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Laboratory Animal Science

实验动物学（英文版）

主　编　赵进顺/Zhao Jinshun
邹宝波/Zou Baobo
副主编　史宏博/Shi Hongbo
露丝•马盖亚/Ruth Magaye
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前　言

随着我国科学技术和国民经济的飞速发展，实验动物科学领域在近20年来发展迅猛。实验动物科学在生物、生命、医学、农业、畜牧业和宠物饲养与管理等领域受到了越来越多的重视。到目前为止，我国在该领域还没有一本全英文的专著，国外尽管已有多本同类著作出版，但各有侧重。本书在吸收国外同类著作优点的基础上，对我国和世界各国在实验动物科学发展的历史和现状进行了比较和阐述，内容系统全面，实用性强，并适合我国国情。该书主要是因应我国双语和纯英语教学、科研和国际交流的需要，目的是在为广大在华留学生和科研教学人员提供一本实验动物科学参考书的同时，向国际展示我国在该学科领域的研究发展现状。

实验动物科学是指脊椎动物在医学、教学或药物和毒物实验研究中的应用，研究人员、技术人员、兽医、教师和学生等在从事动物有关的操作和研究中，必须经过严格的学习和培训，以确保实验动物研究和使用在科学和人道的前提下进行。本书是广大学生、研究人员、实验动物从业人员和兽医等学习和从事动物科学研究的有用指导材料。书中在详细介绍动物科学在我国和世界各国的发展历史的同时，对常见实验动物的解剖和生理特点，繁殖和管理方法，大鼠、小鼠、兔、猫、狗、猪、猴和蛙类等在医学、药学和毒理学中的用途都进行了全面论述。书中还对转基因动物和转基因技术和常用动物实验方法进行了介绍。附录部分列举了动物实验实例操作规程，动物的生理、生化正常值以及世界范围内与实验动物科学有关的网站，供读者继续学习和查阅。

在本书编写过程中，得到了宁波大学科技处和教务处及宁波大学医学院领导的大力支持，并得到了杭州师范大学实验动物中心吴宝金教授的鼎力协助，2012年宁波市自然科学学术著作出版资金以及2010年浙江省本科院校实验教学示范中心（宁波大学基础医学实验教学示范中心）和2012年浙江省高等学校优势专业（宁波大学临床医学）建设项目资助了本书的出版，在此一并向他们表示衷心的感谢。由于作者水平有限，书中错误和疏漏在所难免，恳请广大读者批评指正，批评和建议请电子邮件至：zhaojinshun@nbu.edu.cn。

赵进顺　邹宝波

2012年11月

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Preface

The use of animals in laboratory experiments is a controversial topic. Many people are opposed to experiments using living animals. These people feel that the suffering of lab animals is a moral issue similar to slavery in history. Controversy exists, however, there are also many people who feel that animal experiments are necessary for the prolonging of human life. On this basis, many doctors and scientists are in favor of maintaining animal experimentation.

A "medical laboratory animal" is defined as any vertebrate animal used in medical research, teaching or testing. Investigators, technicians and students who perform experiments on animals must be qualified through training and experience to accomplish these tasks in a scientifically justified and humane manner.

The purpose of this book is to provide a guide for students, research scientists, practicing veterinarians and veterinary technicians and others interested in learning about laboratory animal science. This book includes introduction of laboratory animal science; basic information on unique anatomic and physiologic characteristics; care and maintenance; research use for rodents, rabbits, cats, dogs, pigs, nonhuman primates and amphibians. For training purposes, medical research methodology is included. An example of animal use protocol, normal values of animals, questions for animal research as well as useful Web sites for laboratory animal science are attached in the Appendix.

Authors cannot be held responsible for misuse or misapplication of the material in this book. Any suggestions or comments about this book are appreciated and should be addressed to zhaojinshun@nbu. edu. cn.

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Chapter 1 Introduction of Laboratory Animal Science

1.1 History of Laboratory Animal Science

Animal tests can be dated as far back as the 2nd and 4th centuries B.C. in Greek. Historians believe that during the 2nd and 3rd centuries B.C. many living criminals were subjected to vivisection at the medical school in Alexandria, Egypt. Human dissection and vivisection were generally banned throughout the rest of Egypt and in the Roman Empire due to moral concerns. Galen (ca. 130—200) was a Greek physician who moved to Rome and practiced vivisection on animals. Galen is known as the "father of vivisection" because of his interest in dissecting animals such as pigs and goats. Galen was also a writer and his teachings about vivisection formed the basis of Western medical science well into the Middle Ages. Galen also practiced vivisection on animals and noted its importance in the study of anatomy. In the 17th century, French philosopher René Descartes (1596—1650) and his followers believed that animals were unthinking, unfeeling machines. This way of thinking provided a platform for researchers to perform all manner of experiments on living animals without any moral concerns. These practices and ideas were criticized by French philosopher François-Marie Arouet de Voltaire in 1764. Voltaire proved that animals were not machines, but sentient (feeling) beings by showing that vivisection uncovered organs of feeling in animals. The 19th century also witnessed organized efforts from animal welfare organizations in the U.K. and U.S. to achieve legislation against animals. The Cruelty to Animals Act was passed in Britain in 1849. Vivisection was also fought by welfarists in the U.S. Various antivivisection groups were founded, including the American Anti-Vivisection Society (AAVS) in 1883 and the New England Anti-Vivisection Society (NEAVS) in 1896.

In 1906, the U.S. Congress passed the Pure Food and Drug Act (PFDA). The original act did not require any type of testing to ensure that a product was safe or effective. This would change after many Americans were injured, sickened, or even killed by unsafe potions, "snake oils", and patent medicines marketed by entrepreneurs during the early decades of the 20th century. The U.S. congress passed laws that required safety testing of drugs on animals before they could be marketed in response to the Elixir Sulfanilamide disaster of 1937 in which the eponymous drug killed more than 100 users.

Other countries then followed by enacting similar legislations. Further laws were passed in the 1960s, requiring safety testing on pregnant animals before a drug can be sold. This was in reaction to the Thalidomide tragedy. These events caused people to realize the importance, inevitability and irreplaceability of animal experiments in protection of human health. Supporters of the use of animals in experiments argue that virtually every medical achievement in the 20th century relied on the use of animals in some way. Furthermore, the Institute for Laboratory Animal Research of the U.S. National Academy of Sciences argues that even sophisticated computers are unable to model interactions between molecules, cells, tissues, organs and the environment, making animal research necessary in many areas. Animal rights and some animal welfare organizations question the legitimacy of it, and argue that it is cruel, poor scientific practice, poor regulations and that medical progress is being held back by misleading animal models, since it cannot reliably predict effects in humans. Also the costs outweigh the benefits, or that animals have an intrinsic right not to be used for experimentation.

The use of nonhuman animals for test in *in-vivo* testing is known as animal experiment and also known as animal research. Annually, it is estimated that over 100 million rats and mice are used worldwide. Sources of laboratory animals vary between countries and species. Most animals are purpose-bred in laboratories, while others may be caught in the wild. The research is conducted inside pharmaceutical companies, universities, medical schools and commercial facilities that provide animal-testing services to different companies and industries. It includes pure researches in fields such as developmental biology, genetics, behavioral studies, as well as applied research such as biomedical research, drug testing and toxicology tests. However, different countries have different degrees of regulation.

Laboratory animal medicine is a field of specialty within veterinary medicine. It is concerned with the diagnosis, treatment and prevention of diseases in animals used in research, testing and teaching. It includes methods to minimize and prevent pain, discomfort and distress in research animals and ways to identify factors that may affect animal research. Within an animal care and use program, the veterinarians engaged in laboratory animal medicine may have a variety of responsibilities. They may especially be responsible for the production of quality animals, the management of animal care, the provision of adequate veterinary care and use facilities, assisting biomedical scientists in the selection of and humane use of animals, the education of individuals who care for and use laboratory animals and the assurance of compliance with all regulations and policies that affect research animals.

Medical researchers, another member of the research team, carries out their duties by utilizing the laboratory animals. Laboratory animal science is the body of scientific and technical information, skills and techniques that apply to laboratory animal care and use. This includes health, husbandry, behavior, nutrition, 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 began in China in the early 20th century. In 1918 the Beijing epidemic sanitation began feeding and breeding mice, and later on, others followed one after another. Some breeds or strains of mice were brought in by scholars from abroad, but there were only several research units in major cities at that time. In the 1950s, in order to control the infectious diseases, the Institute of Biological Products established large-scale experimental animal breeding and production areas in Beijing, Shanghai, Changchun, Wuhan, Chengdu and Lanzhou. Beginning in the 1980's, a rapid development in experimental animals in China was initiated. In 1987, the China Institute of Experimental Animal was established, which is continually being supported and strengthened through technical cooperation and academic exchanges with foreign countries. In 1998, the Ministry of Science and Technology established a "National Rodent Laboratory Animal Seed", which is the seed for the national supply of laboratory animals.

1.2 Organizations Associated with Laboratory Animal Science

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.

1.2.1 American Association for Laboratory Animal Science

The Animal Care Panel (ACP), a national organization professionally concerned with the care, production and study of laboratory animals, was established in 1950. In 1967, the ACP became the American Association for Laboratory Animal Science (AALAS). AALAS is a professional, nonprofit association that serves as the principal means of communication between individuals and organizations within the field of laboratory animal science. Currently AALAS has over 10,000 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;* certifies trained technicians; and promotes education through publications, a Web site, and an annual national meeting. Scientists, veterinarians, technicians, managers and suppliers share information through presentations, discussions, and exhibits at the annual meeting.

AALAS provides nondegree training programs with certification at three levels:

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