The BWF-HHMI Courses in Scientific Management: A Case Study

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In 2002 and 2005, the Burroughs Wellcome Fund (BWF) and the Howard Hughes Medical Institute (HHMI) sponsored a course in scientific management for postdoctoral fellows and newly appointed faculty who had received grants from these organizations. Both courses were held at HHMI headquarters in Chevy Chase, Maryland. This case study explains why and how the courses were developed, illustrates the role of evaluation in shaping course content and format, and gives an overview of the course sessions.

WHY HAVE A COURSE IN SCIENTIFIC MANAGEMENT?

The 2002 course was conceived following discussions between BWF and HHMI staff and scientists who had received research training or career development grants from the two organizations and expressed a need for additional training in laboratory management to successfully launch their research programs. The course received such an enthusiastic response that BWF and HHMI decided to hold a slightly revised version in 2005 that reflected feedback from participants of the first course.

The courses had three goals. First, they aimed to provide participants with laboratory management skills that would help them rapidly establish well-run, productive laboratories. Second, they aimed to provide participants with an opportunity to develop networks with their peers and more established scientists. Third, they sought to point out the need for early career training in laboratory management to universities, professional societies, and postdoctoral associations and provide these institutions with an example of how they might design their own courses in laboratory management.

To better accomplish the third goal, as part of the development of the 2005 course, BWF and HHMI established the Partners in Scientific Management Program. In this program, academic institutions and professional societies interested in improving the training of early-career scientists were invited to apply to help plan the 2005 course and attend and critique the course itself. In exchange, applicants committed to carrying out scientific management events suitable for their own constituencies. The organizations that were selected to participate in the BWF-HHMI Partners Program are listed below:

- American Physiological Society
- American Society for Microbiology
- American Society of Plant Biologists
- Association for Academic Surgery
- Medical College of Wisconsin
- National Postdoctoral Association
- Northwestern University
- Sigma Xi, The Scientific Research Society
- Society for Developmental Biology
- Thomas Jefferson University
- University of California–Davis
- University of California–Riverside
- University of California–San Francisco
- University of Cincinnati and Cincinnati Children's Research Foundation
- University of Missouri
- University of Pittsburgh School of Medicine

IDENTIFYING TOPICS FOR THE 2002 COURSE

The 2002 course was developed over a two-and-a-half-year period by staff from BWF and HHMI, with assistance from the American Association for the Advancement of Science (AAAS). The first year was spent identifying the topics to be covered. The course developers convened two focus groups mainly composed of BWF and HHMI grant recipients, including advanced postdocs and newly appointed faculty and physician and nonphysician scientists, that identified a diverse range of career development needs that coalesced under the general theme of scientific management. To further refine the list of topics, the course developers consulted with senior scientists and professionals affiliated with BWF and HHMI.

Because of the limited time frame of the course, it was decided that certain important topics, such as lab safety, would not be covered. Course developers and focus group participants felt that this information was either taught at most universities or was available from other sources. The course developers eventually narrowed down the list of potential session topics to 14, which they thought could be adequately covered within the projected three-and-a-half-day time frame of the course. These topics were:

- Laboratory leadership
- Project management
- Collaborations
- The scientific investigator within the university structure
- Getting funded
- Getting published
- Current issues in research ethics
- Time management
- Data management and laboratory notebooks
- Mentoring and being mentored
- Gender issues in the laboratory
- Technology transfer
- Obtaining and negotiating a faculty position
- Budgets and budgeting

THE 2002 COURSE EVALUATION: PROCESS AND OUTCOMES

The 2002 course participants completed an evaluation at the end of each session and an overall evaluation at the end of the course. Completed forms were collected as participants left the session rooms. The evaluations were anonymous—responses were associated with the participant's badge number on the evaluation form. The number was then linked to the participant's demographic information (e.g., academic level, degree), but not to his or her name. Additional feedback was obtained from a focus group held with several course participants directly after the course ended. Evaluations at six months and at one year were conducted to determine which components of the course had been useful to participants.

Results from the evaluations conducted during and immediately after the 2002 course are presented below. The six-month and one-year evaluations yielded much the same results, except where noted, indicating the long-term usefulness of this type of training.

Overall impressions of the course. All 128 participants at the 2002 course completed the overall course evaluation and said they would enthusiastically recommend the course to their colleagues. Eighty-one percent said the degree of change they anticipated in the way they run or will run their laboratories far exceeded or exceeded their precourse expectations. Many mentioned they planned to share information from the course with coworkers. Some pointed out that the course was especially valuable for postdocs who had yet to set up a laboratory. Some participants thought the course was valuable to both senior postdocs and junior faculty and that it was good to have a mix of people at different levels to get different perspectives.

Participants were asked to rate the overall value of each session. The following six sessions (in alphabetical order) received the highest ratings:
- "Getting Funded"
- "Mentoring and Being Mentored"
- "Obtaining and Negotiating a Faculty Position"
- "Roundtable Discussion of Problems in Scientific
- Management"
- "Time Management"
- "Workshop in Basic Laboratory Leadership Skills"

Note: In the one-year evaluation, course participants rated the "Project Management" session higher in terms of value than they did at the time of the course.

Format of the course. Many participants liked that the course was held as a "retreat" rather than at a university or some other setting where it would be more difficult to focus on the course content and take advantage of the networking opportunities. One individual would not have been comfortable discussing a laboratory management problem if the course had been offered at the home university because of the lack of anonymity in such a setting.

Some participants thought that the course would be improved by providing more take-home materials in book, CD/DVD, or Web format. Several participants felt one way to increase exposure to the course was to offer video conferencing with small groups interacting at local sites. All seemed to agree that the information provided in the course should be disseminated as widely as possible.

Improving the course. Participants had the following suggestions for improving the course
- Increase the input from senior investigators—for example, include them in the roundtable discussion breakout groups and have them sit on more panels and participate in the question-and-answer (Q&A) periods at the end of the sessions.
- Include at least one practicing scientist in each panel session.
- Have panelists review each other's presentations

before the course and adapt their presentations to avoid overlap. Allow more time for Q&A periods in each session, and have a strong moderator to keep the questions focused on the session topic.
- Reduce the number of plenary lectures and increase the number of small-group discussions.
- Use "graduates" of the course to lead small-group breakout sessions in future courses.
- Focus less on "big-picture" aspects of a topic and more on its relation to scientific management and the needs of a beginning investigator.
- Have the speakers include a short executive summary or take-home message for their sessions.
- Promote networking among course participants and with speakers and senior investigators by setting aside more time for informal interactions and organizing the tables by scientific field at one of the dinners.
- Offer a follow-up workshop for more established principal investigators who are getting ready to apply for tenure.

Overall course length. Seventy-four percent felt the length (i.e., three-and-a-half days) was about right. Twenty-four percent felt that the course was too long and should be reduced by half a day to one day. Participants felt that time could be saved by

- Holding the speakers to their allotted time
- Keeping the Q&A sessions more focused
- Offering more simultaneous sessions (however, some participants felt that they were missing something when sessions were offered concurrently)
- Reducing the length of the "Workshop in Basic Laboratory Leadership Skills" by conducting the Myers-Briggs personality inventory assessment before the course
- Giving participants any session-related "homework" materials before the course

Several criticized the 7:30 a.m. start times, especially those who had arrived from the West Coast. Several said they would have appreciated a longer break in the afternoon, with sufficient time for exercise or rest, even knowing that this would then push the course sessions into the evening hours.

Most useful aspects of the course. Many respondents commented that one of the most valuable parts of the course was the Q&A period at the end of each session. This part of the session was sometimes considered more valuable than the structured presentations. Many respondents also felt that the networking opportunities during the breaks and meals were very important and would like to have had even more such opportunities (including a more purely social event). The most popular format for the sessions was the small breakout group—talking to each other about shared lab management problems, often with the participation of a senior scientist, was more useful than listening to panel presentations. Many participants also noted that the most useful panels included background information provided by the presenters, followed by case study examples. Having a diverse panel in terms of age, faculty position, and scientific discipline was also thought to be useful.

Sessions identified as having overlap. The following sessions were identified as having similar material: "Getting Funded" and "Budgets and Budgeting," "Gender Issues" and "Time Management," and "Project Management" and "Time Management." Several respondents commented that they didn't think the sessions were completely redundant but that some information was presented in different ways in more than one session. Some thought that in many cases this overlap was beneficial because it served to reinforce the concepts.

Additional topics for future courses. Many suggestions for additional topics were offered, but there was also concern about lengthening the course to include such sessions. The following is a list of ideas contributed by respondents, in no particular order of popularity:

- Include a separate session for physician-scientists.
- Include a session on designing and teaching an academic course. (It was thought that this could be offered simultaneously with the session for physician-scientists.)
- Provide more specific information on mentoring women and minorities in science.
- Include a discussion of issues related to hiring and firing.
- Include a separate session on how to achieve tenure.

USING THE 2002 COURSE EVALUATION TO IDENTIFY TOPICS FOR THE 2005 COURSE

The evaluation outcomes noted above were crucial in shaping the format and content of the 2005 course. Some sessions were dropped, others were presented in a slightly different format, and some new sessions were added. For example, the following sessions were added to the 2005 course:

- "Teaching and Course Design"
- "Strategies for Success for Basic Scientists"
- "Strategies for Success for Physician-Scientists"
- "Mock Study Section"

On the other hand, "Technology Transfer," "Current Issues in Research Ethics," and "Getting Published" were not offered in 2005 because participants would be able to obtain information about technology transfer and research ethics at their institutions and many were already experienced with the process of publishing their research. Although the course organizers thought sessions on these topics would be useful, other topics seemed to represent a more pressing need for the course participants. The sessions "Data Management and Laboratory Notebooks" and "Budgets and Budgeting" also were not offered, although aspects of these topics were included in the reconfigured sessions on project planning and getting funded. The topic of negotiating a faculty position (paired with the topic of securing a faculty position at the 2002 course) was not addressed in 2005 because participants had already secured their faculty appointments (see page 7 for more on the criteria for selecting participants in the 2005 course).

The following is a list of topics that were included the 2005 course:

- Laboratory leadership and management in science
- How to navigate the university structure
- Securing tenure
- Project planning
- Time management
- Mentoring and being mentored
- Collaborations
- Sex and science
- Teaching and course design
- Strategies for success for basic scientists
- Strategies for success for physician-scientists
- Getting funded and budgets
- Mock study section
- Problems and solutions in scientific management

See page 7 for an overview of the sessions at the 2002 and 2005 courses and details about the session evaluation outcomes.

ORGANIZING THE 2002 AND 2005 COURSE SESSIONS

Once the course topics had been chosen, the next step was to develop the topics into sessions. This process was roughly the same for both courses. The session organizers researched the topics, determined the amount of time needed to address each topic and the format to be used, identified and contacted potential speakers, worked with confirmed speakers to develop the presentations, and organized the background materials for the course notebook. The course coordinator—a third-party consultant paid by both organizations—set the final course agenda, sent out invitations to speakers and participants, and tracked the responses.

In 2002, the six session organizers developed their sessions independently (e.g., selecting speakers and working with them to shape session content) and reported directly to the course organizer. This approach was streamlined for the 2005 course, particularly in the areas of decision making and coordination. For the 2005 course, session organizers had the same responsibilities that they had for the 2002 course, but the structure for managing the course overall was modified a bit. Three people—the course coordinator and the HHMI and BWF course codirectors—now had principal responsibility for managing the development of the course. The course coordinator assigned sessions to the course codirectors who, in turn, oversaw the work of the session organizers. Managing oversight in this way enabled decisions to be made more quickly, ensured more consistency across the sessions, and reduced the potential for overlapping content.

For each course, the preparation time for materials, speaker invitations, presentations, and the course notebook (see "Course Materials") was about 10 months.

Speakers and Participants

Both courses were taught by scientists and other professionals from academia and industry. Participants were limited to current and former BWF and HHMI grant recipients, who were selected on the basis of the stage they had reached in their scientific careers and diversity in terms of gender, geographic location, type of academic institution, and degree (i.e., Ph.D., M.D., M.D./Ph.D.). The 128 participants at the 2002 course were biomedical research scientists who had recently received their first academic appointment or were postdoctoral fellows looking for an appointment. The 100 participants at the 2005 course were farther along in their careers—advanced postdoctoral fellows (individuals who had accepted, but not yet begun, a faculty position) and new faculty (individuals within one to two years of starting their faculty appointments). The decision to target this more advanced group was the result of feedback from the 2002 course in which early-stage postdoctoral fellows noted that they were not yet ready to take full advantage of sessions that focused on more advanced career development and managerial topics, such as preparing for tenure and laboratory leadership.

Cost per Participant

The actual cost per participant is difficult to calculate because HHMI lent much of its infrastructure to the course and most development costs were included in staff salaries or in time donated by speakers. However, not counting these costs, the amount for the 2002 course was approximately $2,800 per participant; the amount for the 2005 course was approximately $2,000 per participant. These costs were paid for by the sponsors. Most of these amounts can be attributed to travel, meals, lodging for participants and speakers, and speaker honoraria. A similar course conducted for onsite participants at a university would cost significantly less.

Course Materials

At both courses, participants were given a course notebook—a large three-ring binder containing summaries of the sessions and learning objectives, outlines of the session presentations, and reference lists. The notebook also contained exercises that were to be completed during or after some of the sessions. For sessions where participants were to be split into smaller groups, the notebook contained lists of participants in each group. The notebook was organized into sections for each day of the course. Participants were asked to bring the notebook with them to each session, or at least each day's material. A map of the conference center and a course schedule were included in the front pocket of the notebook.

Course participants were asked to read the materials for each session ahead of time to familiarize themselves with the session content and logistics. This was particularly important for sessions in the 2005 course that had a somewhat unusual format, such as "Laboratory Leadership and Management in Science" and its small-group sessions.

In addition to the session-specific material, the course notebook contained copies of articles on topics that were not covered in the course, such as scientific publishing and equipping a lab.

In addition to the course notebook, participants were also given an opportunity to view samples of the following resources:

- Barker, Kathy. *At the Helm: A Laboratory Navigator.* Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2002.
- Howard Hughes Medical Institute. Videos on laboratory safety (available at no charge at http://catalog.hhmi.org/).
- Kanare, Howard M. *Writing the Laboratory Notebook.* Washington, DC: American Chemical Society, 1985.
- Medawar, Peter B. *Advice to a Young Scientist.* New York: Harper & Row, 1979.
- Portny, Stanley E. *Project Management for Dummies.* New York: Hungry Minds, 2001.
- Reis, Richard M. *Tomorrow's Professor: Preparing for an Academic Career in Science and Engineering*. New York: IEEE Press, 1997.

2002 AND 2005 SESSION FORMATS

Course topics were presented in four formats: workshop, panel discussion, roundtable discussion, and single-speaker or keynote address. Some sessions of interest to particular subgroups of participants were offered concurrently. Each session concluded with time for Q&A. The courses also included opportunities for participants to informally network with their peers, the speakers, and senior scientists and staff from BWF and HHMI. As a result of the 2002 course evaluation, course organizers included even more time for Q&A in the sessions and provided participants with more opportunities for informal interaction, including more free evenings.

SESSION SUMMARIES: 2002 SESSIONS NOT OFFERED IN THE 2005 COURSE

Budgets and Budgeting

In this one-hour session, the speaker discussed writing effective grant proposals and tracking and managing the fiscal side of conducting research. The format consisted of a half-hour presentation followed by a Q&A period. The session was held concurrently with the "Mentoring Panel Discussion."

Participants thought this session could be combined with the "Getting Funded" session. They thought a panel session, with at least two senior principal investigators, and possibly a workshop or small discussion group section, would be ideal. Participants wanted more information on how to construct a reasonable budget for the first R01 grant application—how much to allocate for salaries, fringe benefits, equipment, and supplies. As such, sample budget forms (perhaps in electronic format on a CD) would be of great use. Participants also wanted specific information about what National Institutes of Health (NIH) or the National Science Foundation (NSF) allows in terms of salaries and how to split salaries between multiple grants or funding sources. Other issues that were of particular interest were equipment ownership (regarding NIH grants), indirect versus direct costs, and how to make the most out of start-up funds.

In the 2005 course, the topic of budgets was folded into the session on obtaining grant funding.

Current Issues in Research Ethics

This session was an evening keynote address. The speaker talked about the challenges of protecting the rights and welfare of all who volunteer to participate in research and to make those protections relevant to the myriad new forms of research. Topics included the examination of medical records, stored human tissue samples, family cohorts, and international collaborative studies. The speaker also talked about the challenge of developing better rules to protect those who cannot decide for themselves to participate, such as children, the mentally ill, or the neurologically impaired, as well as the challenge of managing conflict of interest within review boards.

In the 2002 course evaluation, several participants with Ph.D.s in the basic sciences commented that this talk was geared toward medical researchers, and as such, should be offered as a separate session just for M.D.s. However, others pointed out that it was very helpful to learn more about the human research guidelines and to not be intimidated by experiments dealing with human subjects. Other topics of interest were the production and retention of accurate tissue and medical records, the purpose and structure of Institutional Review Boards, and international research. Some participants thought that it was especially helpful that the bioethics speaker had a law degree because this provided a different perspective than a presentation by a Ph.D. or an M.D. There was also considerable interest in expanding the discussion on laboratory ethics and issues of misconduct, in addition to the "big-picture" ethics of using human subjects in research. It was thought that the session could be reconfigured to have two speakers, one to deal with laboratory research problems and another to discuss the use of human subjects.

The session was not offered in 2005 because course organizers heard from participants at the 2002 course that training on this topic is offered by most universities.

Data Management and Laboratory Notebooks

The format of this two-hour panel session consisted of 15-minute presentations by three panelists, followed by a Q&A period. The panelists were experienced scientists drawn from academia and industry. The session

focused on how to set up a system for efficient flow of information in the lab and how to maintain accurate and consistent records, and the need to maintain these types of records for documentation for patents and technology transfer cases. Case studies were presented to stress the importance of maintaining electronic records and laboratory notebooks.

In the 2002 course evaluation, many participants recommended that this session be combined with the one on project management because the two sessions complemented each other. They thought that having a diverse panel (in terms of faculty position, M.D. and Ph.D. degrees, and scientific discipline) was an advantage. Participants thought it would be helpful to include several senior principal investigators to speak about their experiences in managing a variety of projects simultaneously. There was great interest in learning more about data management and, to a lesser extent, project management software. It was suggested that vendors be invited to display their software.

This session was not included in the 2005 course because there was not enough time in the schedule to devote an entire session to this topic; however, aspects of data management were included in the session on project planning.

Getting Published

This one-hour session gave participants an overview of the submission and review process at a scientific journal, including how the initial assessment of a submission is made, how reviewers are chosen, how the decision to publish is made, and what the process for revisions and appeals is. The format consisted of a 45-minute presentation followed by a Q&A period. Because all the 2002 course participants had some experience in writing scientific papers, this session was geared toward the process of getting a paper published (e.g., selecting the appropriate journal, responding to reviewer comments, and learning more about the editorial process). In the 2002 course evaluation, participants said they would have liked a variety of journals to be represented in the panel, rather than only a single, for-profit journal. Participants were also interested in learning more about how to become reviewers and wanted examples of good and bad submissions. The session was not offered in 2005 because of time constraints for the course and the fact that course participants, who were farther advanced in their careers than those in the 2002 course, were likely to already be familiar with the publishing process.

Obtaining and Negotiating a Faculty Position

This session was included in the 2002 course because the topic was of key interest to advanced postdoctoral participants who participated in the precourse focus groups. The format consisted of three 25-minute lectures followed by a 30-minute Q&A period. The three speakers included a senior scientist/administrator, an assistant professor who had recently secured a tenure-track position, and an expert in doctoral education. Feedback from the 2002 course indicated that this was a very popular session, mostly with postdocs rather than junior faculty who had already gone through the process of finding a job. Participants were particularly eager to learn more about what is allowable in terms of negotiating (e.g., just how much back and forth is acceptable) and wanted more information on typical start-up packages, including sample faculty offers. Panels that consisted of people with diverse perspectives—including individuals who had recently obtained their first faculty positions and others who had served on search committees— were also recommended. Physician-scientist participants wanted to know when it was necessary to obtain legal advice for negotiating clinical duties and call schedules. Participants also wanted tips about negotiating a job for a spouse (especially in locations with only one university).

The session also included information on obtaining tenure. Many junior faculty course participants were unable to attend because they were attending the concurrent session on technology transfer. They strongly recommended that the topic of obtaining tenure be covered in a separate session.

Technology Transfer

This topic introduced participants to the terminology, processes, and concepts related to intellectual property and technology transfer. The speakers demonstrated various scenarios to help participants avoid potential disputes and hazards and maximize their effectiveness in working within the system. Participants received a list of helpful websites, textbooks, and journal articles. The format consisted of three 25-minute lectures followed

by a 30-minute Q&A period. Because this session was offered concurrently with "Obtaining and Negotiating a Faculty Position" and attendance was optional, participants recommended that they be alerted ahead of time why it was worthwhile to attend such a session (namely, this information is necessary to address the burgeoning number of biotechnology-academic partnerships that are being established). It was also recommended that the panel include a technology transfer software specialist. Participants would have appreciated sample completed forms for invention disclosure and boilerplate technology transfer agreements. The topic of technology transfer was not included in the 2005 course because the course organizers believed the information was readily available at participants' home institutions and the 2002 course evaluation indicated that the subject was not of great interest to attendees of that course.

SESSION SUMMARIES: 2002 SESSIONS REVISED FOR THE 2005 COURSE

Both the 2002 and 2005 courses began with an evening reception and welcome and keynote addresses by the senior staff of BWF and HHMI. Excerpts of the 2002 course keynote by HHMI president and Nobel laureate Thomas R. Cech can be found at http://www.hhmi.org/labmanagement. The courses continued over the next three-and-a-half days, with a full schedule of back-to-back sessions.

Collaborations

The 2002 and 2005 courses both included sessions that explored the benefits, challenges, and limitations of collaborative research as well as the practical issues of establishing collaborations across sectors and among researchers in disparate fields. In 2002, the format was a single one-and-a-half-hour panel session that consisted of 10-minute panel presentations by three senior scientists, representing academia and industry, followed by a Q&A period. In the 2002 course, participants noted that the discussion should have been cast in more positive terms (i.e., "tell us what works") and that more time should have been devoted to Q&A. They also wanted more information on collaborating with scientists more senior to themselves.

In the 2005 course, the length and format of the session remained the same. However, the session was held twice, concurrently with the two "Mentoring and Being Mentored" sessions, so that participants could attend each and benefit from the added interaction afforded by a small group (participants were split into two groups, alphabetically by last name: "A–L" and "M–Z"). Speakers at the 2005 course talked about the rewards and risks of collaboration and, in response to feedback from the 2002 course, talked about how beginning scientists can approach someone about starting a collaboration as well as the risks and benefits of sharing work, responsibility, and credit. The following topics were covered:

What are the rewards and risks of collaboration?

- What can be gained from collaborations (e.g., access to postdocs, authorship on high-impact papers, opportunities to branch out beyond your own interests, and other benefits)?
- What are the potential pitfalls (e.g., the problem of being seen as a truly independent scientist at tenure time, the time demands of collaboration, and the potential for your trainees to become involved in authorship disputes or to get little credit for their time)?
- How can you get the best reception from those involved in your tenure review for your collaborative efforts?
- How can I become a better collaborator?
- How to work as a member of a dispersed team
- How to lead a collaborative team
- How to negotiate win-win solutions to disagreements that may arise during a collaboration
- How to best play to your own personality strengths when becoming involved in multigroup projects
- How can I get involved in emerging projects?
- How to determine at what point in your career you should begin considering collaboration
- How to look for opportunities to collaborate
- How to reach out to well-established researchers, especially when a collaboration will benefit you more obviously than it will them
- How to look for funding for collaborations

The following resources for additional information on collaborations were listed in the course notebook:

- Barker, Kathy. *At the Helm, a Laboratory Navigator*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2002.

- BWF and HHMI. *Making the Right Moves: A Practical*

Guide to Scientific Management for Postdocs and New Faculty. Burroughs Wellcome Fund and Howard Hughes Medical Institute, 2004, http://www.hhmi.org/labmanagement.

- National Academy of Sciences. "Large-Scale Biomedical Science: Exploring Strategies for Future Research." Washington, DC: National Academies Press, 2003, http://www.nap.edu/openbook.php?record_id=10718&page=R1.

- National Institutes of Health. "Catalyzing Team Science." Bethesda, MD: National Institutes of Health, 2003, http://www.becon.nih.gov/symposia_2003/becon2003_symposium_final.pdf.

In the 2005 course evaluation, respondents thought that the most useful topics were authorship issues, balancing collaborations with independent research, tips on what makes a collaboration work and what doesn't, how to distinguish between help and a collaboration, how to say no to projects, and the pitfalls of collaboration time commitment with respect to getting ready for tenure review. Several participants commented that although it was interesting to hear about different paths to successful collaborations, they would have preferred less "personal storytelling" and more time for either Q&A or discussion of a case study. They also noted that they preferred the presentations that dealt with the small-scale collaborations in which junior faculty are usually involved. Participants wanted to learn more about how to initiate a collaboration, how to negotiate authorship, and how to work with senior-level collaborators. Others wanted more discussion about the roles of physician-scientists and basic scientists in a collaboration.

Gender Issues in the Laboratory

In 2002, an evening keynote presentation addressed how gender plays a role in the professional life of a research scientist. The speaker, who was female and a senior academic scientist, reviewed data from a study on the status of women faculty in science at the Massachusetts Institute of Technology that indicated inequities in advancement and salary levels and found that women faculty felt more marginalized as their careers progressed. She also spoke about the challenges of balancing work and family and related issues, such as deciding when to have children. She also discussed the special issues that principal investigators face as they mentor women and that female scientists face as they seek to be mentored.

In the course evaluation, participants wanted more statistics (perhaps as "ammunition" to take back to their departments). They also suggested that a handout containing recommended reading on the subject be included in future presentations. Participants wanted to expand the talk beyond women and raising children to include discrimination in the workplace (including minorities) and specific strategies on how to support both male and female junior faculty and postdocs. Instead of having a single-speaker format, participants thought the session would benefit from having panel members who are at different career stages; who have spouses with similar time constraints; and who have spouses who contribute their time, not just income, to child care.

The topic of gender issues was included in the 2005 course in the form of a one-hour lecture, titled "Sex and Science." Topics included working with women in science and being a woman in science. Research was presented on why women are poorly represented in the leadership of science. Following the lecture, participants were presented with two case studies to work through with a facilitator over lunch. Participants were asked to discuss what they would do as women faculty members and as colleagues.

Feedback from the 2005 course evaluation indicated that this session was well received by participants. In particular, they valued the discussion of the case study exercise, which revealed the presence of unintentional gender bias using the examples of letters of recommendation. They also liked the nonconfrontational nature of the speaker's presentation and her use of data in documenting bias. Participants wanted more information on how to address bias in themselves and in others. They also wanted more discussion of minority issues and how to handle sexual harassment. They wanted more case studies with real-life examples and solutions. Several participants suggested having a panel format instead of a single speaker or having a panel discussion at the end of the lecture to discuss topics raised in the lecture.

Getting Funded

This topic was covered in the 2002 and 2005 courses in two-hour sessions that used much the same format: twenty-minute presentations by three speakers, followed by a Q&A period. In 2002, key themes included understanding the mission of the grant-making organization, the intricacies of the review process at NIH, and how best to meet the expectations of review panel members. The 2002 course evaluation showed that participants appreciated that the panel included a representative from NIH to explain the internal structure of NIH and whom to contact with questions or problems, as well as a chair of an NIH study section. They said that they also wanted the panel to include representatives from a university grants and contracts office and from a private foundation that supports scientists, as well as a senior principal investigator from a major research university. Participants wanted an example of a successful R01 grant application (including a sample budget) as a handout for this session. Physician-scientists appeared to have many questions specific to their unique status at medical schools, where they have clinical duties in addition to research. Participants thought a breakout session for this subgroup, with specific information on career development awards and salary limits, would be useful.

In 2005, the session was taught by representatives from NIH and NSF as well as a senior academic scientist. They focused their presentations toward beginning investigators who are writing their first grants. The session also included information about basic budgeting principles, such as what constitutes a reasonable budget, direct versus indirect costs, managing salaries across grants, equipment ownership, and tracking expenditures to manage current funding and prepare for the next grant cycle.

The following topics were discussed:

The NIH review process
- Structure of NIH
- Types of grants offered
- R01 study section review process
- Criteria for rating grant applications
- Funding cycles
- How to actively engage in the process through selecting the right NIH institute or center (I/C), getting assigned to the right study section, and communication as appropriate with the I/C program officer

Writing a successful grant application
- Review of the initial idea and abstract: Getting started on an application
- Components of a successful R01 application and common mistakes
- Specifics to consider, such as the relevance of the proposed research to the mission of the funding agency and writing grants using animals or human subjects
- Internal peer review
- What to do if you are not funded

Other funding sources
- Overview of NSF programs and review process
- Review of other sources of funding outside the NIH

Budgeting
- Reasonable budgets: How much should you ask for?
- Direct versus indirect costs
- Managing salaries across grants
- Equipment ownership
- Basic money management, including tracking expenditures during the course of the grant to manage current funds and prepare for the next grant cycle

This was a very popular session. Participants particularly valued the tips on writing a grant proposal and information about NIH small-grant opportunities. Many appreciated learning more about the roles of NIH staff and the types of grants offered, as well as the process and timelines for NIH grant reviews. Participants would have liked greater clarity about the differences between NSF and NIH funding goals and grant application processes, as well as how to choose a study section and an institute appropriate for the project. Some participants wanted to know about funding sources other than NSF and NIH, such as foundations. Others wanted more information about balancing a budget and keeping track of expenses, and making the most of start-up funds. Many wanted to see a real sample budget, with in-depth recommendations on percent allocations to each category of labor, equipment, and supplies. Several participants mentioned that they would have liked the session to be held at the beginning of the course so they could have

time to discuss the session topics more fully during meals and the course's social gatherings. Several participants noted that they would have preferred shorter speaker presentations and more time for Q&A.

Laboratory Leadership Skills

The first session at both the 2002 and 2005 courses dealt with the topic of laboratory leadership. Because interpersonal skills are among the most difficult to teach effectively and the most important in managing a laboratory, the course organizers allotted the largest amount of time to this session. In both courses, the sessions were facilitated by career development professionals.

The session at the 2002 course consisted of an eight-and-a-half-hour workshop, held over two consecutive days. Extensive time was devoted to understanding and appreciating the variety of interpersonal preferences and helping participants identify their communication styles and personality types. The workshop provided participants with opportunities for practicing lab leadership skills through role-playing exercises. Participants worked on strategies for communicating expectations, giving and receiving feedback, and managing conflict. They also took the Myers-Briggs Type Indicator (MBTI), the widely used personality inventory developed by Isabel Briggs Myers and Katharine C. Briggs. In their evaluations, participants reported that the session worked especially well when they broke into small groups. To reduce the length of the session, some suggested offering the Myers-Briggs testing before the course.

The format of the session was revised for the 2005 course. It began with a one-hour lecture on the first night of the course that provided an overview of what leadership means in the scientific community and illustrated the distinction between management and leadership. The lecture set the stage for the small-group modules that would be conducted the next day. For these modules, participants were divided into five groups of 20 participants; each group met in a different room with a different facilitator. (A list of participants and their assigned groups was included in the course notebook.) Three weeks before the course, participants were asked to complete two personality inventories: the MBTI and Skillscope. Participants were given the results of these assessments in their small groups and used the results to identify the skills they needed to improve to become more effective leaders and practiced these skills.

The modules covered the following topics:

Leadership styles and self-awareness
- Explore various approaches and styles to leadership
- Review MBTI and Skillscope personality assessment results
- Examine what skills you need to improve for your own leadership development

Giving and receiving feedback
- Models of giving effective feedback
- How to receive feedback in order to promote open communication

Working with others
- Decision-making processes and their impacts
- Observing team behavior in decision making
- Modes for handling conflict
- Models of negotiation

Working through others
- What are the elements that make good teams?
- What issues usually derail a team?
- What can you do to get a team unstuck?
- What are three types of teams in most organizations?
- Relating MBTI and Skillscope results to team activity

Acquiring and using organizational power
- Sources of power at individual and organizational levels
- Ways of gaining power

Goal setting
- The relationship between assessment, job challenge, and goal setting
- Ways to develop creative approaches to goal setting

The course notebook included the following as additional resources on the subject of laboratory leadership:

- Barker, Kathy. *At the Helm: A Laboratory Navigator.* Cold Spring Harbor, NY: Cold Spring Harbor Labo-

ratory Press, 2002.

- BWF and HHMI. *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty,* Burroughs Wellcome Fund and Howard Hughes Medical Institute, 2004, http://www.hhmi.org/labmanagement.

- Goleman, Daniel. *Emotional Intelligence.* New York: Bantam, 1995.

- Kotter, John P. *Power and Influence.* New York: Free Press, 1985.

- O'Neil, John R. *Leadership Aikido.* New York: Harmony, 1997.

- Ridley, Matt. *The Origins of Virtue.* New York: Penguin, 1996.

The session was well received by participants. One noted that the session was an "eye-opener." Many commented that they found the session and the exercises to be more practical was helpful to explore interpersonal issues in depth. Some participants would have liked more exercises to practice solutions to common lab problems and problems encountered with outside collaborators and scientific competitors.

Mentoring and Being Mentored

In 2002, the topic was addressed in two separate sessions that explored what it means to be a mentor. The first session, lasting one-and-a-half hours, was an introduction to basic principles of mentoring. The presentations were followed by a 30-minute Q&A period. Participants were given "homework" questions to complete in preparation for a one-hour session the next day that included a panel discussion and a Q&A session in response to questions from the audience. (The second session on mentoring was held concurrently with the session "Budgets and Budgeting.") Participants at the 2002 course appreciated the concrete suggestions for creating an open and productive laboratory environment, including advice on mentoring individuals close in age to themselves (such as postdocs) and writing good recommendation letters. There was also significant interest in learning how to get the most out of being mentored. Participants liked the diverse composition of the panel (age, professional level, and mentoring style).

For the 2005 course, the session was offered twice, concurrently with the two "Collaborations" sessions, so that participants could attend each and benefit from the added interaction afforded by a small group (participants were split into two groups, alphabetically by last name: "A–L" and "M–Z"). The sessions consisted of a panel discussion with two speakers (a third speaker could not attend because of illness): a senior scientist and a junior faculty member. The speakers each gave a brief (10-minute) presentation, followed by 45 minutes of Q&A. Speakers were asked to discuss the following topics:

How can I be a better mentor?
- How to know if you're doing a good job or not
- Mechanics and tools for giving trainees feedback on their performance and your expectations
- What not to do
- Mentoring tips from personal experience
- Mentoring people from different backgrounds (race, ethnicity, and gender)

How can I get mentoring for myself?
- Asking for help and feedback
- Finding mentors outside your usual sphere
- Getting the most out of mentors assigned to you by your institution

How can I encourage members of my lab to mentor one another?
- Establishing a "teaching culture" within your laboratory
- Helping students understand how and why their careers will be built around strong contacts with a few key individuals
- Helping trainees identify and establish good working relationships with their peers, near-peers, and senior scientists, who will form the core of their professional networks

While feedback to the 2005 session was generally positive, many participants thought the time allowed was insufficient. Participants also wanted more case study examples of mentoring situations and of common mistakes and their solutions. They suggested a better format might have involved discussing case studies in small groups and then reconvening to discuss outcomes with senior-level faculty mentors. Other participants wanted

advice on how to maintain personal boundaries when a young investigator is mentoring a postdoc who is close in age and how to distinguish between mentoring and micromanaging. Yet another participant wanted more discussion on writing letters of reference. Another suggestion was to divide the session according to topics such as "mentoring others," "finding a mentor," and "being mentored," with specific guidelines and case studies for each topic.

The 2005 course notebook contained a copy of an article by Jill U. Adams, "How to Be a Good Mentor" (*The Scientist,* 18(15), 2004, 56) In addition, the following resources were listed for additional information on mentoring:

- BWF and HHMI. *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty.* Burroughs Wellcome Fund and Howard Hughes Medical Institute, 2004, http://www.hhmi.org/labmanagement.

- American Heart Association. *Mentoring Handbook*, http://www.americanheart.org/downloadable/heart/1066246125811MentorBook.pdf.

- ASCB Women in Cell Biology Committee. Career Advice for Life Scientists (2002) and Career Advice for Life Scientists II (2004), Bethesda, MD: American Society of Cell Biology, http://www.ascb.org/newsfiles/cals_1_final.pdf and http://www.ascb.org/newsfiles/cals_2_final.pdf.

- Association for Women in Science. *Mentoring Means Future Scientists: A Guide to Developing Mentoring Programs Based on the AWIS Mentoring Program,* http://www.awis.org/careers/mentoring.html#pubs.

- Handelsman, Jo, et al. *Entering Mentoring: A Seminar to Train a New Generation of Scientists.* Madison: University of Wisconsin Press, 2005.

- Medawar, Peter B. *Advice to a Young Scientist.* New York: Harper & Row, 1979.

- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. Committee on Science, Engineering, and Public Policy. *Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering.* Washington DC: National Academy Press, 1997, http://search.nap.edu/readingroom/books/mentor/.

- National Institutes of Health, Office of the Director. *A Guide to Training and Mentoring in the Intramural Research Program at NIH.* Bethesda, MD: National Institutes of Health, 2002, http://www1.od.nih.gov/oir/sourcebook/ethic-conduct/TrainingMentoringGuide_7.3.02.pdf.

- University of Michigan, Horace H. Rackham School of Graduate Studies. *How to Mentor Graduate Students: A Guide for Faculty at a Diverse University.* Ann Arbor, MI: University of Michigan, http://www.rackham.umich.edu/StudentInfo/Publications/Faculty-Mentoring/contents.html

Project Management

In the 2002 course, the format consisted of a two-hour presentation by a single speaker (a professional management consultant) followed by a half-hour Q&A period. Evaluation data indicated that the session might work better with the following format: a one-hour presentation followed by a one-hour small working group session headed by mid- or senior-level career scientists familiar with project management strategies. In the working group session, the participants could try to apply the principles learned in the previous presentation. Participants also thought that the addition of laboratory-based case studies would make it easier to absorb the information.

In response to the 2002 evaluation, the format and focus of the session were modified. The 2005 course session focused more on the concepts of project planning that are most useful to running a new laboratory but with some discussion of large collaborative projects in a clinical setting. The session comprised two parts. The first part was a plenary session consisting of 45-minute presentations by two speakers, both of whom were practicing scientists at the same institution, followed by 30 minutes of Q&A. Speakers introduced participants to the basic concepts of project planning (i.e., defining project outcomes, clarifying project authority, developing schedules, assessing and managing risks, and maintaining control), with a focus on ones most useful to early-career scientists to effectively run a new laboratory. Topics included:

- What project planning is and why it is a useful tool at all levels of scientific investigation.
- An overview of basic project-planning principles with examples of how the principles apply to basic science investigations.
- Using project planning in the day-to-day operation of an early-career scientist's laboratory, with examples.
- Using project-planning principles from the "big picture" perspective to manage large multicenter basic research investigations, such as those encountered in cancer, HIV, genomics, and infectious disease research. Specifically, how project management allows you to manage large multicenter projects and how young investigators fit into this picture.

Part two of the session was a small-group exercise. At the end of the lecture session, teams of 8 to 10 randomly assembled participants were given a case study, presented as a game, to solve over lunch (the case study can be found in the resources at http://www.hhmi.org/labmanagement). The teams were given a set of objectives, a budget, and a list from which to choose staff members and collaborators. Each team was then scored on the basis of the completed objectives and the effective use of funds.

Participant feedback on the session was positive, although many participants thought that the large-scale collaboration discussion was of little value to the beginning investigator. The most useful topics covered in the session included allocation of resources and project plan execution, time management, and project planning software. Some participants wanted to know more about how to build the training of technician staff into project planning and how to motivate postdocs to adopt project-planning strategies. Others wanted to know, given the limited resources of junior faculty, how to prioritize projects.

Many participants felt that the plenary portion of the session was too long and more time should have been set aside for the case study or for Q&A. Some participants thought it would have been more valuable if the speakers had been from different institutions. Participants reacted positively to the case study portion of the session, but several said they would have preferred a more structured setting and time frame for this exercise, instead of having it over lunch, so that participants could be sure of completing the exercise.

The following articles, which were included as additional resources in the 2005 course notebook, can be found at http://sciencecareers.sciencemag.org/career_development/previous_issues/.

- Austin, Rob. "Project Management and Discovery." *Science's* NextWave, September 13, 2002.
- Kashyap, Meenaksh. "Project Management for Scientists, Part 1: An Overview." *Science's* NextWave, May 31, 2002.
- Kashyap, Meenaksh. "Project Management for Scientists, Part 2: Getting Experience." *Science's* NextWave, June 14, 2005.
- Portny, Stanley E. and Jim Austin. "Project Management for Scientists." *Science's* NextWave, July 12, 2002.
- Price, Rich. "Take Your Worst Estimate and Double It: Project Management for Postdocs." *Science's* NextWave, March 15, 2002.

Roundtable Discussion: Problems and Solutions in Scientific Management

The 2002 and 2005 courses both featured a session in which participants discussed case studies that represented common situations encountered by beginning academic scientists. The session was included as a way to tie together all the issues discussed during the course and to provide participants with an opportunity to use what they had learned in the course to develop solutions to lab management problems. The session was offered on the last day of the course after participants had the benefit of attending all the sessions and could use their newly acquired knowledge to address the issues.

Before both courses, participants were asked to submit summaries of problems they had encountered in their labs. BWF and HHMI staff then selected 10 cases that were representative of the topics covered in the course and career situations of course participants. Cases were submitted anonymously, and the situations and characters in the cases were modified by the course coordinator to preserve participant anonymity. Participants met in the conference center auditorium for an introduction to the session. Then participants

were assigned to small groups, each including one or more senior scientists from the course, to discuss the case studies.

The discussions of the case studies were handled differently in the 2002 and 2005 courses. In the 2002 course, 10 case studies were developed and each group was given one case study and 30 minutes to discuss the problem and develop a solution. The groups then returned to the auditorium, and a designated reporter from each group was given 8 minutes to present its solution to all the session participants and receive feedback from a panel that included course presenters and BWF and HHMI staff who had developed the course sessions. In their evaluations of the course, participants noted that they did not find the reporting back of solutions to be useful; the most valuable aspect of the session was the small-group discussion.

For the 2005 course, the format was fine-tuned to reflect this feedback. Participants were asked to review the case studies before the course and keep them in mind throughout the relevant sessions of the course. After participants met in the conference center auditorium for the introduction to the session, they moved to different locations to join their preassigned discussion group. Each group was given three or four of the case studies to discuss over a two-hour period. A moderator, chosen from the course speakers, led the discussions and provided a senior scientist's perspective.

The session generated positive feedback from participants. Small-group, in-depth discussion of a few cases was considered by several participants to be the ideal format for this topic. Several participants said they would have liked even more time for this exercise to incorporate the skills they had learned during the course, and they suggested that the entire last day of the course be devoted to small breakout sessions to discuss the lessons learned in relation to case studies.

The Scientific Investigator Within the University Structure

In 2002, this topic was covered in an evening keynote session, given by a senior scientist/administrator, that gave an overview of the "standard" organizational structure of a university, how the investigator fits within this structure, and the entities the investigator interacts with. Factors involved in promotion and tenure for university faculty were also described. Of special interest was the information on how to assemble promotion materials and develop a "tenure" CV, the administrative structure of a university (e.g., the difference between a chancellor and a provost), and how to make the maximum use of university research resources. Participants were eager to learn more about the tenure process and fulfilling contract obligations. Consequently, in response to this feedback, the 2005 course featured two different sessions to address these topics: One focused on navigating the university structure, and another addressed securing tenure.

The 2005 course session on university structure consisted of a 45-minute presentation by a senior scientist/administrator, followed by a 15-minute Q&A period. In addition to talking about many of the topics covered in the 2005 course, the speaker also discussed the organization of a typical medical center, individuals who can help advance a new investigator's career, research infrastructure (including the topics of direct and indirect costs), and the expectations for the beginning investigator outside the laboratory (e.g., committee service, teaching, advising). Participant feedback to the session was mixed, although the majority of participants thought the information was useful. Of particular interest was the discussion on clinical revenue stream versus the research stream, how to balance scholarship and service, and how to build relationships with key people. Participants wanted to know more about when and how to build a relationship with a dean. More information on how to handle joint appointments across university schools (e.g., arts and sciences and medicine) would have been appreciated. Some participants thought that less time should have been spent on covering the information related to academic health centers, as that topic could have been discussed in the session specifically held for physician-scientists. It was suggested that course developers should poll their target audience to better determine the type of institution on which to focus. Participants said they thought that this subject might be better suited to a panel format with speakers representing university-wide and school-level entities and different levels of administrative governance (e.g., dean, department head) and faculty points of view.

The following resources were listed in the 2005 course notebook for additional information on navigating the university structure:

- Boice, Robert. *Advice for New Faculty Members*. Needham Heights, MA: Allyn and Bacon, 2000.

- Boss, Jeremy M. and Susan H. Eckert. *Academic Scientists at Work: Navigating the Biomedical Research Career*. New York: Plenum Press, 2003.

- BWF and HHMI. *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty*. Burroughs Wellcome Fund and Howard Hughes Medical Institute, 2004, http://www.hhmi.org/labmanagement.

- Commonwealth Fund. *From Bench to Bedside: Preserving the Research Mission of Academic Health Centers*. New York: Commonwealth Fund, April 1999.

- Commonwealth Fund. *Managing Academic Health Centers: Meeting the Challenges of the New Health Care World*. New York: Commonwealth Fund, October 2000.

- Goldsmith, John A., John Komlos, and Penny S. Gold. *The Chicago Guide to Your Academic Career: A Portable Mentor for Scholars from Graduate School Through Tenure*. Chicago: University of Chicago Press, 2001.

- Kennedy, Donald. *Academic Duty*. Cambridge, MA: Harvard University Press, 1997.

- Mallon, William T. *The Handbook of Academic Medicine: How Medical Schools and Teaching Hospitals Work*. Washington, DC: Association of American Medical Colleges, 2004.

Time Management

Both the 2002 and 2005 courses offered a two-hour panel session on this topic. The format consisted of 15-minute presentations by three panelists (a mix of senior and junior faculty), followed by a Q&A period. The sessions focused on various aspects of time management in a laboratory setting: managing day-to-day activities efficiently; prioritizing demands according to goals; long-term planning for professional growth; and managing the concurrent demands of teaching, administrative duties, and family responsibilities.

Results from the 2002 course evaluation showed that this session was extremely popular, especially with participants who were trying to juggle work and family issues. Any concrete suggestions on how to save time or to be more efficient were greatly appreciated. While some participants felt it would make more sense to separate the M.D.s and Ph.D.s into separate sessions because of their different time-management challenges, others thought it was a good idea to keep the groups together to get a better understanding of each other's challenges. The diverse panel (in terms of age, faculty position, mix of M.D. and Ph.D. degrees, and scientific discipline) was thought to be important to the success of this session.

As in 2002, M.D.s and Ph.D.s attended the 2005 session; time-management issues particularly germane to physician-scientists were addressed in the session for that group. Topics covered in the 2005 session are presented below:

Time management tools, challenges, and practical considerations

- The big picture: goals, priorities, and tasks
- Strategies for planning ahead
- The art of multitasking
- Strategies to maximize the time you do have
- The Urgent/Not Urgent matrix tool for time management
- Time spent in the office versus time spent in the lab
- Delegating tasks versus doing it yourself
- Choosing institutional/departmental commitments that you enjoy and are advantageous to your career
- When to accept technicians, undergraduate students, graduate students, or postdocs into your lab
- Life outside the lab: family issues, making time for yourself, bringing work home

As in the 2002 course, this was one of the most popular sessions. Participants particularly appreciated tips on how to motivate and manage without micromanaging, how to set priorities, how to provide constructive feedback, and how to manage the grant-writing process. They also liked the balance between younger and older panelists and professional levels. Participants said they would have liked to hear about how to deal with burnout and how to engage others to help save you time. They also wanted recommendations on software and other tools, as well as more practical examples for

time management. Although participants appreciated the discussion of personal time management as well as lab time management, several thought that too much time was spent on the topic of young children and on other family issues that were of limited concern to participants who did not have spouses and children.

SESSION SUMMARIES: NEW SESSIONS DEVELOPED FOR THE 2005 COURSE

From information provided in the 2002 course evaluations, course organizers decided to develop several new sessions.

Mock Study Section

This evening session was optional. The format consisted of a skit by several scientists who played the roles of administrators and reviewers in an NIH study section reviewing an NIH R01 application and an NIH K award application. One good and one poor application were reviewed. This was followed by a Q&A segment. The session was extremely popular; participants found the session both entertaining and informative. Participants found it helped demystify the study section process. Of particular interest was finding out how quickly decisions are made and, consequently, the importance of presenting ideas clearly and succinctly in the grant proposal. Several participants recommended that grant proposals be handed out to course participants ahead of time so that they could judge the grants themselves and then compare their responses to the mock reviewers'. It was also suggested that an additional R01 grant proposal be used as an example instead of the K award proposal, because many of the participants already had a K award. Several participants thought the session could be longer and requested more time for Q&A.

Securing Tenure

In response to feedback from the 2002 course, this topic was developed into a separate session at the 2005 course to help course participants, who had already secured faculty positions. The format consisted of 15-minute presentations by three panelists, followed by 45 minutes of Q&A. The panel comprised two faculty (an assistant professor and an associate professor) representing a research university and a medical center and a senior scientist at a research university. The session addressed the following issues: tenure in today's environment, the process and criteria for achieving tenure, and pitfalls to avoid along the way. Topics included the tenure review process and expectations for promotion, what to do and when, building a national reputation, developing the dossier, and special tenure-related issues of concern for physician-scientists and women.

This was a popular session. Especially appreciated were the details about the tenure process and what is most important—and less important—for achieving tenure and how to prepare and add documents to the tenure portfolio. Participants also appreciated getting the perspectives of speakers at different career stages; the perspective of someone who had just completed the tenure process was thought to be more valuable than the perspective of someone currently going through it. The discussion on maternity leave was also considered valuable, although one participant commented that the subject might have been better covered by a dean or department chair rather than someone "going through it." Participants wanted to know more about several issues, including how tenure letters are evaluated and scored, how to handle a shortened tenure clock, and the impact of clinical service on promotion and tenure. It was suggested that a sample tenure dossier be included in course materials. Also requested was a case study on someone who failed to achieve tenure, and an analysis of why this occurred and what recourse options the denied applicant might face.

Teaching and Course Design

This session was added because an academic appointment often includes a teaching component for which new faculty are often unprepared. Participants from the 2002 course recognized this fact, citing this topic as one that should be covered in future courses. The session consisted of a panel session with three speakers representing a large research university, a small liberal arts college, and a medical school. Each speaker gave a 30-minute presentation, followed by 30 minutes of Q&A. Speakers introduced participants to some effective tools, including active-learning techniques, to use in their classes. The following topics were covered:

- Teaching at a large research-oriented university. Topics included the importance of scientific teaching, the value of active-learning methods, and resources for teaching assistance.
- Teaching at a medical school. Topics included the

general structure of medical education, teaching at different student levels (i.e., medical, graduate, undergraduate) in a medical school, basic sciences in medical training, and medical school curriculum design.

- Teaching at a liberal arts college or university. Topics included how to take advantage of smaller class sizes to develop effective learning opportunities, creating new courses and redesigning existing ones, pedagogy outside the classroom, and teaching science to nonscience majors.

- Balancing the demands of research, teaching, and service. Topics included developing research collaborations; pacing the development of new, innovative courses; and learning to say no.

Although participants at the 2002 course noted that a session on teaching would be useful, the 2005 course evaluation revealed that many participants found it to be of little relevance to their roles as scientific managers. Others said they did not need some of the information—such as that on course development—at this time. Still others felt there was insufficient time to cover the three types of teaching (liberal arts college, research university, medical school). The most frequent suggestion was to omit the topic of teaching at a liberal arts college and reduce the time spent on teaching at a medical school. Participants recommended splitting the session into three groups to address each topic in greater depth. Participants found the theory behind active learning to be useful. They wanted more clarification on the difference between teaching in the lecture setting and the one-on-one teaching that occurs with postdocs and graduate students. They also wanted more information on active-learning techniques, designing exam questions, leading a discussion, and grading and handling grade-related complaints. They also wanted more discussion of how to be rewarded professionally for good teaching.

The following resources were listed in the 2005 course notebook:

- Handelsman, Jo, et al. "Scientific Teaching." *Science,* 23, 2004, 521–522, http://scientificteaching.wisc.edu/ScientificTeaching/ScientificTeaching.pdf.

- National Academy of Sciences. "Bio 2010: Transforming Undergraduate Education." Washington, DC: The National Academies Press, 2003, http://www.nap.edu/catalog/10497.html.

- National Academy of Sciences. "Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics" Washington, DC: The National Academies Press, 2003, http://books.nap.edu/catalog/10024.html.

- National Academy of Sciences. "Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology," Washington, DC: The National Academies Press, 1999, http://fermat.nap.edu/catalog/10711.html.

- National Academy of Sciences "How People Learn: Brain, Mind, Experience, and School" (expanded edition). Washington, DC: The National Academies Press, 2000, http://www.nap.edu/books/0309070368/html/.

- National Academy of Sciences. "Knowing What Students Know: The Science and Design of Educational Assessment." Washington, DC: The National Academies Press, 2001, http://www.nap.edu/books/0309072727/html/.

- Project Kaleidoscope. *Balancing Career and Personal Life*. Project Kaleidoscope, 2005, http://www.sdbonline.org/pdf/DTS_Balancing-career-and-personal-life.pdf.

- Steen, Lynn Arthur, ed. *Math & Bio 2010, Linking Undergraduate Disciplines*. Washington, DC: The Mathematical Association of America, 2005, http://www.maa.org/mtc/projectreport.html.

- Uno, Gordon E.. "Handbook on Teaching Undergraduate Science Courses: A Survival Training Manual." Stamford, CT: Thompson Custom Publishing, 1999, http://www.ou.edu/cas/botany-micro/faculty/uno-book.shtml.

Two Sessions for Two Distinct Groups: Basic Scientists and Physician-Scientists

Two sessions were targeted to two distinct groups: basic scientists and physician-scientists. The decision to develop these two new sessions was a direct outcome

of the 2002 evaluation, in which many participants who were conducting basic research thought that too much time was being devoted to the challenges faced by the physician-scientist. Although the course organizers recognized the benefit of familiarizing each group with the other's issues, they also decided that there would be significant benefit to hold concurrent sessions for each group.

Strategies for Success for Basic Scientists. This session consisted of a 90-minute panel discussion with three senior basic scientists, each giving a 10-minute presentation, followed by open discussion with the audience. Success for new basic scientists in an academic department is often defined in terms of achieving tenure. Panelists provided some advice on key issues for tenure-track basic scientists: securing and maintaining funding, obtaining peer recognition, publishing, maintaining a productive laboratory, teaching effectively, and fitting in with their respective departments. The session was rated highly by participants. These participants particularly liked the tips on funding, working with editors, managing conflict in the lab, and setting expectations for lab members. Participants noted that they would have liked to learn more about funding opportunities, how a basic scientist should navigate the terrain within a medical school (especially if there are clinicians on the tenure committee), and how to recruit and select graduate students, postdocs, and technicians.

One participant suggested the following: Have the speakers address the following statement: Give us your favorite three insider tricks. Also have them answer the following questions: What took you years to figure out? What do you do that no one else does?

Strategies for Success for Physician-Scientists. This session consisted of a 90-minute panel discussion with four senior physician-scientists, each giving a 10-minute presentation, followed by open discussion with the audience. Panelists provided some advice on issues of concern to physician-scientists, including negotiating for and retaining protected research time, understanding how to approach tenure review by managing tenure and research, and building a clinical base that is aligned with research efforts. The session was rated highly by participants.

The participants particularly liked the "10 rules for success" that were outlined by one of the speakers, the discussion on finding a balance between practical and speculative research, and the advice on the importance of finding a clinical base for individual research projects. The discussions about whether to look for a position in a clinical versus basic department were also valued highly.

Participants would have liked to have more discussion about how to develop a strong basic science research program in a clinical department, how to improve time management skills, and how to address the burnout associated with having a demanding schedule. One person suggested that future speakers address the following two issues specifically: What are the 10 most common problems that a physician-scientist will encounter? How should a physician-scientist deal with these problems?

The following resources for physician-scientists were listed in the course notebook:

Useful Links

- ECFMG: Educational Commission for Foreign Medical Graduates, http://www.ecfmg.org/.
- Information on preparing Human Subject Protocols from NIH, http://www.niaid.nih.gov/ncn/clinical/default_human.htm.
- Loan repayment options through NIH, http://www.lrp.nih.gov/About/5lrps.htm.
- Model pretenure portfolio, University of Minnesota Medical School, http://www.ahceducation.umn.edu/OofE/Faculty/PandT/Model.html.
- Sample annotated NIAID R01, http://www.niaid.nih.gov/ncn/grants/app/default.htm.

Articles

- Bloom, Floyd E.. "Science as a Way of Life: Perplexities of a Physician-Scientist." *Science,* 300, 2003, 1680–1685.
- Zemlo, Tamara, Howard Garrison, Nicola Partridge, and Timothy Ley. "The Physician-Scientist: Career Issues and Challenges at the Year 2000." *FASEB Journal,* 14, 2000, 221–230.

Books

- Batitsky, Steve and James Mangraviti. *The Successful Physician Negotiator.* Falmouth, MA: SEAK, Inc., Legal and Medical Information Systems, 1998.

- BWF and HHMI. *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty.* Burroughs Wellcome Fund and Howard Hughes Medical Institute, 2004, http://www.hhmi.org/labmanagement

- Iserson, Kenneth V. *Iserson's Getting Into a Residency,* 6th edition. Tucson, AZ: Galen Press, 2003.

- McCabe, Linda and Edward McCabe. *How to Succeed in Academics.* New York: Academic Press, 2000.

THE 2005 COURSE EVALUATION: PROCESS AND OUTCOMES

The method for evaluating the 2005 course was generally similar to that for the 2002 course. Participants completed an evaluation for each session as well as for the entire course. However, no postcourse focus group with participants was held. Instead, course organizers obtained feedback from representatives of the organizations in the Partners in Scientific Management Program, who met several times during the course with course organizers to share their observations about course format and content.

Results from the evaluation completed by participants immediately after the 2005 course are presented below. (Because BWF and HHMI do not intend to hold the course again, evaluations at six months and at one year are not planned.)

Overall impressions of the course. Ninety-one of the 100 participants in the 2005 course completed the overall course evaluation. The course was very well received by participants; more than 90 percent of respondents considered the overall quality of the course content, the relevance to their roles as scientific managers, and the opportunities for networking as "excellent" or "very good." More than 90 percent of participants who had labs said they expected to change the way they manage their labs. One participant, for example, noted "[the course] has motivated me to think about how I manage, instead of just letting things happen." Other participants reported feeling more confident and prepared as a result of attending the course. Postdoctoral-level participants considered themselves more likely to use the course information than participants who were junior faculty; M.D.s reported a greater intention to use the course information than did M.D./Ph.D. or Ph.D. participants. Ninety-seven percent of respondents said they would recommend the course to colleagues. When asked to identify the single most important component of the course, participants mentioned the following:

- Advice and perspectives of senior investigators combined with the experience of outside consultants.

- Opportunity to talk with and hear from others in the same situation.

- Opportunity to learn strategies for lab leadership and management in a formal way and gain insights into personality types and methods for developing lab workers.

The mock study session and session of project planning were also mentioned as important aspects of the course.

Most popular sessions. The following, in order of popularity, are the eight most popular sessions, which included lectures, panels, and small-group discussions:

- "Mock Study Section"
- "Getting Funded and Budgets"
- "Time Management"
- "Laboratory Leadership and Management in Science"
- "Securing Tenure"
- "Problems and Solutions in Scientific Management"
- "Strategies for Basic Scientists"
- "Strategies for Physician-Scientists"

Overall course length. Approximately 70 percent felt that the course length was appropriate, although a large number (28 percent) thought it was too long. Both the 2002 and 2005 courses had relatively grueling schedules, with participants involved in sessions from early in the morning until sometimes late in the evening. However, because of the difficulties of arranging schedules

and travel and the perceived lack of time on the part of the participants for anything outside of research pursuits, in both cases it was decided to deliver the course in one intensive retreatlike session. Future course organizers who do not have the option to provide a retreat environment may choose to break up the course sessions over several months, either as brown bag lunches or in two- to three-hour sessions.

Improving the course. Participants had the following suggestions for improving the course:

- Have a panel of senior scientists discuss specific problems they have encountered, the strategies they used to solve the problems, and what they might do differently.
- Include a full session on conflict management.
- Add the topics of budget/purchasing, hiring and firing people in the lab, writing a letter of recommendation, and how to handle oneself professionally (e.g., maintaining a professional distance from lab members, avoiding offending colleagues and lab members).
- Provide even more diversity in presenters to underscore the notion that there are many management styles that can lead to success and failure.
- Cover the subject of teaching in greater depth instead of a cursory way; if this is not possible, use the time for other topics.

Comparison of 2005 course with 2002 course. A large percentage (more than 90 percent) of participants in both courses rated the relevance and quality of the course very highly and said they would recommend the course to colleagues. The opportunities for networking appeared to have improved in the 2005 course (90 percent said it was "excellent" or "very good") compared with the 2002 course (approximately 70 percent said the networking opportunities "far exceeded" or "exceeded" their expectations). Plans to modify current lab management practices appeared to increase (91 percent in 2005 versus approximately 70 percent in 2002). Note that four of the eight most popular sessions were new sessions designed to address feedback from the 2002 course. Approval ratings of sessions or topics that remained from the 2002 course were the same or higher, further indicating that the revised 2005 course, with the changes in content, format, and speaker selection, successfully addressed the specific concerns raised in the 2002 course.

There were fewer gender, position, or degree differences recorded in the second course, suggesting that the course organizers had successfully identified and addressed concerns from the 2002 course. The addition of the concurrent sessions "Strategies for Success for Basic Scientists" and "Strategies for Success for Physician-Scientists" most likely accounted for the reduction in discrepancies in responses based on degree that were noted in the first course.

LESSONS LEARNED FROM THE BWF-HHMI COURSES IN SCIENTIFIC MANAGEMENT

The lessons learned from the two courses can be categorized in four different subjects: preparation, format, content, and logistics.

Preparation

In terms of preparing the participants prior to their arrival at the course, course organizers should consider providing, when possible, readings and other materials in advance so that more time can be spent on questions, discussions, and other activities. This can be accomplished by setting up a Web page with PDF files for downloading. Organizers should also consider asking the participants when they register what issues are of significant interest for them, and specifically raise some of these issues in the course discussion sessions to reflect the participants' pressing concerns. The more the course is tailored to the participants' perceived needs, the better they will internalize the materials.

Format

Throughout the evaluations, from both courses, the participants stressed that they got the most information from the Q&A periods that followed the presentations. As such, future organizers could consider having speakers provide shorter introductions to each session and leave more time for discussion. As learned in the "Teaching and Course Design" session, active-learning exercises are popular. Course organizers should try to involve the participants as much as possible in small discussion groups, breakout sessions, and in role-playing activities whenever possible.

A divide has always existed between basic and clinical scientists. While joint sessions are valuable so that

each group can better understand the challenges faced by the other group, in the 2005 course, having specific sessions for each group was well received.

One participant suggested having small moderated discussion groups that meet once or twice a day to reflect on the large-group sessions. While this would add more time to the course, it could also significantly improve the networking opportunities, especially if the groups consisted of different individuals each day and were organized either by stage of career, basic or clinical research focus, or geographical distribution.

Several participants recommended considering reserving the last day for discussion only—perhaps expanding the "Problems and Solutions in Scientific Management" session, in which speakers and panelists join the participants in small groups to discuss case studies.

In both courses, participants recognized the value of having a chance to rub shoulders with senior principal investigators—in terms of networking opportunities and the advice that could be derived from more "seasoned" principal investigators. We would recommend that future course organizers invite senior principal investigators to attend the course and interact with the participants informally as much a possible.

Content

Often there is resistance in the scientific community to personality inventories and leadership assessments like the Myers-Briggs and Skillscope tools. Feedback from the 2002 and 2005 course participants indicated that the insights gained from these assessments proved valuable when participants returned to their labs. To ensure that participants get the most out of what these tools can offer, training organizers must take great care to explore the results with exercises that reflect the language and everyday concerns of research scientists. After preparing two courses, and developing several new sessions for the second course, there are few topics that have not been covered to some extent. Three areas were identified by participants in the second course as still needing to be addressed, however. Future course organizers might consider adding sessions devoted to conflict resolution, selecting or staffing a laboratory, and writing letters of recommendation.

Logistics

The schedule was demanding and was especially difficult for individuals from the West Coast who faced a three-hour time change. When planning a national course, the organizers might consider starting the morning sessions later or moving the conference/retreat location to another time zone (Mountain or Central).

The two courses each took approximately three-and-a half days plus travel time, or between four and four-and-a-half days for each course. Several people would have preferred having the course offered over a weekend to avoid missing an entire week in the lab. However, others appreciated being able to reserve the weekends for their families. Because of financial and time constraints, it is unlikely that many organizations could offer a similar intensive course. We recommend that organizers not try to cover all the topics from the 2002 and 2005 courses but instead select sessions that are especially pertinent to their audience's interests.