

Volume 9, OCTOBER 2011

THE **Enrichment** RECORD

Global Research Education and Training, LLC
Email: mackta@gr8tt.com • Website: <http://enrichmentrecord.com>

Reflecting On Enrichment

**What does it look like for
Rodents? Rabbits?
Pigs? Primates?**

It's More Than Just Vanity: Pigs May Use Mirror Enrichment as a Way of Coping
With Social Isolation • GERBIL AND HAMSTER ENRICHMENT • Environmental Enrichment
for Captive and Wild-born Macaques • Nesting and Thermoregulation • Meta-Analysis

Rodent Nesting Sheets™



[Click here for more information](#)

Build Your Nest For Less!

Certified (Contaminant Screened)

Pure: made of 100% virgin wood pulp

Lint free sheets minimize eye irritation

Safer alternative to cotton nesting material

Encourages natural nest building behavior

Will not clog automated disposal systems

Autoclave like any other paper or cotton products

Optional dispenser available



Rodent Nesting Sheets
Prod# K3510 - 5,600/Case



Nesting Sheet Dispenser
Prod# 9916

To discuss enrichment options contact our Enrichment Specialist:
Karena Thek – email: kthek@bio-serv.com Ph: 570-730-6055

Bio  **Serv**®

Delivering Solutions™

◆ Nutritional ◆ Enrichment ◆ Medicated ◆ Special Needs

800-996-9908 (U.S. & Canada)
908-996-2155 (Int'l)

Email: sales@bio-serv.com

ISO 9001:2008 Certified

www.bio-serv.com

EDITORIAL BOARD

Tim Allen, M.S.
Animal Welfare Information Center

Genevieve Andrews-Kelly, B.S., LATG
Huntingdon Life Sciences

Elizabeth Dodemaide, B.V.Sc., M.A., MACVSc
Associate Director, Laboratory Animal Services
Rutgers, The State University of New Jersey

Karen Froberg-Fejko, V.M.D., President, Bio-Serv

Joanne Gere, Founder, BioScience Collaborative

G. Scott Lett, Ph.D., CEO, The BioAnalytics Group LLC

Jayne Mackta
President & CEO, Global Research Education & Training LLC

Emily G. Patterson-Kane, Ph.D.
American Veterinary Medical Association (AVMA)
Animal Welfare Division

Kathleen L. Smiler, D.V.M., DACLAM
Consultant, Laboratory Animal Medicine

Rhoda Weiner, Weiner & Associates

Joanne Zurlo, Ph.D.
Director of Science Strategy
The Center for Alternatives to Animal Testing (CAAT)

Please direct all inquiries to
Rhoda Weiner, Editor: rmbw19@verizon.net

WE'D LOVE TO HEAR FROM YOU!

We welcome your comments, observations and contributions to *The Enrichment Record*. Contributors include lab animal veterinarians, principal investigators, animal care staff, animal behaviorists, animal technologists and members of the bioscience community who promote the 4 Rs: reduction, replacement, refinement and respect.

Share your story ideas with Rhoda Weiner, Editor at rmbw19@verizon.net

Guidelines for authors can be accessed at <http://enrichmentrecord.com/contribute/>

Please give credit where credit is due.

Outstanding animal care is truly a team effort, and we ask you to credit colleagues, published reports, articles, and other reference materials that have contributed to your enrichment article. Great ideas don't happen in a vacuum, and we encourage you to list all sources of inspiration.

The Enrichment Record is not a peer-reviewed journal. However, the Editorial Board of this E-Zine is composed of dedicated volunteers who have extensive experience and expertise in the care of laboratory animals. Members of the Board are involved with all aspects of this publication.

The Enrichment Record is published in October, January, April and July. If you are interested in advertising in *The Enrichment Record*, please visit: <http://enrichmentrecord.com/advertise/>

Publisher:
GR8 (Global Research Education & Training, LLC)
<http://enrichmentrecord.com>
Jayne Mackta, President & CEO

Cover photo courtesy of Baylor College of Medicine Center for Comparative Medicine



In Other Words	2
Enrichment Extravaganza	5
Gerbil and Hamster Enrichment	7
A New Swing on Swine Enrichment	9
It's More Than Just Vanity: Pigs May Use Mirror Enrichment as a Way of Coping with Social Isolation	10
Meta-Analysis	13
Environmental Enrichment for Captive and Wild-born Macaques	16
Nesting & Thermoregulation	19
Primate Enrichment and Positive Reinforcement Training in Toxicology: Challenges and Possibilities	21
Meeting Up!	23
Enrichment A Day Keeps the Veterinarian at Bay	24
Enriching Program	26
Resources	28
Enrichment Record Poster Repository	29
Research Abstract	30
Upcoming Meetings	30

Join the Discussion!

To facilitate informed discussion about environmental enrichment, we have joined the LinkedIn Group called **Laboratory Animal Sciences**. This group allows members of the laboratory animal science community and our readers to interact over a web-based platform to compare ideas and methods. To participate, you will need to create a LinkedIn account and then join the Laboratory Animal Sciences Group.

It's easy! It's free! It's a safe and secure place where you can say what's on your mind. [Click here to get started.](#)

Enrichment Resources

National Institutes of Health • Office of Extramural Research

Office of Laboratory Animal Welfare (OLAW) has an online resource for information on nonhuman primate enrichment and social housing. This resource is provided to assist institutions in enhancing the care and well-being of nonhuman primates. You can find new FAQs, a special online seminar, the OLAW report visits to Chimpanzee facilities, a bibliographic guide developed by USDA, NAL, AWIC and more.

Nonhuman Primate Enrichment and Social Housing Resources

http://grants.nih.gov/grants/olaw/primate_enrichment-social_housing.htm
Contact: hampton1@OD.NIH.gov

In Other Words



A QUARTERLY E-ZINE/FORUM FOR:

Discussing environmental enrichment in the optimal care of laboratory animals

Documenting best practices and approaches for addressing challenges of implementation & assessment at every level

Sharing data on the impact of environmental enrichment on the science

Building the case for integrating enrichment into research design

Greetings from Shanghai.

I am writing this message from China where I am working with 22 eager college students planning to pursue careers in laboratory animal science. Happily, we don't need translators to help us understand their love of animals and their desire to learn as much as they can about the role of animal welfare in advancing the science. Our professional trainers introduced the concept of environmental enrichment on the first day of class in the context of encouraging species-typical behaviors, tying efforts to decrease stress with increasing the integrity of the research data.

It may be the jetlag or the view from the other side of the world, but we don't quite "get" the message behind the words of "Environmental Enrichment of Laboratory Rodents: The Answer Depends on the Question" (Vol 61, No 4, 2011, Pages 314-321). The abstract for this article, which appeared in the August issue of *Comparative Medicine*, can be found on page 30. Perhaps the choice of the term "so-called" to qualify enrichment of the cage environment for rodents threw up an immediate reading roadblock.

We will leave it to our readers to comment on the article.

We encourage members of the research community to weigh in on the questions raised as well as the conclusions reached. Perhaps our website can serve as a home for a meaningful discussion among professionals that will advance our understanding of the considerations raised by the authors.

Jayne Mackta, Publisher
President & CEO, Global Research Education
& Training, LLC (GR8)

To facilitate informed discussion about environmental enrichment, we have joined the LinkedIn Group called **Laboratory Animal Sciences**.

This group allows members of the laboratory animal science community and our readers to interact over a web-based platform to compare ideas and methods. To participate, you will need to create a LinkedIn account and then join the Laboratory Animal Sciences Group.

It's easy! It's free! It's a safe and secure place where you can say what's on your mind.

[Click here to get started.](#)

Enrichment Question

Some colleagues and I are looking to start an enrichment committee here within our organization. I was curious if anyone has any experiences, good and bad, with starting up such a committee that they would be willing to share?

Any information would be helpful as we begin this process.



Thank you,

David Cawston, MHA
Veterinary Services Manager
Boston University
dwc01@bu.edu



SHARING CAN ADVANCE ANIMAL WELFARE

The *Enrichment Record* wants to create a searchable database containing policies, protocol questions and SOPs for environmental enrichment. Our success depends on your willingness to share this kind of information.

To learn more, contact
Jayne Mackta, Publisher:
mackta@gr8tt.com

The Enrichment Record is published quarterly. If you are interested in advertising in *The Enrichment Record*, please visit:

<http://enrichmentrecord.com/advertise/>

or contact Jayne Mackta, Publisher: mackta@gr8tt.com

Visit our website—browse past issues: <http://enrichmentrecord.com>

ADVERTISING RATES

Single Issue

1/4 page \$350
1/2 page \$500
Full page \$1,000

4 Issues

1/4 page \$1,120
1/2 page \$1,600
Full page \$3,200

ADVERTISING DEADLINES

January Issue—December 1
April Issue—March 1
July Issue—June 1
October Issue—September 1

The Enrichment Record
is an 8.5" x 11" format.

Full color; 300 dpi pdfs accepted.


Huntingdon
Life Sciences
Working for a better future



Your adaptable development partner...

With over 50 year's experience matched with extensive expertise and speciality services, we ensure we can offer you a professional, practical and flexible solution.

www.huntingdon.com



We know
STRESS is a constant pressure
REDUCING it is our priority

As a leader in animal welfare,

we know the role that stress plays on the health and welfare of animals and its potential impact on your study and start times. And we understand how delays create stress for you in these difficult times.

With Covance, you can have confidence in working with a trusted partner dedicated to reducing your stress and helping you successfully achieve your goals.

COVANCE

COVANCE RESEARCH PRODUCTS INC.

1.800.345.4114 • 1.717.336.4921

www.covance.com



New U.S. factory
+ same world class
quality
+ faster delivery time
- headaches
= Success through
integration.



Tecniplast proudly announces our commitment to helping our customers achieve greater success with our new U.S. factory featuring the same world class quality. Expect lightning fast lead, source and delivery time in North America; plus an efficient production chain that reduces costs to the environment. Basically, all the industry-leading plusses you've come to expect from us, minus all the minuses. **For more information regarding your formula for success, please call 1.877.669.2243 or visit tecniplastusa.com**



“I always love attending
the Extravaganza.
I come away with
something new
every year.”

—2011 Enrichment Extravaganza participant

After being showcased in June at the American Association for Laboratory Animal Science TriBranch Symposium, the **Enrichment Extravaganza** generated such excitement and enthusiasm that *The Enrichment Record* and Yerkes National Primate Research Center have partnered to bring the Extravaganza to Atlanta, GA. On April 24, 2012 the laboratory animal community will come together at Emory University to share ideas and strategies for improving animal welfare in the biomedical research environment. This full-day event will consist of a morning plenary session featuring nationally recognized speakers and topic-specific workshops in the afternoon.

A poster session will also be included at the event. The Enrichment Advisory committee invites the laboratory animal services community to submit abstracts that illustrate a novel enrichment method or solution. Submitting an abstract is an opportunity to share proven best practices and contribute expertise in a highly respected forum.

If you are interested in the latest advances and innovation in the field of environmental enrichment, this is a must attend event. For more information, contact Denise Bianco at bianco@njabr.org



Products that work

 **LabDiet**
Your work is worth it.®



to *enrich* their lives

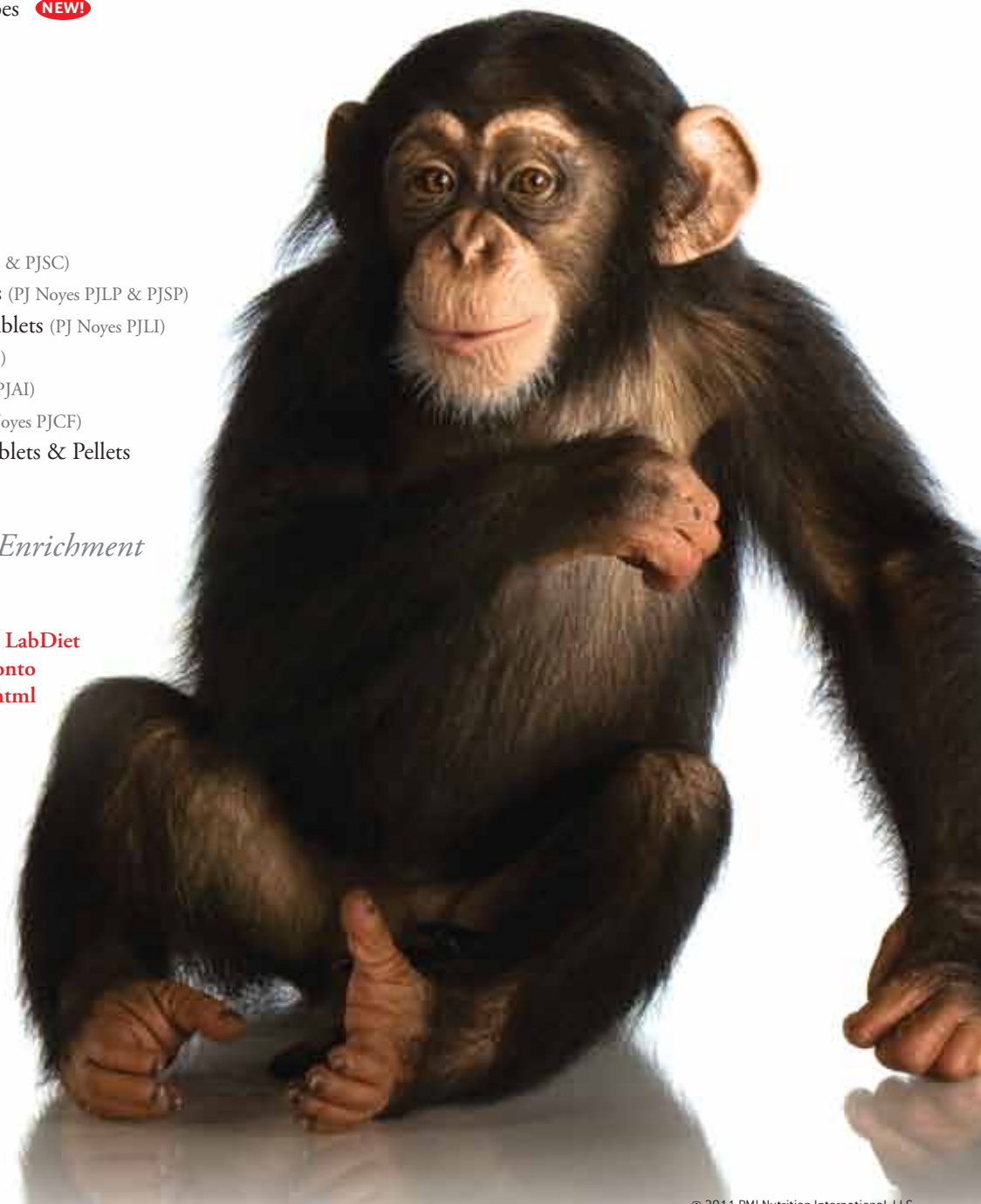
ENRICHMENT PRODUCTS

PicoLab® Certified Canine LabBits™ **NEW!**
PicoLab® Certified Timothy Hay Cubes **NEW!**
Monkey Jumble®
Monkey Morsels
Veggie Relish™
Foraging Bits
Primate Crunch®
PicoLab® Natural Sunflower
Monkey Delight® Tablets
Sucrose Reward Tablets (PJ Noyes PJFSC & PJSC)
Purified Non-Human Primate Tablets (PJ Noyes PJLP & PJSP)
Grain-Based Non-Human Primate Tablets (PJ Noyes PJLI)
Purified Rodent Tablets (PJ Noyes PJPPP)
Grain-Based Rodent Tablets (PJ Noyes PJAI)
Calorie-Free Enrichment Tablets (PJ Noyes PJCF)
LabDiet® OmniTreat® Enrichment Tablets & Pellets
...and many more

*Trust Your Lab Animals To Enrichment
Products From LabDiet.®*

To order, please contact your Certified LabDiet
Dealer. To find a dealer near you, log onto
<http://www.labdiet.com/distribution.html>

For more information or to
download product spec sheets,
please visit www.LabDiet.com
or email info@LabDiet.com



© 2011 PMI Nutrition International, LLC





GERBIL AND HAMSTER ENRICHMENT



In research, it's important to be ready for everything. When we discovered that gerbils and hamsters were arriving, we sprang into action. Because gerbils and hamsters are a USDA covered species, it is important that they receive enrichment that will promote species-typical behaviors. We employed the help of the veterinarians, articles and LAWTE listserv for information about enrichment for these species. We found articles focused on species-typical behavior that helped determine the most suitable enrichment for these animals.

Hamsters and gerbils are a prey species, so seeking refuge is one of the most prominent species-typical behaviors. Many devices can be used for refuge including: cardboard paper towel tubes, PVC pipe, Bioserv™ huts, or Shepherd Shacks™. Digging is a very prominent species-typical behavior for gerbils; providing extra bedding for gerbils satisfies that need. Hamsters and gerbils like to bury their food, so placing food in a crock or on the bedding would be worthwhile and easy. Gnawing is a species-typical behavior used to keep appropriate teeth length, so a suitable gnawing device should also be provided.

From our research, we have learned a lot about these species. So anytime you are in need of information about species-typical enrichment, employ the experts, network with various organizations, research articles online and through your local library. If there is little information about species enrichment, research species-typical behavior and provide the most appropriate enrichment based on species-typical behavior.

Quality Enrichment. *Quality Results.*

*You think
I would trust
just anyone?*



At **Animal Specialties and Provisions** our goal is to give you everything you need to keep your animals physically active and cognitively healthy. From the very best shelters, foraging devices, nesting materials, tunnels, swings, toys and food items to an imaginative and experienced staff – we will help you create the perfect enrichment environment for your animals. Put us to the test today.



We Satisfy Your Animals' Desires

215-804-0144 • Jacky@animalspecialties.biz

www.animalspecialties.biz

Kelsey Neeb, B.S, LAT, Environmental Enrichment Coordinator
Wake Forest School of Medicine, Winston Salem, NC

A NEW SWING ON SWINE ENRICHMENT

Environmental enrichment aims to encourage the expression of natural species-specific behaviors by offering both sensory and motor stimulation to the animals (*Guide 2011*). In the case of pigs, social housing is preferable; however, if the situation requires individual housing, the animals "should have sensory contacts such as visual, smelling or touching noses through the walls of the pen" (Miller 2011). Swine toys are meant to "satisfy their rooting, mouthing and chewing behaviors," and such enrichment devices serve to discourage the development of abnormal behaviors including "bar biting, vacuum chewing, dog sitting and tail and ear biting" (RSPCA 2011). According to Grandin and Johnson (2009), "pigs will avoid enrichment objects that are contaminated with manure."

Pigs at Wake Forest School of Medicine are housed socially if possible. When social housing is not possible due to incompatibility or study constraints, they are kept singly-housed in runs with enrichment devices. Typical presentation of enrichment devices includes a stainless steel chain attached to the cage door, as well as one device (either rubber or hard plastic) placed on the floor of the pen. Devices placed on the floor frequently pose issues with husbandry, and can become contaminated with feces within the first day of placement. This leads to an increase of staff time in changing out and cleaning the devices when soiled. It is also difficult to move around the pens without tripping on the toys when it comes time to clean. If the pigs interact with the devices, it is usually prior to the device becoming feces-coated. Interactions with the toys on the floor were not commonly observed.



Chelcie Ferguson hangs the new enrichment device in Wake Forest's housing room.

With the intent of increasing the frequency of interactions that the pigs have with their enrichment toys, the location of the devices was altered. Rather than having an enrichment device on the ground, the swine were given the opportunity to interact with a manipulable red rubber toy hung within the housing pen. The toy was suspended using a three foot stainless steel chain, a portion of which was contained within a one inch diameter, one foot long PVC pipe. Although the original function of the PVC pipe was to enhance the safety of the elongated chain, the animals were often observed chewing on the pipe, making it an additional enrichment element of the toy. Behaviors commonly seen after the toy was hung included: pulling the toy along the length of the cage, chewing both the rubber toy and the PVC pipe, swinging the device from side to side, and pushing the toy upward with the snout, as if trying to root in it. After three days, noises associated with device interactions were reported by the staff to have

decreased, suggesting diminished use of the toys over time; however, interactions with the devices while staff were in the room continued to occur. Staff members were easily able to change out the hanging toys and the toys are noticeably free of feces now that they have been lifted from the ground.

References:

1. Grandin, Temple and Johnson, Catherine. (2009) *Animals Make Us Human: Creating the Best Lives for Animals*; Boston, New York: Houghton, Mifflin, Harcourt.
2. Miller, Shoreh. (2011) "Swine Enrichment." *The Enrichment Record*; 6: 12-15.
3. National Research Council. (2011) *Guide for the Care and Use of Laboratory Animals*, Eighth Edition. Washington, DC: The National Academies Press.
4. Reinhardt, Viktor and Reinhardt, Annie. (2011) "Comfortable Quarters for Pigs in Research Institutions." Pgs.78-82. *Comfortable Quarters for Laboratory Animals*, Ninth Edition. Washington, DC: Animal Welfare Institute.
5. RSPCA, Research Animals Department. (2011) *Pigs: Good practice for housing and care*, West Sussex: RSPCA.



IT'S MORE THAN JUST VANITY:

Pigs May Use Mirror Enrichment
as a Way of Coping With Social Isolation

Pigs are gaining popularity for use as models in many areas of biomedical research, such as toxicity, wound healing, dental, peptic ulcer, metabolic syndromes, instrumentation/implantation surgical procedures, and organ harvesting studies. This increase in use is largely driven by societal pressure to reduce the number of primates and companion animals, such as dogs, used in such research. In addition, swine have many similar physiological and anatomical features to humans such as their skin, as well as digestive and cardiovascular systems¹.

It is not uncommon for research pigs to be housed individually due to experimental constraints, although it should be avoided if possible. In laboratory settings, a pig isolated from other pigs is often housed in a sterile yet barren enclosure. Naturally gregarious, isolated pigs may show behavioral and physiological signs of stress such as increased

cortisol production², decreased body temperature³, decreased Tumor Necrosis Factor-alpha (TNF-)⁴ and increased frequencies of behaviors associated with anxiety and stress^{5,6}.

A common buffer for many stressors caused by confinement is the implementation of environmental enrichment. Preference tests have been used historically to analyze an animal's partiality for enrichment objects. Our experiment included a preference test that allowed young isolated pigs access to three practical enrichments: a mat, a mirror, and a companion pig in a pen across an alleyway. A mat was chosen since it was known to reduce discomfort in gestating and lactating sows. A visible live companion was chosen because of the pig's highly sociable nature. The mirror was selected as a possible replacement for a companion in situations when complete isolation was necessary. However, with only one previous published study on swine use of mirrors, the pigs' behavioral outcome was difficult to hypothesize⁷.

Our experiment used fourteen farm-type, weaner pigs (Yorkshire × Landrace) housed individually with free access between 4 adjacent pens, 3 of them containing one enrichment and one control pen with no enrichment. Each tested animal was only able to access each enrichment item while in that enrichment's pen. Pigs were video recorded 14 h/day for 7 days and these were analyzed by scan sampling every 10 minutes to determine location, posture and behavior. Differences in the enrichment preference of the pigs were tested using a GLM model in JMP. Our results showed that pigs spent more time in the pen across from the companion than in the control pen, with time spent in the mat pen and mirror pen intermediate. Feeling that this first analysis did not fully grasp all that was occurring with the pigs' preferences, a second analysis was performed on the data to investigate preferences in the presence or absence of a human in the room. The pens were then combined into 2 categories: social pens (companion and mirror) and nonsocial pens (mat and control). The probability of a pig choosing a social pen when a human was present was significantly higher than when absent. Within the social enrichments, the probability of the animal choosing either mirror or companion was equal.

continued on page 12

Our results showed that the pigs' preference was largely dependent upon their environments. Pigs showed an overall propensity to spend their time with the companion enrichment, but when a human was present, the mirror and the companion enrichment were equally preferred. Preference tests are often criticized for their results being highly specific to the particular conditions in which the test is carried out^{8, 9}. Due to the strikingly different enrichment uses when a human is present, our results confirm that preference studies are indeed sensitive to experimental conditions and using time as a cost associated with preference choice may not be a reliable indicator of importance.



One can only wonder what image the pig is seeing and how the visual image is interpreted. However, it is generally accepted that pigs have relatively poor eyesight with severe near-sightedness, utilizing olfactory cues as their primary sense. The way the pig processes its surroundings through these senses is most certainly the key to understanding our observations. One explanation of our results is that although both the companion and mirror enrichments offer something important to the pig, they also have drawbacks. The companion provides both vocal and olfactory feedback to the tested pig, but due to the separating alleyway, the clear visual and tactile components of social support are inaccessible. The mirror enables the pig to receive tactile stimulation by lying parallel to it, as well as clear visual feedback due to its close proximity within the pen, but no olfactory or auditory feedback.

Overall, the pig appears to value the companionship received in the companion pen due to an innate need for communal living, plausibly because neither the mat nor the mirror provides olfactory or vocal feedback to the tested animal. However, unexpectedly, the mirror is also significantly important to the pig during times of perceived stress. Mirror usage has been tested

in a number of different species including rodents, chimpanzees, elephants, rabbits, horses, sheep, poultry and cattle. Many species have shown a preference to be with a mirror when given a choice. Also, many of these species seem to benefit from the supplementation of a mirror to their surroundings. For instance, the addition of a mirror in poultry chicks resulted in an increase in exploratory pecking and decrease in vocalization¹⁰. Isolated heifers exposed to a front-viewed mirror had decreased locomotion as well as reduced heart rate¹¹. Mirrors placed in stables have shown to decrease stereotypic weaving in horses¹².

Unfortunately, the benefit of mirror usage in laboratory animals has been limited to a handful of experiments, and is only commonly implemented as an enrichment addition with non-human primates. In addition, it is not known how many other experiments testing the mirror (or other preference choices for that matter) have mistakenly concluded a possibly benefiting enrichment to be "unpreferred" or "unimportant." Therefore, mirror supplementation for naturally gregarious animals housed in isolation should be further investigated.

ENDNOTES:

1. Bollen, P, Hansen A., Rasmussen H., *The Laboratory Swine*, CRC Press LLC, 2002.
2. Stolba, A., Wood-Gush, D.G.M., 1989. The behavior of pigs in a semi-natural environment. *Anim. Prod.* 48, 419-425.
3. Ruis, M. A.W., te Brake, J.H.A., Engel B., Buist, W. G, Blokhuis, H.J., Koolhaas, J. M., 2001. Adaptation to social isolation: Acute and long-term stress responses of growing gilts with different coping characteristics. *Physiology & Behavior* 73, 541- 551.
4. Tuchscherer, Margret, Ellen Kanitz, Birger Puppea, Tuchscherer A., Stabenow B., 2004. Effects of postnatal social isolation on hormonal and immune responses of pigs to an acute endotoxin challenge. *Physiology & Behavior* 82, 503-511.
5. Herskin, M.S., Jensen K. H., 1991. Effects of different degrees of social isolation on the behavior of weaned piglets kept for experimental purposes. *Animal Welfare* 2000 9, 237-249.
6. Tuchscherer, M., Kanitz, E., Puppe B., Tuchscherer A., 2006. Early social isolation alters behavioral and physiological responses to an endotoxin challenge in piglets. *Hormones and Behavior* 50, 753-761.
7. Broom D. M., Sena, H., Moynihan K. L., 2009. Pigs learn what a mirror image represents and use it to obtain information. *Animal Behaviour* 78, 1037-1041.
8. Kirkden R. D., Pajor E. A., 2006. Using preference, motivation and aversion tests to ask scientific questions about animals' feelings. *Applied Animal Behaviour Science* 100, 29-47.
9. Duncan, I.J.H., 1978. The interpretation of preference tests in animal behavior. *Applied Animal Behaviour* 4, 197-209.
10. Montevechi, W.A., Noel, P.E., 1978. Temporal Effects of Mirror-Image Stimulation on Pecking and Peeping in Isolate, Pair- and Group-Reared Domestic Chicks. *Behavioral Biology* 23, 531-535.
11. Piller, C.A.K., Stookey, J.M., Watts, J.M., 1999. Effects of mirror-image exposure on heart rate and movement of isolated heifers. *Applied Animal Behaviour Science* 63, 93-102.
12. Mills, D. S. Davenport, K., 2002. The effect of a neighbouring conspecific versus the use of a mirror for the control of stereotypic weaving behaviour in the stabled horse. *Animal Science* 2002 74, 95-101.

Meta-Analysis: Better Methods for the Reduction Part of the Three Rs

In past articles, I've highlighted research efforts that study the impact of environmental enrichment (EE) on research outcomes. There is mounting evidence that improved environmental conditions result in more relevant research results. But what challenges face researchers who want to make a change for the better?

Published literature, when available, isn't always clear and consistent about what constitutes best practice for a particular animal species, nor is it clear what the impact is in terms of research endpoints. Not all researchers can afford to take time out from their regular research to undertake a study using rigorous experimental design to answer these questions. How do we make the transition to EE and make sense from the growing mountain of literature? In this article, I write about meta-analysis, an approach to analyzing published experimental results from multiple prior studies.

The Opportunity and the Challenge

Environmental Enrichment Fights Cancer and Improves Research Results—What Now for the Biomedical Researcher?

In the October 2010 issue of *The Enrichment Record*, Emily Patterson-Kane and I reported on the research of Cao *et al*, published in the July 9 issue of *Cell*. The researchers spent 5 years, used 1500 mice and painstakingly demonstrated significant effects of environmental enrichment (EE) on cancer outcomes. Based upon Cao *et al* and other studies, the evidence now suggests that EE is not just a more humane option for research animals, but is necessary to develop better animal models of human diseases. However, we also pointed out some major challenges in making

the transition to EE. For the researcher, it is important to understand how the change to EE will affect her results. It is also important to know "best practice" for the care of research animals, and that the standards have not been set for every species.

Not many researchers can afford to undertake a 5-year 1500-mouse study to determine best practices and measure the effects. In another study, Hanno Würbel (2007) used 432 mice and experiments run in replicate in multiple laboratories to support the conclusion that EE does not disrupt standardization of experiments. Undertaking such studies in every laboratory will produce valuable data, but seems to sacrifice one of the three Rs of animal testing (Reduction) in favor of another (Refinement). Small

studies can help make the transition more affordable, but may miss significant effects, due to small sample size. Published studies may give inconclusive or conflicting results, causing us to wonder which results to believe.

Sample Size and Statistical Power

Before we discuss meta-analysis, let's look at the relationship between sample size and the reliability of research results. It is well understood that there is a great deal of variability in biomedical research. There are both biological sources of variability and technical sources. It is no surprise that similar mice don't all respond identically to the same treatment. A researcher cannot measure the response of

continued on page 14

all mice, so we use data from a small group of mice (the sample) to predict the behavior of all similar mice (the population). For example, a researcher may want to measure the startle response time of a group of mice. The distribution of startle response times of normal mice might look something like the traditional “bell curve” as seen in figure 1.

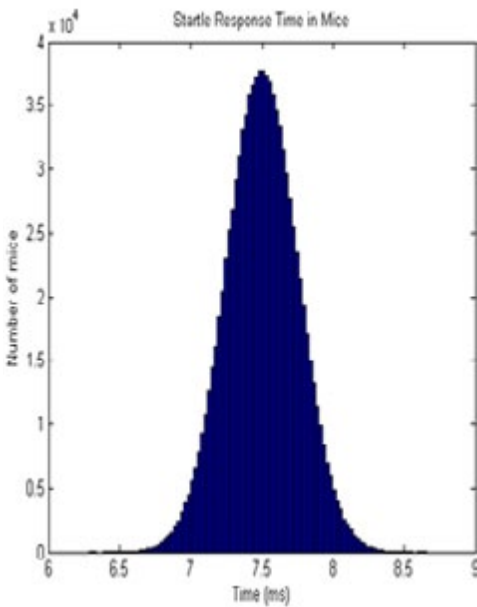


Figure 1: Hypothetical Distribution of Response Times in Mice. Most are near 7.5 milliseconds.

In this hypothetical sample, the average response time is 7.5 milliseconds. We can see that some mice have response times as high as 8.5 ms and more, but most tend to cluster around 7.5 ms. A researcher would like to take a small sample of mice and measure their response times in order to predict the response times of all similar mice. How many mice are required to get a good estimate of the responses? Suppose three researchers each measure the response times of 3 mice each.

Here’s what their results might look like:

	Steve	Amy	Ted
Mouse 1	7.8	7.5	7.7
Mouse 2	7.6	7.7	7.3
Mouse 3	7.5	7.2	7.4
Average	7.6	7.5	7.5

Figure 2: Hypothetical Response Time Measurements: Researchers get different results from similar mice.

We see that Amy and Ted measured average response times of about 7.5 ms, both at the “true” mean of 7.5 ms. Not bad! Steve, on the other hand, measured an average response of about 7.6 ms. Does this mean he made a mistake in measurements? No, it is just the natural biological variability of this type of mouse. The expected variation for a sample size of 3 of these mice is 0.14 ms, so all three researchers were well within the expected error range.

The expected error goes down as the sample size goes up. If Steve had used 9 mice instead of 3, his expected error would go from 0.14 down to 0.08, and if he used 100 mice, his expected error goes down to 0.02 ms.

How many mice does Steve need? This is an important question of study design. Suppose we have two groups of mice; one group with standard cages and environment and the other group housed in EE conditions. The two populations might have slight but important differences in startle response times, but the difference is difficult to see in small studies because their “bell curves” overlap, as seen in figure 3, which illustrates a hypothetical example.

The average response for the EE group is 7.7 milliseconds, compared to 7.5 milliseconds for the standard group, but if Steve uses only 3 mice in each group, there’s a 75 percent chance he won’t detect a significant difference. In fact, there is a 17 percent chance the EE group will appear to have a SHORTER response time than the standard mice! If Steve wants an 80 percent chance of detecting a significant difference, he must use at least 20 mice in each group. The probability of correctly detecting a true effect is called the **statistical power** of the study. Good study design attempts to balance the power of the study with the desire to conserve precious resources, like animals, money and time.

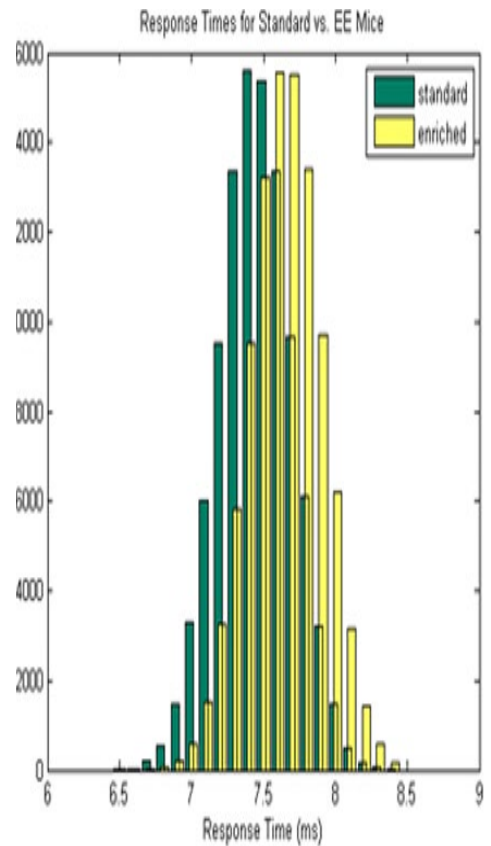


Figure 3: Hypothetical Responses for Standard and EE Mice. Overlapping distributions make it more difficult to detect a difference.

Meta-analysis

In statistics, a **meta-analysis** combines the results of several published studies into a larger "meta-study." In the simplest form, a meta-analysis identifies a common measure of effect size across all the studies, in order to get better estimates of the true effect size than those derived in a single study under a given single set of assumptions and conditions. Another aim is to identify small but important differences in effect sizes that might be missed in a single study. Finally, meta-analysis can help to identify hidden biases in published studies. The idea is really quite simple: by combining the results of published studies, we might get a better picture of best practices and effects of EE than could be seen in any particular published paper.

Karl Pearson is credited with the first published meta-analysis in 1904, studying the effects of inoculation against enteric fever. Combining studies with small sample sizes, he attempted to overcome the problem of reduced statistical power caused by the small samples. Gene V. Glass is credited with first using the term "meta-analysis" and is widely recognized as the modern founder of the method.

Meta-analysis has been successfully used to study environmental enrichment. For example, Averos et al (*Applied Animal Behaviour Science*, 2010) studied the effects of enrichment on the performance of pigs, and Janssen et al (*An enriched environment improves sensorimotor function post-ischemic stroke*, *Neurorehabil*

Neural Repair, 2010) were able to sort through conflicting reports and show efficacy of EE using meta-analysis.

The File Drawer Problem—Biased Published Results

One potential weakness of meta-analysis is the dependence on published studies, which may create exaggerated outcomes. It is very hard to publish studies that show no significant results. For any given research area, one cannot know how many studies have been conducted but never reported and the results filed away. Remember Steve's study design with 20 sample mice in each group? 20 percent of the time he won't detect a difference between standard and EE mice, and he may not be able to publish the results. If all the results were published, we expect to see a bell curve distribution of differences between EE and standard mice. However, if the insignificant results are never published, we see a distribution that looks more like figure 4.

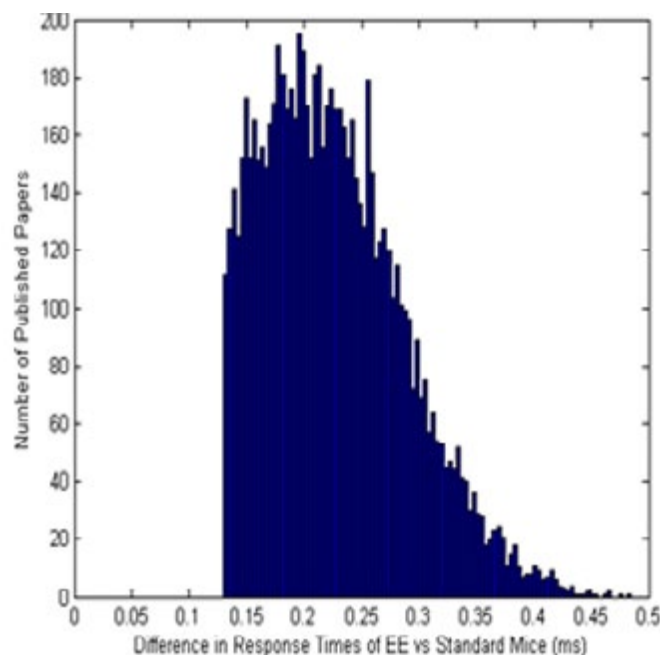


Figure 4: Hypothetical Distribution of Results, showing only the "significant results." 20 percent of the results are too insignificant to be published and remain in the researchers' file drawers.

This file drawer problem results in the distributions that are biased, skewed or completely cut off, and the significance of the published studies can be over estimated. Savvy meta-analysts use techniques to detect these biases and correct for them, but it would be much better to retain these results.

Conclusions

Good study design can optimize precious resources, including animals, money and time. Since researchers cannot afford to size their samples to produce results 100% of the time, meta-analysis can help sort through existing data and develop best practices for EE. Meta-analysis can be an effective tool for moving to better animal care while practicing the "Reduce" of the 3 Rs. The "file drawer problem" can limit our ability to re-use data in meta-analysis. We call for public repositories, where the unpublished and published data can be made available to the research community, providing better information for future meta-analysis.

¹ Dept of Biomedical Services, University of Oxford, Oxford, UK and School of Veterinary Medicine and Science, University of Nottingham, UK.

² Bioculture (Mauritius) Ltd, Riviere des Anguilles, Mauritius.

Environmental Enrichment for Captive and Wild-born Macaques



Abstract

Although the use of wild-born primates in research is banned in some countries, in others it is commonplace. It has been demonstrated that not only do wild-born primates react more strongly to some stressors than those that are captive-born, but they also use inanimate enrichment less. Given our understanding of the consequences of elevated stress for animal welfare, as well as the quality of science, more consideration should be given to the enrichment, and even the use, of wild-born macaques in biomedical research.

Introduction

It is well-established that environmental enrichment programmes should be well structured, goal defined and targeted at the specific characteristics of the animals for whom improvement in captive conditions, and hence welfare, are desired (Bloomsmit et al. 1991; Young 2003; Honest & Marin 2006b). Important characteristics include the species identity, the age-sex class, and aspects of individual temperament. A characteristic that is not often considered as part of this is the origin or birth context of the animals; specifically whether they were wild- or captive-born.

In Europe, under existing or incoming regulation (e.g. Home Office 1986; EU 2010), the use of wild-born, and even first generation captive-bred, primates is prohibited (except where there is specific justification). Ostensibly, these measures are to protect wild populations through the creation of self-sustaining breeding colonies, and counter the disproportionate stress that captive conditions may impose on naïve animals. However, there are regulatory environments (including the USA) where the housing and scientific use of wild-born animals is permitted. It is therefore important for responsible managers to consider this characteristic as one which may



require specific enrichment provision; either in the quantity or quality of the enrichment, or both.

Birth origin and stress

The first question to ask is:

Do wild-born primates react differently to captive environments and routines than captive-born animals? There is evidence from the literature that indeed they do, but not always in the predicted way (Honeess & Marin 2006a).

For example, a study by Carolyn Crockett and colleagues (2000) found that wild-born female pigtailed macaques (*Macaca nemestrina*) exhibited more appetite suppression after being moved between rooms

than captive-born equivalents.

The authors interpret this type of appetite suppression, particularly where it is associated with raised cortisol, to indicate stress. Perhaps more dramatically, other studies have shown that wild-born pigtailed also suffer higher mortality associated with translocation (Ha et al. 2000). On the other hand, in rhesus macaques (*M. mulatta*), wild-born animals have been shown to exhibit less stress-indicative behaviour (self-directed aggression, stereotypes) than captive-born individuals when housed in historically small cages (0.288m³) (Paulk et al. 1977). Of course, lower levels of abnormal behaviour do not in themselves

indicate the absence or magnitude of a stress response.

Birth origin and enrichment

So, given that there is evidence that wild-born macaques can react more strongly to some captive management routines, ***the next question is: Do they react differently to environmental enrichment provided to reduce their stress response?***

It has been reported that among older rhesus macaques, those that were wild-born made less use than captive-born of enrichment (wooden sticks, Kong toys, plastic balls) made available to both (Line et al. 1991). Also, in a study comparing enrichment use (Kong toys) between single-housed pigtail and long-tailed, or cynomolgus (*M. fascicularis*) macaques, the fact that the pigtailed used the toys more was, at least in part, accounted for by more of them being captive-born, and therefore more familiar with such toys (Crockett et al. 1989).

Birth origin and housing context

Therefore while there is some evidence both of a heightened stress response and lower use of enrichment in wild-born macaques, it is relatively limited. Nevertheless, what evidence there is might be in line with hypotheses that suggest that animals of such origins might experience significant challenges in adapting to captivity. Having said this, it is likely that the

continued on page 18

context in which the animal is housed may well be critical in determining the extent of these challenges and their manifestation in the magnitude of the stress response.

Most of the studies cited above involve study subjects that were housed in a socially- and spatially-restricted laboratory environment. Responses may be very different in a breeding facility where animals are housed in species-appropriate, socially-complex groups in expansive caging under ambient tropical conditions. These are the conditions at Bioculture in Mauritius where long-tailed macaques are bred. There is a mixture of wild- and captive-bred animals in this now closed (since 2009) colony and anecdotally there is no meaningful difference in the use of environmental enrichment between them. The extensive range of enrichment (perches, swinging devices, manipulanda and visual barriers, positive reinforcement training and familiarisation to humans) may well mean that there is something provided that appeals to all animals, irrespective of their origin. In the breeding groups with up to forty adults, there is significant social complexity. The housing of primates with compatible conspecifics is perhaps the single most important contribution to their welfare and its beneficial effect is likely to swamp that from inanimate enrichment (Schapiro et al. 1996).

Conclusion

The need for high welfare standards and reduced stress in laboratory animals is well-rehearsed and includes meeting public expectations, addressing the harm:benefit balance and securing the quality of the research

model. Where animals have a sustained or significant stress response to captive conditions or research procedures, it not only constitutes a risk to their health but is a source of unwanted variation and confounding variables in research programmes (Poole 1997; Garner 2005), except where these are examining stress itself. Evidence suggests that not only are wild-born macaques likely to react more strongly to stressors but also that they may be more resistant to attempts to ameliorate that response with environmental enrichment, particularly inanimate options. Therefore, for model quality and study design reasons, as well as animal welfare, it makes sense for researchers and procurement staff to obtain captive-born animals for their studies. Such preference will encourage breeding facilities to become self-sustaining with benefits derived from reducing the pressure on threatened native (non-introduced) populations. One of the macaque species most commonly used in research is the long-tailed macaque. This species, that was previously abundant across its natural range in SE Asia, is now reported to be threatened due, in no small part, to uncontrolled removal of animals from the wild for biomedical research (Eudey 2008). Therefore confining primate use to those individuals that are captive-born may have appreciable benefits for animal welfare, the quality of science, and conservation.

References

Bloomsmith, M., Brent, L. and Schapiro, S. J. (1991). Guidelines for developing and managing an environmental enrichment program for nonhuman primates. *Laboratory Animal Science* 41(4): 372-377.

Crockett, C. M., Bielitzki, J., Carey, A. and Velez, A. (1989). Kong toys as enrichment devices for singly-caged macaques. *Laboratory Primate Newsletter* 28(2): 21-22.

Crockett, C. M., Shimoji, M. and Bowden, D. M. (2000). Behavior, appetite, and urinary cortisol responses by adult female pigtailed macaques to cage size, cage level, room change, and ketamine sedation. *American Journal of Primatology* 52(2): 63-80.

EU (2010). Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes. *Official Journal of the European Union* L276: 33-79.

Eudey, A. A. (2008). The crab-eating macaque (*Macaca fascicularis*): Widespread and rapidly declining. *Primate Conservation* 23: 129-132.

Garner, J. P. (2005). Stereotypies and other abnormal repetitive behaviors: Potential impact on validity, reliability, and replicability of scientific outcomes. *ILAR Journal* 46(2): 106-117.

Ha, J. C., Robinette, R. L. and Davis, A. (2000). Survival and reproduction in the first two years following a large-scale primate colony move and social reorganization. *American Journal of Primatology* 50(2): 131-138.

Home Office (1986). The Animal (Scientific Procedures) Act. UK.

Honess, P. E. and Marin, C. M. (2006a). Behavioural and physiological aspects of stress and aggression in nonhuman primates. *Neuroscience and Biobehavioral Reviews* 30(3): 390-412.

Honess, P. E. and Marin, C. M. (2006b). Enrichment and aggression in primates. *Neuroscience and Biobehavioral Reviews* 30(3): 413-436.

Line, S. W., Morgan, K. N. and Markowitz, H. (1991). Simple toys do not alter the behaviour of aged rhesus monkeys. *Zoo Biology* 10: 473-484.

Paulk, H. H., Dienske, H. and Ribbens, L. G. (1977). Abnormal behaviour in relation to cage size in rhesus monkeys. *Journal of Abnormal Psychology* 86: 87-92.

Poole, T. B. (1997). Happy animals make good science. *Laboratory Animals* 31: 116-124.

Schapiro, S. J., Bloomsmith, M. A., Suarez, S. A. and Porter, L. M. (1996). Effects of social and inanimate enrichment on the behavior of yearling rhesus monkeys. *American Journal of Primatology* 40: 247-260.

Young, R. J. (2003). *Environmental Enrichment For Captive Animals* Oxford, UK, Blackwell Science Ltd.

Nesting & Thermoregulation

What is thermoregulation?

Webster says that thermoregulation is the ability of an organism to keep its body temperature within certain boundaries, even when the surrounding temperature is very different. So, basically, thermoregulation is putting a jacket on when you are cold and taking it off when you are warm.

This is great for humans, but it doesn't work very well for rodents in the lab. Currently, most facilities keep their rooms at the 20-24C temperature where humans are comfortable, yet studies have shown that mice are comfortable at 26-34C. Mice become stressed at temperatures of 18-26C and at temperatures of less than 18C their growth rate is compromised (Moberg 2000).

Nesting material allows mice to regulate their body temperature.

Thermoregulation is very important for rodents.

The Guide says at lower temperatures, building nests and huddling for resting and sleeping helps with thermoregulation. Mice prefer a warmer ambient temperature during the light phase; the light phase is when mice tend to sleep the most. Laboratory rooms are temperature controlled for human comfort which is cooler than what mice prefer.

To compensate, mice may congregate to help regulate their body temperatures during a period of inactivity when their body heat lowers or because housing conditions are too cold. (Gordon, 2004) Burrowing and nesting behaviors help the mice maintain their body temperature. With a macro-environment at 20c rodents expend energy and thus consume more food just to maintain their body temperature. Mice eat less when they are warm.

They will use up to 2/3 less feed per day. As a general rule, when animals are warm they eat less. We all know about the extra 10 pounds humans can put on in the winter when it is cold. Likewise, mice need to eat more to maintain their temperature when they are cold. Providing nesting materials is advantageous as it decreases food



intake with no effect on growth (Lacy et al. 1978, Stephenson & Malik 1984). Lactating mothers and pups present other behavior attributed to thermoregulation. Pups huddle in the nest to keep warm while lactating mothers will leave the nest after feeding the pups as they tend to get hot.

Nesting materials help rodents with their thermoregulation in the unnatural and cold laboratory cage environment. In the wild, mice build complex burrows and nests for predator avoidance and thermoregulation. In the lab, they are often given materials for enrichment that do not allow for nest building. It is very important to make an unnatural environment more natural with biologically relevant nest building materials. Mice can't build nests with enrichments that they don't identify as suitable nest building materials (Garner et al 2008).

Studies have shown that providing nest building materials and promoting nesting behaviors in rodents reduces stress, and in some strains, cannibalization. Being given relevant nesting materials that stimulate their nesting behaviors of gathering, burrowing, sorting and fluffing decreases some abnormal behaviors.

continued on page 20



DAY 1



DAY 3



DAY 6

Less stress = better research

Mice naturally build nests to provide shelter from the elements and predators, but also as a way to compensate for changes in external temperatures. Therefore, nests provide external insulation and create a less thermally stressful habitat (Garner et al 2008).

Mice will alter the quality of their nests in response to ambient temperature. They cannot build a nest if given inappropriate materials. They will build a complex, multilayered nest if given the right materials which stimulate their natural instincts. When mice can control their environment, they will be less stressed. Being cold and not being able to get warm increases stress. Macro environments do not allow the mice control over the temperature of their cages. IVC racks can put what feels to mice like a gale force wind through their cage. This will add stress behaviors without appropriate nesting materials being given to them. It's important to make an unnatural environment more natural.

There are products on the market today that promote nesting behaviors. Enrich-o'cobs™ is one of the products that encourage the natural instincts of mice to build nests and provide operational efficiencies in the lab. Enrich-o'cobs is a cob bedding and twisted paper nesting material combined in one bag. Enrich-o'cobs provides the base behaviors of gathering and sorting as an intermittent step in nesting behavior.

Enrich-o'cobs aids in the construction of a quality nest by providing appropriate nesting material. Mice are highly motivated to build nests. Recent studies have indicated that having a variety of nesting materials is important in nest building and thermoregulation. Offering more than one nesting material allows the animals to mimic more of the complex, multilayered nests that their wild counterparts build naturally.

Offering more than one nesting material gives a choice to animals which empowers them and allows them some control over their environment. Enrich-o'cobs is designed to guarantee every cage has nest building material and enrichment along with providing the "right" amount of nesting material to bedding ratio. This allows each component of Enrich-o'cobs to perform the necessary functions. The nests mice build using Enrich-o'cobs with other commercially available nesting materials helps the animals regulate their temperature and stimulate their species specific behaviors along with allowing them to control their environment.

We are all aware that mice in the labs are in an unnatural environment in which they have no control of temperature, enrichment products, roommates, and other factors. Nesting material not only helps them regulate their body temperature, but allows them some control over their environment. It has been suggested that letting mice regulate their own temperatures by building nests might be more effective than trying to alter room temperatures in the lab. The bottom line may actually be that animals from enriched environments may be more physiologically and psychologically stable and better representatives of the species and thus ensure better data collection and scientific results (Benn 1995, Scharmann 1991, Markowitz & Gavazzi, 1995).

Bibliography

- Home Improvement: C57BL/6J Mice Given More Naturalistic Nesting Materials Build Better Nests, Joseph P. Garner et al
- *The Guide For the Care and Use of Laboratory Animals*, 8th Edition
- *Science Daily*, Stress Relief: Lab Mice That Exercise Control May Be More Normal, Joseph Garner et al
- Preferences for nesting material as environmental enrichment for laboratory mice, V. Baumans et al
- www.mousebehavior.org
- Effect of Cage Bedding on Temperature Regulation and metabolism of Group-housed Female Mice, Christopher J. Gordon
- Some like it hot: Mouse temperature preference in laboratory housing, Brianna N. Gakill, Stephanie A. Rohr, Edmond A. Pajor, Jeffrey R. Lucas, Joseph P. Garner
- Effects of cold on nest-building by wild and domestic mice, *Mus musculus* L., J.L. Wolfe, S.A. Barnett
- Observations on the prevalence of nest-building in non-breeding TO strain mice and their use of two nesting materials, C.M. Sherwin



Primate Enrichment
and Positive Reinforcement
Training in Toxicology:
**Challenges
and
Possibilities**

Implementing and maintaining an enrichment program in a toxicology facility has many challenges. GLPs can impose certain requirements, as can the time constraints of a fast paced, contract research organization. However, despite the challenges and confounding factors, it is possible to create an effective Positive Reinforcement Training (PRT) program and maintain a dynamic enrichment program which optimizes animal care and welfare.

Social Housing

It has often been said that the best enrichment for a monkey is another monkey. Providing a compatible social partner is generally regarded as one of the most effective forms of enrichment for nonhuman primates, and there are no substitutes for the social interaction that social housing can provide.

At Huntingdon Life Sciences, we are committed to providing social housing for our monkeys. This is a lifelong commitment, as we ensure that our animals are socially housed from source to study termination. We partner with vendors that support our

ideology and specifically use vendors that socially house monkeys from breeding colonies and into CDC quarantine.

Once in the facility, social housing is the default. Any exemption from social housing requires scientific justification and IACUC approval. When single housing is required, consideration is given to provide grooming

bars, if possible, and visual interaction with conspecifics.

To further enhance group housing capabilities, HLS has invested heavily in the provision of "EU Caging", which is compliant with current EU standards. These cages are permanently built into the room, and can be configured to allow for gang housing. By using a variety of small food rewards, the monkeys are trained using PRT to be more amenable to study-related procedures. The use of wood shavings for bedding in the EU style caging provides an opportunity for deep foraging.

Innovative cage modifications have also allowed for other means of socialization. Telemetry caging has been retrofitted with a tunnel, which allows for easy pairing of monkeys when



continued on page 22

not collecting data. Tunnels have been built into two over two racks which allow for triple housing.

Positive Reinforcement Training

Essential to any enrichment program, PRT can be helpful for both the animals and the technicians. The benefits of PRT often have a ripple effect which can positively impact a study. Cooperative animals are often less stressed, leading to a reduction in experimental variables.

We take advantage of the quarantine period to establish desired trained behaviors. Our monkeys spend five weeks in quarantine after arrival; we use that time to train and desensitize them for study procedures.

Verbal cues are used to train animals. Examples of some trained behaviors include: "shift"- animals are trained to shift from one side of the cage to the other, "arm"- animals are trained to present arms for study procedures and "hold"—animals are trained to hold still. All of these behaviors are basic components of study procedures. Monkeys are reinforced with the phrase "Good Boy", or "Good Girl" and a small food reward.

Other Enrichment

In addition to the social housing and PRT, our program includes nutritional enrichment, manipulanda, sensory enrichment, structural enrichment and occupational enrichment.

Food treats are offered during the morning and afternoon viability checks. Small food rewards are used for PRT and desensitization. Approved treats include various fruits, vegetables and nuts.

Manipulable objects such as kongs, balls, chew bones, wood, etc. are required to be in each cage. These items are changed at cage change intervals. Our cages also are equipped with hanging toys on the outside of the cage to add to the novelty.



Novel scents, music and television are used as sensory enrichment. Spices and empty shampoo bottles provide olfactory enrichment. Music is played at appropriate intervals and is limited to approved musical selections. Animal rooms are equipped with wall-mounted flat screen televisions. These televisions are controlled from a centralized location, which makes the process easy and efficient.

All cages are equipped with perches and have been modified to include a tunnel, which allows monkeys to move from bottom to top cages. The veterinary staff is responsible for maintaining our "play cages," which are vertical cages equipped with swings, perches and, occasionally, a pool. The play cages are rotated through the colony.

Occupational enrichment, such as foraging devices and puzzle feeders, is provided to all monkeys at regular intervals by the Veterinary Staff. These items are rotated to ensure novelty.

Enrichment is a Team Effort

In addition to the primate training, the staff also undergoes training. The Training and Compliance Group, which includes a Primate Behaviorist, is primarily responsible for training new staff on enrichment. The Behaviorist is also responsible for training new hires on the behavior of primates, and is a valuable resource in our social housing and enrichment program. While the veterinary staff has

primary oversight for the enrichment and training program, the responsibility for enrichment and animal welfare belongs to all staff members. The importance of the staff training cannot be overestimated; the use of PRT is ingrained in our culture.

The management, study directors, technicians, husbandry staff and training staff all play a key role in the support and development of the enrichment program. Our newly implemented "Enrichment and Captive Care Committee" meets regularly and serves as a resource for refining and developing the enrichment program. Representatives from Toxicology Operations, Veterinary Services, Study Directors, and Training and Compliance departments serve on this committee and each provides insight into the needs of each department.

Novel ideas are always encouraged. This past year, for AALAS's Tech Week Celebration, we put out a challenge to our technicians by holding an Enrichment Competition. Several technicians submitted novel enrichment ideas, and the winners were awarded a trip to the 2011 Enrichment Extravaganza and TriBranch Symposium held in Atlantic City, NJ. The new ideas were incorporated into our current enrichment program.

Engaging all staff in the enrichment program is critical to establishing a culture of care and promotes the successful completion of toxicology studies.

There's an old saying that "You can't dance at two weddings at once."

You also can't attend all the meetings and conferences taking place that offer the latest information in the field of laboratory animal science. **Meeting Up** will provide summaries of panels, workshops and symposia covering topics relevant to Environmental Enrichment. If you want more information about any of the presentations described or want to contact the presenters, let us know and we will be happy to connect you: info@theenrichmentrecord.com

International Conference on Environmental Enrichment Meeting of the Minds

*August 14 -20, 2011, Benson Hotel, Portland, Oregon
Hosted by the Oregon Zoo and the Oregon National
Primate Research Center*

By Cynthia Maurus

*Behavior Management Specialist
Novartis Pharmaceuticals Corporation*

This event has been held every other year since 1993. This was the 10th conference and held in Portland, Oregon, as was the very first one. The week opened with a nice "Ice Breaker" event on Sunday night. This was an opportunity for the very diverse attendees to get to know each other. There were approximately 175 attendees from all over the world and from all types of animal facilities, including sanctuaries, labs and zoos. At registration, we all received our usual packets of information, but with a new twist. We also received the standard lanyard with our nametags. We soon learned that they were anything but standard. Part of the lanyard was an actual flash drive that contained all the presentations for the week, proof positive that this is a very progressive organization!

Our learning began on Monday morning with some opening remarks, followed by the well respected Mollie Bloomsmith, Head of Behavioral Management at Yerkes, covering the topic of "Labs, Zoos and Sanctuaries Working Together on Animal Welfare: Do We? Should We? Could We?" This was the general theme for the week, and I think the answer at the end of the week from all was a resounding yes, yes and yes!

Other invited speakers for the week were Dr. Jill Millen from Disney speaking on the topic of the evolution of enrichment, Dr. Richard Reading on the value of enrichment to reintroduction success, Dr. Joy Mench from UC Davis

on enhancing welfare with challenges that match the animal's skills, Dr. Kathy Carlstead on what is animal welfare and the role of enrichment, and we closed the week out with Dr. Carrie Hanna's talk on environmental enrichment for research animals and why investigators should care.

Highlights of the week included video night where we saw some unique videos on animal behavior and enrichment options prepared and presented by workshop attendees, and a very informative poster session. On Tuesday we spent the afternoon and evening at the Oregon Zoo, complete with enrichment opportunities, a great picnic dinner and music by a local band. Monday evening was spent at the Oregon National Primate Research Center with a tour of the facility and a barbeque dinner. Last, but not least we enjoyed a closing banquet at the World Trade Center in Portland, complete with great food, drink, a DJ and dancing till midnight. These events, in particular, provided us with wonderful networking opportunities.

All in all, the conference was very comprehensive, with representation from all fields of animal care, labs, zoos, sanctuaries and even farm animals. Some of the unique take aways that I got from attending this conference were the idea of developing enrichment programs with an awareness of occupational therapy needs for the specific species and thinking about providing more diverse enrichment opportunities for our animals at the time of facility/enclosure design with built in applications. The next conference for this group will be held in South Africa in August 2013. Truly a great opportunity for learning and traveling as well.

We are most appreciative of the sponsors who made this event absolutely wonderful. Our thanks go to: Absolute Primate Enrichment Systems, AALAS, Ancare, Hopworks Urban Brewery, Noldus Information Technology, Oregon Branch AALAS, Otto Environmental, Sokol Blosser Vineyards, Sysco, and Willamette Valley Vineyards.

Drexel University College of Medicine, Department of Surgery and
Certified Veterinary Surgical Nurse Volunteer, Aardvark Animal Hospital

Enrichment a Day Keeps the Veterinary Doctor at Bay

That is exactly how Corinne A. Thomas, VMD and the staff of Aardvark Animal Hospital in Exton, PA like it as they host their exotic family members at 161 Dowlin Forge Road.

Doctors of veterinary medicine are the people who engage in the human endeavor of practicing veterinary medicine. Many people have an altered idea of what being a vet is about. A lot of physical and emotional endurance is necessary to be a successful veterinarian.

Dr. Corinne A. Thomas puts the needs of her patients and owners first. "Too many practices are focusing 100% on what they call 'production'. In a 'production' driven practice, there is not sufficient time to listen to the clients, answer their questions, thoroughly evaluate the pets and come up with the appropriate medical recommendations. There is nothing wrong with making sure a veterinary hospital runs smoothly and efficiently; however, in today's veterinary industry, owners are spending more money for less quality time with their veterinarian."

Dr. Corinne and her staff set out to change this stark reality into old-fashioned client care, education, communication and compassion. They are passionate about their core fundamental values and it is evident, especially through the wonderful array of exotics, which also serve as hosts to greet her clientele as they enter this progressive establishment.



Why do we say progressive? Easy—Dr. Corinne understands the importance of animal environmental enrichment. Not only does she understand it, she lives it! The enrichment programs make for one big happy family—a family that includes chinchillas, various birds, hamsters, guinea pigs, hairless rats, rabbits, iguanas, dog and cat animal rescue, veterinary staff and two children for good measure.

Dr. Corinne and her staff (which includes Jennifer Camili, DVM, veterinary technicians, licensed veterinary nurses, reception staff, and wonderful volunteers) range in expertise from domestic pets, zoo and wildlife to avians, exotics, large animals and research animals. Exposure to all of these modalities has enriched not only Dr. Corinne and company, but all of the animals they help.

It is an interesting dynamic. In research, we strive to bring this concept to the forefront, working tirelessly to add benefits to animal lives—and we have made progress. For some odd reason, in veterinary medicine, the actuality of exotic animals receiving enrichment was not considered. It seems as if enrichment was only reserved for the cats and dogs of the veterinary world.

Not anymore! It is only fitting that veterinary medicine becomes not only influenced by environmental enrichment but enhanced by it. Environmental enrichment should not be going solely to cats and dogs but to ALL the animals we care for and bring into our lives. We can accomplish this through one progressive clinic at a time promoting and recognizing environmental enrichment as part of the routine for effective patient care.



Dr. Corinne A. Thomas

Dr. Corinne (above) and staff not only practice enrichment but also educate their clientele about the importance, concepts and theories of environmental enrichment and its resounding benefits.

It's not every day that you see roommates Patrick and Bob, the hairless rats, residing in a 4 story luxury house with toys and treats, or the hamsters that reside in 'fun-houses', or the chinchillas,



Dr. Jennifer Camill

Barnaby and friends, that rent the 3-story house with a view for summer and winter vacation that comes with a complimentary exercise room. There is Savannah, the longhaired guinea pig and guests who enjoy wooden lounging spots in their spacious rancher with squeaks of excitement at the sound of enrichment treats coming their way. There is the bunny bunch who just moved in together. The iguana vacations in the warmer climates of the hospital, sunning for long hours of the day into evening. There is the cat rescue free-range room dedicated to the socialization and enrichment of feline friendships in-the-making and the puppy rescue program that also participates in free-range-enriching both people and animals together.

Our hats go off to Dr. Corinne and her staff for the promotion, support and recognition of the importance of environmental enrichment to all the animals in our lives and for branching out into fresh territory for all animals of veterinary medicine. To see more enrichment adventures of the Aardvark Animal Hospital gang, please visit www.aardvarkvet.com.



Acknowledgements

The author would like to express sincere appreciation to Bio-Serv of Frenchtown, NJ, for their continued support, education, dedication and exceptional products. The author would also like to thank Absorption Corp for their support and distinctive enrichment products.

Cindy Evans, B.S., RLATG, Animal Resources Manager

Teresa Neubauer, A.A., RLATG, CMAR
Operations Manager: Staff Development and Training

A Conversation with

The Environmental Enrichment Team

**Baylor College of Medicine
Center for Comparative Medicine
Houston, Texas**

Baylor College of Medicine (BCM) is committed to research, unraveling the mysteries of the human body, and finding new ways to cure disease and improve health. BCM's Center for Comparative Medicine (CCM) has one of the largest and most productive animal research programs in the country.

CCM's program supports myriad animal models for studying human disease, in addition to collaborations with researchers across the Texas Medical Center and the Houston Zoo.

A formalized, comprehensive Environmental Enrichment (EE) program for every species was established in 2007 soon after Jennifer Volkmann joined CCM as

a manager. She took the lead in creating an effective EE program that addressed the species-typical needs of the diverse range of animals at BCM. Cindy Evans, under the direction of Teresa Neubauer and Cindy Buckmaster, took this lead and ran with it. She devotes nearly all of her time, when not dealing with managerial responsibilities, to researching, exploring and piloting new enrichment opportunities for all of CCM's animals. Refinements and improvements to the EE program are ongoing at all times.

Structural and Social Environments

In CCM's vivaria, the structural environment includes cage furniture



Left to right: Cindy Evans, Cindy Buckmaster, Teresa Neubauer

Animals should be housed with a goal of maximizing species-specific behaviors and minimizing stress-induced behaviors.

and a broad range of environmental enrichment objects for manipulation by the animals that are rotated on daily, weekly and monthly schedules to preserve their novel appeal. Structural environments include resting cots, shelves or perches, toys, foraging devices, nesting materials, tunnels, swings, and other objects that increase opportunities for the expression of species-typical postures, activities and behaviors, enhancing animal well-being. A large variety of healthy and engaging food treats are also provided regularly.

Natural social behavior is promoted through physical contact and communication among members of the same species (conspecifics) whenever possible. In cases where direct conspecific contact is not possible, opportunities for visual, auditory, and olfactory contact are provided in addition to plenty of human-animal interaction!

All enrichment objects are sanitized regularly to maintain appropriately clean conditions and prevent cross contamination between animals. Soft toys, blankets and dog cots are washed, dried and replaced as necessary.

Environmental Enrichment is documented on EE logs. Special considerations or problems are noted in the "comments" section. EE logs are maintained for each animal holding room and are archived for review and reference.

Research Family

CCM's research family includes more than 2000 investigators and 140 animal care associates, along with

several kinds of animals, including mice, rats, cotton rats, guinea pigs, hamsters, pigeons, rabbits, dogs, pigs, sheep, cattle, monkeys, musk shrews, African clawed frogs, locusts, fruit flies, and zebra fish.

The Attending Veterinarian, Lorraine Hill, D.V.M., DACLAM, is very supportive of environmental enrichment. As an AAALAC Council member, she has exposure to new ideas and enrichment strategies and works closely with the veterinary and husbandry groups of CCM to create new opportunities for enrichment for the animals as well as the staff.

What are the goals of your Environmental Enrichment program?

To reduce stress in our animals by encouraging healthy species-typical behavior. Our program emphasizes social interaction, when appropriate, and novelty. We introduce new ideas and toys to our EE arsenal regularly and rotate EE objects on daily, weekly and monthly schedules to preserve their novel appeal.

Natural behavior is the foundation that informs our EE choices and we always have this in mind when creating new EE opportunities for our animals. For example, monkeys who cannot be socially housed can be difficult to engage effectively. They are avid foragers by nature, and few commercially available foraging puzzles keep their attention because they figure them out so quickly. Tonya Betts, one of our Lead Animal Caretakers, focused her attention on this problem recently and we are

proud to introduce the *Taub Tubby*, a moon shaped pvc pipe attached to the outside of the cage that encourages foraging for hours, not minutes. We drop fruit inside the pipe and our monkeys reach through a grid to pick it apart. Some will spend four hours working on an orange... picking, peeling and eating!



Taub Tubby from a monkey's perspective!

Stress in our animals is a quality of life concern for us, in addition to the fact that it reduces their reliability and effectiveness as models for disease. These animals make tremendous contributions for our benefit and we do all that we can to address their physical and behavioral needs while they are with us.

Environmental Enrichment and Training

Effective training nurtures responsibility and compassion. Education grounded in compassion is the heart and soul of productivity in any animal care and use program. Research animals have allowed us to redefine the limits of the human condition and we consider it a privilege to work with them. CCM is

continued on page 28

committed to ensuring that the animals in our care receive the best quality of life permissible within study constraints.

While husbandry/technical proficiency develops through skill based training and repetition, high-quality research support requires a reasonable understanding of the science and regulatory expectations tied to the needs of our research models. Accordingly, our training programs focus on the development of professionals who are as knowledgeable as they are skilled and emphasize the following:

- Benefits and contributions of research animals
- Species-specific behaviors and requirements
- Russel and Burch's "3Rs" and the critical role of laboratory animal technicians in "refinement"
- Animal welfare regulations, compliance and the function of the IACUC
- Occupational health and safety
- Ongoing training on SOP-defined tasks
- Supplemental training for new procedures to meet the evolving needs of our researchers
- AALAS certification and career development

Thoughts on the Future of Environmental Enrichment...

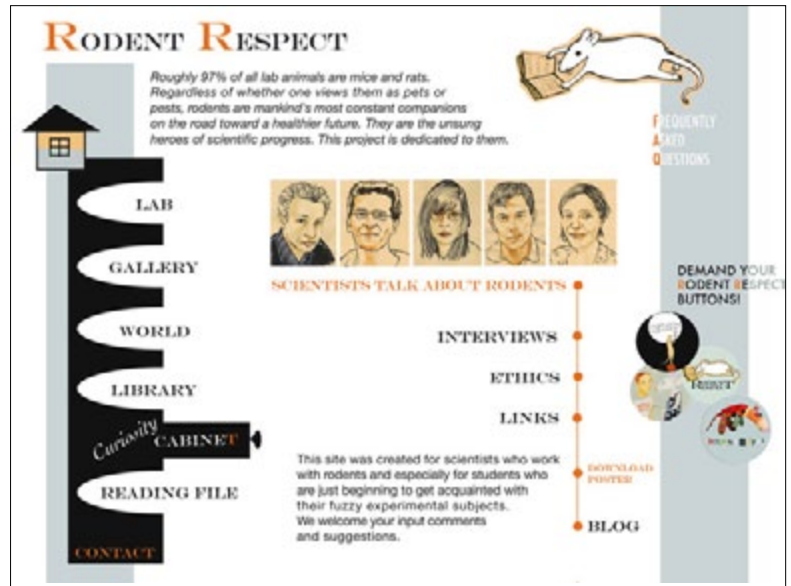
EE will continue to grow in importance in research animal care programs. In a recent survey conducted at the International Conference on Environmental Enrichment (ICEE) in Portland, OR, 100% of the researchers polled indicated they would definitely prefer to have an enriched environment for all their animals.

"Unfortunately, many people still use EE as a response to abnormal behavior in their animals," Cindy Buckmaster notes. "But, an effective EE program is designed to reduce the manifestation of abnormal behaviors from the beginning. If you follow the *Guide* and do everything except EE, you will have abnormal animals, unreliable data and questionable models for research...period.

Research program personnel must pay attention to EE before the animals begin their service. EE needs to be thought of as a normal part of animal care and everyone associated with an animal care program needs to be proactive!"

Resources

See website: <http://www.rodentrespect.com/> for complete **Rodent Respect** info and artwork



<http://www.rodentrespect.com/>

made possible by
a grant from the
wellcome trust

The Enrichment Record and The Veterinary Bioscience Institute (VBI)

NEW ENRICHMENT RESOURCE Enrichment Record Poster Repository

<http://www.vetbiotech.com/posters2.php>

The Enrichment Record and the Veterinary Bioscience Institute (VBI) announce the creation of an open access website to facilitate sharing enrichment research.

- _ Share your enrichment posters (old & new)
- _ Subdivided into categories by species
- _ Simple submission process
- _ Review process in place prior to posting

For questions or more information contact:
Jayne Mackta
mackta@gr8tt.com

Szczepan Baran
szczepanb@VET-BIOTECH.COM

Jayne Mackta
Global Research Education & Training

The Enrichment Record Poster Repository

The Enrichment Record, together with the Veterinary Bioscience Institute, is excited to introduce the **Enrichment Record Poster Repository**. This open access poster repository will provide a structured and safe environment for the deposition of enrichment posters. Often, enrichment information presented as posters at conferences is not published and is lost once a conference is over. If it is published, it is published at a much later date. This repository will provide Laboratory Animal Science community members with access to early enrichment information presented at conferences while allowing authors to maximize the value of their posters by dramatically increasing availability and by helping to prevent lengthy delays before others can benefit from their new enrichment research.

The Enrichment Record Poster Repository is subdivided into categories by species, making it easy to locate information for the viewer.

The submission process is simple and has safeguards in place to ensure applicability and maintain quality standards. After a poster is submitted, there is a 24-hour delay, which allows time for review of submitted information to confirm that it is appropriate for the site.

The Enrichment Record Poster Repository is an open access repository, meaning that anyone will be able to view these posters. We believe open access promotes transparency and supports outreach efforts that help educate both internal and external audiences. Sharing is the optimal way to distribute information to the Laboratory Animal Science community and beyond. There is the ability to post posters anonymously as long as you provide your authorship information to *The Enrichment Record*.

We are looking forward to your submissions and feedback. Visit the site: <http://www.vetbiotech.com/posters2.php>

*Now you see it;
now you don't.
If you did not attend
the recent National
AALAS in San Diego,
you will not have seen
a terrific poster on
a novel delivery device
for rabbit hay.
This poster created
quite a stir, and we
hope it will eventually
find a home in our new
Poster Repository.*

*Shown is
Leslie Shepard Bird.*



Environmental Enrichment of Laboratory Rodents: The Answer Depends on the Question

Toth, Linda A.¹ Kregel, Kevin²; Leon, Lisa³;
Musch, Timothy I.⁴

Comparative Medicine, Volume 61
Number 4 • August • Pages 314-321

¹Department of Pharmacology,
Southern Illinois University School of Medicine, Springfield, Illinois

²Department of Health and Human Physiology,
The University of Iowa, Iowa City, Iowa

³Thermal Mountain Medicine Division, US Army Research Institute
of Environmental Medicine, Natick, Massachusetts

⁴Departments of Kinesiology, Anatomy & Physiology,
College of Veterinary Medicine, Kansas State University, Manhattan, Kansas

<http://aalas.publisher.ingentaconnect.com/content/aalas/cm/2011/00000061/00000004/art00003>

Efforts to refine the care and use of animals in research have been ongoing for many years and have led to general standardization of rodent models, particularly with regard to animal housing, genetics, and health status. Concurrently, numerous informal practices and recommendations have been promulgated with the laudable intent of promoting general animal wellbeing through so-called enrichment of the cage environment. However, the variety of housing conditions fostered by efforts at environmental enrichment (EE) complicates the goal of establishing standardized or even defined environments for laboratory rodents. Many studies over the years have sought to determine whether or how various enrichment strategies affect the behavior and physiology of laboratory rodents. The findings, conclusions, and interpretations of these studies are mixed, particularly with regard to their application across rodent species, strains, genders, and ages; whether or how they affect the animals and the science; and, in some cases, whether the effects are positive, negative, or neutral in terms of animal wellbeing. Crucial issues related to the application of EE in research settings include its poorly defined effect on the animals, the potential for increased variability in the data, poor definition across labs and in publications, and potential for animal or scientific harm. The complexities, uncertainties, interpretational conundrums, varying conclusions, and lack of consensus in the EE literature warrant careful assessment of the benefits and liabilities associated with implementing such interventions. Reliance on evidence, professional judgment, and performance standards are crucial in the development of EE strategies.



8th Annual Zebrafish Husbandry Workshop World Aquaculture Society 2012 Conference

Las Vegas, NV
Wednesday, February 29: 2:00—5:00 PM
Thursday, March 1: 8:30 AM—5:00 PM

The Workshop will include talks on a broad range of subjects, including sections on:

- Husbandry (including a section of peer submitted and ZHA reviewed and selected talks)
- Fish Disease (organized by Dr. Michael Kent/Oregon State University)
- Regulation, Education, and the Zebrafish Community
- Nutrition

The Sessions will provide useful information for Lab Managers, Technicians and others involved in Zebrafish Husbandry and other Aquatic Species and a venue for all of us to exchange ideas and experiences in an upbeat and stress-free environment.

Contact Bobbi Baur
for more information:
bobbi@aquaneering.com



Animal Behavior Management Alliance 2012 Conference May 6-11, 2012 San Francisco San Francisco Airport Marriott

*Join us in the Golden State of California to
discover Behavioral Management Gold!*

The 2012 ABMA conference will be held May 6-11th in beautiful San Francisco and will feature

a key note address by Dr. Hal Markowitz, enrichment pioneer and author of *Behavioral Enrichment in the Zoo*. A 3-part enrichment workshop will also be presented by Dr. David Shepherdson, editor of the ground breaking book, *Second Nature*. In addition to exciting site visits to our Bay Area hosts Oakland Zoo, CuriOdyssey, California Academy of Sciences, and San Francisco Zoo, we'll host our usual bevy of fascinating presentations, posters, networking opportunities, and stimulating conversations.

The ABMA conferences typically offer CE credits for both certified dog trainers through the Certification Council for Professional Dog Trainers (CCPDT) and for behavior consultants through the International Association of Animal Behavior Consultants (IAABC).

Please visit our conference site for information on registration, submitting presentation and poster abstracts, and additional conference details. See you in San Francisco! http://theabma.org/index.php?option=com_content&view=category&layout=blog&id=62&Itemid=154 --

If additional information or action is required, please feel free to contact Darren E. Minier, 2012 conference Chair, Animal Behavior Management Alliance—deminier@ucdavis.edu or Margaret Rousser—margaret@oaklandzoo.org.

REMEMBER:
**Please send notification
of your
Upcoming Meetings
to rmbw19@verizon.net**



**We're always looking
for new ideas!**
Share your ideas with
Rhoda Weiner, Editor at
rmbw19@verizon.net

Reporters Wanted!



In each issue of *The Enrichment Record* we report on Enrichment meetings and conferences in detail. We are seeking volunteers to write summaries of meetings, workshops, and conferences addressing any aspect of environmental enrichment for lab animals. Meeting organizers are welcome to assign a recorder.

To request "Guidelines for Meeting Up Summaries," send your name, contact and meeting information to info@theenrichmentrecord.com

NAME _____

PHONE _____

EMAIL _____

EVENT _____

DATE _____

TIME _____

LOCATION _____

Meeting Announcement submission Form

Please submit the following information to Rhoda Weiner, Editor rmbw19@verizon.net

ORGANIZATION _____

CONTACT NAME _____

PHONE _____

EMAIL _____

DATE OF EVENT _____

TIME OF EVENT _____

EVENT LOCATION _____

TYPE OF EVENT
Conference _____ Workshop _____ Lecture _____
Meeting with featured speaker _____

BRIEF DESCRIPTION OF THE EVENT _____

Enrichment RECORD



ARE YOU A SUBSCRIBER?
Our subscription list numbers
over 2000 of the most dedicated
lab animal care professionals
around the world.

Subscriptions are free.
Visit our website and subscribe today!
<http://enrichmentrecord.com>

The Enrichment Record is a quarterly E-Zine created by the Laboratory Animal Research Community as an online forum for:

- Discussing environmental enrichment in the optimal care of laboratory animals
- Documenting best practices
- Sharing data on the impact of environmental enrichment on the science
- Building the case for integrating enrichment into research design

ADVERTISER INDEX

TECNIPLAST
Innovation through passion™
<http://www.tecniplastusa.com>

COVANCE.
<http://www.covance.com>

ASAP ANIMAL SPECIALTIES
AND PROVISIONS
<http://animalspecialties.biz/>

Bio Serv
Delivering Solutions...
• Nutritional • Enrichment • Medicated • Special Needs
<http://www.bio-serv.com>

Huntingdon Life Sciences
Working for a better future

www.huntingdon.com

LabDiet
Your work is worth it.®
<http://www.labdiet.com/>