



Supplementary resources for members of local ethical review processes

Mice: Good practice for housing and care





**Before using these guidance notes, please read the introductory sheet that accompanies this series:
*Supplementary resources for lay members: an introduction***

Natural history

Most laboratory mice are descended from *Mus musculus*, a species that occurs very widely both in the wild and in close association with humans. Wild and feral mice are active and highly exploratory animals. They are nocturnal and omnivorous, prepared to try new foods and are capable of covering large distances and visiting many different feeding sites every night. Home range sizes are highly variable; there may be one mouse for every 3m² in grain fields, but ranges can be 365m² in open fields or 6000m² in forests.

The mouse is a prey species, so individuals are very strongly motivated to stay close to safe cover, especially during the daytime or when exploring new territory. They prefer to stay in contact with solid objects for feelings of security whenever they can, using sensitive guard hairs along the body to sense objects and overhead cover. The species is highly social and individuals usually live in a family unit of parents and juveniles. Burrows can vary from simple, straight tunnels 1m long with a single nest chamber, to very complex systems with many chambers and exits.

Smell is the most important sense for mice. Odour cues are used to detect and assess food and predators, to identify other mice and to ascertain their age, rank, sexual status and family. Scent marks are laid down at territorial boundaries and also to mark out runs within the territory. Over time, these marks can build up into pillars of urine, grease and dust many millimetres high.

Mice have acute hearing and can also hear ultrasound - it has recently been discovered that male mice will “sing” to females at ultrasonic frequencies. They are less dependent on vision, but their eyes are very sensitive to movement and good at detecting potential refuges and cover. They can see ultraviolet light, which is likely to help with food identification and navigation.

Very few of the mouse’s natural behaviours can be expressed in standard caging, so it is important to provide a better quality and quantity of space wherever possible.

What mice need

There are many strains of laboratory mouse; some may differ in their exact requirements but most have similar basic housing and care needs. The following list of requirements has been defined by researching the literature on mouse behaviour and welfare. More information can be found in the references listed at the end of this document. The BVA/AFW/FRAME/RSPCA/UFAW Joint Working Group on Refinement report *Refining rodent husbandry: the mouse* [1] remains a good general text which covers all of the issues in more detail, as does the mouse chapter in the UFAW handbook [2].



- **Social housing that reduces any risk of aggression**

Mice are highly social animals who should be housed in harmonious stable groups and never singly housed unless there is compelling veterinary, welfare, or scientific justification. If there is justification for singly housing either males or females, they should be able to see, hear and smell members of their own sex.

For female mice, groups should be formed at or before weaning and no new animals should be introduced, as this can lead to fighting. Careful husbandry is required for many strains to minimise the risk of aggression. For example, when cleaning cages, transferring nesting material to the clean cage can reduce the risk of fighting when the mice are reintroduced. This is because nesting material contains odours from the foot glands that reduce aggression. However, litter (such as wood chips) should not be transferred, since this contains odours from urine and faeces that increase aggression.



Male mice can be aggressive, although the level of aggression does vary between strains. Despite this, some strains can be successfully group housed provided that care is taken with group size and husbandry, and disturbance is kept to a minimum. A group size of three has been found to work in some strains [see reference 3], but this can vary with both strain and cage size so it is good practice to check the literature to see whether husbandry has been evaluated for the strain in question. Generally, groups of males should be formed before weaning, and should remain as a stable group with no addition or removal of individuals at a later stage as this can affect the stability of hierarchies and lead to increased aggression.

As with females, transferring nesting material during cage cleaning can help to reduce aggression. Care should be taken to avoid contaminating cages with scents from different strains, and males should not be placed so that they are able to smell females. Male mice of some strains may also become aggressive over enrichment objects, but this can be minimised by providing just nesting material without a refuge and plenty of space.

Any changes to the husbandry routine should be combined with close monitoring of the mice to check for any associated aggression.

- **Solid floor with appropriate litter material**

Solid floors allow litter to be provided for digging and foraging, and behavioural tests have found that mice have a strong preference for resting and walking on solid as opposed to grid floors. Grid flooring should be avoided unless there is a genuine scientific justification for it, in which case a solid resting area (such as a refuge with a solid floor) should always be provided. Studies have shown that this will not affect the quantity or quality of urine or faeces collected for toxicology procedures.

Suitable litter materials for mice are wood chips, cellulose based chips or shredded filter paper, but not fine sawdust as this cannot be manipulated and can cause health problems. Litter should be at least 2cm deep to encourage digging behaviour.



- **Something to gnaw**

The incisor teeth of mice grow continually and are ground down in the wild when hard or gritty food is eaten. Laboratory mice can be provided with cardboard tubes, wood blocks, old plastic water bottles or hay to perform this function.

- **Provide for foraging behaviour**

Foraging is very important for wild mice, who may visit 20 to 30 feeding sites and eat 200 small meals every night. Scattering part of the food ration or additional treats in the litter will encourage this behaviour, keep the mice occupied and help to prevent obesity. Suitable foraging foods include sunflower seeds, mouse food from pet shops or commercially available forage ingredients or mixes, many of which can be irradiated for animals kept in pathogen free environments.

- **Refuges and/or tunnels**

Prey species such as mice must have refuges. They make the animals feel secure (which is especially important for females with litters), fulfil their preference to be in contact with solid surfaces and allow climbing behaviour. Suitable refuges include large cardboard tubes, empty water bottles, commercially available mouse houses made from cardboard or tinted plastic, or empty cardboard packaging. Group housed males who cannot have nest boxes due to aggression should be provided with plenty of nesting material so that they can still feel secure.



- **Nesting material**

Nesting material should be provided for all mice, both male and female, not just nursing females. It enables mice to control their environmental temperature and light levels and to hide and retreat from others. The thermoneutral zone* of the mouse is between 26 and 34°C, which is higher than the temperature in most animal houses, so it is especially important to provide sufficient nesting material for the animals to keep themselves warm [4].

Nesting material also helps mice to occupy their time, especially if it is provided in a form that they have to manipulate (for example, by placing it on the cage top so that the mice have to pull it through the bars) or shred. Suitable nesting materials are hay, straw, shredded paper, paper strips and paper tissues. Materials that separate into thin strands such as cotton wool are not suitable because of the risk of tangling around the animals' limbs, especially juvenile animals.

- **Appropriate light levels and regimes**

Mice are nocturnal and are adapted to see best in very low light levels, so lighting should be below 60 lux for pigmented strains and 25 lux for albino strains. Reducing light levels is extremely important for good mouse welfare, especially for albinos, and can be achieved in a number of ways including selecting appropriate lighting systems (with a UV component where possible) and/or fitting shading above cage racks. Lighting regimes should be set so that the animals' active period (in the dark) is during the human working day wherever possible. This makes it easier to monitor wellbeing and may reduce stress caused by husbandry and experimental procedures.

* Thermoneutral zone: temperature range at which the animal does not have to expend significant energy on maintaining body temperature, so the animal should be "comfortable".



- **Acceptable levels of ultrasound**

There are many sources of ultrasound in the laboratory, such as running water, electronic equipment including PC monitors and the mice themselves. Ultrasound is part of the natural environment for mice and does not necessarily cause problems, but it is good practice to check each room (e.g. with a bat detector) to ensure that electrical equipment is not creating excessive levels of ultrasound, as this would cause distress.

- **Empathetic cleaning protocols**

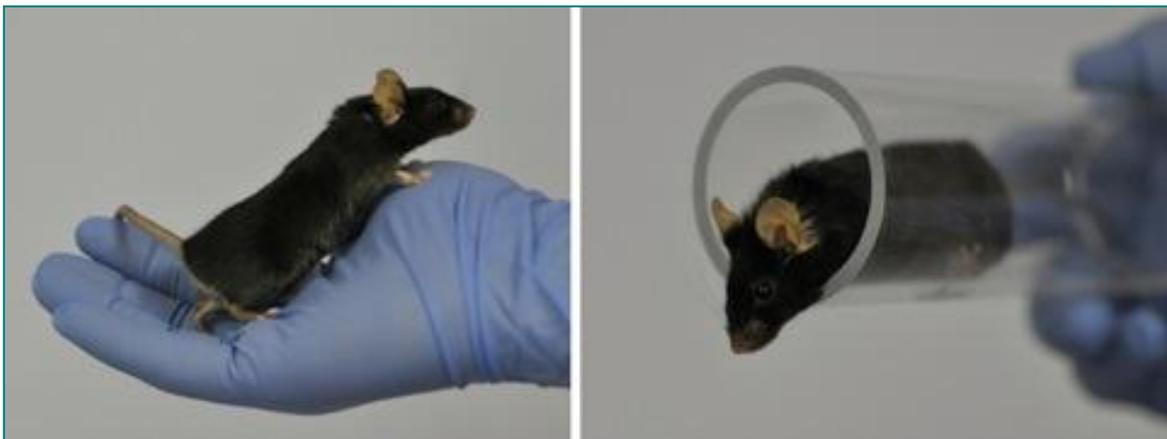
Cage cleaning is disruptive and stressful for mice, as it destroys all of the scent markings that they have laid down. However, cleaning is obviously necessary for good health and hygiene, and may also help to maintain habituation to human handling. In practice, it is necessary to strike a balance between ensuring good health and avoiding excessive disturbance and stress. The best cleaning regime for mice is not yet known, but it appears that transferring some used nesting material (but not litter) when cage cleaning helps to minimise stress and aggression when the group is returned to the clean cage (see 'social housing' above and reference 5).

- **Plenty of space**

Cages should be large enough to enable enrichment to be provided, so as to permit a range of behaviours including exercise, foraging (wild mice will travel their entire territory daily), appropriate social behaviour and play. These behaviours are not possible in many of the very small cages that are commercially available, so use the largest cages available and a stocking density that allows individual animals plenty of space. One option is to house the mice in (empty!) rat cages, first checking that they cannot get their heads stuck in any gaps between the bars and the body of the cage - small mice can squeeze through holes of 6mm or more.

- **Good handling techniques**

Mice are traditionally caught and picked up by the tail, but recent research has shown that this induces aversion and high anxiety. Handling can be refined by scooping them up in the open hand or by using 'handing tunnels' placed in the home cage which they quickly learn to enter [6].





Potential husbandry related welfare problems and how to resolve them

Abnormal behaviours such as stereotypies (e.g. circling or route-tracing), aggression, anxiety or apathy can indicate that an animal's environment is inappropriate and that the animal is unable to cope with it. If any abnormal behaviours are observed there should be a full review of housing and care, addressing all of the issues in this resource. Some strains may be particularly prone to abnormal behaviours, such as aggression and stereotypies in the FVB/N strain. Any requirement to use such strains should be questioned and alternative strains without behavioural problems used instead wherever possible.

Barbering or whisker- or fur-plucking is thought to be associated with dominance. It is apparently painful but despite this the barbered mouse often actively approaches the barber and will lie still to be plucked. The cause is unknown, although genetic factors and boredom may both play a role. Reviewing and improving husbandry may help, but if this does not work it may be necessary to remove the barber.

Obesity and poor condition can result from being housed in an understimulating environment with insufficient space for exercise. Providing a better quality and quantity of space, and encouraging foraging behaviour, should prevent obesity in most strains.



Mouse housing and care: ERP aide-memoire

- ❖ Social housing in stable, harmonious groups, with thoughtful husbandry that reduces the risk of aggression
- ❖ Plenty of space to allow enrichment to be provided and to encourage a variety of normal behaviours
- ❖ Solid floors with at least 2cm deep litter material
- ❖ Something to gnaw (e.g. wood blocks, cardboard tubes)
- ❖ Opportunities to forage in litter for part of the food ration or treats
- ❖ Refuges and/or tunnels
- ❖ Nesting material (such as hay, straw, shredded paper, paper strips or paper tissues) in sufficient quantities to build a nest that will allow feelings of security and help with thermoregulation
- ❖ Appropriate light levels (below 60 lux for pigmented strains and 25 lux for albino strains) and regimes (so that the animals' active period is during the human working day)
- ❖ Acceptable levels of ultrasound
- ❖ Empathetic cleaning protocols with some used nesting material (not substrate) transferred to the clean cage
- ❖ Good handling – cupping in the hand or using tunnels, not capturing by the tail

Notes



Recommended references

1. Jennings M, Batchelor GR, Brain PF, Dick A, Elliott H, Francis RJ, Hubrecht RC, Hurst JL, Morton DB, Peters AG, Raymond R, Sales GD, Sherwin CM & West C (1998) Refining rodent husbandry: the mouse. *Laboratory Animals* 32: p233-259, available at <http://tinyurl.com/6brln7p>
2. Baumans V (2010) The laboratory mouse. Chapter 21 in: *The UFAW Handbook on the Care and Management of Laboratory and Other Research Animals*, 8th edn (ed by R Hubrecht and J Kirkwood), pp 276-310. Oxford: Wiley-Blackwell.
3. Van Loo PLP, Van Zutphen LFM & Baumans V (2003) Male management: coping with aggression problems in male laboratory mice. *Laboratory Animals* 37: 300-313 Open access at <http://la.rsmjournals.com/cgi/reprint/37/4/300>
4. Gaskill BN, Rohr SA, Pajor EA, Lucas JR, Garner JP (2009) Some like it hot: Mouse temperature preferences in laboratory housing. *Applied Animal Behaviour Science* 116: 279-285.
5. RSPCA (2011) *Cage cleaning mice and rats*. Download at www.rspca.org.uk/sciencegroup/researchanimals/ethicalreview/housingandcare
6. Hurst JL & West RS (2010) Taming anxiety in laboratory mice. *Nature Methods* 7(10): 825-826. www.nature.com/news/2010/100912/full/news.2010.462.html
7. Baumans V (2004) The welfare of laboratory mice. Ch. 7 in: *The Welfare of Laboratory Animals* (E Kaliste ed.), pp 119-152 Dordrecht, The Netherlands: Kluwer.
8. FELASA (2007) *Euroguide on the Accommodation and Care of Animals Used for Experimental and Other Scientific Purposes: Based on the Revised Appendix A of the European Convention ETS123*. London: FELASA. Available for purchase at www.rsmjournals.com/bkfelasa.htm
9. Latham N & Mason G (2004) From house mouse to mouse house: the behavioural biology of free-living *Mus musculus* and its implications in the laboratory. *Applied Animal Behaviour Science* 86: 261-289.
10. NC3Rs (2008) *Rodents*. www.nc3rs.org.uk/informationportal click on "Rodents".
11. Reinhardt V (2002) Comfortable quarters for mice in research institutions. In: *Comfortable Quarters for Laboratory Animals*, 9th edn (V & A Reinhardt eds), pp 6-17 Washington DC: Animal Welfare Institute, www.awionline.org
NOTE: the 10th edition of *Comfortable Quarters* is under production at the time of writing.
12. See also the RSPCA/UFAW Rodent Welfare Group meeting reports, which can be downloaded at www.rspca.org.uk/sciencegroup/researchanimals/implementing3rs/rodentwelfaregroup



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RSPCA, Research Animals Department
Wilberforce Way, Southwater, Horsham, West Sussex RH13 9RS
www.rspca.org.uk/researchanimals



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