

Second Edition

Student's guide to Animal Models



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Student's guide to Animal Models, Second Edition

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Preface.

This review is primarily intended as an aid for students of biology or medicine interested in achieving an overview of animal models, including their history, characterization, Pros and Cons.

Animal models are still an absolute prerequisite in the development of e.g. new therapeutic drugs, and researchers already regularly use a dozen or so species, where especially mice and rats are available in thousands of purpose-bred lines. However, development of new and perhaps better models than the existing ones will in all likelihood continue since present models used to imitate human physiology and reactions all have their limitations. They are, after all, not humans, and humans too differ in many variables (e.g. gender, ethnicity, age, body composition, psychological profiles, responses towards drugs, etc.).

Animal models are also used to gain basic knowledge in other fields of life science. To give just one example, one such field is the study of so-called stereotypical behaviours (“stereotypies”) which is a type of monotonous repetitive behaviours regularly displayed by millions of animals used in zoos, research facilities, and in the production of animal products [1]. Spontaneous stereotypies among captive animals have on occasions been proposed as models of various brain lesions and brain dysfunctions in humans (see e.g. [2-8]) because patients suffering from various CNS disorders/lesions or substance abuses have been observed displaying these types of seemingly purposeless behaviours [9-14]).

What you are about to read now is more or less a direct copy of the introduction to animal models I presented in my recently defended PhD dissertation [15]. This second edition of *Student's guide to Animal Models* only adds minor revisions to the first edition. I hope you will enjoy the reading and that you will leave it with a better understanding of animal models and their uses.

Bryan Schönecker.

Hareskovby, Denmark, April 2014.

Chapter 1 - History of animal experimentation.

The history of animals in research dates back through millennia's, at least as far as to the experiments by Aristotle (384-322 BC) and Erasistratus (304-258 BC) on living animals [16]. Erasistratus also appears to have performed vivisections on condemned criminals [17], whereas the famous Greek physician Galen of Pergamon (approx. 129- 200 or 217 AD), operating under the Roman law, had to restrain himself to only use animals such as pigs and monkeys in his dissections and vivisections [18].

During the Renaissance interest grew in the movements of the human body and 15th and 16th century artists were encouraged to engage in dissections of both cadavers of condemned criminals and animals. Where most artists merely watched public dissections performed by trained physicians, others, like Michelangelo, became quite experienced anatomists [19].

The use of rats and mice in biomedical research traces back to the 16th century [20] where Robert Hooke in 1664 used mice for his experiments addressing respiration [21]. According to Grüneberg (1957, cited in [20]), one of the early 19th century amateur breeders of mice with interesting colours/behaviours (a person named "M. Coladon") actually presented results involving segregation of coat colour which were in perfect agreement with the expectations published three decades later by Mendel. Had Mendel not been ordered by his bishop to stop experimenting on segregation of coat colour using mice in his cellule ("*it was not appropriate for a monk to share his living quarters with creatures that had sex and copulated!*") [22]), he would not have had to switch to another more "agreeable" organism (the pea) which eventually would lead to his 1866 publication [23] in a low-impact horticultural journal where it would remain in obscurity for the next 34 years.

Especially from the early 20th century, animals have been used to model more universal principles in other species, as exemplified by the extensive use of the fruit fly (*Drosophila melanogaster*) to elucidate the concept of genes and their actions [24, 25], and both commercial and university breeders have so far produced a wealth of mice and rat strains. To give an impression of scale, the International Mouse Strain Resource database return 3,761 different strains of live mice and

232,548 different strains in total during a search performed in June 2012 [26].

Regarding rats, a survey from 1998, available through the Mouse Genome database, listed 217 major rat strains [27] where the National Bio Resource Project for the Rat in Japan currently (June 2012) lists 577 strains [28].

Besides the above-mentioned mammals and flies, researchers use a plethora of other species as models, e.g. sponges, sea urchins, nematodes, fish, bees, birds, cats, dogs and primates [29-36]. Several open-access databases on the internet are suitable to find information concerning the specific species, availability, and their preferred use (see [37]).

Chapter 2 - Characterization of animal-based models.

Probably the vast majority of the above mentioned rat- and mice strains are used to model aspects of human diseases/physiology, and such models are usually termed “*animal models*”. However, eventhough I agree with...

End of free sample.