

Research Mentee Training

The activities you have chosen for your customized curriculum are drawn from *Entering Research* (2nd edition; Branchaw, Butz, & Smith, 2018; Macmillan). The *Entering Research* materials were developed, reviewed, and tested by many partners across the country. Activity developers are acknowledged in the footer of each page. A full listing of partners and funders can be found at CIMERProject.org and in the *Entering Research* book.



Entering Research (2nd Edition)
Complete Curriculum #2
15 Week Course for Novice Undergraduate Students

Career Stage: Undergraduate Trainees

Trainees' Prior Level of Research Experience: Novice

Implementation Description: This 1 credit seminar course, which meets for 50 minutes each week, is designed for undergraduate students with 0-1 semesters of prior research experience. The students are expected to have found a research mentor prior to the beginning of the semester. In addition to registering for this 1 credit seminar, students simultaneously enroll in

1-3 credits of independent study with their research mentor, equivalent to 4-12 hours of research per week.

Meta Learning Objectives and Areas of Trainee Development: The learning objectives addressed in this curriculum are indicated below with a check mark. The percentage (%) following each learning objective indicates the proportion of sessions that address that learning objective.

Research Comprehension & Communication Skills

- ✓ Develop Effective Interpersonal Communication Skills (47%)
- ✓ Develop Disciplinary Knowledge (27%)
- ✓ Develop Science Communication Skills (53%)
- ✓ Develop Logical/Critical Thinking Skills (20%)
- ✓ Develop an Understanding of the Research Environment (33%)

Practical Research Skills

- ✓ Develop Ability to Design a Research Project (6%)
- ✓ Develop Ability to Conduct a Research Project (6%)

Research Ethics

- ✓ Develop Responsible & Ethical Research Practices (13%)

Researcher Identity

- ✓ Develop Identity as a Researcher (33%)

Researcher Confidence & Independence

- ✓ Develop Confidence as a Researcher (20%)
- ✓ Develop Independence as a Researcher (27%)

Equity and Inclusion Awareness and Skills

- ✓ Develop Skills to Deal with Personal Differences in the Research Environment (6%)
- ☐ Advance Equity and Inclusion in the Research Environment

Professional & Career Development Skills

- ✓ Explore & Pursue a Research Career (13%)
- ✓ Develop Confidence in Pursuing a Research Career (6%)

Week 1

Introduction to Entering Research & Research Experience Expectations

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop an Understanding of the Research Environment

Researcher Identity

- Develop Identity as a Researcher

Activities:

- Introductions
- Course Overview
- Research Experience Reflections 1: Entering Research?

Assignments Due: None

Assessment Tools: None

Research Experience Reflections 1: Entering Research?

Facilitator Instructions

Trainee Level: undergraduate
novice or advanced trainees

Areas of Trainee Development:

- Researcher Identity
 - Develop Identity as a Researcher
- Research Comprehension and Communication Skills
 - Develop an Understanding of the Research Environment

Learning Objectives

Trainees will:

- Explore realistic expectations for working in a research group.
- Self-evaluate their readiness for research.

Activity Components and Estimated Time for Completion:

- In Session Time: 45 minutes

Total time: 45 minutes

When to use this activity

This activity is designed for trainees who are looking for a research experience, both as a novice undergraduate trainee new to research or an advanced undergraduate trainee who is considering a graduate research experience. This activity can help trainees to develop the self-awareness needed to select an appropriate mentor. Research Experience Reflections 2: Reflections Exercise can be used with trainees who are beginning a research experience.

Inclusion Considerations:

Encouraging trainees to share openly about their expectations in this activity may reveal unique perspectives that trainees from diverse backgrounds bring. For example, those from different cultural and/or socioeconomic backgrounds may be influenced by family members who see doing research as unfamiliar and not in alignment with familial notions of success (i.e., working during the summer, getting a job right after college, etc.). This may have bearing upon a trainee's understanding and expectations of a research experience. Invite trainees to share their perspective and discuss strategies they might use to help others better understand research, why they are motivated to do it, and what success in research looks like.

Implementation Guide

Workshop Session (45 minutes)

- Introduction (15 minutes)
 - The goal of this activity is to familiarize trainees with realistic expectations for their research experience.
 - Distribute the trainee materials and give trainees 10 minutes to answer the questions individually. Once they have drafted their answers, give trainees 5 minutes to pair and share with a peer.

- Discussion (20 - 30 minutes)
 - Ask trainees to share their answers with the whole group. If the group is large (more than 10), trainees may be divided into two smaller groups. Encourage participation from everyone. Begin by asking for volunteers to share, but be prepared to call on someone if necessary.
 - Guiding questions to facilitate overall discussion:
 - What goals do you have for your research experience?
 - What are your expectations for working with a research team?
 - What skills are needed to be an effective researcher? Do you have those skills? If not, what can you do to develop those skills?
 - It is important to make note of the areas of concern that trainees share during this discussion so that you can make sure that they are addressed during this and future discussions. Often, there will be variability in the level of sophistication of the trainees' knowledge about research. If so, encourage the group to discuss the differences and to learn from one another. As the facilitator, provide information or clarification only when necessary.
 - Discussion of Expectations:
 - Address any unrealistic expectations that trainees bring up in the large group discussion. If possible, invite an experienced trainee or a panel of trainees to facilitate this discussion.
 - Trainees may have varying levels of knowledge about the research process depending on their career stage and previous research experience. In particular, undergraduate trainees at institutions that do not have a strong tradition of undergraduate research may lack an understanding of what will be expected of them and what they can expect from the research team. For example, they may expect:
 - to be given an independent project on their first day;
 - that faculty members and graduate student mentors work for them and should offer their full attention when the trainee is around;
 - that they will be able to do research in short discontinuous periods of time like other jobs (e.g. during the 30 minutes they have between classes);
 - that they will find the cure for cancer in two months;
 - that they will get a publication after working for just one semester;
 - that the lab is a place to socialize with friends, not necessarily a place of work.
 - Discussion of Abilities / Skills:
 - Frequently, novice trainees identify intelligence, the ability to talk or write about research, and excellent time management skills as traits they must possess in order to participate in a research experience. They may be under the impression that if they do

not already possess these traits that they are not good enough to do research. Therefore, it is important to emphasize that a research experience provides the opportunity to develop abilities and skills through hands on training.

Alternative implementation – novice and experienced research trainees:

This activity can also be implemented in a group with new researchers and those who have one or more semesters of experience with research. This implementation will allow novice researchers to learn from experienced researchers and will encourage experienced researchers to build upon what they have learned in previous semesters. This implementation strategy may be useful in programs with peer mentoring.

Research Experience Reflections 1: Entering Research?

Novice Undergraduate Trainee Materials

Learning Objectives

Trainees will:

- Explore realistic expectations for working in a research group.
- Self-evaluate their readiness for research.

Outline your expectations for your research experience by writing brief answers to the following questions. Once you've answered all of the questions, pair with someone in the group to share.

1. Why do you want to do research?
2. What specific goals do you hope to achieve in your research experience?
3. What are your expectations of working with a research team? Please list them below.
4. What do you think will be expected of you as an undergraduate student conducting research on a "real" research team? Please list them below.
5. What contributions will you bring to your research team?
6. What is your greatest concern, and what are you excited the most about?
7. Explain your understanding of the scientific process as you see it today.
How does a scientist approach a research question?
8. What do you think are important abilities/skills for an individual to have to be able to conduct research?
9. Which of those abilities/skills do you have?
10. Which of those abilities/skills do you lack? What can you do to develop the abilities that you think you may lack?

Research Experience Reflections 1: Entering Research?

Advanced Undergraduate Trainee Materials

Learning Objectives

Trainees will:

- Explore realistic expectations for working in a research group.
- Self-evaluate their readiness for graduate research.

Outline your expectations for your graduate training experience by writing brief answers to the following questions. Once you've answered all of the questions, pair with someone in the group to share.

1. Why do you want to do research and earn a graduate degree?
2. What specific goals do you hope to achieve with your graduate research?
3. What are your expectations of working with a research team? Please list them below.
4. What do you think will be expected of you as a graduate student conducting research as part of a thesis advisor's research team? Please list them below.
5. What contributions will you bring to your research team?
6. What is your greatest concern, and what are you excited the most about?
7. Explain your understanding of the scientific process as you see it today.
How does a scientist approach a research question?
8. What do you think are important abilities/skills for an individual to have to be able to conduct research at the graduate level?
9. Which of those abilities/skills do you have?
10. Which of those abilities/skills do you lack? What can you do to develop the abilities that you think you may lack?

Week 2

Navigating the Mentoring Relationship

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop an Understanding of the Research Environment

Researcher Identity

- Develop Identity as a Researcher

Activities:

- Prioritizing Research Mentors Roles
- Three Mentors

Assignments Due:

- Safety Training Checklist
- Be sure to meet with your mentor to create an expectations agreement

Assessment Tools: None

Prioritizing Research Mentor Roles

Areas of Trainee Development

- Professional and Career Development Skills
 - Explore and Pursue a Research Career
- Research Comprehension and Communication Skills
 - Develop effective interpersonal communication skills.
 - Develop an understanding of the research environment.
- Researcher Identity
 - Develop identity as a researcher.

Learning Objectives

Trainees will:

- Identify the different roles that research mentors can play and prioritize those roles based on needs.
- Establish and align expectations with a mentor(s).

Trainee Level: undergraduate or graduate trainees
novice, intermediate, or advanced trainees

Activity Components and Estimated Time for Completion

- In Session Time: 30–35 minutes

Total time: 35 minutes

When to Use This Activity

This activity can be used when trainees have been working with a mentor long enough to be able to use their experiences to think about the different roles that mentors can play. Alternatively, this activity can be used with advanced undergraduate or graduate trainees as part of a discussion about choosing a mentor to help them reflect on which mentoring roles they most value. This activity can help trainees to understand that one mentor may not fulfill all of their needs and that establishing a network of mentors can be valuable.

Other activities that may be used with this activity include:

- Research Group Diagram
- My Mentoring and Support Network
- The Next Step in Your Career
- Networking 1: Introduction to Networking

Inclusion Considerations

Consider that students from nonacademic backgrounds, especially first-generation college and graduate school trainees, may prioritize the roles of their research mentors differently. Discuss the differences and similarities between high school and college teachers/professors and their relationships with students/research trainees. Discuss the formal and informal interactions in mentor–trainee relationships. Encourage trainees to find a diverse group of mentors to support their training.

Workshop Session (30 minutes)

- Cut out the boxes of different roles of research mentors. Have trainees move the items around to rank the roles based on their priorities (10 minutes).
- Ask trainees to explain their highest and lowest priorities and any additional roles they added to their list. This can be done as a large group or in small groups of two or three followed by sharing with the large group. (20 minutes).
- Discussion Questions:
 - How did your priorities differ from those of other trainees?
 - What roles were NOT important to you? Why?
 - What roles were missing from the list that are important to you?

Implementation Guide for Graduate Trainees

Workshop Session (35 minutes)

- Using the Roles for your Research Mentor Worksheet provided in the graduate trainee materials, have trainees rank the roles they expect their mentor to play (5 minutes).
- For the top 5 roles, have trainees consider whether their primary research mentor effectively addresses each priority (5 minutes).
 - *Note: Skip this question if using with trainees who are in the process of choosing a research mentor*
- Ask trainees to list another individual who could serve each of the top 5 roles during their graduate school training (5 minutes).
- Lead a group discussion to emphasize that each person needs and expects different things from a mentor to have a good experience and achieve their goals from the experience.
- Discussion Questions:
 - Do all these roles need to be fulfilled by one mentor?
 - Who else in your group or beyond can be a mentor for you?
 - Do you expect the rankings you gave these roles to stay the same as you continue in your research experience? In your career?

Prioritizing Research Mentor Roles

Undergraduate Trainee Materials

Learning Objectives

Trainees will:

- Identify the different roles that research mentors can play and prioritize those roles based on their needs.
- Establish and align expectations with their mentor(s).

Consider the different roles of research mentors listed below. Add additional roles that may be missing from the list. Cut out the boxes and rank these roles according to your priorities and expectations of a research mentor.

| |
|--|
| Teach by example |
| Train you in disciplinary research |
| Improve your writing and communication skills |
| Provide growth experiences |
| Help build your self-confidence as a researcher |
| Model and promote professional behavior |
| Inspire |
| Offer encouragement |
| Assist with advancement of your career |
| Facilitate networking with colleagues |
| Help build the bridge between research and application (i.e. industry, clinical work, etc) |
| Provide guidance into future career options |
| Other: |
| Other: |
| Other: |

Prioritizing Research Mentor Roles

Graduate Trainee Materials

Learning Objectives:

Trainees will:

- Identify the different roles that research mentors can play and prioritize those roles based on their needs.
 - Establish and align expectations with their mentor(s).
-

Instructions: Prioritize the roles you expect your mentor to perform with #1 being the most important role. Consider whether your primary research mentor effectively addresses each of your top 5 priorities. List others who could serve these roles in during your graduate school training.

| Role | Priority | Does your primary research mentor do this effectively? | Who else could serve this role in your training during graduate school? |
|---|----------|--|---|
| Teach by example | | | |
| Train you in disciplinary research | | | |
| Improve your writing and communication skills | | | |
| Provide funding | | | |
| Provide growth experiences | | | |
| Help build your self-confidence as a researcher | | | |
| Promote professional behavior | | | |
| Inspire | | | |
| Offer encouragement | | | |
| Assist with advancement of career | | | |
| Facilitate networking with colleagues | | | |
| Other: | | | |
| Other: | | | |

Three Mentors

Areas of Trainee Development

- Professional and Career Development Skills
 - Develop confidence in pursuing a research career
- Research Comprehension and Communication Skills
 - Develop effective interpersonal communication skills.
- Researcher Identity
 - Develop identity as a researcher.

Learning Objectives

Trainees will:

- Identify different mentoring styles.
- Identify preferred mentoring styles.

Trainee Level: undergraduate or graduate trainees
 novice trainees

Activity Components and Estimated Time for Completion

- Trainee Pre-Assignment Time: 20 minutes
- In Session Time: 35 minutes

Total time: 55 minutes

When to Use This Activity

This activity is appropriate for novice researchers in the process of selecting a research mentor.

Other activities that can be used with this activity include:

- Finding a Research Mentor
- Finding Potential Research Rotation Groups and Mentors

A modified description of the three mentors for graduate trainees is provided. The facilitation instructions described below are appropriate for both career stages.

Inclusion Considerations

Trainees from backgrounds historically underrepresented in STEM might perceive typical lab or mentoring dynamics, such as limited access to a mentor or a hands-off style of mentoring, as a negative reflection of their mentor's interest in them. Likewise, power and authority dynamics may be factors that cause distance between a trainee and their mentor. Regardless of mentoring style, encourage all trainees to establish clear expectations to which both they and their mentor can agree. Help them understand that, even with different communication styles and backgrounds from their mentor, they can develop a positive and trusting relationship.

Workshop Session (35 minutes)

- Three Mentors Activity (5 minutes)
 - Ask students to individually complete the Three Mentors Activity
- Small Group Discussion (10 minutes)
 - In small groups, have trainees discuss the advantages and disadvantages of working with each type of professor and share the qualities of their ideal mentors from the Trainee Reflection assignment, located in the trainee materials. Alternatively, facilitators may wish to bring the large group together for this discussion.

Note: Alternative implementation: Trainees can be divided into three small groups with each group discussing one of the professors (1, 2, or 3) for 5-7 minutes. The facilitator can then open the large group discussion by asking each small group to present their discussion.

- Large Group Discussion (20 minutes)
 - Using the questions below, discuss trainees' answers and reflect on which mentoring strategy would work best for each trainee given his/her learning style and level of independence.
 - What are some strategies you discussed that would be helpful when working with each of the professors?
Below are a few examples:

- Professor 1 - If the trainee feels that weekly meetings are too frequent, they could ask the professor to meet once every two weeks or once a month that after they have demonstrated signs of independence.
- Professor 2 - The trainee may want to schedule a once a month meeting to meet with the professor to give her/him an update or to ask questions about other aspects of academia.
- Professor 3 - If a trainee needs more guidance, they should take the initiative to arrange additional monthly meetings with the mentor or whenever the trainee feels the need for more guidance.

- What are the most important elements or characteristics that you would like in your mentor-trainee relationship to have now?
- What does your selection of mentor tell you about how you learn best?
- Do you anticipate that this will change in the future? If so, how?
- What can you do to ensure that you get what you need out of this relationship with your mentor?

Note: Graduate trainee adaptation:

- A modified description of the three mentors for graduate trainees is provided. The Facilitation Instructions described above are appropriate for both career stages.

Three Mentors

Undergraduate Trainee Materials

Learning Objectives

Trainees will:

- Identify different mentoring styles.
 - Identify a mentoring style that works best for them.
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Trainee Reflection Worksheet

1. What kind of learner are you? Do you learn best by looking at diagrams, graphs, and figures (visual learner), by listening (auditory learner) and/or by handling materials (kinesthetic learner)? Do you learn best by using a combination of these methods?
2. How can your mentor support your learning style in your research experience?
3. How much guidance do you feel that you need when joining a new laboratory?
 - a. Consistent individual guidance throughout my entire time in the lab
 - b. A great deal of guidance until I learn the procedures, but after that I can be left alone and would just like to report back my findings and ask for help if I need it.
 - c. Just enough to learn the procedures and then I like to left alone to do my work and will report back or ask for help if I need it.
4. Based on your reflections above, describe YOUR ideal mentor:
5. Why did you pick these characteristics in your mentor?

“Three Mentors”

Read the descriptions of three different types of research mentors. From your perspective, describe the advantages and disadvantages of working with each mentor. Outline strategies you would use to overcome the disadvantages. After completing this exercise, revise the characteristics of your ideal mentor on the trainee reflection worksheet.

Mentor 1

This mentor is very hands-on and likes to be the primary mentor for undergraduate researchers in the lab. The mentor works directly with trainees much of the time and wants to know everything that goes on all the time. The mentor sets up weekly individual meetings and engages in frequent dialogue about the research.

Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Mentor 2

This mentor is very famous and travels a great deal. Because of this, the researchers and the mentor advisers have a formal system in which the senior researchers in the group act as mentors for the newer trainees. The mentor keeps up-to-date on the progress of each trainee via frequent emails and meetings when they are in town.

Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Mentor 3

This mentor is hands-off. The mentor is around, but likes to give trainees space to see how they handle independence. The mentor typically has senior trainees informally mentor the newer ones. This mentor meets with each trainee once a month and holds regular structured lab meetings.

Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Three Mentors

Graduate Trainee Materials

Learning Objectives

Trainees will:

- Identify different mentoring styles.
 - Identify a mentoring style that works best for them.
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Trainee Reflection Worksheet

1. What kind of learner are you? Do you learn best by looking at diagrams, graphs, and figures (visual learner), by listening (auditory learner) and/or by handling materials (kinesthetic learner)? Do you learn best by using a combination of these methods?
2. How can your mentor support your learning style in your research experience?
3. How much guidance do you feel that you need when joining a new laboratory?
 - a. Consistent individual guidance throughout my entire time in the lab
 - b. A great deal of guidance until I learn the procedures, but after that I can be left alone and would just like to report back my findings and ask for help if I need it.
 - c. Just enough to learn the procedures and then I like to left alone to do my work and will report back or ask for help if I need it.
6. Based on your reflections above, describe YOUR ideal mentor:
7. Why did you pick these characteristics in your mentor?

“Three Mentors”

Read the discussions of three different types of mentors and describe the advantages and disadvantages of working with each from your perspective. Outline strategies you would use to be successful in this research environment.

Mentor 1

This mentor is very hands-on and likes to be the primary mentor for the graduate trainees in the lab. Trainees have to work on questions relating to the funded research grants and cannot deviate from such research questions. The mentor works directly with trainees much of the time and wants to know everything that goes on all the time. The mentor keeps tabs of the trainees and questions them if they are not in the laboratory working on their research projects. The mentor sets up weekly individual meetings and engages in frequent dialogue about the research.

Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Mentor 2

This mentor is very famous and travels a great deal. Because of this, the researchers and the mentor trainees have a formal system in which the senior researchers in the group act as mentors for the newer trainees. Although this research mentor hands the students their research questions related to the funded grants, the mentor is open to the discussion of other research questions that relate to the mentor's topic of research. The mentor keeps up-to-date on the progress of each student via frequent emails and meetings when in

town. Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Mentor 3

This mentor is hands-off. The mentor is around, but likes to give students space to see how they handle independence. The mentor typically has senior trainees informally mentor the newer ones. The mentor typically hands students research questions that are related to funded grants, but is open to discuss other research questions as long as they relate to the mentor's topic of research. This mentor meets with each student once a month and holds regular structured lab meetings.

Advantages:

Disadvantages:

What qualities/attributes or skills are needed for a trainee to succeed in this environment?

Week 3

Aligning Mentor-Mentee Expectations

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop Science Communication Skills
- Develop Logical/Critical Thinking Skills

Researcher Identity

- Develop Identity as a Researcher

Research Confidence and Independence

- Develop Independence as a Researcher

Activities:

- Aligning Mentor-Trainee Expectations
- Elevator Sentences

Assignments Due:

- Mentor-Trainee Expectations Agreement
- Elevator Sentence (1st draft)

Assessment Tools:

- Elevator Sentences - peer assessment

Aligning Mentor and Trainee Expectations

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice, intermediate or advanced trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills
 - Researcher Identity
 - Develop Identity as a Researcher
 - Research Confidence and Independence
 - Develop Independence as a Researcher
-

Learning Objectives

Trainees will:

- Understand that their expectations of their research mentoring relationship may be different from their mentors.
- Establish an open line of communication with their mentor in order to address any differences and align their expectations.

Activity Components and Estimated Time for Completion:

One Session Implementation

- Trainee Pre-Assignment Time: 1-2 hours
 - In Session Time: 1 hour, 10 minutes
- Total time: 2 hours, 10 minutes-2 hours, 30 minutes*

Two Session Implementation

- Session 1 Time: 1 hour, 5 minutes
 - Trainee Pre-Assignment Session 2 Time: 30 minutes
 - Session 2 Time : 1 hour, 10 minutes
- Total time: 2 hours, 45 minutes*
-

When to use this activity

This activity is most beneficial when trainees first join a research team, regardless of their career stage (e.g. during lab rotations for graduate students). However, it can be used at any stage of a mentor-trainee relationship to address issues arising from misaligned expectations.

This activity can be implemented with the “Professional Development Plans” activity to explore the relationship between professional development goals and expectations for the mentoring relationship. An example mentor/trainee agreement can be found in the Trainee Materials.

Inclusion Considerations

Individuals from backgrounds historically underrepresented in STEM might perceive typical lab or mentoring dynamics such as occasional limited mentor access and a hands-off style of mentoring as related to their identity. Different mentor and mentee identities may create barriers to connecting and therefore to the development of effective mentor-mentee relationships. Help trainees realize that even with different backgrounds and identities they can develop a positive and trusting relationship through open and honest communication.

Trainees may also be unsure of how to handle the power and authority dynamics they perceive in the relationship and therefore resist asking for exactly what they need from a faculty member who holds authority over them. Reassure them that their mentors are there to support their training and development and encourage them to ask for what they need.

Implementation Guide

This activity may be implemented in either one or two sessions.

One-Session Implementation

Trainee Pre-Assignment (1-2 hours)

- Have trainees write answers to the questions listed in the “Goals and Expectations” exercise.
- Have trainees meet with their mentor to discuss their answers to the questions. Send the research mentor expectations worksheet and allow the mentor to review the questions before the meeting.
 - NOTE: If their mentor is not the leader of the research group (e.g. the Professor), then the leader should be invited to join the meeting. If it is not possible for all to meet together, then separate meetings can be scheduled.

Workshop Session (1 hour, 10 minutes)

- In-Session Activity: Small Group Discussion (30 minutes)
 - In groups of 4-5, have trainees share the expectation agreements they developed with their mentors.
- In-Session Activity: Large Group Discussion (30 minutes)
 - Each small group shares the breadth of responses from their members from one of the questions. Example responses are provided in the box below.
- Wrap-Up (10 minutes)
 - Summarize the main ideas generated from the large group discussion.
 - Encourage trainees to revisit their agreements with their mentor regularly throughout the course of their relationship. Invite trainees to suggest how frequently this should occur (e.g. every 6 months, annually, at milestones during training experience - after a preliminary exam, after a conference presentation, after the publication of a paper, etc.)

| Example Trainee Expectations of Mentor | Example Mentor Expectations of Trainee |
|--|--|
| <p><i>I expect my mentor to:</i></p> <ul style="list-style-type: none"> • meet with me at least every few weeks. • be open to my questions and to take time to think about them carefully. • be patient with me because I am new to research. • initially be directive but eventually let me design and do experiments on my own. • challenge and encourage me. • teach me basic research techniques/procedures and safety protocols. • help me define a project that is doable, yet relevant, and that keeps me busy. • help me understand the basic scientific concepts and study design underlying my project. • understand when I need to take time away from research to focus on my coursework and allow me to take it. • help me network with other researchers in the group and/or discipline. • be willing to discuss possible career goals and/or future jobs that will utilize the skills being learned during this research opportunity. | <p><i>I expect my trainee to:</i></p> <ul style="list-style-type: none"> • be present and punctual when we have scheduled meeting times. • work hard and give their best effort. • manage their time efficiently and effectively when doing research. • keep up with course work, but to let me know if they need a break from research to focus on courses. • make every effort on their own to understand the research our group does, but to ask questions when they do not understand. • listen carefully, take notes, and follow instructions when being taught new techniques. • follow all disciplinary ethics and safety procedures. • gradually gain independence, but to regularly communicate with me about what they are doing. • be able to analyze their experimental data, generate logical conclusions based on that analysis, and propose future experiments, with assistance. • work cooperatively, collaboratively, and respectfully with other members of the research team. • be attentive, creative and contribute at research group meetings. |

Adapted by E. Frazier, C. Pfund, and A. R. Butz from Branchaw, Pfund & Rediske (2010). *Entering Research: A Facilitator's Manual*. New York: WH Freeman & Company, and from Pfund, Wassarman & Skarlupka (2014). *Establishing your Mentoring Relationships for CMB, Biophysics and Nutritional Sciences*. Branchaw, J. L., Butz, A. R., & Smith A. (2018). *Entering Research* (2nd ed.). New York: Macmillan.

Two-Session Implementation

Session One

Workshop Session(1 hour, 5 minutes)

- In Session Activity: Small Group Discussion (30 minutes)
 - Trainees form small groups with members who have varying levels of research experience. If all trainees are beginners, then invite more experienced trainees as guests to join the groups.
 - Discuss and answer questions on the mentor-trainee expectation agreement.
- In Session Activity: Large Group Discussion (30 minutes)
 - Invite groups to share their answers to the questions on the trainee expectation worksheet.
- Wrap-Up: Trainee Pre-Assignment for Session Two (5 minutes)
 - Trainees should schedule an appointment with their research mentor to discuss the questions and align their expectations. Send the research mentor expectations worksheet (see trainee materials) before the meeting to allow the mentor to review the questions ahead of time.

Session Two

Workshop Session (1 hour, 10 minutes)

- In Session Activity: Small Group Discussion (30 minutes)
 - Have trainees discuss how their conversation with their mentor went about expectations.
- In Session Activity: Large Group Discussion (30 minutes)
 - Lead a large group discussion to identify reasonable goals and expectations for the research experience, and to share how easy or difficult it was for trainees to have this conversation with their mentors. Example responses from trainees appear in the boxes below. Discussion Questions:
 - How well did your goals and expectations for your research experience align with your mentor's?
 - How does your project fit with the other projects that your research group is doing?
 - Was it difficult to generate an agreement with your mentor?
 - What were the most and least comfortable topics to discuss with your mentor?
 - What are you most excited about, and what are you most concerned about after talking with your mentor?

Example Responses from Trainees

How well did your goals and expectations for your research experience align with your mentor's?

- I'm still unsure what exactly I would like to get out of the research experience, but am happy with what the mentor defined.
- The research experience is going to be much more independent than I expected and my concern is whether there will be enough guidance in the beginning to get started.
- We talked very little about the research questions. The conversation was focused on learning experimental techniques rather than working on any particular experiment at this early stage in project development.

Example Responses from Trainees

How does your project fit with the other projects that your research group is doing?

- My project is vital to only a certain part of the lab. The lab is broken up to multiple projects and my project is a small part of my mentor's project.
 - There are two projects going on in the group and mine is connected to only one of them.
- My project is considered a "side project" and not connected to the main projects in the lab.

Example Responses from Trainees

Was it difficult to generate an agreement with your mentor?

- The goals and expectations discussion helped.
- We still have a few things to settle, but got most of it got done.
- My mentor didn't really want to go through the agreement, but we had an informal conversation about expectations.

- **Wrap-Up (10 minutes)**
 - Summarize the main ideas generated from the large group discussion.
 - Encourage trainees to revisit their agreements with their mentor regularly throughout the course of their relationship. Invite trainees to suggest how frequently this should occur (e.g. every 6 months, annually, at milestones during training experience - after a preliminary exam, after a conference presentation, after the publication of a paper, etc.)

Alternative Activity for Graduate Trainees (30 minutes)

- Instead of completing the "Goals and Expectations Exercise", graduate trainees can review a sample mentor-trainee agreement (compact) included in the Trainee Materials (see "Example Mentor-Graduate

Trainee Agreement”). Invite trainees to circle items that they think they should discuss with their mentors (or have already discussed). Trainees may also use the questions raised in the Goals and Expectations exercise as a guide for what they wish to discuss with their mentors. Graduate students should send the questions/topics they wish to discuss to their mentor in advance of their meeting.

NOTE: Graduate trainees could incorporate a discussion about expectations into a larger discussion of their Individual Development Plan (IDP; see “Professional Development Plans” activity) with their mentor.

- In Session Activity: Discussion Questions:
 - What items from the example were important to discuss with your mentor?
 - What, if anything, is missing from these agreements (compacts)?
 - What ideas do you have about how you establish expectations with your mentor?
 - How do you start a conversation around expectations?

NOTE: A roleplaying exercise can be used to help graduate trainees practice raising difficult questions with their mentors. Trainees pair up and take turns being the trainee and the mentor.

Aligning Mentor and Trainee Expectations

Trainee Materials - Undergraduate

Learning Objectives

Trainees will:

- Understand that their expectations of their research mentoring relationship may be different from their mentors.
- Establish an open line of communication with their mentor in order to address any differences and align their expectations.

Assignment

1. Answer the questions on the Undergraduate Research Trainee Expectations worksheet.
2. Meet with your mentor to discuss the questions and to align your goals and expectations for the research experience. Send the Research Mentor Expectations worksheet to your mentor before the meeting so that he/she can prepare.
3. Trainees and mentors should tailor their discussion to the specific needs of *their* relationship.
4. After the discussion, complete the Mentor-Trainee Expectation document together.

Undergraduate Research Trainee Expectations

1. Why do you want to do research?
2. What are your career goals? How can this research experience and the mentor–trainee relationship help you achieve them?
3. What would success in this research experience look like to you?
4. How many hours per week and at what times/days do you expect to work on your mentor’s research?
5. Assuming a good fit, how long do you expect to work with this research group?
6. What, if any, specific technical or communication skills do you expect to learn as part of the research experience?
7. How do you learn best (written procedure, verbal instructions, watch and repeat, etc.). What can your mentor do to help you learn the techniques and skills in a timely manner that you need to be successful in your research lab? What can you do before you start in the lab to allow you to be successful in this research group?
8. Once you are trained in basic techniques, would you prefer to continue to work closely with others (e.g. on a team project), or independently?
9. Once you have learned the techniques and procedures used in your lab do you prefer that your mentor watch closely what you do, walking you through all the steps or do you prefer a hands off approach to being supervised?
10. How will you document your research results? Is there a specific protocol for keeping a laboratory notebook in your research group?
11. To whom do you expect to go if you have questions about your research project? Does your mentor expect you to come solely (or first) to them, or should you feel free to ask others in the research group? If others, can your mentor identify those in the group who would be good resource people for your project?
12. Are you comfortable with the methodology used in the lab? Does it involve the use of animals, for example? Does it involve lengthy field trips where you might be isolated with other researchers for weeks at a time? How do you feel about that?
13. Will the research that you will be involved in be confidential? Are you allowed to discuss your project with other individuals outside of your laboratory?
14. What role will your mentor play in the development of your skills as a writer? Is your mentor willing to help you with your research-related writing along the way or does he/she only want to read it after it is in its final version? If your mentor only wants to read final versions of your writing, could he appoint someone in the laboratory/research team to proof read your writings?

15. Do you know all the institutional safety and ethics training that is required to work in your research project? Discuss the required training with your mentor and establish a deadline by which you should complete it.
16. If you have previous research experience, what skills do you expect to bring to your new research group?

Research Mentor Expectations

1. Why do you want to mentor an undergraduate researcher?
2. What are your career goals? How can this research experience and the mentor–trainee relationship help you achieve them?
3. What would success in this research experience look like to you?
4. How many hours per week and at what times/days do you expect your trainee to work on your research?
5. Assuming a good fit, how long would you like your trainee to remain with the group?
6. What, if any, specific technical or communication skills do you expect your trainee to learn as part of the research experience?
7. What level of independence do you expect your trainee to achieve, once basic techniques are learned? How will you let your trainee know when he/she has reached this level?
8. What is your mentoring approach? Once your trainee has learned the techniques and procedures used in your lab do you prefer to watch your trainee closely, walking him/her through all the steps or do you prefer a more hands off approach?
9. How will your trainee document research results? Is there a specific protocol for keeping a laboratory notebook in your research group?
10. To whom should your trainee go if they have questions about your research project? Do you expect them to come to you solely (or first), or should they feel free to ask others in the research group? If others, who would be good resource people for your project?
11. What are your expectations for your trainee’s level of comfort with the methodology used in the lab. For example does your research involve working with animals, lengthy field trips, or working in isolation with other researchers, and is your trainee comfortable with this?
12. Is the research that your trainee will be involved in confidential? Are they allowed to discuss your project with other individuals outside of your laboratory? What are your expectations?
13. What role will you play in the development of your trainee’s skills as a writer? Are you willing to help them with research-related writing along the way or do you only want to read it after it is in its final version? Is there someone else in the lab/research team that is available to help your trainee with their writing?
14. Discuss the institutional training that is required for your trainee to work on your research project and establish a deadline by which they should complete it.

15. If a student has previous research experience, is there anything that you need to share about this research group that is unique and that the student should be aware of?

Mentor – Undergraduate Trainee Expectations Agreement

Trainee (print)_____Mentor (print) _____

This agreement outlines the parameters of our work together on this research project.

1. Our major goals are:
 - A. proposed research project goals –
 - B. trainee’s personal and/or professional goals -
 - C. mentor’s personal and/or professional goals –
2. Our shared vision of success in this research project is:
3. We agree to work together on this project for at least____semesters.
4. The trainee will work at least____hours per week on the project during the academic year, and____hours per week in the summer.
5. The trainee will propose their weekly schedule to the mentor by the____week of the semester.

If the trainee must deviate from this schedule (e.g. to study for an upcoming exam), then they will communicate this to the mentor at least (weeks/days/hours) before the change occurs.

6. On a daily basis, our primary means of communication will be through (circle all that apply):
face to face/phone/email/instant messaging/ _____
7. We will meet one-on-one to discuss our progress, the larger project goals, and to evaluate the trainee’s performance in the lab. We will reaffirm or revise our goals and/or expectations going forward for at least_____minutes____time(s) per month.
 - a. (Circle one): It will be the (trainee’s/mentor’s) responsibility to schedule these meetings.
 - b. In preparation for these meetings, the trainee will:
 - c. In preparation for these meetings, the mentor will:

8. At these meetings, the mentor will provide feedback on the trainee's performance and specific suggestions for how to improve or progress to the next level of responsibility through a
 - a. written evaluation
 - b. a verbal evaluation
 - c. other _____
9. When learning new techniques and procedures, the mentor will train the trainee using the following procedure(s) (e.g. write out directions, hands-on demonstration, verbally direct as trainee does procedure, etc.):
10. The proper procedure for documenting research results (laboratory notebook) in our research group is:

The notebook will be checked _____ (e.g., weekly/monthly).

11. If the trainee gets stuck while working on the project (e.g. has questions or needs help with a technique or data analysis) the procedure to follow will be:
12. The standard operating procedures for working in our research group, which all group members must follow and the trainee agrees to follow, include: (e.g. require institutional training wash your own glassware, attend weekly lab meetings, reorder supplies when you use the last of something, etc.)
13. The mentor and trainee have agreed on a mentoring approach which consists of:
14. The mentor and trainee have discussed the methodology used in the lab in detail and the trainee understands what is expected of them. To become part of the lab the trainee must complete the following safety procedures and/or ethics training(s):

15. The mentor agrees to read and revise the trainees research writing according to the following procedure:
16. The trainee agrees to not present any of the research findings from this laboratory in any shape or form without the explicit consent and approval of the mentor.

17. Other issues not addressed above that are important to our work together:

By signing below, we agree to these goals, expectations, and working parameters for this research project

| | | | |
|---------------------------|-------------|-------------|-----------|
| Trainee's signature _____ | Date: _____ | Mentor's | signature |
| _____ | Date: _____ | Professor's | |
| signature _____ | Date: _____ | | |

Aligning Mentor & Trainee Expectations

Trainee Materials - Graduate

Learning Objectives

Trainees will:

- Understand that their expectations of their research mentoring relationship may be different from their mentors.
- Establish an open line of communication with their mentor in order to address any differences and align their expectations.

Assignment

1. Answer the questions on the Graduate Research Trainee Expectations worksheet.
2. Meet with your mentor to discuss the questions and to align your goals and expectations for the research experience. Send the Research Mentor Expectations worksheet to your mentor before the meeting so that he/she can prepare.
3. Trainees and mentors should tailor their discussion to the specific needs of *their* relationship.
4. After the discussion, complete the Mentor-Trainee Expectation document together.

Graduate Research Trainee Expectations

1. Why do you want to do research?
2. What are your career goals? How can this research experience and the mentor–trainee relationship help you achieve them?
3. What would success in this research experience look like to you? What would you like to achieve:
 - a. By the end of your 1st year?
 - b. By the end of your 3rd year?
 - c. By the time you complete your degree?
4. How many hours per week and at what times/days do you expect to work on your mentor's research?
5. What other commitments or obligations will you have during graduate school (group meetings, teaching, family, religious, community, etc.)? How many hours will these take? How will you schedule around these commitments?
6. Assuming a good fit, how long do you expect to work with this research group?
7. What, if any, specific technical or communication skills do you expect to learn as part of the research experience?
8. How do you learn best (written procedure, verbal instructions, watch and repeat, etc.). What can your mentor do to help you learn the techniques and skills in a timely manner that you need to be successful in your research lab? What can you do before you start in the lab to allow you to be successful in this research group?
9. Once you are trained in basic techniques, the goal should be to gain independence. What can you do to gain independence in your research? How long do you expect this transition to take?
10. What role do you want your mentor to take throughout your graduate career? For example, would you prefer that your mentor is hands-on throughout your graduate work? Or do you prefer a more hands-off approach to being supervised?
11. How will you document your research results? Is there a specific protocol for keeping a laboratory notebook in your research

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group?

12. To whom do you expect to go to if you have questions about your research project? Does your mentor expect you to come solely (or first) to them, or should you feel free to ask others in the research group? If others, can your mentor identify those in the group who would be good resource people for your project?
13. Are you comfortable with the methodology used in the lab? Does it involve the use of animals, for example? Does it involve lengthy field trips where you might be isolated with other researchers for weeks at a time? How do you feel about that?
14. Is the research that you will be involved in confidential? Are you allowed to discuss your project with other individuals outside of your laboratory?
15. What role will your mentor play in the development of your writing skills? Will they provide feedback and guidance on numerous drafts or will they only want to provide feedback on the final draft? If your mentor only wishes to read final drafts of writing, are there others in the lab who are willing to provide feedback on earlier drafts?
16. Do you know all the institutional safety or ethics training that is required to work in your research project? Discuss the required training with your mentor and establish a deadline by which you should complete it.
17. If you have previous research experience, what skills do you expect to bring to your new research group?

Research Mentor Expectations

1. Why do you want to mentor a graduate researcher?
2. What are your research goals? How can this research experience and the mentor–trainee relationship help you achieve them?
3. What would success for you trainee look like to you? What would you like your trainee to achieve:
By the end of his/her
1st year? By the end
of his/her 3rd year?
By the time he/she completes his/her degree?
4. How many hours per week and at what times/days do you expect your trainee to work on your research?
5. Assuming a good fit, how long would you like your trainee to remain with the group?
6. What, if any, specific technical or communication skills do you expect your trainee to learn as part of the research experience?
7. What level of independence do you expect your trainee to achieve, once basic techniques are learned? What can your trainee do to gain independence in research? How long do you expect this transition to take?
8. What is your mentoring approach? Once your trainee has learned the techniques and procedures used in your lab do you prefer to watch your trainee closely, walking him/her through all the steps or do you prefer a more hands off approach?
9. How will your trainee document research results? Is there a specific protocol for keeping a laboratory notebook in your research group?
10. To whom should your trainee go if they have questions about your research project? Do you expect them to come to you solely (or first), or should they feel free to ask others in the research group? If others, who would be good resource people for your project?
11. What are your expectations for your trainee's level of comfort with the methodology used in the lab. For example does your research involve working with animals, lengthy field trips, or working in isolation with other researchers, and is your trainee comfortable with this?
12. Will the research that your trainee will be involved in be confidential? Are they allowed to discuss your project with other individuals outside of your laboratory? What are your expectations?

13. What role will you play in the development of your trainee's writing skills? Will you provide feedback and guidance on numerous drafts or do you only want to provide feedback on the final draft? If you are only willing to read final drafts of writing, are there others in the lab who are willing to provide feedback on earlier drafts?
14. Discuss the institutional safety or ethics training that is required for your trainee to work on your research project and establish a deadline by which they should complete it.
15. If a student has previous research experience, is there anything that you need to share about this research group that is unique and that the student should be aware of?

Mentor - Graduate Trainee Expectations Agreement

Trainee (print)_____Mentor (print) _____

This agreement outlines the parameters of our work together on this research project.

1. Our major goals are:
 - A. proposed research project goals –
 - B. trainee’s personal and/or professional goals -
 - C. mentor’s personal and/or professional goals –
2. Our shared vision of success in this research project is:
3. We agree to work together on this project for at least____years
4. The trainee will work at least____hours per week on the project during the academic year, and____hours per week in the summer. In addition, the trainee is expected to _____
5. The trainee will propose their weekly schedule to the mentor by the____week of the semester.

If the trainee must deviate from this schedule (e.g. to study for an upcoming exam), they will communicate this to the mentor at least (weeks/days/hours) before the change occurs.
6. On a daily basis, our primary means of communication will be through (circle all that apply):
face to face/phone/email/instant messaging/ _____
7. We will meet one-on-one to discuss our progress on the project and to reaffirm or revise our goals for at least____minutes_time(s) per month
 - a. (Circle one): It will be the (trainee’s/mentor’s) responsibility to schedule these meetings.
 - b. In preparation for these meetings, the trainee will:
 - c. In preparation for these meetings, the mentor will:

8. At these meetings, the mentor will provide feedback on the trainee's performance and specific suggestions for how to improve or progress to the next level of responsibility through a
 - a. written evaluation
 - b. a verbal evaluation
 - c. other _____
9. The trainee is expected to participate in the following (e.g. journal club, teaching commitments, etc.)
10. When learning new techniques and procedures, the mentor will train the trainee using the following procedure(s) (e.g. write out directions, hands-on demonstration, verbally direct as trainee does procedure, etc.):
11. The proper procedure for documenting research results (laboratory notebook) in our research group is:

The notebook will be checked _____ (e.g., weekly/monthly).
12. If the trainee gets stuck while working on the project (e.g. has questions or needs help with a technique or data analysis) the procedure to follow will be:
13. The standard operating procedures for working in our research group, which all group members must follow and the trainee agrees to follow, include: (e.g. require institutional training wash your own glassware, attend weekly lab meetings, reorder supplies when you use the last of something, etc.)
14. The mentor and trainee have agreed on a mentoring approach which consists of
15. The mentor and trainee have discussed the methodology used in the lab in detail and trainee understands what is expected of him/her.
16. The mentor agrees to read and revise the trainees research writing according to the following procedure:
17. The trainee agrees to not present any of the research findings from this laboratory in any shape or form without the explicit consent and approval of the mentor.
18. Other issues not addressed above that are important to our work together:

By signing below, we agree to these goals, expectations, and working parameters for this research project

| | | | |
|--------------------------|-------------|-------------|-----------|
| Trainee's signature_____ | Date:_____ | Mentor's | signature |
| _____ | Date:_____ | Professor's | |
| signature_____ | Date: _____ | | |

Example Mentor - Graduate Trainee Agreement

Dr. Trina McMahon, University of Wisconsin-Madison

The broad goals of my research program

As part of my job as a professor, I am expected to write grants and initiate research that will make tangible contributions to science, the academic community, and to society. You will be helping me carry out this research. It is imperative that we carry out good scientific method and conduct ourselves in an ethical way. We must always keep in mind that the ultimate goal of our research is publication in scientific journals. Dissemination of the knowledge we gain is critical to the advancement of our field. I also value outreach and informal science education, both in the classroom and while engaging with the public. I expect you to participate in this component of our lab mission while you are part of the lab group.

What I expect from you

Another part of my job as a professor is to train and advise students. I must contribute to your professional development and progress in your degree. I will help you set goals and hopefully achieve them. However, I cannot do the work for you. In general, I expect you to:

- Learn how to plan, design, and conduct high quality scientific research
- Learn how to present and document your scientific findings
- Be honest, ethical, and enthusiastic
- Be engaged within the research group and at least two programs on campus
- Treat your lab mates, lab funds, equipment, and microbes with respect
- Take advantage of professional development opportunities
- Obtain your degree
- Work hard – don't give up!

► You will take ownership over your educational experience

Acknowledge that you have the primary responsibility for the successful completion of your degree. This includes commitment to your work in classrooms and the laboratory. You should maintain a high level of professionalism, self-motivation, engagement, scientific curiosity, and ethical standards.

Ensure that you meet regularly with me and provide me with updates on the progress and results of your activities and experiments. Make sure that you also use this time to communicate new ideas that you have about your work and challenges that you are facing. Remember: I cannot address or advise about issues that you do not bring to my attention.

Be knowledgeable of the policies, deadlines, and requirements of the graduate program, the graduate school, and the university. Comply with all institutional policies, including academic program milestones, laboratory practices, and rules related to chemical safety, biosafety, and fieldwork.

Actively cultivate your professional development. UW-Madison has outstanding resources in place to support professional development for students. I expect you to take full advantage of these resources, since part of becoming a successful engineer or scientist involves more than just doing academic research. You are expected to make continued progress in your development as a teacher, as an ambassador to the general public representing the University and your discipline, with respect to your networking skills, and as an engaged member of broader professional organizations. The Graduate School has a regular seminar series related to professional

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development. The Delta Program offers formalized training in the integration of research, teaching, and learning. All graduate degree programs require attendance at a weekly seminar. Various organizations on campus engage in science outreach and informal education activities. Attendance at conferences and workshops will also provide professional development opportunities. When you attend a conference, I expect you to seek out these opportunities to make the most of your attendance. You should become a member of one or more professional societies such as the Water Environment Federation, the American Society for Microbiology, or the American Society for Limnology and Oceanography.

► *You will be a team player*

Attend and actively participate in all group meetings, as well as seminars that are part of your educational program. Participation in group meetings does not mean only presenting your own work, but providing support to others in the lab through shared insight. You should refrain from using your computer, Blackberry, or iPhone during research meetings. Even if you are using the device to augment the discussion, it is disrespectful to the larger group to have your attention distracted by the device. Do your part to create a climate of engagement and mutual respect.

Strive to be the very best lab citizen. Take part in shared laboratory responsibilities and use laboratory resources carefully and frugally. Maintain a safe and clean laboratory space where data and research participants confidentiality are protected. Be respectful, tolerant of, and work collegially with all laboratory colleagues: respect individual differences in values, personalities, work styles, and theoretical perspectives.

Be a good collaborator. Engage in collaborations within and beyond our lab group. Collaborations are more than just publishing papers together. They demand effective and frequent communication, mutual respect, trust, and shared goals. Effective collaboration is an extremely important component of the mission of our lab.

Leave no trace. As part of our collaborations with the Center for Limnology and other research groups, you will often be using equipment that does not belong to our lab. I ask that you respect this equipment and treat it even more carefully than our own equipment. Always return it as soon as possible in the same condition you found it. If something breaks, tell me right away so that we can arrange to fix or replace it. Don't panic over broken equipment. Mistakes happen. But it is not acceptable to return something broken or damaged without taking the steps necessary to fix it.

Acknowledge the efforts of collaborators. This includes other members of the lab as well as those outside the lab. Don't forget important individuals like Dave Harring at the CFL and Jackie Cooper at CEE.

► *You will develop strong research skills*

Take advantage of your opportunity to work at a world-class university by developing and refining stellar research skills. I expect that you will learn how to plan, design, and conduct high quality scientific research.

Challenge yourself by presenting your work at meetings and seminars as early as you can and by preparing scientific articles that effectively present your work to others in the field. The 'currency' in science is published papers, they drive a lot of what we do and because our lab is supported by taxpayer dollars we have an obligation to complete and disseminate our findings. I will push you to publish your research as you move through your training program, not only at the end. Students pursuing a Masters degree will be expected to author or make major contributions

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to at least one journal paper submission. Students pursuing a doctoral degree will be expected to be lead author on at least two journal papers submissions, preferably three or four.

Keep up with the literature so that you can have a hand in guiding your own research. Block at least one hour per week to peruse current tables of contents for journals or do literature searches. Participate in journal clubs. Better yet, organize one!

Maintain detailed, organized, and accurate laboratory records. Be aware that your notes, records and all tangible research data are my property as the lab director. When you leave the lab, I encourage you to take copies of your data with you. But one full set of all data must stay in the lab, with appropriate and accessible documentation. Regularly backup your computer data to the Bacteriology Elizabeth McCoy server (see the wiki for more instructions).

Be responsive to advice and constructive criticism. The feedback you get from me, your colleagues, your committee members, and your course instructors is intended to improve your scientific work.

► *You will work to meet deadlines*

Strive to meet deadlines: this is the only way to manage your progress. Deadlines can be managed in a number of ways, but I expect you to work your best to maintain these goals. We will establish mutually agreed upon deadlines for each phase of your work during one-on-one meetings at the beginning of each term. For graduate students, there is to be a balance between time spent in class and time spent on research and perhaps on outreach or teaching. As long as you are meeting expectations, you can largely set your own schedule. It is your responsibility to talk with me if you are having difficulty completing your work and I will consider your progress unsatisfactory if I need to follow-up with you about completion of your lab or coursework.

Be mindful of the constraints on my time. When we set a deadline, I will block off time to read and respond to your work. If I do not receive your materials, I will move your project to the end of my queue. Allow a minimum of one week prior to submission deadlines for me to read and respond to short materials such as conference abstracts and three weeks for me to work on manuscripts or grant proposals. Please do not assume I can read materials within a day or two, especially when I am traveling.

► *You will communicate clearly*

Remember that all of us are “new” at various points in our careers. If you feel uncertain, overwhelmed, or want additional support, please overtly ask for it. I welcome these conversations and view them as necessary.

Let me know the style of communication or schedule of meetings that you prefer. If there is something about my mentoring style that is proving difficult for you, please tell me so that you give me an opportunity to find an approach that works for you. No single style works for everyone; no one style is expected to work all the time. Do not cancel meetings with me if you feel that you have not made adequate progress on your research; these might be the most critical times to meet with a mentor.

Be prompt. Respond promptly (in most cases, within 48 hours) to emails from anyone in our lab group and show up on time and prepared for meetings. If you need time to gather information in response to an email, please acknowledge receipt of the message and indicate when you will be able to provide the requested information.

Discuss policies on work hours, sick leave and vacation with me directly. Consult with me and

notify fellow lab members in advance of any planned absences. Graduate students can expect to work an average of 50 hours per week in the lab; post-docs and staff at least 40 hours per week. I expect that most lab members will not exceed two weeks of personal travel away from the lab in any given year. Most research participants are available during University holidays, so all travel plans, even at the major holidays, must be approved by me before any firm plans are made. I believe that work-life balance and vacation time are essential for creative thinking and good health and encourage you to take regular vacations. Be aware, however, that there will necessarily be epochs – especially early in your training—when more effort will need to be devoted to work and it may not be ideal to schedule time away. This includes the field season, for students/post-docs working on the lakes.

Discuss policies on authorship and attendance at professional meetings with me before beginning any projects to ensure that we are in agreement. I expect you to submit relevant research results in a timely manner. Barring unusual circumstances, it is my policy that students are first-author on all work for which they took the lead on data collection and preparation of the initial draft of the manuscript.

Help other students with their projects and mentor/train other students. This is a valuable experience! Undergraduates working in the lab should be encouraged to contribute to the writing of manuscripts. If you wish to add other individuals as authors to your papers, please discuss this with me early on and before discussing the situation with the potential co-authors.

What you should expect from me

I will work tirelessly for the good of the lab group; the success of every member of our group is my top priority, no matter their personal strengths and weaknesses, or career goals.

I will be available for regular meeting and informal conversations. My busy schedule requires that we plan in advance for meetings to discuss your research and any professional or personal concerns you have. Although I will try to be available as much as possible for “drop in business”, keep in mind that I am often running to teach a class or to a faculty meeting and will have limited time.

I will help you navigate your graduate program of study. As stated above, you are responsible for keeping up with deadlines and being knowledgeable about requirements for your specific program. However, I am available to help interpret these requirements, select appropriate coursework, and select committee members for your oral exams.

I will discuss data ownership and authorship policies regarding papers with you. These can create unnecessary conflict within the lab and among collaborators. It is important that we communicate openly and regularly about them. Do not hesitate to voice concerns when you have them.

I will be your advocate. If you have a problem, come and see me. I will my best to help you solve it.

I am committed to mentoring you, even after you leave my lab. I am committed to your education and training while you are in my lab, and to advising and guiding your career development—to the degree you wish—long after you leave. I will provide honest letters of evaluation for you when you request them.

I will lead by example and facilitate your training in complementary skills needed to be a successful scientist, such as oral and written communication skills, grant writing, lab

Adapted by E. Frazier, C. Pfund, and A. R. Butz from Branchaw, Pfund & Rediske (2010). *Entering Research: A Facilitator's Manual*. New York: WH Freeman & Company, and from Pfund, Wassarman & Skarlupka (2014). *Establishing your Mentoring Relationships for CMB, Biophysics and Nutritional Sciences*. Branchaw, J. L., Butz, A. R., & Smith A. (2018). *Entering Research* (2nd ed.). New York: Macmillan.

management, mentoring, and scientific professionalism. I will encourage you to seek opportunities in teaching, even if not required for your degree program. I will also strongly encourage you to gain practice in mentoring undergraduate and/or high school students, and to seek formal training in this activity through the Delta program.

I will encourage you to attend scientific/professional meetings and will make an effort to fund such activities. I will not be able to cover all requests but you can generally expect to attend at least one major conference per year, when you have material to present. Please use conferences as an opportunity to further your education, and not as a vacation. If you register for a conference, I expect you to attend the scientific sessions and participate in conference activities during the time you are there. Travel fellowships are available through the Environmental Engineering program, the Bacteriology Department, and the University if grant money is not available. I will help you identify and apply for these opportunities.

I will strive to be supportive, equitable, accessible, encouraging, and respectful. I will try my best to understand your unique situation, and mentor you accordingly. I am mindful that each student comes from a different background and has different professional goals. It will help if you keep me informed about your experiences and remember that graduate school is a job with very high expectations. I view my role as fostering your professional confidence and encouraging your critical thinking, skepticism, and creativity. If my attempts to do this are not effective for you, I am open to talking with you about other ways to achieve these goals.

Yearly evaluation

Each year we will sit down to discuss progress and goals. At that time, you should remember to tell me if you are unhappy with any aspect of your experience as a graduate student here. Remember that I am your advocate, as well as your advisor. I will be able to help you with any problems you might have with other students, professors, or staff. Similarly, we should discuss any concerns that you have with respect to my role as your advisor. If you feel that you need more guidance, tell me. If you feel that I am interfering too much with your work, tell me. If you would like to meet with me more often, tell me. At the same time, I will tell you if I am satisfied with your progress, and if I think you are on track to graduate by your target date. It will be my responsibility to explain to you any deficiencies, so that you can take steps to fix them. This will be a good time for us to take care of any issues before they become major problems.

Elevator Sentences

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice, intermediate or advanced trainees

Areas of Trainee Development

- Research Comprehension and Communication Skills
 - Develop Science Communication Skills
 - Develop Logical/Critical Thinking Skills
- Researcher Identity
 - Develop Identity as a Researcher

Learning Objectives:

Trainees will:

- Learn to engage general and expert audiences in a conversation about their research.

Activity Components and Estimated Time for Completion:

- In Session Time: 40 minutes

Total time: 40 minutes

When to use this activity

This activity can be implemented at the beginning of a research experience to help trainees understand how their research can be communicated to both expert and general audiences. Trainees can share revised elevator sentences at the beginning of each session for the first few meetings as they deepen their understanding of their project. This activity can be implemented concurrently or immediately following the “General Public Abstract” activity, or used as a precursor to the “Three Minute Research Story” activity.

Inclusion Considerations:

The background of trainees may influence how they discuss their research with different audiences. For example, first-generation college or graduate students might discuss their research with family members differently than they would the general public or another scientist. Acknowledge that their brief elevator sentence introduction may need to be accompanied by an explanation or justification of the research when presented to family members because the time and energy it takes to do research (i.e., working during the summer and getting a job right after college vs. participating in a summer research program and pursuing further training after graduation, etc.) may not align with familial notions of success.

Implementation Guide

Workshop Session (40 minutes)

- Introduction: The primary purpose of developing elevator sentences is to engage the audience in a conversation about the trainees’ research. For example, an elevator sentence for a general audience might be "I am studying the effect of altitude on fruit fly size". This

sentence might elicit a response such as "I didn't know that flies are different sizes". This response then provides the opportunity for the trainee to give more information about fly size, how it is measured, and why and how they are studying the effect of altitude. This elevator sentence had the right level of detail for the listener to further engage in the conversation.

On the other hand, an elevator sentence such as "I am studying the effect of hypoxia on thorax development in *Drosophila melanogaster*" says the same thing but is less likely to engage the audience in a conversation because it includes too much jargon for the general public. However, this elevator sentence would be appropriate to use with other scientists in the field. This activity is meant to give students practice refining their understanding of their research and communicating it in a way that is appropriate for the audience.

- Activity: Elevator Sentences (20 minutes)
 - Distribute the Elevator Sentences worksheet to trainees to work on individually. They should generate one sentence to answer the question "What are you studying?" This activity could also be presented as an assignment for discussion at the next session.
 - Trainees should work in pairs or trios and take turns asking each other this question as a non-expert (or as an expert, if the trainees are all conducting similar research) and use their elevator sentences to start a conversation about research. Trainees should provide feedback to one another and work as a team to refine each of their elevator sentences. A peer review assessment rubric is provided in the trainee materials.
 - If time allows, mix trainee pairs and do the exercise again with the revised elevator sentence.
- Large group discussion (15 minutes)
 - As a large group, discuss the following questions:
 - How does your answer change when you are speaking to a non-expert as opposed to an expert?
 - What types of questions did your sentence elicit from your partners/group?
 - How easy was it to talk about your research to individuals outside of your field?
 - Why might it be important to be able to communicate what you study to individuals outside of your field?
- Wrap Up (5 minutes)
 - Invite trainees to reflect on the revisions they made during the session, share their elevator sentence with their mentor for feedback, and refine it once more before submitting it for review by the facilitator.
- *Follow up activity:* If this activity is implemented as part of a semester course or summer seminar, facilitators may wish to revisit elevator sentences with trainees periodically. Encourage trainees to keep track of their revisions on the trainee materials worksheet and reflect on how their sentences change over the course of their research experience.

Changes in sentences should reflect an increased understanding of their research and how it fits into the work of their mentor's research group.

Note: Optional activity: Video record students explaining their research in a short period of time (15 seconds) at the beginning, middle, and end of their research experience to document (and celebrate) their improvement over time.

Elevator Sentences

Trainee Materials

Learning Objectives:

Trainees will:

- Learn to engage general and expert audiences in a conversation about their research.
-

Use one sentence to answer the question “What are you studying?”, if it were asked by a **non-expert**, *e.g.*, your mailman?

Draft 1:

Draft 2:

Draft 3:

Use one sentence to answer the question “What are you studying?”, if it were asked by **an expert**, *e.g.*, a graduate student in your lab?

Draft 1:

Draft 2:

Draft 3:

Elevator Sentences
Peer Review Assessment Rubric

Name of the Presenter: _____

Reviewer (circle one): expert/ non-expert in the trainee's area of research

Use the following scale to rate the presenter:

1=strongly disagree, 2=disagree, 3=somewhat agree, 4=agree, 5=strongly agree

- | | | | | | |
|---|---|---|---|---|---|
| 1. I was able to understand the subject of the presenter's research. | 1 | 2 | 3 | 4 | 5 |
| 2. The presenter used terms and phrases that were appropriate to the audience's level of understanding. | 1 | 2 | 3 | 4 | 5 |
| 3. I was able to come up with follow up questions based on the presenter's elevator sentence. | 1 | 2 | 3 | 4 | 5 |

Comments:

Week 4

Research Group Focus

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop Disciplinary Knowledge
- Develop Science Communication Skills

Practical Research Skills

- Develop Ability to Design a Research Project

Activities:

- Your Research Group's Focus

Assignments Due:

- Research Group Diagram

Assessment Tools:

- Your Research Group's Focus-assessment rubric

Your Research Group's Focus

Facilitator Instructions

Trainee level: undergraduate or graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Disciplinary Knowledge
 - Develop Effective Interpersonal Communication Skills
 - Develop Science Communication Skills
- Practical Research Skills
 - Develop Ability to Design a Research Project

Learning Objectives

Trainees will:

- Learn about the research and methods used by the research group.
- Familiarize themselves with the researchers in the research group.
- Create a graphical abstract that represents the research of their mentor's research group.

Activity Components and Estimated Time for Completion:

- Pre-Assignment Time: 1-2 hours
- In Session Time: 1 hour, 20 minutes

Total time: 2-3 hours

When to use this activity

This activity is useful for undergraduate or graduate trainees who are early in their research experience. It can be implemented either before a trainee has selected a mentor (in the case of trainees who are rotating through research groups) or after a trainee has chosen a research group and mentor. Facilitators who are emphasizing science communication in their courses or workshops can use this activity as an opportunity to introduce trainees to the importance of “elevator speeches,” or the ability to briefly summarize the focus and scope of what they do in the research group. Additional activities on science communication include the “3-minute research story” and “Science Communication Discussion.”

Inclusion Considerations

Creation of graphical abstracts provides an opportunity to discuss why it is important for trainees to develop the ability to communicate research in diverse ways and to diverse audiences. Encourage them to engage their own unique backgrounds in developing their graphical abstracts, consider how their graphical representations may be interpreted or perceived by those from different backgrounds, and how they will most effectively convey the meaning of their graphical representations.

Implementation Guide

Trainee Pre-Assignment (1-2 hours)

- Prior to the session, distribute the trainee materials, which include a 2-step pre-assignment.

Trainees should complete this pre-assignment before the session so that they can invest time in understanding the research conducted in the laboratory/research group.

- Have trainees write one paragraph that provides an overview of the research on their mentor's research team.
- Have trainees draw a graphical abstract that provides an overview of the research in their mentor's research group. A graphical abstract is a single, concise pictorial, and visual summary.
- Emphasize to trainees that the intent of the activity is to facilitate discussion about research, not to spend a lot of time and energy learning to use software to create sophisticated images. Simple drawings on white/chalk boards, large poster boards, or flowcharts created using simple software programs are sufficient.
- Facilitators are encouraged to speak with the lab director or graduate students in the research group prior to this session to better understand the research that trainees will be presenting.

Note: Facilitators can revise Question 1 on the pre-assignment to guide trainees to write their paragraph more like an abstract of their work to set trainees up for expanding on their abstract in a research paper/presentation later in a course.

Workshop Session (1 hour, 30 minutes)

- Introduction
 - The objective of this activity is for trainees to learn about the major research questions in the research group. This includes smaller projects and how they relate to the larger aims of the research group, the researchers conducting the projects, and the research methods commonly utilized in the group.
 - The description of the activity below can be used for in class discussions with undergraduate trainees or as part of research group rotations with graduate trainees.
- Activity: Chalk Talks (1 hour)
 - Each trainee presents her graphical abstract that addresses the research questions and methods utilized in her research group and explains any technical language. Example graphical abstracts and guidelines can be found here:
http://www.cell.com/pb/assets/raw/shared/figureguidelines/GA_guideline.pdf
 - Depending upon the setup of the room, a projector or white/chalk board may be used for presentations
 - Trainees who are not presenting can fill out a note card or sheet of paper answering the following questions:
 - What did the presenter do well?
 - What should the presenter improve upon?
 - What two questions do you still have about their research

Note: Facilitators wishing to evaluate chalk talks can use the rubric included at the end of the facilitator notes.

- Discussion (20 minutes)
 - Discussion questions:
 - How does your project fit within the bigger research question in the group?
 - Are you comfortable with the methods you will be using in your research experience?
 - For example, novice students may not be aware that they have to conduct surgery on animals as part of their research. Are they comfortable with the idea of doing animal surgery? Other students in the medical field may expect to be working directly with patients when in reality they will spend most of their time in front of a computer. Field researchers may have to take helicopters and be left in a remote area and picked up later in the day. Are they comfortable with that idea? If not they may want to consider another research team.
- Wrap up (5 minutes)
 - Summarize the key points of the discussion. Encourage trainees to discuss any concerns that they have about research with their mentor.

Your Research Group's Focus *Assessment Rubric*

This rubric can be used for peer review and to assess chalk talks given by trainees.

Name of presenter:

Title/Topic:

| | 0 | 1 | 2 | 3 |
|---------------------------|--------|---|---|---|
| Research Questions | Absent | The presenter did not clearly state their research group's research questions or hypotheses | The presenter somewhat clearly stated their research group's research questions or hypotheses | The presenter clearly stated their research group's research questions or hypotheses |
| Methods | Absent | The presenter explained the methods used by their research group in a way that was unclear. | The presenter explained the methods used by their research group, but some components were unclear. | The presenter clearly explained the methods used by their research group. |
| Jargon | Absent | The presenter used jargon frequently and often did not explain technical language. | The presenter used some jargon and explained most of the technical language used. | The presenter did not use jargon and translated technical language so that the audience could understand. |

Overall Score (circle one):

Poor

Fair

Good

Very Good

Excellent

Suggestions for Improvement:

Your Research Group's Focus

Trainee Materials

Learning Objectives

Trainees will:

- Learn about the research and methods used by the research group.
 - Familiarize themselves with the researchers in the research group.
 - Create a graphical abstract that represents the research of their mentor's research group.
-

Your Research Group's Focus

The purpose of this activity is to help you understand your research group's focus and to practice using multiple modes of communication to convey this understanding to a diversity of audiences. It will also help you get to know other researchers on your research team and how their projects are related.

Pre-Session Assignment:

1. Write one paragraph, in your own words, describing the focus of your group's research. Be sure to include the group's major research questions, smaller projects within the major research question, as well as the names of the researchers responsible for each project, the general methods involved and what areas of this research are interesting to you. You may want to interview your research mentor and members of the research team to get a better understanding of the research.
2. Take the paragraph you've written and create a graphical abstract, which should convey the same points described in the paragraph, but in visual form. An example of a graphical abstract appears on the next page.

In class activity: In the next session, you will give a "chalk talk" (informal oral presentation) of your research group's work in which you will present your graphical abstract and explain any technical language.

To prepare for your chalk talk consider:

- How does your research project fit into the larger research question(s) of the group?
- How does your research project relate to other projects in the group?
- Have you given thought to the methods used by your team to address the research questions? Are you comfortable conducting these procedures?

Pre-Session Assignment: Graphical Abstract

Draw a graphical abstract that provides an overview of the research in your lab. A graphical abstract is a single, concise, pictorial, and visual summary. Often, graphical abstracts are used to summarize the main findings of an article. They can also be used to summarize methods or hypotheses. For more information and examples, visit http://www.cell.com/pb/assets/raw/shared/figureguidelines/GA_guide.pdf

Week 5

Documenting Your Research & Persistence in Research

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop Disciplinary Knowledge
- Develop Science Communication Skills
- Develop an Understanding of the Research Environment

Research Ethics

- Develop Responsible and Ethical Research Practices

Practical Research Skills

- Develop Ability to Conduct a Research Project

Researcher Confidence and Independence

- Develop Independence as a Researcher
- Develop Confidence as a Researcher

Professional and Career Development Skills

- Develop Confidence in Pursuing a Research Career

Activities:

- Research Documentation Process
- Elevator Sentence Practice
- Case Study: Overwhelmed
- Case Study: Frustrated

Assignments Due:

- Research Documentation Process
- Revise Elevator Sentences

Assessment Tools:

- Post-activity mini-reflection & assessment rubric

Research Documentation Process

Facilitator Instructions

Trainee Level: undergraduate and graduate trainees
novice trainees

Areas of Trainee Development:

- Practical Research Skills
 - Develop Ability to Conduct a Research Project
- Research Ethics
 - Develop Responsible and Ethical Research Practices
- Research Comprehension and Communication Skills
 - Develop Disciplinary Knowledge
 - Develop Science Communication Skills

Learning Objectives

Trainees will:

- Explain why it is important to accurately document their research.
- Identify key elements in research documentation.
- Identify commonalities and differences in documentation associated with different research fields.
- Understand the ethical implications of documenting their work.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 1 hour
- In Session Time: 1 hour

Total time: 2 hours

When to use this activity

This activity should be used very early in the novice trainee's research career, preferably as soon as they start working with a research group to establish good practices. It can be implemented before or after a trainee selects a mentor.

Inclusion Considerations

Consider learning styles, differences and disabilities when discussing best practices in research documentation. Ask whether trainees have concerns about traditional best practices to empower them to talk about any of these barriers or concerns with their mentor or another advisor.

Implementation Guide

Trainee Pre-Assignment (1 hour)

- Have trainees complete the “*Research Documentation Process*” assignment, which requires them to discuss with their mentor how research is documented in their group. Trainees should bring their outlines to the session.
- Before the discussion, you may also distribute [*Guidelines for SCIENTIFIC RECORD KEEPING in the Intramural Research Program at the NIH*](#), which is available as a pdf and is a good resource on scientific notebook keeping.

Workshop Session (1 hour)

- Introduction
 - The goal of this activity is to familiarize trainees with the research documentation process in their research group.
- Discussion (30 minutes)
 - Research activities are diverse, thus the documentation of those activities can vary, including both written and electronic forms. What is outlined below may include documentation of activities that none of the trainees in the cohort are doing. Other trainees may have documentation needs that are not addressed. However, **the underlying principle of documenting all work done so that it can be repeated should come through in the discussion.**
 - If this activity is used with graduate students in a program that has rotations, include a discussion about watching for similarities and differences as they rotate among groups. Graduate students may also discuss comparisons to groups in which they worked as undergraduates.
 - Ask each trainee to name one thing that should be included in each research notebook entry. Generate a comprehensive list for the subsequent discussion. (5 minutes) This list might include:
 - Date
 - Hypothesis
 - Explanation of goals/rationale for the experiment
 - Detailed procedures identifying experimental and control treatments
 - Reagents
 - Key for labeling and identifying tubes, animals, etc.
 - Data, both successful and unsuccessful results
 - Analyses of data
 - Interpretation and thoughts about what to do next
 - Computer scripts for data mining and data analysis
 - Locations of transects and other field notes
 - References to locations of specimens and electronic data
 - Citations for methods, reagents, analyses, etc.
 - Using the list of items generated above, discuss the commonalities and differences across trainees’ research groups (20minutes).
 - Discussion Questions:
 - Why is it important to keep a research notebook?

- to be able to repeat the experiment
- to be able to write up the results for publication
- to document for patents
- to defend against accusations of fraud

■ What format is required?

- Does the lab use paper copies or electronic copies?
- If paper copies, what happens to any photo, video or other computer output?
- If electronic copies, how is the electronic copy maintained? How is the data backed up?

■ Who owns the data? Where is the notebook to be kept?

- All data belongs to the research group and university or company.

■ How will the notebook be used in the future? How does planning for the future influence how notes are kept?

- The notebook needs to be detailed for you or other lab members to do follow up experiments.
- Discuss obligations for sharing data post publication (both the scientific ethics of sharing and publication requirements).

■ What elements of research need to be documented? This could lead to a discussion of:

- procedures, including descriptions of experiments, observations and computer scripts
- raw data
- data analysis, including the procedures used to analyze the data
- processed data

■ Are there elements that are used in other research groups that you may find helpful to your own research?

- How do your lab's research documentation protocols reflect the culture in your research group? How do they reflect the communication style in your research group?
- Wrap-up (5 minutes)
 - Summarize key points of the discussion with trainees. Encourage trainees to clarify with their mentor any parts of the documentation process that are unclear to them.

Research Documentation Process

Trainee Materials

Learning Objectives

Trainees will:

- Explain why it is important to accurately document their research.
 - Identify key elements in research documentation.
 - Identify commonalities and differences in documentation associated with different research fields.
 - Understand the ethical implications of documenting their work.
-

Meet with your mentor to go over the protocol you must follow when documenting your research. Aspects of research that need to be documented may include a description of the methods followed, the raw data results, the analysis used and the results of analyses. Discuss the level of detail expected in the documentation for your research group and ask your mentor to identify a research team member who keeps an exemplary notebook, or to show you another excellent example. The specifics of what and how to document research will vary depending on the nature of the research (e.g., field or lab based, computational, library).

Write an outline of the protocol that you are to follow when doing research and identify the parts of the process that are common to your entire research group and which are specific to your project.

In addition, address the following questions:

1. What kinds of notes are kept? Are they hard copy documents or electronic files?
2. Where are the notes kept?
3. What parts of the research are documented? What level of detail is needed in documenting experiments?
4. How are data to be recorded?

Case Study: Overwhelmed

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Researcher Confidence and Independence
 - Develop Confidence as a Researcher
- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills
- Professional and Career Development Skills
 - Develop Confidence in Pursuing a Research Career

Learning Objectives

Trainees will:

- Practice strategies to ask for help from mentor(s).
- Identify additional resources for help.

Activity Components and Estimated Time for Completion:

- In Session Time: 20 minutes

Total time: 20 minutes

When to use this activity

This activity is most appropriate for undergraduate and graduate trainees in their first semester of research.

Inclusion Considerations

Discuss how power and authority dynamics might be at play for trainees, especially those underrepresented in research careers, and why trainees might resist asking for help from a mentor. Encourage trainees to establish clear expectations to which they, their mentor, and others can agree. Remind trainees of their past accomplishments to help them build the confidence to ask for what they need.

Implementation Guide

- Case Study (5 minutes)
 - Pass out the case study included in the trainee materials and ask students to read and individually write down answers to the questions.
- Discussion (15 minutes)
 - Bring the group together to discuss the case using the questions provided in the trainee materials.
 - Alternatively, ask trainees to discuss the case study in small groups and then summarize their conversation for the large group.

Case Study: Overwhelmed

Undergraduate Trainee Materials

Learning Objectives:

Trainees will:

- Practice strategies to ask for help from mentor(s).
- Identify additional resources for help.

Ashley, a sophomore majoring in chemistry, has found an undergraduate research position at the Center for Nanotechnology. She started a couple of weeks ago and is excited about her research project, which involves working on the development of an automatic gene synthesizer, but she doesn't really understand it. She is shy and was completely overwhelmed at the first lab meeting. It was like nothing she had ever experienced. She understood little of what was discussed and she won't take introductory biology until next year. At the meeting, she just nodded whenever they asked if she understood, because she didn't want to look stupid. Now she is terrified to talk to the scientists for fear that they will realize how little she really understands. Her mentor, Sam, a biomedical engineering graduate student, is really nice, but also very busy. He told her to ask questions when she didn't understand something, but he is always engrossed in his work and she doesn't want to interrupt him. She has to write a 1-page summary of her research project for the undergraduate research seminar class by the end of next week, and has no idea where to begin. What should she do?

1. Is there a way for Ashley to approach her mentor to ask questions that respects his busy schedule?

2. Who else beside her mentor could Ashley turn to for help?

3. What resources might she use to help herself better understand the research on her own?

Case Study: Overwhelmed Graduate Trainee Materials

Learning Objectives:

Trainees will:

- Practice strategies to ask for help from mentor(s).
 - Identify additional resources for help.
-

Sam, a biomedical engineering graduate student, has a research assistantship through the Center for Nanotechnology. This is his first year in the graduate program and he is excited about leading a research project for his mentor on the development of an automatic gene synthesizer and mentoring two undergraduate students on the project. Sam knows what needs to be done, but is not sure how to mentor the undergraduates and delegate tasks to get things done. As a result, he ends up doing a lot of the work himself, leading to long hours in the lab. The extended lab hours are compromising his ability to keep up with his coursework. When Sam's mentor asks him how things are going, he always replies "great!" and gives her a brief update on the project. Things are coming along, but with all of the work that he is doing, he has little time to mentor the undergraduate students on his project and the students are hesitant to ask him questions because he always seems so busy. Sam knows that he should be providing more direction to his undergraduate trainees and allow them to help out more with the project, but is not certain what changes need to be made to make his team function more efficiently. He thought about asking his mentor, but is worried that he will look like he is not ready for graduate school if he asks for help. What should he do?

1. Should Sam talk to his mentor? Why or why not?
2. Who else beside his mentor could Sam turn to for help?
3. What resources might he use to help him run his team more efficiently?

Case Study: Frustrated

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills
 - Develop an Understanding of the Research Environment
- Researcher Confidence and Independence
 - Develop Independence as a Researcher

Learning Objectives

Trainees will:

- Practice strategies for communicating with their mentor and members of their mentor's research team.

Activity Components and Estimated Time for Completion:

- In Session Time: 20 minutes

Total time: 20 minutes

When to use this activity

This activity can be used with undergraduate or graduate trainees at any career stage and in conjunction with other activities related to improving communication in mentoring relationships

- Messages Sent and Received
- Barriers to Effective Communication
- Research Experience Reflections 1: Entering Research?
- Aligning Mentor/Trainee Expectations

Inclusion Considerations

Individuals from backgrounds historically underrepresented in STEM may struggle to find common ground with their mentors. Different mentor and mentee identities and backgrounds can create barriers to connecting and to the development of effective mentor-mentee relationships. Help trainees realize that even with different backgrounds and identities it is possible to develop positive and trusting relationships through open and honest communication. Reassure them that their mentors are there to support their training and development, but acknowledge that it may be difficult to speak up when things are not going well given the power and authority dynamics in these relationships. Establishing and aligning clear expectations with their mentor is important.

Implementation Guide

Workshop Session(20 minutes)

- Case Study (5 minutes)
 - Distribute the case study and ask trainees to read and individually write down answers to the questions.

- Discussion (15 minutes)
 - Bring the entire group together to discuss the case.
 - If the group is large, put trainees in small groups to discuss the case, then ask each group to summarize their conversation for the large group at the end.

Case Study: Frustrated

Undergraduate Trainee Materials

Learning Objectives:

- Trainees will practice strategies for communicating with their mentor and members of their mentor's research team.
-

Jamal has been in his research group for almost three weeks and is disappointed with his project so far. When he interviewed with Professor Stanley, she described a molecular biology project that he would work on. However, his graduate student mentor, Roxanne, has not given him any molecular biology experiments, but instead tasks such as making media and growing bacteria. Other undergraduate students in the lab seem to be doing things like cloning and sequencing genes. Jamal is getting frustrated, but doesn't want to complain or look ungrateful. What can he do?

1. To whom should Jamal go to discuss his frustration?
2. What strategies might he use to avoid appearing as though he is complaining?
3. How might establishing specific goals and expectations with his mentor help Jamal to avoid this situation?

Case Study: Frustrated

Graduate Trainee Materials

Learning Objectives:

- Trainees will practice strategies for communicating with their mentor and members of their mentor's research team.

Jamal is a first year Ph.D. student in molecular biology in Professor Stanley's lab. When he interviewed with Professor Stanley, she described a molecular biology project that he could work on as part of his dissertation research. He was excited to already have a potential dissertation topic identified! However, his first few months in the lab have been very frustrating. Professor Stanley has been out of town for much of the semester working on another grant-funded project, and Jamal has received little guidance from the postdocs, who are supervising the project in her absence. He feels like he is lagging behind some of the other students in his cohort, who are already working on manuscripts and conference presentations. Jamal wants to talk with Professor Stanley about this, but doesn't want to complain or look ungrateful; nor does he want the postdocs to feel like he is going over their head. What can he do?

Questions for discussion:

1. To whom should Jamal go to discuss his frustration?
2. What strategies might he use to avoid appearing as though he is complaining?
3. How might establishing specific goals and expectations with his mentor help Jamal to avoid this situation?

Week 6

Reading Scientific Literature

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Science Communication Skills
- Develop Logical/Critical Thinking Skills

Researcher Confidence and Independence

- Develop Independence as a Researcher

Activities:

- Research Articles 3: Practical Reading Strategies
- Elevator Sentence Practice

Assignments Due:

- Research Articles 2: Guided Reading
- Read article assigned in class
- Research Experience Reflections 3: Reflection Exercise

Assessment Tools:

- Research Experience Reflections 3- assessment rubric

Research Articles 3: Practical Reading Strategies

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice and intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Logical/Critical Thinking Skills
 - Develop Science Communication Skills
- Researcher Confidence and Independence
 - Develop Independence as a Researcher

Learning Objectives

Trainees will:

- Develop critical reading skills.

Activity Components and Estimated Time for Completion:

- Pre-Assignment Time: 2 hours
- In Session Time: 1 hour

Total time: 3 hours

When to use this activity

This activity should be used with novice or intermediate trainees who have begun working in a research group and have a specific research topic to guide their selection of a relevant research article from the literature. This activity can be used with the resource “Guide to Reading Research Articles,” found in the Trainee Materials section, and implemented along with “Research Articles 1: Introduction” and “Research Articles 2: Guided Reading.”

Inclusion Considerations

Novice trainees, especially those who have traveled non-traditional academic pathways, may have had limited exposure or opportunity to read research articles. Reassure them that they will learn strategies to break down the articles into manageable chunks and that their reading skills will improve with practice. If trainees have challenges with reading (e.g., disabilities) talk about these challenges and encourage them to seek help from professionals and to share this information with their research mentor, so that he or she is aware and can help.

Implementation Guide

Trainee Pre-Assignment (2 hours)

- Before the meeting, trainees should identify and read at least one research article covering important background information that they will need to plan and conduct their research project. This could be an article published by their own research team or one from another team in the field.
- Distribute the “Guide to Reading Research Articles” (included in the Trainee Materials) as a reference to support trainees as they read their article.

- In addition, facilitators may also refer students to other published resources such as: Ruben, A. (2016) How to read a scientific paper. *Science* DOI: 10.1126/science.caredit.a1600012 <http://www.sciencemag.org/careers/2016/01/how-read-scientific-paper>

Workshop Session (1 hour)

- Activity (30 minutes)
 - Trainees work in small groups of two to four to share and generate a list of reading strategies that they used. Some strategies that students have suggested include:
 - Read the abstract, introduction, and conclusion first to get an overview of the main points.
 - Skip the methods section on the first read, since the methods may be confusing to readers with limited experience doing experiments.
 - Take notes as you read.
 - Write out questions as you read.
 - Search an introductory textbook or the web for terms or ideas that are difficult to understand. These sources often use simple language in their explanations.
- Discussion (30 minutes)
 - Bring the small groups together for the second half of the meeting to share strategies.
 - Generate a common list on a board or flipchart that can be distributed to students as a follow-up after the session.
 - Discuss the pros and cons of each strategy and which types of strategies work best for different types of articles.
- *Optional activity: Mentor Interview (15 minutes)*
 - As an optional follow up activity, facilitators can ask trainees to interview their mentors about reading and reviewing research literature in their discipline. Some potential interview questions include:
 - What are your three “go-to” journals and why?
 - How much time do you spend reading research literature on a weekly basis?
 - What strategies do you use when efficiently reading and deciphering research literature?
 - What advice would you give to a trainee who is just beginning to read and search research literature?
 - To debrief the interviews, trainees can discuss their interviews in small groups and share new reading strategies that they learned from their mentors.

Research Articles 3: Practical Reading Strategies

Trainee Materials

Learning Objectives:

Trainees will:

- Develop critical reading skills.
-

1. Work with your mentor to identify a research article that covers important background information that you will need to plan and conduct your research project. This could be an article published by your mentor's research team or one from another team in the field.
2. As you read the article, use the "Guide to Reading Research Articles" and attempt to answer the questions posed in the guide. Take notes and write questions about each section of the article as you read. Be prepared to share the strategies that you use to understand the article at the next meeting.
3. Develop a set of questions about the article to discuss with your research mentor(s). These questions might be to clarify your understanding of the research presented in the article, or about how the research in the article relates to your research project.

Guide to Reading Research Articles

The BIG Picture

Before trying to understand the details presented in a research paper, it is wise to get an overview. Consider the following questions when first scanning papers.

- What is the central question/hypothesis the author is proposing?
- What assumptions are made both when proposing hypotheses and when evaluating them in light of the data collected?
- What data do they collect to assess their hypothesis?
- What is their conclusion given the data?

Basic Understanding

Research articles are typically organized in sections as outlined below. Knowing what types of information are present in each section allows one to more efficiently and effectively find information.

Title:

Paper titles are usually succinct, stand-alone overviews of a paper's contents. Authors usually make an effort to include keywords that abstracting services could use in indexing the article. So, if you are new to a field and/or subject, it is useful to take note of the words used in the title as they may provide you with useful keywords to use in any literature searches you may perform.

Abstract:

The purpose of the abstract is to provide the reader with a succinct summary of the article. Thus, the abstract should provide information about the specific research problem being investigated, the methods used, the results obtained, and what the results of the study mean in the larger context of the research study and in some cases the field of study. This means that the abstract is a good place to look first if you are trying to decide whether or not the paper is relevant to your work.

Introduction:

The introduction section generally provides an overview of the research problem being studied - why it is a worthy problem, what work has already been done by others to solve it, and what the authors may have already done in this area. Introductions are a good place to go if you are new to the subject.

- What is the main question they are interested in pursuing?
- What background research/pattern/theoretical prediction motivates this question?
- Why is this question interesting in light of the background they discuss?
- Do they offer one hypothesis or more than one?
- What assumptions are made when proposing the hypotheses?

Methods:

The experimental section will provide detailed information on how the authors accomplished the experiments described in their paper. Such information typically includes sources for all reagents and/or materials used, names and models of all instrumentation used, methods for synthesizing any reagents, and provide quantitative information on the characterization of any new materials synthesized.

- Do their proposed methods critically test their hypotheses?
- Are any of their methods confounded?
- Did the authors use a creative method to evaluate their hypothesis?
- Are their methods simple and elegant or complicated and convoluted?
- Did they come up with a new technique to better evaluate a problem others have struggled with?

Results:

Some articles will distinguish between "Results" and "Discussion" while others will combine this information into one section "Results and Discussion." In papers that contain two distinct sections ("Results" and "Discussion"), the data obtained from the study are introduced in the "Results" section and their interpretation is delayed until the "Discussion" section. In papers that contain one section ("Results and Discussion"), results are introduced and interpreted experiment-by-experiment.

- What does the data say about the hypotheses?
- Is there only one interpretation of the data?
- Are there any big surprises/unexpected results?

Discussion:

Keep the following in mind:

- Does the author say that they support or reject the hypothesis?
- Do you agree with the author's interpretation of the data?
- What novel insights are gained from the results?
- What do the results imply more generally for the field of interest? For other fields?
- What will the authors do next?

Sophisticated Understanding

With experience, reading the research literature in a given field will come more easily. This includes the ability to better evaluate what is being presented, and the ability to ask more sophisticated questions.

- When reading papers be critical, but also pay attention to exciting findings, novel insights, and creative ideas. It's easy to criticize, but hard to praise!
- What critical experiment would *you* do to evaluate the proposed hypothesis?
- Form an opinion after looking at the data, before reading the author's interpretation and conclusions.
- Do you agree with the authors' interpretation or are there others?
- If more than one hypothesis is offered, is each exclusive, meaning that it proposes a distinctly alternative explanation that is incompatible with the others, or could some of the hypotheses operate simultaneously?
- Are there compelling alternatives given the data?
- What assumptions are made about the effectiveness of the experiments or the accuracy of the data?

Week 7

Research Self Efficacy

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills

Researcher Confidence and Independence

- Developing Confidence as a Researcher

Activities:

- Fostering Your Own Research Self-Efficacy
- The Power of Social Persuasion

Assignments Due:

- Read Self-Efficacy Article

Assessment Tools:

- Post-activity mini-reflection & assessment rubric

Fostering Your Own Research Self-Efficacy

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice, intermediate or advanced trainees

Areas of Trainee Development

- Researcher Confidence and Independence
 - Develop Confidence as a Researcher

Learning Objectives

Trainees will:

- Define self-efficacy and its sources.
- Clearly articulate steps to complete a research-related task.
- Articulate how the four sources of self-efficacy can be used to support their confidence to complete research-related tasks.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 20 minutes
- In Session Time: 55 minutes

Total time: 1 hour, 15 minutes

When to use this activity

Although this activity can be used at any stage of the research experience, it is most effective when a trainee has an understanding of the research process and has had at least some research experience with his or her mentor. It works well as a precursor to “The Power of Social Persuasion” activity and is appropriate to include in a unit or series of activities on building resilience or the cognitive factors that influence the research experience.

Inclusion Considerations:

Trainees who are members of underrepresented groups may be experiencing unconscious “threats” in the research environment that can undermine the development of their research self-efficacy. These threats must be acknowledged in order to mitigate them. Consider using the *Entering Research* resources on stereotype threat and imposter syndrome (available in “Stereotype Threat” and “Challenges Facing Diverse Teams” to help students identify and acknowledge these issues. Explain that overcoming or dealing with these types of challenges will contribute to building their research self-efficacy.

Implementation Guide

Trainee Pre-Assignment (20 minutes)

- Trainees should complete the following prior to the session:
 - Read “Self-Efficacy” article
(http://psychology.about.com/od/theoriesofpersonality/a/self_efficacy.htm?p=1)
 - Review Handout #1 in trainee materials

Workshop Session (55 minutes)

- Introduction: Define self-efficacy and its sources. (20 minutes)
 - Begin the session by providing a brief overview of self-efficacy and its sources. This can be done in a lecture format, but you may also want to use this as an opportunity for trainees to share what they learned from the pre-reading and their review of Handout #1. Below are some of the major points that should be discussed to ensure trainees have a good sense of what self-efficacy is and the sources of self-efficacy in the research experience.
 - **How would you define self-efficacy in your own words?**
 - Self-efficacy is a belief one has in his/her ability to successfully complete a given goal or task. In other words it is situation-specific self-confidence. It answers the question “can I do this?”
 - **From the reading, what are the four sources of self-efficacy?**
 - Self-efficacy is informed by four sources: mastery experience, vicarious experience, social persuasion, and emotional/physiological state. Here are some examples:
 - **Mastery experience** – a past accomplishment or success: “I’ve done this before”
 - **Vicarious experience** – a model that has successfully completed the task: “I’ve seen others do this before”
 - **Social persuasion** – a social or verbal message reinforcing ability or effort: “Others have told me that I can do this”
 - **Emotional/physiological state** – an emotional, affective, or physiological response: “Doing research in the lab makes me happy,” “I get excited when I’m doing field research,” or “My heart starts racing when I begin to conduct an experiment.”
 - **Conclude the discussion by reminding students of the following:**
 - Each of these four sources has the potential to both raise *or* lower one’s self-efficacy for research. Although mastery experience tends to have the most powerful influence on a trainee’s self-efficacy, another source may be a more powerful predictor of self-efficacy depending upon the situation and the individual. For example, a trainee that has little research experience may rely more upon vicarious experience and social persuasion to gauge their self-efficacy at first, then gradually come to rely more upon mastery experience as he/she obtains more direct experience with research.
- Activity: Significant Research/Learning Moment (15 minutes)
 - Ask trainees to think of a significant moment in their own life when they

Adapted by A. R. Butz from *Promoting Mentee Research Self-Efficacy* (Byars-Winston, Leveritt, Branchaw, & Pfund, 2013, 2016). University of Wisconsin-Madison. Supported by NIH grant # R01 GM094573 (Byars-Winston, PI). Branchaw, J. L., Butz, A. R., & Smith A. (2018). *Entering Research* (2nd ed.). New York: Macmillan.

felt more confident as a learner. This question can be projected onto a screen, written on the board, or prepared as a handout for trainees. (Note: for trainees with previous research experience, you may want to ask them to think of a significant moment when they felt more confident *as a researcher*.)

- In pairs, have trainees discuss the questions below (5 minutes)
 - How did that significant moment happen? What were the events, people, and experiences that contributed to the success?
 - What factors contributed to your sense of efficacy?
 - Were some efficacy sources more common than others in your success story? If so, what are they?
- Large group discussion (10 minutes)
 - Write each of the four sources down on a flipchart or whiteboard. As trainees share their stories, encourage them to categorize the factors that contributed to their self-efficacy into one of the four sources of self-efficacy.
 - Questions for discussion:
 - What sources were common in your “success” stories?
 - Did some sources come up more than others? If so, what were they? What are examples of how the sources help to increase self-efficacy?
 - Do these same sources work well for you in other areas of your studies?
 - Use this as a time to talk about whether all sources work the same across domains. Some sources may be more effective domains than others. Some may work better for different ages/career stages than others. Also talk about differences. For example, some of the literature on self-efficacy suggests that individuals of different genders and cultural backgrounds may rely upon different sources, or find certain sources of self-efficacy more salient than others. Encourage trainees to be mindful of the sources that work well for them, and to seek out opportunities in their research experience that will allow them to boost their self-efficacy for research.
- Activity: Stair Steps (Handout #2; 20 minutes)
 - The goal of this activity is to have trainees clearly articulate steps to complete a research-related task and articulate how the four sources of self-efficacy can be used to support their confidence to complete research-related tasks.
 - Have trainees write down something on their current research to-do list that they are not feeling confident in their ability to complete. Now have the trainees break the task down into at least 2-3 steps. If you are concerned that trainees will have difficulty identifying a task and/or breaking it down into steps, you can use one of the tasks listed in the

alternate activity below. Alternatively, you could also have trainees think back to a task that they successfully completed and identify the steps that they took to complete that task.

- Ask trainees to consider the following questions:
 - What sources of self-efficacy could help you get to the first step? What about to get from the first step to the second?
 - How can you help build your own self-efficacy along the way?
- If an example is helpful, refer trainees to the second page of Handout # 2, where they will find an example of someone who did not feel confident in their ability to identify and complete an analysis to test their hypothesis. This example includes steps that a trainee could take to successfully articulate an analysis plan and complete the analysis. At Step 2, they have identified 3 of the sources of self-efficacy that will help them to boost their confidence to ultimately complete this task.
- In pairs, have trainees discuss the ways that they could support their own self-efficacy at one of these steps using at least three of the sources of self-efficacy. Trainees can reference Handout # 1 to remind them of examples of each of the four sources of self-efficacy.
- Depending upon the size of your group, you may wish to have trainees summarize their discussions and talk about the different ways in which they incorporated the four sources to support them in a challenging task.
- Trainees can use these steps by themselves or in conversations with their mentor to help them recognize each successful step and celebrate it.

Note: Facilitators can use one of the following scenarios for the Stair Steps Exercise.

Ask participants as a group to help break the task down into manageable steps, and identify ways to support self-efficacy at each step. These can also be used in lieu of the example given on Handout #2 or adapted for different trainee levels (e.g., undergraduate trainees, junior faculty trainees).

“I need to learn a new technique in the lab”

Step 1: Ask someone in the lab to model the technique

for you. Step 2: Practice the technique a few times.

Step 3: Ask your PI/supervisor in the lab to provide you with feedback on your technique.

“I need to write an abstract for my research project, but I don’t know where to begin” Step 1: Read a journal article or conference abstracts for examples.

Step 2: Ask your mentor for examples of abstracts that they have written.

Step 3: Exchange abstracts with another student and give each other feedback.

“I need to do an analysis for my manuscript, but I don’t feel confident in my ability to do it” Step 1: Find online readings and tutorials that will walk you through the

analysis process.

Step 2: Attend a workshop or training where you can learn how to do the analysis with others. Step 3: Try the analysis with a different set of data with known results to check your process.

“I need to get started on my grant proposal, but I don’t know where to start”

Step 1: Review the call for proposals and come up with a writing plan by, backmapping your deadlines from the submission deadline.

Step 2: Ask your mentor for an example of a successful grant proposal.

Step 3: Invite colleagues to join a grant writing group with you.

References for additional reading:

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Fostering Your Own Research Self-Efficacy

Trainee Materials

Learning Objectives:

Trainees will:

- Define self-efficacy and its sources.
 - Clearly articulate steps to complete a research-related task.
 - Articulate how the four sources of self-efficacy can be used to support your confidence to complete research-related tasks.
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Handout #1

The Self-Efficacy Tool Box – What Can You Do to be a More Confident Researcher?

From: http://psychology.about.com/od/theoriesofpersonality/a/self_efficacy.htm?p=1

Remember:

Self-efficacy: belief in one's ability to achieve a specific goal or task. Self-efficacy is situation-specific self-confidence. Simply put, "Can I do this?"

Strong self-efficacy beliefs create interest, persistence, actual college degree completion, and career pursuits in science and research fields.

Here are some efficacy-building strategies to try:

Mastery experience – a past accomplishment or success

- Think about your past success during the research experience in particular or academics in general ["If you did it before you can do it now"]. What contributed to that success? How can that be applied to your future research endeavors?
- Apply strategies and habits that have contributed to your past success in research to the task at hand.
- Recall the things you are doing right; devise strategies to improve your skill in areas that are challenging to you.

Vicarious experience – seeing or knowing of someone else who has successfully completed the task

- Do you know of others who have done similar research and have been successful? Talk to those researchers and use their actions as a model for your own. Consider your role models and what research skills (and attitudes) are being modeled by them.
- Be aware of what skills and behavior you are observing about coping with research challenges and setbacks; do they make you feel more or less confident about the work that you do? Ask others to share strategies for what they do when they hit a wall and how they cope with challenges/setbacks in research.
- Think of examples of others who struggled but made it (i.e., successful in research)

Social persuasion – a social or verbal message reinforcing ability or effort

- Seek out individuals that provide encouragement and support to you in your research. Social persuasions relating to a specific effort or ability can be particularly influential.
- Ask for specific, constructive feedback from your mentors.

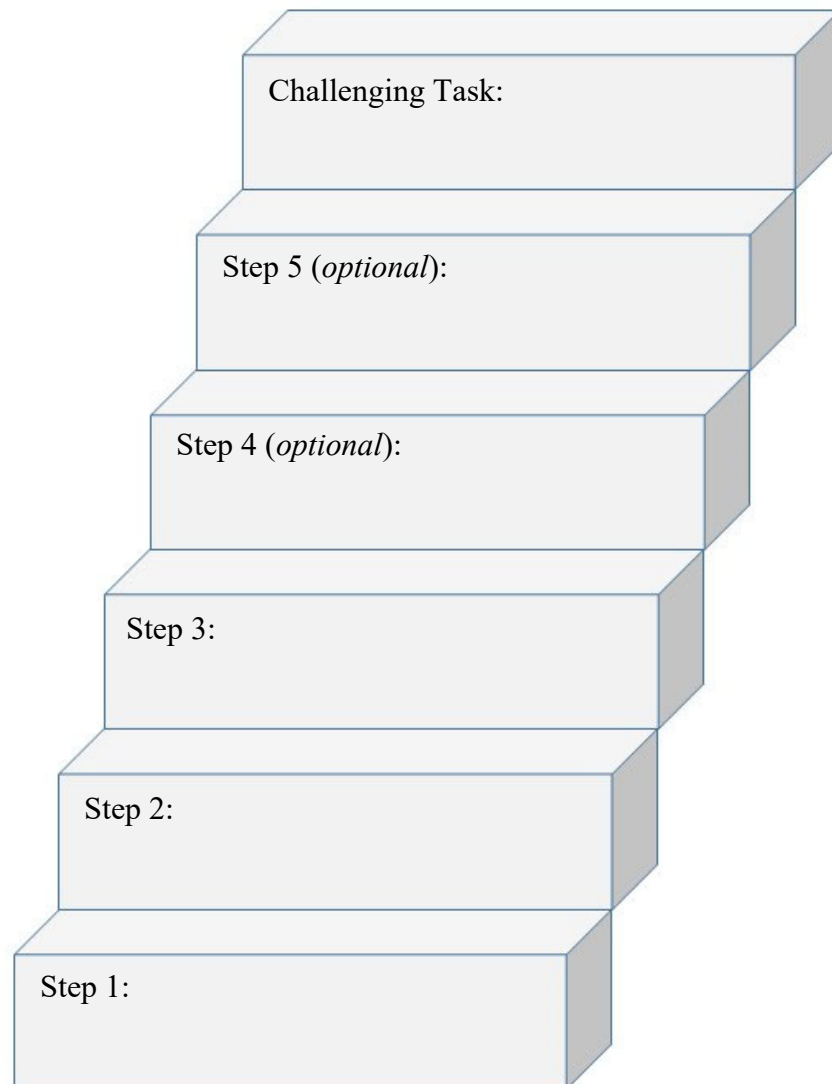
Emotional/Physiological state – an emotional, affective or physiological response

- Be aware of positive (enjoyment) or negative moods (anxiety) that you have related to research/the lab
- Attend to negative, anxiety-related feelings (e.g., negative self-talk that you are not as smart as other researchers)
- Acknowledge and normalize when things are difficult; "It's supposed to be hard, new things usually are"

Handout #2

Stair Steps: Skill Development for Future Researchers

Instructions: Write your challenging task at the top of the stairs. Now break it down into at least 2-3 steps. Place them in sequential order beginning with the skill you believe needs to come first on the bottom step.



The Power of Social Persuasion

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice, intermediate or advanced trainees

Areas of Trainee Development:

- Researcher Confidence and Independence
 - Develop Confidence as a Researcher
- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills

Learning Objectives

Trainees will:

- Assess the influence that mentors have on their confidence in their abilities.
- Devise strategies to cope with and respond to feedback that negatively influences their confidence.

Activity Components and Estimated Time for Completion:

- In Session Time: 50 minutes

Total time: 50 minutes

When to use this activity

This activity is designed for use with trainees who are in a position to receive feedback from their mentors on their work and/or writing. It is best used as a follow up to “Fostering Your Own Research Self-Efficacy” to further explore the concept of self-efficacy. However, it can also be used as a standalone activity. This activity can also be used in combination with the “Case Study: Responding to Feedback” and “Messages Sent and Received” activities as part of a session dedicated to feedback and communication between mentors and trainees.

Inclusion Considerations

Discuss the potential implications or perceptions of cross-cultural/cross gender feedback. Trainees from underrepresented and stereotyped groups in research may carry some unconscious “threats” with them that will impact how they perceive critiques of their research. Discuss how the similarities or differences between the backgrounds of the mentor and the trainee might impact how criticism is intended and how it is perceived. Share information about stereotype threat and imposter syndrome (see Entering Research resources) to help trainees learn to overcome and push past these barriers with confidence in one's ability to complete tasks with success. Encourage trainees to ask questions of their mentors, including, "What else should I know or be doing to be successful on this project?"

Implementation Guide

Workshop Session (50 minutes)

- Introduction (5 minutes)
 - Self-efficacy refers to the confidence that individuals have in their ability to perform

a given task. Individuals evaluate their self-efficacy based on their past accomplishments and experiences, the successes and failures of others, their emotional and physiological state, and the messages that they receive from others.

- This activity focuses on the messages that trainees receive from their mentor. Feedback and criticism are an inevitable part the mentoring relationship, especially when it comes to writing up and presenting research. In this activity, we will consider the influence that feedback from mentors may have on your self-efficacy, and devise strategies to help you maintain confidence in the face of criticism.
- Activity: The Power of Social Persuasion (40 minutes)
 - The goal of this activity is for trainees to assess the influence that mentors have on their self-efficacy and to devise strategies to cope with and respond to feedback that can negatively influence self-efficacy.
 - Have trainees read the prompt on the handout quietly to themselves or out loud in small groups (pairs or triads). (3 minutes).
 - Have the participants discuss the following questions in their small groups, or have the following discussion with the large group (10 minutes)
 - How do you feel right now? Write down some of the emotions and/or physical responses you are feeling.
 - How would this feedback influence your confidence in your ability to continue to prepare this manuscript for publication?
 - How would it influence your confidence in your ability to write future successful manuscripts?
 - How might you go about looking to other sources (i.e., individuals, messages, or experiences) that could increase your self-efficacy to revise this manuscript?
 - If using small groups, have participants share highlights of their discussions with the large group (5 minutes).
 - Engage the large group discussion with the following questions (20 minutes)
 - How might this feedback influence your mentoring relationship? How might it influence your desire to collaborate with this individual in the future?
 - How might this feedback be perceived differently if you were at an earlier stage in your career/training (e.g., as a first year undergraduate or graduate student?) or at a later stage (e.g., as a full professor or senior scientist?)
 - What are the assumptions that you find yourself making about the person giving you this feedback?
 - How do you maintain your confidence in the face of criticism?
 - Would you address how this feedback made you feel with your mentor? Why or why not?

- Invite trainees to look at the same feedback framed in a different way (display or hand out the second set of feedback).
 - How does your reaction to this feedback differ from the first example?
 - What are the assumptions that you find yourself making about the person giving you this feedback?
 - What is the intent behind each of these feedback examples? Is it the same?
- Wrap-up (5 minutes)
 - Teachers and mentors are in a position to have a profound influence on how trainees perceive their capabilities, for better or for worse. One way to deal with critical feedback that may lower your self-efficacy is to consider the intent of what your mentor told you.
 - Social persuasions are just one source of self-efficacy; at any given time, one or all four of the sources of self-efficacy may influence your confidence. Tell trainees that when they receive feedback that lowers their self-efficacy, they should look to other sources to verify their capabilities (e.g., I have successfully navigated the ups and downs of preparing a manuscript before).

The Power of Social Persuasion

Trainee Materials

Learning Objectives:

Trainees will:

- Assess the influence that mentors have on their confidence in their abilities.
 - Devise strategies to cope with and respond to feedback that negatively influences their confidence.
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Self-efficacy refers to the confidence that you have in your ability to perform a given task. Individuals evaluate their self-efficacy based on their past accomplishments and experiences, the successes and failures of others, their emotional and physiological state, and the messages that they receive from others. In this activity, we are going to focus on the messages that you receive from your mentor. Feedback and criticism are an inevitable part the mentoring relationship, especially when it comes to writing up and presenting research. In this activity, we will consider the influence that feedback from mentors may have on your self-efficacy, and devise strategies to maintain confidence in the face of criticism.

Directions: You have written the first draft of a manuscript for which your mentor is a co-author. You spent a lot of time working on the manuscript and are really pleased with the progress that you have made on this paper. You send the manuscript to him/her for feedback. Now, imagine that you have received an email from your mentor with this feedback:

I have included some edits for grammar and clarity in the document. The manuscript needs substantial work before I see it again. You have cited a lot of prior research in the introduction and literature review, but it is disorganized and difficult to follow. The methods and results are okay, but the manuscript will not be ready to submit to the editor until the discussion is further developed. Once you have made these changes, let me know and I will take another look. I do not want to waste any more of my time reviewing this until the manuscript has been drastically improved.

Questions for Discussion:

- How do you feel right now? Write down some of the emotions and/or physical responses you are feeling.
- What are the assumptions that you find yourself making about the person giving you this feedback?
- How would this feedback influence your confidence in your ability to continue to prepare this manuscript for publication?
- How would it influence your confidence in your ability to write future successful manuscripts?
- How might you go about looking to other sources (i.e., individuals, messages, or experiences) that could increase your self-efficacy to revise this manuscript?

Now, turn the page and consider the same feedback framed in a different way:

This is a good first draft of the manuscript. I have included some edits for grammar and clarity in the document. I can tell that you have put in a lot of time and effort into reviewing the literature. The methods and results are clearly articulated and are explained in a way that should be accessible to a broad audience, which should please the journal editor when we submit it. The discussion section needs some work, particularly where you are trying to make the case for how our study extends what is currently known. I think you could also spend a little more time in the introduction setting up the study and doing a little foreshadowing for the reader. I would like to review the manuscript again once you have addressed these comments, but I have every confidence that you can get this manuscript to where it needs to be.

- How do you feel after receiving this feedback?
- What are the assumptions that you find yourself making about the person giving you this feedback?

Week 8

Scientific Posters

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Disciplinary Knowledge
- Develop Science Communication Skills
- Develop Logical/Critical Thinking Skills

Activities:

- Communicating Research Findings 1: Poster Presentations

Assignments Due:

- Scientific Poster Hunt Worksheet
- Mentor Interview about Making Scientific Posters

Assessment Tools: None

Communicating Research Findings 1: Poster Presentations

Facilitator Instructions

Trainee Level: undergraduate and graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Science Communication Skills
 - Develop Disciplinary Knowledge
 - Develop Logical/Critical Thinking Skills

Learning Objectives

Trainees will:

- Identify the characteristics of effective research posters.
- Learn how to give a poster presentation of research findings.
- Recognize that scientific presentations are opportunities for discussing and networking with colleagues about research, not only for reporting research.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 30 minutes
- In Session Time: 1 hour

Total time: 1 hour, 30 minutes

When to use this activity

This activity should be implemented before or concurrently with the “Communicating Research Findings 2: Oral Presentations” activity. It can be used when trainees have been working in their research labs for several months and are preparing to present their results or thinking about how scientists communicate progress on their research.

Inclusion Considerations

Novice trainees, especially those who have traveled non-traditional academic pathways, may have had limited opportunity to give scientific or research presentations. Though all trainees can be nervous about giving presentations, these trainees may be especially nervous and would benefit from extra practice sessions and encouragement. Consider using a “compliment sandwich” approach: start with what was done well, insert what can be improved, and close with a positive comment. Reassure trainees that their presentation skills will improve with practice.

Some trainees may come from backgrounds where humility is valued and they have been acculturated not to speak of their achievements freely. Talk about why it is important to speak about one’s research positively and with confidence and reassure trainees that they can do this while remaining true to their ideals around humility.

Implementation Guide

Trainee Pre-Assignment (30 minutes)

- Trainees should complete the Scientific Poster Hunt and Poster Presentation Video assignments (included in trainee materials)

Workshop Session (1 hour)

- Introduction (5 minutes)
 - Ask trainees to share if they have ever given a research presentation, either a poster or oral presentation. If so, ask them to describe the experience in one word.

- “stressful”
- “terrifying”
- “compact - you’re taking something you’ve been working on for months or years and condensing it into a single poster or a short talk”

- Ask trainees: What is/are the goal(s) of a research presentation?

- “to share the status of a project with colleagues”
- “to meet the scientists in your field and put faces to names from papers you’ve read”
- “to get comments from others in your field about how to further your research”

- Elements of Effective Posters: Results of the Scientific Poster Hunt (15-20 minutes)
 - Put trainees into pairs or small groups to share their notes about the posters they viewed in preparation for class. Have each group discuss the questions below and contribute to a shared list of positive and negative poster features that can be generated on a board, large piece of paper, or a shared online document that is projected.

- *What characteristics of posters make them most effective?*

- “eye catching”
- “clear, concise title”
- “lots of figures and/or images, not too wordy”
- “large font size”
- “clear statement of hypothesis or research question”
- “diagrams/images used to explain experimental techniques”
- “sections are easy to follow”

- *What were the characteristics that made you list a poster as your least favorite?*

- “plain”
- “lengthy, confusing title”
- “few images and/or figures, lots of text”

- “very small font size”
- “hard to know at a glance what the poster is about”
- “No diagrams/images used to explain experimental techniques”
- “hard to follow the flow of the poster”

- Bring the students together as a large group to review the lists of positive and negative features. The facilitator can capture this list and distribute it to the trainees as a guide to use when making posters.
- Poster Presentation Tips (15 minutes)
 - Ask trainees to [view the short video](#) “Giving an Effective Poster Presentation” and complete the worksheet before class. The video provides content on what makes a good poster presentation and highlights some of the common mistakes.
 - Discussion Questions (15 minutes)
 - What are the six tips identified in the video?
 - 1. Don’t read your poster
 - 2. Be prepared
 - 3. Handouts are good – two sided also might be even better
 - 4. Make viewers responsible – give them your information (on a card or on the handouts)
 - 5. Admit when you don’t know
 - 6. Put the viewer first – could be a judge or possible collaboration, this is not the time to chit chat with friends.
 - Do you agree with all of the tips? Why or why not?
 - What kinds of things would you bring as supplemental materials to a poster session?
 - Ask trainees, if given the choice would they prefer to present a poster during a 3 hour poster session or give a 15 minute oral presentation. Which would they choose and why? What factors influenced their answers?

- “I would choose a poster if my research was still in the beginning stages because it would be more useful to have in depth conversations with other scientists about my project”
- “I would choose a presentation because I’m applying for graduate schools so it would be good advertisement to get my name out there”

- Optional (5-10 minutes): Facilitators may identify a few examples from their own work and/or by asking colleagues a few days before class for examples of a poster and oral presentation presented on the same topic. Using printouts of posters and corresponding slides from oral presentations on the same project can help trainees compare formats. Trainees can spend a few minutes looking through the examples while

thinking about their experiences either giving or being in the audience for a talk, and how this compares/contrasts with the posters they found in the Poster Hunt assignment.

Wrap-Up (5 minutes)

- Links for more information/tips on making posters:
 - Making a good poster: <http://colinpurrington.com/tips/poster-design>
 - Online tutorials: <http://www.kumc.edu/SAH/OTEd/jradel/effective.html>
 - Baylor's College of Medicine Beyond the Beakers, Chapters 10-12: <https://media.bcm.edu/documents/2015/37/beyond-the-beakers.pdf>

Communicating Research Findings 1: Poster Presentations

Trainee Materials

Learning Objectives

Trainees will:

- Identify the characteristics of effective research posters.

Scientific Poster Hunt

Explore the halls in the building where your research group resides (or another research building) to find scientific posters hanging on the walls. Select one favorite, and one least favorite poster.

Identify the characteristics of each poster that make it your favorite or least favorite.

1. Favorite Poster Title:

What characteristics make this poster your favorite?

2. Least Favorite Poster Title:

What characteristics make this poster your least favorite?

Communicating Research Findings 1: Poster Presentations

Trainee Materials

Learning Objectives

Trainees will:

- Learn how to give a poster presentation of research findings.

Poster Presentation Tips

Watch this video to answer the questions <https://www.youtube.com/watch?v=vMSaFUrK-FA>

1. What are the 6 tips for giving a poster presented in the video?

2. Do you agree with all of the tips? Why? Why not?

3. What would you put on the second page of your handout?

Week 9

Communicating Science

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Science Communication Skills

Activities:

- Communicating Science to the General Public
- Research Outline Check-In

Assignments Due:

- Draft Poster Introduction

Assessment Tools: None

Communicating Science to the General Public

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Science Communication Skills

Learning Objectives

Trainees will:

- Understand the importance of communicating science in a way that is accessible.
- Define the “general public” and consider scientists’ responsibility to communicate with this audience.
- Compare and contrast ways in which scientists communicate with each other and with non-scientist audiences.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 10- 20 minutes
- In Session Time: 55 minutes

Total time: 55 minutes- 1 hour, 15 minutes

When to use this activity

This activity may be used at any time during the research experience, but is designed as an introductory activity for a unit on science communication skill building. It can serve as a precursor to the “General Public Abstract” and “Three Minute Research Story” activities.

Inclusion Considerations

Consider how trainees from different backgrounds might present their research to family members and to the general public. Trainees who are the first in their family to attend college or graduate school may need to address concerns that their involvement in research does not align with familial notions of success (i.e., working during the summer and getting a job right after college vs. participating in a summer program and going to graduate school). Invite trainees to discuss strategies to deal with this challenge.

Some trainees may come from backgrounds where humility is valued and they have been acculturated not to speak of their achievements freely. Talk about why it is important to speak about one’s research positively and with confidence and reassure trainees that they can do this while remaining true to their ideals around humility.

Implementation Guide

Trainee pre-assignment (optional, 10-20 minutes):

- In advance of the discussion, trainees should view results from a Pew Research survey conducted in 2014 on 2,002 U.S. adults and 3,748 AAAS affiliated U.S. based scientists on

public and scientists' views on science and society (<http://www.pewinternet.org/interactives/public-scientists-opinion-gap/>) and come to the session prepared to discuss their reactions.

- Alternatively, the facilitator can reference figures from the study to open the discussion.

Workshop Session (1 hour)

Note: This activity is designed to be completed in a standard 1-hour session, but can be condensed to fit the amount of time available by limiting discussions to the large group. Alternatively, the discussion questions can be posted online for trainees to answer and comment on each other's responses.

When using this activity with graduate students, one may quickly address questions 1 and 2, or leave them out entirely, and focus on question 3 as a segue into *how* to communicate research effectively to the general public.

- Introduction (5 minutes)
 - This activity is designed to raise student awareness of *why* the ability to communicate science to multiple audiences is an important skill to develop as a scientist. Trainees also start to consider ways to effectively communicate science to various audiences using different approaches.
- Discussion #1: The importance of communicating science to the public (15 Minutes) Trainees form small groups of 2-3 and generate talking points related to three questions. Spend approximately 10 minutes in small groups and 5 minutes sharing ideas as a large group.
 - The general public and scientists can differ in opinion on key issues. Why does this gap in opinion exist?

- People don't trust scientists.
- People don't understand science.
- People have not had opportunities to engage with science.
- People don't think scientists agree.

- How might this opinion gap directly impact scientists?

- Science is often publicly funded so if people don't see science as useful to their daily lives, they are less likely to support funding for research.
- The impact of research is lost if most people don't understand it.

- Why is it important for scientists to communicate with the general public?

- Communicating science can help people make informed decisions.
- If scientists make more of an effort to communicate their research, it can also make science accessible to audiences that traditionally have been

excluded from the process of science, making science more diverse and inclusive.

- Communicating about science may increase the support for and funding of scientific research.

Additional discussion topics:

- **How is academic research in the US typically funded?** The facilitator can briefly describe how public and private funds are used to fund research.
- **Some research projects have been identified as wasteful government spending.** Facilitators can provide an overview of the following resources or invite students to visit these sites as part of an in-class activity or as a follow-up assignment:
 - Proximire's Golden Fleece Awards: <http://www.wisconsinhistory.org/turningpoints/search.asp?id=1742>
 - NSF "Under the Microscope" report: https://www.youtube.com/watch?v=qSLvgCb_eiw
 - Optional follow-up assignment: Students can be directed to read <https://www.whitehouse.gov/blog/2015/06/02/value-basic-research> and check out #basicresearch on Twitter. Students should come to class with an example of a basic research discovery that has led to an unexpected insight or application or post the example on a class blog.
- Discussion #2: What should the general public know about science? What does it mean to be scientifically literate? (20 minutes)
 - Give trainees 3 minutes to reflect on this question and write their responses on a notecard.
 - What should the general public know about science? What does it mean to be scientifically literate?

- The public should appreciate how science is conducted.
- The public should know that science is not just about memorizing facts.
- We shouldn't force everybody to love science.

- After writing responses, watch the Neil deGrasse Tyson video in which he discusses his views on science literacy (3 minutes). Explain that Neil deGrasse Tyson is an astrophysicist who has also become a world renowned science communicator
 - https://www.youtube.com/watch?v=gFLYe_YAQYQ
 - shorter version: <https://www.youtube.com/watch?v=5gK2EEwzjPQ>
- Large group discussion (15 minutes)
 - What were the main points raised by Neil DeGrasse Tyson? What aspects of Neil DeGrasse Tyson's opinion align with your own? Where do you differ in opinion?"

- Scientific literacy doesn't mean you have memorized a lot of scientific facts.
- Being scientifically literate is a way of thinking about how the world works.
- We don't want everybody in the world to be scientists but being scientifically literate is important for everybody because science is at the foundation of a lot of issues that confront society.

Additional discussion questions:

- Whose job is it to communicate science to the public? Should all scientists be required to communicate their research to the public?
 - What role does the popular media (eg. news, radio, social media) play in communicating science?
- Activity: Compare and contrast approaches to communicating science to different audiences (10 minutes)
 - Scientists communicate all the time! Brainstorm all the ways that scientists use written, oral and visual forms of communication to communicate with each other. (5 minutes)

- Written - proposals, primary research papers, review articles
- Oral - Journal clubs, Lab meetings, Conference presentations, Seminars, interpersonal communication
- Visual - figures for papers, poster presentations, papers, and seminars

- How do scientists communicate their research to the public? Brainstorm different modes of communication and venues to communicate with the public. (5 minutes)

- Written - Popular science magazine article, Blog, Social Media
- Oral - TV News, Radio, Science Festival booth, Public Seminar, K-12 School Visit
- Visual - Museum exhibit, infographic, Art exhibit

Additional questions:

- Is there such a thing as a “general audience”? Brainstorm a list of as many types of audiences (elementary school kids, local rotary club, citizen scientists) as you can think of.
 - How would your communication style need to be adapted to reach a specific audience? In a specific venue?
- Wrap-Up (5 minutes)
 - Encourage mentees to meet with their mentor to discuss topics raised in class. Has the mentor had experience engaging with public audiences to talk about their

research? What was the experience like? What were the challenges and benefits of the experience?

- Important follow-ups to this in-class discussion are additional assigned exercises designed to help students develop skill in *how* to effectively communicate science to a public audience in written (general public abstract) and oral (3-minute research story) formats.

Week 10

Research Ethics

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop an Understanding of the Research Environment

Research Ethics

- Develop Responsible and Ethical Research Practices

Activities:

- Ethics Case: Discussion with Mentor
- Case Study: Credit Where Credit is Due
- Case Study: Keeping the Data

Assignments Due:

- Draft Poster Methods
- Discussion of case study with mentor

Assessment Tools:

- Post-activity mini-reflection assessment rubric

Ethics Case: Discussion with Mentor

Facilitator Instructions

Trainee Level: undergraduate trainees
novice, intermediate or advanced trainees

Areas of Trainee Development:

- Research Ethics
 - Develop Responsible and Ethical Research Practices
- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills

Learning Objectives

Trainees will:

- Discuss with their mentor(s) ethical issues associated with working in a research group.
- Learn strategies to deal with ethical situations associated with working in a research group.
- Learn about consequences of unethical behavior.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 20 minutes
- In Session Time: 20 minutes

Total time: 40 minutes

When to use this activity:

This activity can be used any time after a relationship has been established between a trainee and mentor. Ideally it is used after the topics essential to forming the foundation of a research experience, such as documenting research, reading scientific literature, and defining expectations, have been addressed.

Inclusion Considerations

Discuss with trainees how understanding of ethical behavior may be different based on differences in culture, gender or generational backgrounds. Ask trainees to consider how their background and their mentor's background may influence their interpretations of the case study. Emphasize that it can sometimes be as difficult to determine whether behavior is unethical as it is to decide how to deal with that behavior in a sensitive and respectful manner.

Implementation Guide

Trainee Pre-Assignment (20 minutes)

- Trainees should discuss the case study "Too Good to Be True?" with their research mentor. Encourage them to discuss this case study with the PI of the research group; if this is not possible, the trainee can discuss the case study with a graduate student, research scientist, lab manager or post-doc who may also be acting as a research mentor. Trainees should record their mentors' responses to three follow-up questions to the case study.

Workshop Session (20 minutes)

- Trainees should share their mentors' response(s) to the case study "Too Good to Be True?" in either: 1) in small groups of 3 or 4 students, or 2) in a large group where three or four volunteers may be selected. (10 minutes)
- Discussion Questions (10 minutes)
 - 1) Do you agree with your mentor's response to the scientific misconduct case? Why or why not?
 - 2) How do the different responses from mentors reflect the different structures of research groups?
 - 3) What can you do to establish a good relationship with your mentor(s) so that you are taken seriously when/if ethical issues arise?

- Ask questions when you're unsure of what to do in potentially ethically difficult situations
- Be honest and forthcoming about mistakes you make in your research
- Be understanding and supportive when others on the research team admit to making mistakes

- 4) With whom do you feel comfortable discussing ethical issues? Is this different from your classmates who are in different research groups?
- 5) Apart from fabrication of data, what other ethical issues exist in the scientific community?

- Misuse of animals and resources
- Misuse of vulnerable populations for research (e.g. minors, pregnant women, people who cannot decide for themselves, low socio-economic)
- Designing research that is inclusive of gender, race, age, sex, etc.
- Protection of sensitive data with human subjects
- Exploration of innovations or new ideas that can be used for harm
- Sexual harassment
- Appropriate spending of public funding

- 6) Why is misconduct such an important issue in the scientific community?

- Dishonesty can lead to corruption,
- Small lies or fabrications can have large impacts on future work,
- Wastes taxpayer money,
- Defeats the purpose of doing research

- 7) What measures are in place to prevent misconduct?

- Code of ethics agreed upon by scientific society or community
- Peer review
- Trend toward open access data

8) What are the consequences of scientific misconduct?

- Lose grant funding
- Lose ability to apply for future grants
- Retract scientific articles
- Terminated from position
- Loss of colleagues' respect

Ethics Case: Discussion with Mentor

Trainee Materials

Learning Objectives:

Trainees will:

- Discuss with their mentor(s) ethical issues associated with working in a research group.
 - Learn strategies to deal with ethical situations associated with working in a research group.
 - Learn about consequences of unethical behavior.
-

Discuss the case study with the person (Principal Investigator (PI), Professor) who leads your research group. If this person is not available, discuss the case study with another research mentor on your research team. Ask the mentor to consider the undergraduate researcher's perspective when reading the case study. Use the three questions to document your mentors response to the case study.

Too Good to Be True?

Evelyn and John joined the lab at the same time as sophomores and have been doing research on related, yet separate projects for the past year. Evelyn, a quiet and very diligent worker, spends many hours in the lab working on her project. She has encountered several obstacles in her research, but is making slow, yet consistent progress. She sees John there infrequently and notices that he spends most of his time chatting with the other lab members. The PI of the lab travels a lot, but when he is there, John always seems to connect with him.

At lab meeting last week, John presented his research. The results he reported were exactly what the PI was looking for. The PI was ecstatic. Evelyn was stunned. She does not remember seeing John do any of the experiments he presented. She suspects that he is not being truthful, but has no proof. His research is linked to hers, so if the results are not valid, it will negatively impact her project, and the entire research group. Everyone really likes John, including the PI, and everyone knows that she has been dealing with a lot of setbacks in her research. She doesn't want to look like a jealous coworker by accusing John of fabricating data, but she truly suspects that he has.

Discussion Questions:

- 1) What advice would you give Evelyn?

- 2) What are some of the potential repercussions if Evelyn does nothing at all?

- 3) Have you ever experienced a similar situation? If so, how was it handled?

Case Study: Credit Where Credit is Due

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice trainees

Areas of Trainee Development:

- Research Ethics
 - Develop Responsible and Ethical Research Practices
- Research Comprehension and Communication Skills
 - Develop an Understanding of the Research Environment

Learning Objectives

Trainees will:

- Discuss and practice ethical research decision-making.

Activity Components and Estimated Time for Completion:

- In Session Time: 25 minutes

Total time: 25 minutes

When to use this activity

This activity is suitable for undergraduate and graduate level- novice trainees who have chosen a research mentor and who have been conducting research for at least one month. It can be combined with any of the following activities as part of a larger unit on ethics in research:

- Case Study: The sharing of research materials
- Case Study: Selection of data
- Ethics case discussion with mentor
- Truth and Consequences article

Inclusion Considerations

Discuss with trainees how understanding of ethical behavior may be different based on differences in cultural backgrounds or across generations. Facilitators can ask trainees to consider the case study from different cultural or generational perspectives. Emphasize that it can sometimes be as difficult to determine whether behavior is unethical as it is to decide how to deal with that behavior in a sensitive and respectful manner. Encourage trainees to seek input from others, in particular those who can offer different perspectives, when dealing with potentially unethical situations in the research environment.

Implementation Guide

Workshop Session (25 minutes)

- Introduction (5 minutes)
 - The goal of this activity is for trainees to consider ethical dilemmas they may encounter in research and to discuss possible strategies to address these types of challenges.

Workshop Session(20 minutes)

- Case Study (5 minutes)
 - Distribute the case study and ask trainees to read and individually write down answers to the discussion questions.
 - Does Bea have any way of receiving credit for her work?

■ It is unlikely that Bea will be credited after the fact. However, Bea could try and have her technique published elsewhere, so that other researchers may credit her work in the future.
 - Should she contact Dr. Freeman in an effort to have her work recognized?

■ Bea could reach out to Dr. Freeman as a follow up to congratulate him/her on the article. She could mention that she is working to publish the technique and would appreciate it if Dr. Freeman cites her poster until the paper comes out.
 - Is Bea's faculty advisor mistaken in encouraging his students to be open about their work?

■ Different mentors have different philosophies on sharing data, methods, and research. There are also different approaches to how ideas are cited and recognized in presentations and publications. These can vary by discipline and by mentor.
 - What could Bea have done to prevent this from happening?

■ Bea could have mentioned to Dr. Freeman that she intended to publish the technique.
- Alternatively, trainees can discuss these questions in small groups and report highlights from their discussion to the larger group.
- Large Group Discussion (15 minutes)
 - Bring the entire group together to discuss the case.
- Wrap-Up (5 minutes)
 - Summarize the main ideas generated from the large group discussion.
 - Encourage trainees to talk with their mentors about their policies and philosophies regarding sharing work with others outside of the research group.

Case Study: Credit Where Credit is Due

Trainee Materials

Learning Objectives:

Trainees will:

- Discuss and practice ethical research decision-making.

Modified from: “On Being a Scientist: Responsible Conduct in Research”, 2nd ed.,
National Academy Press, 1995

Bea was working on a research project that focused on developing a new experimental technique. She prepared a poster outlining the new technique and presented it at a national conference. During the poster session, Bea was surprised and pleased when Dr. Freeman, a leading researcher in her discipline, engaged her in a conversation. Dr. Freeman asked extensively about the new technique, and she described it fully, happy to be confidently discussing her work with a fellow scientist. Bea’s faculty advisor had encouraged his students to openly share their research with other researchers, and Bea was flattered that Dr. Freeman was so interested in her work.

Six months later Bea was leafing through a journal when she noticed an article by Dr. Freeman. The article described an experiment that clearly depended on the technique that Bea had developed. She did not mind, in fact, she was somewhat flattered that her technique so strongly influenced Dr. Freeman’s work. She turned to the citations, expecting to see a reference to her abstract or poster; however, her name was nowhere to be found.

1. Does Bea have any way of receiving credit for her work?
2. Should she contact Dr. Freeman in an effort to have her work recognized?
3. Is Bea’s faculty advisor mistaken in encouraging his students to be open about their work?
4. What could Bea have done to prevent this from happening?

Case Study: Keeping the Data

Facilitator Instructions

Trainee Level: undergraduate and graduate trainees
novice trainees

Areas of Trainee Development:

- Research Ethics
 - Develop Responsible and Ethical Research Practices

Learning Objectives

Trainees will:

- Explain why it is important to accurately document their research.
- Identify key elements in research documentation.
- Understand the ethical implications of documenting their work.

Activity Components and Estimated Time for Completion:

- In Session Time: 15 minutes

Total time: 15 minutes

When to use this activity

This activity should be used with novice trainees, who are at the beginning of their research experience. The case introduces trainees to important procedures and considerations for documenting their research as they begin to perform experiments and collect and analyze data. This activity can be combined with two other activities to form a unit on research documentation practices:

- Research Documentation Process
- Research Documentation: Can You Decipher This?

Inclusion Considerations

Consider learning styles, differences and disabilities when discussing effective documentation of research data. Ask whether trainees have concerns about the documentation protocols used in their research groups to empower them to talk about any of these barriers or concerns.

Implementation Guide

Workshop Session (15 minutes)

- Case Study: Keeping the Data
 - Distribute the case study “Keeping the Data” (see trainee materials) and let participants read it individually (2-3 minutes).
 - Ask trainees to write down their answers to each of the questions (5 minutes)
 - Discuss the case within the large group. You may want to record the ideas on a whiteboard or flipchart (7 minutes). Some important points raised in previous discussions have included:

- There is no one “right answer” to the questions posed in the case study; different research groups have different standards for keeping data and analysis records.
- If electronic records are backed up regularly and securely, then it may not be necessary to keep hard copy records. However, regardless of whether a research group uses electronic or traditional hard copy laboratory notebooks, real time records of data collection with time and date information must be kept.
- The record of information must be complete enough to allow independent investigators to reproduce the experiments or analysis.

Case Study: Keeping the Data

Trainee Materials

Learning Objectives:

Trainees will be able to:

- Explain why it is important to accurately document their research.
 - Identify key elements in research documentation.
 - Understand the ethical implications of documenting their work.
-

May, who has been doing research with Professor Gonzalez for 2 years, is preparing to present her research results at the campus wide Research Symposium. Because some of her findings are quite novel and contradict reports of similar experiments in the literature, Professor Jones asks to review the raw data before signing off on her presentation. When he reviews May's notebook, however, there are no hard copy records of the data. Instead he finds the data on May's computer.

1. Did May do anything wrong? Why or why not?

1. Is it important to keep hard copy records of data? Why or why not?

Week 11

Visiting Peer Research Groups

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Effective Interpersonal Communication Skills
- Develop an Understanding of the Research Environment

Equity and Inclusion Awareness and Skills

- Develop Skills to Deal with Personal Differences in the Research Environment

Activities:

- Visiting Peer Research Groups

Assignments Due:

- Draft Results

Assessment Tools:

- Assessment of mentor-trainee relationship quality/ Reflection essay

Visiting Peer Research Groups

Facilitator Instructions

Trainee Level: undergraduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Effective Interpersonal Communication Skills
 - Develop an Understanding of the Research Environment
 - Equity and Inclusion Awareness and Skills
 - Develop Skills to Deal with Personal Differences in the Research Environment
-

Learning Objectives

Trainees will:

- Develop an appreciation for differences in culture among laboratory groups.
- Think about what research group attributes they value for their own research success.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 30 minutes-1 hour
- In Session Time: 20 minutes

Total time: 50 minutes-1 hour, 20 minutes

When to use this activity

This activity is appropriate for novice to intermediate undergraduate trainees and can be used at any point after a trainee has joined a research group.

Inclusion Considerations

Encourage all trainees to consider whether they think they would feel comfortable as members of the research teams they visit. What do they notice that makes them think they would “fit in” and what do they notice that makes them think they might not? Trainees from diverse backgrounds may notice markers of attention to diversity and inclusion when they visit other research teams.

Implementation Guide

Trainee Pre-assignment (30 minutes-1 hour)

- Distribute the handout provided in the trainee materials. Ask trainees to make arrangements with two of their peers in the class to visit their research groups. Encourage trainees to find groups that study very different questions or use different approaches than their group.
- Ask trainees to complete Step 1 of the handout and share their paragraph describing their research group with the trainees who will be visiting.

Workshop Session (20 minutes)

- Ask trainees to share one observation about their visit to a peer’s research group, particularly to highlight one similarity and one difference between their group and their peer’s group. (1-2 minutes per student). Observations may include differences in the following areas:

- research group size
 - diversity of the research group members
 - tidiness of research space
 - collaborative vs. individual work
 - amount of talking within the group on a daily basis
 - repetitive tasks vs. new tasks
 - applied vs. basic research
 - amount of funding (e.g. make own stock solutions vs. purchasing solutions)
 - lab hierarchies vs. equal responsibilities
 - type of research (e.g. field, lab-based, computer-based)
- Discuss the benefits and disadvantages of different kinds of groups and what types of groups appeal to trainees. This may be particularly important for trainees considering joining a new research group or applying for a job or graduate school position. (10 minutes).

Visiting Peer Research Groups

Trainee Materials

Learning Objectives

Trainees will:

- Develop an appreciation for differences in culture among laboratory groups.
 - Reflect on what research group attributes they value for their own research success.
-

Make arrangements with two of your peers in the group to visit their research groups. Try to find groups that study very different questions or use different approaches than your group.

1. Before you visit the other groups, write a short paragraph describing the research of your own group. What are the major questions that your research group addresses? What is the nature of the research that you do (e.g., lab, field, computational)? How do members of your research team interact with one another?
2. Before visiting the other research groups, read the paragraphs of your peers to anticipate what you will experience. After your visits, write a short essay comparing the three research groups. Address the following points in your essay:
 - a. How is the research space set up? Is it a laboratory, or some other kind of workspace? Does most of the research occur in the workspace or elsewhere?
 - b. Who are the research group members and what kinds of interactions do you observe between them? Are they undergraduates, graduate students, postdocs? How many people are in the research group? Is the PI in the lab or elsewhere?
 - c. What different types of research activities occur in each research group? What types of approaches or methodologies do the groups use?
 - d. Would you enjoy working in these other groups? Why or why not?

Week 12

Developing a Professional Development Plan

Areas of Trainee Development and Meta Learning Objectives Addressed:

Researcher Identity

- Develop Identity as a Researcher

Researcher Confidence and Independence

- Develop Independence as a Researcher

Professional and Career Development Skills

- Explore and Pursue a Research Career

Activities:

- Professional Development Plans

Assignments Due:

- Individual Development Plan Worksheet

Assessment Tools: None

Professional Development Plans

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice, intermediate or advanced trainees

Area of Trainee Development:

- Professional and Career Development Skills
 - Explore and Pursue a Research Career
- Researcher Confidence and Independence
 - Develop Independence as a Researcher
- Researcher Identity
 - Develop Identity as a Researcher

Learning Objectives

Trainees will:

- Develop a plan to guide their career and professional development.

Activity Components and Estimated Time for Completion:

- Session 1 Time: 35 minutes
- Trainee Pre-Assignment 2 Time: 30 minutes-1 hour
- Session 2 Time: 25 minutes

Total time: 1 hour- 1 hour, 35 minutes

When to use this activity

The ideal time to implement this activity is during or immediately following the mentor selection process, but material from this activity can be discussed at any point in the mentoring relationship. This activity may be better suited for trainees who have worked in their mentor's research group for at least one month and can be used with other *Entering Research* activities related to discussing goals and expectations, such as "Research Experience Reflections 1: Entering Research?" and "Aligning Mentor-Trainee Expectations."

Inclusion Considerations

Consider the importance of cultural, ethnic and family concerns that may influence trainees' career choices, decisions and planning. Encourage trainees to incorporate these issues as they draft their individual development plans. If possible, invite professionals who have taken non-traditional career paths to talk about their journeys with the trainees.

Implementation Guide

Workshop Session #1: Introduction of Professional Development Plans (35 minutes)

- Introduction of IDP assignment (5 minutes)

- Explain to trainees that it is never too early to start thinking about how their research experience can prepare them for additional training, including graduate study, or a career. Share examples from your own experience.
- Distribute the Developing a Professional Development Plan worksheet included in the trainee materials and read through the instructions as a class.
- Tell trainees that this activity is designed to guide them through the development of an individual development plan and to introduce them to the concept of SMART goals.
- SMART¹ goals can be used to develop individual professional development goals.
 - Specific - The goal is clear and focused.
 - Measureable - You can easily determine whether or not you have achieved it.
 - Action-oriented - The action plan for achieving your goal is clear and logical.
 - Realistic - The goal is attainable given the difficulty of the task and the timeframe in which you have to complete it.
 - Time-bound - You have specified a deadline.
- Reviewing Developing a Professional Development Plans Activity (15 minutes)
 - Ask trainees to individually review the example development plan provided in the trainee materials and make notes indicating which aspects of the plan they would like to adopt for use in their own professional development plan.
 - Ask trainees to come up with at least one immediate, one short-term, and one long-term SMART Goal.
 - Additional examples are available at: <http://cimerproject.org>. Mentors may also wish to refer their trainees to <http://myidp.sciencecareers.org> where they can develop their IDP through a guided, online process.
 - Allow trainees time to review their goals, or do peer review in pairs, to see if the goals meet the SMART goal criteria. Ask trainees to modify goals as appropriate. (5 minutes)
- Large group discussion (10 minutes):
 - What elements in the IDP example would you like to add to your own IDP?
 - How difficult was it to create goals that meet the SMART goal criteria? Which criteria were most challenging to meet?
 - How can discussing your IDP with prospective mentors help you assess fit when choosing a mentor, or help you keep on track with progress toward your goals if you already have a mentor?
 - What are some of the concerns or fears you have about discussing career plans with your mentor?
- Wrap up (5 minutes)
 - Ask trainees to complete the Trainee Pre-Assignment for

Workshop Session 2 Trainee Pre-Assignment for Workshop Session 2

¹ Note: There are many variations on the SMART acronym for goal setting. We took our example from Fuhrman, C.N., Hobin, J. A., Clifford, P. S., Lindstaedt (2013). Goal setting strategies for Adapted by A.R. Butz and C. Pfund from Pfund, Brace, Branchaw, Handelsman, Masters & Nanney (2012) *Mentor Training for Biomedical Researchers*. New York: WH Freeman & Co and from Pfund, C., Branchaw, J. L., and Handelsman, J. (2014), *Entering Mentoring: A Seminar to Train a New Generation of Scientists*, 2nd ed., W.H. Freeman & Company. Branchaw, J. L., Butz, A. R., & Smith A. (2018). *Entering Research* (2nd ed.). New York: Macmillan.

scientific and career success. *Science Careers*. doi: 10.1126/science.caredit.a1300263

- Ask trainees to complete a professional development plan using the example provided in the trainee materials, or another template, and bring it to the next class session.
- Additional resources: Guided online IDP tool:

<http://myidp.sciencecareers.org> Workshop Session 2: Discussion of Professional

Development Plans (25 minutes)

- Small group discussion (15 minutes)
 - In pairs or groups of three, have trainees review each other's IDPs. Encourage them to discuss whether the goals listed are SMART goals and whether the plan to achieve the goals is realistic. They should work together to revise and improve their goals and plans.
- Large group discussion (10 minutes)
 - What was challenging about developing your IDP?
 - Did you use any resources (including people) while developing your IDP?
 - What are some of the goals that you have for your research experience and how do these goals support your long-term goals?
 - How will your mentor be involved in supporting you to attain these goals?
 - Have you already discussed these goals with your mentor? If not, when and how do you plan to do so?
- Wrap-Up (1 minute)
 - Encourage trainees to use SMART goal setting as a tool to identify and refine professional development goals throughout their career.

Note: Optional follow-up: If you will be working with trainees over the course of a semester or longer, you may wish to occasionally revisit trainee's professional development plans at key points in the course or workshop series (e.g., at mid-term; at the end of the semester or summer session, etc.) and invite trainees to revise their plans as necessary.

Professional Development Plans

Trainee Materials

Learning Objectives

Trainees will:

- Develop a plan to guide their career and professional development.
-

An Individual Development Plan (IDP) will help you to set goals and identify strategies that will help you reach your goals. It is a self-tracking tool that can also be used to facilitate communication and alignment of expectations with your mentor. Annual (or more frequent) review of the plan will provide opportunities to celebrate your achievements, incorporate revisions, and ensure you're making progress toward your goals.

Setting goals can be challenging. Use the “Questions to Guide IDP Development” handout to guide development of your IDP and use the “IDP Planning Worksheet” to draft your IDP. Once you have some ideas about your goals, make sure they are “SMART:” Specific, Measurable, Action-oriented, Realistic, and Time-bound. Discussions with your mentors, instructors, peers, and family members may help you to refine your goals and your timeline.

A SMART goal is:

- **Specific** - The goal is clear and focused.
- **Measureable** - You can easily determine whether or not you have achieved it.
- **Action-oriented** - The action plan for achieving your goal is clear and logical.
- **Realistic** - The goal is attainable given the difficulty of the task and the timeframe in which you have to complete it.
- **Time-bound** - You have specified a deadline.

As you develop your goals and plans to achieve them, you will start to see where you can benefit from mentoring. The “Identifying Mentors” worksheet will help you to align the skills and competencies you hope to gain with potential mentors so that you can have a clear understanding of what you are seeking from each mentor.

Bring a copy of your draft IDP to the next class for discussion.

Questions to Guide IDP Development

1. What are your goals?

- **Ultimate goal**
 - *" I will be a professor of neuroscience at a research university.*
- **Long-term (5-10 years)**
 - *" I will be a postdoctoral fellow studying the genetic basis of neurological disorders.*
- **Intermediate-term (2-5 years)**
 - *" I will earn my Ph.D. degree in Neuroscience.*
 - *" I will contribute to the discovery of the genetic basis of Alzheimer's disease.*
- **Short-term (1-2 years)**
 - *" I will earn my B.S. degree in Genetics.*
 - *" I will publish my undergraduate research project in a peer-reviewed journal.*
- **Immediate (6 months – 1 year)**
 - *" I will earn an "A" in Biochemistry class.*
 - *" I will learn brain slice immunohistochemical staining techniques.*
 - *" I will participate in a summer research program to experience another university.*

2. What competencies and skills will you need to successfully reach your goals? (See the list at the end of this document for specific ideas)

- Disciplinary knowledge
- Research and Technical skills
- Professional and Interpersonal skills
- Management and Leadership skills

3. What activities and experiences will you engage in to gain the competencies and skills?

- Taking classes
- Tutoring, study groups
- Technique training
- Research experiences
- Scientific meeting attendance
- Professional development workshops

4. How will you assess your progress in mastering these competencies and skills?

- Mastery of coursework
- Mentor/instructor feedback
- Successful experimental outcomes
- Peer review

5. Who will help you reach your goals and how?

- Teachers
- Mentors

- Peers
- Family members

Examples of Skills

Research and Technical

- Critical reading (scientific literature)
- Experimental design
- Experimental techniques
- Computer skills
- Documentation/Laboratory notebook
- Problem solving and trouble-shooting
- Data and statistical analysis
- Critical analysis
- Responsible conduct of research
- Identification of new research directions and next steps

Professional and Interpersonal

- Reliability and follow through
- Communication (oral and written)
- Writing (manuscript, grant, fellowship)
- Teaching
- Mentoring
- Collaborating and working in teams
- Giving/receiving constructive feedback
- Collegiality
- Networking

Management and Leadership

- Time management (meeting deadlines)
- Prioritizing and organizing work
- Leading and motivating others
- Research project management
- Budget management
- Supervising/managing people
- Delegating responsibility

Example 1: Individual Development Plan

An Individual Development Plan is a professional tool which outlines objectives that you and your mentor/supervisor have identified as important for your professional development. A comprehensive review of your career goals and objectives identified at the beginning of your appointment and during your semi-annual appraisal provide constructive feedback from your mentor/supervisor that can help you become an independent investigator.

Use this table to record your goals and how you will achieve your goals through engagement in learning activities and experiences that support development of competencies and skills. Identify how you will assess progress toward your goals and who can support you as you work to achieve your goals.

| Goals | Competencies & Skills | Activities & Experiences | Assessment of Progress | Mentors and Their Roles |
|--|-----------------------|--------------------------|------------------------|-------------------------|
| Long-term 1. | | | | |
| Intermediate-term 1. 2. 3. | | | | |
| Short-term 1. 2. 3. | | | | |
| Immediate 1. | | | | |

If applicable: Please describe your plan for your transitioning from your current position to the next stage in your career (e.g., from graduate study to postdoctoral study, research career, etc.).

Additional Comments:

Identifying and Approaching Potential Mentors

Identifying Mentors

Identify people who can assist you in achieving your goals by developing the skills and competencies you identified in your plan. For each potential mentor, identify objectives, develop a list of what you can offer, and propose outcomes. Put your initial thoughts down on paper before you approach a mentor, and then revise it as your relationship changes.

Approaching Mentors

We suggest that you first approach potential mentors by sending an email that includes a request for a meeting, a brief summary of your goals, and why you think there would be a good fit between you and the mentor. Let them know how you are hoping to work with them, such as one-on-one, as one of many mentors, or as part of a mentoring team or committee. You might want to let them know how you think they would be able to contribute to your professional development.

| Mentorship Plan ² | | | | | |
|------------------------------|-----------------------------------|----------------------------|-------------------------------------|-------------------------|----------------|
| <i>Mentor</i> | <i>Long or Short Term Goal(s)</i> | <i>Skill or Competency</i> | <i>Activities & Experiences</i> | <i>What I can offer</i> | <i>Outcome</i> |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Managing Relationships with Your Mentors

Relationships should be nurtured and respected. If you and your proposed mentor develop a working relationship, have some guidelines for how you will work together. Here are some tips:

- Schedule standing meetings ahead of time and keep them
- Give your mentor(s) plenty of time to review drafts of grants and manuscripts
- Don't be a black hole of need – limit the number of requests you make of any given mentor
- Develop authorship protocols so that expectations are clear
- Saying thank you is priceless

²*Adapted from Ann J Brown, MD MHS, Vice Dean for Faculty, Duke University School of Medicine. Accessed 5/28/10 at <http://facdev.medschool.duke.edu>

Week 13

Poster Peer Review and Presentations

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Science Communication Skills

Professional & Career Development Skills

- Explore and Pursue a Research Career

Activities:

- Poster Peer Review
- Elevator Sentence Practice

Assignments Due:

- Complete draft of poster
- Revised elevator sentence to be used during poster presentation

Assessment Tools:

- Communicating Research Findings 3: Poster Presentation Assessment Rubric & Peer Review Forms

Week 14

Science and Society

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension and Communication Skills

- Develop Science Communication Skills

Activities:

- Science and Society

Assignments Due:

- Read articles on science communication
- Revise and print final poster

Assessment Tools: None

Science & Society

Facilitator Instructions

Trainee Level: undergraduate or graduate trainees
novice or intermediate trainees

Areas of Trainee Development:

- Research Comprehension and Communication Skills
 - Develop Science Communication Skills

Learning Objectives

Trainees will:

- Learn how science can be perceived differently by the scientific community and the general public.
- Become aware of how science and society interact.
- Consider the societal implications of their research.
- Recognize their responsibility to communicate their research to the general public.
- Develop strategies to translate their research to the general public.

Activity Components and Estimated Time for Completion:

- Trainee Pre-Assignment Time: 20 minutes
- In Session Time: 35 minutes

Total time: 1 hour, 5 minutes

When to use this activity

This activity is suitable for trainees at any career stage, but may be most effective when used with trainees who have limited experience communicating their science to a broad audience (i.e., novice to intermediate trainees). It can be paired with “Science Literacy Test” as part of a session (or multiple sessions) on science communication and science literacy.

Inclusion Considerations

Trainees from non-science backgrounds may be particularly adept at connecting science and society, especially if they are the first in their family to pursue a career in science. Encourage them to share how they became interested in science, including where and how they learned about it.

Implementation Guide

Trainee Pre-Assignment (20 minutes)

- Have trainees read a short article on communication in science prior to the session. Suggested readings:
 - Hendrix, M. J.C. and Campbell, P. W. (2001), [Communicating science: From the laboratory bench to the breakfast table](#) . *Anat. Rec.*, 265: 165–167. doi:10.1002/ar.1150
 - Bearzi, M. (2013, October 11). *5 Simple tips for communicating science*. Retrieved from

<http://voices.nationalgeographic.com/2013/10/11/5-simple-tips-for-communicating-science/>

- Distribute the handout included in the trainee materials and have them consider their responses to each of the questions prior to the session. Explain that the discussion of this session will focus on their answers to each of these questions.

Workshop Session (35 minutes)

- Introduction (5 minutes)
 - The goal of this activity is to encourage students to consider the research they are doing from the perspective of the general public.
- Activity: Why is it important for the general public to understand your research? (10 minutes)
 - Show video: “Shrimp on treadmills? Or your benefits?” (AARP): <http://blog.aarp.org/2011/06/16/shrimp-on-treadmills-or-your-benefits/>
 - Explain that the benefits of some studies may not be immediately apparent or seen as relevant to the general public. If studies are taken out of context, they may be seen as not important or a waste of money.
 - The critique offered in this video shows differences in how the scientific community and the public may perceive research. Time permitting, facilitators may wish to pull up research from the Pew Research Center on differences in views between the public and scientists from the American Association for the Advancement of Science (AAAS) on questions about scientific research that have arisen over the past few years:
 - Major Gaps Between the Public, Scientists on Key Issues (Pew Research Center): <http://www.pewinternet.org/interactives/public-scientists-opinion-gap/>
 - Trainees may say that the public does not need to know about their research because it is so basic. If this comes up in your session, encourage them to take a different perspective and try to make a connection between the research that they are doing and the general public.
 - *Note:* Facilitators may wish to use this session to talk about federally funded research and how studies are funded. Federally funded research is administered through agencies like the National Science Foundation (NSF) and the National Institutes of Health (NIH) and paid for with taxpayer dollars. Congress sets the budget for these agencies, who then award grants based on a peer review process (i.e., other scientists determine whose research gets funded). The studies referenced in the video are taken from the report *NSF: Under the Microscope*, by Senator Tom Coburn in 2014 (see <http://lcweb2.loc.gov/service/gdc/coburn/2014500020.pdf> for the full report). For more activities relating to research funding, see the activity “Research Funding.”
- Discussion Questions (20 minutes)
 - What should people know about science?

- Basic science concepts
- The process of research

- Why is it important for the general public to understand your research?

- The research may be funded with taxpayer dollars
- The specific relevance will vary by research topic, but each trainee should be able to answer this question.

- How will you make your research presentation accessible to the general public?

- I will avoid using scientific jargon.
- I will use images and drawings whenever I can to explain my research.
- I will focus on the “BIG” research question and not the specific details of my experiments.

Science & Society Trainee Materials

Learning Objectives

Trainees will:

- Learn how science can be perceived differently by the scientific community and the general public become aware of how science and society interact.
 - Consider the societal implications of their research.
 - Recognize their responsibility to communicate their research to the general public.
 - Develop strategies to translate their research to the general public.
-

Consider the research that you are doing from the perspective of the general public. Based on the readings that you completed for today's session, consider the following questions:

1. What should people know about science?
2. Why is it important for the general public to understand your research?
3. How will you make your research presentation accessible to the general public?

Week 15

Poster Session

Areas of Trainee Development and Meta Learning Objectives Addressed:

Research Comprehension & Communication Skills

- Develop Disciplinary Knowledge
- Develop Science Communication Skills

Research Identity

- Develop Identity as a Researcher

Researcher Confidence and Independence

- Develop Confidence as a Researcher

Activities:

- Present Poster
- Listen and ask questions of peers

Assignments Due: None

Assessment Tools:

- Communicating Research Findings 3: poster presentation assessment rubric & peer review forms
- Comprehensive Course Evaluation & Entering Research Learning Assessment (ERLA) Surveys
 - Trainee self-assessment of learning gains
 - Mentor assessment of trainee learning gains