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OPIOID RECEPTOR SUBTYPES

BY DREW CADWELL

Opioids are one of the oldest classes of drugs and continue to be some of the most widely used. First used by the Sumerians around eight thousand years ago, they are known for their analgesic effects and are used widely in surgical settings as well as post-operatively throughout the healing process. The three main opioid receptor subtypes are mu (μ), kappa (κ), and delta (δ). While all three subtypes are found in the brain and peripheral sensory nervous system, only kappa and mu receptors are found in the spinal cord and only mu receptors are found in the intestinal tract.

While all three of these receptor subtypes have analgesic effects, each has slightly different minor effects. Mu receptors are mainly responsible for causing the physical dependence and euphoria that leads to opioids' addictive potential. Additionally, mu receptors are responsible for respiratory depression, which may in part also be modulated by delta receptors. Being the only receptor type to be found in the intestinal tract, mu receptors are also responsible for the reduced GI motility seen with opioids. Generally speaking, kappa and delta receptors are less associated with relaxation and analgesic effects than their mu counterparts. In fact, research has shown that kappa receptors often suppress activation of the more analgesic mu receptors. Kappa receptors have also been shown to have dissociative and hallucinogenic effects. Meanwhile, delta receptors have been shown to induce initiation of actions, impulsivity, and cause behavioral mobilization. While delta receptors have anti-depressive properties, kappa receptors have depressive and sedative activity. Delta receptors are also considered to have convulsant effects while kappa receptors have anticonvulsant properties.



Although differences in analgesic efficacy and distribution of opioid receptor subtypes across species are still being studied, there are a few things we know so far. Evidence suggests that the different subtypes arose by gene duplication, that there is a vector of opioid receptor divergence, and that there is evidence of the rapid evolution of the mu-opioid receptor. For example, equid species have been shown to have relatively more mu receptors in the cortex of their brains leading to more excitatory behavior from mu agonists. Upon opioid administration, canids tend to become hypothermic while felids tend to become hyperthermic.

Meanwhile, domestic bird species such as parrots and chickens have been shown to have more kappa receptors. That's not to say that parrots are not prone to becoming as physically dependent on them as other species. In fact, wild parrots in the Indian state of Madhya Pradesh in India have become an unexpected nuisance. Poppy cultivators complain of these parrots feeding on the plants 30 to 40 times a day. One farmer complained to the local news source NDTV.com, "This affects the produce. These opium-addicted parrots are wreaking havoc."

In raptor species, such as American kestrels, studies have shown that there is more dependence on mu-opioid receptors for modulation of pain. Therefore, medications such as butorphanol, which is a kappa agonist and mu antagonist, are not effective pain management options. Instead, high concentration buprenorphine (Simbadol), which is a partial mu agonist, is commonly used. In situations where a greater degree of pain management is needed, hydromorphone, a full mu agonist, is also used in raptor species. As more and more species' genomes are mapped and further research is conducted, our understanding of opioid receptor subtypes will only increase, meaning that our ability to provide effective pain management will only improve.

SCHOLARSHIP OPPORTUNITIES!

BY KAYLA LADEZ

Happy scholarship season! Check out these fun wildlife/zoo medicine scholarship opportunities:

Donald L. Burton Veterinary Student Scholarship – National Wildlife Rehabilitators Association

Purpose: To enhance the education of a veterinary student interested in working with wildlife. Scholarship is awarded to help cover expenses of attending the National Wildlife Rehabilitators Association Symposium (tentatively scheduled for February 23-27, 2021 in Delaware). Recipient of award will be notified by January 1, 2021. See application website below for full information.

Amount of Award: \$500

Selection Process: Fill out online application, upload 2 signed letters of recommendation and show proof of student status at <https://www.nwrawildlife.org/page/DonaldBurton>

Deadline: November 1, 2020

Georgia Fletcher Memorial Award Essay Contest – Quaker Parakeet Society

Purpose: To provide a monetary award to a student who is studying exotic/avian medicine at the University of Illinois, School of Veterinary Medicine, in memory of Georgia Fletcher. Georgia was a strong advocate of aviculture, avian medicine and research and a great supporter of the Quaker Parakeet Society. Award will be announced January 15, 2021 via email. Selected essays will be published in the Quaker Parakeet Sentinel.

Amount of Award: \$2,500

Selection Process: The winning essay will be selected by the Quaker Parakeet Society Board.

Deadline: Essays may be submitted to qps.scholarship@gmail.com until midnight of December 1, 2020. Please submit them in MS Word or .pdf format.

Essay: Please tell us why you chose to specialize in exotic/avian medicine? Your answer should be at least one page, but not to exceed three pages.

Interested in more free money? Apply for general veterinary medicine scholarships here:

U of I College of Vet Med: [Intranet --> Students --> Awards + Scholarship Info](#)

SAVMA: Members should check their email where they receive new scholarship and grant opportunities in the SAVMA national newsletter at the beginning of every month

American Veterinary Medical Foundation Scholarships: <https://www.avmf.org/programs/education/>

Zoetis: <https://www.vetvance.com/scholarshipapplication/aavmcoverview>

AMPHIBIAN SKIN

BY COLLEEN ELZINGA

Amphibian skin is an important component to their physiology and serves more purposes than the skin of many other species. Their skin is permeable to water and subsequently an important source of moisture. For this reason, amphibians can lose a lot of water through their skin. Most species are found in moist or humid environments where they can replenish their water reserves. Similar to fish species, amphibians also have a protective slimy coating on their skin. Their skin contains glands that secrete mucous to aide in keeping it moist. The mucous serves a dual purpose by providing a protective layer around the body when the animal is on land and facilitating proper salt and water balance within the internal organs when they are submerged in water. In some species, these glands can be even more protective by also producing toxins that provide a defense against predators. Not only that, but amphibian skin is also permeable to oxygen. Thus, it helps them breathe by providing another route for oxygen to pass through the body. The moisture of the skin helps draw oxygen through it.



Another key feature of amphibian skin is the color, which varies depending on the environment. It is often used to camouflage the animal to evade predators. Some species can even change their color depending on the temperature or surroundings. For instance, switching to a darker color by concentrating their pigments allows them to absorb more heat from sunlight in colder weather. Changing to bright colors can then disperse their pigments in warmer weather. Additionally, species that create poisonous secretions on their skin usually have brightly colored skin to serve as a warning to predators.

When handling amphibian species in a clinical setting, it is important to consider the importance of their skin. Handling them with dry, bare hands can cause their skin coating to rub off, exposing them to bacteria and upsetting the balance of their normal physiological processes. Therefore, amphibians should be picked up with gloves that are wet.

BIRD ENRICHMENT ON A BUDGET

BY EMILY GREZDA

Having a bird can be a joy, but it's easy to fall into a rut with ideas for new enrichment. Birds are highly intelligent, and their natural behaviors cause them to destroy their favorite toys with vigor, leaving the \$50 toy you purchased in splinters on the floor of their cage. As vet students, we can't afford to buy new ones constantly, so what do you do? Here are some ideas that can be used for birds from parakeets to parrots – just change the size based on the bird!

Egg carton toys: Egg cartons can either be hung as they are in their cage, and your bird will be happy to chew them up. To make them a little more fun, you can punch holes in them and zip tie beads, playing cards, or tissue paper to them as well. I've also made little "play boards" out of wine cartons from my online wine purchases (don't judge – this is vet med, after all). You can have a lot of fun with this or keep it simple.

Paper towel rolls: These can be put over perches, zip tied to the sides of the bird's cage, or threaded through the bars.

Packing paper: If your Amazon boxes come with paper, don't throw it out. Crinkle it up and stick pieces through the top of your bird's cage, or put it on top of their cage and hide pellets in it.

Veggie scraps: If you've got a broccoli stalk you were going to throw out, hand it to your pet instead! It's less wasteful. Just make sure you don't give them anything with onion or avocado – these are toxic.

Wood boards: Head to a home improvement store and pick out some untreated wooden boards. These can be cut and hung in your bird's cage for particularly destructive beasts. They love to chew on them! For some extra enrichment, drill holes in them and stick treats, paper towel rolls, paper, or parts of other toys in them.

Spices: Put a little bit of ginger, cinnamon, or paprika in a little bit of water to form a slurry, then rub that over some of your bird's perches. It's a safe, fun new taste for your bird to investigate.

Re-purposed toys: If your bird has destroyed part of a toy, but not all the blocks or pieces, try tying them all together with zip ties or twine to make a new one. You can drill new holes if need be – what was discarded before may be your bird's new favorite.

Things to avoid:

Fabrics: You don't want to encourage nesting behaviors that may cause aggressive/undesirable behaviors from your bird.

Tiny pieces: Some toys have plastic or metal parts that can be pulled off (such as in bells) and swallowed. Since birds are naturally destructive, technically everything is a risk, but try to minimize as much as possible!

There are lots of other ways to find inexpensive, easy enrichment. I hope this at least gives you some more ideas – **good luck!**

Sea Turtle Rehab

BY: ALEC COLOSI

Sea turtles are among the most common species in need of rescuing across the east coast of the United States. They face several threats from human activity including boat strikes, fishing equipment interaction, cold stress, and red tide. All of these situations leave turtles in bad shape and in desperate need of help.

Interactions with fishing equipment can take many forms for an animal who runs into a loose net, hook, or fishing line. Turtles can accidentally ingest fish hooks, among other objects, which cause obstruction and damage in the gastrointestinal tract. If the object is in a safe position, it is possible to remove it from the esophagus or stomach manually. Sometimes, laxatives and mineral oil can be used to help push the object along the GI tract. Other times surgical intervention is necessary.



Cold stunning is another condition that can debilitate sea turtles, particularly in northern waters. Most species of sea turtles are cold-blooded and can't regulate their body temperature. If water temperatures drop below 50°F, they lose coordination, stop swimming and eating, and become very prone to predation or boat strikes. Turtles found in this condition have a long rehabilitation ahead of them. It is important at first to reheat them slowly to avoid complications. Long-term they will need close monitoring to correct any electrolyte imbalances and to return to a healthy weight.

In any case when a sea turtle presents to a rehabilitation facility, it is important to perform a complete physical exam to evaluate the animal's condition. Like any animal, we need to assess mentation, energy level, heart rate, respiration rate, etc. Because of turtles' shells, a heart rate would need to be measured using a doppler instead of a stethoscope. Signs of dehydration in a sea turtle include sunken eyes, dry mucous membranes, and decreased skin elasticity. As with mammals, they will also have an elevated PCV. It is also important to observe the turtles head and look for asymmetry, nasal discharge, and the condition of the eyes.

Most species of sea turtles are threatened or endangered and play a very important role in marine ecosystems. Because of this, facilities dedicated to rehabilitating and releasing injured and sick turtles are incredibly important. There are still considerable gaps in knowledge when it comes to sea turtle medicine, but veterinarians working with them every day both help to preserve their populations and further our understanding of how to care for these animals.



Test Your Trivia Knowledge!

BY: RYAN PATTERSON

1. What can you use to age a shark?

- a. Otolith
- b. Vertebrae
- c. Caudal fin size
- d. Teeth

2. What is the only land mammal with more than seven cervical vertebrae?

- a. Giraffe
- b. Alpaca
- c. 3 toed sloth
- d. Fruit bat

3. What is a unique trait of slow lorises among primates?

- a. Venomous
- b. Ability to fly
- c. Hibernation
- d. Obligate Carnivores

4. What is a group of owls called?

- a. A hoot
- b. A parliament
- c. A congress
- d. A flock

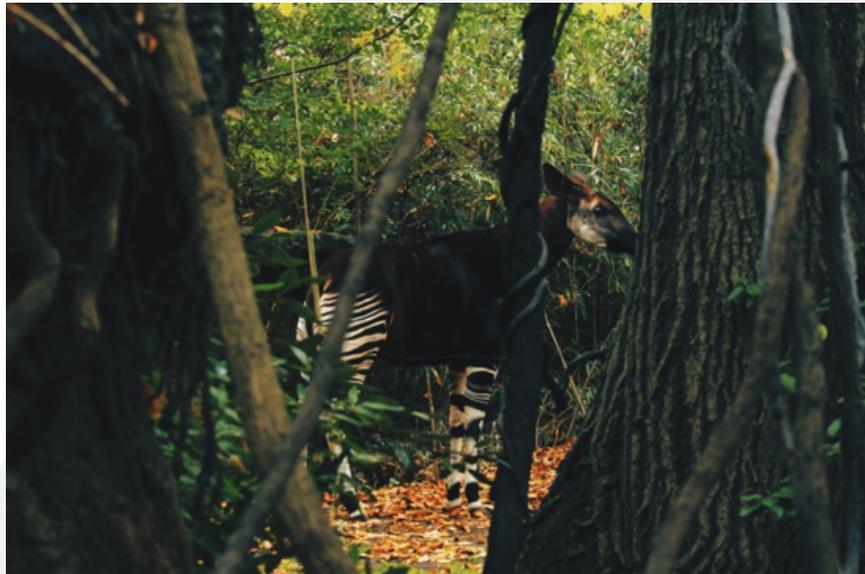
5. What country does not have any snakes?

- a. Ireland
- b. New Zealand
- c. Iceland
- d. All of the above

WORLD OKAPI DAY

BY KENNYMAC DURANTE

Deep within the heart of Africa, hidden amongst the thick shadows of overlapping foliage and rays of sunlight slicing through the dense canopy of the rain forests in the Democratic Republic of Congo, roams a majestic, enigmatic and elusive animal. Some simply call it the "Forest giraffe" while others reference its serene and extraordinary nature appointing it the mythical title; "the African Unicorn." Unbeknownst to the western world until the early 20th century and without a doubt my favorite animal in the world, I am of course talking about, the okapi (*Okapia johnstoni*).



If you are familiar with how much I adore this species, you may know that I think that anytime is a good time to talk about the okapi (yes, even during exam weeks). In fact, it is a better time now than ever to talk about the okapi! Every year, on October 18th, an entire day is dedicated and centered around celebrating this unique animal! World Okapi Day is not only a great way to share information about this species but is also a great way to spread awareness of its entire forest ecosystem in which it and many other species live. But without further delay, let's talk about the one and only, okapi!

Although they are iconic for their white-and-black striped hind quarters, okapis are unique in the sense that they are the only living relative to the giraffe. Just like giraffes, okapis have some distinct anatomical features such as ossicones (ossified cartilage covered by skin) and an elongated-dark prehensile tongue! Adult okapis are typically around 5-6ft tall and can weigh up to 350kg (Females: 225-350kg; Males: 200-300kg). Their fur is a velvety dark hue of purple, reddish-brown, and black and is protected by a layer of oil in order to keep themselves dry during rainy days in the rain forest. Just like our domestic large animal species, okapis are ruminants and are herbivorous. And just like giraffes, they utilize their prehensile tongue to pull leaves from trees. Okapis can travel up to 1km a day as they forage through the rain forest walking along trails created by multiple generations of other okapis.

Okapis can be naturally found in only ONE place on the entire planet, that place being the Ituri Rainforest within the Democratic Republic of Congo (DRC). This forest remains one of the most biologically diverse habitats in all of Africa as it is home to various other natural treasures such as forest buffalo, elephants, leopards, bongo antelope, and 13 different species of primate including gorillas chimpanzees, and bonobos. Due to its endemic nature, okapis are revered as a national and cultural symbol in the DRC and as a result have been protected since 1933. Okapis are the face of conservation for all protected areas of the Congo and appear on the logo for the Congolese Institute for Nature Conservation (ICCN). They can even be found on Congolese franc bank notes!



Shy and elusive as they are serene and gentle, okapis have incredible natural defenses against predators such as their unique markings that provide camouflage, sharp sense of smell and profound hearing capabilities. With such remarkable senses to blend in with and be aware of their environment, it's probably no surprise that this makes them nearly impossible to observe in the wild. However despite its symbolism and elusive nature, wild populations of okapi face various detrimental factors that threaten their survival. The okapi is entirely dependent on its forest sanctuary and due to illegal poaching, slash-and-burn agriculture, and destructive gold mining, they have been listed as an endangered species by the IUCN in 2015.

Despite these threats, okapi conservation has been stronger than ever before. In 1992, the Okapi Wildlife Reserve was established and has been managed by the Okapi Conservation Project (OCP), the ICCN, and local communities throughout the reserve. This reserve consists of 13,700 sq-km of preserved natural habitat in order to protect okapis and the various other species that call this rain forest home. To gain a greater appreciation of just how large this reserve truly is, this protected natural habitat is 1.5x the area of Yellowstone National Park! In addition to profound in situ conservation efforts, okapis are further protected via ex situ efforts as well. Multiple professional zoological facilities house okapis in order to help conserve this species for future generations. Through various efforts such as breeding and education, the OCP relies heavily on zoos around the world to help conserve the okapi.

Sharing information about this species, that has historically been a bit more mysterious than others, is something I genuinely love to do. Okapis are truly magical animals and they continue to be the core inspiration to my passion for conservation. It is my hope that you may feel the same after reading this article and I hope you learned something new about okapis. Come find me if you ever want to talk about okapis!

Fun Facts about okapis!

1. While both sexes of giraffes have ossicones, only male okapis develop fully formed ossicones!
2. The okapi is a solitary species with the exception of the time mothers spend with their calves (approx. 6 months). Okapis however have been documented to feed together in very small groups for short periods of time.
3. Okapis eat leaves, fruits, and fungi that are typically toxic to other species. They will consume charcoal and clay which can act as a detoxifiers and provides them with essential minerals for their diet.
4. Okapis become mature between 2-3 years of age and can live between 20-30 years.
5. Okapis have scent glands on each foot, allowing them to leave behind a sticky tar-like substance to mark their territory.
6. Not only are the stripes of an okapi a great way to provide camouflage within the rain forest but they also serve as a way for a calf to recognize and follow its mother.
 7. The okapi wasn't discovered by the western world until the year 1901.
 8. The ears of an okapi can rotate independently, so they can listen for sounds all around them.
 9. Okapis are sexually dimorphic. Females typically weigh 100 pounds more than males, while males have ossicones.
10. Calves will stay in one place on a "nest" for the first six to nine weeks of their life. They can go up to 60 days before defecating, as to not attract predators with their scent.
 11. Each okapi has its own unique stripe pattern!
12. An estimated 3000-4000 okapi live on the Okapi Wildlife Reserve. It is estimated that their total population is within the range of 15,000-20,000.

HOW TO SEE YOUR SEAFOOD

BY SHEVON MEADOWS



October is National Seafood Month! Keeping that in mind, more than 50% of the seafood produced for global human consumption is farmed, and that number is only expected to increase in the coming years. While sustainable fishing practices have been implemented in a variety of ways, the seafood demands of the world could not be met in a sustainable way if it weren't for the practice of aquaculture.

Aquaculture is a broad sector that encompasses the farming of fish, mollusks, plants and more in both salt and freshwater environments. Methods of farming can vary greatly depending on what is being produced, but a typical saltwater fish setup can include indoor water tanks for egg fertilization and early stages of development, with the fish being moved to open ocean netted enclosures for maturation. Along the way everything from water quality to waste removal is highly regulated.

(Check out this video for a quick look at the process ->
https://www.youtube.com/watch?v=OXOXn_5PtNI&t=136s)

When implemented with proper practice protocols, seafood can be farmed with very little environmental impact. According to Monterey Bay's Seafood watch, "such operations limit habitat damage, disease, escapes of farmed fish and the use of wild fish as feed." In the US, NOAA is on the forefront of regulations and policies for fish farming and has made international partners with a multitude of organizations and bilateral agreements with 10 different countries. NOAA provides a database called FishWatch that allows users to access seafood profiles such as population status and management so that consumers can make informed seafood choices. Our June newsletter piece highlighting sustainable fishing practices also provided a resource called Seafood Watch that provides recommendations on fish to consume based off sustainability and environmental impact. Lastly, here are some fun facts you may not have known about aquaculture:

- Aquaculture has grown at a rate of 8.4% since 1970 and production is estimated to experience an overall increase of 50% from 2011 to 2030.
- Atlantic salmon only require 1 kg of dry food to grow 1 kg of flesh (1:1), while the feed to growth ratios for chickens is 3-5:1, and pigs is 8:1!
- About 580 aquatic species are farmed around the world.
- Over 70% of the world's wild fish stock has been depleted due to overfishing, which is why aquaculture has become a necessity. It ensures the demand for fresh fish for consumption is met, as well as helping to replenish wild stock.

CROCTOBER: HERPS GUARANTEED TO BEAT YOU IN A COSTUME CONTEST

BY BROOKE DUGAN

October marks a great seasonal shift in the year. Crisp air, crunchy leaves, apple cider, pumpkins. But there's more to October than just pumpkins and leaf piles. The most important thing to remember about October is that it's spooky season, and while our spooky times may be a bit different than usual this year, the need for great costumes never goes away. We might not be going to any costume parties anytime soon, but just know in your heart that there's some die hard reptiles and amphibians that are going to that costume party for you. I went through species after species and narrowed down some of the best reptile and amphibian costumes for you.

First, the honorable mentions! These friends tried their hardest, and they get a participation trophy for having a great costume.

Surinam toad: For triggering everyone's trypophobia they didn't realize they had until now. Seriously. Thanks. I didn't need to sleep tonight. Would have won if I didn't want to risk everyone's health and wellbeing by posting a picture of one. 17/10 for the nightmares.

Mossy frog: Not a real frog. Actually moss. 0/10 for being a plant and not a frog.

White-lipped python: That's a first class skull mask you got there. Simple, classic, and still effective. 6/10

And for this year's personal favorites, here are some herp friends that are ready for Halloween 24/7/365

Blunt headed tree snake:

Her 2 year old drew a stick snake on the living room wall in Sharpie, threw some Power Puff Girl eyes on it, and begged her to make it her Halloween costume this year.

12/10 for dedication and not putting the infant in time out until she's at least 7.



Gharial:

Things that make you go huh? You can't just put on a lumpy nose and call yourself a witch. **6/10** for being a funky reptile with a lazy costume.



Asian vine snake:

An excessively judgemental shoelace. Was going for the scary Karen approach, but crossed the line into unsettling. I don't need your sass, and no, you can't speak to my manager.

2/10 for effort. **10/10** for judgement.



Satanic leaf gecko:

Possessed leaf? Cursed object? A warning? I don't know, but clearly we're dealing with a monster that's not from under the bed. Nay. This monster fell from the sky.

9/10 for making me look up suspiciously in the safety of my own house.



Chinese giant salamander:

Cranky grandpa.

7/10 for realistic expectations.



Philippine Sailfin Lizard:

Is it a dragon? A Godzilla stunt double? The next big star in the Jurassic World franchise? Idk but they're going places. **9/10**



Black Knobbed Map Turtle and Ringed Map Turtle:

Cousins with coordinating punk costumes. A bit odd, and they fell a little short of hitting those hardcore turtle vibes, but altogether, a great effort. I'd give them their own franchise. Move aside Mikey and Leo. There's some new edgy turtles on the block, and they're coming for you.

7/10 for bringing punk back.



VETERINARY CARE IN ZOOS: THE IMPORTANCE OF BEHAVIOR TRAINING

BY RACHEL ANGLES

When you take your dog or cat to the vet, chances are that because they are domesticated, they are comfortable enough that it is fairly simple for the veterinary staff to examine them. This process can be a little bit trickier for veterinarians that work in zoos, however. Their patients are not domesticated and not as comfortable around people. So how do zoo veterinarians perform basic procedures like physical exams?

Manual restraint can be used for some of these patients, but often this can be risky for the handler and cause unnecessary stress for the animal. If the animal is stressed this can also affect some types of diagnostic tests and make them more difficult to interpret, like elevating levels of specific chemicals in the blood. Anesthetic darts can also be used to sedate these animals at times but can pose a risk to the animals both from anesthetic complications and complications from the impact of the dart itself. This method is necessary for some veterinary procedures, but minimizing the amount of manual restraint and sedation required allows for more frequent examination of these animals, allowing for earlier detection of disease and better preventative medicine.



So how do zookeepers and veterinarians ensure compliance from these non-domesticated patients without any unnecessary risk? The answer to this question comes in the form of positive reinforcement training. This allows animals to voluntarily participate in veterinary and husbandry procedures without unnecessary risk to the animal, the veterinarians or the zookeepers. Positive reinforcement training is reward-based. Here's how it works: whenever the animal does the desired behavior, the zookeeper or trainer makes a noise called a "bridge" (typically a whistle or a click) then rewards them with something the animal likes (usually a food item). One of the first key behaviors that is taught to many animals is "target training". This involves the animal touching a body part (usually their nose) to an item designated as the "target". Another important behavior that is taught early is the ability to "station". This behavior involves the animal going to a pre-designated spot and staying there. These skills are very important when it comes to shaping more complex behaviors which are useful in a veterinary examination, such as opening their mouths for a dental examination, stepping up onto a scale, presenting body parts for blood draws or ultrasound, or training for cooperation during the application of different medicines.

Another positive aspect of these training sessions is that they are a form of enrichment. Behavioral enrichment enhances the quality of life for animals in captivity by encouraging a range of healthy, species-typical behaviors. They also strengthen the bond between the animals and their keepers, which results in lower levels of stress. Overall, behavior training is vital in zoological institutions in order to keep animals happy, healthy and engaged. Zoos have been utilizing this strategy for care and management of their animals for over 30 years, and still new and innovative ways of training are being discovered for many different species.

Test Your Trivia Knowledge!

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 - a. Otolith
 - b. Vertebrae**
 - c. Caudal fin size
 - d. Teeth
2. What is the only land mammal with more than seven cervical vertebrae?
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 - b. Alpaca
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 - d. Fruit bat
3. What is a unique trait of slow lorises among primates?
 - a. Venomous**
 - b. Ability to fly
 - c. Hibernation
 - d. Obligate Carnivores
4. What is a group of owls called?
 - a. A hoot
 - b. A parliament**
 - c. A congress
 - d. A flock
5. What country does not have any snakes?
 - a. Ireland
 - b. New Zealand
 - c. Iceland
 - d. All of the above**



HAPPY HALLOWEEN!!!
- NTS EXEC BOARD

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