

Session 3:
**Mentoring and Scientific Data Handling, Record
Keeping, and Analysis**

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What is a Mentor?

- **Definition:** “Somebody, usually older and more experienced, who provides advice and support to, and watches over and fosters the progress of, a younger, less experienced person.”
- In the research training setting: “Someone who is responsible for the guidance and the **academic, technical, and ethical** development of a trainee.”
- **Not all advisors are mentors.** Academic advisor/advisee relationships are mandated. Mentor/mentee relationships emerge from a conscious choice by both parties
- **Mentors are the stewards of scientific integrity.** Mentees often take on the traits and values of their mentors (e.g., attitude, intellectual and ethical frameworks).



The Mentor-Trainee Relationship

Mentors...

- **...Demonstrate and teach style/methodology of scientific research.** Mentors share their talents in the practical aspects of research.
- **...Evaluate and critique scientific research.** Mentors identify problems and propose remedies for the mentees to refine their skills.
- **...Provide ethical information and normative behaviors.** Mentors familiarize trainees with policies, guidelines, regulations, appropriate behaviors, standards, and responsible conducts of research.
- **...Promote career development.** “Mentors are advocates. They look out for the professional health and well-being of their trainees.” Career planning, networking, interpersonal skills (negotiation, mediation, persuasion, and poise).



The Mentor-Trainee Relationship (cont.)

- **Mentors perform different duties at different times.** Advisor, confidant, critic, etc. Mentoring roles depend on the specific circumstances and the changing needs of the trainees.
- **Trainees depend on the mentors.** Finances (tuition, conference meeting/workshop, future position). Mentors' evaluation (letter of recommendation).
- **Trainees are vulnerable to abuses of power.** Acts of commission and/or neglect. Advisory committee, other faculty, departmental chairs may be able to help.
- **Mentor-Trainee relationship is long lasting.** Trainees will rely on their mentor for advice (and letter of recommendation). Mentors are often viewed in light of the performance of their former trainees.



Mutual Respect, Trust, and Compassion

- **Mentor-trainee relationship requires mutual respect, trust, and compassion.**
- **Trainees must trust their mentor's advice and action.** For example, assignment of a viable research direction and dissertation project.
- **Mentors must cultivate a trust in the trainee's work** by directly observing lab practices, viewing research data, and listening to the trainee's presentations.
- **Open communication and compassionate support** allow for constructive criticism and guidance. (Not displeasure, hostility, or intimidation.)



Selection of a Mentor

- Selection usually based on:
 1. **Education/Research interest.** Publication records. Financial support.
 2. **Personal interactions.** Mentoring style, interactions between the mentor and other trainees, lab culture.
 3. **Lab rotation program.** Firsthand view of the lab operations, personnel dynamics, day-to-day environment
- Even the most careful decisions can lead to non-working relationships.
 - Conflicting personal styles, disenchantment with the research area, and other problems can emerge over time.
 - Switching mentors can and should be implemented to solve intractable problems



Mentoring Guidelines

- **Assignment of a mentor.** Explicit assignment of a mentor is necessary.
- **Mentors should always keep the trainees best interest in mind.** Mentors should provide enough time and mental bandwidth for the trainees.
- **Avoid conflicts of interests.** Avoid familial or personal relationship, avoid assigning project with a monetary stake.
- **Mentor-trainee ratio must be manageable.** Larger groups need a secondary mentoring network (e.g., postdocs mentoring graduate students)

Mentoring Guidelines (cont.)

- **Supervisory role.** The mentor should have a direct role in designing of experiment and data handling. *Especially* important early on to establish proper methodology.
- **Communication.** Regular meetings should pervade the relationship to provide trainees with informal peer reviews. (Regular ~ once a month according to *Macrina*)
- **Mentors need to provide realistic appraisal of performance**
- **Mentors should be alert to behavioral changes/problems** (stress, substance abuse, mental health problems, etc.)
- **Career counseling.** Providing letters of recommendation, assisting in job placement, and encouraging realistic job prospects.



Expectations for Research Trainees

- Possess a **general knowledge, technical skills**, and be **familiar with literature** of a given field
- The trainees should ask **meaningful questions** and demonstrate effective **communication skills** (oral and written)
- The trainees should demonstrate skills in **designing experiments** and **conducting productive independent research**
- Trainees should **take the initiative** to drive the relationship and be responsible for career development.



Mentoring Summary

- Critical to the development of young scientists and maintaining the scientific integrity
- Mentor-trainee relationships are built on mutual respect, trust, and compassion
- Open communication is vital to a successful relationship

Case Study: Mentoring 1

Prof. Ron Archer is Gordon's graduate advisor. Gordon shows Ron data that describe a novel property of an enzyme, which has major implications. At Ron's request, Gordon repeats the experiments successfully.

However, because of the important implications of this work, Ron approaches another student in the lab, Pam, and asks her to double-check the results. Ron instructs Pam not to discuss the experiments with anyone else in order to obtain independent data.

Are Ron's actions justified in this case?



Case Study: Mentoring 2

Prof. Smith discusses his lab rules with John, before John decides to join the lab. One rule surprises and concerns John: Prof. Smith does not allow his advisees to enter into a romantic relationship with one another. Should such a relationship develop, he insists that one of the members of the relationship find a new lab.

John argues that this rule is a direct interference with personal matters and such relationships are of no concern to the advisor. Prof. Smith counters that twice in the past 5 years his lab has been disrupted by romantic relationships between advisees. These situations have resulted in ill will, diminished productivity, and negative effects on lab morale.

Discuss the issues of mentorship responsibilities, ethics, and conflicts of interest that are important to this scenario.

Scientific data handling, record keeping, and analysis

- In the course of doing science, we generate data
 - “Data are any form of factual information used for reasoning”
- Data must be recorded and stored in a reliable way and reproducible way
 - Basis for reports, grant and patent applications, journal articles, theses etc.
 - Important for accuracy, replication, and reliability
 - Legal implications – granting agencies, intellectual property, FDA, clinical trials

Scientific record keeping

- The laboratory data book:
 - “a bound collection of serially numbered pages used to record the progress of scientific investigations... It contains a written record of the researcher’s mental and physical activities from experiment and observations, to the ultimate understanding of physical phenomena”
- Generally not a direct area of instruction
 - How did you learn to keep a lab notebook?
- Not required to be uniform among all scientists as long as certain criteria are met

What should a good lab notebook detail

- Useful data books explain:
 - What you did
 - Why you did it
 - How you did it
 - When you did it
 - What the materials are
 - What happened (or what did not)
 - Your interpretations
 - Contributions of others
 - What's next
- Good data books:
 - Are legible
 - Are well organized
 - Are accurate and complete
 - Allow repetition of your experiments
 - Are accessible to authorized persons, stored properly, and are appropriately backed up
 - Are the ultimate record of what your scientific contributions are

Data

- What constitutes legitimate and valid data?
 - “Authentic data represent the true results of work and observations. When data deviate from this standard because of carelessness, self deception, or deliberate misrepresentation, they lose their authenticity”
- Intangible vs tangible data
 - “[Intangible data] is, data books which contain hand script or affixed typescript that that records and reports measurements, observations, calculations interpretations, and conclusions”
 - Tangible data describes “materials such as cells, tissues or tissue sections, biological specimens, gels, photos, micrographs etc.”
 - For chemists this could be TLC plates, spectra, or compounds
- Question:
 - A student sketches a drawing of a TLC plate in their notebook. Is it okay to throw away the TLC plate?
- Journals or other institutions can require different forms of data
 - Showing a spectra versus just listing important peaks

Who owns the data

- “As a matter of both policy and practice, the USPHS recognizes the grantee institution as the owner of the data generated by the NIH-funded research” (a.k.a you)
 - The PI assumes the primary responsibility for data collection, recording, storage, retention, and disposal.
- In special cases, permission can be granted to transfer the ownership to a new institution if the PI is moving
 - The PI never owns the data

Data storage and retention

- The NIH requires that data obtained under the aegis of an NIH grant be retained for 3 years beyond the date of the final financial expenditure report.
 - This can be altered at the state level, for example, Virginia requires that data be kept for 5 years.
- Different funding agencies will have different requirements
- As the steward of your information you are responsible for knowing for how long, where, and what data must be stored.

Data keeping tools

- Paper
 - Acid free
 - Keep in a dry place with stable temperature and away from dust
- Ink and pen type
 - This has to last
 - No pencils
 - Graphite smudges easily
 - Do not use aqueous inks
 - Use only black ink
 - Light degrades colored ink more quickly
- Bound books with serially numbered pages are recommended
 - More difficult to delete pages without notice
 - Standard paper quality
 - Uniformity among lab members
 - Easier to locate specific items

Organization

- Data is usually generated in large quantities and needs organization
 - The first several pages in a data book should be reserved for a table of contents.
- A glossary of commonly used abbreviations, symbols or other common designations should also be included
- If there are several data books, a master data book is recommended to summarize which each notebook contains, and where to find them.
- Tangible data should be kept and archived in the best way possible to maximize its longevity.

Format of the databook

- Be concise without compromising the experiment
 - Can some one understand the experiment and repeat it without asking you for details?
- Purpose
 - Regardless of how routine the experiment is, write a sentence explaining why this experiment is being performed
- Materials and Methods
 - Procedure or referenced procedure
 - Suppliers and purities for specialized reagents
 - Specific instrumentation used
- Observations and Results
 - Data should be recorded into the notebook as soon as available. Waiting can alter recollection of results
- Discussion
 - Include comments that capture impressions of results
 - State conclusions of the work
 - Explain why each piece of data was recorded

Good book keeping

- Consecutive chronological experiments
- Don't skip pages
- Date each experiment and time stamp observations
- Cross out unused space to prevent alteration of primary documents
- If any errors are made, use a simple strike through to omit the mistake, and then explain why it was changed.
 - Do not use correcting fluid or completely black out text as it might look like impropriety.

Witnessing of data and working with others

- Industry often requires data witnessing for IP protections
 - Especially true for things that will lead to a patent
- The witness:
 - Signs and dates the page of the book being examined
 - Must understand the work
 - May also write “witnessed and understood”
 - Must not be a co-inventor
- Record discussions you have with others about research
 - Record who when and where
 - Useful for corroborating data and giving credit
 - List all collaborators when using specific materials from or for them

Electronic Lab Notebooks

- Electronic lab notebooks are gaining a lot of popularity because of the rise in use of personal computers and data which is generated and worked with on computers
- As long as ELNs can meet the previously stated conditions, they can be used for routine lab record keeping
 - Largely up to the PI
- ELNs make it much easier to incorporate many forms of data into a single place, and have many advantages including searchability, and minimal space required for storage.
- ELNs, however can also be more easily tampered with and are susceptible to different hazards (i.e. hacking)

Case Study

Sheri is a graduate student colleague about to defend her dissertation and take a postdoc position. Her mentor has instructed her to take all of her data books when she leaves and keep them in her possession. She quotes him as saying “Sheri, you know how disorganized I am. I’ll probably lose track of your data books before a month goes by. Besides, you have one more paper to write and the books are better off in your hands. If I ever need them, I’ll know where to call you.” Are Sheri’s mentor’s actions appropriate?

You are a grad student who has just completed synthesizing a new molecule. When you are typing up the publication, you spill coffee all over your lab notebook. You can no longer read what the yield is of a late stage intermediate, but think you remember it. Is it unethical to write the number you think it might be? Must you re-synthesize everything from scratch to reobtain the yield? What should be done differently?