



Mouse Colony Management

Fundamentals of mouse breeding

This is a general indicator, but these can all differ depending on strain.

Sexual Maturity	Can start as early as 5 weeks. Optimal age of breeding set up is 7-8 weeks old.
Economic Breeding Life	6 litters in 6 months. After this time quality of the pups and litter size generally decreases.
Gestation	19-21 days
Litter sizes	Outbred – 8 or more pups Inbred – Between 5-7 pups
Weaning	19-28 days

What can affect mouse breeding?

Environmental

There are several environmental factors that can affect the outcome of how successful a breeding cage is. This includes temperature, humidity, lighting intensity, noise and vibrations as well as room ventilation.

The optimal room temperature for mice is usually between 20-24°C. ***Be aware that the air temperature will be warmer in the cages than to the room***. Extreme temperatures can affect the development and even the survival of pups.

The parameters for humidity are between 45-65%, however ideally set around 55%. If the humidity is consistently too high or too low, it can lead to chest infections or ringtail.

Home Office Code of Practice states that levels of 350-400 lux at bench height is suitable for experimental and laboratory activities. Care should be taken when regarding albino animals as strong light intensity can cause damage to their retinas.

As rodents are very sensitive to ultrasound, and use it for communication, it is important that extraneous noise is minimised. Ultrasonic noise (over 20 kHz) produced by many common laboratory fittings, including dripping taps, trolley wheels and computer monitors, can cause abnormal behaviour and breeding cycles.



Animal

- *Age – too old or too young?*
- *Health – Sick? Overweight or underweight? Infertile?*
- *Experience – First time parents or not?*
- *Handling – Technician/researcher handling techniques increasing stress*
- *Genotype – Genotype can influence how successful breeding is when reviewing aggressive phenotypes etc.*
- *Strain - An animals strain can dictate how well they'll breed whether it's due to the strains' general temperament, genetic modification, outbred or inbred etc.*

Confirming your strains

Familiarise yourself to the strains that you're looking after. Some strains are more susceptible to disease, ill health or stereotypical behaviours than others.

Ensure these observations are documented so you can review if there is a pattern or trend developing. This will ensure you pick healthy animals for future breeding stock and will aid in choosing when to set up these new breeding animals.

Record keeping

- Pedigree's
- Litter sizes
- Litter interval
- Reproductive life cycle
- Fertility
- Known phenotypes
- Welfare concerns

Minimal stock

The strain will dictate how many stock animals are required as a minimum, whether that be for breeding or experimental.

Minimal experimental stock numbers are dependent on the requirements of the specific experiments, genotype and sample sizes needed.



Types of breeding set ups

Monogamous Pair	1 male and 1 female are paired together until the end of their economic breeding life.
Breeding Trio	1 male and 2 females are paired together until the end of their economic breeding life. <i>*Take note which female is pregnant or producing as one may not be*</i>
Breeding Harem	1 male to 3 or more females are generally paired together until the end of their economic breeding life. <i>*Take note which female is pregnant or producing as one may not be*</i>
Timed Mating	A male is set up with females (the number can vary but is usually 1-2 females). The females are plug checked and usually separated when a plug is found. <i>*Take note of which female plugged*</i> <i>*Just because a plug is found doesn't mean that there will have a successful result, it is only an indication that mating has occurred*</i>

Definitions of Zygosity.

Wild Type (WT) - Wild type refers to an individual having the normal phenotype; that is, the phenotype generally found in a natural population.

Heterozygous (HET) - Heterozygous refers to an individual inheriting different forms of a particular gene from each parent

Homozygous (HOM) - Homozygous refers to an individual inheriting identical forms of a particular gene from each parent.

How to select appropriate breeding schemes

Homozygous mutant (-/-) x homozygous mutant (-/-):

- Can be used if both genders are viable and fertile as homozygotes



- Offspring: 100% homozygous; genotyping not required

Heterozygous mutant (-/+) x homozygous mutant (-/-)

- Can be used if only one gender is viable and fertile as a homozygote
- Offspring: 50% homozygous; 50% heterozygous; genotyping needed

Heterozygous mutant (-/+) x heterozygous mutant (-/+)

- Must be used if neither gender is viable or fertile as homozygotes
- Offspring: 25% homozygous; 50% heterozygous; 25% wild-type; genotyping probably required

Problems that occur and how to overcome them...

<u>Problem</u>	<u>Advise to overcome the problem</u>
Environmental issues	Inform the maintenance team and your NACWO that there is a problem with the environmental parameters and this can usually be resolved quickly.
Animals are not breeding	Review their records and consider a few things... • Have they ever bred since their set up date? • Did the female have difficulties last time she littered down? • Are there other health factors affecting them? • How old are they? • Are they infertile? • Were they set up too soon? • Is it a common problem within the strain? • What are the animals' temperament like? Dependent on the answer to these questions, fresh breeding stock should be used and the other breeders retired.
The animals are breeding but pup survival rate is low to non-existent	It isn't uncommon for first time mums to become too stressed and experience total litter loss, however, if they lose their pups consistently then it is best to refresh the breeding stock as some mums just can't cope.



	This is not always the first answer to jump to and investigating why the losses occur in the first place is wise. It could be stress but then it could be lack of milk production or some other health issue which may inform you that you may not want to set up any other animal related to the ones in the mating.
Runty pups	Again, consider if this is a one off or a pattern of the strain or a particular breeding cage. They will be clearly runty before being weaned so place soaked diet in a bowl/nombrero in addition to hard pelleted food on the cage floor whilst they're still with their parents. Placing the food in a shallow bowl will ensure that bedding and substrate doesn't become saturated with water and prevents the animals from becoming cold and wet. Email and ask your researcher if they can receive additional boost diet to help them.

Things to remember and check!

Check:

- Records
- Animal ages
- Identification markers
- Breeding set up dates
- Litter intervals
- Litter success rate/survival
- When the male was removed at the end of breeding
- MCMS dashboard for mouse ages and background information
- With your researchers about their animals – Keep them informed and ask them questions too!



Useful websites

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/388535/CoPanimalsWeb.pdf

http://ko.cwru.edu/info/breeding_strategies_manual.pdf

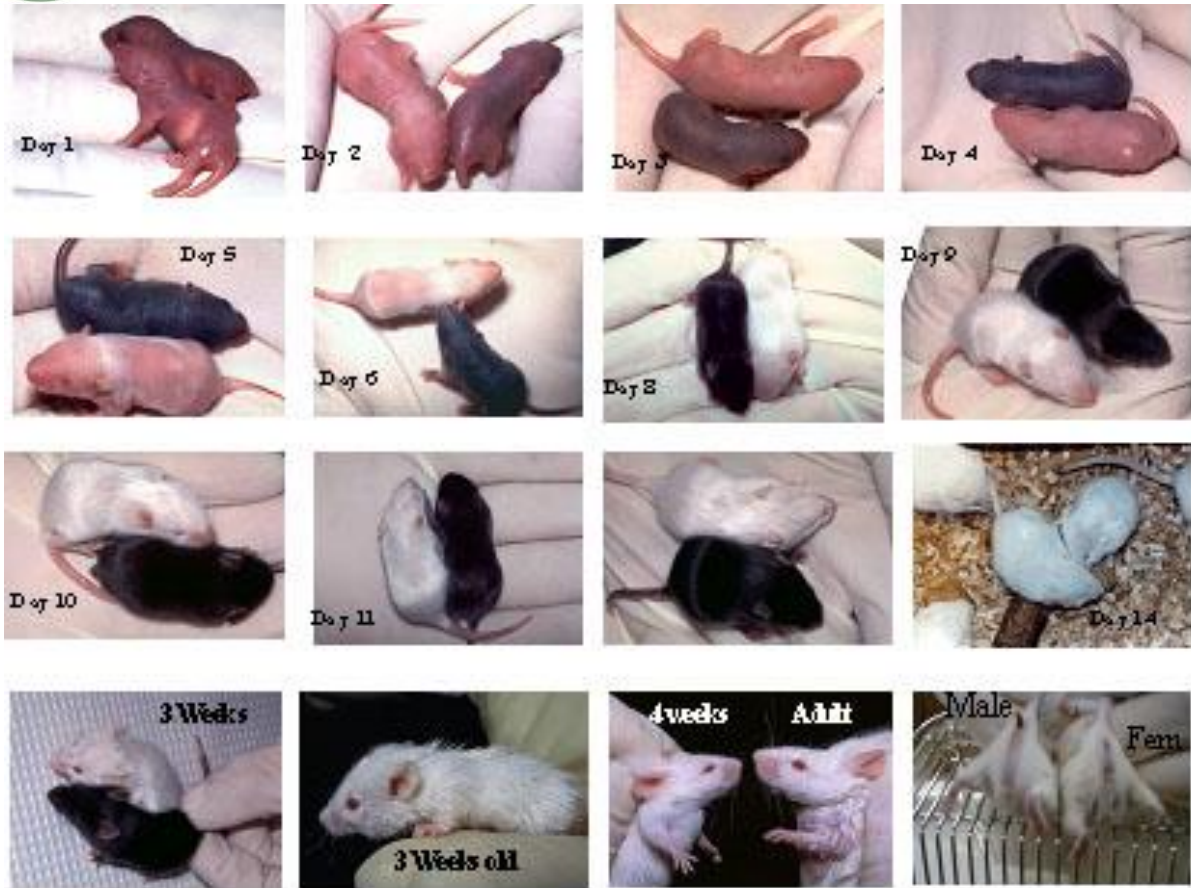
<https://www.jax.org/jax-mice-and-services/customer-support/technical-support/breeding-and-husbandry-support/considerations-for-choosing-controls>

<https://www.jax.org/jax-mice-and-services/customer-support/technical-support/breeding-and-husbandry-support/colony-planning>

<https://nc3rs.org.uk/colony-management-best-practice>

- If you ever want to know more about your strains – look them on the internet or go through Jackson Lab, Charles River or Envigo.

Mouse Pup Appearance by Age (Black and Albino coat)



Description of Developmental Stages: Birth - Day 14

Age	Description
Day 0	- Blood red - Possible milk spot
Day 1	- Lighter colour red - Milk spot present
Day 2	- Ears appear as nubs - Milk spot present
Day 3	Ear flap starting to come away from head (one or both)
Day 4	- Ears fully developed, completely off head, some starting to go towards back - Increasing skin colour
Day 5	- Ears are fully back - Skin appears much thicker with more colour density to skin
Day 6	- Milk spot is disappearing or gone - Coloured fuzz appears behind ears or on neck



Day 7	• Coloured fuzz starting to cover pup
Day 8	• Belly begins to show fur
Day 9	• Fur is now thicker • Females may show nipples (there are five pairs of mammarys)
Day 10	• Fur growth is complete • Pups are more active
Day 11	• Teeth are beginning to erupt • Eyes start to open
Day 12	• Eyes are open • Pups begin to nibble solid food
Day 13	• Pups increase solid food intake
Day 14	• Pups increase in weight and size, eating more solid food

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