Interview with Sarah Johnson, Recipient of the CAP's 2018 Medal for Excellence in Teaching Undergraduate Physics, September 2018 (by Daria Ahrensmeier)

Daria: Congratulations on your CAP teaching medal!

Sarah: Thank you.

Daria: Can you describe to us the work for which you received it?

Sarah: I guess I got it for multiple different things. I got it for my teaching undergraduates, I believe, for introducing innovative teaching methods to my classes at SFU. I also got it for, I believe, for all of my outreach activities. I've been heavily involved in outreach at SFU since I started there, various different events like workshops for girls called "Girls Exploring Physics", twice a year. We also run a big Halloween themed event for children in kindergarten through sixth grade, and I've also worked on a variety of other outreach projects.

Daria: That's pretty impressive. What got you interested in this work, specifically the teaching?

Sarah: Well, I think it was mostly when I was finishing up my PhD and trying to figure out what I wanted to do. I had done some TA'ing and I had started doing outreach, too, at that point, and I realized that I really enjoyed the teaching and the outreach and that kind of work much more than I enjoyed the research. I mean, I liked the research, but I liked the teaching more. I felt like I was better at the teaching than I was at the research. And so I started in the United States, I actually took a sabbatical replacement position at a small college in upstate New York. That sort of cemented it for me that this was something I would enjoy doing as a career. I did go off and then do a postdoc for a year. But then after that, I came back and worked at several different liberal arts colleges in the United States from 1994 until 2005, which is when we moved to Vancouver. We moved to Canada because of my husband's work, and I learned pretty quickly that Canada doesn't really have liberal arts colleges. At liberal arts colleges, you do a lot of teaching and a little bit of research, but these don't really exist in Canada. But I did see that there were big universities like SFU that had teaching faculty positions and I thought, well, that would be an interesting challenge to devote myself purely to teaching and also to teach large classes. The biggest class I had taught up to that point was 70 students, and I thought it would be an interesting challenge to try and teach 200+ students. So when I saw that Simon Fraser was looking for somebody, I was very excited. They were also specifically looking for somebody to teach their studio physics course, and I had a little bit of experience with that. I had just started getting interested in PER-based teaching and had heard about workshop physics, and I tried it out a little bit at La Verne where I was teaching before I moved to SFU. So the idea of being able to help develop a course like that was also very exciting.

Recipient of the 2018 Teaching Medal / Lauréate de la médaille d'enseignement 2018:

Sarah Johnson

Daria: It's so nice to have somebody call teaching - like teaching a large class or developing something new - a challenge in a good sense, in a positive sense. Now I'm curious: The liberal arts colleges in the U.S., do they just put more emphasis on the teaching or is the teaching handled differently as well?

Sarah: Well, the teaching loads are higher than you would expect for someone at a research university. Because of that, when they hire for professors at liberal arts colleges, they very specifically look at your teaching ability and whether you're interested in teaching, whether you have any teaching experience, and if you are good at it. They'll sometimes in the interview even have you do a lesson, to demonstrate your teaching ability. And then the expectation for research is just much lower. They realize that because of the heavier teaching loads, most people can only do any significant research in the summers. And so they don't expect the same kind of research output that a research university would expect.

Daria: But is the level of teaching the same as at a research university? Because of the label "liberal arts college", you might think that it's different?

Sarah: No, it's just what they call them in the United States. It's still undergraduate. Most liberal arts colleges don't have graduate programs, so you're only teaching undergraduate courses. But otherwise, the coursework is the same level, at least within the U.S. There are some differences, I think, between the level in the U.S. colleges and universities and Canadian universities, having to do with the coursework that

Canadian kids take in high school. I think they go a little bit further in high school than American students do.

Daria: Do you notice that in your classes?

Sarah: I do notice that, yes. For example, in B.C., our science students all come in having taken physics 11 and physics 12. Whereas in the United States, I would get students who had taken no physics in high school at all. Some might have taken one course, this was a while ago. Nowadays, I think more students are taking AP physics because there's been this explosion of people taking more AP courses over the last 20-30 years in the United States. But I still think there is a reasonable number of students you see in college that have taken no physics at all but are studying science, which always kind of amazes me. So you definitely notice a difference here, where the students have taken both physics 11 and physics 12.

Daria: Now, let's go back a little further. Did you yourself attend a liberal arts college?

Sarah: No, I didn't. I attended a large state university in New York, a lot like SFU actually. A little bit smaller than SFU but similar. It even looked a lot like SFU: large concrete buildings [it was SUNY Albany].

Daria: And what got you interested in physics? Were you already interested in physics when you started university?

Sarah: No. No, I started actually in chemistry. But then I had an amazingly good first year physics instructor who just made it really exciting and interesting. He was funny. He used to wear this tie that said, "Think" in seven different languages or something. I mean, my chemistry teacher was fine. I was in a small class just for chemistry majors, but he wasn't very inspiring and I had a not so great experience in the chemistry lab. I had a very intimidating TA in my first semester, and so the combination of the chemistry not being terribly exciting and having an exciting, interesting physics class played a role. And I realized how much math there is in physics, and how much I like math and I like using math to solve problems. You don't use as much math as you do in physics anywhere else, at least not in first year chemistry. That was also something I thought I'd be much happier with, less memorization and more solving problems with math.

Daria: This inspiring instructor in first year, is that somebody you think of when you teach? Is he a role model or did he just have a good influence on you?

Sarah: No. Just a good influence, I think. I don't have a lot of memories of it — I remember him doing some demos. It was a pretty traditional lecture class, you know, about a hundred of us. I remember doing a lot of tutoring. I tutored my fellow classmates a lot, in first year physics. So I must have had a good preparation in high school, I guess. But honestly, I didn't actually enjoy my high school physics class all that much. I enjoyed my high school chemistry, my AP I think I started in chemistry because I had a really good teacher in AP chemistry.

Daria: Did you have any mentor on the teaching side when you started teaching?

Sarah: I had some really good colleagues when I got my first tenure track job at Geneseo. I had some really good colleagues there. They have quite an extensive peer evaluation system where the faculty sit in on each other's classes and give you feedback on your teaching. That was quite useful. It was a little stressful at first, but it turned out that it was very much not summative but formative, very much supportive and giving you constructive feedback, so that was good.

Among my colleagues in Geneseo there were some very good teachers, very good about not just teaching but creating a welcoming, friendly physics program. They have an amazing track record of recruiting people to be physics majors and running a program that's supportive of lots of different students pursuing physics. They e-mail or call undeclared entering freshman and say, "have you ever thought about being a physics major?" They would actually convince a few students to give it a try, which I was very impressed with.

Daria: Is that something you think Canadian universities could do, too?

Sarah: Yes.

Daria: Does it require a lot of money?

Sarah: No, it doesn't. It does require somebody being willing to give you the list of undeclared entering students. I think we should not restrict our view of who might be successful in physics and not expect all of our students to be A students. There's nothing wrong with getting a B or a C. Those students won't go to graduate school, but it doesn't mean that they can't go out and be productive. Earning low B's, high C's in physics is still quite an accomplishment, I think, at least for the upper division classes. Those are not easy classes to pass. I worry sometimes that people expect all our physics majors to be like we were. We're the 5 per cent or less of physics students that go on to become physics faculty.

Daria: Do you think we need to do more for these students that are not going towards a career in physics?

Sarah: I think we do, actually. I really like the Phys 201 course here at SFU, the new course where we talk about careers and other options for the students. They take it in their second year

Daria: I've heard it in a workshop recently that the American universities seem to be more aware of these diverse students and supporting them more. Is that something that you have experienced? Was there something else that you think that the U.S. system does better than the Canadian system?

Sarah: I don't know if that's universal across the U.S. I think Geneseo was very good at it. When I was at La Verne, it was such a small program, me and one other guy. We did what we could. I would hire all my physics majors to help set up labs. That's something I did when I was an undergraduate, I set up the first year labs. It was a two-hour-a-week job, but it got me involved in the department. I think we could do more of that, and I think SFU is trying. We have various programs like "Adopt a Physicist" and other things where we try to get students more involved. So I don't think United States schools are universally better at that than Canadian schools. I think it varies a lot with the personality of the departments and the sizes of the departments.

Daria: Now, coming back to your work as an instructor. Where do you get your inspiration and your new ideas? Do you look around, see what's needed and then come up with something?

Sarah: I get lots of inspiration from AAPT (American Association of Physics Teachers) meetings. Now I go twice a year because I'm the B.C. representative to the AAPT. But even before that, I was trying to go when I could. It's easier now that my kids are older. I'm always amazed at these people in physics education research and the ideas they come up with, and the things they've learned over the years about how students learn, or the best way to present material so that they can learn more. I go to the talks and also just talk to people, you know, networking with colleagues who teach physics, both people at those meetings and also local people. People like my friend Marina at UBC, and also you, and other people at SFU. So I've been trying different things. I go to these meetings and then I have this new idea … I really want to try this now! And then I think I'm really lucky that SFU is some place where I've been able to try all these new things and see which ones work with our students and our classes.

The thing that bothers me the most right now is students not putting the time in on the homework, giving up and googling the answer. I just feel like they're missing out on all this learning by not struggling with the problems.

Daria: Can you expand a little bit on that? Why do you think SFU is a place that is welcoming to those innovations?

Sarah: Some of it is the personality of the department, I think. All the department chairs have been very supportive about letting me try new things. When I first got to SFU, we made the switch from open labs to tutorials in most of our first year courses. Just presenting the evidence that tutorials are valuable for student learning, it was relatively easy to convince the department. I've been on the Physics Undergraduate Curriculum Committee for pretty much the entire time I've been at SFU. That's a place where you can present new ideas, and I think as long as you've got some evidence that it's valuable, people are willing to try it. We have a reasonable amount of autonomy and flexibility, and great support from the technicians, too, when you want to do new demos. I introduced a bunch of interactive lecture demonstrations (ILDs). When I came back from an AAPT meeting and said I want to do this and that, it meant not just changing the course a little bit, but requiring one of the technicians to help me. Jeff Rudd, who is an amazing technician we used to have, did all the work. He basically built all these demos for me. We had a lot of the equipment already, but we had to make it fit with the worksheets that went with the ILD's. Jeff Rudd was very inspiring. He knew a lot about teaching and a lot about what demos would work, where and when. He wrote down every demo I did, every time I taught so the next time I taught, he had a list. I feel like teaching is valued here, it's not considered secondary at all.

Daria: Going one step further, doing education research, is that supported as well?

Sarah: Yes. I mean, as much as it can be when your primary job is teaching. My job is 80 per cent teaching, 20 per cent service. So I do small amounts of educational research, sort of, on my own classes. The university offers what are called teaching and learning grants, and I've had two smaller teaching and learning grants to try out different pedagogical changes in my classes. The grants were very helpful to hire research assistants to help analyze data. And then I also got a bigger grant: I was a Dewey Fellow in the Institute for the Study of Teaching and Learning in the disciplines here. I used that money to expand a tutoring program I had started in physics to include chemistry and math and biology. I got some colleagues together, and we did a study on the effectiveness of the program with that money. I hired two different research assistants, one from communications and one from physics, to help me with analyzing the data. The physics person did the numbers, and the communications person did things like focus groups and surveys, things that I'm less familiar with. So I think there's definitely university support for doing projects like that.

Daria: Did you write up your results?

Sarah: It's not published but it is online: https://www.sfu.ca/istld/faculty/grant-programs/projects/ISTLDDeweyFellows/G0155.html.

Daria: Now, speaking of money. If, say, the department, the university, maybe the Faculty of Science received a large amount of money, what would you like to use it for, regarding teaching?

Sarah: Well, one thing I really want to try is learning assistants in the big first year classes. It's a bit like the peer tutoring, except that they're paid, and they come back after taking their undergraduate class and basically help to teach the class. They act sort of like TAs, but they come in during the big first year classes, so that even if you have 200 students in your class, you could have them do group problem-solving because you would have enough people walking around answering questions. You would be able to make it

like a big tutorial session, you could truly flip the classroom. I mean nowadays, we do some flipping, but the things we do in class are still mostly traditional. We make it interactive with clickers and things like that, and interactive lecture demos, but it's hard to make it truly flipped. But if we had these learning assistants come in, then I could do a lot more in terms of hands-on problem-solving with a large class. I'd really like to try that because there are quite a few universities in the United States now who do the learning assistant thing, and I go to their talks at AAPT meetings and it's really inspiring. They're often linked up with their teacher education programs, and they have a lot of the students who are learning assistants go on to become physics teachers. We don't seem to produce very many physics teachers here, and I don't see why we couldn't produce more. I think there is, to some extent, a need for physics teachers. That would be a side benefit, but the main benefit would be improving the big first year classes.

I also really would like to see the peer tutoring program go university-wide. I mean, ultimately, I think the university should be running a tutoring centre, where the tutors are paid and they're available to all students. Right now, I run it just for science and math, and the tutors are volunteers. We've already expanded a little bit this year: a faculty member in computer science is running the peer tutoring independently of science and math, but using the same model. One thing I really would like is our own room, a room to host the peer tutoring, because one of the most difficult parts of the whole program is scheduling the rooms and the tutors. If we had our own room, I think that would also help us with visibility. There would be a place that students would know they can go to and get help with their science and math classes.

Daria: When you think of your students, do you see a general change in student population over the years that you have been here? Are they getting more diverse or not? Are there trends?

Sarah: Not a huge change. I've been here 13 years. The only thing that's somewhat noticeable is more students coming in without physics 12. That seems to be a trend. I think they are concerned about their marks in high school and getting into university because the Canadian system, from what I can tell, is very centred on your marks for acceptance to university. In the United States, they write essays, they get letters from their teachers, there are all these other factors, not just marks. They take SATS. But here in Canada it's very much your high school marks, and so they're worried that if they do poorly in physics 12, it'll hurt their chances of getting into the Faculty of Science. I can understand that, but it's a pity. A lot of people, especially young women, are not taking physics 12 and then that closes the door on their chances for fields like physics and engineering. They can catch up if they take our physics 12 equivalent course, our physics 100, but that puts them at least a semester behind and it's hard to catch up, especially with engineering. Physics is easier to catch up, I think. But it's frustrating and I'm not sure what to do about that. I mean it would be nice if the acceptance at university took more things into account. I know UBC now has essays and I think SFU should think about expanding their acceptance criteria to look at more than just grades.

Daria: That's an interesting idea. Are there other things you can think of that you would like to do but haven't had a chance yet to do, to try?

Sarah: Well, I have study leave coming up and I want to create a new breadth course. I think the university could benefit from another physics breadth course. So one of the things I'm hoping to do on my study leave is have a look at what other people do in their breadth courses and try to come up with a good fit for me and for the university, something that students might like taking. I haven't completely decided. I've taught astronomy in the past, which is one of our big breadth courses. Astronomy is not my field, though, but I do enjoy teaching that class. I think there are lots of possibilities for topics, and I think it's an interesting challenge to teach non-scientists. I really enjoy showing them how cool physics is, and that it's really not this impossibly hard subject only for total brainiac nerds, right? It's something that they can understand. In the past, I also taught future elementary teachers and that was a fun course. We have a course like that coming up at SFU soon, which I'm excited about: it's a science course for education majors, which is starting, I believe, next fall (2019). I'm looking forward to teaching that course, too, because again, it's very rewarding to get to someone who is not at all familiar with physics and maybe even thinks physics is scary, to get them comfortable with it, enjoying it and learning new things. Like I said, it's very rewarding when that happens.

Daria: That's very true. You mentioned earlier how your inspiration and your ideas often come from the AAPT meetings. Now, this interview is for the magazine of the CAP, the Canadian Association of Physicists. Do you think there could be more collaboration between the CAP and the AAPT? Or would it just be a duplication of effort?

Sarah: I think what CAP does with the DPE is great. And I was really impressed with the sessions when I went to [the CAP Congress in] Halifax. I thought that was really great. The last CAP meeting I had gone to was a few years before that and there weren't as many DPE sessions, so I was really impressed with the quality of the speakers and everything. I can imagine trying to do a joint meeting or something. In the past, AAPT has done joint meetings with the American Astronomical Society and with the American Association for the Advancement of Science, I think. I just find AAPT meetings so valuable, and it would be great for more Canadian physics faculty and high school teachers to have the opportunity to have that experience. We could bring in some of the people who've been doing exciting things in the U.S., and then everybody who is doing exciting things in Canada could share their work. I could almost imagine doing a yearly

Canadian Physics Teacher's Conference, so do our own and model it on the AAPT. Something like that where it's all about physics education. I don't know how that would work, but I would go to something like that. It's hard because we're such a smaller population, right? But I could imagine especially if we were to do it in one of the population centres like here or Ontario or Quebec, so that it's relatively easy for people to get to. We do have a few things in Canada that are unique compared to the U.S. like the level of our students coming in.

Daria: Now, would you perhaps like to leave the readers with a puzzle or homework to think about? A really hard physics education question that bothers you, that you haven't been able to figure out yet, something that should be done maybe?

Sarah: Hmm … The thing that bothers me the most right now is students not putting the time in on the homework, giving up and googling the answer. There are so many solutions online for everything. I understand they're busy and they're stressed, and I can see why they resort to that when they get stuck. I just feel like they're missing out on all this learning by not struggling with the problems. We try to get them to do some of that hard work in tutorials or in class, like in the studio in physics, but I think they need a lot more of that, and they need to do some of it on their own at home. I have memories of sitting with my physics textbooks, going through problems, and hours of just thinking and trying things, and I feel like they don't always get that. I think some of them still do, but there's too large a fraction that isn't getting that experience. And then they're confused when they do poorly on exams, because they think that just looking at solutions is enough to understand it. I know our Math Faculty, for example, do quizzes in their classes to try and make up for that, but then they lose class time, and the logistics of giving a quiz are cumbersome. I don't know if that's the best solution for that. I'm not really sure what the solution is. I think that's one thing that has gotten worse over the years. Ten years ago, it was not really a problem, and then it started to get worse about six or seven years ago. I started to notice student with access to the solutions manuals and then it got to the point where students now come in and say "I have the solution, I found it online, but I don't understand it. Can you explain it to me?" Which is fine, but it would have been much better if they came in with "I tried this problem and I got stuck here. Can you help me?" That would be better than copying the solution. I think that's maybe one of the biggest differences for the students over the years, the internet, Google, and the ubiquity of solutions manuals to every single textbook online. It's frustrating.

Daria: Do you know if your students still read their textbooks?

Sarah: I think that some do and some don't. To be honest, I wasn't a huge textbook reader, at least not in first year. I definitely read my books a lot more when I got to the advanced levels. But I think a lot of them aren't reading their textbooks. The thing that frustrates me: it's one thing to read the textbook and not go to class, or to go to class and not read the textbook - but there are students who are doing both. They're not reading the book and they're not going to class, and I really don't know how they expect to learn the material and to do well if they're not doing either. With the FlipIt Physics, we can see how long they spend on the videos. You can see over the course of the semester that they spent less and less time watching the videos. Some of that, I think, is they're just really busy and they have other time commitments. But I do wonder if they're just not finding the videos useful or they just don't have the time.

Daria: My students told me they just don't have the time - when I showed them that I can see all the data.

Sarah: I haven't told my group yet that I can see the data. That's always interesting when you tell them that. Last time I looked, there were very few comments, and I'm going to try and encourage them to start commenting. In the beginning of the semester they commented a lot about the lecture and what they understood and what they didn't. But the last time I looked, only 8 out of 70 commented on the lecture. It always cracks me up, the ones that spent two minutes watching the lectures and then go ahead and comment.

Daria: We've been chatting for almost an hour … can you think of anything I should have asked you that I haven't asked you?

Sarah: No, I don't think so. I don't know what else you have on your list.

Daria: We covered all that.

Sarah: Wow, very impressive.

Daria: Thank you very much.

Sarah: You're welcome.