14th Annual

FORENSIC SCIENCE RESEARCH DAY

Monday April 25th, 2022

- Virtual Event -

OntarioTech UNIVERSITY

Ontario Tech Forensic Science Research Day 2022

Program Schedule

8:30 a.m.	Registration	Zoom Waiting Room
8:45 a.m.	Opening Remarks	Dr. Cecilia Hageman, *Undergraduate Program Director & Associate Teaching Professor*
8:50 a.m.	Keynote Address	Pamela Dixon, *President, Canadian Society of Forensic Science* *Forensic Technology Advisor, Program Support for Biology Services of the National Forensic Laboratory Services, RCMP*
9:10 a.m.	Session I	Chair: Jeff Ward *Program Instructor & Retired Staff Sergeant, DRPS*
10:00 a.m.	Session II	Chair: Dr. Theresa Stotesbury *Assistant Professor*
1:05 p.m.	Closing Remarks	Dr. Cecilia Hageman, *Undergraduate Program Director & Associate Teaching Professor*
	Debrief Session	Dr. Nelson Lafrenière, *Associate Teaching Professor*

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.

The Forensic Science program 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 in February 2019. It is the second such program in Canada granted this distinction by the American Academy of Forensic Sciences' Forensic Education Programs Accreditation Commission (FEPAC).

Follow us on Social media!

@OT_ForensicSci @ot_forensics UOIT Forensic Science

Schedule

8:45 **Welcome and Opening Remarks: Dr. Cecilia Hageman**

8:50 **Keynote Address: Pamela Dixon**

Pamela Dixon joined the Canadian Society for Forensic Sciences (CSFS) in 2000 and has been a member of the Board of Directors since 2015. She was the Treasurer from 2016 to 2021. She is the current President of the CSFS and maintains roles as the Biology Section Chair and Constitution and Bylaws Committee Chair. Pamela Dixon completed her BSc. Hons in Biochemistry and Minor in Chemistry in 1998 from the University of Regina. She began working for the Royal Canadian Mounted Police (RCMP), at the Ottawa forensic lab site in 1999. Pamela worked for more than seven years as a Biology Forensic Technologist; developing DNA profiles from various crime scenes samples. She has testified for court in British Columbia, Alberta, Saskatchewan and Nova Scotia. For the last fourteen years she has worked as a Forensic Technologist Advisor. This involves accreditation maintenance, quality assurance/quality control development, document control review and revision, methodology validation, proficiency testing and training of Biology Analysts across Canada within the RCMP National Forensic Laboratory Services.

Session I Mock Crime Scene Practicum Students
Directed Studies
Chair: Jeff Ward

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.

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.

9:10 **Ashley Brito, Jia Ying Chau, Breha Gassmann, Nirujan Gnanendran, Rachel Melnichuk, Farizeh Minawi, Ameerah Ngai, Nathaniel Peacock-Bowen, Antonio Peluso, Walker Rea, Liv Wilson, Emma Zomer**

Mock Crime Scene Practicum Course

9:30 **Lilah Hosein**

The Crossroads of Forensic Science and Forensic Psychology: How Behavioural and Evidentiary Analysis Predict Patterns Exhibited By Serial Killers

9:35 **Nathan Cunningham**

Probabilistic Genotyping Expert Evidence in the USA

9:40 **Nimrah Saddal**

Assessment of how Canadian Courts have Approached the Introduction of Probabilistic Genotyping

9:45 **Hannah Crowder**

New Approaches to Forensic Fingerprint 'Match' Reporting

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.

10:00 **Stephanie Wilson**

Land and Groove Impression Measurements: IBIS versus Manually Acquired

10:12 **Julia Harvey**

Recovery of Footwear Impression Evidence Using Portable 3D Scanning Technologies

10:24 **Mikayla Higho**

Development of Lucilia sericata (Diptera: Calliphoridae) Larvae Comparison when Reared on Over-the Counter-Drugs Known to be Used in Suicides

10:36 **Arani Maheswaran**

Interactive Forensic Science Laboratory Platform for Undergraduate Forensic Science Students

10:48 **Talija Menegotto**

Pedagogy Development Centered around Fire Investigation and Analysis

11:00 **Rishaun Newell and Lauren Song**

Vehicle Carpet Fibre Database Creation for use in Criminal Investigations in Ontario

11:20 **Durgaa Ragavan**

Transfer and Persistence of DNA on Clothing

- 5 min Break -

11:40 **Adrian Santangelo**

Accuracy of Impact Angle Determinations from Bullet Holes in Drywall Panels

11:52 **Tharnia Thavalis**

Preparedness of the Ontario Criminal Justice System to Accept Evaluative Reporting in Forensic Expert Reporting and Testimony

12:04 **Alyssa Venditti**

DNA Degradation Rate in Embalmed Tissue Over Time

12:16 **Shakada Marshall**

Validation Study: Comparing GeneMapper™ and GeneMarker ™ STR Profile Data

12:28 **Islah Williams**

Corrole Synthesis for Materials Science and Biological Applications

12:40 **Brayden Vale**

Using Optical Profilometry to Investigate Changes in Surface Characteristics of Degrading Bloodstains

12:52 **Lelo Rampete**

Effects of Extreme Temperatures on the UV-Vis Spectra of Dried Bloodstains

1:05pm Closing Remarks: Dr. Cecilia Hageman

The Mock Crime Scene Practicum Course

Ashley Brito, Jia Ying Chau, Breha Gassmann, Nirujan Gnanendran, Rachel Melnichuk, Farizeh Minawi, Ameerah Ngai, Nathaniel Peacock-Bowen, Antonio Peluso, Walker Rea, Liv Wilson, Emma Zomer, Jenna Comstock PhD, Kimberly Nugent, MSc, Jeff Ward[1]

[1]Faculty of Science, Ontario Tech University
ashley.brito@ontariotechu.net, jiaying.chau@ontariotechu.net, brehanna.gassmann@ontariotechu.net, nirujan.gnanendran@ontariotechu.net, rachel.melnichuk@ontariotechu.net, farizeh.minawi@ontariotechu.net, ameerah.ngai@ontariotechu.net, nathaniel.peacockbowen@ontariotechu.net, antonio.peluso@ontariotechu.net, walker.rea@ontariotechu.net, olivia.wilson1@ontariotechu.net, emma.zomer@ontariotechu.net,

---

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 small teams of four, 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; fingerprints, body fluid collection, and weapons. Laboratory analysis included recovery of writing indentations, fingerprint enhancement and examination, and footwear examinations. The investigation was culminated with a police report summarizing the actions, findings, and conclusions, followed by a case review with the Case Manager, Jeff Ward. Throughout the duration of the capstone project, 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.

The Crossroads of Forensic Science and Forensic Psychology: How Behavioural and Evidentiary Analysis Predict Patterns Exhibited by Serial Killers

Lilah Hosein [1]

[1]Faculty of Science, Ontario Tech University
lilah.hosein@ontariotechu.net

The purpose of this study was to analyze the use of forensic science in determining and tracking patterns exhibited by serial murderers. The sample of this study was 11 serial killers, varying in age, race, and location. The results support the hypothesis that forensic science as well as forensic psychology are both necessary for the prediction of serial killer patterns in terms of behavioural and evidentiary analysis. To do so, the questions that needed to be answered were the following: what was considered evidence, how and why was it left, and how was it analyzed?

Probabilistic Genotyping Expert Evidence in the USA

Nathan Cunningham [1]

[1]Faculty of Science, Ontario Tech University
nathan.cunningham@ontariotechu.net

The interpretation of short tandem repeat profiles has been, up to the present decade, performed "by hand", by trained forensic biologists, using validation-derived standards, limitations and thresholds. These interpretations are now, increasingly, performed with the assistance of probabilistic genotyping software. These software packages allow for the interpretation of complex mixture and degraded STR profiles, and work by computing the likelihood of the DNA evidence under competing hypotheses, usually the presence, or the absence, of one or more reference profiles within the complex profile. Both the developmental and internal validations of these software packages have been an issue discussed in a number of criminal cases in the United States, where this type of evidence has been both allowed and disallowed.

Assessment of how Canadian Courts have Approached the Introduction of Probabilistic Genotyping

Nimrah Saddal [1]

[1]Faculty of Science, Ontario Tech University
nimrah.saddal@ontariotechu.net

Probabilistic genotyping is a new and useful tool for forensic biologists to analyze complex DNA (short tandem repeat, or STR) profiles. Probabilistic genotyping evidence has been presented in Canadian courts for a number of years, but there have been very few mentions of this type of evidence in cases reported in the public access Canadian Legal Information Institute (Canlii) website (https://www.canlii.org/en/). There has been no published report of the non-acceptance of this type of evidence in Canadian courtrooms, as has been the case in a number of American decisions.

New Approaches to Forensic Fingerprint 'Match' Reporting

Hannah Crowder[1]

[1]Faculty of Science, Ontario Tech University
hannah.crowder@ontariotechu.net

Fingerprint matching is essential for aiding criminal cases. Fingerprint matching deals with comparing ridge patterns of reference samples to evidence samples. These ridge patterns are whorls, loops, and arches. This technique has been around since the 1800s starting with Henry's Classification System. Since then, new technologies have been developed such as Automated Fingerprint Identification System (AFIS), Analysis, Comparison, Evaluation, and Verification (ACE-V), fingerprint biometrics, and minutiae-based fingerprinting. AFIS and ACE-V are the most common fingerprint matching methods, they have some issues but overall are quite reliable. However, biometric fingerprinting and minutiae-based fingerprinting are less known and do not have a lot of research to back up the creditability of these identification systems. These techniques need to be consistent and tested to consider the results reliable. The question is are new fingerprint matching techniques reliable.

Land and Groove Impression Measurements: IBIS versus Manually Acquired

Stephanie Wilson [1]; Caitlin Gallagher, HBSc[2]; Kimberly Nugent, MSc[1]

[1]Faculty of Science, Ontario Tech University; [2]Physical Sciences Section, Centre of Forensic Sciences
stephanie.wilson3@ontariotechu.net

Land engraved area (LEAs) and groove engraved area (GEAs) widths on bullets are class characteristics entered in a General Rifling Characteristic (GRC) search that returns a list of the make and model of a firearm that may have discharged the questioned bullet. LEAs and GEAs are traditionally measured using a comparison microscope, but may also be measured during the acquisition of bullets onto the Integrated Ballistics Identification System (IBIS). This study aims to determine if IBIS can replace the comparison microscope as the method of choice in measuring LEAs and GEAs for their use in GRC searches. The LEAs and GEAs of 100, 9 mm bullets were measured both using a comparison microscope and IBIS. The measurements from both methods were compared using paired, two-tailed t-tests and Bland-Altman analysis. Due to the t-test results, the null hypothesis, which was that the difference between the comparison microscope and IBIS measurements is zero, was rejected. From the Bland-Altman analysis, it was observed that the majority of the average LEA and GEA measurements fell within then 95% confidence interval, which indicated that both the IBIS and comparison microscope methods are precise. It was found that IBIS measures LEAs and GEAs with a bias of +0.002 inches compared to a comparison microscope. If a standardized variance is applied to the range of LEA and GEA measurements when they are entered into a GRC search, the variance will account for this bias. Therefore, it is possible that IBIS LEA and GEA measurements could replace traditional comparison microscope measurements for GRC searches.

Recovery of Footwear Impression Evidence Using Portable 3D Scanning Technologies

Julia Harvey [1]; Eugene Liscio, P.Eng.[2]; Amanda Lowe, MSc[3]; Theresa Stotesbury, PhD[1]

[1]Faculty of Science, Ontario Tech University; [2]Ai2-3D Forensics; [3]Forensic Identification Services, Ontario Provincial Police
julia.harvey@ontariotechu.net

Footwear impression evidence documentation and collection at a crime scene is currently conducted using two-dimensional (2D) photographs and casting. Casting is a technique used to collect the three-dimensional (3D) parts of an impression that cannot be collected using 2D photography, however, it is a destructive technique that does not allow for further examination of the footwear impression evidence. This work explores the use of 3D scanning technologies to document and collect the 3D characteristics of footwear impression evidence and how this compares to 2D photographs. Footwear impressions were created in sand and garden soil using a sneaker and a boot resulting in four impressions. The footwear impressions were documented and collected using the Polyga Compact L6 structured light scanner, the Artec Space Spider structured light scanner, and Photogrammetry. The data collected from the Polyga Compact L6 acted as the high-resolution baseline that most closely represented the actual footwear impressions. Data collected from the Artec Space Spider and Photogrammetry for all impressions were generated into point clouds and compared to the Polyga Compact L6 meshes in CloudCompare. Signed distance computations and absolute distance computations were conducted to determine the level of intra-variability between the Artec Space Spider and Photogrammetry point clouds and the Polyga baseline. In experimental conditions, it was observed that the Artec Space Spider was the more accurate method of documentation and collection for all impressions with a mean absolute distance of 0.148 mm or less. With a mean absolute distance of 0.176 mm or less for both collection technologies across all impressions, it was found that 3D scanning technologies may be viable as a replacement for casting and a compliment for 2D photographs when collecting footwear impression evidence.

Development of *Lucilia seracata* (Diptera: Calliphoridae) Larvae Comparison When Reared on Over-the-Counter Drugs Known to be Used in Suicides

Mikayla Higho [1]; Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University
mikayla.higho@ontariotechu.net

Entomotoxicology is an expanding discipline within forensic entomology, involving the examination of entomological evidence for indications of drug, as well as the impact drugs may have on the development of different species of immature insects used for the estimation of minimum post mortem interval. In the past few years, drugs – more specifically over the counter drugs – such as acetaminophen, salicylic acid and ibuprofen have become an increasingly frequent method used for suicide among young people due to their accessibility. This study examined the effects of ibuprofen, acetaminophen and salicylic acid on Lucilia sericata Meigen (Diptera: Calliphoridae), when homogenized with beef liver as a food source. Lucilia sericata were chosen for this study due to their presence in a large portion of the world and because they are often one of the primary colonizers of decomposing bodies. Throughout development, larvae were sampled from each of the treatment and control groups in 24-hour intervals. Measurements of length and mass were performed as well as determination of developmental stage. The development was observed in two trials using a biological incubator set at 23.5^{0}C. Acetaminophen was found to have no significant impact on the length, mass or development stage. Ibuprofen was found to have no significant impact on the rate of development, but was found to promote larval growth. Salicylic acid, however, was found to retard development as well as inhibit growth. Importantly, the finding from the salicylic acid treatment could lead to an inaccurate minimum post mortem interval estimation.

Interactive Forensic Science Laboratory Platform for Undergraduate Forensic Science Students

Arani Maheswaran [1]; Nelson Lafrenière, PhD[1]; Kimberly Nugent, MSc[1]

[1]Faculty of Science, Ontario Tech University
arani.maheswaran@ontariotechu.net

Online learning has become a prominent method of instruction and many students have been able to practice their laboratory skills using innovative educational tools. A deeper examination of the literature, revealed gaps in research that has not been explored with regards to online laboratory modules for forensic science. This project aims to address that gap and create a method for students to apply their acquired laboratory skills and field techniques to a virtual platform. This is essential for students, especially when there is no access to in-person learning opportunities. The current project is an extension of a previous thesis project, where a virtual 3D model of the Ontario Tech Crime Scene House was created along with 3D models of evidence (a knife, shoes, and a body). Standard operating procedures (SOPs) were developed for each software program, Scene2Go and 3DF Zephyr Free, so as to help guide students with stepwise instructions on how to use the various elements of each software. A webpage shell was designed by the Ontario Tech web team and content management training provided. The website will serve as the learning platform for this interactive learning module. Various elements of the module were collated and uploaded to the shell, and included; software download links, software manuals, 3D models, SOPs, and laboratory materials. Once complete, this webpage will be accessible to the undergraduate students at Ontario Tech University.

Pedagogy Development Centered around Fire Investigation and Analysis

Talija Menegotto [1]; Nelson Lafrenière, PhD[1]; Kimberly Nugent, MSc[1]

[1]Faculty of Science, Ontario Tech University
talija.menegotto@ontariotechu.net

Teaching methods that incorporate both theoretical and practical components help students to fully understand curriculum concepts while gaining valuable hands-on experience. The fire investigation course at Ontario Tech University includes a theoretical component and a laboratory component. The laboratories are aligned with the main topics of the lecture material. The purpose of this project was to design a laboratory session that provided students with the experience of performing a mock fire investigation where they were tasked with identifying potential sources of ignition and fuel loads. The Origin and Cause Laboratory (OCL) was designed using Kirk's Fire Investigation Textbook and the NFPA 192 and 1033 guidelines. The laboratory set-up included three rooms, two of which involved a mock arson scenario and a third containing various potential sources of ignition and fuel loads. The scenario was set up using images as burn evidence, which were laid out in a form that represents a burned ignitable liquid trail (IL). The images were set up to show low thermal damage as well as direct lines of demarcation of the burned IL trail. The third room included both primary and secondary sources of ignition that the students must identify and predict the likelihood of a combustion reaction occurring through an ignition matrix. The success of the laboratory development and set up concluded the next steps would be to have students participate in working through the designed protocol and potentially be incorporated into the undergraduate fire investigation course.

Vehicle Carpet Fibre Database Creation for use in Criminal Investigations in Ontario

Rishaun Newell [1]; Lauren Song[1]; Philip Chieu[2]; Rachel Banks[2]; Kimberly Nugent[1]; Nelson Lafrenière, PhD[1]

[1]Faculty of Science, Ontario Tech University; Chemistry Section, Centre of Forensic Sciences
rishaun.newell@ontariotechu.net; mikyung.song@ontariotechu.net

---

Databases are very important in forensics as they assist investigators to make connections in a case making their work easier and more efficient. Vehicle carpet fibres can be valuable in forensic science as trace evidence since they can link a thing or a person, whether perpetrator, accomplice, or victim, to a vehicle connected to a crime. 416 carpet samples from vehicle trunks were collected from Dom's Auto Parts to be analyzed statistically by year, make, and carpet general colour, and then in the laboratory by number of fibre types, fibre diameter, shape, delustrant density, and microscopic colour. Only six fibres were analyzed in the laboratory, and these showed notable differences between each vehicle make and model from the same year, 2014. This could be helpful information regarding the practicality of developing a database that is accessible to all investigators; however, this cannot be stated with certainty as the sample size investigated was minute.

Transfer and Persistence of DNA on Clothing

Durgaa Ragavan [1]; Renata Dziak[2]; Stacey Sainte-Marie MSc[1]; Kimberly Nugent, MSc[1]

[1]Faculty of Science, Ontario Tech University; [2]Biology Section, Centre of Forensic Sciences
durgaa.ragavan@ontariotechu.net

Trace DNA is a key form of evidence used in forensic investigations, as they can determine the presence of a person at a crime scene, or if they have come into contact with another person or object. Knowledge of sampling methods can help retrieve key information to assist forensic investigations. The goal of this study was to determine any patterns seen with trace DNA collected from clothing worn by two people, for various lengths of time. Volunteer pairs were recruited to wear six different clothing items as habitual and recent wearers. These items were then swabbed to collect trace DNA. A small 1 cm3 piece of fabric was also cut-out along the sampling area, after being swabbed. The volunteers submitted reference samples. All samples were extracted, quantified, amplified and submitted for STR analysis. The analysis was compared to the reference sample profiles of volunteers, to determine the major and minor contributors of each sample. For clothing items worn for 30 days by a habitual wearer, followed by one day by the recent wearer, the habitual wearer was the major contributor, whether the trace DNA was collected by swabs or a cut-out of the clothing items. For the clothing items worn for five days by the habitual wearer followed by one day by the recent wearer, there was variation in the results, and no patterns were observed. The clothing items worn for one day by the habitual wearer then the recent wearer had the habitual wearer as the major contributor for all samples. The swab samples had major to minor profile ratios of about 1.5:1, while the cut-out samples had larger ratios. The study was done with reference samples on hand, but this is not the case in the world of forensics. Further understanding of the transfer and persistence of DNA on clothing items with multiple wearers can aid forensic investigators determine relevant contributors.

Accuracy of Impact Angle Determination from Bullet Holes in Drywall Panels

Adrian Santangelo [1]; Kimberly Nugent, MSc[1]; Eugene Liscio, P.Eng[2]

[1]Faculty of Science, Ontario Tech University; [2]Ai2-3D Forensics
adrian.santangelo@ontariotechu.net

When a bullet contacts a surface such as a drywall panel it perforates leaving a hole in the surface. The probing method allows for the trajectory of a projectile to be reconstructed inferring where the projectile originated from and where it was travelling. This study used the probing method to analyze bullet impacts in panels of drywall and how the accuracy of this method varies depending on the angle of incidence. Using drywall panels and a rigged frame, the angles of incidence of bullets were able to be controlled and adjusted. The measured angle of incidence via the trajectory rod was compared to the known angle of incidence to determine the accuracy of the measured value. To control the angle of incidence drywall panels were positioned at different angles starting at 90° and decreasing until the panels were at 10°. The study observed how .40 caliber ammunition from four different bullet manufacturers interacted with drywall panels when fired at varying angles. For each ammunition and angled panel there were three repeats per shot leading to a total of 84 shots measured during this study (n=84). Results indicated that when the angle of incidence was between 15 and 90 degrees there was no significant difference in the accuracy of the values obtained using the probing method for the various ammunition types. It was observed that at an angle of incidence of 10° the accuracy of measurements of certain bullet manufacturers was significantly different. Additionally, when applying the probing method, it was observed that as the angle of incidence decreased the error of the measured value increased. At angles of incidence between 60-90°, measurements obtained via the probing method were more precise than measurements obtained at lower angles of incidence, 15-45°.

Preparedness of the Ontario Criminal Justice System to Accept Evaluative Reporting in Forensic Expert Reporting and Testimony

Tharnia Thavalis [1]; Cecilia Hageman, PhD, LL.M[1]

[1]Faculty of Science, Ontario Tech University
tharnia.thavalis@ontariotechu.net

Uncertainty occurs in many scientific disciplines. This is especially true for forensic science. Although uncertainty is challenging, it can be dealt it with a logical manner called Evaluative Reporting (ER). Evaluative Reporting is a system of reasoning that uses likelihood ratios to indicate how more likely the forensic evidence is under two competing propositions. The two propositions are mutually exclusive and are categorized into four different levels: offence level, activity level, source level and sub source level). The ER process involves setting opposing propositions, usually a prosecution and defence hypotheses, and reporting the findings under each in an "evaluative" manner. Without a consistent method to address uncertainty, miscarriage of justice are possible in Ontario's criminal justice system. In this project we begin to assess the preparedness of members of the justice system in Ontario to accept ER in forensic testimony. A coaching document in the form of a PowerPoint presentation was prepared for the participants' review. This was followed by the completion of a survey by each participant to obtain preliminary opinions on this subject. The results included an opinion questioning the incorporation of this technique into courts, due to skepticism that it may cause the forensic practitioner to outweigh the role of the trier of fact.

DNA Degradation Rate in Embalmed Tissue Over Time

Alyssa Venditti [1]; Stacey Sainte-Marie, MSc[1]; Guy Sovak, PhD[2]; Hélène LeBlanc, PhD[1]

[1]Faculty of Science, Ontario Tech University; [2]The Canadian Memorial Chiropractic College (CMCC)
alyssa.venditti@ontariotechu.net

The process of embalming is commonly used in the preservation of a deceased body, as it slows down putrefaction. Chemicals in the embalming solution are known to contribute to DNA degradation, however, the rate at which DNA degradation occurs is currently unknown. Other contributing factors of DNA degradation consist of burial method and storage time. Although DNA degradation is common in embalmed bodies, the retrieval of DNA after death is still crucial as viable DNA samples can be recovered post-mortem and thus, can benefit forensic science investigations and genetic research. Therefore, this project focused on the preparation of required documentation and development of a comprehensive research plan, to obtain a deeper understanding of how DNA degrades in embalmed tissues over time, in an effort to benefit future research.

The first step was to establish a research collaboration agreement between Ontario Tech University and the Canadian Memorial Chiropractic College (CMCC). This was essential as CMCC is one of 10 academic institutions under the authority of the Anatomy Act of Ontario, Canada. Following, research approval request applications were submitted and approved by the Office of the Chief Coroner and the Research Ethics Boards (REB)s of CMCC and Ontario Tech University. It was necessary to obtain these approvals, in an effort to be compliant with ethical regulations. A detailed research plan was then created, consisting of sample type determination, done by conducting a review of current literature as well as, testing potential sampling methods. Also decided was the DNA kits to be used (extraction, quantification, amplification/STR analysis), and were chosen based on appropriate kit size, contents, and function. Additionally, Standard Operating Procedures (SOPs) were created for each procedure and kit within the project.

As for long-term, this research aims to develop guidelines for collection and analysis of DNA recovered from embalmed tissues, as well as to close the gaps within the current body of research, which includes minimal sample diversity, lack of repetition at sample sites, deficient variation in collection time points, and absence of pre-embalming

control samples. The success of these future goals is beneficial as it can aid in determining when DNA is no longer viable in embalmed tissues as well as, which embalmed tissues yield the highest quality of DNA, this will be helpful in situations where cross referencing of DNA from embalmed bodies may be beneficial. Moreover, the viability of bone marrow for genotyping has been shown in publications, thus, an additional future application for this research could be with mass disaster identification.

Validation Study: Comparing GeneMapper™ and GeneMarker ™ STR Profile Data

Shakada Marshall [1]; Cecilia Hageman, PhD, LL.M[1]

[1]Faculty of Science, Ontario Tech University
shakada.marshall@ontartiotechu.net

Validation is an essential part of a quality assurance system in a forensic biology laboratory; it is a process by which new technology is tested to determine the limits of reliability. Data from validation testing is used to compile interpretation guidelines for reporting results. An accredited laboratory will internally validate all new technology, including any software that is a key part of the laboratory process.

Short tandem repeat (STR) technology is, by far, the industry standard in forensic biology laboratories worldwide. This technology requires software to translate dye signals from amplified STR targets to actual allele calls. This software interprets dye signals in terms of DNA length and amount, and then compares data to known alleles ("ladders") in order to produce a complete DNA profile. GeneMapper™ and GeneMarker™ are two such software programs, the latter being a newer and improved software system.

In this study, autosomal and Y (male specific) STR profiles developed in both GeneMapper™ and GeneMarker™ were compared in terms of allele calls, allele amounts and peak height ratios. Differences in results from the two systems were detected primarily with respect to minor alleles – alleles found in small amounts in the profile.

Corrole Synthesis for Materials Science and Biological Applications

Islah Williams [1]; Jean-Paul Desaulniers, PhD[1]

[1]Faculty of Science, Ontario Tech University
islah.williams@ontariotechu.net

This project focuses on the synthesis of corrole compounds and how they can be useful in materials science and biological applications. Corrole compounds are the molecule of interest as they possess a variety of beneficial properties. The ability to produce reactive oxygen species (ROS), the binding of metal ions in high and low oxidation states, and the ability to act as a photosensitizer are only a few of these properties. These characteristics are advantageous as corroles can then be utilised as a dual therapeutic system with siRNA in order to operate as a photosensitizer while also providing gene-silencing effects. Furthermore, these characteristics allow for corroles to attach to a carbon surface for fuel cells. Due to corroles still being relatively new to the field of organic synthesis, further investigation for the purposes of improving current cancer treatment approaches and materials science applications would be beneficial. As a result, it was critical to focus on improving the synthesis, purification and analysis methods in order to obtain a pure product with satisfactory yields.

Using Optical Profilometry to Investigate Changes in Surface Characteristics of Degrading Bloodstains

Brayden Vale [1]; Theresa Stotesbury, PhD[1]

[1]Faculty of Science, Ontario Tech University
brayden.vale@ontariotechu.net

Bloodstain surface morphology is growing area of research in the forensic discipline. Most research on the subject is focused on the surface morphology and appearance of bloodstains after being absorbed into fabrics and other absorbent materials, but very little research has been done to investigate surface morphology on non-absorbent surfaces; the research that has been done has used photography and have not done extensive analysis of surface characteristics. This research uses optical profilometry to analyze changes in surface characteristics of degrading bloodstains up to 4 weeks after deposition. Topographical scans of 7, 15, and 25 μL degrading bloodstains at different time since deposition, and surface characteristics, including surface average roughness, maximum height, and number of cracks and pits were measured; height distributions were also created to analyze changes in height over time. All surface characteristics were found to decrease within ~15 minutes after deposition as the stain begins to dry, and then slightly increase as cracks begin to form, before plateauing ~35 minutes after deposition; height distributions and the scans show that as the red blood cells migrate toward the edge of the stain and from the rim upon deposition, the height will shift from the centre of the stain to the edge. Using the data collected, the 5 drying stages of blood could be identified, and the observations made are similar to those made in the literature using alternate methods. This research exhibits the potential that optical profilometry has as a method for analyzing surface characteristics of degrading bloodstains and sets the groundwork for further research and investigation into how bloodstains dry and how their surface characteristics change over time using this method.

Effects of Extreme Temperatures on the UV-Vis Spectra of Dried Bloodstains

Lelo Rampete [1]; Theresa Stotesbury, PhD[1]

[1]Faculty of Science, Ontario Tech University
kgalalelo.rampete@ontariotechu.net

The determination of time since deposition (TSD) is of great importance to forensic scientists as it can be used to corroborate timelines of events at crime scenes and provide the potential age of a bloodstain. The physicochemical changes that occur in ageing bloodstains can be observed in changes that occur to Hemoglobin. Such changes are affected by environmental variables such as temperature, humidity, and sunlight, which also influence TSD modeling. This study aimed to investigate such trends, focusing on the effects of extreme temperatures on the solid-state UV-Vis spectra of bloodstains, and how such changes influence TSD estimates. 16 drip stains (per replicate) from 8 biological replicates were stored on glass slides in 4 different temperature conditions: -20°C, 4°C, 22°C, and 45°C, keeping relative humidity constant at 30%. The spectra were acquired over 5 time points: 3 hrs, 4 hrs, 24 hrs, 48 hrs, and 96 hrs. The red color of bloodstains reduced in brightness (had lower red values) with increasing temperature and time. Maximum absorbance of the Soret, Beta, and Alpha band increased with lower temperature and reduced over time. Blue shifts in maximum absorbance wavelength (nm) were seen with an increase in temperature at each time point. Also, an increase in bloodstain age resulted in blue shifts on the Alpha and metHb peaks. Red shifts were seen in the Soret and Beta band with increasing time, having blue shifts appearing after time ≥ 96 hrs. The maximum absorbance (or peak area) of the metHb (λrange = 600-690 nm) peak showed a positive correlation with increasing temperature, across all time points. PCA was then used to understand the effects of time, temperature, wavelength, and biological replicate on the spectral response. The temperature factor showed the clearest groupings of data, with the wavelength range of 600-690 nm (attributed to metHb) showing the greatest contributions. Furthermore, linear mixed-models based on PCA transformed data showed that temperature accounted for the largest variability in the data (at λ = 600-690 nm), even with the presence of slight inter-donor variability. This study showed that UV-Vis spectroscopy in solid-state can use metHb signatures to determine the age of a bloodstain, provided the temperature conditions are known.

Congratulations Class of 2022!

Ashley Brito
Jia Ying Chau
Hannah Crowder
Nathan Cunningham
Breha Gassmann
Nirujan Gnanendran
Julia Harvey
Mikayla Higho
Lilah Hosein
Arani Maheswaran
Shakada Marshall
Rachel Melnichuk
Talija Menegotto
Farizeh Minawi
Rishaun Newell
Ameerah Ngai
Nathaniel Peacock-Bowen
Antonio Peluso
Durgaa Ragavan
Lelo Rampete
Walker Rea
Nimrah Saddal
Adrian Santangelo
Lauren Song
Tharnia Thavalis
Brayden Vale
Alyssa Venditti
Islah Williams
Liv Wilson
Stephanie Wilson
Emma Zomer