HABITATS TOUR GUIDELINES

The goals of this tour are to introduce students to the concept of a habitat, familiarize them with several specific biomes and habitats and teach them to appreciate the needs of wild animals. (**Biome** is a group of habitats with similar climates, weather patterns, seasons, and plant species. 5 basic biomes: tundra, grassland, desert, forest—temperate & tropical—& aquatic—marine & freshwater.) The tour highlights selected zoo animals with which we share our world. The amount of information given about each animal and the number of enclosures visited can easily be modified to suit student age and ability.

When presenting to students younger than 8, some concepts may have to be simplified. To help you can evaluate the knowledge level of your group, ask leading questions like; *"What do you need in your home?"* . Include comparison between animals and humans: *"Do you have toys in your home? So do the animals at the zoo… their toys are call enrichment!" Do you like climbing trees? So does the Koala (or Siamang, Howler, or Langur)!"*

To get the point across adapt your language to the student level; the word "home" may replace "habitat"; however, introducing the word "habitat" is important. Use sensitive language when talking about habitat destruction, and always end on a positive note.
Focus on animal homes, biomes are a little abstract for this age group. Animal stories and names always make a tour personal.

Habitat:

- Contains everything that an animal needs to survive, including air, food, water, shelter, sun, space and other animals.
- Many habitats can be found in each type of biome.
- Generally, the tour speaks the general types of biomes: Grasslands, Desert, Forest—tropical & temperate, Tundra, and Aquatic—freshwater and marine

Desert:

- Types: hot and dry, semiarid, coastal and cold; thermoregulation and water conservation is important for plants and animals. Plants must be able to respond quickly to the rain so that they can produce their seeds before things dry out again.
- Some desert habitats include; Sahara in Africa, Mojave in the U.S. and the cold desert of Gobi in Mongolia
- Desert defined as **less than 10 inches of rain annually**; some years there may be none. Animals get most of their water from the food they eat and have various ways to conserve water.
- Temperatures change drastically, days are very hot and nights are cold.
- Antarctica is considered a desert as it receives less than 10" of rain annually.

- Not much shade or shelter. Animals tend to be more crepuscular and nocturnal to avoid hot part of day. Many dig burrows to enter during the hot part of the day.
- Characteristic vegetation is shrubs and succulents.
- **Meerkat:** are light grizzled gray to help reflect the heat of the desert and to conceal them against the dry dusty earth. Dark coloration surrounds the eyes and act as natural sunglasses. They can stare hard into bright sky and spot birds of prey at great distances.
- **Desert tortoises:** Much of the tortoise's water intake comes from moisture in the grasses and wildflowers they consume in the spring. Water that reaches the bladder is not lost to the system but can be drawn upon as needed. They have flattened front limbs with well-developed muscle and sharp claw-like scales adapted for burrowing to remain cool. Adult tortoises can survive a year or more without access to water. To maximize the utilization of infrequent rainfall, tortoises dig catchment basins in the soil, remember where these are, and may be found waiting by them when rain appears imminent.

Forests:

Temperate Forest:

- Get 20-40 inches of rain annually.
- Distinct seasons, usually including cold winters**.**
- Characteristic vegetation: deciduous trees (those that loose leaves in the fall) and evergreen or conifers. Wind pollinated species are predominant.
- Animals use trees for winter shelter.
- Include Redwood forests in California, Eucalyptus forests in Australia, Conifer forests in Europe, Canada and the U.S.
- **Koala:**
    - Koala's get food and water from the eucalyptus. Eucalyptus contain 40-60% water.
    - Need special digestive system and powerful jaws to break down tough, poisonous eucalyptus leaves. They have an extremely long caecum (8 feet) where microbes break down cellulose and detoxify eucalyptus oils that are toxic to most other animals. With the long caecum they can maximize digestion of cellulose from the leaves and also extract water.
    - May stay in one tree for weeks at a time. Compact, pear-shaped body provides stability and a thickly, padded tail provides comfort allowing koalas to sit in tree all day. Their arboreal existence keeps them near their food and water source of Eucalyptus leaves.
    - Koalas are gray to tawny above and whitish below. This countershading provides camouflage from predators that may be looking up against the sky or from above looking down.

- Koalas are nocturnal which allows them to be active in cooler temperatures. They lose less moisture and use less energy at night. Koalas cool themselves by licking their arms and stretching out as it rests in the trees. Koalas have no sweat glands.
- Extra thick fur, especially on the neck and shoulders, helps protect the koala from high and low temperatures and even the worst weather, as koalas do not build nests.
- Specialized paws including opposable thumbs and toes allow for a tight grip when climbing trees. Hind paws: second and third digit fused and used for grooming and wide, clawless opposable toe for good grasping and climbing. Front paw: two clawed opposable digits on each paw for good grasping. They are good tree dwellers with vice like grips. Rough pads on undersurface of hands and feet increase traction while the koala is climbing. Have fingerprints like humans for secure grip while climbing or grasping.

Tropical Rainforest:

- Richest and most diverse environment on Earth; half of all plant and animal species are from rainforests. Over 500 million insects. There are many different habitats at all levels of the environment.
- Seasonality is low. Plants can afford to specialize since food is available year round.
- Warm, wet climate year round with dense vegetation. No need for water conservation but competition for sunlight.
- Vegetation is flowering trees with smooth bark, buttress roots or prop and stilt roots provide extra stability, lianas and bromeliads. Pollination is predominantly done by animals. Leaves tend to have drip tips to enable rain to run off quickly to avoid growth of fungus and bacteria or the leaves becoming too heavy for the plant to support.
- Bromeliad water reservoirs support a thriving eco-system of insects, amphibians and birds.
- Rainforests have **greater than 80 inches of rain annually**. The Tropical Rainforest can have 100-400 inches of rain annually.
- Tropical rain forests have constant warm temperatures and high humidity.
- Some animals can live entirely in the tree branches (canopy), while others stay on the forest floor or fly above the treetops.
- Largest is the Amazon rainforest, biggest than all others put together
- Animals include monkeys, boas, tree frogs, large variety of birds, spiders, tapirs, ocelots, jaguar and tigers
- Serious decline due to clearing for farmland and logging.
- **Sumatran Tiger**
  - These tigers live in the jungles of Sumatra. The Sumatran tiger is smaller than the Siberian, which helps it move around in densely forested areas.
  - Eyes face forward, like the lion, for better depth perception while hunting. Compare this to the zebra, whose eyes are on the sides of its head for defense.

    - Darker coat than Siberian tiger's to conceal in thicker underbrush. Their stripes help camouflage them while they sneak up on their prey by blending into their environment. The striping also helps break up their body shape, making them difficult to detect for unsuspecting prey. Their darker coloration may be a hunting advantage within their heavily wooded forest habitat.
    - Tigers are nocturnal. They have large eyes with a developed tapetum lucidium, which enhances low light conditions by reflecting the light through the eye a second time so see and stalk their prey more easily.
    - Long tails used for balance when making sharp turns in pursuit of prey.
    - Ears have well developed earflaps that are keen sound collectors. Tigers are capable of hearing infrasound, which are sound waves below the range of normally audible sound. Tigers use infrasound to communicate over long distances or dense forest vegetation because the sound is capable of passing through a variety of mediums such as trees and mountains.
    - This tiger has distinctively long whiskers that are useful sensors in the dark and dense underbrush.
    - Tigers are excellent swimmers, easily crossing river 4-6 miles wide and have been known to swim 18 miles. By swimming they are able to increase their territory and available food to them. They have webbing between their toes. Will run hoofed animals into water, which are much slower swimmers.
- **Howler Monkey**
    - These monkeys live in the South American rainforest canopy (branches).
    - Eat mostly leaves, fruit and flowers.
    - Adult males are black, while the females and young are brown.
    - Have prehensile (grasping) tails that are used like an extra hand. Long tail provides balance as they move about in the trees. Their prehensile tail is sensitive to touch and enables the monkey to feel what it is gripping thus assisting when leaping from tree to tree. The Strong prehensile tail that can catch a limb if the monkey falls.
    - Their call that gives them their name, howler monkey, can be heard 3-4 miles away even in the dense forest. Howlers have enlarged throats, due to an extra-large voice box which acts as a resonance box, amplifying the howls. This allows the howler to communicate over great distances, the troops location and territory. Males use their booming voice to defend their territory. Hyoid bone amplifies call.
    - Forward-facing eyes for binocular vision (allowing depth perception) and good movement through the trees.
    - Howlers lack the opposable thumb but their hands have a cleft between index finger and middle finger that affords a secure grip for their arboreal life.
    - Howlers lack the specialized stomach of true leaf eater monkeys but they do have a slightly more complex stomach to handle their leafy diet. The cellulose-digesting bacteria needed for fermentation are found in small sacks below the small intestine.

Not true leaf eater. They eat the tender young leaves and are an important seed disperser.

- **Anaconda**
  - The green anaconda can grow up to 36 feet long and can weigh up to 550 pounds and measure more than 12" in diameter. Can eat larger prey such as a capybara. Generally shorter but wider than reticulated python but outweighs it by 2xs.
  - Eyes and nostrils are located on the top of the snout so the snake can stay submerged while hunting. It lies in a murky pool to ambush prey coming to the water to drink. It can stay submerged for 10 minutes at a time and often lies beneath the surface waiting for prey. It seizes its prey quickly with its sharp teeth and drags it into the water. It is extremely muscular and squeezes tighter each time the animal breathes out so it cannot breath again. The prey dies quickly from suffocation and is swallowed whole. On land it will usually hang from a tree and grab the prey from above.
  - The black patches on its back combine with dull background color to blend in with the thick, wet vegetation of its habitat.
  - Excellent swimmer. This heavy snake is more at home in the water than on land, and it swims with grace and agility. The anaconda is capable of surprising speeds both under water and on its surface.
  - Anacondas have scales to protect their bodies from the variety of terrain they encounter. Its habitat is largely made up of water.
  - Anacondas grow throughout life. 500 fold increase in mass from hatchling to adult. Shed their skin in response to growth and to ensure a continual protection from the environment.
  - A thin transparent scale (brille) protects the anaconda's eyes. The brille helps the anaconda see while submerged and from brush on land. The brille is shed with the skin.
- **Poison Dart Frog** or **Poison Arrow Frog**
  - 40 species of *Dendrobates* poison dart frogs. All have bright coloration, an adaptation for diurnal foraging, in which predators can easily recognize and avoid their toxic skin secretions. Camouflage is their main defense mechanism. An amphibian's poison defense is usually a last resort and will only work if a predator tries to eat it.
  - Four methods of breathing in a frog: gills in tadpole stage, lungs, skin, buccopharyngeal (Gas exchange also occurs across the moist surfaces of the mouth and pharynx – throat pulsation increases with temperature). Need a moist environment to live and breed.
  - Smooth skin that serves as a respiratory membrane, protects against abrasions and parasites, absorbs and releases water, has poisons that protect against predators and acts as camouflage to warn away predators.

    - Naked, not watertight skin. Amphibians are a key to health of an environment. Water quality issues are indicated by a decrease in amphibians.
    - Play an important role in food webs as both predator and prey, maintaining the delicate balance of nature.
    - Terrestrial. Have sticky suction cup pads on toes for climbing and clinging to leaves and branches. Front feet lack webbing.
    - Breed in the trees. Eggs are laid in holes in tree limbs or in plants such as bryophytes or bromeliads that collect enough moisture to pool in the bottom to hold the tadpoles when they hatch.
    - The skin of a poison arrow frog stays sticky from mucus. This feature helps to hold in moisture and it helps tadpoles hold on tight when they are being carried from hatching site to nursery site.
- **Southern Cassowary**
    - The helmet like casque may be used as a shovel to search for food in the leaf litter of the forest floor and may be an indication of dominance and age. The casque may protect its head in the dense vegetation as it is running. It continues to grow slowly throughout the bird's life and may be an indicator of social status and dominance.
    - Course plumage and scaly legs help protect the body from sharp vegetation, thorns and leaves as it moves around the dense forest floor.
    - Primarily frugivorous diet, which they eat whole and are thus are important seed dispersers.
    - Flightless bird with long, strong leg muscles for running and jumping. Can run 30mph through thick underbrush and jump ~ 5 ft.
    - Cassowary has three toes with a stout claw while the middle toe has a long dagger-
    - Most active occurs during early morning and late afternoon as well as moonlit nights. This allows it to be inactive during the hottest part of the day.
    - Excellent swimmer and divers.
    - Cassowaries produce a variety of different sounds, ranging from booming low frequency territorial calls to the coughing contact call used by an adult male to maintain contact with chicks in the dense vegetation.

<u>Grassland:</u>

- Intermediate areas that are too dry for forests but too wet for deserts
- Two types: **Tropical** (Savanna), like the Serengeti Plains and **Temperate**, like the prairies of the American Midwest.
- Hot summers and very rainy seasons, and seasons of drought
- Wide flat, open spaces with grass growing abundantly, few trees, shrubs and bushes
- Home to large herding animals and large predators (zebra, wildebeest, giraffe and lions, wild dogs and leopards
- Few places to hide from predators. Larger herbivores tend to remain in large groups.

- Prey animals in grasslands are fast runners.
- Many grasslands are habitats to burrowing animals like prairie dogs
- Grazers and browsers divide up resources (Zebra and Giraffe)
- Grasslands areas are being taken up for farming and domestic animal grazing
- **Zebras:**
    - Typical prey animals of the African grasslands; Live in large herds and eat tall, coarse grasses (herbivores).
    - Defenses include: eyes are on the side of their heads so they can see predators, ears are large and can rotate so they can hear well, and nostrils are sensitive so they can smell predators.
    - Stripes are <u>not</u> for blending into tall grass. In a large group, zebra stripes break up their outline and confuse predators.
    - Group name for zebras: "dazzle"
    - Incisors developed to facilitate biting off quantities of vegetation. Massive jaws and powerful check teeth and muscles evolved for thorough mastication of course, fibrous plant material.
- **Reticulated Giraffe:**
    - Tallest land animal. This allows them to eat from treetops as well as lower branches and shrubs, thus reducing competition with other hoofed animals. They can spot predators better at that height.
    - The brown "reticulated" fur pattern helps the giraffe to stay camouflaged in the grassland surroundings and hide their outline. The unique patterns are used for individual identification.
    - Giraffe tongues are 18 inches long and prehensile so they can grab leaves from among the thorns of acacia trees. Tongues are bluish-black and slimy to protect from rough browse and provides natural sunblock. Their thick, sticky saliva coats any thorns they might swallow, preventing them from being hurt from the thorns.
    - Nostrils can be closed at will to protect against dust
    - Large eyes are on the sides of their head to spot predators and are shaded by long eyelashes, which protect them from dust and thorns of acacia trees.
    - Giraffes can go weeks without water. Must spread long forelegs to the side or get down on its knees in order to head down to drink. This is a very vulnerable position for predation. Giraffes get some water from the browse (acacia leaves). Usually drink every 2-3 days when water is available.
    - Long legs able to wander long distances in search of food. Also can run away at a speed of 35 mph in avoiding predators.
- **Ostrich:**
    - Largest flightless bird with long muscular legs built for running. Can run over 30 miles per hour to escape predation. Can cover great distances with minimum effort and lead nomadic lifestyle. Feet have two toes each with short nails and powerful thick bare legs (Leg bones are solid). This allows the Ostrich to reach speeds of

35mph.
    - Male: black and white; Female: brown. The female needs to be camouflaged while sitting on the nest during the day (the black male is camouflaged while sitting on the nest during the night).
    - Excellent eyesight with large eyes combined with long neck and long legs giving the ostrich advantages for spotting potential predators from a long way off. Eyes are largest of any land animal.
    - Long eyelashes for protection from the sun and dust from their habitat.
    - Live together in groups. There is safety in numbers. Ostriches travel with antelopes and zebras that stir up insects, small reptiles and rodents, which the ostrich likes to eat. It is a mutually beneficial relationship as the ostriches keep an eye out for trouble.
    - Drinks water every 2-3 days when available. An ostrich can go weeks to months without water.
    - Pink, naked skin-covered pouch is part of the respiratory system and is used in display and a cooling mechanism.
    - Attracted from great distances to grass fires, where they march along the fire front eating fleeing insects and mammals.
    - Storks direct excrement to their legs to aid in cooling.
- **African Lion:**
    - East, South and Central Africa
    - Main predators of the African grasslands
    - Lions spend 20 hours or more each day sleeping in order to save energy and conserve water.
    - 4-6ft at the shoulder and 250-550 lbs.
    - Males' large manes protect their necks from being bitten during fights with other male lions.
    - Strict carnivores (obligatory carnivores)
    - Live in groups called “prides” of 4-6 females and one male. The lion is the only truly social cat and lives in a group (2-3 males in average size pride of 15). Adult males able to defend territory and gain females better than a lone male. About every 3 years, males of the pride are challenged and driven off by other males.
    - Pelage blends in with their environment, helping camouflage the lions while they sneak up on their prey.
    - Lions are mainly nocturnal. They have large eyes with a developed tapetum lucidium, which enhances low light conditions by reflecting the light through the eye a second time so see and stalk their prey more easily.
    - Female is smaller and more agile. The majority of the hunting done by the females. Digitigrade locomotion assists the lion in being generally quicker and able to move more quietly than other mammals.
- **Common Hippopotamus:**

- Hippos have small legs in proportion to its body. Being mainly aquatic reduces the weight burden of the hippo's body.
- Hippos are still extremely fast on land. When threatened the hippo will head to the water for safety.
- Ears, eyes and nostrils are placed high on the head, allow the animal to breathe and keep watch, smell and hear while most of its body remains submerged.
- Ears and nostrils pinch tightly shut when the animal dives underwater, making it easier for them to stay submerged. This allows the hippo to close out the water. A hippo can remain underwater for 3-5 minutes.
- Eyes have a nictitating membrane. The nictitating membrane protects the eye from debris in the water and at the same time allowing the hippo to see.
- Four partially webbed toes aid the hippo on land and water. Hippos have a non-streamlined, barrel-shaped body, and don't swim well but instead walk on the bottom of waterbeds. On land the toes splay out to distribute weight evenly and therefore adequately support it on land.
- Terrestrial at night and herbivorous. Hippos are nocturnal, coming on land nightly to feed, traveling more than 5-miles from water when foraging. Not territorial on land. Hippos establish trails on the land to ease movement and marking their territory with feces. Common dung middens on land may assist in communication and orientation at night.
- Aquatic during the day. The water serves to keep their body cool and hydrated and also gives them buoyancy to ease their weight burden on their limbs. The hippos can dehydrate easily through their thin skin. The hippo has neither sweat nor sebaceous glands but relies on water or mud to keep cool. Hippos spend much of their time in the water, as their skin requires frequent moisture to avoid drying out.
- Thought by the natives to "sweat blood". Skin is glandular and exudes droplets of oily moisture containing a red pigment, which prevents the skin from drying and cracking. This pigment also has an antibiotic property and inhibits the growth of disease-causing bacteria.

- **Kangaroo and Wallaby:**
  - All the animals in the Australian walkabout are brown or grey and blend in with the dirt and underbrush of the Australian grassland.
  - There are very few places to hide, grassland animals usually run to avoid predators.
  - Notice the powerful back legs and tail of the kangaroo and wallaby
  - Australian grasslands are hot, so kangaroos and wallabies are nocturnal; they sleep during the day and are active at night when it is cooler. This helps them to conserve water. They receive water from the plants that they eat, an adaptation to warmer climates.
  - Group name for kangaroo: "Mob"
  - Have the students hop like kangaroos. Would it help to have that big tail for balance and support? They are robustly built, with large, well-muscled tails and powerful

hindquarters. The tail is strong enough to support the kangaroo's body weight, acts as a balance when jumping, and is used, with the two legs, to form a tripod for resting. Kangaroos are able to jump 30 feet in one bound and as fast as 35 mph. The tail can be used as a prop when standing. Hind legs are much larger than their front limbs which an adaptation of jumping.
    - Kangaroos can hop for a very long time without getting tired. They can store energy in their Achilles tendons in their hind legs. Like the spring in a pogo stick, these tendons release more and more energy as the kangaroo hops along. The faster it hops, the less energy it takes for the kangaroo to keep going. Kangaroos can maintain a speed of 12 mph for hours.
    - In high temperatures they often lick their arms, chest and legs using the evaporating saliva to cool the body.
    - Embryonic diapause. The female is able to suspend the development of an embryo until climatic conditions improve or until an earlier joey has left the pouch. Under good breeding conditions, nearly all females have one running offspring and one attached to a teat in the pouch.
    - Foregut fermentation or rumination with large sacculated stomach. Larger particles are selectively filtered out and retained in the rumen to be broken down further, allowing kangaroos to extract maximal nutrition from their diet. By chewing their food twice, kangaroos avoid having to chew their food thoroughly while foraging; proper mastication can be performed while resting during the heat of the day. The multi-chambered stomach allows harsh grasses to be digested.
- **Chacoan Peccary:** relatively small feet to help them to move around the thorny plants of their habitat. They have well-developed sinuses to combat dry, dusty conditions found during much of the year in the Chaco. Peccaries use their tough snout to roll cacti on the ground knocking spines off cactus pads and dig up roots that provide nutrients and water. They may also pull off the spines with their teeth and spit them out. They are non-ruminating with a two-chambered stomach that is specialized to digest cacti and specialized kidneys to break down acid from the cacti and secrete concentrated urine to conserve additional water. Peccarries get most of their water from their diet.
- **Black-Tailed Prairie Dog**
    - Have relatively large eyes on the side of their head giving good peripheral vision when looking for predators. Will stand on hind legs when looking for danger.
    - Short stout body and short legs allow them to be close to the ground and hence their food supply.
    - Tend to be in large groups foraging for food. Larger numbers akin to herbivores. There is safety in numbers.
    - The uniform pale tan to cinnamon-buff pelage provides excellent camouflage from their predators.
    - Prairie dogs have short ears and which are often hidden in the fur. This protects them from dirt when burrowing.

- Prairie dogs have highly organized societies (coteries), living in burrows, which provide them with a refuge and a place to rear their young. Prairie dog colonies, or towns, may contain hundreds of individuals living within a very restricted area. Within the town there are neighborhoods, or coteries. Burrows have inner connected chambers for specific uses like a listening room, sleeping room, nursery and a latrine. The burrows keep them protected from the elements.

Aquatic
Ocean/Marine:

- Open oceans, estuaries and shores, lakes and streams, wetlands (swamps marshes and bogs)
- Cover almost 75% of the planet with salt water.
- 90% of the marine animals live near the surface.
- Within 300 ft. of the surface: sunlight, low pressure, plants and nutrients.
- Mammals of the ocean live near the surface to breath air.
- Few animals live in the deep ocean -- dark, cold, high water pressure.
- Include the California coast, the Great Barrier Reef by Australia and the Gulf of Mexico.
- **Magellanic Penguin**
  - Magellanic penguins don't live where it's cold, unlike some species of penguins. They are in great danger of overheating than freezing because of their excellent insulation. To cool they may hold their wings out. Also they loose extra body heat by panting, holding their wings out to their sides or by fluffing their feathers. The wings are highly vascularized and penguins can direct the blood flow to the wing to help in thermoregulation. They also lie on their belly and extend their feet. During warm weather, they will lose the feathers around their eyes resulting in a pinkish color of the newly exposed skin. These areas are also highly vascularized, allowing the penguin to dissipate excess heat from their bodies. These feathers will grow back as the weather turns cooler.
  - Penguins are birds, but they "fly" through the water instead of the air. The triangular shaped wings have flattened bones and form a rigid flipper, which is an effective hydrofoil with their mobile shoulder. The carina supports strong pectoralis and supracoracoideus muscles, giving penguins a powered upstroke as well as the downstroke. Penguin bones are thicker and denser than flighted birds in order to overcome buoyancy, giving them an improved ability to chase and dive for food.
  - Penguins are not hunted by polar bears -- all penguins live in the southern hemisphere and all polar bears live near the north pole.
  - What special adaptations do penguins have for ocean life? The plumage of the penguin is thick, waterproof, narrow feathers. The small, symmetrical feathers are overlapping and densely packed, with more than 70 feathers per square inch uniformly covering their body. The quality of the coat is maintained by preening and

the application of oil from glands at the base of the tail.
    - Their short legs with webbed feet and are set toward the rear of the body which serves two purposes; first to support their bipedal posture which allows them to move about land and take big leaps; secondly, they are able to become extremely hydrodynamic in the water, with their feet pointed straight backward and their streamlined body.
    - The Magellanic's color pattern is quite distinctive, black back and head top are set off from white front by an encircling strip of black and white. The "tuxedo" coloration of the Magellanic Penguin provides countershading. The dark side blends in with the dark ocean depths when viewed from above by a Petrel. The light side blends in with the lighter surface of the sea when viewed from below by a seal. This camouflaging provides protection from their natural predators.
    - Penguin's use their low light vision to locate and capture prey in the ocean depths. Underwater their eyes are protected by a nictitating membrane that covers the cornea. They are able to reach speeds of over 15 mph and can dive to an average depth of 198 feet. Penguins have a powerful blue-gray hooked bill with a spiny tongue, and horny, rear-directed spines pointed towards the throat, which is ideal for foraging for fish.
- **Sea lions**:
    - Streamline, torpedo-shaped body with 4 limbs modified into flippers for maneuverability in the water makes them excellent swimmers. Head is flattened and face shortened to aid in rapid propulsion through the water. Their hair grows in one direction minimizing drag in the water. This allows them to swim fast in pursuit of prey and avoidance of danger.
    - Nostrils are slit-like and can be closed along with their ears when going underwater, thus keeping the water out.
    - Small external ear flaps to minimize heat loss in cold aquatic environment and minimizes drag for faster swimming.
    - The eyes are generally large with a retina adapted for low light conditions. By having rods only they lack color vision which is not needed in the dark ocean. They also have a reflective tapetum lucidum that enhances low light conditions by reflecting the light through the eye a second time. Their eyes are deeply set in a cushion of fat, which provides protection from the pressure changes of the ocean depths and are protected by a mucous secreted by the eye.
    - Dense fur consisting of long coarse guard hairs underlain by shorter, finer underfur. Pelt protects them from abrasions of sand and rocks as they come ashore for reproduction. The underfur traps air providing insulation against the chilly waters. Molt is not annual but sea lions renew their pelt gradually all year long.
    - Long whiskers, (vibrissae are smooth) loosely attached to the sea lion's upper lip. Each whisker can rotate around with the underwater currents, letting the sea lion "feel" any food swimming nearby.

- Thick layer of subcutaneous blubber for energy reserves, buoyancy and insulation from the cold waters. Countercurrent heat exchange in appendages, blubber, nasal mucosa and reproductive organs. This conserves heat by maintaining a heat differential between arteries and veins.
- Sea lions don't need to drink water. Marine mammals obtain the water they need from the food they eat. This allows them to avoid drinking sea water and the stress of too much salt in their system. Specialized kidneys that reduce water loss by excreting concentrated urine.
- Delayed implantation to adjust gestation periods so that birth and mating occur in a single period and avoid potentially dangerous time ashore. Ovulation is induced.
- Newborns possess subcutaneous brown fat helps keep the pups warm by means of non-shivering thermogenesis. The pups lack the blubber to stay warm so they stay on shore and nurse with mother's high fat content milk (50%). The brown fat is around the back and neck as well as around the vital organs. Instead of shivering seals metabolize this high energy fat to produce heat. When pups have used up brown fat they have accumulated some insulating blubber.

Tundra:

- Tundra, Artic and Alpine
- Frozen all year, little sunlight
- Arctic Circle entirely frozen sea water and Antarctica frozen land
- Arctic tundra is vast open land that butts up to the frozen ocean; in summer, the tundra does thaw and grow plants, but it's too cold for trees.
- Antarctica grows only lichens and moss
- Animals with thick fur and blubber survive here
- Antarctic animal species include Emperor and King penguins, leopard seals and whales
- Arctic species include musk ox, polar bears, walrus, arctic fox, snowy owl, harp seals, reindeer and lemmings

Wetland:

- Wetlands are areas with shallow standing water, like marshes, swamps and bogs
- Saltwater - are usually connected to the ocean; they rise and fall with the tide.
- Freshwater which originally came from a flooded river, excess rain or a high water table.
- Freshwater wetlands can support a wider variety of mammals than saltwater
- Water is still or stagnant and holds little oxygen or nutrients
- Both kinds of wetlands support huge numbers of insects, fish, migrating birds
- Major wetland areas of the world include the Florida Everglades, Africa's Congo Basin,

The Mekong Delta of Southeast Asia, and the Pantanal and Amazon Basin regions of So. America

- Zoo animals associated with wetland areas: snakes, wading birds, ducks and geese, mosquitoes, capybara
- **Chilean Flaming**
    - Live in saltwater wetlands and salt lakes high in the Andes.
    - Colonial birds, living in large flocks of up to ten thousand birds, which stimulates breeding. Group name: “Flamboyant”. Having so many individuals increases the possibility of predator sightings, but decreases the probability of an individual becoming prey.
    - pink color comes from the brine shrimp that they eat.
    - Filter feeders. Uniquely bent bill with tooth-like ridges and hair-like lamellae for filtering food with bill upside down. With their bill upside the flamingo sweep their bill back and forth and are able to feed without getting their feathers wet. The fleshy tongue works to and fro like a piston, moving water back and forth through the bill’s filtering apparatus (lamellae).
    - Long legs are good for wading into much deeper water. Webbed feet support them on soft mud and allow them to swim with ease. Flamingos may stamp their webbed feet in the mud to stir up food from the bottom.
    - Flamingos often stand on one leg, the other tucked beneath the body. Standing on one leg may allow the birds to conserve more body heat, given that they spend a significant amount of time wading in cold water. They typically will stand facing into the wind or rain so that the water does not get into their feathers.
    - Waterproof plumage for staying warm in a wet environment.
    - Flamingos excrete salt through salt glands in the nostrils for osmoregulation.

Freshwater

- **North American River Otter:**
    - These otters live throughout North America in swamps, marshes, rivers, small lakes and seacoasts (they are a different species than sea otters).
    - Spend much of their time in the water. Long, slender, sleek streamlined bodies with strong muscular tails make them excellent swimmers and divers. Short, powerful legs with webbed feet assist with swimming makes otters well developed for a semi-aquatic lifestyle. Webbed feet can help otter save energy so it can swim farther.
    - Otters are intelligent and playful; the zoo keeps them busy by occasionally releasing a live goldfish into their enclosure as food.
    - The river otter is almost impervious to cold because of an outer coat of coarse guard hairs, plus a dense, thick undercoat that helps to "water-proof" the animal. They have no blubber - the fur keeps them warm by trapping air. Doesn’t do deep dives so pressure does not eliminate the trapped air in the fur. Otters must continually groom their fur to maintain its insulating qualities.

- Small ears and nostrils can be closed when diving. River otters can remain under water for 6 to 8 minutes.
- Otters have higher metabolic rates than land mammals of similar size, and generate more body heat. This is because in the water one loses body heat more rapidly than in the air.
- Nictitating membrane covers the otter's eyes when swimming under-water. This gives protection to the eye but allows the otter to see clearly.
- Numerous stiff whiskers (vibrissae) around nose and snout and in tufts on the elbows are tactile hairs that are sensitive to water turbulence and are used in searching for prey. North American river otter can use its whiskers both on land and in water. On land, they are used to feel their way through narrow channels.
- During a dive, their pulse slows to a tenth of the normal rate of 170 beats a minute, thereby conserving oxygen. Remain underwater for up to 6-8 minutes.

Glossary

Biome: A term used to describe a group of areas with similar climates, weather patterns, seasons and vegetation. It is a specific kind of ecosystem and is defined by climate and dominant plants.

Camouflage: The color and patterns of animals' skin, feathers or fur, which makes them harder to see when in their natural surroundings.

Climate: The prevailing set of weather conditions in any place.

Crepuscular: Becoming active at twilight or before sunrise.

Enclosure: The man-made habitat of an animal in captivity.

Environment: The climate, terrain, plants and animals of a certain area or similar areas.

Habitat: The place in which an animal or plant normally eats, drinks, sleeps and moves around. Habitat is an animal's home. It contains everything that an animal needs to survive, including air, food, water, shelter, sun, space and other animals. Many habitats can be found in each type of biome.

Nocturnal: Performing most actions (feeding, breeding etc.) at night.

Predator: An animal that hunts other animals for food.

Prey: An animal that is hunted by other animals as food.

Temperate: Having a climate, which does not get extremely hot or cold.

Territory: The space within an animal's habitat that it actively defends.

Ungulate: A mammal with hooves.