Enrichment for Physical Fitness: Let's Get Physical

Valerie J Hare and Mark Kingston Jones

The Shape of Enrichment, Inc.

Abstract

Environmental enrichment, as a concept, is now well recognized as an important consideration in the welfare status of any captive animal. The behavioral, psychological, and physical benefits of enrichment are well documented.

Since the early days of enrichment, many have touted its benefits for physical health, usually through increased activity. While surely beneficial, we believe that the more common enrichment strategies used to encourage activity today do not provide the animals with opportunities for appropriate types or sufficient levels of exercise.

We have an ethical responsibility to provide all animals in our care with good physical, psychological, and behavioral health but also with good physical fitness. And, for animals destined for reintroduction, it is imperative that each animal possesses the requisite strength, sense of balance, and fine motor control to survive and succeed on its own.

Thus, we propose that animal enrichment programs include strategies designed to address these needs and we will present examples of such. But, as with all enrichment, we encourage animal care professionals to continue to develop new strategies geared toward providing opportunities for appropriate types and levels of exercise.

Behavioral Management of Welfare through Enrichment

At The Shape of Enrichment, we consider enrichment a beneficial tool to enhance three aspects of welfare: Mental Health, Behavioral Health, and Physical Health and Fitness. This paper will focus on the third, specifically Physical Fitness.

Many animal professionals routinely use body scoring to assess an animal's physical condition. In many zoos, the focus seems to be on preventing obesity or emaciation. We would like to expand that focus to include the animal's actual state of fitness.

Physical Health ≠ Physical Fitness

The World Health Organization (1948) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" – a definition that has not changed since 1948.

Fitness can be described as "A measure of the body's ability to function efficiently and effectively in work and leisure activities, resist hypokinetic diseases (diseases from sedentary lifestyles), and to meet emergency situations" (Builtlean, 2013).

An animal can be healthy – be an appropriate weight; disease, parasite, and injury free; have good dentition; and so on – but not physically fit. In fact, many zoo animals in developed countries like the U.S.A seem to be in this condition. Figure 1 shows a tiger pulling against a garage door spring. The tiger is in good health, but it is easy to see that he lacks musculature in his fore and hind legs. Further, most large cats breathe heavily, some even lay down, after just a few minutes of pulling.

The good health these animals enjoy is a testament to quality veterinary care. However, many of these animals are not agile or strong enough to even remotely exhibit the abilities of their wild counterparts.

Photo credit: ©2009, Valerie J Hare

Enrichment Goals to Promote Physical Health and Fitness

Our general enrichment goal is to encourage appropriate types and levels of activity. Specific goals focus on agility (hone balance and fine motor control) and strength and stamina (promote muscle, bone, organ, and soft tissue health).

Current enrichment efforts to promote agility include such examples such as see saws, swings, logs, and tubes on ground. Current strength and stamina examples include such activities as chasing toys, moving heavy objects, digging, and climbing. These are all excellent; we applaud these efforts and encourage their continued use.

However, it's important to ask ourselves "How much benefit are they really getting from these enrichment strategies? Are they developing sufficient fine motor control and balance? Are they building sufficiently strong muscles, ligaments, and skeletons? Are their stamina levels appropriate?"

We think we can do better! The following are some non-food and food enrichment strategies that we feel better meet our agility, strength, and stamina goals.

Non-Food Enrichment Strategies

Tug of War

Large hessian (burlap) sacks stuffed with straw or leaves are great for encouraging tug of wars among cagemates (e.g., a pride of lions; Fig. 2) or between neighbors. For example, in our Tbilisi Zoo, Georgia workshop, one hessian sack was placed inside the adult jaguar enclosure another inside their one-year old cubs' enclosure about 10 meters

away. The sacks were attached to a rope so that when one was manipulated, the other moved.

Photo credit: ©2009, Valerie J Hare

Weight "Lifting"

An existing log in a Lory Park Zoo, South Africa, lion enclosure was about 2 feet in diameter and estimated to weigh over 200 kg. The adult lions were not seen interacting with this log. To encourage interaction, the workshop's Lion Group, attached the hide of an antelope to the log, with the leg skins hanging loose. The adult male was immediately interested in this and grabbing the leg skins, dragged it all around the enclosure (Fig. 3). This lasted for about 40 minutes, until the hide came off.

Photo credit: ©2013, Karen E Worley

Digging

Digging in substrates can provide excellent exercise for many captive animals. We can readily imagine our carnivores, ungulates, pachyderms, lizards, turtles and tortoises, and many more species. However, many bird species regularly dig for food or nesting sites (Fig. 4 and Ng, 2018a)

Photo credit: ©2018, Debbie Ng

Garage Door Spring

Since it was first developed in 1997, the authors have used the garage door spring setup shown in Figure 1 for many individuals and several species, primarily large carnivores.

There are many types of springs available for purchase in do-it-yourself stores but there is one in particular we recommend, especially for stronger animals like the large cats, bears, and apes. This spring, called an overhead torsion spring, can be found in varying lengths and diameters (resulting in different load capacities) but all have (1) safety rods inside that stop the spring from extending beyond twice its resting length and (2) flat metal plates finished on the ends to enable quick, strong attachment (Fig. 4).

For safety, it is imperative that the animal cannot directly access the spring. This can be accomplished by covering the spring for twice its extended length (with PVC, fire hose, etc.) or mounting it outside the enclosure. The second is actually our preferred method as it allows staff to readily move the spring from one enclosure to another.

Once the spring is safely anchored, an interface (the part the animal will touch) must be designed. With carnivores, the preferred interface is a large hessian sack stuffed with leaves or straw – most carnivores just can't seem to resist this (see Fig 1)! For great apes, we have used either knotted rope or fire hose to give them a good grip.

Photo credit: ©2014, Valerie J Hare

Rope Branches

Using ropes for perching provides movement for the animal to practice balance, flying or leaping competence, and fine motor control. For example, a horizontal rope was added to a barn owl enclosure in our Djurpark, Sweden workshop. The first owl to land on the rope spent nearly 1.5 minutes using its wings to try to get and keep its balance (Fig. 5).

Photo credit: ©2014, Valerie J Hare

Artificial Forest

We have created many “artificial rainforests” in various Shape of Enrichment Workshops – the first in 2002, at Porto Alegre Zoo, Brazil. Figure 6 is from an artificial rainforest in a large blue and gold macaw aviary in Ragunan Zoo, Jakarta, Indonesia. Hales (2014) shows a smaller, indoor example for a cockatoo in Raystede Centre for Animal Welfare, U.K.

The artificial rainforest is a system of ropes used to: (a) provide obstacles for flying animals to maneuver among, simulating flying through a forest; (b) create innumerable, dynamic horizontal and vertical landing options for both flighted and non-flighted individuals; and (c) provide numerous, easy-to-fill feeding opportunities throughout the “forest”.

The system is created by first installing ropes, branches, or poles horizontally across most or all of the enclosure. Recommended spacing is about two meters apart, although this (as with all the dimensions given) must be adjusted to be appropriate for each enclosure. The horizontal supports should be placed at a height above the keepers’ heads but not at the top of the aviary – this allows space for unimpeded flight above the “forest”.

Multiple ropes are then hung from these horizontal supports, preferably by splicing but they can also be tied or wired on. Ideally, these would be spaced far enough apart that the animals and keepers can easily move between them but close enough together so that the birds cannot fly between without either slightly tipping their bodies or pulling in their wings. The position of the ropes should be staggered from one horizontal support to the next, rather than lined up.

Perches, swings, hammocks, platforms, ladders, ropes, etc. can be used to connect one or more vertical ropes. But be sure not to significantly reduce the flying options or keeper access.

To prevent the vertical ropes from fraying, they should be finished at the bottom either with a back splice, a barrel knot, or other large knot. If desired, weights can be added to the bottom to prevent the animals from lifting the ropes and becoming entangled.

For safety, it is imperative that the proper rope be used! Rope safety is a controversial subject – and rightly so. But when care is taken to prevent the animals’ limbs, head, etc. from becoming entrapped or entangled and the fibers from being ingested, ropes have been used without incident. Our recommended rope for the large birds and fruit bats is natural fiber rope that is a minimum of about 2 inches in diameter. This rope is commonly used on boats and can be found at shops offering marine supplies. It is expensive, and you will need quite a bit. But once installed it can last for many years, even in tropical climates. For smaller animals, you can save some money using thinner ropes but make sure it is thick and stiff enough that the animals cannot create enough slack to become entangled. Weighting the bottom of the ropes will help.

Finally, feeding options (and novel objects, nesting material, etc.) can be added to the vertical ropes. Various puzzle feeders can be wired or tied onto the ropes. But, if you use thick, stiff marine rope, you can simply untwist the rope, place feeders or food directly inside the rope strands and let go. The rope will naturally spring back into shape trapping the food in place. We strongly recommend that all food and feeders be positioned within reach (without ladders!) of the shortest keeper in the area – that ensures replenishing will be quick and easy!

All in all, this artificial forest approximately the animals’ experience of flying or climbing through (or above) a moderately dense forest, landing on any of the moveable branches (aka vertical ropes), and moving among those branches to find and eat their food.

Photo credit: ©2009, Valerie J Hare

Firehose Net

Many people use fire hose hammocks and nets as enclosure furniture. During a Shape Workshop in Sai Gon Zoo, Vietnam, we created a large-weave net (open spaces approximately 1m x 1m) to provide physical challenges to a group of sliver langurs. Hung at a 45^{o} angle it moved and flexed differently to everything else they had in the enclosure. The youngsters particularly struggled to climb up and down it but persisted and eventually a few little ones started to use it as a slide, climbing up and then zipping back down the slippery surface (See Jones, 2014a).

Photo credit: ©2014, Mark Kingston Jones

Age Factor

Starting from a young age is central to the appropriate development of muscle, bone, balance, and coordination. As an example of this two clouded leopard cubs arrived at a collection after being hand reared for the first six months of their lives. When they began to explore their new enclosure, made up of a complex, static branching system, they did not have the balance and coordination clouded leopards are famous for – they slipped and lost their balance repeatedly as they tried to make their way around the branches.

Cubs that have been parent reared in these enclosures are able to move around the structures well at three months old, attaining full competence by age six months. Some cubs at this age have been seen climbing vertically up the chain link mesh and upside-down along the underside of the roof – 25 feet above the ground.

Dynamic Branches

A way of making enclosures even more challenging is to replace and add to static branches with a connected system of branching that is suspended so that it moves and sways as the animals climb over it developing muscles and coordination even further. Hales (2013a) described a system of suspended branches for an Indian desert cat (Fig. 9) and prepared a video detailing the construction process for this dynamic branch system (Hales, 2011).

Photo credit: ©2011, Mark Kingston Jones

A good primate example is from the Bali Zoo, Indonesia. During a staff training workshop, dynamic branches mixed with ropes and resting areas was added to the gibbon enclosure (Fig. 10 and Ng, 2018b).

Photo credit: ©2018, Debbie Ng

For animals that have not experienced these moving structures before, it is common to see hesitation or stronger neophobic responses when they first start to interact with them. For example, at our 2012 Enrichment Workshop in Paulínia Zoo, Brazil, the coati was frightened the first time he stepped on a branch with a lot of movement – he immediately ran to the ground and began manipulating a feeder there. But within a few minutes, he was back up on the moving branches, exploring a variety of feeders and novel objects (see Hales, 2012).

Like the coati in Paulínia, most animals become accustomed to the movement quickly but our advice would be to limit the movement initially. Once the animal is able to deal with it competently, slowly increase the challenge until it is proficient.

Case Study: Rehabilitated Black Kites

Developing strength and balance is critical for animals destined for release into the wild. Deb Ng (2013), of Kadoorie Farms in Hong Kong was concerned that none of their five rescued black kites would be eligible for release even though their injuries were healed. Although they were in a large, high flight aviary, they rarely attempted flight. When they did, they panted heavily after even short flights and their landings were rough, often landing on the ground.

After some brainstorming, the placement (height and distance) and type of the perches were identified as potential problems. The corner perches on either end were high, which was appropriate for fully flighted birds but were difficult for the recovering birds to access. As these perches were all of the same diameter and texture, they did not provide grip options. Also, there were only two perches located between the end perches; the distance between perching was too far for these birds. Finally, the interior perches were low, made of smooth metal, and too short for the birds to land on with their wings extended while avoiding the vertical post.

Each of these identified problems was fixed, allowing the birds easier access and a better grip on all perches. The intermediate perches, which were now usable, allowed them to start with short flights to build strength and confidence before attempting to fly from end to end.

With no other changes made, 14 months after the initial brainstorming session, three of these kites were released and staff were hopeful the other two would be ready for release soon (Ng, 2014).

Food Enrichment Strategies – No More Free Lunches!

Currently, food enrichment strategies are often geared towards increasing foraging time, such as scattering the daily diet under piles of straw for baboons at Lisbon Zoo, Portugal (Fig. 11). For many species, occupying their time with foraging behavior is a critically important objective! However, we question how much exercise occurs with such feeding strategies.

We can utilize feeding techniques to encourage captive animals to not only extend their foraging time but also to exercise while finding, obtaining, and processing their food as their wild counterparts do. Examples of some of the behaviors (stretch, balance, jump, climb, and pull) we want to encourage are given.

Photo credit: ©2014, Valerie J Hare

Hanging Food

Once a rope or cable is placed out of reach across a hoofstock enclosure, there are many options for hanging food. In the Tbilisi Zoo (Tbilisi, Georgia) workshop, the goat group suspended several woven browse balls on a single long rope. The browse balls were high enough that the goats had to rise up on their hind legs to reach them. And, as some of the goats nibbled at one browse ball, the remainder would bounce, making it more difficult for other goats to reach (Fig. 12). For a similar example with deer from our workshop at Sai Gon Zoo, Vietnam, see Jones (2014b).

Photo credit: ©2012, Valerie J Hare

Also in the Tbilisi workshop, the bear group created a barrel feeder from a large plastic barrel for a pair of European brown bears. To increase the difficulty and encourage stretching and physical exercise, the barrel was “spitted” on a pipe that was chained to the inside of the enclosure bars. To obtain the fruit in the barrel, the bears had to stand bipedal and spin the barrel with their paws, causing the food to fall out of the holes (Fig. 13).

Photo credit: ©2012, Valerie J Hare

Swinging Food Platform

In the Pretoria National Zoological Gardens, South Africa, a wooden platform was suspended about two feet off the ground by a wire cable at each of the four corners. The leopard’s meat was skewered and attached to a bungee cord directly above the platform. The leopard had to stand up on the moving platform, grab the meat, and hold onto it while removing it from the skewer (Fig. 14 and Hales, 2013b). Note that this leopard enjoyed excellent physical welfare. However, for their safety, most zoo carnivores will initially require accommodations to be made (e.g., Tether the platform to allow only minimal motion. As the animal’s balance and strength increase, gradually lengthen the tether until it is no longer necessary.)

Photo credit: ©2013, The Shape of Enrichment, Inc.

Trebouchet

Keepers at The Wildwood Trust in the U.K. have created a simple system for their lynx where a wooden arm can be dropped down to be loaded with meat and then easily raised up and secured. This requires the lynx to leap up around 10 feet up in the air to grab their food (Fig. 15 and Hales, 2015).

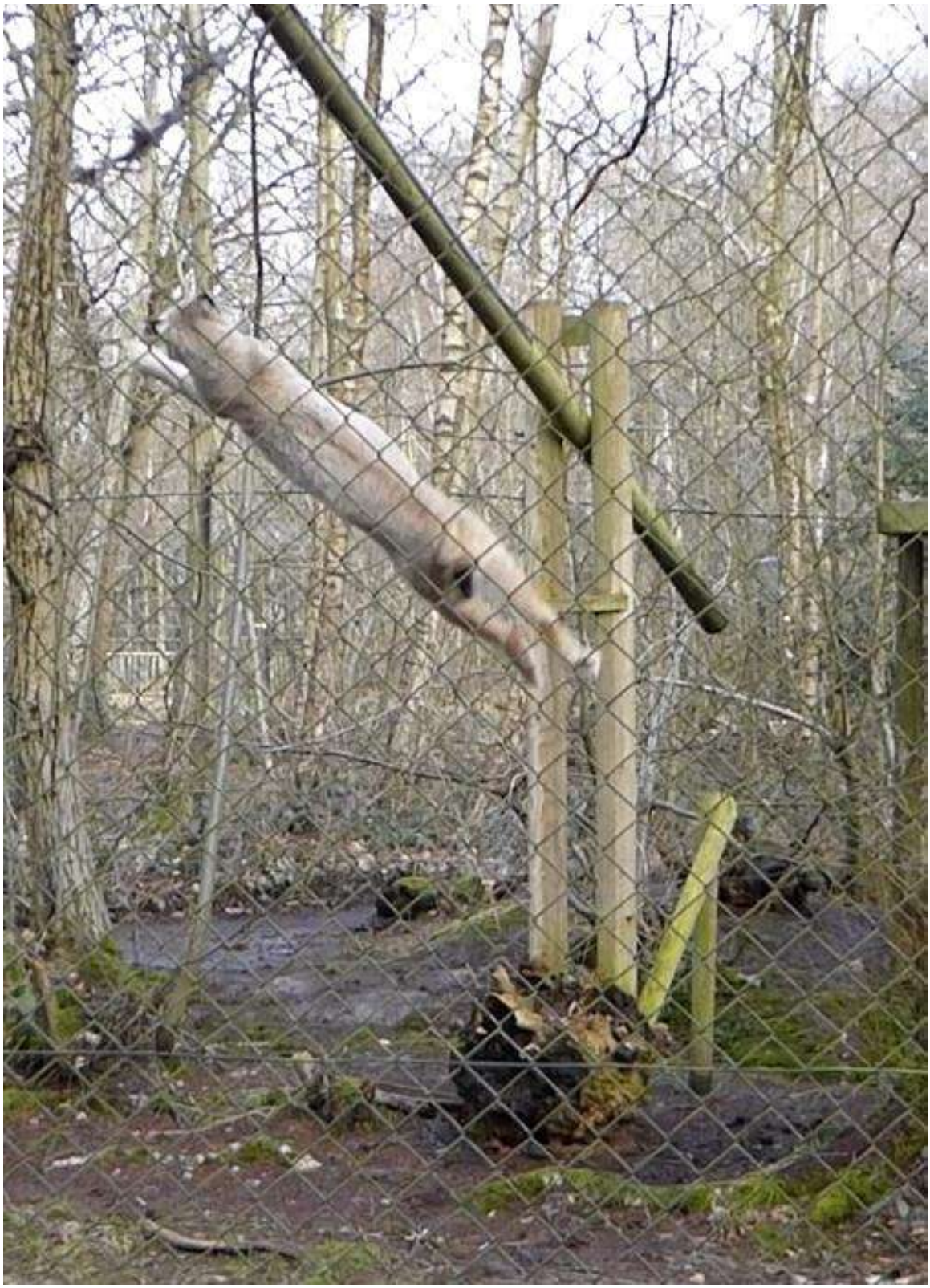


Photo credit: ©2015, Mark Kingston Jones

Cagetop Feeder

At Kaunas Zoo, Lithuania, they have a tree trunk suspended from a metal bracket, which has a metal box at the top. The meat is placed in the box and the snow leopards must climb the pole to reach the box and extract the meat through the hole (Fig. 16).

Photo credit: ©2014, Mark Kingston Jones

Feeder Log on Bungee

Chris Hales suspended a vertical log with bungee cord as a feeder for margays at Port Lympne Reserve, U.K. The lowest part of the log is accessible to the cat if it stands bipedal. Chunks of food were wedged in the holes. The cat has to climb or jump onto the log, pull the food out (which requires significant effort), and jump down before it can eat (Fig. 17).

Photo credit: ©2012, Chris Hales

Pulley Feeder

Keepers at Port Lympne Reserve, U.K., used a reverse zip line design, to promote cooperative physical exercise for their African hunting dogs. Set on a hillside enclosure the meat is attached to a track runner and when resting at the bottom of the slope it is out of reach of the pack. A strip of fire hose dangling from the runner must be used to drag the meat back up the hill, pull it down, and hold it in place while others feed (Fig 18).

Photo credit: ©2015, Rich Barnes

Garage Door Spring

The garage door spring set-up shown in Figures 1 and 4 can also be used as a feeder. However, do not place the food inside hessian or other material that will absorb the scent and juice of the meat. Rather use wire, cable, metal rods, etc. to safely attach the meat (Hare and Jarand, 1998).

Physical Health & Fitness Flow Chart

One way to remember that behavior is just the start of what we are trying to achieve with enrichment aimed at improving physical fitness is detailed in a chart devised by Chris Hales (Fig. 19).

As with all goal-based enrichment, we start by researching the animal's natural behavior and coming up with an appropriate activity. For example, we initially place the

food low on a big cat pole feeder, knowing that this activity works the muscles, which in turn develops the cat's balance, coordination and strength.

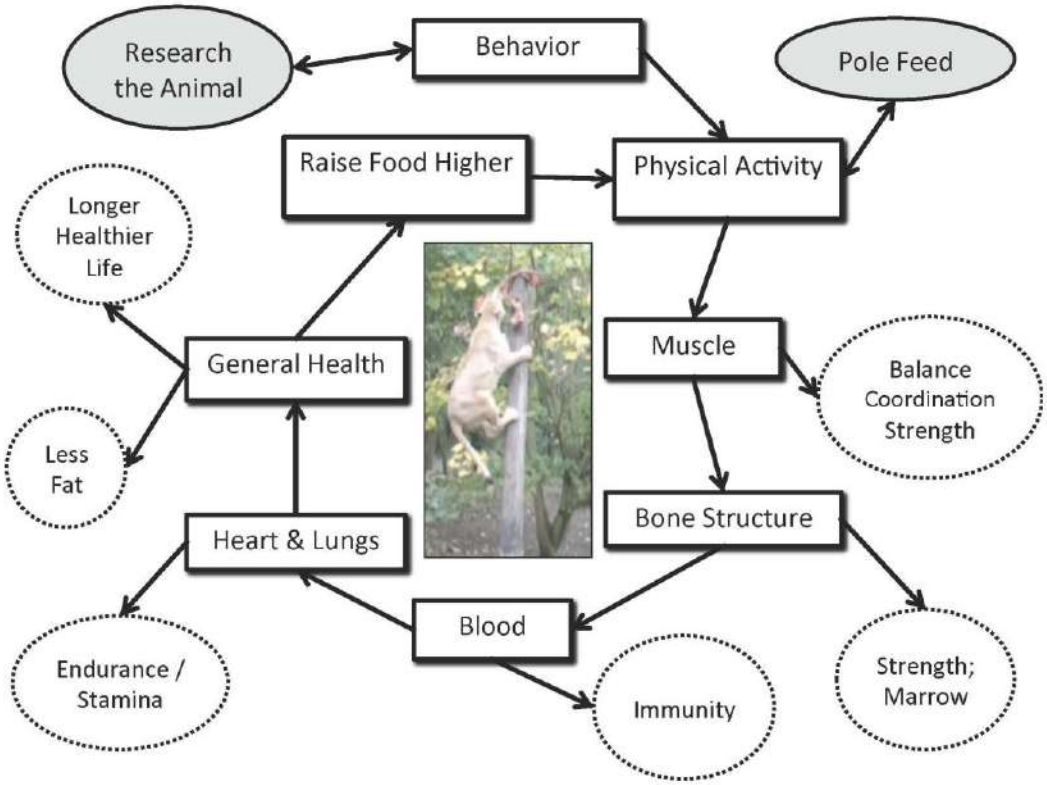
What is often forgotten is that the bones are also being worked and strengthened, as skeletons are routinely being broken down and rebuilt. Also developing is the bone marrow where blood cells are produced, including many of the white blood cells needed to fight disease and develop immunity.

The circulatory and respiratory systems are also stimulated, making them stronger and leading to increased endurance and stamina.

Overall this enrichment strategy should lead to less fat and a generally healthier, and possibly longer, life.

As the cat becomes proficient, thus experiencing less of a physical challenge, we can increase the difficulty by raising the food to a higher position -- and the process continues.

Evidence of this process is supported by the post mortems of two Sumatran tigers, which used pole feeders from a young age on a regular basis. When these animals died at the age of 14 from accidental barbiturate poisoning, their skeletons were free from arthritis – unlike other captive cats of a similar age, which can start to develop arthritis at the age of 6 years (Kitchener, 2004; O'Regan and Kitchener, 2005).



Concept credit: ©2012, Chris Hales

Case Study – Tiger Feed Pole

A female tiger had great difficulty climbing to the top of a new feeder pole and was not able to descend safely – she would drop from about four meters high. Because her legs

could not support her, her chest and abdomen struck the ground hard upon landing. Clearly, this tiger was not up to performing this task safely.

The solution was to mount the food lower at a height she could safely reach and descend – just over 2 meters. A plan was developed so that over time, the food would be raised in increments until she was able to safely climb to and descend from the top of the pole. The amount of time the food was offered at each lower lever was determined by her ability and development.

When I visited this zoo four years later, I observed her easily climbing all the way to the top and then climbing all the way down! The keepers said this required about a year to achieve.

Conclusion

Enrichment aimed toward increasing physical health and fitness should be provided for all the animals in our collections. As animal caretakers, we must regularly re-evaluate the physical, mental, and behavioral challenges we provide our animals to ensure we are managing their behavior to achieve optimal welfare.

Remember, we want to encourage animals to accept physical challenges. But we must not ask an animal to perform beyond its current ability level. Rather than "push" them into tasks too challenging, we can encourage them to develop at their own pace.

Our Challenge to You?

Create and test new enrichment strategies designed to increase physical health and fitness for the animals in your care. And then share them with us through conferences and publications such as The Shape of Enrichment!

References

Builtlean. 2013. www.builtlean.com.

Hales, Chris. 2015. https://www.youtube.com/watch?v=cvupa2K0i70

Hales, Chris, 2014. https://www.facebook.com/EnrichmentShapeUKandIreland/videos/vb.185861671462824/795653907150261/?type=1&theater (artificial forest begins at 1 minute 36 seconds).

Hales, Chris. 2013a. Dynamic Branches. *The Shape of Enrichment* 22(4): 1-3.

Hales, Chris. 2013b. ©2013,The Shape of Enrichment. https://www.facebook.com/EnrichmentShapeUKandIreland/videos/vb.185861671462824/796394230409562/?type=1&theater).

Hales, Chris. 2012. https://www.youtube.com/watch?v=bR_xE2ND634.

Hales, Chris. 2011. https://www.youtube.com/watch?v=bH01Pj0tQ-4.

Hare, Valerie and Jarald, Paul. 1998. Artificial Prey that Fights Back (and Other Tales of Tiger Enrichment). *The Shape of Enrichment*, 7(3); 1-4.

Jones, Mark Kingston. 2014a. https://www.facebook.com/shapeofenrichment/videos/vb.143901003825/10152647831463826/?type=1&theater.

Jones, Mark Kingston. 2014b. https://www.facebook.com/shapeofenrichment/videos/vb.143901003825/10152647863683826/?type=1&theater.

Kitchener, A.C. 2004. Problems with old bears in zoos. *International Zoo News*, 51, 282–293.

O'Regan, H. J. and Kitchener, A. C. 2005. The effects of captivity on the morphology of captive, domesticated and feral mammals. *Mammal Review*, *35*(3- 4), 215-230.
Ng, Deb. 2018a. FB url.
Ng, Deb. 2018b. FB url.
Ng, D. 2014. Personal Communication.
Ng, D. 2013. Personal Communication.
World Health Organization. 1948. http://www.who.int/about/definition/en/print.html.