

Forensic genetics: using the SeqStudio Genetic Analyzer for human identification in an academic setting

Thermo Fisher Scientific: Tell us about yourself and how you got into forensics.

Pam Marshall (PM): I am the director of the Forensic Science and Law Program at Duquesne University. I became involved in the field of forensics in 2002 when I completed my master's in forensic genetics at the University of North Texas. I did not see myself ever becoming a forensic scientist. But the O.J. Simpson case in the United States changed my career trajectory. I found myself as a sophomore in college racing home to watch the forensic scientists discuss blood on socks; the rest, as they say, is history.

Nicole Novroski (NN): I am an assistant professor at the University of Toronto. I got into forensics in the 11th grade while writing a paper on DNA fingerprinting for my biology class. I quickly learned how cool DNA fingerprinting was and how Sir Alec Jeffreys pioneered forensic DNA typing in the 1980s. It completely changed my perspective. I went from wanting to be an accountant to wanting to become a forensic scientist in Canada and abroad.

We recently spoke with Dr. Pam Marshall of Duquesne University and Dr. Nicole Novroski of the University of Toronto about their teaching programs and research projects in forensic genetics. Both universities utilize the Applied Biosystems™ SeqStudio™ Genetic Analyzer in their programs. The instrument is easily used across a broad range of forensic applications by multiple users, making it an ideal instrument for a teaching laboratory.



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Tell us about your university and the program.

PM: Duquesne University is in the city of Pittsburgh, Pennsylvania. The Forensic Science and Law Program is extremely unique, not only to the Pennsylvania region, but also the United States. We are the nation's only entry-level master's program, and we are one of only twenty master's programs accredited by the Forensic Education Program Accreditation Commission (FEPAC). This entry-level program allows our students to come in as freshmen and decide that their career option is forensic science and law. Currently, we have about 143 students enrolled in the program, and students can begin working on their research projects in their third year.

NN: The University of Toronto is one of the oldest institutions in Canada. The forensic science program is the oldest forensic science program in the country. Within our program, we have four streams: forensic psychology, forensic chemistry, forensic biology, and forensic anthropology, where we offer specialist programs, major programs, and a minor program in forensic science at the undergraduate level. We also offer research opportunities in both forensic anthropology and forensic genetics at the graduate level. We partner with all the leading police, forensic, and crime lab agencies within the country and provide all of our students an opportunity for placement in a research lab on campus or out in the community. We also foster great partnerships with organizations such as the Ontario Provincial Police, the Royal Canadian Mounted Police (RCMP), and the Center of Forensic Sciences to prepare our students for what they will experience in the real world. We have an on-site crime scene house where they can process mock crime scene evidence. Our classes provide a very comprehensive set of skills that enables them to walk into a forensic lab and be successful in an entry-level role.

Please describe some of the challenges you and your students face.

PM: Dealing with today's environment has exposed a lot of underlying anxieties among our students. We make sure that we take care of both their academic health and their mental health while they pursue their educational degrees. Another challenge that we face here in the United States is decreasing funds that are available at the academic level for research. We look for new ways to be inventive and creative with the technologies that we have and pursue collaborations, both in-house at our own university and with other partners, such as the Allegheny County Medical Examiner's Office or Pennsylvania

State Police. These have been critical to the development and continued success of our program and our students by advancing the field of knowledge. Learning is a lifelong endeavor, and I want to instill that same love of learning and curiosity in every student—to be passionate about the field and to be passionate about the voices of both the victims and the wrongfully convicted.

NN: One of the challenges of working in forensics at the undergraduate level is that students have a full curriculum, and it can be challenging to recreate the necessary mock crime scenes within a three-hour lab period. It's important that we develop experiments and protocols for them to carry out that are effective and engaging, and that deliver those transferable skills that we want them to leave with. Another challenge is trying to give everybody that incredibly worthwhile experience. The university supports those ambitions by providing state-of-the-art equipment, tools, and resources. My vision for our program and this journey in forensic genetics is to keep exploiting the ease of use, the compatibility, and the capabilities of these new instruments for both teaching and research.

Do you do both research and teaching? Can you tell us how they overlap and how that enriches your program to attract the best students?

PM: The research and teaching intersection is extremely important. It allows students to have those seeds planted early in the teaching environment when they have mainly lecture-based and lab-based courses in their freshman and sophomore years. Often students come to me with these little seedlings of ideas to see if they are in a certain mentor's wheelhouse. I really love when the students have their own ideas that they've generated themselves, because it makes them more passionate and curious about the final answer and the final result that they'll get in their fifth year for their thesis.

NN: There is a necessary balance between teaching and research at the undergraduate level. The program here is extremely competitive, and we get strong students that are academically driven and want a successful internship. This is a wonderful opportunity to go out into the community and get an external research opportunity, or to work in one of the labs here on campus. It has been an extremely rewarding experience to watch these young scientists really blossom into independent investigators with the theory they've gained in coursework and the practical experience they're getting in these research projects.

Do you share your instrumentation with other departments in your university?

PM: We share our SeqStudio system with the biology department and the wildlife conservation biologists. We secured our funding from the dean's office. We are blessed that the dean of our school loves forensics. He has been a phenomenal and critical component to us getting the funding resources that we need for these newer technologies. There was a lot of decision-making behind choosing the SeqStudio system. When you are part of a university, you do not have a lot of laboratory space, so I was looking for a new capillary instrument with a small footprint for a small laboratory. I was also looking for something that would be very easy to use for our students with regards to both troubleshooting and setup. We needed something very plug and play, which the SeqStudio instrument filled, and we wanted new state-of-the-art technology—the SeqStudio system had just been released when we ordered it. The run time of this system fit within a lab session—typically 2.5–3 hours long. This gave us the ability to do a little bit of lecture and theory before providing the students with the time to grasp the hands-on nature of the setup within a single laboratory period.

NN: On an annual basis, the dean's office offers an opportunity for faculty members or small groups of faculty members to apply for priority funding for instruments, reagents, or anything else that they may need to support their teaching programs. As a new faculty member, I was able to request funding on behalf of the forensic biology specialist program, as it was the most underdeveloped program of the four streams. The SeqStudio system was the best piece of capillary electrophoresis (CE) instrumentation for my teaching and research program, and it was within the budget that the dean's office had set. Having this instrument in our program allows us exclusive use where I get to house it within my lab, and I don't necessarily have to share it with anybody else.



What are the benefits of the SeqStudio system that made it the best choice for your program?

PM: It is extremely important that our students are trained on the newer technologies, not knowing what they will face when they get to the crime lab. I've seen an increase in the level of confidence in the students who were using our older Applied Biosystems™ ABI PRISM™ 3130 Genetic Analyzer and are now using the SeqStudio system for their data processing. They're more comfortable with the equipment—they feel like they can handle it without too much oversight. They're so enthusiastic and excited when they get the data, and they don't need help with interpretation. The idea of this integrated and easy-to-use cartridge removes a lot of the fear and cost burden, not only from the student perspective, but also from the mentor perspective since we're not fearful of students doing much handling. We've taken an old cartridge and made a learning standard, so we have all of that properly labeled from that old cartridge, which has become a nice learning tool to get them ready beforehand.



NN: I was looking for something that had relative ease of use—something that was relatively low throughput, given my smaller forensic program, with very good turnaround and easy cleanup. Also, it's the newest CE instrument, and we always want to forge ahead and test the latest technologies. I attended a probabilistic genotyping workshop where we were going through all the different platforms and I asked, "When are you going to develop the software for the newest instrument on the block?" That led to a great conversation about an educational partnership. So, I think having the SeqStudio system is opening doors, not only for my research program, but it's also going to prepare students to be very comfortable with the newer technologies that are going to be in labs in the next few years. I truly believe that the SeqStudio system is the instrument for initial learning of CE. The simple cartridge is plug and play and can stay on the instrument for up to six months. You can type everything in on the screen and then hit the button and go. You're not worrying about scary bubbles or worrying about shattering the capillaries—the fears we've all had. We are very happy with that flexibility and just the overall ease of teaching CE at the undergraduate level using this instrument.

Can you share a little about the installation and training on the instrument?

PM: I want to thank the entire team, from sales to installation to training. We were able to set up the training sessions, not just for me, but also key faculty members and some of our students as well. And then there's just knowing that every day we are in that lab, there's somebody just on the other side of an email or phone call who can assist us in the process and solve any problems.

NN: Some of these newer instruments have a learning curve, because you're so used to the older instrumentation that the simplicity and ease of use can be a struggle. I'm just so grateful to have a team that is very responsive and dedicated to ensuring that I'm getting the best product for my needs and the opportunity to have an open dialogue when I or a student make a mistake over something simple. Having that great team support and the ability to reach out with questions has really been what's made being a young faculty member and instructor truly easy.

Finally, please tell us about the projects you are working on in your lab.

PM: My students are doing very similar work on both the Applied Biosystems™ QuantStudio™ 5 Real-Time PCR System and the SeqStudio system. We are in the Three Rivers area of Pittsburgh, so we are working on detection of human DNA from aqueous and stillwater body environments. We're also very interested in looking at contamination of critical laboratory equipment, such as the permanent markers we use for outlining crime scene evidence on clothing.

Wildlife initiatives have been placed at the forefront again because of the global pandemic and the wildlife trade, particularly with pangolins. We have a local expert, and we're looking forward to using the SeqStudio system to try and enhance recovery of DNA from these endangered species.

NN: We have a variety of fun projects coming up. Our first involves DNA recovery from snow, given that we are in the "Great White North." We're using our QuantStudio 5 system (Debra) coupled with our SeqStudio system (Nancy) to generate all of that data. We're also working on a big population study, where we're exploring Canadian populations from a massively parallel sequencing perspective and testing our concordance on the SeqStudio system in order to help ensure that everything we're getting is top-notch. We're moving into some new areas of single-nucleotide polymorphism (SNP) and short tandem repeat (STR) data, and we use the SeqStudio system to support all of those projects to ensure that the genotypes that we're determining are correct.

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