

Given similar experiences pre-natally and post-birth, if individual siblings differ from one another (and they do) then the genes they inherit must also play a part. The study of individual personalities in animals has also become part of modern behavioural biology. Insects, amphibians, sticklebacks and great tits have all shown evidence of long-lasting temperament differences between individuals. These differences show themselves early and persist over time. Even more fascinating were the results of a research investigation of 40 genetically identical female mice. These were kept in an enriched environment and, despite having the same genes and living in the same environment, different character traits emerged between the individuals. I would have liked more discussion of this amazing finding.

It is a bit of a jump from animal personalities to the chapter on sociobiology and the problem of altruism among animals. Sachser bypasses the controversy of how far sociobiology explains human behaviours, and simply takes the reader through Darwin's theory of natural selection, called Darwinian fitness, whereby the genes of best adapted individuals are preserved in a population, and the genes of those less successful are not. Yet some individuals behave in an altruistic way — lions and mice will suckle the offspring of other females, for instance, when it would 'pay' them to concentrate only on their own offspring. Such altruism runs counter to the idea of the individual survival. However, at the level of gene rather than individual preservation, kinship can explain altruism. If animals act altruistically towards their relatives, they are helping preserve the genes that they have in common. This explains how wolves in a pack, usually a family group, will co-operate to rear the pups of the alpha female. Helpers that are not the pups' parents but are the aunts and uncles or adult siblings of the pups, so share some of the family genes. Another explanation for altruistic behaviour among animals is that it is reciprocal: individuals will share food with an individual who will reciprocate in the future. You scratch my back, and I will scratch yours.

There is an intriguing twist in this chapter. If altruism is found among other warm-blooded mammals so is its opposite. Male lions taking over a pride of females will kill any cubs, so that the mothers are more quickly ready to mate and produce the new male's offspring. There is conflict too among suckling siblings, if the mother's milk is limited, sometimes resulting in death of the weakest. Adult males' struggles in competition for females can be fatal while different groups of chimpanzees will engage in warfare that can result in the death of not just males but also females and children in the losing group. Nor are females the passive participants in sexual competition. When sexual behaviour is studied closely, what looks like male rivalry may be more a matter of female choice. Yellow-toothed guinea pig females, a species from the same cavy genus as the domestic guinea pig, give birth to young that have different fathers, increasing the likelihood that some at least will result from the best available male sperm.

My only criticisms of this book are that it has no index, the references given for each chapter are not numbered in the text, and no attempt has been made to translate even the easy German references. Otherwise, it is a remarkable *tour d'horizon*, accessible to the common reader, prepared to google the occasional science word, and remarkably cheap for a hardback. If I had had this book some years ago when I was an applied animal behaviour student, it would have put the different lectures I attended into one coherent whole. As Sachser declares: "the more we investigate, and the closer we look, the more we see the humanity in our fellow creatures." This closeness between human and beast has important implications for animal welfare.

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### **Handbook of Laboratory Animal Science: Essential Principles and Practices, 4th edition**

Edited by J Hau and SJ Schapiro (2021). Published by CRC Press, Boca Raton, FL 33487, USA. 994 pages Hardback (ISBN: 978-1138341807). Price £141.64.

This is the revised 4th edition of the well-regarded handbook, first published in 1994. This edition is bound as a single volume, rather than the previous three-volume format, which is welcomed in making it easier to manage and navigate.

Within the single volume, the book is divided into four sections: 'Principles of laboratory animal science', 'Practices', 'Animal models', and 'Structures.' The book's editors, Professors Jann Hau and Steven Schapiro, have assembled contributions from over 90 expert authors in the field, with chapters focusing on specific aspects of laboratory animal care and use, as well as more broadly on some basic principles relevant to the field.

The intention is that individual chapters can be read as stand-alone texts on the particular subject, so that the reader can easily find up-to-date and relevant information on the topic of interest and this design works well to produce a reader-friendly handbook of reference.

### **Part I – Principles of laboratory animal science**

In keeping with the 3Rs as the starting point for considering all animal-based research, the book begins with a chapter on ethical issues, including discussion of deontological and utilitarian approaches, before developing the latter in discussion of maximising benefits of the research whilst minimising harms to animals. Garner's therioepistemological approach to analysis of the validity of a proposed model and its imperfections is discussed, together with the current issues of communicating results effectively, including infrequent publication of negative data. The concept of harm-benefit analysis is discussed in light of the 'Five Freedoms', although discussion regarding the evaluation of positive welfare attributes (rather than just freedom from negative ones) and more recent concept of ensuring that animals have 'a life worth living' would have enhanced this section and brought it up-to-date.

Following on from this, the subsequent chapter considers the 3Rs of Replacement, Reduction and Refinement of animal use, describing the legislative requirements in a variety of jurisdictions. A useful addition would be the inclusion of the most modern definitions of each of the 3Rs. Helpfully, the chapter examines not only applications in research and safety testing but also in education and training where, until now, progress on replacement technologies has been relatively slow. The chapter concludes that the search for, and implementation of, alternatives has so far not been effective enough and that further effort and research is required.

The well-explained and very readable chapter on experimental design explains in detail how the good design of experiments is essential for obtaining meaningful data and emphasises the need to take expert advice from a statistician before commencing any work: “statistics is a rigorous way of describing nature.” The consequences of poor design, including under-powering groups, are reviewed and it is noted that poor statistical analysis will also harm the outcomes. The chapter explains considerations both for design and statistical treatment of data, including the importance of setting out (and sticking to) a hypothesis.

The following chapter reviews the behavioural needs and management of laboratory animals, although there is relatively brief consideration of mice and zebrafish, considering that these are the most commonly used species in biomedical research. However, there’s excellent reference to the Swedish RISE centre, which is leading the way in co-operative working with small rodents. A fuller consideration of the effect on welfare and/or scientific outcome, where behavioural needs are not met, would have been helpful here, although this is considered later in Part 2.

Assessment of welfare throughout the animal’s life is discussed, including the contingent suffering that may occur due to non-procedural harms, such as transport, breeding and husbandry practices. There is a practical discussion about use of scoring sheets, with a worked example, which can assist researchers and animal carers devise a system to more objectively assess welfare.

## Part 2 – Practices

This is a very pragmatic section, which examines how the animal’s macro- and micro-environment and specific study practices can impact significantly on both study data and animal welfare.

The chapter on animal health details the reasons for and methods of, health monitoring, including information about individual potential pathogens in various laboratory animal species. It properly distinguishes health status from microbiome, including explanation about the potential importance of the latter in reproducibility of studies and suggests that the researcher should seek expert advice in this field.

An updated section on nutrition applies current knowledge to the research environment, emphasising how contaminants, bioactive ingredients, processing and storage can also impact research data and examines factors that contribute to the good health and welfare of the animal.

An excellent chapter on facility design and management aims to provide the reader with a better understanding of function and operation of a modern animal facility, enabling control of environmental variables, promoting well-being of the animals, while providing a suitable working environment for the humans. Considerations for conventional, barrier and containment facilities are discussed. Having a good understanding of the facility in which studies are conducted is essential for researchers and such practical and detailed advice on this subject is welcomed, given the current crisis in reproducibility of animal experiments.

Chapter 9 reviews genetically altered (GA) mice, providing a clear and comprehensive explanation of the methods used to create altered genome, including conditional mutations, which allow the mouse to live normally until the gene switch is activated, therefore bringing some welfare benefits. Breeding strategy is mentioned in terms of producing the desired genetic alteration, although recommendations for efficient breeding strategies (or references to published guidance) would perhaps have been helpful here, to guide users in minimising the number of mice bred.

Whilst this chapter covers GA mice very comprehensively, there is no mention here (and very little elsewhere in the handbook) about the use of GA zebrafish, which seems a significant omission, given the increasing importance of zebrafish in various fields of research.

The other chapters in this section cover common procedures for handling of, and administering substances to animals, as well as for taking samples, such as blood and urine. Good practice in non-aversive methods of handling mice is illustrated, explaining the consequences on study data if mice are made anxious by use of the tail to capture them. A comprehensive variety of methods of blood sampling are listed; however, some guidance as to the preferred method in terms of potential welfare consequences of, for example, retro-orbital sinus sampling, would enable the reader to make a sensible choice of method while implementing Refinement of the blood sampling procedure.

Anaesthesia, analgesia and euthanasia are discussed in detail, together with information about agents and regimes that could be used for aquatic species and birds, as well as mammals. The use of illustrations is excellent. Reference is made to pain scoring animals, post-procedure, in order to determine their analgesic needs, using methods such as the ‘Grimace Scales’, bringing up-to-date methodologies to the reader.

Surgical procedures are also covered here, emphasising the need for good design and adequate preparation of the facilities, as well as attention to ensuring asepsis at all stages. The chapter does weigh more heavily on the side of larger animals, although rodent surgery is also covered. The authors emphasise that standards of practice should be similar for all species, large or small, and that tuition from experts in up-to-date methods is essential in ensuring success and reproducibility of models and to prevent unnecessary suffering.

Use of telemetry devices to monitor animals is covered in this section’s final chapter, explaining the use of these wireless technologies to provide a less stressful method of collecting data on physiological parameters.

### Part 3 – Models

This section covers a wide variety of animal models, including neurological, behavioural, pain, fetal development, biodefence, metabolic, cardiovascular, oncology, pharmacology, hearing and infection studies. An omission is that no ageing models (and relatively little discussion of neurodegenerative models) are included here, although they are becoming more commonly studied conditions. The specialist authors from the fields consider in detail the principles and problems of the various models within each of the disciplines, providing a large number of references for further reading. Both large and small animal species' models are included, although there is relatively little consideration of the range of zebrafish models in this context.

Besides using laboratory species to study induced disease, some of the chapters also point to the possible study of naturally occurring conditions in domestic animals, particularly where they may be related to genetics and breeding. The ethical controls and permissions needed for such studies are considered, together with the potential direct advantages to the animal of new treatments.

There is perhaps some conflation of the 'ARRIVE Guidelines' (for reporting studies) with the regulations required for conduct of animal studies (which set out the requirement for conduct of a study). Much of this toxicology chapter refers to the various Regulatory guidelines, including OECD series 19 and its inclusion of defined humane endpoints. A suggestion is that this section would benefit from more detail about pros and cons of the currently available non-animal alternatives to some of the current tests, reflecting the huge efforts that have been applied to find non-animal methods in safety and other types of study.

### Part 4 – Structures and legislation

Research is a global business, with collaborations and contracts extending across borders, but the permissive legislation varies according to country and culture, so the animal user must be familiar with local laws and requirements. In the first chapter of this section, the authors succinctly explain the main points of legislation in regions including the EU, USA, Far East, Latin and South America, providing details of the history of the legislation and its requirements in various countries. The essential role of properly defined regulations as a means of promoting public confidence in animal research, as well as for proper control of practices, is highlighted.

Besides National legislation, three main external quality systems may be applied to animal research, including ISO (International Organisation for Standardisation), AAALAC International (Association for the Assessment and Accreditation of Lab Animal Care facilities) and GLP (Good Laboratory Practice) and these are highlighted in their role as ensuring a recognised standard, complementary to National government inspections.

This handbook is very helpful in signposting sources of information, education and further support for those working in *in vivo* research — the brief but useful section on service

organisations gives details of a number of national and international organisations, including those with primarily professional, scientific and animal welfare aims. The role of ICLAS (International Council for Lab Animal Science) is highlighted as an umbrella organisation, as well as organisations which accredit training and competence.

The legal requirements for education and training of those working with animals in research are set out in Chapter 37, pointing out that all national legislations agree that individuals must have appropriate skills and qualifications in their research roles. The chapter sets out neatly the main requirements of legislation in the EU and USA, again signposting the reader to training resource organisations where they can obtain further information.

This well thought out handbook concludes with a short chapter on Refinement and Reduction of animals in research: pointing out that the vast majority of animals experience very little suffering or distress, the authors suggest that particular focus should be on those animals who may experience pain or suffering and that the overall aim should be that all animals used in research should be provided with as high a quality of life as possible.

Overall, this is an excellent, authoritative book, updated to reflect current good practice and full of practical details and information. I would highly recommend it to anyone involved in any research-related role, including PIs, junior researchers, animal technicians, facility managers, welfare scientists and veterinarians.

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### **Understanding the Bird of Prey**

N Fox (2022). Published by Cambria Publishing, Llandeilo, UK. 554 pages Hardback (ISBN: 9780957679139). Price £120.00.

As a budding falconer and, later, a specialist avian vet, the first edition of Dr Nick Fox's *Understanding the Bird of Prey* has always held a prominent position in my library of falconry texts. The book was unique in breaking from the traditions of many other 'how to' falconry guides which proposed rigid 'training systems' that fail to address the individuality of raptors and the variations that occur in their training and management. Many technological, medical, husbandry and training advancements have been made since publication of the first edition, many of which have contributed to improved welfare.

Dr Fox's updated text aims to provide the basic principles that can be applied flexibly to a wide range of scenarios encountered by a falconer. Advances in technology have enabled the book to be published in both electronic and paper forms. In addition, links are provided to a series of ten films that accompany the text and provide a very helpful visual aid to learning.

The author himself needs little introduction to those with an interest in raptors. As a practising falconer and biologist, Dr Nick Fox has been involved in conservation since 1975. He has been instrumental in several significant advancements