February 2017 Instructor of the Month Jeff Kavanaugh

February Instructor of the Month Jeff Kavanaugh blurs the distinction between lecture and lab, between theoretical and practical, so that students start doing and building from day one.

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What do you teach?

I teach a small number of classes in the Department of Earth and Atmospheric Sciences, notably: EAS 100, Planet Earth, a first-year introductory Earth system science course; EAS 327, Environmental Instrumentation; and EAS 458, Cold Regions Geoscience (I’ve taught two versions focusing on alpine regions and the Antarctic). I’ve also taught both first-year and third-year field schools (EAS 110 and EAS 354), and have occasionally run a graduate student seminar course of glacier dynamics.

If asked to pick a favourite to teach of these courses, I’d have to say that it’s a toss-up between Planet Earth and Environmental Instrumentation. Planet Earth covers an enormous amount of ground, from the formation of the solar system to plate tectonics, from the hydrological cycle to evolution – so we cover a lot of very cool content in the class. My goal each time I teach it is to draw a student or two into Earth sciences, and a number of students over the years have told me that they switched majors after taking it. That’s definitely one of the more gratifying things that a teacher can hear!

Teaching Environmental Instrumentation is rewarding because I get to teach both theoretical concepts and practical, hands-on skills. So, for example, students learn the fundamentals of circuit analysis, and then put them to use assembling circuits to measure temperature using a couple of different sensors. The environmental focus of the course allows me to develop the students’ skills towards monitoring various aspects of the natural world—which is critical to our understanding of weather and climate, air and water quality, and other physical attributes that affect the health of both the natural environment and human populations.

Why should people learn about Earth sciences? What are some of its "real-world" applications?

Learning about Earth sciences fundamentally changes the way one sees and understands the world around them. Many times students have commented to me after taking my classes that they notice more detail about the landscape they could see from an airplane window, that weather patterns make more sense to them, or that they can better evaluate news stories regarding environmental issues such as climate change.

Environmental monitoring allows us to monitor and understand weather and climate, air and water quality, and many other aspects of our physical world. These data drive weather forecasting, allow us to ensure compliance with environmental regulations, and optimize agricultural yields. Students have used my Environmental Instrumentation course as a springboard to land a summer position releasing high-altitude weather balloons from Alert, Nunavut, permanent positions at Campbell Scientific Canada, and positions with Environment Canada.

What’s the coolest thing about this subject area?

Personally, having some expertise in this subject area has taken me to some very cool places, including the mountains of Yukon, British Columbia, Alberta, and Alaska, the Canadian high arctic, and Antarctica, to examine some fascinating aspects of ice dynamics and the role of glaciers in the Earth system. One of the most exciting developments over the last few years is the development of new pieces of hardware and software that are both low cost and openly available, which allows anyone with basic skills to develop new tools for environmental monitoring. As an example, I recently built a system (which I called "IceCoreTracker") to monitor the Canadian ice core archive as it was transported from Ottawa to the University of Alberta. The system used a GPS receiver to track the shipment’s location, thermistors to monitor the freezer container’s temperature, and a cellular link to regularly text me updates. The system also tweeted these updates to Twitter.
You’re a Faculty of Science Innovation in Teaching Award winner. What are some of the innovations you use that you’ve found most successful in your classes and what inspired you to try them?

To be honest, most of the teaching methods I use are rather tried and true. It was clear to me throughout my schooling that hands-on laboratory exercises really drove home the concepts I was learning in class, whether in chemistry, physics, or geology. As a result, I work to find ways to effectively tying together these two sides to learning. Moving forward, I’d like to further blur the distinction between lecture and lab, between theoretical and practical, so that students start doing and building from day one as new concepts are introduced.

In my Environmental Instrumentation course, I run the lab exercises with the help of a teaching assistant. I do this for two main reasons. First off, these labs are fun! Second, as a field researcher working remote and harsh environments, I’ve learned that there are a lot of little (and big) things that can determine whether your instruments succeed or fail. Many of these things are difficult or impossible to convey through a lab manual, and can only really be passed on to the students they work through the process of working with the systems.

One unique experience you offer your students is the opportunity to work in a lab on the top of the Tory building. What’s the value in offering students these types of experiential learning opportunities?

The laboratory exercise on the roof of the 15-storey Henry Marshall Tory Building is a very rewarding one, and my idea for it originated from a very real need: I felt it was critical that students in this class learn how to set up weather stations and to see the data that comes from them, but I needed to find an on-campus location to build them. I didn’t want the stations to be tampered with or ‘walk away’ if we let them run through Reading Week, which ruled out the central quad.

So, I looked up—and found the Tory Building. This 15-storey building has a flat roof with a perimeter safety wall, and access is pretty strictly controlled. It worked, and I’ve been running this lab every year since. As it turns out, it’s a great location for other reasons as well, as it requires the students to start thinking about what factors might impact the quality of the data. For example, the tall building and safety wall modify the airflow, which impacts the measured wind speed and direction, and the building’s central heating modifies the energy balance recorded by the net radiation sensor.

These skills—both in assembling the weather station and in critically evaluating the quality of data they produce—are directly transferable to other systems and other situations.

What was your favourite learning experience as an undergrad, and how do you incorporate that experience into teaching your students?

Most of my favourite learning experiences as an undergraduate student were during laboratory exercises. I've always loved to work with my hands, to build things, to program things. The lab courses I took in engineering, chemistry, physics, geology, and geophysics were fun and rewarding—and their lessons stuck with me. So I try to incorporate hands-on learning in my classes whenever possible.

I’ve benefited from a number of incredible teachers and mentors during my education. Looking back, one of the teachers that made the strongest impression on me was my 5th grade teacher, Frau Newby. She had a remarkable life, escaping from Germany as a young teen during World War II to build a new life in the U.S. Each week she would set aside a few hours to give lessons in two topics that were outside of the usual curriculum: music and German. She didn’t need to do this, but put in the extra effort to provide her students with a little bit more of an education than they would have received otherwise. That “little bit more” makes all the difference.

What is one thing that people would be surprised to know about you?

In addition to building instruments for environmental monitoring, I also build musical instruments (to date, an electric bass and electric guitar) and have played bass guitar for a few decades.

Source: Faculty of Science