ontario Institute of Technology (now Ontario Tech University) and is an associate teaching professor in Ontario Tech's Forensic Science Program, where she mentors and supervises student research, and also develops and teaches undergraduate courses in forensic biology, population genetics, criminalistics and law. Her publications include the essential *DNA Handbook* (1st edition, 2002; 2nd edition, 2008) and key book chapters on forensic evidence and the law including *Blood and Bodily Substances* and *Forensic Biology and DNA.* She is a past president of the Canadian Society of Forensic Science, and, is currently a chief scientific officer and reporting scientist in a private forensic laboratory, Wyndham Forensic Group, based in Guelph, Ontario.

Session I **Mock Crime Scene Practicum Students & Directed Studies**
Chair: Jeff Ward, BFI

Mock Crime Scene Practicum Course
The focus of the Mock Crime Scene Practicum is to *apply practical skills* to process a complex crime scene. This is accomplished by simulating all the associated events a person may encounter from crime scene to court. This includes extensive documentation of the scene, collection and identification of evidence, creation of detailed logs and forensic reports, and finally testifying as an expert witness in a mock court setting. Students selecting this capstone experience are expected to individually prepare a written report and collaborate on an oral presentation.

9:10 **Audrée Alarie, Vinushan Arunagiri, Isha Bhatia, Kaleah Dixon, Lauren Jenkins, Sukhneet Mand, Mercedez Pedersen, Jesse Plante, Samer Seety, Jawaria Shaheen, Michael Snea**

Directed Studies

The focus of a Directed Studies Project is to *identify* gaps in the research literature. This is achieved by conducting a thorough literature review on a particular subject. Ultimately, the goal is to review the current state of the chosen field, leaving no stone unturned and putting current research into the broader context of forensic science. Students selecting this capstone experience have the opportunity to investigate more diverse subject matter where conducting original research may be difficult. Students are expected to prepare a written document and a 3-minute oral presentation.

9:45 **Dhrumik Patel**
Comprehensive literature review on direct analysis in real-time mass spectrometry (DART-MS) for analysis of seized drugs

9:50 **Harsika Thavaseelan**
Probabilistic genotyping expert evidence in Canadian Courts

Session II **Thesis Research Students**
Chair: Dr. Theresa Stotesbury

The focus of a thesis project is to *fill the gaps* in the research literature. This is achieved by reviewing previous studies, designing an experiment and conducting original examinations. Ultimately, the goal is to contribute novel research to a relevant field of forensic science or broader natural science. Students work closely with either internal or external supervisors who mentor them throughout the course of their work. Students selecting this capstone experience are expected to prepare a written thesis and oral presentation.

Forensic Anthropology

10:00 **Autumn Steele**
Assessment of bone defleshing techniques and identification of animal

Bloodstain Pattern Analysis

10:15 **Shaijieni Kannan**
Characterizing a blood spatter impact device for practical research and training

Forensic Biology

10:30 **Tristan Rajanayagam & Roxanne Kerr**
Identification of Recent versus Habitual Wearer of Clothing through DNA Analysis: A Preliminary Study

10:50 **Mark Luciano**
Evaluation of DNA degradation in embalmed tissues over time

11:05 **Thureka Gopalasingam**
Exogenous DNA under fingernails from non-scratching events

- 10 minute break -

Forensic Chemistry

11:30 **Shaelyn Maloney & Mariam Shamsi**
Preliminary exploration of automotive carpet fibres for the development of a forensic database in Canada

Forensic Identification

11:50 **Douglas Mena Espinoza & Anuran Chandrakumar**
Footwear impression evidence: A comparison between 2D and 3D documentation techniques

Forensic Materials

12:10 **Daisee Lubrin**
Synthesis and application of oligonucleotide bound alginate materials

Forensic Science: General

12:25 **Kyra MacKenzie & Filip Sankiewicz**
Preparedness of the Ontario criminal justice system to accept evaluative reporting in forensic DNA & forensic chemistry testimony

12:50 **Closing Remarks**
Dr. Hélène LeBlanc

13:00 **Congrats & Group Photo!**
Dr. Nelson Lafrenière & Dr. Jenna Comstock

CONGRATULATIONS TO THE GRADUATING CLASS OF 2023! WE ARE ALL VERY PROUD OF YOU!

Thank you to everyone in attendance today. All of your support of our capstone projects is greatly appreciated!

The Mock Crime Scene Practicum Course

Audrée Alarie; Vinushan Arunagiri; Isha Bhatia; Kaleah Dixon; Lauren Jenkins; Sukhneet Mand; Mercedez Pedersen; Jesse Plante; Samer Seety; Jawaria Shaheen; Michael Snea; Jenna Comstock, PhD; Kimberly Nugent, MSc; Jeff Ward, BFI[1]

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The Mock Crime Scene Practicum was a 12-week course that provided students the opportunity to apply their acquired crime scene and laboratory knowledge to a practical scenario. Students participated in all aspects of a simulated major crime scene, working independently and in teams of three, reporting to a Case Officer throughout the entirety of the investigation.

The scene examination took place at the Ontario Tech University Crime Scene House, and further analysis was conducted at the undergraduate teaching laboratory. Students maintained a paperless documentation record using OneNote software that allowed real-time data entry and collaboration among team members to record the scene, track evidence and maintain information logs. Identifiable evidence varied and included: footwear impressions, fingerprints, body fluids, weapons, and (mock) illicit substances.

Laboratory analyses included: recovery of writing indentations, fingerprint enhancement and examination, physical matches, footwear examination and comparisons, and cartridge casing comparisons. The investigation was culminated with a police report summarizing the actions, findings, and conclusions, followed by a case review with the Case Manager. Throughout the duration of the capstone course, students honed the necessary skills required to be effective at a crime scene. Development of an individual's judgment, critical thinking, deductive reasoning skills, and teamwork, transpired through engagement with their team to solve challenges presented to them.

Comprehensive Literature Review on Direct Analysis in Real Time Mass Spectrometry (DART-MS) for Analysis of Seized Drugs

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Direct Analysis in Real Time Mass Spectrometry (DART-MS) is a new technique used to analyze seized drugs, as the science involves a tool that is used for rapid, simple analysis. Today's challenge is the rise of new psychoactive substances and synthetic opioids that requires new databases to be formed in order to assist in the interpretation of data on illicit substances. Making these databases is challenging as factors of expense, time and evaluation of data each require serious consideration. Resources are also required to help assist in the validation of new analytical techniques through operation, training, data interpretation, and spectral databases as laboratories implement this technique for qualitative seized drug analysis. A standardized training plan, standard operating procedures, and method validation are required to be implemented for newer technologies in laboratories. To address the problem of a review of existing databases for using DART-MS, a thorough study needs to be conducted to address accuracy and precision, specificity and sensitivity, and external limitations from studies and publications. Addressing these issues can be useful in casework involving newly emerging seized drugs and help implement newly proposed techniques in laboratories. The National Institute of Standards and Technology (NIST) is a federal agency that is currently providing expertise and resources to assist a project in the analysis of seized drugs using DART-MS and forensic databases.

Probabilistic genotyping expert evidence in Canadian courts

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In a modern and typical scenario casework scenario involving biological evidence, forensic scientists interpret DNA profiles using internal validation-based guidelines. There are, in general, two types of DNA profiles. A single-source DNA profile comes from one source or, in other words, one person. These profiles are usually very simple to interpret. The other type of DNA profile is a mixture, where there are more than two contributors in a DNA sample, a typical finding in much casework given the sensitivity of modern DNA analysis techniques. These mixture profiles may be difficult, or even impossible, to interpret, depending upon the number of profile contributors and other complexities such as profile degradation. Probabilistic genotyping software uses artificial intelligence algorithms and statistical methods called the Markov chain Monte Carlo method to interpret complex DNA mixtures and will give results in a framework of two competing hypotheses. Probabilistic genotyping (PG) calculates likelihood ratios using statistical and mathematical algorithms.

This literature review focused on what has happened in Canada and the United States in terms of the admissibility of PG evidence and its introduction into the criminal justice system. The American jurisprudence includes a number of cases where PG has been the subject of a *Frye* or *Daubert* hearing. In Canada, however, the published jurisprudence does not include similar reports for PG as a subject *of a Mohan* evidence admissibility hearing. A report commissioned by the Law Commission of Ontario and authored by Jill Presser and Kate Roberston describes serious issues that should be studied and considered as probabilistic genotyping is now being introduced into the Canadian criminal justice system. Some of the primary considerations were as follows. Previous DNA profiling methods should not be used as a legal framework to try PG in courts; a new legal framework may be required. PG should not be used to determine guilt or innocence; data illiteracy can lead to wrongful convictions. Biases such as automation bias can occur; lay people, tend to be impressed by DNA evidence and do not question it. Having barriers in source-code disclosure make it harder for defence experts to validate and challenge these software's meaningfully. Since PG software is complex, finding PG software experts outside of government DNA labs will be difficult, leaving defence counsel with few potential resources.

Assessment of Bone Defleshing Techniques and Identification of Animal Remains

Autumn Steele[1], Hélène N. LeBlanc, PhD[1]

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Forensic anthropology is an essential practice that involves the analysis and identification of skeletal remains for medicolegal purposes. The estimation of age, sex, stature, and ancestry of osseous remains can be determined through anatomical analyses, aiding in the identification of an individual. In forensic settings, the remains must be properly yet quickly defleshed without damaging the structure and integrity of the bones using techniques that are efficient and accessible. The purpose of this research is to assess the efficiency and effectiveness of different chemical maceration techniques on animal remains. Anatomical analyses of the remains were carried out as well to identify unknown specimens. Animal remains of various species donated to Ontario Tech University by the Toronto Zoo were placed outside at an outdoor Forensic Ecology Research Facility to decompose for 5.5 weeks. Four chemical maceration techniques were tested on the remains of two veiled chameleons and at least 1 rat each. A total of 8 chameleons and 7 rats were prepared with chemical techniques and the three highest scoring methods were further assessed using one Eastern Wolf each. Preparation using plain water boiling, 10% bleach solution, Sunlight® liquid dish detergent solution, and Borax® solution were evaluated. The ease of soft tissue removal, time, bone cleanliness, and bone quality of each method was scored, and the appearance of the cleaned bones were examined under a NIKON SMZ645 microscope. The clean bones were sterilized and whitened by placing them in an equal parts water and 3% hydrogen peroxide solution until satisfactory results were achieved. The Borax solution maceration was found to work best for mammalian remains, while the Sunlight® solution was best suited for reptilian remains. The subsequent defleshing of the seven unknown specimens was performed using the Borax solution method, as they were all found to be mammalian. The measurements of prepared bones were taken and compared to those of species found at the Toronto Zoo to determine the identities. Future research can delve into how each method may affect the recovery of DNA from prepared bones. The findings of this research will provide forensic anthropologists with a detailed assessment of bone preparation using chemical maceration techniques.

Characterizing a blood spatter impact device for practical research and training

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Bloodletting events give rise to various bloodstains and bloodstain patterns, as a result of the mechanism by which they are created. Spatter patterns may be encountered at crime scenes and are created from an external force applied to a liquid blood source sending blood droplets through the air. The goal of this research was to systematically characterize a blood spatter impact device, used by police services in Ontario, Canada in Bloodstain Pattern Analysis (BPA) training, using high-speed motion tracking and static pattern image analysis. To characterize the impact device, 35 impacts were performed using bovine blood with different initial blood volumes and impactor dropping heights. High-speed videos were collected and analyzed for the duration of the different stages (prompt splash, crown, jets, droplet formation) of each impact event. A total of 10 different crown symmetries were observed. The average duration of the different stages was prompt splash = 0.22 ± 0.04 ms, crown growth = 99.95 ± 18.25 ms, jet formation = 97.88 ± 21.35 ms, and droplet formation = 106.19 ± 4.55 ms. The location of the blood pool and where the impactor contacted the pool influenced the geometrics. Results indicated that there was no direct correlation between the impact velocity and the maximum crown widths at a constant blood volume. ProAnalyst motion tracking software was used to determine the impact velocity. Impact patterns were also collected on 2 walls of differing distance from the blood source, scanned, and analyzed using Fiji for the total count and size of the stains. The range of impact velocities observed was 2.10 ± 0.0627 m/s – 3.06 ± 0.1431 m/s. At the highest impact velocity, the highest average stain counts were measured (3031 stains), while the lowest average stain counts were measured at the lowest impact velocity. Having characterized the stain distribution, along with the impact velocities, the working limits of this impact device have been evaluated.

Identification of Recent versus Habitual Wearer of Clothing through DNA Analysis: A Preliminary Study

Tristan Yesudas Rajanayagam[1]; Roxanne Kerr[1]; Renata Dziak, MSc[2]; Kimberly Nugent, MSc[3]; Stacey Sainte-Marie, MSc[3]

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When clothing is worn, DNA is transferred from the wearer to the item. Given that clothing is often submitted as forensic evidence and can have multiple wearers, it is important that forensic biology laboratories are aware of the optimal locations from which trace DNA can be sampled. The objective of this study is to determine whether DNA profiles can be used to distinguish between recent and habitual wearers and to compare the success rates of sampling trace DNA using swabs and fabric cut-outs. This knowledge will potentially aid scientists in their ability to make conclusions regarding who wore the clothing. Six different items of clothing were used for the study: a t-shirt, athletic top, sweatshirt, jogging pants, gloves, and a toque. In this study, ten volunteers acted as habitual wearers who wore the items for an extended period followed by the recent wearers who wore each item for a short period, without washing in between wearers. To maximize DNA recovery, sampling locations were chosen based on where the fabric is most likely to contact the wearer's skin and any visual indications of wear. During the visual examination of the jogging pants, t-shirt, and toque there were areas of discoloration observed on the inside surface of the items with the most notable discoloration on the knee of the jogging pants. This observation suggests that the knee may be a suitable location for sampling trace DNA. Future work will focus on quantifying the amount of DNA extracted from the samples and generating DNA profiles. Additional studies can be conducted to analyze the impact of activity performed while wearing, handedness, number of contacts, and sizing of the clothing when interpreting wearer profiles.

Evaluation of DNA degradation in embalmed tissues over time

Mark Luciano[1]; Hélène LeBlanc, PhD[1]; Stacey Sainte-Marie, MSc[1]; Guy Sovak, PhD[2]; Aaron Teitelbaum, PhD[2]

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Embalming is the procedure by which the natural decomposition process of a deceased body is inhibited through the fixation of tissues by the introduction and absorption of an aqueous solution of germicides and preservatives, delivered via the vascular system. Common embalming solutions are formaldehyde-based, a strong antiseptic which may play an active role in the degradation of DNA, the mechanisms of which are not widely documented and limited to few publications. Based on the exposure to this fluid, it is theorized that the effects of embalming differ between tissues, such as compressed and non-compressed tissues which experience various levels of vascularity. This project is a continuation of previous research, aimed to study the effects of embalming solution on various tissues and determine how long post-embalming viable DNA profiles may be obtained from tissues. This was performed from sampling an embalmed cadaver at five locations: tibia (bone marrow), trapezius, quadriceps, liver, and the brain. Sampling was performed 24 hours pre-embalming, 24 hours post-embalming, two weeks post-embalming, and one-month post-embalming. Samples were subjected to DNA quantification and STR analysis to examine degradation quantitatively and qualitatively. Results indicated a negative relationship between duration of exposure to embalming fluid and the average concentration of DNA extracted, with a significant decrease occurring from 24 hours pre- to 24 hours post-embalming. Liver samples had on average the highest concentration of DNA while bone marrow samples had the least, which was determined to be statistically significant ($p=.009$ and $p=0.03$ respectively). DNA concentrations obtained from compressed and non-compressed tissues was not significant. DNA degradation was not observable qualitatively as no consistent indicators arose across electropherograms, rather random artefacts and inter-sample variability as a byproduct of minor differences within analysis processes. Regarding the effectiveness of sampling at various locations, trapezius, quadriceps, liver, and brain tissues produced viable DNA profile up to one-month post-embalming, while tibia bone marrow samples were only viable up until 24 hours post-embalming. Future directions include completing the full duration of this study, as this research contains data representing only one month of a two-year-long project. Additionally, further research may wish to examine DNA degradation after embalming procedures more reflective of real-world process, as this current study is limited in its storage conditions and requirements of degree of tissue preservation.

Exogenous DNA Under Fingernails from Non-Skin Scratching Events

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Most forensic research regarding the presence DNA under fingernails focuses on the interpretation of skin-scratching activities or the optimization of sampling and technical analysis methods. There is relatively little research on the quantitation of exogenous DNA under fingernails in scenarios other than those involving the direct scratching of bare skin.

This study aimed to quantify the amount of exogenous DNA transferred from various substrates preloaded with saliva to a scratcher's fingernails. Two female volunteers scratched various substrates preloaded with male saliva in wet or dry forms. The substrates include a wood desk, glass, plastic, foil, a tarp, and different cloth types. Y-STR amounts were measured, using the Plexor® HY quantitative amplification kit, for each substrate porosity: non-porous dry (n=10, 58.0 pg to 2.83 ng); non-porous wet (n=10, 40.4 pg to 5.36 ng); porous dry (n=8, 4.80 pg to 82.8 pg); porous wet (n=8, 7.16 pg to 456 pg); semi-porous dry (n=4, 45.8 pg to 224 pg); semi-porous wet (n=4, 608 pg to 2.13 ng). The non-porous glass sample displays the highest amount of exogenous Y-DNA, and the related DNA short tandem repeat PowerPlex® 16 profiles showed that the wet sample display more alleles than the dry sample (50 alleles vs 21 alleles).

This information can serve the forensic and legal community by demonstrating quantifiable amounts of DNA that might be collected in different scratching scenarios, thus providing an evaluative assessment to exogenous fingernail sample DNA amounts in competing activity-level propositions, in particular, skin scratching versus non-skin activities scenarios.

Preliminary Exploration of Automotive Carpet Fibres for the Development of a Forensic Database in Canada

Shaelyn Maloney [1]; Mariam Shamsi[1]; Rachel Banks, HBSc[2]; Nelson Lafrenière[1], PhD; Kimberly Nugent, MSc[1]

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Part 1:

The early stages of the validity of a vehicle carpet fibre database were explored by comparing aspects of fibres from domestic vehicles to foreign vehicles to determine if there are any significant differences between the two. From a lot of 418 previously collected fibre samples, 29 total (13 foreign and 16 domestic) samples were selected for examination based on varying make, model, manufacturing location and colour. Examinations were done by first characterizing the cross-sectional shape, surface features including delustrants size and density, presence of striations, fisheyes, crimping, microscopic colour and dimeter of each of the fibre types within each sample. Following this, polarized light microscopy (PLM) examinations were completed to determine the cross-polar colours, degree of birefringence and fibre type. It was found that all but two samples included fibre types with a round cross-sectional shape. For the other two samples, one sample within the foreign set included fibre types with a trilobal cross-sectional shape and one sample within the domestic set included fibre types with a multi-lobed cross-sectional shape. As per the other surface features, there was little variation seen across samples. Similarly, the PLM results displayed that all of the domestic fibre samples had a birefringence of degree 6, meaning the fibres are polyester, while all but two foreign samples included polyester fibres. One foreign sample had fibres of degree 2 meaning possible regenerated proteins, chlorofibres, modacrylics, acrylics and/or acetate while the other sample was of degree 5, meaning possible nylons, polyethylene, degummed silk and/or PBI. All the fibre types within the 29 samples had a positive sign of elongation. Although in comparing the results of foreign and domestic fibre samples there is little validity for a database at this stage, further explorations into azo dye compounds of each fibre sample could yield improved results concerning the validity of a database.

Part 2:

The development of databases is salient in forensic science, where high volumes of reference samples need to be stored and recalled to perform comparative analysis. Databases make forensic analysis more time-efficient, by quickly retrieving data to provide useful information pertaining to identification and classification of evidence. Increasing involvement in sexual assault and homicide casework has imparted evidentiary value to automotive carpet fibres. This research aims to explore whether any discernable differences exist in the microscopic characteristics of automotive carpet fibre populations including their cross-sectional shapes to determine the value of creating a dedicated database in Canada. 29 automotive carpet samples, 16 domestic (from the North American region) and 13 foreign (from South Korea), were examined under a polarized light microscope to determine their characteristics including fibre cross-section, diameter, perceived colour, texture and surface features. A precision fibre microtome was then employed to investigate fibre cross-sections and calculate the modification ratio of non-circular fibres. 27 samples included all round fibres, with the exception of two being identified as a trilobal and a 'Michelin man' trilobal. The majority of fibre types within each sample contained medium-size and medium-density delustrants, were 20 – 32 µm wide in diameter, and mostly grey, dark grey, or black in colour. Classifying the samples according to the manufacturing location: foreign or domestic, did not provide enough discriminatory information. On the contrary, the number of different fibre types and the combination of fibre colour displayed variation across different makes and models. Although, the current findings indicate little significance for a database, alternate approaches including more sophisticated analytical techniques may supplement current data and enhance the value for creating an automotive carpet fibre database. This study provides insight into updating current carpet fibre examination protocols employed by various forensic laboratories, and screen for smaller, round fibres. Furthermore, the data also supports future work in studying automotive carpet fibres from different makes and models across different years to observe evolution of fibre population over time.

Footwear Impression Evidence: A Comparison Between 2D and 3D Documentation Techniques

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The documentation and collection of footwear impression evidence involves the use of photography and casting methods. This research proposes an alternative technique for the documentation and collection of footwear impression evidence using the Artec Space Spider, a three-dimensional (3D) scanner. This research compared traditional methods of photography and casting to the Artec Space Spider to determine if it was a suitable alternative for documentation and collection of footwear impression evidence. A total of 40 footwear impressions were created in soil using four pairs of footwear, both left and right shoes, and were given to five forensic identification professionals who are footwear subject matter experts. The footwear impressions were documented and collected using the Artec Space Spider and by traditional means of photography and casting. Qualitative examinations determined that the Artec Space Spider did not perform optimally in identifying RACs as compared to traditional methods of photography and casting. Results indicated that the Artec Space Spider was not a viable replacement for photography and casting in footwear impression documentation and collection. Future avenues may explore the use of a quantitative approach with various other substrates including mud and sand.

Synthesis and application of oligonucleotide bound alginate materials

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Alginate is a water-soluble polysaccharide that has been used to develop biomaterials with a variety of applications – including developing forensic blood substitutes (1). Once the alginate has been crosslinked to form a network, its structure resembles the extracellular matrix of living tissue, due to its high-water content and viscoelastic behaviour (2). It can be used to make materials with a wide variety of structures and strengths, as the mechanical properties of the polymer can be altered by varying the concentration of the polysaccharide and the length of the cross-linking agent (3) used. Due to high selectivity and specificity of the DNA-based hydrogel, it has applications as a biosensor. This can be used for real time screening and rapid detection of specific targets such as drugs and biomolecules in forensic investigations (4).

We developed an efficient method for the synthesis of an alginate hydrogel with single and double stranded DNA/RNA incorporated into its structure. The oligo-bound alginate hydrogels were synthesized using series of reactions. The first involved an EDC (1-ethyl-3-(-3-dimethylaminopropyl) carbodiimide hydrochloride) /NHS (N-hydroxysuccinimide) coupling reaction where alginate hydrogel was attached to a linker with an azide functional group via an amide bond. Two linkers 2-azidoethamine and 11-Azido-3,6,9-trioxaundecan-1-amine were used to impart different physical characteristics to the alginate hydrogel. FT-IR and NMR confirmed the presence of the amide bond and and rheology demonstrated viscoelastic properties. Next, the oligo (21 bp DNA or RNA)-alkyne was synthesized, purified using HPLC and quantified using UV-Vis spectroscopy. Next, the DNA/RNA-alkyne was bound to the alginate azide using a copper-catalyzed azide-alkyne cycloaddition (CuAAC) click-chemistry reaction (5). The complementary strand of the DNA/RNA was allowed to anneal and UV-Vis spectroscopy and CD spectroscopy were used to confirm the binding of DNA and RNA to the alginate hydrogel.

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Preparedness of the Ontario criminal justice system to accept evaluative reporting in forensic expert reporting and testimony

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Forensic science experts serve the important role of contextualizing case information through opinion evidence. They are tasked with assisting the judge and jury as triers of fact, as well as lawyers and other members of the justice system, in making informed decisions about scientific evidence. As stated by retired Supreme Court of Canada Justice Ian Binnie, there are challenges inherent in expert witness testimony that can negatively impact the judicial process, especially considering that expert witnesses for the prosecution and defense can testify weeks, or months apart, on the same evidence – sometimes citing different conclusions. Evaluative Reporting (ER) is one of the potential remedies to these challenges in the interpretation of testimony and is based upon the *simultaneous* evaluation and comparison of prosecution and defense hypotheses through a likelihood ratio. These likelihood ratios are created by calculating the probability of evidence given one proposition or hypothesis against another mutually exclusive proposition or hypothesis. When a likelihood ratio is calculated in this fashion, the result provides an estimate of the relative strength of the evidence under each competing hypothesis. Although the Ontario criminal justice system does not currently employ ER and likelihood ratios in a systematic and cross-discipline manner, this study aims to support that ER is one way to ensure that evidence is explained in a logical, reasonable, and transparent way. This study involved the creation of an educational video and survey, to assess the preparedness of members of the Ontario criminal justice system in accepting ER in forensic expert reporting and testimony. A beta-testing launch to forensic science faculty and students was met with positive feedback, attesting to familiarity with ER concepts and allowing for respondents to rate their comfort or opinions regarding the applicability of ER in the courtroom. Undergraduate students were more receptive to the idea compared to academia, and a subsequent launch of the resource featuring improvements based on user feedback is planned to be available through the CFS research and development web-page in the near future. Supplemental educational videos were also created, delving into specific applications of ER methodologies to forensic biology DNA analysis and to forensic chemistry gunshot residue evidence, with the aim of providing viewers with an understanding of how likelihood ratios are estimated using data from peer-reviewed research literature.

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The 2023 Conference is being held June 12-15 at **Ontario Tech University**, in Oshawa Ontario. The theme of the conference is "Forensic Science in Canada: An Evolving Community". We welcome academics and professionals from areas of law, crime scene investigation, and the many fields relating to Forensic Science. Presentations and poster sessions will be held throughout the week covering a wide variety of topics and interactive special interest workshops will be offered to provide tools and technical skills in innovative subjects.

Keynote Speaker:

Dr. Williams is a forensic pathologist and coroner with the Ontario Forensic Pathology Service. She is both Cree (Peguis First Nation) and Mohawk (Kahnawake). She is the Director of the Northeastern Regional Forensic Pathology Unit and the Laboratory Medical Director for Health Sciences North (HSN). She is appointed as the First Nations Liaison for the Ontario Forensic Pathology Service (OFPS).

She is the co-chair of the Indigenous Health Committee of the Royal College of Physicians and Surgeons of Canada, a Canadian Medical Association (CMA) Ambassador, and a co-representative for the AFMC Network on Indigenous Health at the University of Toronto. Dr. Williams teaches a fourth year undergraduate course in Forensic Pathology at Laurentian University, and is an Assistant Professor at the Northern Ontario School of Medicine (NOSM). She serves on the Senate at the NOSM, and has recently been appointed to the National Advisory Committee on Residential Schools, Missing Children and Unmarked Burials.