



# C-MORE Professional Development Training Program for Graduate Students and Post-Doctoral Researchers

*Barbara C. Bruno, Jacqueline Padilla-Gamiño  
and Fabio De Leo*

## Abstract

The C-MORE Professional Development Training Program aims to equip graduate students and post-doctoral researchers with the skills and experiences needed to maximize their potential and succeed in their professional careers. The program has formal but flexible requirements, with participants choosing among modules such as outreach, science communication, mentoring, leadership, proposal-writing teaching, diversity and research exchange. This article describes the C-MORE program and analyzes external evaluation results. To date, evaluation results have been very positive and strongly indicate that the students value this type of professional skills training to supplement their research training. We offer this Professional Development Training Program as a model to other research-oriented programs that serve graduate students and post-doctoral researchers.

## Introduction

Established in 2006 by the National Science Foundation (NSF), the Center for Microbial Oceanography: Research and Education (C-MORE) is a Science and Technology Center comprised of six partner institutions: University of Hawaii (UH), Massachusetts Institute of Technology (MIT), Woods Hole Oceanographic Institution (WHOI), Oregon State University (OSU), University of California Santa Cruz (UCSC) and Monterey Bay Aquarium Research Institute (MBARI). C-MORE researchers collaborate across institutions to explore how microbial diversity at the genomic level influences the structure and function of the world's largest biome, the global ocean.

Like all NSF-sponsored Science and Technology Centers, C-MORE has a strong education mandate. One of C-MORE's key goals is to provide state-of-the-art training to graduate students and post-doctoral researchers ("post-docs"). The centerpiece of this training occurs in laboratories and aboard research cruises; it is here that young scientists develop the skills and passion to do cutting-edge research. To supplement this research training, C-MORE offers a Professional Development Training Program (PDTP) to equip graduate students and post-docs with the skills and experiences needed to maximize their potential and succeed in their professional careers.

Program development was informed by the science education literature, the inclusion of broader impacts as a NSF merit review criterion and the changing (increasing) expectations of scientists to teach and mentor students, engage in community outreach and communicate their research to

non-scientists (e.g., Andrews et al 2005; Baron 2010; Friedman, 2008; Gonzalez 2001; Laursen et al 2007; MacFadden 2009, NSF, 2006).

## Program Overview

The PDTP has formal but flexible requirements. There is one required module (outreach) and seven optional modules. To complete the program, M.S. students choose three optional modules; Ph.D. students and post-docs choose five. Most modules consist of a training component, followed by a practical component. Since C-MORE participants are spread across six institutions, the PDTP invokes a variety of formats to maximize access and flexibility, such as individualized activities, online trainings, teleconferences and the incorporation of local institutional resources.

Program modules are summarized below; additional information is provided on the C-MORE website: <https://sites.google.com/site/cmoredprofdevtable/>

*Outreach* (required). Educational outreach promotes public awareness and understanding of science. It can also stimulate interest in science careers among the next generation. The outreach module consists of attending an outreach training session to become familiar with C-MORE educational resources, and then taking a leading role in one (or a supporting role in three) outreach events.

*Proposal Writing*. This module teaches participants where to find funding opportunities and how to write competitive proposals. This is important not only to support current research endeavors, but also to show potential employers that one has the skills to secure external funding. The proposal-writing module entails attending an approved workshop and subsequently submitting a proposal.

*Leadership*. This module provides a range of opportunities to gain valuable leadership skills and experience in preparation for a career as an ocean scientist. Module completion involves serving in a leadership role – for example: serving as a chief scientist or junior chief scientist on a research cruise, serving as a review panelist for C-MORE’s internal proposal competition, or organizing a workshop as part of the PDTP program.

*Science Communication*. Increasingly, researchers are called upon to communicate their findings to policymakers, the media and the general public. This module teaches skills to effectively convey scientific research in jargon-free language to various audiences. To complete this module, participants attend an approved workshop, and then write a press release or other form of communication, which incorporates feedback from a professional.

*Mentoring*. Whether in the classroom, the lab, or at sea, effective mentoring is essential to helping students realize their full potential. Good mentoring can also help you to attract students to your research projects, develop your professional network and extend your academic contribution. This module begins with participants reading a mentoring book (National Academies, 1997) and participating in a discussion on effective mentoring practices. They then apply their newly gained knowledge by mentoring a student on a research project.

*Teaching*. Teaching experience is a “must” for anyone pursuing an academic career. Effective teachers can transmit their passion, explain complex topics clearly, pose compelling questions and, most importantly, inspire students. This module involves completing an approved teacher preparation program, which includes both theory and practice components.

*Research Exchange*. Research is becoming more and more a collaborative effort. A research experience at another research institution can help participants learn new techniques and expand their professional network, and may enhance career prospects. This module entails conducting collaborative research at a C-MORE partner institution and submitting a detailed research report.

*Diversity.* Understanding and advocating for diversity is critical to maximizing the contributions of all lab members. This module begins with an online training to learn basic principles of universal design. Students then interview someone whose job involves diversity and participate in at least one teleconference. The final step is to apply the skills learned by participating in an event or serving on a committee aimed at broadening participation.

## Evaluation

Two program modules (Proposal Writing and Science Communication) were selected for external evaluation, primarily because they involve workshops, which lend themselves more readily to evaluation than the more individualized experiences associated with, say, the Diversity or Outreach module. Details of these workshops and their evaluation results are presented here.

*Evaluation of Proposal Writing Workshop:* A half-day proposal writing workshop offered in conjunction with the 2011 C-MORE annual meeting was attended by 12 graduate students and 12 post-docs (See Figure 1). The workshop began with a lecture on tips for successful proposal writing and how to find funding opportunities. Then, students reviewed a NSF proposal and compared their reviews to those received from review panelists. In the third session, students read a declined proposal and discussed what improvements could be made for resubmission. The workshop closed with a question-and-answer session.

External evaluation results (Table 1) were very positive, with mean responses ranging from 3.41 to 4.00 on a four-point scale. In addition, three yes-no questions were asked (Table 2). Most (81%) of the 23 respondents felt that all key topics on proposal writing were covered in the workshops. All (=100%) of the respondents reported that the discussions and interactive portions of the workshop were an effective method to strengthen positive writing skills, and that the workshop was a good use of their time.

Open-ended responses were solicited through prompts such as “How will you apply what you learned into writing future research proposals?” Four respondents described how they would go back to the notes they took from the workshop and use them to help structure their own proposals. Four others explained how they intended to have an open dialogue with the funding agency, especially if it happens to be NSF. Four others felt



**Figure 1.** A half-day proposal writing workshop offered in conjunction with the 2011 C-MORE annual meeting was attended by 12 graduate students and 12 post-docs.

Photo by C-MORE Staff

**Table 1. Proposal-Writing Workshop Evaluation: Questions on a Scale of 1-4<sup>1</sup> (n=23)**

Question	Mean	St. Dev
Today's workshop topics were informative.	4.00	0.00
The length of time for each event on the schedule was adequate.	3.48	0.73
The “Successful Proposal Writing in Microbial Oceanography” presentation was useful and informative.	3.86	0.35
The “Review of Proposal #1” session was useful and informative.	3.96	0.21
The “Resubmission of Proposal #2” session was useful and informative.	3.78	0.42
The “Question and Answer” session was useful and informative.	3.91	0.29
The sample research proposals were appropriate and easy to understand (e.g., subject matter, content, research methods).	3.73	0.46
Working in pairs was helpful in understanding the “do’s” and “don’ts” of proposal writing.	3.41	0.59

<sup>1</sup>For each survey item, participants were asked to select one choice along a four-point scale: 1=strongly disagree; 2=somewhat disagree; 3=somewhat agree; 4=strongly agree.

**Table 2. Proposal-Writing Workshop Evaluation: ‘yes’ or ‘no’ questions (n=21-23)**

Question	‘Yes’	‘No’
Were there any key topics on proposal writing missing from today's workshop? (n=21)	4 (19%)	17 (81%)
Were the discussions and interactive portions of the workshop an effective method to strengthen proposal writing skills? (n= 23)	23 (100%)	0 (0%)
Overall, was today's workshop a good use of your time? (n=23)	23 (100%)	0 (0%)

*Note.* The *n* size varies for the different questions because some questions were left unanswered by survey respondents.

encouraged to write their own proposals following the half-day workshop. Three others explained how they would apply what they learned “in every way possible”. Another was hopeful about what they learned during the half-day workshop, yet expressed some trepidation: “We’ll see! Writing proposals seems to be a trial and error process. Hopefully less errors on the first trial!”

## Evaluation of Science Communication Workshops

Two science communication workshops, held at MBARI and UH and organized in partnership with the Communication Partnership for Science and the Sea (COMPASS), were externally evaluated. Each one-day workshop kicked off with a panel of journalists explaining what makes a good story. The journalists used, were ones that work in various local and national media, including print, radio, television and internet. Then, participants were challenged to summarize their research through a “message box” activity. The workshops ended with participants communicating their science to journalists in various mock scenarios, such as a scheduled radio interview, or meeting a journalist unexpectedly at a cocktail party.

**Table 3. Science Communication Workshops at MBARI (n=13) and UH (n=19): Assessment of Interest in and Usefulness of the Various Workshop Components on a Scale of 1-5<sup>1</sup>**

Question	Interest in Workshop		Usefulness of Workshop	
	MBARI Mean (SD)	UH Mean (SD)	MBARI Mean (SD)	UH Mean (SD)
“Thinking Story like a Journalist”	4.46 (0.66)	4.32 (0.67)	4.23 (0.60)	4.33 (0.59)
“The Message Box”	4.31 (0.75)	4.26 (0.88)	4.54 (0.60)	4.33 (0.92)
“Mock Interview Scenarios”	4.58 (0.51)	4.68 (0.59)	4.31 (0.75)	4.61 (0.62)

<sup>1</sup>For each survey item, participants were asked to select one choice along a five-point scale: 1=not at all interesting/useful; 2=slightly interesting/useful; 3=moderately interesting/useful; 4=quite interesting/useful; and 5=very interesting/useful.

**Table 4. Science Communication Workshops — Overall Evaluation**

Question	MBARI	UH
Overall, how would you rank this workshop (scale of 1 to 10, with 1=very poor and 10=excellent)	Mean (SD) 8.62 (0.77)	Mean (SD) 9.00 (0.91)
Would you recommend this workshop to a peer? (Yes/No)	YES: 13 (100%) NO: 0 (0%)	YES: 19 (100%) NO: 0 (0%)

In two separate questions, workshop attendees were asked to assess how interesting and how useful the workshop sections were. The workshops had a combined total of 32 survey respondents (19 UH, 13 MBARI). Evaluation results were very positive, with mean responses from the two workshops ranging from 4.26 to 4.68 (interest) and from 4.23 to 4.61 (utility) on a five-point scale (Table 3).

Workshop participants were asked to rate the workshop overall on a scale of 1 to 10 (where 1 = very poor and 10 = excellent), and whether they would recommend the workshop to a peer (Table 4). The mean workshop ratings were 9.00 (UH) and 8.62 (MBARI), with a range of 7-10. All (=100%) of the 32 respondents that they would recommend the workshop to the peer, a strong indication of the workshops’ overall utility.

In response to our request for open-ended comments, students shared:

*“I feel much more prepared and confident not only communicating science, but interacting with others in general.”*

*“Having a framework [message box] to guide how a scientific message is deliverable is a very useful tool.”*

*“I am NOT a fan of role-playing but actually found it [mock scenarios] very useful.”*

*“I think all scientists should have access to this kind of training.”*

## Conclusions & Future Work

The Professional Development Training Program offers graduate students and post-doctoral researchers the skills and experiences needed to maximize their potential and succeed in their careers. To date, evaluation results have been very positive and strongly indicate that the students value this type of professional skills training to supplement their research training. We offer this Professional Development Training Program as a model to other research-oriented programs that serve graduate students and post-doctoral researchers. It is our hope that, when the reader is in a position of selecting a PD training program, or is involved in the development of such a program, the contents of this article will prove useful. Future work entails expanding the scope of the evaluation to track program alumni and developing this program into a graduate course.

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## About the Authors

Barbara C. Bruno, Ph.D. is on the faculty of the University of Hawaii's School of Ocean and Earth Science and Technology. Her research background is in geology and geophysics. Since 2006, she has served as C-MORE's Director of Education, where she oversees a number of science education initiatives at the pre-college and post-secondary levels. Dr. Bruno can be contacted at [barb@hawaii.edu](mailto:barb@hawaii.edu)

Jacqueline Padilla-Gamiño, Ph.D. is a post-doctoral research fellow in the Hoffman laboratory at the University of California Santa Barbara. She is interested in environmental effects on organismal function and the consequences of physiological and evolutionary responses to global change. Dr. Padilla-Gamiño can be contacted at [gamino@lifesci.ucsb.edu](mailto:gamino@lifesci.ucsb.edu)

Fabio Cabrera De Leo, Ph.D. is a deep-sea biologist and environmental consultant for Petrobras (Brazilian Oil Company). He is interested in marine biodiversity and conservation, particularly of deep-sea habitats threatened by oil/gas and mining exploration, pollution and climate change. Dr. De Leo can be reached at [fdeleo@hawaii.edu](mailto:fdeleo@hawaii.edu)

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