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## Environmental Enrichment for Laboratory Animals (2-Apr-2004)

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### **Introduction**

This chapter addresses the requirement for laboratory animals to live in environments that **foster the expression of species-typical behaviors**, or in other words, in an enriched environment. The term, "environmental enrichment" has been coined by laboratory personnel as the principal means of improving the welfare of the animals in their care, rather than relying on the more ambiguous term "psychological well-being" used by the federal government in animal welfare regulations. However, environmental enrichment does not fully capture the intended meaning of enhancing the psychological well-being of laboratory animals. Rather, it is one approach to improving animal welfare, but it is not the sole method. Further, the provision of environmental enrichment does not automatically guarantee animal welfare. Conversely, the term psychological well-being is difficult to define, may vary among individuals of the same species, and is unlikely to be static in an individual animal. In addition, making a determination of psychological well-being in a non-verbal animal might be based more on the subjective assessment of the observer than the actual state of the animal. For these reasons, a more sound approach is to describe the species-typical behavior of the animal, and to determine in an objective manner which behaviors should be encouraged in the laboratory (e.g., affiliative social behaviors) and which behaviors observed in free-ranging counterparts do not need to be expressed (e.g., escape from predation). Also, some behaviors may be actively discouraged in the laboratory environment (e.g., aggression). This animal-based approach to environmental enrichment is much more likely to improve animal welfare.



Animal Care. The Reasons we Care, website: [www.aphis.usda.gov/ac](http://www.aphis.usda.gov/ac)

## Regulatory Compliance

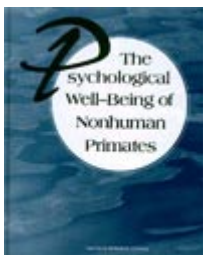
The 1985 amendments to the Animal Welfare Act (Public Law 99-198, the Improved Standards for Laboratory Animals Act) added several new provisions to the law, including the requirements to provide an opportunity for dogs to exercise and a mandate to provide an environment **"adequate to promote the psychological well-being of non-human primates"**. Six years later, the U.S. Department of Agriculture (USDA) published implementing regulations pertaining to this amendment, referred to as the Animal Welfare Regulations (AWRs) [1]. These regulations stipulate several aspects of the housing and management of captive primates, such as addressing the social needs of primates; providing cage complexities; giving special consideration to some classes of primates, such as infants; ensuring adaptation to restraint devices and minimizing their use as much as possible; and having a mechanism to exempt specific animals (e.g., sick animals) from the "environment enhancement" program.

To aid regulated institutions in developing and implementing environmental enrichment plans, the USDA published its "Final Report on Environment Enhancement to Promote the Psychological Well-Being of Non-human Primates" [2], which elaborates the agency's recommendation for a **"critical element concept"** in providing enrichment. This approach identifies five elements that the USDA staff considers essential to an adequate primate enrichment plan. They are: 1) social grouping; 2) social needs of infants; 3) structure and substrate; 4) foraging opportunities; and 5) manipulanda.



Final Report on Environment Enhancement to Promote the Psychological Well-Being of Non-human Primates, website: [www.aphis.usda.gov/ac/eejuly15.html](http://www.aphis.usda.gov/ac/eejuly15.html)

The USDA also was a sponsor of a report developed by the National Academy of Sciences, the "Psychological Well-Being of Non-human Primates" [3]. This report, developed by a committee of subject experts, describes essential elements of a program for enhancing non-human primate psychological well-being, although the elements differ somewhat from those identified by the USDA staff. The National Academy of Sciences committee highlights **social companionship, providing opportunities to engage in species-typical behavior, housing design, personnel interactions, and documentation of the efficacy of the program**. The report describes the general care of and methods to enrich a variety of primate species and provides sample templates for environmental enrichment plans.



Psychological Well-Being of Non-human Primates.

The other federal agency charged with oversight of research animal care and use is the Office of Laboratory Animal Welfare/National Institutes of Health vis-à-vis the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals [4].



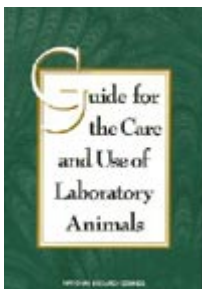
Office of Laboratory Animal Welfare, website: [grants1.nih.gov/grants/olaw/olaw.htm](http://grants1.nih.gov/grants/olaw/olaw.htm)

The PHS Policy, in turn, requires conformance with the *Guide for the Care and Use of Laboratory Animals (Guide)* [5] and endorses the U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training [6].



Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals.

Principle VII is applicable to the subject of environmental enrichment as it underscores the importance of the living conditions of animals in enhancing their health and comfort (see Appendix 1).



Appendix 1. U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training (IRAC 1985). [PRINT](#)

The *Guide* is a general set of recommendations for a quality laboratory animal care and use program to follow. Topics covered in the *Guide* include physical plant, animal husbandry, veterinary care, and institutional program oversight. Although the *Guide* is not federal regulation, because the PHS Policy requires conformance with the *Guide*, its "recommendations" become elevated to "requirements" for those institutions that receive PHS funding.

The most recent edition of the *Guide* includes a section on "Behavioral Management". According to the *Guide*, an appropriate **behavioral management program** addresses three factors: the structural environment in which the animal is kept, the social environment of the animal, and the provision of opportunities for physical and cognitive activity. Specifically, the *Guide* states "Proper housing and management of animal facilities are essential to animal well-being, to the quality of research data and teaching or testing programs in which animals are used, and to the health and safety of personnel. A good management program provides the environment, housing, and care that permit animals to grow, mature, reproduce, and maintain good health; provides for their well-being; and minimizes variations that can affect research results [...]. Depending on the animal species and use, the structural environment should include resting boards, shelves or perches, toys, foraging devices, nesting materials, tunnels, swings, or other objects that increase opportunities for the expression of species-typical postures and activities and enhance the animals' well-being". The *Guide* further states, "It is desirable that social animals be housed in groups; however, when they must be housed alone, other forms of enrichment should be provided to compensate for the absence of other animals, such as safe and positive interaction with the care staff and enrichment of the structural environment [...]. Animals should have opportunities to exhibit species-typical activity patterns".

#### **AAALAC International -**

The Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC) is a non-profit organization that provides a voluntary, confidential, peer-review of animal care and use programs around the world [7].



AAALAC International, website: [www.aaalac.org](http://www.aaalac.org).

The accreditation process includes an extensive self-evaluation conducted by the institution which is summarized in a standardized Program Description. This Program Description is submitted to AAALAC in advance of the on-site evaluation of the institution's animal care and use program conducted by AAALAC representatives every three years. Questions in the Program Description pertaining to the Behavioral Management program are contained in Appendix 3.

AAALAC does not establish policies with which institutions must conform. Rather, AAALAC International relies on the *Guide*; national laws, regulations and policies; and numerous scientifically-based standards, referred to as "reference resources", which address specific subject areas, for evaluation of animal care and use programs, such as the NRC report on non-human primate psychological well-being.

For a complete description of the regulations and guidelines, refer to: Regulatory Compliance. Reuter JD, In: Laboratory Animal Medicine and Management, Reuter J.D. and Suckow M.A. (Eds.).

### **Environmental Enrichment Program Development and Management The Paradigm Shift -**

As previously stated, the *Guide* addresses the importance of the structural environment, the social environment, and the provision of opportunities for cognitive and physical activity for all species of animals. Thus, an animal teaching, testing, or research program that is mandated to follow the recommendations set forth in the *Guide* must integrate environmental enrichment into the daily care and husbandry standard operating procedures (SOPs). Enrichment should be given the same significance as other components of animal care, such as nutrition and veterinary care, and it should not be considered an extra duty that can be neglected on a busy day.

The development of enrichment-related SOPs should be initiated at the administrative level. Adjustments may need to be made in the animal care budget to accommodate the inclusion of enrichment strategies. However, with the many money saving tips listed in Table 1, the implementation of environmental enrichment into animal housing enclosures need not cause undue financial burden to the institution [1].

**Table 1. Cost Saving Tips for Environmental Enrichment Programs**

- Notify local contractor of materials that can be used for the animals, such as small lengths of PVC pipe. The pipes can then be cut to the needed sizes and used for shelters for a variety of species.
- Make arrangements with the institution's food services department/local grocery stores to receive extra fruits and vegetables. These food items can be used as treats for the animals or as a nutritional component of their diet.
- Set up a bin to collect paper tubes from toilet paper and paper towels. Notify via e-mail and postings that paper tubes are needed for the animals. Note: Paper tubes must be autoclaved prior to use with the animals. Paper tubes with certified analysis should be used for GLP studies and other studies where there is concern regarding the glue interfering with results.
- Have the research labs save their pipette-tip boxes, which can be used as shelters for the mice. They are autoclavable and can easily be cut to provide an open end. Each box yields 6 shelters when cut.
- Yard sales often have toys which can be sanitized and presented to infant non-human primates or rabbits (confirm the safety of the item before providing to animals).

### **Program Development: The Environmental Enrichment Committee (EEC) -**

Many institutions housing animals, both in the laboratory animal science field and in zoological parks, have established formal **Environmental Enrichment Committees (EEC)** to oversee the development, implementation and assessment of a comprehensive enrichment program to encompass all of the animals in their care [8-11]. The committee may be comprised of assigned personnel or volunteers from within the institution. Utilizing employees at all levels, such as administrators, attending veterinarians (AV), veterinary technicians, animal caretakers, animal behaviorists, and principal investigators (PI), provides a variety of perspectives on how the welfare of the animals can be enhanced. It also empowers the primary care givers by providing them with a voice in the development of the husbandry SOPs for the animals in their care. The committee is charged with the exploration of new enrichment strategies, the assessment of the feasibility of new ideas, and the development of prototypes. If an enrichment idea is approved by the committee, inclusive of the AV and the PI, the committee then devises a plan for its implementation as well as an assessment strategy.

Implementation of new strategies should occur during the animals' natural active periods. For example, rabbits are crepuscular, i.e., most active at dawn and dusk, thus observations of their behavior should be made at these times. Mice, rats, and other rodents are nocturnal. Observations of these species are best done at night with the aid of red lighting. Observations made only during the normal business hours may inaccurately reflect the animals' true reaction to and use of enrichment devices. The EEC can ensure that implementation and monitoring are conducted at the appropriate time of day.

To date, the assessment of many enrichment techniques has been incomplete. More time should be devoted to obtaining objective data on how each species/animal uses the enrichment devices introduced into their enclosures. Observations need to be made at the time of introduction of enrichment, during the initial minutes and hours following introduction, and after the animals have habituated to the presence of the item. These findings should be shared with the laboratory animal community to foster the use of successful environmental enrichment strategies to enhance the welfare of other animals. The EEC can assist in the dissemination of this information by sponsoring posters at scientific meetings, holding in-house seminars, etc.

A key component to the enrichment program development is the understanding of the natural behavior and habitat of each species housed in the animal facility (Table 2). The knowledge gained about each species' behavioral repertoire and capabilities will allow the committee to develop enrichment plans that are species-relevant. For many animals, behavioral responses to olfactory, visual, and/or auditory stimuli are based on how the animals perceive their surroundings [12]. Some animals rely principally on visual cues while others may rely more on auditory or olfactory cues. Knowledge of an animal's sensory capabilities can greatly enhance the enrichment program and thus an animal's well-being [13]. For example, if a particular species is color blind, then it is of no benefit to the animal to provide it with brightly colored enrichment devices. Enrichment should not be provided indiscriminately, but with careful consideration as to how each species, strain, sex, and even individual animal responds to each form of stimulus. The EEC should ensure that personnel working with the animals are trained in this subject.

<b>Table 2. Natural Behavior and Habitat of Species Housed in the Animal Facility</b>		
<b>Species</b>	<b>Normal Behaviors Exhibited in Captivity</b>	<b>Abnormal/Maladaptive Behaviors</b>
<b>Mice</b>	Nocturnal, nest building, and burrowing, thigmotaxis, foraging, gnawing	Barbering, fighting especially in males, food grinding
<b>Rats</b>	Nocturnal, nest building and burrowing, thigmotaxis, foraging, coprophagic, gnawing	Barbering
<b>Hamsters</b>	Nocturnal, exploratory, hoarding food, foraging, gnawing, burrowing, and escape artists.	Cannibalism, fighting
<b>Guinea pigs</b>	Social, vocalizing, foraging, gnawing, coprophagic	Fighting, stampeding.
<b>Gerbils</b>	Exploratory, gentle, burrowing, gnawing, jumping, and hind limb thumping.	Scratching at the cage corners
<b>Rabbits</b>	Crepuscular, non-aggressive, exploratory	Barber or hair pulling, cage nosing or mouthing, digging, "frisky hopping", chin rubbing (scent marking)
<b>Chickens</b>	Roosting, foraging, pecking	Feather pecking, aggression, cannibalism, excessive fearfulness
<b>Cats</b>	Investigative, social, allogrooming and allorubbing	Excessive vocalization, excessive grooming, pacing, paw shaking, staring
<b>Dogs</b>	Exploratory, social	Excessive aggression, excessive barking, pacing, self-biting, excessive grooming, coprophagia
<b>Non-human Primates</b>	Social, foraging, exploratory	Pacing, back flipping, rocking, self-biting, head banging, and hair plucking

#### **Program Development: the IACUC -**

As mandated by the AWRs, the IACUC must perform semiannual reviews of the animal care and use program. Once the EEC has determined which enrichment strategies will benefit which animals, guidelines or an SOP for enrichment

implementation should be written and made available for the IACUC to evaluate and approve. Daily husbandry SOPs should include the provision of enrichment for each species. The SOPs should address the types of techniques used, the frequency of sanitation or replacement of objects used to provide enrichment, the frequency of presenting novel strategies, and monitoring for animal safety. A method of recording observations should also be included in the SOP.

Once the SOPs are presented to the IACUC and are approved as a component of the daily husbandry, the provision of environmental enrichment becomes codified as an established component of the daily care of the animals. Failure to provide the prescribed enrichments would thus be considered a variance to standard housing practices and would need to be justified based on animal health or scientific reasons. Once the enrichment becomes standardized within the facility, the concern that enrichment introduces additional variables into experiments is alleviated.

### **Program Development: the Attending Veterinarian (AV) and the Principal Investigators (PI)**

Two of the essential players in the development of the enrichment program are the AV and the PI. The AV should be consulted when a new enrichment idea is under consideration to ensure that the animals will not be harmed in any way. Enrichments that could potentially pose gastrointestinal or airway obstruction hazards must be avoided. Potential toxins and items that could otherwise injure the animals (i.e., sharp edges) must also be avoided. The PI will need to be aware of any changes to the environment that occur during his/her research and that may impact an experiment. Ideally, no new enrichment strategies should be introduced to animals that are already on study. Standardizing the enrichment plan for an established group prior to the initiation of the project will mitigate the introduction of confounding variables.

### **Common Environmental Enrichment Strategies**

#### **Social Enrichment -**

The *Guide* states "It is desirable that social animals be housed in groups..." [14]. Thus, pair or group housing should be attempted for all social species of animals. When housed singly, animals have limited opportunity to express many species-typical, social behaviors. However, for animals housed in captivity, various challenges to successful social housing can be encountered. For example, establishing compatible pairs of male mice has proven to be difficult due to bouts of aggression. Similarly, non-human primates may inflict serious wounds on each other as they establish a dominance hierarchy [15]. Also, there may be experimental requirements that dictate that the animals be singly housed.

To allow for non-contact social enrichment of singly housed animals, animal caging should be positioned such that it allows for auditory, olfactory, pheromonal, and visual cues from conspecifics. Mirrors suspended from the front of the cage are often used by non-human primates to view other animals in the room, the room door, etc. Also, structural complexities may be added to the cage to provide non-social stimulation in an attempt to compensate for the absence of social contact (see below).

#### **Non-Social Enrichment: Structural Modifications -**

Federal laws and guidelines dictate many of the specific standards that must be followed regarding the animals' cage environment. The variety of commercially produced caging for many species is also finite. Cage sizes and designs can restrict the types of enrichment that can be used. However, simple additions to the cage can greatly enhance the overall usefulness of the cage for the animals. The addition of perches in caging designed for laying hens provides an opportunity for them to display their natural roosting behavior, while the placement of feed on artificial turf in chick brooders allows the chicks to forage for their food (Fig. 1). Resting boards should be placed at several elevations within an enclosure when group housing cats as it has been demonstrated that the height of the resting place is a desirable factor for many individual cats [16]. When group housing guinea pigs, providing an adequate number of "hiding places" with the use of PVC tubing, commercially available huts, old caging that has been modified to serve as a hut, or empty cardboard feed barrels, greatly reduces aggression among the animals as evidenced by the reduction of inter-animal aggression. The addition of PVC tubing to rodent environments increases the lateral space within the cage while adding a simulated "tunnel" to the cage for these thigmotactic animals.



Figure 1. One day old chicks are provided artificial turf in their brooders. Feed is scattered on the turf, allowing them to display natural foraging behaviors. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -

### **Non-Social Enrichment: Exercise, Play, and Exploration -**

Laboratory animals can be encouraged to investigate their environment through the addition of novel items. Natural behaviors, such as gnawing, rooting, burrowing, stalking, and exploration can be stimulated when enrichment items are placed in the enclosures. An enriched environment can also reduce the occurrence of stereotypic or maladaptive behaviors, such as pacing, self-mutilation, aggression, or lethargy, which can be seen in captive animals maintained in poorly enriched environments [17]. Animal age, sex, genetic variation, individual variation, and the social environment will all influence the animals' reactions to enrichment devices. The introduction of novel items can encourage exploration in many animals, while it may elicit fear in others (e.g., many non-human primates are neophobic). Since it has been shown that animals reared in an enriched environment will be less fearful of novel items and unfamiliar stimuli than animals housed in barren environments, it is important to introduce enrichment to animals at a young age [18,19].

There is a large variety of commercially available toys for non-human primates, dogs, and cats. All items used must meet the following criteria: durable, non-toxic, sanitizable or disposable, constructed with no sharp edges that may injure the animal or areas that will entrap an animal's digit or limb, and constructed with no removable parts that can become a gastrointestinal or airway obstruction intestinal/airway obstruction. For studies that must follow Good Laboratory Practice (GLP) regulations, the items should be purchased from a commercial source that can provide a certificate of analysis. All anticipated enrichment devices must be written into the study protocol. Providing an assortment of items and altering the presentation of the items will continue to stimulate the desired behaviors for each species. In non-human primate cages, the use of plastic rings (Boomerlink Rings®, Discovery Toys, Livermore, CA) to connect items to caging allows the animal to alter the arrangement as desired (Fig. 2). PVC pipes with one inch holes cut in them create a play area for mice. Baby rattles or chew blocks suspended from the top of the rabbit cages can stimulate exploratory behaviors (Fig. 3).



Figure 2. Boomerlink Rings® (Discovery Toys, Livermore, CA) placed on the outside of the cage are often found inside the cage in a different sequence the following day. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -



Figure 3. Baby rattles or Bunny Blocks® (Bio-Serv, Frenchtown, NJ) can be placed in the rabbit cages to stimulate exploratory behaviors. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -

The AWRs regulations mandate that the opportunity to exercise be afforded to dogs, but do not stipulate how it is to be provided or for how long. Studies have demonstrated that increasing the enclosure size is inconsequential for stimulating exercise with singly housed dogs. Alternatively, group or pair housing as well as interactions with personnel encourage greater physical activity, regardless of the size enclosure. Toys, digging areas, platforms that provide sight lines for the dogs, and human interaction are all ways to encourage exercise and play for dogs (Fig. 4).



Figure 4. Human interaction with the dogs will encourage play and allow them to become accustomed to handling. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -

### **Non-Social Enrichment: Allowing Control -**

Studies have demonstrated that animals have reduced stress if they are provided with the opportunity to have control of their environment [20-22]. Providing nesting materials to rodents satisfies their behavioral need to structure their environment. The nesting materials are thought to help the animals with thermal regulation and to shelter them from external disturbances such as lighting and noises [23-25] (Fig. 5). The transfer of nesting materials from group housed mice during cage changing has been shown to alleviate much of the territorial fighting that commonly occurs as the animals are placed in the clean caging [26]. Additionally, nesting materials and shelters offer hiding areas for the animals which alleviates social tensions

among cage mates [26] (Fig. 6).



Figure 5. EnviroDri ® (Shepherd Specialty Papers, Inc Kalamazoo, MI) is an excellent nesting material for the laboratory mice. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -



Figure 6. Pipette boxes that have been cut in half are used in the mouse cages as shelters. The laboratories provide the animal facility with an unlimited supply of these boxes. - To view this image in full size go to the IVIS website at [www.ivis.org](http://www.ivis.org) . -

Commercially available nesting materials, such as EnviroDri<sup>™</sup> (Shepherd Specialty Papers, Kalamazoo, MI) or Nestlets<sup>™</sup> (Ancare, Bellmore, NY), and shelters, such as Shepherd Shacks<sup>™</sup> (Shepherd Specialty Papers, Kalamazoo, MI) or Mouse Igloos<sup>™</sup> (Bio-Serv, Frenchtown, NJ) have been shown to be used by rodents. These commercial products are either disposable or sanitizable.

It has been demonstrated that providing foraging opportunities enhances the well-being of the animals by allowing the animals additional control over their environment [27]. Studies have shown that animals prefer to work for their food, even when food is readily available [28]. In their natural environment, animals use their auditory, visual, and olfactory capabilities to acquire their food, whereas in the laboratory setting, their food is presented in ways that are convenient and cost efficient for the animal care staff. Providing foraging opportunities for the laboratory animal will enhance the mental stimulation, it will encourage locomotion and food gathering efforts, and increase the amount of time that the animals spend on natural behaviors [29].

The presentation of food can be varied in accordance with the capabilities of each species. Hiding food throughout the enclosure is beneficial to animals, such as dogs, that use olfactory cues to gather food. For non-human primates, placing the food in areas that encourage the animals to climb or reach for it, using puzzle feeders that are cognitively challenging, or using foraging devices that prolong the period of time spent feeding can all improve animal welfare. Seeds or other food items may be scattered in the bedding material of rodent cages to encourage foraging. With the use of corn cob bedding in cages, foraging is encouraged each time the cage is changed. The animals quickly learn that there is feed scattered in the bedding when they are placed in a clean cage and spend the first few hours searching for the food following each cage change. (One may need to use bedding other than corn cob for animals on studies which require strict dietary control.)

Variation in the content of the diet, such as providing whole fruits and vegetables, peanuts or other nuts in the shell, has been shown to increase feeding time, increase overall feed intake, and increase dietary diversity; some animals will eat food presented whole that they refuse when it is processed. Mixing the feed for chickens with a substrate such as aspen shavings or corn cob bedding allows them to display their natural hunt and peck feeding behavior.

### **Program Assessment and Monitoring**

The goal of any enrichment program is to enhance the overall well-being of the animals. To assess the success of the program, behavioral indicators of well-being for each species should be monitored. Displaying a balanced temperament, with no evidence of maladaptive behaviors or clinical signs of chronic distress is indicative of the animals' ability to cope with the stressors associated with their social and physical environment [3]. Exhibiting normal species-typical behaviors in association with the environmental enrichment strategies is also an indication of well-being. For example, pair or group housed animals that engage in mutual grooming are demonstrating ease with their social environment.

Data collected during observations can reveal the success of an enrichment strategy. Recommendations for alterations should be based on the individual animal's behaviors and time should be allowed for the animal to acclimate to novel items placed in the cage.



## Resources

Animal Care/USDA Enrichment Report  
[www.aphis.usda.gov/ac/publications.html](http://www.aphis.usda.gov/ac/publications.html)

Animal Welfare Information Center  
[www.nal.usda.gov/awic/pubs/enrich/intro.htm](http://www.nal.usda.gov/awic/pubs/enrich/intro.htm)  
[www.nal.usda.gov/awic/pubs/primates/primate.htm](http://www.nal.usda.gov/awic/pubs/primates/primate.htm)  
[www.nal.usda.gov/awic/pubs/oldbib/primenv.htm](http://www.nal.usda.gov/awic/pubs/oldbib/primenv.htm)

Animal Welfare Institute Enrichment Information  
[www.awionline.org/lab\\_animals/biblio/refine.htm](http://www.awionline.org/lab_animals/biblio/refine.htm)  
[www.awionline.org/lab\\_animals/biblio/index.html](http://www.awionline.org/lab_animals/biblio/index.html)

Institute for Laboratory Animal Research  
[dels.nas.edu/ilar/recentpubs.asp?id=recentpubs](http://dels.nas.edu/ilar/recentpubs.asp?id=recentpubs)

Lab Primate Newsletter  
[www.brown.edu/Research/Primate/](http://www.brown.edu/Research/Primate/)

National Institutes of Health, Non-human Primate Management Plan  
[oacu.od.nih.gov/regs/primate/primex.htm](http://oacu.od.nih.gov/regs/primate/primex.htm)

Office of Laboratory Animal Welfare  
[grants1.nih.gov/grants/olaw/olaw.htm](http://grants1.nih.gov/grants/olaw/olaw.htm)

Primate Information Center  
[primatelit.library.wisc.edu/](http://primatelit.library.wisc.edu/)

The Shape of Enrichment  
[www.enrichment.org/](http://www.enrichment.org/)

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