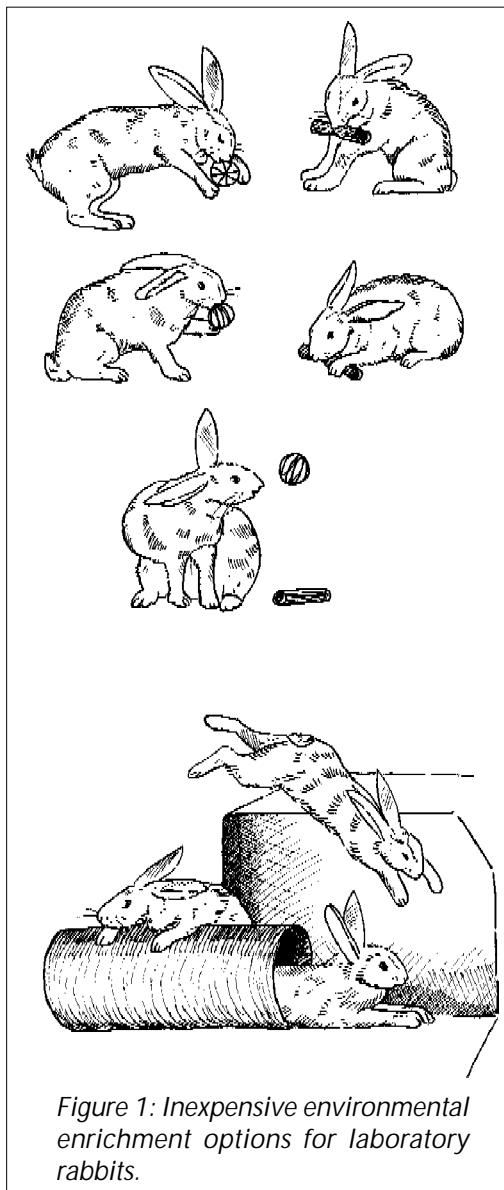


# COMFORTABLE QUARTERS FOR LABORATORY RABBITS

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*Figure 1: Inexpensive environmental enrichment options for laboratory rabbits.*

## The natural behavior of rabbits

The rabbit has 360 degree vision. Its conspicuous white tail serves as an effective warning signal for other conspecifics and distracts predators. The rabbit's defensive adaptation is simply to run fast towards the nearest burrow and bolt down to safety. If caught, the animal may feign death, as predators do not attack dead prey.

The digging of burrows is mainly the function of does. A burrow always has at least one emergency exit. It not only serves as refuge, but also as a safe place for nesting and rearing of the young. The doe will cover the entrance with earth whenever she is absent. Rabbits spend most of the diurnal period underground where they tend to congregate in groups, snuggling together and grooming each other. They venture out in the evening to roam and forage, keeping distinct social distances and appearing less tolerant of one another than during daylight.

Rabbits are gregarious animals living in colonies or warrens. Stable breeding groups comprise one dominant buck with a harem of 3-6 does. Chin-marking, urination and defecation and several conspicuous behavioral displays are used by bucks to mark their breeding territories. Inter-individual scent marking identifies animals as members of the same group.

A group's social structure includes two relatively independent linear rank hierarchies, one for bucks and

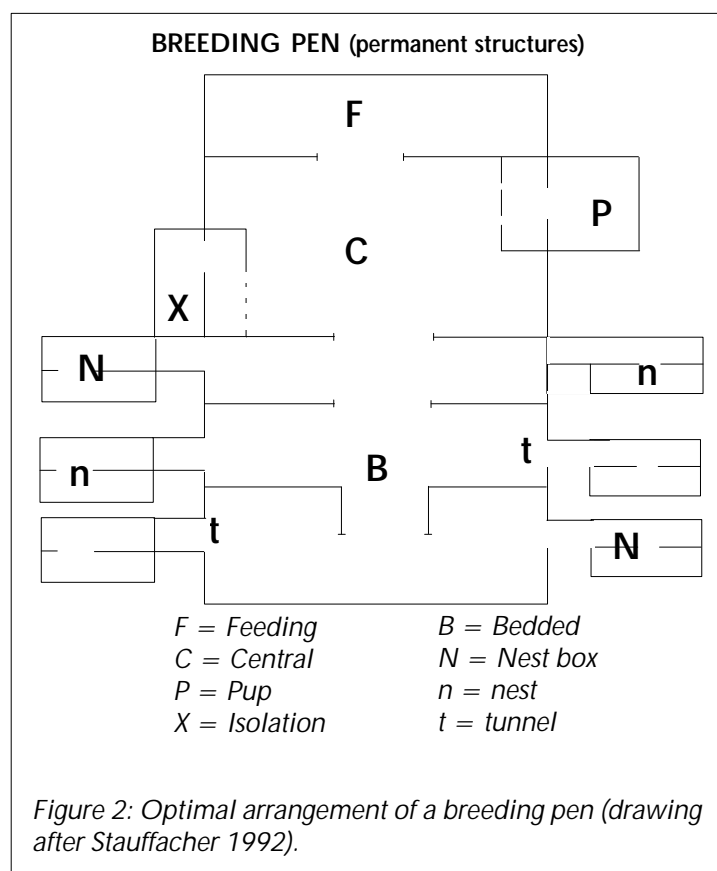
the other for does. Bucks tend to distance themselves from each other, a strategy which effectively minimizes the chances of aggressive confrontations, whereas does stay close together but may compete for burrows. Dominance-subordination relationships are fairly stable and fighting is generally a rare event. Low ranking rabbits are relatively restricted in their movements and spend more time alone and concealed than high ranking group members.

The domestication process has not altered the species-typical behavioral repertoire of rabbits. We therefore have an obligation to provide a species-adequate environment for laboratory rabbits in order to guarantee their behavioral, psychological and physiological health and hence their general well-being.

### Laboratory rabbits housed in single cages

Current caging conditions for singly housed rabbits are designed to be hygienic with metal/plastic walls that are easy to clean. Free access to food and water guarantees that the occupant's physical needs are met. However, single caging deprives rabbits from contact with other conspecifics and the minimal floor space (76x60 cm [30x24 in.]) and height (45 cm [18 in.]) of the standard cage severely restrict the animals' freedom to carry out species-typical activities. The barren cage environment offers no stimulation. Even in terms of external visual stimulation, the barred front of the cage is partly concealed by the food hopper and by the water bottle. Basic activities such as foraging and digging and the exposure to variations in odors, textures and diet are precluded.

Some of the prominent activities of single caged rabbits are behavior disorders. Such disorders substitute for biologically normal behaviors which are inhibited due to a lack of eliciting stimuli. They include stereotypical chewing/licking/biting of the bars, the grid floor, the ceiling, the walls, the hopper and the water bottle, trichotillomania (hair-pulling and -eating), stereotypical nose-sliding, head-swaying and pawing the cage walls, rearing-up-spinning-around-and-falling-over and self-mutilation. The frequency and duration of such stereotypies signifi-





*Figure 3: Groups of does housed in adjacent floor pens with straw bedding and sturdy cardboard boxes.*

cantly increases with the duration of being confined in the barren cage environment. Many of the single rabbits seem to be depressed, sitting in a hunched posture for hours on end, with little incentive to even groom themselves. Such animals may have a staring coat and dull eyes and, therefore, look unhealthy and maladapted to confinement. The extreme boredom and frustration induces some animals to overeat and others to undereat

leading to obesity and severe and acute weight loss, respectively.

If research protocols, such as metabolic studies, require that rabbits have to be singly caged, provision must be made that the animals are not visually isolated from other conspecifics and that the cages are enriched to relieve boredom.

Hay is an inexpensive yet effective substratum to promote the expression of natural behaviors associated with foraging, playing, investigating and nesting. It may also function as a preventive measure against ulcerative pododermatitis, typically occurring in wire-bottom cages. The hay has to be replaced every other day to avoid hygiene problems. Wooden sticks (e.g., tree branches, old broomsticks) are also inexpensive and offer effective means to trigger species-typical behaviors such as gnawing, sniffing and chin-marking (Figure 1). The sticks should be approximately 10 cm (4 in.) long with a diameter of 2.5 cm (1 in.). They have to be replaced regularly due to wear. Sturdy hollow wire balls (diameter 5 cm [2 in.]) entice caged rabbits to roll, kick and toss them and, when filled with pieces of carrots, encourage food-retrieving behavior (Figure 1). The balls have the advantage over wooden sticks of being more durable and easily autoclaved.

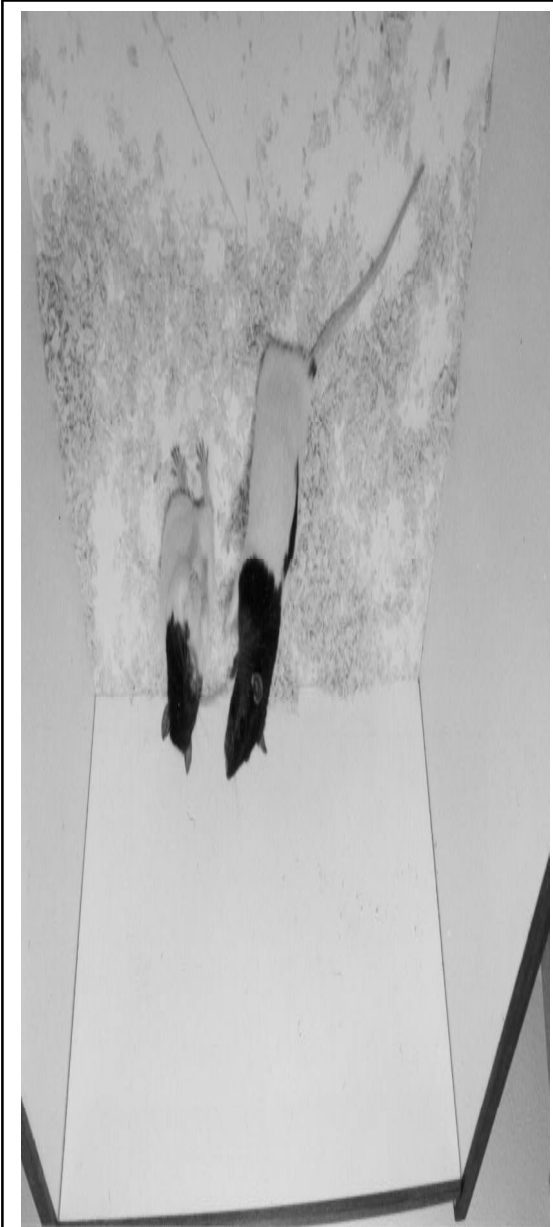
Single animals who have access to hay, wooden sticks or wire balls show a reduction in stereotypical behaviors and a marked increase in their overall activity. This indicates that their behavioral health is promoted by these simple environmental enhancers.

Rabbits also require a den-like hiding area, to provide a refuge in alarming situations. The area beneath a side shelf or a PVC tube readily meet this requirement (Figure 1).

Interconnecting two cages ("double" cage) is particularly beneficial because it offers the possibility of social companionship.

### Group formation of laboratory rabbits

Groups of unfamiliar immature rabbits of both sexes can be formed without undue risk of injury associated with aggression. Ideally, such groups should be established shortly after weaning. Grouping siblings is advantageous over grouping unfamiliar animals since siblings already develop dominance relationships in non-injurious play-contests well before they reach the age of weaning.



*Figure 4: Correct procedure for lifting and carrying a rabbit.*

Individuals of a group can be recognized by distinctive coat color/patterns, by marking them with wool dyes and xylene-free markers (requiring regular renewal), or by implanted microchips.

Group-housing rabbits that have been previously single-caged for more than six months is not recommended. Such animals will be extremely fearful, will lack proper motor coordination resulting from long-term hypoactivity and will be prone to injuries and fractures due to weaknesses in the bone structure. Pair-housing them in “double” cages minimizes these inherent risks while offering a more species-adequate, i.e., social environment. Pair-housing, however, is only recommended for young animals and for adult females. Pair-housing of adult males is associated with serious risks of injurious aggression.

Establishing groups of unfamiliar, sexually mature rabbits poses more of a problem than the grouping of immature individuals. Grouping adult males is not advisable—even if the animals are kin related—because of the insurmountable risks associated with dominance and territorial antagonism. The animals will not establish and maintain a stable linear hierarchy, and the constant social reorganization will be accompanied by intense, possibly injurious aggressive interactions. Even young males who have been reared as a harmonious group become incompatible when reaching sexual maturity and they will suffer distress if they remain in close proximity with one another.

Grouping adult females or adding strange rab-

bits to an already established group of does can be rather risky but there are ways to minimize these risks. The rabbits should not be introduced directly to each other, but future group members should first be given the opportunity to familiarize with each other in a non-contact situation. New animals should be placed in a cage within the group pen to allow mutual olfactory familiarization between the group members and the stranger(s).

When forming a new pair or group of does, separate cages/pens are recommended with temporary wire-mesh partitions. This will allow the animals to establish dominance-subordination relationships without any risk of injury. The initial familiarization process may take 2-5 weeks. Partners are released thereafter into a structured, neutral double cage or pen, respectively. It may take an additional 1-3 weeks for the new companions to “settle down” and form harmonious relationships with each other. Newly paired/grouped or re-paired/grouped does must be monitored closely for injuries and signs of maladaptation (e.g., failure to eat/drink, weight loss, poor health, inactivity, reduced behavioral repertoire, hunched posture, constant hiding).

Aggression (e.g., chasing, biting, attacking, socio-sexual mounting/circling, threatening, nudging) among paired or grouped adult does may occasionally result in minor injuries, such as scratches and superficial bites. This is unavoidable, because confinement is a strong challenge for social relationships, with partners lacking sufficient space for adequate social distancing in situations of possible conflict. The animals may then resort to agonistic interactions in an attempt to reconfirm or reorganize social dominance-subordination relationships. The effects of aggression can be alleviated by means of environmental manipulation, such as the provision of hiding boxes, visual barriers and elevated shelves serving as escape routes and places to retreat.

Individual animals who have to be separated from their companion(s) for any reason (e.g., injury, non-infectious disease, treatment) should always be housed in such a way that they can maintain visual and olfactory communication. This ensures that social relationships are not broken and the temporarily separated individual is re-accepted by the other(s) without risk of overt aggression.

### **Laboratory rabbits housed in groups**

Housing rabbits in compatible groups rather than in social isolation improves their mental and behavioral health by eliminating the occurrence of stereotypies, while fostering the active expression of species-typical social behavior patterns. Housing rabbits in groups provides each group member substantially more space and hence possibilities for exercise that the single caged rabbit lacks. Compatible group-housing does not significantly affect stress-sensitive variables and infectious disease susceptibility when compared with single-housed rabbits.

Until recently, group-housing was not considered an option because of perceived risks associated with aggression. Indeed, isosexual group-housing of adult male rabbits inevitably leads

to severe fighting, reflecting the biological intolerance of mature bucks. This aggression problem develops only after the animals have reached prepuberty, i.e., at 12-14 weeks of age. Young males should therefore be housed in a social environment until this time, to allow them to express their inherent social nature. Keeping them in only-male groups thereafter however, is only advisable if they are castrated, in order to avoid aggressive intolerance.

Adult female rabbits are socially much more tolerant than males and,

therefore, can and should be housed socially. Does actually prefer to be in the company of another conspecific in a pair-situation or with several conspecifics in a group-situation rather than living alone. Housing does in groups not only allows them to express their gregarious inclination but it also makes the animals less susceptible to stress than single-caged does. For managerial reasons, groups should not exceed ten animals.

Rabbits develop rank relationships which are a prerequisite for a relatively harmonious group life. Removing or replacing adult group members inevitably disrupts and/or challenges these relationships and may lead to serious aggressive disputes associated with the restructuring of the social hierarchy. Keeping the composition of a group stable is therefore very important. However, males and females should be separated permanently before they reach the age of 10-12 weeks to avoid unwanted breeding.

A well-structured environment with raised resting areas and tunnels is required to breed rabbits successfully. The pen should be divided into a central resting area, a feeding area and a bedded area (Figure 2). The bedded area should include 5-6 individual nest boxes. The boxes should be designed in such a way that they shield littering females well from each other to prevent infanticide (Figure 2). In addition, an isolation zone is useful to separate individual animals if necessary with a wire mesh window. There should also be a pup-only quarter with an entrance that is too small for adults to pass through (Figure 2).

Does will give birth every 30-33 days. In order to avoid overpopulation and the negative consequences associated with it, the offspring should be removed as soon as they become independent (26-28 days of age) and transferred to rearing groups.

Group-housed rabbits should be kept on a woodchip litter or preferentially on straw or



*Figure 5: An adult rabbit is approximately 80 cm (31 in.) long when resting in typical rabbit-fashion, i.e., full lateral sternal recumbency.*



*Figure 6: An adult rabbit is about 75 cm (30 in.) tall when sitting in the rabbit-typical lookout position.*

shredded paper bedding (Figure 3). Hay must be provided for foraging and nest-building. The vertical dimension of the enclosure should be made accessible by means of shelves, providing preferred resting and hiding places. Wooden sticks and tree branches offer additional environmental enhancement. Cardboard boxes, plastic crates and/or PVC tubes should be available as substitute burrows and “safe” places to retreat in fear provoking situations or during social conflicts. Perforating the boxes and tubes increases the animals’ feeling of security by allowing

them to keep visual contact with the “outside” world. The walls of the pen should consist of wire mesh so that the animals can overlook their surroundings. This effectively eliminates unnecessary alert- and fear-responses to approaching personnel.

### **Handling**

If a rabbit has to be caught, she or he will usually run away and dart into one of the hiding places from where the animal may be readily picked up without struggling. This trick, however, works only if the rabbit does not associate the subsequent handling procedure with discomfort, anxiety or pain. It is crucial that rabbits are handled with gentle firmness and empathy to minimize discomfort and to avoid distress responses. Properly handled rabbits will come to the front of their enclosure when they hear familiar personnel. They will not retreat, but lie still when approached to be picked up. A rabbit should be held by the scruff and firmly supported under the hind legs, and carried with the head gently tucked under the handler’s arm (Figure 4).

### **Space recommendations**

The single cage must provide enough room so that the occupant can comfortably rest in full lateral sternal recumbency. Taking into account that the outstretched length of the average adult, 4-6 kg (8.8-13.2 lb.) heavy rabbit is approximately 80 cm (31 in.; Figure 5), the minimal length of the cage should be no less than 80 cm. To allow such an animal to comfortably turn around and change postures, the cage should be 68 cm (27 in.) wide. The minimum floor area requirement for the single-caged, 4-6 kg adult rabbit is thus 0.54 m<sup>2</sup> (5.8 sq.ft.). Heavier

rabbits (> 6 kg) require more space and have to be kept accordingly in larger cages.

Pair-housed rabbits need twice the floor space of the single-housed rabbit. The “double” cage should be at least 120 cm (48 in.) wide.

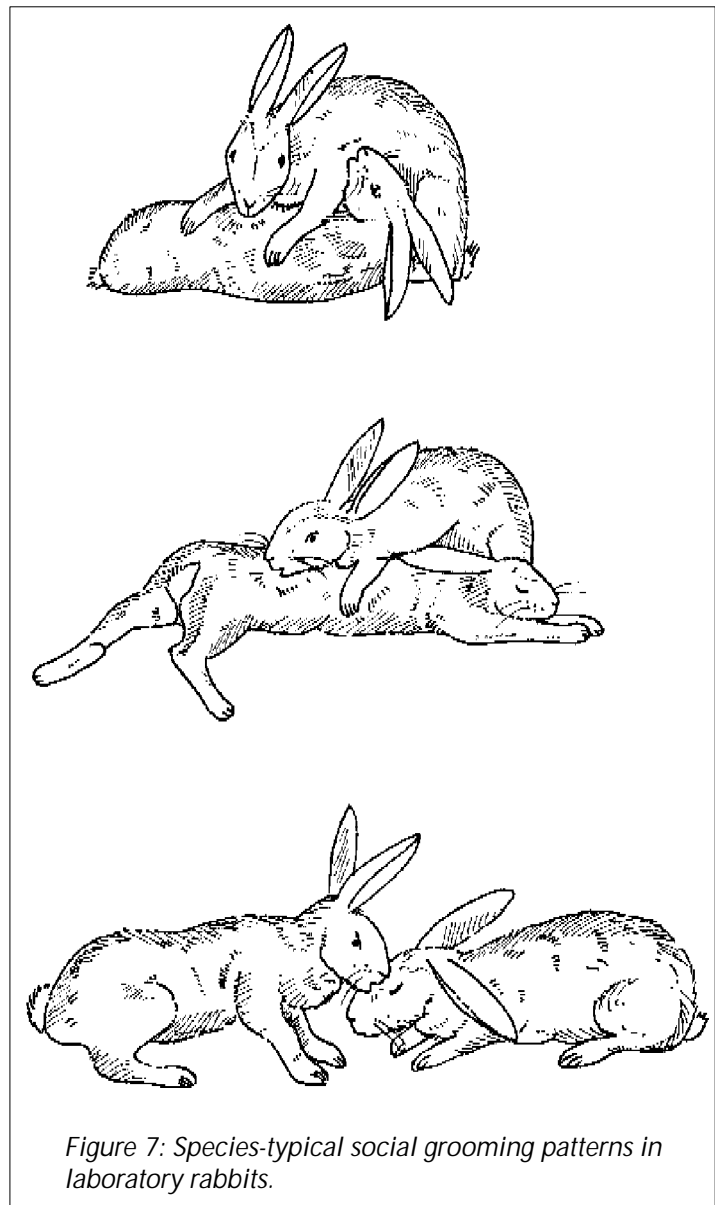
The minimum height of the rabbit cage should be 60 cm (24 in.) to enable the occupants to at least sit up with their ears erect. A height of 75 cm (30 in.), however, would be more appropriate and hence is recommended because it allows the animals to sit up on their hind legs in the typical lookout posture (Figure 6).

If more than two adult rabbits of the weight category 4-6 kg are housed together in a pen, the minimum floor area should be 2 m<sup>2</sup> (22 sq.ft.) for up to four animals, increasing by 0.45 m<sup>2</sup> (4.8 sq.ft.) for each additional rabbit. A breeding group of 2-5 does, one buck and one generation of their offspring should be allocated a floor area of 9 m<sup>2</sup> (97 sq.ft.).

The height of group pens should be 120 cm (47 in.) or more (depending on the height of boxes/shelves) to prevent the occupants from leaping out.

### Summary

The traditional standard-sized single cages currently used for housing rabbits are inadequate to satisfy the animals' behavioral and physiological needs. Group housing arrangements, preferably in well-structured floor pens with straw bedding and individual nest boxes can overcome these shortcomings. Group-housed rabbits express a considerably enhanced behavioral repertoire compared with singly caged rabbits. They are truly rabbits, because they can hop, leap, sit up on the hind legs in rabbit-fashion, hide in “burrows,” forage with other conspecifics, groom each other (Figure 7) and sham-burrow in the substratum before lying down.



In situations where a rabbit has to be caged alone, access to a refuge area and objects for gnawing and playing should be provided. A single caged rabbit must never be kept in social isolation but should always be able to have visual and possibly also olfactory contact with other rabbits.

### Acknowledgement

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