Program Description

R. Heather Macdonald, College of William & Mary
Rachel J. Beane, Bowdoin College
Richelle M. Allen-King, University of Buffalo
Ellen R. Iverson, Cathryn A. Manduca, and *Carol Ormand,* Science Education Resource Center at Carleton College
David W. Mogk, Montana State University
Randall M. Richardson, University of Arizona
Barbara J. Tewksbury, Hamilton College
Richard F. Yuretich, University of Massachusetts Amherst

"The best hope for improving professional practices—including teaching—lies with the cohorts of new faculty." – *Robert Boice (1992)*

2012 *On the Cutting Edge* Early Career Geoscience Faculty Workshop.

An important strategy to improve undergraduate geoscience education is to work with early-career faculty, because influencing faculty at the beginning of their careers has a career-long impact on them and on their students. Through work with early-career faculty, we can also improve the efficiency with which reform in geoscience education occurs. We offered the first national workshop for early-career geoscience faculty in 1999 and have offered one workshop each year since then. Since 2002, the workshops have been offered through *On the Cutting Edge*, a national professional development program for current and future geoscience faculty, which is sponsored by the National Association of Geoscience Teachers with support from grants from the National Science Foundation Division of Undergraduate Education. The aim of the comprehensive and discipline-wide *On the Cutting Edge* program is to develop a geoscience professoriate committed to high-quality instruction based on currency in scientific knowledge, pedagogic practice, and research on learning. The program offers an integrated series of face-to-face and virtual workshops each year and a website that supports workshop participants and extends the reach of workshop resources. The website received the Science Prize for Online Education (SPORE) in 2010 (Manduca et al., 2010).

The annual four-day early-career geoscience faculty workshop and the associated website for early-career geoscience faculty support faculty in the critical transition that occurs at the start of their careers. Our aim is to provide concrete suggestions about "what works" to better prepare early-career faculty for their teaching and research responsibilities, and to provide applicable career management strategies. Such a discipline-specific approach is complementary to the programs and support provided by institutions for graduate students (e.g., preparing for the professoriate programs) and for early-career faculty (e.g., campus teaching and learning centers).

The placement of the early-career faculty workshops in a larger professional development program provides multiple

opportunities for early-career faculty to develop as teachers and scholars. In addition to the annual workshops and the web resources for early-career faculty, *On the Cutting Edge* supports early-career faculty by offering other workshops (e.g., Innovative and Effective Course Design, Teaching Hydrogeology, Teaching Environmental Geology, Assessing Student Learning, Teaching about the Early Earth) and a variety of webinars, an online Course Design Tutorial, online resources of teaching materials including more than 1600 teaching activities contributed by the community, and various networking and sharing opportunities. The Course Design Tutorial and the extensive collection of teaching activities are particularly valuable resources for faculty developing their first courses.

Workshop goals and design

The Early Career Geoscience Faculty Workshop focuses on teaching, research, and career management. The workshop design is aligned with work on attributes of faculty who are "quick starters" (Boice, 2000). These quick starters receive higher teaching evaluations, are more productive in their research, and are happier (less stressed) in their work than other faculty at the same career stage. **The workshop goals, which guide workshop planning and evaluation, are for participants to:**

- Learn a goals-based approach to course design that incorporates active learning and assessment strategies with insights from STEM education research.
- Share ideas and approaches for teaching geoscience courses.
- Consider successful strategies for maintaining an active research program and for working with research students.
- Discuss life as an early-career faculty member and explore ways to balance teaching, research, and service responsibilities.
- Leave with examples of assignments and activities, with strategies for balancing competing demands, with a support network of other early-career geoscience faculty, and with a plan for managing an early career as an academic.

The workshop design follows from these goals and incorporates what participants tell us they want along with advances from education research and insights from other parts of the *On the Cutting Edge* program (e.g., sessions on affective domain, spatial thinking). The workshops are designed to be interactive, to emphasize participant learning, and to model effective teaching practices. As a 2012 participant wrote: "*I now more fully see the benefit of active learning and reflection—as this is what we did during the workshop ourselves. I intend to incorporate these aspects into my courses, and now feel that I have the tools to do so.*"

The workshop design includes plenary sessions, table discussions, concurrent sessions, informal discussions, individual consultations with workshop leaders, and a poster session. We provide opportunities for participants to interact (starting with kinesthetic ice breakers the first evening), to share experience and knowledge, and to reflect on and develop action plans. We focus on concrete suggestions and ask participants to consider how they might apply strategies in their teaching and research and in their professional lives. For example, for the poster session on the last day, participants present two hand-drawn posters: one about a plan for teaching developed during the workshop (e.g., classroom activity, course structure) and the other about a plan for scholarship. We aim for participants to be able to

readily apply what they learn in the workshop. As a 2012 workshop participant wrote: "*I am surprised at how much I am taking away from this workshop, not just with my own attitude and confidence, but in terms of tangible things that I can implement as soon as I get back.*"

Workshop content

Given our intent to support early-career faculty in all aspects of their career, the workshop addresses teaching, research, career management, and life balance. In the early years of the workshop, the focus was primarily on teaching and career management; feedback from participants indicated a desire to add more depth to sessions on research. Participants are particularly interested in strategies for teaching effectively and efficiently, in moving their research program forward, in balancing teaching, research, service, and personal life, and in tenure.

The workshop goals and the participants' interests are reflected in the workshop content. Day 1 begins with a session on strategic decisions, then focuses primarily on teaching. Day 2 focuses primarily on research. The session on working with research students includes examples of written guidelines; after this session participants uniformly state that they will be more explicit in sharing expectations and guidelines with their research students, either verbally or in writing. During day 3 participants develop and discuss a plan for their scholarship, discuss ways to fund their work, and prepare their posters. On day 4, participants receive feedback on their teaching and scholarship posters in the morning and in the afternoon discuss work-life balance and specific issues they face.

The 2012 workshop program, given below, illustrates the overall workshop schedule as well as types of topics and sessions that are addressed in the workshop. The 2012 workshop website provides details and links to the presentations. http://serc.carleton.edu/NAGTWorkshops/earlycareer2012/program.html

Workshop Program (2012)

(filled bullets mark plenary sessions, open bullets mark concurrent session choices)

Opening Evening: Icebreaker, dinner, introductions, workshop goals, evening program with a gallery walk activity

Day 1:

- Strategic Decisions: Elements of a Successful Career
- Course Design (Goals-Activity-Assessment approach)
- Interactive Lectures
- Teaching Strategies: Concurrent Sessions.
    - ❍ Engaging Students in Large Classes
    - ❍ Improving Students' Spatial Thinking Skills
    - ❍ Keeping Seminar Courses Lively and Engaging
    - ❍ Responding Effectively to Student Writing
    - ❍ Reducing Misconceptions through Lecture Tutorials and Concept Tests
- Lesson Design: Preparing for a Class Period
- Overview of Individual Consultations, Daily Roadcheck
- Evening Informal Session (optional) – Sharing Ideas about Specific Courses

Day 2:

- Introduction to Your Research/Scholarly Career
- Working Effectively with Research Students (Models for sharing research expectations and guidelines)
- Strategies for Research and Scholarship: Concurrent Sessions.
    - ❍ Research on Geoscience
    - ❍ Research with Undergraduates
    - ❍ Setting the Scope for M.S. Research
    - ❍ Starting New Research Projects and Building
    - ❍ Setting Up Your Lab and Obtaining High Quality Measurements
- Optional Lunch Discussions: dual academic careers, large classes, two-stage exams, teaching with mobile devices, and diverse classes.
- Finding and Being a Mentor: Listening and Giving Feedback
- Connections, Extensions, Opportunities: Concurrent Sessions
    - ❍ Publishing Your First Few Papers
    - ❍ Scenarios on Mentoring and Feedback
    - ❍ Working with Industry
    - ❍ Working with K-12 Teachers
- Individual Consultations with Leaders

Day 3:

- Developing a Strategic Plan for Research/Scholarly Activity
- Connections, Extensions, Opportunities: Concurrent Sessions
    - ❍ Assessing the Effectiveness of Our Teaching
    - ❍ Work-Life Balance
    - ❍ Effective Display of Data
- Writing Proposals and Getting Funded
- Optional Lunch Discussions: kids, online courses, international faculty, clickers, interdisciplinary research/ collaborations, effective use of start-up funds, and mental health/violence issues with students
- Moving Your Research/Scholarly Activity Forward: Funding and Other Issues
    - ❍ Improving Research Proposals Through Review of Your Proposal Summaries (includes optional review of participants' research proposal summaries, submitted before workshop)
    - ❍ Reviewing Successful Proposals and Developing a Proposal Idea of One's Own
    - ❍ Issues at teaching-centered institutions
- Work on Poster, Individual Consultations

Day 4:

- Poster Session; Poster Follow-up and Reflection
- Strategic Decisions: Elements of a Satisfying Life
- Strategic Action Planning (goal-setting and action-planning session)
- Lessons Learned, Concluding Remarks, and Workshop Evaluation

Day 5:

Optional trip to the National Science Foundation that includes sessions led by NSF program officers as well as individual meetings with program officers.

Website

During the workshop, participants are introduced to the *On the Cutting Edge* website, which includes more than 4500 web pages on 47 pedagogical topics, geoscience topics and themes, and career management. The Early Career Geoscience Faculty component of the website includes sections on Making Choices: Finding Your Balance; Efficient, Effective Teaching; Developing a Thriving Research Program; Getting Tenure; International Faculty Members; Early Career Geoscience Faculty Workshops; and Workshop Leader Career Profiles. Although the examples on the website are geo-specific, the overarching principles can be applied to early-career faculty in other disciplines. The number of visits to the early career part of the website in March 2012 was more than 16,000; the *On the Cutting Edge* website had 1.2 million visitors in the last year. Using the rough estimate that 10% of visitors actually intend to look at the site, the early career site generated intentional visits by 1600 users in March 2012.

Workshop participants

The participants are primarily tenure-track faculty in their first four years of teaching. The workshop draws 40-50 participants a year, with a high of 60 in 2009. In the last decade (2003-2012), 464 faculty participated in the program, with approximately 100 more in the first four years of the program. For most participants, this was their first *On the Cutting Edge* workshop; others had participated in the *On the Cutting Edge* workshop for graduate students and post-doctoral research associates on Preparing for an Academic Career in the Geosciences or one of the topical workshops. Of the participants who provide demographic information, 48% are women, 17% are minorities, and 7% are underrepresented minorities. The percentage of women and of underrepresented minorities in the workshops is higher than in the geoscience faculty population. We encourage participation from all types of institutions across the academic spectrum, including community colleges, liberal arts colleges, comprehensive universities, and research universities. We accept all applicants who are in full-time tenure-track or similar permanent positions. When possible, we also accept applicants who are in positions in which their responsibilities are similar to those of tenure-track faculty. Participants come from across the geosciences: geology, marine science, and meteorology/atmospheric science; geographers and ecologists have also participated in the workshop.

Workshop evaluation

By both structured evaluation and less formal measures, the workshop for early-career faculty is successful. Proxy and anecdotal measures are positive. Early-career faculty members continue to come to the workshop, even as the cost to participants has increased. Some chairs "reserve" spaces in the workshop for their new hires. Participants recommend the workshop to others. Workshop alumni help publicize the workshop, providing glowing endorsements. They respond to calls for assistance in building the website (e.g., providing copies of successful grant proposals, advice on research talks for the job interview). The early-career faculty website has high use, as mentioned earlier. Workshop leaders, many of whom are workshop alumni, are willing to contribute their time to the workshop and they leave the workshop energized. More formal evaluation of the workshop is also positive. That evaluation includes participant surveys and embedded assessment at the workshop itself as well as follow-up surveys, interviews, and national surveys that are used in the overall *On the Cutting Edge* program evaluation, which looks at the impact of the program as a whole.

Participant satisfaction with the workshops is high. Surveys during the workshop include daily road-checks and an end-of-workshop survey in which participants rate specific workshop goals, provide feedback on what they have learned, describe what they plan to implement, and give an overall workshop rating. Overall satisfaction of participants in the workshops averages 9.4 on a 10-point scale. The summer 2012 workshop received an overall mean rating of 9.7. Individual comments about the influence of the workshop are positive and suggest changes in teaching and research practices, changes in thinking about teaching, and higher confidence moving forward. Participants value the practical ideas, the support network that develops, and the opportunity to interact with—and learn from—a diverse leadership team.

The posters constructed by participants for the culminating poster session serve as an embedded assessment for the workshop. A review of poster descriptions and reflections written by participants after the poster session provides information about participant teaching and scholarship plans post-workshop and how the workshop influenced these plans. An analysis of 47 teaching posters from 2010, 2011, and 2012 showed that all intended to make specific changes in their teaching based on what they learned at the workshop. Approximately two-thirds from this sample focused on teaching activities including classroom exercises with specific details for effective implementation. Other posters from this sample focused on courses as a whole, various active learning strategies, small-group discussions, and other approaches. Through the poster reflections, we have a better understanding of participants' prior knowledge, what their new knowledge is, and how they integrate the two. The poster reflection itself provides an opportunity for such integration. Even if the plan isn't implemented exactly as proposed, because participants integrated their prior knowledge with their new knowledge, the likelihood of the practices being implemented in some way is increased. This conclusion is supported by post-workshop interviews, in which participants report implementing the plan or some variation.

Evaluation of the impact of *On the Cutting Edge* shows that the majority of participants report changes in their teaching practices in the classroom and also reveals differences in reports of teaching practices between Cutting Edge

participants and nonparticipants. These results are for the program as a whole, not for individual workshops. Multiple surveys indicate that 80% of respondents report making specific changes to their teaching practices with a measurable shift toward active-learning techniques (Manduca et al, 2010). Interviewees can identify specific changes and trace them to lessons learned at a workshop or from the website. Critical to supporting these changes is a student-centered view of learning which is developed at the workshops. In addition to the impacts on individual faculty, *On the Cutting Edge* has created a culture in which faculty learn from one another and share resources to improve teaching. The workshops encourage discussions about teaching and the website allows faculty to quickly discover what others are doing (Manduca et al., 2010). Analysis of a national survey of geoscience faculty involved comparing Cutting Edge participants (website users or workshop participants who also use the website) to faculty who had not participated in Cutting Edge showed differences between the two groups. Participants were more likely to report adding group work or small group activities to their teaching (40% of participants relative to 15% of nonparticipants); and spending less time lecturing (43% of participants relative to 22% non-participants). Participants reported more frequent use of in-class questioning, small group discussion, and in-class exercises and were more likely to have changed assessment tools/strategies (McLaughlin et al., 2010).

The following three quotes present a picture of the impact of the workshop on participants

"The workshop totally changed my view of teaching from teacher-oriented to student-oriented. It's no more what I want to teach but what students need to learn or take away from the course. This is the essential point that I will keep in mind when I design course goals, syllabi, in-class activities, assignments, and exams." – End-of-workshop survey respondent

"The workshop had a powerful impact on my thoughts of teaching philosophy, highlighting the need for different approaches to get students to learn the material, including group work, and hands-on/inquiry-based approaches to subject matter that is normally covered in a (dry) lecture-based format." – Action Plan follow-up survey respondent

"I think that in the classroom is probably where it's made the biggest difference and that means I don't even do that kind of straight-up, just lecture through for an hour—it isn't even an option to me." – Follow-up survey respondent

Keys to success

We attribute the success of the Early Career Geoscience Faculty workshop in large part to the program design, the workshop leaders, the extensive preparation, and the rapport that develops among participants. Below we highlight key aspects of these four workshop components.

• *Program design*

We design sessions that model varied examples of effective pedagogy to make the workshop stimulating and interactive for the participants. Evidence-based learning principles and examples are offered at an appropriate level for beginning faculty that credits theory while emphasizing application. We use concrete geoscience examples to which participants can relate, and may later adapt or adopt. Leaders facilitate discussions and anticipate the likely outcomes of these discussions. Participants receive direct feedback from other participants and leaders on their ideas and plans

(course goal sharing, research proposal review, teaching activity review, poster review, future plans). The program schedule preserves time for casual interactions and encourages participants to reflect on what they are learning.

• Workshop leaders

Strong leaders contribute to the workshop success. Leader selection focuses on finding effective facilitators who have characteristics of a successful career whether or not they are at the top of their discipline. Leader selection considers type of institution, disciplinary expertise, diversity, geographic balance, international perspective, parent, and dual career. We include leaders from two-year colleges, four-year colleges, and research universities. Leaders range from recently tenured to more experienced, including some with administrative experience. The leader mix adds to the workshop in many ways, including opportunities for individual consultations with participants. The number of leaders allows for facilitated table discussions with six to eight participants per facilitator. The leader team includes past early-career participants who rave about their experiences in the workshop and set a positive constructive tone for the current workshop. The combination of repeat leaders and new leaders creates an ever changing team with expertise and new ideas, which leads to continual fine-tuning and improvement of the workshop.

• Extensive preparation

The workshops involve extensive preparation. Leaders adjust the program each year and discuss the implications of any changes. The relation of plenary sessions to the program and to concurrent sessions is considered. Most sessions are co-led with leaders communicating and exchanging multiple drafts of slides before the workshop. Copies of slides/notes are given to the lead convener for review and inclusion in the workshop notebook. Before developing sessions, leaders are given instructions and the conveners have discussions with new leaders about best practices for facilitating sessions. The given instructions are:

- ***Model effective pedagogy.*** Participant evaluations tell us that our most successful workshop sessions are those taught with good pedagogy in mind and that our least successful sessions are those where a presenter simply stands up and talks. As you plan your sessions, please consider incorporating active learning techniques. These will help the session to be interactive and will model effective teaching for participants.
- ***Engage participants actively during the workshop.*** Nothing is less effective than a workshop where participants do not participate. Ways of engaging participants include small and large group discussions, short problem-solving tasks, reviewing and/or trying out activities, scheduled thinking and writing time, and so forth.
- ***Plan your sessions thoroughly – maybe even minute-by-minute.*** Good sessions that appear to flow spontaneously reflect extensive planning by leaders, a clear understanding of the session and its objectives, and realistic planning for how long activities will really take. Please take care to plan time for questions at the end, and to fit into the specified time for the session.

Workshop leaders arrive early to participate in a five-hour pre-workshop meeting to review the schedule, preview sessions, and talk through any remaining questions they have. Daily breakfast meetings serve to get feedback from the previous day's participant roadcheck, review the day's program, highlight roles of table facilitators, and discuss any concerns.

• *Participant rapport*

We use a variety of approaches to build rapport and community at the workshop. We welcome participants from a range of disciplines and a range of institutions, and participants make connections with faculty they might not otherwise meet. The topics of a gallery walk exercise on the first evening help participants realize that many have similar concerns and serves to foster an early sense of "I'm not alone." Opportunities for participants to interact are planned throughout the workshop week—from paired introductions the first night to small group table discussions during workshop sessions and at lunch, to a picnic mid-way through the workshop, and more. Leaders give positive supportive guidance to participants using phrases such as "have you considered," "something I've tried," and "I know someone who has..." rather than "you shouldn't do that" or "I'm the expert and this is how it's done." Many participants pick up on this positive communication and use it in discussions and feedback. Early opportunities for feedback are lower stakes (e.g., feedback about a course goal) and build trust and support toward higher stakes feedback (e.g., research proposal review, poster session). This rapport is essential for the final session during which participants, in small groups facilitated by a leader, seek advice on a specific question or topic. Throughout the workshop we are sensitive to emotions, welcoming opportunities to smile and laugh to relieve tensions, as well as recognizing that some topics are sensitive, and that some participants have difficult situations/issues.

Conclusions

Since first offered in 1999, the workshop and associated web resources have supported early-career geoscience faculty well. Through the years, the workshop has evolved in response to participant requests, to new ideas from leaders, and to developments in geoscience education research. Some plans for the future are (1) to continue to improve the workshop to reflect new directions in STEM education research and changes in faculty's conceptions of teaching and learning; (2) to continue to recruit faculty participants broadly to reach institutions that have not had faculty participate in the past; (3) to incorporate best practices from other STEM early-career workshops; and (4) to secure funding that will offset workshop expenses and continue to support faculty who otherwise would not have the resources to attend.

Acknowledgments

This material is based upon work supported by the National Science Foundation Division of Undergraduate Education under grants DUE 9752809, 9752801, 9752819, 0127310, 0127141, 0618725, 0618482, 1022910, 1022844.

References

Boice, R. (1992). *The New Faculty Member: Supporting and Fostering Professional Development* (San Francisco: Jossey-Bass.)

Boice, R. (2000). *Advice for New Faculty Members: Nihil Nimus* (Needham Heights, MA: Allyn & Bacon).

Manduca, C. A., Mogk, D.W., Tewksbury, B., Macdonald, R.H., Fox, S.P., Iverson, E.R., Kirk, K., McDaris, J., Ormand, C., and Bruckner, M. (2010). "SPORE: Science prize for online resources in education: On the Cutting Edge: Teaching help for geoscience faculty," *Science* **327**, 1095-1096.

McLaughlin, J., Iverson, E., Kirkendall, R., Bruckner, M., and Manduca, C.A., (2010). *Evaluation Report of On the Cutting Edge*. Available at http://serc.carleton.edu/files/NAGTWorkshops/2009_cutting_edge_evaluation_1265409435.pdf.