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Introduction to Laboratory Animal Medicine

Laboratory animal science is the body of scientific and technical information, skills, and techniques that apply to laboratory animal care and use. This includes husbandry, nutrition, behavior, health, production, and management of laboratory animals. The field of laboratory animal medicine has grown rapidly because of a steady increase in biotechnology and genetically engineered rodent models and because good science and the public interest require that the best possible care be given to animals used in research.

Laboratory animal medicine is the specialty field within veterinary medicine that encompasses the diagnosis, treatment, and prevention of diseases in animals used in research, testing, and education. It includes methods to minimize and prevent pain, discomfort, and distress in research animals and ways to identify factors that may influence animal research. Veterinarians engaged in laboratory animal medicine may have a variety of responsibilities within an animal care and use program. They may be responsible for the provision of adequate veterinary care, the management of animal care and use facilities, the education of individuals who care for and use laboratory animals, assisting biomedical scientists in the selection of and humane use of animals, obtaining and interpreting quality data, and assuring compliance with all regulations and policies that affect research animals. Credentialed veterinary technicians work under the supervision of a veterinarian assisting them in carrying out these responsibilities. They often provide technical support in disease detection, including oversight of sentinel programs, treatment of ill animals, blood sampling, and necropsy and tissue collection. When engaged in research or drug study positions at a pharmaceutical firm or university, they administer test products and collect data. This type of employment

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normally requires the credentialed veterinary technician to have a bachelor's degree. Credentialed veterinary technicians may also work in research compliance or supervise other animal facility staff such as assistant laboratory animal technicians, animal caretakers, and cage-wash personnel.

ANIMALS USED IN RESEARCH, PRODUCT SAFETY TESTING, AND EDUCATION

Biomedical Research

Remarkable advances have been made in medicine and science in the past 60 years, such as the development of vaccines for polio and hepatitis B, antibiotics for infectious diseases, procedures for organ transplantation and open heart surgery, and drugs for chronic disorders such as diabetes and high blood pressure. Animals played a major role in these advances (Table 1.1). New treatment modalities for cancer, less invasive surgical approaches, and the development of equipment such as the laser and endoscope used in surgery would not have been possible without the use of animals. Sophisticated as *in vitro* methods and computer simulations may be, they often cannot generate sufficiently comprehensive data about how a substance affects a complex, living being. These *in vitro* methods are often used as early screens to avoid the use of animals for compounds that may be toxic or ineffective. Likewise, the *in vitro* methods are used to answer questions about compound–receptor interactions; this information can lead to a reduction in animal use. Currently, the best predictors of complex biomedical responses of humans are higher-order animals such as mice and rats.

Product Safety Testing

Several decades ago, consumers were subjected to products that were not adequately tested prior to use. Early treatments for syphilis included mercury and arsenic, which in themselves could cause death. An untested eyelash dye marketed in the early 1930s that caused blindness in a number of people and an untested elixir that caused the death of over 100 people led to the passage of the Food, Drug, and Cosmetic Act. The Food, Drug, and Cosmetic Act mandates that prescription drugs be tested first in preclinical animal studies and then in clinical human trials prior to marketing to the general public to ensure they are safe and effective products. Companies that sell beauty and cosmetic products to a largely uneducated group of consumers often misuse the term "cruelty-free" as a marketing tool. These companies claim that they conduct no animal testing. The reality is that their products are either tested by an outside laboratory or are made of compounds known to be safe through previous animal testing.

Education

Animals play a valuable role in education, starting from preschool and continuing to the college and graduate level. Through interactions with animals, youngsters can learn how to care for another living being. They also learn lessons in responsibility and respect. At the middle and high school levels, animal tissues may be used for hands-on experience with dissection. This often opens up the amazing world of biology and science to young people as they marvel at the complexity and specialization of the various organs. Although com-

Table 1.1. Animal roles in medical discoveries and advancements

Year	Scientist(s)	Animal(s) Used	Contribution
1901	von Behring	Guinea pig	Development of diphtheria antiserum
1904	Pavlov	Dog	Animal responses to various stimuli
1923	Banting, Macleod	Dog, rabbit, fish	Discovery of insulin and mechanism of diabetes
1924	Einthoven	Dog	Mechanism of the electrocardiogram
1945	Fleming, Chain, Florey	Mouse	Discovery of penicillin and its curative effect in various infectious diseases
1954	Enders, Weller, Robbins	Monkey, mouse	Culture of poliovirus that led to development of vaccine
1964	Block, Lynen	Rat	Regulation of cholesterol and fatty acid metabolism
1966	Rous	Rat, rabbit, hen	Discoveries concerning hormonal treatment of prostatic cancer
1970	Katz, von Euler, Axelrod	Cat, rat	Mechanism of storage and release of nerve transmitters
1979	Cormack, Hounsfield	Pig	Development of computer-assisted tomography (CAT scan)
1984	Milstein, Koehler, Jerne	Mouse	Techniques of monoclonal antibody formation
1990	Murray, Thomas	Dog	Organ transplant techniques
1997	Prusiner	Mouse, hamster	Discovery of prions, a new biological principle of infection
2003	Lauterbur, Mansfield	Clam, mouse, dog, rat, chimpanzee, pig, rabbit, frog	Discoveries concerning magnetic resonance imaging
2008	Barre-Sinoussi, Montagnier	Monkey, chimpanzee, mouse	Discovery of human immunodeficiency virus
2008	zur Hausen	Hamster, mouse, cow	Discovery of papilloma viruses causing cervical cancer
2011	Hoffman, Beutler	Fruit fly, mouse	Discoveries concerning the activation of innate immunity
2011	Steinman	Mouse	Discovery of the dendritic cell and its role in adaptive immunity

Sources: National Association of Biomedical Research (www.nabr.org) and Nobel Prize (www.nobelprize.org).

puter modeling and videos can replace some biology learning experiences, tissues and organs look remarkably different in real life. In college, animals are used in a variety of professional and graduate level courses in medical and health-related fields. Surgery courses provide young veterinary surgeons a chance to hone their skills before performing them on client-owned animals. Physicians use animals to practice robotic, endoscopic, and laser surgery prior to performing them in people. Animals are used in training courses for medical personnel so they may update their skills in placing endotracheal tubes and critical care monitoring

devices. Technique courses allow veterinary students and veterinary technician students to learn injection techniques and catheter placement on animals. Many of the animals used for educational purposes are subsequently adopted into loving homes.

Animal Usage Statistics

The majority of animals used in biomedical research are bred specifically for that purpose. According to the United States Government Statistics, 1.13 million animals were used in 2010 for research, product safety testing, and education. The U.S. Government Statistics figures do not include mice, rats, birds, and fish as these animals are not covered by the Animal Welfare Act. The precise number of mice and rats used is not available; however, it is estimated approximately 26 million are used every year. Mice and rats account for greater than 95% of the animals used. The number of dogs, cats, and primates together account for less than 1% of the animals used.

The use of nonrodent animals has been declining over the past two decades primarily due to the development of genetically engineered mice and rats. The number of dogs used in research currently is less than one-third of its numbers in the late 1970s. The number of primates used over the past decade has risen slightly, in part due to increasing emphasis of research into neurodegenerative diseases such as Alzheimer's.

To put the numbers in perspective, 25 million of the 26 million animals used in research in the United States are mice, rats, birds, or fish. According to Speaking of Research (http://www.speakingofresearch.com), "we consume over 1800 times the number of pigs than the number used in research. We eat over 340 chickens for each animal used in a research facility, and almost 9000 chickens for every animal used in research covered by the Animal Welfare Act. For every animal used in research, it is estimated that 14 more are killed on our roads."

Funding Sources

In the United States, the National Institutes of Health (NIH) and the National Science Foundation (NSF) are the primary public granting agencies for biomedical research, providing approximately two-thirds of the funds spent by universities and colleges. The NIH, a branch of the Public Health Service (PHS), provides competitive federal grants for investigators interested in the health-related advancement of humans and animals. The NSF encourages basic research in behavior, mathematics, physics, medicine, biology, and other sciences. In addition to the NIH and NSF, funding comes from universities and colleges, state governments, industry, and private foundations. Acquiring funds to conduct research is difficult because competition for grant money is high, with only 10%–20% of submitted proposals receiving funding. Typically, a grant provides money for the scientist's and research team's salaries, supplies, equipment, and purchase and maintenance of animals for a 3-year period. The scientist or principal investigator (PI) plans and coordinates all phases of the research study. The PI must conduct the research study, tabulate data, publish the results, and report findings to the funding agency. If the study has promise, the funding agency may renew the grant for an additional period of time.

Regulatory Oversight and Accreditation

Multiple levels of regulation (e.g., federal, state, and voluntary) exist to provide oversight of animal care and use. Federal and state regulations mandate standards for animal care and

use. Many institutions choose to obtain the "gold standard" of voluntary accreditation from the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC). Chapter 2 provides additional information regarding the oversight provided by governmental and voluntary organizations.

Institutional Animal Care and Use Committee

Prior to the initiation of a research study, a product safety test, or an educational program that uses animals, a protocol must be submitted to and approved by the institution's Institutional Animal Care and Use Committee (IACUC). The protocol is a detailed, written description of the proposed animal care and use. It justifies the use of vertebrate animals to accomplish the study's aims, details the procedures that will be performed on the animals, and describes how the animals will be housed and cared for throughout the project. Additionally, the PI must give several assurances, including that the study does not unnecessarily duplicate previous studies, that the staff working with the animals have adequate training to accomplish the study tasks in a humane manner, and that alternatives to animal use and painful or distressful techniques have been carefully considered. Animal use protocols are usually approved for 3 years but must undergo an annual review by the IACUC and be resubmitted for full, *de novo* (anew) review every 3 years. Protocols must also be amended each time a study technique or any activity involving an animal changes. Semiannual inspections by the IACUC members are mandated by the United States Department of Agriculture (USDA) and described in the *Guide for the Care and Use of Laboratory Animals* (the *Guide*; ILAR, 2011) to help ensure that all laboratory animals are observed for appropriate care and for adherence to regulations and use guidelines. Additional information about IACUCs can be found at www.iacuc.org.

ETHICAL CONSIDERATIONS

The 3Rs: Replacement, Refinement, and Reduction

Two English scientists, Russell and Burch, coined the term "the 3Rs." In 1959, they carried out a systematic study of the ethical aspects and "the development and progress of humane techniques in the laboratory." The 3Rs represent three ethical tenets of responsible animal use: replacement, refinement, and reduction. Research institutions and regulatory authorities have developed methods to make sure the principles of the 3Rs are followed to ensure animals are used in an ethical manner. There is an ethical imperative that scientists use animals only when they have provided assurance to the IACUC that no nonanimal methods will allow them to achieve their scientific aim. This search for alternatives is mandated for species covered by the Animal Welfare Act (AWA; see, e.g., APHIS, 2010a) regulations. For species not covered by the AWA, both the Public Health Service Policy and the *Guide* refer to the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training," which includes language about consideration of alternatives to animals (see Chapter 2, Table 2.1). The U.S. Government Principles mandate using the minimum number of animals necessary to obtain valid results. This is synonymous with reduction, one of the 3Rs.

Replacement refers to replacing animals with a nonanimal alternative, such as *in vitro* screens with cell culture or computer modeling or by using the least sentient animal that will enable good data collection (rat versus dog or fish versus mouse). The ever-increasing sophistication of testing methods, such as molecular diagnostics, has allowed development of alternative tests. Any alternative test, however, must be validated before it can be used to replace a product safety test currently using animals. The development and use of special rodents, such as nude and transgenic mice, has made it possible to reduce the number of more highly evolved species such as dogs and cats. Environmental toxicity studies often use zebrafish rather than mice and other mammals. Alternate tests for ophthalmic safety testing have been developed using eyes from slaughter animals as well as cell and tissue culture systems.

Refinement refers to methods that incorporate modification of a procedure to lessen animal pain and distress or enhance animal well-being. Use of less invasive procedures, provision of pain relief, provision of environmental enrichment, and decreased restraint time are examples of refinements. For example, a study reported a refinement of the urine concentration test used in behavior and physiology studies. During the test, animals had historically been deprived of water for 24 hours or longer. This was found to be unnecessary because the same results were obtained after only 16 hours of water deprivation. Investigators must constantly review the way animal studies are conducted to ensure that the methods used are the most humane or refined so as to minimize pain and distress. Investigators work closely with laboratory animal veterinarians and the IACUC to assure that humane endpoints are in place to minimize pain and distress to the greatest degree possible. The IACUC often develops humane endpoint guidelines that help investigators determine when an animal should be euthanized or removed from a study. Examples of humane experimental endpoints include a defined percentage of weight loss or tumor size, presence of labored breathing, and an inability to ambulate. There is a delicate balance between collecting the necessary scientific data from a study and ensuring that animal welfare is upheld through the use of euthanasia before an animal becomes extremely ill. When appropriate, less invasive methods should be used, and anesthesia or analgesia must be administered to minimize unnecessary pain and distress of research animals.

Reduction refers to using the minimal number of animals in a study that is consistent with sound scientific and statistical standards. Investigators must constantly strive to find ways to reduce animal numbers. Using a combination of computer-based simulators with the animal portion of the study, employing better statistical methods, or using one control group with multiple study groups are potential methods used to reduce animal numbers. The number of animals used in product safety testing has been significantly reduced through validation of alternative testing methods. Experiments can be designed using multiple sections with the results derived from earlier sections used to refine the number of animals or experimental groups used in later sections. For example, the staircase design is often used in acute toxicology testing. This method involves administration of a limited number of drug dosages (high and low) to then determine a more precise dose range for further testing. Used with sophisticated computer-assisted computational methods, the staircase design can determine a point estimate of the lethal dose, approximate confidence intervals, and determine toxic signs for the substance tested, yet use fewer animals.

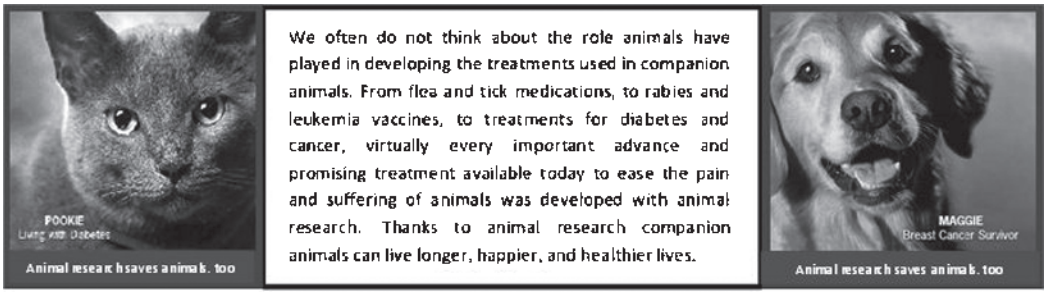

Fig 1.1. Animal research saves animals, too. (Source: Foundation for Biomedical Research.)

Overall, the research community must continually challenge itself to consider whether the animal research being performed is ethical and justifiable. Only in that way will we be assured of continued public support for our use of animals for scientific research that benefits so much of society, including animals! (See Figure 1.1.)

Animal Rights and Animal Welfare

The terms "animal rights" and "animal welfare" are not synonymous. Animal rights is a philosophical belief that gives animals the same equality and protection as humans. In other words, a field mouse has the same right to life as a human. Animal rights purports that animals should not be regarded as property. No matter how humane, animal use is viewed as exploitation and should be banned. This includes keeping dogs and cats as pets; displaying animals in zoos and aquariums; using chickens, cattle, or swine for food; and using animals in research, testing, and education. Their dogmas are not recognized as mainstream ideology and can include abstaining from medication including vaccines or medical treatments that were developed through animal research.

The term animal welfare represents a philosophical belief that it is morally acceptable for humans to use animals provided they are treated humanely and their physical and psychological well-being is met. This creed is based on a belief that animals can contribute to human welfare. Animals provide companionship, entertainment, labor, food, fiber, and advancement of knowledge when used in research and education. When animals are used, it is paramount that responsible practices of animal welfare are adhered to, including provision of appropriate housing, handling, management, disease prevention and treatment, and, when necessary, euthanasia.

Random Source versus Purpose Bred Animals

Dogs and cats used in research and education can come from a number of sources. Random source animals are procured from USDA licensed Class B dealers who obtain them from random sources such as individual owners, breeders, pounds, and animal shelters. Random source dogs may have particularly desirable attributes such as genetic diversity and size. They may be more sociable and tractable, making them easier to handle in a research environment. Purpose bred animals are procured from USDA-licensed Class A dealers or from

privately owned research colonies. These animals are bred and raised specifically for use in research. The most common breeds of purpose bred dogs are beagles and hound crosses. Purpose bred animals are of genetically similar backgrounds, often having known pedigrees and being of a desired age. They tend to have fewer health problems than random source dogs and are accustomed to cage life, but they may be shy and difficult to handle unless previously socialized.

The majority of dogs used in biomedical research are purpose bred. Of approximately 64,000 used in 2010, roughly 1000 were obtained from the nine existing Class B dealers in the United States. Although only a small number of random source dogs are used, there has been growing concern over their use (GAO, 2010). Concerns often cited are the use of prior pets in research or their unsanctioned use after owner surrender at a pound or shelter. Animals must be held at a pound or shelter for a minimum of 5 days, not including the day of acquisition or disposition, to allow an owner adequate time to reclaim a lost pet. Owners who relinquish a pet to a pound or shelter must sign a form that acknowledges the potential release of the animal for research. USDA conducts tracebacks to insure random source animals were obtained through legitimate channels. Three to four million dogs and cats are put to death each year in pounds across our nation. The question becomes, "Should research be permitted access to a small percentage of random source dogs or should all dogs be purpose bred?"

In May 2009, the National Academy of Science delivered a study report, *Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research*, to the NIH that made a number of recommendations. The report concluded that animals should be made available with random source characteristics but that their availability can be accomplished other than through Class B dealers. The NIH is currently implementing a plan prohibiting the procurement of dogs from USDA Class B dealers using NIH grant funds (NIH, 2011a). NIH is anticipating the new policy will be fully implemented by 2015.

Nonhuman Primate Use

Nonhuman primates account for less than 1% of the USDA-regulated animals used in the United States. The vast majority of primates used are rhesus and cynomolgus macaques; only a very small percentage used are chimpanzees. Nonhuman primates share anatomic and physiologic proximity to humans and as such should be used only when another animal model cannot be used. Chimpanzees, our closest relatives in the animal kingdom, have served an important role in advancing human health, especially in the development of vaccines for polio and hepatitis B. It is their evolutionary closeness that brings with it moral and ethical implications for their use. There is debate among scientists as to the further necessity of using chimps. The biomedical community has developed new methods and technologies that have provided alternative models to the use of nonhuman primates. Scientists agree that chimps should be used judiciously although newly emerging, or re-emerging, diseases may require their future use. Studies using chimps in the United States have undergone rigorous review and demonstrated justification for using the species. Many countries, however, currently prohibit invasive research on chimps thus prompting the United States to review its policies. In December 2011, after the Institute of Medicine addressed the issue and reported its findings, the NIH announced it will not fund any new projects for research involving chimps (NIH, 2011b). Proposed federally funded projects utilizing chimps will be evaluated

using three principles and criteria: (1) the knowledge gained must be necessary to advance the public's health; (2) there must be no other research model by which the knowledge could be obtained, and the research cannot be ethically performed on human subjects; and (3) the animals used in the proposed research must be maintained either in ethologically appropriate physical and social environments or in natural habitats.

ORGANIZATIONS

The need for more systematic and specific information on laboratory animal husbandry, medical care, and management of animal facilities led to the development of several organizations that support the laboratory animal science community in a variety of ways. The following is an introduction to some of the most important organizations and a brief description of their purpose.

American Association for Laboratory Animal Science

In 1950, the Animal Care Panel (ACP), a national organization professionally concerned with the care, production, and study of laboratory animals, was established. In 1967, the ACP became the American Association for Laboratory Animal Science (AALAS). AALAS is a nonprofit, professional association that serves as the principal means of communication between individuals and organizations within the field of laboratory animal science. AALAS currently has over 12,000 individual and institutional members and more than 48 local branches. AALAS produces two scientific journals, *Comparative Medicine* and *Journal of the American Association for Laboratory Animal Science*, and several technician-targeted publications; certifies trained technicians; promotes education through publications; hosts an annual national meeting; and supports the AALAS Learning Library, an extensive Web-based continuing education site. Scientists, veterinarians, technicians, managers, and suppliers share information through presentations, discussions, and exhibits at the annual meeting. For further information, contact the American Association for Laboratory Animal Science, 9190 Crestwyn Hills Drive, Memphis, TN 38125; phone, 901-754-8620; fax, 901-753-0046; email, info@aalas.org; Web site, www.aalas.org.

Training programs are available through AALAS with certification at three levels: Assistant Laboratory Animal Technician (ALAT), Laboratory Animal Technician (LAT), and Laboratory Animal Technologist (LATG). The certification levels and minimum qualifications to sit for the certification exam are described in Figure 1.2. The duties of assistant laboratory animal technicians are primarily related to animal care and facility sanitation. Laboratory animal technicians are expected to have increased diagnostic and technical

Eligibility Requirements

Below are the minimum eligibility requirements for each exam. To be eligible for the exam you wish to take, you must meet one of the combinations of education and work experience.

		Education level				
		Current cert. level	HS/ GED or higher	AA/AS or higher	BA/BS or higher	Lab animal work experience (years)
ALAT Exam	❑					2
	❑		•			1
	❑			•	•	0.5
LAT Exam	❑		•			3
	❑			•		2
	❑				•	1
	❑	ALAT	•			0.5*
	❑	ALAT				2**
LATG Exam	❑		•			5
	❑			•		4
	❑				•	3
	❑	LAT	•			0.5*

* Work experience must be acquired after attaining the specified certification.
** Option for those without documentation of education level.

Fig 1.2. AALAS technician certification: Minimum eligibility requirements. (Source: AALAS.)

Fig 1.3. AALAS certification logos.

skills and research responsibilities. Laboratory animal technologists are frequently involved in supervisory capacities and carrying out portions of the research study. The achievement of certification at any level (Figure 1.3) denotes an individual who has dedicated himself or herself to the pursuit of a higher standard of technical skill and knowledge, and this often translates into a lifetime career in laboratory animal science. Many institutions now require or prefer AALAS certification as a prerequisite for obtaining jobs in their animal facility. Alternatively, many institutions encourage employees to pursue certification as a means of advancing their careers and offer classes as part of their training programs. AALAS offers training manuals for each of the three levels in both English and Spanish and suggests other materials appropriate for examination preparation. Employers often provide employees with

Table 1.2. Eligibility requirements for CMAR designation

Education Level	Total Work Experience	Total Management Experience
BA/BS	5 years	3 years
AA/AS	8 years	3 years
HS/GED	10 years	3 years

Source: AALAS

Note: Candidates meeting these requirements who pass the Animal Resources Exam and the Certified Manager (CM) exams will achieve the status of a Certified Manager of Animal Resources and will be able to use the CMAR acronym after their names.

financial support for the examinations and frequently reward the achievement of the various levels with a specific increase in salary.

A Certified Manager Animal Resources (CMAR) certification program is offered through the Institute for Certified Professional Managers (ICPM) and AALAS. The CMAR designation involves successfully completing a series of four examinations, three arranged through ICPM and one arranged through AALAS. The CMAR designation is a sign of professionalism in the field of animal resources management. The minimum eligibility requirements for CMAR designation are listed in Table 1.2. The Laboratory Animal Management Association, an association dedicated to advancing the quality of management of animals throughout the world, encourages members to become certified (Web site, www.lama-online.org).

American Society of Laboratory Animal Practitioners

The American Society of Laboratory Animal Practitioners (ASLAP) was founded in 1966, in response to the 1966 passing of the Laboratory Animal Welfare Act. It is a professional organization through which veterinarians engaged or interested in the practice of laboratory animal medicine can freely exchange ideas, experiences, and knowledge. In 1967, ASLAP was officially recognized as an ancillary organization of the American Veterinary Medical Association (AVMA). In 1986, ASLAP became an affiliate of AALAS. Both veterinarians and veterinary students make up the membership of ASLAP. According to its Web site, "the objectives of ASLAP are to (1) provide a mechanism for the exchange of scientific and technical information among veterinarians engaged in laboratory animal practice, (2) encourage the development and dissemination of knowledge in areas related to laboratory animal

practice, (3) act as a spokesperson for laboratory animal practitioners within the AVMA House of Delegates and to work with other organizations involved in the care and use of laboratory animals in representing their interests and concerns to the scientific community and the public at large, and (4) actively encourage its members to provide training for veterinarians in the field of laboratory animal practice at both the predoctoral and postdoctoral levels and lend their expertise to institutions conducting laboratory animal medicine training programs." For further information, contact ASLAP Coordinator, 9190 Crestwyn Hills Drive, Memphis, TN 38125-8538; phone, 901-333-0498; fax, 901-753-0046; email, aslap-info@aslap.org; Web site, www.aslap.org.

American College of Laboratory Animal Medicine

The College was originally established as the American Board of Laboratory Animal Medicine in 1957 to encourage education, training, and research in laboratory animal medicine; to establish standards of training and experience for veterinarians professionally concerned with the care and health of laboratory animals; and to recognize qualified persons in laboratory animal medicine by certification examination and other means. The name of the organization was changed to the American College of Laboratory Animal Medicine (ACLAM) in 1961. The ACLAM is a specialty board recognized by the AVMA. Veterinarians who have successfully completed the comprehensive certification examination and fulfilled other stated requirements earn the right to be board certified and to be called Diplomates of the American College of Laboratory Animal Medicine. ACLAM sponsors an annual education meeting, the ACLAM Forum, to highlight different topics of importance to the laboratory animal medicine community. In addition, ACLAM has developed a series of textbooks and programs to promote education about laboratory animal medicine. For further information, contact American College of Laboratory Animal Medicine, 96 Chester St., Chester, NH 03036; email, mail@aclam.org; phone, 603-887-2467; fax, 603-887-0096; Web site, www.aclam.org.

National Association for Biomedical Research

nabr National Association *for* Biomedical Research

The National Association for Biomedical Research (NABR) was founded in 1979. It is a nonprofit organization that advocates for sound public policy in support of ethical and essential animal use in biomedical research, higher education, and product safety testing. NABR serves as a unified voice in Washington, DC, for the scientific community on legislative and regulatory matters affecting laboratory animal research.

NABR supports the responsible and humane care and use of laboratory animals and believes that only as many animals as necessary should be used; that pain or distress animals may experience should be minimized; and that alternatives to the use of live animals should be developed and employed whenever feasible. NABR, however, recognizes that now and in the foreseeable future it is not possible to completely replace the use of animals. The study of whole, living organisms is an indispensable element of biomedical research and testing that benefits all animals. For more information, contact National Association for Biomedical Research, 818 Connecticut Ave. NW, Suite 900, Washington, DC 20006-2702; phone, 202-857-0540; fax, 202-659-1902; email, info@nabr.org; Web site, www.nabr.org.

Foundation for Biomedical Research

The Foundation for Biomedical Research (FBR), sister organization to NABR, was established in 1981. It is a nonprofit organization dedicated to improving the quality of human and animal health by promoting public understanding and support for the humane and responsible use of animals in scientific and medical research. The FBR provides information to teachers, students, the media, and the general public on the essential need for animals in medical research and scientific advancement. A wide variety of educational materials, including brochures, posters, reference papers, discussion papers, and videos to support their effort are available from the FBR. For further information, contact the Foundation for Biomedical Research, 818 Connecticut Ave. NW, Suite 200, Washington, DC 20006-2702; phone, 202-457-0654; fax, 202-457-0659; Web site, www.FBResearch.org.

Institute for Laboratory Animal Research

The Institute for Laboratory Animal Research (ILAR) was founded in 1952 under the guidance of the National Research Council (NRC) of the National Academy of Sciences. ILAR is made up of a staff that manages the daily activities of the organization and an ILAR Council composed of experts in laboratory animal medicine, medicine, bioethics, and other biomedical sciences, to provide advice on all aspects of ILAR's activities. ILAR develops guidelines and disseminates information on the scientific, technological, and ethical use of animals and related biological resources for research, testing, and education. ILAR promotes high-quality, humane care of animals and the appropriate use of animals and alternatives. ILAR functions as an advisor to the federal government, the biomedical research community, science educators and students, and the public. ILAR prepares

authoritative reports on subjects of importance to the animal care and use community, including the *Guide for the Care and Use of Laboratory Animals*. ILAR also publishes the *ILAR Journal*, a quarterly peer-reviewed publication on a variety of topics pertinent to the biomedical research community. For further information, contact ILAR, 500 Fifth Street NW, Washington, DC, 20001; phone, 202-334-2590; fax, 202-334-1687; Web site, www.dels.nas.edu/ilar.

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CHAPTER 1 REVIEW

Match Up

Match the following with their respective descriptions:

A. IACUC
B. ACLAM
C. AALAS
D. FDCA
E. ILAR
F. NIH
G. ASLAP
H. NABR
I. CMAR
J. FBR

1. ____ Professional organization for veterinarians engaged or interested in the practice of laboratory animal medicine
2. ____ Certification program for managers of animal facilities
3. ____ Passage of this law led to product safety testing.
4. ____ Develops guidelines and disseminates information on scientific, technological, and ethical use of animals
5. ____ Specialty board recognized by the American Veterinary Medical Association (AVMA)
6. ____ Nonprofit organization dedicated to advocating sound public policy that recognizes the vital role of animal use in biomedical research
7. ____ Prior to use of animals, a protocol must be approved by this committee.
8. ____ Main public granting agency for biomedical research
9. ____ Nonprofit organization that serves as the principal means of communication between individuals and organizations within the field of laboratory animal science
10. ____ Nonprofit organization dedicated to promoting public understanding and support for use of animals in research through educational materials

(*Continued*)

Fill in the Blank

Fill in the blank with one of the following:

REF = for refinement method
RED = for reduction method
REP = for replacement method

11. ____ Use cell culture in oncology study.
12. ____ Give nonsteroidal anti-inflammatory drug in food for pain relief.
13. ____ Use mice rather than dogs in study.
14. ____ Use Corrsitex *in vitro* method to determine the dermal corrosive potential of chemicals.
15. ____ Employ better statistical methods.
16. ____ Use tumor size as endpoint for study.
17. ____ Use excised porcine corneas that are normally discarded as waste in food production for ocular irritation assay.
18. ____ Use staircase design for study.
19. ____ Use computer model rather than rats.
20. ____ House primates in pairs or groups.
21. ____ Use multiple areas on back of pig for skin study.
22. ____ Fast rat for 8 hours rather than 16 hours before procedure.
23. ____ Use hollow fiber bioreactors for monoclonal antibody production instead of rabbit.
24. ____ Use Limulus Amebocyte Lysate Assay for pyrogen testing; blood is taken from horseshoe crabs, which are then returned to the ocean.

Suggested Activities

Use the Web site of the National Association for Biomedical Research http://www.nabr.org/uploadedFiles/nabrorg/Content/Biomedical_Research/FactMyth.pdf to initiate a discussion on common myths involving utilization of animals in research. For example:

MYTH—Animals are not needed for medical research. Most medical breakthroughs have resulted from epidemiological studies, computer models, and cell cultures.
FACT—Biomedical research involving lab animals has played a vital role in virtually every major medical advance of the last century.

Use the Web site North Carolina Responsible Owners Alliance www.ncraoa.com/AR or similar site and discuss the difference between the terms "animal rights" and "animal welfare." Do you place human beings or animals first? Would you go so far as to harm another human being to help an animal? Do you believe animals were put here for our use? Should our role be making sure animals are treated humanely?

Use the interactive Web site Animal Ethics Dilemma http://ae.imcode.com/en/servlet/StartDoc to explore various ethical dilemmas about our treatment of animals. There is no cost to use the Web site. You do need to register to use the site; however, the registration does not require you to provide any personal information.

Read *The Immortal Life of Henrietta Lacks*, by Rebecca Skloot.

Discuss the following:
1. Benefits of using HeLa cells in oncology research
2. Ethical implications of using cells without permission