Head of the class

From animal and cellular puzzles to virtual labs and inverted teaching, award-winning Faculty of Science professors light the spark

By Laura Byrne Paquet, photos by Yeremia Djaja

Maria DeRosa: The classroom re-arranger

Think back to your days as a student. Chances are, you spent a lot of time sitting in lecture halls taking notes while listening to a professor talk. Beyond whiteboards, PowerPoint and laptops, the basic concept hasn't changed in decades. Which is why Carleton chemistry professor Maria DeRosa wants to turn this model on its head.

DeRosa has received a Teaching Achievement Award to test a new approach called the "flipped classroom." Instead of sitting through a lecture and then doing homework, students in flipped classrooms watch lecture videos before class, then do hands-on work during class to apply the concepts as the professor circulates around the room.

Over the years, DeRosa noticed that grades fell into two distinct clusters. Some students did extremely well, while others struggled. She tried adding more assignments and extending office hours, which raised the stronger grades, but had little effect on other marks. While researching engagement strategies, DeRosa came across the flipped classroom and thought it might offer a solution. When observing hands-on work, for instance, she might detect several students making the same mistake. She would be able to stop the class and take questions, ensuring that everyone understands the concept before moving forward. "In a flipped class," she says, "they're taking advantage of the time they have with me to actually get to the bottom of things."

John Oommen: The pattern sleuth

Since people first started looking for patterns — whether in groups of animals, voices, fingerprints or anything, really — we have focused on how similar an object is to a relevant mean. If this animal has a neck similar in length to the mean length of all giraffes' necks, for instance, it's more likely to be a giraffe than, say, a lion. This idea has a formal scientific name: Bayesian pattern recognition, named after an 18th-century English statistician. So when John Oommen, a chancellor's professor of computer science at Carleton, began exploring an alternative approach to probability four years ago, it seemed like a counterintuitive search.

The research began when one of Oommen's PhD students developed an algorithm rooted in grouping elements based

on their *dissimilarity* to a relevant mean. Or, as Oommen explains it, to determine which animals are giraffes and which are lions, "you look at the lion that sounds most like a giraffe, and you look at the giraffe that sounds most like a lion." Just as Oommen and his student were about to publish a paper about what is now called the Anti-Bayesian algorithm, they learned that researchers in Australia had come across the same paradigm. But neither team knew *why* the new algorithm worked, so Oommen, a fellow of the International Association of Pattern Recognition, set out to answer that question — and has received a Research Achievement Award for his work.

Bill Willmore: The cancer tracker

Cancerous tumours are unpredictable. Cells can break free and become circulating tumour cells (CTCs) that drift downstream in the blood or lymph, looking for new organs to colonize. The most common way to detect CTCs early is to inject a tumour with dye before surgically removing it. Tracing the path the dye follows allows doctors to make educated guesses.