

Chapter 9

Entering Mentoring: A Mentor Training Seminar for REU Mentors

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Mentoring plays a key role in the success of undergraduate research students. Proper mentoring is a key to building a successful Research Experience for Undergraduates Program. Many REU programs struggle with how to best train REU mentors to provide appropriate mentoring to their REU students. This chapter discusses an easy to implement mentor training seminar, Entering Mentoring, that can be integrated into any REU program. Included in the chapter are the history of Entering Mentoring, an overview of the Chemistry focused Entering Mentoring curriculum, tips for integrating Entering Mentoring into a Chemistry REU program, where to find access to free training materials, and how evaluate the impacts of Entering Mentoring.

Introduction

One of the most difficult jobs of a Research Experience for Undergraduates director is how to best prepare the direct mentors of REU students to provide effective mentoring. In many cases REU students will work directly with graduate students and/or post docs who themselves are currently being mentored. Often these graduate students and post docs are mentoring for the first time and experimenting with mentoring styles that will work best for them. First time mentors often will use mentoring techniques that were effective from their success as a researcher, but may not fit their personality style or the personality style of their REU students. Alternatively, graduate students and post docs who have had poor mentoring experiences will choose mentoring styles that are opposite to their experiences but may not be appropriate for mentoring a REU student. When a mentor chooses a mentoring style that does not fit their personality it is often apparent to the REU student and may not appear to be genuine. Because many Chemistry REU students are experiencing research for the first time through the REU program, the importance of proper mentoring is vital to the success and long-term career choices of REU students. Studies of the impact of mentorship have shown that students who receive strong mentoring during research experiences have enhanced self-efficacy toward their research experiences (1–5); greater persistence while engaged in research (6–8), increased research productivity (9, 10), overall higher career satisfaction (11, 12), and enhanced recruitment of underrepresented students (13).

While there is significant evidence to the value of promoting strong mentorship for REU students there are very few mentors who receive effective mentor training and mentors often rely solely on their past experiences and observing other mentors to provide effective approaches to mentoring (14, 15). For REU programs, it is vitally important that we as REU directors provide appropriate training for our mentors so we can help our REU students be as successful as possible during the REU program and throughout their research careers.

Entering Mentoring: A Brief History

The University of Wisconsin-Madison has been at the forefront of research mentor training for over a decade. The beginnings of Entering Mentoring started through conversations in 2005 at the Wisconsin Program for Scientific Teaching to train future biology faculty to be more effective research mentors. Graduate students, post docs, faculty and staff were included in these conversations. The outcomes of the conversations led to publication of the first edition of “Entering Mentoring”. The Entering Mentoring curriculum is based on an experiential facilitated seminar where a facilitator will lead a small group of students, 8-12, in exercises, discussions, and case studies on mentoring experiences. Evaluation of the initial “Entering Mentoring” (16) seminar found that mentors who participated in the training were more likely to discuss topics including expectations, consider issues related to diversity, and seek advice from their peers. (17).

Based off the success of the original Entering Mentoring seminar, the authors received an NSF CCLI grant to expand the curriculum beyond the original biology focus. From 2007 to 2010 a series of faculty and staff met weekly to work on adaptations of Entering Mentoring into discipline specific mentor trainings. Chemistry was included in the adaptations. Prof. Tehshik Yoon and I represented Chemistry for adaptation of Entering Mentoring, which led to the publication of the Chemistry specific Entering Mentoring Curricula (18). During the adaption process, we wrote case studies and activities that were related to experiences that chemistry undergraduates and graduate students would find familiar. All of the case studies developed were based on real mentoring experiences and challenges that occurred in chemistry laboratories using topics related to organic synthesis, physical chemistry laboratory and computational experiments, and situations related to biochemistry focused research. During the adaptation, all identifying information was removed from written case studies. The goal of the adaptation was to provide a curriculum that would resonate with chemistry faculty, students, and post docs and encourage them to critically think about how mentoring impacts research experiences in the chemical related sciences. The adaption team developed curricula in multiple disciplinary topics including, Astrophysics, Engineering, Math, Field Biology, Psychology, Physics, and Multidisciplinary version that includes case studies from multiply disciplines. All of the disciplinary curricula are available to download for free from the Center for Improvement in Mentored Experiences for Research (cimerproject.org). In 2014, Entering Mentoring (19) was published by W.H. Freeman as an updated multidisciplinary training for mentors of research students.

Chemistry Research Mentor Training Seminar Curriculum

The Chemistry Mentor Training Seminar is an adaptation of the original Entering Mentoring curriculum that was completed as part of a NSF funded CCLI project. The adaptations were developed by Prof. Janet Branchaw, Prof. Teshik Yoon and me. The material is broken into eight one-hour sessions that highlight different aspects of building and maintaining effective mentoring relationships. On the following pages are the overall seminar objectives, a sample syllabus, key mentoring concepts, and learning objectives for each of the eight sessions.

Each of the eight sessions is designed to be facilitated by a faculty and/or staff facilitator. The downloadable seminar materials include in-depth facilitation notes including questions to ask during each session and activity. By including detailed facilitation notes, the goal is to allow someone who has not facilitated an interactive seminar to easily implement mentor training without a great deal of training or preparation. For new facilitators a general guide to facilitation is included in the seminar materials. It is important to note that the role of the facilitator is to generate discussion and it is not expected that the facilitator be an expert in mentoring. The seminar works best when participants are engaging one another in discussion of mentoring topics and the facilitator keeps the process moving. During the process of implementation, there will be disagreements on how to approach different mentoring challenges. It is important that facilitators

encourage all participants to express their opinions. There will be multiple solutions to many mentoring challenges and hearing from all seminar participants will allow students to hear multiple solutions to a mentoring problem and choose the one that best fits their mentoring style. For facilitators who are ambivalent about facilitation there are train the trainer workshops for interested faculty to learn about best practices in facilitating mentor training. Workshops are offered by CIMER, the NIH supported National Research Mentoring Network, and the NSF supported EFRI-REM Mentoring Catalyst Project.

The curriculum is designed to be experiential with the goal of building a learning community of mentors interested in strengthening their mentoring skills. The curriculum is built around participants having conversations and sharing solutions to mentoring experiences. To help generate lively and inclusive discussion the curriculum includes case studies that are designed to be open ended and purposely vague leading to multiple interpretations. As facilitator, you can target an aspect of the case through asking questions provided in the facilitation guide. As you become a more confident facilitator, you will be able to guide the discussion in the direction that you find to be the most valuable. Regardless of the skill of the facilitator, the conversations that are generated are rich and dynamic with participants taking a critical look at their own mentoring experiences as mentor and mentee through the lens of being a participant in the seminar.

In addition to the weekly conversations and activities, there are suggested assignments and readings for each session. Assignments are listed in the sample syllabus provided on the next page. How a facilitator uses the assignments and readings will depend greatly on how the sessions are structured and implemented. Later in this chapter I will discuss different timelines for integrating a mentoring seminar into your REU program.

One of the key assignments of the mentoring seminar is the development of a Mentoring Philosophy similar to a teaching philosophy. The goal of the Mentoring Philosophy is to allow participants to express their philosophy of mentoring students. Mentoring Philosophies, while not required like a teaching philosophy, are extremely valuable tools for mentoring seminar participants and their professional development. Many students use their philosophies to help with future job applications and interviews. As a facilitator I encourage my mentoring seminar participants to revisit their mentoring philosophies on a regular basis and use it like a journal to track how the seminar has helped them change their philosophy and approach to mentoring. During the last mentoring session, students will share their mentoring philosophies and see how their peers approach to mentoring differs from their own.

Mentoring Seminar Session Descriptions and Learning Objectives

Chemistry Mentoring Seminar Objective: Seminar participants will work with a community of peers to develop and improve their mentoring skills. By the end of the class, participants should be able to clearly articulate a personal mentoring philosophy to anyone inside or outside their discipline, and have multiple strategies for dealing with mentoring challenges.

Session 1: Getting Started and Project Design

Learning Objectives

Mentors will:

- Explore their perceptions of the research mentoring relationship in their discipline
- Become oriented to the process and expectations for the seminar sessions
- Identify qualities of good research projects for their mentees
- Prepare to establish effective research mentoring relationships with their mentees

During the first session you will introduce the importance of mentoring and establish your learning community. One of the main goals of this session is to build an agreed upon group dynamic. One approach I have taken is to collectively build a list of ground rules the group will adhere to during the remainder of the sessions. This helps to set a tone of respect.

Session 2: Establishing Expectations and Maintaining Effective Communication

Expectations

One critical element of an effective mentor-mentee relationship is a shared understanding of what each person expects from the relationship. Problems between mentors and mentees often arise from misunderstandings about expectations. Importantly, expectations change over time so frequent reflection and clear communication about expectations are needed on a regular basis.

Learning Objectives

Mentors will have the knowledge and skill to:

- Establish expectations and clearly communicate them to the mentee
- Design and communicate clear goals for the mentoring relationship
- Listen to and consider the expectations of their mentee in the mentoring relationship
- Assess the mentee's knowledge and skill level and adjust the project design accordingly
- Consider how differences may affect the relationship

Communication

Good communication is a key element of any relationship and a mentoring relationship is no exception. As mentors, it is not enough to say that we know good communication when we see it. Rather, it is critical that mentors reflect upon and identify the specific characteristics of effective communication and take time to practice communication skills. to practice communication skills.

Learning Objectives:

Mentors will have the knowledge and skill to:

- Foster open communication with the mentee
- Address how difference in communication styles, background, position of power, etc. can alter the intent and the perception of what is said and heard
- Use multiple strategies for improving communication

The second session is the most important of the sessions as expectations and communications are often at the root of many mentoring issues. During this session you help seminar participants learn ways of establishing expectations early in a mentoring relationship. Through establishing expectations, both mentor and mentee can verbalize what is needed for each to have a successful research experience. Often we see REU students who arrive with expectations that are beyond the scope of a REU program. For instance, one REU student in my program had the expectation that they will be a first author on a paper submitted to *Science* after completion of their 10-week summer program. While we know this is an unrealistic expectation, the student did not know this. Had we not had a discussion of expectations with the student, there was a chance the student would have been disappointed with their REU experience because the outcomes did not match their expectations. By discussing the student's expectations at the beginning of the program, we were able to help the student realize what an appropriate expectation would be for a 10-week experience. The student ultimately had a great experience because of a better understanding of what can be accomplished during a REU program. While this is an extreme case, it highlights the importance of discussing expectations with REU students.

The other topic that often leads to many mentoring challenges is communication. Many mentoring issues can be tracked back to poor communication between mentor and mentee. In this session you highlight importance of maintaining effective communication and how the words we use can have positive and negative impact on a mentoring relationship.

Table 1. Sample Research Training Syllabus

<i>Sessions</i>	<i>Topics</i>	<i>Assignments Due</i>	<i>Readings</i>
Week 1	Getting Started and Project Design		
Week 2	Establishing Expectations & Maintaining Effective Communication	Draft mentoring strategy or philosophy Description of mentee's research project	National Academy of Sciences, (1997). "What is a Mentor?"
Week 3	Assessing Understanding & Fostering Independence	A short biography of mentee Summary of the discussion about expectations or a draft mentoring contract	
Week 4	Mentoring Challenges and Solutions	Bring in copies of your own case study to share with the class (or be prepared to present one verbally)	Handelsman, Pfund, Miller Lauffer, & Pribbenow, (2005). "Mentoring Learned, Not Taught."
Week 5	Addressing Diversity	Reflection on differences and how they affect the research experience	Fine & Handelsman, (2005). "Benefits and Challenges of Diversity." Crutcher, B.N., (2007). "Mentoring across cultures."
Week 6	Dealing with Ethics	Look over the general ethics guidelines for your discipline Be prepared to talk about how they apply to you and your work. Bring a copy of them to class.	Lee, Dennis, & Campbell, (2007). " <i>Nature's</i> Guide for Mentors."
Week 7	The Elements of Effective Mentoring	Summary of your mentor's response to a mentoring challenges	
Week 8	Developing a Mentoring Philosophy	Revised mentoring philosophy	

Session 3: Assessing Understanding and Fostering Independence (20)

Understanding

Determining if someone understands you is not easy, yet knowing if your mentee understands you is critical to a productive mentor-mentee relationship. Developing strategies to assess understanding is an important part of becoming an effective mentor.

Learning Objectives

Mentors will have the knowledge and skill to:

- Assess their mentees' prior knowledge of the research field
- Assess/determine their mentees' understanding of core concepts and procedures in the research field
- Consider diverse strategies for enhancing mentee understanding
- Explain and/or model the practice of science and research in their discipline
- Assess their mentee's ability to develop and conduct a research project, analyze data and present results

Independence

An important goal in any mentoring relationship is helping the mentee become independent; yet defining what an independent mentee knows and can do is not often articulated by either the mentor or the mentee. Defining what independence looks like and developing skills to foster independence are keys to becoming an effective mentor.

Learning Objectives

Mentors will have the knowledge and skill to:

- Consider the important roles they play in the academic, professional and personal development of their mentees
- Employ various strategies to build their mentees' confidence
- Implement varied approaches to foster their mentees' independence in scientific research
- Establish trust between themselves and their mentees
- Create an environment where mentees can achieve goals
- Stimulate creativity

In this session, you discuss how to assess what our mentees understand. For REU students, especially those from small schools with limited research capabilities, the REU program is their first opportunity to participate in authentic research. The topics students work on are often new and students are learning the science as they are conducting research for the first time. REU students may fear saying they do not understand instructions or material presented to them by their mentors. This session will help mentors learn how to encourage REU students to assess their own understanding and effectively communicate what they do not understand.

One of the main goals of the REU program is to provide an authentic research experience where REU students take ownership of their research projects. In order to meet this goal of the REU program, mentors need to learn how to foster independence in their mentees. During case studies and activities, mentors will learn how to best guide their mentees toward independence as a researcher.

Session 4: Mentoring Challenges

Learning Objectives

Mentors will:

- Explore the dynamics of their relationships with their mentees
- Understand more about their mentees' perspectives

You will use the middle session to take a step back and reflect on what has been learned during the first three sessions. As a facilitator, we ask participants to bring a mentoring challenge to discuss with the group as well as take time to think about their relationship with their mentee.

Session 5: Addressing Diversity

Diversity

Diversity along a range of dimensions offers both challenges and opportunities to any mentor-mentee relationship. Learning to identify, reflect upon, and engage with diversity is critical to forming and maintaining an effective mentoring relationship.

Learning Objectives

Mentors will have the knowledge and skill to:

- Recognize some of the biases and prejudices they bring to the mentor-mentee relationship
- Implement concrete strategies for addressing issues of diversity
- Engage in conversations about diversity with their mentees
- Recognize how they can influence their mentees' decisions to commit to careers in science
- Improve their multicultural competency

Often the diversity session can be the most difficult session to facilitate, but one of the most interesting and important sessions. During the session, you ask mentors to think about their own biases and how they affect the mentoring relationship. Participants are often hesitant to share opinions on topics related to race and ethnicity. Once the group is comfortable, many important conversations occur that will help mentors be self-reflective. One of the key take aways from this session is learning that having unconscious biases is innately human and should not be a source of embarrassment. Through the session, we encourage mentors to understand their biases and be more intentional about not letting them negatively influence their mentoring relationships.

Session 6: Ethics

Ethics

Mentors play an important role in both teaching mentees about ethical behavior and modeling ethical behavior. Moreover, there are many ethical issues to consider when entering a relationship with a mentee based on the power dynamic that exists between mentors and mentees. Reflecting upon and discussing ethical behavior is an important part of becoming an effective mentor.

Learning Objectives

Mentors will have the knowledge and skills to:

- Articulate the issues of ethics they need to discuss with their mentees
- Clarify the roles they play, both as teachers and role models, in educating mentees about ethics

During this session, you discuss the role that mentors play in teaching REU students ethical behavior. While many mentors assume their mentees understand what is considered ethical behavior, often new researchers do not know the nuances of research ethics. This will highlight gray areas of research ethics and help mentors guide their REU students.

Session 7: Elements of Good Mentoring

Learning Objectives

Mentors will:

- Explore and compare different approaches to mentoring
- Identify specific elements of their own approach to mentoring

This session is an opportunity for mentors to self-reflect on their experiences with mentoring and mentor training. You will lead a discussion focusing on mentors thinking about their growth throughout the mentor training experience.

Session 8: Developing a Mentoring Philosophy

Learning Objective

Mentors will:

- Critically and constructively, review their approaches to and experiences of mentoring relationships.

The final session asks mentors to share their mentoring philosophies with their peers. Mentors learn that mentoring is a very personal experience and how they approach mentoring may not be the same as their peers, but ultimately mentoring is ultimately grounded in a few core best practices that can integrate with individual approaches.

Integrating Entering Mentoring into a Chemistry REU Program

When adapting Entering Mentoring for Chemistry mentors one of the goals of the adaptation was to build capacity for better mentoring in REU programs. While mentors will have the greatest benefit by completing all eight sessions, it is unrealistic for all REU programs to be able to implement a full mentor training for their REU mentors. All of the eight sessions can be completed independently of the others allowing for discrete implementation of a session. A REU program director can decide which topics are of the most importance to their individual programs. For instance for REU programs that have supplements for ethics it may not be necessary to include the ethics session in your mentor training sessions. With that in mind, the curriculum is designed to allow for multiple implementation timelines, as programs will differ with their ability to meet with their REU mentors. In the

next few pages, I will discuss the advantages and disadvantages of three of the most popular implementation timelines.

Eight Weekly One-Hour Sessions

As a REU program director since 2006, meeting weekly with REU mentors has been a benefit to the REU program at the University of Wisconsin-Madison. I typically will meet for the first session with the REU mentors the week prior to the students arriving to introduce the mentoring seminar and prepare them for arrival of their students. When scheduling weekly sessions I schedule sessions over lunch and provide pizza for the mentors. While not necessary, serving lunch helps the mentors to feel appreciated and increases their attendance to the seminar. There are both advantages and disadvantages to meeting weekly.

Advantages

The eight one-hour sessions provide numerous advantages to other implementation timelines. The mentoring seminar works best when a strong learning community can be built. The goal of the learning community is for mentors to rely on one another when solving mentoring issues, during the eight-week session group dynamics begin to change and the group discussions shift from being focused on the facilitator to being focused on the learning community. This shift leads to greatest outcomes from seminar. In other implementation timelines there may not be enough time to build a community.

While the majority of learning takes place in the sessions through meaningful discussions, the seminar will have the greatest impact when participants are able to complete all of the assignments and readings. The eight-week timeline allows participants to work on weekly assignments and do weekly readings. I ask my participants to start a mentoring philosophy after our first meeting and update weekly based on the topics we have discussed. This allows mentors to track their growth and change in their approach to mentoring, other timelines may not allow for completion of some of the assignments and readings before each implementing a session.

Program directors often find it hard to have time to check in with all of the mentors of our REU program. By having mentors attend weekly mentor training sessions, I am able to determine what is working well and whether there are issues. This has been very beneficial to overall success of the REU program. Additionally, I start each session with Highs and Lows where I ask mentors to share a mentoring high and a mentor low for the week. As a group, we will discuss how to handle lows and cheer the successes of the highs. Mentors see this exercise as a part of the seminar. As a program director, I see this as a way of monitoring REU mentoring and providing needed support for REU mentors.

Disadvantages

While there are significant advantages to implementing over eight weeks there are disadvantages as well. We are asking a great deal of our mentors and adding a weekly commitment may be too much for many of our mentors. Invariably some of the mentors may not be able to attend all of the sessions, which can limit the benefit the mentor will have from the seminar. Additionally a facilitator must be available weekly, which may not be possible during a busy REU schedule.

Two Four-Hour Sessions

This implementation timeline can be completed in two days where during each day four sessions are completed with REU mentors.

Advantages

Many REU programs like to train their mentors prior to the start of the program. Having two four-hour sessions can accomplish this goal because this only requires two days to complete mentors can complete the entire seminar prior to the start of the REU program. Many mentors prefer only having to commit to two days rather than commit weekly to eight sessions. It makes scheduling sessions much easier.

Disadvantages

The ability to build a strong learning community may not be as possible with a two-day implementation. While the contact between mentors is the same number of hours, not meeting weekly and not having time to reflect has not led to the same sense of community. With this timeline there is less time for reflection between sessions during each day. Much of the growth of mentors come from reflection of mentoring topics outside of the seminar. Having mentors reflect on one topic each week helps with growth. This timeline does not allow for weekly check in with REU mentors, which can help with program administration.

One Four-Hour Session

Many REU programs are not able to commit to implementing a full eight-hour training. Because the curriculum is designed to be modular with each session being its own distinct module, it is still beneficial to implement a smaller version of the seminar.

Advantages

One four-hour implementation requires less time for REU mentors and less prep time for a facilitator. For new facilitators it can be less daunting to do a four-hour training when first implementing mentor training. A REU program can choose the topics that are of most importance to that particular program.

Disadvantages

The disadvantages for one four-hour session are similar to those for two four-hour sessions with the additional disadvantage of mentors not receiving the full seminar and missing opportunities for growth as mentors.

Tips for Facilitation

One of the main concerns raised by the facilitators that I train is their ability to facilitate the seminar on their own. There are detailed instructions for facilitation within the downloadable materials that suggest the time to spend on individual activities, explicit questions to ask mentors, and other general tips on how to facilitate. These are suggestions and questions and are not meant to be followed exactly. Just as mentoring is a personal experience, the same can be said for facilitation of mentor training. I encourage facilitators to personalize facilitation by adding case studies from their own program, bringing in their experiences, and spending more time on their preferred activities and less on others. This helps them feel more comfortable and confident in facilitation. The most important aspect of mentor training is to have a dialogue with mentors and not to follow a curriculum exactly as written. Additionally, many facilitators choose to co-facilitate their mentor training sessions; this allows multiple perspectives on mentoring and lessens the burden of facilitation. As they gain experience, facilitators will find that facilitating mentor training is a rich and rewarding experience and will bring great value to their program.

Evaluation of Entering Mentoring with a REU Program

The effectiveness of the Entering Mentoring curriculum has been studied and shown to be effective in changing the behavior of trained mentors. In a study published in 2006, using the Entering Mentoring curriculum, researchers looked at the how behaviors of mentors who were trained versus those who were not trained differed (17). It was determined that there were statistical significant increases in trained mentors behaviors related to mentoring undergraduate research students. In particular trained mentors were more likely to discuss expectations with their mentees, orient students to the building they were working in, consider views of diversity, and discuss aspects of the mentoring relationship with their advisors (17).

If you choose to implement mentor training there is no expectation that you will run a full research study including a control group to determine the impact

on your mentors and mentees. There are other ways to interpret the value of mentor training on your program. Questions on mentoring satisfaction of your REU students can be included in your current evaluation tool. You do not need to use many questions to see an impact on the mentoring of your students. For my program I ask questions related to the mentoring experiences of my REU students these are related to the topics covered in mentor training here is a summary of data from five of our mentoring related questions. (Table 2).

Table 2. Mentee Evaluation of the Mentored Experience^a

<i>Evaluative Statement (1 is poor to 5 is excellent)</i>	<i>Mean Score</i>
Working relationship with my mentor	4.7
Amount of time spent with my mentor	4.6
My working relationship with research group members	4.9
The workplace atmosphere for students of my gender	4.9
The workplace atmosphere for students of my race/ethnicity	4.9

^a Data is from the 2015 REU Summer Program Cohort.

The mentoring seminar's impact on knowledge and behaviors is also evaluated through a survey tool. In response to the question "How would you rate the overall quality of your mentoring thinking back to before the training and now, after the training?," the average score was 3.67 (where 1 is low and 7 is high) before the training and 6.00 after the training. In response to the question "Have you made any, or do you plan to make any changes in your mentoring as a result of this training?," 100% of the participants said "yes." In response to the question "How likely are you to recommend the mentor training to a colleague?," 2/3 of the participants said "very likely" and 1/3 of the participants said "likely." No one was "undecided," "unlikely," or "very unlikely."

There are additional tools that are both valid and reliable that can be used to evaluate the effectiveness of the mentoring that students during their REU program. The Mentoring Effectiveness Tool (20) was developed as part of research study to evaluate the impact of mentoring on culturally diverse summer undergraduate research students. The tool is free to use with permission from the authors. If you are interested in facilitating a section of mentor training and would like assistance in developing an appropriate, please contact me and I will share evaluation resources with you.

Final Thoughts

REU program directors often look at the goal of the REU program to solely be the development of REU students and often do not think about the professional development of graduate student, post doc, and faculty mentors of our students. As a program director, I think about participants of the program broadly, mentors who work with undergraduate REU students are as much participants in the REU

program as the undergraduate researchers. There is as significant an opportunity for growth of the mentors through the REU program as there is for mentees. Mentor training is an opportunity to provide significant professional development for mentors. The impact of that professional development can reach far beyond the REU program. Graduate students and post docs who participate in mentor training will have gained valuable skills for future careers. Those who choose faculty careers will have a toolkit of mentoring skills to help with the transition to faculty life. Additionally an unexpected outcome of the program has been the impact on current mentoring relationships of graduate students and post docs who participate. Participants have stated that their mentoring relationships with their own advisors have strengthened due to participation in mentor training. Finally faculty who participate look critically at their own mentoring and make meaningful changes to how they approach mentoring of their students, which can lead overall greater satisfaction for both the faculty member and their students.

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References

1. Bland, C.; Taylor, A.; Shollen, S. *Faculty Success through Mentoring: A Guide for Mentors, Mentees, and Leaders*; Rowman & Littlefield Publishers, Inc.: Lanham, MD, 2009.
2. Cho, C.; Ramanan, R.; Feldman, M. Defining the ideal qualities of mentorship: a qualitative analysis of the characteristics of outstanding mentors. *Am. J. Med.* **2011**, *124* (5), 453–458.
3. Feldman, M. D.; Arean, P. A.; Marshall, S. J.; Lovett, M.; O’Sullivan, P. Does mentoring matter: results from a survey of faculty mentees at a large health sciences university. *Med. Educ. Online* **2010**, *23*, 15.
4. Garman, K.; Wingard, D.; Reznik, V. Development of Junior Faculty’s self-efficacy: outcomes of a National Center of Leadership in Academic Medicine. *Acad. Med. J. Assoc. Am. Med. Coll.* **2001**, *76* (10), S74–76.
5. Palepu, A.; Friedman, R.; Barnett, R. Junior faculty members’ mentoring relationships and their professional development in US medical schools. *Acad. Med. J. Assoc. Am. Med. Coll.* **1998**, *73* (3), 318–323.
6. Sambunjak, D.; Straus, S. E.; Marus’ic’, A. Mentoring in academic medicine. *JAMA, J. Am. Med. Assoc.* **2006**, *296* (9), 1103–1115.
7. Gloria, A. M.; Robinson Kurpius, S. E. Influences of self-beliefs, social support, and comfort in the university environment on the academic

- nonpersistence decisions of American Indian under- graduates. *Cult. Divers. Ethn. Minor Psychol.* **2001**, 7 (1), 88–102.
8. Solorzano, D. *The Road to the Doctorate for California's Chicanas and Chicanos: A Study of Ford Foundation Minority Fellows*; California Policy Seminar: Berkeley, 1993.
 9. Steiner, J.; Curtis, P.; Lanphear, B. Assessing the role of influential mentors in the research development of primary care fellows. *Acad. Med. J. Assoc. Am. Med. Coll.* **2004**, 79 (9), 865–872.
 10. Wingard, D.; Garman, K.; Reznik, V. Facilitating faculty success: outcomes and cost benefit of the UCSD National Center of Leadership in Academic Medicine. *Acad. Med. J. Assoc. Am. Med. Coll.* **2004**, 70 (10), S9.
 11. Schapira, M. M.; Kalet, A.; Schwartz, M. D.; Gerrity, M. S. Mentorship in general internal medicine: investment in our future. *J. Gen. Intern. Med.* **1992**, 7 (2), 248–251.
 12. Beech, B. M.; Calles-Escandon, J.; Hairston, K. G.; Langdon, S. E.; Latham-Sadler, B. A.; Bell, R. A. Mentoring programs for under-represented minority faculty in academic medical centers. *Acad. Med. J. Assoc. Am. Med. Coll.* **2013**, 88 (4), 541–549.
 13. Hathaway, R. S.; Nagda, B. A.; Gregerman, S. R. The relationship of undergraduate research participation to graduate and professional education pursuit: an empirical study. *J. Coll. Stud. Dev.* **2002**, 43 (5), 614–631.
 14. Keyser, D. J.; Lakoski, J. M.; Lara-Cinisomo, S.; Schultz, D. J.; Williams, V. L.; Zellers, D. F.; Pincus, H. A. Advancing institutional efforts to support research mentorship: a conceptual framework and self-assessment tool. *Acad. Med.* **2008**, 83, 217–225.
 15. Silet, K. A.; Asquith, P.; Fleming, M. F. Survey of mentoring programs for KL2 scholars. *Clin. Transl. Sci.* **2010**, 3, 299–304.
 16. Handelsman, J.; Pfund, C.; Miller Lauffer, S.; Pribbenow, C. M. *Entering Mentoring: A Seminar to Train a New Generation of Scientists*; University of Wisconsin Press: Madison, WI, 2005.
 17. Pfund, C.; Maidl Pribbenow, C.; Branchaw, J.; Miller Lauffer, S.; Handelsman, J. Professional skills. The merits of training mentors. *Science* **2006**, 311 (5760), 473–474.
 18. Branchaw, J.; Greenberg, A.; Yoon, T. *Chemistry Research Mentor Training Seminar*; 2011. www.cimerprojec.org (accessed 02/01/2018). Adapted from Handelsman, J.; Pfund, C.; Miller Lauffer, S.; Pribbenow, C. M. *Entering Mentoring: A Seminar to Train a New Generation of Scientists*; University of Wisconsin Press: Madison, WI, 2005.
 19. Pfund, C.; Branchaw, J.; Handelsman, J. *Entering Mentoring*; W.H. Freeman & Company: New York, 2014.
 20. Byars-Winston, A.; Branchaw, J.; Pfund, C.; Leverett, P.; Newton, J. Culturally diverse undergraduate researchers' academic outcomes and perceptions of their research mentoring relationships. *Int. J. Sci. Educ.* **2016**, 37 (15), 2533–2554.