Biology of rodents and lagomorphs

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Taxonomy of rodents

Class: Mammalia (mammals)

Order: Rodentia (rodents)

Family: Muridae (rats and mice)

Sub-family: Murinae

Genus: Mus

Species: Mus musculus Linnaeus, 1758

Genus: Rattus

Species: Rattus norvegicus (Berkenhout, 1769)
Rodent origin and distribution

- Rodents are monophyletics.

- The sub-family *Murinae* emerged in Southeastern Asia at the end of the oligocene and the start of the miocene periods (25-20 million years ago).

- Occurs throughout the world, excluding Antarctica.
Rodent features

- 2 pairs of incisors in the upper and lower jaw
- Behind the incisors is a large gap in the tooth rows called diastema
- Most species are nocturnal
- Most species are continuously polyoestrous
Rodent diet

- Most species are herbivores, some are omnivores and insectivores
- Herbivore rodents are coprophagous
Mouse breeding

- The modern laboratory mouse is a hybrid of three sub-species: *Mus musculus musculus*, *M. m. domesticus* and *M. m. castaneus*
- Lifespan is 1-2 years
- Mouse as all rodents is polyoestrous
- Sexual cycle lasts 5 (4-7) days
- The Whitten effect occurs – the synchronization of the estrous cycles of female exposed to the pheromones of a male
- The Bruce effect occurs - the exposure of a recently bred mouse to the pheromones of a strange male mouse prevent implantation or produce pseudopregnancy
- Lee Boot effect occurs
Mouse breeding

- The gestation period is 20 days
- The average litter size is 10-12
- The pups weigh 0.5 to 1.5 grams at birth
- Pups are weaned at 3 weeks of age
Mouse behaviour

- Nocturnal
- Laboratory mice lack "rapid running" behavior
- "freezing" behavior in open landscapes
- Fighting is related to establishment of hierarchy and defence to territory
- Barbering – local loss of hear and whiskers
- Mice is a social animal
Mouse as laboratory animals

- First utilized as laboratory animals in studies of reproduction and blood circulation

- Mendel’s rule was tested in laboratories all over the world: (Bateson 1903) in England, (Cuenot 1908) France and (Castle 1901) in USA

- Castle and Allen (1903) for the first time described albino mice as recessive strains

- Tumor experiments influenced the development of different inbred strains such as A,C, CBA, C3H, C57BL/J, C57BL/10, BALB/c and others.
Mouse as laboratory animals

- In the 1920’s and in the 30’s, inbred mice were not commercially available

- This changed dramatically over the next 15 years, especially when The Jackson Laboratory emerged and sold mice all over the world
The rat

Rattus norvegicus
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Rat breeding

- The rat was the first mammal to be bred for use as a laboratory animal
- Lifespan as in house-mice
- Sexual cycle as in house-mice
- The Whitten effect occurs but is not as pronounced as in mice
- The Bruce effect does not occur in rats
Differences between *Rattus rattus* and *R. norvegicus*
Rat breeding

- The gestation period is 22 days
- The average litter size is 6-12
- The pups weigh 5-6 grams at birth
- Cannibalism is uncommon except with new mothers
- Pups are weaned at 3 weeks of age
Rat as laboratory animal

- In the 18th and 19th century rats were first caught and bred for use in rat-fights

- Albino, black and hooded rats were selected for desirable traits

- In the 19th century albino rats were used for the first time in the laboratory for physiological studies

- *Wistar Institute of Anatomy and Biology* is responsible for most of the Wistar and Sprague-Dawley rats throughout the world
Why are rodents use in biomedical research?

- easy to keep and handle
- small and inexpensive
- high reproductive capacity
- short generation time and lifespan
- large number of strains and stocks for traditional laboratory rodents
Lagomorphs were previously classified as rodents, but in 1951 moved to their own order Lagomorpha
Taxonomy of lagomorphs

Class: *Mammalia*

Order: *Lagomorpha* (lagomorphs)

Family: *Leporidae* (rabbits and hares)

Genus: *Oryctolagus* (Rabbits)

Species: *Oryctolagus cuniculus* Linnaeus, 1758 (European rabbit)
The rabbit
Rabbit origin

- The rabbit is native to western Europa and northwest Africa
- The species was domesticated already in Roman times in Italy and Northern Africa
- Today we know more than 50 races of domestic rabbit, originating from one species
Rabbit behavior

- Rabbit are generally timid and nonaggressive
- Rabbits are gregarious animals
- Rabbits are nocturnal
- All rabbit have en escape instinct
Rabbit digestive system

- Coprophagous
- They eat moist fecal pellets produced at night
- Feces, rich in vitamins and protein, are consumed directly from anus
- The cecum is very large
Rabbit breeding

- Lifespan is 5-6 years
- Rabbits are induced ovulators with ova released 10-13 hours following copulation
- Average gestation is 32 days
- The average litter size is 7-8
- The young weigh 30-100 g at birth
- Cannibalism is rare
Rabbit as laboratory animal

- Because of size, rabbits are used in surgical research
- They are used in production of polyclonal antibodies and pyrogen testing
Nomenclature of laboratory rats and mice is authorized by:

- International Rat Genetic Nomenclature Committee
- International Committee on Standardized Nomenclature for Mice
Every approved breeder is coded in the nomenclature’s abbreviation

Outbred stocks:
- HanTac:WH
- NTac:SD

Inbread strains:
- BALB/cJBonTac
- LE/HanMolTac

Substrains:
- DBA/1J
- DBA/2J
Useful links

- Institute for Laboratory Research
  http://dels.nas.edu/ilar

- Nomenclature rule for rats and mice
  http://www.informatics.jax.org/

- Taconic M&B AS
  http://www.m-b.dk

- Laboratory animal department (Vivarium, BBB, Gade)
  http://www.uib.no/dyreavd/
Housing of rodents
A wide variety of cages is available for rodents.

The size and height of the cages used for each rodent species is regulated by recommendations of the European Convention.

Plastic in the form of macrolon is the most often used cage material.
Rodent bedding and food

- The bedding must be absorptive
- Aspen shaving is used in our department
- Both food and bedding are certified to be free of chemical and microbial contaminants
- Food is supplied in the form of pellets
- For rats and mice MR1 (Rat and Mouse nr. 1 Maintenance) from Special Diet Service is used
The rat
The mouse
Macrolon cages type IV
Macrolon cages type III
IVC system for mice
Why use the IVC system?

- Protect the staff against allergens
- Protect the animals against infections
- Isolates cages from their neighbours