A FINE BALANCE: Research and the Classroom

DR. LYNDIA COLGAN – INFUSING MAGIC INTO MATH AND SCIENCE
(e)AFFECT is published twice a year by the Office of the Vice-Principal (Research). The mission of our office is to stimulate, enhance and facilitate ethical research and scholarship at Queen’s by providing leadership, support and services to advance Queen’s position as a research-intensive university, while raising awareness of the excellence of Queen’s research and providing accountability to our stakeholders.

Our goal is:
*Helping people achieve excellence in research and scholarship.*

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Dear Colleagues and Friends,

Queen's University charts a course that reflects a commitment to the balanced academy – one that equally advances the excellence of our research enterprise and provides a transformative learning experience for our undergraduate and graduate students. A quick look at recent public rankings, by Maclean’s and RESEARCH Infosource, for example, provides a glimpse of our strong reputational standing on both fronts. I deeply believe that it’s the careful and strategic investment in our top-calibre faculty that, in turn, allows us to attract the best and most accomplished students. The positive reciprocal influence that results from the presence of both contributes to a cycle of success that is undeniable, and makes Queen's University unique from other institutions in Canada. I cannot emphasize enough the fact that given our status as a mid-sized university, Queen's continues to punch above its weight when it comes to success in both research and learning outcomes.

With this in mind, this issue of (e)AFFECT focuses on the ways in which our faculty are integrating their research and teaching, thereby making their own individual contributions to the balanced academy. Our feature story introduces two of our Queen's National Scholars – one already established at Queen's and one newly recruited. The aim of the QNS program is to "enrich teaching and research in newly developing fields of knowledge as well as traditional disciplines." Both Robert Morrison and Armand Garnet Ruffo (Department of English) have found ways to make literature come alive in the classroom. Denise Stockley of the Centre for Teaching and Learning is interested in pedagogy quite broadly, and is tailoring educational strategies for disciplines all over campus, from health sciences to computing. Lynda Colgan (Faculty of Education) is improving math and science literacy for students of all ages by changing negative attitudes about these disciplines and engaging students in creative ways. Finally, as always, we present the work of some of our students who have immersed themselves in projects that allow them to get out of the classroom – or return to the classroom as is the case for PhD candidate Annie Riel – and really “learn by doing.”

I hope that you enjoy reading this issue and, as always, I welcome your comments and encourage you to explore, discover, and engage in the research enterprise at Queen’s.

Dr. Steven N. Liss
Vice-Principal (Research)
Across faculties and departments, Queen's researchers are capturing headlines in Canada and around the world. Here are a few highlights from the past few months:

Highly cited researcher makes exclusive list

Professor Ian Janssen (School of Kinesiology and Health Studies) earned a place on the Thomson Reuters’ Highly Cited Researchers list. The exclusive international list is determined by Essential Science Indicators and includes scientists and researchers whose papers rank among the top 1% most cited in their subject field from 2002 to 2012. Janssen is the Canada Research Chair in Physical Activity and Obesity and has published influential research on the role that physical inactivity and obesity play in the development of poor health in both child and adult populations. He is one of only 88 researchers working in Canada, and the only Queen’s researcher, to land on the list.

Investing in innovation

Recently, the Honourable Reza Moridi, Minister of Research and Innovation, announced that $900,000 from the Government of Ontario’s Campus-Linked Accelerator (CLA) program will be allocated to support innovation at Queen’s. Part of the Ontario Youth Jobs Strategy, the CLA program represents the government’s investment of $20 million over two years to build on world-class innovation and entrepreneurial programs for youth. The funds will allow the university-based Queen’s Innovation Connector and campus-based accelerator to partner with Launch Lab, Kingston’s regional innovation centre, to increase regional youth entrepreneurial activity.
A royal success for Queen’s researchers

In 2014, Queen’s has garnered exceptional results in its nominations to the Royal Society of Canada (RSC), the nation’s senior national body of distinguished scholars, artists, and scientists. This year’s bumper crop of winners includes an institutional record-breaking nine new fellows, two award winners, and three members elected to the inaugural cohort of the RSC’s College of New Scholars, Artists and Scientists. The distinguished researchers are:

New Fellows of the RSC

- **Professor Erwin Buncel** (Chemistry)
- **Professor John Burge** (Music)
- **Professor Wendy Craig** (Psychology)
- **Professor Roger Deeley** (Pathology and Molecular Medicine)
- **Professor Myra Hird** (environmental studies)
- **Professor George Lovell** (Geography)
- **Professor Ian McKay** (History)
- **Mr. Peter Milliken** (Specially Elected Fellow)
- **Professor François Rouget** (Études Françaises)

Award Winners

- **Professor John McGarry** (Political Studies)
  The Innis-Gérin Medal for distinguished and sustained contribution to the literature of the social sciences
- **Professor Guy Narbonne** (Geology)
  The Bancroft Award for instruction and research in the science of geology

College of New Scholars, Artists and Scientists

- **Professor Pascale Champagne** (Civil Engineering)
- **Professor Una D’Elia** (Art History)
- **Professor Morten Nielsen** (Economics)

QUICK FACTS about the **RSC**:

- It was established under an Act of Parliament in 1882 as Canada’s senior collegium of distinguished scholars, artists and scientists.
- It exists to promote Canadian research, scholarly accomplishment, and to advise governments, non-governmental organizations and Canadians on matters of public interest.
- Its objective is to promote learning and research.
- Fellows and award winners are selected by their peers for outstanding contributions across disciplines.
Denise Stockley began her career almost 25 years ago in an elementary school classroom, and might have been content to stay there much longer than she did. However, curiosity and opportunity intervened, leaving the rest of us able to count ourselves lucky for the way things worked out.

For the last decade, Stockley has been an educational developer with the university’s Centre for Teaching and Learning in Mackintosh-Corry Hall. That role might conjure up images of a fairly straightforward service – making better instructors out of graduate students and faculty members – but the reality is far different.

She has directly assisted hundreds of instructors, but Stockley also brings an infectious energy and enthusiasm to the formal study known as pedagogy. If that pursuit sounds all too stuffy or downright quaint in an era where students are attending massive open online courses and webinars, it has served her well as an invitation to a dazzling array of educational environments.

“I work with anyone who gets excited about how we can enhance and encourage learning,” she says. These collaborations have led her to deliver guest lectures in every faculty and teach term-length courses in four faculties, demonstrating the effectiveness of techniques such as direct interactions with students, regardless of how large the class might be. Yet her activities have gone far beyond the comparatively simple task of building better teachers. Stockley has used these occasions to open up new avenues for research into the many different ways people learn, and the many different ways that learning can be affected.

She acknowledges that pedagogical research might sound like a fairly abstract, purely academic pursuit, but it is one that has landed her front-and-centre in a number of major projects demanding an understanding of how participants acquire knowledge. For example, when the Human Mobility Research Centre sought to establish a new training program in bone and joint health technologies, the organization turned to her for input on how to set up this activity for biomedical students. The resulting proposal was among the first in Canada to receive a $1.65 million grant from NSERC’s Collaborative Research and Training Experience (CREATE) program, which was launched in 2009.
She has since worked with two more CREATE grants for educational ventures – one dedicated to students who will be working with ultra-large-scale computer systems and the other to engineers who will be developing sustainable engineering in remote parts of the world. In each case, Stockley has helped to tailor an educational strategy to meet the particular goals supported by this substantial funding.

She also chairs the education and training committee of the Technology Evaluation in the Elderly Network (TVN), a national Network of Centres of Excellence dedicated to helping the country’s frail elderly population. TVN is based at Queen’s, where Stockley has framed a comprehensive approach to training for more than 100 individuals who will go on to play key roles in enabling the country’s health care system.

Colleagues marvel at her publication record, which features journal articles in specialized areas where she has no formal training, and often little specific knowledge. “My focus is not the disciplinary content but how we create environments for people to learn within the disciplines.”

“The idea of creating individual learning opportunities, recognizing that each person learns differently – all those things are what play out in my work now,” she explains. “The assumption that we have to transmit knowledge through a traditional lecture is not the assumption now. Now the idea is that there are other ways for people to learn, and sometimes those ways are out of our comfort zone.”

Stockley, for her part, appears to be entirely content outside of her own comfort zone. She is currently on academic leave to take up a one-year post as Researcher-In-Residence at the Office of Health Sciences Education, where she is looking forward to staking out the pedagogical territory in yet another discipline that is new to her.

In the meantime, during her absence, she expects the Centre to continue to evolve as it has done since she arrived some 14 years ago.

“We were always focused on practice-grounded pedagogical research,” she says. “What’s changed is that we’re doing more outreach. When I do pedagogical research, it’s about how we are building capacity, how we are creating networks and bringing in the right people.”

Nor is she surprised by an emphasis on using pedagogy as a way of making educators more accountable, given the considerable investments that are now being made in learning technology and ambitious programs such as CREATE.

Having taught or researched in practically every academic nook and cranny of the campus, Stockley finds it all too easy to express the common underlying objective.

“We have very high expectations for our learners,” she concludes, “and we should have very high expectations for teaching.”
Transforming
Solo Scholarship into
One of the most important relationships in every academic’s professional life is the one between research and teaching. Research will invariably influence what a professor does in the classroom, since the breadth and quality of their scholarship is what makes the professor an authority in the eyes of his or her peers and students. But the relationship can also work the other way, as when a perceptive or offbeat question by a student leads a professor on an entirely new research path. Here, we introduce two Queen’s National Scholars, one who’s been at Queen’s for a while, and another who’s new to the university. Both are celebrated scholars of literature. Both have unique ways of employing their research in their teaching. But perhaps their biggest similarity is one they share with every successful academic – a passion for their subject that motivates their research and inspires their teaching.

Robert Morrison: Reviving words of the past

Thomas De Quincey was an English essayist whose literary career started in the early 1800s. His most famous book, *Confessions of an English Opium Eater* (1821), chronicles the author’s experiences with laudanum, a drink consisting of opium dissolved in alcohol. At the time, it was a commonly used medicine. De Quincey became hooked, and the *Opium Eater’s* vivid language describes the soaring highs and crippling lows he experienced when he took the drug and when he tried to kick the habit. The work brought him great fame – and notoriety.

Thirty years ago, De Quincey was a mere footnote in English literature. One reason he has risen to greater prominence has much to do with Robert Morrison, a professor of 19th-century British literature at Queen’s. In the mid-1980s, when Morrison was a graduate student at Oxford University in England, his tutor was Jonathan Wordsworth, a great-great-great nephew of the legendary English poet, William Wordsworth. At one point Morrison had to write four essays for Wordsworth, a sharp, acerbic critic who plainly told his student that three of the essays weren’t up to scratch. The fourth one, however, showed some promise. Its subject was Thomas De Quincey.

“I figured that if Jonathan Wordsworth told me it was okay, I better keep pursuing the subject,” recalls Morrison, who went on to become a world-renowned authority on De Quincey. Morrison penned the introduction to the Oxford World’s Classics version of the *Opium Eater*, and has published scholarly examinations of several other De Quincey essays and lesser-known works. Morrison wrote the definitive De Quincey biography, which provided the basis of a best-selling crime novel, *Murder as a Fine Art*. Its author, David Morrell (who also wrote *First Blood*, the novel that inspired the Rambo movies), co-dedicated the book to Morrison.
Morrison spends much of his working life outside Queen’s in his book-lined study in his home, a former rectory north of Kingston. The walls of his house are adorned with engravings of De Quincey and other titans of literature such as Samuel Taylor Coleridge, Wordsworth, Byron, and Jane Austen. When Morrison speaks, his breadth of knowledge and enthusiasm for his subject is palpable. He becomes animated when speaking of De Quincey’s seminal influence on later generations of writers including Edgar Allan Poe, William Burroughs, Aldous Huxley, Aleister Crowley, and others known for writing about their experiences with drugs.

Morrison also spends countless hours in great English libraries, poring over obscure texts to shed further light on aspects of De Quincey’s life and work. This is his research. He simply reads and writes a lot. It is solitary, painstaking labour, and obviously it informs his work in the classroom. Still, he regards teaching as a separate scholarly activity.

“I once had a teacher who told me that the scholar has two roles,” says Morrison. “He is both a monk and an actor.”

Armand Garnet Ruffo: Shedding light on contemporary Native issues

Armand Garnet Ruffo would subscribe to that notion, since he too is constantly exploring new ways to learn and teach. Ruffo is an associate English professor of Ojibway ancestry who came to Queen’s earlier this year from Carleton University, where he’d been teaching since 1996. His research explores the changing relationship between Canada’s Aboriginal peoples and mainstream Canadian society over the past 30 years, and sheds light on contemporary Native issues such as representation, environment, spirituality, education and self-determination.

However, unlike most other Aboriginal and non-Aboriginal scholars in the same field, Ruffo is also a creative writer who conveys what he’s learned through poems, stories, and even a critically-acclaimed feature film about residential schools called A Windigo Tale – which won the Best Picture award at the 2010 American Indian Film Festival in San Francisco. In a way, then, Ruffo’s research – or the fruits of it – is his teaching.

“Rather than continue on that academic path and always publish in journals, I’ve shifted my gaze,” says Ruffo. “I’m trying to rearticulate my research through a creative lens.”

Over the past 20 years, that lens has focused on work in various artistic genres. Ruffo has edited anthologies of literature, such as An Anthology of Canadian Native Literature in English, and published three volumes of his own poetry. He wrote a children’s play called The Stone Canoe, based on an Ojibway myth. He penned an epic-poem biography of Archie Belaney – better known as Grey Owl – an Englishman who came to Canada in the early 1900s to immerse himself in Native culture by living and trapping with “Indians” in northern Ontario and Saskatchewan and writing about his experiences. In his popular books and lectures, Grey Owl advocated for fair treatment of Canada’s Native peoples and respect for the natural world. He also had a close relationship with Ruffo’s great-grandparents, which allowed Ruffo to bring a personal touch to his portrayal of the eccentric, yet influential activist and conservationist.

In his recently published biography of the Anishinaabe (Ojibway) artist Norval Morrisseau, Ruffo draws on his...
research on Native spirituality and artistic practice and even sexuality to examine his subject’s life. However, the story sometimes departs from fact to tell Morrisseau’s story from a uniquely Native perspective. For instance, when Morrisseau was 12, he undertook a vision quest, a tradition in which young Native males spend a few days alone in the wilderness and, with luck, emerge as a man. The mystical rite of passage is difficult to describe in traditional narrative, so Ruffo imagined Morrisseau’s first-person experience of the quest.

“I tried to infuse the book with an Anishinaabe worldview, which is all about spirituality, thunder, the Manitous, that whole pantheon of demi-gods. The text has Western influences, because I’m Western educated, but at the same time I wanted to bring the Anishinaabe worldview to the text by breaking with realism and showing this spirituality where other Mishipeshu, Windigo, all these Manitous are in there to inform Morrisseau’s life.”

Ruffo also brings an Aboriginal perspective to the classroom, where he uses the notion of the “talking stick.” In Native discussions, the talking stick denotes the person who has the right to speak.

“In academia, we constantly think about the standard hierarchical model where the professor is the wise man on the mound and the students are empty vessels. I look at it as a reciprocal relationship.”

Armand Garnet Ruffo
“You’ll hear people say all the time they can’t do math, and they think this is okay,” says Lynda Colgan, associate professor of education at Queen’s and director of the Community Outreach Centre. “In contrast, it’s socially unacceptable not to be able to read.” Colgan thinks one reason for the tolerance of math illiteracy is that most of the math that people do on a daily basis is invisible. Invisible math is a problem.

“We know from a number of studies that parents hold very high standards for their children, they want them to do well in math but they don’t value math themselves. That dichotomy makes it impossible for children to succeed, because if the parents don’t value it, they’re not supporting it.” Colgan takes a multifaceted approach to improving math literacy by dreaming up creative and fun initiatives to engage both children and their parents.
Raising an army of math advocates
Research in education shows that math anxiety is rampant among students, parents, and teachers. Colgan is directly addressing the twin woes of invisible math and negative attitudes by devoting herself to making math fun in the real world. Her projects have included a bi-weekly newspaper column devoted to everyday math, a children’s book of magic tricks with Kids Can Press (2011) entitled Mathemagic, and a video series for parents of elementary school children in Ontario. Parents are important, believes Colgan. Her goal is “to establish a more positive disposition towards mathematics, in order for parents to see themselves as mathematicians, to see themselves as math role models, to see themselves as math supporters without having to know the content.”

Math = Mathemagic!
Since 2011, Colgan’s work has also been translated to the screen, in conjunction with TVOKids. The Prime Radicals, a children’s educational television series, has been bursting math anxiety bubbles in living rooms across Canada with its live action, character-driven drama. Each episode is based on Colgan’s research into how children learn – such as through humour and music – and takes multiple approaches to presenting math concepts, all grounded in the experiences of children.

Research on teaching
Education research involves following intuition of what works in teaching and what doesn’t, and then examining empirically whether those intuitions are worth pursuit and worth sharing with other people. Colgan’s research looks at the effects of education outside the typical classroom scenario. Museums, guest appearances, community theatre – these are all examples of “informal education.” Colgan’s work is adding support to the notion that rich, fundamental learning takes place in these settings, which also translates into greater success in school. Teaching outside the classroom has significant effects for teacher candidates as well. The low pressure environment alleviates their fears of science, and enriches their understanding of its relevance.

A rendezvous with science
One of Colgan’s main audiences is the general public. In 2011, she initiated the first Kingston Science Rendezvous. Four years later, the annual festival is a contender for the largest of its kind in Canada. The event invites science and technology organizations of all stripes to engage families through displays, experiments, and demonstrations. Part of Colgan’s impetus for this work is to bring the reality of the scientist out in the open. “If you ask an average person to draw you a picture of a scientist they’ll draw an Einsteinian character with whacky hair and they’ll write things like ‘they’re lonely, they work in the lab all night,’” explains Colgan. “But by having opportunities for scientists to make the work that they do accessible to the public… they’re changing stereotypic perceptions. It helps people to understand that scientists are working to improve the quality of their lives.”
The sweeter side of teaching

BY IAN COUTTS
"What I do is what I like to do with chocolates – provide a lot of variety and then have people take what they like from it and make something of it."

That's how Queen's geography professor Anne Godlewska explains her general theory of teaching. The bon-bon analogy may seem a little odd, but it reflects one of her interests. In addition to her academic credentials (author or editor of five monographs, one web-based atlas, many articles and a former associate dean), Godlewska is also an avid amateur chocolate maker (her orange creams are particularly noteworthy).

As pedagogical goals go, plenty of variety and the chance to make something of what you are offered are right up there. But as Godlewska herself discovered in 2010 after returning to teaching undergraduates after several years in administration, providing isn't so easy. Queen's has a strong reputation for quality undergraduate education, but at universities everywhere today there are a lot of pressures that make this difficult to deliver – student enrollments have climbed, and with that their disengagement. The number of instructors has dropped, and professors are under considerable pressure to chase funding for research.

"How," Godlewska asks, "can you teach a large number of students in an engaged way" given these competing, sometimes contradictory, forces? Since 2010, Godlewska has been trying to find the answer to that question, by turning her introductory course Geography 101: Human Geography into a virtual pedagogical laboratory. Over the years (she has taught the one-semester course five times since then), she has used a spate of teaching techniques in this introductory course – lectures (both live and online), podcasts, peer evaluation, online quizzes, different class sizes and so on – to try to create an environment in which students can be active participants in learning, not merely passive recipients.

Godlewska cautions that "101 is very much an ongoing experiment," but, when it comes to keeping students engaged in large introductory classes, she has already reached a few conclusions. Generally, the traditional model, which she characterizes as a hub and spoke (spatial metaphors come easily to someone who teaches geography), with the professor at the hub, delivering knowledge via lectures, doesn’t work. And it isn’t enough to put the lectures online, either. "As difficult as conventional lectures are for some students, they’re almost impossible for all students to watch online. They’re just not engaging."

Using another spatial metaphor, Godlewska characterizes what seems to work best in terms of engagement – nodes (groups of different people interacting at different times). Sometimes it is students with her, sometimes with TAs, sometimes with each other. It is, she says, "a much more complex series of actions."

January 2015 will see the sixth and most radical version of Geography 101 yet. "We’re going to be offering it entirely online and in-person at the same time, trying to get a design that is almost identical, to compare and contrast what’s going on."

In place of lectures, the course will feature a series of ten minute podcasts on particular subjects and also on skill acquisition such as where to find sources, how to read them and so on. "In class," says Godlewska, "they are going to be working in teams to solve particular problems."

"They’ll be arguing a debate point, but not so much pros and cons. One group might be looking at the oil sands and arguing that economic factors are all that matter. Another, at food."

There’s a twist. "In your individual work you’ll be required to argue the opposite and deliver not a paper, but a poster. It’s like a ten or fifteen page paper in terms of text and argument, but a little harder to produce. It’s also more interesting for me and the TAs to mark. There are no exams and no quizzes, it’s all about what it will take to make the group and the individual programs work."

In this nodal approach, says Godlewska, "You don’t need to be in control all the time." Instead, the professor’s job becomes "to set up structures for them [the students] to play a more important part." The professor is overseer and provider, but not the sole, ultimate authority.

"Returning to the chocolate mode for a moment, you provide things they might like, but ultimately they are responsible for their choices."
Richard Ascough is a Queen’s professor of religious studies whose research explores the origins of Christianity during the first two centuries after the death of Christ. As most people know, Christ’s earliest followers banded together in small groups. But what did these groups look like? How did they develop? How did they fit into the broader Greek and Roman cultures of which they were a part?

Ascough is trying to reveal the social organization and structure of these and other groups of the day. Known as associations, they were the ancient equivalent of today’s Rotary Clubs or Lions Clubs. Like their modern-day counterparts, they were localized gatherings of people who shared certain social or job-related interests.

Much of Ascough’s research involves translating and comparing inscriptions left by these associations and “Christ groups” to better understand the latter. The inscriptions are carved in stone, or inscribed on pottery or bronze, while their documents are written on papyrus. They record the regulations of the associations and provide insight into how they functioned, who the leaders were and the activities the members were involved in.

Historically, Christ groups have typically been portrayed as radical, threatening to the Romans and more important than the other groups. The research of Ascough and his colleagues is challenging this idea.

That’s not to say Christ groups weren’t a threat. Romans demanded a very clear social order. There was nothing more important than preserving the Pax Romana – the Roman Peace. Anything that undermined the status quo had to be quickly dealt with. For example, the pantheist Romans thought of their emperor as an earthly God. If the gods were not appeased, they might wreak havoc on earth. As monotheists, Christ groups refused to worship the emperor, and were thus a threat to the social order.

The Romans did take measures to discourage nonconformity, which has given rise to legends of widespread persecution of early Christians. However, Jews were also monotheists. Other groups, such as some worshippers of Dionysus, were also perceived as threats for other reasons. As Ascough and his colleagues have demonstrated, Christ groups were not unique, but similar to many other groups. Thus, through his research, Ascough hopes to help overturn the oversimplified popular categorization of Roman religions as Christians, Jews and pagan “others.”

“Framing the discourse that way privileges Christianity in a way that, historically, didn’t happen,” says Ascough.

Ascough has only a few chances at Queen’s to teach classes directly related to his research on early Christ groups, although this winter he will teach a new course on Greek and Roman Religions. His other regular courses include Religion in Film and Religion and Business Ethics, where he attempts to inspire students to think critically about what they’re reading or watching by recognizing and analyzing any conscious or subconscious assumptions they may bring to the material.

Says Ascough: ‘I’ve been asked before, ‘How does your research manifest in the classroom?’ To answer that, I can describe what I research in the Greco-Roman period and how it shows up in certain courses, where I use it to help students work through changes in their perceptions or paradigms of Christianity. But another way research shows up is when students generate discussion outside of my field. For example, in the Religion and Film course they may pose questions I don’t know the answer to. It’s then that I employ my research skills and I say to the students, ‘That’s a good question, we need to know more about it.’ I then model the skills of a researcher to address their questions.”
Big data is big buzz these days. Companies now track millions of retail transactions, even exchanges in open social media, every day to learn as much as possible about their customers’ behaviour. Many are using that information to develop new pricing strategies to bolster their bottom line.

Yuri Levin, a Distinguished Professor of Management Science and Operations Management in the Queen’s School of Business, is an expert in how massive sets of customer data can be used to strategically set prices, a practice known as “revenue management.”

“Revenue management is about charging the right price to the right customer at the right time,” says Levin. “The idea is that different customers will pay different amounts for the same or similar products, so companies can come up with a segmentation structure and people pay what they are willing to pay.”

It’s an idea pioneered by the airlines, which have long charged different fares to different passengers based on when they fly, how far in advance they purchase, and an array of other factors. But the practice has spread to many other industries in recent years, driven by the availability of data from the proliferation of e-commerce, electronic payments and loyalty cards.

“In the good old days they used to give you a loyalty card to make sure that you come back, these days they give you a loyalty card in order to track every single transaction you do with them,” says Levin. “They can use this information to micro-market to you, for example, by sending personalized coupons based on your shopping habits.”

Levin has published widely on revenue management and also consults for companies on pricing strategies. His recent work with the Molson–Coors Brewing Company saw him and his collaborators tackle the complex problem of how lowering the price of a certain kind of beer would impact its sales, as well as sales of the company’s other beers at similar price points. They analyzed large data sets and created a pricing strategy model to maximize revenues. The results earned Levin and his team the prestigious 2013 INFORMS Revenue Management and Pricing Practice Award.

His research also delves into the emerging issue of how consumers change their behaviour in response to complex pricing strategies. He recently co-authored a paper that examined the benefits to consumers of sharing information and cooperating in name-your-own-price situations, such as bidding on hotel rooms with companies like Priceline.

“The rise of social networking can help consumers share information and figure out...
a company’s pricing patterns,” says Levin. “So just as businesses become more sophisticated, so too do consumers. So there is a game going on and it’s interesting to see how this game will play out.”

Levin is quick to point out that data alone can’t drive a business plan. You need talent to get from the raw numbers to the insight needed to create an effective strategy.

As the director of the School of Business’s new Masters of Management Analytics Program and an active teacher in the school’s MBA program, Levin is doing his part to help future managers leverage big data. His skill in the classroom has twice won him the MBA Professor of the Year Award, an accolade which Levin attributes to how closely his research and consulting work informs his teaching, and vice-versa.

“In the classroom I don’t just talk about abstract theoretical concepts, I try to relate them to problems that companies are facing,” says Levin. “And in turn my research and consulting work benefits from my experience in the classroom, learning from our very sharp MBA students about the challenges they have faced within their companies.”

Levin hopes his students will leave the classroom with the understanding that revenue management isn’t just good for business, it is good for consumers, too.

“It sounds like companies are just trying to get more money from regular consumers, but at the end of the day, it’s a win-win, since consumers can end up paying less,” says Levin. “It’s more about understanding and being able to offer what each individual consumer is looking for in the market.”
Anyone who’s spent time in a hospital ward or emergency room knows it can be a chaotic environment. And anyone who’s read the news knows that health care workers sometimes make mistakes. The errors may derive from the number of patients they deal with, insufficient training, faulty equipment, or inadequate hospital systems and policies.

For the patient, the consequences of error can range from inconveniently long wait times to serious physical harm, even death. Doctors, nurses, and hospital administrators everywhere lose sleep over these issues, and all hospitals take measures to ensure that correct procedures are followed. So do schools that prepare health care professionals, whose job it is to instill the right knowledge, skill and ability so that they can provide the best care possible.

Remarkably, however, Queen’s is the only university in Canada to offer a stand-alone graduate-level program that focuses on how everyone working in health care – from administrators to front-line staff – can reduce risk and improve quality and safety on the job. Called the Master of Science in Healthcare Quality, the two-year, part-time program is taught by Queen’s experts in disciplines including law, medicine, nursing, engineering, education, health policy and business. Between 20 and 40 student-professionals in these and other fields are enrolled in each cohort of the program. The week-long introductory course takes place at Queen’s, but since the students live and work across Canada, most of the other courses are delivered online (distance learning).

The program’s co-director, Kim Sears, assistant professor in the School of Nursing, helped launch the program in 2011. She teaches in the program’s introductory course, which includes a section on how to safely administer drugs to patients. She also teaches in another course on health care policy. In both cases, she draws on her considerable research and practical experience to illuminate her material.

Sears began her career as a registered practical nurse in 1989. Later, she enrolled in a master’s program in nursing at the University of Toronto, and while working at the bedside she researched the best sleeping positions for babies and how to administer medications to newborns. Her literature reviews on best practices in these areas helped to change policies at the neonatal intensive care unit where she was working. Later, as a doctoral student at the University of Toronto, she researched the relationship between nurses’ work environments and the occurrence of pediatric medication errors. Her next stop was Dalhousie University, where for her postdoctoral fellowship she worked with a pharmacist to examine medication safety for adults and children in Canada and internationally. The work broadened her prior research by targeting not only hospital nurses, but other health care providers in the community.

When she arrived at Queen’s in 2010, she approached the vice-dean and director of the School of Nursing, Dr. Jennifer Medves, to discuss starting a course on quality and safety for undergraduate nursing students. Dr. Medves, in collaboration with anesthesiologist Dr. David Goldstein, identified the need for a master’s program in this area, and after much consultation about program content with experts in the field from around the world and advice from the Queen’s Centre for Teaching and Learning, this idea eventually blossomed into the current master’s program. It is an ideal vehicle for Sears’ research.

“It’s a privilege to bring my research right into the classroom setting,” she says. “Because it’s linked to my field, I can share, and I know a lot of the main resources and places the students need to go to for resources and things like that. I’m in a very fortunate position because I have an opportunity to work with people who are setting policy, people who are working at the bedside, and researchers. The program brings them together, which I think is kind of cool.”

But the program does more than allow Sears to pass along her research insights. That’s because the program itself has a built-in research component. At the start of the program, students are surveyed on their knowledge of quality, risk and safety. They complete the survey a few more times as they move through the program so that Sears and her colleagues can gauge their progress.

“Our first student cohort at the end of the first year showed a statistically significant increase in their knowledge of different aspects of quality, risk and safety,” says Sears. “That was good to see. It showed that the program is actually achieving the desired outcomes.”
Kim Sears (in red) speaks to colleagues and trainees
A Nexus of Networks for Learning

BY IAN COUTTS

Professor Scott Yam cares about networks. That’s not surprising for an engineer who specializes in fibre optics. But Yam is also interested in creating networks that enhance his graduate students’ learning experience, expose them to cutting-edge research in government and industrial laboratories, and, once they have finished their degrees, help them ease relatively painlessly into the workplace.

It’s all part of the Next Generation Optical Networks (NGON) program run jointly by Queen’s, McGill and Laval. Funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) through the Collaborative Research and Training (CREATE) initiative, the idea is to encourage integrative approaches to training, and foster state-of-the-art research and collaboration among different universities, government and the private sector that Canada needs to advance the field into the future.

With his research on the transmission of high-speed data (over thousands of kilometres of silica glass fibre no thicker than a strand of human hair), Yam represents one-sixth of the teaching power behind the academic heart of the NGON program, ELEC 868 – Simulation of Optical Communications Systems. Taken by students at all three universities (utilizing interactive software that enables students to raise questions and converse with the professors as well as students at other schools), this one-semester, online course teaches them how to model the performance of these systems numerically.

“Our collective expertise,” says Yam of his colleagues, “spans a wide, complementary spectrum. While some of us specialize on the end-to-end system performance of an optical fibre link, others are experts in the opto-electronic components that enable these systems. And instead of having just two professors to call on at each institution, students now have access to six across all three.”

Students also take advantage of their professors’ own professional networks. Unlike most graduate programs, where students’ time is generally spent, as Yam puts it, “doing research and publishing papers,” those in NGON spend time outside their home university, taking up internships lasting anywhere from two months to a full year. “We place them in private industry, government labs, or other academic institutions nationally or internationally,” where they work on topics relevant to their research interests, with technical input from both their workplace and academic supervisors.

Internships have other benefits, too. “They give the industry an opportunity to screen potential employees. Is this person easy to work with? Is this person a team player? Does this person have the skill to prioritize resources for competing requirements on a project?” Thanks to the internships, says Yam, “Employers would already have a good idea before they hire.”

NGON works to enhance their students’ marketability in other ways, too. “At least once a year we round them all up in a workshop,” says Yam. “They get to meet one another, and we provide them with the ‘soft skills’ training that is generally missing from graduate programs – What are best practices in the workplace when operating capital-intensive test and measurement equipment? If you only have seven minutes in a weekly meeting with your front-line technical manager, how do you state your progress and develop a convincing case for scarce company resources? These are the sorts of things that everyone is looking for these days.”

“We’ve had trainers from Industry Canada come in to tell the trainees about intellectual property and trademark regulations. Recently, in June 2014, we had a serial entrepreneur visit from Genia Photonics (a start-up) to talk about commercialization.”

The approach seems to be working. “Over the years,” says Yam, “a significant number of our graduate students have been snatched up by the optical industry almost immediately after graduation.”

The students aren’t the only ones who benefit. “In the academic world,” says Yam, “researchers like us are very interested in how industry sees things.” Having students moving out into industry and then returning to the university helps this process. “We hope this will give us a better idea of where industry wants to be in five to ten years.”

Other graduate engineering programs at Queen’s are adopting the idea of graduate internships, in a modified style. And while NSERC’s funding for the program runs out at the end of the 2015-16 school year, Yam and his colleagues are convinced that the NGON should continue.

“Our work,” he says, “has just started.”
“If you want to be a good archaeologist, you gotta get out of the library!”

These wise words spouted by the famous fictional character, Dr. Indiana Jones, drum up memories of the bullwhip-snapping adventurer and professor of archaeology, who travelled the world uncovering the relics and stories of lost peoples. Jones’ adventures undoubtedly inspire countless with a passion to learn about the ancient past, who are then discouraged when confronted by the typical classroom setting – listening to lectures, viewing photos and watching videos. Few individuals ever get the opportunity to experience the excitement of real-life archaeology – uncovering, with their bare hands, the artifacts of ancient people and their histories.

Fortunately, the Department of Classics at Queen's University offers two programs that allow students of all disciplines to truly “experience archeology.” While not exactly raiding the Temple of Doom, students actively participate on digs and in the preservation of artifacts to reconstruct the past and thus more fully understand the social lives and interactions of the inhabitants of ancient worlds.

Caere

Cerveteri is a town on the west coast of Italy (48 km north of Rome) which exists on the site of the Etruscan city of Cisra, called Caere by the Romans. Situated on a tufa outcrop overlooking the Tyrrhenian Sea, Caere was a rich and powerful city and a metropolis of the ancient Mediterranean. Caere was an ally of Carthage, developed good relationships with its southern neighbours, the Romans, and had far reaching commercial connections.

Recently made a UNESCO World Heritage site, Caere is famous for its necropolis of rock-cut tombs imitating houses and complete with carved furniture and decorations. Many of the most famous Etruscan artworks, such as the Sarcophagus of the Spouses, were found in the tombs of Caere. While the cemetery and its tombs have attracted great scholarly attention, the general plan of the city is still largely unknown.

Directed by Dr. Fabio Colivicchi, the Queen's excavation is focused on investigating the central area of the city, and in particular a religious complex with an underground room and tunnels. The goal is to further understand what daily life was like in the city, which will ultimately provide greater insights into its urban planning, manufacturing and production, and language and literacy. “We know a lot about the tombs and death, but we do not know much about the living. It’s the minutiae of everyday life that we are interested in. Caere was a pocket of regular habitation,” says Colivicchi.

Humayma

The Humayma Excavation Project examines a small Nabataean settlement and trading post founded in the first century BC in the Hisma Desert of southern Jordan. The Romans built a fort there after converting the Nabataean Kingdom to their Provincia Arabia in AD 106, and the site continued to prosper in the Byzantine and Early Islamic periods, as evidenced by five churches, a Roman and Byzantine bathhouse, and the manor house. The site was abandoned around AD 750.

The excavations at Humayma have been ongoing for many years, and Dr. Barbara Reeves of Queen's University has been the project director since 2008. In this role, she coordinates all activity on the site, including the distribution of the substantial volumes of materials generated – animal bones, human bones, coins, pottery, glass – to specialists in those particular areas. “It takes an army of people to collect the data,” says Reeves, “but it’s a drop in the bucket relative to all the time it takes to do the processing on all the different objects and understand them.”

Her own area of scholarly focus, at least most recently, has been on ceramic building materials, like bricks and other “mundane” objects, which have been overlooked as unremarkable by other archaeologists. These objects number in the thousands, and by grouping these items into categories that differ in shape and material, for example, their characteristics can be used as a diagnostic tool to date other surrounding items.
Caere Excavation

Students pictured working in the excavation site. Here they discovered new evidence on Caere’s history between the 3rd century BCE and the Roman Imperial period.

The image shows a cross section of a point cloud generated by aerial photos and a laser scanner of Site A. Each point is precisely positioned in the three dimensions and one point cloud is made of several million points.

This cross section is through the underground complex, showing the main room and other related structures. Such sections are effective in studying multi-level structures such as this one. Point clouds can be used to produce a countless number of sections, can be rotated, and seen from above. They also work as maps, and 3D models can be built with them.

Professor Fabio Colivicchi stands in the underground chamber of the sanctuary. In this space, the Queen’s team discovered previously unknown inscriptions and wall paintings, changing the previously held views about the function of the structure.

Student Rachel Di Cresce shows her latest find: a Roman silver coin. More precisely, it is a denarius issued in 90 BCE.

Student Sam Hopkins cleans a sample of the floor of the underground chamber of the sanctuary. The floor is a nice example of an early Roman cement floor covered in a mosaic design.
Humayma Excavation

Understanding context is more important than any individual artifact. Here, Queen’s students excavate part of a Roman bathhouse that the Romans later blocked off and abandoned when their heating costs became too high. Luckily for archaeologists, the abandoned room was also used as an ancient dump and the team found many interesting artifacts within.

Dr. Barbara Reeves, associate professor of classics and director of the Humayma Excavation Project, instructs archaeological students on the day’s research goals.

Basiliki Vicky Karas, a graduate of Queen’s Master of Art Conservation program, cleans a leather artifact excavated at Humayma. Many ancient objects experience accelerated decay when they are removed from the ground, so it is imperative to have a professional conservator on the team. The conservator also instructs students on the proper techniques for handling any ancient artifacts encountered, whether they are made of leather, bone, ivory, metal, ceramic, stone, or glass.

Excitement abounds as a new excavation area is opened. Queen’s students paired with Jordanian villagers will discover together what lies hidden beneath the ground. In addition to learning archaeological techniques, new friendships and international perspectives will be gained.

A Roman bathhouse re-emerging, piece by piece, from the Jordanian desert under the careful hands of Queen’s archaeologists and local villagers.
Chemical bonds

Whether she’s working in the classroom or on the other side of the world, Dr. Cathy Crudden’s chemistry creates all sorts of connections. 

BY ROSIE HALE
I'm a bit early for my meeting with Dr. Cathy Crudden, so when I arrive at her office she's in the middle of discussing a current research project with one of her students. Crudden invites me in anyway and it's immediately obvious that working with students is a huge job perk for her.

“Students are incredibly fun to work with. Everyone has a different approach and we encourage them to have their own ideas and because of that, they bring so much to the science,” says Crudden, a professor in the Department of Chemistry.

The science, in this case, revolves around questions of catalysis – acceleration of chemical reactions – and chirality – structural asymmetries and “mirror images” in different forms of the same molecule. Crudden and her group are involved in developing new reactions to prepare compounds of interest to the pharmaceutical, environment and energy industries.

Of particular note is their recent work published in *Nature Chemistry*, where the Crudden group described a process to allow organic compounds to bind to metal surfaces. They have prepared the most stable self-assembled-monolayers on gold reported since the original report of organic-on-metal coatings in 1983. These results are considered game-changing. At only 1/100,000th the width of a human hair, these films have already been shown to reduce corrosion and dramatically improve stability and reproducibility in biosensors. Their potential for wide application is unquestionable.

And discoveries like this rely on the close collaboration with her students. For the last few months, the Crudden group had close to 20 undergraduate students, graduate students and postdoctoral fellows on the team, which made for a busy summer.

“Our lab is very different from your cookie-cutter, undergraduate lab where the experiments are designed to work,” says Crudden. “In my lab, students get to do things that won’t necessarily work. While that doesn’t sound great, it’s another important approach to exploring chemistry, which at times can be unpredictable. It’s a very challenging, but very fun experience.”

“Perseverance is critical in research. You’ve got to be stubborn. That said, a successful experiment is so rewarding. That’s what makes it all worthwhile.”

Furthermore, opportunities for working in Crudden’s lab aren’t limited to Kingston, or even Canada, thanks to her longstanding connection with Nagoya University in central Japan.

With no less than four trips to Nagoya per year, a huge part of Crudden’s career is based across the globe where she studied for part of her PhD and returned to for her sabbatical year.

In 2013, Crudden became involved with the creation and development of the Institute of Transformative Bio-Molecules (ITbM) – a research facility based at Nagoya dedicated to solving scientific problems and making these solutions readily available for researchers all over the world. Projects at the ITbM currently include the development of molecules that control biotic function and production, as well as developing innovative bio-imaging technologies.

“Japan is an incredible country and working with researchers over there brings a totally different perspective and intensity to the table,” says Crudden, who now holds an adjunct faculty position at Nagoya. “Going to Japan as a student was such a great experience for me and it really is a huge pleasure to be able to send students there.”

Trainees in Crudden’s lab are encouraged to take research positions at Nagoya, just as students at Nagoya are encouraged to come to Queen’s. In ITbM’s first year of operations, Crudden sent three Queen’s students to the Institute. Two undergraduate Queen’s students conducted research there this past summer. “Having Canadian and Japanese students able to interact and learn from each other is a huge benefit of having this connection with Nagoya,” says Crudden.

With only about 14 per cent of researchers in Japan being female, the relationship that Crudden has cultivated with Nagoya has also been encouraging for budding female scientists at the university.

“Japan is very keen to increase their number of female scientists and many scientists over there will often talk to me about how I, as a female scientist, balance my work and home life,” Crudden says, adding that she’s seeing many more female students and researchers at universities than she did when she was in Japan as a graduate student.

As a leader in her research field, Crudden is a role model for women in science and as an acclaimed mentor, clearly has the ability to inspire passion in her students. However, this goes both ways. At the close of our interview, I notice a number of empty champagne bottles that line the window sill of her office. I ask her what these mementos represent and she responds that each bottle celebrates the success of one of her students.

“When one of my graduate students finishes or a postdoctoral fellow secures a job, we celebrate as a group by cracking open a bottle of bubbly,” Crudden tells me, adding that the bottles are all signed and dated by each student – a reminder of their work and success under her guidance.
We live in a world where we are inundated with information. Glued to multiple screens, with the answers to our most pressing questions and curiosities just a simple click away, we no longer seek and consume information the way we used to. The Internet has brought information to one’s fingertips, more rapidly and widely accessible than ever before.

Countless studies have demonstrated the behavioural implications that this technological shift has had on the average person, especially on attention span. The current generation of post-secondary students, many of whom have never known anything but high speed broadband and public Wi-Fi access, now process and therefore expect information to be delivered differently than what has been the norm.

The question then arises – how does one effectively teach this incoming generation? Annie Riel, PhD candidate in the Department of
French Studies, is actively seeking the answer. Currently in her fourth year under the joint supervision of Professors Catherine Dhavernas in the Department of French Studies and Denise Stockley in the Faculty of Education, Riel is studying the effects of active learning and the impact of physical space on teaching and learning as part of her hybrid dissertation.

Encompassing several models of instruction, active learning strategies engage students in higher-order thinking tasks such as analysis, synthesis and evaluation. “Instead of passively listening, they must read, write, discuss and solve problems,” Riel explains. “I strongly believe in active learning as a method to keep students engaged. I work on creating and adapting teaching strategies, which, unlike previous models, also incorporate the effect of physical space, so that educators can more effectively use them.”

It was in her graduate studies that Riel’s interest in education became a passion. Having always been an avid reader with a deep interest in classic literature, Riel naturally enrolled in literary studies at l’Université du Québec à Montréal (UQAM). “Throughout my studies at UQAM, I was extremely stimulated by my work. It was in my master’s program there that I was inspired by two truly gifted professors. The way they taught brought the works we studied to life. That’s when I realized I wanted to bring that same level of discussion and student engagement to classrooms everywhere.”

Now at Queen’s, Riel is seamlessly combining her first love, literary studies, with pedagogical research. In her unique hybrid dissertation, she examines the intersections between literature, music and cinema – as well as learning – in the works of four prominent French authors who have had a significant influence on the second half of the twentieth century: Marguerite Duras, Pascal Quignard, Louis-René des Forêts, and Nancy Huston.

These authors, unlike those before them, were conscious of the limitations of portrayal via the written word and chose to integrate other forms of the arts in their writing, namely music. Music helped the authors not only establish an atmosphere for each scene but also evoke feelings in the reader with regards to a certain character or situation. Following the completion of their revolutionary works, much subsequent literature was inspired to enhance depth by this mode of intertextuality. In Riel’s dissertation, the works of these four authors also serve as case studies for the implementation of active learning strategies in the classroom.

“Much of my primary research has been completed in the new Ellis Hall active learning classrooms. These classrooms have been specifically designed to facilitate student-centered interactions while taking into account the impact of space on learning.” The presence of collaborative workstations, mobile tables and chairs, and technology all promote and encourage interactions between members of the classroom. “Working with the newly-designed space, I was able to plan and deliver a senior level French literary studies course, in which parts of the four focus works of my dissertation could be presented in an active learning context.”

Reflection and classroom discussion were heavily encouraged throughout the term. “Students would be required to individually complete a short reflection paper on the work prior to each class. Additional reflection and discussion would be facilitated by requiring small groups of students to answer and present a series of questions related to the work, as a team. Alternatively, as a class, we would complete the reflection process together while working with Google Docs simultaneously. These team-based and active learning strategies would have been very difficult to accomplish in a traditional classroom.”

Using this past and all future renditions of her course, Riel hopes to present a novel conceptual model for learning and teaching that incorporates both the impact of space and student-centered interactions. Aside from ensuring the continued appreciation and understanding of literature, developing pragmatic teaching and learning strategies that continue to engage students of all backgrounds is Riel’s main mission.

“Pedagogical research is, of course, very important to me. It should be important to everyone. The more we know about how human beings learn and the more effectively instructors can teach, the more prosperous our society can be.”
A unique summer research experience

Each year, the Undergraduate Student Summer Research Fellowship (USSRF) provides an opportunity for students to engage in discovery-based learning and develop their research and presentation skills. The program is targeted to students in the social sciences, humanities, and education.

ART, CULTURE, AND RELIGION AT DUNHUANG – TRANSMISSION VIA THE SILK ROUTE

Dunhuang, on China’s western frontier, was an important geographical location where the Silk Route split into a Northern route, reaching as far as Rome and Italy, and Southern routes, reaching toward India. It provided the only access westward for the Chinese Empire and eastward for western nationalities, and therefore serves to document the presence and influence of different cultures on one another. In my research, I focus on the Mogao and Yulin Grottoes at Dunhuang, and what they reveal about the region, specifically during the dynastic rule from 439 to 1368 AD.

EMILY GONG, A 4TH YEAR FINE ART AND ART HISTORY UNDERGRADUATE ON SITE AT MOGAO GROTTOES IN DUNHUANG
The connection between the artistic achievements in wall painting and the social/political situation of Imperial China is inseparable. My investigation of the wall paintings in the grottoes helped to identify and contextualize the different styles of art and the hallmark of each dynasty and empire. The wall inscriptions and scriptures found mostly in cave 17, known as the library cave, shed light on the richness of the exchanges between cultures in Dunhuang – for example, between the Han Chinese and various different minority groups including Mongol, Xianbei, Tibetan, Tangut, Uyghur, Jin, Manchu, Persian, Indian, and Turkic. These exchanges ultimately shaped the landscape of western China.

Many of these religious and cultural influences were carried on the Silk Route to Chang’an, the ancient capital of China for thirteen dynasties. The records at Dunhuang show the dominance of Daoism, Confucianism, Christianity, and Buddhism in the region. Particularly, Dunhuang was an important centre for the transmission of Buddhism, since the earliest Buddhism travelled from India to Dunhuang into Central China.

The paintings on the cave walls in Dunhuang are rich in Buddhist symbolism, representing core Buddhist teachings, which differ from each sect. Visible differences exist between the depictions of Indian Buddhism in the earlier caves, flourishing Chinese Buddhism in later caves, and Tibetan Buddhism that prevailed mostly during the Tibetan occupation and Yuan Dynasty. These differences reflect variations in dominant schools of thought in each dynastic era.

This experience enabled me to conduct field research, collect data and make observations first-hand. I learned to analyze archival information and literature, document observations, and synthesize findings. In this process, I travelled from the Gobi Desert of Dunhuang, in China’s Gansu province, to the snowy Himalayas of Tibet, while crossing great historic capitals of Beijing and Xi’an, present day Chang’an. On my trip, I had the privilege of communicating with scholars and experts in the fields of Imperial Chinese history, cultural anthropology, archaeology, Chinese and Tibetan art, and Tibetan Buddhism studies. I learned the importance of working with other researchers as a form of peer evaluation and in discussing key topics of my research results.

This research fellowship gave me the chance to apply the knowledge from my rigorous academic studies at Queen’s University and then expand on my area of interest to develop a deeper rooted understanding in this area. I have published in the Queen’s Journal and I look forward to exhibiting my paintings produced from fieldwork research. As well, my work will appear in upcoming publications of The Journal of The National Association of Student Anthropologists (NASA) and UK’s Nee Hao Magazine.

EMILY GONG, FINE ART
Associate professor of physics, Dr. James Fraser, is known for his innovative research on ultra-fast light-matter interactions and non-linear optics. He’s working to make precision cutting with lasers more effective, and when not working in his lab, Fraser is being a bit of a maverick in the classroom. Recently, Andrew Stokes spoke to Fraser about his research and teaching styles, and learned that physics is no “spectator sport.”

By having his students teach one another and by acting as a mentor rather than instructor, Fraser is creating a generation of apprentice scientists.
You have an unconventional teaching style that eschews standing at the front of class lecturing. Why is that?

I have a really strong belief that science, and physics in particular, is something you learn by doing, so I don’t think it’s fair to ask my students, whether upper- or first-year, to sit quietly and listen to me. I collaborate often in my own research and I think the success I’ve had with my graduate students comes from welcoming input from everyone involved and creating a variety of perspectives. Whenever I’ve surveyed my students about a time they’ve really learned a concept well, and how they did so, only two or three will say it was from the lecture portion of the class. The rest comment that they had the best grasp of the subject when they saw a mentor demonstrate something and then had the chance to practice it and get feedback. My teaching staff and I are mentors who set the bar in terms of what should be learned and then help our students to get there. We give them lots of feedback whenever we can.

What does that look like in practice?

It can look quite chaotic. Students are given readings to complete before class and a series of problems to work out online. The classes are totally dependent on their questions that result from those problems – I put their questions up on the screen and, after a bit of prompting from me, they set about solving them together in small groups. The room explodes into noise as they’re debating with one another about the best way to do it. Working like that gives students a sense of control about what they’re doing. It’s not just me pushing information at them. This style of teaching becomes really addictive because it’s so fun – you know exactly what the students are having trouble with and you get to see them resolve those problems.

And so what are you doing while they’re making all that noise?

I walk around the classroom while they’re discussing and help the groups that have gotten stuck, asking them questions, but mostly it’s the students teaching one another. When you’ve got a group of four who have all gotten the wrong answer, but different wrong answers, there’s a tremendous amount of learning going on. Queen’s has superb students and when they work together they can have a really enriching discussion. After they’ve had a chance to work it out I poll the class using iClickers (hand-held polling devices) or flash cards and if most of them have the right answer we’ll move on, but if they’re still having trouble, we’ll take on a simpler problem so they can better understand the concept. To succeed in physics requires a strong grasp of some fundamental ideas, so I make sure the students know the basics.

This sort of teaching sounds like it requires an atmosphere of trust and comfort. How do you develop that?

Trust is absolutely necessary, especially when students don’t know the answer to a question. They can be very reluctant to admit it for fear of not looking smart enough. I try to make my students comfortable right from day one and I do that by first making them uncomfortable. They get into the class and are put into small groups of about five people. The groups are selected according to some common factor, usually according to residence hall, but the members don’t really know each other. I make sure they get to know each other’s names and ask them constantly over the first week about their group mates’ names. I don’t think you can trust someone until you know who they are.

Greater student interaction makes them more interested, but how do you know this type of teaching is more effective?

I do various standardized tests, not for marks, but to help ascertain where my students’ understanding is. It helps both me and them to know where their shortcomings are. With passive, lecture-based learning, students have been shown to retain about 20 per cent of the information, but with a more active learning style that number jumps to over 40 per cent.
The students are okay with the switch from what they’re used to?

Absolutely. I acquaint them with the data on different teaching styles and show them it’s proven to work. I think the active learning style also helps them with identity formation, which can be so important to success in learning physics. Because they’re helping one another with the problems and explaining their thinking, they can more readily imagine themselves as apprentice scientists. They’re on the path to becoming proficient scientists and working in groups gives them a chance to act like it. They learn to speak, share, evaluate, judge and critique one another while remaining supportive. After we’ve had some standardized tests I’ll show them their results as compared to other universities. When they see they’re keeping pace with students in active learning courses at Harvard, they trust the method is working. Seeing their success creates a positive spiral where their confidence leads to better understanding and thus further improves confidence.

Speaking of Harvard, you spent time there on a sabbatical recently. How was that?

My time at Harvard was illuminating. I was working in the lab of Dr. Eric Mazur, a scientist who is doing a lot of interesting work both with lasers and with education. Because he has such an eminent lab, there were many distinguished scholars frequently coming through and we got to share ideas about what worked and what didn’t. I found myself spending more and more time in classrooms, observing teaching rather than working in the lab.

What did you see in the classrooms?

I saw a lot of great ideas and methods fall apart in practice. But, I also saw some really innovative techniques find great success. For example, having students take on a teaching role is something that seems to work well.

Any insights from the success stories?

Teaching students course content is sometimes not as important as teaching them transferable skills. Content can have a limited application, but learning to analyze, critique and communicate are essential everywhere.