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

NIH Ethics Seminar
03/17/15
MENTORING
What is a Mentor?

- **Defined:** “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 academic, technical, and ethical development of a trainee.

- Different than advisor
  - A distinguishing feature is choice – academic advisor and advisee are mandated relationships; Mentor-trainee relationships emerge from a conscious choice by both parties
  - “In research training, in pursuit of either a graduate degree or postdoctoral fellowship, the relationship is destined to take on characteristics of a mentoring one.”

- **Scientific integrity is derived from effective mentoring**
  - “trainees emerge from their programs with an intellectual and ethical framework strongly shaped by their mentors”
The Mentor-Trainee Relationship

- Mentors demonstrate and teach style and methodology in doing scientific research
- Mentors evaluate and critique scientific research (how are things going?)
- Mentors foster the socialization of trainees (ethics, appropriate behaviors, responsible conduct of research)
- Mentors promote career development
- Mentors perform different duties at different times (mentor-advisor, mentor-confidant, mentor-critic, etc.)
- Trainees depend on mentors – vulnerable to abuses of power
- The mentor-trainee relationship is an exclusive one
- The mentor-trainee relationship requires trust
Mentor Selection

• Usually selected based on three activities:
  – Education – research interests, websites, publications, seminars
  – Interpersonal interaction
    • Mentor and other trainees
    • Mentoring style (supervision, general expectations, goal setting)
    • Lab members (training climate, enthusiasm, and corroboration of mentor’s self-description)
  – Lab operations and personnel dynamics (rotations, open houses, group meetings)

• Some criteria that might be sought by incoming trainees
  – Publication record
  – Financial support base
  – National recognition (seminar invitations, consultantships)
  – Rank, tenure status, proximity to retirement
  – Prior training record
  – Placement of graduates
  – Coauthorship practices
  – Organizational structure of the lab
Mentoring Guidelines

• Assignment of a mentor
  – Specific assignment of trainees to faculty members must be made
  – Might start with a temporary advisor, continue to dissertation advisor who usually becomes the trainee’s primary mentor

• Mentor-trainee relationship
  – Professional courtesy and trust
  – Mentor and trainee must properly acknowledge respective contributions
  – Keep trainees’ best interests in mind—some guidelines say individual interests of trainees should take precedence over those that further the research group or mentor
  – Provide enough time for each trainee
  – Don’ts (potential conflicts of interest):
    • Familial or personal relationships
    • Projects with a monetary stake for mentor – not acceptable training exercises

• Mentor-trainee ratio must be manageable
  – Larger groups need a secondary mentoring network in place – still can compromise mentor-mentee interchange
Mentoring Guidelines (cont.)

• Supervisory role of the mentor
  – “The mentor should have a direct role in supervising the designing of experiments and all activities related to data collection, analysis and interpretation, and storage”
  – Especially important early on to establish proper methodology

• Communication
  – “Collegial discussion among mentors and trainees should pervade the relationship”
  – Regular group meetings and one-on-one meetings
  – Mentor is responsible for developing responsible conduct of research (human/animal subjects, radioactive/hazardous substances, etc)
  – Some guidelines suggest:
    • Need to provide realistic appraisal of performance
    • Be alert to behavioral changes/problems (stress, substance abuse, mental health problems, etc)

• Career counseling – letters of rec; help in job placement; encourage trainees to view job prospects realistically
Expectations for Trainees

Individual Development Plans (FASEB; faseb.org/opar/ppp/educ/idp.html)

- Is a written document made by the postdoctoral fellow and his/her mentor.
- Describes a plan for action and forms the basis for periodic evaluation.
- Can be modified as the goals and needs of the fellow change.
- Contains professional development needs and career objectives for postdocs.
- Promotes communication between the mentor and trainee.

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<th>BASIC STEPS</th>
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<td><strong>Step 1:</strong></td>
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<td>Conduct a self assessment</td>
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<td><strong>Step 2:</strong></td>
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<td>Survey opportunities with mentor</td>
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<td><strong>Step 3:</strong></td>
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<td>Write an IDP, share IDP with mentor and revise</td>
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<td><strong>Step 4:</strong></td>
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<td>Implement the plan</td>
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<td>Revise the IDP as needed</td>
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<th>... for Postdoctoral Fellows</th>
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<td><strong>... for Mentors</strong></td>
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<tr>
<td>Become familiar with available opportunities</td>
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<td>Discuss opportunities with postdoc</td>
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<td>Review IDP and help revise</td>
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<td>Establish regular review of progress and help revise the IDP as needed</td>
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Mentoring: Summary

- Critical to development of young scientists and fostering high quality research
- Mentor-trainee relationship built on mutual trust and respect
- Some guidelines are in place
- Candid communication is vital to successful training relationships
Ron Archer is the graduate advisor for several predoctoral students. One of his students, Gordon Polk, shows Ron data that describe a novel property of an enzyme under study. Both Ron and Gordon believe this work has major implications for expanding the knowledge of this enzyme. At Ron’s request, Gordon repeats the experiments successfully. Then, because of the important implications of this work, Ron approaches another predoctoral student in the lab and asks her to perform the same experiments in order to double-check the results. Ron instructs the student not to discuss the experiments with anyone else in the lab in order to obtain independent data to confirm Gordon’s potentially important findings. Are the advisor’s actions justified in this case?
Mentoring: Case Study 2

John Brandt and Professor Woodworth have met several times to discuss possible projects that John might take on as a doctoral dissertation project. During the last discussion Woodworth recites a series of rules that he applies uniformly to his advisees. He indicates that he wants John to know the rules of his laboratory fully before making a decision to join the lab. Most rules of his laboratory are straightforward, reasonable and come as no surprise to John. However, one rule surprises and concerns him. Woodworth says that he does not permit his laboratory advisees to enter into romantic relationships with one another. Should such a relationship develop, he insists that one of the members of the relationship find a new advisor and a new laboratory. John argues that this is direct interference in personal matters and that such relationships are of no concern to the advisor. Woodworth counters with the fact that twice in the past 5 years his laboratory has been disrupted by romantic relationships between student advisees. These situations have resulted in ill will, diminished productivity and negative effect on the overall morale in the laboratory. The faculty member indicates that he has carefully considered the implication of such relationships and has decided that the only reasonable thing to do is to prevent the problems they create by asking those involved to decide which of the two of them will leave the laboratory. Discuss the issues of mentorship responsibilities, ethics, and conflicts of interest that you feel are important to this scenario.
Dr. Mitchell Conrad has received a grant from an industrial source to do basic research that has long-term implications for commercialization. A new graduate student, Michelle Lawless has just joined his lab following the completion of one semester of graduate coursework. Dr. Conrad outlines several projects that can be pursued by Michelle under this industrially-sponsored research program. Dr. Conrad indicates that there is a proviso listed in the industrial grant agreement which says that all material to be submitted for publication first be reviewed by the company. This review must always be completed within 120 days. Dr. Conrad points out that this presents only a minimal disruption to the normal publication process as compared to the unrestricted publication of material gathered under federal research grants. He also mentions that the positive aspects of working on this proposal include the fact that there is money in the grant for Michelle to travel to at least two meetings per year. Also the grant application provides money for a personal computer that will be placed at Michelle's lab station while she is working on the project. Dr. Conrad emphasizes that working on the project will likely give Michelle an "inside track" with the company should she want to pursue job possibilities there following graduation. Michelle agrees to work on the project. Comment on the ethical and conflict of interest implications of this scenario.
SCIENTIFIC DATA HANDLING, RECORD KEEPING, AND ANALYSIS
Record Keeping

• Crucial for scientific research
• Generally not an active area of instruction, but rather learned through trial and error
• No uniform prescription – more than one “right way”
• Important principles to be followed

Useful data notebooks explain:
What you did
Why, how and when you did it
Where materials are
What happened (and what did not)
Your interpretations
Contributions of others
What’s next

Good data books:
Are legible, well organized, accurate and complete
Allow repetition of your experiments
Are compliant with granting agency and institutional requirements
Are accessible to authorized persons, stored properly, and appropriately backed up
Are the ultimate record of your scientific contributions
Why keep records?

• Kanare – “…serially numbered pages used to record the progress of scientific investigations…a written record of the researcher’s mental and physical activities from experiment and observation, to the ultimate understanding of physical phenomena.”

• Basis for reports, grant and patent applications, journal articles, theses and dissertations

• Accuracy, replication and reliability – may be the “torch” to be passed to another researcher

• Legal implications – granting agencies, patents, FDA, intellectual property
Data

• Factual information used for reasoning
• Intangible vs tangible data
  – Intangible data: written records of measurements, observations, calculations, interpretations, and conclusions
  – Tangible data: cells, tissues, specimens, gels, photos, and other physical manifestations of data
  – Chemistry specific: TLCs, compounds, printouts of spectra
  – Data can evolve, and each form is legitimate, including electronic forms
• What constitutes legitimate and valid data?
• We should recognize the importance of multiple data forms and clarify and define their importance
  – Journals have a role too – e.g. JOC requires publication of all spectra, etc.
Whose data is it? Refresher

- NIH Research: USPHS recognizes the grantee institution as the owner of the data generated by NIH-funded research.
- Permission can be granted to transfer the ownership to, e.g., a new institution – a formal process requiring mutual consent.
- PIs never own the data – transfer is from institution to institution.
Data Storage and Retention

• NIH: data obtained under an NIH grant must be kept for 3 years beyond the date of last expenditure report
• Different agencies may have different requirements
• Responsibility is generally that of the PI, not the institution
• *Know (and follow) your granting agencies’ policies*
• State laws will supercede federal ones regarding data retention
Data Keeping Tools

• Paper
  – Acid-free
  – Keep away from light, high humidity, extreme temperatures and excessive dust

• Ink and pen type
  – No pencil!
  – Avoid aqueous inks
  – Light degrades colored ink faster than black
  – Kanare recommends black ballpoint pens

• Data books - bound books with serially numbered pages are recommended
  – More difficult to delete pages without notice
  – Paper quality is standardized
  – Uniformity is a plus for organization and storage
  – Better ease of use for locating a specific record
Lab Record-keeping Policies

• PIs are advised to set up a policy for their lab
• Some institutions have policies or guidelines
Suggestions for Record Keeping

- **Data Books**: Control the distribution of your data books, noting date, user and project

- **Organization (in order of appearance)**:
  - Table of contents
  - Data book user and location (and financial sponsor, PI, etc if desired)
  - Glossary of abbreviations, symbols or common designations
  - A methodology notebook for standard group procedures – also good to keep records of old methods

- **Tangible data and the data book**
  - Include tangible data in the book when possible (plastic sleeves could be useful)
  - Printed material should not come in contact with plastic
Suggested Formatting

- Concise is good, but not paramount to capturing detail
  - Including interpretations and future plans
- Plan how data will go into the book
- Include
  - Purpose – no matter how routine
  - Materials and Methods
    - Suppliers and grades, for specialized reagents
    - Specify instrumentation if necessary
    - Calibration processes
  - Observations and Results
- Discussion
  - Comments throughout experiment
  - Debate over “editorializing”
    - Capture all the mental activities of the researcher
    - Avoid misleading future readers and creating confusion
  - Industrially, advised to “never make comments that could be subject to misinterpretation by others”
Good Book Keeping

- Consecutive, not parallel, data books
- Continuous and chronological order
- Don’t skip pages
- Date each experiment and recorded data and comments
- Cross out unused space

- Errors: single strikethrough and explanation – reference another page if more space is necessary
- Do not obliterate mistakes with ink or cover them with correcting fluid
  - Info may be useful later on
  - Might look like impropriety
Wintessing of Data

• Industrially required (for IP protection); less common academically (may be required by funding agency for contract work)

• Witnessing of data is necessary if the work may lead to a patentable discovery or invention – lab director’s responsibility

• 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
Interactions with Others

• Good habit to record discussions you have with others about the research
• Record: Time, who, relevant points
• Useful for corroborating data and attributing credit
• List collaborators as well, including fee-for-service work
Example Notebook Instruction

The following information is required in chemistry notebooks from a biotech company:

• Title: “Preparation of…,” “Solubility testing of compound #…,” etc.
• Top of page: date when experiment was started.
• Structural formulas or common abbreviations (such as EDC, HOBT).
• Molecular weight, amount of compound used in both g and mmol; if a reactant is measured by volume, then its density must be listed.
• Source of reactants and solvent (vendor; notebook page, if someone else’s notebook, then also include that person’s name)
• Reference to literature procedure or other notebook pages and purpose of the experiment, if appropriate.
• Detailed description of the experiment (ask yourself: can someone else repeat the procedure without asking you for details?); reference to other pages is okay if the reaction is conducted in about the same way (e.g., “procedure as described on p. 56 except that reaction time is increased to 2 h”); referring to a procedure on a 10 mg scale when the reaction itself is conducted on a 5 g scale is not acceptable.
Example Notebook Instruction

The following information is required in chemistry notebooks from a biotech company:

- Order of mixing reactants.
- Mixing temperature.
- Temperature of reaction: is it the temperature of the heating/cooling bath or is it measured inside the reaction mixture?
- How is the reaction monitored? Reaction time?
- Workup: if it involves extraction, how much solvent was used?
- Chromatography: medium (silica gel?), column dimensions, eluents. If a gradient is used, it must be clear what combinations (“mixture of DCM and MeOH” alone is not acceptable). If prep. HPLC is used, the conditions can also be printed and filed together with the analytical data. If TLC is used for monitoring the reaction or the elution from a column, then the TLC sheets must be copied into the notebook together with the eluents used.
- If material is submitted, list information necessary for compound registration (compound #, vial bar code, etc.).
• Analogy to speech writing:

“Notes prepared for a talk can be categorized into two general forms. The first includes short phrases, words, or occasional sentences that provide triggers for the speaker. The second form is a verbatim text of the speaker’s remarks—a script of every word he or she will speak. There are no abbreviations, cryptic reminders, or shorthand notations. If the speaker is suddenly taken ill, a colleague could easily give the speech. However, it is doubtful that a substitute could successfully deliver the speech using only the abbreviated notes.”
Case Study 1

Jim, a new assistant professor, is getting ready to submit his first paper since joining the faculty. He reviews one of the figures for his paper, which is a photograph of an ethidium bromide-stained agarose gel. The gel contains the products of PCR-amplified whole-cell DNA. The photograph displays the predicted 3-kb DNA fragment. Jim comments to you, his faculty colleague, that a second, minor signal was also evident on the original gel. Based on its size, Jim believes that this second fragment represents a very exciting discovery, but it needs considerable additional work. This second fragment cannot be seen in the photograph. Jim discloses that this is because he has deliberately prepared an underexposed print in order to obscure the second fragment. He says he did this because he is worried that competing groups in larger, more established labs will recognize the potential of the second fragment and will "scoop" him. He has prepared a figure legend that says: "A second, minor signal of unexplained origin was present in this experiment but is not visible in the photograph." But the figure legend does not indicate the size of the unexplained fragment. Thus, he argues, he will be telling the truth while protecting himself from his competition. Are Jim's actions appropriate? Is he (i) simply playing fairly in the hotly competitive arena of biomedical research, (ii) falling victim to self-deception, or (iii) perpetrating scientific fraud?
Case Study 2

A predoctoral trainee under your supervision has had several difficult years finishing up his dissertation research. He has needed continual guidance, and his attitude has not been positive. He does not seem motivated about the work, but you press him almost daily until the work is completed and the dissertation is finally written. The student turns in an average defense and informs you that he is leaving science to take a job in biomedical sales. Several areas of the student's dissertation need additional work before the research can be written up in manuscripts for publication. You turn several portions of the dissertation work over to a competent postdoctoral trainee in your laboratory. Over the course of the next several weeks, the postdoctoral trainee pursues these new lines of experimentation. In the process, however, he uncovers several problems with the data in the dissertation. In fact, a number of experiments cannot be repeated. Moreover, some of the results obtained are opposite to those reported in the student's dissertation. These results have serious implications regarding interpretations and conclusions reached by the student in his dissertation. You review the student's data books and are unable to find entries that could have been used to construct some of the tables included in the dissertation. Moreover, other data sets written into the data book have been used selectively to construct some tables in the dissertation; i.e., critical points that would have confused analysis were omitted in the dissertation. After considerable analysis and discussion with the postdoctoral trainee, you decide that the student has at least falsified data and possibly fabricated data presented in his dissertation. You have not yet published any of the work of the student's dissertation in manuscript form. However, one published abstract contains accurate information that has been authenticated by your postdoctoral trainee. All of the student's work was supported by your NIH grant. What actions, if any, will you take in this situation?
Case Study 2

- You have submitted a manuscript to a peer-reviewed journal that contains primary nucleotide sequence data for a new gene and its upstream sequences. When you receive the paper back from the editor it is accompanied by two favorable reviews.
Useful resources

• Writing the Laboratory Notebook – Howard Kanare