

Introduction

New Frontiers in Education and Training for the Laboratory Animal Community and the Public: An Overview of Select Proceedings from the June 2006 Forum of the American College of Laboratory Animal Medicine¹

Leticia V. Medina and Lynn C. Anderson

Key Words: animal care; continuing education; ethical issues; laboratory animal medicine; learning; public outreach; training; workshops

The proper and humane care and use of laboratory animals and the quality of research results derived from those animals all depend on the personnel who support and work with them. The old adage, “knowledge is power,” might be better stated in this context as “education empowers employees.” Power may be defined as the ability to influence outcomes in a particular situation, thus educational empowerment of employees may be described as the process of gaining the ability to influence work outcomes positively through increased knowledge or experience. To accomplish this objective, research institutions must assure that the personnel who care for or conduct scientific research with laboratory animals have the relevant qualifications and experience or must be provided with the appropriate training. Such training not only helps personnel to perform their job duties with confidence and competence but also potentially helps to avoid unnecessary animal pain or distress, loss of research time and effort, and wasted expenses. In addition, the provision of employee training is a legal and regulatory requirement according to US Department of Agriculture (USDA²) regulations (9 CFR 1985), Public Health Service (PHS²) Policy (PHS 2002), and the

Guide for the Care and Use of Laboratory Animals (NRC 1996).

A sustained and effective training program will also help to build a cohesive and collaborative work environment. All personnel engaged in animal care, use, or oversight must understand their respective roles in the animal research enterprise and how they complement and support each other. While scientists are primarily responsible for conducting research, the laboratory animal veterinarians, animal care technicians, and institutional animal care and use committee (IACUC²) members support the scientific research in a variety of ways: by providing optimal animal care, preventing the introduction of disease, and avoiding unnecessary animal pain or distress. Educating personnel about the effects of inappropriate care and use will also help them to understand how optimal animal health and welfare directly affects the outcome of the research. In addition, it helps to assure that the institution is compliant with the relevant laws, regulations, and guidelines. Working collaboratively results in the shared goals of good science and humane animal care.

“Modern laboratory animal science and medicine” (Wolfle 2003) was officially recognized almost 60 yr ago, and much has been learned about the appropriate care and use of laboratory animals during the past six decades (AALAS 1999). However, it was not until 1985 that USDA regulations and PHS Policy required training for animal care and use personnel. In 1988, to help institutions comply with the regulatory requirements and to assist them in developing training programs, the Institute of Laboratory Animal Resources (renamed in 1997 to the Institute for Laboratory Animal Research), National Research Council, appointed a Committee on Educational Programs in Laboratory Animal Science. As a result, in 1991 ILAR published *Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Program* was published (NRC 1991). This manual, which includes a course syllabus, training resources, and educational tools, continues to provide useful guidance for training research and animal care personnel. However, new approaches to education and training, advancements in technology, and many improvements in animal care and use have been introduced in the last 15 yr. This issue of *ILAR Journal* is intended to update and enhance the ILAR training manual.

Leticia V. Medina, D.V.M., DACLAM, is Manager, Animal Welfare and Compliance, Preclinical Safety, Abbott Laboratories, Abbott Park, IL. Lynn C. Anderson, D.V.M., DACLAM, is Executive Director, Consulting and Staffing Services, Charles River Laboratories, Wilmington, MA.

Address correspondence and reprint requests to Dr. Leticia V. Medina, Manager, Animal Welfare and Compliance, Abbott Laboratories, Preclinical Safety, R46G, AP9A-1, 100 Abbott Park Road, Abbott Park, IL 60064-6105, or email Letty.medina@abbott.com.

¹Held in St. Petersburg, Florida.

²Abbreviations used in this Introduction: ACLAM, American College of Laboratory Animal Medicine; CCM, Center for Comparative Medicine; IACUC, institutional animal care and use committee; LABSG, Laboratory Animal Boards Study Group; MGH, Massachusetts General Hospital; NCR, National Center for Research Resources; NJABR, New Jersey Association for Biomedical Research; NLM, National Library of Medicine; PHS, Public Health Service; USDA, US Department of Agriculture.

Recognizing that the training and education of animal care and research personnel are very important components of animal care and use programs, the American College of Laboratory Animal Medicine (ACLAM²) convened a forum on the topic in June 2006 in St. Petersburg, Florida. The 4-day program, “New Frontiers in Education and Training for the Laboratory Animal Community and the Public,” included presentations and workshops on a variety of topics related to training. Several presenters were invited to submit manuscripts on their topics, which are included as separate articles in this issue (e.g., “Emerging Technologies in Education and Training: Applications for the Laboratory Animal Science Community” [Ketelhut and Niemi 2007] and “Training Strategies for Laboratory Animal Veterinarians: Challenges and Opportunities” [Colby et al. 2007]). In addition, other Forum information is summarized below.

Turning Learning Theory into Practice

The keynote address at the ACLAM Forum, “Turning Learning Theory into Practice,” was presented by William Rando, Ph.D., Director of the Yale Office of Teaching Fellow Preparation and Development. Dr. Rando compared education with “Sputnik,” the first artificial satellite launched into space by the Soviet Union, which marked the start of the space age. He stated that effective education and training are the building blocks from which our future scientists and laboratory animal care staff develop. To develop effective training materials, one must carefully assess three variables—the learners, the teachers, and the skills or abilities of the learners. One approach is to pose the following three basic questions:

1. Learners: How can we engage students when motivation varies so widely within a single class?
2. Teachers: How can we design and teach an effective class when students’ skills, backgrounds, abilities, and intellects are very diverse?
3. Skills: How can we teach students when language skills make communication and understanding so difficult?

Dr. Rando recommended the reference book *Applying the Seven Principles of Good Practice in Undergraduate Education* (Chickering and Gamson 1991). A list of these seven principles is provided in Table 1.

Learners. To help answer the first question above, Dr. Rando outlined several approaches that teachers can use to engage learners. First, teachers should set high expectations for the students that are consistent with student desires and described in terms of clear behaviors. In one study involving a class of 30 students, the teacher told 10 individuals before the course began that they were exceptional. Not surprisingly, by the end of the course, the 10 “exceptional” students had performed significantly better than the other participants. This outcome is directly related to several factors. The 10 students had a very positive attitude about their

Table 1 Seven principles for good practice in undergraduate education^a

1. Encourage contacts between students and faculty.
2. Develop reciprocity and cooperation among students.
3. Use active learning techniques.
4. Give prompt feedback.
5. Emphasize time on task.
6. Communicate high expectations.
7. Respect diverse talents and ways of learning.

^aChickering AW, Gamson ZF, eds. 1991. *Applying the Seven Principles for Good Practice in Undergraduate Education*. San Francisco: Jossey-Bass Inc.

own abilities in part because the teacher treated them differently from the other students. He set higher expectations for the 10 students, and he spent more time and/or had more eye contact with them. Dr. Mando stressed the importance of teachers taking time to know students. Student motivation is enhanced when the teacher relates to them and when the students also know the teacher and other students. Finally, teachers should individualize student motivation. This technique can evolve from active, collaborative exercises.

Teachers. In addressing the second question listed above, Dr. Rando discussed ways in which teachers can design and teach an effective class when the students’ abilities and backgrounds vary significantly. First, the teacher must assess the students’ experiences and abilities with respect to the information that must be taught. This assessment can be accomplished by asking questions in class or having students complete a written survey. Second, the teacher should apply limited but well-placed individualized attention, using different teaching styles to reach students at different levels. This approach will help students recognize that the teacher is sincerely attempting to meet their needs. Third, the teacher should demonstrate openness and be receptive to negotiation rather than being closed to discussion or inflexible to change if the students require a different teaching approach. Finally, an effective teacher will use multiple teaching modes (lecture, writing, active/social learning) to meet the needs of the various students because individual learning styles vary.

Skills. To help address the third question, Dr. Rando discussed the barriers that are created when students speak different languages or have different cultural backgrounds. These common barriers must be addressed directly by the teacher and are best alleviated when both the learners and teachers collaboratively suggest ways to overcome the barriers. Learners who have limitations based on language or cultural differences often respond well to visual modalities.

Dr. Rando concluded by suggesting several steps that will help teachers strive to be the best they can be. He recommended that teachers spend time reflecting on their classes and soliciting input from the students. They should learn from each experience, determine what works well, and

refine their teaching style accordingly. Finally, teachers should rejoice in teaching others because it is a great gift for both the teacher and the learner.

Transitioning to Learner-centered Instructional Environments

Maria-Grace Castor-Scheufler, Ph.D., Independent Consultant, MD Anderson Cancer Center, presented information about the principles of student-centered learning. She noted that instructor-led training is not as effective as once thought because it presents “just the facts, ma’am” and does not adequately engage the learner (Cook and Cook 1998). This type of training results in “vomit testing,” wherein facts are merely regurgitated rather than applied to demonstrate real understanding. Learning must be both relevant and interesting to the students for them to become actively engaged in the learning process. Much of what Dr. Castor-Scheufler presented is included in the second manuscript in this article titled “Training in the Laboratory Animal Science Community: Strategies to Support Adult Learning” (Dobrovolny et al. 2007). We recommend that teachers use the characteristics of student-centered learning (see Table 2) to assess whether they are utilizing effective strategies to turn their classroom into a learning community, with students actively seeking information.

Engaged learning is another teaching approach that helps to ensure that learning tasks are challenging and realistic. In this approach, the teacher presents situations that can be integrated into the life of the students. For example, the teacher might require animal care students to compare two different rodent beddings over the course of 1 wk and to prepare a written report of their findings. This assignment requires the students to analyze various aspects of the bedding, including its effect on the animals and differences in cost and in absorbency, all of which are relevant to the daily care of rodents. This type of hands-on training helps students integrate these experiences into their daily animal care practices rather than simply memorizing different bedding types and properties that would likely be forgotten.

Table 2 Characteristics of student-centered learning

Students are responsible for their own learning.
Students are intrinsically motivated to learn.
Students are experts in the learning process.
Students are able to collaborate with others.
The teacher is no longer the expert but is instead part of a mentorship/apprenticeship relationship because teachers can also learn from their students.
Collaborative, heterogeneous groups are the foundational unit of learning. The instructor is a facilitator, a learner, and an explorer of information.

Health Informatics: The Role of the National Library of Medicine

Jack Snyder, M.D., J.D., Ph.D., Associate Director, National Library of Medicine (NLM²), demonstrated how the NLM website (www.nlm.nih.gov/) can be used to support the laboratory animal science community. He emphasized the importance of understanding the acquisition, organization, dissemination, and retrieval of biomedical information. Understanding this powerful tool allows access to information that can enhance the way we live and work. The NLM website can serve as a resource for one’s own personal health and one’s professional needs in the laboratory animal sciences. Dr. Snyder stated that up to 20% of veterinary literature is considered “gray or fugitive literature” because it is not indexed in Pubmed or other information services. This literature includes publications by government, industry, and academia (e.g., dissertations, trade journals, conference proceedings, working papers, and corporate documents) and others for whom publishing is not the primary focus. Dr. Snyder concluded by stating that it is incumbent on the laboratory animal community to identify the information in the veterinary literature that should be published and archived and to follow through accordingly.

Use of Case Studies, Problem-based Learning, and Reflection in Training

Steven M. Niemi, D.V.M., DACLAM, Director, Center for Comparative Medicine (CCM²), Massachusetts General Hospital (MGH²), and Donna Jarrell, D.V.M., DACLAM, Associate Director, CCM, MGH, utilized case studies of Wal-Mart and Toyota, respectively, to demonstrate how interactive learning and problem solving can be used effectively for training. Background information for each case study was provided to attendees before the ACLAM Forum to prepare them for the training sessions held during the Forum. During each training session, a trainer led the discussion and posed questions to stimulate student interaction. The participants’ comments were recorded on flip charts.

The Wal-Mart case study addressed the development strategies used by Sam Walton, who founded the company. Participants discussed strategies such as remote store locations, low cost, effective merchandising, product placement, local manager empowerment, management by walking around, a high level of employee morale, strong vendor relationships, and the use of advanced informational technologies to manage inventories and sales. The trainer then led a group discussion to determine ways in which Wal-Mart’s successful strategies could be applied in the laboratory animal setting.

In the Toyota case study, the trainer provided information about an actual problem that arose during the manufacturing of a line of automobiles. Students were asked to discuss what led to the problem, whether the employee and manager handled it properly, and what could have been

done differently to avoid the problem. The students then identified several strengths of Toyota's operations including employee empowerment, accountability, and strong management support. Finally, the students discussed ways in which these strengths could be used to benefit a laboratory animal facility operation.

Both of these case studies effectively engaged the students by having them analyze what led to each company's success or helped the company to resolve problems that arose. Using case studies based on actual events allowed the students to use their previous experiences to understand the lessons and readily apply them to their own work situation.

Laboratory Animal Postdoctoral Training: Clinician Versus Scientist

Jack Kinkler, D.V.M., DACLAM, Group Director, Pfizer, led a roundtable discussion focused on training laboratory animal veterinarians as clinicians and/or scientists. Dr. Kinkler noted that while the National Center for Research Resources (NCRR²) provides training grants to prepare veterinarians for research careers in comparative medicine and/or comparative pathology, no federal funds are currently available for training laboratory animal clinicians. Many of the roundtable participants commented that laboratory animal veterinarians are challenged by the demands of conducting research and fulfilling their clinical, regulatory compliance, and administrative responsibilities. However, several individuals shared their successes in pursuing research alongside their other management responsibilities. It was also noted that while many laboratory animal veterinarians have not spent their career conducting research, they have enough knowledge to understand and support the scientists working with laboratory animals. In addition, laboratory animal veterinarians are valued for their expertise in regulations and guidelines for laboratory animal care and use.

The group's subsequent discussion addressed the critical shortage of qualified laboratory animal veterinarians and a recent initiative to obtain NCRR funding for clinically oriented laboratory animal medicine training programs. Group members agreed that veterinary students are not encouraged to pursue laboratory animal medicine as a career choice during veterinary school. Numerous viewpoints were expressed and are presented more broadly in this issue in the article titled "Training Strategies for Laboratory Animal Veterinarians: Challenges and Opportunities" (Colby et al. 2007).

Laboratory Animal Boards Study Group Electronic Mailing List and Website

Angela King-Herbert, D.V.M., DACLAM, Head, Laboratory Animal Management, National Institute of Environmental Health Sciences/National Toxicology Program, led the discussion of the Laboratory Animal Boards Study

Group (LABSG²) Electronic Mailing List and Website, which she initiated 10 yr ago while studying for boards. After Dr. King-Herbert provided an overview of the functions of the email list and the way it operates, Deb Hickman, D.V.M., M.S., DACLAM, Veterinary Medical Officer, Portland Veterans Affairs Medical Center, provided a demonstration of the LABSG website and its many educational resources. Although the LABSG email list was originally intended to be an electronic journal club for veterinarians preparing for the ACLAM Board examination, it is open to anyone and regularly provides reviews of pertinent laboratory animal resources in a "question and answer" format. A recent article by Drs. King-Herbert, Hickman, and Murphy (Hickman et al. 2006) provides a list of the many summarized journal volumes and other relevant materials that are available through this resource. We encourage readers to visit the website (www.labsg.org) to learn more about this educational resource, to consider becoming a LABSG member, and to support ongoing efforts to maintain new journal and book reviews.

Educating Coworkers, Family Members, and the General Public

Best practices for educating coworkers, family members, and the general public were presented in five sessions. Coauthor L. Medina and Dale Cooper, D.V.M., M.S., DACLAM, Veterinary Resources Group at Eli Lilly, shared their experiences with educating staff members who do not work directly with animals. Arguably, the scientific community has failed to proactively engage the public, thus allowing misconceptions and misinformation about animal research to prevail. As a result, employees who are not directly involved with animal care or use may have concerns about how the animals at their institution are treated.

At one institution, the need to educate coworkers was recognized when an employee unfamiliar with animal research entered the facility, became concerned about an appropriate animal handling procedure, and threatened to contact the media and expose the company for mistreatment of animals. However, once the employee was educated about the company's animal care program and the laws and guidelines that govern animal care and use, he was reassured that the company was ethical in its treatment of animals. Nevertheless, as a result of this incident, an Animal Program Overview training module was developed and is now presented to all individuals who enter the animal facility. This training could be provided to all interested employees but is instead required for staff members who provide services within or related to the facility including security, engineering, facility maintenance, housekeeping, human resources, quality assurance, information and technology support, employee relations, and public relations. Contractors who enter the animal facility are also required to receive this training. Although the training is relatively brief (<30 min), it provides an overview of the relevant

animal program information and enables individuals to ask questions. Table 3 provides a list of potential topics that can be included in this type of training module.

Abbott Laboratories and Eli Lilly have trained thousands of employees and contractors and have never experienced a negative reaction to their respective training. On the contrary, most individuals are very interested in learning about animal research and are reassured that the animals receive good care. By incorporating specific examples and histories of drugs that were discovered and developed through animal research, the training promotes an understanding of the benefits realized by both the human and animal populations. An excellent example to which most people can relate is the discovery of insulin, which now helps millions of people and animals around the world survive with diabetes. Drs. Medina and Cooper both urged others to initiate a similar training program at their institutions if they did not already have one.

Jayne Mackta, President of the New Jersey Association for Biomedical Research (NJABR²), presented “The Culture of Care,” a training tool that can be used to help educate employees and/or the public about the importance of animal research. During a 3-hr workshop, participants addressed ethical issues related to animal research. Seizing an opportunity provided by the global pharmaceutical company sanofi-aventis, which demonstrated its commitment to

establishing an internal Culture of Care (also described by Klein and Bayne [2007] in the preceding issue of *ILAR Journal*), and following a model ethics workshop developed by AstraZeneca in Sweden, NJABR helped to customize and test this training tool over a 2-yr period.

The workshop began with an overview of the research process as well as the care and use of the animals being studied. Background information covered laws and regulations that protect animal subjects and the role of the IACUC and various organizations and agencies concerned with animal welfare. A short video traced the story of animal research in a compelling and honest way, which helped the workshop participants relate to the hope that research offers to patients.

Workshop participants were then divided into small groups and asked to complete an ethical decision-making scale after practical and philosophical discussion of a case study based on the mouse model for multiple sclerosis. Facts about the human disease (e.g., incidence, progressive suffering, and cost to society) were provided, and information about the animal model (e.g., how the disease develops and progresses, issues of pain and distress, number of animals required) was also provided. Participants were asked to weigh the human benefits of the proposed study, the cost to the animals, and the ethical value of the study itself.

Table 3 Animal program overview training topics for employees who do not work with animals

Ask whether they have ever wondered about animal research—most of them have!
Present an abbreviated description of an animal program—typically >95% rats and mice.
Describe highly trained veterinary and animal care staff—requiring 365 days/yr coverage! Show photographs of veterinarians or technicians working with animals.
Provide a basic overview of laws and guidelines governing care and use of laboratory animals, including AAALAC^a accreditation.
Describe IACUC^a responsibilities—how to report animal concerns.
Discuss the animals' welfare, alternatives (the 3Rs^a), and humane endpoints.
Pay tribute to research animals.
Describe housing and environmental enrichment.
Ask participants how they feel about animal research—no right or wrong answers!
Discuss whether animal research is really necessary. Give examples of Nobel Prize winners whose work was based on animal research.
Give examples of benefits from animal research—vaccines, medications, transplants.
Emphasize that animals benefit too!
Pose the question, “Do researchers care about the animals?,” and discuss.
Explain that good science and animal welfare are complimentary.
Discuss what happens at the end of the studies.
Stress the difference between animal rights philosophy versus animal welfare philosophy.
Mention common myths told by animal rights proponents.
Describe examples of animal extremist tactics.
Summarize highlights of the program.
Provide further information if participants express an interest in learning more (e.g., about AALAS,^a AMP,^a FBR,^a and/or ILAR^a).

^aAAALAC, Association for Assessment and Accreditation of Laboratory Animal Care International; AALAS, American Association for Laboratory Animal Science; AMP, Americans for Medical Progress; FBR, Foundation for Biomedical Research; IACUCs, institutional animal care and use committees; ILAR, Institute for Laboratory Animal Research; 3Rs, refinement, reduction, replacement (Russell WMS, Burch RL 1959. *The Principles of Humane Experimental Technique*. London: Methuen & Co. LTD. [Reissued: 1992, Universities Federation for Animal Welfare, Herts, England] and available online [http://altweb.jhsph.edu/publications/humane_exp/het-toc.htm]).

The discussions were facilitated by laboratory animal veterinarians, scientists, animal care technicians, and IACUC members, who encouraged open and frank discussion of personal feelings about the use of animals in drug discovery. Program evaluations consistently confirm that participants develop a much better appreciation of the complexity of animal research and the care with which institutions deliberate all aspects of animal use. We recommend that readers visit the NJABR website (www.njabr.org) for more information on this innovative training tool.

Beverly Shelton, M.S., R.L.A.T.G., an NJABR volunteer who has worked in the animal care field for many years, presented a variety of ways to educate children about animal research. She stressed the importance of using language appropriate to their age level, engaging them in the discussion so that they personalize the information, and using sports figures or popular vocal artists who are being treated for serious illness to illustrate the benefits of animal research. She also emphasized using visual aids or props such as laboratory coats, gloves, and masks to assist in the training and to help make the learning fun. Ms. Shelton has participated in numerous outreach programs at area schools attended by children of all ages, and she encouraged attendees to be involved in teaching young students the facts about animal research so that they will not be misled by propaganda from animal rights organizations.

Cindy Pekow, D.V.M., DACLAM, Chief, Veterinary Medical Unit of the Veteran's Administration Puget Sound Health Care System, presented "How to Answer the Tough Questions" that people ask about animal research. She assured attendees that people want to know about animal research and are interested in hearing about laboratory animal scientists' personal experiences from a firsthand perspective. However, she cautioned people to (1) be sensitive to the reason for the question (i.e., curiosity, hostility, or concern); (2) watch the person's body language; (3) always be honest; and (4) avoid engaging in debates. Frequently asked questions or comments include the following: "Why can't we use alternatives?" "Can rodent data really be relevant for humans?" "How can people care about animals and use them in research?" "I heard about how animals are tortured at XYZ facility" and "Don't animals have rights?"

The most commonly asked questions may be grouped in three categories: ethical questions, accusatory questions, and questions that require a long or complex answer. Dr. Pekow provided examples of each type of question and suggested a variety of responses that could be given in a clear and forthright manner. Sample questions and suggested responses are also available at numerous websites (e.g., www.aalas.org, www.kids4research.org, www.statesforbiomed.org, www.fbresearch.org, and www.rds-online.org.uk/home.html). Dr. Pekow encouraged attendees to be proud of the important work they do and not to shy away from sharing important facts about laboratory animal science and medicine with the general public.

Research and Continued Learning

Linda Toth, D.V.M., Ph.D., DACLAM, Director, Division of Laboratory Animal Medicine, Southern Illinois University, addressed the attributes of a research career involving grant writing, and the benefits of continued learning. Dr. Toth has successfully managed a career that involved directing an animal care and use program while also pursuing her research interests. She encouraged others to remain open to the opportunities for applied research that arise in the general laboratory animal environment, including clinical cases or unusual phenotypes, in addition to pursuing a specific topic of interest, as she has done with sleep research. Dr. Toth discussed the keys to successful grant writing and emphasized the need to submit grants that are free of errors and to provide evidence that the research is worthy of funding. She also emphasized that one of the keys to a successful research program is having a dedicated and hard-working team of individuals in the laboratory. She acknowledged that much of her professional success can be attributed to her research team and their ongoing support. Dr. Toth concluded by stating that a research career provides an excellent mechanism for people to enjoy the challenge of continuous learning.

Summary

The information in this issue reflects the combined effort of many professionals with expertise in laboratory animal science and medicine, regulatory affairs, and education. Collectively, their diverse experience and perspectives introduce a wealth of new educational strategies, technologies, training options, assessment tools, and curricula that can be used to meet the education and training needs of the laboratory animal research community. It is our hope that publication of this issue will build on the foundation of *Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs* and will provide contemporary methods for developing or expanding institutional animal care and use training programs.

Appropriate education and training help to empower employees and enable them to conduct responsible and humane animal research. This essential foundation also helps individuals to discuss the benefits of their research and related support efforts with coworkers, family, and the general public. However, it is equally important for institutions to continuously provide opportunities to educate and train their employees because advancements in scientific knowledge and technologies are constantly evolving. The continuity and maintenance of high-quality education and training programs will not only help to ensure optimal animal care and use but will also provide assurance to the public that animal research is conducted responsibly.

References

- AALAS [American Association for Laboratory Animal Science], 1999. 50 Years of Laboratory Animal Science. Memphis: AALAS.
- Chickering AW, Gamson AF. 1991. Applying the Seven Principles for Good Practice in Undergraduate Education. San Francisco: Jossey-Bass Inc.
- CFR [Code of Federal Regulations]. 1985. Title 9 (Animals and Animal Products), Subchapter A (Animal Welfare). Washington DC: Office of the Federal Register.
- Colby L, Turner P, Vasbinder MA. 2007. Training strategies for laboratory animal veterinarians: Challenges and opportunities. *ILAR J* 48:143-155.
- Cook JS, Cook LL. 1998. How technology enhances the quality of student-centered learning. *Qual Prog* 31:59-64.
- Dobrovolny J, Stevens J, Medina LV. 2007. Training in the laboratory animal science community: Strategies to support adult learning. *ILAR J* 48:75-89.
- Hickman DL, King-Herbert A, Murphy SJ. 2006. The Laboratory Animal Boards Study Group: A multi-faceted tool for preparation for the American College of Laboratory Animal Medicine Board Examination. *JAALAS* 45:33-39.
- Ketelhut DJ, Niemi SM. 2007. Emerging technologies in education and training: Applications for the laboratory animal science community. *ILAR J* 48:162-168.
- Klein HJ, Bayne KA. 2007. Establishing a culture of care, conscience, and responsibility: Addressing the improvement of scientific discovery and animal welfare through science-based performance standards. *ILAR J* 48:3-11.
- NRC [National Research Council]. 1991. Education and Training in the Care and Use of Laboratory Animals: A Guide for Developing Institutional Programs. Washington DC: National Academy Press.
- NRC [National Research Council]. 1996. Guide for the Care and Use of Laboratory Animals. 7th ed. Washington DC: National Academy Press.
- PHS [Public Health Service]. 2002. Public Health Service Policy on Humane Care and Use of Laboratory Animals. Washington DC: US Department of Health and Human Services. (Public Law 99-158, Health Research Extension Act of 1985.)
- Wolfle TL. 2003. 50 Years of the Institute for Laboratory Animal Research (ILAR): 1953-2003. *ILAR J* 44:324-337.