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Carri LeRoy (bottom left) with two Evergreen students and collaborator, Deb Finn at Mount St. Helens, 2019.

Early Career Members

Tips for Maintaining a Successful Research Program while Teaching

by Carri J. LeRoy

Teaching college courses can be all-consuming. Anyone who has put a course together knows how much work it takes to write a well-crafted syllabus, choose books, design assignments, write quizzes and exams, prepare lectures and hands-on labs, plan field trips, and evaluate student work. Some of us teach more, and some of us teach less, but most of us still have expectations (either those we set for ourselves or those set by departments and tenure committees) to do scholarly research as well. How do we fit it all in? There are clearly many different ways that we can balance these types of work, and some may work better for each individual college professor than others. Here I will share some tips for how I have been able to keep up a research program while at a teaching college.

I have been teaching at The Evergreen State College (a primarily undergraduate institution) since 2006. First of all, Evergreen is a little different than other colleges in some ways that make our teaching more intense and in some ways that may make incorporating research into our teaching more streamlined. Regardless, I hope some of you find these ideas useful. We have no standard curriculum at Evergreen, and we are encouraged to design new courses all

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the time. (Remember how hard it is to put together a new course? We usually create new courses every quarter!) We are also encouraged to team-teach interdisciplinarily, which is both awesome (since it helps students integrate their learning across disciplines) and challenging (since different disciplines approach the world in different ways). Our students only take one course at a time, but since they are interdisciplinary courses, we call them 16-credit "programs of study." For example, one program I have taught is called "Environmental Analysis," which integrates analytical chemistry, geology, freshwater ecology, and statistics. It is within these 16-credit programs that I can blend my teaching with research that I want to pursue. And, I have found that this is the crux—figuring out how to get meaningful research done WHILE teaching instead of trying to fit it in outside of my teaching.

Evergreen's experimental teaching model is ideally suited to collaborative work with undergraduates, but many of our practices could be (and have been) adopted by traditional colleges and universities. In the next several paragraphs I will expand on several tips that you might be able to use to integrate your teaching and research.

1. Highlight Several Unanswered Questions in Your Field

During your teaching, highlight several unanswered questions in your field. Invite students into the scientific process by helping them understand that not everything is known (in fact, very little is). Be explicit and tell students you are going to involve them in an active research project. Use class time to brainstorm experimental designs to answer research questions. Involving students at the design phase will encourage ownership (*which improves data quality*). This is a great opportunity for you to introduce statistical concepts and basic analytical methods. Have students draw graphical hypotheses—graphs of the results they expect they might find.

2. Organize Students into Groups as Part of the Experiment Design

To ensure high quality data and protect against confounding errors, organize students into groups as an explicit aspect of the experimental design. Don't let one group of students handle controls and another handle treatments because if you do, your experiment will be confounded by student group. Instead, use student groups as "blocks" in your design; essentially, student groups should be used as replicates or analytical replicates. When you do this, you can effectively toss the data from one whole group without sacrificing the entire project. If a couple of student groups struggle with data quality, all that happens is your overall sample size goes down a little. Another way to improve data quality is to have very clear expectations for how data will be collected. For complex methods, write standard operating procedures so that all groups have step-by-step instructions for lab and field methods.

3. Be Explicit about the Skills Students Are Developing in the Field or Lab

Often undergraduate students don't understand *why* they are being asked to do things in the field or in the lab. They can think labs are tedious or a waste of time. To avoid this attitude, be explicit about the skills students are developing and adding to their tool box (experimental design, field and lab methods, instrumentation, GIS, taxonomic identification, data management, data analysis, scientific writing, science communication, collaboration, etc.). Tell them that employers are interested in all of these skills and that they will also serve them well in graduate school.

4. Treat Your Undergraduate Students like Colleagues

Treat your undergraduate students like colleagues. If you have high expectations, they will meet them. Expect students to engage with the primary literature. Even freshmen can glean important information from engaging with scientific literature. Teach them *how* to read scientific articles, what the purpose of each section of an article is, and tips for dissecting articles and not getting bogged down in jargon. For students doing research in my lab, I expect them to read one to five scientific articles per week. To get the most out of their reading, encourage them to keep notes while they read and write annotated bibliographies so that you can see how they are engaging with the papers. Start a journal club and invite undergraduates to join. Encourage students to continue to collaborate on research projects after the course comes to an end.

5. Expect Your Students to Begin to Write Scientific Articles

Similarly, expect that your students can start to write scientific articles. If they are working on a small-group project, give them opportunities to write the methods and results collaboratively. The ability to collaborate is one of the most compelling job skills on the market today. It is especially difficult to write collaboratively (right?!), so make sure they have opportunities to do this in low-risk environments. Have them practice "yes, and" reactions to new ideas and have your collaborative writing be inspired by the generative environment of improv theater. If you want to see what they can do individually, give them experience with independent interpretation by having them write solo introductions and discussions. Provide them with the expectation that they cite 15 to 25 articles in their papers.

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Their annotated bibliographies will be invaluable to them in this process, and they will be valuable to you as well. I often find several papers in student annotated bibliographies that are new to me and their notes and summaries provide a quick glimpse of the paper and its overall findings. Offer students the option of staying involved in the research project even after the course is finished. Being involved in the publication of a research project is an invaluable experience for undergraduates. It helps to place their involvement in research into the broader context of what it means as a scientist to be involved in the scientific community.

As you teach your students about the scientific process, you will be making progress on your own research agenda. The feedbacks between teaching and research can be very generative, creative, and productive. Your students will be more engaged in their learning, and collaboratively you will be collecting valuable data to further your own research goals. Merging your teaching and your research is helpful in terms of training the next generation of scientists but also helps to open doors to students who may not think they can succeed in science. Teaching science process skills breaks down stereotypes about what science is, who scientists are, and what scientists do.

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Career Center

The deadline for Career Center listings is the first of the month preceding publication (e.g., 1 March for the April issue). Charges are based on the number of characters and whether or not the listing will appear online, in CSA News *magazine, or both. For complete information about advertising opportunities, including rates and deadlines, and to submit a listing, visit www.careerplacement.org. Please email jobs@sciencesocieties.org or call 608-273-8080 if you have questions. Note: These are only a few of the job opportunities available. View all positions at www.careerplacement.org.*

Doctorate/Equivalent Required

Montana—Montana State University, Assistant Professor - Weed Science. The position will be located at the Southern Agricultural Research Center (SARC) near Huntley, MT. SARC is one of seven off-campus research centers in the Department of Research Centers / College of Agriculture. The position is one of three tenure-track positions at SARC. SARC consists of 462 irrigated and dryland acres and is well-equipped with modern field plot equipment, laboratory equipment, facilities, and greenhouse space. The major commodities grown in the region include cereals, sugar beets, corn, oilseeds, pulse crops, and forages. The research center is located 20 miles east of Billings, the largest metropolitan city in Montana, and 160 miles east of Bozeman and the main campus of Montana State University. **Duties and Responsibilities:** Develop an applied, field-oriented research program focused on weed management strategies associated with crops and cropping systems of the region with an emphasis on irrigated row crop and cereal production. An integrated approach to developing weed control strategies while reducing the risk of developing herbicide resistance is expected. Cooperation with MAES weed scientists, private industry, other research/extension personnel, farmers, and related commodity groups will be necessary to develop research priorities. Opportunities exist to mentor graduate students. Grant writing to secure an operational budget through funds from state, regional, and national sources as well as the agricultural industry will be necessary to fund the research program. This appointment is an 80% Research, 10% Teaching/Outreach and 10% Service. **Required Qualifications:** (1) Ph. D. in weed science or related discipline. (2) Knowledge of weeds, weed biology, herbicides, and integrated weed management with a demonstrated experience in field crop production. (3) Demonstrated experience in planning, designing, and implementing field research and interpreting research results using accepted scientific methodology. (4) Publications in peer-reviewed scientific journals. **Preferred Qualifications:** (1) Documented grant writing skills. (2) Post-doctoral experience and/or commercial weed control experience. (3) Knowledge and/or experience in the molecular characterization of herbicide resistance of weed species. (4) Experience interacting with producers, agricultural professionals, and other clientele at field days, conferences, and/or crop management schools. Screening of applicants to begin Nov 1, 2019, however, applicants will continue to be accepted until an adequate applicant pool has been established. **To apply:** https://jobs.montana.edu/postings/17879. Equal Opportunity Employer, Veterans/Disabled. **For more information:** Contact the search committee chair, Dr. Kent A. McVay, 406-348-3400 or email, kent.mcvay@montana.edu.

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